Interim Reference Guideline for the South East Queensland Construction and Establishment Guidelines *for Swales, Bioretention Systems and Wetlands*

This Interim Reference Guideline has been produced for Sydney based WSUD practitioners to enable the practical application of the *South East Queensland (SEQ) Construction and Establishment Guidelines* for WSUD.

This Interim Reference Guideline does not replace the *SEQ Construction and Establishment Guidelines*, but identifies Queensland references and proposes Sydney specific alternatives. The main issues *relevant to Sydney* are outlined as follows and are detailed in the following two section of this document:

1. Key issues for the Construction and Establishment of WSUD elements in Sydney, including irrigation, liners and planning terminology.

2. Additional considerations when applying this document to small systems in established urban areas.

Construction and establishment stages are critical periods for the success of vegetated WSUD elements. Poorly established systems can lead to negative outcomes for developers, councils and the community. Costly corrective maintenance can be avoided if best practice management techniques are deployed during construction and landscaping.

The *South East Queensland Construction and Establishment Guidelines* provide guidance on common construction and establishment issues associated with the delivery of vegetated WSUD elements. The guidelines are a valuable reference document on avoiding common faults and potential failure at both the delivery and design stage. Sample checklists are included to prompt the inspection and verification of critical aspects and components of swales, bioretention systems and constructed wetlands.

The information contained within this Interim Reference Guideline will be updated as required to ensure that it is consistent with NSW Government Policy.

Why Use the Construction and Establishment Guidelines in Sydney

These guidelines provide key insight into issues associated with the construction and establishment of WSUD and are based on years of practical, on-ground experience, most of which is relevant to WSUD practitioners in Sydney.

For parties involved in the design and delivery of vegetated stormwater management systems the guidelines can be used to:

- Improve civil and landscape designs and specifications so as to avoid complications and potential rectification works;
- Establish roles and responsibilities during construction and establishment and nominate construction inspection hold points for relevant persons;
- Assist in the staging and timing of material supply, earthworks, planting, protecting and maintenance;
- Quickly and clearly illustrate construction techniques to civil and landscape construction crews; and
- Guide the inspection and assessment of complying and non-complying works.

Who Should Use the Construction and Establishment Guidelines in Sydney?

The following practitioners should use this guideline:

- WSUD designers,
- Landscape contractors,
- Civil contractors,
- Foreman and site superintendents,
- Parties who commission, assess or sign off on WSUD elements.

Using Checklists within the Construction and Establishment Guidelines

Sample checklists have been included in *South East Queensland Construction and Establishment Guidelines* to assist the certification process for WSUD elements during the construction phase, maintenance phase and at asset handover.

The sample checklists establish a detailed procedure for verifying that systems are built as designed. Practitioners are encouraged to tailor their own checklists to specific projects, but the checklists are a useful tool for practitioners of WSUD and any level of experience. An example of a tailor checklist has been prepared by Landcom in their Water Sensitive Urban Design Guideline 4: Maintenance (see http://www.landcom.com.au/downloads/uploaded/WSUD_Book4_Maintenance_Draft_0409_5312.pdf)

Systematically following these forms will impart years of on ground experience to people new to WSUD construction and landscaping. The checklists also serve as a prompt and a paper record of inspections, which is critical for those responsible for overseeing the construction and establishment of multiple systems.

The sample checklists may also be included as part of a construction and landscaping contract to ensure that hold points are observed and short cuts are not taken during construction.

Advice is also provided on how local government can integrate the checklists into council operations to enforce the Guidelines and promote established construction and establishment methods. Poorly established systems can lead to negative outcomes for developers, councils and the community. Costly corrective maintenance can be avoided if best practice construction and landscaping techniques are deployed.

1. Key issues for the Construction and Establishment of WSUD elements in Sydney

While most of the information in the *SEQ Construction and Establishment Guidelines* can be readily applied by practitioners in Sydney, there are several specific references, which relate directly to the Queensland context or publications. Those issues include;

- irrigation and watering;
- the use of liners; and
- planning terminology.

Irrigation and Watering Program

The *SEQ Construction and Establishment Guidelines* recommends a watering program for the establishment of plants (See Sections 2.5.6, 3.6.6 and 4.4.7). This watering program suggests 40mm of water per week during the first six weeks of establishment. In Sydney the following recommendations on watering are suggested, based on dry summer conditions in Sydney.

Week 1-6	5 waterings per week
Week 6-10	3 waterings per week
Week 11-15	2 waterings per week

These application rates can be relaxed during wetter and / or cooler seasons.

Use of Liners for Conventional Bioretention Systems

Section 3.4.4 of the *SEQ Construction and Establishment Guideline* suggests that most bioretention systems "should be lined with a permeable filter cloth". In Sydney this should be assessed on a case by case basis, particularly where sodic soils occur and systems that are within close proximity to footings and other infrastructure.

Sodic soils have high salt contents and dispersive qualities leading to rapid erosion when exposed to air and water. These soils are common to Western Sydney and other areas of New South Wales, and require special consideration when designing WSUD systems.

Bioretention systems and constructed wetlands must be designed to prevent a raised local water table forming around infrastructure (damaging footings and other infrastructure) and prevent the leaching of salt out of surrounding sodic soils into stormwater (hostile growing conditions for plants).

It is common practice to use **impermeable liners** in these situations. Refer to Council approved methods and Facility for Advancing Water Biofiltration guidelines (http://www.monash.edu.au/fawb/) when selecting liners for such systems. At a minimum, liners should be deployed where there is a real risk of sodic soils within the supporting substrate dispersing into stormwater and eroding the foundation.

Planning Terminology

The staging and approval information in the *SEQ WSUD Construction and Establishment Guideline* can be readily applied to compliance, sign off, certification and handover processes in Sydney. However there are several Queensland specific references, which have different terminologies in NSW. The following table presents a list of planning stages in Queensland and their equivalent terms in NSW for Compliance (Sections 2.10, 3.12 and 4.10) and Certification (Sections 2.11, 3.13 and 4.11).

Queensland	NSW
Development/Planning Approval	Development/Planning Approval
Operational Works Approval	Construction Certification Approval
Construction	Construction
Practical Completion	Compliance Certificate
Plan Sealing	Subdivision Certificate
On Maintenance	Defect liability period
Off maintenance	Off maintenance

2. Additional considerations when applying this document in a retrofit WSUD situation in established urban areas

Establishment of retrofitted WSUD elements in urban catchments is often overlooked in Sydney. Key considerations include:

- design and construction around underground utilities and services;
- vegetation establishment stages for swale and bioretention system retrofits;
- sediment control in upstream catchments;
- existing drainage lines and overland flow paths; and
- protection of the system from high intensity inflows.

Design and Construction Implications of Underground Utilities

In the context of established urban areas, the implementation of WSUD elements is often constrained by underground services. Services can affect the depth and surface area of WSUD elements, as well as the depth of the stormwater drainage which drains the WSUD element. For more information about the role of subsurface drainage in specific WSUD elements, refer to Water by Design's *WSUD Technical Design Guideline for South East Queensland*.

Approvals from relevant utility providers need to be attained when working within close vicinity of these services. To avoid potential delays "Dial Before You Dig" investigations should be undertaken and service locators engaged to determine the depths and alignments of services as early as possible during the feasibility and/or planning stage. Service protection may be required in some instances and the relevant authorities need to be made aware of the proposed works. In addition to this, stormwater infrastructure in some areas of Sydney are owned by Sydney Water Corporation and require that additional approvals be sought before modifying or diverting water from these systems.

Vegetation Establishment Stages for Swale and Bioretention System Retrofits

The suggested stages of construction and establishment for bioretention systems and swales in retrofit situations are illustrated in the figure below. The figure is similar to Figure 3-10 and Figure 3-12 in the *SEQ Construction and Establishment Guideline* and identifies construction phase as well as three stages of vegetation establishment in swales and bioretention systems with fully developed urban catchments.

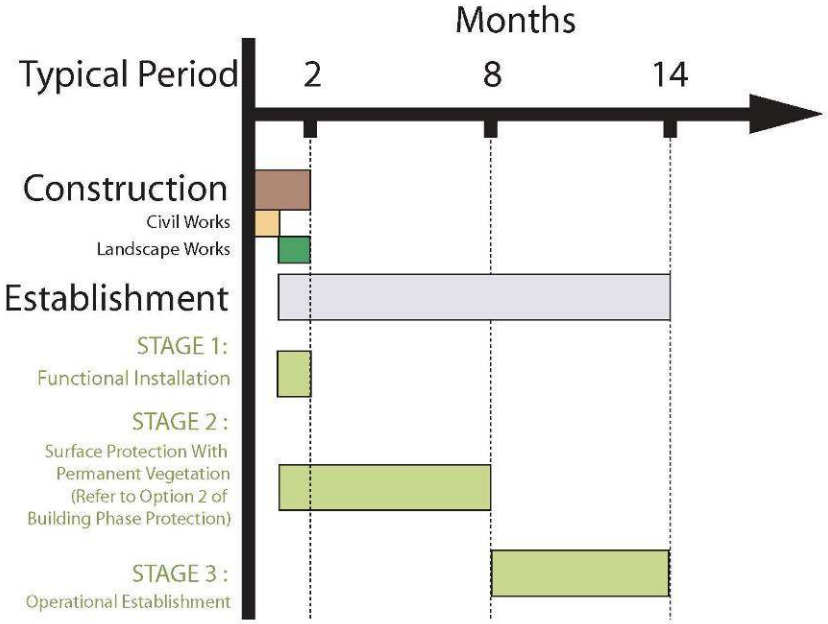


Figure 1: Stages of construction and establishment for bioretention systems retrofitted in urban catchments

Sediment Control in Urbanised Catchments

Sediment management in urban environments is less crucial as these areas will typically generate less sediment laden runoff than new allotments; however stormwater inflows will be high and may damage plants, erode planting and filter media; inhibiting plant growth and establishment.

Existing Drainage Lines and Overland Flow Paths

The selection of suitable retrofit sites for WSUD elements in developed areas must be cognisant of overland flowpaths and existing flooding behaviour. Blocking existing flow paths and introducing diversion structures within stormwater drains can impact on localised flooding. Retrofit designs must accommodate for existing flow paths and allow for surface protection without impacting on local flooding behaviour.

Protection of the System from High Intensity Inflows

The following should be applied to construction and establishment phases for swales and bioretention systems retrofitted to urban areas.

1. During landscaping works and for 6 months after completion of WSUD civil works (Stage 1 and Stage 2 of Figure 1) retrofitted swales and bioretention systems should be protected from flowing stormwater by adopting surface protection measures.

2. Ideally, protection works should be in place during the entire construction phase, however this depends on site constraints and the feasibility of diverting stormwater around the work area.

3. The appropriate surface protection measures to be implemented during Stage 2 above are described as “Option 2: Bypass flows and early establishment of vegetation” are presented in Section 2.7.2 and Section 3.8.2 for swales and bioretention systems respectively.

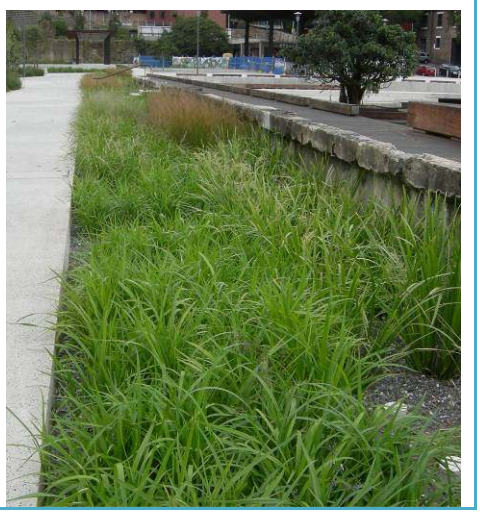
4. The *SEQ Construction and Establishment Guideline* acknowledge the risk of sedimentation during construction of new dwellings in new estates. For retrofit scenarios, the risk of sediment inflows and the need for sediment protection needs to be assessed on a case by case basis. Where catchments are highly urbanised consider omitting sediment protection. Where catchments are developed but steep and exhibit erosion, consider installing sediment protection at the WSUD system inlet to act as a temporary bund as described in the following point.

5. Temporary partition bunds should be used for 6 months after completion to deflect high velocity inflows, allowing plant root systems to establish and bind to filter media and top soil. Bunds should be at a suitable scale to the WSUD system. Earthen bunds are suited to large bioretention systems subject to inflows associated with a lot of momentum. Baffle structures made from boards held in place with star pickets are suitable for medium sized systems with relatively small inlet pipes (less than 600mm in diameter). Sand bags or hay-bails are examples of bund materials suited to small systems that receive only surface runoff.

Examples of surface protection measures for bioretention systems and wetlands are shown in the next two sections.

Examples of Stage 2 Surface protection with permanent vegetation associated for retrofitted bioretention systems and swales

Issue	Photo
Example 1 An establishing bioretention system after heavy rain. This system has a steep catchment and is prone to high velocity in flows. Temporary surface protection measures have not been deployed and damage has occurred after heavy rains. Note the displaced plants and erosion. Immature plants are not resilient to such conditions. As plants mature however, their root balls expand and mitigate this occurring in the future.	
Woven fabric bags full of stones have been deployed at the inlet as a temporary surface protection measure to allow the reestablishment of vegetation. The hessian bags will allow water to trickle into the bioretention system while preventing high flows from flowing across the establishing plants.	
Example 2 Bioretention system establishing with a temporary baffle across the inlet to protecting the surface from stormwater inflows	

Issue	Photo
The same bioretention system as above after establishment without loss of plants or filter media. Note that plants have been irrigated during establishment due to isolation of low flows.	

Stages of construction associated for retrofitted constructed wetlands

During civil and landscaping works and landscaping works and for a period (nominally 6 months), retrofitted constructed wetlands should be protected from stormwater inflows by adopting surface protection measures described in *South East Queensland's Construction and Establishment's Guideline's Section 4.6.1 "Option 1 : Bypass flows and early establishment of vegetation".*