PRACTICE NOTE 7

Landscape measures

Landscape measures used in conjunction with infiltration in the centre of a boulevard

WaterSmart development involves simple design and management practices that take advantage of natural site features and minimise impacts on the water cycle. It is part of the contemporary trend towards more 'sustainable' solutions that protect the environment and cost less.

This WaterSmart Practice Note describes a variety of landscape measures that can be used to manage stormwater flows, utilise stormwater within the site and minimise supplementary watering.

- **Gravel basins & channels**
- **Filter strips, banks & soaks**
- **Minimising lawn**
- **Efficient irrigation**

Landscape measures

Introduction

This Practice Note describes a variety of landscape measures that can be used to manage stormwater flows, utilise stormwater within the site and minimise supplementary watering of landscaping. These include:

- rock or gravel basins
- vegetated filter strips
- contour banks
- soak or bog areas
- wind and sun protection
- plant selection
- minimising lawn
- efficient irrigation

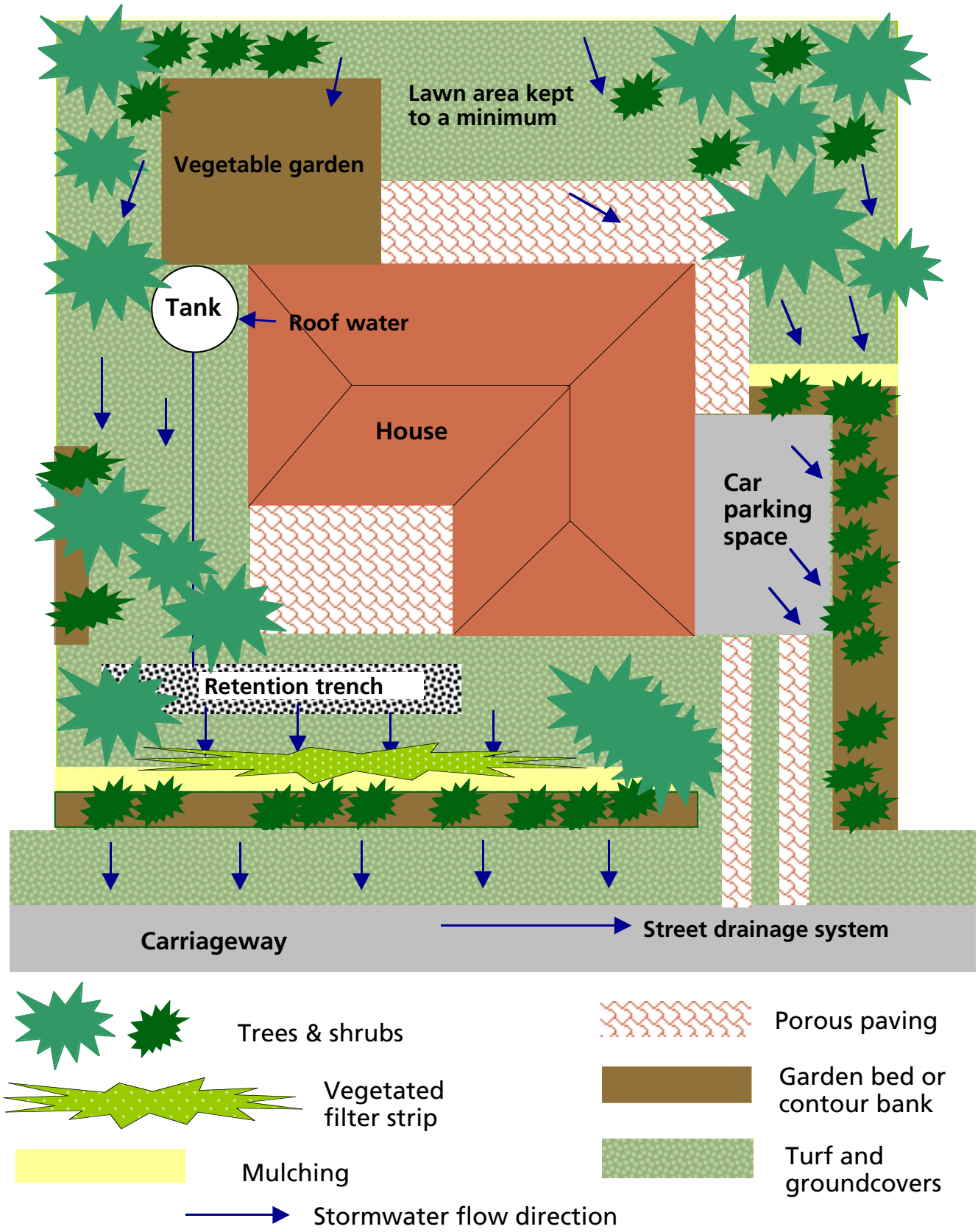
For optimal results, these measures need to be undertaken in conjunction with careful site planning (see Practice Note 2) and drainage design (see Practice Note 3), as well as appropriate landscape practices (see Practice Note 8).

Overall design issues

The design and installation of WaterSmart landscape measures needs to be undertaken as part of planning for an integrated functional system for the whole site. Specific issues that need to be considered include the following.

- **Integrated planning:** Landscape measures should be designed in conjunction with the other stormwater management measures. Expected flows and discharge rates should be factored into the design criteria, layout, earth shaping and the selection of plants and other materials.
- **Diversification:** Aim to create a diverse system within the landscape that is not reliant on a single device to manage stormwater. This will allow other parts of the landscape to adequately deal with stormwater flows in the event of failure or exceedance of design capacity, For example, a gravel-lined pond collects overflow from a water tank – spills over to a turfed filter strip – drains gently to a series of drainage swales spot-planted with species that tolerate temporarily saturated soil – drains to a soak area … and so on! This interconnecting system collects flow at a point source, reduces its speed and allows it to progressively infiltrate the soil, thereby reducing the risk of erosion, sedimentation and flooding.
- **Water tanks:** The overflow point from water tanks needs to be positioned so that it does not cause erosion or other damage, such as localised inundation of fragile plants.
- **Vegetated filter strips & turfed areas:** These will become compacted by foot or vehicular traffic, reducing the soil's ability to take up water. Erosion of the surface is also likely, leading to soil loss and downstream sedimentation.
- **Paved areas:** Always consider the safety of users when minimising impervious paved areas. The most frequently used paths (for example, to the front door) must be laid securely on a well prepared base. This prevents pockets of settlement and loose or uneven surfaces that can become a hazard, particularly to the frail or aged.
- **Grey water:** The use of domestic grey water as part of an irrigation or disposal system should not be applied consistently to one area as this can cause a build-up of salts and other contaminants that can alter the pH and ecology of the soil and affect plant health. It is important to know the soil's characteristics, infiltration and capacity rates before relying on such a system.

Landscape measures



An integrated suite of stormwater management measures on a typical urban allotment. The landscape design is an integral part of the overall system.

Landscape measures

Rock or gravel basins

Rock, stone or gravel can be used to line stormwater basins or channels. This can act to slow the rate of flow, dissipate energy and prevent surface erosion. It is a particularly useful method for managing concentrated stormwater discharges due to topography or from adjoining properties, stormwater easements, downpipes or water tank overflow pipes.

Locally-sourced rock should be used wherever possible as this will minimise energy inputs and allow the design to blend with the local landscape. Rock should not be removed from undisturbed areas as this destroys fauna habitat and promotes erosion. Obtain rock from on-site excavation works, other local construction sites or a local quarry. Avoid using blue metal as runoff from it will alter the soil pH.

On steeper slopes, rocks or stones need to be adequately secured to prevent dislodgment and downslope movement.

The size and composition of rocks or boulders must remain in proportion to the scale and style of the project and the site. Larger sites can accommodate larger features and unit materials without being overwhelmed, although it is possible to contain some large elements within a smaller area provided that it is cohesively designed.

Large pebbles or deep beds of gravel can be used to complement landscape themes. They can be used as an alternative to organic mulches for preventing soil moisture loss.

Vegetated filter strips

Vegetated filter strips are strips of grasses and shrubs placed across stormwater water discharge routes. They act to remove pollutants by filtering stormwater runoff, enabling limited infiltration and reducing stormwater discharge velocities.

Filter strips must receive stormwater as sheet flow. Concentrated flow will scour the surface and is likely to dislodge groundcover and plant roots, leading to failure. To ensure sheet flow, minimise the length of unobstructed stormwater discharge upstream of the strip.

Factors such as width of the strip, gradient, soil permeability and density of vegetation influence the effectiveness of filter strips. Various combinations of these variables are possible depending on site features (natural slope, soil properties, choice and placement of plants), how the filter strip is designed and constructed to fulfil its intended role and how the filter strip fits into the overall scheme.

Wider strips can hold greater volumes of water, as will those with higher embankments on the downslope side. Filter strips on land with a slope less than 5% are better able to trap sediment. Soil that is friable and with an open pore structure allows greater infiltration of water, compared to compacted and heavy soils. Using vegetation to act as a baffle to slow down stormwater flow must be balanced against obstruction of flow that may cause backing up of waters and localised flooding. Plant species chosen must be capable of withstanding conditions of periodic saturation of soil, foliage or trunk.

Filter strips need to be regularly monitored and checked after major storm events. They may require periodic repair, mowing, replanting and sediment removal to remain effective.

Because they offer a form of garden bed (and possibly an area of turf for casual recreation), vegetated filter strips are recommended for low and medium density urban areas as a multi-purpose landscape element.

Landscape measures

Contour banks

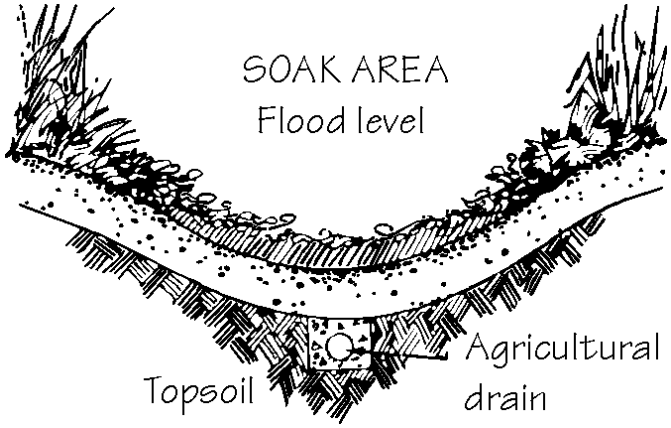
Contour banks are low earth mounds placed perpendicular to the direction of overland stormwater flow. They are very effective for reducing stormwater peak discharges and volumes, promoting infiltration and controlling erosion. On larger sites they can be used in series, and to link other landscaped areas in a system of stormwater control and harvesting. Combinations of contour banks, mulching and vegetated filter strips provide a very effective suite of stormwater management measures.

Contour banks are usually quite resilient, and require little or no maintenance. Special attention may be required to establish vegetation (shrubs, turf, grass and other groundcovers) on the contour banks. If constructing a larger dimensioned bank wall (for example, on a steep site or where large volumes of stormwater need to be accommodated), avoid planting trees on the bank as their large root systems will destabilise the earthen embankment.

Sediment may need to be removed from the upstream side of the bank from time to time. Accumulated sediment will smother low-growing vegetation, and will restrict the efficiency and carrying-capacity of the system. Provided that it is free of contaminants, collected sediment can be used to supplement topsoil elsewhere on the site. Ensure that all relocated sediment is contained and stabilised (such as with mulch or organic matting) to prevent it being the subject of further erosion.

Soak or bog areas

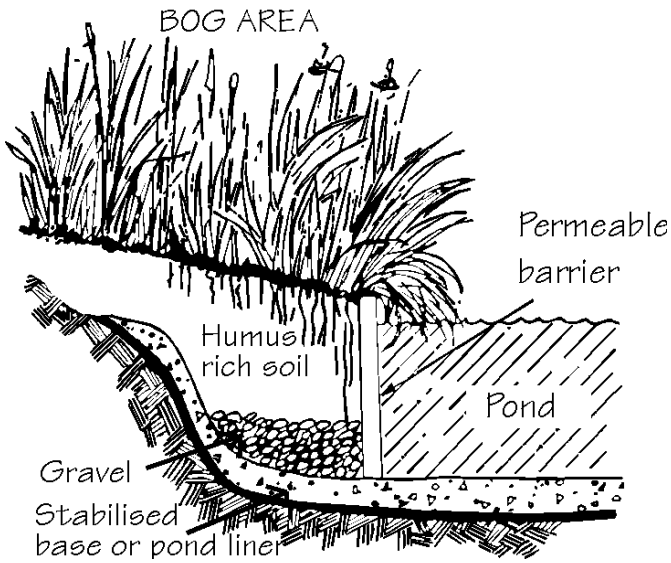
Many sites contain natural depressions or low points containing species that indicate temporary bogginess (for example, sedges, swamp grasses, frogs, water dragons and dragonflies). Consider utilising such sites within the system rather than altering existing drainage patterns, thereby promoting retention of valuable habitat.



The creation of an area that holds water as a temporary wetland is dependent on underlying geology, water table height, potential or existing soil salinity, quality and quantity of water received into the soak area and the type of vegetation it contains. Other landscape devices may be better suited to the site and location of the detention feature.

Avoid any dramatic alteration to the quality and volume of water. Replication of this system elsewhere, given the same geological, soil and drainage conditions, is also possible with careful observation, design and monitoring.

An artificial soak or bog area can also be built at the edge of a pond. This can act as a refuge for fish and other pond creatures when the water level is low.



Landscape measures

The practicality and appropriateness of establishing a soak or bog area will depend on whether there is likely to be any impacts on buildings, soil structure or ecosystem values. Further issues are outlined below.

Expected stormwater volumes

The site may have a small catchment, such as a car parking area or turning circle. This needs to be reflected in the dimensions of the soak area. Maturing vegetation with growing trunks will displace some volume of water as it is received, but this can be taken up more quickly with the more extensive root system and transpiration rate of the larger plant structures.

Plant species selection

Species choice is dependent on the function of the constructed soak area. Some plants are more tolerant of contaminants. For example, runoff from a car washing area can be collected and infiltrate in a separate area that acts as a buffer to other, more sensitive plantings. Select species that will withstand periods of soil saturation and anaerobic conditions.

The species best suited to the site's soil and climatic conditions are those that grow naturally within the local area. In most cases, preference should be given to local provenance species. Exceptions may be required where species do not tolerate a manufactured or disturbed soil profile, or a high nutrient or sediment loading from urban stormwater flows.

Always check with your local council or regional botanical gardens that plants chosen are not environmental weeds in your area.

The following lists includes a combination of native and exotic plants that could be used as part of an ornamental planting scheme. They are suited to conditions of silty or uncompacted soils with some organic matter and a pH of 5-7.

Matting plants

These species colonise and stabilise the edges of soaks, dams, ponds or wherever water levels may fluctuate, inundating them for a brief period.

Blechnum penna-marina (Alpine Water Fern)
Cotula coronopifolia (Water Buttons)
Crassula helmsii (Swamp Crassula)
Isotoma fluviatilis (Swamp Isotome)
Lilaeopsis brasiliensis
Marsilea species (Nardoo)
Mazus pumilo (Swamp Mazus)
Montia australasica (White Purslane)
Myriophyllum species. (Milfoil)
Pratia species.
Ranunculus inundatus (River Buttercup)
Sphagnum species (Moss)
Viola hederacea (Native Violet)

Low growing plants & shrubs

Colocasia antiquorum (Taro)
Caltha palustris (Marsh Marigold)
Cyperus papyrus (Sedge)
Drosera species (Sundew)
Iris ensata (syn *I. kaemferi*) (Japanese Flag Iris)
Iris pseudacorus (Yellow Flag Iris)
Nymphoides crenata (Wavy Marshwort)
Sagittaria sagittifolia
Thalia dealbata (Water Canna)
Triglochin striata (Streaked Arrowgrass)

Trees & larger shrubs

Check for the local species that suit your site and locality.

Allocasuarina species (Sheoak)
Baekea species
Callistemon species (Bottlebrush)
Casuarina species (River Oak, Swamp Oak)
Eucalyptus species (Gum Tree)
Leptospermum species (Tea-Tree)
Melaleuca species (Paperbark)

Maintenance of soak areas

The biggest threat to a soak or bog area is contaminated waters, so the selection of plants is dependent on the role of the soak area. For example, if it is to collect stormwater directly from paved areas with car traffic, only the hardiest species are likely to survive. More filtered or cleaner waters in a less polluted situation will allow a greater diversity of species to be selected.

Stormwater pollutants

Stormwater quality is adversely affected by fertilisers from gardens and lawns and oily deposits made by cars on sealed surfaces. Stormwater pollutants, including nitrogen, phosphorous, potassium and other substances, are eventually deposited in the soil, and are toxic to some plants, especially native species. Stormwater pollutants also encourage weeds and the growth of algae in ponds, thereby displacing other less vigorous plants.

Regular monitoring

Check for excess build-up of sediment, especially after major storm events. Silty deposits may smother smaller matting plants, preventing regeneration. Remove any litter or other inorganic debris.

Wind & sun protection

Providing protection from harsh climatic forces makes garden areas more pleasant and reduces moisture loss from soil and plant tissue. Wind and sun exposure helps to strip moisture from leaves, requiring the plant to use greater levels of available soil moisture than in less exposed conditions. In addition, soil moisture levels are reduced by high rates of evaporation. This can unnecessarily stress the plant's physiology.

A multi-rowed windbreak planted in staggered heights can offer leeward protection equivalent to about 7 times the height of the plantings. Plant garden beds on the leeward side of any existing clump or row of trees, as this will take advantage of existing wind protection. Do not plant directly underneath the canopy of established trees as the ground disturbance is likely to compromise the health and functioning of their root zone.

As part of overall site planning, locate trees so as to provide seasonal shade to garden areas with softer plants, outdoor entertaining areas and to north- and west-facing walls of the house. Deciduous trees allow winter sun to penetrate whilst helping to break wind flow with their network of branches. Evergreen trees need to be more strategically placed so that they do not cast deep shade on living areas of the house and garden.

Consider erecting a lattice screen or other structure if there is insufficient room to plant a screen for sun or wind protection. This may double as a boundary fence. A wire fence can support climbing plants providing a privacy screen as well as sun and wind protection. Shrubs can cover the lower part of the fence whilst the climber occupies the top. With solid walls that face north or west, consider the effects of light reflection and heat radiation during the hotter months. Protection structures may need approval depending on their location, scale, construction or other specifications – check with your local council.

Species selection

Planting a variety of species will help ensure that there is not a complete loss of screen planting in the event of unfavourable circumstances such as prolonged drought, attack by a host-specific pest or disease or unsuitable growing conditions. Unless a formal avenue of a single species is required for a landscape theme or style, choose hardy specimens from various genera with a mixture of habits, but with similar horticultural, watering and soil fertility requirements.

If space allows, plant 3–5 rows with staggered spacings along the rows. Place the taller growing

species in the centre row and shorter ones to the outside rows: this reduces the effects of turbulent eddies on the leeward side. Calculate spacings of plants to roughly two-thirds of their expected mature canopy width.

Some tree species are genetically more prone to branch loss or have earned a reputation as 'branch droppers'. This may be due to weak structural growth patterns, or susceptibility to pests and disease attack. Seek advice from your local native plant supplier for the most suited mix of species.

Maintenance

A newly planted windbreak will require closer attention during the first two growing seasons to ensure establishment of a balanced root system that is well anchored and widely spread. Depending on local soil and climatic conditions a regime of deep waterings and a 80-100 mm layer of organic mulch will encourage this. The mulch should be topped up annually to help suppress competitive weed growth, stabilise soil temperature and reduce moisture loss.

If planting trees close to houses or water tanks, keep the roof clear of overhanging vegetation and check roofs and gutters weekly for leaves and other debris.

Check plantings after storm events and prune any broken limbs back to major branch junctions. In the event of severe damage, seek professional advice regarding tree surgery or removal. Replacement strategies may be needed to restore the functional nature of the plantings.

Plant selection

Select plants suited to the site's soil and microclimatic conditions. Some species are able to withstand low soil moisture or high wind exposure due to special adaptations such as hard leaf tissue, small leaves, deep root systems, deciduous leaves, silvery or furry leaves (or combinations of these).

Local native plants have evolved to handle local conditions. Other Australian natives also cope with very little water. Some exotic plants from the Mediterranean region, California and Southern Africa are able to survive on limited water and a range of soil conditions.

Some plants are so well adapted to severe conditions that they can colonise and dominate native bush areas. Check with your local council, landcare group, regional botanical gardens or native plant nursery that plants chosen for your site (including native species from other parts of Australia) are not environmental weeds or declared noxious weeds.

Explore your neighbourhood to find out which species grow well, including street trees and other rarely watered plantings.

Group plants with similar water needs together so that watering schedules can suit different parts of the garden. Examples of different levels of water use include the following.

- *High use*: lawns, leafy vegetables, soft-fruit trees, exotic shrubs like azaleas and camellias, flowering herbaceous annuals and many bulbs.
- *Medium use*: hardy vegetables like pumpkins and potatoes, hardy fruit trees and vines like nut trees and grapes, many herbs, some exotic shrubs, most grey-leaved or tomentose (hairy) plants, roses and daisies.
- *Low use*: most Australian natives including banksias, grevilleas, hakeas, wattles and eucalypts. Succulents and cacti and some exotic ornamentals such as bougainvillea also fall within this category.

Place plants in the areas of the garden that suit the conditions provided. For example, place moisture-loving plants in protected spots with deeper soils, and hardy silvery-leaved plants in full sun, all with layers of mulch on the surface.

Landscape measures

Minimising lawn

Turf grasses are shallow-rooted groundcovers that generally require regular watering to maintain a green leaf cover. Compared to garden beds, lawn areas require significantly more water, fertiliser and maintenance per unit area to maintain healthy growth. Lawn areas also require greater inputs of energy, time and money. Fertiliser costs money and adds to the nutrient burden in run-off. Mowing is time-consuming and motors rely on petrol or electricity, adding to environmental pollution.

Rationalising the size and design of lawn areas can be easily undertaken, resulting in significant reductions in water use. There are many options....

- Replace lawn areas with vegetable patches, garden beds, screen planting, or a shade tree and garden bench.
- Site turfed areas closer to the house for more efficient watering from roofwater tanks.
- Choose other groundcovers and low-growing shrubs for a green outlook.
- Use other pervious surfaces for trafficked areas, such as mulch, gravel or permeable paving units. This will avoid the need to repeatedly repair worn out tracks across the turf.
- Alter maintenance practices to encourage deeper root growth (reduced mowing frequency, higher blade height, less frequent but deeper watering).
- Replace with grass species that are slower growing and require less water to remain green. Check with your local supplier for native and introduced grasses that suit local conditions.

The Table on page 10 provides brief details on a variety of readily available low maintenance ground covers that can be used to replace conventional lawns. They are all well adapted to coast and ranges of New South Wales.

Efficient irrigation

Only install irrigation systems if it is needed. Landscape measures that collect and utilise stormwater by slow infiltration can replace reliance on supplementary water. Irrigation will generally not be required if plant species are carefully chosen to suit the soil, climate, aspect and microclimate, and appropriate planting and maintenance techniques are implemented.

However, some gardeners have high expectations, or a preference for species that do not thrive with natural rainfall. The aim in this case is to apply water in the most efficient manner. Points that need to be considered regarding the choice of irrigation system, its installation and use, are outlined below.

- Match the system's design and specifications to the conditions on your site, including water source and quality, soil types and depth, moisture infiltration rates, evapotranspiration rates, frequency and intensity of rainfall, slope, plant choice and layout. Consult an irrigation specialist for a tailor-made efficient system.
- Re-fit an existing system with the most efficient low-flow fittings (jets, sprays and nozzles, etc.). Fix any leaks from joiners, hoses and pipes. Rationalise its layout. Adjust it to suit the changing requirements of plants as they mature (generally reduced water demand).
- Connect each garden area to separate valves to create 'hydrozones'. Plants grouped with similar water needs are precision-watered to suit them. Lawn areas will require the most water.
- Water according to the weather and plant needs, not to a fixed time schedule. Install soil moisture indicators as a guide. Allow soils sensors to override an automated system.
- Reduce the frequency of watering so that plants become less reliant on irrigation. Monitor plants individually and replace systematic watering with manual watering of stressed plants.

Landscape measures

Name	Description	Location	Soil	Sun	Watering	Mowing	Use	Establishment
Dryarna flavius	Aust. native turf	Dry or boggy conditions	Any	Full sun to part shade	Drought tolerant	None or very little	Can filter grey-water	Turf rolls available. Needs watering in first 3-6 weeks
Sporobolus virginicus Nather's green	Prostrate fine leaf native grass	Dry or boggy conditions, handles heat & light frost	Many (prefers sandy)	Full sun to part shade	Drought tolerant	Few times per year	High traffic. Can filter grey water	Propagate from small tubes or plant division
Phyla nodiflora Lippia, Fog Fruit	1-3cm high creeper, up to 2m wide. 2cm lilac flower most of year	Tropical, sub-tropical & temp. regions. Frost resistant	Tolerates waterlogging & salt spray	Full sun to part shade	Some during warmer months	None	High traffic	Propagate from rooted runners or plant division
Dichondra repens Kidney Weed	Rapid growing, 1-2cm high 1m wide. Small green-yellow flower in Spring	Moist areas. Does not tolerate cold climates	Well drained soil	Sun or shade	None/ low	A few times a year	Takes mild traffic; recovers well after wear; good around edges/strips	Propagate from plant division, seed (purchase from native plant nurseries) or tube stock. Can be invasive–don't plant near less vigorous plants
Mazus pumilio Swamp Mazus	Forms a dense mat 1m wide. Small white-violet flowers in Spring	Frost resistant	Tolerates moist boggy soils	Sun or partial shade	Survives on rainfall if in correct position	None to few	Tolerates foot traffic in moist, shaded areas	Propagate from plant division or plants–purchased from native nursery
Chamaemelum nobile 'Treneague' Lawn Chamomile	Non-flowering 5-10cm high	Warm & cold climate	Most soil types	Moderate sun	Very low water needs once established	When necessary	Good companion plant. Use as a tea, shampoo & fertiliser	Propagate from plant division, seeds or plants. Needs considerable weeding while establishing.
Mentha pulegium var. 'Decumbens' Pennyroyal	2-3cm high, spreads 70 cm/yr. Red-purple flowers in Summer, fragrant when stepped on	Grows in warm & cold climate	Grows in all soil types, preferring moist area	Full sun to part shade	Only in extreme heat. Not drought tolerant	None	Suited to high traffic	Propagate from runners (cut stem pieces that have rooted & replant), plant division, seeds or plants–purchase from herb nursery
Mentha requenii Corsican Mint	3-6cm high green cushion, hardy, tiny flowers early Summer, fragrant when stepped on	Suited to growing among stones in a path	Well drained, mildly enriched & moist soil	Full sun or light shade	Low water needs	None	Can stand some traffic	Propagate from plants (set in early Spring) or plant division (in Spring)
Thymus serpyllum Wild Thyme	3-12cm high carpet, aromatic leaves, rosy to white flowers	Grows in warm & cold climates	Suited to dry, well drained soil as well as damp clay	Full sun	None to low	Withstands mowing but not usually needed	Suited to occasional trampling. Herb that can be used to for tea	Propagate from seeds, cuttings (rooted stem sections) or plants (in Spring, 20-40cm apart). Apply manure or compost in Autumn & Spring
Myoporum parvifolium 'prostrate form' Creeping Boobialla	4cm high. 1-2m wide. Small white or pink flowers in Spr-Sum	Ideal for coastal areas. Frost hardy. Salt tolerant	Any soil with good drainage	Full sun	Drought tolerant	None required	Good for weed suppression	Propagate from plants (from native nurseries) or firm tip cuttings (harder areas of the plant stem)

Low maintenance groundcovers that can be used to replace lawns. *Source: Friends of the Earth*.

- Install drip systems for sparsely distributed plants and underground or surface leak systems for dense garden beds as they are the most efficient irrigators—there is less vapour loss from spray or misdirected water.
- With spray systems, avoid overlapping areas or directing it onto paths and driveways.
- Ensure that the water is directed to the roots as much as possible.
- Set a timer to turn off watering systems if it is not automated. Adjust according to the season and plant needs.
- Maintain the whole system routinely, inspect for blockages, repair leaks and replace worn parts.

Irrigation is best done in combination with mulching of garden beds to conserve applied water. Always avoid over-watering to the point where the soil is saturated and excess water flows away from where it is intended.

The costs and maintenance of an efficient irrigation system should be measured against the benefits. Consider redesigning and replacing with plants that have less demand for constant supplementary water.

Useful websites

Environment Australia (2001). *Your Home: Technical Manual and Consumer Guide*: www.greenhouse.gov.au/yourhome

Friends of the Earth (Sydney): www.homepages.tig.com.au/~foesyd/SustainableConsumption/garden/gardenhome

Australian web site dedicated to promoting better water conservation: www.savewater.com.au

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Other practice notes

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