

Summary Sheet

Constructed Wetlands

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Constructed wetlands are designed to utilise the benefits of natural wetland functions and processes to improve water quality and provide biodiversity and social benefits.

Wetlands are complex, natural, shallow water environments that are dominated by water loving vegetation.

Constructed wetlands are versions of a natural wetland system that use vegetation, enhanced sedimentation, fine filtration and biological pollutant uptake to improve water quality. Wetlands can also provide habitat, passive recreation, improved landscape amenity and temporary storage for reuse schemes.

The five principal purposes of constructed wetlands are:

- To compensate for and help offset the rate of loss of natural wetlands as a result of agriculture and urban development;
- To improve and maintain water quality;
- To attenuate flood flows;
- To provide habitats which support aquatic life and wildlife (i.e. biodiversity function); and
- To provide recreational amenity.

What is Water Sensitive Urban Design?

Water Sensitive Urban Design (WSUD) is an approach to urban planning and design that integrates the management of the total water cycle into the urban development process. It includes:

- Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values;
- Storage, treatment and beneficial use of runoff;
- Treatment and reuse of wastewater;
- Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity; and
- Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non-drinking water supplies.

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 each development (or redevelopment).

Those measures are described in detail in the WSUD Technical Manual, which can be found online at www.planning.sa.gov.au/go/wsud
Constructed wetlands are one such measure.

Application and Scale

Wetlands are most appropriate on sites that meet or exceed the following criteria:

- Catchment area of more than approximately 1 hectare;
- Soils that are silty through clay;
- No steep slopes or slope stability issues; and
- No significant space limitations.

Constructed wetlands should only be used in areas that have enough inflow to ensure the long-term viability of wetland processes.

Constructed wetlands are most applicable on the street scale and precinct or regional scale.

The water quality performance efficiency of constructed wetlands can alter greatly due to changes in environmental conditions over a diurnal and seasonal time period. Treatment efficiencies will also depend on the hydraulic efficiency and the design of the wetland.



Design Considerations

Wetlands generally consist of:

- An inlet zone, which is a sedimentation basin that removes coarse sediments and regulates flows entering the macrophyte zone. The inlet zone typically treats inflows up to 1 year ARI and bypasses higher flows around the macrophyte zone;
- A macrophyte zone which is a shallow, heavily vegetated area to remove fine particulates and uptake soluble pollutants; and
- A high flow bypass channel which protects the macrophyte zone from scour and vegetation damage.

Key design considerations include:

- The notional detention time of a wetland should be 72 hours and not less than 48 hours in order to remove nutrients effectively. The notional detention time is used to provide a point of reference in modelling and to determine the design criteria for outlet structures;
- Hydrologic effectiveness is an important consideration. This is the percentage of the mean annual volume of runoff from the contributing catchment treated by the wetland. The hydrologic effectiveness of the wetland should be greater than 80%. The placement of flow control structures and the length and width ratio of the macrophyte zone influence hydraulic efficiency;
- The macrophyte (wetlands planting) zone design needs to have a suitable extended detention depth for the target pollutants (between 0.25 and 0.5 metres). The bathymetry (underwater ground contours) of the macrophyte zone should provide for a sequence of zones with different wetting and drying characteristics;
- Design features to prevent mosquito breeding are important and include providing access for mosquito predators and reducing opportunities for isolated pools to form when water levels fall or after heavy rainfall. Regular monitoring for mosquito activity should be a component of the maintenance plan; and

- Constructed wetlands need to be consistent with public safety requirements for new developments including standard principles of informal surveillance. Safety features include reasonable batter profiles for edges to facilitate public egress from areas with standing water and fencing where water depths and edge profile requires physical barriers to public access.

Design Process

Key steps in the design process include:

- Identify any site constraints or opportunities (e.g. landscape, groundwater, contamination, services and ecology);
- Establish design objectives and targets (e.g. specific water quality parameters and flood attenuation targets);
- Meet with local council and other relevant authorities to check planning, building or health requirements that need to be met;
- Identify land and asset ownership to ensure that maintenance and management responsibilities are clearly understood;
- Investigate the range of design tools available (e.g. MUSIC, EPA SWMM, XP- SWMM and HecRas);
- Undertake a concept design including verification of design performance, determination of design flows based on catchment characteristics, inlet and macrophyte zone layout, design of outlet structures and preliminary costing;
- Consider a mechanism to enable the macrophyte zone to be drained for water level management during the plant establishment phase;
- Consider maintenance access requirements of all components of the wetland;
- Consider any requirements for access across the wetland as part of an overall pathway network and provide opportunities to create alternative recreation spaces;
- Obtain relevant approvals;
- Undertake detailed design including design of civil works, additional geotechnical studies, detailed design drawings, procurement plan and planting plan;
- Ensure the planting design aims to fulfil the intended water treatment function as well as integrating with the surrounding landscape. Wetlands can be designed as a significant landscape feature;
- Ensure the outlet structure of the macrophyte zone includes measures to trap debris to prevent clogging;
- Develop a construction and maintenance plan; and
- Put procedures in place to ensure successful vegetation establishment including site preparation, stock sourcing, vegetation establishment and maintenance plans. Vegetation requires approximately two growing seasons to reach design condition i.e. usually 70-80% cover.

Legislative Requirements and Approvals

A thorough investigation of required permits and approvals should be undertaken as part of the conceptual design. This can be assisted through discussions with your local council. A proposed system needs to meet the requirements of the following legislation:

- *Development Act 1993;*
- *Environment Protection Act 1993;*
- *Public and Environmental Health Act 1987;* and
- *Natural Resources Management Act 2004.*

Maintenance Requirements

A detailed maintenance plan should be developed that specifies short and long-term maintenance of the constructed wetland including the monitoring requirements. Maintenance plans should address the inspection frequency, maintenance frequency, data collection requirements and detailed clean out procedures. The plan should be updated at least every three years.

Specific issues that should be addressed in a maintenance plan include:

- A monitoring plan that as a minimum includes monitoring of surface and groundwater levels to determine whether the wetland hydrology matches that of the design intent. Monitoring of the inflow and outflow water quality, in particular total suspended solids and nutrients, during low and high flow periods should also be undertaken;
- Aesthetic maintenance including graffiti removal, grass trimming, weed control and other tasks which require frequent attention to maintain an attractive appearance; and
- Functional maintenance including vegetation inspections during both the growing and non-growing period, litter and debris removal, sediment removal and disposal, mechanical components maintained in accordance with manufacturers instructions, structural damage inspections and remediation including erosion management.



Further Information

While there is a large range of useful resources and further information available on constructed wetlands, in the first instance it is suggested that people read Chapter 13 of the *Water Sensitive Urban Design in Greater Adelaide Technical Manual*. Further information is available at www.planning.sa.gov.au/go/wsud

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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