Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland)

Version 1.0 - May 2010

waterbydesign

Water by Design is a program of the South East Queensland Healthy Waterways Partnership

HEALTHY WATERWAYS
Because we're all in the same boat

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Water by Design welcomes feedback on this publication, which can be directed to info@waterbydesign.com.au

Water by Design

The Water by Design program was established in 2005 and is a program of the South East Queensland Healthy Waterways Partnership. Water by Design builds the capacity of the water and urban development sectors to help successfully implement sustainable urban water management in South East Queensland. Sustainable management of the urban water cycle supports sustainable development, including protection of the natural water cycle.

South East Queensland Healthy Waterways Partnership

The South East Queensland (SEQ) Healthy Waterways Partnership (formerly the Moreton Bay Waterways and Catchments Partnership) is a collaboration between government, industry, researchers and the community. The Partnership was created in 2001. The partners work together to improve catchment management and waterway health in Moreton Bay and the rivers of South East Queensland between Noosa and the Queensland–New South Wales border. The South East Queensland Healthy Waterways Partnership developed and implemented the *South East Queensland Regional Water Quality Management Strategy* (2001) and its successor, the *South East Queensland Healthy Waterways Strategy 2007–2012* (2008). The Partnership also manages the Ecosystem Health Monitoring Program, which produces an annual report card on the health of the region's waterways, estuaries and bays.

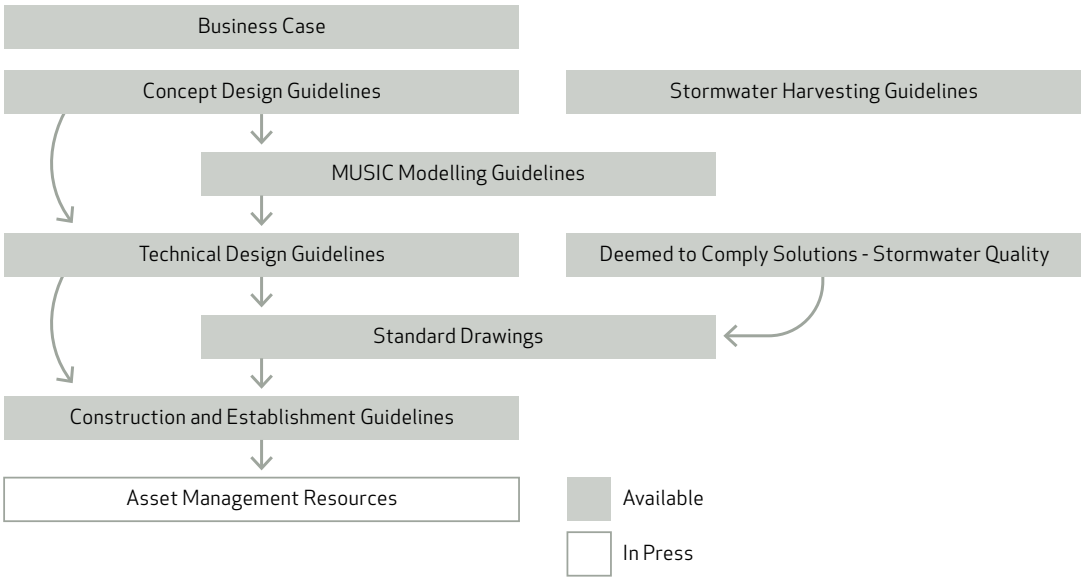
Further information in the SEQ Healthy Waterways Partnership and the Water by Design Program, is available from:

www.healthywaterways.org

www.waterbydesign.com.au

This document is available for download from www.waterbydesign.com.au

Water by Design Tools and Resources



The above diagram demonstrates the context in which *Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland)* relates to other resources which assist in the planning, design and implementation of water sensitive urban design.

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1 Introduction

The Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland) (the Solutions) are accepted solutions for managing urban stormwater quality in South East Queensland (SEQ). The Solutions comply with the requirements of the Department of Infrastructure and Planning's (DIP) *South East Queensland Regional Plan Implementation Guideline No. 7: Water Sensitive Urban Design* and the draft provisions of the Department of Environment and Resource Management's (DERM) *Draft State Planning Policy for Healthy Waters (2009)*. Developed for assessment authorities and the development industry, the Solutions simplify the design, development assessment, implementation and compliance processes for managing stormwater quality for small scale and straightforward urban developments in South East Queensland.

The Solutions:

- provide stormwater management solutions that address stormwater quality objectives for common development scenarios
- support regionally accepted standards, giving confidence to design teams for regulatory compliance
- increase the transparency of development assessments
- encourage cost-effective and maintenance-friendly stormwater management measures
- reduce the reporting and assessment requirements for developments (i.e. eliminate the requirements for further modelling and reduce the requirements for stormwater management plan reporting).

This document outlines the process for selecting and designing preferred stormwater quality management solutions for small scale, straightforward urban developments in SEQ and provides simple reporting and compliance requirements. If an assessment authority or developer chooses not to adopt or apply the Solutions provided in this document to a development application, then a stormwater management plan may need to be prepared to support the application in accordance with current guidelines e.g. the *Draft Best Practice Environmental Management Guidelines — Urban Stormwater* (DERM, 2009b) and the assessment authorities development assessment requirements.

***Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland)* only address the stormwater quality objectives for urban development**.

2 Background to the Deemed to Comply Solutions

2.1 Policy

In 2009, the Department of Infrastructure and Planning (DIP) released the *SEQ Regional Plan Implementation Guideline No. 7: Water Sensitive Urban Design*. This regional guideline sets minimum design objectives for stormwater management in new developments in SEQ.

Policy 11.1.2 of the *SEQ Regional Plan 2009-2031* supports the application of the guideline by planners and assessment managers. In addition, assessment authorities in SEQ must also give due consideration to the *Draft State Planning Policy for Healthy Waters* (DERM, 2009a) and the associated *Draft Urban Stormwater Management Code*.

In the past, one of the challenges for assessment authorities has been how to rapidly assess compliance for small scale or `common' developments. Concurrently, design teams have sought more efficient ways to develop designs for these types of applications. To address these challenges, the Solutions have been developed to provide a process for selecting and designing preferred stormwater management solutions.

Within the SEQ region the Solutions are accepted by DIP and DERM as urban stormwater management solutions that comply with the relevant policy requirements of:

• the *SEQ Regional Plan Implementation Guideline No. 7* (DIP, 2009)

• the *State Coastal Management Plan 2001* or its replacements

• the *Environment Protection (Water) Policy 2009*

• the *Draft State Planning Policy for Healthy Waters* (DERM, 2009).

Assessment authorities can determine the extent to which these Solutions are accepted and used within their respective jurisdictions. Use of this Guideline will enhance the efficiency and regional consistency of the design and development assessment of urban stormwater management solutions.

2.2 Design objectives

The Solutions are based on the design objectives referenced in the *SEQ Regional Plan Implementation Guideline No. 7* (DIP, 2009) and the Draft *Best Practice Environmental Management Guidelines — Urban Stormwater* (DERM, 2009b).

These documents set out three urban stormwater management design objectives for South East Queensland:

- **Stormwater quality:** This objective is to protect receiving water quality by limiting the quantity of stormwater pollutants discharged. It adopts a best practice pollutant load reduction approach.
- **Waterway stability:** This objective is to prevent exacerbated in-stream erosion downstream of urban areas by controlling the magnitude and duration of sediment-transporting flows.
- **Frequent flow:** This objective aims to protect in-stream ecosystems from the significant effects of increased runoff frequency by capturing the initial portion of runoff from impervious areas. This approach ensures that the frequency of hydraulic disturbance to in-stream ecosystems in developed catchments is similar to predevelopment conditions.

The Solutions currently focus on the stormwater quality design objective. Future versions of the Solutions may address other design objectives. Performance measures and targets for each design objective can be found in Appendix A.

3 Development scenarios covered by the Deemed to Comply Solutions

The Solutions provide compliant stormwater treatment measures for four small scale and straightforward development scenarios.

Prior to lodging an application the designer should check with the assessment authority the extent to which the Solutions are accepted within the local area. Some assessing authorities may accept Solutions at different scales to those identified in Table 1.

To qualify for using the Solutions, developments must fall into one of the common development types, shown in Table 1 or as otherwise determined by the assessing authority. If a development does not conform with the development types listed below or other assessing authority limits, then a stormwater management plan will need to be developed in accordance with current guidelines e.g. the *Best Practice Environmental Management Guidelines – Urban Stormwater* (DERM, 2009b), and the assessing authority reporting requirements.

Table 1: Development types/scenarios that form the basis of the Deemed to Comply Solutions

LAND USE	DEVELOPMENT SCENARIO	SCALE
Residential	Residential greater than 2 lots up to 20 lots	N/A
	Residential greater than 2 dwellings (townhouse style up to 2 storeys)	⩽ 12,500 m^2
	Residential high density multiple dwelling apartments (flats, high-rise)*	⩽ 12,500 m^2
Commercial and/or Industrial	Commercial and/or Industrial	⩽ 12,500 m^2

* May include commercial or retail within the building.

In terms of scale, the upper limits of the scenarios presented (i.e. 20 lots and 12,500m^2) were set to:

- ensure that the Solutions address the bulk of applications received by authorities (consisting of small scale applications within the ranges defined)
- ensure that development applications which justify full scale stormwater quality modelling and reporting are excluded from the Solutions. These include large scale and more complex applications which do not lend themselves to generic deemed to comply solutions.

The lower limits of the residential development scenarios outlined in Table 1 (i.e. 2 lots) were set by modelling work which examined the economic feasibility of applying stormwater management to various scales of development. The modelling work suggested that stormwater quality management using current technology was not economically feasible on single lots. Since this work was completed, knowledge of costs and benefits associated with stormwater quality treatment has been refined, as has modelling software. As a result, the assumptions to determine the minimum development scale for the solutions may be superseded by further work and assessment authorities may be justified in applying stormwater quality objectives to single lot residential developments.

4 Deemed to Comply Solutions

The Solutions adopt current 'best practice' stormwater management measures. 'Best Practice' in this instance refers to structural stormwater management designed and constructed to contemporary design standards[1] and sized to operate at the technology's reasonable limit of economic performance as defined by the "point of diminishing return" on treatment performance curves derived from the predictive modelling DERM and EDAW (2009) and Water by Design (2007).

The Solutions establish the required sizes for rainwater tanks, bioretention systems and constructed wetlands to meet the requirements of the *Queensland Development Code Mandatory Part 4.2 and 4.3* and the stormwater quality objectives outlined in the *SEQ Regional Plan Implementation Guidelines No. 7* (DIP, 2009), and the *Draft Best Practice Environmental Management Guidelines — Urban Stormwater* (summarised in Appendix A).

The treatment measures and combinations adopted for the Solutions include[2] :

- bioretention systems
- constructed wetlands[3]
- rainwater tanks + bioretention systems
- rainwater tanks + constructed wetlands.

Table 2 summarises the range of Solutions in the context of the following:

- development type
- water conservation (rainwater tanks)
- stormwater treatment measure
- location of stormwater treatment
- Deemed to Comply Solution ID number.

4.1 Water conservation

Water conservation requirements for development in Queensland are mandated by the *Queensland Development Code Mandatory Parts 4.2 and 4.3*. In most cases rainwater tanks will be adopted and will form part of the preferred solution for a development. However, there are a number of situations where water conservation will not be mandatory and in these cases the stormwater treatment benefits associated with reduced runoff volumes have not been taken into consideration in the stormwater treatment measure sizes.

1 Contemporary design standards for stormwater management infrastructure can be found in the most recent revision of *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design) or a locally relevant equivalent.

2 Other treatment systems such as swales, sand filters and gross pollutant traps were considered for incorporation in the Solutions, however as these treatment systems will not achieve the stormwater quality management objectives they were not included.

3 Although wetlands are rarely expected to be the preferred treatment option for the scales of developments addressed by the Solutions (because they are large compared to bioretention systems), they have nevertheless been included as an alternative option which provide high ecological and landscape amenity outcomes.

4.2 Vegetated treatment measures

The stormwater treatment size for bioretention systems and constructed wetlands are provided for four climatic regions of SEQ. The bioretention system and constructed wetland sizes have been established using the stormwater treatment performance curves provided in the DERM and EDAW (2009), Water by Design (2007), and have been supplemented by extensive stormwater quality modelling (Model for Urban Stormwater Improvement Conceptualisation [MUSIC[4]] modelling) for each scenario. The modelling was completed in accordance with the assumptions outlined in the *MUSIC Modelling Guidelines* (Water by Design 2010).

A contingency is included in the bioretention system and constructed wetland sizes to allow for:

- variation in climate within the climatic regions
- some flexibility in the design of treatment measures (e.g. a minor adjustment in a system's design such as a slight decrease in bioretention extended detention depth)
- variation in the proportion of impervious surfaces within the development.

4.3 Location of stormwater treatment

The Solutions also identify the likely ownership of the stormwater treatment measures as defined by location:

- private land (i.e. allotment)
- public land (i.e. such as road reserves, drainage reserves or parklands)
- combination of private and public land.

Stormwater treatment infrastructure located on private land will be operated and maintained by the private owner. Infrastructure located on public land will generally be operated and maintained by the local authority. Operation and maintenance often dictates the preferred location for stormwater treatment infrastructure and the Solutions allow for a variety of ownership types.

4.4 Deemed to Comply Solution ID number

Details of each solution (i.e. the size of rainwater tank, bioretention system or constructed wetland) are provided in Appendix B. Each solution can be referenced by the Deemed to Comply ID number provided in Table 2.

4 MUSIC is a software based tool which assists in the evaluation of conceptual designs of stormwater management systems to meet water quality objectives for their catchment. Version 3 of the software was used in determining the Solutions contained herein. For more information on MUSIC software visit: http://www.toolkit.net.au/ The Water by Design MUSIC Modelling Guideline are available from http://www.waterbydesign.com.au/

Table 2: Summary of Deemed to Comply Solutions

DEVELOPMENT TYPE			WATER CONSERVATION (TANKS)	STORMWATER TREATMENT MEASURE	LOCATION OF STORMWATER TREATMENT (Public and/or private land)	DEEMED TO COMPLY ID's (Referred to in Appendix D)
Land Use	Development Scenario	Scale				
Residential	Residential greater than 2 lots up to 20 lots	N/A	Tanks	Bioretention	Public, Private and Public	R1
			No Tanks	Bioretention	Public, Private and Public	R2
			Tanks	Constructed Wetland	Public, Private and Public	R3
			No Tanks	Constructed Wetland	Public, Private and Public	R4
Residential	Residential greater than 2 dwellings (Townhouse style up to 2 storeys)	≤ 12,500 m²	Tanks	Bioretention	Private	R5
			No Tanks	Bioretention	Private	R6
			Tanks	Constructed Wetland	Private	R7
			No Tanks	Constructed Wetland	Private	R8
Residential	Residential high density multiple dwelling apartments (flats, high-rise)*	≤ 12,500 m²	No Tanks	Bioretention	Private	R9
			No Tanks	Constructed Wetland	Private	R10
Commercial and Industrial	Commercial and/or Industrial uses	≤ 12,500 m²	Tanks or No Tanks**	Bioretention	Public, Private and Public	CI1
			Tanks or No Tanks**	Constructed Wetland	Public, Private and Public	CI2

* May include commercial/retail in building. The water savings targets in the *Queensland Development Code MP 4.2 and 4.3* do not apply to flats or apartments.

** Rainwater tanks designed to satisfy the requirements of the *Queensland Development Code* for industrial and commercial developments result in essentially no reduction on treatment measure size. Therefore the Deemed to Comply Solutions apply the same treatment measure sizes irrespective of whether tanks are adopted.

5 Treatment measure selection considerations

While the requirement for water conservation is mandated by the *Queensland Development Code Mandatory Parts 4.2 and 4.3*, selecting the preferred stormwater treatment measure is influenced by a number of site conditions and development characteristics including:

- topography and receiving drainage or waterway levels
- space
- landscape intent.

5.1 Topography and receiving drainage or waterway levels

Topography and drainage have an important influence on selecting stormwater treatment measures. Topography defines catchment boundaries and informs the location and scale of stormwater treatment measures.

Undulating to steep sites (>2% grade) generally support a range of stormwater treatment solutions such as bioretention systems and constructed wetlands. Importantly undulating sites allow for traditional pit and pipe drainage to the surface of treatment systems and the subsequent 'free drainage' to the receiving drainage system or waterway. Given the relatively large size of constructed wetlands compared to bioretention systems, consideration must be given to how the wetland will integrate with the undulating to steep topography. This involves identifying a suitably large flat area on the site for the wetland. If this area is not available then bioretention systems with their smaller footprint will be more appropriate.

Flat sites (<2% grade) represent a challenge to traditional pit and pipe drainage because of a need for large pipe diameters to compensate for the mild grades. Long runs of large diameter pipe can result in the pipe invert being several metres below ground. At this depth, draining to the surface of a stormwater treatment measure and then subsequently achieving 'free drainage' to the receiving drainage system or waterway is generally not possible. In response to flat topography, stormwater needs to be drained on, or close to, the surface and discharged to stormwater treatment systems located close to the source of runoff (i.e. at surface). Often this means stormwater treatment will occur within public road reserves and on private allotments (for large allotments). Provided there is enough elevation above a receiving drainage or waterway system (>1,000 mm), bioretention systems can be adopted. If this elevation is not available then either filling is required to support bioretention systems or constructed wetlands should be adopted.

Appendix B provides detailed guidance on minimum level requirements for bioretention system and wetlands. Further discussion and guidance is provided in the *Concept Design Guidelines for Water Sensitive Urban Design* (Water by Design, 2009b).

5.2 Space

The competition for space on development sites, particularly small developments, has a strong influence on the selection of stormwater treatment measures. Maximising development yield and creating other functional spaces, such as open space, often means there is a preference to reduce the footprint of stormwater treatment measures. Where space are preferable , bioretention systems is supported because of the relatively small size (1–2 % of the catchment) required to meet the stormwater quality objectives compared to wetlands (4–8%).

5.3 Landscape intent

When considering a stormwater treatment measure, its context within the overall development form and landscape intent is important. In many situations, stormwater is used in the landscape to maximise visual and recreational amenity and to promote water in the urban environment. Although this can be achieved using bioretention systems, it is generally accepted that constructed wetlands provide greater amenity through diverse vegetation, permanently ponded water, some of which can be open water (<20% by area), and wildlife habitat.

5.4 Selection matrix

The site conditions and development characteristics discussed in the previous sections have been used to establish the stormwater treatment measure selection matrix shown in Table 3. The selection matrix allows assessment authorities, developers, and designers to select the stormwater treatment measures, either bioretention systems or constructed wetlands, most suited to a particular development site. The selection matrix should be used in conjunction with Table 2 to select the preferred Solution.

Table 3: Stormwater Treatment Measure Selection Matrix

TOPOGRAPHY	SPACE	PREFERRED STORMWATER TREATMENT MEASURE
Undulating to steep (i.e. >2% grade)	Constrained	Bioretention system
	Less constrained	Bioretention system or Constructed wetland (provided there a suitable flat location for the wetland, preferred for high amenity)
Flat (i.e. <2% grade)	Constrained	Bioretention system (provided that free draining of the system can be achieved)
	Less constrained	Constructed wetland

6 Step-by-step design process

The selection, design and integration of Deemed to Comply Solutions within a development requires a logical and collaborative process. The *Concept Design Guidelines for Water Sensitive Urban Design* (Water by Design, 2009b) provides a detailed step-by-step design process. To select and design a Deemed Comply Solution, the step-by-step process has been simplified and is illustrated in Figure 1. Each step corresponds with the development assessment checklist provided in Section 7.

For the purposes of Material Change of Use (MCU) or Reconfiguring of an Allotment (ROL) applications, proponents are required to demonstrate and document how the requirements of the Deemed to Comply Solution have been met. A number of documents must be submitted to the local authority with the development application:

- development assessment checklist
- conceptual drawings
  - site details plan (refer STEP 3)
  - development details plan (refer STEP 4)
  - stormwater treatment measure conceptual plan and sections drawings (refer STEP 7)

Importantly, skilled and experienced engineering and landscape design judgement is required for selecting and designing a Deemed Comply Solution.

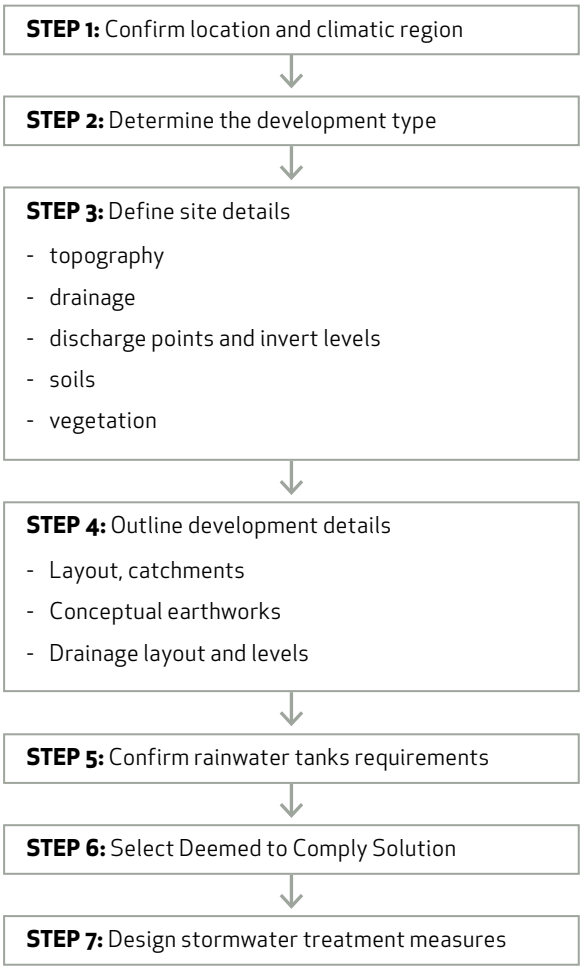

Figure 1: Step-by-step selection and design process for a Deemed Comply Solution

6.1 STEP 1: Confirm location and climate region

DIP (2009), sets regional stormwater quality objectives for SEQ and the Solutions define four climatic subregions within this region presenting separate deemed to comply solutions for each of the climatic subregions.

The project name, address and local government area should be noted and Figure 2 used to define the climatic region.

Step 1 inclusions for Development Assessment Checklist (Appendix C):

✓ Development address

✓ Local Government Area

✓ Climatic region

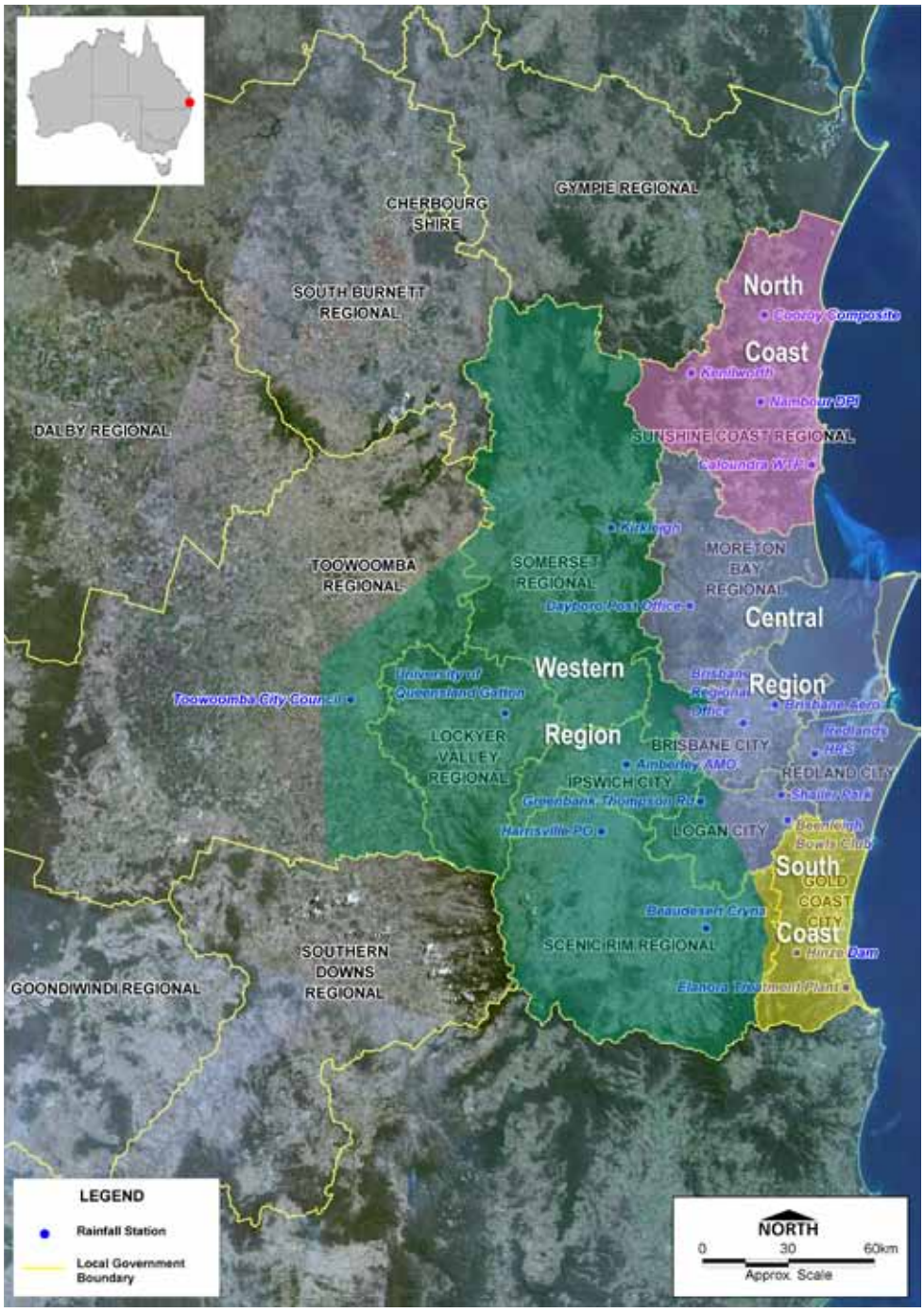

Figure 2: Delineation of climatic regions for South East Queensland (BMT WBM, 2009)

6.2 STEP 2: Determine development type

To assess whether a Solution can be applied to a particular development, the development type must be defined. The proposed development land use, type and scale should be confirmed and compared with the criteria listed in Table 1 (repeated below as Table 4 for convenience).

Additionally, the local authority should be consulted to ensure they support applying the Solutions as part of the development approval process.

Table 4: Development types/scenarios that form the basis of the WSUD Deemed to Comply Solutions

LAND USE	DEVELOPMENT SCENARIO	SCALE
Residential	Residential greater than 2 lots up to 20 lots	N/A
	Residential greater than 2 dwellings (townhouse style up to 2 storeys)	≤ 12,500 m^2
	Residential high density multiple dwelling apartments (flats, high-rise)*	≤ 12,500 m^2
Commercial and/or Industrial	Commercial and/or Industrial	≤ 12,500 m^2

* May include commercial or retail within the building.

Step 2 inclusions for Development Assessment Checklist (Appendix C):

✓ Development type

✓ Number of dwellings

✓ Site area (m^2)

6.3 STEP 3: Define site details

There are range of site conditions that influence the selection and design of the Deemed to Comply Solutions. To determine the site's capacity to support a Solution, the following information is required:

- Existing topography — A suitable ground survey of the site is required to allow an assessment of existing grades and flow pathways.
- Existing drainage characteristics — Drainage details upstream, within, and downstream of the development must be surveyed for size, location and level.
- Proposed discharge points and invert levels — Define likely flow paths and the level of the receiving drainage system or waterway. Critically, levels must be collected for inverts of drainage systems that will accept treated water from the stormwater treatment systems. If water is ponding in these drainage systems, the water level must also be surveyed.
- Vegetation — If the site contains vegetation that is to be preserved, the size, location and level of the vegetation must also be surveyed, together with the drip zone/canopy of the vegetation.
- Soils — The Solutions assume soils on the site are of poor quality and require impermeable liners to support bioretention systems and constructed wetlands. If alternative liners are used (i.e. filter fabric for bioretention system) or no liners used at all, then this must be supported by a soil evaluation undertaken in accordance with AS/NZS 1547:2000 Clause 4.1.3. The soil evaluation should identify soil type, hydraulic conductivity, presence/absence of sodic soils, saline soils, potential acid sulfate soils, rock, and general groundwater details. Impermeable liners are also required wherever groundwater levels impact on treatment measures.

Existing topography, drainage and vegetation details must be presented on an annotated site details plan along with the boundary of the development.

Step 3 inclusions for Development Assessment Checklist (Appendix C):

✓ Site details plan - scaled, annotated plan showing boundary of the development, existing topography, drainage and waterway invert levels and vegetation details

✓ Soil evaluation, if using an alternative to an impermeable liner for bioretention systems or constructed wetlands

6.4 STEP 4: Outline development details

Development details strongly influence the selection and design of the preferred Solution:

- Layout - The proposed layout of the development will define the available space for stormwater treatment measures. Layout includes defining the total area of the development, the area for road reserves, driveways or parking, pavement areas, easements, landscape areas and any other relevant areas. Specifying the layout allows the definition of the space available for stormwater treatment, although it may be part of the landscape area.
- Catchments - Define catchments/sub catchments considering the likely location of stormwater treatment measures and discharge points from the development. Catchments will be influenced by the conceptual earthworks, however, often the catchment requirements dictate the final earthworks. The catchments will also define the number of Solutions (i.e. treatment measures), for the development. All subsequent steps must be completed for each catchment.
- Conceptual earthworks - Earthworks are designed according to building, access, landscape and drainage requirements. Importantly, the earthworks should provide suitable levels for draining to the surface of the stormwater treatment measures (taking into account pipe sizes and suitable cover).
- Conceptual drainage layout and invert levels - Conceptual drainage location and invert levels must be defined. On flat sites, this is a particularly important step because the requirement to drain the surface often dictates drainage and stormwater treatment measures locations. The drainage layout and inverts must be defined to ensure stormwater enters the surface of the stormwater treatment measures and can freely drain to the receiving drainage system or waterway.

Layout, conceptual earthworks and drainage must be designed considering the requirement of the Solutions. Therefore, Step 4 and Step 7 should be undertaken at the same time to ensure integration between layout and the engineering, landscape and stormwater management design.

The development details including layout, general earthworks, catchment details, conceptual drainage layout and conceptual drainage invert levels must be presented on a suitably annotated and scaled development details plan. This plan must also include the location and scale of the rainwater tanks and stormwater treatment measure (refer Steps 5 to 7).

Step 4 inclusions for Development Assessment Checklist (Appendix C):

✓ Total area of the development (m^2)

✓ Roof areas (m^2)

✓ Areas of road reserves, driveways or parking (m^2)

✓ Pavement areas (m^2)

✓ Easements (m^2)

✓ Landscape areas (m^2)

✓ Any other relevant areas (m^2)

✓ Space available for stormwater treatment (m^2)

✓ Development details plan (scaled annotated) depicting:

- development layout and land type
- catchment areas
- conceptual earthworks
- conceptual drainage and invert levels
- rainwater tanks and stormwater treatment measure location and scale (refer Steps 5 to 7)

6.5 STEP 5: Confirm rainwater tank requirements

The *Queensland Development Code Mandatory Parts 4.2 and 4.3* mandates water savings targets for all new dwellings and other buildings in Queensland. To achieve the targets, demand management combined with the use of alternative sources of water for toilet flushing, laundry and outdoor water use is required. Alternative water source options include rainwater tanks, communal rainwater tanks, greywater reuse, dual reticulation or stormwater reuse. In most cases, the alternative source of water will be supplied by rainwater tanks.

For each catchment in the development, the number, location and size of rainwater tanks should be included on the annotated and scaled development plan. The *Queensland Development Code* (QDC) provides minimum rainwater tank requirements, which are summarised in Table 5 below.

Compliance with the Deemed to Comply Solutions requires all overflow from the rainwater tanks to be directed to stormwater treatment measures. The number, location and size of rainwater tanks must be included on the annotated and scaled development details plan.

Step 5 inclusions for Development Assessment Checklist (Appendix C):

✓ Number, size and location of any rainwater tanks on the development details plan

Table 5: Minimum rainwater tank requirements defined in *Queensland Development Code Mandatory Parts 4.2 and 4.3*[1]

BUILDING TYPE (Building Code of Australia Class)	DEFINITION[2]	RAINWATER TANK REQUIREMENTS[3]		
		MINIMUM CONNECTIONS FROM TANK	MINIMUM RAINWATER TANK VOLUME	MINIMUM ROOF AREA CONNECTED TO TANK
Detached buildings (Class 1ai)	A single detached dwelling (i.e. free-standing house)	Toilets and washing machine (cold water)	5kL	The lesser of 50% of total roof area or 100 m^2
Attached buildings (Class 1aii)	One or a group of attached dwellings (i.e. row houses, townhouses, terraces, villas)		3kL	
Boarding House (Class 1b)	A boarding house, hostel, guest house or similar with <300 m^2 floor space and <12 residents		3kL	
Units/Apartments (Class 2)	A building containing 2 or more sole occupancy units	N/A	N/A	N/A
Accommodation Buildings (Classes 3, 9a/c)	Commercial buildings with > 50% space classified as Classes 3, 9a or 9c	Swimming pools, required toilets, an external use, and washing machine (cold water).	Pools: refer Appendix B QDC MP4.3 Toilets:1.5 kL per required toilet	50 m^2 per toilet (or total area if less)
Large Commercial and Industrial Buildings (Classes 3–8,10)	Commercial Buildings that are not accommodation with ≥10 toilets			
Small Commercial and Industrial Buildings (Classes 3–8,10)	Commercial Buildings that are not accommodation with <10 toilets			

1 - Users should check for updates to the *Queensland Development Code Mandatory Parts 4.2 and 4.3* prior to undertaking design.
2 - Building code definitions obtained from the Building Services Authority of Queensland.
3 - Additional requirements may be stipulated by assessment authority.

6.6 STEP 6: Select Deemed to Comply Solution

With an understanding of site and development details and rainwater tank requirements, the preferred Deemed to Comply Solution can be selected. Table 2 provides the basis for this selection process by defining the development type, water conservation and stormwater treatment categories. Table 3 assists with the selection of the stormwater treatment measure based on topography and constraints.

Using Tables 2 and 3, select the preferred Solution for each catchment in the development and note the specific ID provided in Table 2. The Deemed to Comply Solutions Appendix D provides the required stormwater treatment size - either bioretention system filter media area or construction wetland macrophyte zone area - for each climatic region. This treatment measure size for each catchment within the development must be noted and used for the design of the stormwater treatment measure (STEP 7).

Table 2 and 3 are repeated below as Tables 6 and 7 for ease of reference.

Step 6 inclusions for Development Assessment Checklist (Appendix C):

- ✓ Selected Deemed to Comply Solution ID
- ✓ Bioretention system area as a % of the catchment area
- ✓ Constructed wetland area as a % of the catchment area

Table 6: Summary of Deemed to Comply Solutions

DEVELOPMENT TYPE			WATER CONSERVATION (TANKS)	STORMWATER TREATMENT MEASURE	LOCATION OF STORMWATER TREATMENT (Public and/or private land)	DEEMED TO COMPLY ID's (Referred to in Appendix D)
Land Use	Development Scenario	Scale				
Residential	Residential greater than 2 lots up to 20 lots	N/A	Tanks	Bioretention	Public, Private and Public	R1
			No Tanks	Bioretention	Public, Private and Public	R2
			Tanks	Constructed Wetland	Public, Private and Public	R3
			No Tanks	Constructed Wetland	Public, Private and Public	R4
Residential	Residential greater than 2 dwellings (Townhouse style up to 2 storeys)	≤ 12,500 m2	Tanks	Bioretention	Private	R5
			No Tanks	Bioretention	Private	R6
			Tanks	Constructed Wetland	Private	R7
			No Tanks	Constructed Wetland	Private	R8
Residential	Residential high density multiple dwelling apartments (flats, high-rise)*	≤ 12,500 m2	No Tanks	Bioretention	Private	R9
			No Tanks	Constructed Wetland	Private	R10
Commercial and Industrial	Commercial and/or Industrial uses	≤ 12,500 m2	Tanks or No Tanks**	Bioretention	Public, Private and Public	CI1
			Tanks or No Tanks**	Constructed Wetland	Public, Private and Public	CI2

* May include commercial/retail in building. Queensland Development Code MP 4.2 and 4.3 do not mandate rainwater tanks for flats or apartments.

** Rainwater tanks required by Queensland Development Code for industrial and commercial developments result in essentially no reduction on treatment measure size. Therefore the Deemed to Comply Solutions apply the same treatment measure sizes irrespective of whether tanks are required by the Queensland Development Code (i.e. there is no separate Solution with and without tanks).

Table 7: Stormwater Treatment Measure Selection Matrix

TOPOGRAPHY	SPACE	PREFERRED STORMWATER TREATMENT MEASURE
Undulating to steep (i.e. >2% grade)	Constrained	Bioretention system
	Less constrained	Bioretention system or Constructed wetland (provided there a suitable flat location for the wetland, preferred for high amenity)
Flat (i.e. <2% grade)	Constrained	Bioretention system (provided that free draining of the system can be achieved)
	Less constrained	Constructed wetland

6.7 STEP 7: Design stormwater treatment measures

The following sections outline the minimum conceptual design requirements for the stormwater treatment measures. Importantly, skilled and experienced engineering and landscape design judgement is required for the design process. The design process involves interaction with the design of the development layout to ensure the integration of stormwater treatment measures with the engineering and landscape design.

The following steps must satisfy the range of design requirements for bioretention systems and constructed wetlands provided in Appendix B. If the compliance with these design requirements cannot be achieved, then the Solution will not apply and a stormwater management plan will need to be submitted to the assessment authority.

6.7.1 Catchments

Catchment areas should be defined based on the development layout, earthworks, discharge points for the development and potential stormwater treatment locations. The combined catchments should encompass the whole development site and the catchment areas include all pervious and impervious areas of the site. External catchments should bypass treatment areas unless they are accounted for in the sizing of the treatment measures.

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

✓ Total catchment area (m^2)

6.7.2 Treatment measure size

The size of the stormwater treatment measure can be defined using the catchment area and the bioretention system or constructed wetland area values (i.e. % of catchment area) provided by STEP 6. The size relates to either:

- bioretention system filter media area
- constructed wetland macrophyte zone area.

The treatment areas for each catchment are obtained by multiplying the treatment measure size (the percentage of the catchment area) by the relevant catchment area:

Treatment size = treatment measure size (% of catchment from Solutions) x catchment area (m^2)

The total footprint for each treatment measure must be defined to take into account batters and an area for coarse sediment management, as well as the stormwater treatment area. The total footprint is best defined by developing suitably detailed concept drawings (Section 6.7.7). As a starting point, for small bioretention systems and constructed wetlands, adopt the following total footprint:

- bioretention system total footprint area = **3 x filter media area**
- constructed wetland total footprint area = **3 x macrophyte zone area.**

The ultimate size of treatment measures may also be influenced by compliance with objectives not addressed by this guideline. Other objectives should also be checked to ensure adequate area has been allocated on site to address the full suite of objectives applicable to the site.

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

- ✓ Location of treatment measure
- ✓ Filter media area as % of catchment area for bioretention systems
- ✓ Filter media area (m^2) for bioretention systems
- ✓ Macrophyte zone area as % of catchment area for constructed wetlands
- ✓ Macrophyte zone area (m^2)
- ✓ Total footprint of treatment area (m^2) (up to 3 x filter media area or macrophyte zone area)

6.7.3 Confirm coarse sediment management

Apart from organic matter, coarse sediment represents the largest volume of pollution in urban stormwater. It can smother vegetation, compromising the effectiveness of bioretention systems and constructed wetlands. Coarse sediment removal also requires the most maintenance effort. The design and construction of stormwater treatment measures must allow for coarse sediment to be captured before it enters bioretention systems or constructed wetlands to ensure easy and infrequent maintenance.

For bioretention systems, coarse sediment must be managed using these guidelines:

- For bioretention systems that receive no road or car park runoff, no management of coarse sediment is required.
- For bioretention systems that receive road or car park runoff (or other impervious areas which generate high coarse sediment loads), a coarse sediment forebay with easy access for infrequent cleaning, (such as once every 1–2 years), using standard equipment (by hand, sucker truck, bobcat or excavator) is required.

Gross pollutant traps can be used upstream of bioretention systems where space is constrained and if the owner or manager of the site must agree to regular maintenance (i.e. monthly cleanout). The drainage levels to the bioretention system must allow for incorporation of the gross pollutant trap.

For constructed wetlands, coarse sediment must be managed using the following guidelines:

- An inlet zone incorporated into the wetland design to capture coarse sediment prior to flows entering the macrophyte zone (preferred).
- Gross pollutant traps can be used upstream in the place of a wetland where space is constrained however a high flow bypass will also need to be incorporated into the design. The owner or manager of the site must agree to regular maintenance (i.e. monthly cleanout) and the drainage levels to the constructed wetland must allow for incorporating the gross pollutant trap.

Coarse sediment management for bioretention systems and constructed wetlands (i.e. inlet ponds) should be designed in accordance with the *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

✓ Description of coarse sediment management

6.7.4 Confirm high-flow bypass (constructed wetland)

Flows entering the macrophyte zone of a constructed wetland must be regulated to avoid the risk of erosion or re-suspension of biofilm and pollutants during large storm events. If flows are greater than the 'design flow' (typically the 1 year Average Recurrence Interval (ARI event)) they must be bypassed around the macrophyte zone. This is generally achieved via a bypass weir, which is incorporated into the inlet zone, and a bypass channel designed in accordance with the *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

For the Deemed to Comply Solutions, the high flow bypass must be vegetated and clearly marked on conceptual design drawings.

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

- ✓ Description of high flow bypass method
- ✓ High flow bypass area (m^2)
- ✓ Conceptual design drawings of any pipe and pit diversion structures or alternative overland flow paths

6.7.5 Conceptual location and configuration

In collaboration with the other disciplines (i.e. urban planners, surveyors, architects, landscape architects), define the conceptual location and configuration of the stormwater treatment measures. This is an iterative process and should occur when refining the development layout for the site (STEP 4). Any conflict between development layout and stormwater treatment measure requirements can be resolved at this stage, or any synergies explored and incorporated in the design.

The location and size of the stormwater treatment measures will respond to the topography, available space (i.e. development layout), available landscape areas (i.e. landscape intent), likely catchment areas, and discharge locations to receiving drainage or waterways.

The location of the treatment measures will dictate the ownership of the measure. Final selection of location and ownership will depend on the site and development conditions and discussions with the assessment authority and development owner. Rules that guide the ownership decision are:

- runoff from private land can be treated in measures located on either private or public land
- runoff from public land must be treated in measures located on public land (runoff from public land should generally not be treated on private land).

6.7.6 Conceptual design levels

Conceptual design levels must be defined for the stormwater treatment systems. These levels are defined on the basis of the invert levels or ponded water levels in the receiving drainage infrastructure or waterways (STEP 3). The suggested surface or water level requirements listed in Tables B1 and B2 (Appendix B) can be used as a starting point for defining the levels of the stormwater treatment measures. Refining these levels requires the development of a drainage cross-section diagram for each measure, which considers:

- invert levels or ponded water levels in receiving drainage or waterway
- pipe grade from treatment measure to receiving drainage or waterway (typically 0.5% grade)
- any level changes in the outlet structures
- media requirements (bioretention only)
- extended detention depths
- batter slopes bund and/or embankment level requirements.

Figures B1, B2, B3 and B4 and Tables B1 and B2 in Appendix B provides minimum design requirements in this regard.

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

✓ Receiving drainage or ponded water level (m AHD)

✓ Outlet pipe level (m AHD)

✓ Surface or water level (m AHD)

✓ Media depth (bioretention including filter media, transition and drainage layers) (m AHD)

✓ Extended detention (m AHD)

✓ Bund or embankment level (m AHD)

6.7.7 Plan and section conceptual drawings

Detailed conceptual drawings are to be developed for each of the stormwater treatment measures adopted for a development using a Deemed to Comply Solution. The drawings must be comprised of a suitably scaled and annotated conceptual plan and section views.

Plan

- pipe arrangement to describe how stormwater is discharged into the treatment system
- outlet pit and pipe locations
- functional treatment areas (bioretention filter media or constructed wetland macrophyte zone)
- coarse sediment management
- high flow bypass (weir and channel for constructed wetland only)
- batters and embankments
- surrounding ground levels
- conceptual design levels for functional elements.

Section

- conceptual design levels and earthworks levels
- inlet and outlet pits and pipes invert levels (including connection to receiving drainage/waterway)
- coarse sediment management
- extended detention levels
- batters and embankments slopes and levels
- liner, underdrainage pipes, drainage layer, transition layer and filter media (bioretention only)

Step 7 inclusions (for each catchment) for Development Assessment Checklist (Appendix C):

CONCEPTUAL PLANS

✓ Inflow arrangement

✓ Outlet pit and pipe locations

✓ Treatment areas (bioretention filter media or constructed wetland macrophyte zone)

✓ Coarse sediment management

✓ High-flow bypass

✓ Batters and embankments

✓ Functional and surround ground levels

CONCEPTUAL SECTIONS

✓ Conceptual design levels

✓ Inflow and outlet pits and pipes invert levels

✓ Coarse sediment management

✓ Extended detention levels

✓ Batters and embankments slopes and levels

✓ Media depth (bioretention only)

7 Reporting requirements for development approval

For the purposes of Material Change of Use (MCU) or Reconfiguring of a Lot (ROL) application, the proponent is required to provide documentation which confirms that the requirements of the Deemed to Comply Solution have been met. This involves completing and submitting the following to the assessment authority with the development application:

- development assessment checklist (see below)
- conceptual drawings
  - site details plan (refer STEP 3)
  - development details plan (refer STEP 4)
  - stormwater treatment measure conceptual plan and sections drawings (refer STEP 7)

It is the responsibility of the site designer to ensure the most recent version of the Development Assessment Checklist (Appendix C) is being used.

8 Design and documentation requirements for Operational Works Approval

Following receipt of development approval (MCU or ROL), detailed design of the stormwater treatment measures will occur in accordance with the conditions of approval. The design process and reporting must follow the guidance and methods provided in technical design guidelines relevant to the assessment authority.

At the time of writing this document the *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design) are being used to guide design for operational works approval for stormwater treatment systems other than in the Gold Coast *(Land Development Guidelines Chapter 13: WSUD Guidelines)*.

Typically the following information should be provided with the Operational Works application to the assessment:

- Engineering drawings showing plan, section, outlet, and coarse sediment capture details. Standard drawings published by the Institute of Public Works Engineering Australia (Queensland) are available for some bioretention and constructed wetland details.
- Stormwater treatment (WSUD) design reporting, which provides an overview of the treatment strategy, details of calculations associated with each treatment measure and the complete Design Calculation Summary and Design Assessment Checklist provided in the relevant technical guidelines (see above).
- Stormwater treatment specifications or reference from the drawings and design report to relevant specifications provided in the *WSUD Construction and Establishment Guideline: Swales, Bioretention Systems and Wetlands* (Water by Design).
- Stormwater treatment construction and Establishment Method or appropriate reference from the drawings and design report to relevant specifications provided in the *WSUD Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands* (Water by Design).

9 References

Australian Standards (2009) AS 4419 - *Soils for Landscaping and Garden Use*.

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Department of Environmental and Resource Management and EDAW (2009). *Technical Note: Derivation of Design Objectives. Brisbane*.

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Water by Design (2006). *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland Version 1*. Moreton Bay and Waterways Catchments Partnership, Brisbane.

Water by Design (2007). *Developing Design Objectives for Urban Development in SEQ*. South East Queensland Healthy Waterways Partnership, Brisbane.

Water by Design (2009a). *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*. South East Queensland Healthy Waterways Partnership, Brisbane.

Water by Design (2009b). *Concept Design Guidelines for Water Sensitive Urban Design*. South East Queensland Healthy Waterways Partnership, Brisbane.

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APPENDIX A - WSUD Design Objectives for Queensland

The *SEQ Regional Plan Implementation Guideline No. 7: Water Sensitive Urban Design* (DIP, 2009) and the Draft *Best Practice Environmental Management Guidelines - Urban Stormwater* (DERM, 2009b), outline three stormwater management design objectives. The intent and performance measure or target associated with the objectives are summarised in Table A-1.

The stormwater quality design objective adopts a best practice pollutant load reduction approach and the objectives vary in response the climatic variation across Queensland.

The best practice stormwater quality quantitative objectives are provided in Table A-2.

Table A-1: Stormwater Management Design Objectives for Queensland

DESIGN OBJECTIVE	INTENT	PERFORMANCE MEASURES OR TARGETS
Stormwater quality	To protect receiving water quality by limiting the quantity of discharged stormwater pollutants.	Treat in accordance with best practice for each climatic region. Minimum required reductions in total pollutant loads, compared to untreated stormwater runoff from developments, are defined in the *Draft Best Practice Environmental Management Guidelines—Urban Stormwater* (DERM, 2009b) for: - total suspended solids (TSS) - total phosphorus (TP) - total nitrogen (TN) - gross pollutants.
Waterway stability	To prevent exacerbated in-stream erosion downstream of urban areas by controlling the magnitude and duration of sediment-transporting flows.	Limit the post-development peak one-year Average Recurrence Interval (ARI) event within the receiving waterway to the pre-development peak one-year ARI event discharge.
Frequent flow management	This objective aims to protect in-stream ecosystems from the significant effects of increased runoff frequency by capturing the initial portion of runoff from impervious areas. This approach ensures that the frequency of hydraulic disturbance to in-stream ecosystems in developed catchments is similar to predevelopment conditions.	Capture and manage the design runoff capture depth (mm/day) from all impervious areas so that the frequency of surface runoff is the same as pre-development conditions: - developments with a total fraction impervious <40%: design runoff capture depth = 10mm/day - developments with a total fraction impervious >40%: design runoff capture depth = 15mm/day Note: Runoff capture capacity needs to be replenished within 24 hours of the runoff event.

Table A-2 Summary of design objectives for stormwater quality management — operational (post construction) phase of development. (From Chapter 2 of the *Draft Best Practice Environmental Management Guidelines – Urban Stormwater*)

CLIMATE REGION	[5]MINIMUM REDUCTION IN DEVELOPED SITE POLLUTANT LOADS (%)			
	SUSPENDED SOLIDS (TSS)	TOTAL PHOSPHORUS (TP)	TOTAL NITROGEN (TN)	GROSS POLLUTANTS > 5MM
Eastern Cape York	75	60	35	90
Central and Western Cape York (north)	75	60	40	90
Central and Western Cape York (south)	80	65	40	90
Wet Tropics	80	65	40	90
Dry Tropics	80	65	40	90
Central Coast (north)	75	60	35	90
Central Coast (south)	85	70	45	90
South East Queensland	80	60	45	90
Western Districts	85	70	45	90

5 It is expected that application of best practice designed stormwater treatment technologies configured in an appropriately sequenced 'treatment train' will meet or exceed the design objectives presented in Table A-2

APPENDIX B - Design Requirements for Stormwater Treatment Measures

Bioretention systems

Bioretention systems treat stormwater by filtering runoff through densely planted vegetation and percolating the runoff through a filter media, such as loamy sand. As the water is percolated through the soil, pollutants are captured by fine filtration, adsorption and biological uptake. Comprehensive description of bioretention system function and design is provided in *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

Figure B-1 shows that bioretention systems have a number of elements:

- **Extended detention:** When stormwater enters the bioretention system, it temporarily ponds to a depth of 0–400 mm over the surface of the filter media. This ponding depth, or the 'extended detention', is created by raised field inlet pits (overflow pits). Extended detention helps to manage flow velocities over the surface of the filter media as well as increasing the overall volume of stormwater runoff that can be treated by the bioretention system.
- **Filter media:** The layer of 'filter media' provides the most treatment of the pollutants through fine filtration and supporting the vegetation. The vegetation improves filtration, keeps the filter media porous, provides substrate for biofilms to form and takes up some nutrients and pollutants. The filter media should be deep enough to support vegetation. The typical depth for filter media is between 600 mm–1,000 mm with a minimum depth of 400 mm.
- **Transition and drainage layers:** Under the filter media, a 'transition layer' of coarse sand is used to prevent the filter media moving into the drainage layer and the perforated under-drains. The transition layer is typically 100 mm deep. The 'drainage layer' is made up of fine aggregate (2–4 mm). The drainage layer collects treated water from the base of the bioretention system and delivers it into the perforated under-drains. Perforated under-drains are made from slotted rigid pipe.

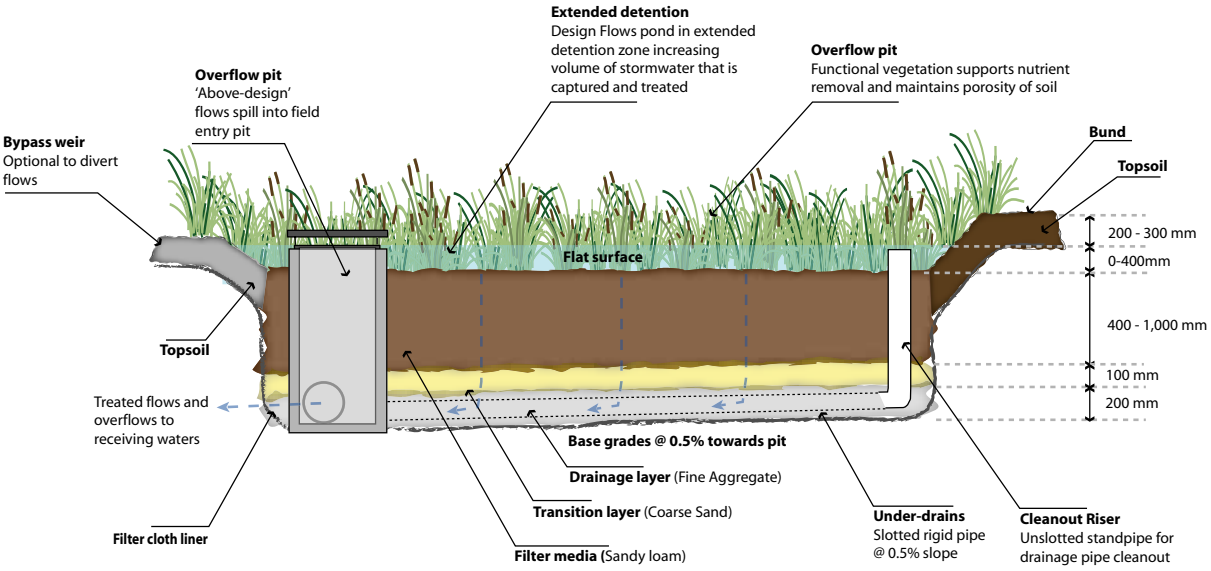

Figure B-1: Typical cross-section through a bioretention system

- **Hydraulic structures (overflow pit):** During flood events that are 'above design' of the bioretention system, stormwater flows are conveyed through overflow pits or bypass paths. Hydraulic structures protect the surface of the filter media from high-flow velocities that can dislodge collected pollutants or scour vegetation.
- **Vegetation:** Vegetation in bioretention systems improves the treatment of stormwater by providing a substrate layer for biofilm growth, helping to transport oxygen to the soil and enhancing microbial communities that transform pollutants. The roots of the vegetation continuously break up the surface of the filter media, which prevents the surface from clogging. Wind agitating the vegetation can also help to break up the surface. Vegetation should cover the surface of the filter media. The type of vegetation used must be able to withstand minor and major runoff followed by dry periods. It must also be dense enough prevent preferred flow paths (short circuiting), scour and re-suspension of deposited sediments.

Including a saturated zone in the base of bioretention systems is a new development in design. Experimental trials conducted by the Facility for Advancing Water Biofiltration (FAWB) show benefits for plants and for removing nitrogen. By using a saturated zone soil moisture can be maintained to sustain vegetation for a number of months without rainfall or stormwater inflow. Figure B-2 shows that saturated zones are a relatively simple modification to standard bioretention designs by:

- incorporating an impervious liner to ensure the system holds water
- amending the hydraulic structures at the outlet to allow 400–500 mm ponding in the base
- using coarse gravel (10–20 mm) mixed with a source of carbon (straw and hardwood chips) in the base of the saturated zone to support the removal of nitrogen
- ensuring the base of the system is flat.

Bioretention systems adopted as part of a WSUD Deemed to Comply Solution must include a saturated zone when applied in dry climate regions.

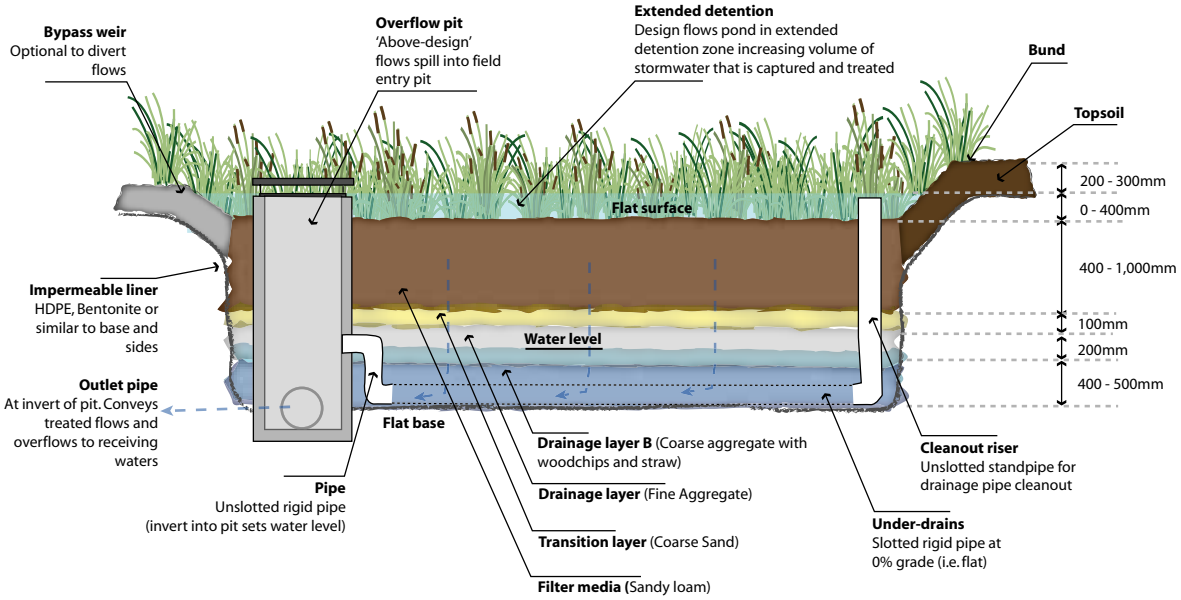

Figure B-2: Typical cross-section through a bioretention system with a saturated zone

When considering designing bioretention systems as the stormwater treatment measure solution for a particular site, the drainage and topography of the site must be closely considered to ensure surface of the bioretention system (top of filter media) is suitably high enough to allow free drainage of the system to the receiving drainage system or waterway. **The bioretention system must freely drain to the receiving waterway or drainage system.**

In order to define the surface level of the bioretention system, the designer must work back from the outfall level to the receiving drainage or waterway. This requires accurate survey of this downstream drainage or waterway. When setting the drainage outfall level the following must be considered:

- When draining to a waterway, a suitable freeboard must be allowed for siltation within the stream to ensure the outlet is above the level of baseflows. Additionally the outfall must be set above the wet season standing water level. **As a general rule of thumb, the outfall should be set at least 300 mm above the invert of the waterway.**
- When draining to an engineered drainage system, there ideally should be a small level drop (50 mm) in the connecting pit. Additionally, the outfall should be set above any wet season baseflows that may exist in the drainage system.

The Figures B-3 and B-4 illustrate the typical level requirements for **conventional bioretention systems (minimum 700+ mm above receiving drainage) and saturated zone bioretention systems (minimum 500+ mm above receiving drainage).**

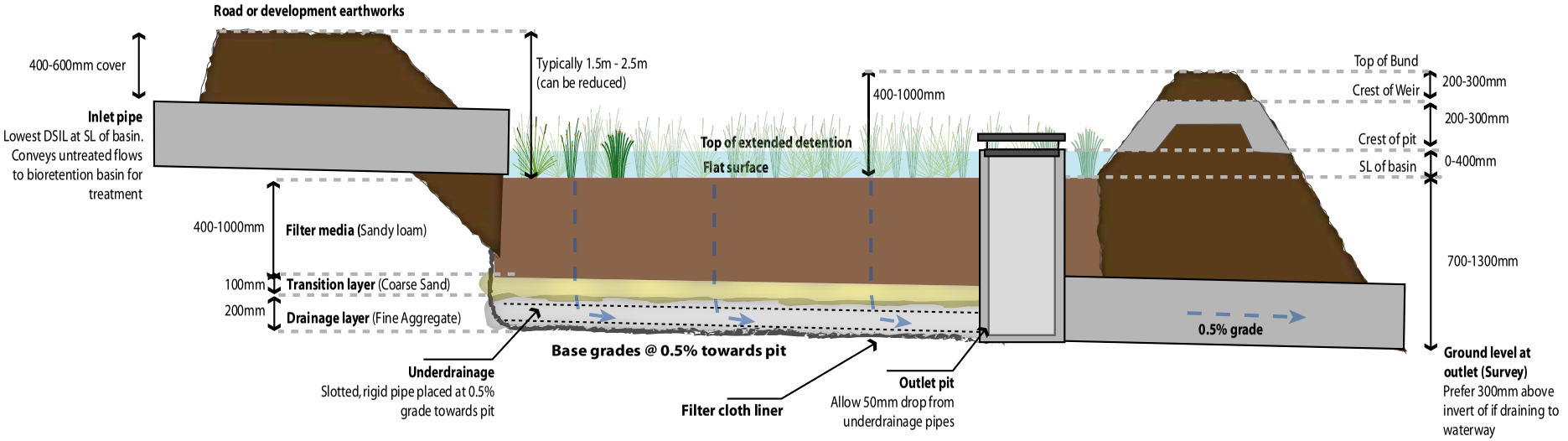

Figure B-3: Minimum level requirements for a conventional bioretention system

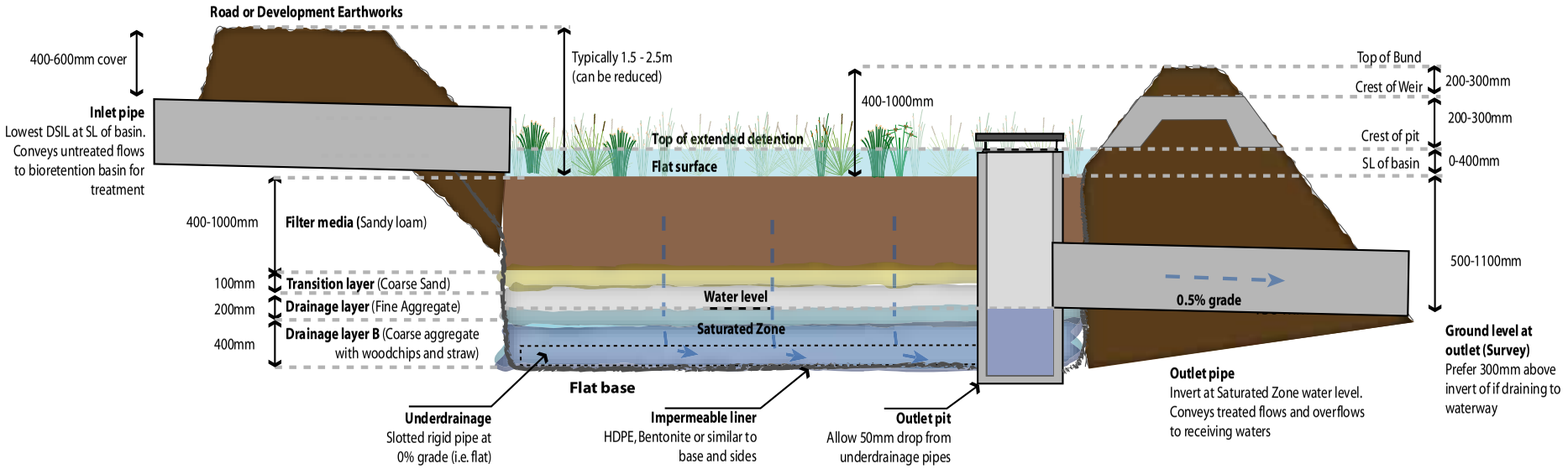

Figure B-4: Minimum level requirements for a saturated zone bioretention system

Table B-1 summarises the design requirements for bioretention systems that must be satisfied to ensure long-term function. Compliance with these design requirements must be illustrated as part of the Deemed to Comply Solution selection and design process (Section 6).

Table B-1: Bioretention System Design Requirements

DESIGN ELEMENT	FUNCTION	DESIGN REQUIREMENT
Filter media	Filter media area of the bioretention represents the functional part of the bioretention through which stormwater filters. The media supports vegetation that improves filtration, keeps the filter media porous, provides substrate for biofilm to form and takes up some nutrients and pollutants. The filter media should be deep enough to support vegetation.	Filter media area = refer to Deemed to Comply Solution Appendix D Filter media depth = 600 mm - 1,000 mm (minimum depth of 400 mm) Filter media must meet the relevant specification provided by the Facility for Advancing Biofiltration (FAWB) and the *WSUD Construction and Establishment Guidelines*.
Transition and drainage layers	Under the filter media, a 'transition layer' of coarse sand is used to prevent the filter media moving into the drainage layer and the perforated under-drains. The transition layer is typically 100 mm deep. The 'drainage layer' is made up of fine aggregate (2–4 mm) and is typically 200 mm deep. The drainage layer collects treated water from the base of the bioretention system and delivers it into the perforated under-drains.	Transition layer depth = 100mm Drainage layer depth = 200 mm (min) Drainage layer and base of bioretention system graded at 0.5% slope to overflow weir. Drainage pipes are required to be the slotted and rigid type, spaced 1.5m apart and not covered in any type of fabric.
Filter media surface level (minimum elevation above receiving drainage or waterway)	The surface of the bioretention system (top of filter media) must be suitably high enough to ensure free drainage of the system to the receiving drainage system or waterway (>1,000 mm).	Surface level of system must be >1,000 mm above the invert or ponded water level within the receiving drainage system or waterway. Ground survey of the invert and ponded water level is required to define the minimum bioretention surface level.
Outlet pipe	The outlet pipe conveys water from the outlet pit, base of the bioretention system, to the receiving waterway or drainage system. The levels on the pipe must ensure free drainage of the bioretention system to the receiving system.	The invert of the outlet pipe should be: - upstream end - at or below the base of the drainage layer - downstream end - preferably 300 mm above waterway invert of 50 mm above drainage pipe - pipe must have at least 0.5% grade Refer to Figure B-4 for design level and grade requirements.
Extended detention	When stormwater enters the bioretention system, it temporarily ponds over the surface of the filter media. This ponding depth, or the 'extended detention', is created by raised field inlet pits (overflow pits).	Extended detention depth = 300 mm (200 mm minimum)

DESIGN ELEMENT	FUNCTION	DESIGN REQUIREMENT
Overflow Pit	The crest of the pit defined the top of extended detention. During storm events, flows enter the overflow pit and discharged via the pipe system to the receiving drainage system or waterway. The overflow pit also receives treated flow from the base of the bioretention system.	Pit crest = 300 mm above filter media surface (200 mm minimum) Pit size = convey the minor storm event (or major storm if required) Pit invert must be at or below the base of the bioretention system.
Overflow weir (optional)	Where required, an overflow weir is provided to convey the major storm event.	Weir sized = convey the major storm event
Bund or Embankment Levels	The bunds and embankments hold stormwater in the bioretention system during both small rainfall event and large stormwater events. The bund/embankment level needs to be suitably high enough to ensure the required design storm flows can enter the overflow pit or overflow weir.	Bund/Embankment Level = minimum 500mm above the overflow pit (300 mm minimum). For small-scale applications such as car parks, streets and allotments the level may be reduced provided there is a suitable flow path for stormwater to drain from the site.
Liner	Bioretention systems are lined with filter cloth or an impermeable liner depending on the surrounding soil and ground water conditions.	Default liner for bioretention systems adopted as part of Deemed to Comply Solutions is an impermeable liner. The proponent has the opportunity to adopt a filter cloth liner or no liner, however, this must be justified through soil and groundwater investigation (refer Section 6).
Vegetation	Vegetation in bioretention systems improves the treatment of stormwater by providing a substrate layer for biofilm growth, helping to transport oxygen to the soil and enhancing microbial communities that transform pollutants. The roots and movement of stems of the vegetation continuously break up the surface of the filter media, which prevents the surface from clogging.	Vegetation specification will differ across Queensland and should occur in consultation with the local authority and an ecologist or landscape architect. The *WSUD Technical Guidelines for South East Queensland* provides some guidance on plant selection.
Bioretention System With Saturated Zone		
Saturated Zone below drainage layer	The saturated zone is located below the drainage layer of the bioretention and holds water permanently.	Depth = 400 mm to 500 mm Media can be coarse sand, gravel, coarse gravel and must contain 2% by volume fine straw (or similar) and 4% by volume hard wood chips
Liner	Considering the saturated zone holds water the liner must be impermeable.	Impermeable liner

DESIGN ELEMENT	FUNCTION	DESIGN REQUIREMENT
Bioretention System With Saturated Zone		
Filter media surface level (minimum elevation above receiving drainage or waterway)	Adopting a saturated zone in a bioretention system allows the depth of the filter media to be reduced to typically 500-600 mm depth (minimum 400mm) and same level of ponding can occur in the drainage layer. This means the elevation of the bioretention surface to the receiving drainage system or waterway can be reduced to 800mm.	Surface level of system must be >800 mm above the invert or ponded water level within the receiving drainage system or waterway. Ground survey of the invert and ponded water level is required to define the minimum bioretention surface level. Refer to Figure B-4 for design level and grade requirements.
Coarse Sediment Management		
Design and construction of bioretention systems must allow for capture of coarse sediment in a manner that allows easy infrequent maintenance: - For small bioretention systems (<20 m^2) that receive no road or car park runoff, no management of coarse sediment is required. - For bioretention systems that receive road or car park runoff (or other impervious areas which generate high coarse sediment loads), a coarse sediment forebay with easy access for infrequent cleaning, (such as once every 1–2 years), using standard equipment (by hand, sucker truck, bobcat or excavator) is required - Gross pollutant traps can be used upstream of bioretention systems where space is constrained, if the owner (Council or private allotment owner) agrees to regular maintenance (i.e. monthly cleanout) and the drainage levels to the bioretention system allow incorporation of the gross pollutant trap.		Coarse sediment forebay designed in accordance with *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

Constructed wetlands

Natural wetlands are places in the landscape that are inundated with water for all, or at least part, of the year. The plants that grow in natural wetlands adapt so they can survive inundation or wet and dry cycles. The capacity of wetlands to absorb pollutants led wetlands to be artificially constructed to improve the quality of stormwater in urban environments. Constructed wetlands are used as biological filters that bring together a range of processes, both physical and chemical, to improve the quality of stormwater.

Constructed wetlands consist of an inlet zone, a sediment basin to remove coarse sediments, a macrophyte zone[6] and a high-flow bypass channel to protect the macrophyte zone from scour and vegetation damage. Figure B-5 shows the key elements of a constructed wetland system. Further description of the elements of constructed wetland systems is provided in *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

6 A permanently ponded, shallow, heavily vegetated area that removes fine particulates and takes up soluble pollutants

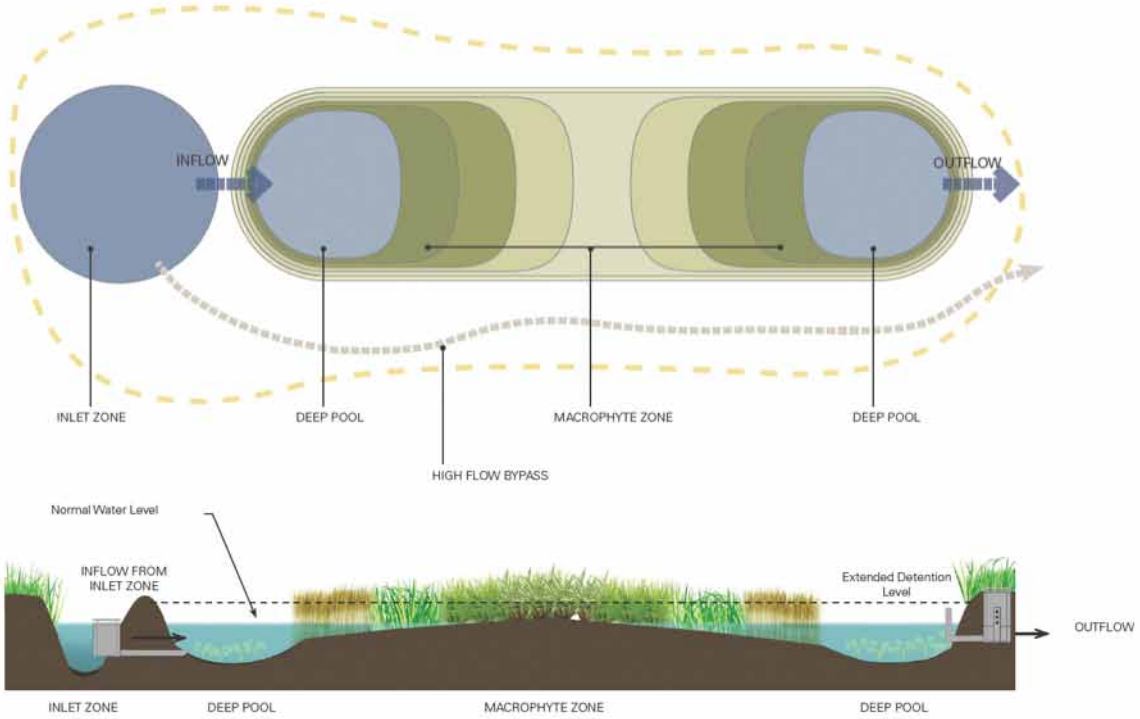

Figure B-5: Typical components of a constructed wetland (source: *Fundamentals of Constructed Wetlands Training Course Notes*)

Table B-2 summarises the design requirements for constructed wetlands, which must be satisfied to ensure long-term function. Compliance with these design requirements must be illustrated as part of the Deemed to Comply Solution selection and design process (Section 6).

Table B-2: Constructed Wetland Design Requirements

DESIGN ELEMENT	FUNCTION	DESIGN REQUIREMENT
Macrophyte Zone Area	Predominantly wet marsh zone (80% +) with some ephemeral zones and open water. Uses a combination of physical, chemical and biological processes to intercept and retain/process fine sediment and associated particulate nutrients and heavy metals, soluble nutrients, and pathogens.	Macrophyte zone area = refer to Deemed to Comply Solution Appendix D
Macrophyte Zone depths	Depths through the macrophyte zone must support plant coverage of greater then 80% of the surface area. This means depths must 0.5m or less for 80% of the surface area. The bathymetry of the macrophyte zone should be designed to promote a sequence of ephemeral, shallow marsh, marsh and deep marsh zones in addition to small open water zones.	Depths = 0.5m deep or less for 80% of the surface area with a mix of depths preferred. Profiling = Base on macrophyte zone to slope at 2% grade or greater (no benches) Refer *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).
Extended detention	During storm events, stormwater fills the extended detention storage of the macrophyte zone (i.e. above the plants) and then drains following cessation of rainfall.	Extended detention depth = 0.5 m
Notional detention time	The time taken for water to pass through the wetland.	Notional detention time = 36hrs to 48hrs (preferably 48hrs)
Macrophyte Zone Outlet	Controls the flow through the wetland to ensure the notional detention time is achieved at all depths.	Riser pipe or plate design to support 0.5 m extended detention depth and notional detention time of 36hrs to 48hr (preferably 48hrs)
Macrophyte Zone water level (minimum elevation above receiving drainage or waterway)	The water level within the macrophyte zone of the wetland must be suitably high enough to ensure free drainage of the wetland to the receiving drainage system or waterway.	Water level of the wetland must be >500 mm above the invert or ponded water level within the receiving drainage system or waterway. Ground survey of the invert and ponded water level is required to define the minimum wetland water level.
Bunds or Embankments	The bunds and embankments hold stormwater in the constructed wetland during both small rainfall event and large stormwater events. The bund/embankment level need to suitably high enough to ensure the required design storm flows can enter the overflow pit or overflow weir.	Bund/Embankment Level = minimum 500mm above the top of extended detention (preferably 1,000 mm above standing water level) For small-scale applications such as car parks, streets and allotments the level may be reduced provided there is a suitable flow path for stormwater to drain from the site.

DESIGN ELEMENT	FUNCTION	DESIGN REQUIREMENT
Liner	The macrophyte zone is required to retain water permanently and therefore the base must be of suitable material to retain water (e.g. clay). If in-situ soils are unsuitable for water retention, a clay liner (e.g. compacted 300 mm thick) must be used to ensure there will be permanent water for vegetation and habitat.	Default liner for constructed wetland adopted as part of Deemed to Comply Solutions is a 300 mm clay liner. Soil investigation (refer Section 6) is required to confirm in-situ soils are suitable for holding water and the removal of the clay liner.
Topsoil	The provision of suitable topsoil in wetlands is crucial to successful macrophyte establishment and to the long-term functional performance of the wetland.	Topsoil depth = 300 mm. Design levels for the wetland are INCLUSIVE of topsoil, such that an additional 300 mm of excavation will be required. Topsoil must meet AS 4419 – *Soils for landscaping and garden use*.
Vegetation	Vegetation in wetlands improves the treatment of stormwater by providing a substrate layer for biofilm growth, helping to transport oxygen to the soil and enhancing microbial communities that transform pollutants. The roots and movement of stems of the vegetation continuously break up the surface of the filter media, which prevents the surface from clogging.	Vegetation specification will differ across Queensland and should occur in consultation with the local authority and an ecologist or landscape architect. The *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design) provides some guidance on plant selection.
Coarse Sediment Management (Inlet Zone)		
Design and construction of constructed wetlands must allow for capture of coarse sediment in a manner that allows easy infrequent maintenance. For constructed wetlands the following applies: - An inlet zone must be incorporated into the wetland design to capture coarse sediment prior to flows entering the macrophyte zone. The inlet zone must be designed in accordance with the *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design). - Gross pollutant traps can be used upstream in the place of an inlet pond where space is constrained, if the owner/manager agrees to regular maintenance (i.e. monthly cleanout) and the drainage levels to the constructed wetland allow incorporation of the gross pollutant trap.		Coarse sediment forebay designed in accordance with *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).
High Flow Bypass		
Conveys flood flows (above 1yr ARI) away from the macrophyte zone providing protection to the wetland plants (macrophytes) and preventing scouring of the bed sediments in the macrophyte zone. For the Deemed to Comply Solutions, the high flow bypass must be achieved via bypass weir (incorporated into the inlet zone) and vegetated bypass channel. The vegetated bypass channel provides additional removal of sediment while stormwater bypasses the macrophyte zone. Alternative approaches to bypass high flows, such as pipe and pit diversion structures or alternative overland flow paths, can be considered and must be clearly located on conceptual design drawings. If alternative bypass approaches are to be adopted then suitable pre-treatment of flows into the wetland must be provided (preferably vegetated swale) focusing on TSS removal.		High flow bypass weir and vegetated channel designed in accordance with *Water Sensitive Urban Design Technical Design Guidelines* (Water by Design).

APPENDIX C - Reporting Tables/ Development Assessment Checklist

Development Assessment Checklist
Summary of Development and Deemed to Comply Solution

DEVELOPMENT ADDRESS
Development application ID
Project name
Applicant's name
Street address
Suburb
Postcode
Local Government Area
Climatic region

DEVELOPMENT TYPE & DETAILS
Development type (e.g. residential detached dwellings)
Number of dwellings/buildings
Site area (m^2)
Roof area (m^2) (for detached dwellings typical roof area per dwelling m^2/dwelling)

DEEMED TO COMPLY SOLUTION
Deemed to Comply Solution ID
Rainwater tank volume (kL) (for detached dwellings tank volume per dwelling kL/dwelling)
Bioretention area* (m^2)
Constructed wetland area** (m^2)
Total footprint of bioretention or wetland system(s) (m^2)

* Refers to the bioretention system filter media area
** Refers to the constructed wetland macrophyte zone area

Development Assessment Checklist **Steps 1 to 3**

STEP 1: DEVELOPMENT LOCATION AND CLIMATE REGION
Project name
Street address
Suburb
Postcode
Local Government Area
Climatic region (Figure 2 and A-2, Appendix A)

STEP 2: DETERMINE DEVELOPMENT TYPE
Development type (e.g. residential detached dwellings)
Number of dwellings/buildings
Site area (m^2)

STEP 3: DEFINE SITE DETAILS
Site Details Plan (scaled annotated)
Plan ID
Existing topography (Yes/No)
Existing drainage characteristics upstream, within, and downstream of site (including catchment areas)
Proposed discharge points and the downstream drainage size and invert levels (or ponded water levels) (Yes/No)
Existing vegetation and vegetation to be retained (Yes/No)
Soil evaluation in accordance with AS/NZS 1547:2000 Clause 4.1.3 if necessary (Yes/No)
General comments (where required)
Topography:
Drainage:
Vegetation:

Development Assessment Checklist **Step 4**

STEP 4: OUTLINE DEVELOPMENT DETAILS
Development area (m^2)
Private land
Roof area (m^2) (for detached dwellings typical roof area per dwelling m^2/dwelling)
Road reserve, driveway or parking (m^2)
Pavement area (m^2) *
Easements (services or drainage) (m^2)
Landscape area (m^2)
Other areas (m^2)
Area available for stormwater treatment (may be part of landscape area) (m^2) *
Public land (ultimately owned by local authority)
Road reserve (m^2)
Parkland (m^2)
Easement (services or drainage) (m^2)
Other areas (m^2)
Space available for stormwater treatment (may be part of landscape area)* (m^2)
Development Details Plan (scaled annotated plan)
Plan ID
Development layout clearly depicted with land type areas (Yes/No)
Catchment areas defined with ID (Yes/No)
Conceptual earthworks provided including finished levels (Yes/No)
Conceptual drainage layout and inverts levels (Yes/No)
Existing/proposed infrastructure layout and invert levels (required to demonstrate no conflict with treatment measures)** (Yes/No).

General comments

* Designers should consult with the project landscape architect to check which landscape areas are available for stormwater treatment. Assessment authority standards should also be checked to ensure areas proposed for treatment will not be required to feature incompatible plantings (e.g. large trees).

** Infrastructure may include (sewer, power, water, gas etc). Any infrastructure which may impact on location or drainage of treatment measures should be considered. External infrastructure which has the potential to influence location or drainage of treatment measures should also be shown.

Development Assessment Checklist **Step 5**

STEP 5: CONFIRM RAINWATER TANK REQUIREMENTS *(QUEENSLAND DEVELOPMENT CODE)*					
Are rainwater tanks to be installed (Yes/No)?					
Roof area draining to tank (m^2 or m^2 per dwelling)					
Total rainwater tank volume (kL or kL per dwelling)					
Connections (i.e. toilets, external, washing machine, pool)					
Overflow from the rainwater tanks to be directed to stormwater treatment measures* (Yes/No)?					
Rainwater tanks per catchment	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5
Number of tanks per catchment					
Roof area draining to tank (m^2 or m^2 per dwelling)					
Tank volume (kL or kL per dwelling)					
Confirm location of rainwater tanks on the scaled annotated plan (Yes/No)					
Comments:					

Development Assessment Checklist **Step 6**

STEP 6: SELECT DEEMED TO COMPLY SOLUTION					
	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5
Selected Deemed to Comply Solution (include ID and full name)					
Bioretention system area (% of catchment area) **					
Constructed wetland area (% of catchment area)***					
Comments:					

* Compliance with the Deemed to Comply Solutions requires all overflow from the rainwater tanks to be directed to stormwater treatment measures.
** Refers to the bioretention system filter media area.
*** Refers to the constructed wetland macrophyte zone area.

Development Assessment Checklist **Step 7**

STEP 7: DESIGN STORMWATER TREATMENT MEASURES					
	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5
Catchment area (m^2)					
Location of treatment measure (public/private)					
Bioretention system					
Filter media area (% of catchment area)					
Filter media area (m^2) • required • provided in concept					
Total footprint* (m^2)					
Media depth (m) • filter media • transition layer • drainage layer					
Extended detention (m above surface level)					
Coarse sediment management					
Coarse sediment management area (m^2)					
Constructed wetland					
Macrophyte zone area (% of catchment area)					
Macrophyte zone area (m^2)					
Coarse sediment management					
Coarse sediment management area (m^2)					
High flow bypass method					
High flow bypass area (m^2)					
Total footprint* (m^2)					
Conceptual design drawings of any pipe and pit diversion structures or alternative high flow bypass flow paths					

* Total footprint to include all relevant design requirements including batters, high flow bypass, sediment forebay etc

	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5
Conceptual design levels (m AHD) – These sections apply to both bioretention systems and wetlands.					
Inlet type • upstream invert level • downstream invert level					
Receiving drainage invert or ponded water level					
Outlet pipe level • upstream invert level • downstream invert level					
Surface or water level					
Extended detention level (pit crest level)					
Minimum bund/embankment level					
Checks • Inlet at or above surface or water level? • Outlet pipe DSIL above receiving drainage? • Bund level minimum 150mm above extended detention level?					
Comments					

	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5
Conceptual Plan and Section – Checklist (mark with ✓ to indicate item has been shown on drawings)					
Conceptual Plan (scaled and annotated plan view drawing)					
Drawing ID					
Inflow drainage arrangement					
Outlet pits and pipes					
Treatment areas (filter media and/ or macrophyte zone)					
Coarse sediment management					
High flow bypass					
Batters and embankments					
Functional and surrounding ground levels					
Conceptual Section (scaled and annotated section view drawing)					
Drawing ID					
Conceptual design levels					
Surround earthworks levels					
Inflow and outlet pits and pipes					
Coarse sediment management					
Extended detention (crest or pit)					
Batters and embankments					
Media depths (bioretention only)					

Designer

Signed by Designer: .....

Print name: .....

Date: .....

Development Assessment Officer

Signed by officer: .....

Print name: .....

Date: .....

APPENDIX D1- Deemed to Comply Solutions for residential development greater than 2 lots but only up to 20 lots

Appendix D1 provides the Deemed to Comply Solutions associated with 'residential development greater than 2 lots but only up to 20 lots'. The Solutions are listed in the table below with the subsequent pages providing the specific details for each solution including:

- **Rainwater tank requirements** – Where required by the Queensland Development Code, the minimum size of rainwater tank is provided.
- **Stormwater treatment measure size** – Bioretention system filter media area or constructed wetland macrophyte zone area required to meet the stormwater quality objectives for each climatic region in Queensland. The sizes are presented as a percentage (%) of the catchment area.

DEVELOPMENT TYPE	WATER CONSERVATION (TANKS)	STORMWATER TREATMENT	LOCATION OF STORMWATER TREATMENT (Public and/or private land)	DEEMED TO COMPLY ID
Residential development greater than 2 lots but only up to 20 lots	Tanks	Bioretention	Public, Private and Public	R1
	No Tanks	Bioretention	Public, Private and Public	R2
	Tanks	Constructed Wetland	Public, Private and Public	R3
	No Tanks	Constructed Wetland	Public, Private and Public	R4

Deemed to Comply Solution R1 – utilising rainwater tank(s) and bioretention systems(s)

R1

Deemed to Comply Solution R1 only applies to residential development greater than 2 lots but only up to 20 lots.

REGION	RAINWATER TANKS	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	Detached dwellings 5kL	
- Greater Brisbane	Attached dwellings 3kL	1.1 %
- North Coast		1.4 %
- West Region		0.9 %
- South Coast		1.3 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes.

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. **The total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems can be placed in the following locations:

- Public Land – Runoff from allotments and road can be treated in bioretention systems located on land that will ultimately be dedicated to the local authority as public land (i.e. road reserve, drainage reserve or parkland)
- Public and Private Land – Runoff from the road must be treated in bioretention systems located on public land (road reserve, drainage reserve or parkland). Runoff from private allotments can be treated in bioretention systems located within the private allotments.

Final selection of location will depend on site and development conditions and discussions with assessment authority.

Deemed to Comply Solution R2 – utilising bioretention system(s) only

R2

Deemed to Comply Solution R2 only applies to residential development greater than 2 lots but only up to 20 lots.

REGION	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	1.5 %
- North Coast	2.1 %
- West Region	1.3 %
- South Coast	1.8 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. The **total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems can be placed in the following locations:

- Public Land – Runoff from allotments can be treated in bioretention systems located on land that will ultimately be dedicated to the local authority as public land (i.e. road reserve, drainage reserve or parkland)
- Public and Private Land – Runoff from the road must be treated in bioretention systems located on public land (road reserve or, drainage reserve parkland). Runoff from private allotments can be treated in bioretention systems located within the private allotments.

Final selection of location will depend on site and development conditions and discussions with assessment authority.

Deemed to Comply Solution R3 – utilising rainwater tank(s) and constructed wetland(s)

R3

Deemed to Comply Solution R3 only applies to residential development greater than 2 lots but only up to 20 lots.

REGION	RAINWATER TANKS	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland		
- Greater Brisbane		4 %
- North Coast		6 %
- West Region		3 %
- South Coast		5 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes.

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands can be placed in the following locations:

- Public Land – Runoff from allotments and road can be treated in constructed wetlands located on land that will ultimately be dedicated to the local authority as public land (i.e. road reserve, drainage reserve or parkland)
- Public and Private Land – Runoff from the road must be treated in constructed wetlands located on public land (road reserve, drainage reserve or parkland). Runoff from private allotments can be treated in constructed wetlands located within the private allotments.

Final selection of location will depend on site and development conditions and discussions with assessment authority.

Deemed to Comply Solution R4 – utilising constructed wetlands only

R4

Deemed to Comply Solution R4 only applies to residential development greater than 2 lots but only up to 20 lots.

REGION	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	6 %
- North Coast	8 %
- West Region	4 %
- South Coast	7 %

NOTES

Region - Refer to STEP 2 of Selection and Design Process of main document for schematic of climatic regions

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands can be placed in the following locations:

- Public Land – Runoff from allotments and road can be treated in constructed wetlands located on land that will ultimately be dedicated to the local authority as public land (i.e. road reserve, drainage reserve or parkland)
- Public and Private Land – Runoff from the road must be treated in constructed wetlands located on public land (road reserve, drainage reserve or parkland). Runoff from private allotments can be treated in constructed wetlands located within the private allotments.

Final selection of location will depend on site and development conditions and discussions with assessment authority.

APPENDIX D2 - Deemed to Comply Solution for residential development greater than 2 dwellings (townhouse style up to 2 storeys) but ⩽ 12,500m^2 in site area

Appendix D2 provides the Deemed to Comply Solutions associated with 'residential greater than 2 dwellings (townhouse style up to 2 storeys) but ≤12,500m^2 in site area'. The Deemed to Comply Solutions are listed in the table below with the subsequent pages providing the specific details for each solution including:

- **Rainwater tank requirements** – Where required by the Queensland Development Code, the minimum size of rainwater tank is provided.
- **Stormwater treatment measure size** – Bioretention system filter media area or constructed wetland macrophyte zone area required to meet the stormwater quality objectives for each climatic region in Queensland. The sizes are presented as a percentage (%) of the catchment area.

DEVELOPMENT TYPE	WATER CONSERVATION (TANKS)	STORMWATER TREATMENT	LOCATION OF STORMWATER TREATMENT	DEEMED TO COMPLY ID
Residential greater than 2 dwellings (Townhouse style up to 2 storeys) but ≤ 12,500m^2 in site area	Tanks	Bioretention	Private	R5
	No Tanks	Bioretention	Private	R6
	Tanks	Constructed Wetland	Private	R7
	No Tanks	Constructed Wetland	Private	R8

Deemed to Comply Solution R5 – utilising rainwater tank(s) and bioretention system(s)

R5

Deemed to Comply Solution R5 only applies to residential development greater than 2 dwellings (townhouse style up to 2 storeys) but ≤12,500m^2 in site area.

REGION	RAINWATER TANKS	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	Detached dwellings 5kL	
- Greater Brisbane	Attached dwellings 3kL	1.1 %
- North Coast		1.7 %
- West Region		0.9 %
- South Coast		1.3 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes.

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. The **total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the bioretention system which could be handed to the local authority but this would require approval.

Deemed to Comply Solution R6 – utilising bioretention systems only

R6

Deemed to Comply Solution R6 only applies to residential development greater than 2 dwellings (townhouse style up to 2 storeys) but ≤12,500m^2 in site area.

REGION	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	1.5 %
- North Coast	2.1 %
- West Region	1.3 %
- South Coast	1.8 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. The **total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the bioretention system which could be handed to the local authority but this would require approval.

Deemed to Comply Solution R7 – utilising rainwater tank(s) and constructed wetland(s)

R7

Deemed to Comply Solution R7 only applies to residential development greater than 2 dwellings (townhouse style up to 2 storeys) but ≤12,500m^2 in site area.

REGION	RAINWATER TANKS	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland	Detached dwellings 5kL	
- Greater Brisbane	Attached dwellings 3kL	4 %
- North Coast		6 %
- West Region		3 %
- South Coast		5 %

NOTES

Region - Refer to STEP 2 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes.

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the constructed wetland which could be handed to the local authority but this would require approval.

Deemed to Comply Solution R8 – utilising constructed wetland(s) only

R8

Deemed to Comply Solution R8 only applies to residential development greater than 2 dwellings (townhouse style up to 2 storeys) but ≤12,500m^2 in site area.

REGION	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	6 %
- North Coast	8 %
- West Region	4 %
- South Coast	7 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the constructed wetland which could be handed to the local authority but this would require approval.

APPENDIX D3 - Deemed to Comply Solution for residential development including high density multiple dwelling apartments (flats, high-rise etc.) but ⩽ 12,500m^2 in site area

Appendix D3 provides the Deemed to Comply Solutions associated with 'residential high density multiple dwelling apartments (flats, high rise etc) but ≤12,500m² in site area'. The Deemed to Comply Solutions are listed in the table below with the subsequent pages providing the specific details for each solution including:

- **Rainwater tank requirements** – Where required by the Queensland Development Code, the minimum size of rainwater tank is provided.
- **Stormwater treatment measure size** – Bioretention system filter media area or constructed wetland macrophyte zone area required to meet the stormwater quality objectives for each climatic region in Queensland. The sizes are presented as a percentage (%) of the catchment area.

DEVELOPMENT TYPE	WATER CONSERVATION (TANKS)	STORMWATER TREATMENT	LOCATION OF STORMWATER TREATMENT	DEEMED TO COMPLY ID
Residential high density multiple dwelling apartments (flats, high-rise etc) ≤ 12,500m² in site area	No Tanks	Bioretention	Private	R9
	No Tanks	Constructed Wetland	Private	R10

Note: May comprise commercial/retail in building. The Queensland Development Code MP 4.2 and 4.3 does not mandate rainwater tanks for flats/apartments so the Deemed to Comply Solution provided does not include rainwater tanks.

Deemed to Comply Solution R9 – utilising bioretention system(s) only

R9

Deemed to Comply Solution R9 only applies to residential high density multiple dwelling apartments (flats, high rise etc) but ≤12,500m^2 in site area.

REGION	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	1.5 %
- North Coast	2.1 %
- West Region	1.3 %
- South Coast	1.8 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank are not required by Queensland Development Code MP 4.2 and 4.3. If tanks are to be adopted to reduce the treatment size (bioretention or wetland) then these Solutions to not apply and a Stormwater Management Plan is to be submitted to the local authority.

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. The **total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the bioretention system which could be handed to the local authority but this would require approval.

Deemed to Comply Solution R10 – utilising constructed wetland(s) only

R10

Deemed to Comply Solution R10 only applies to residential high density multiple dwelling apartments (flats, high rise etc) but ≤12,500m^2 in site area.

REGION	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland	
- Greater Brisbane	6 %
- North Coast	8 %
- West Region	4 %
- South Coast	7 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank are not required by Queensland Development Code MP 4.2 and 4.3. If tanks are to be adopted to reduce the treatment size (bioretention or wetland) then these Solutions to not apply and a Stormwater Management Plan is to be submitted to the local authority.

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent completes develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands should remain on private land and be managed by the owners (body corporate). There exists an option to create a small parkland or drainage reserve for the constructed wetland which could be handed to the local authority but this would require approval.

APPENDIX D4 - Deemed to Comply Solutions for commercial and/or industrial development without new public road and ⩽ 12,500m^2 in site area

Appendix D4 provides the Deemed to Comply Solutions associated with 'commercial and/or industrial development without new public road and ≤12,500m^2 in site area'. The Solutions are listed in the table below with the subsequent pages providing the specific details for each solution including:

- **Rainwater tank requirements** – Where required by the Queensland Development Code, the minimum size of rainwater tank is provided.
- **Stormwater treatment measure size** – Bioretention system filter media area or constructed wetland macrophyte zone area required to meet the stormwater quality objectives for each climatic region in Queensland. The sizes are presented as a percentage (%) of the catchment area.

DEVELOPMENT TYPE	WATER CONSERVATION (TANKS)	STORMWATER TREATMENT	LOCATION OF STORMWATER TREATMENT	DEEMED TO COMPLY ID
Commercial and/or Industrial development without new public road and ≤ 12,500m^2 in site area	Tanks or No Tanks	Bioretention	Private	CI1
	Tanks or No Tanks	Constructed Wetland	Private	CI2

NOTE: Rainwater tanks required by Queensland Development Code for commercial result in essentially no reduction in treatment measure size. Therefore the Deemed to Comply Solutions apply the same treatment measure sizes irrespective of whether tanks are required by the Queensland Development Code.

Deemed to Comply Solution CI1 – with bioretention system(s) and with or without rainwater tank(s)

CI1

Deemed to Comply Solution CI1 only applies to commercial and/or industrial development without new public road and ≤12,500m^2 in site area.

REGION	RAINWATER TANKS	BIORETENTION SYSTEM FILTER MEDIA AREA (% of catchment area)
South East Queensland	1.5 kL per toilet	
- Greater Brisbane		1.6 %
- North Coast		2.2 %
- West Region		1.4 %
- South Coast		1.8 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes. Rainwater tanks required by Queensland Development Code result in essentially no reduction in treatment measure size.

Bioretention system filter media area refers to the functional flat portion of the bioretention system only and does not allow for coarse sediment capture and batters/bunds to surrounding ground levels. The **total bioretention footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for batters and coarse sediment as well as filter media area. Typically for small bioretention systems (<50m^2), the Total Footprint Area = 3 X Filter Media Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

Location on Public or Private Land - The bioretention systems should remain on private land and be managed by the owners (body corporate). In limited circumstances there exists an option to create a small parkland or drainage reserve for the bioretention system which could be handed to the local authority for management but this would require approval from the authority.

Deemed to Comply Solution CI2 – utilising constructed wetland(s) only

CI2

Deemed to Comply Solution CI2 only applies to commercial and/or industrial development without new public road and ≤12,500m^2 in site area.

REGION	RAINWATER TANKS	CONSTRUCTED WETLAND MACROPHYTE ZONE AREA (% of catchment area)
South East Queensland	1.5 kL per toilet	
- Greater Brisbane		7 %
- North Coast		9 %
- West Region		5 %
- South Coast		8 %

NOTES

Region - Refer to STEP 1 of Selection and Design Process of main document for schematic of climatic regions

Rainwater Tank requirements defined by Queensland Development Code MP 4.2 and 4.3. Refer to code to confirm tank sizes. Rainwater tanks required by Queensland Development Code result in essentially no reduction in treatment measure size.

Constructed wetland macrophyte area refers to the functional planted permanently wet portion of the wetland only and does not allow for the inlet zone, high flow bypass or batters/bunds to surrounding ground levels. The **total constructed wetland footprint area** must be defined as part of Selection and Design Process (STEP 7) to account for inlet zone, high flow bypass and batters as well as a vegetated macrophyte zone. Typically for small constructed wetlands (<200m^2), the Total Footprint Area = 3 X Macrophyte Zone Area. This should be used as a starting point for the design process and refined provided the proponent develops suitable detailed concept drawings as part of the Development Approval.

The constructed wetland sizes have included a vegetated high flow bypass to assist with total suspended solids removal. If the high flow bypass cannot be vegetated then this Solution does not apply.

Location on Public or Private Land - The constructed wetlands should remain on private land and be managed by the owners (body corporate). In limited circumstances there exists an option to create a small parkland or drainage reserve for the bioretention system which could be handed to the local authority for management but this would require approval from the authority.

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