Plant Selection for WSUD Systems in the Coastal Dry Tropics

Appendix A

Appendix A **A-2**

A.1 Introduction

This chapter provides guidance on selecting appropriate plant species for Water Sensitive Urban Design (WSUD) systems where the plants have a functional role in stormwater treatment and/ or erosion protection. Selecting suitable plant species is critical to the long term landscape amenity, functional performance and structural integrity of WSUD systems.

Due to the strong seasonal rainfall patterns in the Dry Tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities. The vegetation design to manage weed infestation takes on high importance and requires special consideration to achieve the following objectives:

- Maintain, throughout the year, a dense cover of the design vegetation to occupy habitat and avoid excessive colonisation by weeds.
- Manage potential weed ingress from edges by sustaining perennial littoral vegetation.
- In bioretention systems the vegetation must be able to tolerate long dry periods, periodic inundation and free draining sandy soils.
- Provision of irrigation to wetland littoral zones
- Provision of irrigation to bioretention systems designed without saturated zones.

Careful selection of plant species and by adopting suitably high planting densities can significantly reduce costs associated with weed management.

A list of recommended plant species for various WSUD systems, including appropriate planting densities, is provided in the following tables:

Table A-1 and **Table A-2**:

- Swales (incorporating Buffer Strips)
- Bioretention Swales
- Bioretention Basins

Table A-3 and **Table A-4**:

- Sedimentation Basins
- Wetlands

The plant species lists in Table A-1 and **Table A-2** are not exhaustive and other plants may be used provided their physiological and structural characteristics match the characteristics of the plant species listed in the tables.

Non-indigenous natives and exotics should only be considered when there is a specific landscape need and the species has the appropriate growth form and habit. If non-indigenous natives and exotics are chosen, careful consideration should be given to the potential impacts on downstream receiving ecosystems. Species (including natives) that have the potential to become invasive weeds should be avoided.

A.2 Swales (and Buffer Strips), Bioretention Swales and Bioretention Basins

A.2.1 Required Plant Characteristics

Planting for bioretention basin elements may consist of up to three vegetation types:

- Groundcovers for stormwater treatment and erosion protection
- Shrubbery for screening, glare reduction and character
- Trees for shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table A-1 and Table A-2 which outline plant species suitable for the Coastal Dry Tropics. The designer should also refer to any relevant local guidelines.

A.2.1.1 Groundcovers

The plant (groundcover) species listed in Table A-1 have been specifically selected, based on their life histories, physiological and structural characteristics, to meet the functional requirements of swales, buffer strips and bioretention systems (i.e. bioretention swales and bioretention basins). Bioretention systems must have filter media with a minimum depth of 400mm for groundcover plants to provide an adequate depth of aerobic soil for healthy root development.

Plant species selected for bioretention systems must be able to tolerate free draining sandy soils and be capable of withstanding long dry periods punctuated by short periods of temporary inundation. The addition of saturated zones in bioretention systems will help retain moisture during the dry season where supplemental irrigation is not provided. Suitable plants species are listed in Table A-1. Where irrigation of bioretention systems is provided, a more diverse range of species may be selected to achieve the desired landscape aesthetic provided they are tolerant of the filter media conditions and have the required features to fulfill the functional roles of the WSUD element. In general, the plant species in Table A-1 have the following features:

- They are able to tolerate short periods of inundation punctuated by longer dry periods. For bioretention systems these dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the Dry Tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture.
- They generally have spreading rather than clumped growth forms.
- They are perennial rather than annual.
- They have deep, fibrous root systems.
- Groundcover plants can be turf, prostrate or tufted.
- Prostrate species would typically be low mat forming stoloniferous or rhizomatous plants.
- Tufted species would typically be rhizomatous plants with simple vertical leaves

Most of the groundcovers listed in Table A-1 are widespread, occurring throughout the Coastal Dry Tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area and to compliment surrounding vegetation communities. Please refer to the local authority for further guidance in this regard.

A.2.1.2 Shrubs and Trees

Shrubs and trees are not a functional requirement within swales, bioretention swales or bioretention basins, but can be integrated to provide amenity, character and landscape value. Planting trees and shrubs in bioretention systems requires the filter media to have a minimum depth of 800mm to avoid root interference with the perforated subsurface drainage pipes. They must also be accompanied by densely planted shade tolerant groundcover species with the characteristics outlined above. Trees and shrubs are to be managed so that the ground cover layer is not out-competed. To avoid over-shading, trees and shrubs should be planted at low densities. Periodic thinning of the upper vegetation layers may also be required. In general, tree and shrub species that can be incorporated into bioretention systems have the following general features:

- Trees need to be able to tolerate short periods of inundation punctuated by longer dry periods. These dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the Dry Tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture.
- They need to have relatively sparse canopies to allow light penetration to support dense groundcover vegetation

- Have shallow root systems and root systems that are not known the be adventurous 'water seekers' to reduce the risk of root intrusion into subsurface drainage pipes
- Trees must not be deciduous
- Preferably native and occur naturally in the local area

The shrubs and trees listed in **Table A-2** are recommended as they display the above features.

Most of the shrub and tree species listed in **Table A-2** are widespread, occurring throughout the Coastal Dry Tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area and to compliment surrounding vegetation communities. Please refer to the local authority for further guidance in this regard.

A.2.2 Plant Species Selection

Well established uniform groundcover vegetation is crucial to the successful operation of swale and bioretention system treatment elements. As a result, plant species selection needs to consider both the aesthetic and functional requirements. The functional plant traits required for effective water treatment are different for different devices. For example:

- Swales – require plants with vigorous growth and a spreading habit to hold soil in place against flow. They should also be suited to growth in wet clay soils. Examples include turf grasses, tufted grasses and sedges.
- Bioretention Swales - require plants with vigorous growth and a spreading habit to hold soil in place agaisnt flow. They should be drought tolerant and suited to growth in sandy soils. Examples include turf grasses, tufted grasses and sedges.
- Bioretention Basins – plants should be drought tolerant and suited to growth in sandy soils. Examples include grasses, shrubs and trees. A diverse mix is recommended.

When selecting plant species from Table A-1, consideration must be given to the following factors:

- other WSUD objectives such as landscape, aesthetics, biodiversity, conservation and ecological value
- region, climate, soil type and other abiotic factors
- roughness of the channel (Manning's *n* roughness factor) (for swales)
- extended detention depth (for bioretention systems).

Typical heights of each plant species and comments relating to shade and salt tolerances and soil moisture requirements are provided in Table A-1 and will help with the selection process. The low growing and lawn species are suitable for swale elements that require a low hydraulic roughness. The treatment performance of bioretention systems, in particular, requires dense vegetation to a height equal to that of the extended detention depth. Therefore, a system with a 300 mm extended detention depth should have vegetation that will grow to at least 300 mm high. Turf is not considered to be suitable vegetation for bioretention basins. The stems do not grow high enough and the root structure of turf is not suitably robust to ensure the surface of the bioretention filter media is continuously broken up to prevent clogging.

Included in Table A-1 is a recommended planting density for each plant species. The groundcover planting densities should ensure that 70-80 % cover is achieved after two growing seasons (2 years) given adequate irrigation and weed control. High density planting to avoid weed ingress is particularly important in the Dry Tropics due to the climatic conditions which favour opportunistic (colonizing) seasonal weed species. High density planting also ensures runoff does not establish preferential flow paths around the plants and erode the swale/ bioretention surface. Dense vegetation is also required to ensure a uniform root zone, which is particularly important in bioretention systems.

If prostrate shrubs that form scrambling thickets are used (in place of or in conjunction with the plant species in Table A-1) they should be planted at high densities (8-10 plants/m^2) and may require pruning to ensure even plant cover and to maintain an even root distribution below ground.

A.2.3 Vegetation Establishment and Maintenance

Swales, buffer strips and bioretention basins are living systems and require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. In addition, specific requirements for plant stock sourcing, topsoil selection and testing and vegetation establishment, as detailed in the relevant WSUD element chapters, are necessary to maximise successful vegetation establishment and system treatment performance. Particular reference is made to the sections titled 'Landscape Design Notes', 'Maintenance Requirements' and 'Construction and Establishment' for guidance on vegetation establishment and maintenance procedures. The 'Construction and Establishment' section also details a staged implementation approach by which the functional elements of the WSUD system are protected from building site runoff and associated sedimentation, weeds and litter during the building phase.

Table A-1: Groundcover plant species list for swales (incorporating buffer strips), bioretention swales and bioretention basins

S Swale,
BS Bioretention Swale,
BB Bioretention Basin
Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density [1] (Qty/m^2)	Comments
Atriplex muelleri	Salt Bush	BB	Prostrate	100	2-3	Very common low prostrate mat in saline areas, silver foliage highly ornamental
Bacopa monnieri	Bacopa	BB	Prostrate	100	6-8	Not suitable for sandy soils with low water holding capacity, Native to region prostrate herb
Bothriochloa pertusa	Indian Couch	S, BS, BB	Turf		Seeded or rolled	Tolerates prolonged dry periods
Carex fascicularis	Tassel Sedge	S	Tufted	1000	6-8	Not suitable for sandy soils with low water holding capacity,
Carex polyantha	Creek Sedge	S	Tufted	To 900	6-8	Not suitable for sandy soils with low water holding capacity,
Cymbopogon refractus	Barbed Wire Grass	S	Tufted	300	8-10	Does not tolerate prolonged dry periods
Cyperus haspan	Haspan Flatsedge	S	Tufted	400	8	Suitable for, sandy soils, perennial, native to region
Cyperus javanicus		S	Tufted	1400	8	Suitable for, sandy soils, perennial, native to region
Cyperus polystachyos	Bunchy Sedge	S	Tufted	600	8	Suitable for both sand and clay soils, perennial, native to region, tolerates salinity
Cyperus scariosis#		S		900	8	Suitable for, sandy soils, perennial, native to region, tolerates salinity levels may suppress *Urochloa mutica* (para grass)
Dianella longifolia var. longifolia	Pale Flax-lily	S, BS, BB,	Tufted	300-800	8	Shade tolerant, native to region
Eragrostis elongata	Lavender Grass	S, BS, BB			8	Annual or weak perennial, best in rockeries and roadsides
Fimbristylis dichotoma		BS, BB	Tufted	750	8	Suitable for, sandy soils, perennial, native to region
Fimbristylis ferruginea	Rusty Finger Rush	BS, BB	Tufted	650 -800	8	Suitable for, sandy soils, perennial, native to region, salt tolerant
Fimbristylis tristachya		BS, BB	Tufted	600	8	Suitable for, sandy soils, perennial, native to region
Gahnia aspera	Saw Sedge	S	Tufted	1000	6	Not suitable for sandy soils, native to region, difficult to propagate

1 Planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs. S = Swale, BS = Bioretention Swale, BB= Bioretention Basin

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density [1] (Qty/m^2)	Comments
Gahnia sieberiana	Red-fruited Sword Sedge	S	Tufted	1500-3000	6	Aesthetic, difficult to propagate
Imperata cylindrical#	Blady grass	S, BS, BB	Tufted	500	8	Only use when it occurs in natural surroundings, native to region,
Juncus usitatus#	Common Rush	S, BS, BB	Tufted	500	8-10	Not suitable for sandy soils
Lomandra hystrix	Creek Matt Rush	S, BS, BB	Tufted	1000	6	Shade tolerant, native to region
Lomandra longifolia	Matt Rush	S, BS, BB	Tufted	500-1000	6	Shade tolerant, native to region
Paspalum distichum	Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Not suitable for sandy soils, native to region
Paspalum vaginatum cv 'Saltene'	Salt Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Salt tolerant, native to region
Platyzoma microphyllum	Fern	BB	Fern	150-500	8	Not suitable in areas expecting prolonged dry periods , Native to region
Eragrostis spartinoides	Love Grass	S, BS, BB	Grass	600	8	Native to region
Sporobolus virginicus	Marine Couch	S, BS, BB	Turf	To 400	Seeded or rolled	Salt tolerant, Native to region
Themeda triandra	Kangaroo Grass	S, BS, BB	Tufted	300-500	6-8	

Table A-2: Shrub and Tree plant species list for bioretention basins. Note: Trees not suitable for systems requiring flow conveyance (i.e swales and bioretention swales) due to shading reducing growth of ground cover.

Scientific Name	Common Name	Form	Height (m)	Planting Density [2] (Qty/m^2)	Comments
Breynia oblongifolia	False Coffee Bush	Shrub	1-2	2-4	Native to region
Corymbia tessellaris	Moreton Bay Ash	Tree	10-20		Suitable for sandy soils, native to region
Aidia racemosa		Shrub	10-15		Native to region, tolerates high winds
Atractocarpus fitzalanii	Ivory Curl Tree	Shrub	3-10		Native to region
Eugenia reinwardtiana	Cedar Bay Cherry	Tree	1-3		Native to region
Leptospermum polygalifolium	Wild May	Shrub	1-4	2-4	Sunny position, native to region
Myoporum acuminatum	Coastal Boobialla	Shrub	0.5-6	2-4	Sun or semi-shade, salt tolerant, native to region
Albizia canescens	Townsville Siris	Tree			Native to region, rare
Buckinghamia celsissima		Tree	20-30		Native to region

2 Planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

Scientific Name	Common Name	Form	Height (m)	Planting Density [2] (Qty/m^2)	Comments
Chionanthus ramiflorus	Native Olive	Tree	6-8		Native to region
Colubrina asiatica		Tree			Salt tolerant
Cupaniopsis anacaroides	Beach Tuckeroo	Tree	8-15		Suitable for sandy soils, native to region
Callistemon(Melaleuca) viminalis	Weeping Bottle Brush	Tree	5-10	<1	Requires moist soils during establishment but tolerates dry periods once established
Eucalyptus raveretiana	Black Ironbox	Tree			Tolerates high winds
Eucalyptus tereticornis	River Blue Gum	Tree	20-50m		Native to region
Ganophyllum falcatum		Tree	10-25		Native to region
Lophostemon grandiflorus		Tree	8-12		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca dealbata	Cloudy Tea Tree	Tree	5-15		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca fluviatilis		Tree			Native to region, tolerates high winds and periods of flooding, forms a root mat good for erosion cotrol
Mimusops elengi		Tree	10-15		Suitable for all soil types, native to region, tolerates high winds

A.3 Wetlands and Sedimentation Basins

Due to the strong seasonal rainfall patterns in the Dry Tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities such as wetlands and sediment basins. Therefore, the design and management of these systems to manage weed infestation takes on high importance. Management of weeds is achieved through the plant selection and landscape design as follows (see also Chapter 6):

- Planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season.
- Designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5m - 0.7m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities.

During the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

A.3.1 Required Plant Characteristics

Planting for wetlands and sedimentation basins may consist of two vegetation types:

- Macrophytes and groundcovers for stormwater treatment, erosion protection and weed management. The macrophytes are divided further into several different zones as outlined in Table A-3.
- Shrubbery and trees for screening, shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table A-3 and Table A-4 which outline plant species suitable for the Coastal Dry Tropics. The designer should also refer to any relevant local guidelines.

A.3.1.1 Macrophytes and Groundcovers

The plant species listed in Table A-3 have been specifically selected based on their life histories and physiological and structural characteristics, to meet the functional requirements of wetland systems. Plant species suitable for wetlands will also be suitable for edge planting around sedimentation basins. The following sections address wetlands specifically as they have very defined vegetation requirements for stormwater treatment. This includes consideration of the wetland zone/ depth range, typical extended detention time (typically 48 hrs) and extended detention depth (typically 0.5 m).

Other species can be used to supplement the core species listed in Table A-3 provided they have the required features to fulfill the functional roles of the wetland zone. Careful consideration of the water depth range and wetland hydrological regime (water depth and inundation period) is also required to assess the suitability of alternate species for constructed wetlands. Wetland plants in the dry tropics must be able to tolerate large water level variations and dry periods of up to 60 days. Short growing emergent macrophytes will not be suitable for the deep marsh zone as they will become over inundated. As a guide, emergent macrophytes require 1/3 of their foliage to extend above the water level 80% of the time. However, during the plant establishment phase emergent macrophytes require 50% of their foliage above the water level.

In general, the species in Table A-3 have the following features:

- They grow in water as either submerged or emergent macrophytes, or they grow adjacent to water and tolerate periods of inundation (typically sedge, rush or reed species).
- They generally have spreading rather than clumped growth forms.
- They are perennial rather than annual.
- They generally have rhizomatous growth forms.
- They have fibrous root systems.
- They are generally erect species with simple vertical leaves (e.g. *Juncus spp, Baumea spp*).

A.3.1.2 Shrubs and Trees

Shrubs and trees are not a required element of wetlands or sedimentation basins but can be integrated to provide amenity, character and landscape value. Shrubs and trees (generally only planted in the littoral zones) should be accompanied by dense shade tolerant groundcover species as an understorey to occupy habitat and provide a weed ingress barrier. **Table A-4** provides a list of shrubs and trees that are natives to the Coastal Dry Tropics and are suitable for planting in the littoral zone (i.e. on the batters) around wetlands and sedimentation basins.

Littoral zone vegetation is primarily for weed management (to avoid weed ingress into the macrophyte zone), batter stabilisation, aesthetics and to restrict public access, rather than for stormwater treatment. For this reason, species that do not have all of the above structural features, but fulfill the primary littoral zone requirements (e.g. weed management and erosion protection) and landscape objectives may still be acceptable for inclusion in this zone (refer to the 'Landscape Design Notes' section in the relevant WSUD chapter).

A.3.2 Plant Species Selection

Plant species listed in Table A-3 are recommended as core species for wetland planting. These plant species have been grouped into a wetland macrophyte zone according to their preferred water depth and the hydrologic conditions of the zone. The perennial wetland plants must be able to tolerate large water level variations and periodic drying (potentially of up to 60 days duration). In general, the deep marsh emergent macrophytes must be capable of a standing water level of 0.5 m – 0.7 m punctuated with short episodes of extended detention (up to 1.2 m in total water depth) and seasonal drying.

While individual plant species can have very specific water depth requirements other species can be quite adaptive to growing across various zones over time. It is however, recommended that the suggested zones and plant groups are adhered to for planting purposes. Plant species listed against the shallow marsh and lower batters are only suited for edge planting in wetlands and sedimentation basins. Planting densities recommended should ensure that 70-80 % cover is achieved after two growing seasons (2 years). This is particularly important for weed management and therefore the recommended planting densities should not be reduced.

Suitable plant species for the littoral zone that surrounds wetlands and sedimentation basins have also been recommended in Table A-3. The littoral zone relates to the berms, batters or embankments around the systems. Plants that have a drier habit should be planted towards the top of batters, whereas those that are adapted to more moist conditions should be planted closer to the water line. High density planting of the littoral zone is required to provide a barrier (by occupying habitat) to prevent weed ingress into the wetland or sediment basin.

A.3.3 Vegetation Establishment and Maintenance

To maximise the success of plant establishment in wetland macrophyte zones specific procedures are required in site preparation, stock sourcing, vegetation establishment and maintenance. Reference is to be made to procedures detailed in 'Landscape Design Notes' Chapter 6 as follows:

- Sourcing plant stock (6.5.3)
  - Lead times for ordering plants
  - Recommended planting systems/ products
- Topsoil specification and preparation 6.5.4)
  - Sourcing, testing and amendment
  - Top soil treatments (e.g. gypsum, lime, fertiliser)
- Vegetation establishment (6.5.5)
  - Weed control
  - Watering
  - Water level manipulation

Constructed wetlands are living systems and they require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. Reference must also be made to the sections titled 'Maintenance Requirements' (Section 6.6) and 'Construction and Establishment' (Section 6.5) for guidance on maintenance procedures and vegetation establishment.

Similarly, the vegetation planted in sedimentation basins require an equivalent vegetation establishment period (i.e. 2 years) and level of attention to site preparation, stock sourcing, vegetation establishment and maintenance to ensure success. Reference must be made to the sections entitled 'Landscape Design Notes', 'Maintenance Requirements' and 'Construction and Establishment' in Chapter 4.

A.3.4 Vegetation Selection for Mosquito Management

Species selected should have a stiff, thin, upright growth habit. This allows mosquito predators to access all wet areas and control mosquito larvae. Species with a spreading habit such as turf grasses or wide strappy leaves such as *Typha* can isolate pockets of water where mosquitoes can breed and avoid predation.

Table A-3: Macrophyte and Groundcover Plant Species List for Wetlands and Sedimentation Basins

Key to Table A-3:

Zone		Depth*(m)	Form	
P	Permanent Pool	2.0– 0.7	S	Submerged macrophyte
DM	Deep Marsh	0.7 – 0.35	E	Emergent macrophyte
SM	Shallow Marsh	0.35 – 0	Am	Amphibious
LB	Lower Batters	0 – +0.5**	A	Annual Groundcover
UB	Upper Batters	+0.5- +1.0**	Sh	Shrub
			Tr	Trees

* 'Depth' refers to depth below permanent pool water level

** '+' denotes levels above permanent pool water level

\# Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal.

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density [3] (Qty/m^2)	Comments
Isolepis inundata	Swamp Club-rush	SM	Emergent Macrophyte		To 300	6-8	High surface area; rapid growth
Oryza australiensis	Native Rice	SM	Emergent Grass	Perennial	2500		Attracts birds, native to region
Actinoscirpus grossus		DM	Emergent	Perennial	3000	6	Suitable for clay soils
Baumea articulataarticulate#	Jointed Twig-rush	DM	Emergent	Perennial	1000-2000	6-8	Slow growth, plant solo
Eleocharis sphacelata#	Tall Spike-rush	DM	Emergent	Perennial	500-2000	6-8	Plant solo, rhizomes can restrict growth of other plants; slow establishment, flow resistant,
Leersia hexandra	Swamp Ricegrass	DM	Emergent	Perennial	2000	6	Tolerates periods of flooding, fire resistant
Lepironia articulataarticulate#	Grey Rush	DM	Emergent	Perennial	600-2300	4-6	Tall grey sedge from Hidden Valley, very ornamental, popular in wetland plantings
Phragmites australis#	Common Reed	DM	Emergent	Perennial	5000	6	Native to region, forms dense swards
Phragmites karka (vallatoria)#	Spiny MudgrassTropical Reed	DM	Emergent	Perennial	1000-2000	6	Native to region
Schoenoplectus litoralis	Shore Club-rush	DM	Emergent	Perennial	600-1500	4-6	Tolerates salinity
Schoenoplectus validus #	River Club-rush	DM	Emergent	Perennial	600-1600	4-6	
Scleria poiformis		DM	Emergent	Perennial	2200	6	Requires irrigation
Thoracostachyum sumatran	Sedge	DM	Emergent	Perennial	2500	6	
Eleocharis dulcis#	Water Chestnut	DM & SM	Emergent	Perennial	1000-1500	4-6	Plant solo, flow resistant

3 Planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density [3] (Qty/m^2)	Comments
Oryza australiensis	Native Rice	DM & SM	Emergent	Perennial	2500	6	Attracts birds, native to region
Carex polyantha#	Creek Sedge	LB	Emergent Macrophyte	Perennial	To 900	6-8	
Cyperus digitatus	Sedge	LB	Amphibious Sedge	Wet Season Annual	500-1500	8	
Cyperus iria	Rice Flat Sedge	LB	Amphibious Sedge	Wet Season Annual	600	8	Tufted growth
Cyperus tenuispica		LB	Amphibious Sedge	Wet Season Annual	400	8	Suitable for sand and clay solids
Fimbristylis littoralis	Fimbry	LB	Amphibious Sedge	Wet Season Annual		8	Native to region
Juncus pristmatocarpus	Branching Rush	LB	Emergent Macrophyte	Perennial	300-600	6-8	
Phyla nodiflora		LB	Herb	Perennial	200		Native to region
Schoenoplectus lateriflorus		LB	Amphibious Sedge	Wet Season Annual	700	8	
Schoenoplectus praelongatus		LB	Amphibious Sedge	Wet Season Annual	350	8	
Ceratophyllum demersum	Hornwort	P	Submerged	Perennial	600		Native to region
Myriophyllum dicoccum	Water Milfoil	P	Submerged	Perennial or Annual	To 200	1	
Myriophyllum filiforme	Water Milfoil	P	Emergent Aquatic Herb	Dry Season Annual	150	1	
Myriophyllum verrucosum	Red Water-milfoil	P	Submerged	Perennial	100-1500	1	Native to region
Najas tenuifolia	Water Nymph	P	Submerged	Perennial	500	1	
Potamogeton crispus	Curly Pondweed	P	Submerged	Perennial	To 4500	1	Growth can be dense, native to region
Potamogeton octandrus	Pondweed	P	Submerged	Perennial	To 4500	1	
Potamogeton tricarinatus	Pondweed	P	Submerged	Perennial		1	
Vallisneria gigantea	Ribbonweed	P	Submerged	Perennial	To 3000	1	Rapid growth; salt tolerant (1500 ppm),
Vallisneria nana	Ribbonweed	P	Submerged	Perennial	700	1	Native to region
Ischaemum australe	Zipper Grass	SM	Amphibious Grass	Perennial	1500	6	Forms dense swards
Ischaemum rugosum		SM	Amphibious Grass	Perennial	1200	6	Native to region
Schoenoplectus mucronatus#	Club Rush	SM		Perennial	0.35-1.0m	8	Native to region
Cyperus scariosis	Sedge	SM & LB	Amphibious Sedge	Perennial	800	8	Native to region, salt tolerant
Fimbristylis dichotoma#		SM & LB	Amphibious Sedge	Perennial	1000	8	Native to region
Juncus usitatus#	Common Rush	SM & LB	Emergent Macrophyte		300-1200	8-10	Rapid growth

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density [3] (Qty/m^2)	Comments
Dianella longifolia var. longifolia	Pale Flax-lily	UB	GrassLily	Perennial	300-800	6-8	Aesthetic; shade tolerant
Lomandra filiformis spp. filiformis	Wattle Mat-rush	UB	Tufted	Perennial	150-500	6-8	Shade tolerant when established, native to region
Lomandra longifolia #	Spiny-headed Mat Rush	UB	Tufted	Perennial	500-1000	4-6	Shade tolerant, native to region
Sorghum plumosum	Plume Sorghum	UB	Grass		To 4000	6	Growth can be dense
Themeda triandra	Kangaroo Grass	UB	Grass	Perennial	750	8	Requires local propagation, does not tolerate water logged soils
Cyperus polystachyos#	Bunchy Sedge	UB & LB	Sedge	Perennial	To 600	6-8	Suitable for sand and clay soils, Native to region, salt tolerant
Gahnia siberiana	Red-fruited Sword Sedge	UB & LB	Tufted	Perennial	1500-3000	4-6	Aesthetic. difficult to germinate

Table A-4: Shrub and Tree Plant Species List for Wetlands and Sedimentation Basins

Scientific name	Common name	Zone	Form	Height (mm)	Planting Density [4] (Qty/m^2)	Comments
Callistemon viminalis	Weeping Bottle Brush	UB	Tree	5.0-10.0	<1	Moist, medium to heavy soils, tolerates dry periods once established
Eucalyptus coolabah		UB	Tree		<1	
Livistona decora		UB	Tree		<1	Native to region
Lophostemon suaveolens	Swamp Box	UB	Tree	5.0-25.0	<1	Moist sandy soils
Melaleuca leucadendron	Weeping Paperbark	UB	Tree		2-4	
Melaleuca nodosa	Prickly-leafed Paperbark	UB	Tree	2.0-7.0	2-4	Deep sands and moist sandy soils
Melaleuca viridiflora		UB	Tree		2-4	Native to region
Nauclea orientalis	Leichardt Tree	UB	Tree		<1	Native to region, tolerates high winds and periods of flooding
Pandanus cookii	Screw Pine	UB	Tree		<1	Native to region, tolerates high winds, periods of flooding, fire resistant, will drop leaves
Myoporum acuminatum	Coastal Boobialla	UB	Shrub	0.5-6.0	2-4	Sun or semi-shade, salt tolerant Native to region

4 Planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

A.4 References

BCC 2005, Growing Native Plants in Brisbane, BCC, Brisbane, accessed 25th July 2005, http://www.brisbane.qld.gov.au/

BCC, DMR & PRSC (Brisbane City Council, Queensland Department of Main Roads & Pine Rivers Shire Council) 2001, Preferred Species Manual: Green Routes Program, prepared for the Green Routes Program by BCC, DMR & PRSC, Brisbane