Plant species selection stormwater biofilters & wetlands

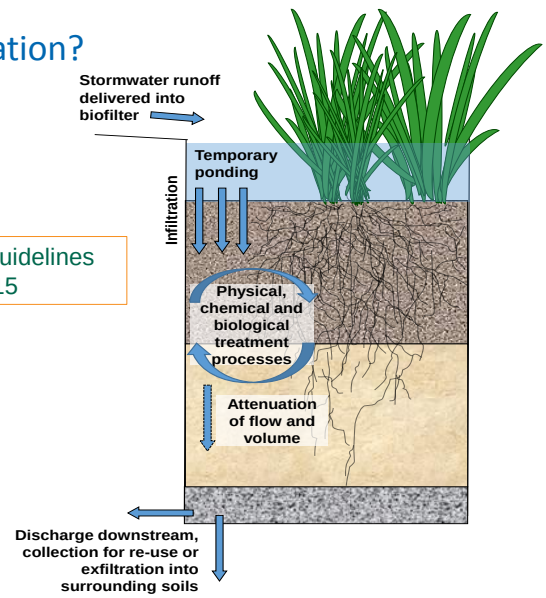
For amenity & resilience

Shaun Kennedy

Friday, 16 October 2015

What is Biofiltration?

CRCWSC Adoption Guidelines
Version 2 October 2015



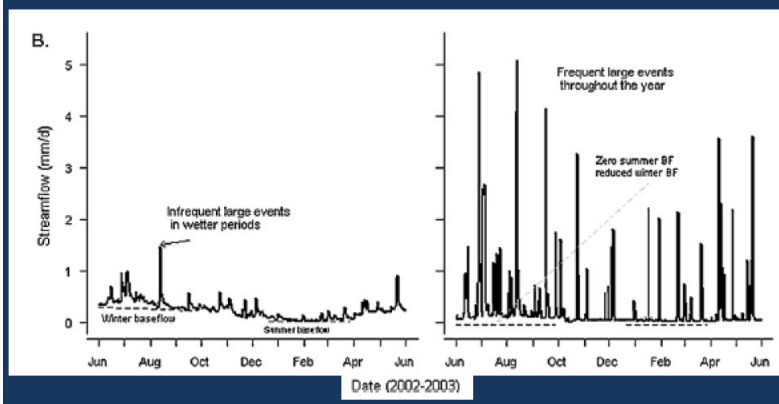
Why Biofiltration?

- Healthy streams
  - Efficient at nutrient retention
  - Rich in biodiversity
  - High intrinsic value

Why Biofiltration?

- Most urban streams are degraded
  e.g. 'Urban Stream Syndrome' – Walsh et al. 2005
  Internationally – King et al. 2011
- There are multiple stream 'stressors'
- Altered hydrology is a big one
  - (e.g. Burns et al., 2012)

Why most urban streams are degraded



Altered hydrology (Burns et al., 2012)

CRC for Water Sensitive Cities

An Australian Government Initiative

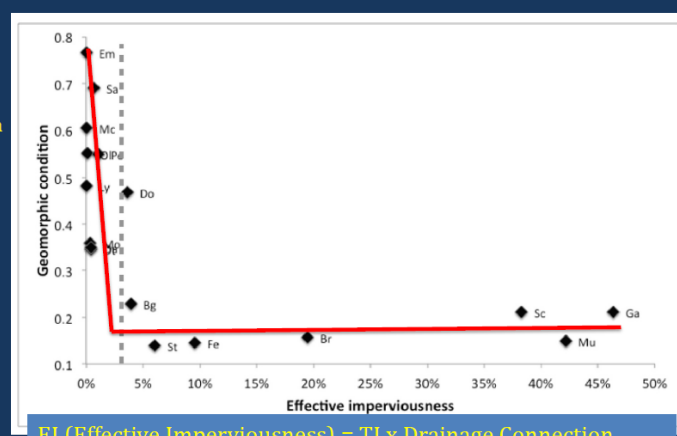
Melbourne Water

Waterway Ecosystem Research Group

Melbourne Waterways Research Practice Partnership : www.mwrpp.org
Waterway Ecosystem Research Group : www.thewerg.org

Urbanisation and geomorphic condition

Where Geomorphic condition = function of (bedload sediment depth, bank erosion severity, channel incision, presence of bars and benches, large wood loadings)



EI (Effective Imperviousness) = TI x Drainage Connection

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Melbourne Waterways Research Practice Partnership : www.mwrpp.org
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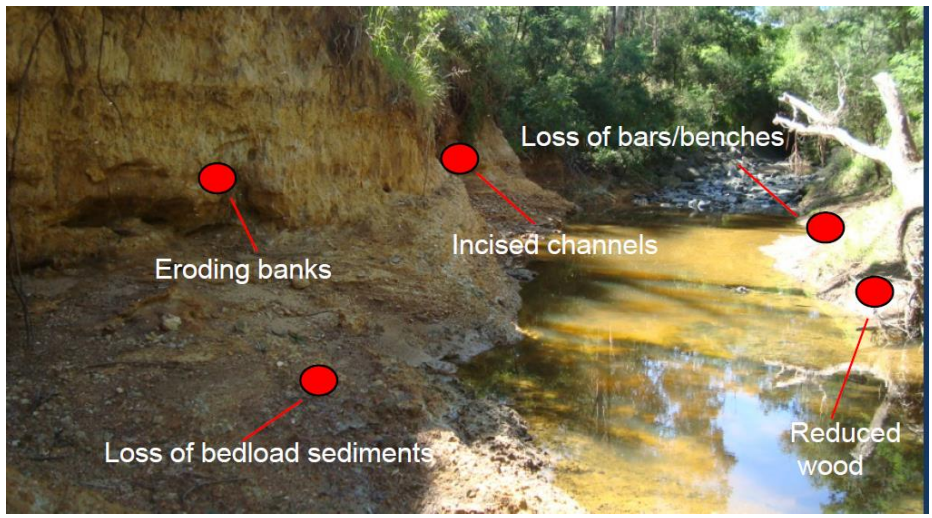
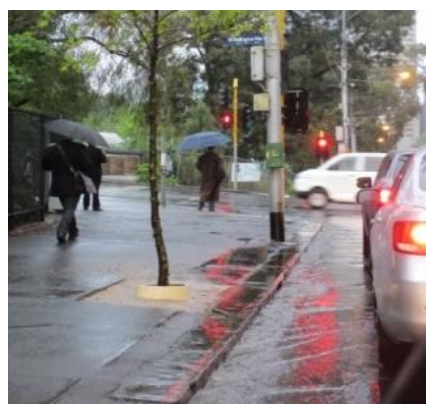


Sometimes it rains…

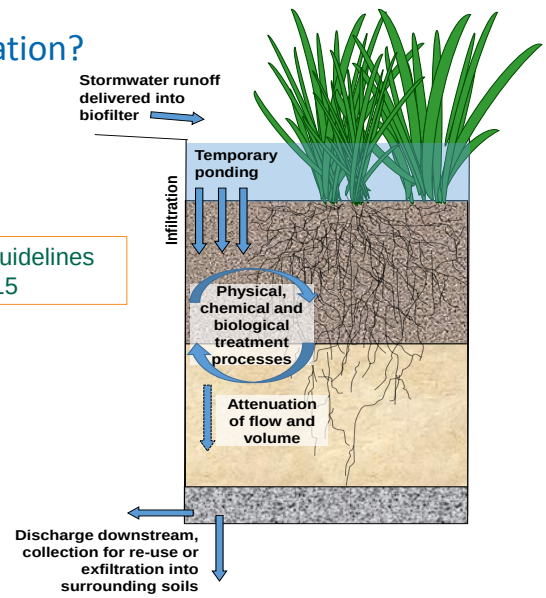


Why Biofiltration?

- **Planning level:** towards hydrological regime >> closer to pre-development
- **Local level**: Green space, urban biodiversity, amenity, reduced heat island

What is Biofiltration?

CRCWSC Adoption Guidelines
Version 2 October 2015



Examples

Examples

Examples

Examples

Examples

Plant selection

CRCWSC Adoption Guidelines
Table 14 – Detailed Considerations

- Root characteristics
- Survival
  - sandy medium, low OM, <u>withstand prolonged drying with intermittent inundation</u>
- Site specific characteristics
  - i.e. assess site and use a functional design approach
  - Underlying soil type, catchment size, WQ, aspect/micro-climate, streetscape interactions
- Hydraulic gradient
- Resilience = Diversity
- Plant forms (clumping vs spreading)
- Aesthetics

Mulch

- Organic mulch not recommended
- Gravel mulch restricts
  - plant spread,
  - heat stress,
  - impedes removal of accumulated sediments

- Answer: Use high planting density

>> But what should we plant?

WATER SENSITIVE SA

DRAFT – in development

Fact sheet # 01

Raingarden plant species – for nitrogen removal and companion planting

When designing your rain garden a holistic design approach to vegetation selection is essential. Consideration of the placement of species in appropriate positions corresponding to inundation frequency and drought tolerance is needed in addition to other considerations such as trees and shrubs for shade, tap rooted plants to maintain filter media infiltration, spreading plants including herbaceous plants may negate the need for mulch.

It is also essential that plantings are undertaken at the right time of year. They should be planted either at the beginning of winter or, if planted at other times, they will require watering with an alternative supply while they establish themselves. If you construct a bio-retention bed in summer, you should delay plantings until late autumn/winter. Local provenance species are recommended. To ensure this, planning your plant selection at the commencement of the design process will help ensure the right plants will be available in time for planting.

The indigenous flora of the Adelaide Plains and Mount Lofty Ranges includes several species adapted to varying degrees of seasonal inundation as well as drought (wetting and drying cycles). This provides us with several species suitable for use in bio-filtration rain gardens, and many of these species occur in the Adelaide region. Plan for planting well in advance and use local provenance species.

Research undertaken indicates that plants are essential for removing nutrients, in particular, nitrogen, in addition to assisting with maintaining infiltration within the biofiltration system. This research has also determined that some plant species are more efficient at nutrient removal than others, and since nitrogen is a pollutant of interest to the Adelaide coastal waters region, at least 50% of your plantings should be effective at removing nitrogen. It is recommended that plants have extensive fibrous root systems, and that there is a mix of shallow and deep rooted plants, a mix of both fast and slow growing plants and plants should be tolerant to wetting and drying cycles. Having a variety of plants will provide a more robust system that can better tolerate varying conditions

Plant species native to the Adelaide region proven to be effective at nitrogen removal

Plant species listed below have proven to be effective at nitrogen removal and are native to the Adelaide region. At least 50% of the plants you select for a bio-filtration rain garden must be from this group.

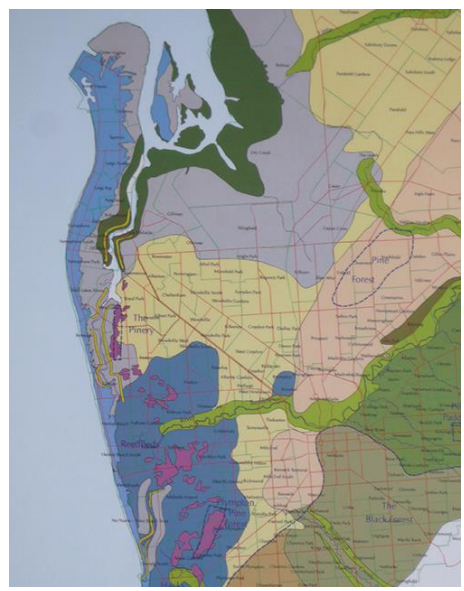
Nitrogen removal

CRCWSC Adoption Guidelines
Version 2 October 2015

Table 4. List of known plant species tested for their performance in stormwater biofilters (Chandrasena et al., 2014; Feng et al., 2012; Le Coustumer et al., 2012; Oversby, 2014; Read et al., 2008)

Objective	Effective	Medium or Mixed performance with different conditions	Poorer performers
Nitrogen removal	• Baumea juncea • Baumea rubiginosa • Carex appressa • Carex tereticaulis • Ficinia nodosa • Goodenia ovata • Juncus amabilis • Juncus flavidus • Juncus pallidus • Juncus subsecundus • Melaleuca ericifolia • Melaleuca incana • Melaleuca lateritia	Medium • Poa labillardieri • Poa sieberiana • Sporobolus virginicus Effective in wet/ poorer in dry • Allocasurina littoralis • Cyperus gymnocaulos • Juncus kraussii • Leptospermum continentale Effective in dry/poorer in wet • Poa poiformis	• Acacia suaveolens • Astartea scoparia • Austrodanthonia caespitosa • Banksia marginata • Dianella revoluta • Dianella tasmanica • Gahnia trifida • Gahnia sieberiana • Hakea laurina • Hypocalymma angustifolium • Leucophyta brownii • Lomandra longifolia • Microlaena stipoides • Pomaderris paniculosa • Rytidosperma caespitosum
Pathogen removal	• Carex appressa • Leptospermum continentale • Melaleuca incana • Palmetto buffalo		• Dianella tasmanica • Poa labillardieri • Sporobolus virginicus
Infiltration capacity	• Melaleuca incana • Melaleuca ericifolia		
Iron removal	• Carex appressa		

Pre-European Vegetation of Adelaide

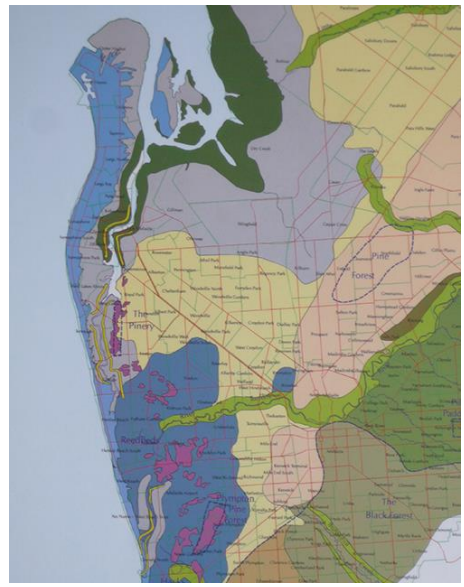


DEWNR

Red Gum Flat – Belair NP

Remnants (Relics) – Happy Valley

Pre-European Vegetation



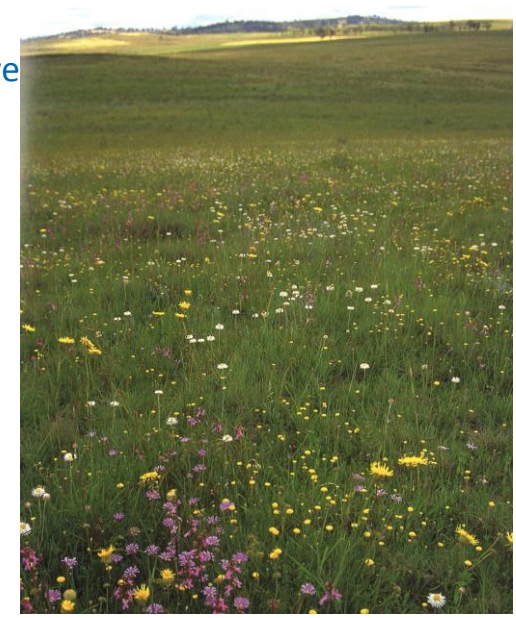
DEWNR

CSIRO Land of Sweeping Plains, 2015

Intact Native Grasslands in SE Australia

CSIRO Land of Sweeping Plains, 2015

Intact Native



CSIRO Land of Sweeping Plains, 2015

Intact Native Grasslands in SE Australia

CSIRO Land of Sweeping Plains, 2015

Intact Native Grasslands in SE Australia

CSIRO Land of Sweeping Plains, 2015

Topperwein NFR, near Nangwarry


South Australian
Seed Conservation Centre


South Australian
Seed Conservation Centre
South Australian
Seed Conservation Centre

16/10/2015

Adelaide MLR Region – applicable species

Preferred Position:

I = Requires seasonal inundation to survive
T = Terrestrial plant that can tolerate inundation

Current availability:

Ra = Rare
Av = Available from indigenous plant growers

Plant forms:

- ***Clumping Sedges***
- ***Spreading Sedges***
- ***Mat-forming***
- ***Herbs***
- ***Seasonal colour***
- ***Trees & Shrubs***

Adelaide MLR Region – **Clumping sedges**

Species	Effective nitrogen removal	Water dependency
Baumea articulata	Yes	I +
Baumea juncea	Yes	I +
Baumea rubiginosa	Yes	I +
Carex appressa	Yes	I +
Carex tereticaulis	Yes	I
Juncus krausii	Yes	I
Juncus pallidus	Yes	I
Juncus subsecundus	Yes	I
Cyperus gymnocaulos	Yes	I
Ficinia nodosa	Yes	I / T
Gahnia filum	No / Unknown	I / T

Preferred Position:

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T = Terrestrial plant that can tolerate inundation

Adelaide MLR Region

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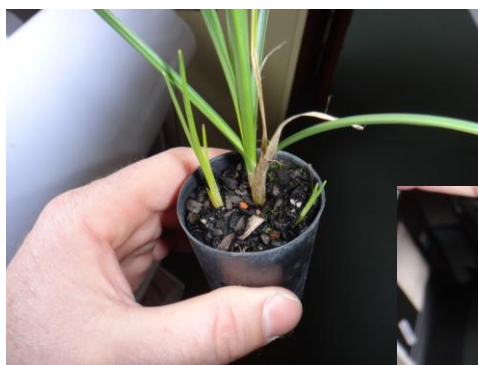
Adelaide MLR Region – **Spreading sedges**

Carex inversa var. inversa *T / I* *Ra*

Adelaide MLR Region – **Spreading sedges**

Carex inversa var. inversa






Inlet

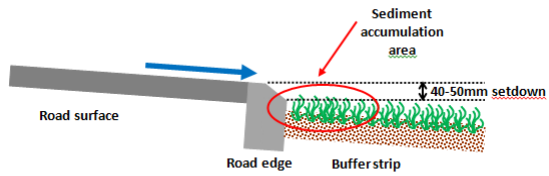
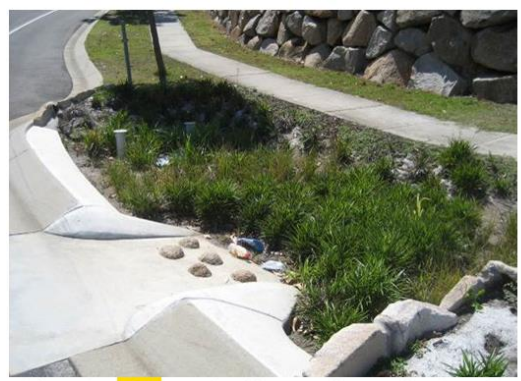


Figure 16. Edge detail of biofilter inlet zone showing setdown (source: Melbourne Water, 2005).

Inlet -2



ight) at the inlet to a biofilter can be used reduce flow
our and erosion damage.

The Value of spreading plants

DENSITY plants/m2	6		8		12
spacing (m)	0.41		0.35		0.29
Scenario:					
total rain garden area (m2)	1000		1000		1000
plants required	6000		8000		12000
cost / unit supply & install	$4		$4		$4
	$24,000		**$32,000**		**$48,000**
difference		$8,000		$16,000	

"Dense planting is strongly recommended in biofilters to enhance water treatment and reduce the occurrence of weeds and erosion."
– *CRCWSC Adoption Guidelines 2015*

Chorizandra enodis *T / I* *Ra*

Adelaide MLR Region

Chorizandra enodis *T / I* *Ra*

Adelaide MLR Region – **Spreading sedges**

Chorizandra enodis

Adelaide MLR Region – applicable species

Preferred Position:

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Plant forms:

- ***Clumping Sedges***
- ***Spreading Sedges***
- ***Mat-forming***
- ***Herbs***
- ***Seasonal colour***
- ***Trees & Shrubs***

Adelaide MLR Region – **Mat-forming**

Mimulus repens *T / I* *Av*

Adelaide MLR Region – **Mat-forming**

Mimulus repens *T / I* *Av*

Adelaide MLR Region – **Mat-forming**

Selliera radicans *T / I* *Av*

Adelaide MLR Region – **Mat-forming**

Montia fontana *I* *Ra*

Adelaide MLR Region – useful species plants

Preferred Position:

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Plant forms:

- ***Clumping Sedges***
- ***Spreading Sedges***
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- ***Herbs***
- ***Seasonal colour***
- ***Trees & Shrubs***

Adelaide MLR Region – **Herbs**

Glycine tabacina T Ra

Adelaide MLR Region – **Herbs**

Mentha diemenica *T* *Ra*

Adelaide MLR Region – **Herbs**

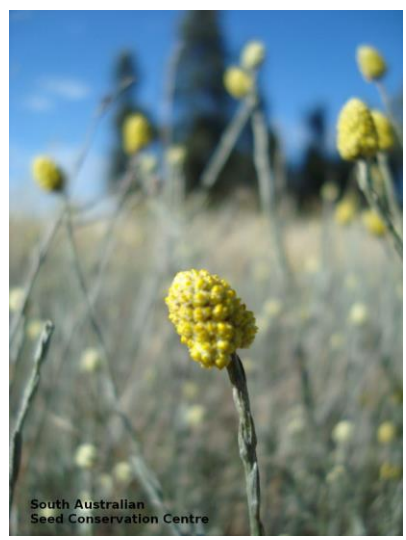
Mentha satureioides *T/ I* *Ra*

Adelaide MLR Region – **Seasonal Colour**

Brachyscome graminea *T/I* *Ra*

Adelaide MLR Region – **Seasonal Colour**

Calocephalus citreus *T* *Av*

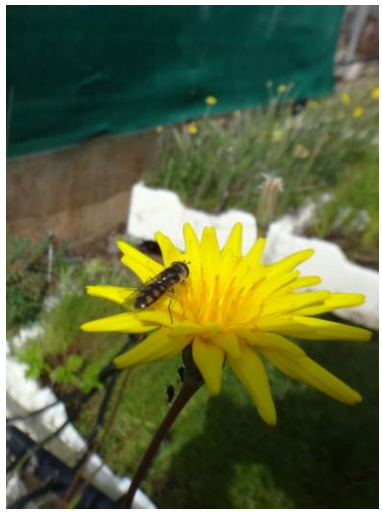


Adelaide MLR Region – **Seasonal Colour**

Coronidium gunnianum *BT/ I* *Ra*

Adelaide MLR Region – **Seasonal Colour**

Microceris lanceolata *T* *Av*



Adelaide MLR Region – **Seasonal Colour**

Pauridia vaginata var. vaginata *I* *Ra*

Adelaide MLR Region – **Seasonal Colour**

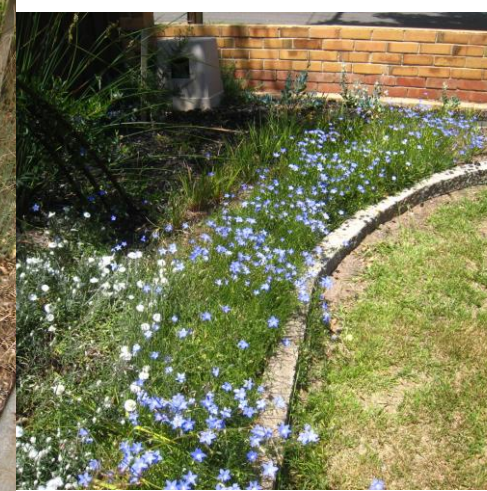
Ranunculus papulentus *T/ I* *Ra*

Adelaide MLR Region – **Seasonal Colour**

Ranunculus lappaceus *T* *Av*

Adelaide MLR Region – **Seasonal Colour**

Wahlenbergia luteola *T* *Av*



Adelaide MLR Region – **Seasonal Colour**

Wahlenbergia luteola - Robsart St Parkside, City of Unley

Adelaide MLR Region – **Seasonal Colour**

Patersonia occidentalis *T / I* *Av*

Adelaide MLR Region – **Seasonal Colour**

Xerochrysum bracteatum *T* *Av*

Adelaide MLR Region – **Shrubs**

Goodenia ovata *T* *Av*

Adelaide MLR Region – Shrubs

Goodenia ovata *T* *Av*

Adelaide MLR Region – **Trees**

Acacia melanoxylon *T* *Av*

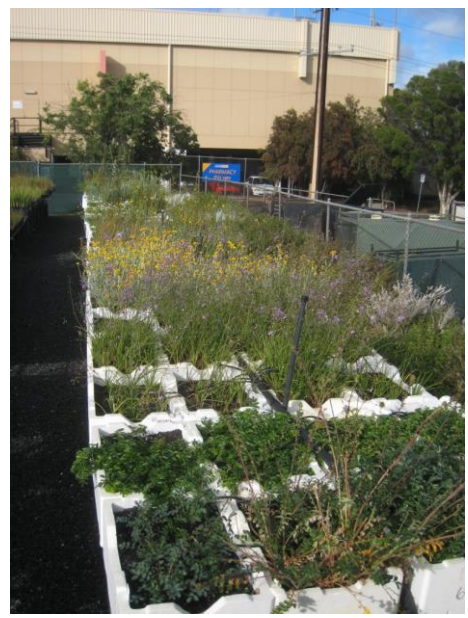
Trees, Shrubs & Grasses

Trees:
- *Pittosporum angustifolium*
- *Melaleuca lanceolata*
- *Eucalyptus cosmophylla*
- *Exocarpos cupressiformis*

Tall shrubs:
- *Bursaria spinosa*
- *Callistemon rugulosus*
- *Callistemon sieberi*
- *Banksia marginata*

Native Grasses:
- *Poa labillardieri*
- *Poa poiformis*
- *Microlaena stipoides*
- *Rytidosperma sp.* (13 Adelaide species)

Seed production

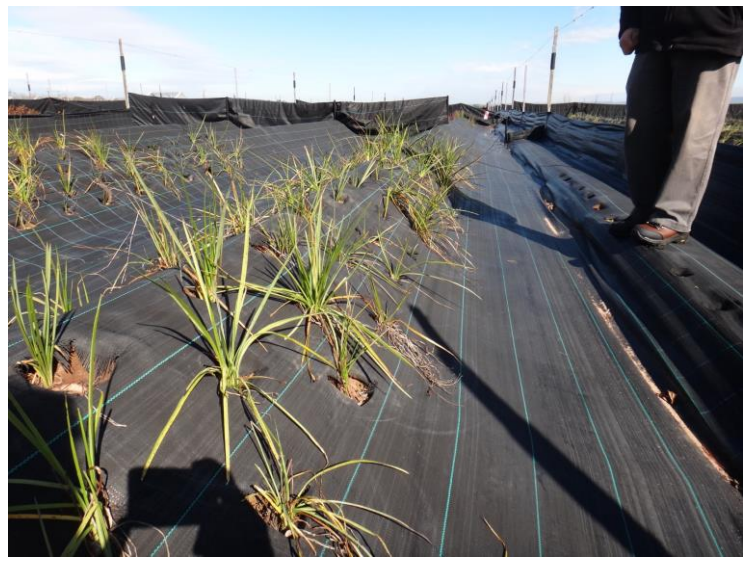


Seed production

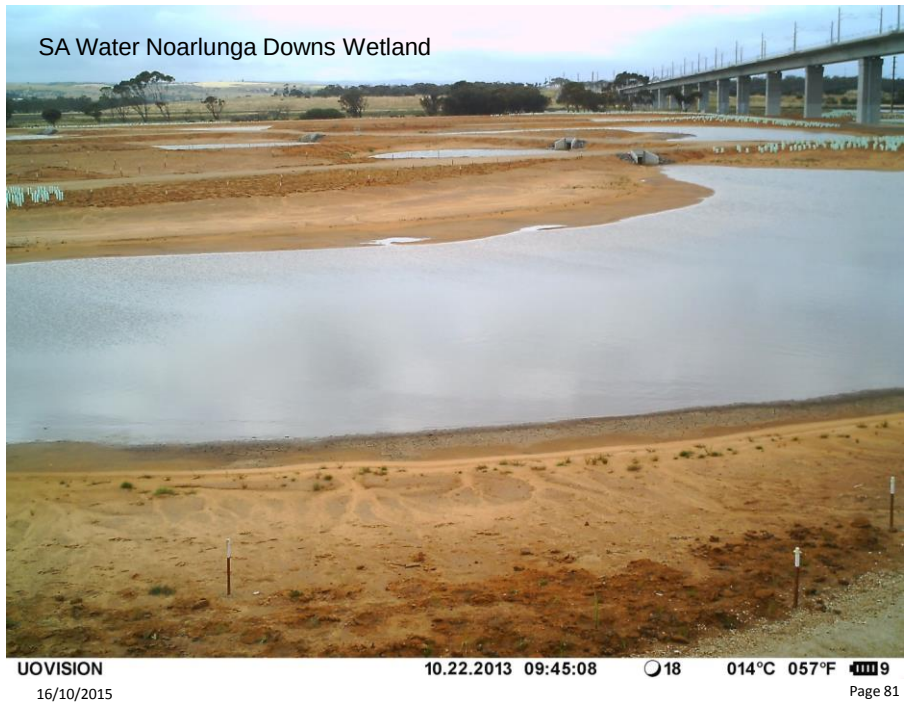
Seed production

Seed production

Seed production – Greening Australia NSW



Seed production –
Dr. Paul Gibson-Roy, Greening Australia, NSW



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Native Plant Growers – Adelaide Metro Region

- http://www.naturalresources.sa.gov.au/adelaidemtloftyranges/plants-and-animals/native-plants-animals-and-biodiversity/urban-biodiversity

Native plant nurseries list

Natural Resources
Adelaide and Mt Lofty Ranges

Backyards 4 Wildlife

Metropolitan area - **Please ring the growers before you visit to check that they have the capacity for direct sales.**

Company name	Contact	Address	Contact details	Services and web	Open
Adelaide Advanced Trees	Paul Draggett	264 Cherry Gardens Rd, Cherry Gardens	P: 8270 7700 F: 8388 2711 M: 0417 844 194 E: aatrees@natives.net.au	Advanced tree supply. W: www.natives.net.au	M to F 7 am to 4 pm.
Coromandel Native Nursery	Duncan Kaye	28 Star and Arrow Rd, Coromandel East	P: 8388 2777 F: 8388 2711 M: 0418 902 855 E: coro@natives.net.au	Plant supply, landscaping and plant advice. Native grasses and wetland plants also available. W: www.natives.net.au	M to Sa 8 am to 4 pm.
Greening Australia SA	Luke Kingston	5 Fitzgerald Rd, Pasadena	P: 08 8372 0100 F: 08 8372 0122 E: general@greeningsa.org.au	Commercial supply of local native plants. Vegetation services including seed collection, plans, on-ground works and training. W: www.greeningaustralia.org.au	M to F 9 am to 5 pm.
Growing Bush!	Karen Lane	31 Gum Grove, Belair	P: 8278 1587 E: growingbush@adam.com.au	Specialises in plants of the Adelaide Grey Box Woodlands.	
Indigeflora Nursery	Louise Mugridge	43 Chapman Rd, Hackham	P: 8326 2143 F: 8326 6501 M: 0404 130 053 E: indigeflora@internode.on.net	Seed collection, specialising in a native plants including wetland species. Contract growing. Plants available in tube cells or pots.	M to F 8.30 am to 4.30 pm.
Nesbitts Orchids	Les Nesbitt	PO Box 72, Walkerville	P: 8261 1550 E: lesn@adam.com.au	Australian terrestrial orchid specialists. Local Mt Lofty Ranges orchids available.	By appointment.
Provenance Indigenous Plants	Peter Hemmings	Sandy Crescent, Salisbury Park (formerly Salisbury Council Nursery Facility)	P/F: 8250 0477 M: 0409 675 477 E: provindig@bigpond.com	Native plants of the Adelaide coast, plains and foothills. Wholesale plants for schools, councils, industries, landscapers, nurseries, revegetation projects, etc. W: www.provenance.net.au	M to F 9 am to 4 pm.
Southern Native Plant Nursery	Morine Gould	251 Chalk Hill Rd, McLaren Vale	P: 8323 8259 F: 8323 8191	Provenance plants and Australian natives.	Tu to Su 9 am to 4.30 pm.
State Flora Nursery – Belair	Josh Laynes	Within Belair National Park - instructions at main entry gate.	P: 8278 7777 F: 8278 7801 E: dewnrstateflora@sa.gov.au	Native plant supply. W: www.environment.sa.gov.au	M to F 9 am to 5 pm. Weekends and public holidays 10 am to 5 pm. Good Friday and Christmas Day closed.
Themeda Indigenous Plant Growers and Revegetators	Phil Bagust	6 Hampden Street, Firle	P: 8431 5768 E: Paisley@internode.on.net	Adelaide plains tubestock and sales. *Native plants of Adelaide* book available from Wakefield Press.	Open by appointment.
Trees For Life	Ian Lett, Tree Scheme Manager	Corner Sir Donald Bradman Drive and May Terrace, Brooklyn Park	P: 8406 0500 E: info@treesforlife.org.au	Indigenous seedlings grown to order or grow your own. Weed management, bush regeneration and direct seeding. W: www.treesforlife.org.au	M to F 9 am to 4.30 pm. Closed public holidays.

Find out which native plants are best suited to your area, create shopping lists and view plants with our plant catalogue, explore garden designs and learn how to create wildlife friendly spaces at: www.naturalresources.sa.gov.au/adelaidemtloftyranges/plants-and-animals/native-plants-animals-and-biodiversity/urban-biodiversity

This list is current as at **November 2014.** For more information native plants please call 8273 9100 or visit **www.naturalresources.sa.gov.au/adelaidemtloftyranges**.

Questions??