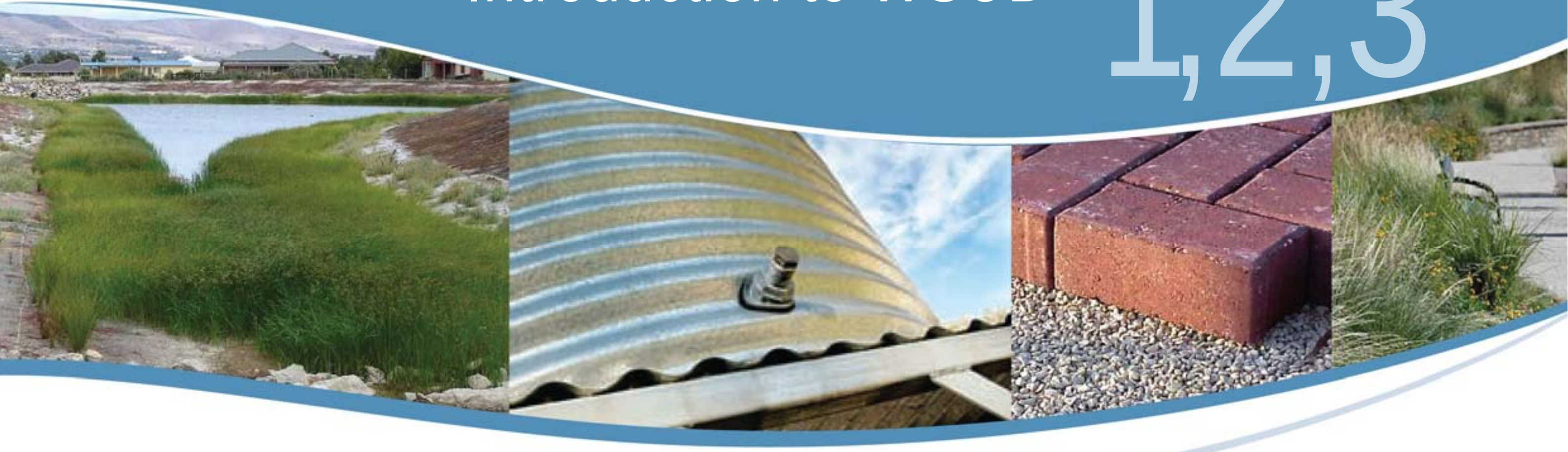
Summary Sheet

Introduction to WSUD 1,2,3



What is Water Sensitive Urban Design?

Water Sensitive Urban Design (WSUD) is an approach which integrates the management of all water resources and the total water cycle into the urban development process.

WSUD includes:

- Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non-drinking water supplies;
- Storage, treatment and beneficial use of runoff (at building and street level, including stormwater);
- Treatment and reuse of wastewater; and
- Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity and amenity.

There are many different WSUD measures which together form a 'tool kit' from which individual measures can be selected to form a specific response suiting the characteristics of any development (or redevelopment).

Those measures are outlined in this Summary Sheet and described in detail in the WSUD Technical Manual, which can be found online at www.planning.sa.gov.au/go/wsud

WSUD recognises all water streams in the total water cycle as valuable resources, including:

- Rainwater (collected from the roof);
- Runoff (including stormwater) collected from all impervious surfaces;
- Potable mains water (drinking water);
- Groundwater;
- Greywater (water from bathroom taps, showers, and laundries); and
- Blackwater (from kitchen sinks and from toilets).

By applying appropriate measures in the design and operation of development, it is possible to (among other things):

- Stabilise and improve the health of coastal waters, inland watercourses and groundwater systems;
- Make more efficient use of water resources;
- Minimise demand on the reticulated water supply system;
- Reduce flood risk in urban areas; and
- Reduce erosion of waterways, slopes and banks.

Guiding Principles of WSUD

There are a number of guiding principles that underpin the objectives for water management and the implementation of WSUD in the Greater Adelaide Region. These principles should be addressed when undertaking the planning and implementation of water management.

These guiding principles and how they could be applied are outlined below. Many opportunities exist for WSUD measures to address more than one principle.

WSUD Principle	Example of WSUD Approach
Incorporate water resources as early as possible in the land use planning process	■ Review what WSUD measures might be appropriate for a site prior to developing a concept design ■ Meet with council early in the concept design phase
Address water resource issues and conservation of biodiversity at the catchment and subcatchment level	■ Develop a stormwater management (or water management) plan to guide actions in the catchment ■ Limit the increase in runoff volume using natural drainage paths and infiltration basins
Ensure water management planning is precautionary and recognises inter-generational equity, conservation of biodiversity and ecological integrity	■ Protect waterways by providing a buffer of natural vegetation to urban development ■ Use of native vegetation in all runoff management measures and all landscaping to maximise habitat values
Recognise water as a valuable resource and ensure its protection, conservation and reuse	■ Ensure developments incorporate water efficient appliances ■ Ensure fit for purpose reuse is incorporated on site or in the catchment
Recognise the need for site-specific solutions and implement appropriate non-structural and structural solutions	■ Install rainwater tanks to collect rainwater to supply toilet flushing and outdoor uses ■ Minimise the use of hard engineered structures
Protect ecological and hydrological integrity	■ Use natural channel design and landscaping to ensure that the drainage network mimics the natural ecosystem ■ Control sediment-laden runoff from disturbed areas, in particular during construction of developments
Integrate good science and community values in decision making	■ Support research and demonstration sites of WSUD measures ■ Conduct community education programs
Ensure equitable cost sharing	■ Consider life cycle costs of the WSUD measures ■ Provide incentives through the use of rebates for implementation of on-site measures which may reduce the need for drainage infrastructure upgrades

WSUD measures suitable for Greater Adelaide – the WSUD 'Toolkit'

There is a wide range of WSUD measures which can be applied to developments in the Greater Adelaide Region. Those that are best suited to our region include (but are not limited to):

- Demand reduction;
- Rainwater tanks;
- Rain gardens;
- Green roofs;
- Infiltration systems;
- Pervious pavements;
- Urban water harvesting and reuse;
- Gross pollutant traps;
- Bioretention swales and basins;
- Swales;
- Buffer strips;
- Sedimentation basins;
- Constructed wetlands;
- Wastewater management; and
- Siphonic roofwater systems.

An introductory overview of these WSUD measures is provided on pages 4-11 of this Summary Sheet.

Further detail, including technologies and design features, can be found in the *Water Sensitive Urban Design in Greater Adelaide Technical Manual*. A CD of the Technical Manual and further information is available at www.planning.sa.gov.au/go/wsud or by contacting the Department of Planning and Local Government on telephone 08 8303 0724 or email plnsa.orders@saugov.sa.gov.au

Demand Reduction

The purpose of demand reduction is to conserve water. New development, redevelopment and alterations to existing buildings can contribute to environmental sustainability and conservation of water supplies by incorporating a variety of water efficiency (or demand reduction) measures.

Demand reduction applies to residential, commercial, industrial, community service and recreational developments, redevelopments and retrofitting. Demand reduction is applicable at the allotment scale.

The following measures can be applied to reduce water demand:

- Water-efficient fixtures and appliances;
- Rainwater tanks plumbed in to the building;
- Improved landscape practices;
- Runoff and treated wastewater reuse; and
- Education and incentives.

Rainwater Tanks

A rainwater tank is designed to capture and store rainwater from gutters or downpipes on a building. Harvested water is then available for toilet flushing, laundry, hot water uses and for outdoor irrigation.

Rainwater tanks provide an excellent opportunity to gain a range of environmental benefits including:

- Potential reduction in peak runoff rates and volumes and the consequent negative environmental impacts these cause (including flooding, stormwater pollution and stream erosion);
- Reduced importation of water from distant catchments; and
- Reduced drinking water consumption (when health standards are met).

Rainwater tanks are generally applied at the allotment level, on residential, commercial and industrial development sites. They can be applied at the street level in larger development projects.

Rain Gardens

Rain gardens resemble a standard garden with one major difference – they have runoff directed into them from downpipes, paved areas or overflow from rainwater tanks.

Rain gardens retain runoff for infiltration into the soil, reducing the amount of runoff that would otherwise discharge quickly into the local drainage system (or watercourse). Rain gardens also improve the quality of runoff while providing habitat for native fauna (i.e. biodiversity benefits).

Rain gardens can be applied at the allotment scale as well as within major developments. They are appropriate for commercial, industrial and residential sites, and can be incorporated into new construction or added to existing gardens.

Green Roofs

Green roofs are also known as rooftop gardens, vegetated roof covers, living roofs, eco-roofs and nature roofs. Green roofs are a series of layers on top of built structures, consisting of vegetation, growing medium and a range of drainage and protective layers.The benefits of green roofs include:

- Runoff management;
- Improved water quality;
- Reduced impervious areas;
- Reduced heat island effect;
- Additional living space;
- Reduced air pollution;
- Increased biodiversity;
- Improved insulation; and
- Increased carbon dioxide/oxygen exchange.

Green roofs may be appropriate for commercial, industrial and residential structures, especially those with a wide roof area. Green roofs can be retrofitted to existing structures or installed during construction of a new development.

Infiltration Systems

Infiltration systems generally consist of a shallow excavated trench, designed to detain runoff and enable subsequent infiltration to the surrounding soils. They reduce surface runoff volumes by providing a pathway for treated water to recharge local aquifers.

Infiltration systems are highly dependent on local soil characteristics and are best suited to sandy soils with deep groundwater. Infiltration measures sometimes require pre-treatment of runoff before infiltration to avoid clogging of the surrounding soils and to protect groundwater quality.

Infiltration systems require sufficient setback distances from structures to avoid structural damage from soil shrinkage or expansion.

Pervious Pavements

Pervious pavements (also known as porous and permeable pavements) are load-bearing pavement structures that are permeable to water.

The purpose of pervious pavements is to:

- Minimise the export of sediments and pollutants from the site;
- Provide for on-site retention of runoff, therefore reducing peak flows; and
- Reduce the overall volume of runoff from a site.

Pervious paving can be used as an alternative to conventional paving and hardstand surfaces. It is most appropriately used in residential or commercial situations where vehicle traffic is low and where there are low sediment loads.

Urban Water Harvesting and Reuse

Urban water harvesting and reuse refers to the collection and reuse of various water sources for drinking and non-drinking water substitution purposes.

The purpose of these schemes is to:

- Conserve water;
- Prevent increased stream erosion;
- Maintain water balance;
- Improve water quality; and
- Provide on-site detention and retention and therefore reduce peak runoff rates.

An integrated urban water harvesting and reuse scheme should provide five core functions: (1) collection, (2) treatment, (3) storage, (4) flood and environmental flow protection, and (5) distribution to the end user. They can be applied at the street, precinct or catchment scale and can utilise various sources of water. One of the greatest challenges facing urban water harvesting and reuse is the storage of water for subsequent use.

Typical urban water harvesting and reuse measures include:

- Wetlands, ponds and lakes;
- Rainwater tanks;
- Underground or subsurface tanks;
- Pervious pavement systems with underlying or off-line storages; and
- Managed aquifer recharge (MAR).

Gross Pollutant Traps

Gross pollutant traps (GPTs), also known as litter traps or trash racks, are constructed devices designed to remove solids usually greater than 5 millimetres in diameter from the stormwater drainage system. They remove the large debris washed into the stormwater system before the stormwater enters the downstream receiving waters or treatment device.

There are many differing types of GPTs that are commercially available. They can range from simple to complex constructions.

Bioretention Swales

Bioretention swales (sometimes called filtration or bioretention trenches) are a subsurface water filtration system capable of holding runoff to allow infiltration and/or temporary detention. Vegetation that grows in the filter layer of bioretention swales is an integral component of these treatment systems.

Bioretention swales can provide the following functions:

- Provide infiltration of runoff into the soil;
- Provide on-site detention and retention capacity;
- Conveyance of water;
- Improve water quality discharging from the swale; and
- Reduce the peak flow of a storm event in the system.

Bioretention swales can provide attractive landscape features in an urban development and provide biodiversity benefits. They are commonly located in the median strip of divided roads, in carparks and in parkland areas. Bioretention swales offer opportunities in both new construction and 'retrofit' situations.

Bioretention Basins

Bioretention basins operate with the same treatment processes as bioretention swales except they do not have a conveyance function. High flows are either diverted away from the basin or are discharged into an overflow structure.

Bioretention basins are applicable at a range of scales and shapes and have flexibility for use within a new or existing development. Smaller systems may take the form of 'planters' that can be located within allotments or along roadways.

A wide range of vegetation can be used allowing them to be easily integrated into the landscape theme of an area and provide biodiversity benefits.

Swales

Swales are linear depressions that are used for the conveyance of runoff instead of, or in association with, underground pipe drainage systems and can be used to capture coarse and medium sediment. They can be grassed or more densely vegetated with a variety of species.

Swales provide a number of functions, including:

- Reduce total runoff through infiltration;
- Add to the local biodiversity and amenity;
- Reduce the speed of runoff;
- Trap sediments and attached pollutants; and
- Accommodate pedestrian movement across and along them, when grassed.

Swales can be incorporated into urban designs along streets, in parklands and between allotments where maintenance access can be preserved. Careful consideration is required with the establishment phase and irrigation requirements during prolonged dry spells.

Buffer Strips

Buffer strips are broad, sloped areas of grass or other dense vegetation, capable of withstanding shallow sheet runoff.

Buffer strips provide:

- Sediment and pollutant removal from runoff prior to entering a drainage system;
- Some reduction in runoff volume through infiltration; and
- A small reduction in peak volumes through attenuated runoff.

The density and length of vegetation used in buffer strips is important as it can impact on treatment performance and conveyance ability.

Sedimentation Basins

Sedimentation basins (otherwise known as sediment basins) can take various forms. They can be used in permanent systems as well as temporary structures to reduce sediment discharge during construction activities.

Sedimentation basins are typically the first element in a treatment train. They play an important role by protecting downstream elements (i.e. constructed wetlands or bioretention basins) from becoming overloaded or smothered with sediments, thus optimising treatment performance and minimising ongoing maintenance costs.

Sedimentation basins are typically installed to provide two key roles:

- Coarse sediment removal; and
- Stormwater flow regulation.

Constructed Wetlands

Constructed wetlands are created versions of a natural wetland system that use vegetation, enhanced sedimentation, fine filtration and biological pollutant uptake processes to improve water quality.

Wetlands improve water quality by:

- Removing sediments and suspended solids, together with their attached pollutants; and
- Removing a range of dissolved nutrients and contaminants.

Wetlands can also have significant biodiversity and community benefits. They provide habitat for wildlife, provide a focus for recreation, improve the aesthetics of a development and can be a central feature in a landscape.

Wetlands can be constructed on many scales, from residential estate scale to large regional (or catchment) systems.

Wastewater Management

The majority of water used for indoor purposes is discharged after use as 'wastewater'. Wastewater is generally collected by a reticulated sewerage system and treated at a conventional wastewater treatment plant (WWTP). Alternatively, it can be collected, treated and reused on site, thereby promoting more efficient water use. This has many significant economic and environmental benefits for the community.

On-site wastewater management measures include the installation of a greywater treatment system. Larger scale measures include sewer mining and wastewater treatment plants on a community or residential subdivision scale.

Siphonic Roofwater Systems

Siphonic roofwater systems are an efficient way to harvest roofwater (rain) that falls on high-rise, multi storey residential buildings, large commercial and industrial buildings or large sport stadia.

Designing a WSUD Strategy for Your Development

There are numerous ways to incorporate Water Sensitive Urban Design (WSUD) in a given development or redevelopment project to meet water quantity and quality targets.

WSUD strategies at a given site are dependent on various factors including:

- Site conditions and catchment characteristics;
- Building function and occupancy;
- Development or redevelopment scale;
- Water use and demand;
- Water sources available, including local climate;
- On-site catchment area;
- Urban landscape design; and
- Greenhouse gas emissions.

The most appropriate WSUD approach will require input from a range of disciplines, including architects, landscape architects, engineers, planners, regulators and local community members with an appreciation of WSUD to produce innovative and optimal solutions.

The preferred optimum solution at one site - such as utilising runoff (i.e. rainwater and stormwater) or reusing treated wastewater - may not be appropriate at another. A wide range of feasible solutions are usually available.

As a general rule, site conditions and the characteristics of any target pollutant(s) influence the selection of an appropriate type of treatment measure, while climate conditions and catchment characteristics influence the hydrologic design and ultimately the overall pollutant removal effectiveness of measures.

Examples of WSUD strategies for the following forms of development are contained in the WSUD Technical Manual.

- Single residential development;
- Residential subdivision development;
- Residential multi-unit development;
- Streetscape development;
- Vehicle parking areas (including driveways, and access ways on public or private property);
- Commercial and industrial development;
- Upgrade of drainage systems or pavements; and
- Publicly owned land.

An outline of some of these appear on pages 13-15 of this Summary Sheet. Further information can be obtained from the *Water Sensitive Urban Design in Greater Adelaide Technical Manual.*

WSUD Measures for Different Types and Scale of Development

Research and experience demonstrates that WSUD measures can be designed for all different types and scale of development, including inner city areas where limited space is available. Appropriate planning and design are required to ensure successful WSUD outcomes.

The implementation of WSUD, either in a greenfield, brownfield, infill or retrofit context, requires careful consideration of the broad objectives and principles of WSUD for the Greater Adelaide Region and the required objectives and targets that may be specific to a site.

To accomplish this, a formalised process is beneficial to determine whether a proposed strategy is suitable and/or appropriate and whether it integrates detailed planning, engineering, landscaping and ecology.

Consideration of water management should occur in the initial layout and design of a development rather than as an ad-hoc development requirement or one that is left until all other elements (such as lot layouts and street design) have been completed.

Single Residential Development

There are various WSUD techniques which can be used when developing water management strategies for single residential developments. For example, a rainwater tank can supply rainwater for toilet flushing, washing machine, and for outdoor use while water-efficient fittings reduce mains water consumption elsewhere. Landscape practices also influence selection (and location) of species to reduce water demand and to achieve biodiversity outcomes.

During prolonged or heavy storms, rainwater can overflow from the rainwater tank to an infiltration (or retention) trench. Runoff from paths, driveways and lawns is directed to garden areas (i.e. a rain garden). Excess runoff from impervious surfaces is directed to the retention trench, or overflows to the street drainage system. Pervious pavements can be installed to minimise runoff and improve infiltration to groundwater.

Residential Subdivision

WSUD use in residential subdivisions offers opportunities for:

- Narrow road reserves which reduce the area requiring irrigation (and maintenance);
- Integrating design of accesses and crossovers to maximise scope for retention of existing vegetation and for new plantings which minimise water requirements;
- Variation in road reserve widths to facilitate integrated stormwater management and substantial plantings;
- Pervious paving for footpaths and parking areas;
- Appropriate landscape practices that include the selection of species to reduce water demand;
- Constructed wetlands to detain, retain and treat urban runoff;
- Wastewater treatment and reuse to irrigate public open spaces.

Streetscape Development

Roads account for a significant percentage of the overall impervious hard surfaces created within a typical development and therefore can significantly change the way water is transported through an area and the volume of runoff that is generated. These areas also generate water borne pollutants that can adversely impact on receiving waterway health (e.g. fine sediments, metals and hydrocarbons). Consequently, it is important to mitigate the impact of runoff generated from road surfaces.

A WSUD streetscape integrates road layout, and vehicular and pedestrian requirements with water management needs. It uses design measures such as maximising pervious areas, local stormwater detention (and retention) in road reserves and managed landscaping.

Water sensitive streetscapes offer opportunities for:

- Varying road and road reserve widths to facilitate integrated stormwater management, maximise and enhance open space and landscaping possibilities and streetscape amenity;
- Integrating footpaths within road reserves to respond to natural features and stormwater management to create spaces that are easy to maintain and efficient to irrigate;

- Incorporating pervious paving in roads, driveways and parking areas where appropriate;
- Incorporating water absorbing drainage facilities (e.g. swales or bioretention swales) into the streetscape, using surface exposed systems, rather than underground piping systems;
- Incorporating local filtration by using rock/gravel filter beds with drainage channels; and
- Appropriate landscape practices that include the selection of species to reduce water demand (including artificial turf).

Industrial and Commercial Sites

Typically in office buildings, water usage is dominated by toilet flushing. Relatively small demand exists for drinking water and garden irrigation. Little greywater generation is expected as there is generally minimal showering in these buildings. The commercial sector goes beyond offices to include schools, universities, hospitals, markets and event venues.

Industrial water use is dependent on the specific industry and site. For example, water use ranges from cooling water for industrial equipment to very high purity water for technology companies. Industry should use 'fit-for-purpose' water and be able demonstrate best water management and practice.

Commercial and industrial sites can reduce water demand through efficient toilets and appliances. Buildings with large catchment areas can harvest rainwater which can be utilised for toilet flushing and irrigation, as such sites often have large garden areas. Runoff can also be harvested from large carpark areas.

Other opportunities for industrial sites include multiple uses of water within a manufacturing site, the use of treated wastewater for process cooling applications and harvesting runoff for onsite use. As industrial developments and their water use are varied throughout the Greater Adelaide Region, approaches should be developed on a case-by-case basis.

Public Open Space

Integration of public open space with conservation corridors, stormwater management systems and recreational facilities is a fundamental objective of WSUD. Public open space areas can potentially incorporate stormwater conveyance, detention, retention and treatment systems as landscape features within a multiple use corridor.

The following are examples of techniques which can be used to integrate water management and the open space network:

- Incorporation of waterways and wetlands within parks as ecological and/or recreational features;
- Integration of playfields within the basin of a dry detention basin;
- Design of subsurface storage and/or infiltration systems beneath playfields within parks or school yards; and
- Development of gardens within open space areas such as bioretention systems.

Other Summary Sheets

Other Water Sensitive Urban Design Summary Sheets for the Greater Adelaide Region are available in this series. To download the summary sheets, visit www.planning.sa.gov.au/go/wsud

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