DRAINAGE DESIGN GUIDELINES

October 2020

ENGENY WATER MANAGEMENT

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CONTENTS

Appendices

List of Tables

List of Figures

1. GLOSSARY

ARR – Australian Rainfall and Runoff

WSUD – Water Sensitive Urban Design

ARI- Average Recurrence Interval

AEP – Annual Exceedance Probability

LPOD - Legal Point of Discharge

OSD - On Site Detention

PSD - Permissible Site Discharge

TBM - Temporary Bench Mark

Vs – OSD storage volume

PIF - Property Information Form

2. INTRODUCTION

2.1 Context

Wyndham City Council (Council) currently reviews and approves drainage designs for development based on information contained within the following guidelines:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2019;
- WSUD Engineering Procedures – CSIRO, 2005; and
- Wyndham City Council WSUD Asset Selection and Design Standards Guideline, 2018

This document has been developed as an overarching guideline for the design of stormwater systems in the City of Wyndham, addressing gaps in previously listed guides and anomalies as a result of the introduction of the 2019 Australian Rainfall and Runoff Guidelines (ARR 2019).

This document includes references to the following guidelines and should be considered as having priority over these:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2019
- WSUD Engineering Procedures – CSIRO, 2005
- Australian Rainfall and Runoff 2019 (ARR 2019)
- Austroads Guide to Road Design,
    - Part 5: Drainage – General and Hydrology Considerations
    - Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface
    - Part 5B: Drainage – Open Channels, Culverts and Floodways
- Melbourne Water's Land Development Manual
- Latest release of Melbourne Water's Flood Mapping Projects Guidelines and Technical Specifications Version 10 September 2019 (or later version as agreed with Council).
- Australian Standard AS 3725 - Design for installation of buried concrete pipes

All references in supporting documents referring to a superseded version of the Australian Rainfall and Runoff Guidelines should be replaced with ARR 2019 unless otherwise agreed with Council.

3. PLANNING

This section relates primarily to new subdivision developments.

New developments require the submission of a drainage or stormwater management strategy to be approved by Council.

3.1 Primary reference

The planning considerations for detailed design for drainage systems should be undertaken in accordance with:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2019

Unless otherwise specified in the sections below.

3.2 Timing of Drainage Infrastructure

The timing of the ultimate drainage infrastructure needs to be considered by the designer when developing the drainage strategy.

Any staged construction approach must demonstrate that both stormwater management and water quality treatment objectives are achieved at each stage. This is to be presented to council for consideration.

3.3 Easements

Where drainage easements are required, they are to be designed to provide maintenance access from no less than two publicly accessible roads, even if no drainage infrastructure is required at these locations.

Overland flow paths up to and including the 1 % AEP event are not to enter private property, via an easement or otherwise, from non-private land.

Deviations from the above are to be submitted to council for approval.

3.4 Temporary Retarding Basin

Temporary retarding basins for new subdivisions will only be accepted if completion of downstream drainage has been proven to be impossible prior to the completion of upstream works. The developer (or their representative) will be required to demonstrate that negotiations with the downstream property owners have been attempted and have not been resolved before any temporary drainage will be accepted. The use of temporary retarding basins will be subject to approval by Council.

Retarding basins are intended to provide peak flow attenuation as well as sediment control during the construction phase of the upstream catchment, basin design should consider both of these design aspects.

Wyndham WSUD Design guidelines are to be referred to for the design of temporary retarding basins.

The area of land to be set aside for the temporary retarding basins (if approved) is to be 30 % of the upstream developable area, unless otherwise agreed with Council

Any approved temporary drainage works will require the developer to ensure ongoing maintenance and remediation upon completion of downstream drainage assets. Temporary works will not be reimbursable under the Melbourne Water Drainage Services Scheme. A draft maintenance programme should be submitted with the basin design for approval

Any temporary retarding basin will have will be assessed on the criteria of landscaping, fencing and public protection, and each of these aspects must be approved by the relevant Council departments.

4. HYDROLOGY

4.1 Primary reference

Hydrological modelling for drainage systems should be undertaken in accordance with:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2019 (VPA Engineering Standards);
- Australian Rainfall and Runoff (ARR) 2019; and
- Latest release of Melbourne Water's Flood Mapping Projects Guidelines and Technical Specifications Version 10 September 2019 (or later version as agreed with Council).

Unless otherwise specified in the sections below.

4.1.1 Computation of Runoff

The recommended method for the calculation of peak flow rates for catchments up to 0.2 ha is the Rational Method.

The supported methodology for undertaking Rational Method calculations is included in Section 13.3 of the VPA Engineering Standards.

For larger and more complex catchments, it is recommended to adopt a dynamic flow calculation. RORB is the recommended model, with the methods as per ARR 2019 and the latest release of Melbourne Water's Flood Mapping Projects Guidelines and Technical Specifications Version 10 September 2019 (or later version as agreed with Council).

Clarification from Council should be sought if there is uncertainty about which method should be adopted for a particular catchment.

4.1.2 Rainfall Intensity

The rainfall intensity used for the calculation of peak flow rates is to be obtained from the Bureau of Meteorology website (www.bom.gov.au) for the catchment location and supplied to Council with the design calculations.

4.1.3 Average Exceedance Probability

The target average exceedance probability for design of urban, industrial and floodway land use is included in Section 13.5 of the VPA Engineering Standards.

4.1.4 Time of Concentration

The method of calculation of Time of Concentration is included in Section 13.6 of the VPA Engineering Standards

4.1.5 Runoff Coefficient C

The method of calculation of the appropriate runoff coefficient is included in Section 13.7 of the VPA Engineering Standards, including values specific to Wyndham in Table 17. Any deviation from these values should be accompanied with supporting documentation.

5. DETAILED DRAINAGE DESIGN

This section is intended for large scale subdivision development.

5.1 Primary reference

Hydraulic modelling and detailed design for drainage systems should be undertaken in accordance with:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2011 (VPA Engineering Standards);
- Australian Rainfall and Runoff (ARR) 2019;
- Austroads Guide to Road Design Part 5A: Drainage- Road Surface, Networks, Basins and Subsurface;
- Melbourne Water Land Development Manual; and
- Australian Standard AS 3725 - Design for installation of buried concrete pipes

Unless otherwise specified in the sections below.

5.2 Planning & Layout

General design considerations and criteria for the planning and layout of the drainage network are included in Section 13.2 of the VPA Engineering Standards.

5.3 Pipe Flow Design Criteria

5.3.1 Pipe Hydraulics

Drainage design shall be based on hydraulic grade line analysis, using appropriate pipe friction and drainage structure head loss coefficients. All pipe sizes are to be computed using a velocity and discharge diagram based upon Manning's equation. HGL's shall be shown on drainage plans.

Pipe friction is as per Section 13.12 of the VPA Engineering Standards.

Pit alignment is as per Section 13.17 of the VPA Engineering Standards.

Pit head losses are to be calculated using procedure in ARR 2019 Book 9, Chapter 5, and AustRoads Guide to Road Design Part 5A

5.3.2 Hydraulic Grade Line Limits

The hydraulic grade line shall be at least 300 mm below the surface or kerb and channel invert, and not more than 2 m above the pipe obvert.

5.3.3 Pipe Flow Velocity and Grade

Requirements for the pipe velocity and grade are included in Section 13.15 of the VPA Engineering Standards.

5.3.4 Minimum Pipe Size

The minimum pipe sizes to be adopted are included in Section 13.13 of the VPA Engineering Standards.

5.3.5 Minimum Cover to Pipe

The minimum required cover to underground pipe is included in Section 13.11 of the VPA Engineering Standards.

If minimum cover cannot be achieved as per the VPA Engineering Standards, the designer must submit pipe class and cover calculations, in accordance with AS 3725 to Council for approval.

5.3.6 Pipe Material

Reinforced concrete pipes only are to be used in accordance with AS3725 - Design for installation of buried concrete pipes.

Other pipe materials will require prior approval by Council.

5.3.7 Drainage Pits and Inlets

Drainage pits, including junctions and inlets, are to be in accordance with Wyndham City Council's standard drawings.

Drainage pit locations are to be in accordance with Austroads *Guide to Road Design Part 5A: Drainage- Road Surface, Networks, Basins and Subsurface*. Deviations from this guideline, or for situations not covered, prior approval from Council is required.

The design criteria for kerb inlets is included in Section 13.19 of the VPA Engineering Standards.

Grated inlets only are to be specified. Other inlet types require prior approval from Council.

Inlet capacity is to be calculated using ARR 2019 Book 9, Chapter 5 - Stormwater Conveyance.

Blockage of inlets is to be as per ARR 2019 Book 9, Chapter 5 - Stormwater Conveyance.

5.3.8 Property Connections

Property connection details are to be in accordance with Wyndham City Council's standard drawings SD6-1, SD6-2 and SD6-3.

Requirements for property connections not included in the standard drawings are included in Section 13.21 of the VPA Engineering Standards.

6. OVERLAND FLOW

6.1 Primary reference

Hydraulic modelling and detail design for drainage systems should be undertaken in accordance with:

- Engineering Design and Construction Manual for Subdivision in Growth Areas – Victorian Planning Authority, 2019 (VPA Engineering Standards);
- Australian Rainfall and Runoff (ARR) 2019; and
- Melbourne Water Land Development Manual

Unless otherwise specified in the sections below.

6.2 Within Private Land

Overland flow paths up to and including the 1 % AEP event are not to enter private property, via an easement or otherwise, from non-private land.

Designated overland flow paths within private land, where flow originates from the neighbouring property, must be covered by an easement that includes the full flow width for the 1 % AEP flow.

6.3 Within Road Reserves

Overland flow within road reserves is to be designed in accordance with Melbourne Water's Land Development Manual Section 5 - *Drainage design and construction guidelines and requirements*.

6.4 Floodway

Floodways are to be designed in accordance with Melbourne Water's Land Development Manual Floodway Safety Criteria

6.5 Culverts

Culverts under roads and rail are to be designed using ARR 2019 Book 9, Chapter 5 - Stormwater Conveyance.

6.5.1 Blockage of Culverts

Culverts are to be designed with consideration to blockage of the structures. Blockage is to be analysed with reference to ARR 2019 Book 6, Chapter 6 – Blockage of Hydraulic Structures.

The risk assessment matrix should be undertaken with the results presented to Council for review prior to detailed design. The risk assessments results' impact on the design will be at the discretion of the Council and may be included as an input to the design, or as a sensitivity analysis.

7. ON SITE DETENTION

7.1 Primary reference

The design of onsite detention for new developments should be undertaken as per the specifications in the sections below.

7.2 Introduction

Redevelopment of a site usually increases the area of impervious surfaces such as roofing and paving. The change in the average permeability of the site significantly increases the volume and flow rate of storm water runoff and the additional drainage loads may cause local flash flooding downstream of the site.

Due to the number of residential redevelopments and other redevelopments taking place within the City of Wyndham, it has become necessary to limit the peak rate of runoff reaching Council's drainage system.

On-site Stormwater Detention (OSD) is a stormwater management technique that enables the runoff discharge rates of individual development sites to be controlled.

An OSD system requires a flow control device to limit the discharge of runoff to an acceptable rate, and a storage system to hold the excess discharge until capacity becomes available in the downstream drainage system.

Large detention basins are expensive even if built on public land and only provide protection against downstream flooding. Properties upstream of a detention basin are not protected from the increased runoff caused by redevelopment.

Well-designed OSD systems control the peak discharge rates to match the capacity of the downstream drainage system. The total volume of stormwater leaving the site is not reduced but the retained volume is released when downstream drainage capacity becomes available. OSD systems on redevelopment sites ensures that there are no adverse impacts from stormwater runoff on downstream properties as a result of ongoing development within the catchment.

7.3 Need for On-Site Stormwater Detention

The design and construction of an OSD system to control runoff from a site will be required for developments within Wyndham, where an increase in impervious areas (above the original designed values) has been determined.

A requirement of an OSD system is expected as a condition on the planning permit, and the number of dwellings/buildings is immaterial.

7.4 Principles of On-site Stormwater Detention

On-site Stormwater Detention systems are used as part of the stormwater drainage system to reduce the impacts of site development on receiving drains and waterways.

At the onset of a storm, stormwater will commence to discharge from the site. The earliest flow will be from areas nearest to the discharge point but will increase significantly as water from the furthest points of the property reaches the discharge point. As the intensity of the storm approaches its peak, the discharge rate will increase relatively sharply to a maximum. The discharge rate will subside after the peak has passed.

If the highest discharge rate for the critical storm event for the site will exceed the permissible site discharge (PSD) rate, as indicated by the Responsible Authority, an on-site stormwater detention (OSD) system will be required. The system will temporarily store any excess flow and release it at a controlled lower rate over a longer period of time.

A detention system has two components – a device to control the flow rate of the discharge from the site, and storage for the excess stormwater. The storage can be provided via underground or aboveground pipes or tanks, or a combination of both. Ground level storage is provided by allowing water to pond in a broad but shallow depression in a paved area such as a relatively large carpark.

7.5 Design & Construction Parameters & Details for OSD

7.5.1 Design Parameters

OSD designs shall be prepared by a suitably qualified and registered engineering consultant, in accordance with Council requirements.

Key aspects of the OSD procedure are to determine the Permissible Site Discharge (PSD) and Storage Volume (Vs) for the storage configuration that is adopted by the designer. The following are the main criteria required to determine the PSD and Vs.

- Site area;
- Weighted coefficient of runoff at the predevelopment stage;
- Weighted coefficient of runoff at the post development stage;
- Time of concentration for the subject site (t_c);
- Travel time from the site discharge point to the catchment outlet; and
- Average Recurrence Intervals:

Design parameters for residential to residential/commercial development:

- (Pre-development AEP (20 %),
- Post development AEP (20 %),
- Coefficient of runoff for impermeable areas (0.9).

Design parameters for commercial/industrial development:

- Pre-development AEP (10 %),
- Post development AEP (10 %).
- Post development design AEP of 1 % is applicable for flood sensitive area.

In established areas where additional impermeability is created within an existing lot, the PSD shall be calculated using only those areas contributing runoff to the existing LPOD. Permeable areas not contributing runoff to the LPOD should not be considered in the PSD runoff calculations.

Runoff in excess of the new drainage system capacity should be able to runoff to the road reserve from within the property boundary. Exceedance flow shall not be permitted to flow into neighbouring properties. If this is not possible (e.g. due to level constraints) the designer will need to consider on site storage for Q100 flows either below or above ground (refer to 7.5.3.3).

7.5.2 Calculation using Software

Council does not object to software packages such as OSD4 or Excel Spreadsheets being used to generate designs based upon the Swinburne method.

If the stormwater discharge needs to be controlled, then the permissible site discharge for the relevant site is to be determined by the designer and agreed with the council. The Calculated PSD shall be taken as the "Nominated PSD" in the software program.

If the designer is using OSD4 software, the rainfall zone shall be taken as "Werribee", and the previously specified AEP's must be adopted.

7.5.3 Design Details

7.5.3.1. On-site Storage Volume (Vs)

The minimum volume of the on-site storage depends upon the following:

- Permissible Site Discharge; and
- Adopted storage system and/or configuration.

The storage volume should be calculated for a range of storm durations for the same AEP to determine the critical storage volume. The designer will be required to "maximise" the storage volume to ensure that the system does not fail for a storm event of any duration.

7.5.3.2. Underground Storage Systems

Where underground storage systems are used as OSD storages these systems should be located in areas where they can be readily accessed for inspections and maintenance. These systems must be watertight, otherwise there is the potential for water seepage, which may cause damage to adjacent properties or structures.

Where possible, a “visible overflow” should be built into the system.

7.5.3.3. Surface Storage Systems

Surface storage can be provided either in landscaped and/or large car park areas in an industrial or commercial setting.

In the interests of safety and amenity, storage water depths for detention systems should not exceed the following:

Table 7-1 Maximum Depths of Surface Storage

Feature	Maximum Depth
Parking / Paved Area	100 mm desirable 150 mm maximum
Front Setback / Landscaped / Common areas	300 mm desirable 600 mm maximum
Covered / Fenced Storage	Consult with Council for Limits

The following shall also be considered:

- The finished levels of external areas intended to remain outside of the flood storage shall be set a minimum of 100 mm above the top of water level of the basin;
- As a minimum, an access/escape route shall be provided for individual residences unencumbered by the 1 % AEP flood;
- An additional 20 % storage volume shall be provided beyond the calculated requirements in open space areas to allow for future unintentional reduction in storage; and
- All storage areas must be able to drain via gravity.

7.5.4 Flow Control Outlet

The outlet shall be designed such that the flow going into the Council drainage system is limited to the Permissible Site Discharge when the storage is at the OSD storage volume (Vs).

Acceptable flow control outlet types are;

- Orifice System,

- Proprietary systems are available which may be acceptable, subject to approval by Council Stormwater Engineer.

The outflow system from the site shall include the provision for high flow bypass in the event of extreme rainfall or blockage of the system.

7.5.4.1. Orifice System

The size of the orifice should be designed using the following orifice formula:

$$d = \sqrt{\frac{4Q}{c\pi\sqrt{2gh}}}$$

Where,

- d is the diameter of the orifice in millimetres (m).
- Q is the permissible site discharge in meters cubed per second (m3/s)
- c is the orifice discharge coefficient (0.60 for a sharp-edged orifice)
- g is acceleration due to gravity (9.81 m/s/s)
- h is the water head for the orifice (height between centreline of the orifice pipe and maximum level of the temporary site storage) in metres (m)

Outlet controls require the provision of a trash grate with 20x20 mm mesh over the orifice inlet when the orifice size in between 40-100 mm.

7.5.5 Pump-out System

Pump-out systems for roof and surface water are discouraged as an OSD system. In circumstances in which a pump out system is required for these flows; the design arrangement must consider the following and will be subject to Council approval.

- Two (2) pumps are required for suitable operation of the pumping system and to provide redundancy in the case of failure.
- A control panel is to be provided with warning lights to alert of pump or electrical supply failure. The control panel must be placed in a prominent location where property owner/s has easy access and exposure to warning systems.
- Pump systems must have battery back power up for 3hrs continuous operation in the event of mains power failure. Warning lights to be illuminated when battery back-up is in use.
- The pump well shall be easily accessed and maintained and have a grated lid to enable visual inspection of the well.
- Minimum pump/wet well storage is 3 m^3.

- For approval, Council will require submission of a comprehensive design basis report describing how flows up to and including the 1 % AEP will be captured and conveyed by the proposed system.

Stormwater and groundwater are separate entities. The Victorian Water Act 1989 recognises that the Crown has control over groundwater, while the Responsible Drainage Authority (Wyndham City Council) has control over stormwater drainage. Wyndham City, acting as the drainage authority, is not legally required to accept any groundwater into the stormwater drainage network. Discharging groundwater/basement seepage to the stormwater drain reduces the capacity of the drain to handle rainfall events and can lead to excessive flooding.

Groundwater/Basement seepage may be discharged to a wastewater drain under a relevant trade waste agreement with the local sewer authority, or filtered and reused on site via water tanks

7.6 Other design considerations:

- Minimise the inundation of private and public land and ensure that surface flow paths, where possible and practical, convey floodwaters within suitable velocity/depth limits
- Minimise inconvenience to traffic and pedestrians as a result of storm events by applying control measures to flow where possible.
- Consider all ultimate upstream and downstream characteristics to achieve a total system which does not adversely affect existing systems or properties within the stream flow path and catchment.
- Minimise the impacts of erosion and sediment on the environment.
- Minimise maintenance requirements and enhance the urban landscape.
- Employ principles of Water Sensitive Urban Design.

7.7 Submission to council for approval

Where drainage plan approval is mandated by the Planning Permit, OSD plans are to be prepared and submitted to Council. These plans are to be submitted as per the attached checklist in the appendix A.

8. RAINWATER TANKS

8.1 For use as OSD

Rainwater tanks may be acceptable for providing some or all of the OSD storage volume. If the developer/consultant proposes to use rainwater tanks, the rainwater tank shall be modified to comply with Figure 1 and other comments listed below.

Council accepts the following types of design:

- Rainwater tank for each dwelling that collects water from the roof of both dwelling and garage. The maximum temporary storage (airspace) of tanks shall not be exceeded one third of the total site storage amount calculated in Section 7 above. However, the temporary storage volume provided in the rainwater tanks also cannot exceed one third of the rainwater tank, with the remaining two thirds used for reuse.

- The roof area/impervious area connected to the rainwater tank shall be proportionately equal to the percentage of temporary storage within the rainwater tank.

- For residential developments, where a single dwelling is connected to a tank, a controlled outflow from the airspace of each rainwater tank shall be a maximum 1 l/s. This would require an outlet no greater than 25 mm diameter from the rainwater tank if the outlet is located approximately 600 mm below the top of the rainwater tank.

- To avoid having a closed system (ie. To get rid of the effect of additional water head), the 100 mm diameter outlet pipe connected to the tank shall have a 25 mm diameter orifice to restrict flow. The outflow pipe shall then connect to a minimum 450x450 mm pit with grated cover (Refer Figure 5.1) prior to connecting to the subject site's underground drainage system.

- For larger developments, including multiple dwellings connected to a single tank, and commercial and industrial developments, OSD calculations will need to be in accordance with Section 7, of which a rainwater tank may form a part of the system.

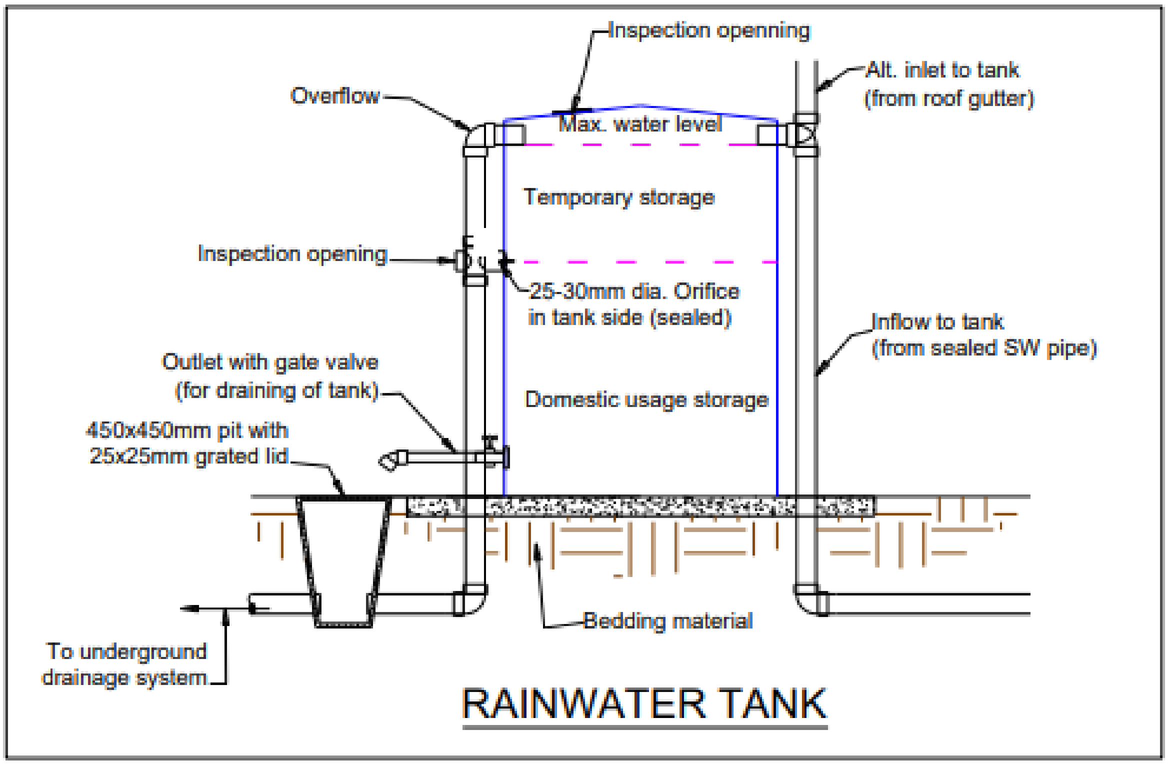


Figure 8.1 – Rainwater Tank for OSD

Note: Details of connection of down pipes to the rainwater tank can be seen from the publications of Plumbing Industry Commission.

The installation of rainwater tank must comply with the National Plumbing and Drainage Code AS/NZS 3500 and HB230-2008 - Rainwater Tank Design & Installation Handbook by Standards Australia. Provision of this requirement must be clearly shown on endorsed layout plan or drainage plans.

8.2 For Reuse

It is recommended that rainwater tanks are implemented in accordance with the specifications outlined in the *Australian Government's 'Your Home'* online publication as well as other relevant guidelines. The following provides some key features which should be considered for all installations:

- Leaf shedding rain-heads / leaf guard to gutter: reduces the excessive build-up of leaves in the first flush diverter and tank.
- First flush diverters: ensures the roof runoff of poorer water quality from the first rain after a dry spell is captured prior to entering the rainwater tank. Excessive sediment accumulation at the bottom of the tank and impacts to the water quality are minimised.

Figure 8.2 shown below displays these key features and the typical arrangement.

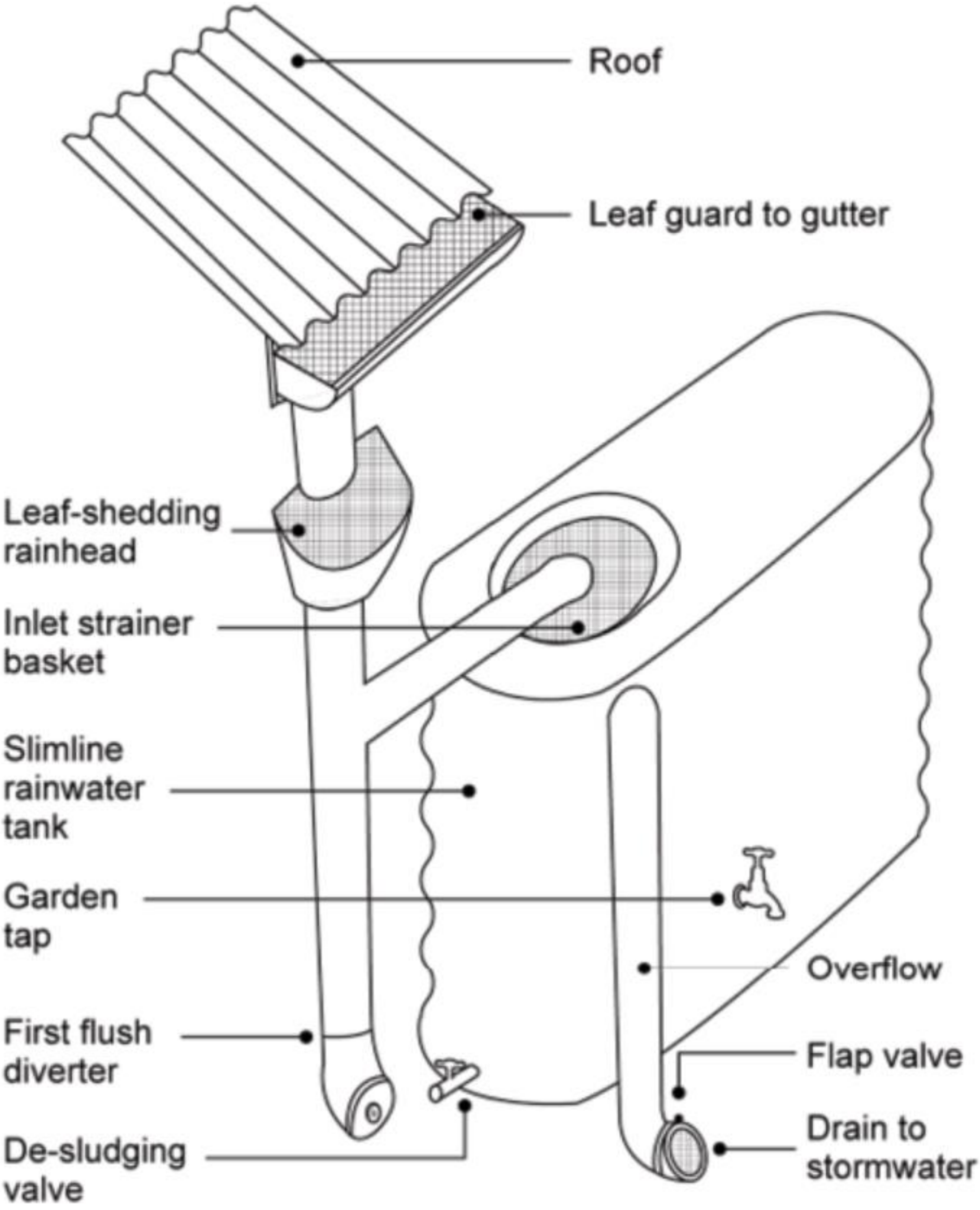


Figure 8.2 Typical Rainwater Tank Arrangement (without detention space)

These measures and others discussed within the “Guidance on use of rainwater tanks’ document (The Department of Health, 2011) are recommended for all proposed tanks to ensure the rainwater’s quality is maintained overtime.

9. WATER SENSITIVE URBAN DESIGN

9.1 Primary reference

This section of the guidelines is intended for lot scale developments only. Large scale subdivision developments must follow:

- Wyndham City Council WSUD Asset Selection and Design Standards Guideline, 2018

The design of water sensitive urban design for new developments must be undertaken in accordance with:

- WSUD Engineering Procedures – CSIRO, 2005

Unless otherwise specified in the sections below.

9.2 What is water sensitive urban design?

Urban development impacts the natural water cycle by creating impervious surfaces that affect the quantity and quality of stormwater. This in turn generates increased pollution and erosion. In Wyndham, stormwater runoff is discharged to Port Phillip Bay via Werribee River, Lollypop Creek, Cheetham Creek, and Skelton Creek. Stormwater runoff and pollutants are detrimental to these creeks, the Bay and the ocean.

Water sensitive urban design mitigates these impacts while reducing water bills and creating greener urban areas.

Meeting the above VPP requirements can be done via adopting water sensitive urban design principles.

9.3 Benefits of water sensitive urban design

Water sensitive urban design also provides many social, economic and environmental benefits including:

- Minimising impact on receiving waters
- Reducing potable water use
- Recharging local groundwater through the infiltration of stormwater
- Creating greener urban environments with high visual amenity, and
- Passive cooling through increased vegetation cover.

9.4 Best practice

The Victorian Urban Stormwater Best Practice Environmental Management Guidelines (Victorian Stormwater Committee, 1999) mentioned in the VPP's define best practice stormwater pollutant removal as:

- 80 % reduction in the typical urban load of total suspended solids
- 45 % reduction in the typical urban load of total phosphorous
- 45 % reduction in the typical urban load of total nitrogen
- 70 % retention of typical urban load of litter.

In addition, the VPP require flow from the site to be:

- Designed to ensure that flows downstream of the site are restricted to pre-development levels unless increased flows are approved by the relevant drainage authority and there are no detrimental downstream impacts.

9.5 Demonstrating meeting best practice

Meeting the VPP requirements can currently be demonstrated in two ways:

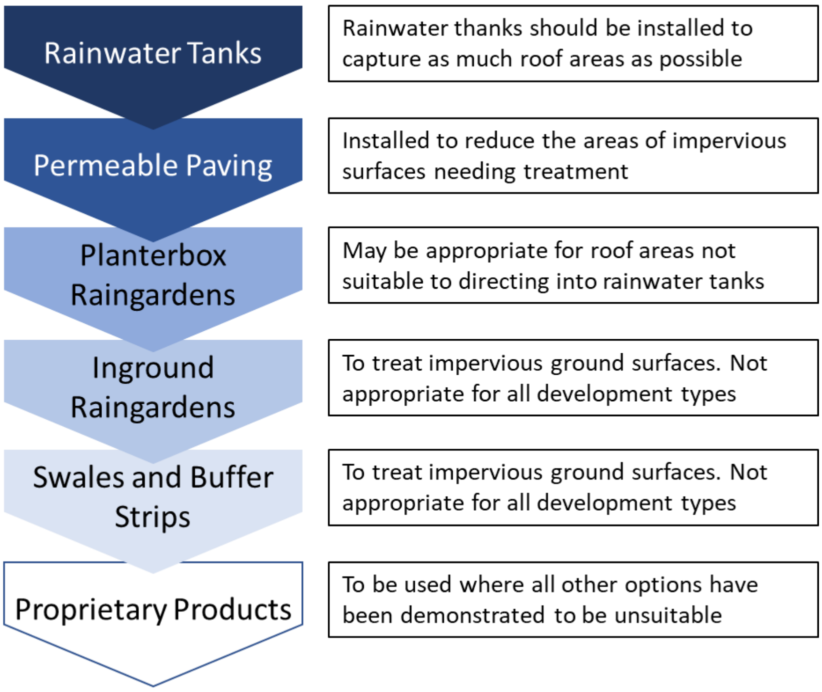
Either:

- Submitting a STORM report achieving a score of 100 % or above; or
- Submitting a MUSIC model demonstrating a treatment train that achieves the above targets.

9.6 Water sensitive urban design treatments

A range of water sensitive urban design treatments can be used to demonstrate best practice stormwater management.

Wyndham City Council has adopted a hierarchy to demonstrate which treatments are considered to meet the intent of the VPPs and have a good track record of successful implementation within the Wyndham City Council.



A detailed list of treatment options is included in Appendix C for reference.

9.7 How to develop a response

A water sensitive urban design (WSUD) response must clearly demonstrate how stormwater runoff will managed in accordance with the VPP Stormwater Management objectives.

9.7.1 Step 1: When should you develop a WSUD response?

WSUD responses should be developed as early as possible in the development process to allow WSUD to be fully integrated with the site design, such as roof shape and site levels. This will result in a better WSUD response and easier assessment process.

9.7.2 Step 2: Determine catchment area and discharge point(s)

Identify and measure the area of all outdoor “hard” surfaces on your site plan. Hard surfaces include roofs, balconies, verandas, pergolas, concreted and paved areas. (Note that permeable paving does not count as a hard surface with respect to generating stormwater runoff).

Depending upon the type of roof construction, sections of the roofed areas may drain to different points of the development, and therefore may need to be separated into sub-roof areas. Sub-roof areas may be combined where the roof runoff will be diverted to a common WSUD treatment, i.e. rainwater tank.

The legal point of discharge for the property should also be identified. Discharges from WSUD treatments will need to be conveyed to this point.

9.7.3 Step 3: Choosing WSUD infrastructure

Select which WSUD treatment will be used to treat runoff from each hard surface using the above hierarchy, such as a rainwater tank or a raingarden. Take into account any constraints on available space and site levels relative to the legal point of discharge.

9.7.4 Step 4: Size rainwater tank and/or treatment system

Two assessment tools are available to assist applicants to size WSUD infrastructure to meet the stormwater quality standards:

- STORM Calculator; or
- MUSIC

Option 1: STORM Calculator

The STORM Calculator is a user friendly, free online tool developed by Melbourne Water. It is designed to be suitable for applicants without any formal training in designing stormwater treatment systems.

STORM Calculator inputs include the total development area and all impervious areas (including impervious areas where no treatment will be provided for stormwater runoff). The calculator enables users to select from a range of WSUD treatment types.

An overall STORM score of at least 100 % is required to demonstrate that best practice Stormwater Management has been achieved.

The storm calculator can be found here:

https://storm.melbournewater.com.au/

Option 2: MUSIC

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is a modelling tool that uses historic rainfall data to estimate catchment runoff and predict the performance of WSUD infrastructure. It enables a significantly higher degree of modelling complexity and flexibility compared to the STORM calculator.

The MUSIC model should only be used by those with appropriate expertise. MUSIC models used to prepare WSUD Responses for the City of Wyndham must be developed in accordance with Melbourne Water MUSIC Guidelines.

MUSIC users must have a software licence and a minimum level of training and competency to develop a MUSIC model. MUSIC training is provided by eWater. MUSIC is generally used by professionals with stormwater treatment expertise. MUSIC is generally the most suitable assessment tool for complex and/or large developments (e.g. large multi-lot subdivisions) and any proposal that involves stormwater harvesting.

9.8 Submission to Council

A WSUD checklist is included in Appendix B and should be submitted to Council in conjunction with the design plans.

10. REFERENCES

This guideline has been developed with input from the everyday practitioners, Council staff. The following documents have also been utilised to inform this guideline.

- Victoria Planning Authority Engineering Design and Construction Manual for Subdivision in Growth Areas

- GUIDELINES FOR ON-SITE STORMWATER DETENTION, Melton Shire Council

  https://www.melton.vic.gov.au/files/assets/public/services/building-planning-amp-transport/engineering/infrastructure-planning/on-site_stormwater_detention_guidelines.pdf

- Victorian Planning Provision Section 53.18

  https://planning-schemes.delwp.vic.gov.au/schemes/vpps/53_18.pdf

- Wyndham City Council WSUD Asset Selection and Design Standards Guideline, 2018

- OSD Workshop Documents of Swinburne University of Technology

- OSD Policy of Liverpool City Council

- OSD Policy of Warringah Council

- OSD Policy of Holroyd City Council

- OSD Policy of Manningham City Council

- OSD Policy of Ballarat City Council

- WSUD Engineering Procedures – CSIRO, 2005

- Australian Rainfall and Runoff 2019 (ARR 2019)

- Austroads Guide to Road Design,
  - Part 5: Drainage – General and Hydrology Considerations
  - Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface
  - Part 5B: Drainage – Open Channels, Culverts and Floodways

- Melbourne Water's Land Development Manual

- Current Melbourne Water's Flood Modelling Guidelines

- Australian Standard AS 3725 - Design for installation of buried concrete pipes

APPENDIX A

Drainage Design Checklist

Project Address	
Name of the designer/engineer	
Address of the designer/engineer	
Email	
Phone	
Planning permit number	

Information to be supplied to Council			
Supply stormwater plans via email to council: planningdrain.submission@wyndham.vic.gov.au	☐	Depth and existence of existing Council pit/drain to be checked/estimated on site and shown on plans to verify design intent is achievable	☐
Supply set of engineer's calculations (runoff, storage and orifice)	☐	Below ground storage system pipes are not located beneath a habitable building	☐
Supply ESD/SMP report from planning department if applicable under clause 22.08	☐	Easement widths and locations are shown. No private drainage assets within the easement	☐
Supply a completed OSD checklist	☐	WSUD elements are shown in accordance with endorsed Condition 1 plans (if applicable)	☐
Supply legal point of discharge documents	☐	Apply Councils runoff parameters to hydrology calculations	☐
Supply a drainage plan showing: • Proposed location of internal drainage • All existing drainage within the property boundary • Pipe size material and grade • Location of pits, pipe sizes, type and depth • AHD Levels • All invert levels and pit sizes • Pipes are labelled with length, grade and diameter Min grade of outlet pipes is 1:100	☐	Supply detailed design drawing for the flow control pit showing: • A plan of the baffle pit • Cross section of the pit • Dimensions and depth of pit • Orifice Size (or details of alternate approved flow control) • Min 100 mm between the top of the baffle wall and the underside of the pit lid	☐
• Min grade of OSD pipes (225 mm dia and greater) is 1:200	☐		

APPENDIX B

WSUD Checklist

Item	Provided?	Comments
Description of site and proposed development	☐	
Table showing catchment areas (pervious and impervious) and corresponding treatment systems. Table includes the entire site including any areas that don't receive any treatment.	☐	
Description of the stormwater quantity and quality strategy • Type of WSUD infrastructure • WSUD infrastructure location(s) • Catchment areas directed to each system • Harvesting demands (e.g. toilet flushing) • Connections between WSUD systems • Connections to the legal point of discharge	☐	
A site layout plan identifying: • Site boundary • Catchment areas (pervious and impervious) and flow directions with areas (m^2) of each sub-catchment • Site levels including contours • Assumed legal point of discharge • Location and size of WSUD infrastructure including allowance for batter slopes • Indicative alignment of pipes conveying stormwater to and from WSUD infrastructure (including pump(s) and pipe(s) from tank(s) to house for toilet flushing)	☐	
STORM Report or an electronic copy of MUSIC file	☐	
Sectional diagram of treatment systems showing indicative levels and vegetation species	☐	

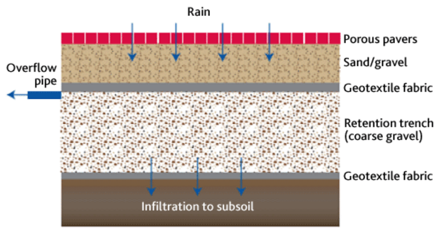
APPENDIX C

WSUD Treatment Options

The following table is a summary of the various types of Water Sensitive Urban Design (WSUD) treatment options and a description of how they may be best used within the Wyndham municipality.

Table 2: Water Sensitive Urban Design (WSUD) treatment options

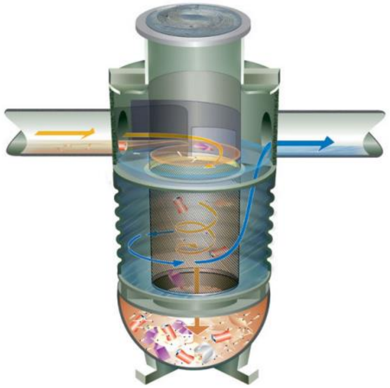
Infrastructure type	Description	Common applications	Key maintenance considerations
Rainwater tanks  Image source: WSUD Engineering Procedures, CSIRO Publishing, 2005	Rainwater tanks are ranked highest on Wyndham's WSUD Hierarchy as they provide multiple environmental benefits (stormwater pollutant and volume reduction) and can save occupants money by reducing household mains water use. Roof runoff is diverted to a rainwater tank and the rainwater is used for toilet flushing and other available non-potable uses (e.g. laundry, wash down and outdoor irrigation). Rainwater tanks can be located above or below ground. Rainwater tanks connected to toilets require a pump system and generally include a switch system which automatically switches the supply to mains water when the water level in the rainwater tank is low. Charged stormwater pipes (i.e. store water between rainfall events) can be used to deliver stormwater from a large roof area into an above ground rainwater tank. Council recommends that charged pipes do not pass under buildings (i.e. pipe configurations should be in accordance with Victorian Building Authority Guidance).	Rainwater tanks provide environmental benefits (reduction in pollutant loads and runoff volume) as well as reducing household water bills. Rainwater tanks are particularly effective where the harvesting demand is high relative to the roof area. Wyndham encourages the minimum rainwater tank size to be 3,000 L. A larger tank may be needed to ensure optimal water harvesting and/or comply with Part 3.12 of Volume Two of the National Construction Code (NCC). The NCC requires new residential buildings to have a rainwater tank or a solar hot water system. If a rainwater tank is used to comply with the NCC, it must be at least 2,000 L, receive runoff from at least 50 m2 of building.	Pumps typically require servicing every 2-5 years. Leaf filters at entrance to tank generally require cleaning once a year (can be done by householder).

Infrastructure type	Description	Common applications	Key maintenance considerations
	For additional information about rainwater tanks refer to: Melbourne Water fact sheet; and information on DEWLP's website.		
Permeable paving  Image source: Melbourne Water	Permeable paving can be used in public and private spaces to increase the amount of water that soaks into the underlying soil and therefore decrease the volume of stormwater runoff - therefore reducing the area of impervious surfaces needing treatment. Permeable paving can consist of: • porous pavers or concrete that allow water to pass through the paving surface into the subsurface layers; or • modular interlocking pavers with gaps in between the pavers which allow water to infiltrate into the subsurface layer. It is important to consider the loading on the paving (e.g. pedestrian versus vehicle) when selecting the most suitable permeable paving product. Where permeable paving is used above poorly drained soil, e.g. heavy clays, an underdrain can be used to limit the proportion of runoff that soaks into the soil. For further information on permeable paving please refer to Melbourne Water's website or Instruction Sheet.	Permeable paving is suitable for driveways, carparks and footpaths where water can infiltrate into the underlying soil. Note: Permeable paving should not be used to "treat" adjacent impervious surfaces, but rather used to reduce the overall area of impervious surfaces. Note: Areas to be covered with permeable paving are assumed to be pervious and can be excluded from STORM calculations. Areas to be covered with permeable paving must be clearly indicated on town planning drawings.	Permeable paving needs to be periodically swept (e.g. manually with a broom for small areas or with a street sweeper for larger areas) or pressure hosed to prevent clogging and therefore a reduction in the infiltration capacity.

Infrastructure type	Description	Common applications	Key maintenance considerations
Above Ground Raingardens  Image source: WSUD Engineering Procedures, CSIRO Publishing, 2005	Raingardens are specialised garden beds that treat stormwater by infiltrating the water through a vegetated soil filter. Stormwater can temporarily pond above the raingarden surface before passing through the filter media. Raingardens are also referred to as bioretention systems or biofilters. Above ground raingardens may be an appropriate WSUD treatment for treating areas of roofs that may not be suitable for directing to rainwater tanks. e.g. in "middle" townhouses or other surfaces not appropriate to direct to tanks e.g. balconies. Above ground raingardens have some advantages over in-ground raingardens in that they can be easily plumbed and don't require excavation. However, they do not allow for infiltration of water from the raingarden. Healthy vegetation is integral to pollutant removal and long term raingarden sustainability. For further information on raingardens please refer to information on Melbourne Water's website.	Above Ground raingardens are suitable for treating runoff from roofs and/or hard surfaces. Raingardens included in Wyndham WSUD responses must be at least 1 m^2 in surface area with a minimum width of 350 mm. Typically above ground raingardens are 900 mm tall.	Raingardens typically require maintenance every 3-6 months and are best suited to locations under a maintenance contract (e.g. body corporate managed land). Check overflow is clear of debris ~4 times a year and after heavy rain. Check surface is free draining ~4 times per year. Remove accumulated sediment as required. Properly constructed raingardens can last without major maintenance (i.e. new layers underneath the surface) for 10 + /15 + years, if maintained correctly.
Raingardens (inground)	Raingardens are specialised garden beds that treat stormwater by infiltrating the water through a vegetated soil filter. Stormwater can temporarily pond above the raingarden surface before passing through the filter	Raingardens are suitable for treating runoff from roofs and/or hard surfaces. In-ground raingardens may be an appropriate WSUD treatment where there is adequate	Raingardens typically require maintenance every 3-6 months and are best suited to locations under a maintenance contract (e.g. body corporate managed land). Check

Infrastructure type	Description	Common applications	Key maintenance considerations
 Image source: WSUD Engineering Procedures, CSIRO Publishing, 2005	media. Raingardens are also referred to as bioretention systems or biofilters. Healthy vegetation is integral to pollutant removal and long term raingarden sustainability. Unlined in-ground raingardens are configured to allow treated stormwater to soak into the surrounding soil, thus reducing the volume of stormwater runoff and increasing soil water available to vegetation. Unlined raingardens should be used where possible. Raingardens that are within 5 m of a building or building foundations should be lined with an impermeable barrier such as a HDP liner to avoid impacting the adjacent structure. In-ground raingardens may also take the form of a “tree pit.” For further information on raingardens please refer to information on Melbourne Water’s website.	space to easily accommodate their size and specific level requirements. Due to this requirement, they are generally unsuitable for smaller developments where space is constrained, but may be appropriate for larger sub-division style developments. The outlets to in-ground raingardens are typically approximately one meter below the inlet and so the level of the site relative to the legal point of discharge needs to be considered when specifying raingardens. Raingardens included in Wyndham WSUD responses must be at least 1 m^2 in surface area with a minimum width of 350 mm. Due to the above complexities associated with in-ground raingardens, in-ground raingardens will only be accepted by Council if accompanied at the planning stage with Civil Engineering details demonstrating: • They do not cause any flooding issues • Untreated water can adequately drain into the raingarden • Treated water can adequately be discharged to the legal point of discharge (note Wyndham will not accept pumping from a raingarden to the legal point of discharge) If Civil Engineering details cannot be provided at the Planning stage, then other WSUD	overflow is clear of debris ~4 times a year and after heavy rain. Check surface is free draining ~4 times per year. Remove accumulated sediment as required. Properly constructed raingardens can last without major maintenance (i.e. new layers underneath the surface) for 10 + / 15 + years, if maintained correctly.

Infrastructure type	Description	Common applications	Key maintenance considerations
		treatments such as rainwater tanks, permeable paving and above ground raingardens should be used instead.	
Buffer strips and swales  Image source: WSUD Engineering Procedures, CSIRO Publishing, 2005	A buffer strip is a line of vegetation along the downslope edge of a hard surface and is designed to trap pollutants as water flows slowly through the vegetation. Buffer strips are typically planted with grass. Swales are typically planted with other vegetation such as reeds and sedges.	Buffer strip and swales are commonly used along the edge of roads, driveways or paths. Buffer strips and swales are appropriate for treating small areas of impervious surfaces. They are generally unsuitable for smaller developments where space is constrained but may be appropriate for larger sub-division style developments. Buffer strips and swales included in Wyndham WSUD Responses can receive runoff from an impervious area not wider than 3 m.	Check vegetation and any accumulated sediment is not blocking flow paths~4 times a year and after heavy rain.
Sand filters  Image source: WSUD Engineering Procedures, CSIRO Publishing, 2005	Sand filters are similar to raingardens systems but have a coarser filter media that drains too quickly to support vegetation. Sand filters can be effective at removing sediment and phosphorous but have limited ability to remove nitrogen.	While STORM provides sand filters as an option for treatment, due to the low exfiltration rates within the Wyndham municipality and the lack of any benefits that meet the VPP objectives to "contribute to cooling, improving local habitat and providing attractive and enjoyable spaces," Wyndham City Council does not accept sand filters as an acceptable technology for meeting the BPEM standards / VPP requirements	Sediment that accumulates on the surface of the sand filter requires regular removal to ensure the filter does not clog.

Infrastructure type	Description	Common applications	Key maintenance considerations
Gross pollutant traps  Image source: Rocla	Gross pollutant traps (GPTs) are structures that use physical processes to trap solid waste such as litter. They are commonly used upstream of other treatment systems which remove finer particles.	GPTs are ideal for catchments containing commercial land use. GPTs come in a range of sizes and can be installed in local pits near shopping centres through to large traps at the entrance to a regional constructed wetland. GPT's may be required in large sub- division style developments however are unlikely to be needed for other style development.	Typically sized to require emptying every three to six months. Empty as per manufacturer's instructions.
Proprietary stormwater treatment products (other than GPTs)	A number of 'off the shelf' proprietary products are available for onsite treatment of stormwater runoff. Proprietary products generally comprise of prefabricated filtration systems, often with replaceable filter cartridges. Alternative products with drop in planter boxes are also available. Proprietary products are often used in constrained situations where conventional stormwater treatment measures may not be suitable; for example, large paved areas. In many cases, the installation of proprietary products will be accompanied by a fixed maintenance contract with the supplier, whereby the unit will be serviced/replaced on a regular basis.	Melbourne Water does not currently accept any "proprietary products" as meeting the intent of the VPP's. Melbourne Water is responsible for ensuring that waterways in the Port Phillip and Westernport region are protected and improved on behalf of the community. Therefore, Wyndham City Council also does not accept proprietary products or devices as providing any pollution reduction towards the BPEM standards / VPP requirements. Proprietary treatment systems are generally more expensive than other options and so are used when space/level constraints make other treatment types unsuitable.	As per manufacturers' instructions.