

Guideline for onsite wastewater effluent dispersal and recycling systems

May 2024



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Acknowledgement

The Environment Protection Authority (EPA) acknowledges Aboriginal people as the First peoples and Traditional Custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders past and present.

As Victoria's environmental regulator, we pay respect to how Country has been protected and cared for by Aboriginal people over many tens of thousands of years.

We acknowledge the unique spiritual and cultural significance of land, water and all that is in the environment to Aboriginal people and Traditional custodians. We recognise their intrinsic connection to and aspirations for Country.

This guideline, prepared by Decentralised Water Australia (DWA) documents the outcomes from a project to assist the Environment Protection Authority Victoria (EPA) and the Department of Energy, Environment and Climate Action (DEECA) undertake a technical and scientific review of specific sections of EPA publication 891.4 Code of Practice - Onsite Wastewater Management.

EPA led the development of the guideline as part of an Onsite Domestic Wastewater Management Steering Committee with representatives from:

- EPA Victoria
- Department of Energy, Environment and Climate Action (DEECA)
- Department of Health
- Colac Otway Shire Council
- Coliban Water
- Barwon Water
- Gippsland Water
- Greater Geelong City Council
- Greater Shepparton City Council
- Greater Western Water
- Latrobe City Council
- Manningham City Council
- Mansfield Shire Council
- Mornington Peninsula Shire Council
- North East Water
- Strathbogie Shire Council
- Southern Grampians Shire Council
- Yarra Valley Water
- Yarra Ranges Shire Council
- Victorian Building Authority

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Reference to the Australian Standard (AS/NZS1547:2012 - On-site domestic wastewater management) in this publication is for guidance only and is not intended to be a substitute for the Australian Standard which can be purchased at <https://store.standards.org.au/product/as-nzs-1547-2012>

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Glossary

Term	Definition
Absorption	The process by which a solid material takes in a liquid, for example, the uptake of wastewater into the soil.
Adsorption	The process by which a substance binds other substances onto its surfaces, for example, soil particles bind molecules to their surface.
Advanced secondary treatment	A wastewater treatment plant which produces treated effluent of advanced secondary treatment standard. This is defined as 90th percentile concentrations of ≤ 10 mg/L of 5-day biochemical oxygen demand, ≤ 10 mg/L of total suspended solids and ≤ 10 cfu/100 mL of <i>Escherichia coli</i> (<i>E. coli</i>).
Aerated wastewater treatment system	Air bubbled through wastewater in a tank provides oxygen to microorganisms to facilitate aerobic biological digestion of the organic matter in the wastewater.
Aerobic	Organisms and processes that require oxygen (i.e., microbiological digestion and assimilation of organic matter using oxygen).
Anaerobic	Living or occurring without oxygen (i.e., microbiological digestion and assimilation of organic matter in the absence of oxygen).
Biochemical oxygen demand	The amount of dissolved oxygen consumed by microbiological and chemical processes when a sample of liquid is incubated over 5 days at 20°C. Biochemical oxygen demand is used as a measure of the organic content that requires bacterial oxidation.
Blackwater	Wastewater from toilets.
Cation exchange capacity	The potential capacity of a soil to bind and hold positively charged ions (cations) within the soil. It can be used to indicate plant nutrient availability and retention with a soil and is estimated by summing cations within the soil.
Design irrigation rates	The daily loading rate that applies to the distribution of effluent to the design area of an effluent dispersal system. This is usually expressed in mm/day.
Design loading rate	The daily loading rate of effluent that is applied to the effluent dispersal system. This is usually expressed as a depth in mm/day.
Disinfection	The method of treatment of wastewater that kills or inactivates microbial pathogens to a level that is satisfactory for the intended use. The disinfection effectiveness is usually measured by the reduction in faecal indicator bacteria <i>E. coli</i> .
Dispersive soil	Structurally unstable soil which, when placed in water forms a cloudy suspension that will not settle due to dispersion of constituent particles. Dispersive soils can reduce soil hydraulic conductivity.

Term	Definition
Effective cation exchange capacity	One of the methods for providing a measure of CEC at field pH. It is calculated by summing the concentrations of exchangeable cations and the exchangeable aluminium in the soil.
Effluent	Liquid that flows out of a wastewater treatment plant following treatment.
Effluent dispersal system	An engineered system designed to enable controlled distribution of treated effluent into or onto the land for water and nutrient uptake and filtration, sorption and further biological degradation.
Effluent recycling system	A system designed to enable beneficial reuse of appropriately treated effluent from a greywater treatment plant for either indoor or outdoor use.
Emerging contaminants	Emerging contaminants are compounds that are newly introduced into the environment (for example, pharmaceutical, industrial or agricultural compounds that have only recently been developed) or that, although possibly around for longer times, have only recently been detected in the environment due to advances in detection technologies (for example PFAS). They present a new regulatory challenge, as their prevalence and concentrations, and their potential risks, are not generally well understood.
<i>Escherichia coli (E. Coli)</i>	A gram-negative, facultative-anaerobic, rod-shaped bacterium measured in colony forming units (cfu) or Most Probable Number (MPN)/100mL. It is a member of the faecal coliform group of bacteria and is commonly found in the lower intestine of warm-blooded animals. It is often measured in water to present a basic indication of the effectiveness of disinfection.
Evaporation	The transfer of water from a liquid to a gas.
Evapotranspiration	Transfer of water from the soil to the atmosphere through evaporation and plant transpiration.
Greywater	Wastewater from showers, baths, hand basins, washing machines, laundry troughs and kitchens.
Groundwater	The body of water within soil or rock where all the pores are filled/saturated with water. Groundwater can be permanent, where the pores are always saturated, or temporary where saturation only occurs due to excess rainfall and a limiting layer which causes the formation of a perched water table.
Land capability assessment	An assessment of the risks of harm to human health and the environment of a proposed or existing onsite wastewater management system at the site, taking into account the proposed or existing use of the system (Environment Protection Regulations 2021).
Linear loading rate	The loading rate along the contour per lineal metre of the effluent dispersal area.

Term	Definition
Low pressure effluent distribution (LPED) irrigation	Shallow subsurface irrigation of effluent into topsoil through low pressured effluent distribution (LPED) lines.
Low Pressure Effluent Distribution (LPED) Line	A pressure line perforated with drilled squirt holes and nestled in a distribution line to provide even distribution of effluent.
Onsite wastewater management system	An onsite wastewater treatment plant with a design or actual flow rate of sewage not exceeding 5,000 litres on any day and includes all beds, sewers, drains, pipes, fittings, appliances, and land used in connection with the treatment plant (Environment Protection Regulations 2021).
Onsite wastewater treatment plant	A treatment plant for the bacterial, biological, chemical or physical treatment of sewage generated onsite. Examples include septic tank system, wet or dry composting toilet, aerobic treatment and sand filter (Environment Protection Regulations 2021).
Pathogen	A microorganism capable of causing disease.
Perched water table	Groundwater that forms a saturated horizon within porous media (soil/rock) above the permanent water table. Typically, these lenses of water either drain laterally to downslope locations or slowly percolate into the porous media below. Perched water tables are usually seasonal.
Primary treatment	The separation of suspended material from wastewater by settlement and/or flotation in septic tanks, primary settling chambers or other structures. In addition to physical separation of solids from liquid, liquid and solids may be decomposed by aerobic or anaerobic microbiological processes and digestion (for example, anaerobic sludge digestion) (adapted from AS 1546.3:2017).
Reasonably practicable	Put in proportionate controls to mitigate or minimise the risk of harm. Proportionate means the greater the risk of harm, the greater the expectation for you to manage it.
Secondary treatment	Microbiological digestion and physical settling and filtering processes and decomposition of wastewater constituents following primary treatment (AS 1546.3:2017).
Sewage	Wastewater containing any of human excreta, urine and toilet flush water and includes greywater (which is also called sullage and may include water from the shower, bath, basins, washing machine, laundry trough and kitchen) (Environment Protection Regulation 2021).
Sodicity	Amount of exchangeable sodium cations in the soil. Sodicity relates to the likely dispersion on wetting and the soil shrink-swell properties because of exchangeable sodium concentrations in the soil.
Soil structure	The arrangement of soil particles and pores within the soil to form aggregate such as peds or clods. Soil structure influences soil behaviours including water holding capacity, infiltration, permeability and hydraulic conductivity.

Term	Definition
Stormwater	Rain that flows over ground surfaces as runoff and appears in surface streams and creeks.
Wastewater	Waste principally consisting of water and includes any of the following: sewage or other human-derived wastewater, wash down water or cooling water, irrigation runoff or contaminated stormwater, contaminated groundwater, water containing any commercial, industrial and trade waste (Environment Protection Regulation 2021).
Wisconsin mound	A raised effluent dispersal system that is commonly used on sites with high groundwater, shallow bedrock or sites located within flood prone land.

Acronyms

Term	Definition
AEP	Annual exceedance probability
AS/NZS	Australia/New Zealand Standards
AWTS	Aerated wastewater treatment system
BOD5	Biochemical oxygen demand (5-day test)
CEC	Cation exchange capacity
CFU	Colony forming unit
DIR	Design irrigation rates
DLR	Design loading rate
E. coli	Escherichia coli
EDS	Effluent dispersal system
EDRS	Effluent dispersal and recycling system
EAT	Emerson aggregate test
EPA	Environment Protection Authority
ERS	Effluent recycling system
ESP	Exchangeable sodium percentage
ETA	Evapotranspiration absorption
FAO	Food and Agriculture Organisation of the United Nations
LAA	Land application area
LCA	Land capability assessment
LLR	Linear loading rate
LPED	Low pressure effluent distribution
MEDLI	Model for Effluent Disposal using Land Irrigation
N	Nitrogen
OWMS	Onsite wastewater management system

Term	Definition
P	Phosphorus
PVC	Polyvinyl chloride
TKN	Total kjeldahl nitrogen
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1 Introduction

1.1 Background

This technical guidance for onsite wastewater management systems (OWMS) with a design or actual flow rate of sewage not exceeding 5,000 litres on any day is a reference document designed to support the environment protection regulatory framework. It contains information that supports a risk-based approach for the design and use of effluent dispersal and recycling systems (EDRS). It is complementary to EPA's Guideline for onsite wastewater management (GOWM) which replaces EPA Publication 891.4: *Code of Practice: Onsite Wastewater Management*.

Note that this is not a design manual for EDRS and it should be used in conjunction with other industry guidelines when making decisions about OWMS.

1.1.1 Definitions

1.1.1.1 Effluent dispersal system

For the purposes of this guidance an effluent dispersal system (EDS) is:

An engineered system designed to enable controlled distribution of treated effluent into or onto the land for water and nutrient uptake and filtration, sorption, and further biological degradation.

1.1.1.2 Effluent recycling system

For the purposes of this guidance an effluent recycling system (ERS) is:

A system designed to enable beneficial reuse of appropriately treated effluent from a greywater treatment plant for either indoor or outdoor use.

Additional definitions are included in the Glossary of this document.

1.1.2 Relationship between this guideline and other guidelines

This technical guideline is part of a suite of guidelines that relate to the management of OWMS. This technical guidance supports and supplements the GOWM. The GOWM outlines a risk-based approach to managing OWMS and provides links to guidelines about onsite wastewater management. This guideline should also be used together with other relevant guidelines when making decisions about OWMS.

EPA has more information about OWMS on its website. The GOWM also contains more general information on EDRS.

1.1.3 Target audience

This guidance is targeted at wastewater practitioners and duty holders with a reasonable level of technical knowledge of OWMS, including:

- designers and installers of EDRS
- plumbers and service technicians of EDRS
- land capability assessors
- councils and water corporations.

Property owners/occupiers may wish to refer to:

- GOWM for more general information about EDRS
- Chapter 7 of this guideline for information on the maintenance of EDRS.

1.2 Document overview

This guidance provides wastewater practitioners with information, technical and practical guidance on the selection, design, construction and operation of EDRS.

Figure 1 outlines the structure of the document and provides suggestions on the chapters that stakeholders may find relevant.



Figure 1: EDRS Guideline document structure

2 Classification of effluent dispersal and recycling systems

2.1 Scope

This chapter describes the EDRS commonly used in Victoria and Australia.

2.2 Chapter overview

This chapter specifies what is categorised as an EDRS and provides clarity about what EDRS are suited for soil types referenced in AS/NZS 1547:2012, and other land capability risks. Classifications cover most available land application categories for use in Victoria and include the classification of systems not included in AS/NZS 1547:2012.

It addresses performance objectives that should be considered during the selection and design of EDRS and provides guidance on effluent quality requirements and soil and system suitability. This chapter also addresses the regulatory matters that must be considered during the selection and design of EDRS.

The topics addressed in this chapter include:

- performance and regulatory matters
- EDRS categories
- effluent quality suitability guide
- soil and system suitability guide.

2.3 Performance and regulatory matters

This section addresses performance objectives that should be considered by wastewater practitioners during the selection and design of EDRS. It also addresses the regulatory matters that must be considered. This will ensure that the final system type and design aligns with the overarching performance objectives of the project, and legislative provisions related to environmental protection principles and the general environmental duty¹ (GED) under the *Environment Protection Act 2017* (EP Act).

The performance statements in Section 2.3.2 describe how to achieve a sustainable, constructable, and cost appropriate EDRS that is suitable for the site and meets council approval requirements through the permit application process.

Under the EP Act and Environment Protection Regulations 2021 (EP Regulations) an EDRS is not an onsite wastewater treatment plant that can be permissioned for use as a part of an OWMS unless it has a certificate of conformity. The certificate of conformity confirms the proposed onsite treatment plant meets the appropriate Australian Standard from an accredited assessment body under the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) or any other accreditation body approved by EPA. Consequently, no additional treatment within the EDRS should be assumed or relied

¹ The general environmental duty (GED) is at the centre of the EP Act. The GED requires anyone conducting an activity that may give rise to risks of harm to human health or the environment from pollution or waste, to minimise those risks so far as reasonably practicable. Doing what is reasonably practicable means that you must put in proportionate controls to mitigate or minimise the risk of harm. For further information about how to determine what is reasonably practicable, refer to EPA Publication 1856: *Reasonably practicable*.

upon when selecting a suitable downstream EDRS. Refer to Table 4-7 in the GOWM for guidance on suitable EDRS options for different effluent quality standard.

The core performance principles for EDRS are like that for any OWMS, including:

- the protection of human and animal health
- the maintenance and enrichment of the environment
- the preservation of community amenity and cultural values
- the protection of natural resources
- consideration of sustainable technologies
- consideration of climate change
- compliance with regulatory requirements.

2.3.1 Key performance objectives

This section provides guidance on key performance objectives for any OWMS.

2.3.1.1 Human health, amenity, and cultural values

The selection and design of the EDRS should consider the following human and animal health, amenity, and cultural objectives:

- understanding human and animal health risks associated with the management of onsite wastewater
- managing pathogen concentrations to acceptable levels to minimise the risk to human and animal health
- ensuring that people do not encounter untreated sewage or effluent (whether treated or not) in their ordinary activities on the premises concerned
- understanding and controlling transmission pathways of pathogens, nutrients and other chemicals of concern to sensitive receptors, including the surrounding environment (surface and groundwaters) and humans and animals
- minimising reduction in property and community amenity
- considering any items of cultural and heritage significance that might be affected by disturbance of lands.

2.3.1.2 Environmental protections, resource use, and sustainability

The selection and design of the EDRS should consider the following environmental protection and resource use objectives:

- minimising the potential for contamination of waters
- minimising the potential for degradation of land
- minimising the removal or degradation of vegetation
- discouraging the proliferation of insects and vermin
- reusing resources (including nutrients, organic matter and water) where appropriate
- introducing energy efficient technologies when and where appropriate.

2.3.2 Performance statements and considerations

The performance statements below link the key objectives to specific elements of the system selection and design process. Where possible, these performance statements have been aligned to AS/NZS1547:2012.

2.3.2.1 Site and soil information

Performance statement: Collect enough information about site, environmental and soil characteristics of the property and broader surrounds to enable the best practicable decisions on the selection, design, and construction of the EDRS.

Considerations: To help achieve the performance objective for site, soil, environmental and development evaluation consider:

- obtaining information about the property, area of influence surrounding the property, development, and development site
- obtaining site-specific information that enables the site, soil, and environmental characteristics to be understood, evaluated and considered during the EDRS selection, design and assessment phases
- identifying and evaluating potential risks posed by site, soil and environmental characteristics that might influence the constructability or compromise the long-term effectiveness of the EDRS
- identifying and evaluating potential risks of contamination of land or waters and any associated human and animal health risks
- identifying suitable measures that may be necessary to reduce and/or monitor risks including safety-in-design measures.

2.3.2.2 Effluent dispersal and recycling systems

Performance statement: The performance objectives for EDRS are to:

- safely disperse effluent volumes into the soil and plant environment
- enable a range of biological, chemical and physical processes that result in the assimilation of potential pollutants into the receiving environment
- assimilate the treated wastewater into the soil on the site in a manner that reduces the probability of soil saturation causing wastewater breakout, ponding, channelling and runoff
- have a high probability of remaining structurally stable during construction and throughout the life of the system
- maintain amenity throughout the life of the system
- ensure that the effluent quality requirements of the selected EDRS align with the performance characteristics of the onsite wastewater treatment plant.

Considerations: To help achieve the performance objectives for EDRS consider:

- the capacity to receive and absorb all treated wastewater flows
- the capacity to facilitate the uptake and absorption of the effluent within the boundaries of the property
- the effluent quality requirements of the range of available EDRS
- the capacity of the EDRS to minimise or prevent the production of unpleasant odour or exposure with effluent whether treated or not.

2.3.2.3 Constructability and operability

Performance statement: The performance objectives for the construction, installation, and operation of an EDRS are to:

- confirm that enough land area is available for the proposed design
- consider the degree of difficulty of construction on the site – including post-construction access for maintenance
- determine and evaluate the capital and operational costs of the proposed design
- ensure that the stability of other structures close to the system are not compromised

- consider the operability of the EDRS in the context of the site restrictions and responsible person(s).

Considerations: To help achieve the performance objectives for constructability and operability of EDRS consider:

- assessing the available land area within the development site to enable construction and operation of the EDRS with consideration of buffers and site access
- obtaining information, where required, that enables an evaluation of the capital and lifecycle costs of the proposed EDRS in the context of the scale, cost and lifespan of the development
- obtaining information that demonstrates the degree of difficulty in construction of the EDRS and any potential impact on the stability of structures on the development site.

2.3.3 Regulatory matters

The EP Act sets out the legislative framework for the protection of human health and the environment from pollution and waste in Victoria.

The GED is a centrepiece of the laws. It requires anyone conducting an activity that may give rise to risks of harm to human health or the environment from pollution or waste, to minimise those risks so far as reasonably practicable ([Refer to EPA's Publication 1856: Reasonably practicable](#)).

The GED establishes a prevention-based approach to the risks and impacts associated with OWMS. Minimising the risks of harm to human health and the environment from OWMS (including EDRS) will depend on factors that influence the level of risk, such as the type of OWMS, site constraints, treatment method and the end use of the treated wastewater.

The EP Act and EP Regulations contain prescribed matters that local councils must consider when making decisions on applications to construct, install or alter an OWMS (which includes the EDRS). Understanding these matters will assist property owners, land capability assessors and installers to provide a level of consistency and alignment between the EDRS design outcomes and regulatory requirements.

Specifically, Section 50 and Section 81 of the EP Act and Part 3.3 of the EP Regulations set out the matters relevant to applications to councils in relation to OWMS. This includes the information that must be included with the permit application (regulation 26(2) and the matters that council must consider when deciding whether to issue a permit for OWMS (regulation 28(h)).

Part 5.7 of the EP Regulations provides the ongoing obligations for a person in management or control of an OWMS.

Chapter 2 of the GOWM provides more information on the regulatory framework.

Refer to [EPA Publication 1974: Regulating onsite wastewater management systems: local government toolkit](#) for more information on the laws for OWMS that councils can enforce. The toolkit also provides practical tips and advice on how to investigate complaints and issues relating to OWMS using the EP Act's risk-based compliance framework.

2.4 Effluent dispersal and recycling systems

Effluent dispersal systems (EDS) are the predominant method for the management of treated effluent generated by onsite wastewater treatment plants. They form a critical part of the overall OWMS and

assist in achieving environment, human health, and community amenity protection outcomes. Their primary purpose is to:

- safely disperse liquid (effluent) volumes into the plant and soil environment
- enable a range of biological, chemical and physical processes that result in the assimilation of potential pollutants into the receiving environment.

When selected, designed, constructed and operated correctly EDS provide a high level of protection to the environment and human health through the uptake, filtration, sorption and biological degradation of effluent as it moves through the system and into the receiving environment (USEPA, 2002; Siegrist & Van Cuyk, 2001a; Geary & Whitehead, 2009; Yarra Valley Water, 2021). On the other hand, inappropriate practice at the selection, design, construction and operational phases of the EDS can result in adverse impacts on human health, the environment and community amenity.

An overview of the biophysical processes that function as part of, or in conjunction with, EDS is presented in Figure 2 and a detailed summary of these processes is presented in Figure 3.

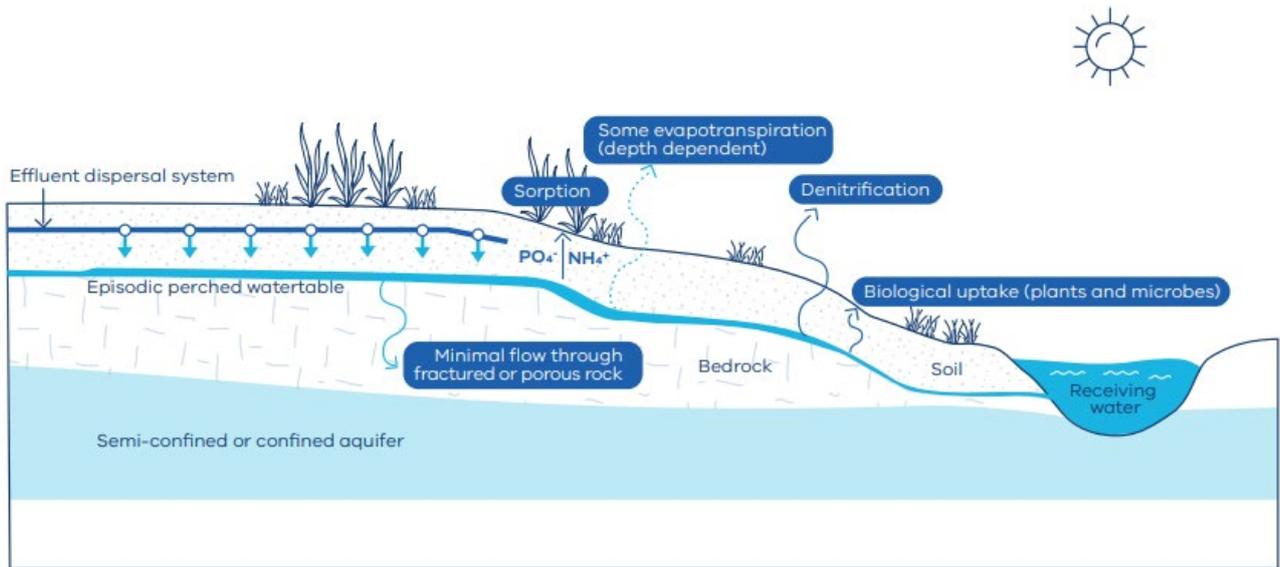


Figure 2: Overview of typical biophysical processes governing EDS function in landscape

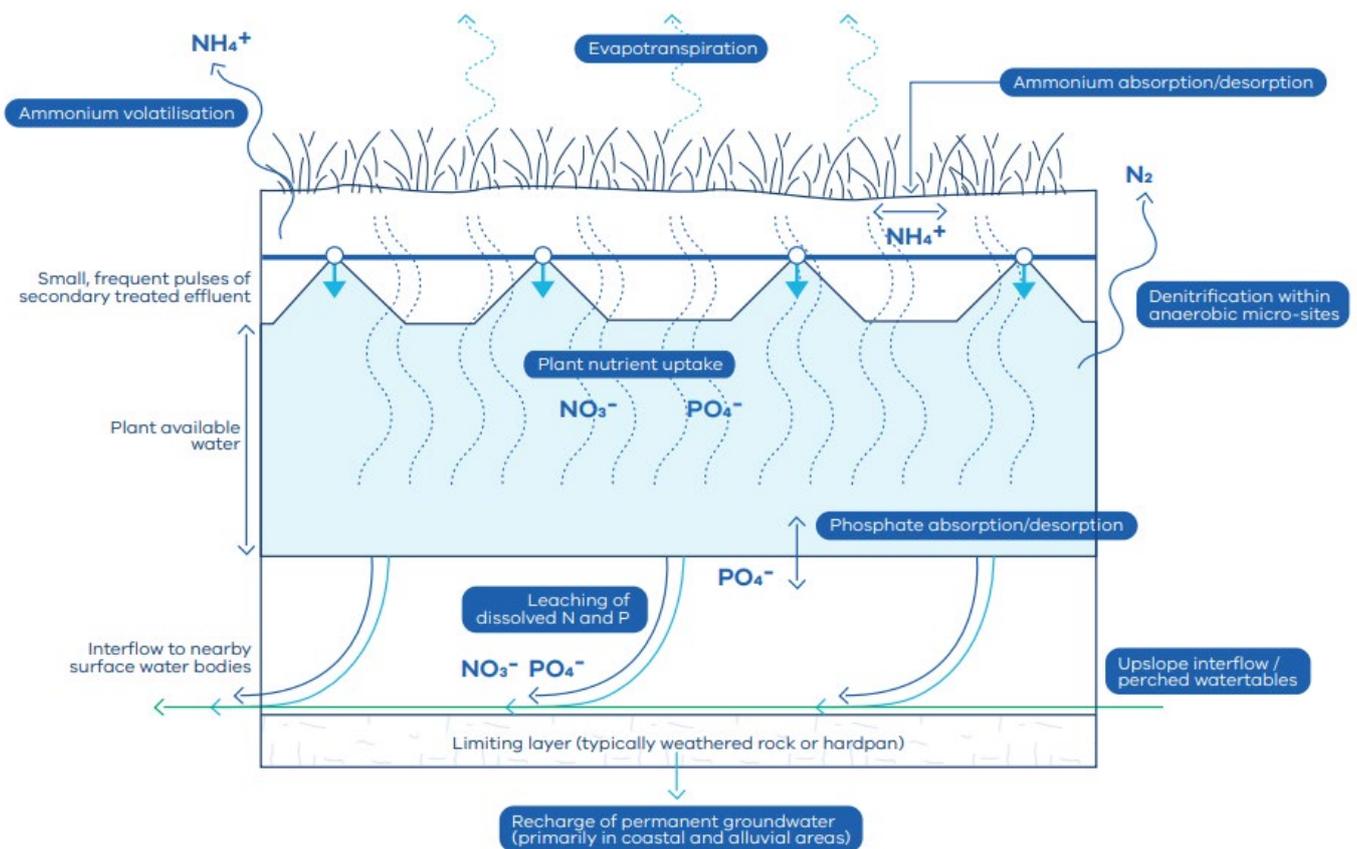


Figure 3: Detailed summary of EDS biophysical processes (subsurface irrigation)

Effluent recycling systems (ERS) differ from EDS because they are designed to provide water of appropriate quality for a specific purpose such as toilet flushing or garden watering. In the case of garden watering or irrigation, the difference between effluent recycling and dispersal is that recycling may involve applying the effluent at a rate that matches demand and does not pose a risk harm to human health and the environment. When the effluent generated exceeds plant watering requirements it needs to be stored safely for later reuse or discharged to a sewerage system. Maintaining a safe, fit for purpose recycled water quality that matches the end use is of critical importance for ERS.

2.4.1 Effluent dispersal and recycling system categories

EDRS have been categorised to assist with the selection and design process. These categories are generally consistent with AS/NZS 1547:2012. Additional effluent management system types are included in this guidance that are not found in AS/NZS 1547:2012, however, most of these are a sub-category of the broader EDRS types adopted in AS/NZS 1547:2012.

EDRS have been classified under 4 categories in this guidance. Table 1 lists the system categories, corresponding document section and external reference where appropriate.

Table 1: EDRS categories and references

System category	Details	Reference in this document	External reference
Soil absorption and evapotranspiration systems	Conventional trenches and bed systems	Section 2.4.2.1 Appendix 2.2.1/2.2.2	AS/NZS 1547:2012 Appendix L
	Evapotranspiration trenches and bed systems	Section 2.4.2.2 Appendix 2.2.1/2.2.3	
	Enhanced evapotranspiration systems	Section 2.4.2.3 Appendix 2.2.1/2.2.3	GOWM (Section 4.1.3)
	Amended soil systems	Section 2.4.2.4	Designing and Installing On-site Wastewater Systems (WaterNSW)
Shallow subsurface and surface systems	Shallow subsurface irrigation	Section 2.4.3.1 Appendix 2.2.4	AS/NZS 1547:2012 Appendix M
	Low pressure effluent distribution (LPED)	Section 2.4.3.2 Appendix 2.2.4	
	Surface irrigation	Section 2.4.3.3 Appendix 2.2.4	
Mound systems		Section 2.4.4 Appendix 2.2.5	AS/NZS 1547:2012 Appendix N
Greywater recycling systems	Indoor recycling	Section 2.4.6.1 Appendix 2.2.6	AS 1546.4:2016 GOWM (Section 4.5)

System category	Details	Reference in this document	External reference
	Outdoor recycling	Section 2.4.6.2 Appendix 2.2.6	Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1, November 2006, EPHC)

2.4.2 Soil absorption and evapotranspiration systems

2.4.2.1 Conventional trenches and beds

Conventional trenches and beds have historically been widely used EDS due to their relatively small footprint and inherently passive characteristics. These systems typically consist of a shallow excavated trench or bed in which the bottom portion is filled with distribution aggregate to a depth of up to 600 mm. A slotted or drilled distribution pipe is installed in the aggregate to distribute primary or secondary treated effluent throughout the length of the trench or bed. Alternatively, self-supporting arch trench can be used instead of aggregate and pipe (refer to Appendix L of AS/NZS 1547:2012). Topsoil is then spread on top of the distribution aggregate (separated by a filter cloth). Effluent distribution within the system can be facilitated by either gravity or pressure dosed methods.

A combination of aerobic and anaerobic microorganisms become established on the aggregate/topsoil within the trench and the soil along the base and part of the side walls of the trench, forming a biofilm or clogging layer. This biofilm limits exfiltration out of the trench or bed and provides further treatment of effluent (USEPA, 2002). Once the system is established, the dosed effluent exfiltrates into the surrounding soils through the base and side walls of the trench or bed. The primary method for hydraulic flow out of conventional trenches or beds is dynamic and varies between side wall exfiltration and drainage through the base of the trench (Beal et al, 2006). Figure 4 depicts the conceptual water balance for a conventional trench or bed system.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 0 - 40%
Percolation and seepage: 60 - 100%

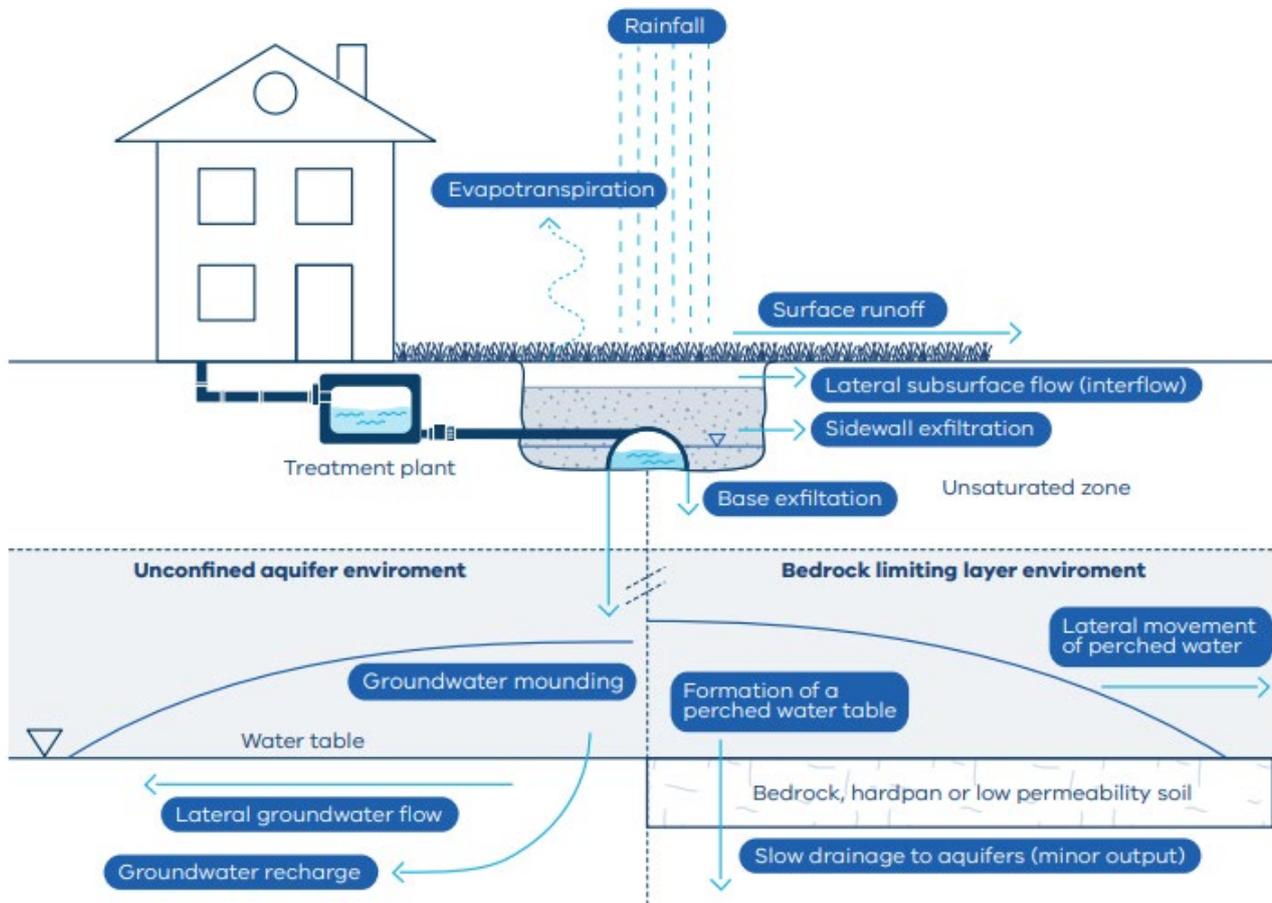


Figure 4: Conventional trench or bed water balance

2.4.2.2 Evapotranspiration trenches and beds

Evapotranspiration trenches and beds are like conventional trenches and beds but include design elements that are considered to increase the potential uptake of effluent through evapotranspiration. These systems are most suited to areas with low rainfall, high evaporation and soils with relatively low permeability. However, there is limited evidence to support the theory that evapotranspiration trenches and beds have significantly higher rates of evapotranspiration compared to conventional trenches and beds.

Like conventional trenches and beds, these systems are constructed through excavation of natural soil material. They can be either gravity or pressure dosed and are suitable for primary or secondary treated effluent. A distribution pipe is installed in a gravel (or scoria) layer to enable even distribution of effluent, and a thin layer of sand is installed below this to provide an interface with the natural soil profile. A sand layer is installed above the gravel layer and topsoil is placed on this to draw water upwards and promote evapotranspiration by providing nutrients and water for stimulation of plant growth. Aerobic and anaerobic bacteria become established within the distribution bed and the topsoil for breakdown and attenuation of nutrients and pathogens.

Shallow-rooted vegetation is planted to use the water and nutrients and release water through their leaves into the atmosphere. Remaining effluent will leave the system through exfiltration from the base and side walls or by surface runoff (however, this is very limited in these systems). Figure 5 depicts the conceptual water balance for evapotranspiration trenches and beds.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 0 - 40%
 Percolation and seepage: 60 - 100%

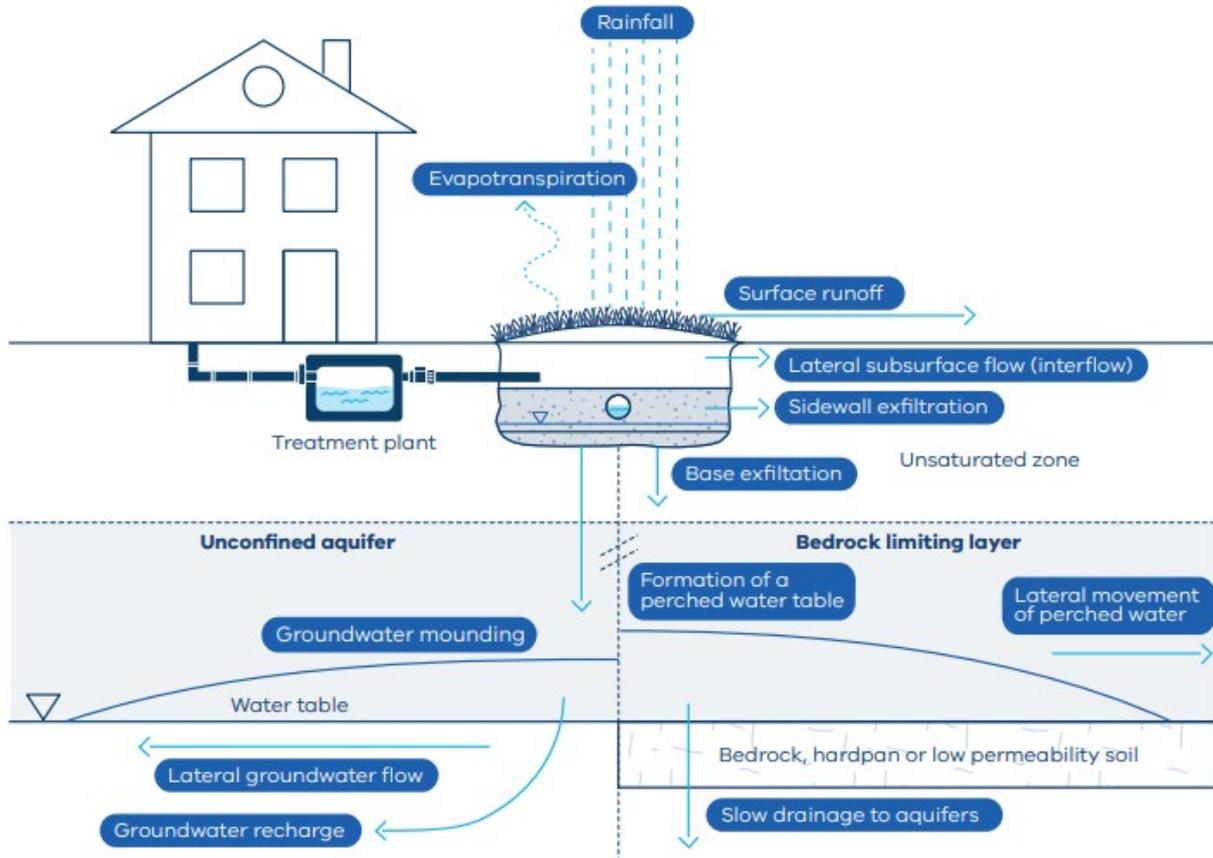


Figure 5: Evapotranspiration trench or bed water balance

2.4.2.3 Enhanced evapotranspiration

Enhanced evapotranspiration systems can be desirable on highly constrained sites, particularly in clay soils (soil category 5–6) or relatively small sites where a reduced EDS footprint is warranted. Enhanced evapotranspiration can be achieved by a range of methods, with 2 common approaches being wick trenches and vegetated recirculating evapotranspiration beds.

Wick trenches

One common approach to achieving enhanced evapotranspiration is the installation of geotextile fabric within a trench or bed to create capillary suction and cause a wicking effect along the geotextile fabric. Evapotranspiration from wind, sun, and plant leaves and roots creates suction which draws water upwards through the EDS and it leaves the system through evapotranspiration.

This method theoretically increases the area over which effluent is dispersed – including side walls or extended basal areas – and more evenly distributes effluent throughout the trench, increasing the overall evapotranspiration of the system. Some designers use this approach to justify a reduced design loading rate (DLR), resulting in a smaller EDS footprint. Figure 6 depicts the conceptual water balance for the wick trench system.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 0 - 40%
 Percolation and seepage: 60 - 100%

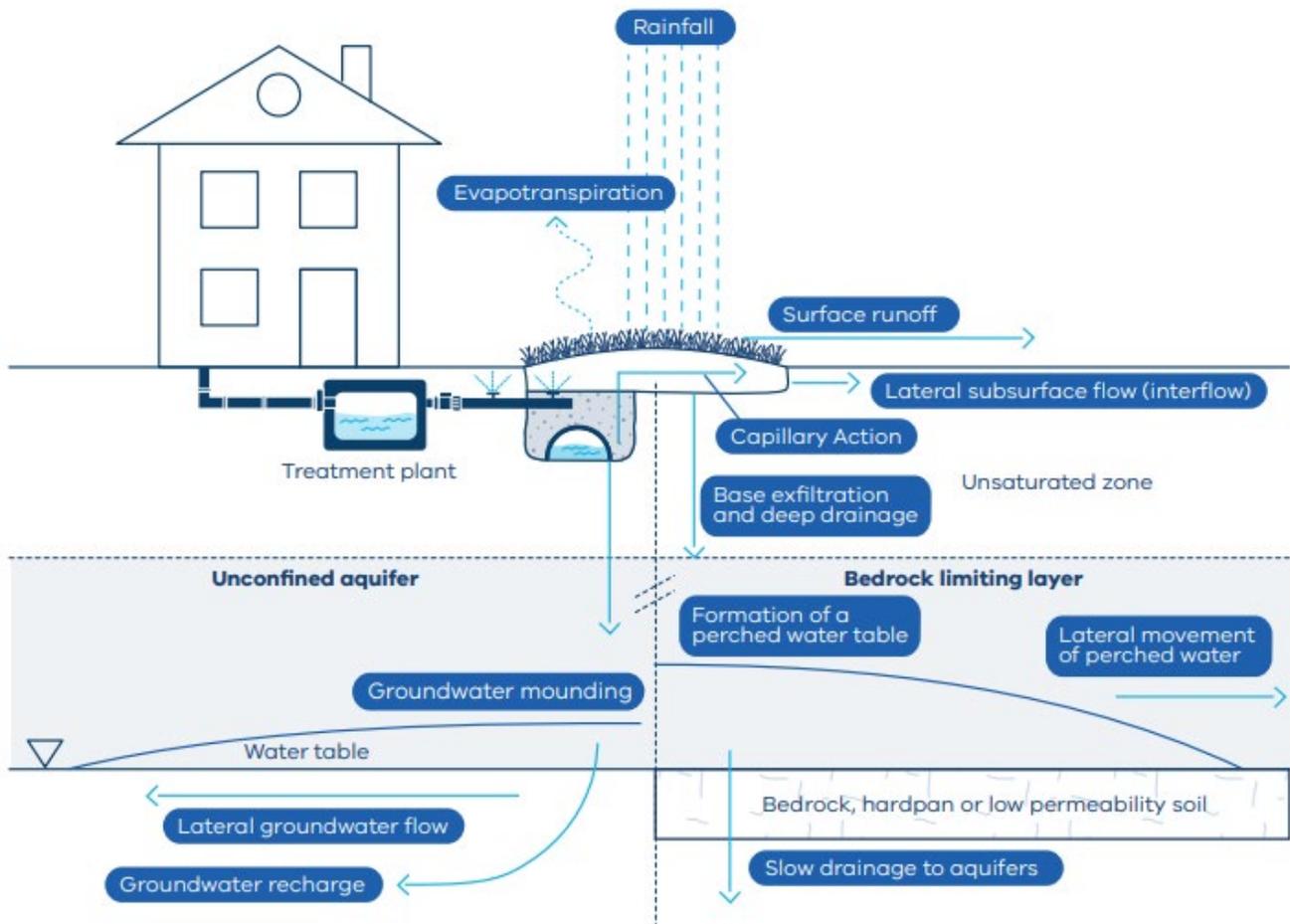


Figure 6: Wick trench water balance

Vegetated recirculating evapotranspiration beds

Vegetated recirculating evapotranspiration beds are designed as closed systems to promote evapotranspiration. The beds are completely lined and impervious to prevent rainwater from entering and effluent from leaving the system through processes such as deep drainage or lateral movement through the soil profile. The only way effluent can be lost from the system is through evapotranspiration or being managed through a subsequent EDS for dispersal. Plant selection and maintenance is critical to the success of vegetated recirculating evapotranspiration systems.

These systems are constructed with a sandy loam layer below the surface cap (for example, plastic sheeting) to promote plant water uptake from a permanent water layer. At the base of the sandy loam profile is a sand layer which overlays a geotextile membrane separating the bottom aggregate from the

sand to prevent blockage. A slotted underdrain is installed in the aggregate to drain effluent to the holding/wet weather storage tank. Effluent drained to the holding tank will then be time-dosed back to the vegetated bed and this process continues as effluent leaves the system through evapotranspiration.

These systems can be used as EDS downstream of primary or secondary treatment plants and are desirable on sites with poor soil conditions, sensitive receiving environments or limited area available for land application of effluent. An accumulation of dissolved salts, nutrients and other contaminants can occur in closed systems over time, which can be managed through periodic removal of recirculating effluent for disposal at a place authorised to receive it.

As the removal mechanism of wastewater in closed systems is through evapotranspiration processes, climatic conditions should be considered. Closed systems are most suited to relatively hot climates where evapotranspiration rates exceed rainfall. However, it may be possible to install a vegetated recirculating evapotranspiration bed system where effluent volumes not lost to evapotranspiration are discharged to a second suitable EDS. In this combined EDS scenario, the risk assessment should include the consideration of the water quality of the discharged effluent being dispersed by the second EDS. Consideration should also be given to minimising the effects of an accumulation of dissolved salts, nutrients and other contaminants that occur in closed systems over time prior to effluent being dispersed by the second EDS.

While this system does not recycle 100% of effluent, it does provide a way of promoting recycling of wastewater in climates that are not favourable to full evapotranspiration and it reduces the volume of effluent that needs to be assimilated within the site.

For recommendations on the maintenance of this EDS refer to Chapter 7.

Figure 7: depicts the conceptual water balance for vegetated recirculating evapotranspiration systems.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 50 - 100%

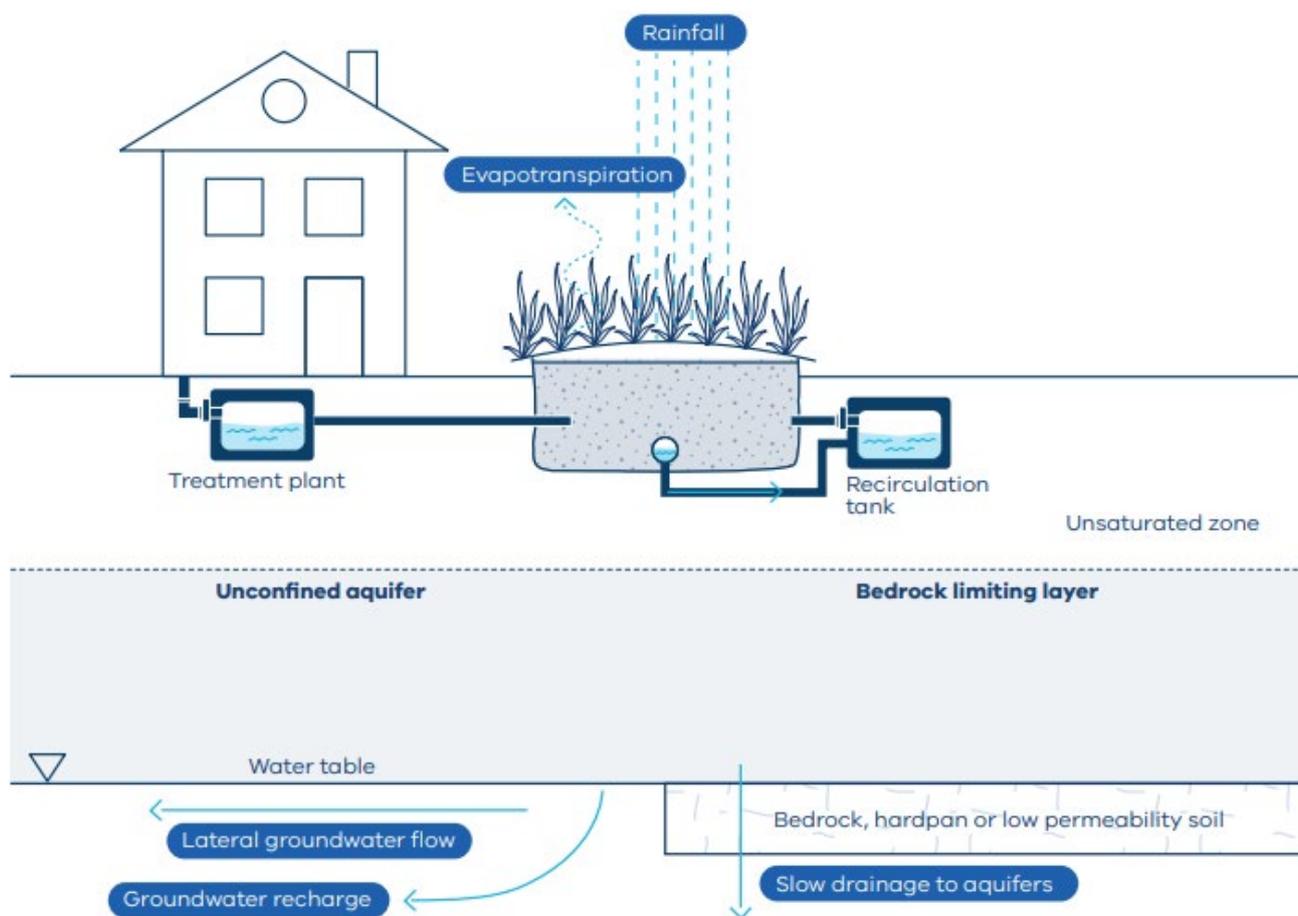


Figure 7: Vegetated recirculating evapotranspiration bed water balance

2.4.2.4 Amended soil systems

Amended soil systems can take many forms. They involve importing a media, soil or engineered material to enhance the distribution of effluent and/or improve the pollutant removal capacity of an EDS, which may result in a reduced system footprint. These systems are often adopted for constrained sites with sensitive receiving environments and have been used to increase the performance of conventional trenches and beds, ETA systems, LPED systems and Wisconsin mounds.

It is important to note that, while pollutant removal can be enhanced by implementing an amended soil system, this cannot be relied on to meet the wastewater treatment quality standards for an onsite wastewater treatment plant as defined by the EP Act. However, recognition of the capability of amended soil systems to reduce pollutants may be considered in the selection, design, and assessment stages of EDRS.

One limitation of amended soil system materials that rely on soil adsorption processes for nutrient reduction is the finite capacity of the adsorption itself. When the capacity on these surfaces is reached, the system can no longer adsorb/remove phosphates and desorption can occur. So the design of these

systems should include the application rate of any soil amelioration product and consider the longevity of the system. One design configuration involves use of a sealed 'tub' that contains the amended material with the treated effluent overflowing into a thin sand layer under the tub. This approach requires careful design and water balance calculations to ensure the effluent does not overload this relatively thin layer or cause clogging due to a limited transfer of oxygen caused by the overlying plastic liner.

Several materials are commonly used in amended soil system designs to facilitate phosphorus reduction, which may be required on highly constrained sites with sensitive receiving environments. These include:

- **Blast furnace slag** – a by-product of iron making is an example of a material commonly used in amended soil system designs. Phosphate is removed from effluent by providing enough calcium for physical adsorption and precipitation of phosphates in alkaline wastewater (Yasipourtehrani, Strezov, & Evans, 2019).
- **Iron and aluminium sesquioxide** is also an industrial by-product suitable for enhanced phosphate removal. The physical adsorption mechanism to the amended soil surface is like that described for blast furnace slag. An example of this material is bauxite. This approach has previously been used in mound amended soil systems (WaterNSW, 2023).

Some amended soil system designs use engineered materials rather than soil amelioration. For example, they may incorporate pipes wrapped in an engineered material designed to facilitate effluent distribution within the EDS. The pipes may be encased in a sand material designed to promote aerobic activity as the primary effluent percolates through the sand and into the natural soil. These systems operate hydraulically in a similar way to conventional or ETA trenches.

Figure 8 depicts the conceptual water balance for a common amended soil system.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 10 - 50%
Percolation and seepage: 50 - 90%

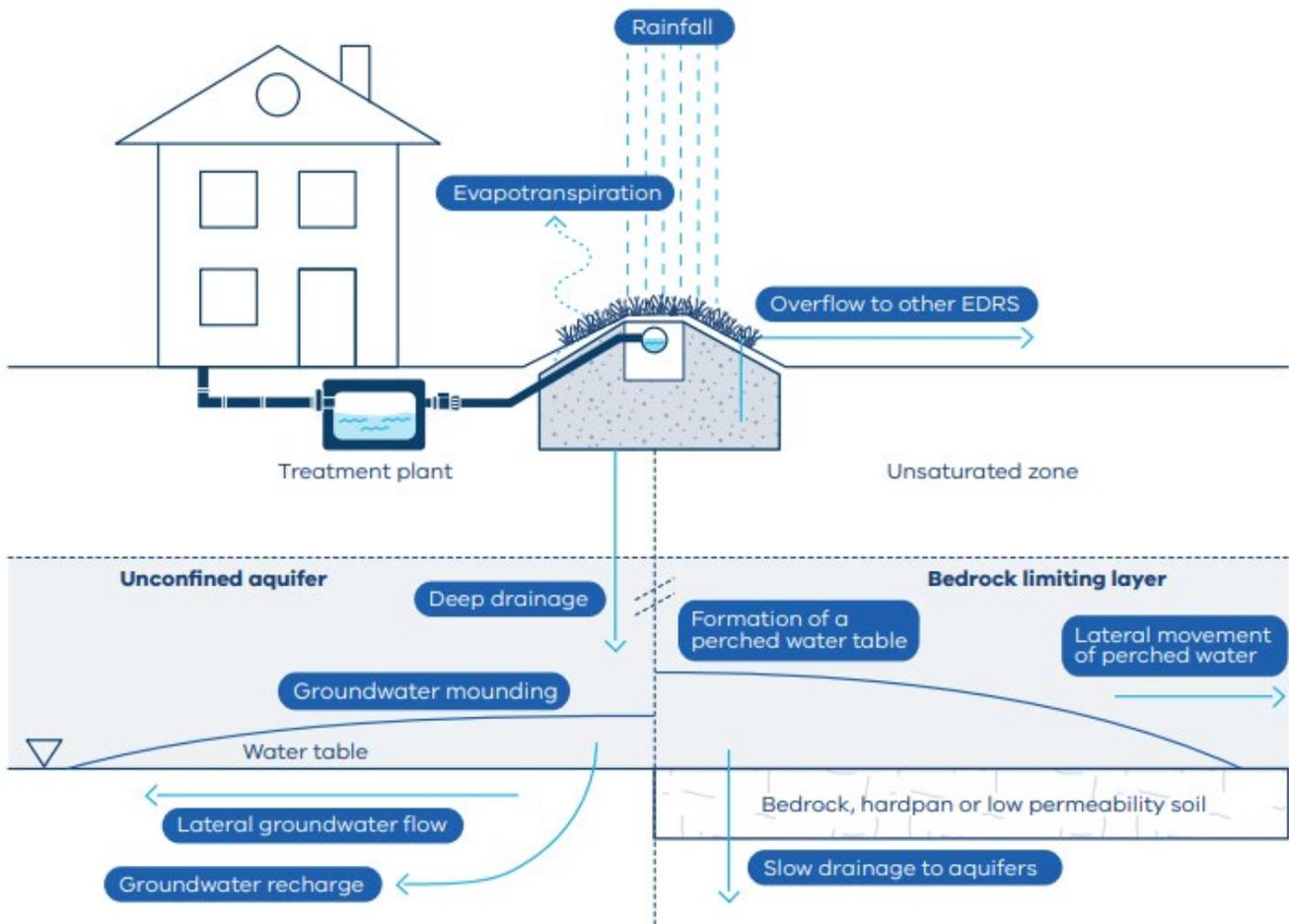


Figure 8: Amended soil system water balance

2.4.3 Shallow subsurface and surface systems

This system category encapsulates technologies that involve the application of treated effluent in the topsoil or above ground.

2.4.3.1 Shallow subsurface irrigation

Shallow subsurface irrigation systems involve a pressure compensating dripline trenched or ploughed into the topsoil to a depth of ~100–150 mm to promote transpiration of secondary treated effluent, limit evaporation and significantly reduce the potential for surface runoff. These systems are commonly used to irrigate public open spaces or by property owners to irrigate their lawn or garden beds. Additionally, subsurface irrigation can be configured to nonstandard shapes for installation around common site constraints including trees, driveways and pools.

This approach also includes covered surface drip irrigation as described in Appendix M of AS/NZS 1547:2012. The dripline is pinned to the topsoil surface and covered with mulch or another suitable material. The mulch should be secured using measures such as bird resistant netting.

Pressure compensating emitters are essential for both applications. Pressure compensating dripline is a small diameter pipe with evenly spaced pressure compensating emitters that pulse dose effluent at low, even loading rates over a wide variety of operating pressures. This enables even distribution over variable elevations without the need for complex hydraulic controls. Effluent enters and fills the dripline until the required back pressure is reached and the emitters can release it. Subsurface irrigation fields are often divided into multiple hydraulic zones to provide each zone with rest periods, which is often a useful design tool on highly constrained or low permeability sites.

Due to the low DLR of these systems, they generally promote a high level of evapotranspiration and nutrient attenuation and, therefore, require a larger footprint than other EDS types. Where possible, they are often used on highly constrained sites with optimised lineal length to reduce the risk of harm to the environment and human health.

Figure 9 depicts the conceptual water balance for a shallow subsurface irrigation system.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 10 - 80%
Percolation and seepage: 20 - 90%

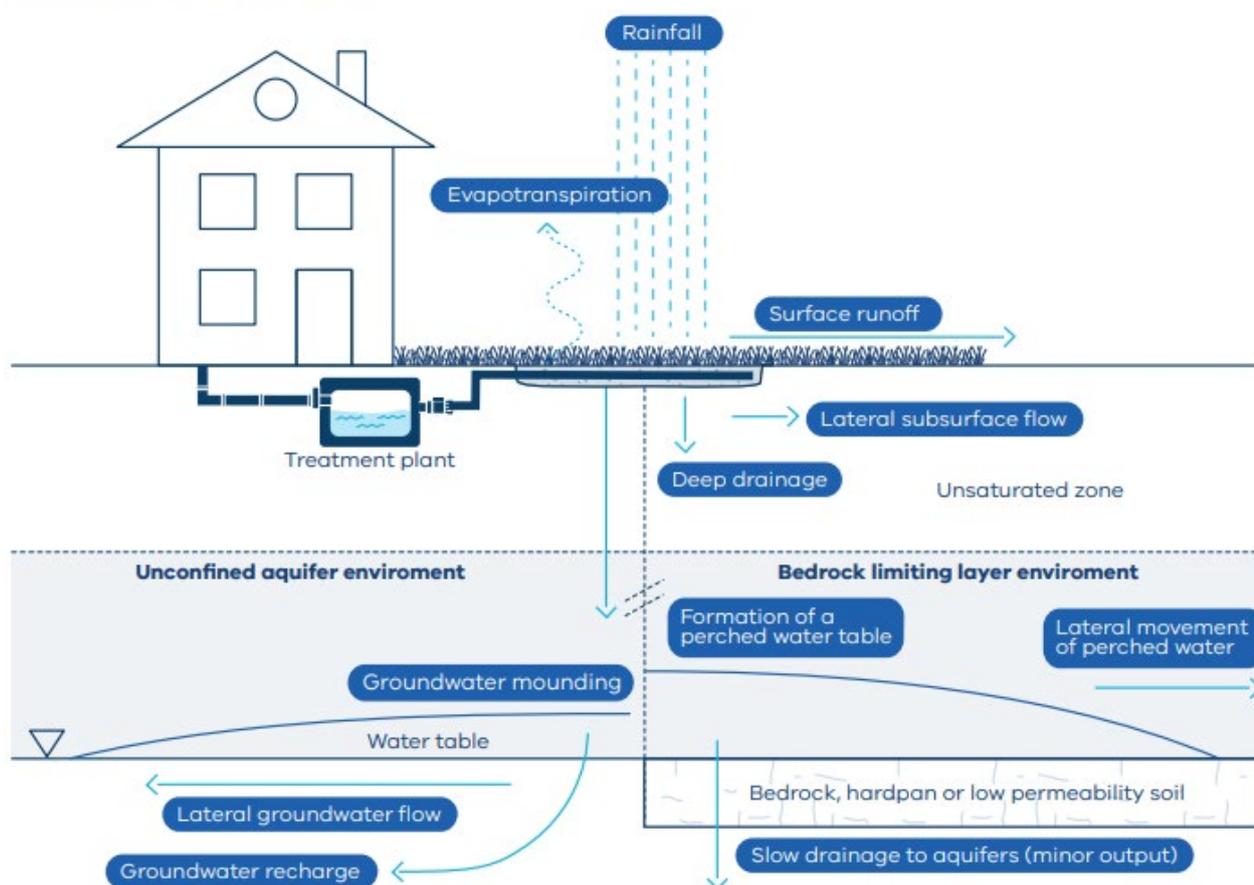


Figure 9: Shallow subsurface irrigation water balance

2.4.3.2 Low pressure effluent distribution

LPED systems are a series of thin, gravel filled trenches with a perforated distribution pipe installed to distribute effluent evenly using pump pressurisation. Like trenches and beds, aerobic and anerobic

bacteria (and other organisms) form a biofilm within the gravel trenches to assist the removal of nutrients and pathogens.

Good quality, permeable topsoil is installed between each trench to promote even distribution of effluent over the entire LPED area through the movement of effluent through trench sidewalls and into the adjoining aerobic topsoil. The chosen topsoil has favourable physical and chemical characteristics to promote vegetation cover and growth to maximise evapotranspiration. The presence of a suitable depth of good topsoil underpins the use of a DLR that considers the topsoil between each trench.

LPED systems are often used on constrained sites with limited area available for onsite wastewater management. The smaller trench area provides limited soil water storage capability, so careful design and sizing of the system is essential to ensure that hydraulic failure does not occur. These systems are suitable for land application of both primary and secondary treated effluent. Careful hydraulic design is required on sites where laterals are at varying elevations and zoning is often required.

Figure 10 depicts the conceptual water balance for an LPED system.

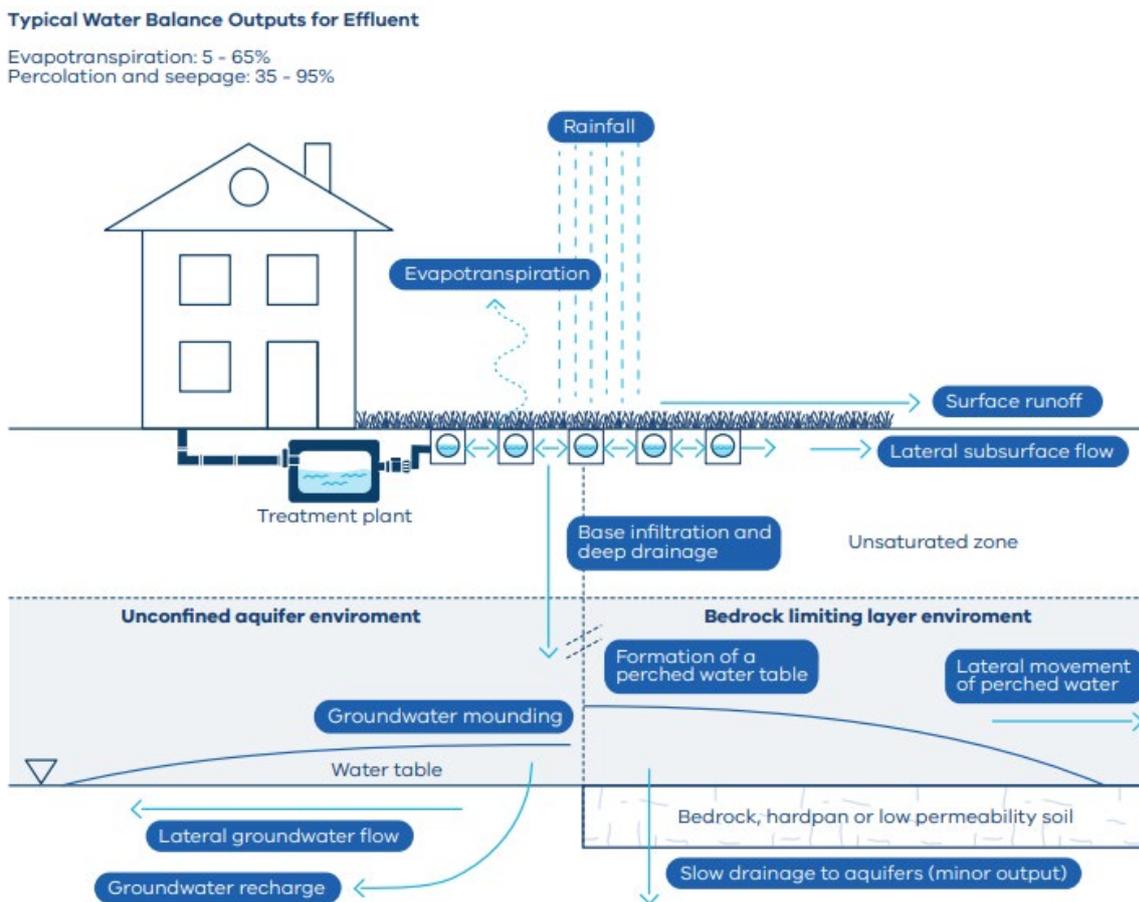


Figure 10: LPED water balance

2.4.3.3 Surface irrigation

Surface irrigation systems consist of sprinklers or ‘wobblers’ type sprays that spray secondary treated effluent at a relatively low irrigation rate and heavy droplet size over a large, vegetated area. These

systems rely on sufficient topsoil and evapotranspiration within the topsoil layer to remove effluent from the water cycle and reduce surface runoff.

Surface irrigation systems should only be installed on large residential properties with enough area to enable restricted access, or large industrial or commercial premises with enough area to prevent access and ensure no human and animal exposure. Due to the potential effluent runoff, surface irrigation is only suitable for sites with low or minor onsite wastewater management constraints and long distances to sensitive receiving environments. Sloping sites with low permeability soils are likely to experience significant runoff from these systems and are not generally suitable unless wet weather controls and storage have been incorporated into the system.

Surface irrigation systems are designed to promote evapotranspiration, and the area is planted with vegetation that is water tolerant and at an optimum density for growth. Due to their reliance on evapotranspiration, the site climate and overall existing water balance should be considered when determining the suitability and long-term sustainability of this system. They are unsuitable for areas with high and/or intense rainfall patterns without the use of wet weather storage to enable irrigation to cease during rainfall.

Disinfection of treated effluent is crucial, given the increased potential for human and animal exposure and entrainment in rainfall runoff.

Figure 11 depicts the conceptual water balance for a surface spray irrigation system.

Typical Water Balance Outputs for Effluent

Evapotranspiration: 10 - 80%
 Percolation and seepage: 15 - 80%
 Entrainment in Runoff: 5 - 10%

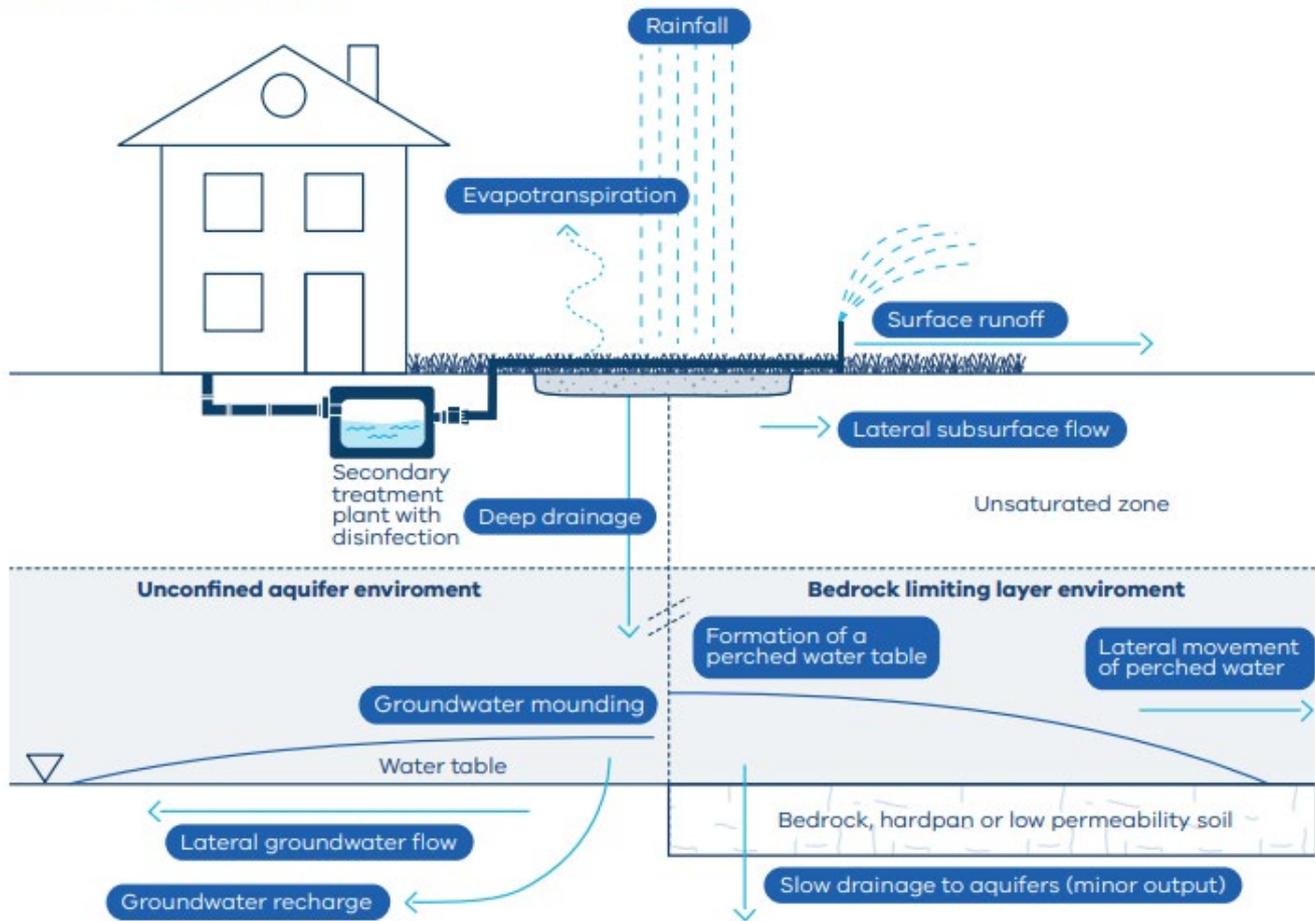


Figure 11: Surface irrigation water balance

2.4.4 Wisconsin mounds (raised or above grade systems)

Wisconsin mounds are a raised EDS commonly used on sites with high groundwater and shallow bedrock, or sites located within flood prone land. Wisconsin mounds are constructed on land that has been ploughed to promote infiltration of effluent from the base of the mound into the soil surface below. A specific grade of clean sand fill media (400–600 mm) is used to create the mound upon which a distribution bed of coarse aggregate is constructed and provide additional pollutant removal through sorption, filtration, and biological degradation.

A pressure distribution (LPED type) manifold is constructed with perforated pipe and laid level within the distribution bed to emit effluent and promote even distribution. To promote evapotranspiration a finer textured soil is placed over the distribution bed (also forming a capping later) and a thin topsoil layer is placed over the entire mound.

Wisconsin mounds are pressure dosed systems that can be used to disperse primary or secondary treated effluent. On sloping sites Wisconsin mounds are constructed to be as long and narrow as possible with a longer or extended toe to reduce the likelihood of breakout and assist with infiltration of

effluent. Careful selection of a linear loading rate (LLR) is crucially important to the hydrologic performance of mounds. LLR is a design criterion that accounts for the ability of applied effluent to infiltrate into the existing soil profile and move laterally within the subsoil without breakout at the interface between the mound and existing soil. This has been found to be a critical design consideration for any raised EDS (Converse & Tyler, 2000).

Wisconsin mounds are thought to promote enhanced evapotranspiration due to being raised above the existing vegetated surface, however, limited research has been done to confirm this.

While the installation of a Wisconsin mound may be desirable on highly constrained sites to reduce the risk of pollution through additional pollutant removal, these systems should not be relied on to meet the onsite wastewater treatment standards for an onsite wastewater treatment plant (as defined by the EP Act).

Figure 12 depicts the conceptual water balance for a Wisconsin mound system.

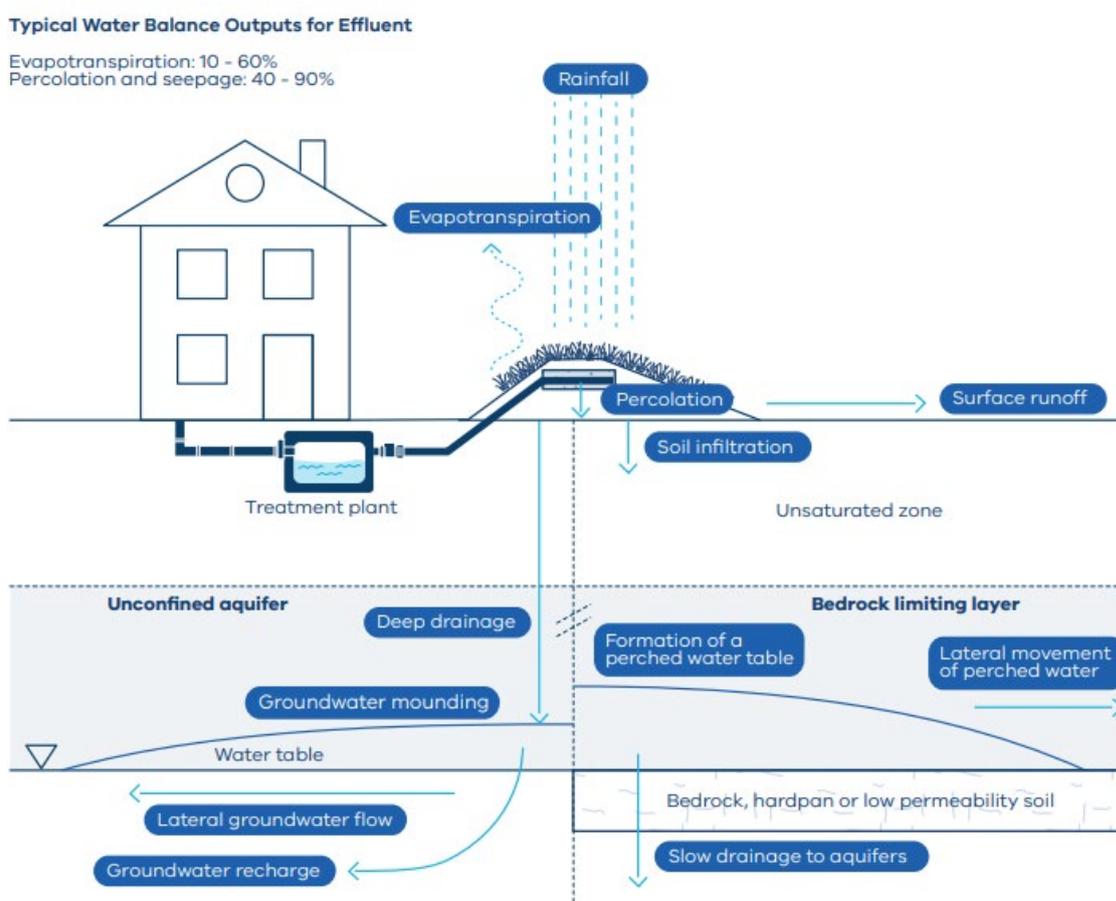


Figure 12: Wisconsin mound water balance

2.4.5 Enhancement and augmentation of effluent dispersal systems

The EDS categories described above can be enhanced or augmented through several measures that are not necessarily unique to a specific system type. However, they can play a significant role in a risk-based EDS selection and design process. Some common examples include:

- timed and intermittent dosing to the EDS
- zoning and alternative dosing (rest periods)
- pressure dosing (for example, of conventional trenches and beds) to ensure even distribution
- designation and protection of EDS reserve areas.

Further guidance on these augmentation options is provided in Chapter 4 – Design of effluent dispersal and recycling systems.

2.4.6 Greywater recycling systems

2.4.6.1 Indoor recycling

Homeowners can recycle highly treated greywater for toilet flushing or as a laundry cold water supply to wash clothes. The minimum effluent quality for indoor recycling is 10 mg/L for biochemical oxygen demand (BOD₅), 10 mg/L for total suspended solids (TSS) and 10 cfu or MPN /100 mL for *E. Coli* (i.e., advanced secondary treatment). It is recommended that the greywater recycling system is tested annually by a NATA accredited laboratory to confirm the minimum water quality requirements are being achieved. Copies of the laboratory analysis may be provided to the system servicing agent. If the system is failing to meet the required effluent quality targets, the recycled water should be discharged to a sewer or appropriate EDS or serviced/rectified to ensure advanced secondary treatment targets are achieved.

Indoor recycling of effluent can only recycle a relatively small portion of wastewater generated on the site, so homeowners will still need to have an EDS to apply the remaining wastewater to land. Blackwater should not be used for recycling purposes in a single residential setting.

2.4.6.2 Outdoor recycling

The overarching principle of outdoor recycling of effluent is that treated effluent is irrigated at a rate that does not exceed the garden's water or nutrient requirements while maintaining soil water conditions that are optimum for plant growth.

Domestic households can install greywater treatment plants that are certified to the appropriate Australian Standard to reuse treated greywater for lawn/plant irrigation by subsurface irrigation systems or dedicated handheld (purple) hoses for surface irrigation. The greywater treatment plant is required to produce advanced secondary treated effluent with minimum BOD₅, TSS and faecal coliform concentrations of 10 mg/L, 10 mg/L and 10 cfu/100 mL or MPN /100 mL respectively. You should also consider the end use of the effluent and water quality for the end use to minimise risk to human health and the environment.

Non-domestic developments in sewerred areas should recycle greywater using subsurface irrigation and cannot use hoses or surface irrigation for garden watering. This includes hospitals, multi-dwelling residential developments, childcare facilities and schools.

In unsewered areas advanced secondary treated greywater can be used to irrigate commercial premises using both subsurface and surface irrigation, provided that any surface irrigation systems are low trajectory and produce coarse droplets. Recycled greywater may be used to irrigate:

- horticultural crops (for example, grapes) if subsurface irrigation is used and effluent does not contact the edible parts of the crop

- sporting fields or golf courses using surface or subsurface irrigation systems where players do not encounter recycled water – a 4-hour withholding period is required between the application of treated wastewater and use of the sporting field.

2.5 Effluent quality suitability guide

2.5.1 Primary effluent

Primary treated effluent is usually achieved by a primary treatment plant (septic tank) that treats raw wastewater prior to discharge to an EDS or secondary treatment plant. Primary treatment plants do not have a specific water quality standard; however, they can be expected to achieve the following effluent quality ranges (Tchobanoglous, 1998):

- BOD5: 100–250 mg/L
- TSS: 20–140 mg/L.

2.5.2 Secondary effluent

Secondary treatment plants receive either raw sewage or primary treated effluent from septic tanks for further treatment prior to discharge to an EDS. Effluent compliance criteria for a secondary treatment system (90th percentile) as stated in AS1546.3: 2017 (Tables 2.1 and 2.2) are:

- BOD5: <20 mg/L
- TSS: <30 mg/L
- E. Coli: <10 cfu/100 mL or MPN (where disinfection is required).

Note: A risk-based approach to the selection of disinfection should be applied that considers potential impacts to human health and the environment. The approach can consider several factors such as EDS type, identified soil and site constraints, sensitive receiving environments or regulatory requirements.

Example 1: Surface irrigation EDS – disinfection would be required to achieve the effluent compliance criteria for E. Coli where a surface spray irrigation system was selected.

Example 2: Subsurface irrigation EDS – disinfection may not generally be required for subsurface irrigation in low-risk situations. However, disinfection may be an appropriate risk mitigation measure where the site, soil or environmental limitations are indicative of a higher risk of impact on human health or the environment.

2.5.3 Advanced secondary effluent

Advanced secondary treatment plants receive either raw sewage or primary treated effluent from a septic tank and discharge it to an EDS. Effluent compliance criteria for an advanced secondary treatment system (90th percentile) as stated in AS1546.3: 2017 (Tables 2.1 and 2.2) are:

- BOD5: <10 mg/L
- TSS: <10 mg/L
- E. Coli: <10 cfu/100 mL or MPN (where disinfection is required).

Table 2 outlines the effluent quality suitable for discharge into different EDS types. While advanced secondary treatment plants can be used for all EDS types (subject to disinfection) these systems may increase the installation or maintenance cost of systems and should not be designed or installed as a general approach. However, they are a useful design tool that should be used on constrained sites that may have sensitive receiving environments or reduced setback distances, or on properties with limited

area available for the application of effluent. It should also be noted that chlorine disinfection is not suitable for effluent dispersal systems (including trenches, beds and mounds) that rely on microbial breakdown of effluent within a distribution bed, as the chlorine can kill bacteria.

Table 2: EDS effluent quality suitability²

Effluent quality	Trenches and beds	ETA	Surface irrigation	Subsurface irrigation	Mounds
Primary	S	S	NS	NS	S
Secondary	S	S	NS	S	S
Secondary with disinfection	S	S	S	S	S
Advanced secondary	S	S	S	S	S
Advanced secondary with disinfection	S	S	S	S	S

2.6 Soil and system suitability guide

Soil characterisation is one of the key land capability assessment (LCA) factors that should be considered when selecting an EDS for a site. As outlined in AS/NZS 1547:2012, soil type can be broken down into 6 categories, with category 1 being sandy soils with high permeability and category 6 being medium heavy clay soils with low permeability. Table 3 outlines which EDS are suitable for different soil categories and soil structures. It is only to be used to guide the selection of EDS and does not specify which EDS can be installed or are permissible for each soil category. However, some EDS require specialist design to ensure they are performing in a manner that minimises the risk of harm to human health and the environment. Those systems are identified as 'SD' in Table 3.

2.6.1 Treatment capacity and effluent loading rate

AS/NZS 1547:2012 highlights the relationship between the treatment capacity of the soil and selection of the effluent loading rate for category 1 and 2 soils. While the stated DLRs may be applicable in low-risk scenarios to achieve adequate hydraulic performance, AS/NZS 1547:2012 cautions wastewater practitioners that lower DLR values may be necessary to achieve the required human health and environmental performance standards in higher risk situations. This is due to the generally lower treatment processes afforded by category 1 and 2 soils.

² S = EDS is suitable for effluent treated to this quality subject to assessment outcomes and implementation of selected control mitigation measures. NS = EDS is not suitable for effluent treated to this quality.

2.6.2 Effluent distribution

Ensuring even effluent distribution within the EDS is a critical factor in maximising the treatment capacity of the in-situ soil. When guided by the outcomes from the site and soil evaluation, soils with higher permeability characteristics may require consideration of alternative effluent distribution techniques than traditional gravity dosing to meet site and project performance criteria. A common alternative to gravity dosing is pressure dosing where pumped effluent is distributed within the EDS through a PVC pipe manifold.

Further information on EDS suitability is available in AS/NZS 1547:2012 .

Table 3 EDS suitability based on soil category and structure³

Soil category	Soil texture	Soil structure	Trenches and beds (See Note 1 and 2)	ETA systems	Irrigation systems	LPED	Mounds
1	Gravels and sands	Structureless (massive)	SD	NS ⁴	S	NS	S
2	Sandy loams	Weakly structured	SD	NS ⁴	S	S	S
		Massive	S	S	S	S	S
3	Loams	High/moderate structure	S	S	S	S	S
		Weakly structured or massive	S	S	S	S	S
4	Clay loams	High/moderate structure	S	S	S	S	S
		Weakly structured	S	S	S	S	S
		Massive	S	S	S	S	SD
5	Light clays	Strongly structured	S	S	S	S	S
		Moderately structured	SD ⁵	S	S	S	SD
		Weakly structured or massive	SD ⁵	S	S	S	SD
6	Medium and heavy clays	Strongly structured	SD	S	S	NS	SD
		Moderately structured	SD	S	S	NS	SD
		Weakly structured or massive	SD	S ⁶	S	NS	SD

³ S = suitable for this soil category and structure. NS = generally not suitable for this soil category and structure. SD = special design requirements, distribution techniques, specialist soil advice or soil modifications may be necessary (refer AS/NZS 1547:2012 for further information).

⁴ AS/NZS 1547:2012 advises that ETA systems are not normally used on these soil categories.

⁵ Special design requirements may not be necessary where secondary treated effluent is proposed.

⁶ Only suitable for use with secondary treated effluent.

Notes to Table 3:

1. There is elevated risk associated with primary treated effluent being dispersed to trenches and beds in soil categories 1 and 2a. This is due to the high infiltration rate of these soils, which leads to uneven distribution along the base of the trench. These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.
2. Use of absorption trenches/beds in category 1 and 2a soils require design by a suitably qualified and experienced person. Where groundwater quality is at risk, secondary treatment is required and consideration should also be given to disinfection, nutrient removal, soil modification and/or distribution over a large application area.

3 Selection of effluent dispersal and recycling systems

3.1 Scope

This chapter provides guidance on the factors and key considerations that influence the selection of an EDRS. It provides complementary guidance in the application of a risk-based selection process consistent with AS/NZS 1547:2012.

3.2 Chapter overview

Selecting a suitable EDRS for a site is a critical step in the design process. Depending on the nature of the facility being serviced and site constraints, the type of EDRS selected can have more influence on outcomes than the design itself and selecting a suitable system type is essential to ensure the EDRS operates as designed.

Good decision making on the selection of a suitable EDRS should not be limited solely to the physical outcomes resulting from an LCA but should also include other considerations that may influence constructability, operation, maintenance and owner/occupier engagement. Examples of other considerations include:

- intended use of the treated effluent
- owner/occupier's ability to manage and maintain the system
- availability of good quality information such as soil and climate data
- experience of the land capability assessor, designer and wastewater practitioner
- completeness of the available data and information
- assessment of factors such as system constructability, cost and maintenance requirements
- expectations and intentions of the property owner or system operator.

Generally, the more complex and challenging the site is the more severe and numerous the constraints will be, resulting in fewer available options and posing greater risk that it may be more costly to install, operate and maintain. The level of detail, effort and scrutiny applied to the EDRS selection process should be adapted using a risk-based approach.

The topics addressed in this chapter include:

- risk based decision making
- guidance on selection of an EDRS
- guidance tables for site and soil selection
- guidance notes.

3.3 Risk based decision making

This guidance material has been prepared within a risk assessment and management framework generally consistent with ISO 31000 (see Figure 13). A risk-based approach to EDRS selection requires designers and council officers to evaluate the range of hazards and constraints on a site and consider how each EDRS option manages the risk associated with those hazards. Where risks are low, this process should be streamlined and simple. Where risks are high, more rigour is required.

Selection of a suitable EDRS is normally an iterative process that is influenced by design and vice versa. While this chapter concentrates on the selection process, in practice EDRS selection will often be done in parallel with design and reconsideration of the originally selected system is often required.

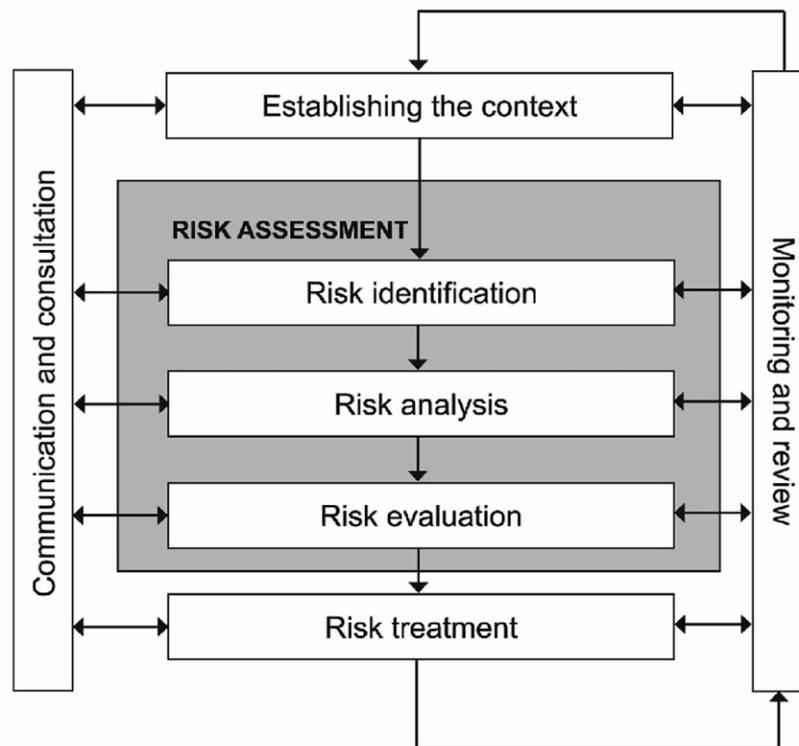


Figure 13: Risk management process (ISO 31000)

3.4 Guidance on selection of an EDRS

The selection of a suitable EDRS is an iterative process comprising many different stages, with each stage influenced by both internal and external considerations and decision points. An example selection process flowchart is presented in Figure 14.

3.4.1 Establishing context

Key elements of the EDRS construction and installation project that have an important influence on the outcome should be established. This helps to develop a clear understanding of what needs to be achieved and what important matters will be required or may need to be addressed during the selection process. Some of the key project elements include:

- the overarching EDRS construction and installation project plan
- objectives and intended use of the effluent
- available or required data

- available budget
- identification of important stakeholders
- project timeline.

3.4.2 Collect data

This stage involves the collection and collation of data and information relevant to the project. The traditional source of data will be from the outcomes of the LCA, which will generally include data and information about the site (including amenity features), soils, environment, intended use and project. If an LCA is not available or required, then data about the site (including amenity features), soil and project will need to be obtained from other sources.

Table 4 lists information typically required for the selection process.

Table 4: Typical data sources and Important selection features

Data source	Feature
Site	<ul style="list-style-type: none"> • Locality • Lot size • Lot plan that includes amenity features • Climate datatabe • Landform, slope, surface/subsurface features and other topographic/site features
Soils	<ul style="list-style-type: none"> • Geology • Physical data • Chemical data
Environment	<ul style="list-style-type: none"> • Surface waters • Groundwaters • Bores • Vegetation and biodiversity areas • Sensitive receiving environments (drinking water catchments, aquaculture areas, etc.)
Project	<ul style="list-style-type: none"> • Development location, type, and description • Intended use of effluent • Site plans • Floor plans • Development plans • Owner preferences

The collated information and data should be assessed to determine its completeness, suitability and accuracy.

Missing or unsuitable data can be assessed as either a critical or noncritical gap. A critical gap indicates that continuing to the next stage of the selection process may not be possible until the identified information gap is rectified. A noncritical gap indicates that the information while incomplete, unsuitable or inaccurate is minor and may not preclude continuing the process. However, the number of noncritical information gaps should be considered when determining whether to continue the process.

3.4.3 Identify and evaluate constraints

This stage of the selection process involves identifying, evaluating and interpreting the collected information. Constraint levels are categorised as:

- Nil/minor constraint – this outcome indicates that the result for the assessed feature is within the acceptable criteria range for the EDRS.
- Moderate constraint – this outcome indicates that the result for the assessed feature is on the outer limits of the acceptable criteria range for the EDRS. A moderate result may still be acceptable, however, consider suitable control measures or modifying the EDRS design.
- Major constraint – this outcome indicates that the result for the assessed feature is outside the preferred limits of the criteria range for the EDRS. This result generally indicates an unacceptable feature result for the specific EDRS and that, where available and feasible, alternative EDRS options should be considered. Where there are no lower-risk feasible alternatives, it will be necessary to introduce suitable control measures or to manage or at least minimise risk through design modification.

Several tools may assist during this stage, including:

- GIS – geographic information systems are a contemporary and valuable tool commonly used by assessors and designers.
- Maps – examples of maps include soil landscapes, biodiversity, groundwater, registered bores, etc.
- Literature – published standards, guidelines and reference documents are available on a wide range of wastewater-related topics that can be useful to assessors and designers.

The assessor/designer should evaluate the constraint and level of limitation against known criteria outlined in Section 3.5 to determine suitable effluent dispersal options.

3.4.4 Shortlist and select

In most situations the outcomes from the constraints identification stage will result in a list of effluent dispersal options most appropriate for the site.

On complex and challenging sites, it is possible that all assessed features could be identified as major constraints or a combination of moderate and major. In this situation it is the assessor/designer's role to use their experience and knowledge to critically assess the outcomes against the development and adopted performance principles and objectives to determine if a suitable and sustainable solution is available. This can involve completing design calculations and siting options of the EDRS to confirm if there are suitable risk control options available and if they represent the best practicable option for an EDRS for the site.

Following this, if no feasible and acceptable EDRS can be identified, designers should consult with the council on the specific project.

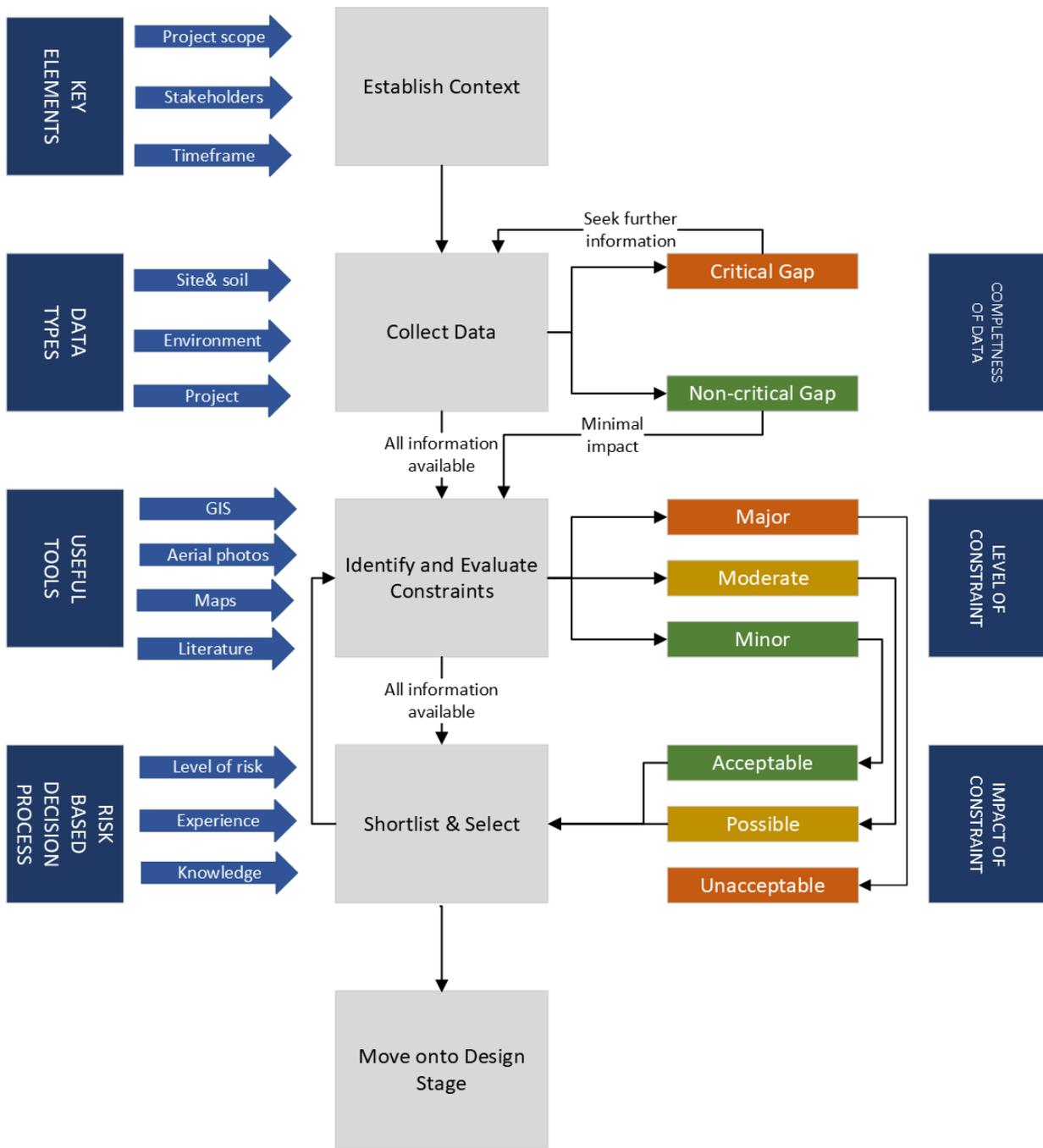


Figure 14: EDRS selection process flowchart

3.5 Guidance tables

Table 5 to Table 9 provide guidance on how site and land capability constraints may limit the effectiveness and suitability of an EDRS. A limitation scale is presented, which indicates how the severity of the constraint may impact the functionality of the EDRS. The tables are for guidance purposes to assist designers to choose the most appropriate EDRS for the subject site. On highly constrained sites it is likely that there will be many site constraints that are high. Under these circumstances it is best

practice to reconsider the original EDRS selection and/or consider if onsite wastewater management is the most sustainable long-term wastewater management approach for the site.

Table 5: Site and soil selection guidance for conventional trench/bed systems

Item	Constraint feature	Guidance information for conventional trench/bed systems	Limitation scale		
			Lesser	← →	Greater
1	Slope	<ul style="list-style-type: none"> Steep slope can impact constructability and increase potential for erosion Assess in conjunction with landform 	<5%	5–15%	>15%
2	Soil depth (BGL)	<ul style="list-style-type: none"> Soil category is important in determining suitability of available depth Shallow depth can reduce effluent storage capacity and treatment by soil processes Shallow depth can impact system design Consider depth and type of limiting layer on design selection 	>1.2 m	0.9–1.2 m	<0.9 m
3	Soil category	<ul style="list-style-type: none"> High permeable soils require consideration of groundwater impacts and offsite movement Low permeable soils result in increased design footprints per unit volume of effluent 	3–4	–	1–2 5–6
4	Landform (Figure C2 from AS/NZS 1547:2012)	<ul style="list-style-type: none"> The land-surface characteristics are important to understand how surface and soil drainage can potentially impact land application area (LAA) location and design A divergent slope promotes natural site drainage by widening the spread of surface and subsurface water A convergent slope promotes water retention or accumulation by concentrating surface and subsurface water Consider location of LAA 	Waxing divergent Linear divergent	Waning divergent Waxing planar Linear planar Waxing convergent	Waning convergent Linear convergent Waning planar
5	Dispersive soils	<ul style="list-style-type: none"> Can result in low soil permeability over the life of the system 	Non-dispersive soils	ESP 6–15%	Dispersive soils

Item	Constraint feature	Guidance information for conventional trench/bed systems	Limitation scale		
			Lesser	←————→	Greater
		<ul style="list-style-type: none"> Typically related to soil category (i.e., category 5–6 soils) Assess soil test results including Emerson aggregate test (EAT) and exchangeable sodium percentage (ESP) 	ESP <6% EAT Class 7/8	EAT Class 3	ESP >15% EAT Class 1/2
6	Climatic factors	<ul style="list-style-type: none"> System design generally compatible with most climatic conditions Caution should be taken relying on monthly water balance calculations where rainfall significantly exceeds evaporation over many months 	Annual evaporation exceeding retained rainfall	Annual retained rainfall exceeding evaporation Alpine regions	–
7	Fragments	<ul style="list-style-type: none"> High coarse fragments result in low storage capacity, high infiltration potential, and high risk of offsite transport May result in increased difficulty in constructability 	<10%	10–50%	>50%
8	Depth to seasonal water table	<ul style="list-style-type: none"> Assess duration of seasonal water table Assess soil category to determine rate of vertical movement Assess potential preferential pathways 	>1.2 m	0.9– 1.2 m dependent on point of application	<0.9 m subject to site-specific assessment
9	Flooding	<ul style="list-style-type: none"> Subsurface point of application reduces risk of pollutant export EDS cannot easily be raised by importing fill 	Above 1% Annual exceedance probability (AEP) flood level	1–5% AEP flood level	Below 5% AEP flood level
10	Seasonal soil saturation	<ul style="list-style-type: none"> Deeper point of effluent application may be impeded by prolonged saturated subsoils 		Site-specific assessment required	
11	Lot size	<ul style="list-style-type: none"> Can be beneficial for smaller lot sizes, however, assessment of other constraint features is required 		Site-specific assessment required	

Table 6: Site and soil selection guidance for evapotranspiration systems

Item	Constraint feature	Guidance information for evapotranspiration systems	Limitation scale		
			Lesser		Greater
1	Slope	<ul style="list-style-type: none"> Steep slope can impact constructability and high potential for erosion Assess in conjunction with landform 	<5%	5–10%	>15%
2	Soil depth (BGL)	<ul style="list-style-type: none"> Soil category is important in determining suitability of available depth Shallow depth can reduce effluent storage capacity and treatment by soil processes Shallow depth can impact system design Consider depth and type of limiting layer on design selection 	>1.2 m	0.9–1.2 m	<0.9 m
3	Soil category	<ul style="list-style-type: none"> Not typically used on category 1–3 soils Low permeable soils result in increased design footprints per unit volume of effluent 	4–5	6	1–3
4	Landform (Figure C2 from AS/NZS 1547:2012)	<ul style="list-style-type: none"> The land-surface characteristics are important to understand how surface and soil drainage can potentially impact LAA location and design A divergent slope promotes natural site drainage by widening the spread of surface water A convergent slope promotes soil retention by concentrating surface water 	Waxing divergent Linear divergent	Waning divergent Waxing planar Linear planar Waxing convergent	Waning convergent Linear convergent Waning planar

Item	Constraint feature	Guidance information for evapotranspiration systems	Limitation scale		
			Lesser		Greater
		<ul style="list-style-type: none"> Consider location of LAA 			
5	Dispersive soils	<ul style="list-style-type: none"> Can result in low soil permeability over the life of the system Typically related to soil category (i.e., category 5–6 soils) Assess soil test results including Emerson aggregate test (EAT) and exchangeable sodium percentage (ESP) 	Non-dispersive soils ESP <6% EAT Class 7/8	ESP 6–15% EAT Class 3	Dispersive soils ESP >15% EAT Class 1/2
6	Climatic factors	<ul style="list-style-type: none"> System design generally compatible with most climatic conditions Caution should be taken relying on monthly water balance calculations where rainfall significantly exceeds evaporation over many months 	Annual evaporation exceeding retained rainfall	Annual retained rainfall exceeding evaporation Alpine regions	
7	Fragments	<ul style="list-style-type: none"> High coarse fragments result in low storage capacity, high infiltration potential, and high risk of offsite transport May result in increased difficulty in constructability 	<10%	10–50%	>50%
8	Depth to seasonal water table	<ul style="list-style-type: none"> Assess duration of seasonal water table Assess soil category to determine rate of vertical movement Assess potential preferential pathways 	>1.2 m	0.9–1.2 m dependent on point of application	<0.9 m subject to site-specific assessment

Item	Constraint feature	Guidance information for evapotranspiration systems	Limitation scale		
			Lesser		Greater
9	Flooding	<ul style="list-style-type: none"> Subsurface point of application reduces risk of pollutant export EDRS cannot easily be raised by importing fill 	Above 1% Annual exceedance probability (AEP) flood level	1–5% AEP flood level	Below 5% AEP flood level
10	Seasonal soil saturation	<ul style="list-style-type: none"> Deeper point of effluent application may be impeded by prolonged saturated subsoils Prolonged saturation of upper soil impedes treatment and hinders absorption 		Site-specific assessment required	
11	Lot size	<ul style="list-style-type: none"> Can be beneficial for smaller lot sizes, however, assessment of other constraint features required 		Site-specific assessment required	

Table 7: Site and soil selection guidance for subsurface irrigation systems

Item	Constraint feature	Guidance information for subsurface irrigation systems	Limitation scale		
			Lesser	←————→	Greater
1	Slope	<ul style="list-style-type: none"> • More complex design and constructability requirements • Requires careful hydraulic assessment to ensure adequate performance and efficient distribution • A range of proprietary drip line and ancillary products available • Assess in conjunction with landform 	<10%	10–30%	>30%
2	Soil depth (BGL)	<ul style="list-style-type: none"> • Shallow depth can reduce effluent storage capacity and treatment by soil processes • Can be used within constructed landscaped areas and garden beds where soil depth is typically good 	>0.7 m	–	<0.7 m
3	Soil category	<ul style="list-style-type: none"> • Category 1–2 permeable soils require consideration of groundwater impacts and lateral movement • Category 5–6 soils result in increased design footprints per unit volume of effluent • Category 5–6 soils require consideration of leakage management, lateral spacing and zoning 	3–4	1–2	5–6
4	Landform (Figure C2 from AS/NZS 1547:2012)	<ul style="list-style-type: none"> • The land-surface characteristics are important to understand how surface and soil drainage can potentially impact LAA location and design • A divergent slope promotes natural site drainage by widening the spread of surface water 	Waxing divergent Linear divergent	Waning divergent Waxing planar Linear planar Waxing convergent	Waning convergent Linear convergent Waning planar

Item	Constraint feature	Guidance information for subsurface irrigation systems	Limitation scale		
			Lesser		Greater
		<ul style="list-style-type: none"> A convergent slope promotes water retention by concentrating surface water Consider location of LAA Consider landform in conjunction with slope, soil category and soil depth 			
5	Dispersive soils	<ul style="list-style-type: none"> Typically related to soil category (i.e., category 5–6 soils) Assess soil test results including Emerson aggregate test (EAT) and exchangeable sodium percentage (ESP) Less likely as topsoils where dripline is installed can be less prone to dispersiveness 	Non-dispersive soils ESP <6% EAT Class 7/8	ESP >6 <EAT Class 3	–
6	Climatic factors	<ul style="list-style-type: none"> Not significant: will operate in high or low rainfall areas, but more efficient in low rainfall and high evapotranspiration areas Caution should be taken relying on monthly water balance calculations where rainfall significantly exceeds evaporation over many months 	Annual evaporation exceeding retained rainfall	–	Annual retained rainfall exceeding evaporation Alpine regions
7	Fragments	<ul style="list-style-type: none"> High coarse fragments result in low storage capacity, high infiltration potential, and high risk of offsite transport May result in increased difficulty in constructability High coarse fragments may result in damage to the dripline 	<20%	20–50%	>50%

Item	Constraint feature	Guidance information for subsurface irrigation systems	Limitation scale		
			Lesser		Greater
8	Depth to seasonal water table	<ul style="list-style-type: none"> Assess duration of seasonal water table Assess soil category to determine rate of vertical movement Assess potential preferential pathways 	>0.9 m	0.6–0.9 m dependent on point of application	<0.6 m subject to site-specific assessment
9	Flooding	<ul style="list-style-type: none"> Subsurface point of application reduces risk of pollutant export EDS can easily be raised by importing fill 	Above 5% Annual exceedance probability AEP flood level	Below 5% AEP flood level	–
10	Seasonal soil saturation	<ul style="list-style-type: none"> Prolonged saturation of upper soil impedes treatment and hinders absorption 	Site-specific assessment required		
11	Lot size	<ul style="list-style-type: none"> Can be unsuitable for smaller lot sizes, however, assessment of other constraint features required Consider setback distances to property boundaries, buildings, and sensitive receptors Can result in reduced available areas for recreational purposes 	Site-specific assessment required		

Table 8: Site and soil selection guidance for surface irrigation systems

Item	Constraint feature	Guidance information for surface irrigation systems	Limitation scale		
			Lesser	←————→	Greater
1	Slope	<ul style="list-style-type: none"> Typically more cost effective than other methods Simpler constructability, however, requires careful design to ensure even and efficient distribution Steep slope can result in high runoff during rainfall events Assess in conjunction with landform 	<5%	5–10%	>10%
2	Soil depth (BGL)	<ul style="list-style-type: none"> Soil category is important in determining suitability of available soil depth Shallow depth can reduce effluent storage capacity and treatment by soil processes Can be used within constructed landscaped areas and garden beds where soil depth is typically good 	>0.6 m	–	<0.6 m
3	Soil category	<ul style="list-style-type: none"> Category 1–2 permeable soils require consideration of groundwater impacts and offsite movement Category 5–6 soils result in increased design footprints per unit volume of effluent Category 5–6 soils require consideration of leakage management, lateral spacing and zoning 	3–4	1–2	5–6
4	Landform (Figure C2 from AS/NZS 1547:2012)	<ul style="list-style-type: none"> The land-surface characteristics are important to understand how surface and soil drainage can potentially impact LAA location and design 	Waxing divergent Linear divergent	Waning divergent Waxing planar Linear planar Waxing convergent	Waning convergent Linear convergent Waning planar

Item	Constraint feature	Guidance information for surface irrigation systems	Limitation scale		
			Lesser	← →	Greater
		<ul style="list-style-type: none"> • A divergent slope promotes natural site drainage by widening the spread of surface water • A convergent slope promotes water retention by concentrating surface water • Consider location of LAA • Consider landform in conjunction with slope, soil category and soil depth 			
5	Dispersive soils	<ul style="list-style-type: none"> • Typically related to soil category (i.e., category 5–6 soils) • Assess soil test results including Emerson aggregate test (EAT) and exchangeable sodium percentage (ESP) • Less likely as topsoils can be less prone to dispersiveness 	Non-dispersive soils ESP <6% EAT Class 7/8	ESP 6–15% EAT Class 3	Dispersive soils ESP >15% EAT Class 1/2
6	Climatic factors	<ul style="list-style-type: none"> • System design best suited to climates where intense rainfall events are uncommon and evapotranspiration exceeds rainfall in most months • Requires consideration of EDRS location in windy environments to minimise impacts caused by wind drift • Caution should be taken when relying on monthly water balance calculations where rainfall significantly exceeds evaporation over many months 	Annual evaporation exceeding retained rainfall	–	Annual retained rainfall exceeding evaporation Alpine regions Areas of high rainfall intensity
7	Fragments	<ul style="list-style-type: none"> • High coarse fragments result in low storage capacity, high infiltration potential, and high risk of offsite transport • May result in increased difficulty in constructability 	<20%	20–50%	>50%

Item	Constraint feature	Guidance information for surface irrigation systems	Limitation scale		
			Lesser	←————→	Greater
8	Depth to seasonal water table	<ul style="list-style-type: none"> Assess duration of seasonal water table Assess soil category to determine rate of vertical movement Assess potential preferential pathways 	>0.9 m	0.6–0.9 m dependent on point of application	<0.6 m subject to site-specific assessment
9	Flooding	<ul style="list-style-type: none"> Surface point of application significantly increases risk of pollutant export EDS can easily be raised by importing fill 	Above 1% Annual exceedance probability (AEP) flood level	1–5% AEP flood level	Below 5% AEP flood level
10	Seasonal soil saturation	<ul style="list-style-type: none"> Prolonged saturation of upper soil impedes treatment and hinders absorption 		Site-specific assessment required	
11	Lot size	<ul style="list-style-type: none"> Can be unsuitable for smaller lot sizes, however, assessment of other constraint features required Consider setback distances to property boundaries, buildings and sensitive receptors Can result in reduced available areas for recreational purposes 		Site-specific assessment required	

Table 9: Site and soil selection guidance for mound systems

Item	Constraint feature	Guidance information for mound systems	Limitation scale		
			Lesser	← →	Greater
1	Slope	<ul style="list-style-type: none"> • More complex design and constructability requirements • Requires careful hydraulic assessment to ensure adequate performance and efficient distribution • Assess in conjunction with landform • Risk of toe seepage on steeper slopes • An increase in imported sand for construction of the downslope batter is needed as slope increases 	<5%	5–15%	>15%
2	Soil depth (BGL)	<ul style="list-style-type: none"> • Mounds are designed to overcome shallow soil limitations • Shallow depth of natural soil can reduce effluent storage capacity and treatment by soil processes 	>0.6 m	<0.6 m	–
3	Soil category	<ul style="list-style-type: none"> • Mounds are a suitable choice for most soil categories • Should be considered in conjunction with soil depth and depth to seasonal or permanent water tables 	1–2 3–4	5–6	–
4	Landform (Figure C2 from AS/NZS 1547:2012)	<ul style="list-style-type: none"> • The land-surface characteristics are important to understand how surface and soil drainage can potentially impact LAA location and design • A divergent slope promotes natural site drainage by widening the spread of surface water • A convergent slope promotes soil retention by concentrating surface water • Consider location of LAA 	Waxing divergent Linear divergent	Waning divergent Waxing planar Linear planar Waxing convergent	Waning convergent Linear convergent Waning planar

Item	Constraint feature	Guidance information for mound systems	Limitation scale		
			Lesser		Greater
		<ul style="list-style-type: none"> Consider landform in conjunction with slope, soil category and soil depth 			
5	Dispersive soils	<ul style="list-style-type: none"> Typically related to soil category (i.e., category 5–6 soils) Assess soil test results including Emerson aggregate test (EAT) and exchangeable sodium percentage (ESP) May be limited by low effluent infiltration in underlying natural soil 	Non-dispersive soils ESP <6% EAT Class 7/8	ESP 6–15% EAT Class 3	Dispersive soils ESP >15% EAT Class 1/2
6	Climatic factors	<ul style="list-style-type: none"> Not significant – will operate in high or low rainfall areas Surface and groundwater controls required in wet areas 	Annual evaporation exceeding retained rainfall	Annual retained rainfall exceeding evaporation e.g., Alpine regions	–
7	Fragments	<ul style="list-style-type: none"> High coarse fragments result in low storage capacity, high infiltration potential, and high risk of offsite transport 	<20%	>20%	–
8	Depth to seasonal water table (from point of application)	<ul style="list-style-type: none"> Mounds designed to overcome shallow groundwater constraints Assess duration of seasonal water table Assess soil category to determine rate of vertical movement Assess potential preferential pathways 	>0.6 m	0.3–0.6 m dependent on point of application	<0.3 m subject to site-specific assessment
9	Flooding	<ul style="list-style-type: none"> Mounds are designed to overcome flood constraints EDS is a raised system that can be customised to meet flood levels by importing fill 	Above 5% Annual exceedance probability (AEP) flood level	Below 5% AEP flood level	–

Item	Constraint feature	Guidance information for mound systems	Limitation scale	
			Lesser	Greater
9	Seasonal soil saturation	<ul style="list-style-type: none"> Mounds designed to overcome soil saturation constraints Prolonged saturation of upper soil impedes treatment and hinders absorption 		Site-specific assessment required
10	Lot size	<ul style="list-style-type: none"> Can be suitable for smaller lot sizes, however, assessment of other constraint features is required Consider setback distances to property boundaries, buildings and sensitive receptors 		Site-specific assessment required

3.6 Guidance notes

AS/NZS 1547:2012 provides detailed information to support a risk based EDRS selection process. This section provides further guidance information including reference to the relevant sections of AS/NZS 1547:2012, which is provided in Tables 10 to 19.

Additional guidance is also provided in Chapter 4: Design of EDRS.

3.6.1 Site characteristics

Site characteristics, including land surface shape, slope and area, are important features that require consideration in the selection and design of an EDRS.

3.6.1.1 Slope and gradient

Gradient is a measure of how steep or gentle a slope is, that is the rate of incline or decline of a slope. Slope is the ratio of the vertical and horizontal distances between 2 points on a line if the line is horizontal.

Considerations of slope and gradient include:

- link to landform and soil category
- effect on infiltration and runoff of effluent applied to the surface
- effect on infiltration and runoff of stormwater
- potential erosion and surface stability
- effect on constructability of the system
- relationship with effluent dispersal methods
- locations of site features, sensitive receptors, buildings and other structures
- use of suitable control measures.

Table 10: AS/NZS 1547:2012 references to slope and gradient

Section	Subsection	Page number
General	1.11 Conversion of percent grade, slope, and gradient	19
Appendix K Land applications systems – Guidance on selection	Tables K1 and K2	128
Appendix L Land application methods – Absorption systems	L5.4 Surface water	147
Appendix M Land application methods – Irrigation systems	CM7.1	161
	M9.3 Sloping sites	162
	Table M2 Recommended reductions in design irrigation rates (DIR) according to slope	163
	CM9.3	163

Section	Subsection	Page number
Appendix N Land application methods – Mounds	N1 General	170
	N2.1 Sizing	170
	CN2.1	171
	Figure N1 Wisconsin mound system	174

3.6.1.2 Land surface shape and landform

The surface shape of the land or landform plays an important role in the movement of water onto, within and off a site with subsequent implications to surface and soil drainage. All EDRS are affected similarly by the various landforms:

- landform type and limitation:
 - minor limitation – hill crests, convex side slopes and plains
 - moderate limitation – concave side slopes and foot slopes
 - major limitation – drainage plains and incised channels.

Table 11: AS/NZS 1547:2012 references to land surface shape

Section	Subsection	Page number
General	1.9 Definitions	12
Appendix C Site and soil evaluation for planning, rezoning and subdivision of land	C3.2 Land surface shape	92
	CC3.2	92
	Figure C2 Slope and configuration and surface drainage	93

3.6.1.3 Lot size and available area

The size of the lot is an important consideration, however, the area of land on the lot that is suitable and available for effluent dispersal is of equal or even more importance.

Table 12: AS/NZS 1547:2012 references to lot size

Section	Subsection	Page number
General	1.9 Definitions	14
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Appendix K Land applications systems – Guidance on selection	Tables K1 and K2	128

3.6.2 Soil characteristics

3.6.2.1 Depth, structure, texture

The depth of soil available on the lot should be adequate to:

- enable construction of the selected EDRS
- meet effluent storage requirements
- enable attenuation of pathogens nutrients and other contaminants by soil processes
- provide an adequate separation distance to groundwater or restrictive layer such as hardpan.

The criteria for soil depth stated in the guidance tables in Section 3.5 and AS/NZS 1547:2012 should not necessarily be taken as absolute values, rather as starting values for consideration together with other relevant factors. Other factors that should be considered include:

- soil structure and texture
- slope and landform
- location and depth of sensitive receptors and restrictive layers.

Table 13: AS/NZS 1547:2012 references to soil depth

Section	Subsection	Page number
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Appendix R Recommended setback distances for land application	Table R1 Guidelines for horizontal and vertical setback distances	184

Table 14: AS/NZS 1547:2012 references to soil texture and structure

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	Table 5.1 Determination of soil category	39
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Appendix F Dispersive soil and sodicity	F2 Discussion	111
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3.6.2.2 Dispersiveness, saturation and sodicity

Dispersive soils pose limitations on EDS because of the potential loss of soil structure when effluent is applied. Soil pores can become smaller or completely blocked, causing a decrease in soil permeability, which can lead to system failure.

The level of exchangeable sodium cations in soil is referred to as sodicity. It relates to likely dispersion on wetting and shrink/swell properties. Sodic soils tend to have low infiltration capability, low hydraulic conductivity and a high susceptibility to erosion. Exchangeable sodium percentage (ESP) is used as a measure of sodicity (EHP 1998).

Indicators of dispersiveness include the Emerson aggregate test and sodicity as measured by the ESP. The ability to overcome sodicity constraints and the management strategy required depends on the cause – which can be a deficiency in calcium and magnesium in the soil or high sodium concentrations, or a combination of both.

Table 15: AS/NZS 1547:2012 references to dispersiveness and sodicity

Section	Subsection	Page number
Section 5 Design of onsite systems	C5.1.1	34
	Table 5.1 Determination of soil category (Note 3)	39
	C5.5.5.1	54
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Appendix F Dispersive soil and sodicity	F1 and F2	111
Appendix G Soil permeability measurement	CG4.1	117

Table 16: AS/NZS 1547:2012 references to soil saturation

Section	Subsection	Page number
Appendix K Land applications systems – Guidance on selection	Table K1 Land application systems	130
	Table K2 Selecting land application systems	135

3.6.2.3 Coarse fragments and rock

Coarse fragments include hard rock material and nodules or segregations, which may have developed as the soil formed. The rock may have weathered from the parent material or have been transported from elsewhere.

When coarse fragments make up more than 20% of the soil volume consider changing the soil category by one class (for example, from category 2 to category 3).

Table 17: AS/NZS 1547:2012 references to coarse fragments and rock

Section	Subsection	Page number
Appendix B Site and soil evaluation procedures	Table B1 Summary of investigation procedures	86
	Table B2 Soil properties	87
Appendix E Site and soil properties	E1 Scope	104
	E5 Assessment of coarse fragments	107–108

3.6.2.4 Soil/water regime and drainage

Soil characteristics – including texture, structure, porosity, dispersiveness and hydraulic conductivity – influence the rate at which water or effluent moves through the soil. Finer soil types (i.e., silt and clay) have a higher soil porosity than coarse soil types (i.e., sand and gravel) and have a better ability to retain water under gravity due to the higher adhesive forces between the water and soil particles. However, the hydraulic conductivity of finer grained soils is much lower than that of coarse soils, meaning these soils are slower draining and are more at risk of becoming saturated after rain events or hydraulic overloading of effluent. As such, the DLR of finer soils is much lower than that of coarse soil types. The structure of a soil can also drastically influence the hydraulic conductivity and effluent renovation capacity, and this is to be considered when determining a sustainable DLR for any EDRS.

Table 18: AS/NZS 1547:2012 reference to soil water regime

Section	Subsection	Page number
Appendix M Land application methods – Irrigation systems	Table M1 Soil category, soil texture, structure, and indicative permeability	160

3.6.3 Climatic factors

The climatic conditions of an area significantly influence the soil hydrology and the ability of an EDRS to sustainably disperse or recycle effluent. For example, areas with high rainfall and low evapotranspiration are unlikely to be suitable for systems that rely heavily on evapotranspiration for removal of effluent from the water balance such as vegetated recirculating evapotranspiration beds or enhanced evapotranspiration systems. These systems are suitable for areas with relatively low rainfall compared to evaporation. However, all systems should be designed with consideration given to how the site climate may influence the DLR. In areas with particularly wet climates the DLR should be reduced to accommodate the significantly lower evapotranspiration processes that will occur in these conditions.

3.6.4 Groundwater

Groundwater characteristics influence the suitability of each EDRS to a particular site, and design aspects including DLR, LLR and setback distances from receiving environments should be considered. A 600 mm separation between the point of effluent injection and the episodic high groundwater level should be maintained for all systems (USEPA, 2002). Raised systems – such as Wisconsin mounds – are often a preferred solution in areas of high groundwater to enable adequate attenuation prior to effluent plumes reaching the groundwater.

Areas with unconfined aquifers should ensure that there are sufficient setback distances between EDRS and sensitive receiving environments due to the more rapid movement of pollutants and reduced attenuation (under most circumstances) in groundwater compared to lateral subsurface flow through the soil profile. In highly constrained environments, completion of a more detailed impact assessment is required to confirm that the proposed EDRS can meet environment and human health objectives.

Table 19: AS/NZS 1547:2012 reference to groundwater

Section	Subsection	Page number
Appendix M Land application methods	Table R1 Groundwater and associated notes	185 and 186

4 Design of effluent dispersal and recycling systems

4.1 Scope

This chapter provides information and guidance on the technical and practical requirements that inform the design of EDRS.

4.2 Chapter overview

The overall design process is an integration of the classification, selection, and design chapters. This chapter applies the information on system categories from the classification chapter (Chapter 2) and builds on the data and outcomes from the selection process (Chapter 3).

The topics addressed in this chapter include:

- EDRS design basis
- EDS sizing methods
- location and setback distances
- EDS design considerations
- risk management
- documentation requirements.

The principal goals of the design process are the adoption and development of an EDRS that:

- is suitable in type, size and location for the identified site, topographical and project characteristics
- has an area large enough to manage the expected flow of effluent from the wastewater treatment plant and is able to distribute the effluent evenly over the entire land application area (LAA).

While the selection and design components are both fundamental stages of the broader EDRS development process, they are also integral to each other. Each stage cannot be done in isolation. Determining the final system design could require several revisions, and further re-evaluation of data, limitations, assumptions, calculations and risk management measures. Also consider the constructability, affordability, and ease of maintenance – particularly on highly constrained sites.

The flowchart in Figure 15 graphically represents the design process from the outcomes of the selection stage through to adoption of a final EDRS design. It presents a complete process, however, the level of design work required will be guided by the complexity of the site, identified limitations and scale and characteristics of the development.

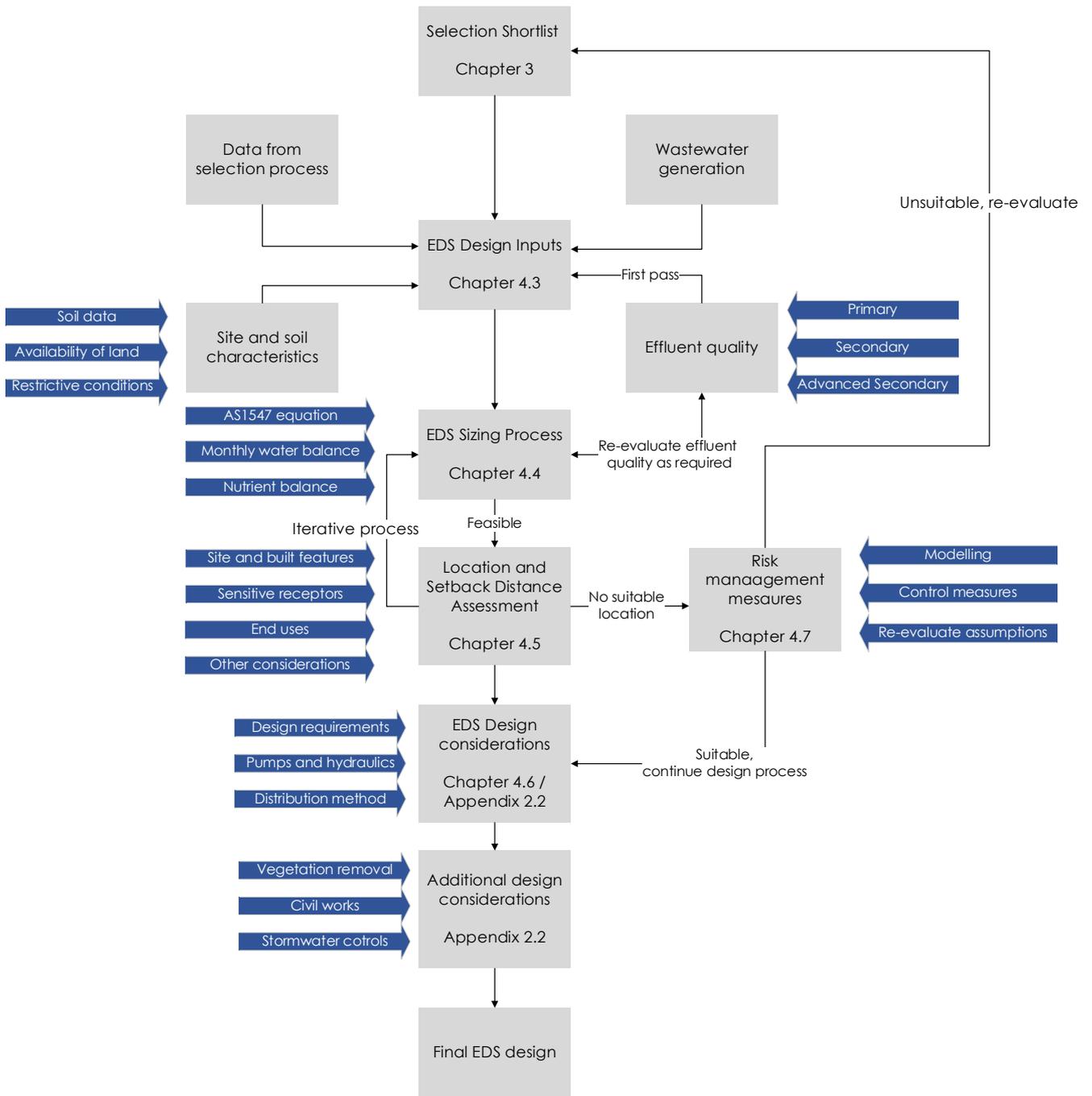


Figure 15: Process flow chart

4.3 EDRS design basis

This section provides guidance to assist in the evaluation of design inputs and development of suitable design bases for EDRS.

4.3.1 Wastewater generation

The wastewater generated by a development should be characterised to enable an adequate and suitable EDRS design. Typical and irregular or surge wastewater flows should be characterised to adequately capture the variability in flow and enable a suitable design wastewater flow rate to be determined to prevent wastewater from flowing offsite.

The wastewater and effluent quality characteristics, including BOD₅, TSS, total nitrogen (TN) and total phosphorus (TP) concentrations are important inputs in the EDRS sizing process. For example, a reduction in the soil DLR value with resulting increase in EDRS size may be appropriate for sites near sensitive receiving environments to minimise nutrient transportation.

This section outlines the calculation of flow rates, occupancy and organic loads and provides guidance on consideration of variable flow rates and non-residential wastewater flow rates and loads.

4.3.1.1 Occupancy

Domestic premises

The Victoria 2021 Census identified that the average number of people per household is 2.5 (Australian Bureau of Statistics, 2022). However, understandably, the actual occupancy of individual Victorian households varies. It is important for adequate capacity to be provided for short-term peaks in wastewater generation. One way to determine the potential occupancy of residential premises to calculate design wastewater flow rates is to use the formula – the number of bedrooms plus one. This approach correlates reasonably well with measured wastewater generation rates from Victoria (Yarra Valley Water, 2021).

Non-domestic premises

The occupancy of non-domestic premises can vary greatly due to a range of factors, including the nature of the development, development size, location and operating times. Determining the occupancy of these types of premises should be carefully considered based on site-specific investigations and actual data where available.

Examples of useful information for 2 different development types include:

- for accommodation facilities:
 - maximum capacity derived from number of rooms and beds
 - water use data (for example, water bills)
 - historical and representative occupancy information in the form of number of guests per night or percentage occupancy – ideally a minimum of one year of data provided
 - in the absence of occupancy data, provision of typical minimum, mid and peak season daily or weekly occupancy numbers or percentages
- for food and beverage service establishments:
 - estimated low, mid and peak season daily guests over a typical week
 - number of seats
 - water use information (for example, water bills, metered supplies)
 - licenced or approved capacity.

Where the premises has significant seasonal variability in flows, the development of an annual wastewater flow profile with an appropriate timestep should be considered (typically weekly or monthly, but sometimes daily is justified). For existing sites, installing a flow meter to obtain site-specific wastewater generation rates may be considered as this data will be most representative for the site and can avoid both under and over design.

4.3.1.2 Flow rates

Domestic premises

Daily wastewater flow rates can vary significantly. The following development-specific factors may be useful when determining design flows:

- the number of bedrooms
- average and peak occupancy
- average and peak per capita wastewater volume
- type of water supply (rainwater or reticulated water)
- type of water fixtures (for example, installation of water saving fixtures)
- type of wastewater treatment plant and EDRS, and the resilience of these systems to variable hydraulic loads.

Flow rates for residential premises are typically based on the number of bedrooms in the dwelling because the number of occupants can vary over time and may not adequately represent peak periods. The daily household wastewater generation rate is calculated by multiplying the occupancy (for example, number of bedrooms plus one person) by the adopted minimum wastewater flow rate. The equation to calculate the daily wastewater flow generation rate for a residential dwelling is:

$$\text{Daily Wastewater Flow Rate} = \text{Occupancy (Number of Bedrooms + 1)} \times \text{Daily Hydraulic Flow Rate} \quad (1)$$

The occupancy and design daily flow rates for households can be found in the GOWM, Table 4–1 (Design flow rates for households).

Non-domestic premises

Wastewater generation rates for non-domestic premises can be highly variable and, like occupancy, depend significantly on the type of premises. Discuss what wastewater generating activities are occurring at the site with the site manager. The installation of a flow meter at existing sites to obtain site-specific wastewater flow rate information is always beneficial, but there is often insufficient funds or time available to obtain this. In the absence of this information, it is often possible to examine the water use data from water bills to help calibrate approximate wastewater flow rates per person. Note: this data may be unavailable for sites using a non-reticulated water supply as the primary water source (for example, rainwater harvesting and tank storage).

Organic loads

The organic concentration of wastewater generated in domestic households and commercial premises is typically increasing as water use decreases through education and the implementation of water saving fixtures. It is essential, especially for non-domestic developments, that the wastewater treatment system is capable of adequately managing the organic load.

The organic loading rate for residential dwellings is typically 70 g BOD₅/person/day based on 150 L/person/day (Standards Australia, 2012).

4.3.2 Maximum daily and surge flows

It is important to consider the maximum instantaneous wastewater flow variation for both domestic and non-domestic developments to ensure that the EDRS type and design can satisfactorily manage irregular and surge flows. The design of the EDRS should be capable of dispersing irregular and surge flows from the development. Alternatively, other design measures such as flow balancing or flow equalisation can be implemented to help manage flow variability.

4.3.3 Soil, site and effluent characteristics

Site and soil characteristics assessed during the LCA or site and soil assessment in conjunction with effluent quality can influence EDRS design. The influence of site and soil characteristics on the selection of EDRS is not considered in these sections as it has been previously discussed in the Selection chapter (Section 3.6). However, it is important to recognise that in some situations the selection and design of an EDRS can be an iterative process sometimes requiring re-evaluation of system selections, data, assumptions and inputs.

These characteristics are discussed in further detail in Appendix 2:

- soil characteristics – Appendix 2.1.1
- site characteristics – Appendix 2.1.2
- effluent quality – Appendix 2.1.3

4.4 EDS sizing methods

There are 3 methods for sizing EDS – the simple hydraulic equation, water balance calculation and nutrient balance sizing method. Best practice is to calculate all 3 methods when sizing an EDS to determine the most limiting design factor (hydraulic, nitrogen or phosphorus limited). While it is not always practical to size the EDS to the most limiting design factor, the severity of all design factors should be identified to enable adequate design or risk reduction measures to be implemented. This section provides guidance on a risk-based approach to EDS sizing.

Section 4.4.4 provides guidance on which sizing method should be adopted based on site-specific constraints.

4.4.1 Simple hydraulic equation

The simple hydraulic equation uses the design flow rate and DLR to determine the required EDS basal area. The simple hydraulic equation is presented in Equation L1 in Section L4 of AS/NZS 1547:2012.

Equation L1
$$L = \frac{Q}{DLR \times W}$$

Where:

L = Length in m

Q = Design daily flow in L/day

DLR = Design loading rate in mm/d

W = Width in m.

AS/NZS 1547:2012 recommends this equation and use of a DLR/DIR as a conservative benchmark for sizing of all EDS. However, it recognises that there will be some circumstances where the DLR may need to be reduced or increased subject to a site-specific assessment by a suitably qualified person.

The simple hydraulic equation has advantages in its simplicity. With only 2 parameters (design wastewater flow and DLR) there is less potential for compounding errors associated with a larger number of assumed inputs (for example, water balance). However, the equation does not consider the nutrient uptake or adsorption capability of the soil or site limitations including wet climates, steep slopes or shallow soils.

AS/NZS 1547:2012 advocates a risk-based approach to the selection of a DLR as a suitable method for considering a wider range of constraints as part of EDS sizing. Water and nutrient balance calculations are an example of resources that can be used to make these risk-based DLR decisions.

Where significant site constraints are present, including wet climates or reduced setbacks to sensitive receiving environments, consider reducing the DLR to adopt a larger EDS area to ensure the long-term sustainability of the treatment system. More specific guidance on the application of this risk-based approach is given in Section 4.4.4 Calculation method for EDS suitability and selection. Guidance on DLR/DIRs can be found in AS/NZS 1547:2012 (Section 5 and Appendix L, M and N).

Understanding design loading rates and design irrigation rates (adapted from AS/NZS 1547:2012)

As described in Section 5.5.5 and Appendix L4 of AS/NZS 1547:2012, the DLR/DIR is a conservative approximation of the long-term receiving capacity of an EDS but is not a long-term acceptance rate (LTAR), which takes into consideration a wider range of site-specific heterogeneous factors that are difficult to extrapolate as a design tool (effluent organic load, surface area of EDS impeded by gravel and differences in the hydraulic conductivity of upper soil horizons).

DLR/DIRs have been derived using the basal area of an EDS only (not the sidewalls in a trench or bed system). DLRs are not an empirical parameter and represent a conservative 'best estimate' of sustainable loading rates for EDS. Adjustment of these values through a risk-based process is considered appropriate where justified.

4.4.2 Water balance calculation

Monthly water balance calculations are a mass balance equation for all water entering and leaving an EDS over a monthly timestep. They are a relatively simple tool for evaluating the influence of climate on EDS performance over a year. As articulated in the Victorian Land Capability Assessment Framework (LCA Framework) (Municipal Association of Victoria, 2014) 'The complex interactions between the soil, climate, topography and wastewater inputs may mean that there is no one 'correct' method or absolute 'right' answer'.

The inputs to calculating a water balance for trench and bed systems are presented in Section 4.4.1 and Appendix 1 of the LCA Framework. Additionally, a water and nutrient balance calculation sheet has been created using the method presented in the LCA Framework and can be accessed from the [MAV website](#).

Sections 4.4.2.1 to 4.4.2.5 of this document provide additional information for key water balance inputs and outputs not presented in the LCA Framework. Refer to the LCA Framework where additional water balance information is required.

Limitations of water balance calculation

While this method provides some indication of the hydraulic capacity of the system over a monthly basis, it can be a significant oversimplification of dynamic soil water processes and can lead to significant oversizing of EDS, particularly in wet climates (i.e., high rainfall and low evapotranspiration). Under these conditions, lumped monthly water balance calculations do not adequately simulate day to day soil moisture storage or dynamics and will often result in significantly larger EDS that are not feasible or cost effective to construct. This is especially the case for water balances conducted in regions with low winter evapotranspiration and EDS types that have lower DLRs such as irrigation systems.

In this situation, a water balance can be used to inform a risk-based approach to sizing the EDS through a reduction in DLR based on professional judgment by a suitability qualified practitioner. Alternatively, other design elements may be altered to manage risk (for example, increased setbacks). Further guidance on risk management measures is provided in Section 4.7 and AS/NZS 1547:2012.

For larger non-domestic EDS or highly sensitive and/or constrained sites, consider daily numerical modelling, which better represents soil water dynamics at a daily timestep. One application that is widely accepted for use is the Model for Effluent Disposal using Land Irrigation (MEDLI) (Department of Environment and Science, Queensland Government, 2015), however, other models are available. Daily modelling is relatively complex and should be undertaken by an experienced practitioner.

4.4.2.1 Climate data

The median monthly rainfall data should be obtained from the closest rainfall station available on the [Bureau of Meteorology website](#). Where there is no nearby rainfall data, consider obtaining monthly rainfall data from [SILO](#) (Queensland Government, 2022). Given the compounding conservatism of the monthly water balance approach, use of higher percentile rainfall data is not recommended.

Reference evapotranspiration or pan evaporation data are available for locations in Victoria. It is important to understand the difference between these values. Reference evapotranspiration is the evapotranspiration calculated using the Penman-Monteith equation (Food and Agriculture Organisation (FAO), Paper #56, 1998) based on a standardised grass crop cover. Pan evaporation is the evaporation measured from a (typically) Class A Pan. The choice of data influences the crop factors adopted (see 4.4.2.3).

4.4.2.2 Applied effluent

The applied effluent refers to the depth of effluent applied to the EDS per month. It is generally expressed as mm/month and can be calculated as outlined in Appendix 1 of the LCA Framework.

4.4.2.3 Evapotranspiration and crop factors

Evapotranspiration refers to the sum of evaporation of water from soil and other surfaces and transpiration of water from plants. Evapotranspiration data can be sourced from the [Bureau of Meteorology](#) or [SILO](#) (Queensland Government, 2022) or estimated as a percentage of pan evaporation, which is calculated by multiplying pan evaporation by a 'crop factor'. Crop factors vary considerably and depend on the type of vegetation, growth stage, harvesting (cutting) regime, climate and exposure to sunlight. Care should be taken to ensure the correct crop factors are being applied to the specific data source. The crop factors from EPA Publication 168 [Victorian guideline for irrigation with recycled water](#) are pan evaporation to evapotranspiration crop factors and should not be applied to reference evapotranspiration. Crop coefficients described in Table 12 of FAO Paper #56 (FAO 56, 1998) have been

derived directly from reference evapotranspiration (and for most EDS subject to mixed grass cover can only be expected to range from 0.8–1.05 with little to no variation in established turf grass (0.85–0.95).

Similarly, use of crop coefficients (kc) with pan evaporation requires application of a 'pan factor' or pan coefficient (kp) beforehand as described in FAO Paper #56. Pan coefficients range from 0.65–0.85 for most scenarios applicable to EDS.

The monthly evapotranspiration depth is calculated as shown in Appendix 1 of the LCA Framework.

Table 20 presents monthly crop factors for pasture, lucerne and eucalypts suitable for use with Class A pan evaporation.

Table 20: Monthly crop factors⁷

Vegetation type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pasture	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70
Lucerne	0.95	0.90	0.85	0.80	0.70	0.55	0.55	0.65	0.75	0.85	0.95	1.00
Eucalypts (1 year old)						0.40						
Eucalypts (2 years old)						0.60						
Eucalypts (3 years old)						1.00						

4.4.2.4 Percolation

Percolation is the daily DIR for irrigation areas or DLR for other EDS types. The monthly percolation is calculated by multiplying the daily DLR/DIR by the number of days in the month (as specified in Appendix 1 of The LCA Framework).

4.4.2.5 Required land area

The required land area equation is presented in Appendix 1 of the LCA Framework and is calculated for all 12 months of the year. Given that each month has different water balance parameters, the required land area is different for each month. The most limiting month (i.e., the wettest month) will have the largest required land area and this number is presented as the output of the water balance calculation.

4.4.3 Nutrient balance calculations

Nutrient balance calculations can be undertaken for nitrogen and phosphorus to determine a minimum EDS area required to ensure no significant nutrient export from the EDS area. However, similarly to water balance calculations, it can often be impractical to size and install an EDS that meets the minimum nutrient balance size, particularly for coarse soils with poor phosphorus sorption capacity.

⁷ Adopted from EPA Victoria Publication 168 *Guidelines for Wastewater Irrigation* (1983). Table 7. Example Water Budget.

Therefore, often the minimum EDS size for no nutrient export is determined for risk management purposes, but it is not necessarily the adopted size.

Where the minimum EDS size is not achieved, consider calculating the minimum setback distance (or indicative minimum downslope buffer) required for effective attenuation of nitrogen and phosphorus. For constrained sites the minimum setback distance should be achieved prior to any sensitive receiving environments. Example calculations of minimum downslope buffer for nutrient setback are provided in Appendix 2.5.1.

The LCA Framework excludes phosphorus balance procedures, however, there are some circumstances where it may be warranted. While it is recognised that soil phosphorus sorption capacity is highly heterogeneous, it is possible to obtain a reasoned estimate of the degree of risk of phosphorus export from the process. See Appendix 2.5 for information on phosphorus-sorption capacity.

On highly constrained sites where the nutrient setback distance cannot be achieved, a more detailed investigation should be sought to calculate the potential risk to sensitive receiving environments. This may include daily numerical pollutant modelling (for example, using MEDLI) and/or groundwater attenuation modelling to determine the likely attenuation rates and setback distances required to achieve site-specific targets. Risk reduction measures are presented in Section 4.7.1 of this document.

4.4.3.1 Calculations

Like water balances, nutrient balance calculations are simply a mass balance or bucket model calculation that sums the inputs and minus the outputs or losses. The key nutrient constituents in wastewater are nitrogen and phosphorus as presented in Table 56. While the inputs and outputs of nitrogen and phosphorus nutrient balances are broadly the same, there are some key soil removal/attenuation processes that differ between the 2. These are discussed in Section 4.4.3.2 of this document.

Nitrogen balance calculations and equations are presented in Appendix 1 of the LCA Framework. The NSW Environment and Health Protection [Guidelines: On-site Sewage Management for Single Households](#) (Department of Local Government, 1998) provides phosphorus balance equations and example calculations in Sustainable Development Density for On-site Sewage Management. On-site Sewage Risk Assessment System Handbook (NSW Department of Local Government – 2001)..

4.4.3.2 Soil processes

Nitrogen

Nitrogen is removed from effluent in the soil profile by a range of microbiological, chemical and physical processes:

- mineralisation of organic nitrogen by microorganisms forming ammonium or nitrate
- nitrification of ammonia to nitrate by nitrifying bacteria under aerobic conditions
- denitrification under anaerobic conditions leading to the release of nitrogen gas to the atmosphere.

Nitrogen is one of the primary nutrients needed for plant growth, making plant uptake the dominant process that removes nitrogen from the soil profile. Plants uptake nitrogen in the form of nitrate, which is generated by the mineralisation and nitrification processes outlined above. Denitrification is a more minor component of nitrogen removal than plant uptake but can range from 10–60% in some soil environments (Geary & Gardner, 1996). Higher rates of nitrogen removal through denitrification occur in soils that undergo both aerobic and anaerobic conditions.

Phosphorus

Unlike nitrogen, plant uptake of phosphorus is only a minor contributor to the removal of phosphorus within the soil profile. The primary mechanism for removing phosphorus is soil adsorption, which is where phosphorus is attached or bound to the surface of soil particles (predominately clay) and forms immobile compounds. Phosphate adsorption increases when the soil is more acidic or alkaline and can be increased by adding lime to the soil.

Given that soil profiles have a finite number of surfaces available for sorption, phosphorus sorption will not occur at the same rate over the long term and operates in equilibrium with dissolved phosphate concentrations in soil pore water. When all the available surfaces have been filled and soil water concentrations increase above the equilibrium, desorption will begin. Therefore, consideration should be given to ensuring phosphorus sorption can occur within the soil profile for the expected life of the EDS, which is typically assumed to be 50 years.

4.4.3.3 Crop uptake values

Crop uptake of nitrogen and phosphorus vary quite considerably and depend on several factors, including plant species. Typical crop uptake values adopted for nutrient balance calculations for nitrogen and phosphorus are 220–250 kg/ha/year for nitrogen and 20–30 kg/ha/year for phosphorus. Table 21 presents approximate nutrient uptake values for selected crops. Where possible site-specific values should be adopted. In the absence of site-specific information, conservative values should be adopted.

Table 21: Approximate nutrient uptake rates⁸

Plant species	Nitrogen uptake (kg/ha/year)	Phosphorus uptake (kg/ha/year)
Bent grass	170	–
Bermuda grass	280	30–50
Clover	180	20
Eucalypts	90	15
Grapes	20	–
Lemons	60	–
Lucerne	220–540	20–30
Oats	60	50
Oranges	40	–
Poplars	115	25
Radiata pine	95	10

⁸ Information obtained from [Technical Information for Victorian Guidelines for Water Recycling](#) (EPA Victoria, 2021).

Plant species	Nitrogen uptake (kg/ha/year)	Phosphorus uptake (kg/ha/year)
River Sheoak	140	20
Ryegrass	200–280	60–80
Rye/clover (2:1)	220	50
Sorghum	90	15
Tall fescue	150–320	30

4.4.4 Calculation method for EDS suitability and selection

The most suitable method for sizing an EDS depends on the site constraints including climate, proximity to receiving environments, soil permeability and EDS type. Generally, the guidance in Table 22 is driven by the impact that climate has on water balance calculations and the rate at which nutrients are transported within the soil or groundwater at the site.

Where nutrients are the limiting design characteristic, nutrient balance results should be considered as a suitable design sizing tool as this could result in pollution of nearby sensitive receiving environments. As outlined in Section 4.4.2, sites that are hydraulically limited may result in very large or oversized EDS when water balance calculations are used. In situations where the most limiting design parameter results in what could be an oversized EDS, consider if it is the correct sizing method for the site.

If it is deemed to be the most appropriate method and the EDS is still considered oversized consider completing a more detailed analysis, which may include daily numerical modelling of soil water conditions or nutrient balance and/or groundwater plume modelling to determine attenuation rates of nutrients.

The information in Table 22 is for guidance purposes only and the suitable sizing method should be determined on a site-by-site basis by a suitably qualified person. Multiple sizing methods are often calculated for comparative purposes to aid in determining the most suitable method.

Table 22: Guidance on calculation method suitability

Calculation method	Method suitability indicator	
	More suitable ←	→ Less suitable
Simple hydraulic equation	<ul style="list-style-type: none"> Low to moderately constrained sites where sufficient site and soil information has been collected to adjust the DLR using a risk management approach. 	<ul style="list-style-type: none"> Highly constrained sites where there is insufficient information available to assess risks and determine an appropriate DLR. Sites near sensitive receiving environments where nutrients are likely to be the most limiting design parameter.

Calculation method	Method suitability indicator	
	More suitable ←	→ Less suitable
Water balance	<ul style="list-style-type: none"> • Locations with moderate to dry climates where rainfall only slightly exceeds evaporation for up to 2 months of the year. This is most typical of inland regions of Australia. • Sizing of soil absorption and evapotranspiration trenches and beds. 	<ul style="list-style-type: none"> • Locations with wet climates where rainfall exceeds evaporation for many months of the year. • Sizing of irrigation EDS types as this will likely result in a very large and oversized EDS. • Sizing of Wisconsin mounds which should be sized using the techniques outlined in Appendix 2.2.5
Nutrient balance	<ul style="list-style-type: none"> • Sites with high permeability soils (category 1–2 soils) and near sensitive receiving environments (e.g., rivers, estuaries etc.). Nutrients are transported more rapidly under these conditions. • Sites with shallow groundwater or perched aquifer conditions. 	<ul style="list-style-type: none"> • Unconstrained sites with low permeability soils and no sensitive receiving environments.

4.5 Location and setback distances

This section provides guidance on the adoption of setback distances for a range of built and natural features located within and surrounding the property. The development of suitable setback distances for an OWMS (including the selected EDS) is an important practical control measure in achieving an appropriate level of protection for human health and the environment. Equally important is the siting or location on the property of the EDS in the context of natural or built features and resulting availability of suitable land.

4.5.1 Applicability

A 2-tiered approach to the assignment of setback distances can be considered.

Tier 1

Where appropriate and available, the setback distances referenced in Table 4-10 of the GOWM (Section 4.5) can be adopted. These distances are a conservative minimum that may be used as a basis to assist in the selection of setback distances, however, if they are not achievable and need to be varied consider using the Tier 2 approach.

The setback distances and guideline information documented in Table 4-10 of the GOWM (Section 4.5) provide a simple yet conservative approach to the selection of setback distances.

Table 4-10 of the GOWM (Section 4.5) provides a guide on the setback distances that may be applied to OWMS. These setback distances are a conservative minimum that may be varied if sufficiently justified

by the applicant and approved by the council. However, if they are not practicable for the site and need to be varied, a risk and performance-based approach can be used to determine alternative setback distances using the Tier 2 approach.

Wastewater consultants and assessors may decide to seek alternative setback distances through demonstration of appropriate protections and controls. When this occurs, a risk and performance-based approach can be used to determine alternative setback distances using the Tier 2 approach.

Tier 2

If the outcomes from a setback distance evaluation performed during the selection and design process determine that adoption of one or more setback distances referenced in GOWM (Table 4-10) is not practicable for the site, wastewater consultants and assessors may decide to choose alternative setback distances through demonstration of appropriate protections and controls. When this occurs, a risk and performance-based approach can be used to determine alternative setback distances.

The alternative setback distance assessment method adapts an approach outlined in AS/NZS 1547:2012 Appendix R. The appropriate distance for each specific site feature is determined by evaluating feature-specific contributing factors, the selected EDS/treatment plant and the outcomes from the site and soil assessment. Suitable control measures can then be developed (if required) to minimise impacts to site features from wastewater.

Where OWMS are proposed for highly constrained sites or sites near sensitive receiving environments, quantitative environmental modelling may be warranted to determine site-specific setback distances using AS/NZS 1547:2012 Appendix R.

4.5.2 Other considerations

The location of an EDS will predominantly be influenced by site features and achievement of appropriate setback distances, however, there are several other factors that may require consideration. These considerations are provided in Table 23.

Table 25 provides a quick reference to the sections in AS/NZS 1547:2012 that may be relevant in determining setback distances.

Table 23: EDS siting and location considerations

Feature	Consideration
Amenity	The location of the EDS may be influenced by additional factors including visual amenity, property owners’ expectations, remaining open space land and landscaping plans. While achievement of appropriate setback distances is the primary objective, integration of the EDS location with the secondary objectives may be achievable.
Dwellings and habitable buildings	While setback distances address the proximity of an EDS to a habitable building, there may be situations that further influence the EDS location. For example, on sloping sites it is preferable to locate the EDS below the dwelling especially if unconstrained by availability of suitable land.

Exposure	Where possible the EDS should be located to achieve exposure to prevailing winds and sun.
Future development	The location of the EDS should always consider potential future developments of the property.
Planning and regulatory requirements	The EDS should be located so that it is consistent with planning or regulatory provisions.
Proximity to treatment plant	The location of the EDS in relation to the location of the treatment plant may need to be considered. The conveyance of effluent from the treatment plant to the EDS should be feasible and constructable.
Recreational areas	The location of the EDS should consider the proximity of recreational areas including swimming pools and children’s play equipment, especially on sloping sites.

Table 24 outlines examples of constraints and scale descriptors for site or system elements. The list should not be considered exhaustive as other site or system elements may be applicable. When determining the setback for a specific site feature or sensitive receptor, it is essential to be informed by the outcomes of a risk assessment. The assessment should consider the position of the relevant site and system constraints within the respective constraint scale. The higher the constraint, the greater the setback distance required.

Whenever feasible, selection of the setback distance should be supported by a quantitative evaluation of the relevant site or system features. AS/NZS 1547:2012 Appendix R provides further information in determining setback distances based on site constraints.

Table 24: Guidance on setback distance selection (aligned with Table 4-10 of the Guideline for onsite wastewater management)

Site or system element	Constraint scale	
	Lesser	Greater
Building/allotment boundaries		
Effluent quality	<ul style="list-style-type: none"> Secondary effluent quality 	<ul style="list-style-type: none"> Primary effluent quality
Slope	<ul style="list-style-type: none"> 0–6%, surface EDRS 0–10%, subsurface EDRS 	<ul style="list-style-type: none"> >10%, surface EDRS >30%, subsurface EDRS
EDRS Type	<ul style="list-style-type: none"> Subsurface or sub-soil EDRS 	<ul style="list-style-type: none"> Surface and above ground EDRS
Services (for example, supply pipes/channels, drains)		
Effluent quality	<ul style="list-style-type: none"> Secondary effluent quality Active disinfection 	<ul style="list-style-type: none"> Primary effluent quality No disinfection

Site or system element	Constraint scale	
	Lesser	Greater
Slope	<ul style="list-style-type: none"> • 0–6%, surface EDRS • 0–10%, subsurface EDRS 	<ul style="list-style-type: none"> • >10%, surface EDRS • >30%, subsurface EDRS
EDRS type	<ul style="list-style-type: none"> • Subsurface or sub-soil EDRS 	<ul style="list-style-type: none"> • Surface and above ground EDRS
Recreational areas (for example, swimming pools)		
Effluent quality	<ul style="list-style-type: none"> • Secondary effluent quality • Active disinfection 	<ul style="list-style-type: none"> • Primary effluent quality • No disinfection
Fall direction	<ul style="list-style-type: none"> • Downgradient of feature 	<ul style="list-style-type: none"> • Upgradient of feature
Slope	<ul style="list-style-type: none"> • 0–6%, surface EDRS • 0–10%, subsurface EDRS 	<ul style="list-style-type: none"> • >10%, surface EDRS • >30%, subsurface EDRS
EDRS Type	<ul style="list-style-type: none"> • Subsurface or sub-soil EDRS 	<ul style="list-style-type: none"> • Surface and above ground EDRS
Surface waters (for example, waterways, dams, reservoirs or lakes)		
Effluent quality	<ul style="list-style-type: none"> • Secondary effluent quality • Active disinfection 	<ul style="list-style-type: none"> • Primary effluent quality • No disinfection
Surface water pollution hazard	<ul style="list-style-type: none"> • Lower rainfall • Evaporation exceeding rainfall most months • Category 1–3 soils • Lower resource or environmental value 	<ul style="list-style-type: none"> • Higher rainfall • Rainfall exceeding evaporation most months • Category 4–6 soils • Higher resource or environmental value • Used as a as a source of water for drinking or within a special water supply catchment
Slope	<ul style="list-style-type: none"> • 0–6%, surface EDRS • 0–10%, subsurface EDRS 	<ul style="list-style-type: none"> • >10%, surface EDRS • >30%, subsurface EDRS
Fall direction	<ul style="list-style-type: none"> • Downgradient of feature 	<ul style="list-style-type: none"> • Upgradient of feature

Site or system element	Constraint scale	
	Lesser	Greater
Drainage	<ul style="list-style-type: none"> • Good drainage with no visible signs of seepage or soil saturation 	<ul style="list-style-type: none"> • Poor drainage with visible seepage and soil saturation • Low lying area
Flood level (with respect to the EDRS)	<ul style="list-style-type: none"> • Above the 5% AEP 	<ul style="list-style-type: none"> • Below the 5% AEP
EDRS Type	<ul style="list-style-type: none"> • Subsurface or sub-soil EDRS 	<ul style="list-style-type: none"> • Surface and above ground EDRS
Depth to highest seasonal water table		
Effluent quality	<ul style="list-style-type: none"> • Secondary effluent quality • Active disinfection 	<ul style="list-style-type: none"> • Primary effluent quality • No disinfection
Groundwater pollution hazard	<ul style="list-style-type: none"> • Category 5 and 6 soils • Lower resource or environmental value 	<ul style="list-style-type: none"> • Category 1 and 2 soils • Higher resource or environmental value • Gravel aquifers
Geology and soils	<ul style="list-style-type: none"> • Category 3 and 4 soils • Deep uniform soils • Low porosity regolith 	<ul style="list-style-type: none"> • Category 1 and 6 soils • Gravel aquifers • Higher porosity regolith • Fractured rock
Drainage	<ul style="list-style-type: none"> • Good drainage with no visible signs of seepage or soil saturation 	<ul style="list-style-type: none"> • Poor drainage with visible seepage and soil saturation • Low lying area
Landform	<ul style="list-style-type: none"> • Hill crests, convex side slopes or plains 	<ul style="list-style-type: none"> • Drainage plains, and incised channels
EDRS Type	<ul style="list-style-type: none"> • Subsurface or sub-soil EDRS 	<ul style="list-style-type: none"> • Surface and above ground EDRS
Depth to hydraulically limiting layer (for example, bedrock)		
Effluent quality	<ul style="list-style-type: none"> • Secondary effluent quality • Active disinfection 	<ul style="list-style-type: none"> • Primary effluent quality • No disinfection
Groundwater pollution hazard	<ul style="list-style-type: none"> • Category 5 and 6 soils 	<ul style="list-style-type: none"> • Category 1 and 2 soils

Site or system element	Constraint scale	
	Lesser	Greater
	<ul style="list-style-type: none"> Lower resource or environmental value 	<ul style="list-style-type: none"> Higher resource or environmental value Gravel aquifers
EDRS type	<ul style="list-style-type: none"> Surface and above ground EDRS 	<ul style="list-style-type: none"> Subsurface or sub-soil EDRS

Table 25: AS/NZS 1547:2012 references to setback distances

Section	Subsection	Page number
1.9 Definition	Setback	17
2.4 Implementing risk management	2.4.1(k)	22
4.3 Primary performance requirements	4.3.1 Public health and environment	32
5.5 Land application system design	5.5.3.3 Siting considerations	50
	C5.5.3.3	50
	5.5.6.2 / C5.5.6.2 Pathogens	57
Appendix A Risk management process guidelines	Table A1	78
Appendix B Site and soil evaluation procedures	B2.1 Objective	83
Appendix K Land application systems – Guidance on selection	K3.5 Setback distances	128
	Table K1	131
Appendix L Land application methods – Trenches beds and ETA systems	Various references	142
Appendix M Land application methods – Irrigation systems	Various references	155
Appendix N Land application methods – Mounds	Various references	170
Appendix R Setback Distances for Land Application Systems	Tables R1/R2	185

4.6 EDS design considerations

This section provides practical design guidance on the different EDS types and what design aspects should be considered when determining configuration, effluent distribution, materials and other site-specific design considerations. DLRs and EDS sizes should be completed as outlined in Section 4.4.

The design considerations provided in Appendix 2.2 have been prepared to accompany the individual example EDRS schematics in Appendix 1. These examples provide detailed guidance on a range of design and construction factors that should be considered. EDS designers and council officers can use them to support the preparation and assessment of OWMS permit applications.

The design information provided in this document provides guidance on key design parameters. However, the purpose of this document is not to provide detailed equations or example calculations required to complete each design. Where this is required, reference to suitable literature or information sources is provided.

For OWMS that contain a pump to transfer treated effluent to the EDS and/or pressure dose an EDS, selection of the correct size and type of pump is critical to the operation of the system and its long-term performance. Pump selection and key hydraulic design criteria should be considered during the design process to confirm feasibility. It is common for the installer to select the pump as part of pricing and final design.

Further guidance can be found in Appendix 2 of this document for:

- soil, site and effluent quality characteristics
- detailed design considerations for EDRS types
- pumps and hydraulics
- civil works, retaining walls and vegetation.

4.7 Risk management

While risk management is inherent to the selection and design process, there may be sites and situations where additional assessment or control measures will be required. This section provides guidance and references to assist in evaluating and reducing risk, with the objective of reducing the risk and potential consequences to acceptable levels. Information about the risk management process can be found in Section 3.3 with references to AS/NZS 1547:2012 (Appendix A) provided in Section 4.7.1.7

4.7.1 Risk reduction measures

The implementation of further risk evaluation or reduction measures may be necessary when the level of risk within a specific aspect of the selection, design, assessment or construction phase of a challenging site has been assessed as high. Risk reduction may involve implementation of one or more physical, procedural or administrative control measures by the system designer, installation company, council or a referral agency (such as a water corporation).

Physical and procedural risk reduction measures can be used to further enhance the system design or the operation and maintenance of the system. Examples of physical and procedural risk reduction measures include:

- adoption of conservative assumptions where justified, such as a reduction in the DLR
- provision of adequate surface and subsurface drainage controls
- consideration of nutrient and pathogen management
- consideration of flow balancing where the hydraulic profile indicates significant variability

- consideration of the need for increased oversight, monitoring and/or maintenance requirements
- provision of educational information.

AS/NZS 1547:2012, Appendix A, Tables 1 and 2 contain further examples of design and operation and maintenance risk reduction measures.

Administrative risk reduction control measures can include:

- further environmental assessments by wastewater practitioners to verify protection targets, assumptions or system design – examples include offsite impact assessment, pathogen die-off modelling, and cumulative impact assessment and modelling (refer Section 4.7.1.5)
- verification of the technical performance of the proposed onsite wastewater treatment plant where available information is limited or unable to be easily evaluated
- technical peer review of the LCA or associated design report
- inclusion of conditions in the permit application

AS/NZS 1547:2012, Appendix A, Table 3 contains further examples of administrative risk reduction measures. The following subsections provide guidance on some of the common risk reduction measures that require consideration as part of the EDS design process.

4.7.1.1 Adjustment of design loading rate

As discussed in Section 4.4 there are circumstances where site and soil constraints and/or receiving environment sensitivity may warrant consideration of a reduced DLR/DIR as a risk reduction measure. Table 26 summarises the key constraints that may trigger DLR reduction, guidance on adjustment and additional resources available to assist in decision making (primarily AS/NZS 1547:2012).

Table 26: Design loading rate adjustment

Risk factor	EDS type	Considerations	Possible reduction
Slope	Shallow subsurface and surface	Steeper slopes increase potential for downslope seepage, breakout, and migration of effluent	Table M2 from AS/NZS 1547:2012
Depth to limiting layer	All	Site where >0.6 m of unsaturated soil cannot be achieved between point of application and limiting layer (e.g., hardpan, rock or water table)	10–25%
Apedal and/or sodic category 6 soils	All	Primary effluent dosed EDS	25–50%
		Secondary effluent dosed EDS	10–25%
High rainfall/low evapotranspiration	Trenches and beds	Void storage can provide a buffer for constrained climates	10–25%
	Shallow subsurface and surface	Heavily reliant on soil water content of upper horizons	25–50%
	Mounds	Operate effectively in a wide range of climatic conditions	None

4.7.1.2 Stormwater control

Surface water and subsoil moisture can be detrimental to the performance of EDS. Consideration should be given to the design and installation of appropriate control measures when there is potential for upslope surface and subsoil water inflows. The design process should include identification of site water management infrastructure and any natural flow paths or areas of subsurface water flow with the potential to impede EDS performance. These may include (but not be limited to) EDS locations:

- downslope of impervious areas such as roads, roofs, hardstands, driveways and other vegetation, sealed or compacted areas
- downslope of, or near, breaks in slope and other landscape positions prone to surface water accumulation and/or subsurface water discharge
- with overland flow paths created through landscaping and development of a site (EDS should by design be setback from natural or constructed drainage flow paths)
- subject to episodic or permanent high groundwater or lateral subsurface water flow
- with discharge points for constructed stormwater systems.

Suitable surface water control measures can include diversion drains, spoon drains, dish drains or 'V' drains. On steeper sloping land subsoil drainage may be required. Subsoil moisture can be controlled through the design and installation of deeper drainage measures such as cut drains. Subsurface drainage should be installed as close as possible to the limiting layer impeding vertical drainage (for example, heavy clay or rock). On low lying sites where a permanent water table requires management to maintain adequate vertical separation, relief or curtain drains require engineering design (American Society for Civil Engineers, 1993) and a legal and suitable point of discharge.

When correctly designed and installed both control measures can assist in keeping the LAA drier. Both measures will be constructed in a way that protects the LAA without impacting neighbouring properties through redirected flows. Wherever possible diversion drainage should be integrated with the broader property water management system.

An example of a design for stormwater control measures is provided in Appendix 1.

4.7.1.3 Raised effluent dispersal systems

In situations where the point of effluent application is less than 0.6 m from a limiting layer it may be possible to overcome this through raising the level of the EDS by importing fill. The fill should be of a suitable quality and texture for effluent dispersal and plant growth. It is also crucial to ensure the existing natural ground is suitably prepared prior to careful laying. Gently compact the fill to reduce the potential for preferential flow along the interface between the fill and existing ground (refer to Appendix 2.4.2 for details on risks associated with importing fill for EDS construction).

The work of Converse and Tyler (1994) suggested that LLR is a crucial consideration with any EDS subject to restrictions to vertical drainage but more so with raised systems. Where an EDS is proposed to be raised, it is recommended that the LLR presented is adopted to determine its width.

4.7.1.4 Pathogen and nutrient management

Outcomes from the system selection process may indicate site and soil features (for example, risk to groundwater) or end use activities that require an onsite wastewater treatment plant capable of producing a higher effluent quality. While effluent quality is typically associated with the type of treatment plant, selection of the right EDRS in combination with the treatment plant is an important step in mitigating residual risk. An important decision point in the selection and design process is the

adoption of pathogen and/or nutrient management measures. The required level of human health and environmental protection will influence the requirement for one or both management measures and the degree of risk reduction. Setback distance also plays an important role in pathogen and nutrient risk management – see Section 4.5: Location and setback distances.

Pathogen reduction is typically achieved through chemical and physical disinfection methods associated with secondary and advanced secondary treatment plants (for example, chlorine and ultraviolet systems). Disinfection is normally required when there is a higher exposure risk from EDS or surface irrigation.

In general terms, nutrient reduction can be achieved by an improvement in the level of treatment (i.e., nutrient concentrations from secondary treatment systems are lower than primary treatment systems). However, EDS also provide a level of attenuation and removal through physical and biological processes. The design of EDS can also be enhanced to include additional nutrient management measures where specific nutrient targets are determined through the selection and design process (for example, amended soil systems).

Emerging contaminants

Emerging contaminants are compounds that are newly introduced into the environment (for example, pharmaceutical, industrial or agricultural compounds that have only recently been developed) or that, although possibly around for longer times, have only recently been detected in the environment due to advances in detection technologies (for example, PFAS and antimicrobial resistance genes). Some are present in many of the products we rely on – from medication to common toiletry products, to a wide range of common household products (for example, non-stick cookware, cleaning products, food packaging). Antimicrobial resistance (AMR) and antibiotic resistant bacteria are also recognised worldwide as emerging contaminants.

Emerging contaminants present a new regulatory challenge, as their prevalence and concentrations, and their potential risks, are not generally well understood. Also, many emerging contaminants do not have water quality reuse criteria or water quality guidelines and there is insufficient knowledge of the toxicological properties of individual chemicals along with the combined mixture effects.

However, under the GED duty holders have a responsibility to minimise risks of harm to human health and the environment from pollution and waste, so far as reasonably practicable ([Refer to EPA's Publication 1856: Reasonably practicable](#)). This is particularly relevant when deciding the control measures for emerging contaminants. For OWMS the key method available for control is to prevent or reduce potential for emerging contaminants to enter wastewater, for example:

- do not discharge your unwanted and expired medicines into your OWMS – the Therapeutic Goods Administration (TGA) has guidelines on disposal of unwanted medicines through the Return Unwanted Medicines (RUM) scheme (Refer to TGA's website for more information <https://www.tga.gov.au/safe-disposal-unwanted-medicines>)
- avoid use of products containing PFAS (per- and polyfluoroalkyl substances).

Treatment of wastewater for emerging contaminants is a developing field and new, innovative solutions for treatment at the domestic scale are likely to be available in the future. In this regard, it would be prudent for decision-makers/authorities to stay engaged with new relevant innovations.

For further information on the regulatory environment and research reports for emerging contaminants, refer to EPA's webpage on [emerging contaminants \(including PFAS\)](#)

4.7.1.5 Impact assessment and modelling

There are some sites and EDS design scenarios where it is not possible to adequately mitigate risks through design and construction strategies. In these cases it may be possible to do a more detailed site-specific analysis of EDS performance and offsite impact to evaluate the risk associated with any design concessions required. Table 27 summarises some of the tools available for impact assessments of proposed EDS.

Table 27: Available tools for offsite and cumulative impact assessment

Assessment type	Sub-component	Tools
Overall EDS environmental and human health risk	N/A	Application of the health and environmental risk assessment methods documented in Australian Guidelines for Water Recycling (AGWR)
Offsite impact assessment	EDS performance	Long-term continuous daily water and nutrient balance modelling (e.g., MEDLI or similar)
	Effluent migration/plumes	<ul style="list-style-type: none"> • Viral die-off (Cromer et al 2001) • Pathogens and dissolved nutrients: steady state one dimensional groundwater plume modelling (Domenico or Ogata-Banks equations – Alvarez and Illman, 2006) • Steady state or dynamic groundwater modelling (e.g., MODFLOW) • Comparison of steady state concentrations at receiving environment to the appropriate Environment Reference Standard (ERS).
	Background water quality	MUSIC software can be used to characterise background pollutant loads from the site to provide context in terms of the percentage increase attributable to the EDS.
Cumulative impact assessment	N/A	Two methods provided in Jelliffe (2000) and Dungog Shire Council (NSW) On-site Sewage Management Technical Manual (2015)

These tools require expert understanding of EDS function and receiving environment modelling and should be undertaken by experienced and suitably qualified wastewater practitioners.

4.7.1.6 Reserve area

A reserve area is a duplicate land area of equal size to the designated LAA that may be used if the original area fails, is inadequate or needs to be rested. A reserve area is recommended for all trench and bed systems (including ETA and LPED systems) unless council is satisfied based on evidence from a comprehensive LCA that there is a low risk of negative impact to the environment or human health. AS/NZS 1547:2012 provides extensive guidance on reserve areas with text box C5.5.3.4 describing when reserve areas are normally used, when they can be reduced and when they may not be applicable. For example, AS/NZS 1547:2012 advises that the requirement for a reserve area with a size equivalent to the primary area is normally applied to septic tank and conventional land application systems.

4.7.1.7 References to risk reduction measures

Table 28 contains AS/NZS 1547:2012 and USEPA Onsite Wastewater Treatment Systems Manual references to risk reduction measures.

Table 28: References to risk reduction measures

Element	Section	Subsection	Page number
AS/NZS 1547:2012			
Risk reduction measures	Appendix A Risk management process guidelines	Table A1 – Examples of design risk reduction measures	77
		Table A2 – Examples of operation and maintenance risk reduction measures	79
		Table A3 – Examples of administrative risk reduction measures	81
Stormwater control	5.5 Land application system design	5.5.3.6 Stormwater control	51
	Appendix A Risk management process guidelines	Table A1 – Examples of design risk reduction measures	77
		Table A3 – Examples of administrative risk reduction measures	81
	Appendix M Land application methods – Irrigation systems	M9.3 Sloping sites	162
Disinfection	Appendix A Risk management process guidelines	Table A1 Examples of design risk reduction measures	78
		Table A3 Examples of administrative risk reduction measures	82
		Table K2 Selecting the land application system	138
	M2.2 Spray Irrigation	156	

Element	Section	Subsection	Page number
	Appendix M Land application methods – Irrigation systems	CM2.2	156
		CM4	157
		M8 Spray irrigation	162
	Appendix P Disinfection	All	177
	Appendix Q Water balance and land application systems	Q5 Water-balance and secondary treated effluent	183
	Appendix R Setback distances for land application systems	Tables R1/R2	185
Reserve areas	1.9 Definitions	Reserve area	16
	2.4 Implementing risk management	2.4.1 Protection of public health and the Environment	22
	5.5 Land application system design	5.5.3.4 Reserve areas	50
		C5.5.3.4	51
	Appendix D Site and soil evaluation for individual lots	D4 Reserve land application areas	99
USEPA Onsite Wastewater Treatment Systems Manual			
Surface and subsurface control measures	Chapter 4 Treatment processes and systems	4.4.4 Subsurface drainage	4–8

4.8 Documentation

This section should be read in conjunction with Section 5.2 of the GOWM.

4.8.1 Layout plans

Plans provide an important visual, spatial and graphical representation of the various elements that contribute to the broader onsite wastewater assessment, design, permit application evaluation and construction processes. Types of plans can include building/structure floor plans, locality plans, site assessment plans, onsite wastewater management plans and construction plans. Information about the various types of plans is provided in Table 29.

Several characteristics and features are common across most plans such as:

- plan information – typically includes plan title, preparation date, unique identification and revision information
- plan size – should be adequate to enable the annotated features to be easily identified and understood, they are typically presented in A4 or A3

- scale bar or ratio – provides the reader with the ability to measure length and distance
- north direction – provides the reader with a point of orientation for information on the plan relative to the direction north, which can also be helpful when the locality of the plan is unfamiliar and there are no known points of reference
- legend or key – defines the symbols and notations used on the plan (presentation of the symbols should consider the possibility of the plan being presented in black and white rather than colour)
- text characteristics – font type, size and colour for annotated or overlaid text should enable the text to be easily read.

Table 29: Types of layout plans

Plan type	Description	Typical information
Locality plan	Locality plans are a simple way of spatially locating the property on which the OWMS is proposed in the context of the broader area. A locality plan can be a useful inclusion in reports where the target audience is unfamiliar with the area.	<ul style="list-style-type: none"> • The property (i.e., boundary indication) • Road names (i.e., roads surrounding the property) • Key points of reference (e.g., towns or other main features)
Site assessment plan	Site assessment plans typically focus on the outcomes of the site and soil investigation. Site, soil, environmental and built features either observed from the site investigation or identified from GIS mapping data or other sources are included on the plan. The plan can be useful in conveying the degree of limitation that the features may pose to onsite wastewater management.	<ul style="list-style-type: none"> • Property boundaries • Existing buildings, structures, driveways and easements • Water features such as drains, groundwater bores, dams and waterways • Sensitive receiving environments and potential receptors • Topography and terrain features • Soil test pit locations • Elevation contours of an appropriate resolution and/or indication of ground slope and direction • Aerial photography (if applicable and available) • Plan information, legend, scale and northing
Site wastewater management plan	Site wastewater management plans focus on the selected wastewater system determined to be most appropriate for the site. This type of plan provides readers with the ability to conceptualise how the	<ul style="list-style-type: none"> • Property boundaries • Existing and proposed buildings and other structures • Treatment tank(s) location

Plan type	Description	Typical information
	<p>location and footprint of the selected treatment plant and EDS integrates with the built environment (i.e., the development) and the site, environmental and surrounding characteristics.</p> <p>The level of information captured in the onsite wastewater management plan will vary depending on the complexity of the development and property features.</p> <p>Depending on the size of the property, it may be necessary to prepare several plans such as a broader overview plan and a separate more detailed plan of the OWMS area.</p>	<ul style="list-style-type: none"> • Primary and reserve effluent dispersal areas including any EDS design features • Buffer or exclusion zones that may be relevant to the system design. The annotation of measured distances between the EDS and identified features can be a helpful inclusion • Location of storm water and subsoil water control measures (if applicable) • Topography and terrain feature relevant to the property and OWMS • Elevation contours of an appropriate resolution and/or indication of ground slope and direction • Plan information, legend, scale and northing
Construction plan	<p>Construction plans are a set of documents that define the requirements for construction of the OWMS. The need for construction plans will depend on the scale and/or complexity of the EDS design and scope of works. Construction plans are typically not required for standard domestic EDS projects.</p> <p>An intermediate option that can be useful for EDS design and construction is the use of standard drawings and typical arrangements to support a conceptual design and onsite wastewater management plan without preparing a site-specific design. Appendix 1 contains some examples of EDRS schematics.</p>	<ul style="list-style-type: none"> • Plans can include both plan views and cross-section views and may form part of a system design specification package (Section 4.8.2) • OWMS design, materials, location and dimensions • Construction technique • EDRS schematics can capture a wide range of important design and construction decisions that can be adapted to each site

4.8.2 System design and construction specification

System design and construction specifications provide documented, practical and detailed information about the technical and hydraulic aspects of the OWMS design. Specifications will generally contain:

- criteria and construction methods that the installation company will need to achieve during system construction

- specific information about the materials, system configuration, construction technique and hydraulic performance
- text, plans, diagrams, photographs and other images that illustrate the design.

While historically not typical practice in the onsite wastewater industry, design specifications are a critical element of the engineering design process. They ensure the installation company has a clear understanding of the critical elements of the design that is progressed through to construction to meet regulatory objectives.

Specifications should be prepared by people and companies with suitable qualifications and experience in wastewater design, hydraulic assessment, construction and engineering.

Table 30: AS/NZS 1547:2012 references to system design and construction specifications

Element	Section	Subsection	Page number
Layout plans	Section 3 Roles and responsibilities	3.1 The regulatory authority	23
		3.4 Designers	27
	Appendix B Site and soil evaluation procedures	B2.3 Site plans	84
	Appendix C Site and soil evaluation for planning, rezoning and subdivision of land	C3.8 Final plan	95
	T5 Typical content of operation and maintenance guidelines for households	T5.1.4 Reserve areas	199
Specifications	Section 2 Risk management process	2.2 Performance requirement	20
	Section 6 Construction, installation, operation, and maintenance	6.2.5.5 Manuals	61
	Section 7 Administrative guidance	C7.2	69
	L8 installation – pipe laying	L8 Installation – pipe laying	149

5 Assessment of effluent dispersal and recycling systems

5.1 Scope

This chapter provides information and guidance to assist council environmental health officers during the permit application process for EDRS.

5.2 Chapter overview

The permit application process provides council officers with an opportunity to critically assess the suitability, functionality and regulatory compliance of a proposed EDRS for the intended site and development activity.

The EP Act and EP Regulations include prescribed matters that must be satisfactorily considered and addressed during the permit application process. The regulatory framework is discussed in Chapter 2 of the GOWM. Prescribed matters relating to permit applications are contained in Part 3.3 of the EP Regulations. Matters relating to the operation and maintenance of OWMS are contained in Part 5.7 of the EP Regulations.

This chapter provides guidance and information on the assessment of the suitability and functionality of an EDRS to assist council environmental health officers during the permit application process for the construction, installation or alteration of an OWMS. It also includes guidance for council officers when assessing an existing OWMS to determine compliance with the EP Regulations (Part 5.7).

The topics addressed in this chapter include:

- assessment of system suitability and functionality for new systems, including:
 - environmentally sensitive sites
 - receiving environment and human health analysis
 - potential hazards
 - cautionary situations
- assessment of OWMS.

5.3 Assessment of system suitability and functionality – new systems

An assessment of the suitability of the selected EDRS can be defined in terms of its appropriateness for the site, soil and environmental conditions and the intended development activity. The main objective of the assessment is to determine if the selected EDRS in combination with the selected treatment plant can manage potential impacts on human health and the environment to an acceptable level.

Functionality on the other hand can be defined, and therefore assessed, in terms of the design, practicality and constructability of the EDRS. Several EDRS designs may be selected based on achieving their respective suitability criteria, however, they may not be adequate or fully address the functionality criteria.

A checklist is provided in Appendix 3 that can be used by councils as a tool to prompt, document and record the outcomes of the permit application assessment process. The checklist can be customised to the complexity of each permit application.

A range of information and tools is also available to council officers to assist the permit application assessment process. These include:

- planning permit application information
- LCA report information
- wastewater treatment plant specifications
- geographic information system (GIS) – cadastre, planning data, physical features, etc
- mapping – soil landscape, registered groundwater bores, biodiversity mapping, etc
- aerial imagery – current and historical photography
- historical planning, property, and wastewater system (existing) information
- site inspections.

5.3.1 Request for further information

If the assessing officer believes that a specific element of the assessment process has not been satisfactorily considered or addressed, then a request for further information (RFI) may be required. Providing limited information on a specific element in isolation may not be sufficient for an RFI, however, if several unsatisfactory responses are identified or the unsatisfactory responses are critically linked an RFI may be considered necessary.

5.3.2 Environmentally sensitive sites

Assessment of the environmental sensitivity of the site that is the subject of the permit application must be taken into account by council when determining whether to issue a permit (s.81(3) of the Act and regulation 28(h)(i)). While the EP Regulations do not specifically define the term, it does provide examples:

Environmentally sensitive sites for the purposes of Regulation 28 (h)(i) may include freshwater lakes, sites located in sandy areas with high water tables and sites in sensitive areas where the receiving waters may be at risk of algal blooms from high nutrient levels.

Additional examples of sites that may be considered environmentally sensitive include drinking water catchments and aquaculture areas. Environmentally sensitive sites include:

- potable water catchments
- watercourses and waterbodies
- groundwater aquifers
- stormwater systems.

The classification and location of environmentally sensitive sites forms a critical decision point in the evaluation of the adopted setback distance and location of not only the EDRS but also potentially the selection and design of the OWMS – both treatment plant and EDRS. It may be appropriate for receiving environments to have different setback distances from the EDRS, especially in the context of the identified local site and soil conditions, nature of the development activity, level of treatment and method of application. For sites that are close to potable water catchments, referrals to the relevant water corporation may be required.

Table 31 provides references to further information about setback distances and environmentally sensitive sites.

Table 31: AS/NZS 1547:2012 references to environmentally sensitive sites

Section	Subsection	Page number
Section 5.4 Wastewater treatment units	C5.4.2.5.1	47
Appendix R Recommended setback distances for land application systems	All	184
	R3 References/guidelines used in the development of setback distances	190

5.3.3 Receiving environment and human health analysis

This section provides qualitative guidance to assist council officers to determine the potential level of risk of a proposed OWMS to sensitive receiving environments (including considerations of potential risks to human health). The list of proximity or sensitivity classifications provided in Table 32 is not exhaustive, with additional council-specific classifications possible. Determining the final level of risk from the analysis should always be done in conjunction with the outcomes of the LCA.

Table 32: Receiving environment and human health analysis

Description	Potential level of risk	Comments	Potential action/comment
Receiving environment and human health analysis: Proximity			
Property and/or position of the EDRS can achieve the maximum setback distance criteria to the identified sensitive receptor.	Low	Limited proximity risk.	Nil
Property and/or position of the EDRS proposes adoption of setback distance criteria in the midsection of the acceptable range for the identified sensitive receptor.	Medium	Proximity risk may be elevated particularly if land capability limitations exist and containment onsite is assessed as marginal.	<ul style="list-style-type: none"> Assess and consider the type of treatment plant and effluent quality. Assess and consider the selection, design and location of the EDRS. Consider implementation of additional control measures.
Property and/or position of the EDRS proposes adoption of setback distance criteria at the lower end of the acceptable range for the identified sensitive receptor.	High	Higher proximity risk. Careful evaluation of system selection, design and location required. High level of justification for selected setback required.	<ul style="list-style-type: none"> Assess and consider the type of treatment plant and level of treatment. Assess and consider the selection, design and location of the EDRS. Consider requesting impact assessment modelling to verify assumptions and level of protection.

Description	Potential level of risk	Comments	Potential action/comment
			<ul style="list-style-type: none"> Consider additional control measures. Recommend higher level of council oversight during system construction and commissioning.
Receiving environment and human health analysis: Sensitivity			
None present, maximum setback distance for the sensitive receptor achieved.	Low	Acceptable level of risk.	Nil – represents a low-risk situation. Standard assessment may be considered acceptable.
Stormwater drains located upslope of property or EDRS.		Example: Typical swale drain or piped system on street.	
Degraded or cleared intermittent drainage lines.		Example: Gully lines with predominantly grass cover and some scattered trees and shrubs.	
Dams or small waterbodies located downslope of the property or EDRS.	Medium	Example: Farm dams possibly used for the irrigation of edible crops or watering livestock.	A higher level of assessment is recommended to ensure that the system design, size and location proposed by the applicant and their agents have satisfactorily considered and addressed the identified receiving environments.
Partially vegetated or rehabilitated ephemeral watercourses.		Some ecosystem value, seeking to not degrade further.	
Open stormwater drains accessible to the public located downslope of the property or EDRS.		Adjacent to and within parks, reserves, schools or shops.	
Environmental significance overlay (ESO) indicates vegetation communities (non-riparian).		Non-riparian ESO or bioregion.	
Non-potable ground water bore.		Example: Domestic stock and irrigation bores from available data.	
Property is located within a potable water supply catchment.	High	Protection of human health (priority).	<ul style="list-style-type: none"> The highest level of assessment is required to ensure that the system design, size, and location proposed

Description	Potential level of risk	Comments	Potential action/comment
Potable groundwater bore located down gradient of property or EDRS.		Protection of human health (priority).	by the applicant and their agents have satisfactorily considered and addressed the identified receiving environments.
Permanent watercourse or waterbody located downslope of the property or EDRS.		Perennial or near perennial streams and rivers, or large lakes and reservoirs.	<ul style="list-style-type: none"> Referral to state agencies or other internal departments may be required depending on the type of receiving environment (e.g., potable water catchment or aquatic ecosystem or amenity features).
ESO (high value) indicates aquatic ecosystems.		Riparian polygons of ESOs and bioregions.	<ul style="list-style-type: none"> Further information may be required to assist in the assessment. This may include offsite impact assessment modelling.

5.3.4 Potential hazards

Effluent from OWMS, whether treated or not, poses a risk to human health and the environment. Potential hazards associated with effluent are typically limited to nutrients and pathogens, however, other chemicals of concern may also require consideration. Assessment of the harmful effects of nutrients, pathogens and other chemicals is a primary performance requirement stated in AS/NZS 1547:2012 (Sections 4.1 and 4.3) and this technical guidance.

Table 33 contains references to published standards that provide further information on nutrients and pathogens.

Table 33: AS/NZS 1547:2012 Reference to nutrients and pathogens

Section	Subsection	Page number
Nutrients		
Section 5.4 Wastewater treatment units	S5.4.1.4	43
Section 5.5 Land application system design	5.5.4.2.1(m) Site	53
	5.5.6.1 Nutrients	56
Appendix A	A3 Risk management process	72
Appendix K	Table K1	133
	Table K2	135, 138, 140

Section	Subsection	Page number
Appendix S	All	191
Pathogens		
Section 5.4 Wastewater treatment units	C5.4.2.5.1	47
Section 5.5 Land application system design	5.5.4.2.1(m) Site	53
	5.5.4.2.2(b) Soil	55
	5.5.6.2 Pathogens	57
	C5.5.6.2	57
Appendix A	A3 Risk management process	72
	A3.2.3 Identify risks	74
	A3.2.4 Analyse risks	75

5.3.5 Cautionary situations

Cautionary situations, or 'red flags' represent more significant or extreme conditions where specific environmental and land capability criterion have been assessed as a high level or risk. It may be that in these situations the risk level is evaluated as extreme or even prohibitive. Permit applications in these highly constrained properties should be carefully and critically evaluated.

Table 34 provides examples of situations where the resulting evaluation could be considered a red flag.

Table 34: Red flag situations

Red flag situations	Comment
Inadequate land capability to manage wastewater onsite	The outcomes from the site and soil evaluation (or LCA) have determined one or several site and soil features that represent a significant limitation.
Small lot size	The size of a property and the availability of land are important features in the selection, design and location of a suitable EDRS. Typically, smaller lot sizes influence the availability of setback distance to sensitive receiving environments.

Red flag situations

Comment

Close proximity to sensitive receiving environment

The proposed location of the EDRS has adopted setback distances to one or more sensitive receiving environments based on the lower end of the range for that receiving receptor.

The proposed location of the EDRS is within one or more sensitive receiving environments or where human health and environmental protections are considered important.

5.4 Assessment of onsite wastewater management systems

Part 5.7 (regulation 59) of the EP Regulations states, '*A person in management or control of land on which an OWMS is located must take all reasonable steps to ensure the system is operated so as not to pose a risk of harm to human health or the environment*'.

Part 5.7 of the EP Regulations predominantly addresses the operation, maintenance and reporting responsibilities of property owners and occupiers of land with an OWMS.

Appendix 3.2 provides an example checklist to assist council officers to evaluate the technical and practical aspects of the OWMS for compliance with the requirements of Part 5.7 of the EP Regulations.

NOTE

The example checklist has been developed with reference to the EP Regulations (Part 5.7). It is not a comprehensive assessment of the features and characteristics that could be assessed for the various system types as part of council's routine inspection program.

6 Construction of effluent dispersal systems

6.1 Scope

This chapter provides information on the construction and installation of EDS. Additional important stages critically linked with construction are also included addressing preconstruction activities, inspections and commissioning.

6.2 Chapter overview

Construction of an EDS in accordance with the approved design, published standards and guidelines is important to achieve the adopted performance objectives and to meet regulatory compliance. Good construction practice also ensures positive outcomes for the end user of the EDS, and protection of human health and the environment.

This chapter is designed to assist OWMS installers and council staff to ensure the intent of the approved design is realised. It is not intended to provide comprehensive EDS construction and installation procedures. It provides guidance and practical information for consideration by council staff, installers and other relevant people. It is recommended that the chapter is read in conjunction with AS/NZS 1547:2012, the example EDRS schematics in Appendix 1 and other reference documents that may be relevant and appropriate.

The topics addressed in this chapter include:

- example EDRS schematics
- preconstruction activities
- construction activities
- post-construction activities
- inspection and commissioning
- reporting requirements
- AS/NZS 1547:2012 references.

6.3 Construction process flowchart

The flowchart presented in Figure 16 graphically represents the construction process from the receipt of the A20 permit through to completion of reporting requirements. The flowchart presents a complete process, however, it is acknowledged that not all activities will be required depending on the scale, risk and complexity of the EDS.

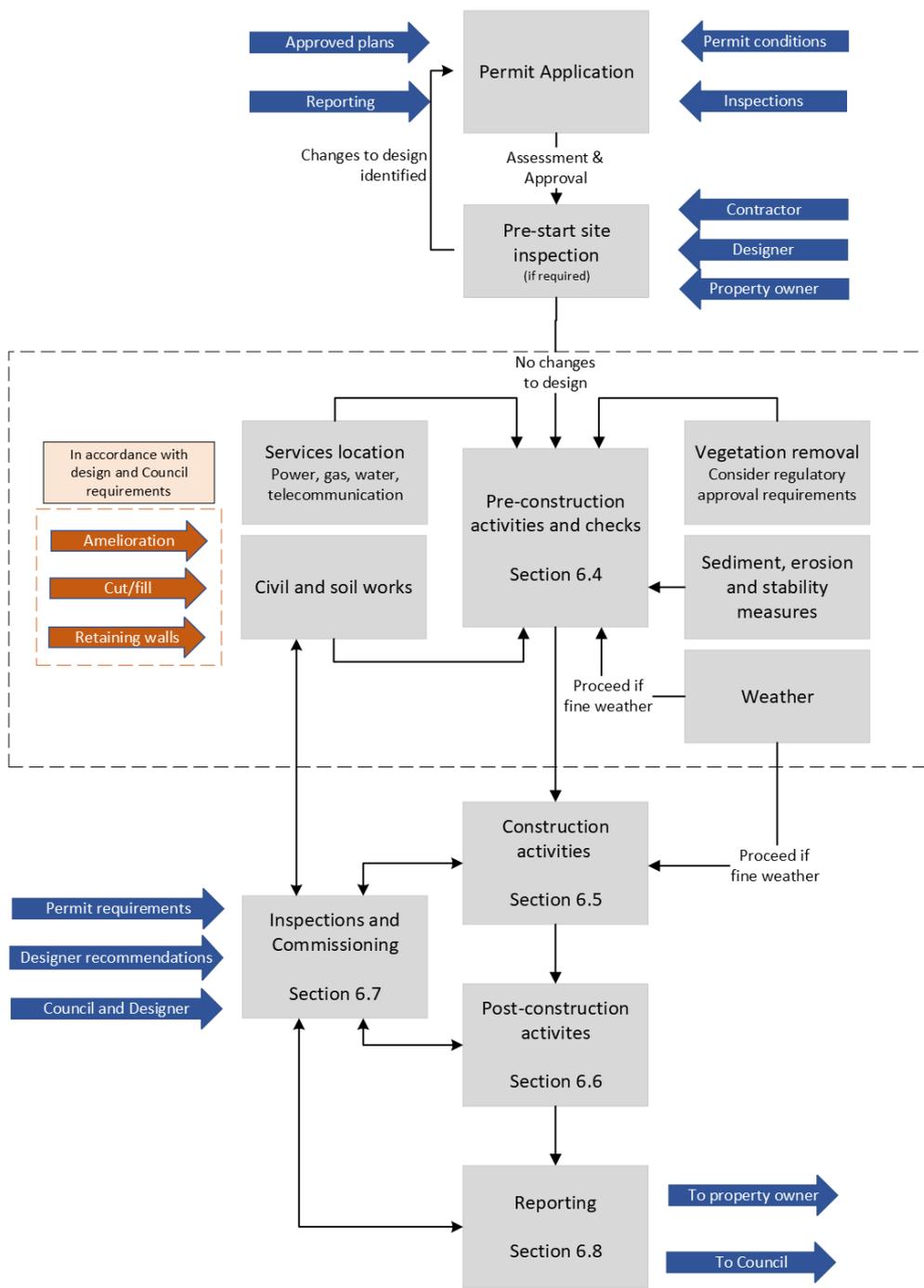


Figure 16: Construction process flowchart

6.4 Effluent dispersal system drawings

Appendix 1 contains a set of example EDRS schematics prepared as guidance for approval, design, and construction activities. They provide typical arrangements and guidance notes on a range of EDS types and configurations. They should be used in conjunction with the LCA, design, A20 permit conditions and AS/NZS 1547:2012 to finalise the configuration, components and construction process for a site. The Example EDRS schematics are not 'for construction' drawings and can be adapted to each site based on specific conditions and installer preferences and practices.

6.5 Preconstruction activities

Preconstruction activities provide an important opportunity to locate services, ensure good access and complete site preparation works. Table 35 provides guidance on the activities for this preconstruction stage that are common for most EDS types. The need for the individual activities will depend on site-specific conditions and outcomes of any LCA and/or design process. The failure of an EDS can often be attributed to some of these issues, which cannot always be addressed during or following construction.

Table 35 Common preconstruction activities

Activity or element	AS/NZS 1547:2012 or other reference	Details
Permit and EDS design	Victorian Legislation	It is important that the installer has a complete and current copy of the permit, plans and any EDS design specification.
EDS design changes	AS/NZS 1547:2012 M7.2 AS/NZS 1547:2012 T5.2.2	In some situations, the commencement of either preconstruction or construction activities by the installer may result in a need to modify one or more design elements of the EDS. If this occurs the contractor should consult council and the system designer. Any alteration to the EDS design should be made by the designer for subsequent submission to council for approval.
Services location	AS/NZS 1547:2012 Section 5.2 Site and soil evaluation Good work practice	It is recommended to do a services location check to ensure that construction works will not impact on underground services such as water, gas, power and telecommunications. While AS/NZS 1547:2012 advocates that this is done as a component of the site and soil evaluation, it is recommended that it is completed prior to any works involving excavations.
Vegetation removal	AS/NZS 1547:2012 Section 6 Construction, installation, operation, and maintenance	While the system designer and council will try to avoid vegetation removal where feasible, it may be unavoidable in some circumstances. Alternatively, it may be necessary to develop strategies to avoid damage to vegetation that is to be retained. Consultation with the council is recommended to determine any approval requirements.

Activity or element	AS/NZS 1547:2012 or other reference	Details
Soil improvement works	AS/NZS 1547:2012 Section 6 Construction, installation, operation, and maintenance	<p>In some circumstances the consultant or designer may determine that soil improvement works are required within the area of the EDS to manage constraints to hydraulic or pollutant removal functions.</p> <p>Soil improvement work typically occurs prior to construction of the actual EDS and can involve adding lime, gypsum and organic matter or importing additional soil.</p> <p>The weather conditions should be considered to minimise damage to the site, movement of sediment and soil, and to maximise the benefit of the improvement work. Work should not be done if it may result in damage to soil conditions through compaction or potential soil movement or erosion.</p> <p>Arrange inspections by the council or designer if required.</p>
Civil works Cut, fill or construction of retaining walls	AS/NZS 1547:2012 Section 6 Construction, installation, operation, and maintenance	<p>In some circumstances the design of the EDS will involve civil works such as cutting, filling or construction of retaining walls.</p> <p>These types of activities require careful implementation to ensure intended outcomes are achieved and to minimise damage to the site and movement of sediment and soil.</p> <p>Consultation with the council is recommended to determine any approval requirements. Arrange inspection by the council or designer if required.</p>
Sediment and erosion control	–	<p>The potential for sediment and erosion impacts associated with the work site should be evaluated with suitable control measures implemented as required.</p>
Site access	–	<p>All-weather access to the work site should be considered. The access location should prevent damage to the proposed EDS due to compaction and soil degradation.</p>
Site and construction safety	Victorian Legislation EPA Publication 1834: Civil construction, building and demolition guide	<p>Construction activities should be performed safely and in accordance with Victorian Health and Safety legislation.</p> <p>Risk assessments are a good method of identifying and controlling site hazards such as overhead power lines, excavations, etc.</p> <p>EPA Publication 1834: Civil construction, building and demolition guide supports the civil construction, building and demolition industries to eliminate or reduce the risk of harm to human health and the environment through good environmental practice.</p>

6.6 Construction activities

6.6.1 Common activities

Some common construction activities exist, however, most activities will be unique to each EDS type. Table 36 provides guidance on common construction activities.

Table 36 Common construction activities

Activity or element	AS/NZS 1547:2012 or other reference	Details
Weather	AS/NZS 1547:2012 Appendix L7 Construction techniques	<p>Weather conditions should be considered before commencing civil works involving excavation or significant disturbance of the ground.</p> <p>Excavation work during poor weather conditions can result in unnecessary damage to the EDS and work site, especially on sloping ground. Key risks include soil compaction and structural degradation and erosion, and potential sediment export.</p>
Marking out the EDS	Good work practice	<p>Marking or setting out the shape and size of the EDS with suitable marking material before commencing work is good practice. This provides installers with a visual representation of the system that can enable identification of problems not previously known. It also provides excavator or machinery operators with a clear understanding of the EDS boundaries.</p>
Supply line/pipe	Good work practice	<p>The alignment and installation of the effluent supply line or pipe from the treatment plant may be influenced by features such as soil depth, rock, vegetation, or existing or proposed structures. This may influence pump and pipe sizing or, in extreme cases, EDS location and should be confirmed before starting EDS excavation or construction activities.</p>
Treatment plant installation	Good work practice Manufacturer's instructions	<p>Tanks should be installed according to the manufacturer's instructions including consideration of minimising potential buoyancy.</p> <p>Tanks should be filled with water immediately following installation to minimise buoyancy.</p> <p>Filling the tank provides a water supply for subsequent EDS testing and commissioning.</p>

6.6.2 EDS-specific construction activities

While there are some common construction activities as listed in Table 36, most EDS construction activities are unique to each system type. Construction guidance information for each EDS type is provided in a set of example EDRS schematics in Appendix 1.

6.6.2.1 Pumped effluent distribution methods

Some EDS designs incorporate a pumped effluent distribution method such as irrigation systems, pressure dosed systems, dose loaded systems and LPED systems. EDS using these distribution methods generally require hydraulic design to ensure required hydraulic performance conditions can be achieved (for example, minimum scouring velocities). It is important during the construction phase that equipment selection and construction techniques align with the system design, permit and approved plans. An appropriate level of testing should be implemented to verify performance and design assumptions. Further guidance on construction and testing of these systems is provided below.

Shallow subsurface and surface systems

Shallow subsurface systems include surface spray, subsurface, and LPED designs. Further information describing each distribution method can be found in Appendix 2.2

Guidance on construction and testing is presented in Table 37 for subsurface irrigation systems, Table 38 for surface irrigation systems and Table 39 for LPED systems.

Table 37 Subsurface irrigation systems – equipment, construction and testing

Subsurface irrigation

Equipment and construction

Dripline should be a proprietary product that has the following general characteristics:

- suitable for secondary treated effluent
- pressure compensating
- anti-siphon and anti-leakage (where required)
- lilac colour or lilac strip
- contains a suitable method of root intrusion prevention
- available in several emitter flow rates and spacing configurations.

Designs incorporating multiple zones should use automatic sequencing valves in preference to manual valve arrangements. The valve should be installed according to the manufacturer's instructions. As a rule, the valve is located close to the pump to maximise the pressure at the valve to help ensure the sequencing action is activated.

A suitable non-return valve should be installed into the supply pipe to minimise effluent returning to the pumpwell or to lower irrigation zones after pump shutoff.

Dripline should be installed across the slope (i.e., installed perpendicular to the slope direction) with the zone elevation differential less than ~1 m from lowest to highest point within each hydraulic zone. Where the elevation differential is greater than ~1 m the design will require additional leakage management to minimise potential dripline leakage.

Dripline should be installed at a nominal depth of 100–150 mm below ground level. Lateral/emitter spacings and emitter flow rate for the dripline is to be in accordance with the approved design.

Subsurface irrigation

Testing guidance

Pre-testing activities:

- Ensure treatment plant pumpwell contains enough water for testing activities.
- Ensure a power supply is available to the treatment plant.
- Leave sections of the lateral trench open to allow visual inspection of the dripline (i.e., inspection by council officers).
- Ensure flush valves are open. This allows for the flushing of debris and visual indication of pump operation.
- Operate the pump to charge the dripline.

Visual observations:

- Check flush valves for discharge of water. Close valves when debris has been flushed to pressurise the drip system.
- Check dripline emitters for signs of operation. This may be determined by damp soil around the emitter or actual emitter dripping.
- Check for leaks in dripline connections, pipework, filters and valves.
- Check for wetness or sogginess along each lateral/trench to ensure even distribution.
- For zoned designs using an automatic sequencing valve, shut off the pump and allow system to depressurise. Restart pump and carry out checks as listed above for all zones and confirm sequencing valve operates as required.

Table 38: Surface irrigation systems – equipment, construction and testing

Surface irrigation

Equipment and construction

Pipework should be a proprietary product that has the following general characteristics:

- suitable for secondary treated effluent
- lilac colour or lilac strip.

The spray system and spray heads should be a type suitable for use with effluent that provide for the following characteristics:

- produce coarse droplets (not fine mist or aerosols)
- distribute effluent evenly across the EDS
- generally, achieve a spray height <500 mm above ground level and a wetted diameter not greater than 2,000 mm (unless specified and approved with greater values).

Laterals should be installed across the slope (i.e., installed perpendicular to the slope direction) with the spray heads generally at the same height. Where this is not possible, pressure and drainage management (after pump shut-off) may be required to ensure even distribution of effluent.

Surface irrigation

Designs incorporating multiple zones should contain automatic sequencing valves in preference to manual valve arrangements. The valve should be installed according to the manufacturer's instructions. As a rule, the valve is located close to the pump to maximise the pressure at the valve to help ensure the sequencing action is activated.

A suitable non-return valve should be installed into the supply pipework to minimise effluent returning to the pumpwell or lower irrigation zones after pump shut-off.

Testing

Pre-testing activities:

- Ensure the treatment plant pumpwell contains enough water for testing activities.
 - Ensure a power supply is available to the treatment plant.
 - Ensure flush valves are open. This allows for the flushing of debris and visual indication of pump operation.
 - Operate pump to charge laterals.
-

Visual observations:

- Check flush valves for discharge of water. Close valves when debris has been flushed to pressurise the system.
 - Check spray heads along each lateral for effective/even operation and attainment of height and throw criteria.
 - Check the variation in spray height and throw (should be <15%).
 - Check for leaks in connections, pipework, filters and valves.
 - For zoned designs using an automatic sequencing valve, shut off the pump and allow the system to depressurise. Restart the pump and carry out checks as listed above for all zones and confirm sequencing valve operates as required.
-

Table 39: LPED systems – equipment, construction and testing

LPED systems

Equipment and construction

LPED system distribution pipework typically consists of:

- Outer pipe (distribution): nominal diameter of 90–100 mm uPVC slotted/drilled or alternatively 100 mm agricultural line (un-socked). This pipe is installed with slots or orifice direction facing down. As an alternative to an outer pipe, orifice covers may be used.
- Inner pipe (dosing): nominal diameter of DN25–50 mm, class 12 PVC. Distribution orifice diameter is typically 3 mm, however, can be subject to hydraulic design. This pipe is installed with orifice direction facing up.
- Each lateral end to be fitted with flush valve or similar.

LPED systems typically require multiple hydraulic zones consisting of one or more laterals. The preferred dosing method to each zone is an automatic sequencing valve. The valve should be installed according to the manufacturer's instructions. As a rule, the valve is located close to the pump to maximise the pressure at the valve to help ensure the sequencing action is activated. An automatic sequencing valve may be used, however, caution should be taken with primary treated effluent due to potential blocking of the valve. Check with the valve manufacturer to confirm effluent quality criteria and suitability.

A suitable non-return valve should be installed into the supply pipework to minimise effluent returning to the pumpwell or lower hydraulic zones.

Testing

Pre-testing activities:

- Ensure the treatment plant pumpwell contains enough water for testing activities.
 - Ensure a power supply is available to the treatment plant.
 - Ensure flush valves are open. This allows for the flushing of debris and visual indication of pump operation.
 - Operate pump to charge laterals. Note: laterals are tested prior to fitting the outer distribution pipe or orifice cap).
-

Visual observations:

- Check flush valves for discharge of water. Close valves when debris has been flushed to pressurise the system.
 - Check orifice squirt height along each lateral being tested for evenness of squirt height. Assess squirt height against the design criteria. As a rule, a typical squirt height is 0.9–1.2 m with no more than 15% variation across each zone. Squirt height should be no less than 0.9 m (equates to a residual pressure at orifice of 1.3 m).
 - Check for leaks in connections, pipework, filters, and valves.
 - Check for wetness or sogginess along each lateral/trench to ensure even distribution.
 - To test each lateral and the automatic sequencing valve, shut off the pump and allow the system to depressurise. Restart the pump and carry out checks as listed above for all laterals.
-

Post-testing activities:

- Install outer distribution pipe or orifice caps to each dosing lateral.
 - Complete construction in accordance with the design and AS/NZS 1547:2012.
-

Pressure dosed and dose loaded systems

Dose loaded systems can distribute effluent by either slotted distribution pipe or a self-supporting arch, while pressure dosed trenches are supplied through an LPED pipe design. This type of effluent distribution method is described in Appendix 2.2. Guidance on construction and testing for pressure dosed systems is presented in Table 40 and Table 41 for dose loaded systems.

Pressure dosed systems

Equipment and construction

Pressure dosed system distribution pipework typically consists of:

- Outer pipe (distribution): nominal diameter of 90–100 mm uPVC slotted/drilled or alternatively 100 mm agricultural line (un-socked). This pipe is installed with slots or orifice direction facing down. An alternative approach is to use self-supporting arch with the inner pipe installed within the centre of the arch.
- Inner pipe (dosing): nominal diameter of DN25-50 mm, class 12 PVC. Distribution orifice diameter is typically 3 mm, however, can be subject to hydraulic design. This pipe is installed with orifice direction facing up.
- Each lateral end to be fitted with flush valve or similar.

Pressure dosed distribution pipework is typically divided into multiple hydraulic zones consisting of one or more laterals. The preferred dosing method to each zone is with an automatic sequencing valve. The valve should be installed according to manufacturer's instructions. As a rule of thumb, the valve is located close to the pump to maximise the pressure at the valve to help ensure the sequencing action is activated. While automatic sequencing valves are typically used with secondary effluent they can be used with primary treated effluent, acknowledging however, that the valve may require additional maintenance. Check with the valve manufacturer to confirm effluent quality criteria and suitability.

A suitable non-return valve should be installed into the supply pipework to minimise effluent returning to the pumpwell or any lower hydraulic zones.

Testing

Pre-testing activities:

- Ensure treatment plant pumpwell contains enough water for testing activities.
- Ensure a power supply is available to the treatment plant.
- Ensure flush valves are open. This allows for the flushing of debris and visual indication of pump operation.
- Operate the pump to charge laterals. Note: laterals are tested prior to fitting the outer distribution pipe/arch.

Visual observations:

- Check flush valves for discharge of water. Close valves when debris has been flushed to pressurise the system.
- Check orifice squirt height along each lateral being tested for evenness of spray and height. Assess squirt height against design criteria. As a rule, a typical squirt height is 0.9–1.2 m with no more than 15% variation across each zone. Squirt height should be no less than 0.9 m (equates to a residual pressure at orifice of 1.3 m).
- Check for leaks in connections, pipework, filters and valves.
- Check for wetness or sogginess along each lateral/trench to ensure even distribution.

Pressure dosed systems

- To test each zone and the automatic sequencing valve, shut off the pump and allow the system to depressurise. Restart the pump and carry out checks as listed above for all zones.
-

Post-testing activities:

- Install outer distribution pipe/arch to each dosing lateral.
 - Complete construction in accordance with design and AS/NZS 1547:2012.
-

Table 41: Dose loaded systems – construction and testing guidance

Dose loaded systems

Equipment and construction

Dose loaded distribution systems typically consist of 2 methods:

- Method 1: pipework with a nominal diameter of 90–100 mm uPVC slotted/drilled. Slots or drilled holes can be contained to the upper half of the pipe lateral to facilitate distribution along the lateral. Each lateral end to be fitted with screw cap.
- Method 2: self-supporting arch can be installed instead of a piped design. Self-supporting arch is typically available in several sizes depending on manufacturer and design height requirement. Example heights can range between 230 mm and 410 mm with 350 mm being a commonly used height. Width and length generally remain similar. Effluent is dose loaded using the supply pipe through a penetration in the self-supporting arch – generally at the mid-point.

The supply pipe or distribution main between the pump and distribution system may be low density polyethylene (LDPE) or high-density polyethylene (HDPE) of a suitable class and diameter in accordance with the system design.

Dosing to multiple laterals or trenches can be achieved using several methods, for example:

- Method 1: distribution pit or splitter box. Effluent is pumped (or siphoned) into the splitter box for distribution to each lateral or trench. The splitter box is located at or above the highest lateral/trench for distribution to the lower laterals/trenches. For even distribution the outlet pipes are installed at an equivalent height within the box. The pump specifications should be adequately matched to the design, capacity and location of the splitter box to ensure efficient operation without overtopping or leakage.
 - Method 2: automatic sequencing valve. An automatic sequencing valve may be used, however, caution should be taken with primary treated effluent as blockages may occur.
-

A suitable non-return valve should be installed into the supply pipework to minimise effluent returning to the pumpwell.

Testing

Pre-testing activities:

- Ensure the treatment plant pumpwell contains enough water for testing activities.
 - Ensure a power supply is available to the treatment plant.
-

Dose loaded systems

- Operate the pump to charge the supply pipe to the distribution box or sequencing valve.
-

Visual observations:

- Splitter box: Observe height of effluent within the splitter box on operation of the pump (or siphon). Check correct operation of the box by observing flow of effluent into each lateral/trench.
 - Automatic sequencing valve: To test the automatic sequencing valve, shut off the pump and allow the system to depressurise. Restart the pump and carry out checks as listed above for all laterals or trenches. Check correct operation of valve by observing flow of effluent into each lateral/trench.
 - Check for leaks in connections, pipework, filters and valves.
 - Check for wetness or sogginess along each lateral/trench to ensure even distribution.
-

6.6.2.2 Gravity dosed effluent distribution methods

When the location of the EDS has a lower elevation than the treatment plant and it is not a pressurised EDS conveyance or distribution method (irrigation, LPED or pressure dosed), it is likely that a gravity dosed effluent distribution method can operate effectively. This type of effluent distribution method is described in Appendix 2.2. Guidance on construction and testing is provided in Table 42.

Table 42: Gravity dosed systems – construction and testing guidance

Gravity systems

Equipment and construction

Gravity dosed systems typically consist of 2 methods:

- Method 1: pipework with a nominal diameter of 90–100 mm uPVC slotted/drilled. Slots or drilled holes can be contained to the upper half of the pipe lateral to facilitate distribution along the lateral. Each lateral end to be capped.
- Method 2: self-supporting arch can be installed in lieu of a piped design. Self-supporting arch is typically available in several sizes depending on manufacturer and design height requirement. Example heights can range between 230 mm and 410 mm with 350 mm being a commonly used height. Width and length generally remain similar. Effluent is dosed into the arch using the supply pipe through a penetration in the self-supporting arch either at the mid-point or end depending on the design.

The supply pipe between the treatment tank and the EDS or distribution system (where fitted) and EDS is typically 100 mm DWV uPVC pipe.

Dosing to multiple laterals or trenches can be achieved with the use of a distribution box or splitter box:

- Effluent is gravity dosed into the splitter box for distribution to each lateral or trench. The splitter box is located at or above the highest lateral/trench for distribution to the lower laterals/trenches. For even distribution the outlet pipes are installed at an equivalent height within the box.
-

Gravity systems

Testing

Visual observations:

- Run water into the treatment tank and observe correct discharge into the pipe or self-supporting system.
- Splitter box (where fitted): Run water into the treatment tank and observe height of effluent in the splitter box. Check correct operation of the box by observing flow of effluent into each trench or bed.
- Observe effluent dosing into trench ends (to be left exposed or use observation bore) to confirm even distribution.
- Check for leaks in connections, fittings and pipework.

6.7 Post-construction activities

Post-construction activities take place when construction of the EDS has been completed. Activities occurring in this stage may be ancillary to the EDS such as planting vegetation, constructing stormwater controls, or generally tidying up the site. Table 43 provides guidance on common post-construction activities.

Table 43: Common post-construction activities

Activity or element	AS/NZS 1547:2012 or other reference	Details
Surface and subsoil water control measures	AS/NZS 1547:2012 2.4 Implementing risk management 5.5.4.2.1 Site M9.3 Sloping sites T5.2.2 Advice on maintenance	Construction of control measures designed to manage surface waters or subsoil conditions may be required on some sites. Generally, these devices will be included in the approved EDS design. The timing of construction of the devices should consider access to their location in relation to the EDS, site boundaries or other structures.
Vegetation	Approved design Good work practice	The surface of the EDS should be vegetated in accordance with the approved design.
Finishing the site	Good work practice	On completion of construction the EDS and surrounding work area should be made good. This may involve removing spoil, importing soil material for site levelling, and removing excess materials, rubbish and debris.
System commissioning	AS/NZS 1547:2012 Appendix L, M, N for each EDS type	Perform operational checks and commissioning activities in accordance with the permit, design report and manufactures instructions where appropriate.

Activity or element	AS/NZS 1547:2012 or other reference	Details
Inspections	Council permit	Arrange inspections in accordance with the council permit.

6.8 Inspections and commissioning

Inspection and commissioning are important stages through preconstruction, construction, and pre-operation of not only the EDS but the OWMS more broadly. Inspection and commissioning activities provide benefits to all stakeholders, including providing:

- the property owner with a reasonable level of certainty that the system has been constructed in accordance with the A20 permit and associated conditions
- the construction contractor with confidence that the system as constructed aligns with the plans, specifications and approval documents
- the system designer with verification that the system as constructed aligns with the system as designed
- the council with the ability to establish that the system has been constructed as designed and approved.

6.8.1 Inspections

Inspection of the EDS at several milestones during the preconstruction and construction stages is recommended. The inspections can be used for several purposes, including to:

- establish alignment with the permit conditions
- establish alignment with the approved design
- verify construction practices
- confirm operability.

Inspections will typically be performed by council officers in accordance with the inspection schedule advised in the installation permit and by the system designer where conditioned or requested as part of the design.

Inspections by either council and/or the system designer provide timely opportunities to identify and raise with the contractor critical design or construction matters that may require modification prior to completion of construction.

The timing and number of inspections will be determined by council officers based on the type of EDS and complexity of the site. The outcomes from inspections should be documented and recorded.

Councils may have developed their own standard operating procedure for performing inspections. The information presented here is a guide and may be adapted where necessary.

AS/NZS 1547:2012 Inspection guidance

Installation inspections are addressed in several sections of AS/NZS 1547:2012. The inspection should cover all necessary sections and could vary between sites based on different risk profiles, types of systems and site. Section 6.2.5.1 of the standard provides the following guidance.

The installation will be checked to ensure that:

- it is located as specified in the design
- it is constructed as specified in the design
- the soils exposed in the base of the beds or trenches are as observed during the site-and-soil evaluation and have not been compacted or smeared during excavation
- any onsite wastewater treatment plant has been installed in accordance with the manufacturer's instructions and requirements of the regulatory authority, is watertight, and free of debris
- the system meets related standards and practice.

Inspection information is summarised in Table 44.

Table 44: Summary of inspection information

When performed	Inspected by	Purpose and detail
Site and soil preparation inspections		
<p>Prior to, during or on completion of the improvement work, but before construction work commences.</p> <p>This work can involve:</p> <ul style="list-style-type: none"> • vegetation removal • soil improvement • site levelling (cutting/filling) • retaining wall construction. 	<p>EDS designer and council, depending on inspection requirements.</p>	<p>To verify and record that the site and soil preparation work proposed by the system designer has been completed to a satisfactory standard. Verification can be completed in many ways including:</p> <ul style="list-style-type: none"> • the evaluation of receipts that demonstrate purchase of materials in the correct quantities such as lime, gypsum, soil or organic matter • the evaluation of receipts that demonstrate engagement of suitable contractors • the collection of soil samples for analysis to confirm the material meets design or approval requirements • observations by the designer or council officer of site and soil improvement work activities in progress • collection of measurements such as soil depth. <p>Documents and records should be collected including receipts for materials or services, photos, laboratory results or inspection checklists.</p>
Construction inspections and testing		
<p>During construction. However, this depends on the EDS type and design noting that several inspections may be required during this stage.</p>	<p>EDS designer and council officer, depending on inspection requirements.</p>	<p>The purpose of these inspections is contingent on the EDS type and design, and complexity of the project. There are several types of EDS design checks that can be completed at this stage including those detailed below.</p>

When performed

Inspections may be performed:

- after excavation and prior to further works
- during construction when laying dripline, pipework, arch, aggregate, sand, soil or geofabric, etc.
- prior to backfilling.

Inspected by

(For remote or minor checks, photographic evidence from the installer may be adequate.)

Purpose and detail

Absorption, ETA and Wick systems

Verify that the following conforms with the approved design:

- EDS location, dimensions, depth and levelness of base
- distribution method (pressure dosed, dose loaded or gravity)
- aggregate size (where used)
- installation of geofabric in the correct location.

Test pressure dosed or pump dosed systems by requesting the installer to operate the treatment plant pump. The test is to confirm the correct operation of the distribution manifold, that a correct residual head (squirt height) has been achieved and that the pressure loss within the distribution lateral is acceptable.

(Note: this may require provision of a temporary power supply, i.e., generator.)

Irrigation systems (subsurface)

Verify that the following conforms with the approved design:

- EDS location and dimensions
- dripline type and lateral spacings
- system layout (e.g., location of supply and flush manifolds)
- hardware components such as filters, air release and flush valves, non-return valves, check and DNL valves (where required) and sequencing valve (where required).

Test the system by requesting the installer to operate the treatment plant pump. The test is to confirm the correct operation of the dripline and valves and check for leaks.

For designs with multiple zones and an automatic sequencing valve, have the installer switch off and restart the pump to confirm that the valve has rotated to the next subsurface zone. Reconfirm correct operation of the dripline and valves and check for leaks.

(Note: this may require provision of a temporary power supply, i.e., generator.)

Irrigation systems (surface spray/drip)

Verify that the following conforms with the approved design:

- EDS location and dimensions
- system layout
- hardware components such as filters and spray heads.

Test the system by requesting the installer to operate the treatment plant pump. The test is to confirm the correct operation of the spray heads, spray head plume distance and height, valves and to check for leaks.

(Note: this may require provision of a temporary power supply, i.e., generator.)

Mounds

Verify that the following conforms with the approved design:

- EDS location and dimensions
- levelness of distribution trench base if required by design
- uniformity coefficient and effective size of sand media (particle size distribution)
- height of the lower sand layer and aggregate bed (check aggregate size)

When performed

Inspected by

Purpose and detail

- distribution manifold design, dimensions, and location of feed line.

Test the system by requesting the installer to operate the treatment plant pump. The test is to confirm the correct operation of the distribution manifold, that a correct residual head (squirt height) has been achieved and that the pressure loss along the distribution laterals is acceptable.

(Note: this may require provision of a temporary power supply, i.e., generator.)

Design conformity evaluation

On completion of construction and prior to final inspections by council.

EDS designer

To verify and sign off that the EDS has been installed in accordance with the design. This step can be beneficial for highly constrained sites or non-domestic sites with non-standard design approaches.

Final inspections (post construction) and testing

On completion of construction and prior to operation.

Council (primary)
EDS designer (secondary)

To verify and record satisfactory completion of EDS construction in accordance with the design and permit conditions. This inspection can include:

- reconfirming finished dimensions of the EDS
- confirming provision of vegetation such as turf (if required)
- verifying location and number of warning signs (if required)
- observing overall condition of finished EDS and surrounding area.

6.8.2 Commissioning

Commissioning of an OWMS will generally be required for all systems at some level, however, the scale and complexity of the commissioning will vary according to the type of OWMS and specific circumstances of the project. As an example:

- Commissioning of single domestic wastewater systems located on a site that is relatively unconstrained may be limited to simple verification checks of the EDS by the construction contractor with the outcome reported to the property owner and council in a basic installation report or equivalent. As reported in Section 6.8.1 inspections by the council may include one or 2 inspections during construction and on completion.
- Commissioning of a system servicing a more constrained domestic development, or a system located in a sensitive receiving environment will typically be more complex, and may involve the designer, installer and council. Commissioning can include validation checks with inspections performed by the system designer, installer, and council at various construction milestones. Reporting to the property owner and council could include a detailed installation report (or equivalent) from the construction contractor and a report from the system designer documenting the outcomes of a design assessment of the 'as built' system.
- Commissioning plans for large-scale systems servicing non-domestic development should be developed on a case-by-case basis.

There is no single guideline that defines the content and complexity of the commissioning plan, however, the permit application may include conditions advising on the requirement for a commissioning plan, what documents should be provided to council and when inspections by council (and/or the designer) will take place.

Note

Satisfactory performance of the treatment system, including pumps, is important in ensuring satisfactory performance of the EDS.

AS/NZS 1547:2012 Guidance information

Section 6.2.5 of the AS/NZS 1547:2012 standard provides the following guidance.

Commissioning of pump systems (Clause 6.2.5.2):

- check that the pump is installed and operating as specified by the manufacturer
- check on the emergency storage volume above alarm level
- check each float switch and associated control function
- check other control functions.

Other equipment (Clause 6.2.5.3):

- Other equipment, such as blowers, siphons, outlet filters and automatic sequencing valves will be commissioned according to the manufacturer's instructions.

6.9 Reporting

The outcomes from inspections and commissioning activities should be recorded for reporting to stakeholders as required. Depending on the objective of the inspection or commissioning activity, reports can be prepared by several people as detailed in Table 45. Determining mandatory inspections

and commissioning requirements will be at the discretion of the council and documented in the permit approval.

Table 45: Summary of reporting activities

Reporting activity	Objective	Prepared by	Provided to
Site and/or soil improvement works	Verify outcomes of soil improvement, retaining wall construction or terracing, etc.	System designer	Council
Construction Typically, an 'open trench' inspection will be performed during the early construction stage.	Verify permit conditions such as EDS design, location and dimensions. Can also include verification of components, fill material depth and quality, media, construction techniques and hydraulic performance.	Council and/or system designer	Council
Construction Typically, a final inspection will be performed later during construction or on completion of construction.	Verify all permit conditions have been achieved. Can also include verification of EDS post-construction activities, such as stormwater control measures and vegetation requirements. Will typically include inspection of the treatment plant.	System designer	Council Property owner
Construction verification statement	Confirms that construction of the EDS (and treatment plant) has been completed in accordance with the permit and system design.	Construction contractor	Council Property owner
System designer statement	Confirms that the constructed system has been completed in accordance with the design prepared by the system designer and which is subject of the permit.	System designer	Council Property owner

AS/NZS 1547:2012 Guidance information

Installation and commissioning report(s) (AS/NZS 1547:2012 Clause 6.2.5.4)

Reports on installation and commissioning should be produced, verifying that all system components have been installed and operate in conformity with the approved design. The report(s) should include a signed copy of the results of the commissioning test(s) and a copy of any regulatory authority approval or completion certificate. The report(s) are to be provided to the owner of the OWMS and to the regulatory authority, if required (refer AS/NZS 1547:2012 3.4€ and (f)).

Note

Examples of a system designer statement and construction verification statement are provided in Appendix 4 and Appendix 5.

6.10 References to AS/NZS 1547:2012

Table 46 provides the main references to AS/NZS 1547:2012 regarding construction, inspection, commissioning and reporting activities.

Table 46: AS/NZS 1547:2012 References to inspections, commissioning and reporting

Element	Section	Subsection	Page number	
Construction, inspection, commissioning and reporting	Section 3 Roles and responsibilities	3.1 The regulatory authority	23	
	Section 6 Construction, installation, operation, and maintenance	6.2.5 Commissioning and inspections	60	
	Appendix A Risk management process guidelines	Table A3 Examples of administrative risk reduction measures	82	
	Appendix L Land application methods – Trenches, beds, and ETA systems	L5 Construction		144
		L6 Effluent Loading		147
		L7 Construction Techniques		148
		L8 Installation – Pipe laying		149
		L10 Pre-commissioning tests		150
		L11 Commissioning		150
		L13 Reporting		150
	Appendix M Land application methods – Irrigation systems	M3 Drip irrigation		156
		M4 Spray irrigation		147
		M5 LPED irrigation		158
		M9 Construction		162

Element	Section	Subsection	Page number
		M10 Installation	164
		M11 Pre-commissioning tests	166
		M12 Commissioning	166
		M14 Reporting	166
	Appendix N Application methods – Mounds	N3 Construction and installation	172
		N3.3.5 Pre-commissioning tests	175
		N4 Commissioning	176
		N5 Reporting	176

7 Operation and maintenance of effluent dispersal and recycling systems

7.1 Scope

This chapter provides information and guidance on the operation and maintenance activities for both onsite treatment plants and EDRS and includes mandatory requirements under the EP Regulations.

7.2 Chapter overview

This chapter provides owners, occupiers and operators with information addressing the operational and maintenance requirements for OWMS with a focus on EDRS.

While this guidance focuses on EDRS, the operational performance of an onsite treatment plant can influence the quality of the effluent produced and directed to the EDRS. The performance and longevity of the EDRS is therefore directly linked to the operation and maintenance of the treatment plant as well as maintenance activities performed on the EDRS. Therefore, operation, and maintenance conditions for treatment plants with the potential to influence EDRS performance are also addressed here.

The topics addressed in this chapter include:

- operation and maintenance activities
- troubleshooting
- AS/NZS 1547:2012 references
- legislative requirements.

7.3 Operation and maintenance activities

The operation and maintenance of onsite wastewater treatment plants and EDRS can directly and indirectly influence system performance and durability.

For this guidance, operational activities can be described as actions performed by the property owner/occupier or servicing technician to enable the EDRS to function. These actions include volume of water use, use of appropriate cleaning chemicals and routine inspection to confirm adequate function.

Maintenance activities can be described as activities performed on the treatment plant or EDRS to clean, repair or renew components to maintain operation and system life. These activities can be routine servicing tasks or reactive repairs and responses to incidents or failed components.

The importance of operation and maintenance is acknowledged in AS/NZS 1547:2012 with the inclusion of a section dedicated to construction, installation, operation and maintenance (Section 6).

All OWMS will require operation and maintenance activities, with the scale and complexity of the activities and actions influenced by the type of treatment plant and the EDRS design.

Operational matters are discussed in Table 47 and guidance on maintenance activities is provided in Table 48. Activities listed for treatment plants are limited to those considered critical to the maintenance of effluent quantity and quality, which fundamentally influences the EDRS performance.

Table 47: Operational objectives and actions

Operational objective	Purpose	Possible actions	Responsible people
Manage and restrict access to the treatment plant and EDRS.	<p>To permit access to the treatment plant and EDRS for inspection and maintenance purposes.</p> <p>To restrict access to the treatment plant and EDRS by unauthorised people.</p>	<ul style="list-style-type: none"> Consider access requirements to the treatment plant and EDRS when proposing new development, landscaping or minor property works. Ensure there is access to the treatment plant for maintenance and management purposes as required. Maintain vegetation in and surrounding the EDRS and treatment plant. Monitor and manage warning signage (where required). Restrict use of the EDRS for recreational purposes. Restrict placement of children’s play equipment within the EDRS. Restrict the access of domestic animals to prevent damage to the EDRS (soil compaction, fitting breakage, etc). 	<p>Owner</p> <p>Occupiers</p>
Minimise the entry of foreign matter and reduce build-up of sludge in the treatment plant.	Minimise entry of food scraps.	<ul style="list-style-type: none"> Scrape plates and dishes. Fit strainer to kitchen sink waste outlet. 	<p>Owners</p> <p>Occupiers</p> <p>Guests</p>
	Minimise entry of oils and greases.	<ul style="list-style-type: none"> Drain oil into container for disposal in waste system. Wipe pans and dishes with paper towelling. 	
	Minimise entry of hygiene products.	<ul style="list-style-type: none"> Provide alternative disposal facilities in bathrooms and toilets. 	
Maintain healthy processes in the treatment plant, EDRS and soils.	Minimise impact on biochemical, biological and soil processes, and soil structure.	<ul style="list-style-type: none"> Endeavour to use cleaning products, soaps and detergents that are suitable for OWMS. 	

Operational objective	Purpose	Possible actions	Responsible people
		<ul style="list-style-type: none"> • Endeavour to use soaps and detergents that are biodegradable, low-phosphorus and low in sodium. • Minimise, where possible, the excessive use and quantity of cleaning chemicals such as bleaches, disinfectants and nappy soakers. • Avoid disposing of chemicals into the drainage system (i.e., into the overflow gully). 	
	Minimise impact on treatment processes.	<ul style="list-style-type: none"> • Consider installing water conservation fixtures, fittings and appliances in the dwelling. • Consider reducing water use. • Consider scheduling of laundry washing times where feasible. 	
Provide information, education and training.	To ensure people with responsibility for operation of OWMS have access to suitable and appropriate guidance and training.	<ul style="list-style-type: none"> • Provide copies of operation and maintenance information to people with responsibility for operation of the system. • Provide suitable and appropriate education and training to people with responsibility for operation of the system. 	Owners System suppliers Estate agents Servicing companies
Comply with all regulatory provisions.	To operate and maintain the system in a manner that reduces risk to occupants, neighbours, local amenity and the environment.	<ul style="list-style-type: none"> • Operate and maintain the system in good working order. • Engage plumbing and servicing companies that have suitable experience with OWMS. • Regularly inspect the treatment plant and EDRS to determine correct operational performance. • Repair malfunctions, faults and failures promptly. 	Owners Occupiers

Operational objective	Purpose	Possible actions	Responsible people
Inspection of the treatment plant and EDRS.	Ensure that the treatment plant is maintained in accordance with the manufacturers recommended frequency or council requirements.	<ul style="list-style-type: none"> Maintain records of routine and non-routine servicing. Notify the council if the system poses a risk to human health or the environment. 	Owner

Table 48: Maintenance activities and actions

Maintenance activity	Possible actions	Applicable systems	Responsible people
Treatment plant related activities			
Monitor the condition of the irrigation filter where fitted – typically secondary treatment systems.	<ul style="list-style-type: none"> • Maintain the filter in good operating condition. • Inspect and clean the filter regularly. • Report changes in the filter operating frequency to servicing company. 	<ul style="list-style-type: none"> • Secondary treatment plant • Greywater plant 	<ul style="list-style-type: none"> Owner Occupier
Maintain the system according to the manufacturer’s recommended instructions.	<ul style="list-style-type: none"> • Ensure the servicing company engaged to maintain the treatment plant is suitably experienced with the treatment plant manufacturer and model. • Periodic inspections of septic tanks including measurement of sludge levels. • Primary and secondary sludge management (e.g., desludging). • Maintain and repair mechanical equipment (including pumps and pipes). • Assess and maintain the biological and chemical processes integral to the proper functioning of the system. 	<ul style="list-style-type: none"> • All 	<ul style="list-style-type: none"> • Servicing company • Plumbing company

Maintenance activity	Possible actions	Applicable systems	Responsible people
EDRS related activities			
Monitor the EDRS (and surrounds) for indications of poor performance or signs of failure. As an example, this can be identified by odour, surfacing of effluent, damp spots and inconsistency in vegetation growth colour.	<ul style="list-style-type: none"> Report to council. Contact and discuss with the servicing company (typical for secondary treatment plants and irrigation EDRS). Contact and discuss with the plumbing company (typical for primary treatment plants and absorption/ETA EDRS). 	<ul style="list-style-type: none"> Absorption and evapotranspiration systems Irrigation systems Mound systems 	<ul style="list-style-type: none"> Owner Occupier Servicing company Plumbing company
Monitor vegetation within or covering the EDRS.	<ul style="list-style-type: none"> Maintain vegetation as required including regularly mowing the system (Note: grass clippings should be removed). Avoid placement of deep rooting vegetation within EDRS. 	<ul style="list-style-type: none"> Absorption and evapotranspiration systems Irrigation systems Mound systems 	<ul style="list-style-type: none"> Owner Occupier
Monitor irrigation equipment for signs of damage or failure. This can include: <ul style="list-style-type: none"> filters pipework valves spray equipment subsurface dripline. 	<ul style="list-style-type: none"> Monitor and operate system valves as required. Periodic flushing of pressurised systems using flush valves (e.g., subsurface irrigation or LPED). Replace or repair equipment as required. Contact and discuss with the servicing company if required (Secondary treatment plant and related EDRS). 	<ul style="list-style-type: none"> Absorption and evapotranspiration systems Irrigation systems Mound systems 	<ul style="list-style-type: none"> Owner Occupier Servicing company Plumbing company

Maintenance activity	Possible actions	Applicable systems	Responsible people
	<ul style="list-style-type: none"> Contact and discuss with the plumbing company if required (Primary treatment plant and related EDRS). 		
Monitor condition of warning signage (where required).	<ul style="list-style-type: none"> Ensure that the appropriate effluent warning signs remain in place and visible to people entering the EDRS. 	<ul style="list-style-type: none"> Irrigation systems 	Owner Service technician
Monitor EDRS for inappropriate uses.	<ul style="list-style-type: none"> Avoid the placement of children’s play equipment within the EDRS. Restrict access to people, vehicles and livestock. 	<ul style="list-style-type: none"> Irrigation systems 	Owner Occupier
Monitor condition of stormwater control measures.	<ul style="list-style-type: none"> Maintain and clean stormwater control measures located upslope and around the EDRS. 	<ul style="list-style-type: none"> Absorption and evapotranspiration systems Irrigation systems Mound systems 	Owner
Provide, monitor and maintain measures to restrict unauthorised access (where required) to the EDRS by people, vehicles and livestock.	<ul style="list-style-type: none"> Ensure that the appropriate effluent warning signs remain in place and visible to people entering the EDRS. Maintain fencing. 	<ul style="list-style-type: none"> Absorption and evapotranspiration systems Irrigation systems Mound systems 	Owner Occupier

7.4 Troubleshooting

Despite correct operation and routine maintenance, problems and breakdowns may still happen from time to time. When they do, one or more warning signs may be visible or evident to either the owner, occupier or service technician depending on the nature of the problem or the system type. Problems and breakdowns relating to treatment plants can typically be identified through alarm systems, however, problems and issues relating to EDRS are generally identified through observations or unusual changes in surface conditions. In some situations a problem relating to an EDRS may present elsewhere such as in the treatment plant or even the dwelling rather than the EDRS.

Some faults and malfunctions may be noncritical, however, others may be critical and if not rectified promptly may result in component or system failure. It is important that all problems, breakdowns and system failures are identified and actioned without delay to minimise risks to the environment and human health. This section provides information about warning signs commonly observed at either the dwelling, treatment plant or EDRS.

Guidance about common faults and malfunctions is provided in Table 49.

Note

Some problems or system failures may be the result of one or several causes. In some situations the problem may be the result of one cause but is exacerbated by another cause or contributing factor such as unfavourable weather conditions.

Several corrective actions may be possible. The actions considered most appropriate to achieve a safe and suitable outcome should be performed first.

Table 49: Troubleshooting guidance

Fault or malfunction	Possible cause or concern	Possible corrective action
Dwelling/building		
Overflowing surcharge gully.	<ul style="list-style-type: none"> Blocked or partially blocked sanitary drainage (pipework) between gully and treatment tank. Blocked tank inlet dropper (Tee). 	<ul style="list-style-type: none"> Isolate area and avoid contact. Contact and discuss with the plumbing company or service agent.
Slowly draining toilet or internal drain.	<ul style="list-style-type: none"> Blocked or partially blocked sanitary drainage (pipework) between fixture and treatment tank. Elevated levels in the treatment tank caused by blocked outlet filter. Elevated levels in the treatment tank caused by blocked inlet dropper or pipework blockage between tank and EDS. Elevated levels in the mechanical treatment tank caused by pump failure. 	<ul style="list-style-type: none"> Contact and discuss with the plumbing company or service agent.
Odour from drains (e.g., floor wastes).	<ul style="list-style-type: none"> S-trap may be dry with no water seal. Faulty pan seal on toilet. Strong prevailing winds. 	<ul style="list-style-type: none"> Ensure drain trap has adequate water seal.
Treatment plants – Primary treatment plant (septic tank), secondary treatment plant, greywater treatment plant, wet composting treatment plant		
Elevated water level in tank.	<ul style="list-style-type: none"> Blocked or partially blocked outlet filter (if fitted). 	<ul style="list-style-type: none"> Inspect and clean outlet filter.

Fault or malfunction	Possible cause or concern	Possible corrective action
	<ul style="list-style-type: none"> Blocked or partially blocked pipework between tank and EDRS. Clogged EDRS. 	<ul style="list-style-type: none"> Contact and discuss with the plumbing company.
	<ul style="list-style-type: none"> Elevated groundwater level⁹. 	<ul style="list-style-type: none"> Consider alternate system design. Contact council for advice.
High water level alarm.	<ul style="list-style-type: none"> Blocked or partially blocked pipework between tank and EDRS. 	<ul style="list-style-type: none"> Contact and discuss with the plumbing company.
Treatment failure.	<ul style="list-style-type: none"> Elevated groundwater level. 	<ul style="list-style-type: none"> Consider alternate system design. Contact council for advice.
Change in effluent quality as identified by: <ul style="list-style-type: none"> odour turbidity. 	<ul style="list-style-type: none"> Excessive inflow to system. <hr/> <ul style="list-style-type: none"> Potential changes to biological treatment processes depending on system type. Possible causes include effects from harsh chemicals, medications, increased or decreased influent flow rates, reduced level of aeration, etc. 	<ul style="list-style-type: none"> Monitor water usage and scheduling of high-water usage activities such as washing machines and dishwashers. Investigate causes of non-wastewater related flows such as stormwater intrusion or leaking water taps. <hr/> <ul style="list-style-type: none"> Monitor use of harsh chemicals. Investigate use of alternative products known to be septic tank system friendly. Monitor property water use.

⁹ Elevated groundwater that has entered a gravity dosed EDS can restrict or prevent discharge of effluent from the treatment tank.

Fault or malfunction

Possible cause or concern

Possible corrective action

- Change in type or quantity of household products (e.g., laundry detergent).

- Contact and discuss with the system servicing company (if applicable system).
- Monitor type and quantity of laundry detergents or other products. Use according to the manufacturer's instructions.
- Contact and discuss with the system servicing company (if applicable system).

Effluent dispersal systems – Absorption and ETA system

Damp or soggy/soft areas on the surface of the EDS whether localised or widespread. May or may not be associated with odour.

- Weather conditions including elevated rainfall and/or cooler temperatures.
- Higher than normal effluent inflows due to change in occupancy or wastewater generating activities (temporary or permanent).
- Surface or subsurface run-on from upslope catchment.

- Monitor to verify if cause is temporary and weather related or related to another cause.
- Monitor to verify if cause is temporary or related to another cause.
- Investigate water usage to determine if related. Reduce water use or spread scheduling of activities if possible.
- Contact and discuss with a plumbing company experienced in OWMS.
- Contact council for advice.
- Discuss with the system designer.
- Contact council.
- Avoid contact.

Fault or malfunction

Possible cause or concern

Possible corrective action

Ponding of effluent on the surface of the EDS whether localised or widespread. Typically associated with odour and colour consistent with sewage. May be intermittent or constant.

- Weather conditions including elevated rainfall and/or cooler temperatures.

- Avoid contact and restrict entry.
- Monitor to verify if cause is temporary and weather related or related to another cause.

- Higher than normal effluent inflows due to change in occupancy or wastewater generating activities (temporary or permanent).

- Avoid contact and restrict entry.
- Monitor to verify if cause is temporary or related to another cause.
- Investigate water usage to determine if related. Reduce water use or spread scheduling of activities if possible.
- Contact and discuss with a plumbing company experienced in OWMS.
- Contact council for advice.

- Blocked or partially blocked EDS. This may be the result of one or more causes including system age, system design, poor construction technique or extended application of reduced effluent quality.

- Avoid contact and restrict entry.
- Contact and discuss with a plumbing company experienced in OWMS.
- Contact council for advice.

Irregular and patchy vegetation growth across the surface of the EDS.

- Inefficient and ineffective distribution of effluent within EDS.

- Contact and discuss with a plumbing company experienced in OWMS for possible repair to distribution system.
- Contact council for advice.

- Reduced effluent inflows.

- Monitor to verify if cause is temporary.

Fault or malfunction

Possible cause or concern

Possible corrective action

	<ul style="list-style-type: none">Seasonal weather conditions (elevated temperatures/low rainfall).	<ul style="list-style-type: none">Monitor to verify if cause is temporary and weather related.
Excessive vegetation growth and/or greenness typically observed in localised areas of the EDS sometimes downslope. May appear as an elongated diverging 'plume'.	<ul style="list-style-type: none">Breakout or leaching of effluent from EDS.	<ul style="list-style-type: none">Avoid contact and restrict entry.Contact and discuss with a plumbing company experienced in OWS for possible repair.Contact council for advice.

Effluent dispersal systems – Irrigation systems including surface and subsurface

Damp areas or ponding of effluent on the surface of the EDS, whether localised or widespread.	<ul style="list-style-type: none">Weather conditions including elevated rainfall and/or cooler temperatures.	<ul style="list-style-type: none">Avoid contact and restrict entry.Monitor to verify if cause is temporary and weather related or related to another cause.
	<ul style="list-style-type: none">Broken or missing spray head(s) (surface irrigation).	<ul style="list-style-type: none">Repair or replace spray heads.
	<ul style="list-style-type: none">Damaged supply pipework (both).	<ul style="list-style-type: none">Repair or replace pipework
	<ul style="list-style-type: none">Damaged dripline (subsurface irrigation).	<ul style="list-style-type: none">Repair or replace dripline.
	<ul style="list-style-type: none">Higher than normal effluent inflows due to change in occupancy or wastewater generating activities (temporary or permanent).	<ul style="list-style-type: none">Monitor to verify if cause is temporary or related to another cause.Investigate water usage to determine if related. Reduce water use or spread scheduling of activities if possible.Increase size of EDS, contact council for advice.

Fault or malfunction	Possible cause or concern	Possible corrective action
	<ul style="list-style-type: none"> Surface or subsurface run-on from upslope catchment. 	<ul style="list-style-type: none"> Discuss with the system designer. Contact council. Avoid contact.
Damp areas or ponding of effluent on or immediately downslope of the EDS. Subsurface irrigation only.	<ul style="list-style-type: none"> EDS not constructed in accordance with design. Dripline type not anti-leakage. 	<ul style="list-style-type: none"> Discuss with the construction contractor. Contact council. Avoid contact.
	<ul style="list-style-type: none"> EDS not designed correctly for site with elevation differential >1.5 m (i.e., inadequate leakage management). 	<ul style="list-style-type: none"> Discuss with system designer. Contact council. Avoid contact.
Effluent observed inside valve boxes.	<ul style="list-style-type: none"> Damaged or leaking air, flush or zone valve (subsurface irrigation). Damaged or leaking flush or zone valve (surface irrigation). 	<ul style="list-style-type: none"> Repair or replace valve. Contact and discuss with the system servicing company (if applicable system).
Effluent dispersal systems – Mound system		
Effluent breakout from toe of downslope batter	<ul style="list-style-type: none"> Higher than normal effluent inflows due to change in occupancy or wastewater generating activities (temporary or permanent). 	<ul style="list-style-type: none"> Monitor to verify if cause is temporary or related to another cause. Investigate water usage to determine if related. Reduce water use or spread scheduling of activities if possible. Contact and discuss with a plumbing company experienced in OWMS.

Fault or malfunction	Possible cause or concern	Possible corrective action
		<ul style="list-style-type: none"> Contact council for advice.
	<ul style="list-style-type: none"> Weather conditions including elevated rainfall and/or cooler temperatures. 	<ul style="list-style-type: none"> Monitor to verify if cause is temporary and weather related or related to another cause.
	<ul style="list-style-type: none"> Stormwater impacts. 	<ul style="list-style-type: none"> Construct stormwater control measures upslope of mound. Inspect and maintain existing stormwater diversion drains.
Wet or boggy upslope mound toe	<ul style="list-style-type: none"> Surface or subsurface run-on from upslope catchment. 	<ul style="list-style-type: none"> Discuss with the system designer. Contact council. Avoid contact.
Irregular and patchy vegetation growth across the surface of the mound.	<ul style="list-style-type: none"> Inefficient and ineffective distribution of effluent within EDS. 	<ul style="list-style-type: none"> Ensure correct operation of pump. Contact and discuss with a plumbing company experienced in OWMS for possible repair to distribution system. Contact council for advice.
	<ul style="list-style-type: none"> Reduced effluent inflows. 	<ul style="list-style-type: none"> Monitor to verify if cause is temporary and weather related or related to another cause.
	<ul style="list-style-type: none"> Seasonal weather conditions (elevated temperatures/low rainfall). 	<ul style="list-style-type: none"> Monitor to verify if cause is temporary and weather related or related to another cause.

7.5 References to AS/NZS 1547:2012

References from AS/NZS 1547:2012 relevant to operation and maintenance activities are provided in Table 50.

Table 50: AS/NZS 1547:2012 References to operation and maintenance

Element	Section	Subsection	Page number
Operation and maintenance	Section 3 Roles and responsibilities	3.1 The regulatory authority	23
		3.6 Equipment manufacturers and suppliers	28
		3.7 Maintenance and desludging/pump-out contractors	28
		3.8 Property owners	29
		3.9 Estate agents and property transfer agents	29
	Section 4 Performance statements	4.2.5 Operation and maintenance	32
	Section 6 Construction, installation, operation and maintenance	6.3 Operation, maintenance and monitoring	62
	Section 7 Administrative guidance	7.1 Administration and management	68
		7.3 Advice and education	69
	Appendix A Risk management process guidelines	A3.2.6 Reduce risks	76
A4 Risk management examples including table A2		76	
Appendix T Operation and maintenance guidelines	All	196	

7.6 Legislative requirements

Mandatory maintenance, record keeping and reporting requirements apply to owners and operators of OWMS under Part 5.7 of the EP Regulations. The requirements are summarised in Table 51.

Table 51: Mandatory operation and maintenance requirements

Subject	Reference in regulation ¹⁰	Requirement
Operation and maintenance of an OWMS.	Regulation 159 (1)	<p>Operation</p> <p>A person in management or control of land on which an OWMS is located must take all reasonable steps to ensure the system is operated so as not to pose a risk of harm to human health or the environment.</p> <hr/> <p>Example</p> <p>Ensuring the system is not overloaded to an extent that causes a blockage, runoff, spillage or leak.</p>
	Regulation 159 (2)	<p>Maintenance</p> <p>A person (other than a renter within the meaning of the <i>Residential Tenancies Act 1997</i>) in management or control of land on which an OWMS is located must take all reasonable steps to ensure the system is maintained in good working order.</p> <hr/> <p>Examples</p> <ul style="list-style-type: none">• Regular desludging to remove the contents of the system.• Ensuring the integrity of pipes, tanks and storage systems.• Repairing and (when required) replacing all the components and fittings of the system.• Maintaining the biological and chemical processes integral to the proper functioning of the system.• Maintaining the integrity of the land used in connection with the system to ensure access to the system is not impeded.• Complying with the system manufacturer's specifications and recommendations (if provided).• Complying with any relevant council requirements.• Monitoring the system for signs of failure.

¹⁰ Victorian Environment Protection Regulation, Part 5.7.

Subject	Reference in regulation ¹⁰	Requirement
	Regulation 159 (3)	<p>Operation of a septic tank system</p> <p>A person in management or control of land on which a septic tank system is located must ensure the contents of the septic tank system do not overflow.</p>
Duty to provide information to the occupier about an OWMS	Regulation 160	<p>An owner of land on which an OWMS is located must provide to a person in management or control of the system, written information regarding the correct operation and maintenance of the system.</p>
Duty to notify council about the condition of an OWMS	Regulation 161 (2)	<p>A person in management or control of land on which an OWMS is located must notify the council in whose municipal district the system is located, as soon as practicable after the person becomes aware, or reasonably should have been aware, that the system poses a risk of harm to human health or the environment or is otherwise not in good working order.</p>
	Regulation 161 (3)	<p>Examples</p> <p>The following are examples when an OWMS poses a risk of harm to human health or the environment. The list should not be considered exhaustive.</p> <ul style="list-style-type: none"> • The absorption field of the system becomes sodden with wastewater pooling on the surface of the surrounding land. • There is wastewater runoff from the disposal area. • There is an odour of effluent emanating from or near the system. • The drain or toilet of the system is running slowly. • The grease trap of the system is full or blocked. • There are any other signs that indicate that the system poses a risk of harm to human health or the environment or is otherwise not in good working order.
	Regulation 161 (4)	<p>Risk management steps</p> <p>A notification under this regulation must include the steps the person has taken, or proposes to take, to ensure the system no longer poses a risk of harm to human health and the environment and is returned to good working order.</p>

Subject	Reference in regulation ¹⁰	Requirement
Duty to keep and provide maintenance records for an OWMS	Regulation 162 (1)	<p>Keeping records</p> <p>An owner of land on which an OWMS is located must keep and hold a record of all maintenance activities carried out on the system, including any pump-out and service records, for 5 years after each maintenance activity.</p>
	Regulation 162 (2)	<p>Inspection of records by council</p> <p>An owner of land on which an OWMS is located must make available for inspection on request by the council or the Authority any records kept under sub regulation (1).</p>

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Appendix 1. Example EDRS schematics

NOTES

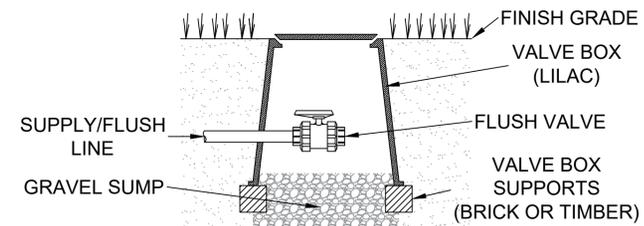
- DRIPLINE TO BE INSTALLED PARALLEL WITH SITE CONTOURS
- DRIPLINE TO BE INSTALLED 100 - 150 mm BELOW THE SURFACE, UNLESS OTHERWISE SPECIFIED IN DESIGN
- MAXIMUM RECOMMENDED ELEVATION HEAD OF 1 m BETWEEN THE TOP & BASE OF FIELD INCLUSIVE OF CROSSFALL. USE NON-RETURN VALVES, BACK PRESSURE CHECK VALVES OR ZONING WHERE 1 m HEAD IS EXCEEDED TO MINIMISE WEEPING
- NON-RETURN OR SUITABLE BACK PRESSURE CHECK VALVES ARE TO BE INSTALLED TO ENSURE LATERALS REMAIN CHARGED & PREVENT DRAIN-BACK TO TREATMENT SYSTEM OR LOWER ZONES
- FLUSH & AIR RELEASE VALVES TO BE HOUSED IN VALVE BOXES - SEE INSET

	FLUSH VALVE
	AIR RELEASE / VACUUM BREAK VALVE
	NON-RETURN VALVE
	FILTER SCREEN (125µm)
	SUPPLY LINE
	FLUSH LINE
	DRIPLINE LATERALS

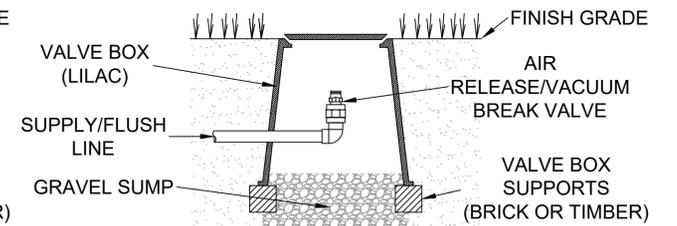
PLAN VIEW



CROSS SECTION OF FLUSH VALVE



CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



Example EDRS Schematics

00	25/11/22	FOR INFORMATION		HV (DWA)	HV (DWA)	BAA (DWA)	N/A				
REV	DATE	REVISION DESCRIPTION		DRAWN	DESIGNED	CHECKED	CLIENT APPROVED				

INSERT LOGO HERE

INSERT COPYRIGHT STATEMENT HERE

NOTES:
THIS DRAWING IS PROVIDED FOR GENERAL GUIDANCE ONLY.
EXACT CONSTRUCTION DETAILS TO BE DETERMINED BY THE DESIGNER &/OR CONSTRUCTION CONTRACTOR

EDS SYSTEM DRAWINGS:
SINGLE ZONE SUB-SURFACE IRRIGATION SPECIFICATION

DRAWING No.

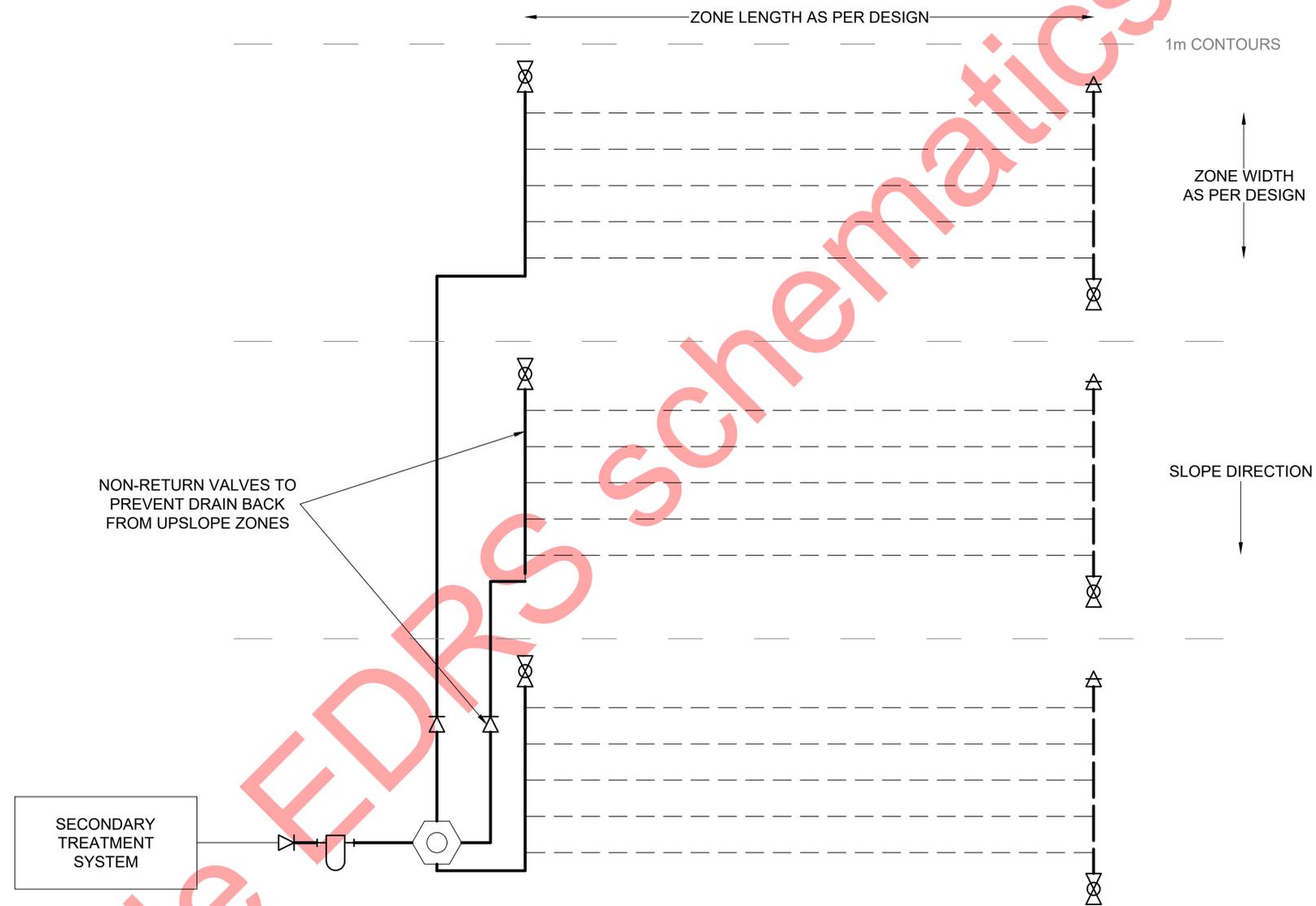
SCALE SHEET
NTS 1 of 1

A1

NOTES

- DRIPLINE TO BE INSTALLED PARALLEL WITH SITE CONTOURS
- DRIPLINE TO BE INSTALLED 100 - 150 mm BELOW THE SURFACE, UNLESS OTHERWISE SPECIFIED IN DESIGN
- MAXIMUM RECOMMENDED ELEVATION HEAD OF 1 m BETWEEN THE TOP & BASE OF FIELD INCLUSIVE OF CROSSFALL. USE NON-RETURN VALVES, BACK PRESSURE CHECK VALVES OR ZONING WHERE 1 m HEAD IS EXCEEDED TO MINIMISE WEEPING
- NON-RETURN OR SUITABLE BACK PRESSURE CHECK VALVES ARE TO BE INSTALLED TO ENSURE LATERALS REMAIN CHARGED & PREVENT DRAIN-BACK TO TREATMENT SYSTEM OR LOWER ZONES
- FLUSH & AIR RELEASE VALVES TO BE HOUSED IN VALVE BOXES - SEE INSET

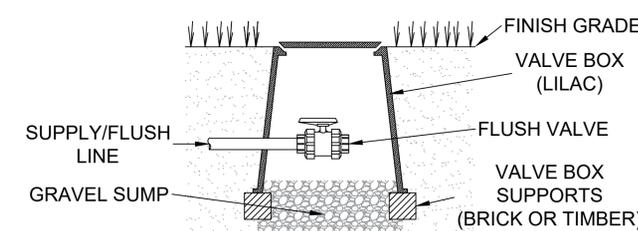
PLAN VIEW



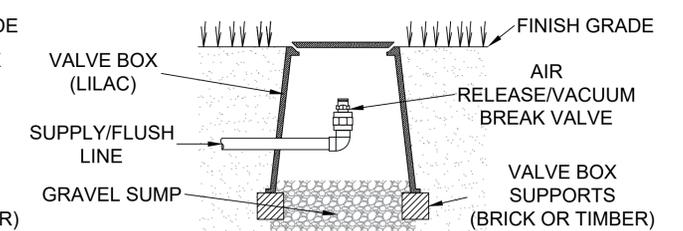
	FLUSH VALVE
	AIR RELEASE / VACUUM BREAK VALVE
	NON-RETURN VALVE
	AUTOMATIC ZONE SELECTION VALVE
	FILTER SCREEN (125 µm)
	SUPPLY LINE
	FLUSH LINE
	DRIPLINE LATERALS

NON-RETURN VALVES TO PREVENT DRAIN BACK FROM UPSLOPE ZONES

CROSS SECTION OF FLUSH VALVE



CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



Example ED RS Schematics

00	25/11/22	FOR INFORMATION	HV (DWA)	HV (DWA)	BAA (DWA)	N/A
REV	DATE	REVISION DESCRIPTION	DRAWN	DESIGNED	CHECKED	CLIENT APPROVED

INSERT LOGO HERE

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EDS SYSTEM DRAWINGS:
MULTIPLE ZONE SUB-SURFACE IRRIGATION SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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NOTES

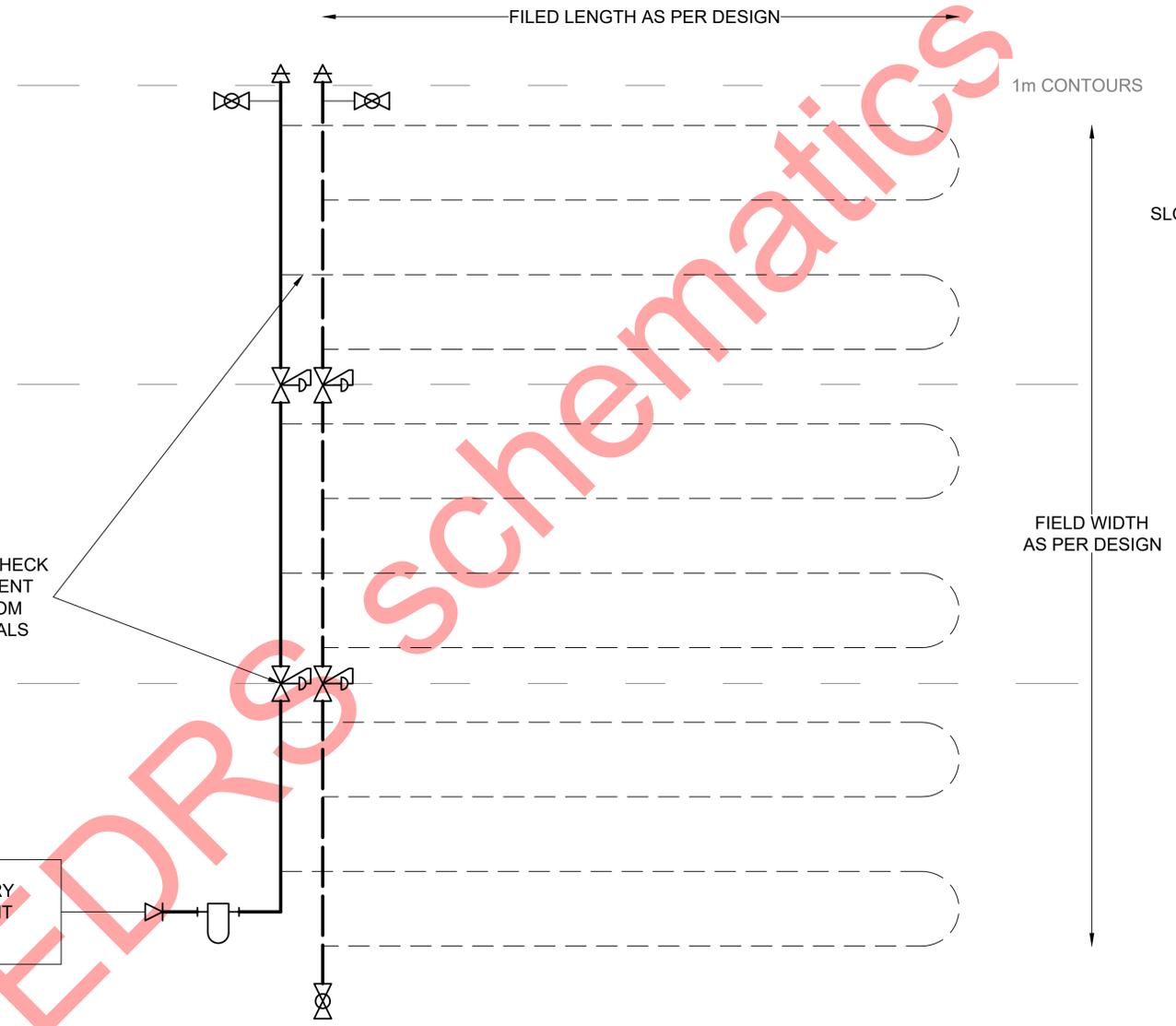
- DRIPLINE TO BE INSTALLED PARALLEL WITH SITE CONTOURS
- DRIPLINE TO BE INSTALLED 100 - 150 mm BELOW THE SURFACE, UNLESS OTHERWISE SPECIFIED IN DESIGN
- MAXIMUM RECOMMENDED ELEVATION HEAD OF 1 m BETWEEN THE TOP & BASE OF FIELD INCLUSIVE OF CROSSFALL. USE NON-RETURN VALVES, BACK PRESSURE CHECK VALVES OR ZONING WHERE 1 m HEAD IS EXCEEDED TO MINIMISE WEEPING
- NON-RETURN OR SUITABLE BACK PRESSURE CHECK VALVES ARE TO BE INSTALLED TO ENSURE LATERALS REMAIN CHARGED & PREVENT DRAIN-BACK TO TREATMENT SYSTEM OR LOWER ZONES
- FLUSH & AIR RELEASE VALVES TO BE HOUSED IN VALVE BOXES - SEE INSET

	FLUSH VALVE
	AIR RELEASE / VACUUM BREAK VALVE
	NON-RETURN VALVE
	BACK PRESSURE CHECK VALVE
	FILTER SCREEN (125µm)
	SUPPLY LINE
	FLUSH LINE
	DRIPLINE LATERALS

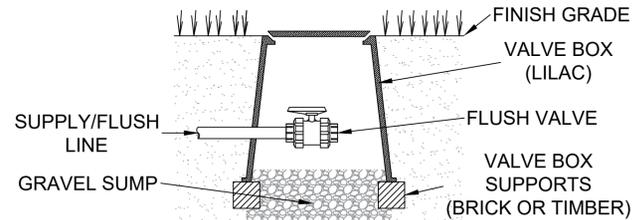
BACK-PRESSURE CHECK VALVES TO PREVENT DRAIN BACK FROM UPSLOPE LATERALS

SECONDARY TREATMENT SYSTEM

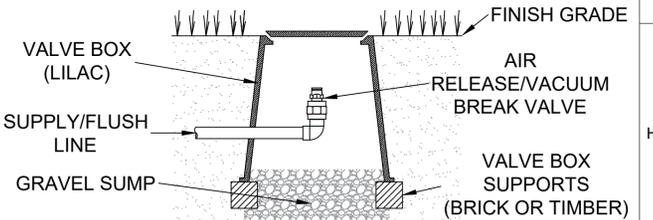
PLAN VIEW



CROSS SECTION OF FLUSH VALVE



CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



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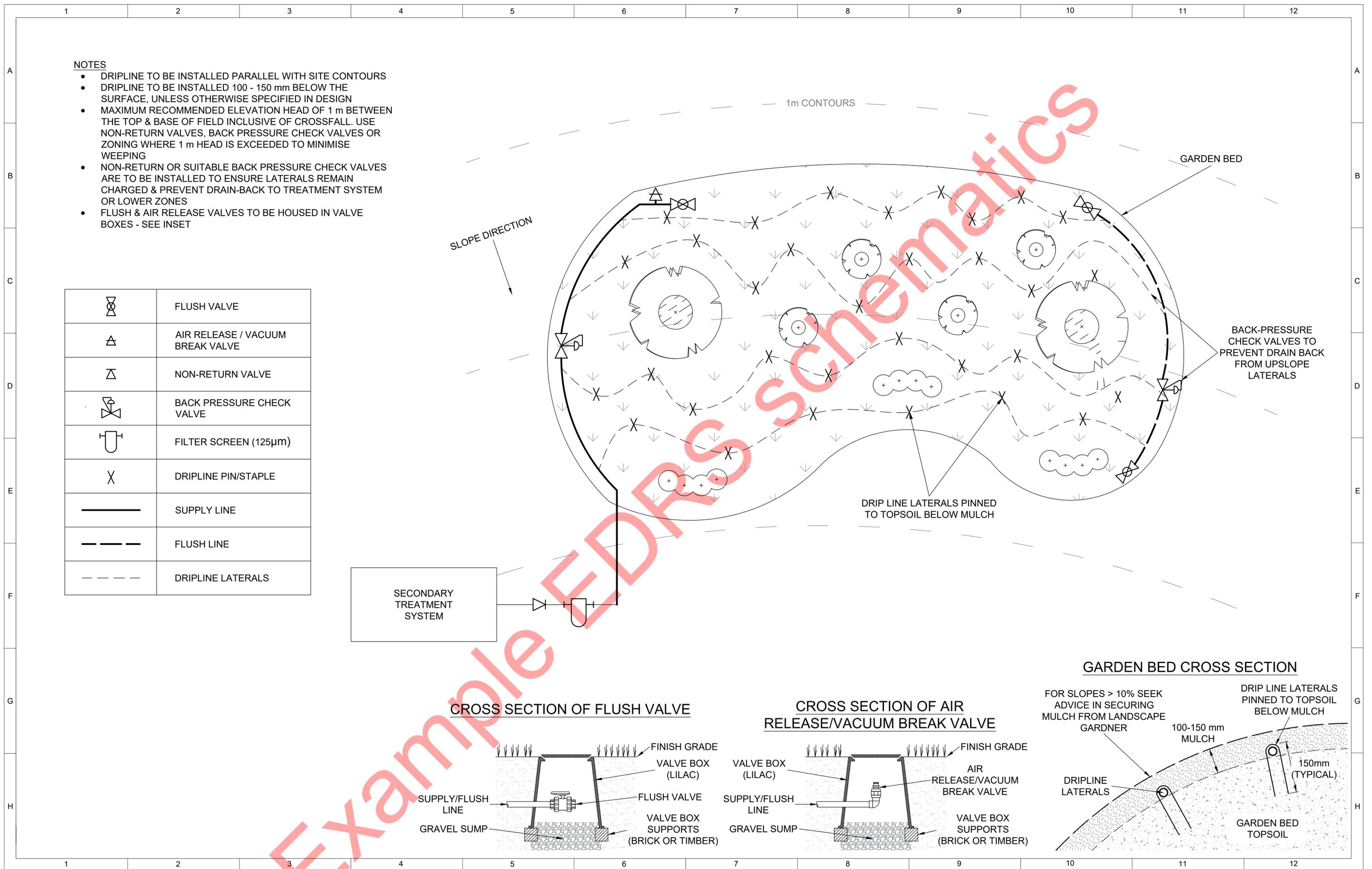
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EDS SYSTEM DRAWINGS:
LOOPED SUB-SURFACE IRRIGATION SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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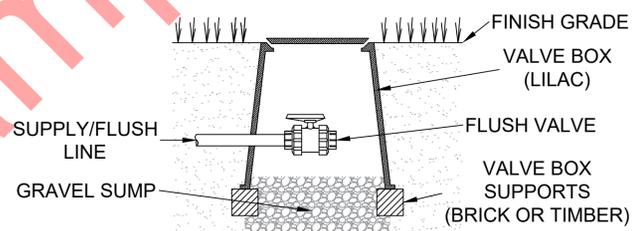


- NOTES**
- DRIPLINE TO BE INSTALLED PARALLEL WITH SITE CONTOURS
 - DRIPLINE TO BE INSTALLED 100 - 150 mm BELOW THE SURFACE, UNLESS OTHERWISE SPECIFIED IN DESIGN
 - MAXIMUM RECOMMENDED ELEVATION HEAD OF 1 m BETWEEN THE TOP & BASE OF FIELD INCLUSIVE OF CROSSFALL. USE NON-RETURN VALVES, BACK PRESSURE CHECK VALVES OR ZONING WHERE 1 m HEAD IS EXCEEDED TO MINIMISE WEEPING
 - NON-RETURN OR SUITABLE BACK PRESSURE CHECK VALVES ARE TO BE INSTALLED TO ENSURE LATERALS REMAIN CHARGED & PREVENT DRAIN-BACK TO TREATMENT SYSTEM OR LOWER ZONES
 - FLUSH & AIR RELEASE VALVES TO BE HOUSED IN VALVE BOXES - SEE INSET

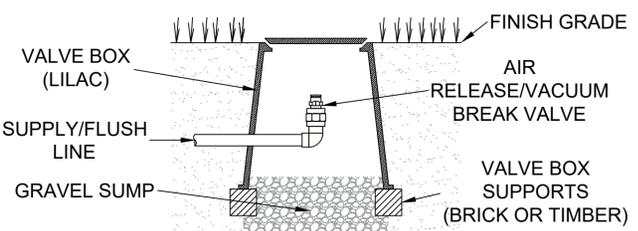
	FLUSH VALVE
	AIR RELEASE / VACUUM BREAK VALVE
	NON-RETURN VALVE
	BACK PRESSURE CHECK VALVE
	FILTER SCREEN (125µm)
	DRIPLINE PIN/STAPLE
	SUPPLY LINE
	FLUSH LINE
	DRIPLINE LATERALS



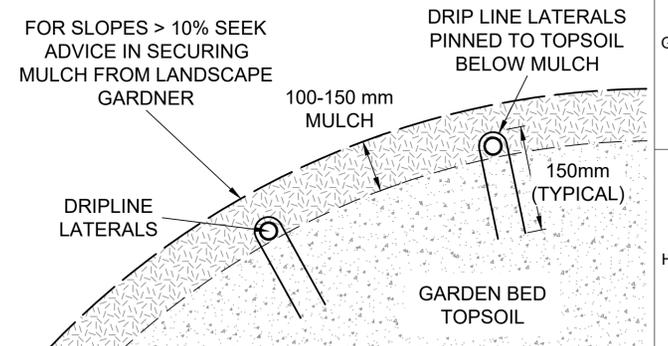
CROSS SECTION OF FLUSH VALVE



CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



GARDEN BED CROSS SECTION



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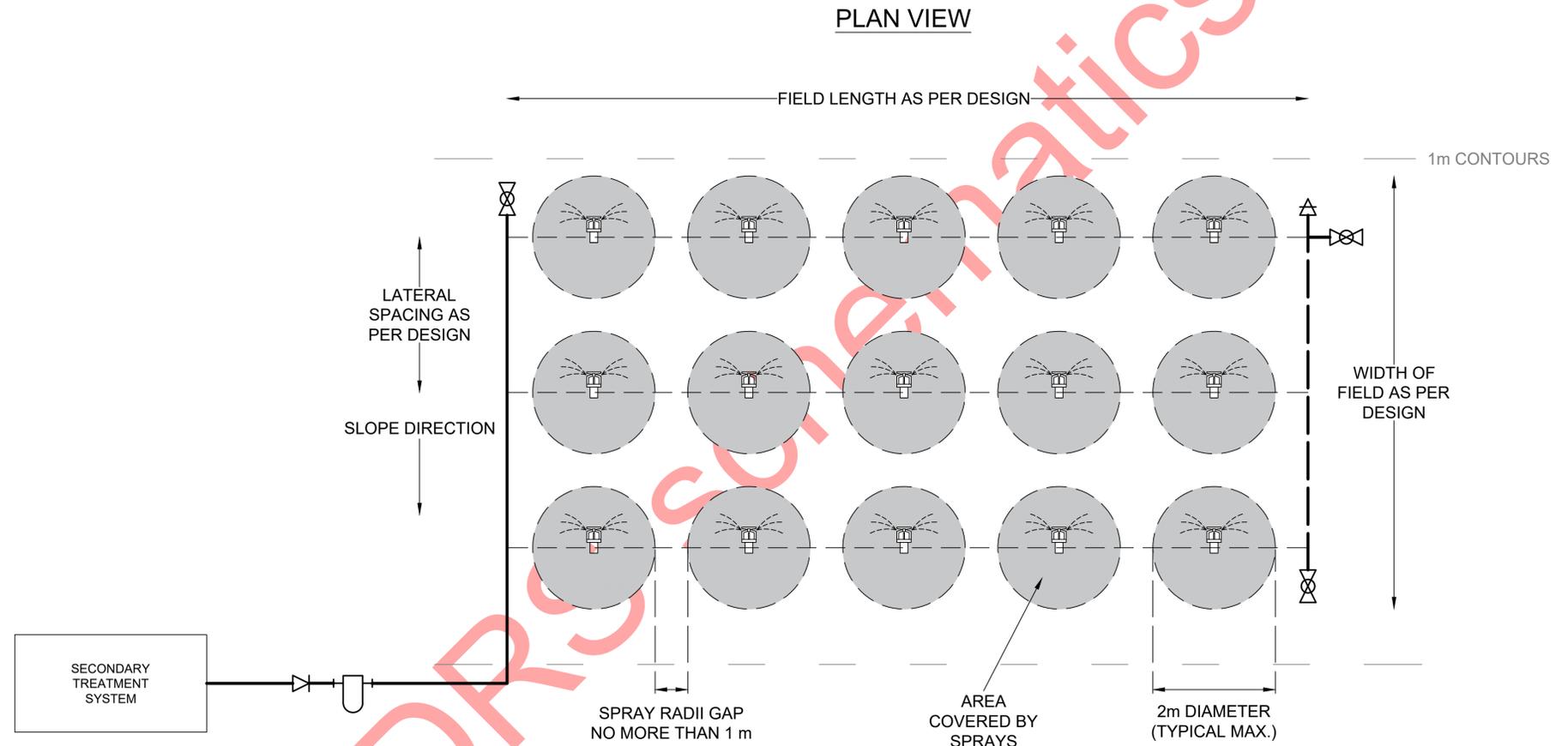
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EDS SYSTEM DRAWINGS: SUB-SURFACE IRRIGATION IN GARDEN BED SPECIFICATION			
DRAWING No.	SCALE NTS	SHEET 1 of 1	A1

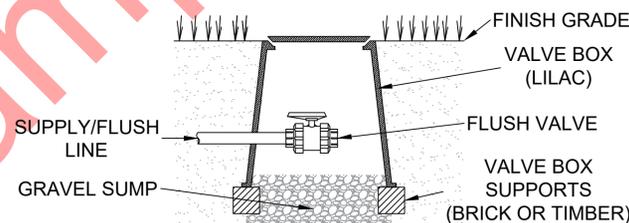
NOTES

- IRRIGATION LATERALS TO BE INSTALLED PARALLEL WITH SITE CONTOURS
- IRRIGATION LATERALS TO BE INSTALLED 100 - 150 mm BELOW THE SURFACE
- SURFACE SPRAYS ARE TO BE MOUNTED NO HIGHER THAN 500 mm ABOVE GROUND SURFACE
- MAXIMUM RECOMMENDED ELEVATION HEAD OF 1 m BETWEEN THE TOP & BASE OF FIELD INCLUSIVE OF CROSSFALL. USE NON-RETURN VALVES, BACK PRESSURE CHECK VALVES OR ZONING WHERE 1 m HEAD IS EXCEEDED TO MINIMISE WEEPING
- NON-RETURN OR SUITABLE BACK PRESSURE CHECK VALVES ARE TO BE INSTALLED TO ENSURE LATERALS REMAIN CHARGED & PREVENT DRAIN-BACK TO TREATMENT SYSTEM OR LOWER ZONES
- FLUSH & AIR RELEASE VALVES TO BE HOUSED IN VALVE BOXES - SEE INSET

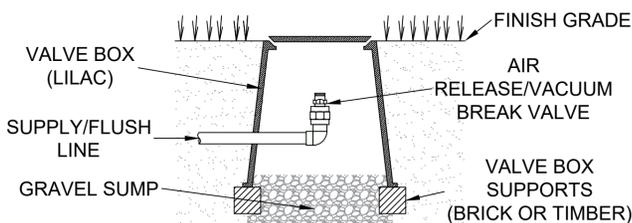
	FLUSH VALVE
	AIR RELEASE / VACUUM BREAK VALVE
	NON-RETURN VALVE
	LARGE DROPLET SPRAY
	FILTER SCREEN (125µm)
	SUPPLY LINE
	FLUSH LINE
	IRRIGATION LATERALS



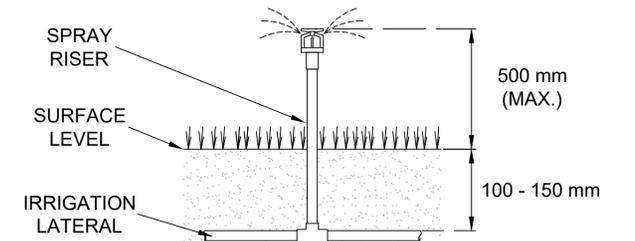
CROSS SECTION OF FLUSH VALVE



CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



CROSS SECTION OF LATERAL & SPRAY RISER



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EDS SYSTEM DRAWINGS:
SURFACE SPRAY IRRIGATION SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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	1	2	3	4	5	6	7	8	9	10	11	12
A	CONSTRUCTION GUIDE			deburred) at the nominated centres facing upward. Each LPED lateral shall be fitted with a 90 mm slotted PVC or agricultural pipe. Note: the squirt height must be tested prior to covering with the outer pipe. (AS/NZS 1547 L8, L6.1.2, L6.1.3)			CHECKS & INSPECTIONS'			COMMISSIONING GUIDE		
B	PRE-CONSTRUCTION CONSIDERATIONS			GRAVEL			COMMENCEMENT OF WORKS			PRE-COMMISSIONING		
C	SERVICES LOCATION			Distribution aggregate should be carefully placed into the beds to avoid damage to the base, sidewalls & pipework. gravel is generally clean 20 - 40 mm aggregate. (AS/NZS 1547 L7.3)			Prior to commencement of any works, ensure works are approved & copy of councils permit is available.			Check that inspections of the eds have been completed in accordance with the permit conditions. (AS/NZS 1547 6.2.5)		
D	It is recommended that a services location check be performed to ensure that construction works will not impact on underground services such as water, gas, power, & communications.			FILTER CLOTH (GEOTEXTILE FABRIC)			VEGETATION REMOVAL			AS/NZS 1547 advises that the following pre-commissioning tests are to be carried out after all on-site components including the pump have been installed, but prior to covering laterals (see also AS/NZS1547 6.2.5). As a minimum the test shall take the following steps: • Fill the pump chamber to 'pump-on' level with water • Start the pump • Checking the LPED manifold to ensure uniformity in distribution (+15% variation). • Checking the pipework for leaks. • Testing the high-water level alarm. • Follow pump manufacturer's recommendations for commissioning pump (AS/NZS 1547 Appendix L, L10)		
E	VEGETATION REMOVAL			Filter cloth can be a synthetic non-woven polyester fabric suitable for civil construction. A typical fabric grade is A12 (120 GSM) which has a pore size (095) of 130 µm. Note: filter cloth should not be placed beneath distribution pipes/arches as it can form a clogging layer. (AS/NZS 1547 N3.3.6)			Ensure necessary approvals for vegetation removal have been obtained & a copy of the approval is available. Arrange inspections as required in accordance with approval.					
F	Undertake vegetation removal in accordance with the approved design having regard to a vegetation removal approval that may be required from the local council. (AS/NZS 1547 Section 6)			TOPSOIL COVER			SITE CIVIL WORKS					
G	SOIL IMPROVEMENT & CIVIL WORKS			Beds must not be covered with an impermeable layer. Soil cover is generally 150 mm unless otherwise stated in the design. (AS/NZS 1547 L7.3)			Ensure necessary approvals for proposed site works have been obtained & a copy of the approval is available. Arrange inspections in accordance with permit or other approvals.					
H	Undertake soil improvement & civil works in accordance with the approved design. Arrange inspection by the local council or designer if required to do so. (AS/NZS 1547 Section 6)			VEGETATION			SOIL IMPROVEMENT WORKS			COMMISSIONING		
	WEATHER			A suitable grass cover should be established as soon as possible after completion of construction works. The vegetation should be maintained & carefully irrigated until established. (AS/NZS 1547, L3)			arrange inspections in accordance with permit.			AS/NZS 1547 advises that the on-site system shall be inspected, checked, & commissioned according to 6.2.5		
	The weather conditions should be considered prior to commencement of civil works. Excavation work during poor weather conditions can result in unnecessary damage to the EDS & work site.			UPSLOPE SURFACE WATER/SUBSURFACE CONTROLS			CONSTRUCTION STAGE			Verify that construction of the EDS aligns with the permit conditions & the approved design.		
	SEDIMENT & EROSION CONTROL			Construct surface water &/or subsurface diversion drains upslope of the beds where there is potential for water impacts. (AS 1547 L5.4)			Check that the location & dimensions of the EDS aligns with the permit & approved site plan.			Complete inspection & commissioning requirements in accordance with the permit conditions.		
	Evaluate potential for sediment & erosion impacts associated with the work site & implement suitable control measures as required.			MARKING			Verify that the type of dripline is in accordance with the design.			Provide copies of the inspection & commissioning reports to the property owner & local council. (AS/NZS 1547 Appendix L, L11)		
	EDS DESIGN CHANGES			The presence of buried pipes shall: • Be indicated, for example, using underground marking tape to AS/NZS 2648.1; OR • Be indicated by signage, prominently displayed with the words: 'sewage effluent pipework installed below. do not dig.'			Verify that the type & capacity of pump is as designed (if installed).					
	Alteration to the design of the effluent dispersal system must be approved by the designer & the local council. (AS/NZS 1547 M7.2, T5.2.2)						Perform a hydraulic check on pumped systems by operating the pump. This is to determine effective operation, compliance with hydraulic specifications & to detect any leaks in joints & connections (refer pre-commissioning checks below). If a permanent power supply is not available, a temporary supply may be required.					
	CONSTRUCTION CONSIDERATIONS						POST CONSTRUCTION					
	SITE PROTECTION & PREPARATION						Arrange inspections in accordance with permit or other approval.					
	Excavations should only take place during fine weather & avoid excavation when the soil has a moisture content above the plastic limit. If rain is forecast then cover any open trenches, to protect them from rain damage. Smear soil surfaces can be improved by 'raking' to reinstate a more natural soil surface. Avoid compaction by keeping people off the finished trench or bed floor. Excavate perpendicular to the line of fall or parallel to the contour of sloping ground & ensure that the inverts are horizontal. (AS/NZS 1547, L7)											
	PIPEWORK INCLUDING LPED DOSING MANIFOLD											
	Pipes & fittings must: • Comply with AS2439.2, AS2698.2, AS/NZS4129, AS/NZS413 OR AS/NZS1477. • Be an approved type of system, material, diameter, perforation size, spacing & location. Distribution pipe shall be slotted or drilled of a suitable size & number. Pre-formed arches shall be slotted along the lower portion of the arch. LPED manifold design & construction: • The pressurised dosing manifold shall consist of 25 mm PVC pipe PN12 with 3 mm holes drilled (&											

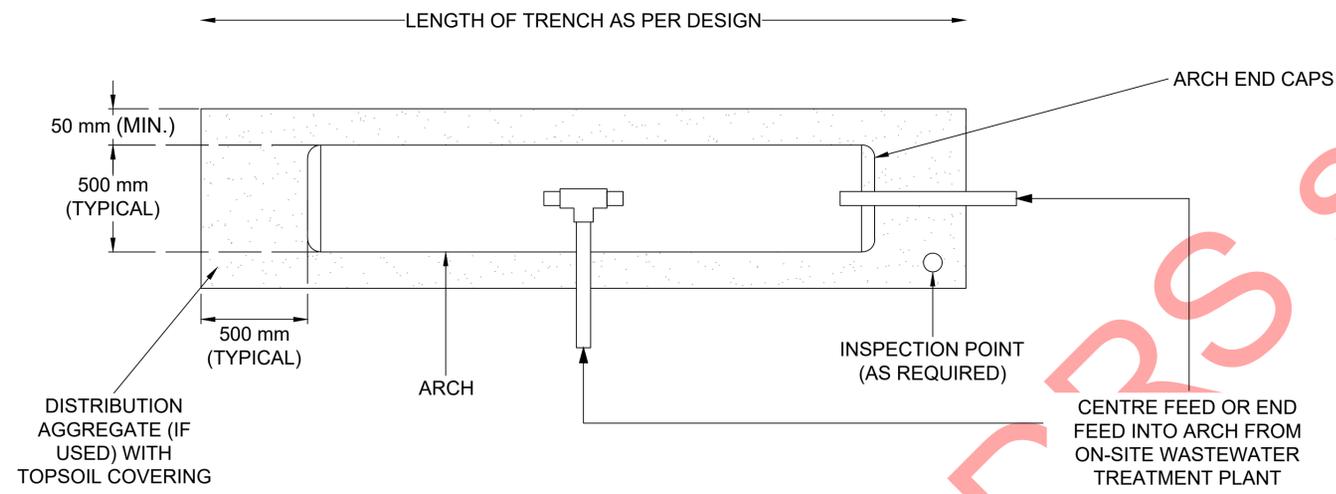
Example EDRS Schematics

								INSERT COPYRIGHT STATEMENT HERE	NOTES: THIS DRAWING IS PROVIDED FOR GENERAL GUIDANCE ONLY. EXACT CONSTRUCTION DETAILS TO BE DETERMINED BY THE DESIGNER &/OR CONSTRUCTION CONTRACTOR			
								INSERT LOGO HERE	EDS SYSTEM DRAWINGS: TRENCH & BED CONSTRUCTION & COMMISSIONING SPECIFICATION PAGE			
01	07/11/23	FOR INFORMATION	HV (DWA)	HV (DWA)	BAA (DWA)	N/A						
REV	DATE	REVISION DESCRIPTION	DRAWN	DESIGNED	CHECKED	CLIENT APPROVED				SCALE	SHEET	A1
										1 of 1		

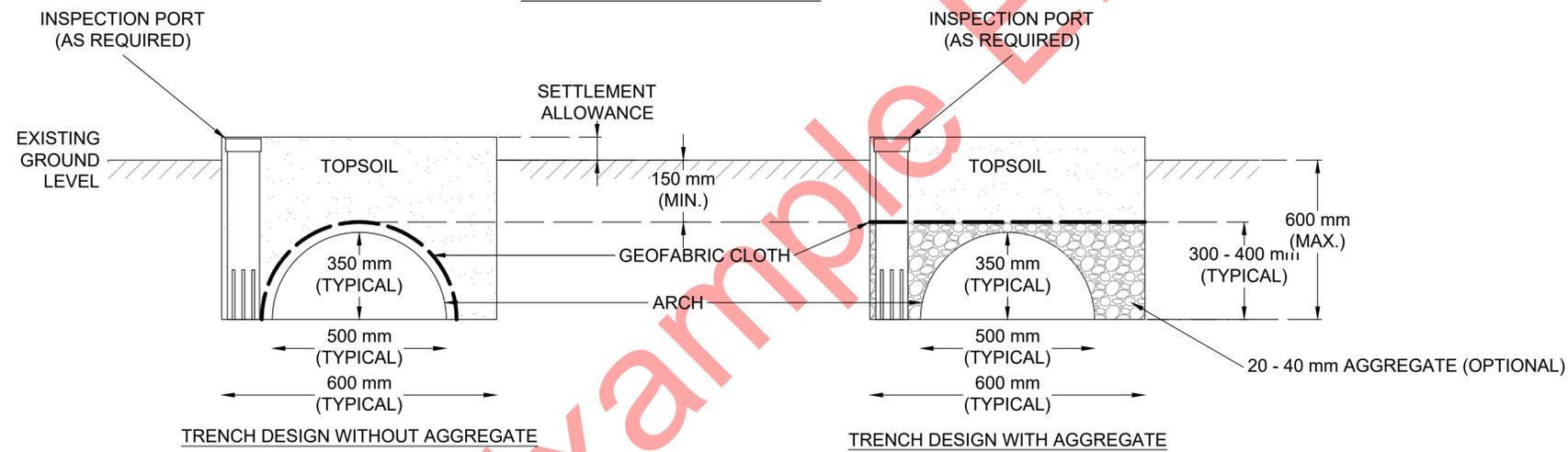
NOTES

- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- SMALLER ARCH (230 mm) IS AVAILABLE FOR SHALLOW TRENCHES WHERE REQUIRED TO ACHIEVE ADEQUATE VERTICAL SEPARATION.
- INSPECTION PORT TO BE INSTALLED ON THE DOWNSLOPE SIDE OF TRENCH: TO CONSIST OF 50 mm PVC SLOTTED AT THE BASE. TO BE FINISHED AT OR JUST BELOW SURFACE LEVEL WITH REMOVABLE CAP
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)

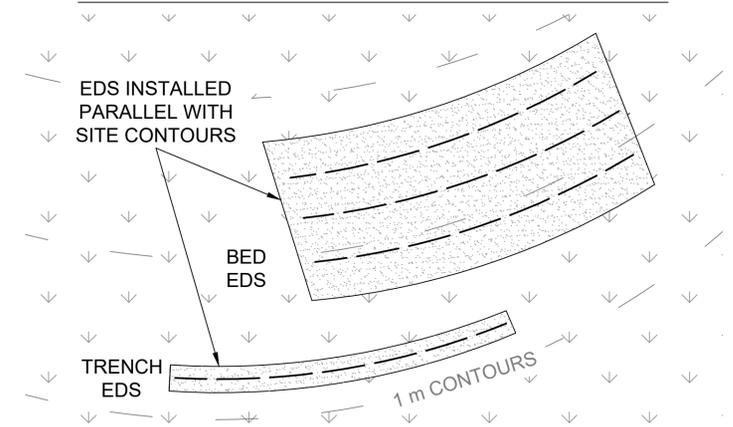
PLAN VIEW



CROSS SECTION VIEW



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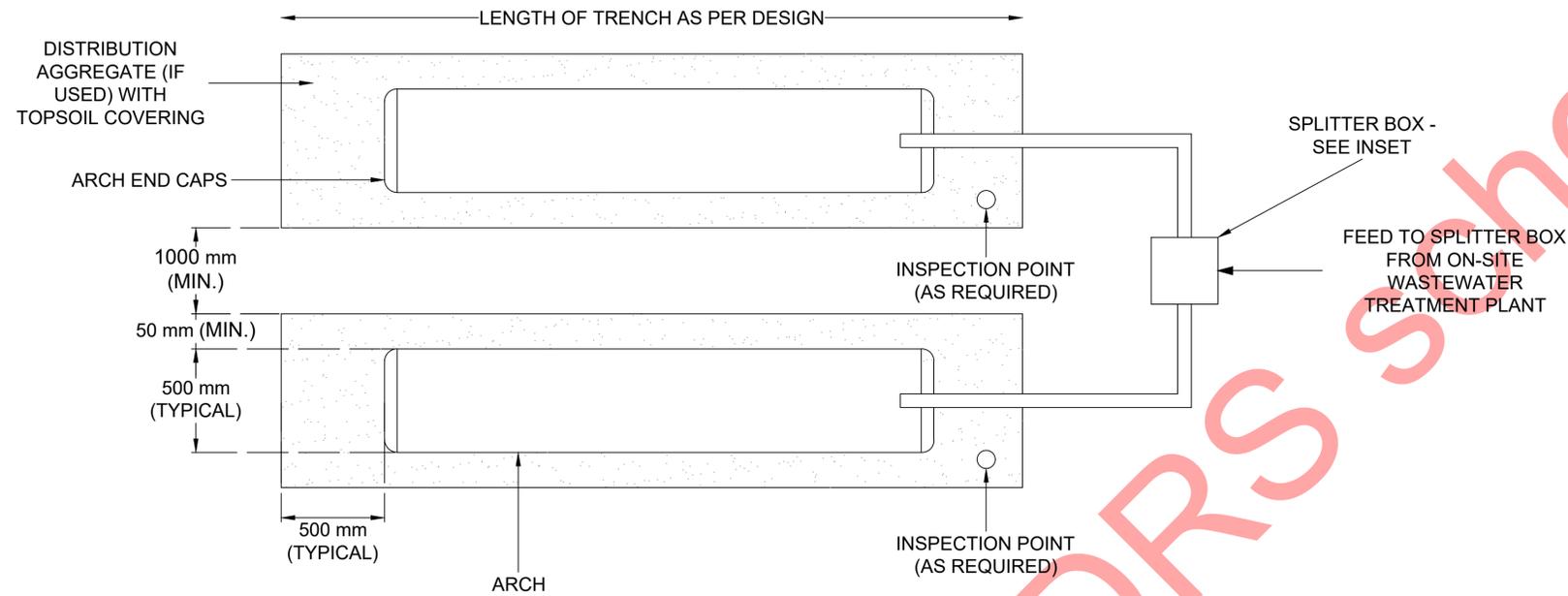
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EDS SYSTEM DRAWINGS: ARCH IN TRENCH SPECIFICATION			
DRAWING No.	SCALE NTS	SHEET 1 of 1	A1

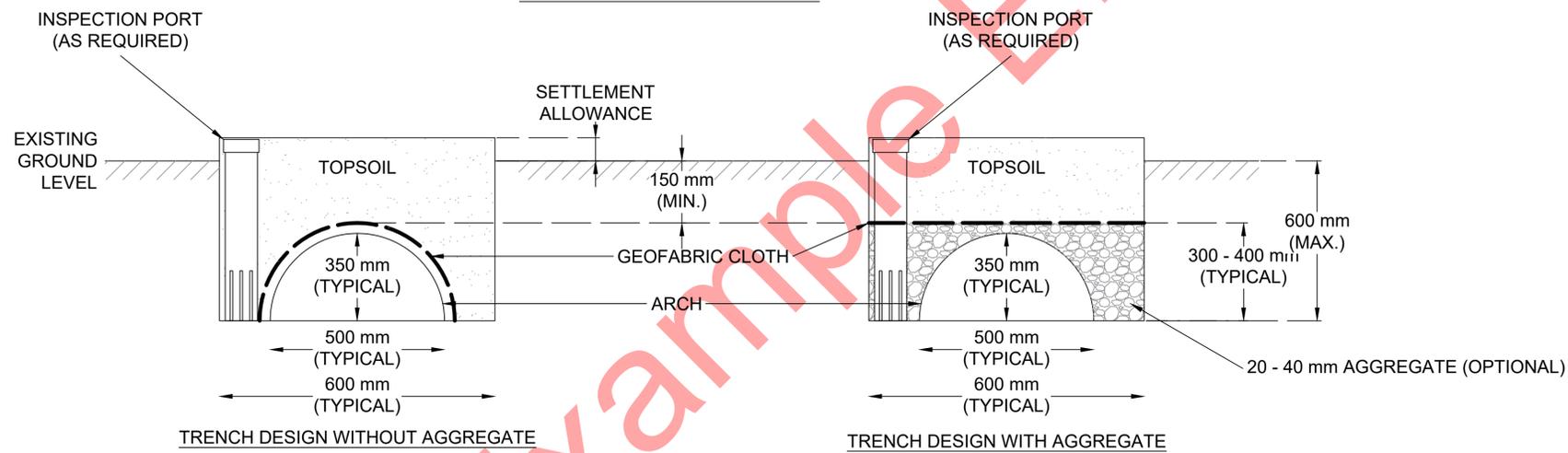
NOTES

- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- SMALLER ARCH (230 mm) IS AVAILABLE FOR SHALLOW TRENCHES WHERE REQUIRED TO ACHIEVE ADEQUATE VERTICAL SEPARATION.
- INSPECTION PORT TO BE INSTALLED ON THE DOWNSLOPE SIDE OF TRENCH: TO CONSIST OF 50 mm PVC SLOTTED AT THE BASE. TO BE FINISHED AT OR JUST BELOW SURFACE LEVEL WITH REMOVABLE CAP
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)

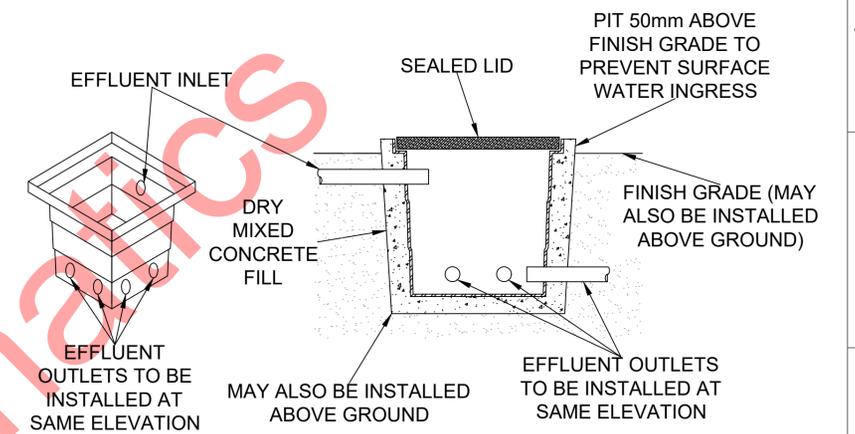
PLAN VIEW



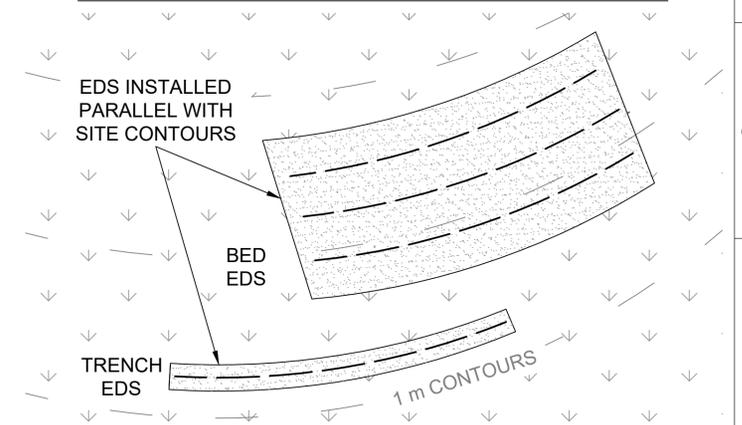
CROSS SECTION VIEW



SPLITTER BOX DETAIL



EDS INSTALLED PARALLEL TO CONTOUR



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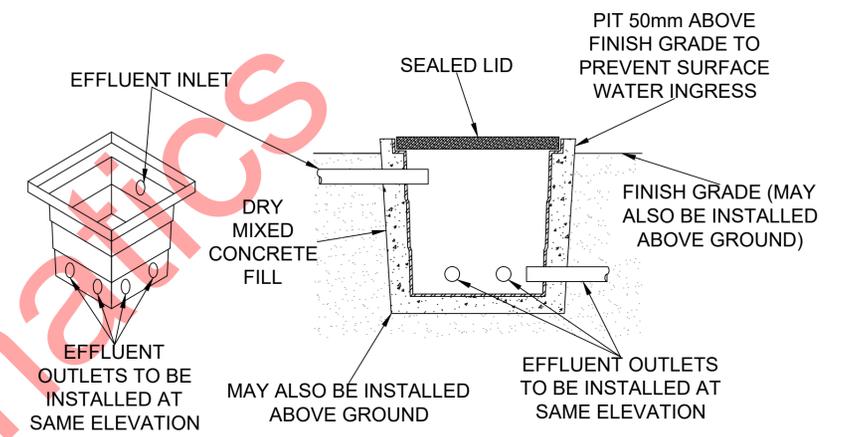
EDS SYSTEM DRAWINGS:			
ARCH IN MULTIPLE TRENCH SPECIFICATION			
DRAWING No.	SCALE NTS	SHEET 1 of 1	A1

NOTES

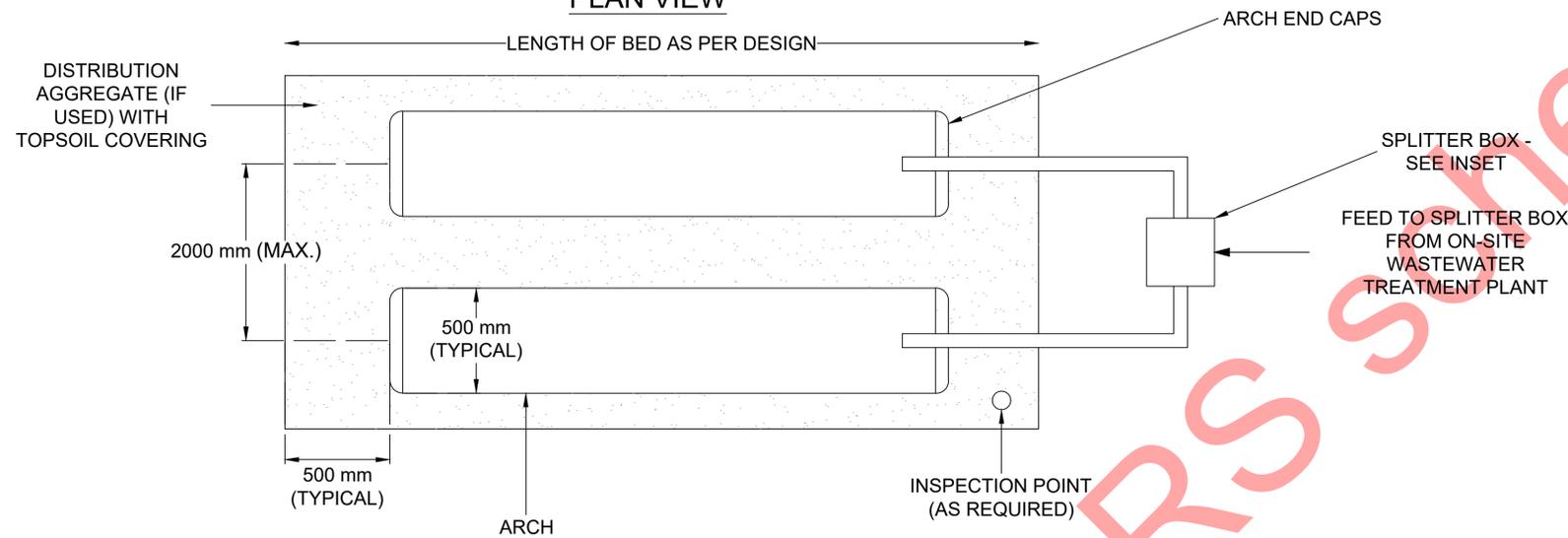
- BASE OF BED MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- SMALLER ARCH (230 mm) IS AVAILABLE FOR SHALLOW TRENCHES WHERE REQUIRED TO ACHIEVE ADEQUATE VERTICAL SEPARATION.
- INSPECTION PORT TO BE INSTALLED ON THE DOWNSLOPE SIDE OF TRENCH: TO CONSIST OF 50 mm PVC SLOTTED AT THE BASE. TO BE FINISHED AT OR JUST BELOW SURFACE LEVEL WITH REMOVABLE CAP
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- MAXIMUM BED WIDTHS WILL BE INFLUENCED BY THE

- SITE TOPOGRAPHY TO ENSURE A LEVEL BASE & VERTICAL SEPARATION REQUIREMENTS.
- WIDER BEDS WILL REQUIRE ADDITIONAL SLOTTED PIPE LATERALS.

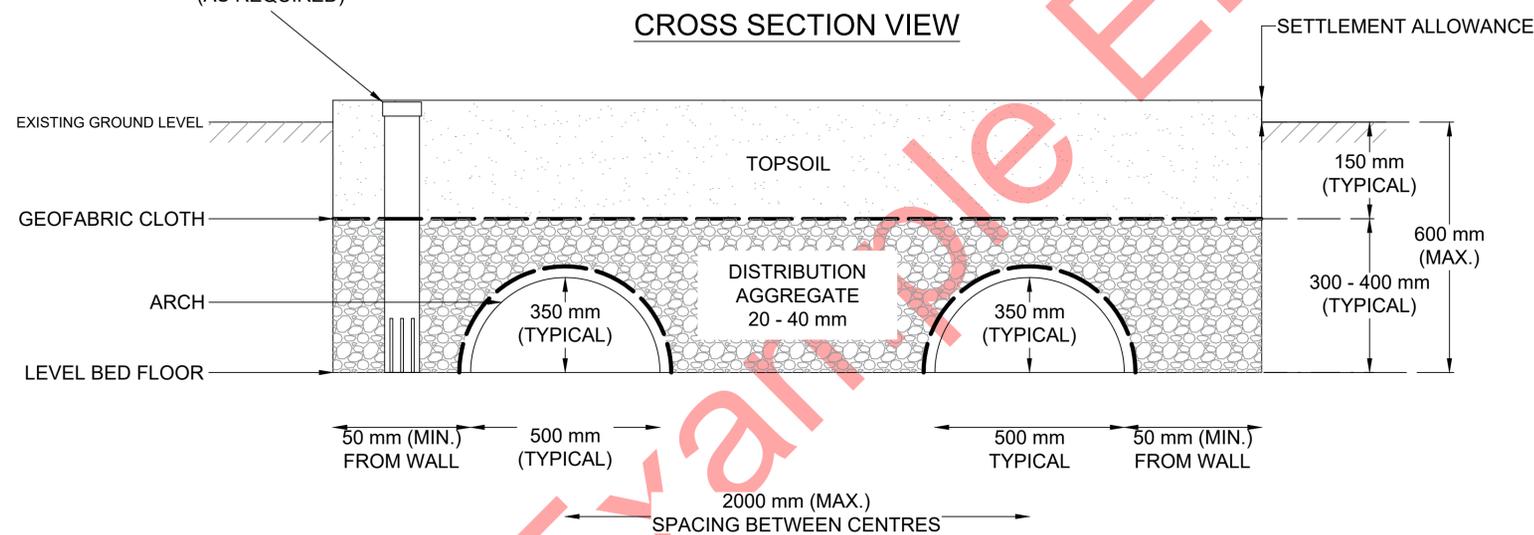
SPLITTER BOX DETAIL



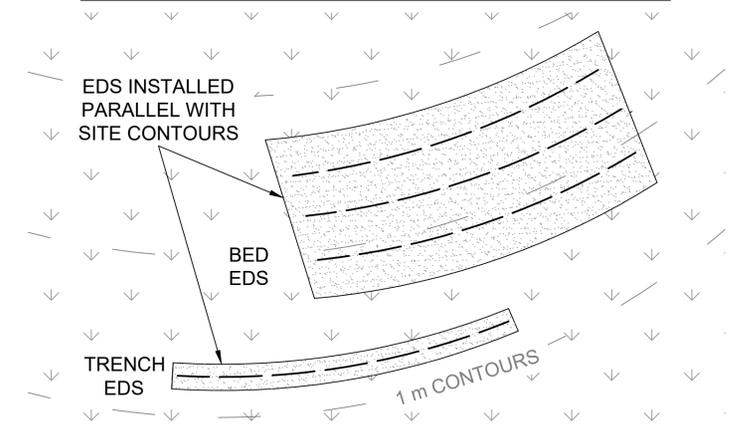
PLAN VIEW



CROSS SECTION VIEW



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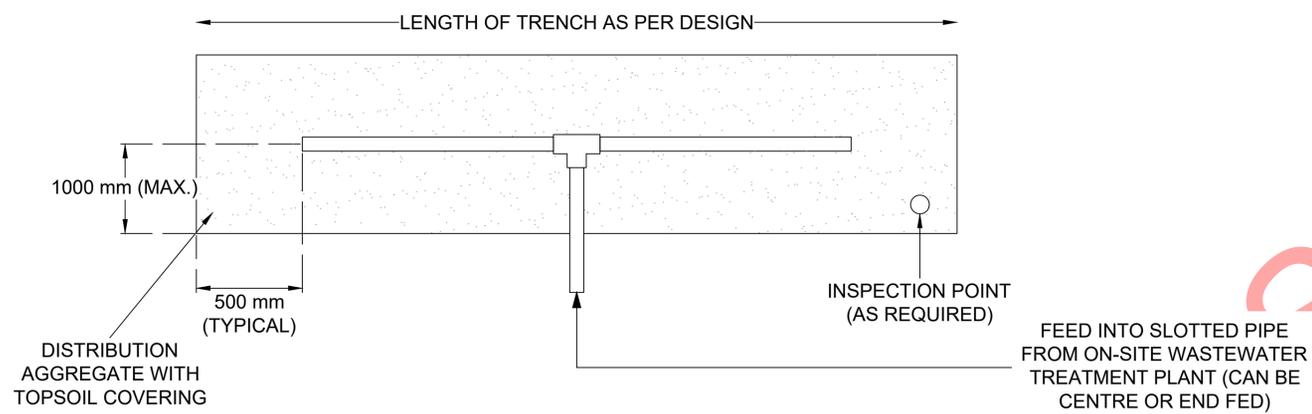
EDS SYSTEM DRAWINGS:
ARCH IN BED SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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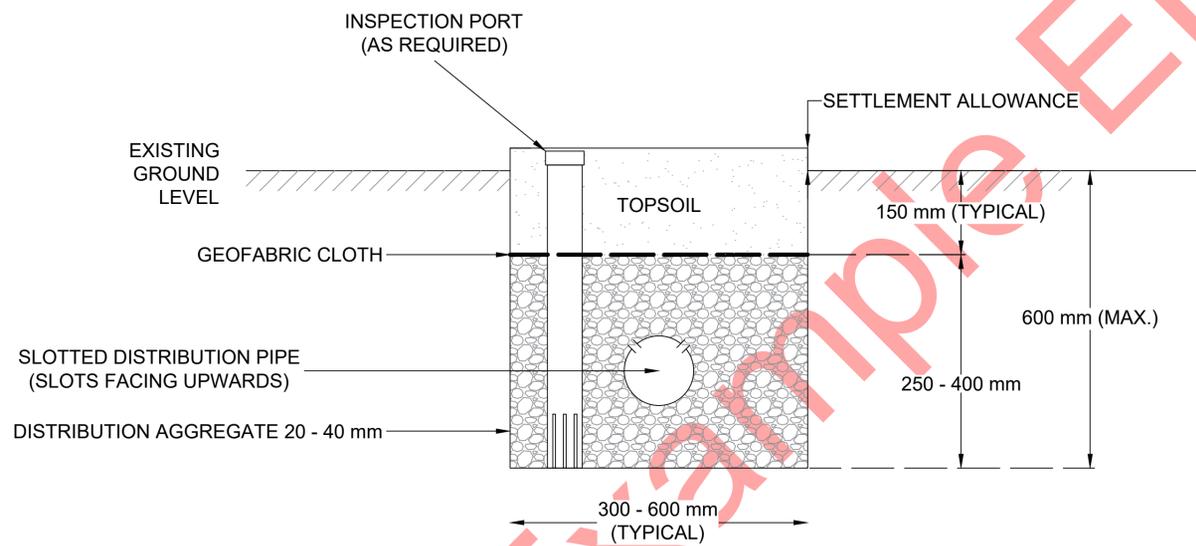
NOTES

- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)

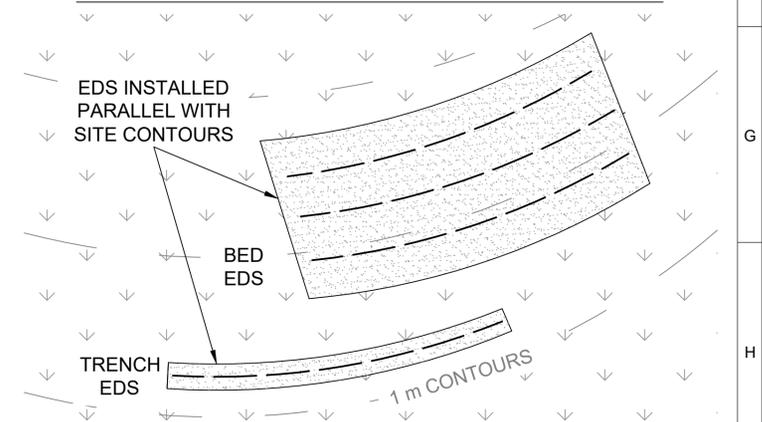
PLAN VIEW



CROSS SECTION VIEW



EDS INSTALLED PARALLEL TO CONTOUR



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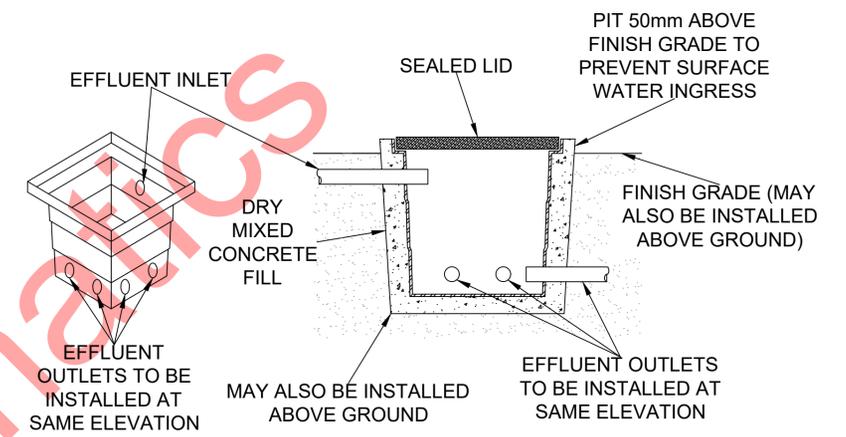
EDS SYSTEM DRAWINGS:
SLOTTED PIPE IN TRENCH SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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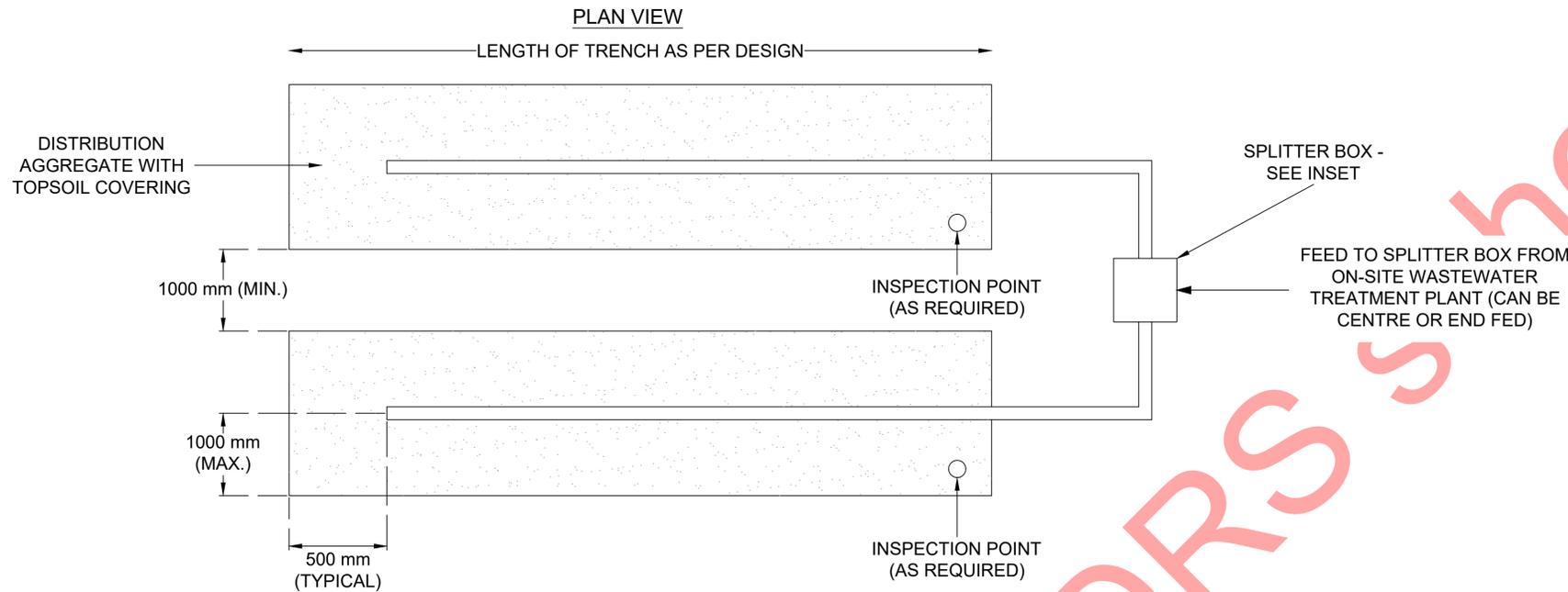
NOTES

- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)

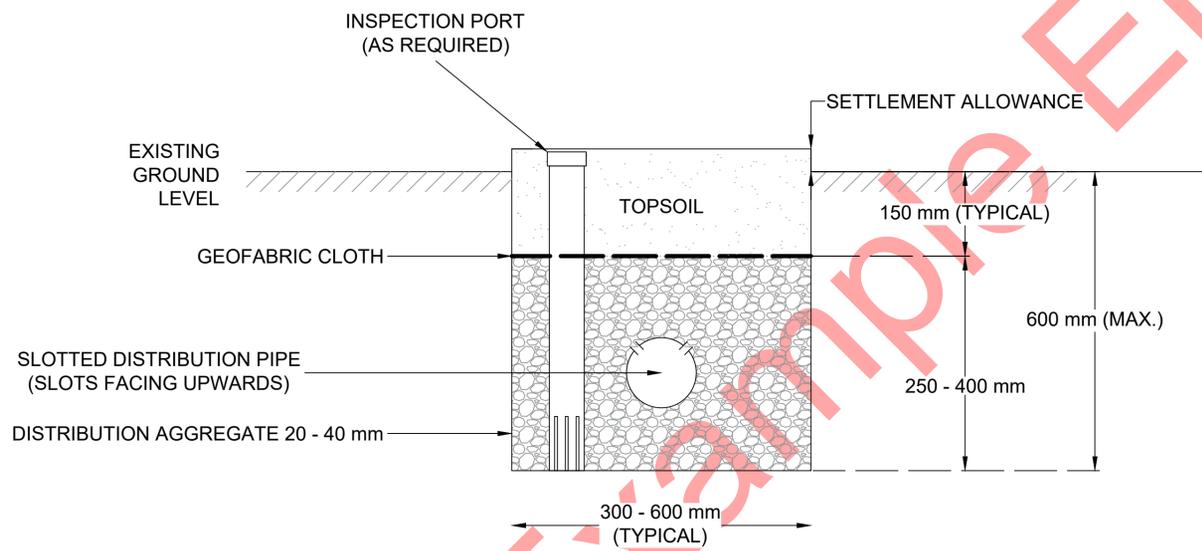
SPLITTER BOX DETAIL



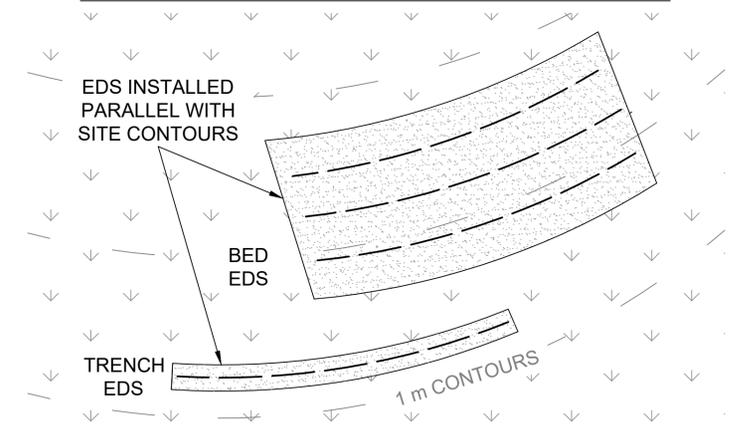
PLAN VIEW



CROSS SECTION VIEW



EDS INSTALLED PARALLEL TO CONTOUR



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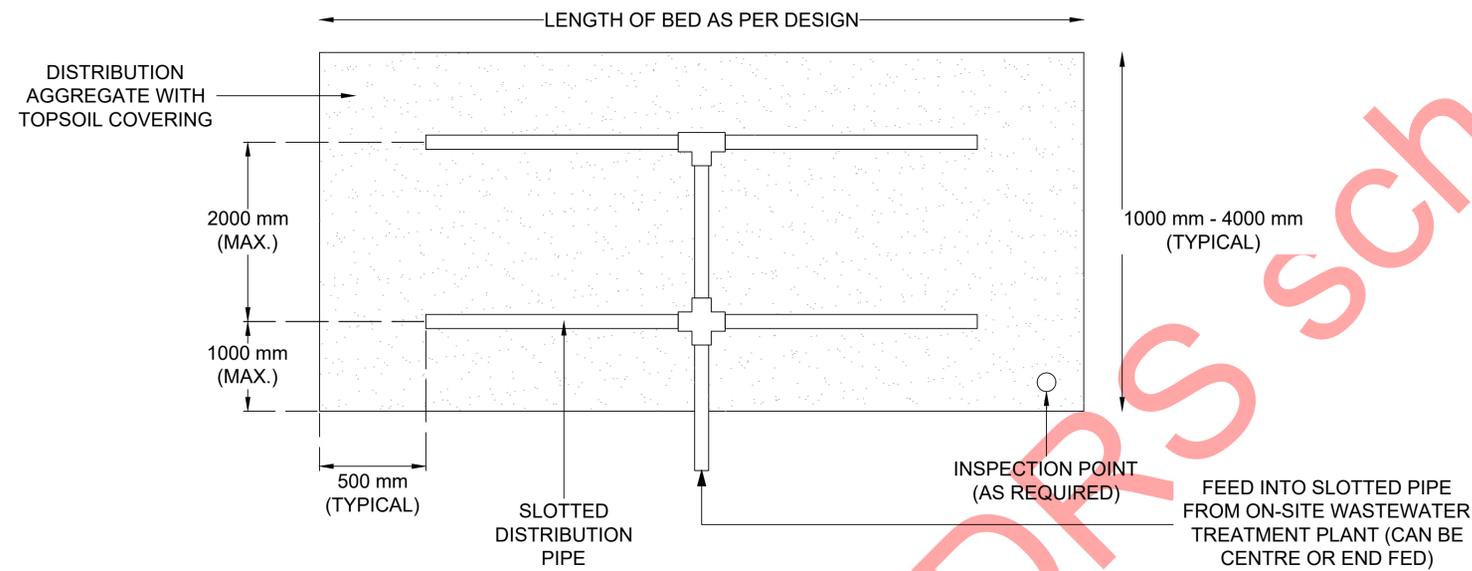
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EDS SYSTEM DRAWINGS:			
SLOTTED PIPE IN MULTIPLE TRENCH SPECIFICATION			
PROJECT No.	SCALE	SHEET	A1
DRAWING No.	NTS	1 of 1	

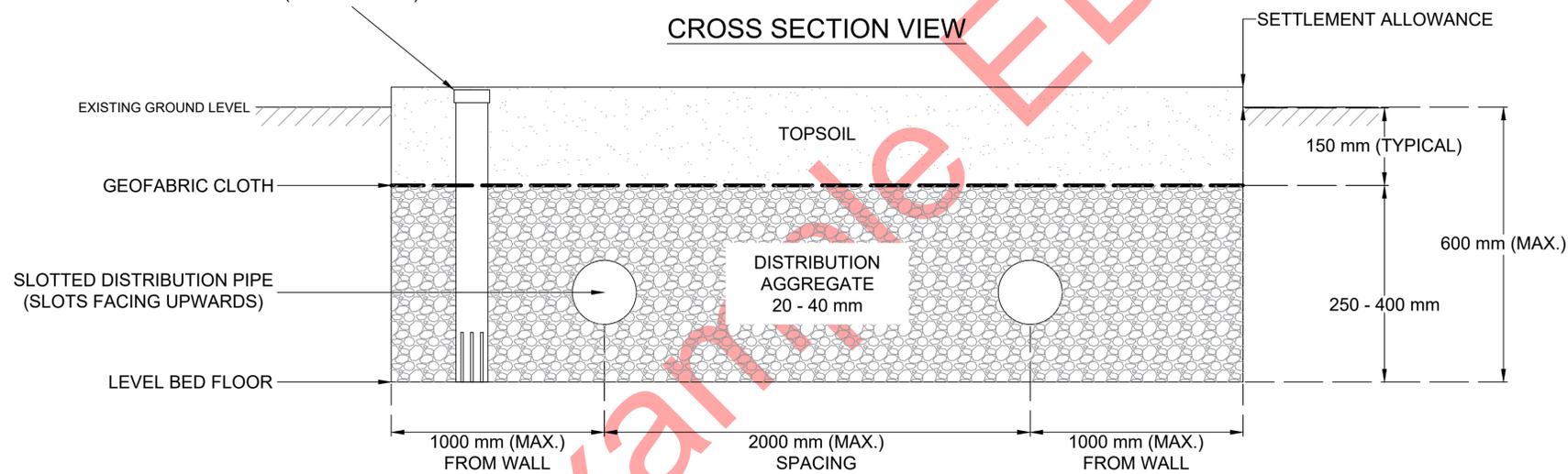
NOTES

- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- BASE OF BED MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- MAXIMUM BED WIDTHS WILL BE INFLUENCED BY THE SITE TOPOGRAPHY TO ENSURE A LEVEL BASE & VERTICAL SEPARATION REQUIREMENTS.
- WIDER BEDS WILL REQUIRE ADDITIONAL SLOTTED PIPE LATERALS.

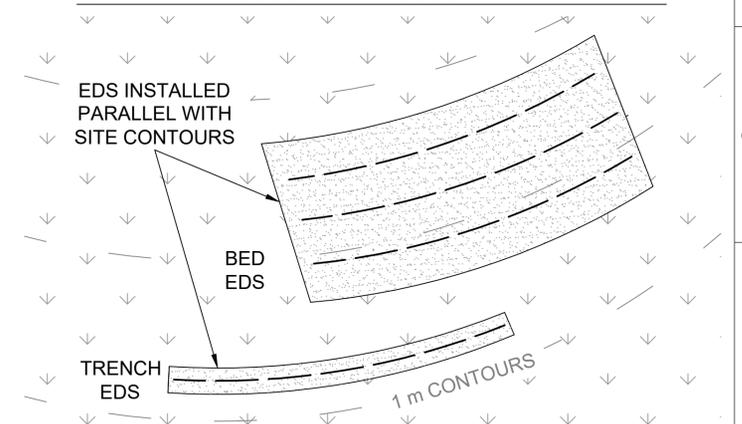
PLAN VIEW



CROSS SECTION VIEW



EDS INSTALLED PARALLEL TO CONTOUR



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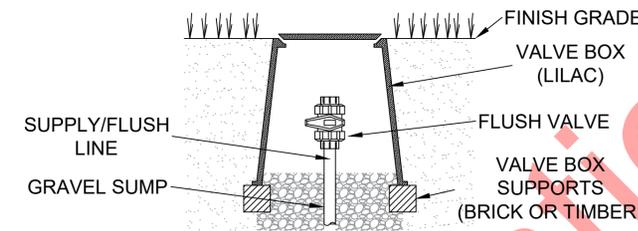
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EDS SYSTEM DRAWINGS:
SLOTTED PIPE IN BED SPECIFICATION

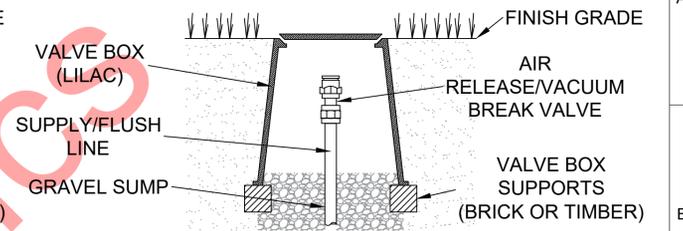
DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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- NOTES**
- IF USING SLOTTED PVC PIPE FOR DISTRIBUTION, ENSURE END CAPS ARE USED & INSTALL WITH SLOTS FACING DOWN TO ENSURE SLOTTED PIPE DRAINS
 - BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
 - FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
 - THE SQUIRT HEIGHT OF LATERALS SHOULD BE CHECKED DURING COMMISSIONING. A MINIMUM SQUIRT HEIGHT OF 0.9 m MUST BE ACHIEVED WITH <15% VARIATION WITHIN EACH ZONE

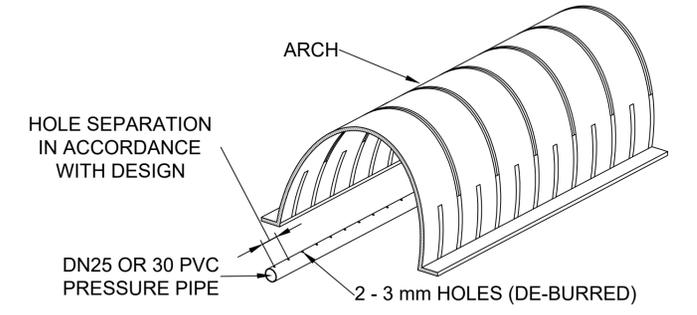
CROSS SECTION OF FLUSH VALVE



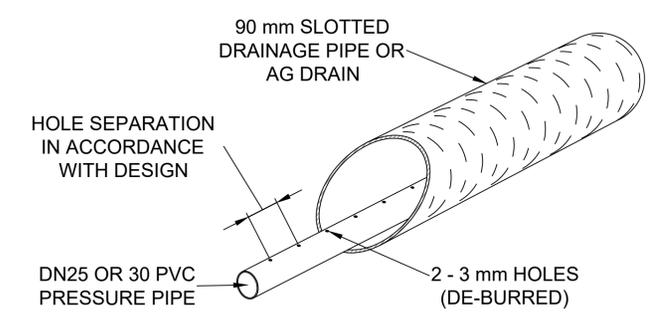
CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



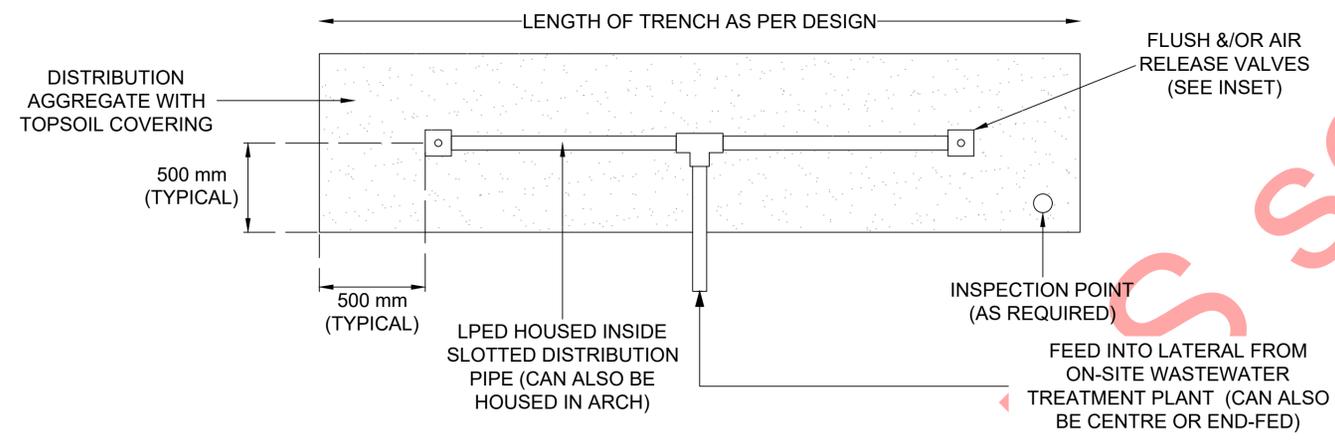
PIPE-IN-ARCH DETAIL



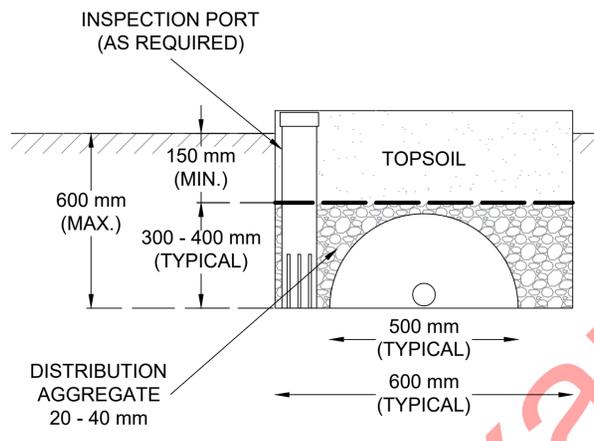
PIPE-IN-PIPE DETAIL



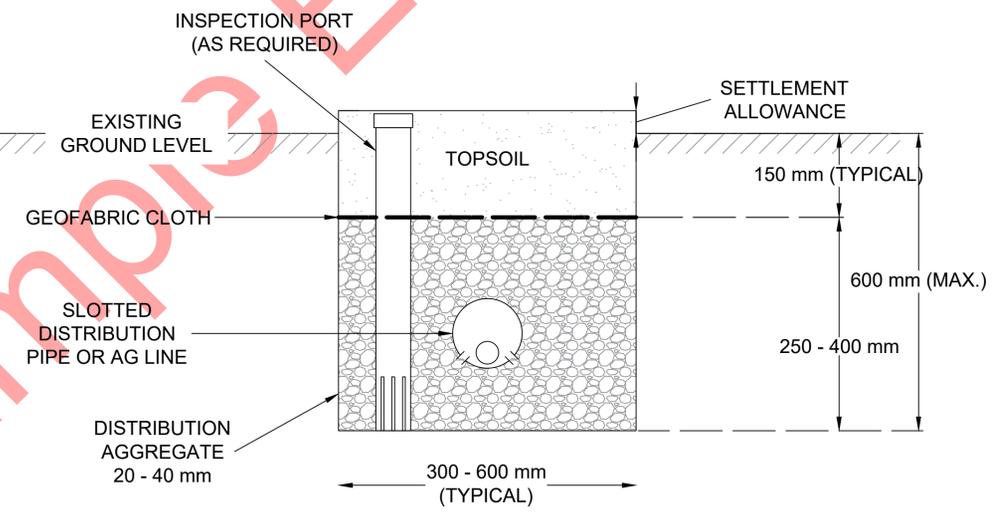
PLAN VIEW



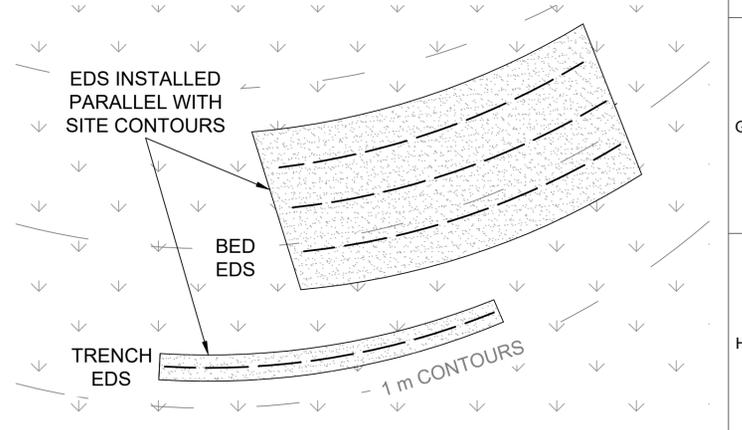
CROSS SECTION ARCH



CROSS SECTION SLOTTED PIPE



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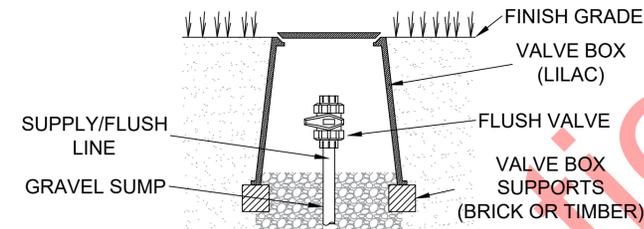
**EDS SYSTEM DRAWINGS:
PRESSURE DOSED TRENCH SPECIFICATION**

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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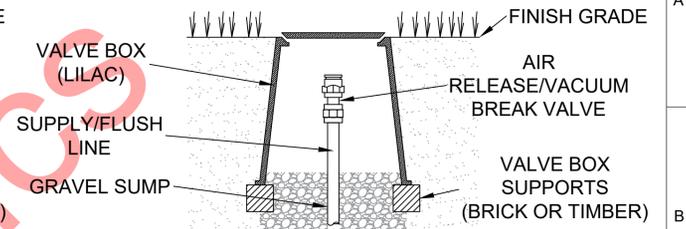
NOTES

- IF USING SLOTTED PVC PIPE FOR DISTRIBUTION, ENSURE END CAPS ARE USED & INSTALL WITH SLOTS FACING DOWN TO ENSURE SLOTTED PIPE DRAINS
- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- THE SQUIRT HEIGHT OF LATERALS SHOULD BE CHECKED DURING COMMISSIONING. A MINIMUM SQUIRT HEIGHT OF 0.9 m MUST BE ACHIEVED WITH <15% VARIATION WITHIN EACH ZONE

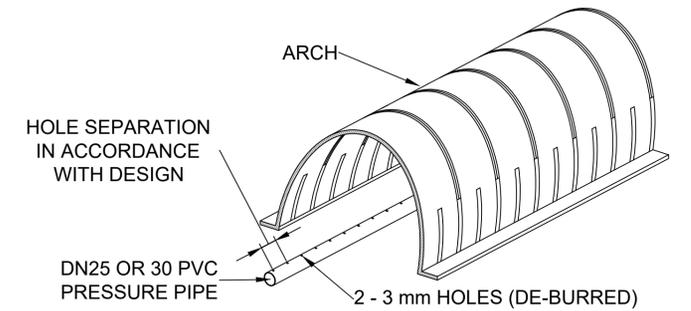
CROSS SECTION OF FLUSH VALVE



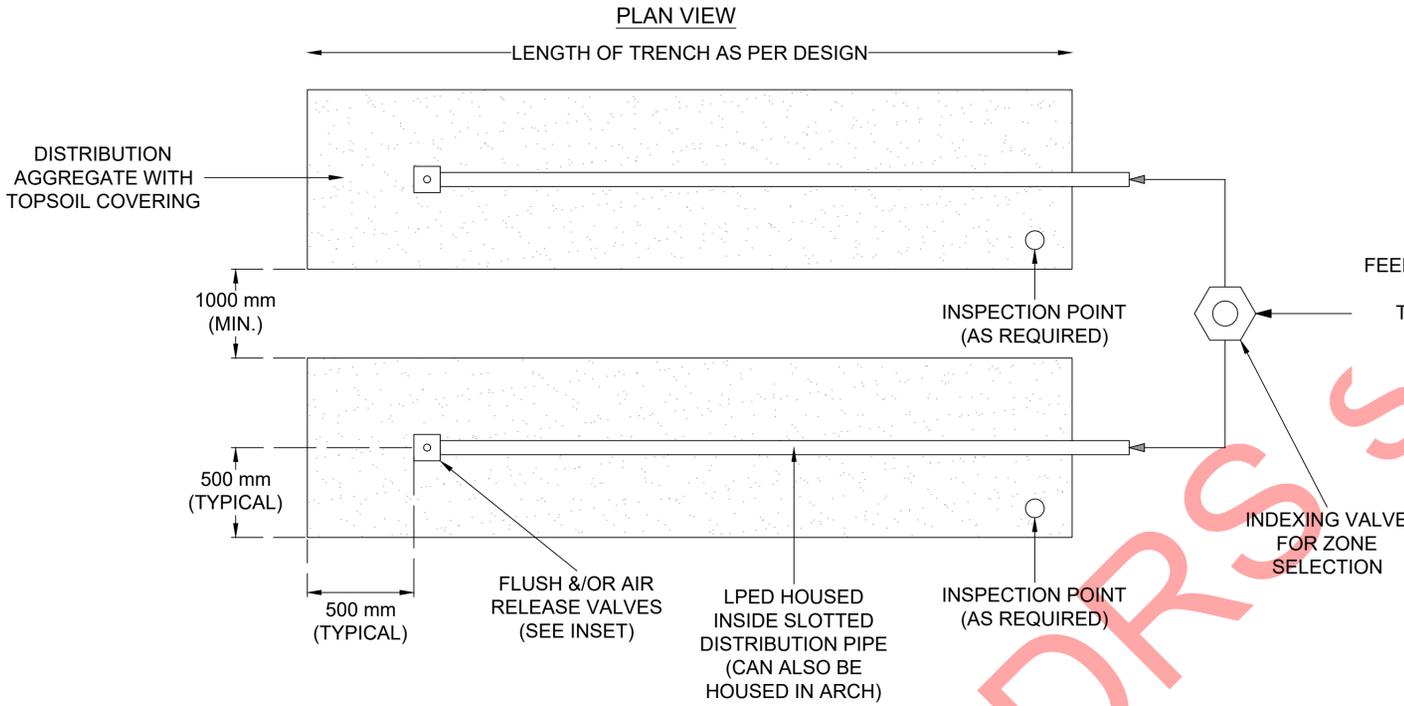
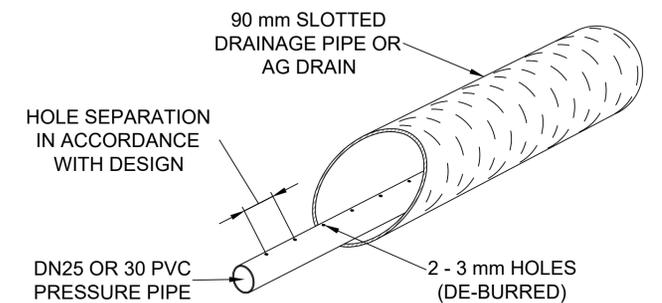
CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



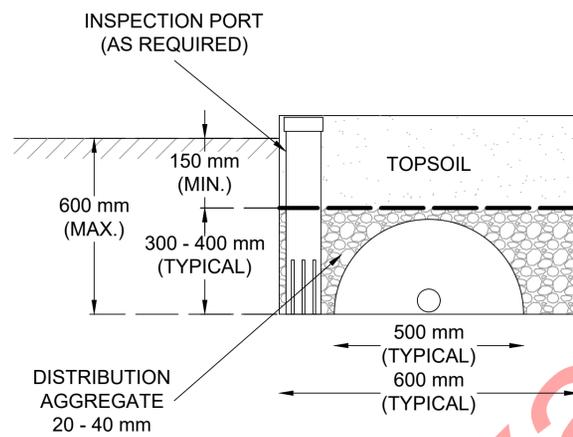
PIPE-IN-ARCH DETAIL



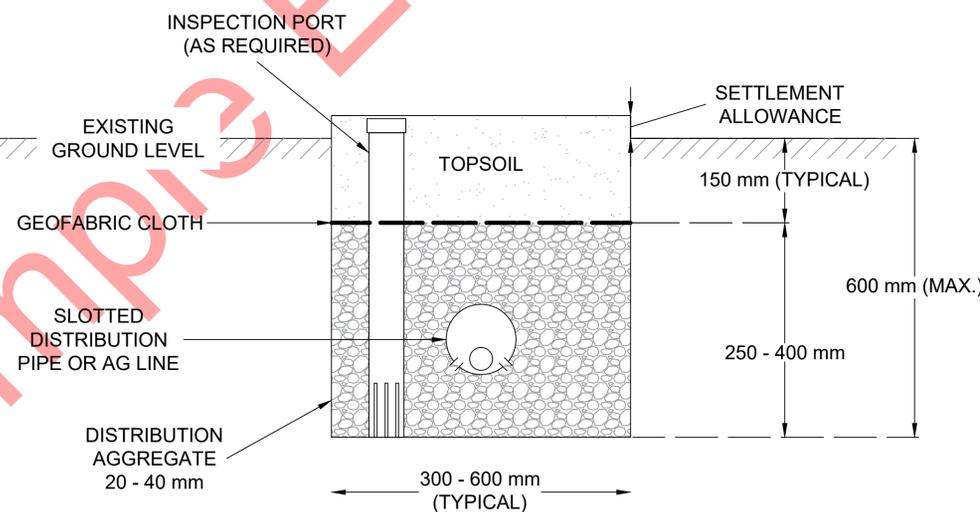
PIPE-IN-PIPE DETAIL



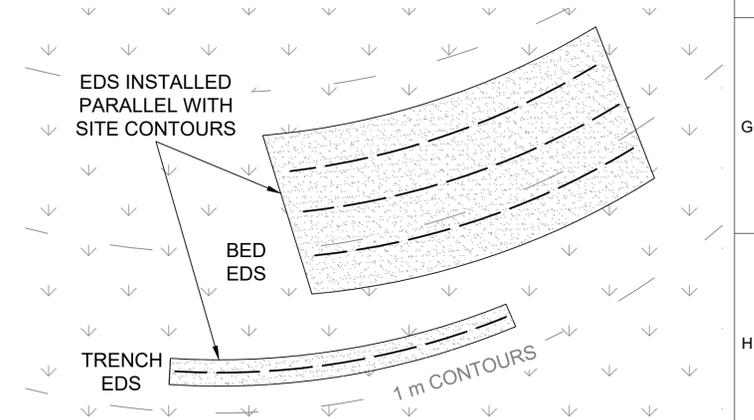
CROSS SECTION ARCH



CROSS SECTION SLOTTED PIPE



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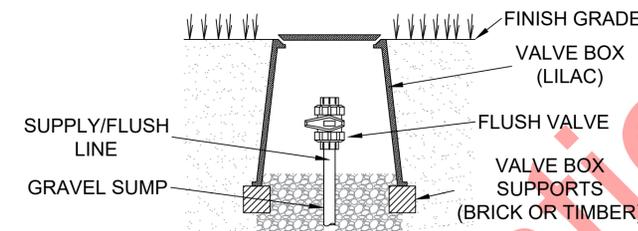
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DRAWING No.	SCALE	SHEET	A1
	NTS	1 of 1	

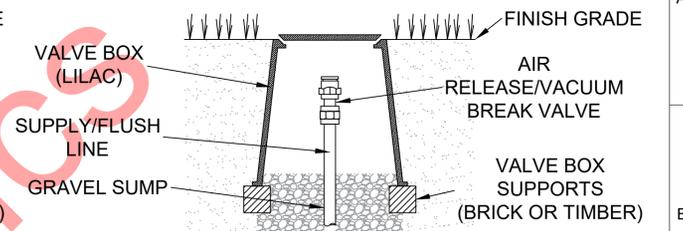
- NOTES**
- IF USING SLOTTED PVC PIPE FOR DISTRIBUTION, ENSURE END CAPS ARE USED & INSTALL WITH SLOTS FACING DOWN TO ENSURE SLOTTED PIPE DRAINS
 - FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
 - ARCH MAY BE USED IN PLACE OF SLOTTED PIPE - SEE INSET
 - BASE OF BED MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
 - MAXIMUM BED WIDTHS WILL BE INFLUENCED BY THE

- SITE TOPOGRAPHY TO ENSURE A LEVEL BASE & VERTICAL SEPARATION REQUIREMENTS.**
- WIDER BEDS WILL REQUIRE ADDITIONAL SLOTTED PIPE LATERALS.
 - THE SQUIRT HEIGHT OF LATERALS SHOULD BE CHECKED DURING COMMISSIONING. A MINIMUM SQUIRT HEIGHT OF 0.9 m MUST BE ACHIEVED WITH <15% VARIATION WITHIN EACH ZONE

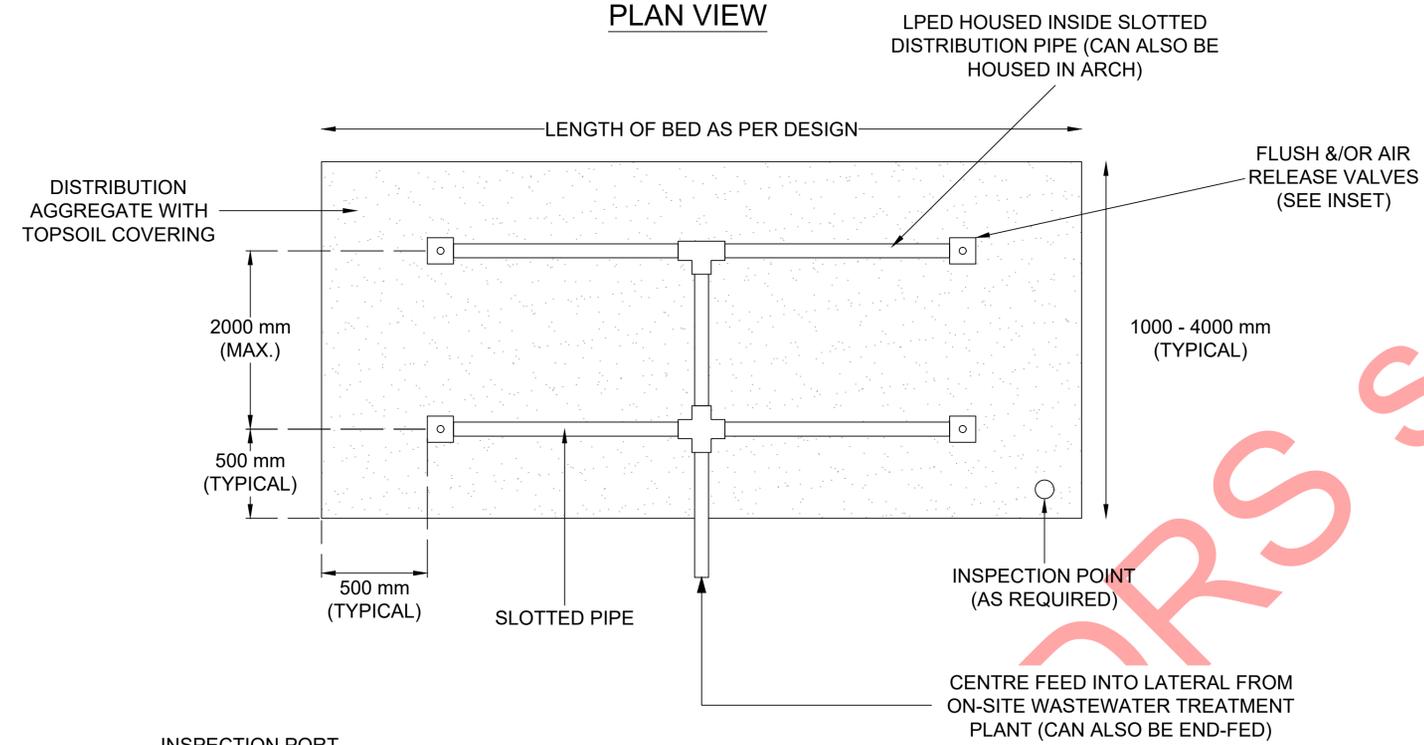
CROSS SECTION OF FLUSH VALVE



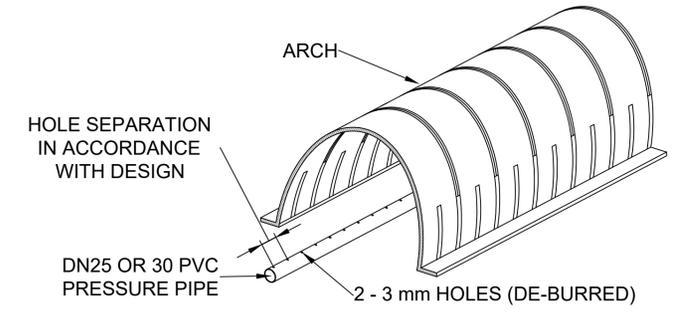
CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



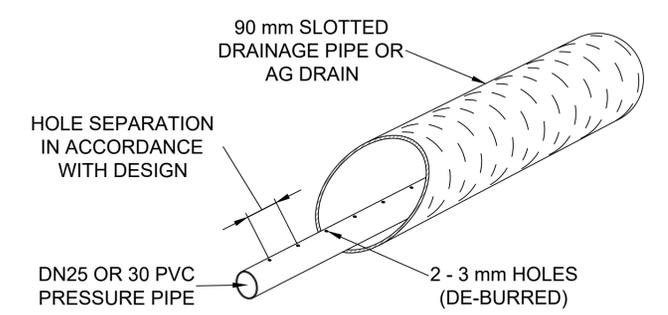
PLAN VIEW



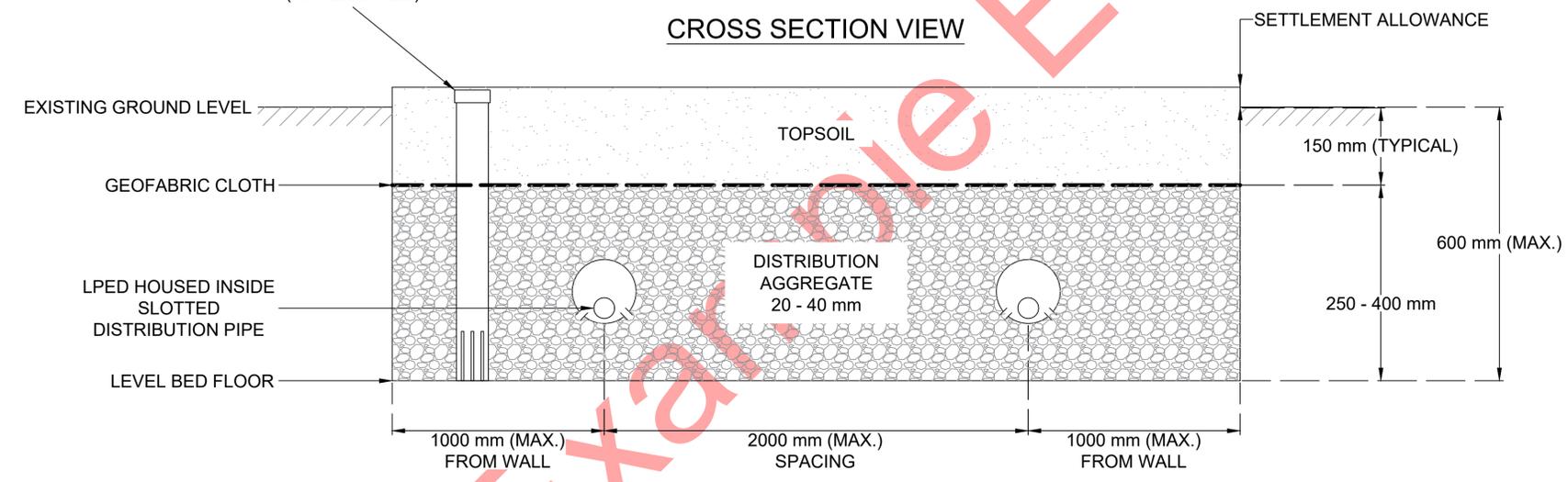
PIPE-IN-ARCH DETAIL



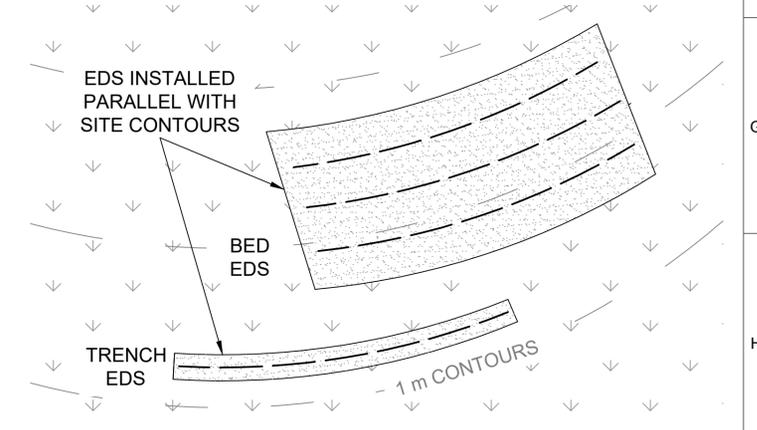
PIPE-IN-PIPE DETAIL



CROSS SECTION VIEW



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PRESSURE DOSED BED SPECIFICATION

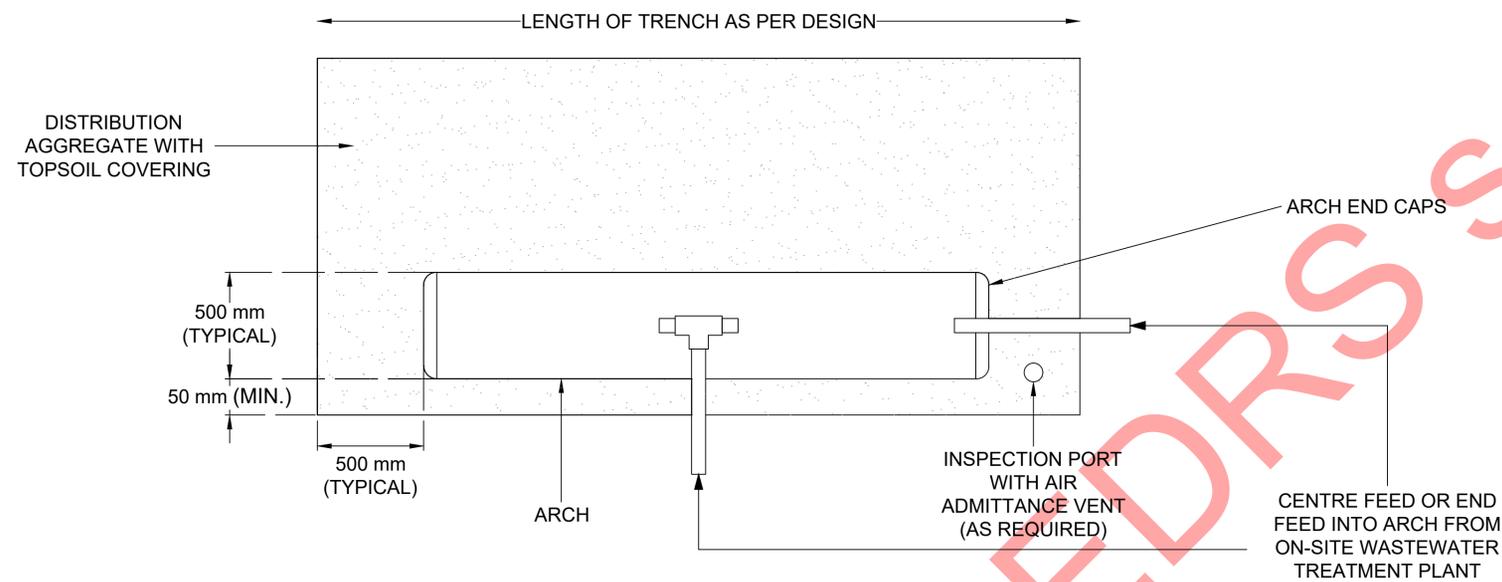
DRAWING No.	SCALE	SHEET	A1
	NTS	1 of 1	

NOTES

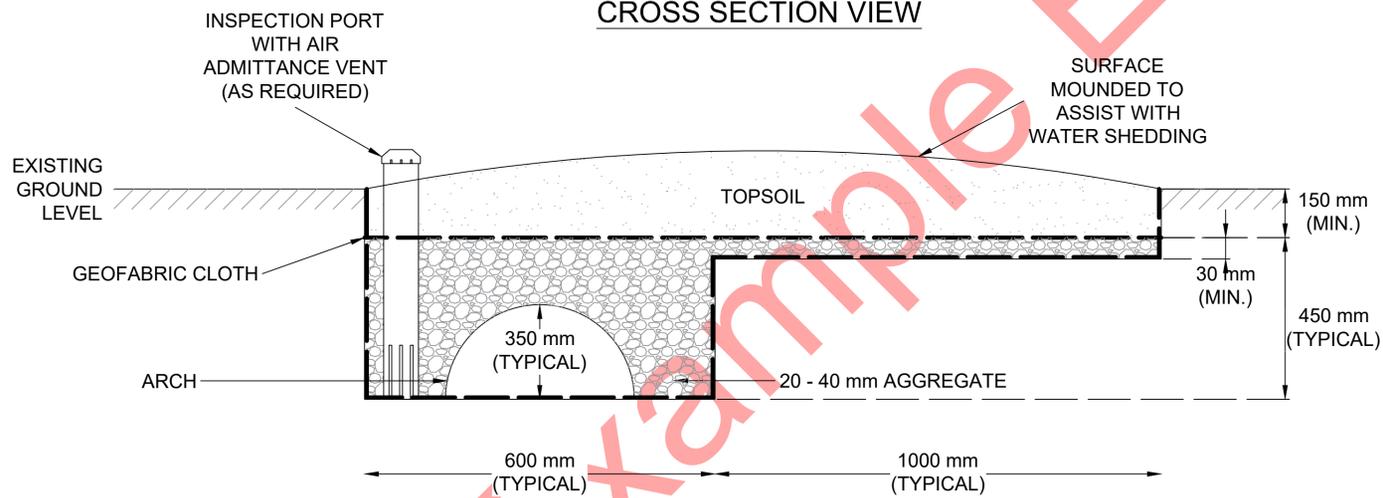
- THIS DRAWING HAS BEEN ADAPTED FROM THE WATER NSW CRP "DESIGNING & INSTALLING ON-SITE WASTEWATER SYSTEMS"
- THE WICK TRENCH & BED SYSTEM MUST BE INSTALLED ON FLAT L& WHERE THE IN-SITU SOIL TYPE IS UNIFORM ALONG THE LENGTH OF THE TRENCH.
- THE TRENCH DEPTH MUST BE UNIFORM ALONG THE LENGTH TO PROVIDE EFFECTIVE PERFORMANCE
- THE SURFACE LEVEL OF THE WICK TRENCH MUST BE 150 mm (MINIMUM) BELOW INVERT OF THE SEPTIC TANK OUTLET FOR GRAVITY EFFLUENT DISTRIBUTION METHODS
- PLANT THE SURFACE OF THE SYSTEM WITH VEGETATION (I.E, GRASS OR PLANTS) THAT THRIVES UNDER DAMP TO WET SUB-SURFACE CONDITIONS.
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE

- TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- BASE OF TRENCH MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET

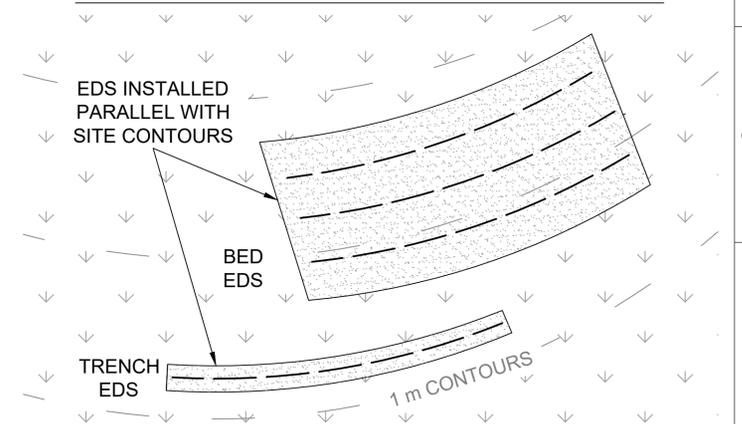
PLAN VIEW



CROSS SECTION VIEW



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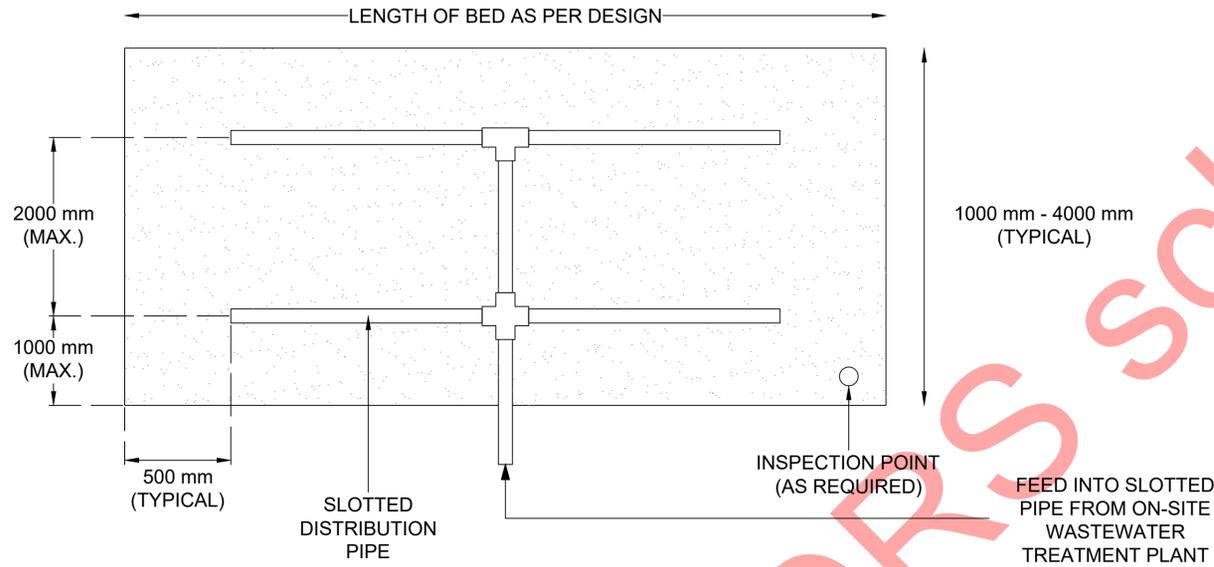
EDS SYSTEM DRAWINGS:
WICKING BED SPECIFICATION

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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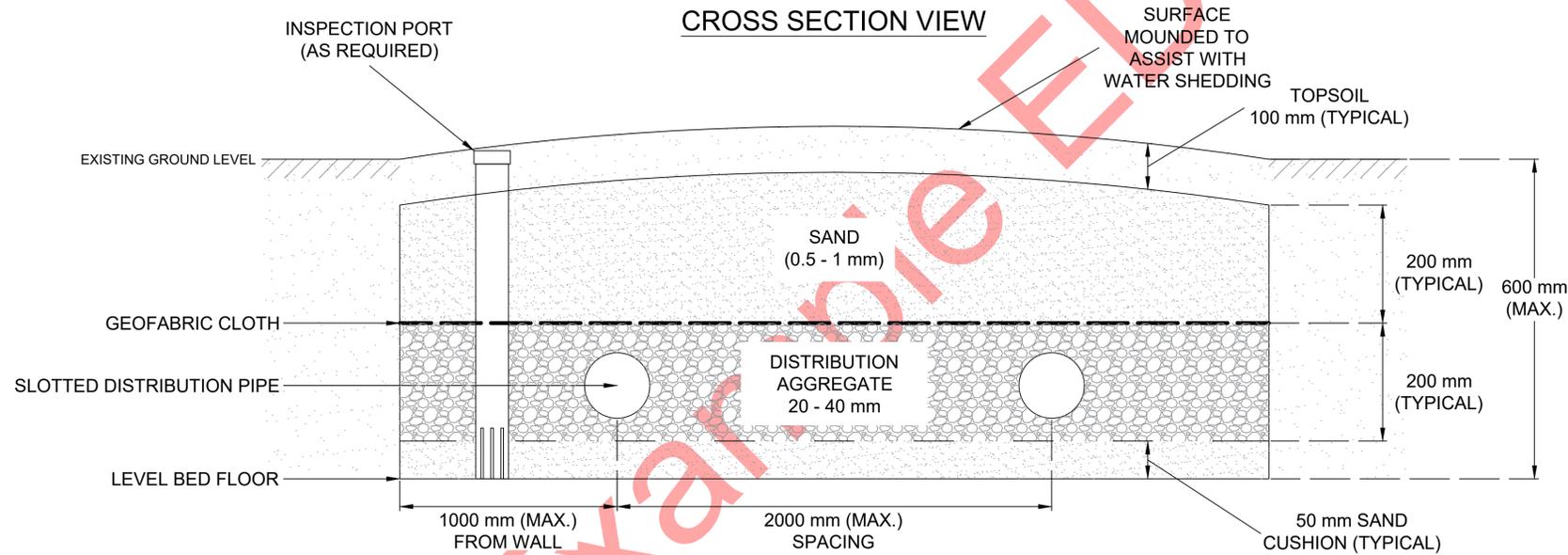
NOTES

- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- BASE OF BED MUST BE LEVEL & ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- MAXIMUM BED WIDTHS WILL BE INFLUENCED BY THE SITE TOPOGRAPHY TO ENSURE A LEVEL BASE & VERTICAL SEPARATION REQUIREMENTS.
- WIDER BEDS WILL REQUIRE ADDITIONAL SLOTTED PIPE LATERALS.

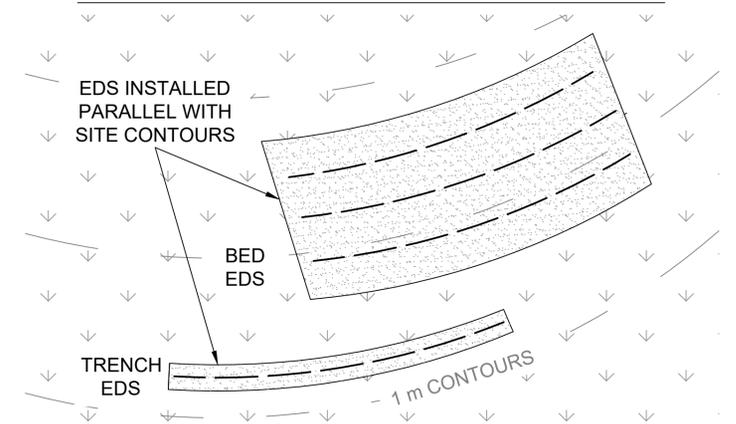
PLAN VIEW



CROSS SECTION VIEW



EDS INSTALLED PARALLEL TO CONTOUR



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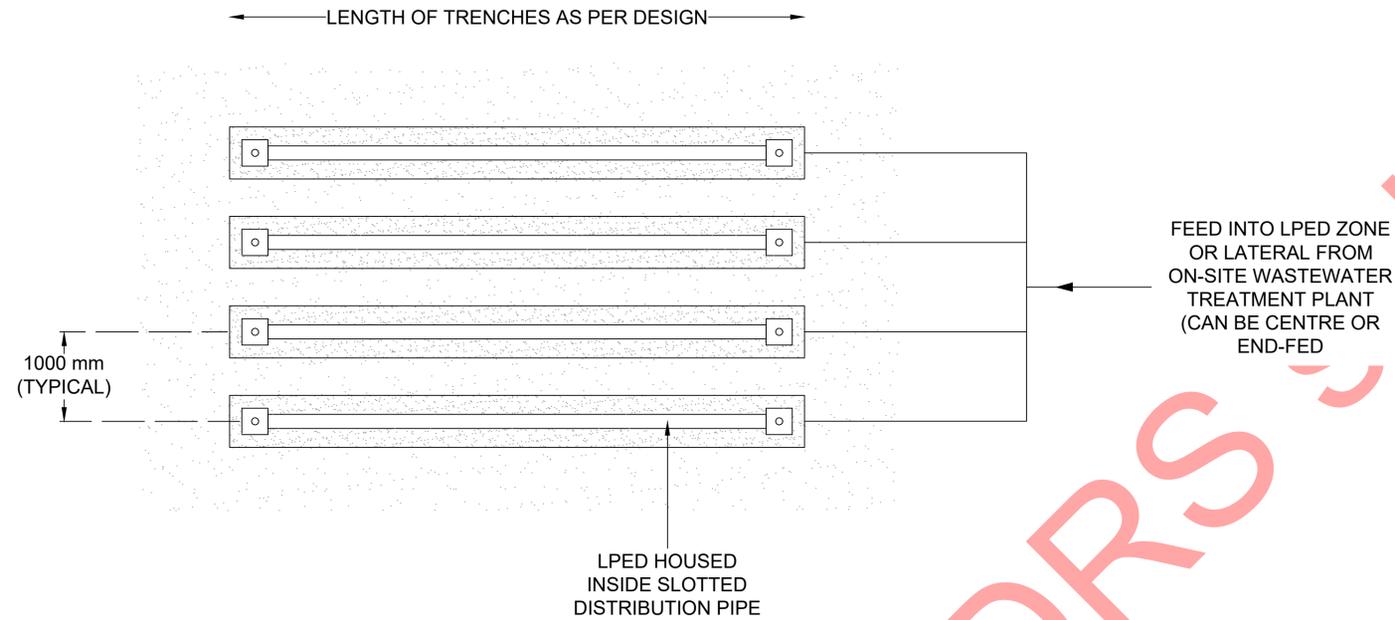
EDS SYSTEM DRAWINGS:
EVAPOTRANSPIRATION AREA

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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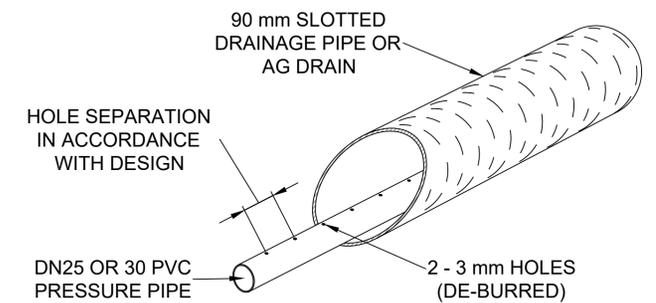
NOTES

- IF USING SLOTTED PVC PIPE TO HOUSE PERFORATED DN25, ENSURE END CAPS ARE USED & INSTALL WITH SLOTS FACING DOWN TO ENSURE SLOTTED PIPE DRAINS
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- BASE OF EACH LPED TRENCH MUST BE LEVEL AND ALIGNED TO BE PARALLEL WITH ELEVATION CONTOURS - SEE INSET
- MAXIMUM BED WIDTHS AND HYDRAULIC ZONING WILL BE INFLUENCED BY THE SITE TOPOGRAPHY TO ENSURE A LEVEL BASE AND VERTICAL SEPARATION REQUIREMENTS.
- NON RETURN VALVES MAY BE REQUIRED TO PREVENT DRAIN BACK TO LOWER ZONES ON SLOPING SITES.
- THE SQUIRT HEIGHT OF LATERALS SHOULD BE CHECKED DURING COMMISSIONING. A MINIMUM SQUIRT HEIGHT OF 0.9 m MUST BE ACHIEVED WITH <15% VARIATION WITHIN EACH ZONE

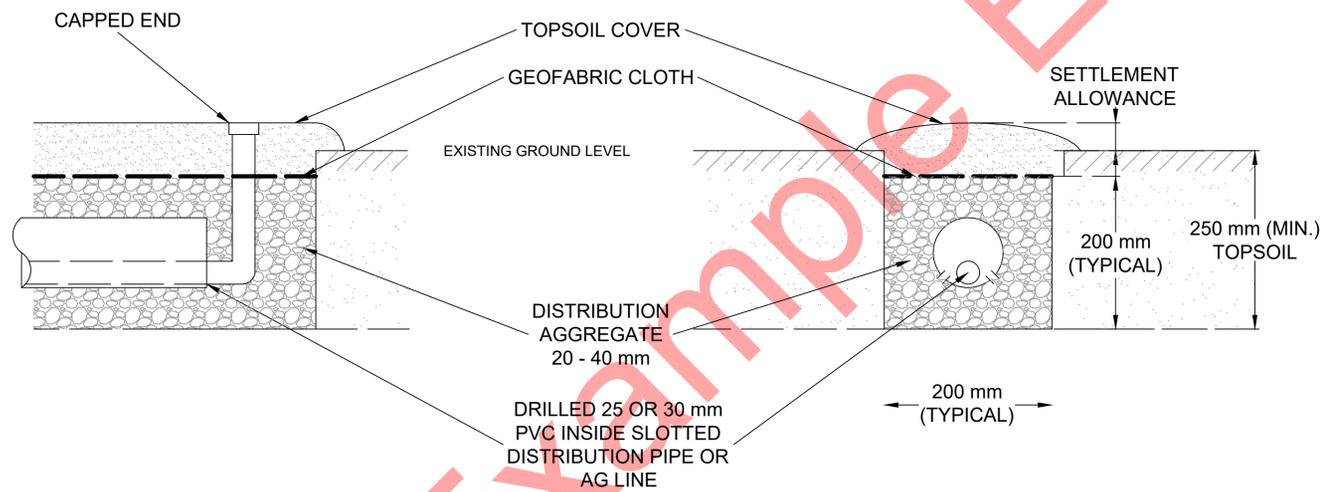
PLAN VIEW



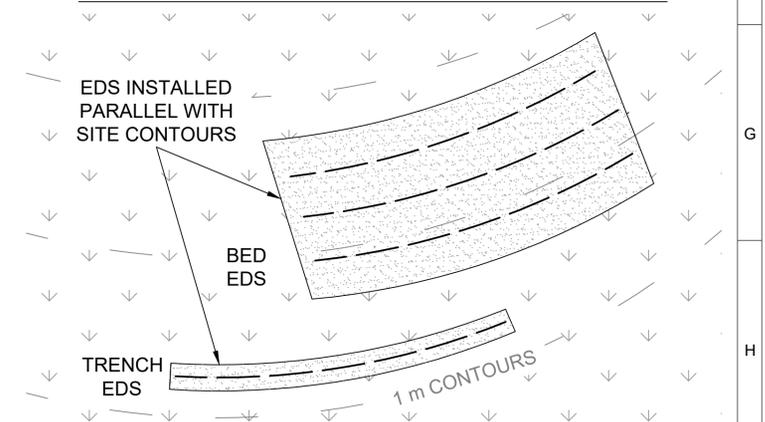
PIPE-IN-PIPE DETAIL



CROSS SECTION VIEWS



EDS INSTALLED PARALLEL TO CONTOUR



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LPED SHALLOW SUB-SURFACE IRRIGATION SPECIFICATION

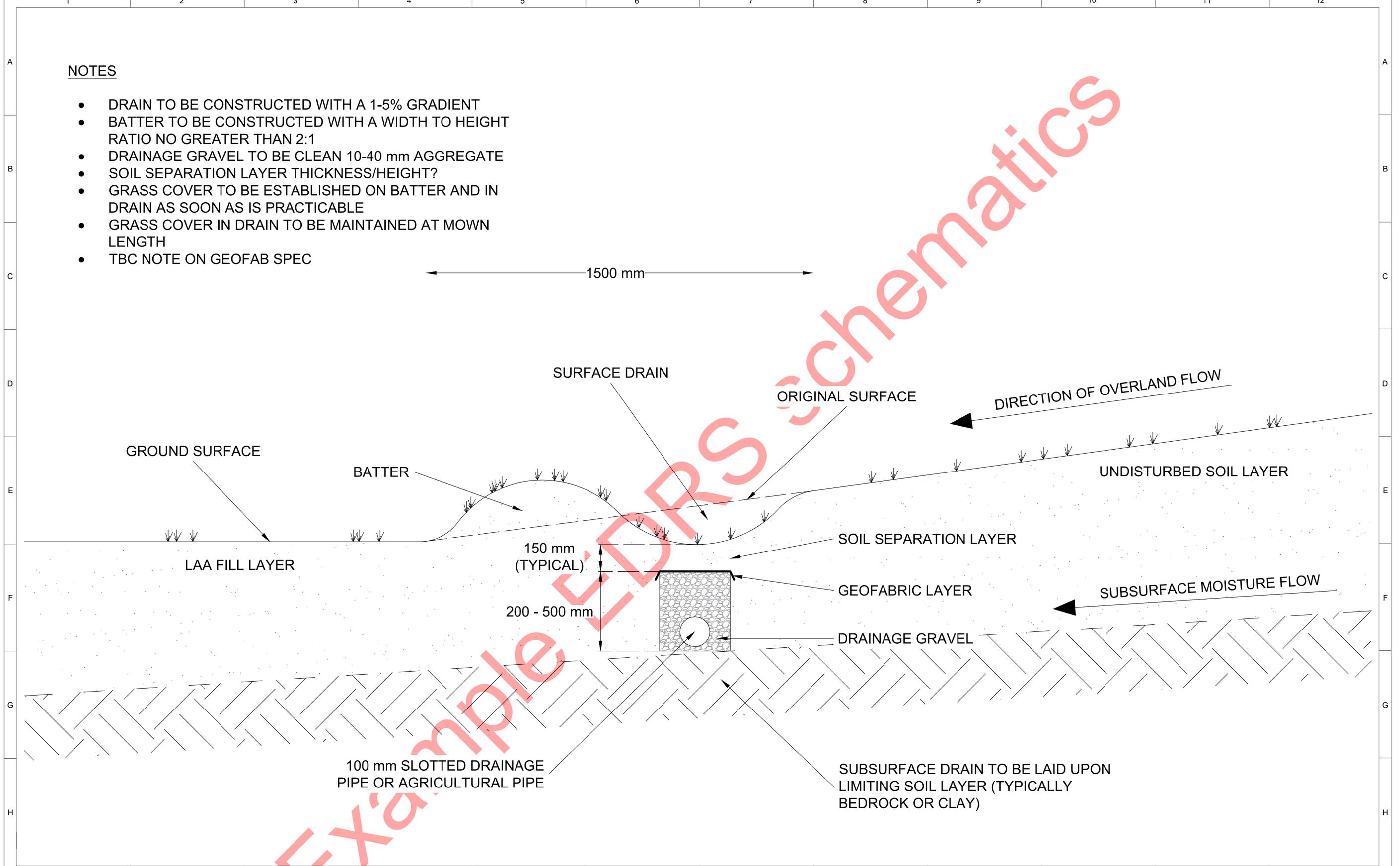
DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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1 2 3 4 5 6 7 8 9 10 11 12

NOTES

- DRAIN TO BE CONSTRUCTED WITH A 1-5% GRADIENT
- BATTER TO BE CONSTRUCTED WITH A WIDTH TO HEIGHT RATIO NO GREATER THAN 2:1
- DRAINAGE GRAVEL TO BE CLEAN 10-40 mm AGGREGATE
- SOIL SEPARATION LAYER THICKNESS/HEIGHT?
- GRASS COVER TO BE ESTABLISHED ON BATTER AND IN DRAIN AS SOON AS IS PRACTICABLE
- GRASS COVER IN DRAIN TO BE MAINTAINED AT MOWN LENGTH
- TBC NOTE ON GEOFAB SPEC

← 1500 mm →



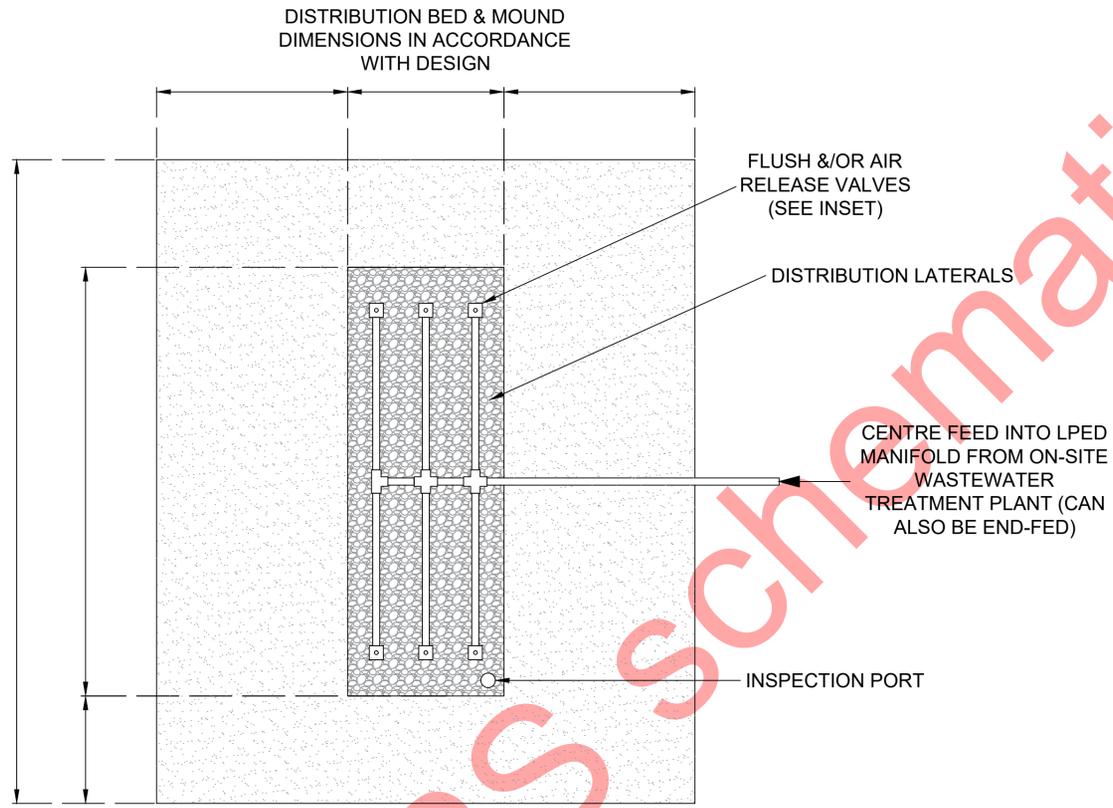
				INSERT LOGO HERE				INSERT COPYRIGHT STATEMENT HERE		NOTES:		EDS SYSTEM DRAWINGS: UPSLOPE & SUB-SURFACE DIVERSION DRAIN SPECIFICATION	
00	25/11/22	FOR INFORMATION		HV (DWA)	HV (DWA)	BAA (DWA)	N/A					SCALE	SHEET
REV	DATE	REVISION DESCRIPTION		DRAWN	DESIGNED	CHECKED	CLIENT APPROVED					1 of 1	A1
												DRAWING No.	

1 2 3 4 5 6 7 8 9 10 11 12

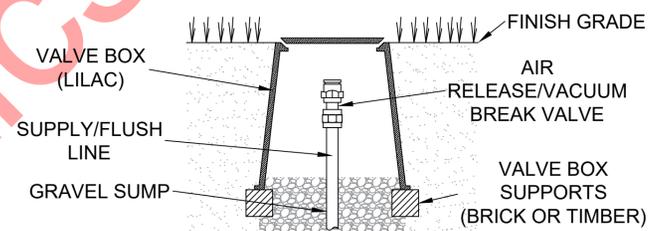
NOTES

- DISTRIBUTION LATERALS ARE CONSTRUCTED OF PIPE IN PIPE LPED LINES - SEE INSET
- LPED DISTRIBUTION MANIFOLD OFTEN NEEDS TO BE ZONED TO MATCH AVAILABLE PUMP OPTIONS. MULTIPLE ZONES SHOULD BE AUTOMATICALLY DOSED WITH A SEQUENCING VALVE
- SLOPES ON ALL FOUR SIDES OF THE MOUND BATTER SHOULD BE NO STEEPER THAN A 1:3 GRADIENT
- WIDTH & LENGTH OF THE DISTRIBUTION BED AS WELL AS THE LARGER MOUND AREA WILL BE SPECIFIC TO HYDRAULIC DESIGN & SITE TOPOGRAPHY
- FILTER CLOTH SHOULD BE A DURABLE PERMEABLE TEXTILE SUITABLE FOR USE WITH SOIL (A12 GRADE TYPICAL)
- THE SQUIRT HEIGHT OF LATERALS SHOULD BE CHECKED DURING COMMISSIONING. A MINIMUM SQUIRT HEIGHT OF 0.9 m MUST BE ACHIEVED WITH <15% VARIATION WITHIN EACH ZONE

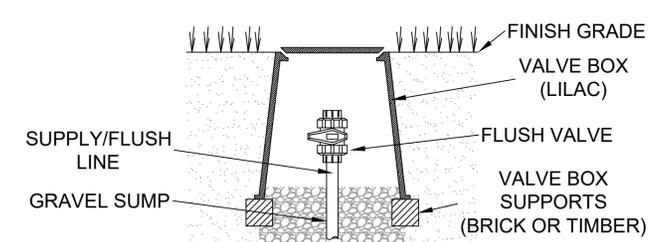
PLAN VIEW



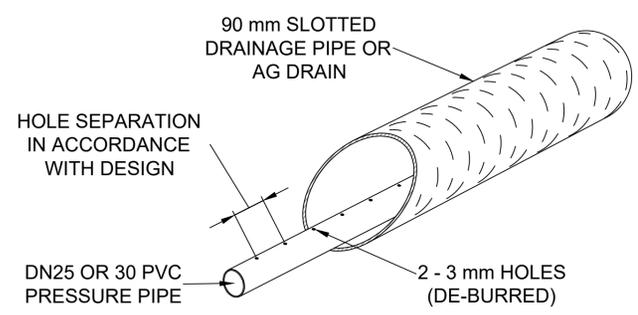
CROSS SECTION OF AIR RELEASE/VACUUM BREAK VALVE



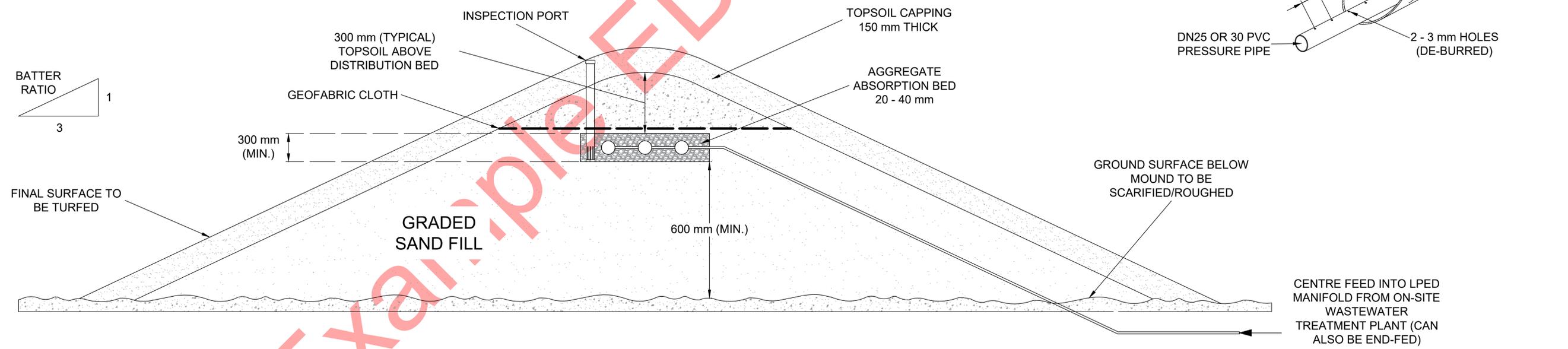
CROSS SECTION OF FLUSH VALVE



PIPE-IN-PIPE DETAIL



CROSS SECTION VIEW



1 2 3 4 5 6 7 8 9 10 11 12

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EDS SYSTEM DRAWINGS:
WISCONSIN MOUND ON FLAT GROUND

DRAWING No.	SCALE NTS	SHEET 1 of 1	A1
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Appendix 2. Supplementary design guidance

Appendix 2.1 Soil, site and effluent quality characteristics

This section contains further guidance information addressing soil, site and effluent quality characteristics that can influence EDRS design.

Appendix 2.1.1 Soil characteristics

Soil characteristics important in the EDRS design process are presented in Table 52

Table 52: Soil characteristics influencing EDRS design

Soil characteristic	Potential influence on design	Design considerations
Texture	<p>Texture influences the permeability and hydraulic conductivity of soils. Soils with a finer texture typically have a lower permeability and hydraulic conductivity. As such, these soils have a lower DLR.</p> <p>The most limiting, or highest category soil, within 600 mm of the point of effluent application/injection, should be adopted as the limiting soil layer.</p>	Select the suitable DLR for the chosen EDRS using Tables L1, M1 and N1 in AS/NZS 1547:2012.
Structure	Structure influences the permeability and hydraulic conductivity of soils. Strongly structured soils have a higher permeability and hydraulic conductivity than weakly structured or massive soils.	Select the suitable DLR for the chosen EDRS using Tables L1, M1 and N1 in AS/NZS 1547:2012.
Mottling	Provides an indication of periodic saturation of the soil profile. Highly mottled clay subsoils will experience prolonged periods of saturation.	Consider adopting a lower DLR, siting the EDRS in a different location or installing a raised EDRS if significant mottling is present.
pH	<p>Alkaline soils (pH>7) or acidic soils (pH<7) may reduce vegetation growth. Additionally, alkalinity may cause nutrient deficiencies and acidic soils may mobilise pollutants (e.g., nitrate leaching) (Soil Conservation Commission of New South Wales, 2000).</p>	If the soil pH in the root bearing zone is <5.5, consider the application of lime. Refer to Table 53.
Sodicity	Sodic soils can cause severe surface crusting, low infiltration and reduced hydraulic conductivity and very hard and dense subsoils. This can strongly reduce	<p>Consider adopting a lower DLR.</p> <p>Apply gypsum at a minimum rate of 1 kg/m² to all disturbed</p>

Soil characteristic	Potential influence on design	Design considerations
	the long-term effluent loading capacity of the soils (Hazelton & Murphey, 2016).	soil surface areas (AS/NZS 1547:2012).
Cation exchange capacity (CEC)	CEC describes the ability of the soil to hold and exchange cations and is a measure of nutrients available for plant growth and ability to bind and hold potential pollutants (such as nitrogen and phosphorus) (Hazelton & Murphey, 2016).	For sites with low CEC, consider using a lower DLR or the application of a soil ameliorant (e.g., lime).
Phosphorus sorption capacity	The phosphorus sorption capacity describes the ability of the soil to bind phosphorus applied to it.	Consider the adoption of a lower DLR or increased setback distance.
Salinity	Soils with high salinity can significantly affect plant growth and increase soil erosion. Measuring the electrical conductivity of soil: water suspensions is used as a salinity indicator (Hazelton & Murphey, 2016).	Consider adopting a lower DLR. Vegetate with saline tolerant species.

Soil improvement

Soil characteristics can directly or indirectly influence the long-term efficiency and performance of EDRS. In some situations the outcomes from the soil assessment may identify one or more soil characteristics that are outside the optimum range for that characteristic. Examples of soil characteristics capable of influencing EDRS performance include pH, salinity, sodicity, dispersiveness, CEC and heavily compacted soils.

Soil improvement work may be required to manage the identified deficiency if it has been determined that the surface or subsurface soils within the land application area (LAA) are considered unsuitable for plant growth or effluent assimilation. In some situations it may be recommended as a preventative measure (e.g., application of gypsum to maintain a lower exchangeable sodium percentage).

Soil improvement work should be carefully designed and correctly performed. In most situations the recommendation for soil improvement work should be determined by a suitably qualified and experienced person as there may be other factors or approvals that must be considered. Examples of soil improvement works may include one or a combination of the following:

- adding gypsum
- adding lime
- adding organic matter
- importing suitable fill material
- importing amended soil (higher phosphorus sorption capacity)
- removing rock (i.e., floaters and loose boulders)
- ploughing the soil within the LAA (i.e., typically to a depth of 200 mm)
- laying turf, applying seed or planting suitable vegetation species.

Acidic soils

Acidic soils have the potential to mobilise pollutants and significantly impact plant growth, which can affect EDRS performance. Lime application is recommended for acidic soils, particularly if the pH is <5.5 in the upper 100 mm to neutralise the soil pH and promote vegetation growth and cover over the EDRS. Table 53 outlines the lime application rate based on effective CEC and pH of the soil within the upper 100 mm.

Table 53: Soil lime requirement

Effective CEC (cmol+/kg)	Lime application rate required to raise the pH of the upper 100 mm of soil ¹¹			
	pH from 4.0 to 5.2	pH from 4.3 to 5.2	pH from 4.7 to 5.2	pH from 5.2 to 5.5
1	0.2	0.1 ¹²	0.03	0.02
2	0.2	0.1	0.1	0.04
3	0.4	0.2	0.1	0.1
4	0.4	0.2	0.1	0.1
5	0.5	0.3	0.1	0.1
6	0.6	0.3	0.1	0.1
7	0.6	0.3	0.1	0.1
8	0.7	0.4	0.2	0.1
9	0.8	0.4	0.2	0.1
10	0.9	0.5	0.2	0.1
15	1.3	0.7	0.3	0.2

Sodic soils

Absorption trench systems are typically not suitable in sodic soils. Clay soils that tend to be dispersive require special design and construction attention. During construction gypsum may be applied at 1 kg/m² to the base of the trench or bed to prevent the clay dispersing. The trench will be closed in as soon as possible to protect the gypsum from rain.

¹¹ Values in Table 53 are adopted from *Soils: their properties and management* (Soil Conservation Commission of New South Wales, 2000).

¹² It is recognised that low rates are difficult to apply, however, over-limiting can cause nutrient deficiencies.

Selection of DLR

When selecting a DLR, the guidance provided in AS/NZS 1547:2012 should be adopted to determine the maximum loading rate for the limiting soil characteristic in the soil. As outlined in Table 52, the limiting soil category is defined as the highest soil category, or soil with the highest clay content, within 600 mm of the point of effluent application or injection. For example, the most limiting soil profile for a conventional bed system would be the highest soil category within 600 mm of the base of the bed.

Table 54 provides references to AS/NZS 1547:2012 regarding DLR values for the main EDS types. The DLR values referred to in the AS/NZS 1547:2012 tables should be considered maximum values with a reduction in DLR evaluated where there are significant site or soil constraints.

Table 54: AS/NZS 1547:2012 references to DLR

EDRS type	AS/NZS 1547:2012: 2012 reference location
Trenches, beds and ETA/ETS systems	Table L1 in Appendix L
Irrigation systems	Table M1 in Appendix M
Mounds	Table N1 in Appendix N

Appendix 2.1.2 Site characteristics

Site characteristics that can influence EDS design, and potential design considerations are provided in Table 55.

Table 55: Site characteristics influencing EDS design

Site characteristic	Potential influence on design	Design considerations
Flood prone land	Increased risk of EDS inundation and transport of contaminants.	Site the EDS outside flood prone land extent. Raise the EDS so that the point of effluent injection is at or above the 5% AEP flood level.
Topography	The site topography can have inherent site constraints including inundation (e.g., floodplains or alluvial flats adjacent to rivers) or mountains/hills.	Assess how topography will impact EDS design and develop mitigation measures as required.
Landscape position	The landscape position of the EDS can have a significant impact on potential site constraints including run-on potential, soil depth and water logging.	Site the EDS in a suitable landscape position. Avoid depressions, breaks in slope (i.e., potential subsurface flow breakout points), crests (if shallow soils are experienced), areas with high stormwater run-on potential and low-lying areas where possible.

Site characteristic	Potential influence on design	Design considerations
Landform	Influences the amount of surface and subsurface water run-on and runoff.	Identify the EDS location landform and identify run-on and runoff processes. If high run-on potential and/or low runoff potential is likely, consider installing surface and subsurface drainage mitigation measures (e.g., diversion drains or curtain drains). Refer to Figure C2 in AS/NZS 1547:2012 for information on landform types.
Stormwater run-on and runoff	Areas with high stormwater run-on and runoff potential have increased risk of hydraulic failure and transport of contaminants.	Design upslope diversion drainage and downslope diversion as required.
Groundwater	High water tables have an increased risk of contaminant transport.	Position the EDS in a location with a lower water table (usually at higher elevations). Install a raised EDS. Adopt a lower DLR.
Vegetation	Thick or large vegetation may reduce the area available for installation of EDS. Good vegetation cover helps to prevent erosion and increase nutrient and water uptake.	EDS should be installed in well vegetated areas. EDS should be adequately vegetated (i.e., turfed or seeded) as required.
Exposure	Solar exposure influences the hydraulic performance of the EDS. Areas with higher solar exposure are less likely to become waterlogged or damp during wet periods.	Position the EDS in areas with high sun exposure where possible. If this is not possible, consider adopting a lower DLR.
Proximity to receiving environments	The setbacks to receiving environments outlined in Section 4.5 should be achieved where possible to reduce risk to the environment and human health.	Adopt setbacks outlined in Section 4.5. Where setbacks can't be achieved, complete adequate environmental and health assessment to demonstrate the risk is adequately managed.
Landslip potential	Unstable areas are usually unsuitable for the installation of EDS.	Avoid siting EDS in areas with landslip potential.

Appendix 2.1.3 Effluent quality

Effluent quality should be considered when designing an EDRS as it can influence the size. Primary treatment plants (i.e., septic tank) do not have a specific water quality standard. Typical effluent quality ranges of primary treated wastewater are presented in Table 56.

Table 56: Typical residential septic tank effluent concentration¹³

Constituent	Typical range ¹⁴
BOD ₅ (mg/L)	150–250
TSS (mg/L)	40–140
NH ₃ as N (mg/L)	30–50
Org. N as N (mg/L)	20–40
TKN as N (mg/L)	50–90
TN (mg/L) ¹⁵	50–60
TP as P (mg/L)	12–20
Oil and grease (mg/L)	20–50
<i>E. Coli</i> (org/100 mL) ¹⁶	106–108

Domestic scale secondary treatment plants must be certified against AS 1546.3:2017 for installation and use in Victoria. It should be noted that the required treatment system performance criteria for systems with no nutrient reduction do not have any TN or TP performance requirements. So the assumed effluent quality for TN and TP should be adopted using supplier specific effluent nutrient concentrations. In the absence of these results the parameters in Table 57 can be considered for use in sizing or risk reduction calculations. However, these nutrient concentrations are representative of aerated wastewater treatment systems (AWTS) only and the performance of different secondary treatment system types, brands and systems should be determined or considered based on the actual system proposed or installed¹⁷.

¹³ Adopted from Crites and Tchobanoglous 1998 (except faecal coliforms and TN).

¹⁴ Typical ranges without an effluent filter.

¹⁵ Adopted from the *Environment and Protection Guidelines* (NSW Department of Local Government, 1998).

¹⁶ Adopted from the US EPA *Onsite Wastewater Treatment Systems Manual 2002*.

¹⁷ Adopted from the *Environment and Health Protection Guidelines* (NSW Department of Local Government, 1998).

Table 57: Approximate effluent quality of AWTS

Parameter	Concentration
TN (mg/L as N)	20–50
TP (mg/L as P)	10–15

Appendix 2.2 Detailed EDRS design considerations

Appendix 2.2.1 Soil absorption and evapotranspiration systems

Different soil absorption and evapotranspiration systems are suited to different sites based on site and soil limitations. Additionally, there are several different effluent distribution solutions and design configurations that include gravity or pressure distribution of effluent, trench or bed width, length and depth. These design considerations are discussed further in subsequent sections.

Effluent distribution methods

The method of distribution adopted to convey effluent from the treatment plant to and within the EDS is an important design consideration to ensure satisfactory hydraulic performance, even distribution and long-term operation.

Gravity, pressure dosed or siphon

The effluent conveyance methods used are gravity dosed, dose loaded (using a pump or siphon) and LPED systems. Gravity dosed and dose loaded systems can distribute effluent by either slotted distribution pipe or a self-supporting arch, while pressure dosed trenches are supplied through an LPED pipe design.

Designers should consider the advantages and disadvantages of the available conveyance methods for their site and determine the most appropriate method to ensure environmental and human health outcomes can be achieved. The advantages and disadvantages of both solutions are presented in Table 58.

Table 58: Effluent conveyance methods

Method	Advantages	Disadvantages	Design considerations
Gravity	No pump required, reducing operation and maintenance cost and potential failure point. Simple and easy to construct.	Suitable grade from the wastewater treatment plant to the EDS is required. There is no control over timing of effluent dosing to the EDS, which may lead to surge loading. Maximum recommended trench or bed length is 20 m. Discharges are typically too low to flow throughout the	Suitable for relatively unconstrained sites with gravity fall available from the treatment plant to the EDS.

Method	Advantages	Disadvantages	Design considerations
		entire distribution network, resulting in uneven distribution and localised overloading of the infiltration surface, leading to poor treatment and progressive soil clogging (Bouma, 1975; McGauhey & Winneburger, 1964; Robeck et al., 1964.	
Dose loaded (using pump or siphon)	<p>Enables intermittent dosing of infiltrative surface, which provides rest periods for maintenance of unsaturated flow through soil pores and aerobic breakdown.</p> <p>Enables trenches and beds to be upslope of septic tank or treatment plant (pump).</p> <p>Enables alternate or sequenced dosing of EDS which can manage constraints relating to low or high (pollution hazard) permeability soils (pumped).</p>	<p>Requires a pump, increasing operational cost and operation and maintenance requirements.</p> <p>Does not ensure even distribution of effluent throughout the EDS.</p> <p>Pump and distribution mainline selection/ calculations are required.</p>	Required on sites where gravity fall cannot be achieved.
Pressure distribution (LPED)	<p>The pump can be set on a timer control to intermittently dose effluent from the pump chamber to the EDS which provides better distribution of effluent and reduces peak short-term loading.</p> <p>Beneficial for highly constrained sites with low hydraulic conductivity soils or highly permeable sites with sensitive receiving environments.</p> <p>Trench or bed lengths can exceed 20 m given hydraulic calculations show even distribution can be achieved.¹⁸</p>	<p>Requires a pump, increasing operational cost and operation and maintenance requirements.</p> <p>Hydraulic design and more construction oversight typically required.</p>	<p>Required on sites where gravity fall cannot be achieved.</p> <p>Suitable for constrained sites with sensitive receiving environments or low permeability soils.</p>

¹⁸ The length of the LPED line should be hydraulically designed to ensure adequate residual pressure can be achieved. Additionally, care should be taken when designing longer trenches as this can increase the risk of the trench base being constructed without a level base, which eliminates the benefit of installing a pressure dosed system on low permeability soils.

Arch or slotted pipe

Gravity and dose loaded systems can be designed with either arch or distribution pipe for distribution of effluent. The distribution pipe can be either slotted or drilled and is to be laid parallel with the horizontal bottom of the trench or bed. The internal diameter of the pipe should not be less than 80 mm.

Pre-formed distribution arches can be installed along the base of the trench or bed. Arches typically have a slot width of 10–15 mm.

Self-supporting arch trenches can be a useful design alternative for sites with undesirable climatic conditions (i.e., high rainfall and low evapotranspiration) as these systems can store more water/effluent due to the increased void space within the arch. The increased void space in the arch can be used in water balance calculations to determine a representative minimum arch trench or bed size.

Distribution boxes, drop boxes and sequencing valves

Distribution boxes, drop boxes and sequencing valves are used to split effluent between multiple hydraulic zones or trenches/beds.

Distribution boxes are typically used for gravity dosed systems on sloping sites. They involve a shallow, watertight structure with a single inlet and multiple outlets for each hydraulic zone of the trench/bed. Outlet pipes are constructed at the same elevation to evenly distribute effluent. Distribution boxes are constructed on a level surface to ensure effectiveness and even distribution (U.S. Environmental Protection Agency, 2002).

Drop boxes distribute effluent to a series of cascading trenches on a sloping site. The top trench is loaded until completely flooded before effluent is discharged to the next trench and so on. One drop box is installed for each trench, and these are connected to manifolds to trenches above and below. The overflow outlet to the next drop box is placed towards the top of the trench to ensure the trench fills completely before discharging to the next trench. The inlet from the septic tank or trench above is installed above this outlet, and the trench outlet is installed in the lower half of the drop box (U.S. Environmental Protection Agency, 2002).

Sequencing valves, also called indexing valves, are installed within pumped systems to distribute wastewater to different hydraulic zones. They are activated when enough pressure is applied to open the outlet to the first hydraulic zone, which occurs when the pump turns on and discharges effluent to the EDS. When the pump turns off the sequencing valve indexes to the next supply line, distributing effluent to the next hydraulic zone. Sequencing valves index through all the hydraulic zones before reaching the start of the sequence again. For larger and more complex systems several sequencing valves can be installed to distribute effluent to multiple zones. There are also volume-based sequencing valves available.

The advantages and disadvantages of these distribution methods are presented in Table 59.

Table 59: Design considerations of distribution methods

Method	Advantages	Disadvantages	Considerations
Distribution boxes	<p>Simple to design and cost effective.</p> <p>No pump required so reduced operation and maintenance costs.</p>	<p>Constructed on a level surface otherwise effluent will not be distributed evenly.</p> <p>Have the potential to be disturbed/moved over time.</p> <p>Are often constructed poorly, leading to uneven distribution of effluent.</p>	<p>Only suitable on sites with relatively minor slopes and no cross fall due to construction risk.</p> <p>Only suitable for gravity dosed systems.</p> <p>Suitable for primary effluent.</p>
Drop boxes	<p>Simple to design.</p> <p>No pump required so reduced operation and maintenance costs.</p> <p>Optimises hydraulic use of all bottom and sidewall infiltration surfaces.</p>	<p>Trenches suffer hydraulic failure faster and progressively because infiltration surfaces are never given the opportunity to regenerate.</p> <p>Overloads one trench and does not provide even distribution.</p>	<p>Leads to progressive premature failure of trenches due to overloading. This distribution method is not recommended.</p> <p>Only suitable for gravity dosed systems and primary effluent.</p>
Sequencing valves	<p>Simple to construct and install.</p> <p>Cost effective.</p> <p>Provide even distribution of effluent.</p> <p>Can be used for both primary and secondary treated effluent.</p>	<p>Can become blocked or jammed.</p>	<p>Most reliable distribution method for pumped systems.</p> <p>Risk of blockage is increased for primary treated effluent</p>

Appendix 2.2.2 Conventional trenches and beds

Conventional trenches and beds can be designed in several configurations. Some design parameters able to be varied include trench or bed length, width, depth of aggregate and spacing between adjacent trenches or beds. Table 60 outlines when designers may want to maximise or minimise these design parameters. Refer to Appendix L of AS/NZS 1547:2012 for conventional trench and bed design requirements.

Table 60: Design considerations for trenches and beds (including conventional and evapotranspiration)

Design parameter	Maximise parameter	Minimise parameter
Length	<p>Maximising the length decreases the linear loading rate (LLR) and reduces the likelihood of downslope effluent breakout or soggy soils. Therefore, it can be useful for low permeability soils.</p> <p>This also increases the nutrient and pathogen attenuation rate as groundwater plumes travel downslope, reducing required setback distances to receiving water environments. Therefore, it is also useful for sites with sensitive receiving environments.</p>	<p>The length should not exceed 20 m for gravity dosed systems.</p> <p>Sometimes designers may need to minimise the length to site the EDS in an area of optimal land capability or reduced site constraints.</p>
Width	<p>Maximising the bed width is generally not recommended as this would result in a shorter length, causing increased LLR. This is less of a concern for trenches as the difference between minimum and maximum widths is minor (i.e., 150 mm).</p> <p>However, widths may need to be maximised on sites with limited area available for the EDS or to site it in an area of optimal land capability or reduced site constraints.</p>	<p>Widths should generally be minimised where possible to reduce LLR and improve nutrient and pathogen attenuation capacity and so groundwater plumes move downslope.</p>
Depth of aggregate	<p>Maximising this parameter increases the effluent and water storage capacity of the trench or bed, which decreases the EDS size if water balance calculations are used as the sizing mechanism.</p> <p>Increased depth of aggregate also provides additional sites within the EDS for aerobic and anaerobic bacteria to form biofilm and breakdown nutrients and pathogens.</p> <p>Depth of aggregate can be implemented on sites with a greater depth to limiting layer.</p>	<p>Depth of aggregate can be limited on sites that are relatively unconstrained, can meet setback distances and are not located within wet climates.</p> <p>Minimising the depth of aggregate can also be advantageous on sites with limited available depth of soil. This can often be required on sites where the depth to bedrock or groundwater is less than ~1.2 m from the soil surface to ensure the minimum 600 mm separation between the point of effluent application and the limiting layer can be achieved.</p>

Design parameter

Maximise parameter

Minimise parameter

Spacing between adjacent beds or trenches	Spacings between adjacent trenches/beds of 1–2 m can improve the distribution of effluent and reduce the likelihood of poor hydraulic performance (i.e., soggy soils). However, a separation distance between adjacent trenches/beds greater than 2 m does not generally provide significantly improved hydraulic performance.	AS/NZ 1547:2012 (Table L2 of Appendix L) advocates a minimum spacing between adjacent trenches/beds of 1 m (sidewall-to-sidewall).
Effluent quality	The DLR values for secondary treated effluent are higher than corresponding primary effluent values (Table L1 of AS/NZS 1547:2012). This results in a smaller trench or bed size which may be beneficial on sites that are constrained by availability of land or site or soil characteristics. May be necessary on sodic clay soils.	The DLR values for primary treated effluent are smaller than corresponding secondary effluent values (Table L1 of AS/NZS 1547:2012). This results in trench and bed sizes that are larger than systems receiving secondary effluent. EDS systems receiving primary treated effluent are suitable for relatively unconstrained sites and sites which have sufficient space to install the EDS.

Additional information for effluent quality

Specialist design approaches are typically required for trenches and beds dosed with primary effluent on low permeability and/or sodic soils. One potential option for addressing risks associated with the long-term acceptance rate of these soils is to incorporate a depth of unsaturated permeable soil (typically sand) between the point of application and the base of the trench (i.e. the interface with the low permeability soil). This has been shown to improve the quality of water at the interface between the trench and in situ soil (U.S. Environmental Protection Agency, 2002).

This layer should remain predominantly unsaturated to provide significant improvement in the organic and solids loading on the trench base which will not be feasible on some sites due to available soil depth. The depth of unsaturated permeable soil should be maximised with a recommended range of 300–600 mm. Measures to achieve even, intermittent dosing (see Table 58) are recommended.

Such systems will require a site specific, specialist design and represent a risk mitigation option for primary effluent dosed trenches and beds on Category 5 and 6 soils with permeability constraints. They cannot be used to adopt DLRs for secondary treated effluent from Table L1 of AS/NZS 1547:2012.

Appendix 2.2.3 Evapotranspiration trenches and beds

Like conventional trenches and beds, evapotranspiration trenches and beds can be designed in several configurations. The allowable dimensions are presented in Table L2 in Appendix L of AS/NZS 1547:2012. Table 60 outlines when designers may want to maximise or minimise these design parameters.

Enhanced evapotranspiration

Wick trenches

As with conventional and evapotranspiration trenches and beds, the selected length and width of wick trenches can vary depending on the constraints present at the site. The DLRs presented in Table L1 of AS/NZS 1547:2012 for trenches and beds can be adopted for wick trenches. A similar equation to Equation L1 in AS/NZS 1547:2012 is used to calculate the size of the wick trench. This equation is presented in Section 10.8 of *Designing and Installing On-Site Wastewater Systems: A Sydney Catchment Authority Current Recommended Practice* (Sydney Catchment Authority, 2012).

Wick trenches are typically built with a trench containing a plastic self-supporting arch and a shallower evapotranspiration bed which is connected to the trench using a geotextile fabric liner which wicks effluent from the trench. The evapotranspiration bed is the same length as the trench and approximately twice the width. The length, width and depth of the trench can be adopted from the typical trench dimensions as outlined in Table L2 of AS/NZS 1547:2012. The typical depth of the gravel media of the evapotranspiration bed is ~200 mm.

Table 60 outlines when designers may want to maximise or minimise these design parameters.

Vegetated recirculating evapotranspiration beds

Vegetated recirculating evapotranspiration beds are sized using a water balance model developed for the site. As described in Section 4.4, a water balance model includes local rainfall data, evapotranspiration potential, crop coefficient and wastewater volume. For zero discharge systems, the size and number of beds should be designed to be water balanced so there is no excess or 'discharged' water. The design of these systems includes sizing the bed and recirculation tank and wet weather storage tank and downstream EDS if required.

For systems that require some discharge of effluent, an EDS should be designed in accordance with this document to manage the excess effluent generated. The selected EDS options should be based on the level of treatment provided by the onsite wastewater treatment plant as outlined in the GOWM (Table 4-5).

For sites with only periodic or seasonal excess effluent it may be beneficial to size wet weather storage infrastructure to limit the size of the total bed or EDS required. Wet weather storage would normally be sized using a water balance with daily timestep to avoid oversimplification of the model and overdesigning of EDS and wet weather storage infrastructure.

Vegetated recirculating evapotranspiration beds can be installed as multiple beds to reduce the size of the impermeable (often plastic) pod required. This can make transportation and handling of the pods less challenging. Often, plastic tubs 6 m² (3 m long x 2 m wide) are used. However, any configuration can be adopted if the system is sized appropriately.

Additionally, consider planting appropriate vegetation with high water uptake in the system. Bamboo (*Bambusa Oldhamii*) is commonly used.

Appendix 2.2.4 Shallow subsurface and surface irrigation systems

This section provides guidance on irrigation systems including subsurface, LPED and surface.

Shallow subsurface irrigation

Shallow subsurface irrigation systems are installed approximately 100–150 mm beneath the soil surface. Pressure compensating, antisiphon, non-leakage dripline is recommended to reduce leakage from the dripline emitters during non-operational periods. The DLRs adopted for these systems are presented in Table M1 of AS/NZS 1547:2012.

Design parameters, which can be altered when undertaking system hydraulic calculations are presented in Table 61.

Table 61: Design considerations for shallow subsurface irrigation systems

Design parameter	Description	Suitability indicator	
		Lesser	Greater
Emitter flow rate	Typical emitter flow rates for pressure compensating subsurface dripline are either 1.6 L/hr or 2.3 L/hr. Selection of an appropriate emitter flow rate can be influenced by the required zone flow rate or in response to the permeability of the receiving soil.	1.6 L/hr emitter adopted if a lower zone flow rate is required. Recommended for category 3–6 soils.	2.5 L/hr emitter adopted if a higher zone flow rate is required. Recommended for category 1–2 soils.
Emitter type Anti-siphon (AS) or compensating, non-leak (CNL)	Emitter types include AS or CNL emitter. AS emitters allow effluent to only flow in one direction and prevent effluent or soil particles from being siphoned back into the dripline. AS emitters prevent flow up to pressures of ~0.3m head ¹⁹ CNL emitters output the same drip rate for a range of supply pressures and output no effluent unless the change in elevation across the zone >~1.4–2.5 m ²⁰ .	AS emitters are appropriate for flat sites or zoned systems with <0.3 m change in elevation across the hydraulic zone.	CNL emitters are appropriate for sites with >0.3 m change in elevation across the hydraulic zone. CNL emitters assist in minimising emitter leakage. Where the change in elevation >1.5 m additional leakage management should be implemented.

¹⁹ Dependent on the emitter brand and model.

²⁰ Dependent on the emitter brand and model.

Design parameter	Description	Suitability indicator	
		Lesser	Greater
Emitter spacing	Dripline emitter spacings are typically 0.4 m and 0.5 m. While other spacings exist, these may require a special order and should be avoided where possible to enable construction to be cost effective and practical.	Adopt 0.4 m spacings to increase zone flow rate.	Adopt 0.5 m spacings to decrease zone flow rate.
Lateral spacing	Lateral spacings of the dripline typically range between 0.6–1.0 m to maximise effective effluent distribution. Lateral spacing can be influenced by factors such as soil category and slope.	Adopt 0.6 m spacing to improve distribution (wetting) on very high and very low permeability soils on flat sites.	Adopt 1.0 m spacing on gently sloping sites with category 2–3 soils.
Zoning	<p>Hydraulic zoning can be used to reduce the required operating pressure and pump size of the system.</p> <p>Increasing the number of hydraulic zones may reduce the width of the irrigation field with a subsequent reduction in the elevation differential between the top and the bottom of the zone. This could eliminate the requirement for additional leakage management.</p> <p>Hydraulic zoning provides each zone with rest periods, which can facilitate increased hydraulic and treatment performance.</p>	<p>Single zoned systems are suitable for:</p> <p>Smaller irrigation fields (e.g., EDS size <400 m² depending on pump).</p> <p>Sites that are reasonably unconstrained (e.g., relatively flat, category 3–4 soils and without sensitive receiving environments).</p>	<p>Zoning is beneficial for sites with larger wastewater flows and highly constrained sites (e.g., slopes >10%, in proximity to sensitive receiving environments and soils with either high or very low permeability).</p> <p>Zoning can assist in reducing the size of the irrigation pump.</p>

Valves

The purpose of flush valves is to enable lateral flushing. Flush valves are installed on the flush line below all the laterals. It may be beneficial to install multiple flush valves in other locations so the system can be flushed in multiple directions.

The purpose of air release/vacuum valves is to release entrained air and break the vacuum after pump shut off. Air release/vacuum valves are to be installed at the top or higher point of each zone. Multiple valves may be required where subsections of a zone are isolated from each other. Entrained air pockets can increase head loss and reduce or prevent flow. The development of vacuums can cause emitter blockage through entrainment of soil particles and, in some cases, siphon the contents of the effluent pumpwell.

Leakage management in the form of check valves or DNL valves is required where changes in elevation exceed ~0.3m for AS drip line and ~1.4m for CNL drip line²¹. Check valves and DNL valves operate as a one-way valve and are opened when sufficient pressure is achieved (i.e., through pump operation). When the pump is turned off, the valves return to the closed position and effluent cannot pass through the valve. Check valves have an adjustable shutoff pressure while DNL valves have a static shutoff pressure. The shutoff pressure is dependent on the brand and model of the valve chosen.

Check valves and DNL valves should be installed as follows:

- Check valves are installed on distribution mainlines and flush submains and must be installed above or below the same lateral to prevent flow to the bottom of the field after pump shut off.
- DNL valves are installed on the laterals to prevent flow below the valve after pump shut off.

Alternative dripline installation methods

In some situations it may be challenging to install dripline ~100–150 mm below the soil surface due to the presence of mature trees and tree roots or due to significant site slopes. In these cases the dripline may be able to be pinned to the soil surface and then covered in imported mulch or topsoil. This approach also enables driplines to be installed more easily in abstract design configurations or in garden beds.

One of the key limitations to this approach is that mulch may be eroded or washed away, particularly on sites with steeper slopes. The depth of mulch should be periodically checked, and additional mulch imported as required. Where the potential for surface water erosion is high, netting and upslope diversion drainage should be installed. It is important that the existing soil is ripped or scarified to encourage infiltration into the soil profile.

Lateral alignment

Lateral alignment should follow the contour (i.e., perpendicular to the slope) of the EDRS where possible. Containment of wastewater onsite may be challenging where laterals are installed down the slope. Where lateral alignment across the contour is not possible due to site and landform constraints, laterals can be installed as required subject to implementation of appropriate control measures such as leakage management. An example of leakage management may include check valves installed on the mainline and flush line or DNL valves installed on individual laterals where a change in elevation between laterals exceeds 1 m.

²¹ The exact change in elevation is dependent on the pressure rating of the product used.

Lateral looping

Lateral looping refers to the connection of the dripline laterals into the distribution main (supply manifold) and flush manifold that are located on one side of the irrigation field within the same trench. This is different to non-looped designs where the distribution main and flush manifold are within individual trenches located on opposite sides of the field. This can be beneficial in reducing lateral length variation for relatively thin or abstract shaped irrigation fields. It is important to keep lateral lengths as consistent as possible to reduce the potential for pressure loss along longer laterals (Refer to example EDRS schematics in Appendix 1).

Low pressure effluent distribution irrigation

Sizing

Distribution pipes should be laid in 200 mm x 200 mm trenches filled with aggregate. The aggregate is to be 10–15 mm in size and should be clean and free of organic matter.

The maximum effective soakage area that should be used is 1 m width between each shallow trench. On flat sites the effective area is taken as half of this width either side of the LPED line and for sloping sites this is taken as the full width downslope of each line.

The DLRs for LPED irrigation systems are presented in Table M1 of AS/NZS 1547:2012.

Effluent distribution

LPED irrigation systems are a pressure dosed system and should not be gravity dosed or dose loaded. The EDS should consist of 25–30 mm perforated pipe with 2–3 mm holes drilled at equal spacings. This perforated pipe is typically installed in an 80–100 mm slotted distribution pipe to provide an air space around the discharge orifice. Given that the system is pressurised, distribution to multiple zones is by sequencing valves and not drop boxes or distribution boxes. Further guidance on LPED hydraulics can be found in Appendix 2.3.7.

Surface irrigation

Surface irrigation systems are designed with low throw, heavy droplet sprinklers (for example, wobblers or similar) to reduce the risk of aerosol dispersion and the likelihood of wind drift distributing effluent beyond the designated area. As outlined in Section M8 of AS/NZS 1547:2012, signs must be installed at the boundaries of the designated surface irrigation area to warn site users. The signage must be compliant with AS 1319:1994 and have wording such as '*Recycled Water – Avoid Contact – DO NOT Drink*'. The DLRs adopted for these systems are presented in Table M1 of AS/NZS 1547:2012.

Sprays should not have a height greater than 500 mm above the finished ground level or a wetted perimeter of greater than 2 m. Refer to Appendix M of AS/NZS 1547:2012 for further design guideline criteria.

Design parameters which can be altered when undertaking system hydraulic calculations are presented in Table 62. Flush valves and air release valves are required as outlined in Appendix 2.2.4. Refer to Appendix 1 for surface irrigation schematics.

Table 62: Design considerations for surface irrigation systems

Design parameter	Description	Suitability indicator	
		Lesser	Greater
Lateral spacing/spray throw	Lateral spacings are chosen to ensure that the distance between laterals is equal to the diameter of the sprinkler throw as a minimum to ensure satisfactory distribution of effluent. Larger spacings may be adopted, however, consideration should be given to ensure the required irrigation area coverage is achieved.	Lateral spacings are equal to the diameter of the sprinkler wetted perimeter.	Lateral spacings are equal to the diameter of the sprinkler wetted perimeter plus ~0.5 m.
Zoning	<p>Hydraulic zoning can be used to reduce the required operating pressure and pump size of the system.</p> <p>Increasing the number of hydraulic zones can reduce the irrigation field width and reduce the elevation differential between the top and the bottom of the zone, which may mean additional leakage management is not required.</p> <p>Hydraulic zoning provides each zone with rest periods, which can facilitate increased hydraulic and treatment performance.</p> <p>A common zone configuration for surface irrigation is one lateral along the elevation contour per zone. This helps minimise issues associated with drain down and leakage.</p>	Single zoned systems are suitable for smaller irrigation fields and/or sites that are reasonably unconstrained (e.g., category 3–4 soils and without sensitive receiving environments).	<p>Zoning is beneficial for sites with larger wastewater flows and highly constrained sites (e.g., soils with either high or very low permeability).</p> <p>Zoning reduces the size of the pump required.</p>

Appendix 2.2.5 Wisconsin mounds (raised or above grade systems)

Wisconsin mounds have several design parameters that can be modified to accommodate site-specific constraints. These parameters include effluent quality, batter slope, alignment, and several hydraulic parameters. Refer to Appendix N of AS/NZS 1547:2012 for Wisconsin mound design requirements.

Table 63 outlines the design parameters that should be considered when designing a Wisconsin mound.

Table 63: Design considerations for Wisconsin mound systems

Design parameter	Description	Suitability indicator	
		Lesser	Greater
Effluent quality	Wisconsin mound systems are suitable to receive either primary or secondary effluent.	<p>Primary dosed systems have a lower sand loading rate (SLR) resulting in a larger footprint.</p> <p>Suitable for sites that are relatively unconstrained, and where availability of suitable land is not a limitation.</p> <p>Constructed with a minimum sand depth of 600 mm between the ground surface and base of the distribution bed. This has been shown to provide a level of pollutant reduction comparable to secondary treatment.</p>	<p>Secondary dosed systems have a higher sand loading rate (SLR) and therefore a smaller footprint.</p> <p>Suitable for highly constrained sites or sites with limited area available for EDS installation.</p>
Batter slope	Typical mound batter slopes are 3H:1V. Increased batter slopes can significantly increase the mound footprint, especially for sites with steeper slopes.	Adopt a mound batter slope of 3H:1V.	Adopt a batter slope of 4H:1V for larger mounds to assist accessibility for maintenance.
Mound alignment	For highly constrained or small sites, consider installing multiple shorter mounds instead of a single longer mound.	<p>Install one single mound on sites where it can be sited to meet environmental and human health requirements.</p> <p>Longer EDS have lower loading rates and therefore can meet environmental targets in shorter downstream distances (e.g., setbacks to achieve total viral die-off).</p>	<p>Install multiple shorter mounds.</p> <p>One disadvantage of shorter mound lengths is an increase in the LLR which may increase the required attenuation setback distance.</p>
Lateral spacing	Lateral spacings are chosen to ensure that the distance between laterals is sufficient to ensure even distribution of effluent throughout the distribution bed.	Adopted lateral spacings are 0.4 m and the zone flow rate is increased.	Adopted lateral spacings are 0.6 m and the zone flow rate is decreased.

Design parameter	Description	Suitability indicator	
		Lesser	Greater
	Lateral spacings should not exceed 0.6 m and are typically 0.4–0.6 m.		
Zoning	<p>Hydraulic zoning can be used to reduce the required operating pressure and pump size of the system.</p> <p>Hydraulic zoning provides each zone with rest periods, which can facilitate increased hydraulic and treatment performance.</p>	<p>Single zoned systems are suitable for smaller mounds and/or sites that are reasonably unconstrained (e.g., category 3–4 soils and without sensitive receiving environments).</p>	<p>Zoning is beneficial for sites with larger wastewater flows and highly constrained sites (e.g., soils with either high or very low permeability).</p> <p>Zoning reduces the size of the pump required.</p>

Loading rates

Design loading rate

Table N1 in Appendix N of AS/NZS 1547:2012 presents the DLR for Wisconsin mounds. The DLR determines the minimum basal area required to enable percolation of effluent into the underlying soil profile. The configuration of the effective basal area to which the DLR is applied is determined by the surface slope the mound is to be constructed on.

Refer to Appendix N (N2.1) of AS/NZS 1547:2012 for the calculation method.

On sloping sites the mound shall extend along the contour with the toe of the mound constructed parallel to the contour to control the LLR. The toe length should be designed and extended where risk of breakout is expected.

Linear loading rate

Selection of an appropriate LLR is essential to the hydraulic performance of Wisconsin mounds. Adopted LLRs should be based on the slope in the proposed mound location and limiting soil texture in the top 600 mm from the base of the mound distribution bed. For secondary dosed mounds, the limiting soil texture should be the limiting soil in the top 200 mm of the natural soil profile, while for primary dosed mounds, the limiting soil texture is effectively the topsoil or surface texture. Guidance LLRs are presented in Table 64.

Sand media loading rate

The design sand loading rate for the absorption area (i.e., the aggregate/sand interface) determines the required size of the distribution bed. Section N2.2 of AS/NZS 1547:2012 outlines that the sand media loading rate shall not exceed 40 mm/day. Consider reducing this value where the mound is to receive primary treated effluent. Converse and Tyler (2000) recommend 50 mm/day for secondary effluent and 35 mm/day for primary effluent.

Table 64: Wisconsin mound linear loading rates

Soil texture	Soil structure	Linear loading rate (L/m/day) ²²								
		Slope <5%			Slope 5–10%			Slope 10–15%		
		Depth to limiting layer								
		0.2–0.3	0.31–0.6	>0.6	0.2–0.3	0.3–0.6	> 0.6	0.2–0.3	0.3–0.6	>0.6
Gravel, sand, loamy sand, clayey sand	Massive	60	75	89	75	89	104	89	104	119
Sandy loam, fine sandy loam	Massive	45	52	60	54	61	69	75	89	104
	Weakly to moderately structured	52	67	82	60	75	89	75	89	104
Loam, fine sandy loam	Massive	30	34	39	36	40	45	40	48	55
	Weakly structured	45	52	60	49	57	64	54	61	69
	Highly to moderately structured	49	57	64	54	61	69	58	66	73

²² Linear Loading Rates were adopted from Tyler E.J (2001) and are widely accepted LLRs for Wisconsin mounds. For example, the WaterNSW *Designing and Installing On-site Wastewater Systems* (2023) guideline also recommends these values.

Linear loading rate (L/m/day)²²

Soil texture	Soil structure	Linear loading rate (L/m/day) ²²								
		Slope <5%			Slope 5–10%			Slope 10–15%		
		Depth to limiting layer								
		0.2–0.3	0.31–0.6	>0.6	0.2–0.3	0.3–0.6	> 0.6	0.2–0.3	0.3–0.6	>0.6
Clay loam, sandy clay loam, fine sandy clay loam, silty loam	Massive	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Weakly structured	30	37	45	33	40	48	36	43	51
	Highly to moderately structured	36	43	51	40	45	49	45	52	60
Sandy clay, silty clay, clay	Massive	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Weakly structured	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Highly to moderately structured	30	37	45	33	40	48	36	43	51

Media

As outlined in Section N3.3 of AS/NZS 1547:2012, Wisconsin mounds are formed with a sand-fill media. A distribution bed is constructed with selected aggregate, and a distribution manifold is constructed within the middle portion of the aggregate which is covered with fabric, a capping layer and topsoil. The fabric prevents finer soils particles from the capping layer from clogging the aggregate.

The sand-fill media should be:

- medium sand with an effective size of 0.25–1.0 mm
- have a uniformity coefficient of <4
- have <3% fines passing through a 200 sieve (0.074 mm)
- be free of clay, limestone, and organic materials.

The distribution aggregate should be:

- graded river run aggregate
- 20–60 mm in size
- rounded and non-crushed.

The minimum depths of media required for Wisconsin mounds are presented in Table 65. For further information, Refer to Appendix N of AS/NZS 1547:2012.

Table 65: Minimum media depths required for Wisconsin mounds

Parameter	Value (m)
Minimum depth of sand-fill media from the surface elevation to base of the distribution bed	Primary treated effluent – 600 mm Secondary treated effluent – 400 mm
Minimum depth of distribution aggregate	225 mm (typically 300 mm adopted)
Capping layer	300 mm
Topsoil	150 mm

Effluent distribution method

Effluent is distributed to Wisconsin mounds using pressure dosing. The distribution main from the pump is connected to a distribution manifold that conveys effluent to the perforated pipe distribution laterals. The distribution laterals are normally of LPED type. It is possible to use pressure compensating dripline to pressure dose secondary effluent loaded mounds. This requires specialist design.

The distribution main and laterals should be hydraulically designed to ensure adequate residual pressures and efficient pump operability is achieved (refer to Appendix 2.3 for hydraulic guidance). Mound distribution manifolds typically require zoning to enable use of available pumps for all but the smaller domestic mounds.

Sizing calculations

Detailed Wisconsin mound sizing calculations are presented in Figure N1 of AS/NZS 1547:2012. An example calculation is presented in the *Wisconsin Mound Soil Absorption System: Siting, Design and Construction Manual* (Converse & Tyler, 2000). This manual also includes additional information on the calculation of parameters that are dependent on the site slope, which include the basal length and width, slope widths and the depth of sand beneath the downslope end of the distribution bed.

Appendix 2.2.6 Effluent recycling systems

As described in the GOWM and Chapter 2 of this guidance, treated effluent from domestic, commercial or industrial greywater treatment systems can be used for (limited) indoor and outdoor recycling purposes subject to regulatory approval.

Reference documents providing information and guidance can be found in Table 66.

Indoor recycling

Greywater treated to an appropriate standard can be used in single and multi-dwelling residential settings and commercial settings. The standard of treatment will in part be influenced by the setting and proposed activity.

Outdoor recycling

Outdoor recycling may include irrigation of lawns and gardens through either fixed irrigation or handheld purple hose based on the GOWM. Guidance on suitable uses for outdoor recycling can be found in Section 4.3 and Table 4-6 of the GOWM.

Table 66: Greywater information reference sources

Reference document	Relevant matters
GOWM Sections 4.3 and 4.4	<ul style="list-style-type: none"> Wastewater treatment (4.3) Quality standards (4.3.1) Greywater treatment (4.3.4) Wastewater dispersal and recycling (4.4)
AS 1546.4:2016 – On-site domestic wastewater treatment units Part 4: Domestic greywater treatment systems	<ul style="list-style-type: none"> Domestic premises (predominantly) Installation, operation, and maintenance
AS/NZS 1547:2012 On-site domestic wastewater systems	<ul style="list-style-type: none"> General information about greywater Subsurface land application of greywater
<i>Australian Guidelines for Water Recycling: Managing Health and Environmental Risks</i> (Phase 1)	<ul style="list-style-type: none"> Domestic Commercial Industrial

Appendix 2.3 Pump and hydraulic guidance

When specifying and/or selecting a pump for an onsite wastewater application consider the:

- liquid properties/effluent characteristics
- proposed pump duty
- maintainability and safety
- hydraulic performance
- transfer to a gravity dosed EDS or another tank
- pressure compensating drip irrigation
- LPED – including Wisconsin mounds.

Appendix 2.3.1 Liquid properties/effluent characteristics

Pump selection must be matched to the effluent being conveyed with consideration given to the following characteristics:

- solids content (soft and hard solids)
- chemical characteristics (particularly pH)
- temperature
- depth of submergence.

Some pumps will specify a millimetre particle size they are capable of conveying. Dirty water style pumps are typically warranted for secondary quality effluent suspended solids levels (30 mg/L) but may handle primary effluent. Vortex (open impeller) pumps have a greater ability to transfer larger solid materials but may not handle raw sewage. Macerator and grinder pumps are designed to transfer raw sewage in a macerated form.

Appendix 2.3.2 Proposed pump duty

It is also important to consider the duty and conditions the pump is required to operate under. Will the pump need to start and stop frequently? Is the pump you're considering rated for a specific number of starts per day? Alternatively, is this a pump that will only start one to 3 times per day but run for a longer period? In most onsite wastewater pumping scenarios, pumps with a high number of rated starts per day are usually desirable.

Appendix 2.3.3 Maintainable and safe

Pumps used in OWMS should not be 'hard wired' to the available power supply. They should be connected to a general-purpose outlet rated for its location (typically IP65).

Also consider the maintenance requirements for pumps, including accessibility and removal. It is preferable that a suitable removal device is installed that facilitates the safe and effective removal of pumps, such as chains or similar mechanisms. The devices must be made with material capable of withstanding the corrosive environment of a wastewater chamber. The use of barrel union or camlock style connections (or other suitable alternatives) can also make maintenance more practical.

Appendix 2.3.4 Hydraulic performance

The most important consideration in selecting a pump is selecting one with a performance curve (flow versus operating head) that matches the end duty. This will depend on the type of EDS or transfer. All hydraulic systems – such as LPED pipe, pressure compensating subsurface irrigation or DN100 slotted pipe – will have a different operating curve depending on operating pressure (known as the system

curve). The point where the pump curve and the system curve intersect is the duty point of the system. This is shown in Figure 17.

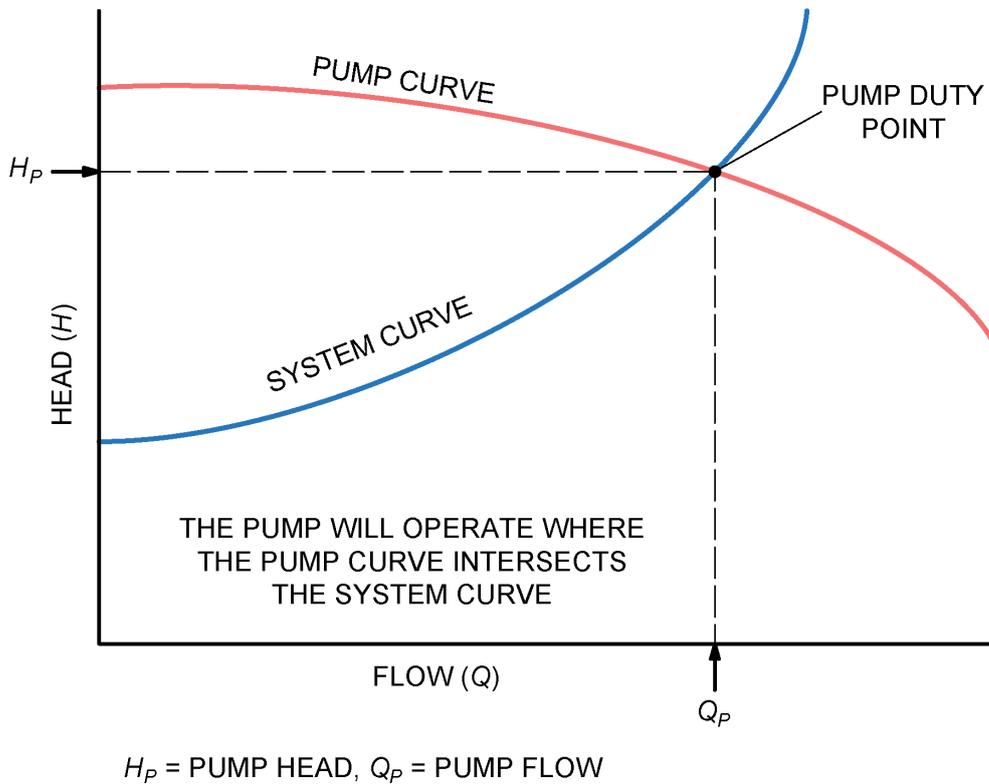


Figure 17 Example pump curve

Appendix 2.3.5 Transfer to a gravity dosed land application area or tank

Transfer pumps that convey effluent from a pumpwell to a gravity fed EDS or second tank or chamber must be sized to deliver an appropriate flow rate based on the static lift between pump and destination in addition to friction loss during flow through pipes and fittings, and energy lost at the point of discharge. Typical friction loss can be estimated from diagrams from pipe manufacturers or several online calculators.

An undersized pump will not be able to overcome the head losses making the resulting flow inadequate. Oversized pumps can also result in poor performance due to potential short-term overloading of the EDS. This will be particularly important on low permeability soils where there is limited head loss in the transfer system. It is common for submersible ‘sump’ pumps to operate with very high flow rates at low pressures (>200 L/min). This can be managed through installation of a valve in the transfer line designed to ‘throttle’ the flow.

Appendix 2.3.6 Pressure compensating drip irrigation

Hydraulic design is critical to the effective operation of a subsurface irrigation system. A common misconception among designers and installers is that the pressure compensating function of the emitters eliminates the need for adequate hydraulic design. Reference to standard sizing tables and

charts from dripline suppliers can be appropriate for smaller residential systems with limited constraints, however, this simplistic approach may not cater for more complex scenarios such as sloping sites, larger systems (for example, non-domestic flows) or complex EDS zoning arrangements.

Pump selection is also important. It is recommended that the pump can deliver 20–30 m of head at the emitters after allowing for static lift and friction loss in the delivery pipework and any fittings, filters or indexing valves. While the typical minimum operating pressure of the emitters is 10 m, performance of dripline is more reliable at operating heads >20 m. Similarly, heads up to 40 m can be accommodated, however, this increases the risk of leakage and damage to fittings which should be avoided where possible. The pressure compensating nature of these systems means the 'system curve' is almost flat between 10–40 m head resulting in improved flexibility.

Pressure compensating emitter leakage after pump shut-off

Commonly used pressure compensating (PC) emitters in drip irrigation (sometimes referred to as anti-siphon) operate at a uniform discharge flow rate between ~10–40 m head. However, emitters can 'weep or leak' until the hydraulic head at each emitter is approximately 0.3 m. This means that the contents of supply/flush lines and dripline laterals higher than 0.3 m above the emitters will drain slowly into the soil after the pump has shut off.

On relatively flat sites this is a negligible volume. However, on sloping sites with subsurface irrigation zones that are subject to significant crossfall, this can result in significant proportions of the daily effluent volume draining through the lower few laterals in a zone. This has the potential to overload the soil in localised areas and cause ponding or runoff.

To minimise the potential for emitter leakage where individual zones have more than 1 m of elevation change between the highest and lowest laterals, the following options are recommended:

- split the subsurface EDS into zones to reduce overall elevation differential
- use 'non-leakage' emitters with a higher shut-off head (custom order with ~1.5–5 m shut off available)
- install adjustable check valves on both the supply and flush pipework to minimise drainage after pump shut off at 1 m elevation intervals – suitable check valves are available from irrigation equipment suppliers
- install DNL valves on individual laterals with potential for significant seepage after pump shut-off.

It is common for subsurface irrigation fields to fail hydraulically due to this issue, which is often mistaken for overloading of the soil across the whole EDS. Further guidance on this can be found in Appendix 2.2.4 and the example schematic in Appendix 1.

Appendix 2.3.7 Low pressure effluent dosing (LPED) including Wisconsin mounds

Hydraulic design and pump selection for LPED systems can be complex due to the relationship between several factors including the zoning arrangements, length of laterals, orifice size and pipe diameter. It is recommended that a hydraulic design is provided by a suitably qualified person as part of the LCA/permit process. LPED can refer to dosing manifolds for:

- LPED systems as defined in Appendix M of AS/NZS 1547:2012
- LPED dosing manifolds in Wisconsin mounds (Appendix N of AS/NZS 1547:2012)
- pressure dosing manifolds in trenches and beds as a risk reduction measure on constrained sites.

There are 3 'rules of thumb' that should be considered when selecting a pump through hydraulic design of LPED systems:

- design for roughly 1.5 L/min per orifice to achieve the necessary velocity for scouring of pipe and discharge orifice
- achieve a minimum discharge pressure of 1.3 m at the orifice (equates to a 'squirt height' of ~0.9 m) with 1.5 m an optimum target
- ensure there is less than 15% variation in squirt height across the LPED zone.

There are limits to both the total number of laterals and lateral length before the variation in discharge pressure and achievement of scouring velocities are compromised when using typical commercially available domestic wastewater and dirty water pumps. In these cases, consider splitting an LPED manifold into multiple zones. These zones are typically sequentially dosed using an indexing valve or similar (refer to Appendix 2.2.4). More complex systems may justify the use of solenoid valves or similar actuated valves.

Friction loss calculations should be completed using 'Moody' diagrams or through site-specific calculations using the Darcy-Weisbach and Colebrook White equations. A nominal value for pressure loss at the discharge orifice for domestic scale LPED systems is 0.4 m head, however, site-specific calculation may be warranted on larger or more complex systems. Refer to the relevant example schematic in Appendix 1 for further guidance on LPED design and configuration. Further guidance on hydraulic design of LPED systems can be obtained from Ball (1995) and Orenco Systems (2017).

Appendix 2.4 Civil works, retaining walls and vegetation

Works involving the addition/removal of soil or the construction of retaining walls may be proposed as part of the development or as a design element for the selected EDS. In all situations careful consideration of the implications of the works will be necessary to evaluate potential impacts on the EDS such as constructability, system performance and unintentional downslope environmental consequences (i.e., preferential pathways).

Note

Design and construction of retaining walls and/or civil works must be performed by a person with appropriate qualifications and experience.

In some situations, approval may be required for the work. Contact the council to determine if an approval is required.

Appendix 2.4.1 Cutting or terracing

Cutting or terracing involves moving soil from one place to another to make the ground on which the EDS is to be constructed more level. Terracing may be required on sloping sites and involves the creation of a series of level pads on which the EDS is constructed. Cutting or terracing are common techniques used in the construction of EDS, however, the technique carries certain disadvantages and risks, including:

- disturbance of the natural level of soil compaction and creation of preferential flow paths or subsurface seepage breakout points
- removal of higher soil horizons that are typically a soil category better suited to effluent application
- change in depth of soil and subsequent reduced vertical separation distance to a limiting layer.

Cutting or terracing should be avoided where possible when siting EDS, particularly trench and bed systems. Where shallow subsurface systems are proposed, engineering design may be required for the earthworks and drainage. It is also recommended that a minimum of 250 mm of organic topsoil is established on the terrace through either topsoil retention and/or importation.

Appendix 2.4.2 Filling or raising

Filling or raising involves importing soil to level the site on which the EDS is to be constructed. Filling beneath the base of an EDS design such as a raised pressure dosed bed may also be an explicit design consideration to elevate the point of effluent application. For example, raising an EDS may be required because of groundwater levels or the flood prone nature of the property. Filling or raising land carries certain disadvantages and risks, including:

- creation of a 'lens' effect from introducing imported soil over in-situ soil, which can result in the creation of preferential pathways and movement of effluent
- stability issues associated with imported soil on sloping land
- requirement to carefully evaluate and select a compatible soil to import and use.

EDS located in raised fill material should be designed by an experienced wastewater practitioner and may require engineering input about geotechnical risks on sloping sites. As discussed in Section 4.7.1.3 LLR are critical to the hydraulic performance of all raised EDS, not just Wisconsin mounds. Stormwater control is also essential to ensure raised EDS operate effectively.

Appendix 2.4.3 Retaining walls

Retaining walls are vertical structural devices used to hold back (retain) soil to prevent it from moving downslope. The principal objective of retaining walls is being able to withstand the pressure exerted by the retained material under different situations. However, additional operational and environmental considerations will be required when they are proposed as an element of the EDS design. Retaining walls are not recommended as part of an EDS unless there are no alternatives. If implemented, the designer will need to consider the potential effects on the wall from construction and long-term operation of the EDS, especially soil moisture conditions. Retaining walls create an artificial dam for subsurface seepage (including applied effluent) and drainage measures designed to protect the stability of the wall may 'short circuit' EDS processes if constructed too close to the EDS itself.

Appendix R of AS/NZS 1547:2012 provides setback distance information for retaining walls and embankments, escarpments and cuttings.

Note

The height, design and location of the wall will influence the level of engineering required and the requirement for approval from the council.

Appendix 2.4.4 Vegetation

The selection of appropriate vegetation for the surface of the completed EDS is an important design consideration as not all vegetation is suited to all EDS types. While grass cover is suitable for most EDS – and typically provides higher water and nutrient uptake in a residential setting – plants, shrubs and trees are only suited to some designs. Large trees are not recommended as they can affect the performance of EDS from damage caused by root intrusion and reduced evapotranspiration resulting from shading and maturation of the tree (dependent on species).

Table 67 provides a guide to the selection of vegetation for each EDS type.

Table 67: Vegetation suitability

EDS	Suitable vegetation
Surface and subsurface Irrigation systems	Grass Gardens with plants and shrubs
Absorption trenches, beds and ETA systems	Grass
Wick trenches	Grass
Wisconsin mounds	Grass
Vegetative systems	Species selection by supplier

Vegetation removal

In some situations vegetation removal may be necessary to enable construction of the EDS. This may not always be the case as some EDS types and designs can be integrated with existing vegetation. As an example, subsurface irrigation designs can be incorporated onto the surface of vegetated areas by pinning and overlaying with mulch, however, the species of vegetation should be considered.

In all situations vegetation should only be removed where necessary. When this is required consultation with council is recommended prior to the works to determine local requirements.

Appendix 2.4.5 References to AS/NZS 1547:2012

Table 68 provides the references to AS/NZS 1547:2012 regarding other considerations for civil works, retaining walls and vegetation.

Table 68 AS/NZS 1547:2012 References to other considerations

Consideration	Section	Subsection	Page number
Cut, fill and retaining walls	Section 5.5 Land application system design	5.5.3.2 Design output	49
		5.5.3.3 Siting considerations	50
		Appendix R Setback distances for land application systems	Tables R1/R2
Vegetation	Section 5.5 Land application system design	5.5.3.2 Design output	49
		C5.5.5.4	56
		C5.5.6.1	57
	Section 6 Construction, installation, operation, and maintenance	6.2.4.1 Instructions	60
	Appendix A Risk management process guidelines	Table A1 – Examples of design risk reduction measures	77
	Appendix K Land application systems – guidance on selection	Table K2 Selecting the land application system to fit the site and soil	135
	Appendix L Land application methods – trenches, beds, and ETA systems	CL1	142
		L3 Plants	143
CL5.3		146	
Appendix M Land application methods – Irrigation systems	M7.1 General	161	

Appendix 2.5 Phosphorus-sorption capacity

Phosphorus sorption capacity refers to the capacity of a soil to adsorb phosphorus to the surface of clay particles. Phosphate adsorption rates in soil range quite significantly and are usually much higher in clay dominant soils than soils with coarser textures.

The actual phosphorus sorption capacity can be measured in a laboratory to allow a site-specific phosphorus balance or numerical modelling to be completed. The recommended method for calculating the phosphorus sorption capacity is Method 9J Phosphate Sorption Curve as presented in *Soil Chemical Methods – Australasia* (Rayment & Lyons, 2010). Where possible it is recommended that site-specific soil samples be taken, and the abovementioned analysis is completed to determine the site-specific phosphorus sorption capacity. Either a composite soil sample or subsoil horizon sample should be submitted for this analysis. In the absence of site-specific data, a conservative value should be assumed. An example nutrient balance setback distance calculation can be found in Table 69.

Appendix 2.5.1 Example nutrient balance setback distance calculation

This section provides an example nutrient buffer calculation scenario. In this example, the LCA assessor has completed a calculation to determine the size of an EDS using the simple hydraulic equation, monthly water balance and nitrogen and phosphorus balances. The theoretical results from the example scenario are presented in Table 69.

Table 69: Example EDS sizing assessment

Calculation method	EDS size (m ²)
Simple hydraulic equation	270
Monthly water balance	1,090
Nitrogen balance	220
Phosphorus balance	370

Interpretation

Except for the monthly water balance calculation, the phosphorus balance can be the most limiting design factor. This scenario is common along the east coast of Australia, particularly on sites with permeable soils due to the lower phosphorus sorption capacity of sandy soils.

Climate conditions along the eastern seaboard can exhibit higher rainfall levels than total pan evaporation. Monthly rainfall levels during the cooler seasons can also be significantly higher than monthly pan evaporation rates compared to the warmer months where the reverse is typically observed. This can influence the monthly water balance calculation resulting in an EDS footprint that is very large as it relates specifically to the 'wettest' month. Therefore, use of the monthly water balance calculation should be carefully considered to ensure it is appropriate for the climatic conditions.

An EDS size of 300 m² has been adopted as, in this example, there is limited suitable area available on the theoretical site, however, there are no sensitive receiving environments in proximity.

Therefore, an additional downslope area of 70 m² is required outside of the adopted EDS footprint as a nutrient buffer. This is to attenuate the excess phosphorus that cannot be attenuated within the proposed EDS area for the life of this system (assumed 50 years). This area is determined by subtracting the adopted EDS size from minimum area required for the EDS determined for phosphorus (i.e., 370 m²– 300 m² = 70 m²).

If the width of the EDS (across the slope/contours) is assumed at 20 m, the minimum downslope phosphorus setback distance required is calculated by dividing the required downslope buffer area by the width of the proposed EDS (i.e., 70 m² ÷ 20 m = 3.5 m).

The example LCA identified that the closest sensitive receiving environment is a non-perennial watercourse located ~40 m from the closest boundary of the EDS. Given the proposed phosphorus setback distance of 3.5 m is significantly less than the distance to the sensitive receiving environment, the proposed location and size of the EDS and nutrient buffer is considered appropriate.

This method can also be used where nitrogen may be the limiting feature.

Appendix 3. Checklists

Appendix 3.1 Permit application assessment checklist

The checklist provided in Table 70 can be used by councils as a tool to prompt, document and record the outcomes of the permit application assessment process.

The checklist can be customised to match the complexity of each permit application. Not all elements in the checklist may need consideration for every situation (for example, cost). The extent and level of assessment should be guided by the physical nature of the site in terms of the site, soil and environmental features and the scale of the development activity.

Table 70: Permit application assessment process checklist

Element	Sub-element	Literature references	Satisfactorily considered and addressed
Permit application assessment			
Prescribed matters	Application form completeness	EP Act 2017, Part 4.5 EP Regulations, Part 3.3, Cl. 25, 26(1)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Detailed plans, specifications, and particulars: <ul style="list-style-type: none"> • Site plan • Floor plan • Specifications • Proposed construction details 	EP Regulations 26(a)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Details of the development activity (proposed use)	EP Regulations 26(b)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Wastewater treatment plant: <ul style="list-style-type: none"> • Certificate of conformity, or • Exemption granted by the Authority 	EP Regulations 26€(i) 26€(ii)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Description of the proposed method of treatment and management of the effluent and evidence confirming the system	EP Regulation 26(d)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

Element	Sub-element	Literature references	Satisfactorily considered and addressed
	is appropriate for the proposed use		
Suitability assessment			
Treatment plant	Type	GOWM	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Permissibility (i.e., Sewered vs Unsewered)	GOWM	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Proposed use (i.e., EDS, RS (indoor), RS (Outdoor))	GOWM	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Site	Locality	EDRS Technical Guidance	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Lot size and available area	EDRS Technical Guidance Section 3.6.1.3	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Climate	EDRS Technical Guidance Section 3.5 guidance tables	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Landform and slope	EDRS Technical Guidance Section 3.6.1.2	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Surface and subsurface features	EDRS Technical Guidance Section 3.5 guidance tables	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Soils	Physical characteristics	EDRS Technical Guidance Section 2.6 and Section 3.6.2	<input type="checkbox"/> Yes
	<ul style="list-style-type: none"> • soil category • depth • fragments • dispersiveness 		<input type="checkbox"/> No <input type="checkbox"/> N/A

Element	Sub-element	Literature references	Satisfactorily considered and addressed
	<ul style="list-style-type: none"> groundwater saturation (seasonal) 		
	Chemical characteristics:		<input type="checkbox"/> Yes
	<ul style="list-style-type: none"> proposed soil treatments 		<input type="checkbox"/> No
			<input type="checkbox"/> N/A
Environment	Surface waters		<input type="checkbox"/> Yes
			<input type="checkbox"/> No
			<input type="checkbox"/> N/A
	Groundwaters and bores		<input type="checkbox"/> Yes
			<input type="checkbox"/> No
		<input type="checkbox"/> N/A	
	Vegetation and biodiversity values		<input type="checkbox"/> Yes
			<input type="checkbox"/> No
			<input type="checkbox"/> N/A
	Environmentally sensitive receiving environments	EP Regulation 28(h)(i)	<input type="checkbox"/> Yes
	Examples:		<input type="checkbox"/> No
	<ul style="list-style-type: none"> freshwater lakes sites located in sandy areas with high water tables receiving waters at risk of algal blooms from nutrients drinking water catchment aquaculture area 		<input type="checkbox"/> N/A

Functionality assessment

Design	Matters relating to the EDRS design:		<input type="checkbox"/> Yes
			<input type="checkbox"/> No
	<ul style="list-style-type: none"> consistency with planning requirements and restrictions 		<input type="checkbox"/> N/A
	<ul style="list-style-type: none"> appropriateness of method of effluent distribution alignment with Australian Standards 		

Element	Sub-element	Literature references	Satisfactorily considered and addressed
	<ul style="list-style-type: none"> compliance with water and sewer authority requirements factors related to ongoing maintenance requirements 		
Constructability	Matters relating to construction of the EDRS: <ul style="list-style-type: none"> site access distance from treatment plant slope soil stability availability/accessibility of services (e.g., power) 		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Costs²³	Matters relating to the financial cost of the EDRS as a function of the scale of the development: <ul style="list-style-type: none"> cost of construction cost of operation cost of ongoing maintenance 		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Regulatory assessment			
Prescribed matters confirmatory check under EP Regulations Part 3.3	Satisfactory assessment of the environmentally sensitive nature of the site and suitability of the site for the system and EDRS	EP Regulation 28(h)(i)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Satisfactory assessment of the system and EDRS for the site and proposed use	28(h)(ii)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Satisfactory alignment of the system and EDRS with any design specifications	28(h)(iii)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

²³ The cost-effectiveness of systems is a principle raised in AS/NZS 1547:2012 and the Principles of Environment Protection (Part 2.3 - Victorian *Environment Protection Act 2017*). It is acknowledged, however, that a cost evaluation would only be required in non-standard situations.

Element	Sub-element	Literature references	Satisfactorily considered and addressed
	Satisfactory assessment of the availability and size of the land in which the EDRS is proposed	28(h)(iv)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	Satisfactory alignment between the proposed system and any findings of the LCA (if required under regulation 26(2)€)	28(h)(v)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

Appendix 3.2 Example OWMS assessment checklist

Table 71 provides an example checklist to assist council officers to evaluate the technical and practical aspects of the OWMS for compliance with the requirements of Part 5.7 of the EP Regulations.

Note: It has been developed with reference to the EP Regulations (Part 5.7), however is not a comprehensive assessment of the features and characteristics that could be assessed for the various system types as part of council's routine inspection program.

Table 71: Example OWMS assessment checklist

OWMS assessment checklist

Property details				
Owner's name:				
Address:				
Suburb:				
Occupancy:	<input type="checkbox"/> Owner	<input type="checkbox"/> Occupier	<input type="checkbox"/> Other	
Bedrooms (No.):	Water supply:			
Wastewater treatment plant details				
System type:	<input type="checkbox"/> Septic tank	<input type="checkbox"/> Aerobic treatment system	<input type="checkbox"/> Greywater system	
	<input type="checkbox"/> Septic tank/Pumpwell	<input type="checkbox"/> Biological treatment system	<input type="checkbox"/> Other	
Date of last service:	Date of last desludge:			
Observations:	O1: Was the system overflowing at the time of inspection?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O2: Is there odour of effluent emanating from or near the system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O3: Is the grease trap (if applicable) full or blocked?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O4: Has the owner/occupier advised that the drain or toilet is running slowly?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

OWMS assessment checklist

	O5: Is the condition of pipes, tanks and storage systems satisfactory?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O6: Are the biological and/or chemical processes in the treatment system satisfactory?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O7: Is the system being maintained in accordance with the manufacturers specifications and recommendations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O8: Is the land used in conjunction with the system being maintained in a satisfactory manner with adequate access available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O9: Are records of maintenance activities available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Condition of system:	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Minor issues	<input type="checkbox"/> Unsatisfactory	
Comments:				
Effluent dispersal systems details				
EDS type:	<input type="checkbox"/> Absorption trench	<input type="checkbox"/> Conventional bed	<input type="checkbox"/> ETA/ETS	
	<input type="checkbox"/> Subsurface irrigation	<input type="checkbox"/> Surface irrigation	<input type="checkbox"/> Mound	
	<input type="checkbox"/> LPED	<input type="checkbox"/> Other:		
Observations	O10: Is the land application area damp or sodden?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O11: Is wastewater pooling on the surface of the surrounding land?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	O12: Is there wastewater runoff from the land application area?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

OWMS assessment checklist

	O13: Is the land used in conjunction with the system being maintained in a satisfactory manner with adequate access available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Regulatory assessment				
Regulation and observation	Requirement summary	Outcome		
159(1) Observations: O1, O2, O11, O12	A person in management or control of land on which an OWMS is located must take all reasonable steps to ensure the system is operated so as not to pose a risk of harm to human health or the environment.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A
159(2) Observations: O8, O5, O7, O13	A person (other than a renter) in management or control of land on which an OWMS is located must take all reasonable steps to ensure the system is maintained in good working order.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A
159(3) Observation: O1	A person in management or control of land on which a septic tank system is located must ensure the contents of the septic tank system do not overflow.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A
160 Observations: O9	An owner of land on which an OWMS is located must provide to a person in management or control of the system written information regarding the correct operation and maintenance of the system.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A
161(2) Observations: O1, O2, O3, O4, O10, O11, O12	A person in management or control of land on which an OWMS is located must notify the council, in whose municipal district the system is located, as soon as practicable after the person becomes aware, or reasonably should have been aware, that the system poses a risk of harm to human health or the environment or is otherwise not in good working order.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A
161(3)	A notification under this regulation must include the steps the person has taken, or proposes to take, to ensure the system no longer poses a risk of harm to human health or the environment and is returned to good working order.	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	<input type="checkbox"/> N/A

OWMS assessment checklist

162 Observation: 09	An owner of land on which an OWMS is located must keep and hold a record of all maintenance activities carried out on the system, including any pump-out and service records, for a period of 5 years after each maintenance activity.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory <input type="checkbox"/> N/A
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Comments, actions, or repairs needed	
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Name of inspector:		Date of inspection:	
--------------------	--	---------------------	--

Appendix 4. Example system designer statement

File reference:

Date: XX

Property owner, Company or council name

Address

State, Postcode

System designer statement – Onsite wastewater management system

Dear XX,

[Company XX] has completed an assessment of the onsite wastewater management system (*'the System'*) installed at the subject property under a permit issued by council to construct, install or alter an onsite wastewater management system.

This system designer statement relates to the design of the system documented in Onsite Wastewater Report [Report Reference] prepared by [Consultant]. This is not a certification against the council permit. Information regarding other mandatory inspections that may be stated in the permit can be obtained from the council or the construction company.

Property and approval details

Property owner/applicant:

Property address:

Council area:

Permit application reference:

Assessment details

The following records the details of the initial inspection or subsequent re-inspections as required.

Inspection date	Purpose	Assessor	Owner or agent name
Date	Initial Inspection or Re-inspection	Name	Name

Document list

The documents listed in the table below have been used in the assessment of the system design and construction.

Date provided	Document title

Follow-up action

What is required to address identified design inconsistencies?

[Company XX] can reassess the installation following completion of the actions listed in the table below. Please contact [Company XX] to arrange a re-inspection.

Design review outcomes (Report by exception)

A review of the general design of the system as constructed against the documented design subject of the permit has identified the following inconsistencies. The table below outlines any actions deemed appropriate or necessary to rectify the identified design inconsistencies. Reporting of outcomes is on an exception basis only.

Design review outcomes

No.	Identified inconsistency	Basis	Reference ¹	Level of inconsistency ²	Action required
1					
2					
3					
4					

¹Reference is to the permit, wastewater report, or relevant guideline such as AS/NZS 1547:2012 or the GOWM.

² The outcome of a review of the level of inconsistency is based on a simplified traffic light approach where:

- The identified design inconsistency is mostly minor, however, is within acceptable design tolerances.
- The identified design inconsistency is unsatisfactory and rectification work will be required.

Designer statement

Based on the outcomes of the design review and information available, [Company XX] states that the subject onsite wastewater management system **has/has not** been constructed in accordance with the design as detailed in the nominated documents and/or permit. Details of any nonconformances are provided in the design review outcomes table along with any actions require to enable [Company XX] to re-evaluate the installation as conforming.

If you have any queries regarding this designer statement, please do not hesitate to contact the undersigned using the contact details provided below.

Yours faithfully

[Company XX]

Assessor

Title

Date

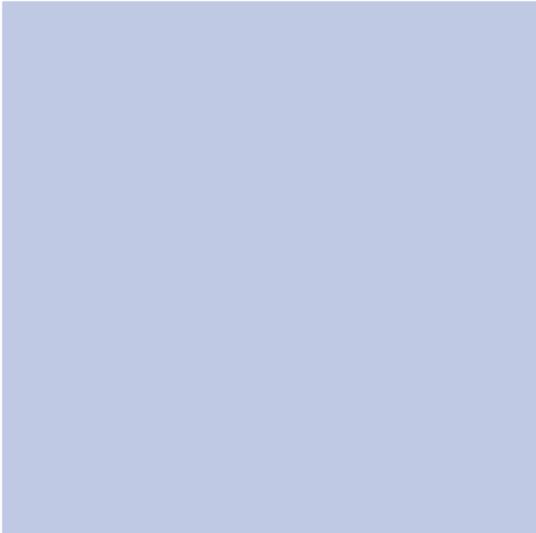


This System Designer Statement is strictly based on the nominated design documents, observations and measurements made at the time of inspection. [Company XX] accepts no liability for any non-conformances that are concealed or withheld from [Company XX] or for any modifications made to the System after this time without prior notification to [Company XX] of any intended modifications.

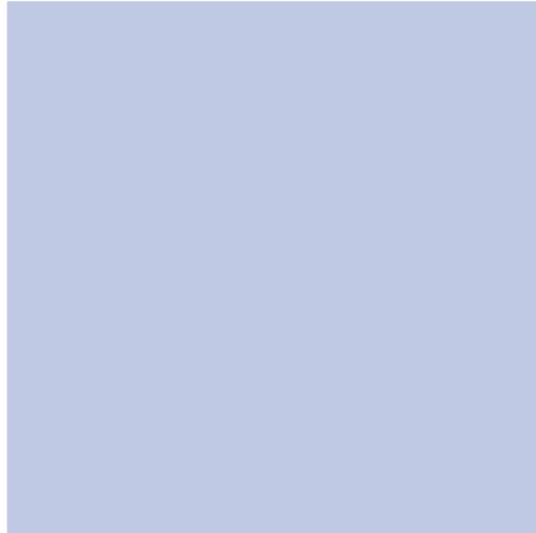
Similarly, [Company XX] accept no liability for the performance of the system resulting from any non-conformance identified in Table 1 of this Statement regardless of whether it is within tolerances for the Design or not. Failure to rectify or address any non-conformance listed in Table 1 is at the risk of the construction company, property owner or operator.

Site and system photos

Date and title



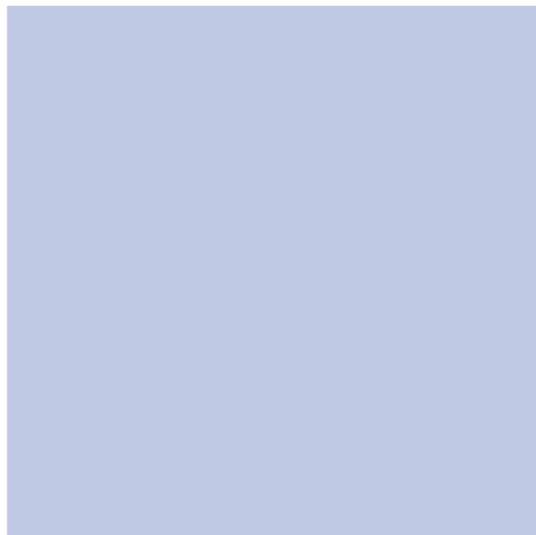
Date and title



Date and title



Date and title



Attachments

Add any attachments that may be relevant to the inspection, assessment, re-inspection, or permit. These may include:

- equipment or tank specifications
- certifications
- emails and correspondence
- plans.

Appendix 5. Example constructor verification statement

File reference:

Date: XX

Property owner, company, or council name

Address

State, Postcode

Constructor verification statement – onsite wastewater management system

[Company XX] has completed construction of the onsite wastewater management system installed at the subject property under a permit issued by council to construct, install or alter an onsite wastewater management system.

Details of the property, system and construction are provided below.

Property, system and approval details

Property owner/applicant:			
Property address:			
Council area:			
Permit application reference:			
Treatment plant type:			
Effluent dispersal system type:	Effluent dispersal system size (m ²):		
Date of construction (completion):	As-built plan(s) attached:	Yes/No	

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Comments and/or alteration²⁴ (List comments and/or alteration to the design)

1.

2.

3.

4.

Constructor verification statement

I believe on reasonable grounds that the onsite wastewater management system has been constructed in accordance with the design, related plans and documents as detailed in the abovementioned permit.

If you have any queries regarding this statement, please do not hesitate to contact the undersigned on the contact details provided below.

Yours faithfully

[Company XX]

Name

Title

Date



Add appropriate disclaimer statement

²⁴Alteration to an OWMS must be performed in accordance to the requirements under an A20 permit. The approval of the appropriate regulatory authority must be sought prior to proceeding with any alteration to the approved design or permit conditions.

Accessibility

Contact us if you need this information in an accessible format such as large print or audio. Please telephone **1300 372 842** or email contact@epa.vic.gov.au

Interpreter assistance



If you need interpreter assistance or want this document translated, please call 131 450 and advise your preferred language. If you are deaf, or have a hearing or speech impairment, contact us through the **National Relay Service**.



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