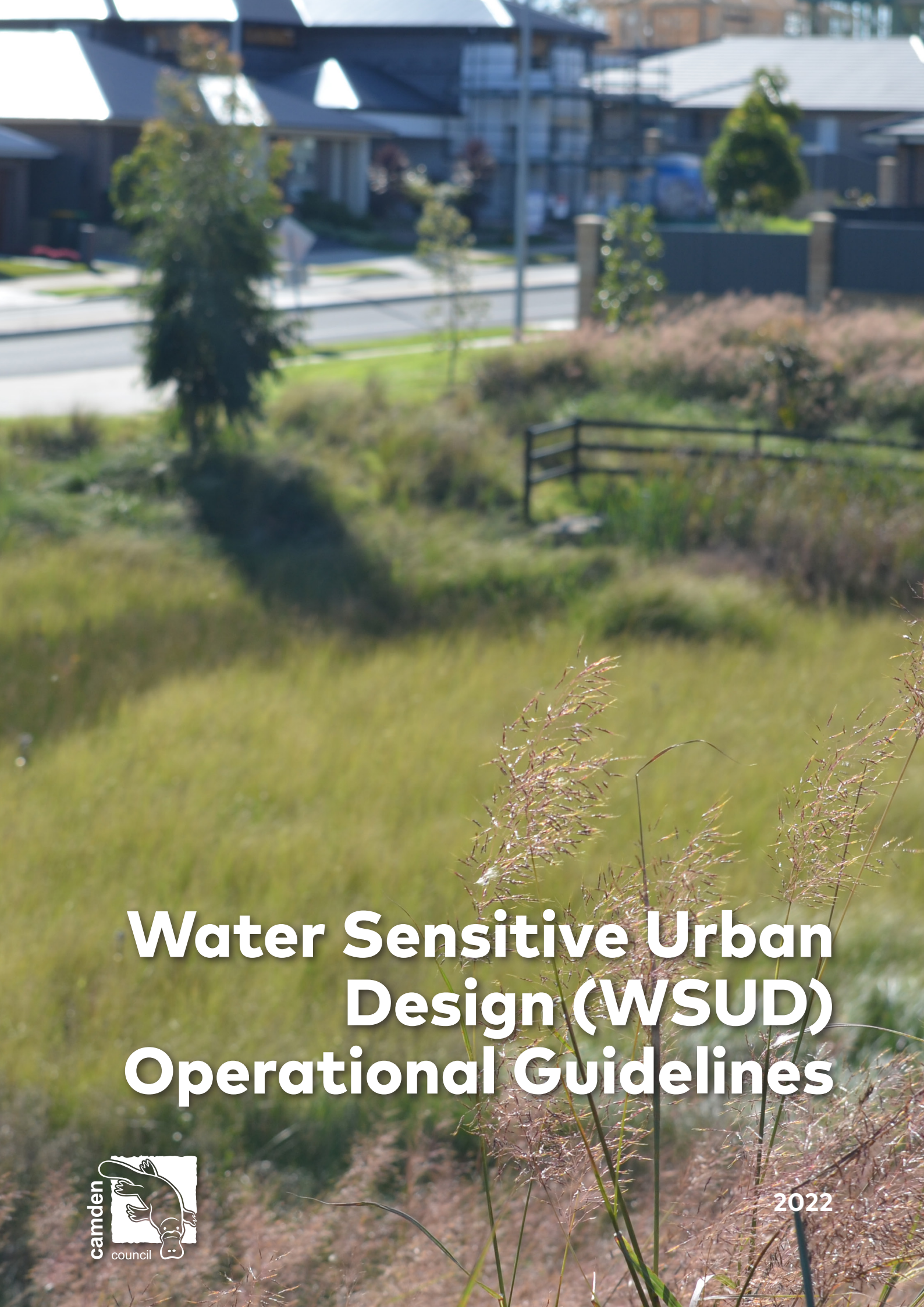

Water Sensitive Urban Design (WSUD) Operational Guidelines

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Little Pied Cormorant in Harrington Park Lake, Harrington Park.

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About this guide

This guide will assist asset managers, developers, the general public, maintenance personnel and Council staff to effectively manage water sensitive urban design (WSUD) assets.

The guide is set out in three parts:

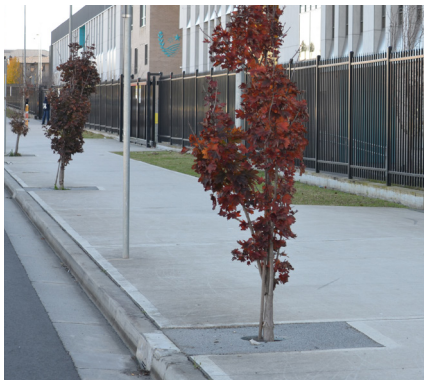
A. Overview of managing WSUD assets;

B. Description of each asset type and its functional components; and

C. Visual and descriptive summary of each functional component.

The reference and inspection sheets in Part B, along with the reference images in Part C help determine the condition score of an asset's functional components.

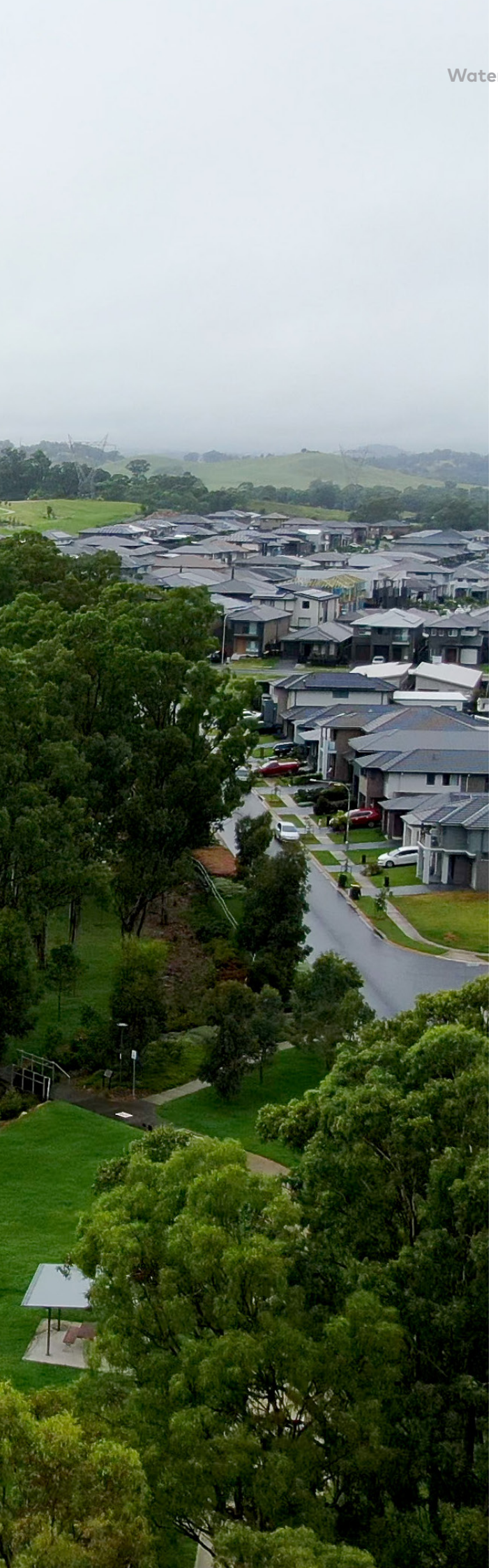
The condition score determines whether maintenance is required and the maintenance sheets in Part B specify suggested routine maintenance. These maintenance sheets can also be used for reporting.



Glossary and abbreviations

Catchment	An area of land which drains all runoff water to the same lowest point.
Confined space	An enclosed or partially enclosed space that: • is not designed to be occupied by a person; and • is intended to be at normal atmospheric pressure while any person is in the space; and • is or is likely to be a risk to health and safety from: o an unsafe oxygen level; or o contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion; or o harmful concentrations or any airborne contaminants; or o engulfment.
Detention time	The time it takes for water to flow from the inlet to the outlet.
EDD	Extended detention depth. The depth between the outlet pit invert and biofilter surface. It is usually between 100 and 300mm.
Functional component	The discrete parts that form the asset.
GPT	Gross pollutant trap. A GPT is a structure used to trap litter and large pieces of debris (>5mm) transported through the stormwater system.
Invert level	The floor or base level of a pipe or pit.
Macrophyte	Types of plants that grow in waterlogged conditions, such as rushes in surface wetlands.
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.
Orifice plate	This plate controls the flow of water discharging from an on-site stormwater detention system.
OSD	On-site stormwater detention.
Pavement	Any outdoor hard surface including concrete, asphalt and pavers.
PPE	Personal protective equipment. Anything that is used or worn to minimise risk to workers' health and safety including but not limited to boots, gloves, high visibility clothing, safety harnesses and sunscreen.
Rainwater	Runoff from roof surfaces.
RHAA	Rainwater Harvesting Association of Australia.
Scour	The removal of sediment by fast or swiftly moving water.
Stormwater	Runoff from all urban surfaces.
WHS	Work health and safety.
WSUD	Water sensitive urban design.

Aerial view of Wianamatta South Creek catchment in Gregory Hills.



PART A: MANAGING WATER SENSITIVE URBAN DESIGN (WSUD) ASSETS

The Camden Local Government Area has more than 26 kilometres of open drainage and over 720 kilometres of stormwater pipes that drain into the Wianamatta South Creek and Nepean River catchments.

The rapid transformation of rural land into urban areas with hard surfaces means less rainwater is absorbed into the ground. During rain events, the increased volume of fast-moving urban runoff (stormwater) collects pollutants and flows into stormwater drains and eventually into our local waterways.

Water sensitive urban design (WSUD) helps us manage stormwater and reduce the impact it has on waterways.

1. Water sensitive urban design (WSUD)

Water sensitive urban design (WSUD) is the scientifically proven technology and approach adopted by Camden Council to effectively manage stormwater.

Stormwater has a detrimental impact on our waterways due to the excess nutrients and pollutants it carries. After rain events, large volumes of stormwater flows enter our waterways contributing to creek bed and bank erosion.

WSUD can provide many benefits to our community and environment including:

- Improved waterway health by filtering, reducing 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;
- Increased green spaces helping reduce urban heat; and
- Reduced reliance on potable water as harvested stormwater can be used as an alternative resource for uses such as irrigation and toilet flushing.

2. Common types of (WSUD)

- Rainwater tanks (with and without on-site stormwater detention capacity)
- Biofilters (also known as bioretention systems or raingardens)
- Biofilter street tree pits
- Wetlands
- Floating wetlands
- Vegetated buffer strips or swales
- On-site stormwater detention (OSD)
- Gross pollutant traps (GPTs)
- Filter cartridges
- Pit inserts
- Permeable paving
- Temporary sediment basins.

3. Inspections

Part B includes reference and inspection sheets for different WSUD assets to help you determine the condition of the asset and its functional components. The condition determines the type of maintenance that should be taken. This is illustrated in the chart below.

Part C is a visual catalogue of all functional components in various conditions, which can be used to guide condition scoring during inspections.

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

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

4. Maintenance

Maintenance requirements are identified through regular asset inspections and scoring of their functional components.

No maintenance

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

Routine maintenance

Functional components scored as moderate (2) require routine maintenance. This usually consists of simple tasks that can be completed using basic landscaping tools such as rakes, spades, and shovels. General advice for maintaining these functional components is provided in the 'maintenance recommendation and information' column of the maintenance sheets in Part B. Most functional components will require this level of maintenance on a 3-monthly basis.

A lack of maintenance, or infrequent inspections, might reduce the overall asset condition and require greater efforts and costs to rectify later.

Corrective maintenance

Functional components scored as poor (3) require immediate rectification or renewal as they could be a public safety hazard or affect the asset function and operation. These may require consultants or contractors with specialist skills and knowledge to identify the underlying issue and repair the asset.

The scale of such works can vary from a simple repair of a damaged or broken component to a complete redesign or asset replacement.

Generally, a well-designed, constructed and maintained asset can have a life cycle of 20 to 30 years for vegetated asset or longer for non-vegetated assets. Civil elements and trees have a limited life and will eventually need replacement. Vegetated assets that can self-propagate may last indefinitely.

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

5. Outsourcing management

There are contractors specialised in WSUD asset management that can identify operational issues and rectify them appropriately. They should also be suitably licensed to dispose of waste correctly and work around confined spaces, if necessary.

Some maintenance contractors specialise in the inspection and maintenance of proprietary devices. Where parts or whole components of the asset require replacement or repair, these contractors must be engaged to complete the works.

Small routine maintenance tasks can be undertaken by the property owner; however, the most appropriate management option will depend on the size and complexity of the asset and the skills and expertise of the people managing them.

Under no circumstances should an untrained person enter a confined space. Where entering a confined space is necessary for an inspection or maintenance activity, a suitably qualified person must be used. Assets that commonly require confined space access have warning signs.

Part B contains more information about the level of expertise required for inspecting and maintaining each WSUD asset.

6. Safety

Council values the health and welfare of our residents. Any suggestions within this document outlining physical activities are meant as a guide only and are to be undertaken within the abilities of the individual.

Note that some activities require mandatory licencing and training. Council recommends engaging qualified contractors.

When conducting works you should be aware of hazards and use the appropriate personal protective equipment (PPE).

If you are a business, refer to your WHS legislation, regulations and your policies.

Under no circumstances should an untrained person enter a confined space.

Biofilter basin and On-site Stormwater Detention system at Matilda Road, Leppington.

PART B: TYPES OF WSUD ASSETS

Part B provides an overview of the common types of WSUD assets, their associated functional components and the expertise required to inspect and maintain them. Part B also includes reference, inspection and maintenance sheets for each asset.

Rainwater tanks at Mount Annan Leisure Centre, Mount Annan.

1 RAINWATER TANKS

A rainwater tank captures and stores roof water for reuse on-site. It may also function as local flood control.

The rainwater tank should fill and empty regularly to avoid health hazards associated with water being stored in tanks for extended periods of time.

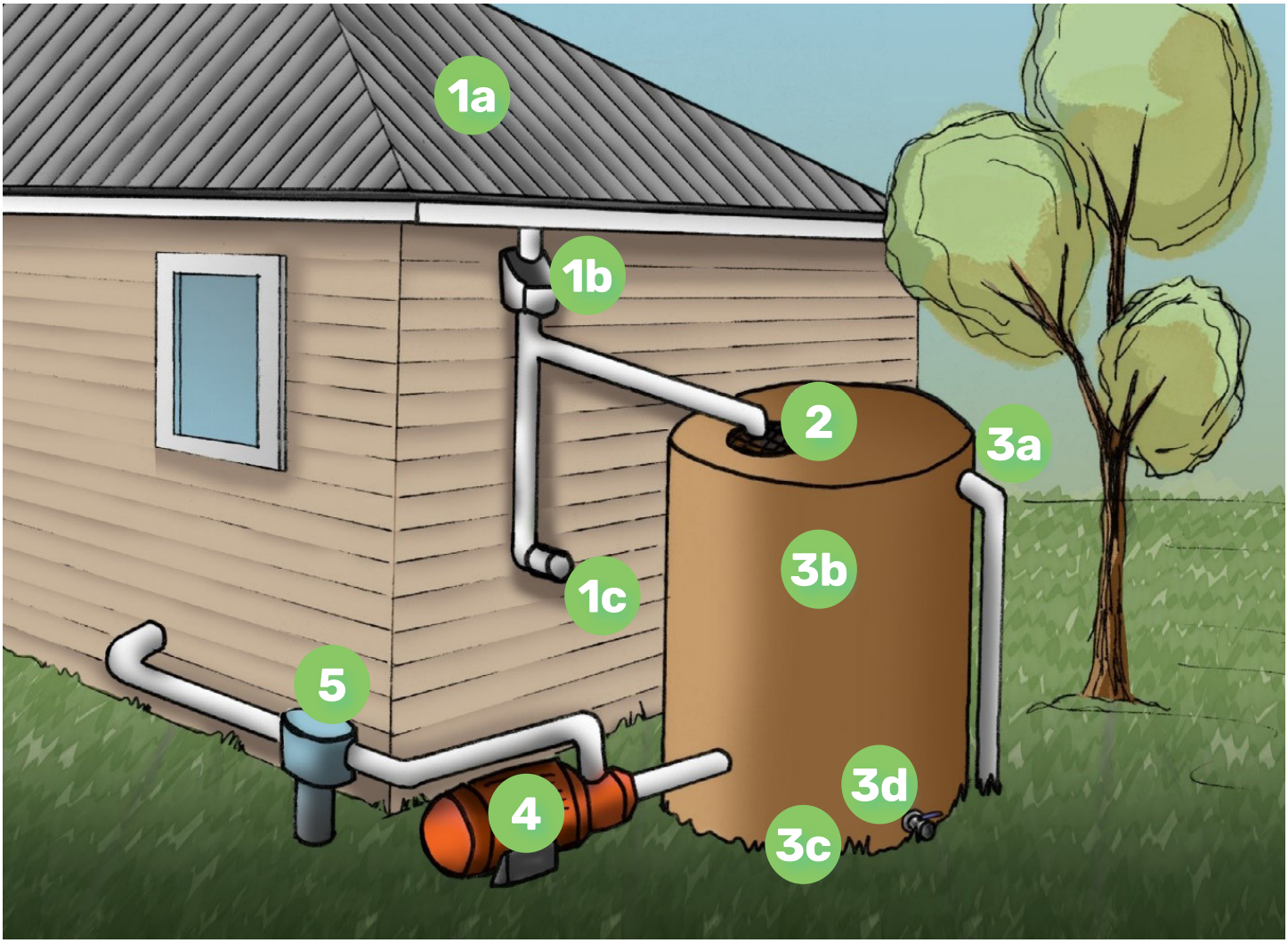


Figure 1: The functional components of a rainwater tank and its connections.

1.1 Functional components

1 Roof, gutters and downpipes

a) Roof and gutters collect rainwater and direct it towards the rainwater tank.

b) Downpipes and screens (rainhead) are the connections between the gutter and the tank. These can include a leaf diverter and mosquito screen.

c) First flush device captures the initial runoff from the roof and diverts it away from the tank.

2 Inlet screen

This filters the water for gross pollutants and keeps mosquitoes and pests out of the tank.

3 Tank

The tank stores the captured water for reuse. Most tanks have an internal float valve which automatically determines when storage levels are low and potable water top up is needed.

a) Overflow pipe connects the rainwater tank to the stormwater drainage network where excess flows drain to.

b) Tank body holds the rainwater and is commonly constructed of steel, concrete or plastic.

c) Tank base is where the tank is placed.

d) Sludge can be checked from the sludge valve which is on the base of the tank.

4 **Pumps, filters and valves**

These take water from the tank and prepare it for indoor and outdoor use.

5 **Rainwater supply pipe**

This connects the rainwater tank to end uses such as irrigation systems, toilets and washing machines.

This may include:

- Potable mains backup device (optional) which includes a rainwater/potable water supply diversion valve and dual check to enable the tank to be refilled with potable water when low on rainwater supply.
- Backflow prevention device which prevents rainwater going into the potable water supply. This is required when a potable water top-up is used.
- Flow meter which monitors usage from the tank and is generally used on commercial and industrial developments.
- Isolation valve which controls the flow of water from the potable water supply into the tank. These need to be installed before and after pump systems.
- Dual check valve which is a testable backflow prevention device to ensure the safety of potable water supply by preventing cross-contamination.
- Charged systems which have a pit and outlet pipe that can be drained and cleaned out.

For more information on backflow prevention devices, contact your plumber or Sydney Water.

The Rainwater Harvesting Association of Australia (RHAA) provides general guidance on rainwater tank functional components: www.rainwaterharvesting.org.au

1.2 Expertise required

A complete rainwater tank inspection may need to be done by a qualified and licenced tradesperson such as a plumber.

The mechanical and potable water components require specialist skills to service and some tasks may be difficult for a property owner to do, due to access and safety issues such as cleaning roofs and desludging tanks.

The property owner can undertake some basic checks and maintenance such as listening for any unusual noises from the pump and cleaning leaf litter from screens and first flush devices.

Some tasks are a working at heights hazard and an unlicensed person should never enter a confined space such as a rainwater tank.

RAINWATER TANK – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
1	**Roof, gutters and downpipes**				
1a	Roof and gutters (25)	6	Stable roof and guttering with minimal rust. No leaf litter on roof or in gutter impacting flows into tank.	Roof or guttering has minor damage or areas of rust. Leaf litter on roof or gutters may impede flows into the tank.	Roof or guttering has major damage or areas of rust. Build-up of leaf litter on roof or gutters blocking flows into the tank. Poses risk to public safety or asset function.
1b	Downpipes and screens (rainhead) (8)	6	Secure downpipe with no holes or leaks. Downpipe and screen (rainhead) are clear of leaf litter and debris.	Downpipe showing signs of wear or has holes or leaks. Downpipe or screen (rainhead) have some leaf litter and debris present but water can still enter the tank.	Downpipe or screen (rainhead) is unstable or damaged. Downpipe or screen (rainhead) is blocked by leaf litter and debris.
1c	First flush device (12)	6	No blockage.	Partial blockage of first flush device causing some restricted inflows.	Blockage of first flush device causing significant bypass or restriction of inflows.
2	**Inlet screen**				
2a	Screen (26)	6	No holes, damages or blockages to the screen.	Some holes, light damage or blockages to the screen. Can still function to filter most gross pollutants. Water can enter the tank at a reduced rate.	Large holes/heavy damage or blockages to the screen. Gross pollutants can pass through. Screen not securely attached to the tank.
3	**Tank**				
3a	Overflow (19)	6	No blockages and connected directly to the stormwater drainage network. No erosion or scour at the overflow outlet.	Partially blocked or indirectly connected to the stormwater drainage network (via overland flow path). Minor erosion or scour at the overflow outlet.	Blockage of overflow or completely disconnected from the stormwater drainage network. Major erosion or scour at the overflow outlet.
3b	Body integrity (4)	6	No damage or leaks on the tank body.	Some small holes, cracks or leaks on the tank body.	Tank body integrity is undermined by extensive holes or cracks.
3c	Base stability (2)	6	No damage to base with tank stable.	Some instability to the tank base with tank unlikely to move. Some cracks and signs of wear on the tank footing or foundation.	Tank base is unstable with tank likely to move. Poses risk to public safety or asset function. Major cracks and signs of wear on the tank footing or foundation.
3d	Sludge (28)	6	Clear water with no sediment in outflow.	Clear water with minor amounts of sediment in outflow.	Discoloured or cloudy water with large amounts of sediment in outflow.
4	**Pumps, filters and valves**				
4a	Pump (24)	12	Pump working correctly and clear of dust and debris.	Pump working but requires adjustment. Accumulated some dust and debris.	Pump not working or requires replacement. Produces an unusual noise or vibration when operating. Accumulated a significant amount of dust and debris.
4b	Filter (11)	12	Clean filter in good condition.	Filter requires cleaning or replacement.	Filter damaged or failed.
4c	Valves (32)	12	Valves working correctly.	Valves working but require adjustment.	Valves not working or require replacement.
5	**Rainwater supply pipe**				
5a	Potable mains backup device (23)	12	Potable mains backup working correctly.	Potable mains backup working but requires adjustment.	Potable mains backup not working or requires replacement.
5b	Backflow prevention device (1)	12	Backflow prevention device working and fitted correctly.	Backflow prevention device working but requires adjustment.	Backflow prevention device not working, requires replacement or not fitted correctly.
5c	Flow meter (14)	12	Flow meter working correctly and readings for top-up, pump and potable mains backup are consistent with last reading.	Flow meter readings are inconsistent with the last inspection.	Flow meter system is not working or requires replacement.

SHEET 1 OF 1

RAINWATER TANK – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

Functional component		Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
1	**Roof, gutters and downpipes**	
1a	Roof and gutters	1 2 3 NA Notes:
1b	Downpipes and screens (rainhead)	1 2 3 NA Notes:
1c	First flush device	1 2 3 NA Notes:
2	**Inlet screen**	
2a	Screen	1 2 3 NA Notes:
3	**Tank**	
3a	Overflow	1 2 3 NA Notes:
3b	Body integrity	1 2 3 NA Notes:
3c	Base stability	1 2 3 NA Notes:
3d	Sludge	1 2 3 NA Notes:
4	**Pumps, filters and valves**	
4a	Pump	1 2 3 NA Notes:
4b	Filter	1 2 3 NA Notes:
4c	Valves	1 2 3 NA Notes:
5	**Rainwater supply pipe**	
5a	Potable mains backup device	1 2 3 NA Notes:
5b	Backflow prevention device	1 2 3 NA Notes:
5c	Flow meter	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

RAINWATER TANK – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

Functional component		Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
1	**Roof, gutters and downpipes**		
1a	Roof and gutters	Recommendation: Clean roof and gutters by removing moss, lichen, leaf litter and debris. Information: Roof and gutters may need to be cleaned more regularly where overhanging vegetation is present.	Y N NA Notes:
1b	Downpipes and screens (rainhead)	Recommendation: Remove debris and leaf litter out of downpipes and screens. Information: Downpipes and screens may need to be cleaned more regularly where overhanging vegetation is present.	Y N NA Notes:
1c	First flush device	Recommendation: Remove debris, leaf litter and sediment from the first flush device. Information: First flush devices may need to be cleaned more regularly where overhanging vegetation is present.	Y N NA Notes:
2	**Inlet screen**		
2a	Screen	Recommendation: Remove screen to perform a clean or repair and reattach securely to the tank. Information: Check the screen for rust or corrosion, especially at corners or welds. Depending on the type of screen, replacement may be as simple as placing another screen on the existing fitting with no tools required.	Y N NA Notes:
3	**Tank**		
3a	Overflow	Recommendation: Repair overflow as necessary. Remove debris and ensure adequate connection to the stormwater drain. Information: If the overflow was not designed to be connected to a stormwater drain, check that erosion has not been caused.	Y N NA Notes:

3b	Body integrity	Recommendation: Contact licensed plumber to repair any defects or leaks to the tank body. Information: Do not enter a tank without having confined spaces certification. Secure any open access covers to prevent risk of entry.	Y N NA Notes:
3c	Base integrity	Recommendation: Contact licensed plumber if base stability is questionable. Information: If tank is on a stand or concrete slab, check structural integrity of support.	Y N NA Notes:
3d	Sludge	Recommendation: Empty and rinse the tank by opening the sludge valve and allowing the water and sludge to pass out. Information: First flush devices and mesh screens on tank inlets will reduce the amount of sediment and debris that enter the tank. For large tanks, a professional tank cleaner should be engaged as confined spaces entry might be required. Plastic tanks should be tied down prior to being emptied if strong winds are present. Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A tank is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
4	**Pumps, filters and valves**		
4a	Pump	Recommendation: Clear any accumulated dust or debris and ensure the power supply is switched on. The pump should be regularly serviced by a licensed professional. Information: Contact the manufacturer, an electrician or licensed plumber if you suspect a problem. These should be maintained by a professional as they have the potential to contaminate the potable water supply.	Y N NA Notes:
4b	Filter	Recommendation: Clean and replace cartridges in line with manufacturer's instructions. Information: The filter may require more frequent attention than the other rainwater tank functional components.	Y N NA Notes:
4c	Valves	Recommendation: Contact licensed plumber to rectify any malfunctions, in line with the manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	Y N NA Notes:
5	**Rainwater supply pipe**		
5a	Potable mains backup device	Recommendation: Contact licensed plumber to rectify any malfunctions, in line with the manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	Y N NA Notes:
5b	Backflow prevention device	Recommendation: Contact licensed plumber to rectify any malfunctions, in line with the manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	Y N NA Notes:
5c	Flow meter	Recommendation: Contact licensed plumber to rectify any malfunctions, in line with the manufacturer's instructions. Information: Flow meters help tell if the system is working. Frequent flow readings ensure issues are detected early.	Y N NA Notes:

Other:

Biofilter basin at Devlin Drive, Gledswood Hills.

2 BIOFILTERS

Biofilters (also referred to as bioretention systems or raingardens) are engineered garden beds that filter stormwater runoff through a vegetated filter media.

Treatment of stormwater occurs as the water infiltrates/soaks down vertically through the system, where plant roots and microbes in the soil naturally remove pollutants. Biofilters can be constructed as basins (in raised beds, planter boxes or at ground level), swales or medians, and have the same inspection and maintenance requirements.

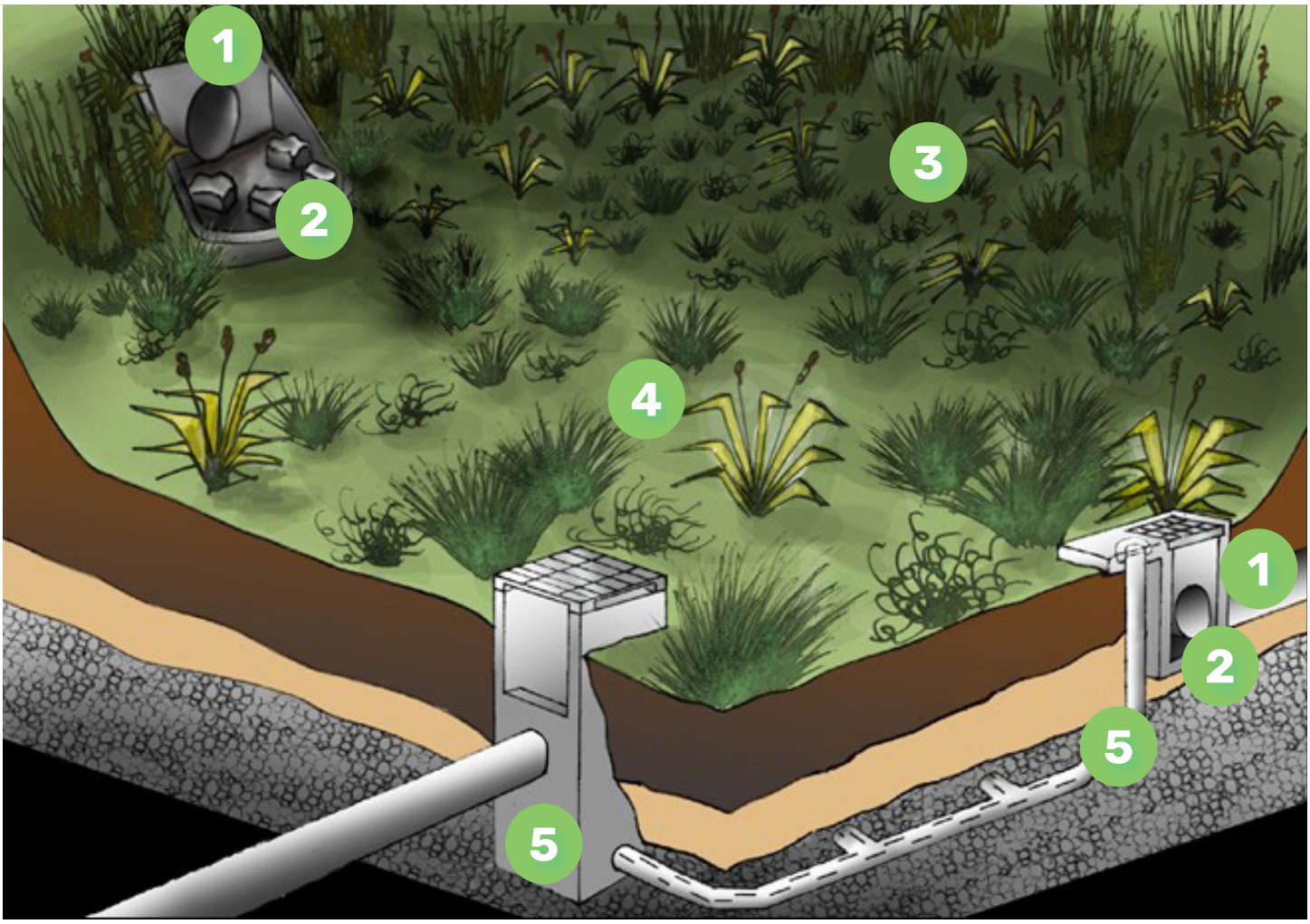


Figure 2: The functional components of a biofilter with a saturated zone.

2.1 Functional components

1 Inlet

This includes inlet pipes that can enter the biofilter from a surface inlet or an upflow pit. Surface inlets (left) are often encased in a headwall with a concrete pad or rock scour protection.

2 Inlet sediment pits/forebay

Sometimes a sediment pit/forebay is installed to prevent sediment build-up, scouring of the filter media surface and to dissipate inflows.

3 Batters

These connect the lower biofilter surface with the surrounds at a gentle slope to reduce safety hazards. Batters should be vegetated to help prevent erosion. Some biofilter systems have retaining walls instead of vegetated batters.

4 Biofilter surface

The flat surface at the bottom of the batters is called the biofilter surface. This is the component that absorbs stormwater and to function correctly, should be flat and even with a dense vegetation cover. Plants are a critical component for the pollutant infiltration capacity of a biofilter.

5 Outlet, overflow pit and inspection pipes

During a storm event, stormwater infiltrates through the filter media underneath the biofilter surface, the drainage layers further

below and then into slotted stormwater underdrainage pipes. These pipes drain to a stormwater pit, larger stormwater pipes and into local waterways. Underdrainage pipes can be inspected by the vertical inspection pipes (also called flushing points).

The overflow pit usually has a grated cover that is elevated above the biofilter surface (usually 300mm). This causes stormwater to build-up in the biofilter until water reaches the invert level of the grate before overflowing into the outlet pit.

The outlet (overflow) pit is raised above the filter surface to allow the biofilter to temporarily store water and encourage infiltration and treatment before overflowing. The depth between the outlet pit invert and biofilter surface is known as the extended detention depth (EDD) and is usually between 100 and 300mm.

Other features include:

- Free-draining or unsaturated zone systems (retain no permanent water below the filter media). Saturated zone systems will always have a free-draining filter media and extended detention.
- Mulch placed over the filter media to provide a protective covering. Organic mulch is generally not recommended as it can float and clog outlets. Clean gravel can help prevent evaporation, drying out of filter media and limit weed growth. Jute matting can be used to stop erosion on batters while plants establish, however, it is preferable to densely plant rather than use mulch.
- Liners which prevent the exchange of water, sediments and nutrients from the biofilter with the surrounding soils.
- Maintenance access ramps which facilitate access for machinery. They are generally concrete or aggregate base and are more common on large biofilters, particularly those that include a sediment forebay.

2.2 Expertise required

Biofilter inspections can typically be undertaken by the property owner as specialised equipment to access and view the system is generally not required.

Depending on the outcomes of the inspection, further specialised assessment may be needed to understand the causes observed.

Larger systems may be easier to maintain with specialised equipment, such as a high-pressure hose and suction truck to clean the underground pits and pipes.

During the establishment period, the vegetated components should be inspected more frequently.

BIOFILTER – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Inlet sediment pits and forebays**				
2a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
2b	Permeability and clogging (20)	6	No clogging of sediment pit. Pit can drain so that there is no standing water.	Some clogging of the drainage holes. Some evidence of standing water which is draining very slowly.	Clogging of drainage holes is preventing the pit from draining.
2c	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows.
3	**Batters**				
3a	Erosion (9)	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3b	Plant health (22)	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
3c	Plant cover (21)	6	Good vegetation cover (>80% cover or >6 plants per m^2).	Moderate vegetation cover (50-80% cover).	Poor vegetation cover (<50% cover).
3d	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows.
3e	Vehicle or pedestrian damage (33)	6	No compaction, plant loss, or vandalism impacting system function.	Minor compaction and/or plant loss. Does not pose risk to structural integrity or asset function.	Significant compaction and/or plant loss. Poses risk to structural integrity, public safety or asset function.
3f	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
4	**Biofilter surface**				
4a	Erosion (9)	6 (and after major rain events)	No erosion. Filter surface receiving water evenly.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
4b	Extended detention depth (10)	12	Design extended detention depth provided (typically between 100-300mm).	50-75% of design extended detention provided.	Less than 50% of design extended detention depth provided.
4c	Leaf litter (16)	3	Minimal leaf litter present or covers <20% of surface.	Some wet and decaying leaf matter present (covering 20-50% of surface). Aesthetic issue. Some obstruction of flow paths	Large amount of wet and decaying leaf matter present (covering >50% of the surface). Impacting vegetation growth. Obstructing flow paths and blocking inlets or outlets.

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
4d	Permeability and clogging (20)	12	In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (100-300mm) for biofilters is drawn down over 1-3 hours after inflow to the system has stopped following rainfall. No algae or moss present on filter surface. No stagnant water ponding on surface.	In dry conditions, water poured on surface infiltrates through the surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding observed for longer than normal (>3 hours). 10-20% surface coverage of algae and moss. Small, isolated ponds of stagnant water present.	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (100-300mm) remains for >12 hours after inflow to the system has stopped following rainfall. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation. >20% surface coverage of algae and moss present on filter surface. Large volumes of stagnant water ponding on filter surface.
4e	Plant health (22)	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
4f	Plant cover (21)	6	Good vegetation cover (>80% cover or >6 plants per m2).	Moderate vegetation cover (50-80% cover)	Poor vegetation cover (<50% cover).
4g	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows.
4h	Sediment accumulation (27)	6 (and after major rain events)	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
4i	Surface levels (31)	6 (and after major rain events)	Even surface with no depressions or mounds. Base is flat with flows evenly distributed across biofilter surface. There is an adequate drop from the inlet to the filter surface (>100 mm) that does not result in ponding.	Some small depressions or mounds present or preferential flow paths. Base is mostly flat with flows evenly distributed across most of biofilter surface. There is a small drop from the inlet to the filter surface (50-100 mm).	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short-circuiting flows, blocking flows, limited flow distribution). Biofilter surface is at the same level or higher than the inlet.
4j	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
5	**Outlet, overflow pit and inspection pipes**				
5a	Blockage (3)	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
5b	Inspection pipes (15)	6	Saturated zone system: water level is not above filter media depth. Non-saturated zone system: no standing water present in the inspection pipe.	Saturated zone system: water level is slightly above filter media depth. Non-saturated zone system: some standing water or sediment present in the inspection pipe.	Saturated zone system: water level is significantly above filter media depth. Non-saturated zone system: significant standing water or sediment present in the inspection pipe.
5c	Erosion (9)	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

SHEET 2 OF 2

BIOFILTER – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Inlet sediment pits and forebays**	
2a	Blockage	1 2 3 NA Notes:
2b	Permeability and clogging	1 2 3 NA Notes:
2c	Litter and debris	1 2 3 NA Notes:
3	**Batters**	
3a	Erosion	1 2 3 NA Notes:
3b	Plant health	1 2 3 NA Notes:
3c	Plant cover	1 2 3 NA Notes:
3d	Litter and debris	1 2 3 NA Notes:
3e	Vehicle or pedestrian damage	1 2 3 NA Notes:
3f	Weeds	1 2 3 NA Notes:

4	Biofilter surface	
4a	Erosion	1 2 3 NA Notes:
4b	Extended detention depth	1 2 3 NA Notes:
4c	Leaf litter	1 2 3 NA Notes:
4d	Permeability and clogging	1 2 3 NA Notes:
4e	Plant health	1 2 3 NA Notes:
4f	Plant cover	1 2 3 NA Notes:
4g	Litter and debris	1 2 3 NA Notes:
4h	Sediment accumulation	1 2 3 NA Notes:
4i	Surface levels	1 2 3 NA Notes:
4j	Weeds	1 2 3 NA Notes:
5	**Outlet, overflow pit and inspection pipes**	
5a	Blockage	1 2 3 NA Notes:
5b	Inspection pipes	1 2 3 NA Notes:
5c	Erosion	1 2 3 NA Notes:

Other:

SHEET 2 OF 2

BIOFILTER – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	Y N NA Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
2	**Inlet sediment pits and forebays**		
2a	Blockage	Recommendation: Unblock inlet sediment pits. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2b	Permeability and clogging	Recommendation: Remove sediment and debris from drainage holes and ensure permeability. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2c	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:

3	Batters		
3a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
3b	Plant health	Recommendation: Variable watering for the first 6-8 weeks after construction is required for plant establishment. Watering during dry periods may be required to prevent plant death. Information: Watering during the plant establishment phase enables quick plant establishment.	Y N NA Notes:
3c	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: The composition of plant species in the batter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well and were approved for planting.	Y N NA Notes: Number of plants added:
3d	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:
3e	Vehicle or pedestrian damage	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Replace lost plants and reprofile filter surface if affected. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
3f	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the filter media.	Y N NA Notes: Hours spent on weed removal:
4	Biofilter surface		
4a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Biofilter surface should be flat and even. Information: Typically required after heavy rainfall. For smaller incidents of scour and erosion, try transplanting some plants from a denser vegetated part of the biofilter. If you require further investigation into a current issue, refer to Water by Design (2012) *Rectifying Vegetated Stormwater Assets.*	Y N NA Notes:
4b	Extended detention depth	Recommendation: Remove overfilled material and re-level biofilter surface to obtain the extended detention depth as specified on the Works as Executed plans. Information: The depth of filter media should meet those specified in the Works as Executed plans.	Y N NA Notes:
4c	Leaf litter	Recommendation: Manually remove leaf litter. Information: The filter media should not be compressed as this can damage the underdrainage and reduce infiltration capacity.	Y N NA Notes: Hours spent on leaf litter removal:
4d	Permeability and clogging	Recommendation: If the filter media is clogged, remove and replace media. Remove any algal presence by removing the top layer of filter media or silt using a shovel. Replace top layer of filter media, reprofile and replant as required. Information: Conduct the hydraulic conductivity test in line with *Adoption Guidelines for Stormwater Biofiltration Systems* (2015) measurement of hydraulic conductivity. If the cover of moss or algal growth is >10%, refer to Water by Design (2012) *Rectifying Vegetated Stormwater Assets.* The minimum hydraulic conductivity as defined by ASTM F1815-11(2018) is to be a minimum of 100 mm/hr.	Y N NA Notes:
4e	Plant health	Recommendation: Variable watering for the first 6-8 weeks after construction is required for plant establishment. Watering during dry periods may be required to prevent plant death. Information: Watering during the plant establishment phase enables quick plant establishment.	Y N NA Notes:

4f	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: The composition of plant species in the biofilter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well and were approved for planting.	Y N NA Notes: Number of plants added:
4g	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Time taken to remove litter:
4h	Sediment accumulation	Recommendation: If accumulated sediment is present on the biofilter surface, remove using a flat shovel or rake and restore to design levels as required. Replacement of vegetation may be required. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA Notes: Thickness of sediment removed:
4i	Surface levels	Recommendation: Reprofile the biofilter surface to ensure a flat and even surface. The extended detention depth should be maintained. Information: Ensure the filter media is not filled up to the invert level of the inlet.	Y N NA Notes:
4j	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the filter media.	Y N NA Notes: Hours spent on weed removal:
5	**Outlet, overflow pit and inspection pipes**		
5a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
5b	Inspection pipes	Recommendation: Flush underdrainage pipes using a water jet or pipe snake until a clear stream of water is present in the outlet pit. If a saturated zone is present, the saturated zone should be drained before flushing out underdrainage pipes. Information: Most underdrainage pipes rarely need flushing and some underdrainage systems are not connected to an outlet pit which makes inspection and flushing impossible. The inspection openings are often covered by vegetation and you may need to refer to the Works as Executed plans to find their location. Underdrainage pipes can be damaged if the water jet is too strong.	Y N NA Notes:
5c	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

Biofilter basin in establishment phase at Dawson-Damer Park, Oran Park.

Passively irrigated street trees on Podium Way, Oran Park.

3 BIOFILTER STREET TREE PITS

Biofilter street tree pits are small biofilter systems with filter media and underdrainage fitted into the street tree pit.

They are very similar to biofilters in design, operation and inspection and maintenance requirements.

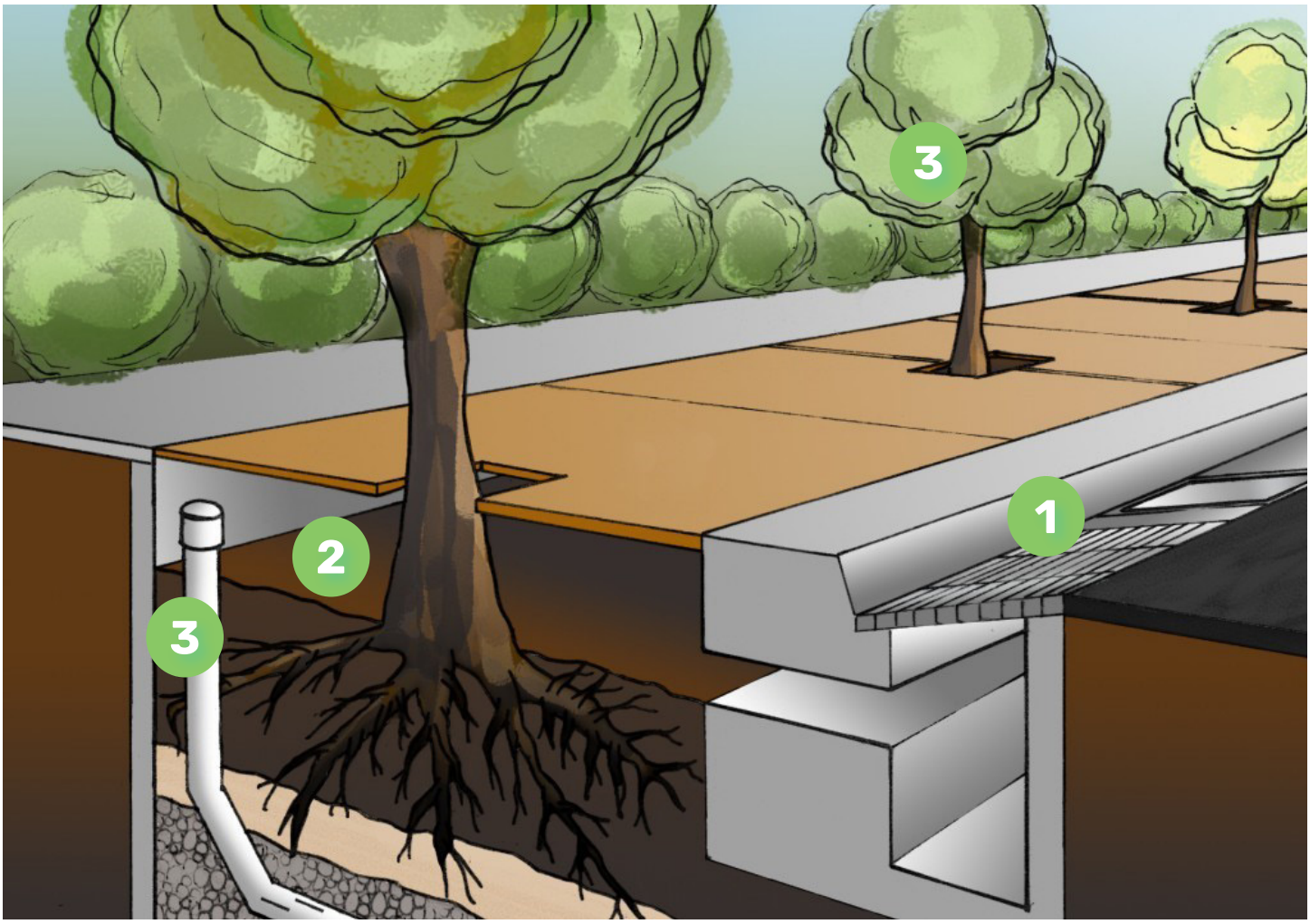


Figure 3: The functional components of a biofilter street tree pit.

3.1 Functional components

1 **Inlet**

This is where water is directed from the gutter towards the tree. This is usually a pit or direct opening from the kerb which directs stormwater into the biofilter street tree pit for treatment. The inlet may contain a grate, filter or pit insert to prevent gross pollutants from entering the tree pit.

2 **Biofilter surface**

Stormwater is directed to the biofilter surface where it infiltrates down towards the tree roots for treatment. To function correctly, the biofilter surface must be flat and even and be lower than the inlet to allow water to flow freely into the tree pit.

All tree pits include a tree but may also contain other vegetation planted into the biofilter surface.

3 **Outlet, overflow and inspection pipes**

Most biofilter street tree pits have slotted underdrainage pipes that collect treated stormwater and drain into the stormwater drainage network. They are typically installed with flushing points for inspection and maintenance. Biofilter street tree pits do not require dedicated overflow structures as excess flows continue along the kerb.

Other features include:

- Biofilter street tree pit covers constructed of permeable paving or metal grate, depending on the level of traffic.
- Extended detention depth (EDD) that is usually 100mm above the biofilter surface. This allows the biofilter street tree pit to temporarily store water and encourage infiltration and treatment.

Biofilter street tree pits are usually free draining. The use of mulch is not recommended as it can block inlets.

3.2 Expertise required

Biofilter street tree pit inspection and maintenance tasks can typically be undertaken by the property owner as specialised equipment to access and view the system is generally not required.

Inspection and maintenance of the street tree itself may require the services of a specialised tree contractor.

During the establishment period, the vegetated components should be inspected more frequently.

BIOFILTER STREET TREE PIT – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
	Vehicle or pedestrian damage (33)	6	No compaction, plant loss, or vandalism impacting system function.	Minor compaction and/or plant loss. Does not pose risk to structural integrity or asset function.	Significant compaction and/or plant loss. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Biofilter surface**				
2a	Erosion (9)	6	No erosion. Filter surface receiving water evenly.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting.
2b	Extended detention depth (10)	6	Design extended detention depth provided (typically between 50-100mm).	50-75% of design extended detention provided.	Less than 50% of design extended detention depth provided.
2c	Leaf litter (16)	3	Minimal leaf litter present or covers <20% of surface.	Some wet and decaying leaf matter present (covering 20-50% of surface). Aesthetic issue. Some obstruction of flow paths.	Large amount of wet and decaying leaf matter present (covering >50% of the surface). Impacting vegetation growth. Obstructing flow paths and blocking inlets or outlets.
2d	Permeability and clogging (20)	12	In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (50-100mm) for biofilters is drawn down over 1-3 hours after inflow to the system has stopped following rainfall. No algae or moss present on filter surface. No stagnant water ponding on surface.	In dry conditions, water poured on surface infiltrates through the surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding observed for longer than normal (>3 hours). 10-20% surface coverage of algae and moss. Small, isolated ponds of stagnant water present.	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (50-100mm) remains for >12 hours after inflow to the system has stopped following rainfall. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation. >20% surface coverage of algae and moss present on filter surface. Large volumes of stagnant water ponding on filter surface.
2e	Plant health (22)	6	Healthy vegetation.	Tree or other vegetation is stressed. Tree requires minor remedies (e.g. watering, spraying for pests) or poor health (e.g. signs of disease, pests, wilting) in 20-50% of other vegetation.	Tree or plants are dying. Significant issue with tree that requires major intervention or replacement or poor health (e.g. signs of disease, pests, wilting) in >50% of vegetation.
2f	Plant cover (21)	6	Tree present. Good vegetation cover (>80% cover or >6 plants per m2).	Tree not present, replacement only required. Moderate vegetation cover (50-80% cover).	Tree not present and other functional issues. Poor vegetation cover (<50% cover).
2g	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows.

SHEET 1 OF 2

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
2h	Sediment accumulation (27)	6	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 20-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
2i	Surface levels (31)	12	Even surface with no depressions or mounds. Base is flat with flows evenly distributed across biofilter surface. There is an adequate drop from the inlet to the filter surface that does not result in ponding or backflow.	Some small depressions or mounds present or preferential flow paths. Base is mostly flat with flows evenly distributed across most of biofilter surface. There is a small drop from the inlet to the filter surface that does not result in ponding or backflow.	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short-circuiting flows, blocking flows, limited flow distribution). Biofilter surface is at the same level or higher than the inlet.
2j	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
3	**Outlet, overflow and inspection pipes**				
3a	Blockage (3)	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
3b	Inspection pipes (15)	12	Saturated zone system: water level is not above filter media depth. Non-saturated zone system: no standing water present in the inspection pipe.	Saturated zone system: water level is slightly above filter media depth. Non-saturated zone system: some standing water or sediment present in the inspection pipe.	Saturated zone system: water level is significantly above filter media depth. Non-saturated zone system: significant standing water or sediment present in the inspection pipe.
3c	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

BIOFILTER STREET TREE PIT – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
	Vehicle or pedestrian damage	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Biofilter surface**	
2a	Erosion	1 2 3 NA Notes:
2b	Extended detention depth	1 2 3 NA Notes:
2c	Leaf litter	1 2 3 NA Notes:
2d	Permeability and clogging	1 2 3 NA Notes:
2e	Plant health	1 2 3 NA Notes:
2f	Plant cover	1 2 3 NA Notes:
2g	Litter and debris	1 2 3 NA Notes:
2h	Sediment accumulation	1 2 3 NA Notes:
2i	Surface levels	1 2 3 NA Notes:
2j	Weeds	1 2 3 NA Notes:

3	Outlet, overflow and inspection pipes	
3a	Blockage	1 2 3 NA Notes:
3b	Inspection pipes	1 2 3 NA Notes:
3c	Erosion	1 2 3 NA Notes:

Other:

SHEET 2 OF 2

BIOFILTER STREET TREE PIT – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
	Vehicle or pedestrian damage	Recommendation: Reprofile damaged or compacted surfaces and replace lost plants. Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	Y N NA Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
2	**Biofilter surface**		
2a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Biofilter surface should be flat and even. Information: Typically required after heavy rainfall. For smaller incidents of scour and erosion, try transplanting some plants from a denser vegetated part of the biofilter street tree pit.	Y N NA Notes:
2b	Extended detention depth	Recommendation: Remove overfilled material and re-level biofilter surface to obtain the extended detention depth as specified on the Works as Executed plans. Information: The depth of filter media should meet those specified in the Works as Executed plans.	Y N NA Notes:

2c	Leaf litter	Recommendation: Manually remove leaf litter. Information: The filter media should not be compressed as this can damage the underdrainage and reduce infiltration capacity.	Y N NA Notes: Hours spent on leaf litter removal:
2d	Permeability and clogging	Recommendation: If the filter media is clogged, remove and replace media. Remove any algal presence by removing the top layer of filter media or silt using a shovel. Replace top layer of filter media, reprofile and replant as required. Information: Conduct the hydraulic conductivity test in line with *Adoption Guidelines for Stormwater Biofiltration Systems* (2015) measurement of hydraulic conductivity. If the cover of moss or algal growth is >10%, refer to Water by Design (2012) *Rectifying Vegetated Stormwater Assets*. The minimum hydraulic conductivity as defined by ASTM F1815-11(2018) is to be a minimum of 200mm/hr.	Y N NA Notes:
2e	Plant health	Recommendation: Variable watering for the first 6-8 weeks after construction may be required for tree and vegetation establishment. Watering during dry periods may be required to prevent plant death. Information: Watering during the plant establishment phase enables quick plant establishment.	Y N NA Notes:
2f	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: The composition of plant species in the biofilter street tree pit may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well and were approved for planting.	Y N NA Notes: Number of plants added:
2g	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:
2h	Sediment accumulation	Recommendation: If accumulated sediment is present on the biofilter surface, remove using a flat shovel or rake and restore to design levels as required. Replacement of vegetation may be required. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Thickness of sediment removed:
2i	Surface levels	Recommendation: Reprofile the biofilter surface to ensure a flat and even surface. The extended detention depth should be maintained. Information: Ensure the filter media is not filled up to the invert level of the inlet.	Y N NA Notes:
2j	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the filter media.	Y N NA Notes: Hours spent on weed removal:
3	**Outlet, overflow pit and inspection pipes**		
3a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3b	Inspection pipes	Recommendation: Flush underdrainage pipes using a water jet or pipe snake until a clear stream of water is present in the outlet pit. If a saturated zone is present, the saturated zone should be drained before flushing out underdrainage pipes. Information: Most underdrainage pipes rarely need flushing and some underdrainage systems are not connected to an outlet pit which makes inspection and flushing impossible. The inspection openings are often covered by vegetation and you may need to refer to the Works as Executed plans to find their location. Underdrainage pipes can be damaged if the water jet is too strong.	Y N NA Notes:
3c	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

SHEET 2 OF 2

Wetland and pond at Kolombo Reserve, Oran Park.

4 WETLANDS

A wetland is a vegetated wet basin (or series of wet basins) that filters and treats stormwater before it enters our waterways.

The plants in a wetland capture fine particles and absorb nutrients from stormwater by slowing and filtering the water and allowing sediment to settle.

Wetlands commonly have a gross pollutant and sediment trap upstream of them to capture coarse material before stormwater enters the macrophyte zone.

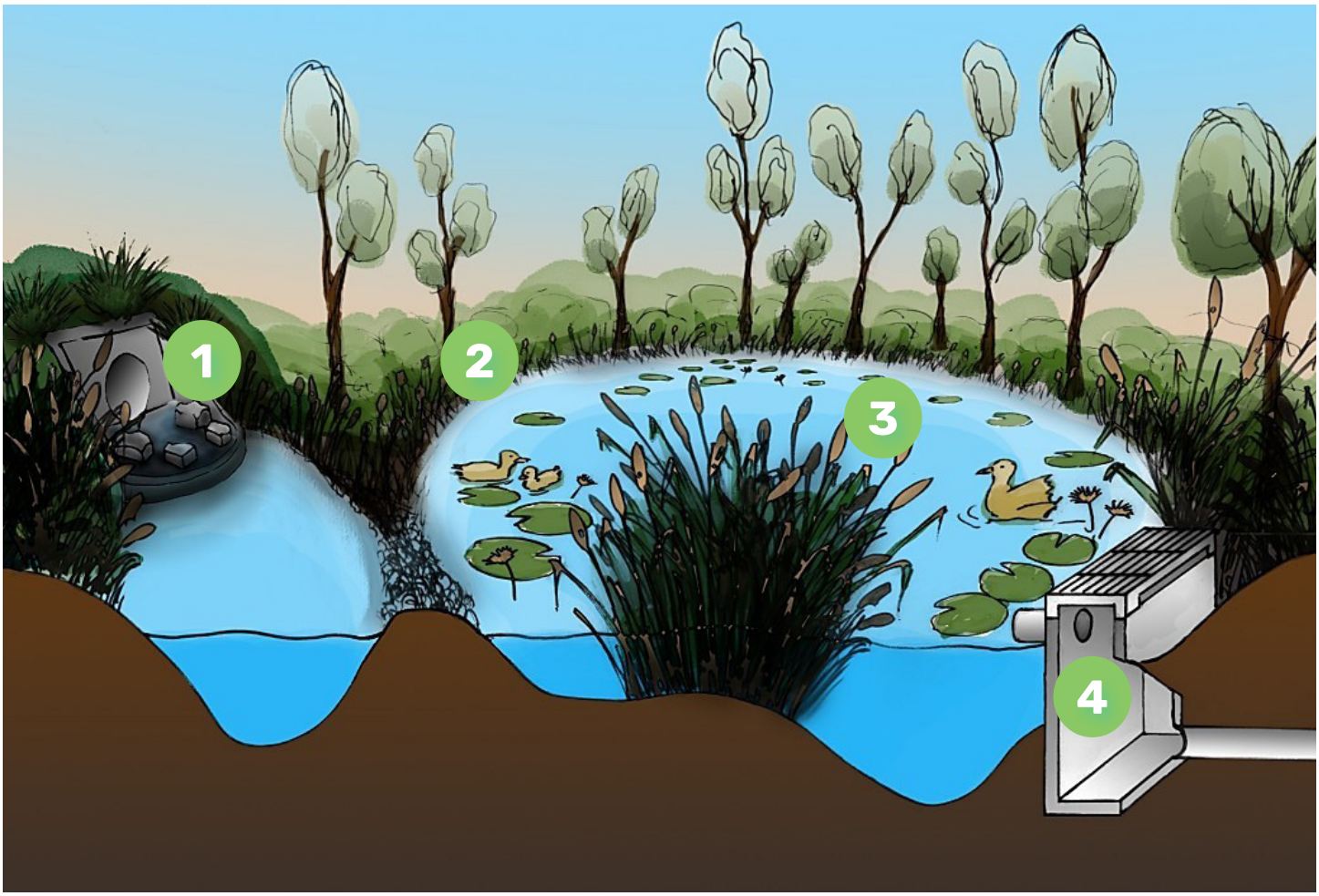


Figure 4: The functional components of a wetland.

4.1 Functional components

1

Inlet

Stormwater is piped into the sedimentation pond of the wetland. This allows flows to slow, coarse sediments to settle and protects the macrophyte zone.

2

Batters

These connect the wetland water surface with the surrounds at a gentle slope to reduce safety hazards. Batters should be vegetated to help prevent erosion and aid stormwater treatment. Vegetated batters also support animal and insect life living around the wetland.

3

Macrophyte zone

This is a densely vegetated zone where fine particles and dissolved pollutants are removed. Plant life can include submerged, emergent and floating plants. The macrophyte zone includes a range of shallow and deep-water levels and may include areas that are only wet during rain (ephemeral zones).

4

Outlet and overflow

The outlet of a wetland is usually a partially submerged pipe or weir that drains to an outlet pit. The outlet pit contains an orifice plate or weir that controls the water level in the wetland. Typically, the outlet is set to a detention time of 72 hours.

Wetlands usually include an overflow weir that direct flows in excess of the wetland capacity downstream into the stormwater drainage network.

4.2 Expertise required

A small boat or kayak may be required for inspection and maintenance of the wetland. All appropriate boat licences and WHS requirements must be met.

During the establishment period, the vegetated components should be inspected more frequently.

WETLAND – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
1c	Sediment accumulation (27)	6	No accumulated sediment or minimal sediment with no obvious impacts (<20%).	Some accumulated sediment (covering 20-50% of the sedimentation pond). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the sedimentation pond). Impeding flows. Smothering vegetation.
2	**Batters**				
2a	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2b	Plant health (22)	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
2c	Plant cover (21)	6	Good vegetation cover (>80% cover or >6 plants per m^2).	Moderate vegetation cover (50-80% cover).	Poor vegetation cover (<50% cover).
2d	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows. Large volumes of stagnant water ponding on filter surface.
2e	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
3	**Macrophyte zone**				
3a	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3b	Floating plants (13)	6	No or minimal nuisance floating plants (<10%).	Moderate cover of nuisance floating plants (10-50%).	High cover of nuisance floating plants (>50%) or are problematic.
3c	Mosquitoes (18)	12	No isolated depressions that can become breeding sites when water levels recede. Deep pools present to provide refuge to mosquito predators. No dead or rafting pieces of vegetation.	Potential mosquito habitats observed (e.g. isolated pools, rafting pieces of vegetation).	Nuisance populations of mosquitoes observed or reported by local community. Numerous potential mosquito habitats observed (e.g. isolated pools, rafting pieces of vegetation).
3d	Plant health (22)	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
3e	Plant cover (21)	6	Good vegetation cover (>80% cover or >6 plants per m2).	Moderate vegetation cover (50-80% cover).	Poor vegetation cover (<50% cover).

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
3f	Sediment accumulation (27)	12	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
3g	Water levels (34)	12	Water level variation is as designed. Flows after a rainfall event appropriately draw down and dry periods are not extensive (<70 days per year). Diverse vegetation confirms	Some concerns about water level variation that can be easily adjusted. Small impact on treatment performance.	Significant concerns about water level variation. Significant impact on treatment performance.
3h	Water quality – oil slicks, odour, algae (35)	12	No water quality issues.	Some minor water quality issues visible but no major impact on aesthetics or water quality.	Significant water quality issues. Heavily impacting aesthetics or water quality.
3i	Litter and debris (17)	6	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or blocking flows.
3j	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Some litter. Diminished aesthetics and/or causing some visible blockage. Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
4	**Outlet and overflow**				
4a	Blockage (3)	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
4b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

SHEET 2 OF 2

WETLAND – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
1c	Sediment accumulation	1 2 3 NA Notes:
2	**Batters**	
2a	Erosion	1 2 3 NA Notes:
2b	Plant health	1 2 3 NA Notes:
2c	Plant cover	1 2 3 NA Notes:
2d	Litter and debris	1 2 3 NA Notes:
2e	Weeds	1 2 3 NA Notes:
3	**Macrophyte zone**	
3a	Erosion	1 2 3 NA Notes:
3b	Floating plants	1 2 3 NA Notes:
3c	Mosquitoes	1 2 3 NA Notes:
3d	Plant health	1 2 3 NA Notes:
3e	Plant cover	1 2 3 NA Notes:
3f	Sediment accumulation	1 2 3 NA Notes:
3g	Water levels	1 2 3 NA Notes:

3h	Water quality – oil slicks, odour, algae	1 2 3 NA Notes:
3i	Litter and debris	1 2 3 NA Notes:
3j	Weeds	1 2 3 NA Notes:
4	**Outlet and overflow**	
4a	Blockage	1 2 3 NA Notes:
4b	Erosion	1 2 3 NA Notes:

Other:

WETLAND – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date		**Purpose of visit:**	**Rainfall conditions:**
Location		☐ Maintenance	☐ Rainfall today (mm)
Asset name		☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID		☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)			

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	Y N NA Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
1c	Sediment accumulation	Recommendation: Clean out and dispose of accumulated sediment. Reset surface levels. Information: Sediment can be dried on-site and must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA Notes: Thickness of sediment removed:
2	**Batters**		
2a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
2b	Plant health	Recommendation: Variable watering for the first 6-8 weeks after construction is required for plant establishment. Watering during dry periods may be required to prevent plant death. Information: Watering during the plant establishment phase enables quick plant establishment.	Y N NA Notes:

2c	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: The composition of plant species in the batter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well and were approved for planting	Y N NA Notes: Number of plants added:
2d	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:
2e	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the wetland.	Y N NA Notes: Hours spent on weed removal:
3	**Macrophyte zone**		
3a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Larger areas of erosion may require the water levels to be drawn down for rectification. Replant if required. Temporary measures such as jute matting and establishing a dense vegetation cover may be required to prevent further erosion. Sometimes rock scour protection can be added. Information: Typically required after heavy rainfall.	Y N NA Notes:
3b	Floating plants	Recommendation: Mechanical removal is best suited to large temporary sediment basins. In most cases, floating plants can be removed by hand using rakes or floating booms. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). Floating plants are less common in densely planted wetlands that shade the water.	Y N NA Notes:
3c	Mosquitoes	Recommendation: Remove any potential mosquito habitats by filling in any isolated depression which could fill with water after rain. Remove dead or rafting pieces of vegetation around deep water zones and maintain deep pools to provide refuge to mosquito predators such as freshwater fish and macroinvertebrates. Ensure the vegetation around the deep water zones are thin, vertical and upright as these maximise predation of mosquito larvae by allowing passage of fish and macroinvertebrate predators. Information: A site specific investigation may be required if there is an ongoing issue and nuisance population of mosquitoes in the temporary sediment basin.	Y N NA Notes:
3d	Plant health	Recommendation: If there are over or under inundation issues with the wetland, adjust the water levels in the wetland (see functional component 3g). If there are disease or pests, prune affected plant matter or remove entire plant. Treat affected plants and replant where plants have been lost or removed. If plants are affected by shading, look to trim overhanging trees or branches or plant shade tolerant species. Information: Where water levels and inundation periods are an issue, review species selection and replant with species more suited to the inundation conditions.	Y N NA Notes:
3e	Plant cover	Recommendation: Replanting small areas can be done by dividing and relocating existing mature vegetation with rhizomatous root systems. Simply choose vegetation from similar inundation zones, split the plant through the base, divide into sections and plant into the area that requires more coverage. Information: Where water levels and inundation periods are an issue, review species selection and replant with species more suited to the inundation conditions. Monitoring, weeding, infill planting and irrigation may be required for establishing areas. More mature plants may be required in low water level areas or where grazing waterbirds are present. Otherwise, tube stock can be used for replanting.	Y N NA Notes: Number of plants added:
3f	Sediment accumulation	Recommendation: Clean out and dispose of accumulated sediment. Remove plants before removing sediment and replant after levels have been corrected. Information: Sediment can be dried on-site and must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA Notes: Thickness of sediment removed:

3g	Water levels	Recommendation: If plants are over inundated, irrigation or adjustments to the water levels may be required. Potential leaks at the outlet, base or batters should also be investigated and repaired. If plants are under inundated, the frequency patterns should be investigated and potential adjustments to the inlets, planting patterns, hydraulic structures or outlets made. Information: Plants may become stressed in dry periods (>70 days) or if there are leaks in the wetland. Over inundation patterns are a common cause of plant loss in wetlands.	Y N NA Notes:
3h	Water quality – oil slicks, odour, algae	Recommendation: Slicks on the water surface may be nitrogen-fixing bacteria or oil. If it is a large oil spill, impacts to the downstream stormwater drainage network or waterways can be minimized using barriers such as floating booms or removal such as an eductor truck. If blue-green algae or other health and safety concerns, signage should be placed around the wetland. Excessive filamentous algal blooms may block inlets and outlets and can be removed using rakes or specialist machinery. Information: Wetlands are good at treating low conditions of hydrocarbons. Blue-green algae presents a human health risk and must be managed to protect the safety of the public. For identification of algal blooms, refer to the Camden Council or Water NSW website.	Y N NA Notes: Odour: yes/no Oil/grease: yes/no Blue-green algae: yes/no Filamentous algae: yes/no
3i	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:
3j	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the wetland.	Y N NA Notes: Hours spent on weed removal:
4	**Outlet and overflow**		
4a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
4b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

Wetland plants in Kolombo Reserve, Oran Park

Floating wetland raft installation at Harrington Park Lake Wetlands, Harrington Park.

5 FLOATING WETLANDS

Floating wetlands are buoyant rafts planted with wetland plants that assist in the removal of pollutants from stormwater. They are commonly retrofitted into ponds or wetlands that are experiencing water quality issues.

Floating wetland rafts remove common waterway pollutants and regulate the oxygen, temperature and erosion potential of water.

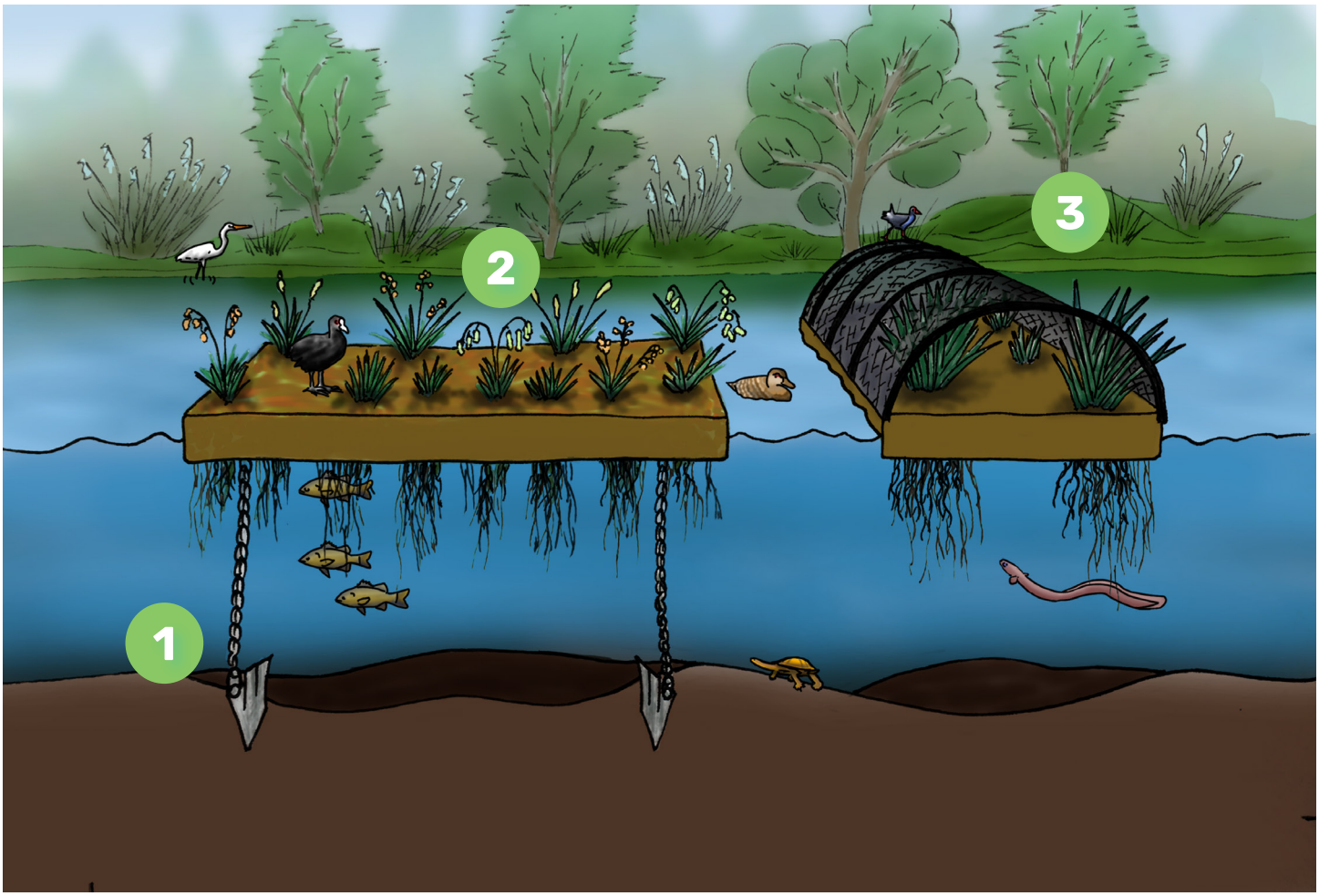


Figure 5: The functional components of a floating wetland raft.

5.1 Functional components

1

Anchors

A floating wetland raft is kept in place through anchors attached to ropes or chains driven into the floor or attached to the banks of the waterbody.

2

Floating raft

The floating raft is typically made from a buoyant product such as plastic piping in which the growing medium (coir or gravel) is placed into. This allows macrophyte plants to grow roots into and below the medium. The roots and leaves of the plants host microorganisms (biofilms) that capture and hold onto sediment and pollutants in stormwater.

3

Protection netting

Some waterbodies may be home to waterbirds that use macrophyte plants for food or habitat. To protect the floating raft from birds during the establishment phase or lifetime of the floating wetland raft, protection netting may be used.

5.2 Expertise required

The floating wetland can usually be inspected from the bank using binoculars.

A small boat or kayak may be required for inspection and maintenance of the floating wetland raft. All appropriate boat licences and WHS requirements must be met.

During the establishment period, the vegetated components should be inspected more frequently.

FLOATING WETLAND – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	3	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Anchors**				
1a	Damage or removal of structures (6)	3 (and after major rain events)	Anchors are secure and floating raft is in the same location. Stable structures with no damage.	Anchors have loosened causing some movement of the floating raft. Does not pose risk to asset or public safety.	Anchors have detached causing significant movement of the floating raft. Potential risk to structural integrity, public safety or asset function.
2	**Floating raft**				
2a	Plant cover (21)	3	Good vegetation cover (>80% cover or >6 plants per m^2).	Moderate vegetation cover (50-80% cover).	Poor vegetation cover (<50% cover).
2b	Plant health (22)	3	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
2c	Weeds (36)	3	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
2d	Litter and debris (17)	3	No litter.	Some litter. Diminished aesthetics and/or reducing plant growth.	Large amount of litter. Heavily impacting aesthetics and/or plant growth.
2e	Leaf litter (16)	3	Minimal leaf litter present or covers <20% of surface.	Some decaying leaf matter present (covering 20-50% of surface). Aesthetic issue.	Large amount of decaying leaf matter present (covering >50% of the surface). Impacting vegetation growth.
2f	Sediment accumulation (27)	12	No benthic layer or minimal sediment with no obvious impacts (<10%).	Some benthic layer (covering 10-50% of the lake floor) with possibility of resuspension.	Benthic layer (covering >50% of the surface) with high possibility of resuspension.
3	**Protection netting**				
3a	Damage (5)	3	No holes or damage.	Some small holes/light damage. Can still function to protect the floating raft from most birds.	Large holes/heavy damage to the protection netting. Birds can access the floating raft. Bird protection not securely attached to floating raft.

FLOATING WETLAND – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

Functional component		Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Anchors**	
1a	Damage or removal of structures	1 2 3 NA Notes:
2	**Floating raft**	
2a	Plant cover	1 2 3 NA Notes:
2b	Plant health	1 2 3 NA Notes:
2c	Weeds	1 2 3 NA Notes:
2d	Litter and debris	1 2 3 NA Notes:
2e	Leaf litter	1 2 3 NA Notes:
2f	Sediment accumulation	1 2 3 NA Notes:
3	**Protection netting**	
3a	Damage	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

FLOATING WETLAND – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Anchors**		
1a	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
2	**Floating raft**		
2a	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: The composition of plant species in the floating raft may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well.	Y N NA Notes: Number of plants added:
2b	Plant health	Recommendation: Plants may take up to 12 months to be well established. Information: Floating raft systems may be submerged or floating on the water surface. Ensuring the roots are in water will enable quick plant establishment.	Y N NA Notes:
2c	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the floating raft.	Y N NA Notes: Hours spent on weed removal:

2d	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Counts of litter removed:
2e	Leaf litter	Recommendation: Manually remove leaf litter. Information: Dead and decaying leaf litter should be removed to allow new leaves to grow and prevent nutrients being released into the waterbody. Roots and submerged branches should be left in the water as biofilms live on these.	Y N NA Notes:
2f	Sediment accumulation	Recommendation: Clean out and dispose of benthic layer. Information: Sediment can be dried on-site and must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA Notes: Thickness of sediment removed:
3	**Protection netting**		
3a	Damage	Recommendation: Secure any damage to the protection netting with ties or replace damaged netting. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:

Other:

Vegetated buffer strip and swale at Emberson Street, Leppington.

6 VEGETATED BUFFER STRIPS AND SWALES

Vegetated buffer strips and swales are simple stormwater transfer systems that treat runoff through filtration and sediment capture.

Buffer strips are vegetated surfaces (usually grassed) that allow runoff to flow towards a downstream outlet.

Swales generally form a sloped vegetated channel that conveys stormwater along a long path.

Both systems slow and filter stormwater as it flows through vegetation, capturing large sediments and absorbing stormwater runoff.

Figure 6: The functional components of a vegtated buffer strip.

6.1 Functional components

1

Inlet

The inlet into a vegetated buffer strip or swale is the area where water first flows into the asset.

Buffer strips are often used on the side of roads or driveways where the boundary between the paved area and the vegetated buffer strip becomes the inlet.

A swale transfers stormwater down a channel and can have a traditional piped inlet or receive waters from a buffer.

2

Vegetated base and batters

These are the surface areas of the buffer strip or swale that are grassed or vegetated with small shrubs. Vegetation is important in preventing scouring and soil erosion. Buffer strips and swales must have an even grade to allow all water to eventually drain. An uneven surface can result in ponding and boggy conditions.

3

Outlet

The outlet of a buffer strip is the point where stormwater stops running over the surface. This is either a pit or direct flow into a swale, overland flow path or biofilter.

A swale usually has a defined outlet with a pit at the downstream end

6.2 Expertise required

Buffer strip and swale inspections can typically be undertaken by the property owner as specialised equipment to access and view the system is generally not required.

The required maintenance is similar to maintaining a lawn or garden bed.

During the establishment period, the vegetated components should be inspected more frequently.

VEGETATED BUFFER STRIP AND SWALE – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	12	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	12	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Vegetated base and batters**				
2a	Erosion (9)	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2b	Plant health (22)	12	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10-20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
2c	Plant cover (21)	12	Good vegetation cover (>80% cover or >6 plants per m^2).	Moderate vegetation cover (50-80% cover).	Poor vegetation cover (<50% cover).
2d	Litter and debris (17)	12	No litter.	Some litter. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter. Heavily impacting aesthetics and/or plant growth.
2e	Sediment accumulation (27)	12	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
2f	Standing water or boggy conditions (29)	12	Well drained surface with no ponding or boggy areas.	Temporary ponding and boggy areas after rain events. Typically drying out within 24 hours.	Standing water present and/or continued boggy areas affecting asset performance and ease of maintenance.
2g	Surface levels (31)	12	Even surface with no depressions or mounds.	Some small depressions or mounds present or preferential flow paths.	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short-circuiting flows, blocking flows, limited flow distribution).
2h	Weeds (36)	12	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
3	**Outlet**				
3a	Blockage (3)	12	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
3b	Erosion (9)	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

VEGETATED BUFFER STRIP AND SWALE – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Vegetated base and batters**	
2a	Erosion	1 2 3 NA Notes:
2b	Plant health	1 2 3 NA Notes:
2c	Plant cover	1 2 3 NA Notes:
2d	Litter and debris	1 2 3 NA Notes:
2e	Sediment accumulation	1 2 3 NA Notes:
2f	Standing water or boggy conditions	1 2 3 NA Notes:
2g	Surface levels	1 2 3 NA Notes:
2h	Weeds	1 2 3 NA Notes:
3	**Outlet**	
3a	Blockage	1 2 3 NA Notes:
3b	Erosion	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

VEGETATED BUFFER STRIP AND SWALE – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the buffer strip or swale. Sediment generally accumulates at the boundary between a paved surface and the buffer strip or swale.	Y N NA Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
2	**Vegetated base and batters**		
2a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:
2b	Plant health	Recommendation: Variable watering for the first 6-8 weeks after construction is required for plant establishment. Watering during dry periods may be required to prevent plant death. Ideally, trimming plants or mowing grass requires using a catcher. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Watering during the plant establishment phase enables quick plant establishment.	Y N NA Notes:
2c	Plant cover	Recommendation: Replant vegetation to achieve desired plant coverage. Information: If replanting is required, look at what species are performing well. Plants should be evenly spaced to prevent localised erosion.	Y N NA Notes: Number of plants added:

2d	Litter and debris	Recommendation: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. The litter pick tool may be used for litter pick-ups. All disposal procedures are to adhere with NSW EPA and local authorities' requirements.	Y N NA Notes: Time taken to remove litter:
2e	Sediment accumulation	Recommendation: If accumulated sediment is present on the surface, remove using a flat shovel or rake and restore to design levels as required. Replacement of vegetation may be required. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA Notes: Thickness of sediment removed:
2f	Standing water or boggy conditions	Recommendation: Ensure the buffer or swale is sloped towards the outlet so water can drain. Buffers and swales naturally infiltrate stormwater so may be temporarily wet after rainfall. Information: Standing water or boggy areas may make maintenance difficult and affect the performance of the buffer or swale.	Y N NA Notes:
2g	Surface levels	Recommendation: Reprofile any local depressions or mounds so the buffer or swale is as even as possible. Replant if necessary. Information: Standing water is a good indicator that the buffer or swale is not sloped adequately towards the outlet.	Y N NA Notes:
2h	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the buffer or swale.	Y N NA Notes: Hours spent on weed removal:
3	**Outlet**		
3a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

SHEET 2 OF 2

 On-site Stormwater Detention (OSD) system with biofilter basin at Matilda Road, Leppington.

7 ON-SITE STORMWATER DETENTION (OSD)

On-site Stormwater Detention (OSD) is the temporary storage and controlled release of stormwater generated on-site. OSD systems are designed to temporarily store and slow down the rate of stormwater runoff from a property, so it does not worsen flooding downstream.

OSD systems can be above or below ground and should remain empty except during periods of rainfall and shortly after the rainfall ceases. In most rain events, ponding of water should not last more than 2 hours.

In some cases, below ground OSD systems can include filter cartridges.

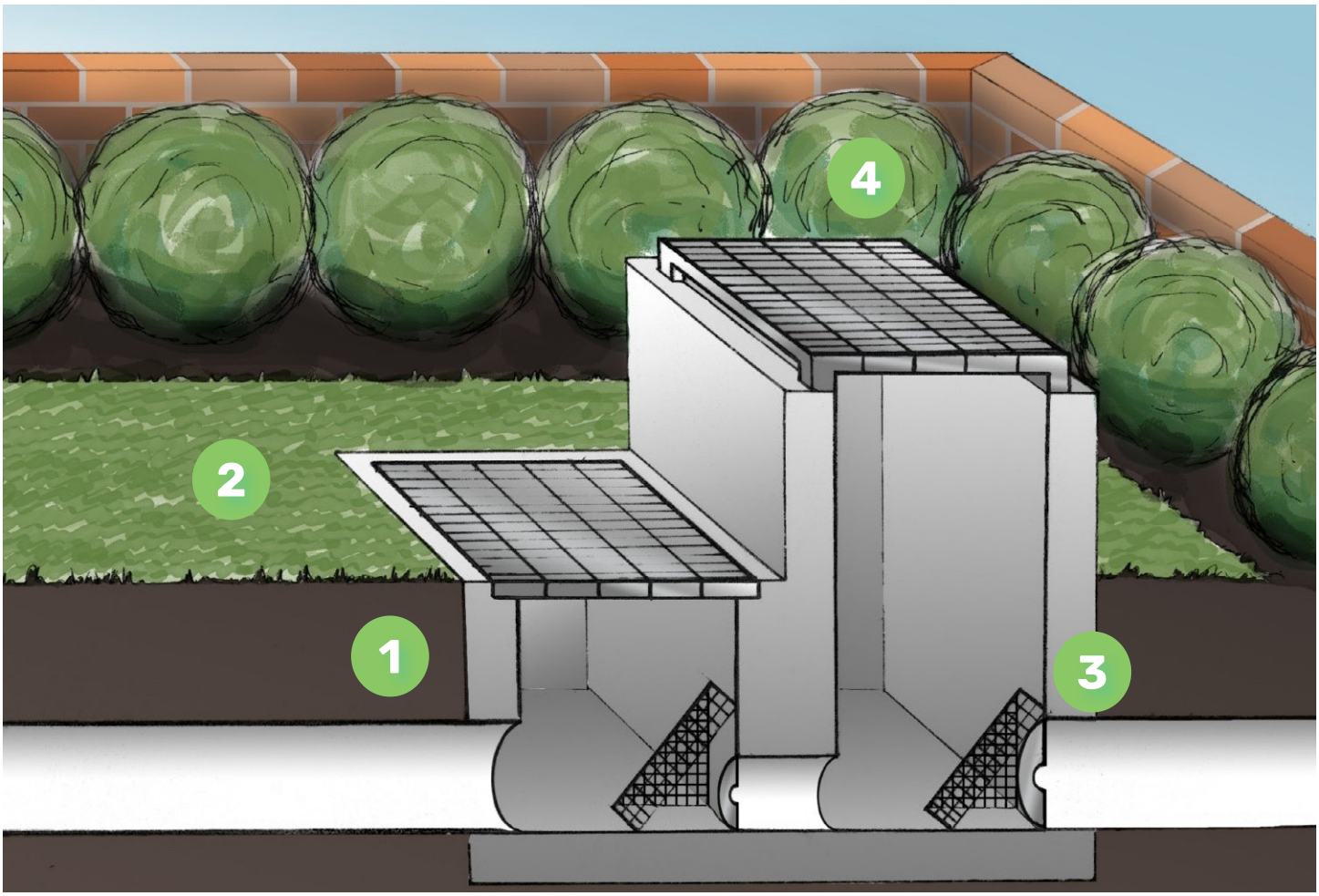


Figure 7: The functional components of an above ground OSD.

7.1 Functional components of an above ground OSD

1 **Inlet**

The inlet drains upstream roof downpipes and drainage to the OSD storage area.

2 **Storage area**

The storage area of an above ground OSD is usually a walled or battered area that fills with stormwater during a rain event. It may be a garden, lawn, car park, paved courtyard, tank or a combination of these spaces that temporarily stores and drains stormwater. It is vital to ensure that the required volume to store water is retained.

3 **Outlet**

This is the outlet pipe that drains the storage area. It is located within the discharge control pit and usually has an orifice plate that controls the rate at which stormwater leaves the site. This causes stormwater to pond in the storage area where it remains until the rain eases.

4 **Overflow**

When the storage area is filled, water is allowed to overflow into an elevated pit or weir that allows water to leave the system.

Other features include:

- Primary orifice, which is a flat, stainless steel plate structure that controls the rate at which stormwater discharges from the outlet to maintain extended detention storage.
- Secondary orifice which controls the rate at which stormwater discharges from the storage area when the system is at capacity.
- Screens or trash screens that are installed in front of the outlet pipes. These are usually on a 45-degree angle to reduce the chance of blockage.

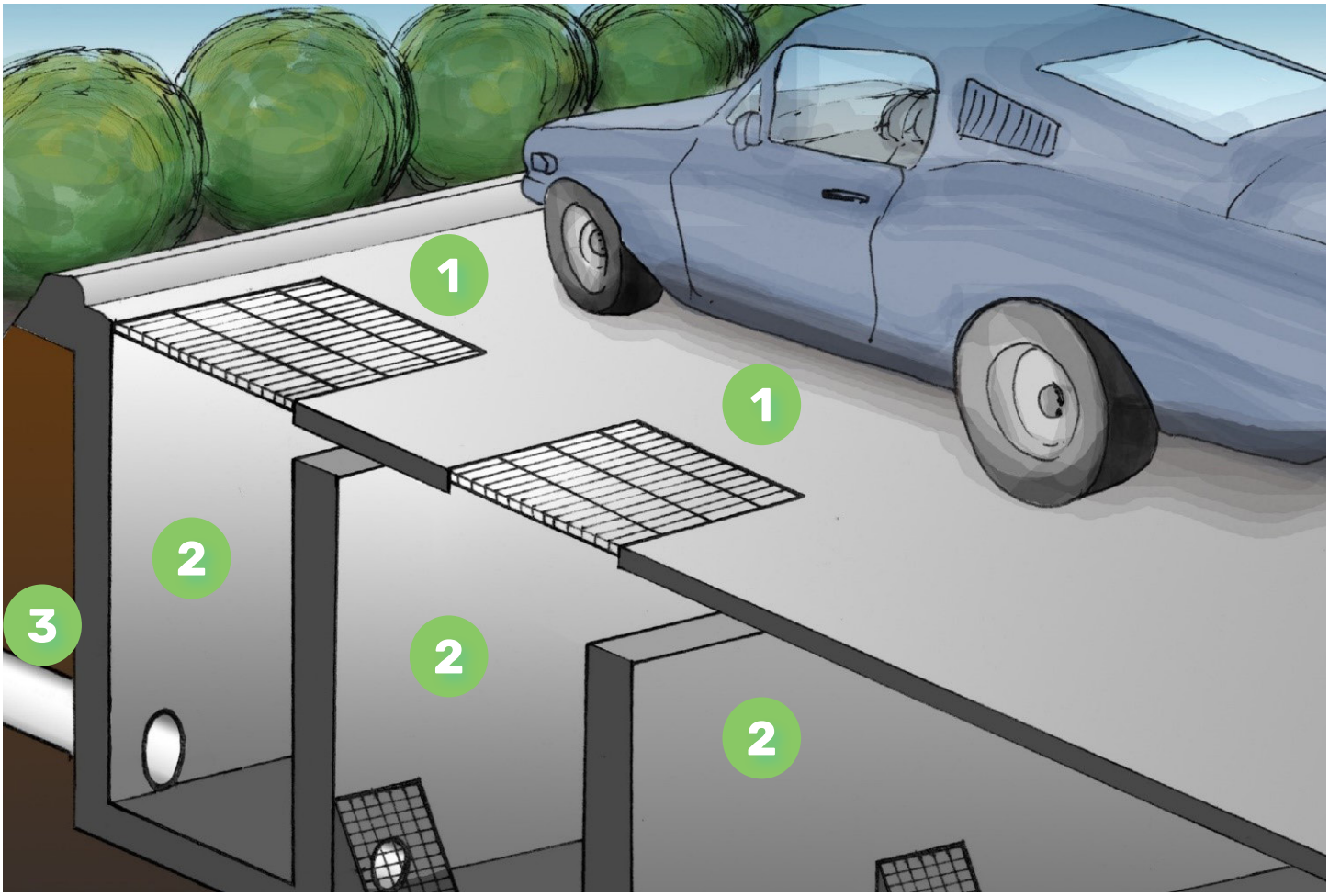


Figure 8: The functional components of a below ground OSD.

7.2 Functional components of a below ground OSD

1 **Inlet**

The inlet drains upstream roof downpipes and surface flow from grated pits to the OSD storage area.

2 **Storage area**

The storage area of a below ground OSD is an underground tank that fills with stormwater during a rain event. It may be 1 or multiple tanks in a series.

3 **Outlet**

This is the outlet pipe that drains the storage area and control pits. The orifice plate controls the rate of stormwater discharge into the stormwater drainage network.

Other features include:

- Primary orifice, which is a flat, stainless steel plate structure that controls the rate at which stormwater discharges from the outlet to maintain extended detention storage.
- Secondary orifice which controls the rate at which stormwater discharges from the storage area when the system is at capacity.
- Screens or trash screens that are installed in front of the outlet pipes. These are usually on a 45-degree angle to reduce the chance of blockage.
- Overflow which enables flows to bypass when the storage capacity of the OSD system is full. Unlike the outlet, there are no orifice plates or controls on the discharge rate in the overflow outlet.

7.3 Expertise required

Most above ground OSD systems can be maintained by the property owner. Larger below ground OSD systems require specialist cleaning companies that have specialised maintenance and monitoring vehicles and specialised equipment for opening manholes and lids.

Confined spaces certification and equipment is required for access to conduct some maintenance and monitoring tasks.

Personal protective equipment (PPE) should also be worn, and road safety considered where applicable.

ON-SITE STORMWATER DETENTION (OSD) – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some obstruction of inflows or requiring removal.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Storage area**				
2a	Storage volume (30)	6	No significant sediment accumulation or other volume reduction.	Some accumulated sediment with <5% of volume being lost.	Significant sediment or debris accumulation resulting in >5% of volume being lost.
2b	Sediment accumulation (27)	6	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows.
2c	Standing water or boggy conditions (29)	6	No standing water.	Standing water visible at the time of inspection.	Standing water >5% of depth remains more than 12 hours after rainfall.
3	**Outlet**				
3a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of outlet preventing or significantly obstructing inflows.
3b	Screen (26)	6	No holes or damage to the screen. No clogging evident	Some small holes/light damage. Can still function to remove most gross pollutants. Screen not securely attached to the pit wall.	Large holes/heavy damage. Gross pollutants can exit the OSD. Screen completely detached from the pit wall.
3c	Sediment accumulation (27)	6	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows.
4	**Overflow**				
4a	Blockage (3)	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.
4b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

ON-SITE STORMWATER DETENTION (OSD) – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Storage area**	
2a	Storage volume	1 2 3 NA Notes:
2b	Sediment accumulation	1 2 3 NA Notes:
2c	Standing water or boggy conditions	1 2 3 NA Notes:
3	**Outlet**	
3a	Blockage	1 2 3 NA Notes:
3b	Screen	1 2 3 NA Notes:
3c	Sediment accumulation	1 2 3 NA Notes:
4	**Overflow**	
4a	Blockage	1 2 3 NA Notes:
4b	Erosion	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

ON-SITE STORMWATER DETENTION (OSD) – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the OSD.	Y N NA Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Information: Typically required after heavy rainfall.	Y N NA Notes:
2	**Storage area**		
2a	Storage volume	Recommendation: Remove sediment, litter and debris from storage areas. Information: Ensure that the detention volume is maintained as per the design. Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2b	Sediment accumulation	Recommendation: If accumulated sediment is present on the surface, remove using a flat shovel or rake and restore to design detention volume as required. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Thickness of sediment removed:
2c	Standing water or boggy conditions	Recommendation: Storage area and screens should be free of sediment, litter and debris to prevent water ponding. Information: Water should drain away within hours after rain events.	Y N NA Notes:

3	Outlet		
3a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3b	Screen	Recommendation: Use a broom, hose or high-pressure hose to clean debris off the screen. Replace screen if required. Information: Remove screen and examine for rust or corrosion especially in corners and welds.	Y N NA Notes:
3c	Sediment accumulation	Recommendation: If accumulated sediment is present on the surface, remove using a flat shovel. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Thickness of sediment removed:
4	**Overflow**		
4a	Blockage	Recommendation: Unblock overflow pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
4b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

Cleaning of an Ecosol Gross Pollutant Trap (GPT) at Healy Avenue, Gregory Hills.

8 GROSS POLLUTANT TRAPS (GPTS)

Gross Pollutant Traps (GPTs) capture litter, sediment and debris that is washed into the stormwater system. Most GPTs are proprietary products that vary in exact form and function but are comprised of similar components.

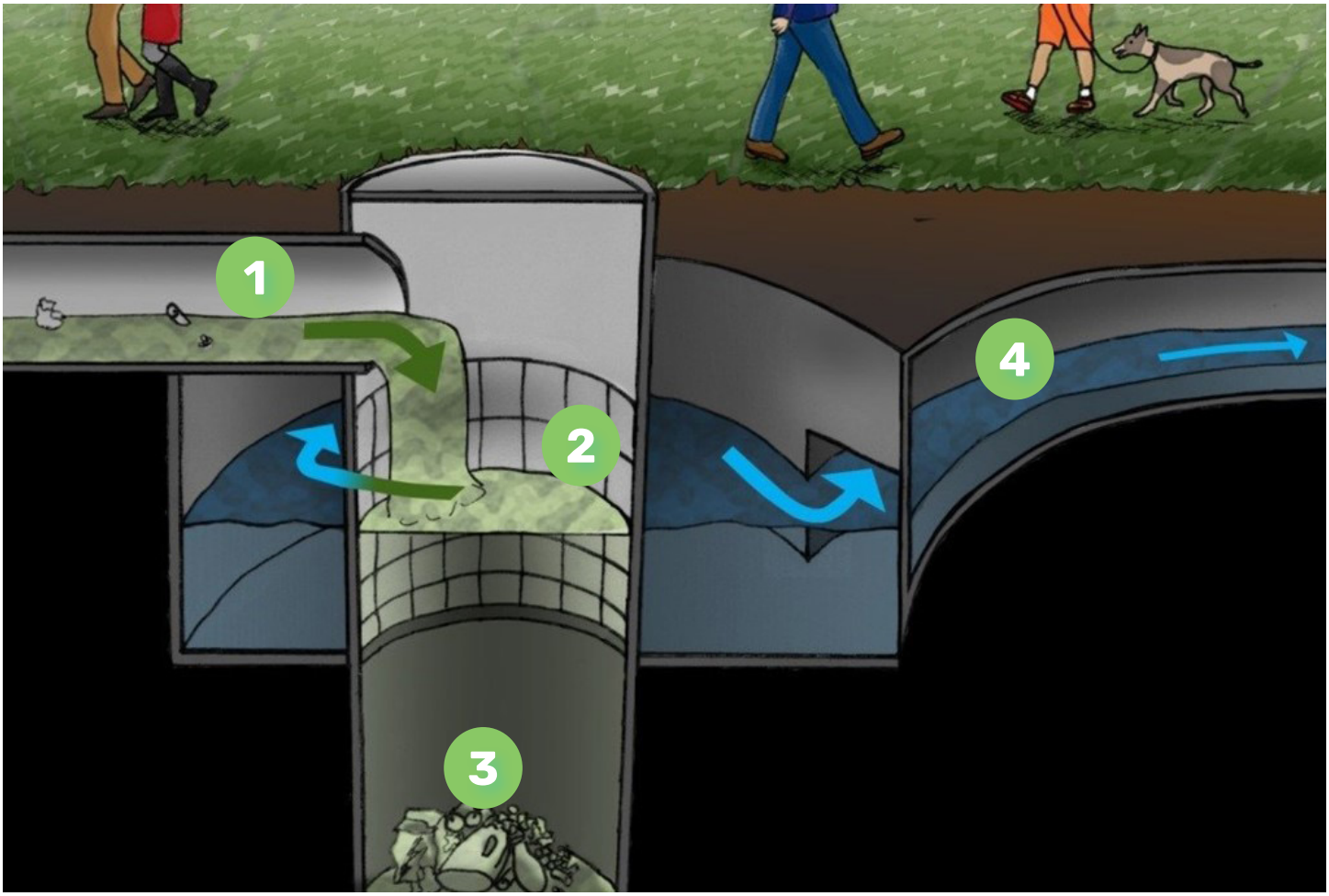


Figure 9: The functional components of a typical underground GPT.

8.1 Functional components

GPTs include a wide range of different designs with different components and can be proprietary devices or designed and constructed to suit the site.

There are many proprietary GPT products available on the market.

Key components of most GPTs are:

1 **Inlet**

This is usually an underground pipe that diverts water into the GPT. The inlet can generally be viewed when the inspection cover is removed.

2 **Screens**

GPTs generally use screens to separate out litter, sediment and debris from stormwater.

3 **GPT sump**

The GPT sump is where litter and debris captured by the screens is stored. The captured gross pollutants are removed from the GPT sump by an eductor or vacuum truck during cleaning. A grab truck can also be used for partial cleans.

4 **Outlet**

The outlet is where GPTs discharge the screened water back into the stormwater drainage network or into other stormwater treatment measures such as biofilters.

Other features include:

- Above ground GPTs may have storage areas where gross pollutants are captured. These can be accessed by concrete maintenance access tracks and cleaned using a small excavator, backhoe, tipper truck, shovels and brooms, depending on the size and type of GPT.
- Maintenance access ramps are usually provided for GPTs to ensure safe and stable access for cleaning trucks and vehicles. They are generally concrete or aggregate base.
- Some GPTs are designed with weir walls upstream or within the unit. These are constructed to divert designed stormwater flows into the GPT for treatment and allow excess flows to bypass the system

8.2 Expertise required

The required expertise depends on the type of GPT installed. Proprietary GPTs require specialised equipment such as small cranes, tip trucks, clam shell grab excavators and eductor or vacuum trucks. There are many contractors that are experienced in maintaining GPTs and licensed to transport GPT waste.

The site may require access for specialised maintenance and monitoring vehicles, and specialised equipment for opening manholes and lids.

Confined spaces certification and equipment may be required for access to conduct some maintenance and monitoring tasks.

Personal protective equipment (PPE) should also be worn, and road safety considered where applicable.

GROSS POLLUTANT TRAP (GPT) – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	3	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	3	No blockage.	Partial blockage of inlet causing some obstruction of inflows or requiring removal.	Blockage of inlet causing significant bypass or restriction of inflows.
2	**Screens**				
2a	Damage (5)	3	No holes or damage.	Some small holes/light damage. Can still function to filter most gross pollutants.	Large holes/heavy damage to the screen. Gross pollutants can pass through. Screen not securely attached to wall.
2b	Blockage (3)	3	No blockage.	Partial blockage of screen causing some obstruction of flows or requiring removal.	Blockage of screen preventing or significantly obstructing flows.
3	**GPT sump**				
3a	Debris, sediment and oil accumulation (7)	3	None or minimal accumulated solids/ oil (<10% capacity).	Some accumulated solids/oil (>50% capacity).	Accumulated sediment/oil is above capacity (>100%) or sediment/oil is present behind the screens.
4	**Outlet**				
4a	Blockage (3)	3	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

GROSS POLLUTANT TRAP (GPT) – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
2	**Screens**	
2a	Damage	1 2 3 NA Notes:
2b	Blockage	1 2 3 NA Notes:
3	**GPT sump**	
3a	Debris, sediment and oil accumulation	1 2 3 NA Notes:
4	**Outlet**	
4a	Blockage	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

GROSS POLLUTANT TRAP (GPT) – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date		**Purpose of visit:**	**Rainfall conditions:**
Location		☐ Maintenance	☐ Rainfall today (mm)
Asset name		☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID		☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)			

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2	**Screens**		
2a	Damage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Standing water in a wet sump system may have to be drawn down for screen maintenance. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2b	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Standing water in a wet sump system may have to be drawn down for screen maintenance. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3	**GPT sump**		
3a	Debris, sediment and oil accumulation	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: GPTs often require suction equipment to clean. Wet sump systems can be dewatered before maintenance is undertaken. If oil present, the GPT cannot be dewatered on-site. Waste must be transported to an appropriately licensed waste facility. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Pollutants removed (please add units): Gross pollutants: _____ Sediment: _____ Vegetation: _____ Oil/grease: yes/no
4	**Outlet**		
4a	Blockage	Recommendation: Refer to Stormwater NSW (2020) Guidelines for the Maintenance of Stormwater Treatment Measures. Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:

Other:

SHEET 1 OF 1

Cleaning of an Ecosol Gross Pollutant Trap (GPT) at Audley Circuit, Gregory Hills.

90 Privately owned SPELFilter cartridges.

9 FILTER CARTRIDGES

Filter cartridges include sand filters and proprietary products that are designed to filter finer pollutants such as fine solids, soluble heavy metals, oils and nutrients.

Filter cartridges may require a GPT upstream or include pre-treatment within the unit to prevent clogging from other gross pollutants. They are typically located offline with a high flow bypass as they are designed to treat limited flow rates.

9.1 Functional components

There are many proprietary filter cartridges available on the market.

Key components of most filter cartridges are:

1 **Inlet**

This includes pipes that enter the pit where the filter cartridges are installed, as well as where stormwater enters the filter cartridge unit. Depending on the proprietary device, this could be from the bottom of the unit or from a designated inlet area.

2 **Filter media and cartridge**

Each proprietary filter cartridge product operates differently which is why the install and replacement of the filter cartridge and media has to be undertaken by the manufacturer.

3 **Outlet**

This could be the pipes that allow treated water to exit the pit where the filter cartridges are installed or the outlet pipes within the filter cartridges that drain to pipework below the pit floor.

Other features include:

- Diversion weir which may be included in the filter cartridge product or in the pit upstream of the filter cartridges.
- Pollutant storage area which can be the floor of the pit that the filter cartridges are installed into.

Sand filters are non-proprietary devices that are similar to a biofilter system. Stormwater percolates through a filter media, like sand, and is collected by pipes in the bottom that are connected to the stormwater drainage network. However, they are not vegetated so can be installed underground. The following reference, inspection and maintenance sheets can be used for sand filters too.

9.2 Expertise required

There are many contractors that are experienced in maintaining filter cartridges and licensed to transport cartridge waste.

Some devices can only be maintained by their manufacturer as the filter media is specific to the product.

The site may require access for specialised maintenance and monitoring vehicles and specialised equipment for opening manholes and lids.

Confined spaces certification and equipment is required for access to conduct some maintenance and monitoring tasks.

Personal protective equipment (PPE) should also be worn, and road safety considered where applicable.

FILTER CARTRIDGE – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	3	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**				
1a	Blockage (3)	3	No blockage.	Partial blockage of inlet causing some obstruction of inflows or requiring removal.	Blockage of inlet preventing or significantly obstructing inflows.
2	**Filter media and cartridge**				
2a	Damage (5)	3	No holes, damage or missing components.	Some small holes/light damage. Can still function to filter stormwater.	Large holes, heavy damage or missing parts on the filter cartridge or media. Stormwater not being treated.
2b	Litter and debris (17)	3	No litter.	Some litter.	Large amount of litter.
2c	Debris, sediment and oil accumulation (7)	3	None or minimal accumulated solids/ oil (<10% capacity).	Some accumulated solids/oil (10-50% capacity). Minor impact to flow through the filter media.	Accumulated sediment/oil is above capacity (>50%). Blocking the flow through the filter media.
2d	Erosion (9)	3	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3	**Outlet**				
3a	Blockage (3)	3	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

FILTER CARTRIDGE – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
2	**Filter media and cartridge**	
2a	Damage	1 2 3 NA Notes:
2b	Litter and debris	1 2 3 NA Notes:
2c	Debris, sediment and oil accumulation	1 2 3 NA Notes:
2d	Erosion	1 2 3 NA Notes:
3	**Outlet**	
3a	Blockage	1 2 3 NA Notes:

Other:

FILTER CARTRIDGE – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2	**Filter media and cartridge**		
2a	Damage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Standing water may have to be drawn down for cartridge maintenance or replacement. An appropriately licensed contractor or manufacturer should be engaged to undertake any repairs. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2b	Litter and debris	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. All disposal procedures are to adhere with NSW EPA and local authorities' requirements. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Counts of litter removed:
2c	Debris, sediment and oil accumulation	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: An appropriately licensed contractor or manufacturer should be engaged to undertake any cleans. Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Oil/grease: yes/no Thickness of sediment removed:
2d	Erosion	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Typically required after heavy rainfall.	Y N NA Notes:
3	**Outlet**		
4a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:

Other:

SHEET 1 OF 1

Council inspection of Ecosol Litter Basket at Vicary Avenue, Elderslie.

10 PIT INSERTS

These devices are fitted into stormwater drainage pits to capture litter, debris and other gross pollutants from urban runoff. They are often used as primary treatment of stormwater before it enters a secondary or tertiary treatment system.

10.1 Functional components

There are many proprietary pit insets available on the market.

Key components of most pit inserts are:

1 **Drainage pit lid**

The hinged grate allows stormwater to flow off hard surfaces into a drainage pit. This lid can be lifted by hand or using pit lifters.

2 **Inlet**

The inlet may be pipes into the pit or surface flow through the drainage pit lid. Sometimes there are multiple inlets into the pit.

3 **Screening bag**

This is the proprietary product that is inserted into the drainage pit to catch coarse pollutants (depending on the screen size) before they enter the downstream stormwater drainage network. The screening bags are designed to be free draining and should be dry between rain events.

4 **Outlet**

The outlet pipes drain the screened stormwater into the stormwater drainage network.

Other features include:

- Flow diverter or skirting which extends from the screening bag to the walls of the pit. This directs all flows entering the pit into the screening bag.
- Overflow weir which allows the excess flows to overtop the screening bag.
- Oil and grease trap socks.

10.2 Expertise required

Maintaining pit inserts is simple and may only require pit lifters.

If the screening bag is damaged, clogged or missing, the product should be replaced by the manufacturer.

Confined spaces certification and equipment may be required for access to conduct some maintenance and monitoring tasks.

Personal protective equipment (PPE) should also be worn, and road safety considered where applicable.

PIT INSERT – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	3	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Drainage pit lid**				
1a	Blockage (3)	3	No blockage.	Partial blockage of inlet causing some obstruction of inflows or requiring removal.	Blockage of drainage pit lid preventing or significantly obstructing inflows.
1b	Damage (5)	3	No holes, damage or missing components. Drainage pit lid can be safely lifted.	Some small holes/light damage. Drainage pit lid is slightly damaged or rusted.	Large holes, heavy damage or missing parts on the drainage pit lid. Drainage pit lid or hinges are damaged causing unsafe lifting.
2	**Inlet**				
2a	Blockage (3)	3	No blockage.	Partial blockage of inlet causing some obstruction of inflows or requiring removal.	Blockage of inlet preventing or significantly obstructing inflows.
3	**Outlet**				
3a	Damage (5)	3	No holes, damage or missing components.	Some small holes/light damage. Can still function to filter stormwater.	Large holes, heavy damage or missing parts on the screening bag. Stormwater not being treated.
3b	Litter and debris (17)	3	No litter.	Some litter (<50% full).	Large amount of litter (100% full and overflowing with litter).
3c	Debris, sediment and oil accumulation (7)	3	None or minimal accumulated solids/oil (<10% capacity). No impact on flow through screening bag.	Some accumulated solids/oil (10-50% capacity). Minor impact to flow through the screening bag.	Accumulated sediment/oil is above capacity (>50%). Blocking the flow through the filter media.
4	**Outlet**				
4a	Blockage (3)	3	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

PIT INSERT – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Drainage pit lid**	
1a	Blockage	1 2 3 NA Notes:
1b	Damage	1 2 3 NA Notes:
2	**Inlet**	
2a	Blockage	1 2 3 NA Notes:
3	**Screening bag**	
3a	Damage	1 2 3 NA Notes:
3b	Litter and debris	1 2 3 NA Notes:
3c	Debris, sediment and oil accumulation	1 2 3 NA Notes:
4	**Outlet**	
4a	Blockage	1 2 3 NA Notes:

Other:

PIT INSERT – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

Functional component		Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA Notes:
1	**Drainage pit lid**		
1a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the screening bag.	Y N NA Notes:
1b	Damage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: An appropriately licensed contractor or manufacturer should be engaged to undertake any repairs.	Y N NA Notes:
2	**Inlet**		
2a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3	**Screening bag**		
3a	Damage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: An appropriately licensed contractor or manufacturer should be engaged to undertake any repairs. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3b	Litter and debris	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. All disposal procedures are to adhere with NSW EPA and local authorities' requirements. A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Pollutants removed (please add units): Gross pollutants: _____ Sediment: _____ Vegetation: _____

3c	Debris, sediment and oil accumulation	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes: Oil/grease: yes/no
4	**Outlet**		
4a	Blockage	Recommendation: Refer to Stormwater NSW (2020) *Guidelines for the Maintenance of Stormwater Treatment Measures.* Information: A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:

Other:

SHEET 2 OF 2

Ecosol Litter Basket with sediment and organics removed from stormwater.

Privately owned permeable paving in Gledswood Hills.

11 PERMEABLE PAVING

Permeable paving allows water to infiltrate through the paving, reducing the volume of runoff from hard surfaces such as roads, car parks and footpaths. This reduces local flooding and surface ponding, and promotes infiltration.

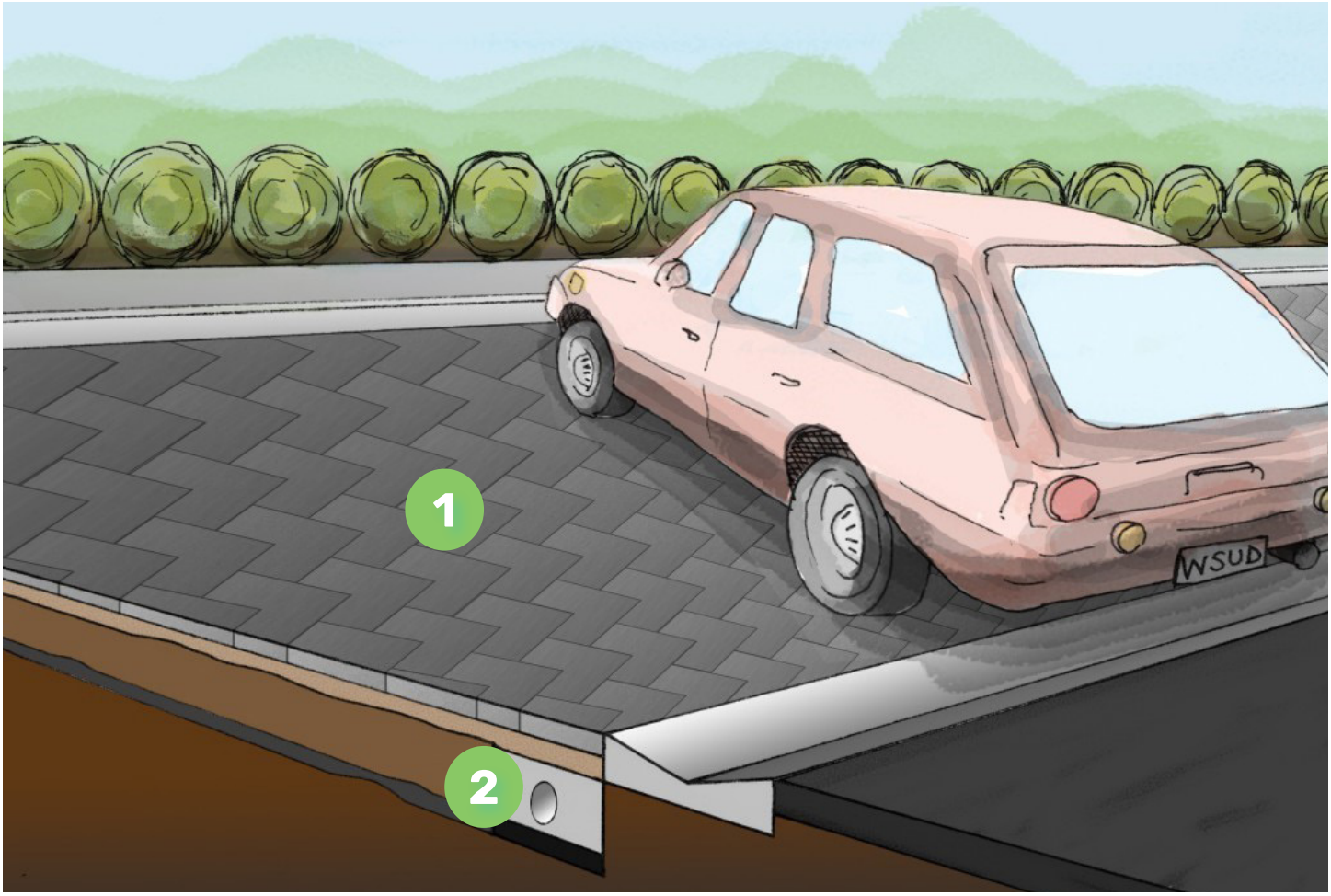


Figure 10: The functional components of permeable paving.

11.1 Functional components

1

Pavement surface

Permeable paving can be in the form of permeable surfacing (such as paving blocks or a continuous surface of porous asphalt, concrete, pebble or rubber mix) or as permeable gaps in the surface (gravel or sand filled voids) in between impermeable paving blocks.

For both styles, it is important that the pavement surface is even and level and kept clear of leaf litter and sediment.

2

Outlet

Some designs of permeable paving drain directly into underlying soils. In areas of low infiltration such as clay soils, permeable paving has an underdrainage system with a liner. Slotted pipes sit in a gravel layer and collect and direct flows towards the stormwater drainage network.

Other features include:

- Base course such as coarse sand, gravel or aggregate, laid underneath the pavers.
- Inspection pipes which can be used for monitoring and maintenance of underdrainage pipes.
- Extended detention depth which extends up to 50mm above the pavement surface. The temporary detention of water during a rain event allows a greater volume of water to be captured and slowly filtered.

11.2 Expertise required

Permeable paving inspections can typically be undertaken by the property owner as specialised equipment to access and view the system is generally not required.

If permeability and clogging issues are not rectified with basic maintenance (using a broom and high-pressure hose) or structural issues are identified, then a more detailed inspection and infiltration testing by a specialist contractor should be obtained.

PERMEABLE PAVING – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Pavement surface**				
1a	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. minor loose pavers, no tripping hazards).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. loose pavers, tripping hazards).
1b	Permeability and clogging (20)	12	In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (100-150mm) is drawn down within 2-3 minutes after inflow has ceased. No stagnant water ponding on surface.	In dry conditions, water poured on surface infiltrates through the surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding (100-150mm) takes 3-10 minutes to draw down. Small, isolated ponds of stagnant water present.	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (100-150mm) remains on the surface for >10 minutes after inflow has ceased. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation. >20% surface coverage of algae and moss present on filter surface. Large volumes of stagnant water ponding on surface.
1c	Sediment accumulation (27)	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of the surface). Causing some redirection of flows over the system or reduced infiltration.	Accumulated sediment (covering >50% of the surface) impeding infiltration.
1d	Vehicle or pedestrian damage (33)	6	No broken pavers or damage.	Minor damage to pavers. Does not pose risk to structural integrity or asset function.	Significant paver damage. Poses risk to structural integrity, public safety or asset function.
1e	Surface levels (31)	6	Even surface with no depressions or mounds.	Some small depressions or mounds present. Base is mostly flat with flows evenly distributed across most of pavement surface.	Significant depressions or mounds present. Surface levels are impacting flows through the asset (e.g. short-circuiting flows, blocking flows, reduced extended detention depth). Isolated pools on the pavement surface.
1f	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
2	**Outlet**				
2a	Blockage (3)	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
2b	Inspection pipes (15)	12	No water in the inspection pipe.	Some water present in the bottom of the inspection pipe.	Water is close to the pavement surface.

PERMEABLE PAVING – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Pavement surface**	
1a	Erosion	1 2 3 NA Notes:
1b	Permeability and clogging	1 2 3 NA Notes:
1c	Sediment accumulation	1 2 3 NA Notes:
1d	Vehicle or pedestrian damage	1 2 3 NA Notes:
1e	Surface levels	1 2 3 NA Notes:
1f	Weeds	1 2 3 NA Notes:
2	**Outlet**	
2a	Blockage	1 2 3 NA Notes:
2b	Inspection pipes	1 2 3 NA Notes:

Other:

SHEET 1 OF 1

PERMEABLE PAVING – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

Functional component		Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*	
	Surrounds and other infrastructure			
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA	Notes:
1	**Pavement surface**			
1a	Erosion	Recommendation: Void and joint material may need to be topped up. Information: Refer to Works as Executed plans for specifications.	Y N NA	Notes:
1b	Permeability and clogging	Recommendation: Clean with vacuum sweeper or wash with high pressure hose. Information: Vacuum cleaning is the preferred cleaning method however a high-pressure hose may be used if sweeping or vacuum cleaning is ineffective. Cleaning with a high-pressure hose is better suited to fully permeable surfaces as the pressure of the hose can removed the gravel or sand out of the permeable spaces between pavers. Void and joint material may need to be topped up after pavement cleaning.	Y N NA	Notes:
1c	Sediment accumulation	Recommendation: For coarse sediment accumulation, sweep with a stiff broom or wash with high-pressure hose. A vacuum sweeper may be required to remove fine particles from the pavement. Information: Void and joint material may need to be topped up after pavement cleaning.	Y N NA	Notes:
1d	Vehicle or pedestrian damage	Recommendation: Replace broken pavers if required. Information: Void and joint material may need to be topped up after pavement repair.	Y N NA	Notes:
1e	Surface levels	Recommendation: Reprofile any local depressions or mounds so the permeable paving is as even as possible. Reprofile under pavers, refill base course and replace broken pavers if necessary. Information: Refer to Works as Executed plans for specifications.	Y N NA	Notes:
1f	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the permeable paving.	Y N NA	Notes:
2	**Outlet**			
2a	Blockage	Recommendation: Unblock outlet pipes and ensure pipes can drain freely. Remove sediment from outflow areas. Information: There is usually a downstream pit where the underdrainage pipes drain to. A pit is considered a confined space, requiring safety equipment and training.	Y N NA	Notes:
2b	Inspection pipes	Recommendation: Flush underdrainage pipes with a high-pressure hose. Information: Flushing of the underdrainage pipes ensures there is no blockage or debris that can accumulate.	Y N NA	Notes:

Other:

SHEET 1 OF 1

Temporary sediment basin in Oran Park.

12 TEMPORARY SEDIMENT BASIN

Temporary sediment basins are installed during the construction stage of a development to help manage stormwater impacts during construction.

These open water bodies treat stormwater by allowing coarse sediments and particles to settle.

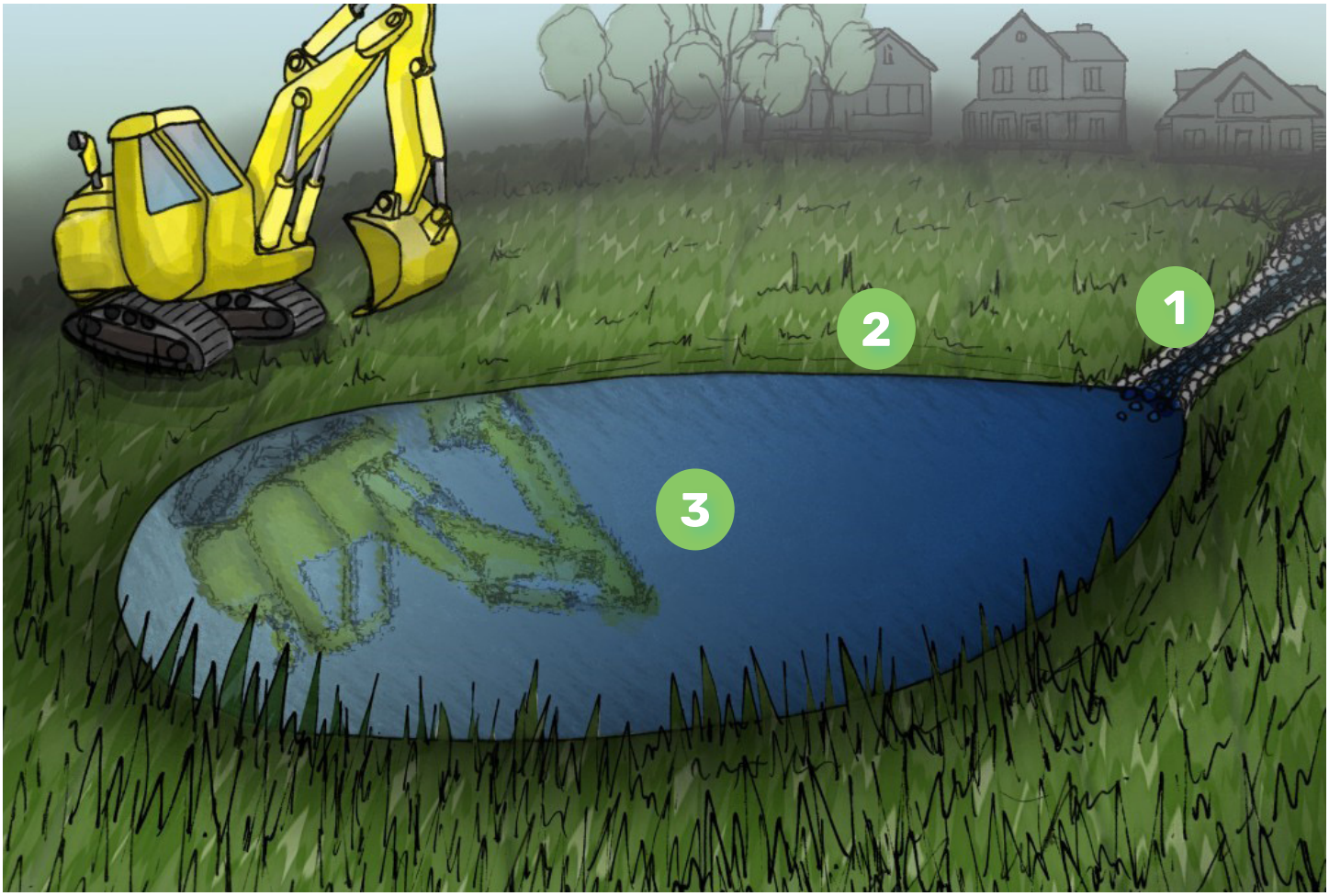


Figure 11: The functional components of a temporary sediment basin

12.1 Functional components

1 **Inlet**

This is usually a channel or surface inlet that directs stormwater flows into the basin.

2 **Batters**

These connect the temporary sediment basin water surface with the surrounds at a gentle slope. Batters on a temporary sediment basin may be vegetated.

3 **Sedimentation zone**

Water ponds in the sedimentation zone allowing coarse sediments to settle out.

4 **Outlet and overflow (not shown)**

The outlet and overflow pits direct water back into the stormwater drainage network.

Some temporary sediment basins have a riser outlet so water can drain away after sediments have settled out. This ensures the basin is dry between rain events. Dry basins are generally not suitable in areas of dispersive soils.

Other features include overflow spillways that allow high flows to exit the basin.

12.2 Expertise required

Temporary sediment basins are normally maintained by civil construction contractors who have the necessary equipment and expertise to manage these systems.

A small boat or kayak may be required for maintenance and monitoring of the temporary sediment basin. All appropriate boat licences and WHS requirements must be met.

TEMPORARY SEDIMENT BASIN – REFERENCE SHEET

Functional component With Part C number in brackets		Required frequency (months)	Functional component condition score		
			Good (1)	Moderate (2)	Poor (3)
	Surrounds and other infrastructure				
	Damage or removal of structures (6)	6	Stable structures with no damage. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Pavement surface**				
1a	Blockage (3)	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion (9)	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Batters**				
2a	Erosion (9)	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3	**Sedimentation zone**				
3a	Floating plants (13)	6	No or minimal nuisance floating plants (<10%).	Moderate cover of nuisance floating plants (10-50%).	High cover of nuisance floating plants (>50%) or are problematic.
3b	Mosquitoes (18)	6	No isolated depressions that can become breeding sites when water levels recede. Deep pools present to provide refuge to mosquito predators. No dead or rafting pieces of vegetation.	Potential mosquito habitats observed (e.g. isolated pools, rafting pieces of vegetation).	Nuisance populations of mosquitoes observed or reported by local community. Numerous potential mosquito habitats observed (e.g. isolated pools, rafting pieces of vegetation).
3c	Sediment accumulation (27)	6 (and after major rain events)	Acceptable levels of accumulated sediment. Sediment does not impede flows.	Sediment accumulation is within 100mm of the design maximum level.	Accumulated sediment is >100mm above the design maximum sediment level.
3d	Water quality – oil slicks, odour, algae (35)	6	No water quality issues.	Some minor water quality issues visible but no major impact on aesthetics or water quality.	Significant water quality issues. Heavily impacting aesthetics or water quality.
3e	Weeds (36)	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
4	**Outlet and overflow**				
4a	Blockage (3)	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
4b	Erosion (9)	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

TEMPORARY SEDIMENT BASIN – INSPECTION SHEET

Date	**Purpose of visit:**	**Rainfall conditions:**
Location	☐ Inspection	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ After major rain event	☐ No recent rainfall
Inspected by (Name and company)	☐ Other (specify)	

	Functional component	Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Batters**	
2a	Erosion	1 2 3 NA Notes:
3	**Sedimentation zone**	
3a	Floating plants	1 2 3 NA Notes:
3b	Mosquitoes	1 2 3 NA Notes:
3c	Sediment accumulation	1 2 3 NA Notes:
3d	Water quality – oil slicks, odour, algae	1 2 3 NA Notes:
3e	Weeds	1 2 3 NA Notes:
4	**Outlet and overflow**	
4a	Bockage	1 2 3 NA Notes:
4b	Erosion	1 2 3 NA Notes:

Other:

TEMPORARY SEDIMENT BASIN – MAINTENANCE SHEET

Functional component condition score:	Maintenance required:
Good (1)	No maintenance required
Moderate (2)	Routine (simple) maintenance tasks
Poor (3)	Corrective (specialist) maintenance tasks

	Purpose of visit:	Rainfall conditions:
Date		
Location	☐ Maintenance	☐ Rainfall today (mm)
Asset name	☐ Response to complaint	☐ Rainfall in last 3 days (mm)
Asset ID	☐ Other (specify)	☐ No recent rainfall
Maintained by (Name and company)		

	Functional component	Maintenance recommendation and information *Please consider safety, personal ability and circumstance if and when undertaking these maintenance recommendations.*	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*	
	Surrounds and other infrastructure			
	Damage or removal of structures	Recommendation: Rectification works for structural and safety issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications.	Y N NA	Notes:
1	**Inlet**			
1a	Blockage	Recommendation: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the temporary sediment basin.	Y N NA	Notes:
1b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA	Notes:
2	**Batters**			
2a	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA	Notes:
3	**Sedimentation zone**			
3a	Floating plants	Recommendation: Mechanical removal is best suited to large temporary sediment basins. In most cases, floating plants can be removed by hand using rakes or floating booms. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site).	Y N NA	Notes:

3b	Mosquitoes	Recommendation: Remove any potential mosquito habitats by filling in any isolated depression which could fill with water after rain. Remove dead or rafting pieces of vegetation around deep water zones and maintain deep pools to provide refuge to mosquito predators such as freshwater fish and macroinvertebrates. Information: A site specific investigation may be required if there is an ongoing issue and nuisance population of mosquitoes in the temporary sediment basin.	Y N NA Notes: Thickness of sediment removed:
3d	Water quality - oil slicks, odour, algae	Recommendation: Slicks on the water surface may be nitrogen-fixing bacteria or oil. If it is a large oil spill, impacts to the downstream stormwater drainage network or waterways can be minimized using barriers such as floating booms or removal such as an eductor truck. If blue-green algae or other health and safety concerns, signage should be placed around the temporary sediment basin. Excessive filamentous algal blooms may block inlets and outlets and can be removed using rakes or specialist machinery. Information: Blue-green algae presents a human health risk and must be managed to protect the safety of the public. For identification of algal blooms, refer to the Camden Council or WaterNSW website.	Y N NA Notes: Odour: yes/no Oil/grease: yes/no Blue-green algae: yes/no Filamentous algae: yes/no
3e	Weeds	Recommendation: Manually remove weeds. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Remove weeds before they flower and seed. Herbicides are generally not recommended as they may compromise the integrity and performance of the temporary sediment basin.	Y N NA Notes: Hours spent on weed removal:
4	**Outlet and overflow**		
4a	Blockage	Recommendation: Unblock outlet pipes. Remove sediment from outflow areas. Information: Waste must be transported to an appropriately licensed waste facility (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
4b	Erosion	Recommendation: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y N NA Notes:

Other:

Temporary sediment basin in Leppington.

Lake Yandel'ora in Mount Annan.

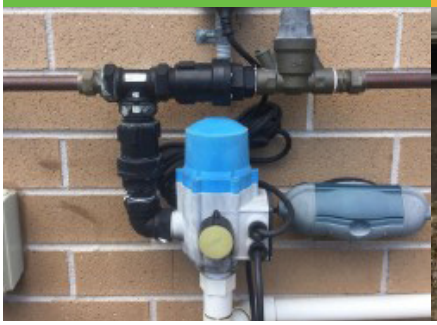
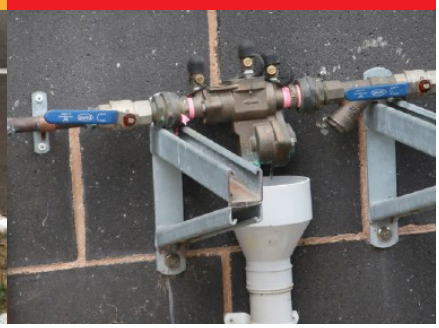
PART C: FUNCTIONAL COMPONENT CONDITION REFERENCE

Part C provides a visual and descriptive summary of how each functional component looks when in a good, moderate or poor condition. The images in this catalogue will help you correctly identify and score the functional components of your WSUD asset.

1. Backflow prevention device

Applicable assets: rainwater tank

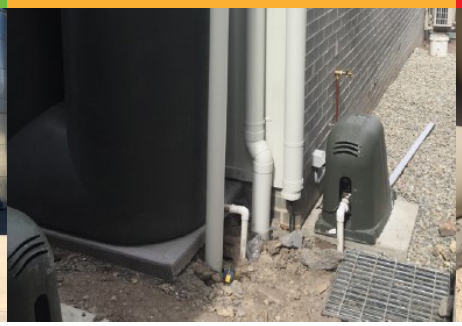
A backflow prevention device is required on water supply systems that have a potable backup. They ensure that water stored in a rainwater tank cannot flow back into the water supply pipe and contaminate the greater water supply network. Backflow prevention devices can only be maintained by a licensed plumber.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

2. Base stability

Applicable assets: rainwater tank

Rainwater tanks require a strong, flat, compacted and stable base to support the tank when it is full. If the base is not structurally adequate or completely flat, regardless of the constructed material, there is a risk that the tank will become unstable and potentially dangerous.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

3. Blockage

Applicable assets: biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, GPT, filter cartridge, pit insert, permeable paving, temporary sediment basin

Blockages are generally sediment accumulation, leaf litter and rubbish. It is important to remove any blockage impeding flow through an asset as it may prevent water entering, resulting in partial or complete bypass. In vegetated assets, blockages can prevent water reaching plants, resulting in plant loss, rapid asset failure and reduced stormwater treatment. Blockages can also cause localised flooding.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

4. Body integrity

Applicable assets: rainwater tank

The integrity of a tank can reduce over time as tank materials age, resulting in holes, gaps or cracks in the tank body. Seals around taps and other connections should be checked for leaks or wear.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

5. Damage

Applicable assets: floating wetland, GPT, filter cartridge, pit insert

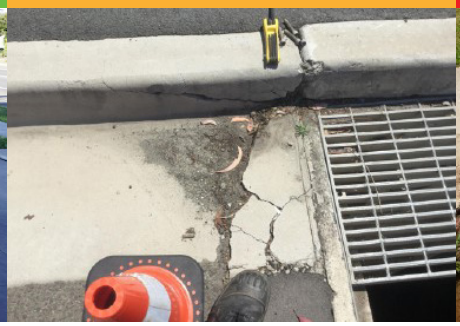
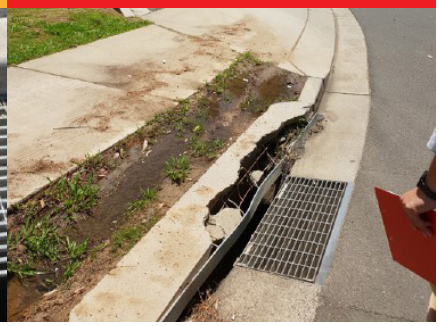
Damage can occur to an asset during a storm event, cleaning or from a lack of cleaning. In most cases, damage requires consultation with the proprietary supplier for repair or replacement.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

6. Damage or removal of structures

Applicable assets: biofilter, biofilter street tree pit, floating wetland, wetland, vegetated buffer strip and swale, OSD, GPT, filter cartridge, pit insert, permeable paving, temporary sediment basin

Structures within and adjacent to a WSUD asset, including bollards, seating, pathways, pits, pit lids and kerbs, need to be in a good working condition and not pose a risk to the public. Structures can be impacted by age, vehicles, vandalism, storm events and debris damage.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

7. Debris, sediment and oil accumulation

Applicable assets: GPT, filter cartridge, pit insert

Stormwater runoff can carry a large quantity of debris, sediment and oil. WSUD assets are designed to trap this pollution to protect downstream receiving waters, however, an excessive accumulation of debris, sediment and oil can prevent a WSUD asset from working correctly. This usually results from a lack of asset maintenance.

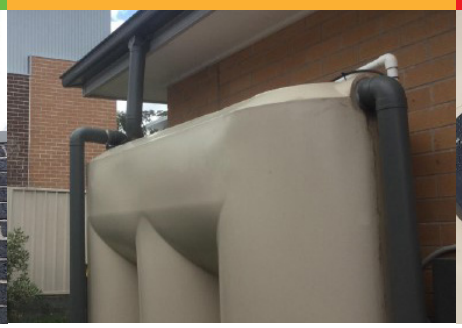
Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

Pit insert

8. Downpipes and screen (rainhead)

Applicable assets: rainwater tank

Downpipes and screens deliver water from a roof into a rainwater tank. For the tank to function correctly, the downpipes and screen must not be leaking and be kept clear of leaf litter and other debris.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

9. Erosion

Applicable assets: biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, GPT, filter cartridge, permeable paving, temporary sediment basin

Erosion is usually caused by high velocity flows, poor vegetation cover, poor soil conditions or a combination of factors. It is important to identify the cause of erosion before undertaking maintenance works. Erosion on batters, surfaces, around inlets and outlets and in the gaps between permeable pavers can create issues of public safety whilst impacting the function of the WSUD asset.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

10. Extended detention depth

Applicable assets: biofilter, biofilter street tree pit

The extended detention depth (EDD) is the difference between the asset surface level and the outlet level. When a storm event occurs, the EDD is filled with stormwater and draws down as water infiltrates through the filter media or flows through the outlet pipe or weir in a controlled manner. It is important that the EDD is not compromised through over-filling of filter media, mulch or excessive sediment accumulation as these reduce the storage volume of the asset, treatment effectiveness and can result in system bypass. The EDD is specified in the design of the asset and should not be compromised by overfilling filter media during construction or maintenance.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

11. Filter

Applicable assets: rainwater tank

Before water is reused from a rainwater tank, it is usually filtered to remove pollutants. Filters will vary between uses and some tanks, primarily used for household irrigation, may not have a filter at all. Filters often comprise of a cartridge that is easily replaceable, however, further maintenance may require a licensed plumber.

Functional component condition score example images	
Good (1)	Poor (3)

12. First flush device

Applicable assets: rainwater tank

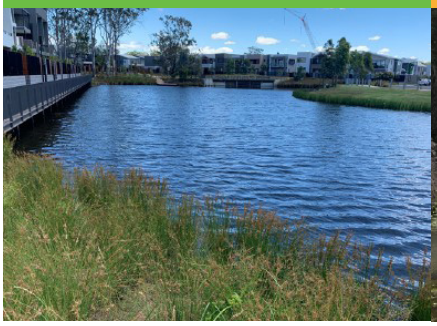
A first flush device captures the initial runoff from a roof at the beginning of a rain event. This keeps a large quantity of pollutants out of the tank as the initial runoff is usually the most polluted. A first flush device can be attached to the downpipe or tank.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

13. Floating plants

Applicable assets: wetland, temporary sediment basin

Nuisance floating plants can be an issue in assets where they cover the entire surface and take over desired species in the asset. Floating plants can exist on the water surface without any contact with the submerged soil.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

14. Flow meter

Applicable assets: rainwater tank

A flow meter measures the amount of water that passes through a pipe. These can be placed on potable backup systems to measure how much potable water is being used compared to rainwater. Flow meters can only be maintained by a licensed plumber.

Functional component condition score example images
Good (1)

15. Inspection pipes

Applicable assets: biofilter, biofilter street tree pit, permeable paving

An inspection pipe is an upturned pipe in the surface of a WSUD asset with underdrainage pipes, allowing cleaning and maintenance to occur. Some biofilter systems are designed to hold permanent water in the underdrainage pipes.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

16. Leaf litter

Applicable assets: biofilter, biofilter street tree pit, floating wetland

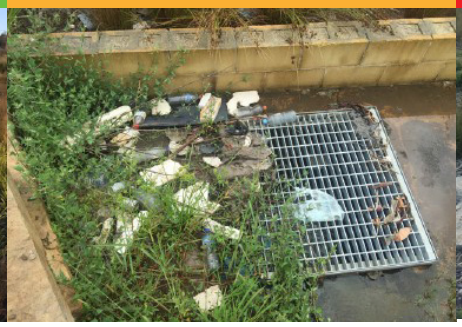
Leaf litter can accumulate and become saturated within a WSUD asset or in the immediate catchment area. In saturated conditions, leaves breakdown and produce a fine organic matter that can leach nutrients into the asset and downstream waterways, and can also cause clogging of the filter media surface in the long term. A high amount of leaf litter can block inlets and outlets and impede flows and vegetation growth.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

17. Litter and debris

Applicable assets: biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, filter cartridge, pit insert

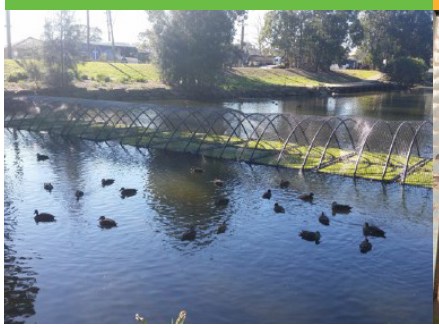
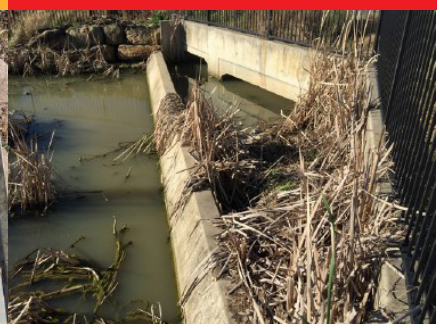
Storm events can wash litter and debris into WSUD assets. Large amounts of litter and debris can block inlets and outlets and detract from the amenity of the asset.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

18. Mosquitoes

Applicable assets: wetland, temporary sediment basin

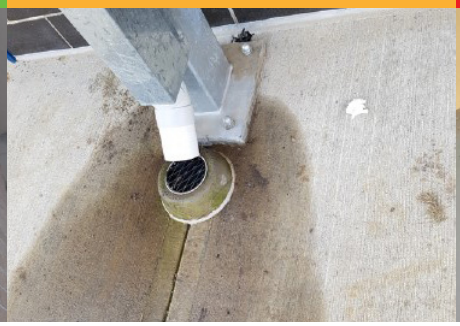
Mosquitoes can be an issue in systems that contain isolated depression that can store small amounts of stagnant water. Mosquito populations can be kept controlled by providing habitat for mosquito predators. These predators generally require deep pools connected to potential mosquito breeding areas.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

19. Overflow

Applicable assets: rainwater tank

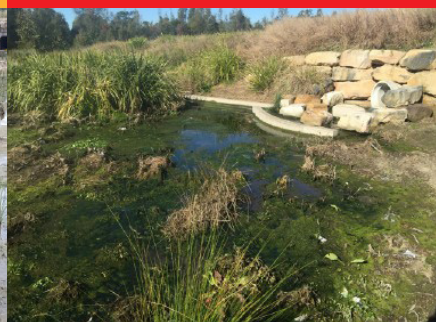
A rainwater tank has a defined overflow that allows controlled overflow to enter the stormwater drainage network. A rainwater tank overflow should be kept clear of blockages at all times.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

20. Permeability and clogging

Applicable assets: biofilter, biofilter street tree pit, permeable paving

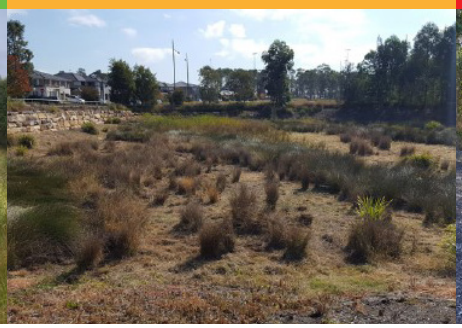
The biofilter or treatment surface should always be free draining. Algal growth, moss or ponding water can be signs that the surface is not draining fast enough and that the filter media is clogged. For a biofilter, the infiltration rate can be measured through a hydraulic conductivity test in line with *Adoption Guidelines for Stormwater Biofiltration Systems (2015).*

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

21. Plant cover

Applicable assets: biofilter, biofilter street tree pit, wetland, floating wetland, vegetated buffer strip and swale

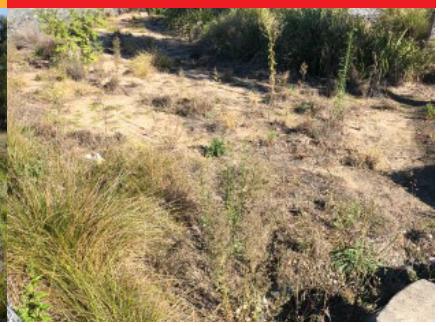
To treat stormwater effectively, vegetated WSUD assets must have adequate plant coverage in the biofilter or treatment surface. A dense plant cover also helps prevent erosion of the treatment surface and batters.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

22. Plant health

Applicable assets: biofilter, biofilter street tree pit, wetland, floating wetland, vegetated buffer strip and swale

Poor plant health can impact a WSUD asset performance and be caused by inappropriate species selection, excessive inundation, competition from weeds, smothering by sediment, leaf litter and lack of water due to inlet blockage or flow distribution problems. Vegetated assets will not perform to their full capacity without healthy vegetation.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

23. Potable mains backup device

Applicable assets: rainwater tank

A potable mains backup device allows a rainwater reuse system to use potable water when the rainwater tank empties. These devices can be integrated with a flow meter and backflow prevention device and can only be maintained by a licensed plumber.

Functional component condition score example images
Good (1)

24. Pump

Applicable assets: rainwater tank

Rainwater tanks that supply water for indoor use require a pump to generate the required pressure. Most rainwater tanks that are used for household irrigation do not require a pump. Pump issues can usually be identified through a lack of pressure or from unusual noise generated during operation.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

25. Roof and gutters

Applicable assets: rainwater tank

The roof and gutters that supply water to a rainwater tank must be kept clear of excessive leaf litter and debris. This ensures that material is less likely to block the screen or enter the rainwater tank.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

26. Screen

Applicable assets: rainwater tank, OSD

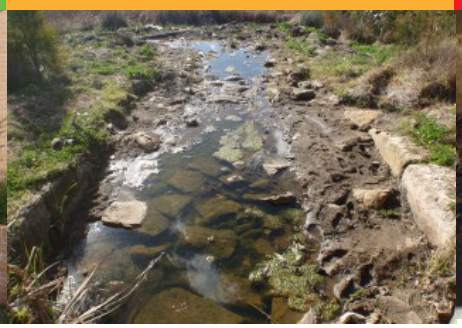
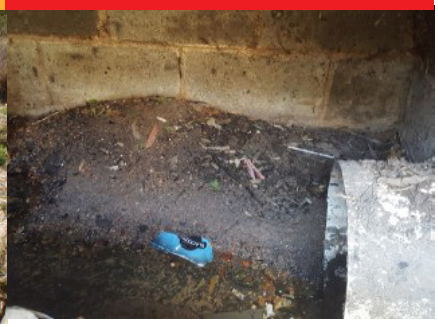
Screens help to filter out large particles and litter from the inflow into systems. They can become clogged or broken and prevent water entering or existing a tank or storage area. A screen with holes or gaps can allow debris into the tank or storage area.

	Functional component condition score example images		
	Good (1)	Moderate (2)	Poor (3)
Rainwater tank			
OSD			

27. Sediment accumulation

Applicable assets: biofilter, biofilter street tree pit, wetland, floating wetland, vegetated buffer strip and swale, OSD, permeable paving, temporary sediment basin

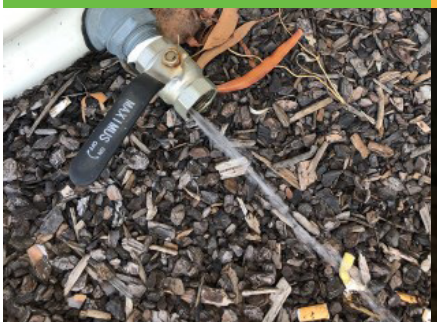
Stormwater can deposit high levels of sediment in WSUD assets. Sediment accumulation in WSUD assets can change the profile of the asset, cause bypass, redirection and short circuiting of flows, smother vegetation and clog filter media.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

28. Sludge

Applicable assets: rainwater tank

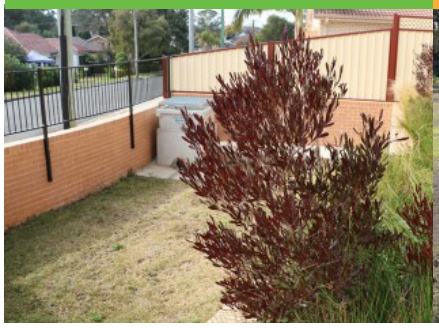
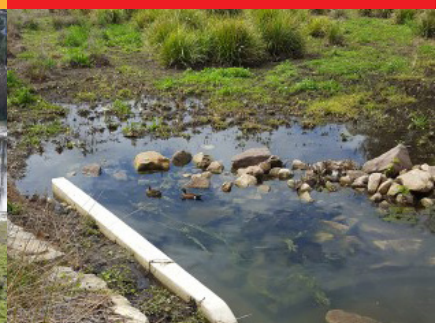
Screens help to filter out the larger pollutants entering a rainwater tank system but do not remove the finer sediment. Sludge is the accumulation of fine sediment in the base of the tank. If water in the tank is cloudy with sediments, it suggests the tank needs a de-sludge. Most tanks have a valve at the base that allows sludge to be drained.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

29. Standing water or boggy conditions

Applicable assets: vegetated buffer strip and swale, OSD

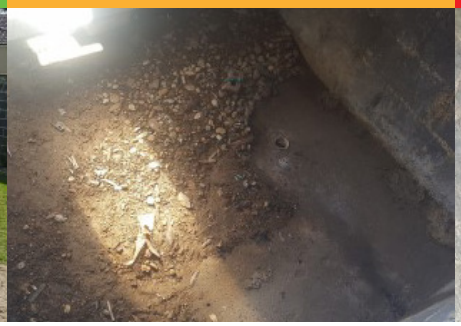
Some WSUD assets are designed with a slope to freely convey stormwater along the length of the asset. These systems naturally infiltrate stormwater and will be wet after rainfall. If the assets retain water or become boggy, it could be a sign that the surface slopes are too flat or that the outlet is too high. OSD systems are designed to hold stormwater during rain events and discharge at a controlled rate. Issues with discharge in an OSD system may result in standing water in the storage area.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

30. Storage volume

Applicable assets: OSD

An OSD system requires available storage volume to detain runoff after a storm. A reduction in the OSD storage volume reduces the effectiveness of the system and can occur from a build-up of sediment and debris or from items that have been placed in the OSD storage area.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

31. Surface levels

Applicable assets: biofilter, biofilter street tree pit, vegetated buffer strip and swale, permeable paving

An evenly graded surface allows stormwater to flow through the WSUD asset without issues of preferential flow paths or isolated pools. It also ensures that the whole surface is treating stormwater and equally receiving runoff. Common causes of uneven surface levels are lack of levelling during construction, erosion, sediment accumulation and slippage of batters.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

32. Valves

Applicable assets: rainwater tank

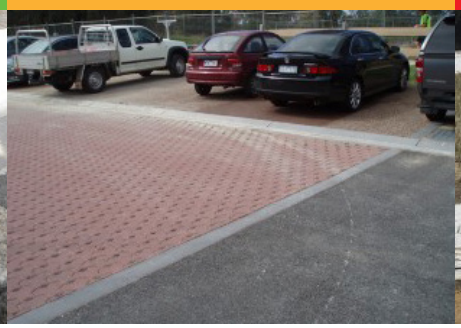
Valves are used at several connections within a rainwater tank system where a connection between pipes are required. Valves should be checked to ensure they are intact and not leaking and should be maintained by a licensed plumber.

Functional component condition score example images	
Good (1)	Moderate (2)

33. Vehicle or pedestrian damage

Applicable assets: biofilter, biofilter street tree pit, permeable paving

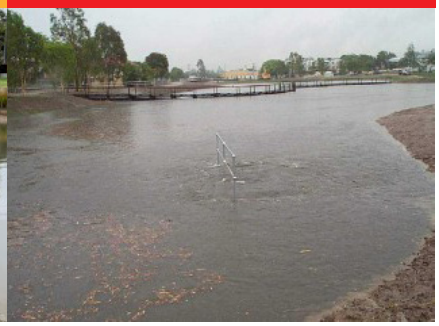
WSUD assets located within driveways, carparks or streetscapes with high levels of vehicular or pedestrian movement can be damaged if vehicles or pedestrians enter the WSUD asset. Damage can be in the form of compaction, surface erosion, structural damage or loss of vegetation. Permeable paving is particularly susceptible to vehicle damage.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

34. Water levels

Applicable assets: wetland

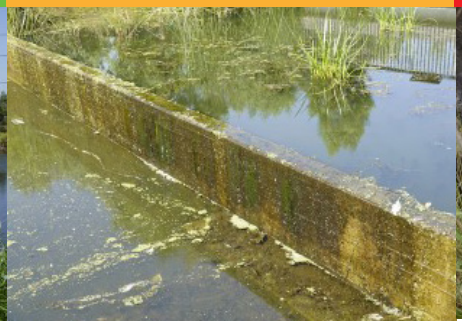
Wetlands are designed so that water levels can vary between designated levels, without affecting vegetation. The normal water level of a wetland system should be checked at least 72 hours after rainfall.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

35. Water quality – oil slicks, odour, algae

Applicable assets: wetland, temporary sediment basin

The water quality within a WSUD asset can vary depending on the season and time since the last storm event. The water may have pollutants from a spill, decomposition, high levels of hydrocarbons or high nutrient levels resulting in algal growth.

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)
		

36. Weeds

Applicable assets: biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, permeable paving

Weeds and nuisance plant species can impact the aesthetics and function of WSUD assets. These plants should be removed as soon as they appear or are noticed. Details of specific weeds can be found at weeds.dpi.nsw.gov.au

Functional component condition score example images		
Good (1)	Moderate (2)	Poor (3)

Further reading

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Melbourne Water 2013, *WSUD maintenance guidelines A guide for asset managers.*

Melbourne Water 2017, *Constructed wetlands design manual,* version 1, July 2017.

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Payne et al. 2015, *Adoption Guidelines for Stormwater Biofiltration Systems,* version 2, Cooperative Research Centre for Water Sensitive Cities.

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Upper Parramatta River Catchment Trust (UPRCT) 2005, *On-site Stormwater Detention Handbook*, 4th edition, December 2005.

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