WATER SENSITIVE SA

Water sensitive urban design (WSUD) assets

Inspection and maintenance guidelines

Overview

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Disclaimer

Water Sensitive SA welcomes feedback on any improvements to these guidelines, particularly WSUD assets images in differing conditions for the *Condition assessment audit visual reference sheets*.

Acknowledgements

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These guidelines have been adapted from:

- Blacktown City Council (2019) *Water sensitive urban design (WSUD) inspection and maintenance guidelines* that were developed with assistance from E2Designlab Pty Ltd. A previous version was developed with assistance from Alluvium Consulting Australia Pty Ltd.
- DesignFlow (2022) *Maintenance of WSUD assets* course material, prepared for Water Sensitive SA
- Water by Design (2012) *Rectifying Vegetated Stormwater Assets (Draft),* Healthy Waterways Ltd developed with assistance from DesignFlow, Brisbane.
- Melbourne Water (2013) *WSUD maintenance guidelines. A guide for asset managers.*
- Stormwater Victoria and E2DesignLab *(2017) WSUD Audit Guidelines.*

About this suite of guidelines

This suite of guidelines provides information to effectively manage water sensitive urban design (WSUD) assets and provide certainty for maintenance and reporting requirements.

Inspection and maintenance guideline | Overview *(this document)*

This document is an introduction to inspection, maintenance, rectification and condition assessment audits of a variety of WSUD assets. It provides general information and an overview of how to apply asset management condition scoring techniques to WSUD assets.

This document should be read in conjunction with the inspection and maintenance guideline for the relevant WSUD asset.

How to use the *Inspection and maintenance guidelines for WSUD assets*

The individual inspection and maintenance guidelines for each WSUD asset type are set out as follows:

Section 1 Asset description and functional components provides an overview of the key functional components of each asset type. Before attempting to inspect and maintain a WSUD type, the relevant crew must be familiar with the relevant components of the WSUD asset and how they work.

Section 2 Inspection and maintenance forms and activities includes

Form ***01: Inspection & maintenance sheet – routine (proactive) & major*** – for use by maintenance crews to undertake regular, 3-12 monthly inspections to record:

- the condition of the various components of the WSUD asset
- the routine (proactive) maintenance activities undertaken at the time of the inspection
- details of Works Requests for any additional maintenance or rectification works.

Form ***02: Condition assessment audit – descriptive reference sheet*** – provides a condition assessment audit guide and matrix for all functional components of the WUSD asset.

Form ***03: Rectification sheet*** (if applicable) provides guidance on rectification activities for WSUD assets with complex functions.

Each asset should be inspected routinely, as well as during or after rainfall, to assess whether the system is working correctly and as intended. The inspection frequency is variable for each functional component and may be dependent on design, catchment size, surrounds and/or maintenance history.

WSUD assets covered by this guideline series

This guideline forms part of a suite of inspection and maintenance guidelines for common WSUD assets:

1. Biofilters (also known as bioretention systems or raingardens)
2. Swales and vegetated buffer strips
3. Stormwater detention basins
4. Permeable paving
5. Infiltration systems
6. Wetlands
7. Rainwater tanks (with and without on-site stormwater detention)

Contents

Managing water sensitive urban design assets

1 Water sensitive urban design

Water sensitive urban design (WSUD) is a scientifically proven approach to the planning and design of urban environments focused on integrating the urban water cycle (including potable water, wastewater and stormwater) with the built and natural urban landscape. It is linked to ecologically sustainable development, with a focus on the sustainable management of urban water resources and environmental protection, and the enhancement of socio-cultural conditions.

WSUD measures and technologies can be applied to residential, commercial and industrial developments and buildings. They range from the storage, treatment and use of runoff to water-efficient landscaping. WSUD can help communities achieve greater water sustainability and become pleasant places to live and work.

Untreated urban stormwater has a detrimental impact on waterways because of excess sediments, nutrients and other pollutants it carries. Additionally, after it has rained, large volumes of stormwater flow into waterways, which contributes to creek bed and bank erosion.

WSUD can provide an array of benefits to our community and environment including:

- improved waterway health by filtering, reducing the volume and slowing the rate of stormwater before it flows into local waterways
- enhanced flora and fauna habitat
- improved landscape attractiveness of streetscapes and other open spaces
- establishment of more green spaces to help reduce urban heat
- reduced reliance on potable water as harvested stormwater is used as an alternative resource for uses such as irrigation and toilet flushing.

Refer to the Water Sensitive SA website for more information on the design, construction and maintenance of WSUD assets.

2 Maintenance and rectification works

Maintenance involves regular or scheduled activities undertaken to keep vegetated assets functioning properly, for example weeding or removing sediment and litter. To identify if a vegetated stormwater asset is functioning properly, compare the state of the asset against the performance indicator (PI) provided in the checklists in the separate inspection and maintenance guideline for each asset type listed on page iii.

If the asset is meeting all PIs, it can be assumed to be functioning properly. However, if the asset is not meeting the PIs, it needs to be determined whether maintenance will be sufficient to resolve the problem or whether rectification is needed.

The maintenance of stormwater treatment assets often comprises a combination of engineering, landscape, ecological or horticultural components.

To effectively manage and operate treatment assets, a number of skilled people are required.

It is important that asset owners, managers and maintenance personnel understand the intended purpose and function of a stormwater treatment asset, and activities and equipment required for maintaining it.

Maintenance of stormwater treatment systems may be:

- undertaken in-house using works crews
- outsourced to a single contractor
- outsourced to separate civil and landscape contractors.

Rectification is required if there is a problem with function (e.g. the asset's ability to treat stormwater) that maintenance activities cannot address. Examples include:

- A design flaw, such as the levels of the hydraulic structures within the asset are not correct.
- Poor construction.
- The collapse of a hydraulic structure.
- Mass plant failure.

Engineering or horticultural experience may be required to identify whether a problem requires rectification and in what timeframe. Problems will develop over different timeframes, and some problems, if left unchecked, will develop into more serious asset management issues and become more difficult to rectify than the original problem.

For WSUD assets with complex functions guidance is provided on rectification activities in the separate inspection and maintenance guideline, as required.

3 Condition assessment audits

Routine audits

It is recommended that **routine audits** of WSUD assets are undertaken periodically, nominally every three to 12 months to:

- monitor the condition of assets
- identify required maintenance activities
- assess the effectiveness of maintenance (especially important when assets are maintained by an external party)
- determine likely timeframes for renewal.

Comprehensive audits

Comprehensive asset condition assessment audits should be undertaken at least every five years to ensure:

- the hydraulic function of the asset is as per the design requirements
- catchment conditions have not altered such that the WSUD asset requires design modifications or rectification works.

These audits should be undertaken by a specialist inhouse WSUD practitioner or an external consultant.

It is good practice for the condition assets assessment audit to be undertaken at the start and end of any WSUD asset maintenance contract.

Condition scoring

Maintenance and rectification requirements are identified through regular inspections of the assets and their functional components.

Table 3.1 Overview of maintenance requirements for the range of condition scores

Functional component condition score	Condition description	Maintenance required
Not rated (0)	Asset has been decommissioned, no longer exists or was not able to be rated due to serviceabilty issues	N/A
Very good (1)	As new	No maintenance required
Good (2)	Working well, performance indicators met	Minor maintenance required*
Fair (3)	Satisfactory functional performance	Routine (proactive)maintenance required*
Poor (4)	Limited functional performance	Major maintenance/minor rectification works required*
Very poor (5)	Loss of functional performance	Major rectification works required*

* Refer to maintenance response and information in the following maintenance sheets

Not rated – Condition score 0

Asset has been properly decommissioned, no longer exists (it should be removed from inaccurate plans), has not been condition-rated (or assigned an extrapolated condition), or is unable to be rated due to serviceability issues.

No maintenance – Condition score 1

When a functional component is scored as very good (1) or as new during an inspection, no maintenance is required.

Minor maintenance – Condition score 2

Functional components scored as good (2) and have met the PI as described in Part E, only minor maintenance is required. For example, removal of some litter and weeds, and desilting of inlets with a shovel.

Routine (proactive) maintenance – Condition score 3

Functional components scored as fair (3) require routine (proactive) maintenance. This usually consists of simple manual tasks that can be completed using basic landscaping tools such as rakes, spades, shovels and hoes to remove excess leaf litter and human litter, e.g. drink bottles; weed; desilt inlets and forebays with a shovel or vacuum truck where available; and replace a modest number of plants.

A lack of routine (proactive) maintenance or infrequent inspections may reduce the overall asset condition and require greater efforts and costs to rectify later.

Major maintenance/minor rectification works – Condition score 4

A lack of regular maintenance combined with will generally result in functional components scored as poor (4). This may require either major maintenance or minor rectification works to restore the function of the asset.

Major rectification – Condition score 5

Functional components scored as very poor (5) require immediate rectification or renewal as they could be a public safety hazard or affect the asset function and operation. Consultants or contractors with specialist knowledge may be required to identify the underlying issue and repair the asset. The scale of such works may include a complete redesign or asset replacement.

Generally, a well-designed, constructed and maintained asset can have a lifecycle of 20 to 30 years for vegetated assets or longer for non-vegetated assets.

Changes in the catchment condition, design or construction issues, or other emerging problems may cause an asset to require corrective maintenance.

4 Application to private developments

Developers subject to a basic infrastructure scheme will be required to submit a maintenance report to the relevant authority, e.g. Council at:

- practical completion
- the end of the maintenance period (i.e. at handover), typically 12-24 months after practical completion.

This report must detail the inspection and maintenance activities carried out on-site during the defects liability period, including any waste disposal dockets. The inspection and maintenance sheets in this guide can be submitted as part of an annual maintenance report, or can be submitted to Council as inspection and maintenance activities are undertaken.

Council reviews the reports to ensure appropriate maintenance is occurring and is authorised under the Local Government Act 1999 to enter premises and serve penalty notices for failure to comply with maintenance requirements set out in the Infrastructure Deed.

5 Workplace health and safety (WHS)

Workplace health and safety (WHS) is mandatory in all inspection and maintenance activities and must apply to everyone.

It is important that inspection and maintenance contractors, sub-contractors and personnel:

- have a thorough knowledge of relevant WHS risks associated with maintenance and monitoring activities
- are equipped with adequate personal protective equipment (e.g. high-visibility clothing, safety boots, ear plugs)
- have relevant training/certification to undertake the required inspection and maintenance activities (e.g. confined spaces training, plumbing licence, traffic control)
- maintain up-to-date WHS systems and processes, and can demonstrate compliance with these procedures through relevant written records.

Glossary and abbreviations

Algae	Algae or alga (singular) is a catch-all casual term to describe a broad and diverse range of organisms that are not all necessarily closely related. For example, some algae in freshwater lakes and wetland ponds can be a cyanobacteria in which some strains of are toxic and others aren't. Oddly enough, although sometimes referred to as "blue-green algae," it is not actually a real alga. There are several different forms that cyanobacteria may express itself including floating mats, colonial hair-like filaments often called "filamentous algae" which can also be a slime that is coated on plants, or is suspended within the water column which looks like pea soup.
ASTM	ASTM International, formerly known as American Society for Testing and Materials, is a developer of international voluntary consensus standards.
Basic infrastructure schemes	Basic infrastructure schemes will apply to defined "designated growth areas" and provide the mechanism to ensure the delivery of infrastructure that is immediately needed to make a neighbourhood liveable, such as water, sewerage, gas, electricity, telecommunications, roads, bridges and stormwater management.
Batter	A receding slope of earthwork.
Bioretention system	Vegetated depressions designed to collect, drain and treat stormwater. Stormwater infiltrates into a prescribed filter media that is densely planted. Pollutants are primarily removed by adsorption and biological transformation within the filtered media. Biofiltrations systems are also called **biofilters**, **biopods**, **biofiltration basins**, **raingardens** and **bioretention swales**.
CBR	California bearing ratio test is a simple strength test that compares the bearing capacity of a material with that of a well-graded crushed stone.
Catchment	An area of land that drains all run-off water to the same lowest point.
Charged system (rainwater tank)	A "charged line" system is needed if the pipe does not slope downwards along its length to the rainwater tank. The pipe can go down, often underground, and then up again, usually at the tank. The term 'charge' comes from the water being pushed up the pipe by the pressure of the water in the pipe.
Confined space	A confined space is an enclosed or partially enclosed structure that poses a danger because it is not designed or intended to be an area occupied by people. An enclosed or partially enclosed space: ▪ is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space ▪ is or is likely to be a risk to health and safety from: – an atmosphere that does not have a safe oxygen level – contaminants, including airborne gases, vapours and dusts, that may cause injury from • fire or explosion • harmful concentrations of any airborne contaminants • engulfment.
EDD	Extended detention depth defines the depth of water above the permanent pool that must be reached in the pond, detention basin or sedimentation basin before flow starts to discharge over the outflow weir.
Filter media	A prescribed soil media used in bioretention systems to filter stormwater and support plant growth.
Functional component	The discrete parts that form the asset.
GPT	Gross pollutant trap is a structure used to trap litter and large pieces of debris (>5mm) transported through the stormwater system.
Infiltration	The process by which surface water enters the soil.
Invert level	The floor or base level of a pipe or pit.
Macrophyte	A plant adapted to living in water or periodically inundated (ephemeral) habitats.
Major erosion	Erosion that requires earth moving equipment to remediate and/or significant quantities of soil, between $3m^3$ and $15m^3$.
Minor and localised erosion	Erosion that can be remediate with hand tools and small quantities of soil less than $1m^3$.
Moderate erosion	Erosion that requires a bobcat, or similar, to remediate and/or moderate quantities of soil, between $1m^3$ and $3m^3$.
Normal water level	The water level in a wetland or sediment basin equal to the level of the lowest free-draining outlet. After rainfall, water will pond up within the wetland or sediment basin in the extended detention zone, and then after three or four days the water level will return to its normal level.

Nutrients	Elements that are important for biological growth but are also a type of stormwater pollutant. Major nutrients of interest in stormwater are nitrogen and phosphorus.
Pollutants	Substances that may naturally occur but are present at harmful levels (e.g. sediment or nutrients in a water body) or that may be unnatural in the environment and capable of producing environmental harm (e.g. chlorinated pesticides).
Preferential flow path	The flow path of least resistance through a vegetated stormwater asset.
Priority weed	A declared prescribed under the Landscape South Australia Act 2019 or an environmental weed being a plant species that invade and dominate biofilter.
PVC	Poly vinyl chloride pipe, contains plasticisers to increase its flexibility and make it easy to bend.
Rainwater	Runoff from roof surfaces.
Rectification	The works involved in repairing a failed or underperforming vegetated stormwater asset back to a function state.
Riprap	Human-placed rock or other material used to protect waterways and other stormwater management structures against scour and water erosion.
Scour	The removal of sediment by fast or swiftly moving water.
Substrate stabilisers	Typically stabilised synthetic fibers, filaments, nettings and/or mesh that secure plant roots, stems and soil. This permanent material consolidates and protects the soil and prevents it being washed away (e.g. reinforced turf matting).
Stormwater	Runoff from all urban surfaces.
Swale	Swales are formed, vegetated depressions (or channels) that are utilised for the conveyance of runoff from impervious areas. They are typically linear, shallow and wide.
Treatment train	A series of stormwater quality treatment assets.
uPVC	Unplasticised poly vinyl chloride pipe, more rigid than PVC pipe.
Vegetated buffer strip	Grassed or vegetated areas that treat shallow overland flow before it enters the drainage network (or a discharge point).
Weed	A plant that is growing where it is not wanted.
WHS	Workplace health and safety, sometimes called occupational health and safety (OH&S), involves the management of risks to the health and safety of everyone in a workplace. This includes the health and safety of anyone who does work, as well as customers, visitors and suppliers.
WSUD	Water sensitive urban design is an approach to the planning and design of urban environments focused on integrating the urban water cycle (including potable water, wastewater and stormwater) with the built and natural urban landscape. It is linked to ecologically sustainable development, with a focus on the sustainable management of urban water resources and environmental protection, and the enhancement of socio-cultural conditions.