

Water Sensitive Urban Design Guidelines

For Individual Lots, Infill Development and Subdivision



September 2014

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Note: Diagrams from the Department of Water's *Stormwater Management Manual for Western Australia*

Introduction

The purpose of this document is to provide guidance on a number of water sensitive urban design (WSUD) measures which may be employed to meet the City's requirements for stormwater management on individual lots, or through infill development and subdivision. These requirements are outlined in draft Local Planning Policy provisions 8C.

These guidelines are to be read in conjunction with the Western Australian Planning Commission's *Better Urban Water Management*, and the Department of Water's *Stormwater Management Manual for Western Australia* and other supporting publications on WSUD which can be found via the following link: <http://www.water.wa.gov.au/Managing+water/Urban+water/Urban+water+management/default.aspx>

This is a live document that will be updated as new data and information becomes available. These guidelines should be used to assist development of WSUD treatments appropriate to your site, however alternative mechanisms not discussed here can be considered based on the conditions evident at a particular site, as a wide range of variables may apply.

Further technical standards and details can be found in:

- Local Planning Policy 8C: Storm Water Management Policy Provisions;
- The City's Engineering Technical Standards Section 06: Property Development – Technical requirements and guidelines for earthworks, drainage and parking;
- Australian Standard 3500.3:2003 – Plumbing and Drainage: Part 3 – Stormwater Drainage.



Elements of WSUD

WSUD aims to incorporate water quality treatment into the stormwater management process, in order to:

- Protect waterway health by minimising pollutant runoff;
- Reduce water demand through on site reuse and recycling;
- Replicate pre-development natural water infiltration and flows;
- Provide a range of stormwater management options for development, including aesthetic alternatives.

There are a wide range of stormwater management methods which are considered as WSUD, including (but not limited to):

[Generally described here:]

- Retention of remnant vegetation;
- Landscaping techniques;
- Rainwater tanks that are plumbed into the house;
- Soakwells;
- Infiltration trenches;
- Rain gardens/ biofiltration systems;
- Permeable paving;

[Not described here, refer to the Department of Water WSUD brochures for further details on WSUD elements relevant for WA:]

- Vegetated swales and tree pits;
- Sediment basins, constructed wetlands, and living streams;
- Rooftop and vertical gardens;
- Oil and grease separators;
- Gross pollutant traps;
- Litter baskets;
- Detention and infiltration basins.

Water sensitive urban design elements used to meet the guidelines' objectives should be selected on the basis of effectiveness and likelihood of integration with other aspects of site planning and local development requirements. For example, when planning private open space, water sensitive urban design elements should be of value to future occupants, providing elements that are both functional and aesthetic.

In selecting and planning the appropriate water sensitive urban design elements for your development, it is recommended that further research be undertaken on the design, effectiveness, and maintenance requirements of each element.

For the purposes of WSUD, roof run-off is generally considered to be clean water and run-off from paved areas is considered to be polluted and needs treatment. Examples given in these guidelines are for guidance purposes and treatments available are not limited to these.

Retention of Remnant Vegetation

The retention and re-establishment of deep-rooted vegetation in open space areas and corridors aids the maintenance of pre-development groundwater levels and reduces the amount of runoff from new development areas. Retention of bushland also provides an opportunity to infiltrate frequent stormwater events. Bushland may also be used for detention storage for flood events provided that the frequency, extent and duration of inundation is within the natural variability of the ecosystem.

To protect remnant vegetation during construction, as well as controlling stormwater run-off during the construction phase, a construction and building site management plan is recommended.



Landscaping Techniques

There are a variety of landscaping techniques that can be used to manage stormwater flows, minimise irrigation requirements of public open spaces, use stormwater onsite and minimise reliance on scheme water supply for garden watering.

Recommended landscaping techniques include soil improvement to retain moisture; xeriscaping; hydrozoning; smart irrigation systems including monitors and controllers; mulching; buffer and filter strips and use of appropriate areas and species of turf.

Waterwise turf species include the following:

Scientific name	Common name	Cultivar or selection
<i>Cynodon dactylon</i>	Couch or Bermudagrass	Wintergreen Windsor Green CT-2
<i>C. dactylon</i> x <i>C. transvaalensis</i>	Couch hybrid or Bermudagrass hybrid	Santa Ana
<i>Paspalum vaginatum</i>	Saltene or Seashore Paspalum	
<i>Stenotaphrum secundatum</i>	Buffalo or St. Augustine grass	
<i>Pennisetum clandestinum</i>	Kikuyugrass	

Soil testing and appropriate fertilizer application is the best way to reduce nutrient runoff, and soil amendment is another simple way to minimise the transport of nutrients to the groundwater and stormwater system. Much of the Swan Coastal plain contains sandy soils which have limited ability to absorb nutrients. In these areas, soil amendment in garden areas to maximise the phosphorus retention capability of the soil is critical to reduce the transport of fertilisers to the groundwater and stormwater systems.

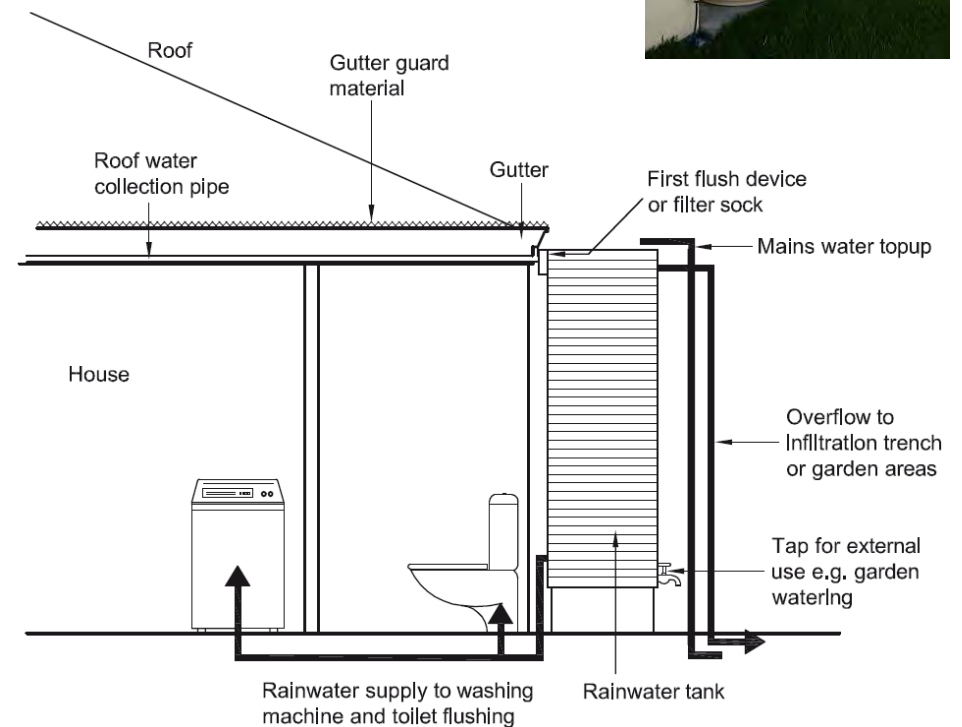
Any imported fill should also have the capacity to reduce phosphorus export via soil leaching, whilst also meeting the Local Government's soil permeability and soil compaction criteria. Where the phosphorous retention index is insufficient, the fill should be amended.

Rainwater Tanks

- What is it?** Large steel or plastic tanks to collect stormwater run-off for retention and reuse.
- Where used?** Typically to capture roof run-off.
- Stormwater role:** Temporary storage of water to reduce peak runoff rates through detention and trickle release to garden beds.
- Other benefits:** Can capture clean run-off for reuse as non-potable water (such as garden water, toilet flushing, washing machines, and car washing) or potable water (drinking) when treated.
- Considerations:** First flush treatments should be installed with the water bypassed to garden areas to ensure that the water captured is of the highest quality. The capacity required will depend on the roof area. May require building permit.
- More information:** Refer to “Rainwater storage and reuse systems” via the following link:
<http://www.water.wa.gov.au/Managing+water/Urban+water/Stormwater/Stormwater+management+manual/default.aspx#1>



Elements of a domestic rainwater system

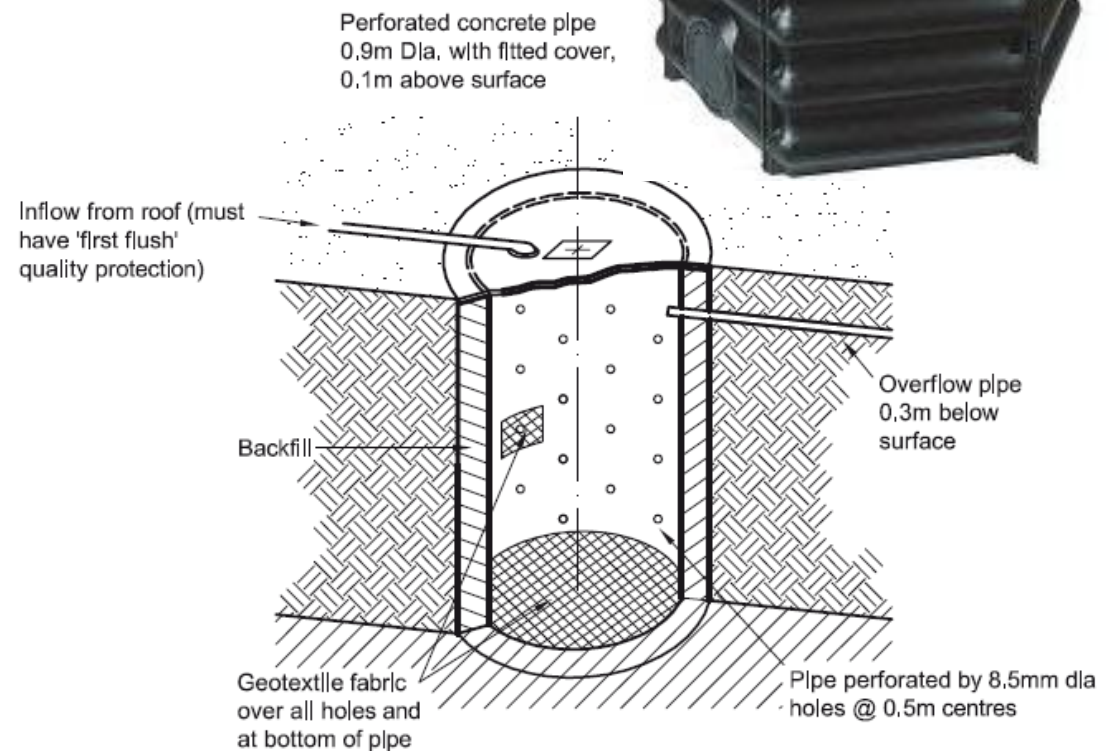


Soakwells

- What is it?** Reinforced UPVC, concrete or similar cylinders and associated geotextile materials.
- Where used?** Installed underground to allow run-off infiltration into groundwater.
- Stormwater role:** All runoff types, typically used for run-off from paved areas although should be employed with other WSUD methods to achieve adequate water quality treatment.
- Other benefits:** Largely unseen, do not take up usable space.
- Considerations:** Many areas in the City of Busselton have a high water table therefore achieving the separation can be difficult. Sometimes it may be necessary to use more of the shorter soakwells to achieve the required volume. There should be a minimum separation of 300mm between the base of the soakwell and the water table unless conditions and assessment prove otherwise. Soakwells also need to be installed with the appropriate separation from any buildings or boundaries in accordance with Local and State Government regulations.

More information:

<http://www.water.wa.gov.au/Managing+water/Urban+water/Water+Sensitive+Urban+Design+brochures/default.aspx>



Infiltration Trenches

What is it? Typically a trench filled with gravel or other aggregate (e.g. blue metal), lined with geotextile and covered with topsoil. Often a perforated pipe runs across the media to ensure effective distribution of stormwater along the system. Trenches typically have a slope of 1 in 100 to 1 in 200.

Where used? Underground infiltration system.

Stormwater role: Direct infiltration of clean water (typically roof run-off), though can benefit from integration with other WSUD methods to achieve adequate water quality treatment.

Other benefits: These are effective in sandy soils, they are simple to construct and low maintenance, can be used in confined areas. Largely unseen, do not take up usable space.

Considerations: The presence of a high groundwater table limits the potential use of infiltration systems in some areas, but does not preclude them. An assessment should be made to ensure shallow groundwater does not reduce the ability of the soakwell to manage the required volume of stormwater.

Landscaping textiles are used to prevent migration of the drainage material as well as preventing dirt and roots from entering and clogging the drainage pipe. The perforated pipe provides a minor underground storage volume but the prime purpose is for the perforations to drain the area along the full length of the pipe.

More information: Refer to “Infiltration basins and trenches” via the following link:

<http://www.water.wa.gov.au/Managing+water/Urban+water/Water+Sensitive+Urban+Design+brochures/default.aspx>



Rain Gardens (Biofiltration Systems)

What is it? A specially designed garden bed, typically porous, normally sand / loam based and is planted with various plant species (eg. *Ficinia nodosa* - Knobby club rush) local to the region and well suited to the task of nutrient stripping.

Where used? Gardens.

Stormwater role: Typically takes run-off directly from paved outdoor areas, using natural and physical processes to treat water quality and infiltrate into ground.

Other benefits: They are excellent for coarse sediment, suspended solids, heavy metals, although have limited capacity for hydrocarbons (high volumes oil can cause detriment to performance). Aesthetically pleasing and easy to integrate into gardens.

Considerations: Biofiltration systems should be sized at approximately 2% of the directly connected, constructed impervious area to ensure satisfactory performance, subject to a consideration of detention depth (nominally 300mm).

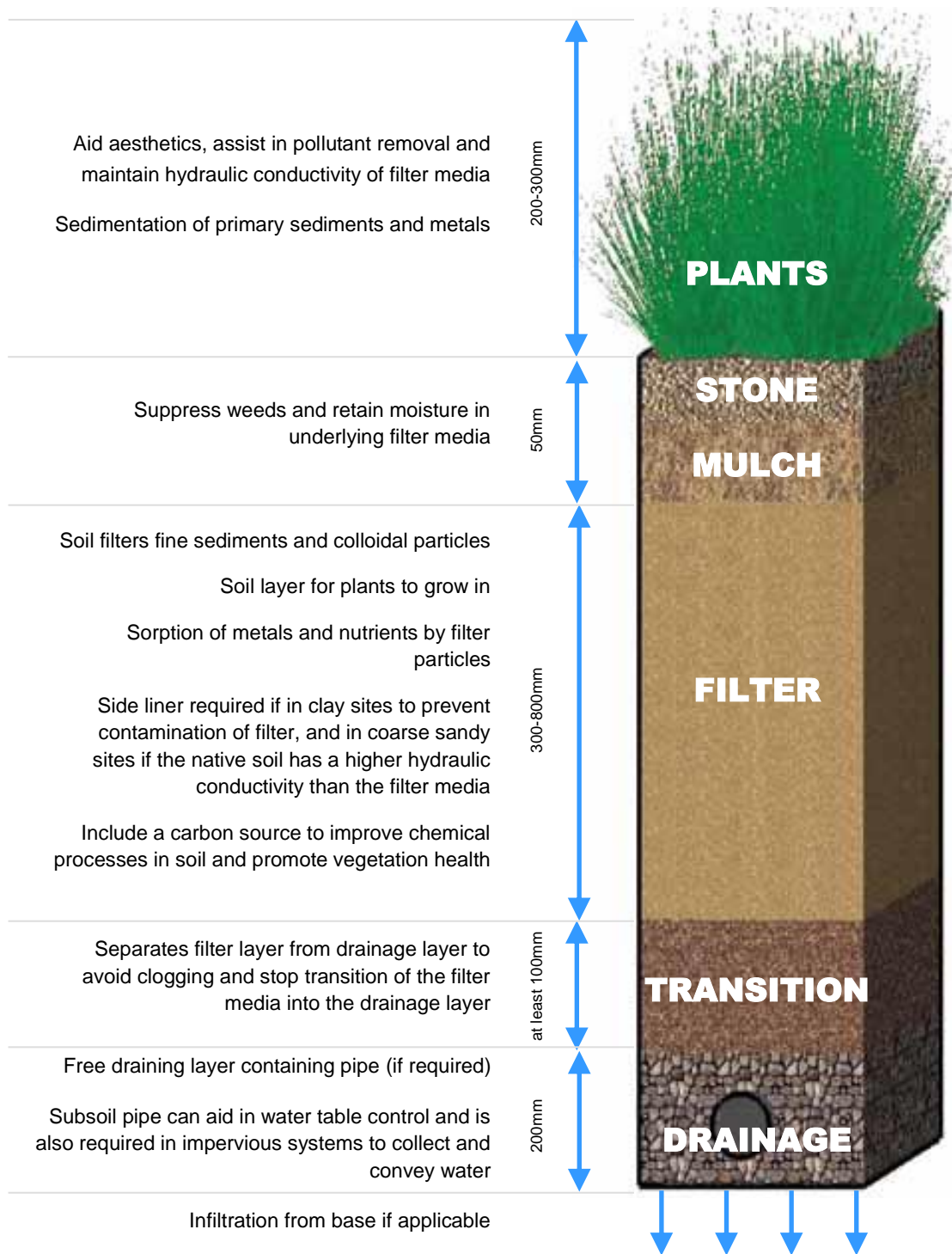
Reticulation is required in biofiltration systems (eg. drainage basins) for the first three summers after planting to ensure good plant establishment and therefore good performance of the biofiltration system.

Note that wood mulch should not be used. For commercial and greater than five residential unit developments, testing of the hydraulic conductivity of the filter media will be required to ensure it conforms with FAWB guidelines. Seek further guidance from the City of Busselton about how to obtain the required test results. For single residential general landscaping can be used in lieu of rain gardens.

More information: FAWB guidelines should be used and can be found via the following link: <http://www.monash.edu.au/fawb/products/index.html>
Also refer to "Biofilters" via the following link:
<http://www.water.wa.gov.au/Managing+water/Urban+water/Water+Sensitive+Urban+Design+brochures/default.aspx>



Typical Biofiltration System Profile



Vegetated Swales

What is it? Broad, shallow channels planted with vegetation and used to convey stormwater run-off using overland flows and mild slopes, instead of conventional pipe system.

Where used? Gardens, adjacent to driveways, parking and other paved areas.

Stormwater role: Captures, infiltrates and slowly conveys run-off while providing water quality treatment (traps sediment, uses nutrients, slows water velocity).

Other benefits: Swales can be integrated into vehicle parking areas and driveways to treat pollutants and sediments, and add to the aesthetic character of an area. They can also be a feature of a landscape and, once established, have lower capital costs than traditional pipes systems and require minimal maintenance.

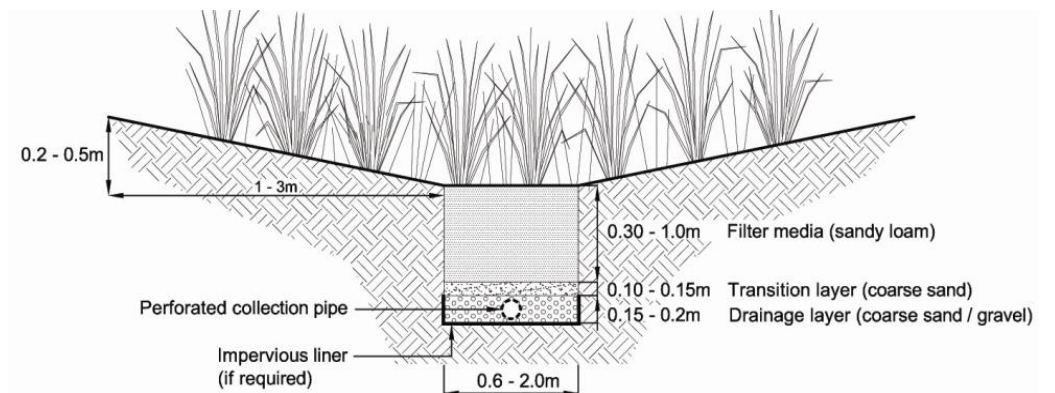
Considerations: Vegetation used in the system can range from grass to native sedges and shrubs depending on the hydraulic and landscape requirement of the site. Native sedges and rushes are preferred because of their proven ability to strip nutrients from storm water. Swales should be used with other treatments where possible. Note that for a grassed swale, clippings need to be removed. In single residential settings general landscaping can be used in lieu of swales.

More information: Refer to “Swales and buffer strips” via the following link:

<http://www.water.wa.gov.au/Managing+water/Urban+water/Water+Sensitive+Urban+Design+brochures/default.aspx>

Diagram sourced from the Stormwater Management Manual for Western Australia via the following link:

<http://www.water.wa.gov.au/Managing+water/Urban+water/Stormwater/Stormwater+management+manual/default.aspx>



Permeable Paving

What is it? An alternative to paved areas using porous pavements or incorporating vegetated gaps to absorb run-off.

Where used? To manage run-off from paved surfaces or as an alternative to using paved surfaces, such as car parking and footpaths.

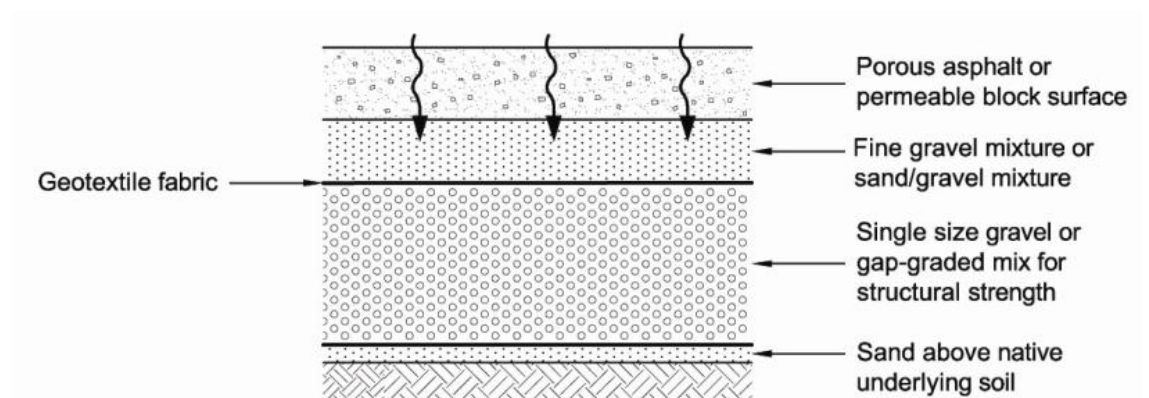
Stormwater role: Stormwater run-off passes through voids in the pavement, providing temporary storage in the pavement and aggregate or gravel layer as the water gradually infiltrates into the subsoil. Pollutants are managed by a combination of absorption, filtration and biological decomposition.



Other benefits: Permeable paving surfaces can remove sediments and some nutrients, heavy metals and hydrocarbons from polluted stormwater. Is an aesthetically pleasing replacement to bitumen, concrete and other hard surfaces which are typically impermeable and result in high run off rates during storm events that may cause serious erosion and siltation of waterways and other surface water bodies.

Considerations: Permeable pavements are designed to replace impervious areas, not to manage stormwater from other impervious surfaces on site. Use of this technique must be part of an overall on site management system for stormwater, and should be used in conjunction with other techniques not as a replacement for them. Generally used in low traffic areas, and may require special maintenance consideration to reduce clogging.

More information: Refer to “Pervious paving” via the following link:
<http://www.water.wa.gov.au/Managing+water/Urban+water/Water+Sensitive+Urban+Design+brochures/default.aspx>



Stormwater Management Examples

Water sensitive urban design provides a range of alternative ways of managing stormwater run-off. A variety of stormwater management methods may be preferred to suit the conditions of the site and to separate treatment of clean run-off and run-off requiring treatment.

The City is currently finalizing new planning policy provisions relating to stormwater management and developer contributions for drainage, which will determine the volume of stormwater required to be managed on site as part of development. A Stormwater Management and WSUD Calculator is currently being developed to accompany these requirements to help landowners work out how to manage stormwater using water sensitive urban design methods. This will be on the City's website as soon as it is available.

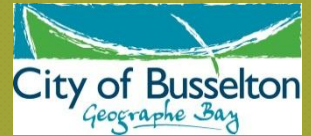
The following case studies demonstrate some examples of WSUD methods can be used and integrated with common methods of stormwater management in order to achieve the best water quality outcomes as well as capture and use of stormwater on site as a new water resource. These cases are provided as indicative only and do not meet the requirements for stormwater management under the City's provisions currently being finalized. The suitability of all stormwater management methods should always be assessed against the conditions and constraints of an individual site in order to determine the most practical and cost efficient approach.

Water sensitive urban design will improve the quality of stormwater which enters local waterways, wetlands and ultimately Geopraphe Bay.





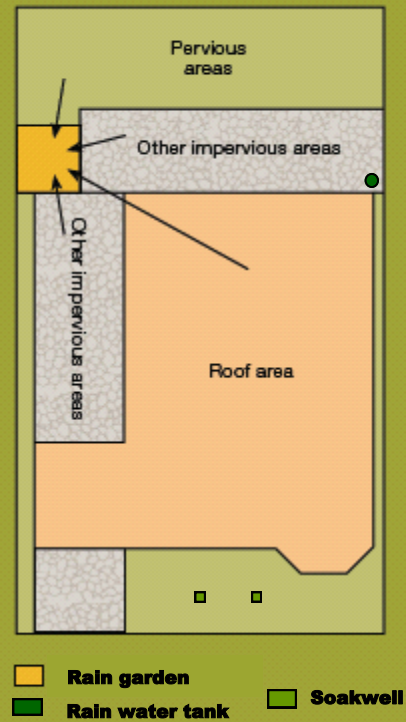
Case Study No.1



Single Dwelling

The strategy demonstrated is to direct run-off from the roof and other impervious areas to a rain water tank and rain garden feature. In addition to treating stormwater the rain garden will provide a landscape feature that is an integral part of the landscape of the site.

This diagram presents one possible strategy for stormwater collection and treatment at a typical family home

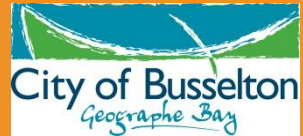


Case study No. 1: STORM rating equation





Case Study No.2

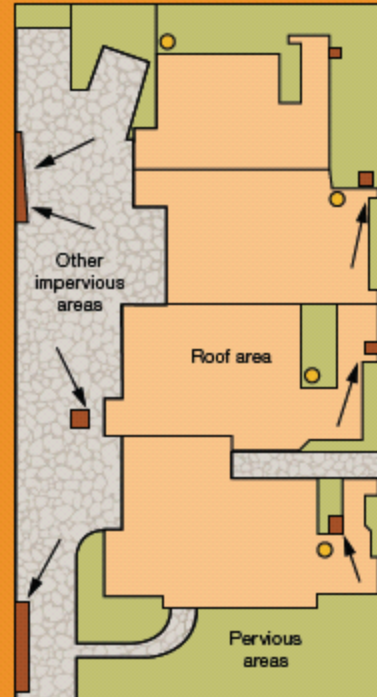


Grouped Dwelling

This strategy directs each unit's roof run-off to a tank with additional capacity than just for storm water events for toilet flushing, and direct run-off from paved areas to bioretention systems.

A site Storm rating of more than 100% can be achieved and potable water demand is reduced through re-use of rain water for toilet-flushing. The bioretention system will form part of the garden landscape.

This diagram presents a strategy for stormwater collection, treatment and re-use within a unit development



Rainwater tanks – 4 x 1m³
 Swales/ soakwells and rain gardens

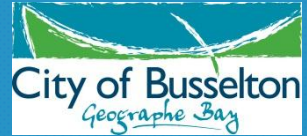
Case study No. 2: STORM rating equation



Compliance Guidelines for new Development 15v

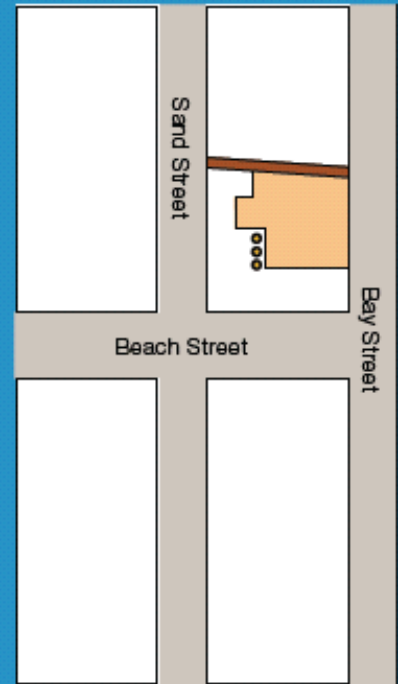


Case Study No.3



Commercial / Mixed Use / Apartments

This strategy utilises a combination of rainwater tanks and rain gardens as treatment options. Rainwater tanks collect roof run-off for toilet flushing and other on-site re-use. In addition, bioretention systems along the driveway collect some roof run-off and treat pavement and driveway run-off.



Yellow square: Rainwater tanks (3 = 25m²)
Brown square: Onsite Bioretention (28m²)

This diagram presents a strategy for stormwater collection, treatment and re-use at an apartment block.

Case study No. 3: STORM rating equation

Roof area
3500m²



Impervious area
On site
750m²



Swales & Soakwells
16m³

Rainwater tanks *
3 x 25m³



Onsite Bioretention
12m²



Total STORM rating achieved
103%





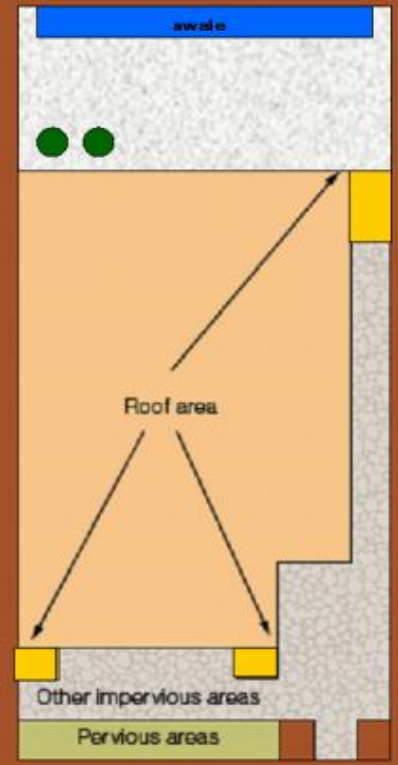
Case Study No.4

Industrial Development

This strategy directs run-off from the roof to rainwater tanks bioretention systems. Due to limited space available, a combination of planter box and 'in-ground' bioretention systems is used. The bioretention systems form part of the garden landscape.

Planter boxes are more versatile than 'in-ground' systems as they can be retrofitted to existing developments.

This diagram presents a strategy for stormwater collection, treatment, and re-use at a typical warehouse/wholesale site.



- Rainwater tanks 2 x 10 m³
- Swale - 10 m³
- Garden bed for irrigation from rainwater tanks
- Bioretention - 12m²

Case study No. 4: STORM rating equation

Roof area 1400m²	+	Impervious area 850m²	=	Rainwater tanks * 2 x 10m³
Trafficable soakwell 12m³	-	Bioretention system and swale 13m² + 10m³	=	STORM rating achieved 102%

*This size of tank will only provide for stormwater management, larger tanks will be required for rainwater harvesting

Calculators that will be available on the City of Busselton website.

CALCULATOR 1

CITY OF BUSSELTON STORMWATER & WSUD	
RESIDENTIAL CALCULATOR 1m³ per 40m²	
For typical development based on LPP 8C provision 5.1 - impervious area 1 in 5 yr event	
Complete information in RED BOXES only	
STORMWATER RUN-OFF (Treatment not required)	
Roof Area - (m ²)	600
Total run off - clean water no treatment - litres	13,716
INSTALLED CAPACITY REQUIRED	
Rainwater tank plumbed into the house - litres	6,000
Total Soakwell capacity (m ³)	8
french drains - (m ³)	0
Storm rating achieved must be minimum 100%	102%
STORMWATER RUN-OFF (Treatment required)	
Impervious Area e.g paving - (m ²)	350
Total run off - water requiring treatment - litres	7,112
Total landscape area (m ²)	68
Storm rating achieved must be minimum 100%	102%

CALCULATOR 2

CITY OF BUSSELTON STORMWATER & WSUD	
COMMERCIAL/INDUSTRIAL CALCULATOR 1m ³ per 40m ²	
For typical development based on LPP 8C provision 5.1 - impervious area 1 in 5 yr event	
Complete information in RED BOXES only	
STORMWATER RUN-OFF (Treatment not required)	
Roof Area - (m ²)	1,400
Total run off - clean water no treatment - litres	32,004
INSTALLED CAPACITY REQUIRED	
Rainwater tank plumbed into the house - litres	20,000
Total Soakwell capacity (m ³)	12
french drains - (m ³)	0
Storm rating achieved must be minimum 100%	100%
STORMWATER RUN -OFF (Treatment required)	
Impervious Area e.g paving - m ²	850
Total run off - water requiring treatment - litres	17,272
INSTALLED CAPACITY REQUIRED	
bio retention/rain garden - m ²	13
Storm rating achieved	51%
swale - m ³	10
Storm rating achieved	52%
Storm rating achieved combined must be minimum 100%	103%

Our Vision

A vibrant and cohesive community that protects its natural environment meets the needs of its population and ensures that future development maintains the City's unique character, lifestyle and community values

**The
best place
to be.**

Our Values

Honesty

A 'can do' attitude

Openness, transparency
and accountability

Mutual respect in
everything we do

Striving for excellence