Green Infrastructure
Guidelines
May 2012

01 INTRODUCTION

GUIDELINES NAME:	**GREEN INFRASTRUCTURE GUIDELINES**
AIMS:	The aim of these guidelines is to provide best practice Green Infrastructure advice for developers.

Introduction

Green Infrastructure incorporates various infrastructure elements including:

- Water Sensitive Urban Design (WSUD) – sustainable drainage systems, swales, wetlands, rivers and canals and their banks, and other water courses, parks, green spaces, urban landscaping and gardens, green roofs and walls; and
- connections like footpaths, cycleways and wildlife corridors;
- energy efficient infrastructure – wind turbines, solar panels and sustainable design principles.

In the long term, Green Infrastructure has real benefits in terms of saving money and energy for residents and end users. The image of places can be improved, boosting property values including house prices. The appeal of green spaces with enhanced natural features and the availability green energy can attract new residents, tourists, creative people, entrepreneurs, businesses and inward investment

For more information see:

Australian Green Infrastructure Council at:
www.agic.net.au/

Australian Institute of Landscape Architects Green Infrastructure Brochure at:
http://www.aila.org.au/greeninfrastructure/docs/AILA_green%20infrastructure.pdf

Pre-application Advice

Planners have a key role in green infrastructure through the processing of planning applications. Pre-application discussion can be invaluable in developing a common understanding of what is proposed, and to assist the efficient and effective processing of applications. Developers are strongly encouraged to approach the planning authority at the earliest possible stage to explore which combination of design measures are possible in the particular circumstances.

Guideline Objectives

The objectives of these guidelines are to encourage developers to:

- Construct more environmentally friendly buildings within Esperance.
- return excess stormwater to the natural water cycle with minimal adverse impact on people and the environment;
- protect/restore/enhance the environmental, economic and social (i.e. recreation and scenic) values of water management;
- incorporate multi-functional spaces into developments that manage water and provide recreation opportunities and wildlife habitats.

Green Infrastructure elements that can be incorporated into any development

A range of Green Infrastrucuture elements are described below. These elements are encouraged for use in planning and development proposals.

For full technical details on Water Sensitive Design Elements, applicants should refer to the Stormwater Management Manual for Western Australia

(http://www.water.wa.gov.au/Managing+water/Urban+water/Stormwater/Stormwater+management+manual/default.aspx).

02 BENEFITS OF GREEN INFRASTRUCTURE

Economic Benefits

- reduce energy costs
- reduce landscape maintenance costs
- improving the image of a place
- boosting property values including house prices due to proximity to greenspace and green power.
- helping developers get the most out of the site by combining uses, eg open space and water sensitve urban design, helping development viability
- attracting businesses and inward investors by creating attractive settings
- making it cheaper and easier to deal with surface water by keeping it on the surface
- saving energy and money for residents and end users

Social Benefits

- encourage a healthier community
- become less reliant on cars
- more comfortable working environments
- beautify neighbourhoods
- calm traffic
- creating green spaces for socialising, interaction and events
- more opportunities and places for children to play
- providing improved physical connections through green networks to get between places; and to communities,
- services, friends and family and wider green spaces
- providing spaces for practising and promoting horticultural skills
- creating opportunities for community participation and volunteering to manage ponds, eco-zones etc
- encouraging exercise and physical activity by providing quality green spaces for walking, cycling, sports and play
- providing better opportunities for active travel and physical activity
- improving mental well-being by providing access to nature and attractive green spaces and breathing spaces
- providing opportunities for growing food locally and healthy eating

Environmental Benefits

- reduced carbon footprints
- decreased use of vehicles
- provide habitat
- reduce the urban heat island effect
- increase groundwater recharge
- reducing pollution through use of water sensitive urban design and buffer strips
- providing new and linking existing habitats or natural features, to allow species movement
- protecting aquatic species through appropriate management of waterside habitats
- preventing fragmentation of habitats
- allowing diverse habitats to be created which are rich in flora and fauna

Climate Change

- reducing CO^2 emissions by providing non-vehicular travel routes encouraging walking and cycling in eco-zones
- decreased reliance on fossil fuels
- providing carbon storage and sequestration in vegetation
- providing shelter and protection from extreme weather
- managing flood risk: living roofs, large trees and soft landscape areas absorb heavy rainfall
- providing for storage of surface water in times of peak flow in SUDS and other water features
- cleaning and cooling the air, water and soil, countering the 'heat island' effect of urban areas
- saving energy: through using natural rather than engineered solutions
- saving energy: living roofs insulate buildings, and large trees provide shade, reducing the need for air
- conditioning in the summer and raising ambient temperatures in the winter, reduction in heating costs in the winter due to slowing of wind speeds in urban areas

03 GREEN INFRASTRUCTURE

The table below demonstrates which Green Infrastructure elements that can be incorporated into various forms of development.

Green Infrastructure	Type of development				
	Household	Medium to large scale residential / mixed use	Commercial and Industrial	Subdivision	Urban Retrofit
Rainwater Tanks	Yes	Yes	Yes	Yes	Yes
Porous Pavements	Yes	Yes	Yes	Yes	Yes
Rain Gardens	Yes	Yes	Yes	No	Yes
ATUs	Yes	Yes	Yes	Yes	Yes
Green Roofs	Yes	Yes	Yes	No	Yes
Swales	Yes	Yes	Yes	Yes	Yes
Buffer Strips	Yes	Yes	Yes	Yes	Yes
On-site infiltration systems	No	Yes	Yes	Yes	Yes
Gross pollutant traps	No	Yes	Yes	Yes	Yes
Bioretention systems	Yes	Yes	Yes	Yes	Yes
Retarding basins	No	Yes	Yes	Yes	Yes
Sediment basins	No	Yes	Yes	Yes	Yes
Wetlands	No	Yes (large)	Yes	Yes	Yes
Ponds and lakes	No	Yes (large)	Yes	Yes	Yes
Ecozones (parks)	No	Yes (large)	Yes	Yes	Yes
Pollution Control systems	No	Yes (large)	Yes	Yes	Yes
Footpaths	No	Yes	Yes	Yes	Yes
Cycleways	No	Yes	Yes	Yes	Yes
Green corridors	No	Yes	Yes	Yes	Yes
Street Trees	Yes	Yes	Yes	Yes	Yes
Wind turbines	Yes	Yes	Yes	Yes	Yes
Photovoltaic systems	Yes	Yes	Yes	Yes	Yes
Sustainable building design	Yes	Yes	Yes	Yes	Yes
Community Gardens	No	Yes	Yes	Yes	Yes
Sustainable Building Design	Yes	Yes	Yes	Yes	Yes

Table1: Green infrastructure elements and types of development

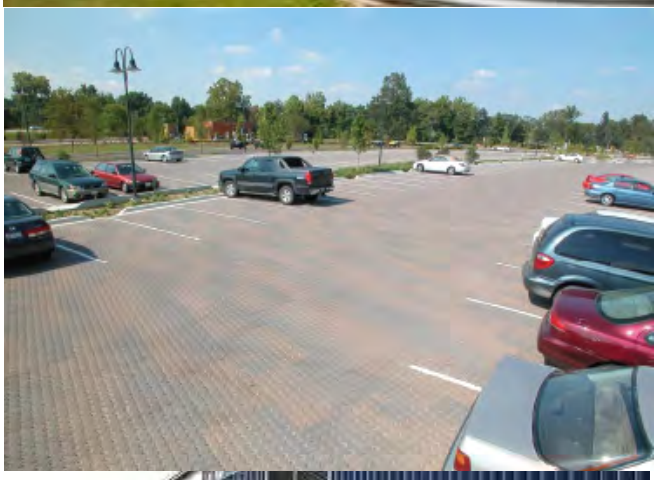
04 GREEN INFRASTRUCTURE

Rainwater Tanks

Rainwater tanks conserve water by collecting rooftop run-off to reduce stormwater flows and provide a source of non-potable water supply. Some pollutants can be prevented from entering water sources through the settlement of suspended soils within the tanks. The stored water can create savings through its re-use for garden irrigation, flushing toilets etc. The tanks are often the most appropriate WSUD elements for residential developments for managing stormwater.

Porous Pavements

Porous (or pervious) pavements allow stormwater to be filtered by a coarse sub-base enable infiltration to the underlying soil. This can mitigate (or even zero) peak stormwater surges, while improving groundwater recharge and stormwater quality. Underground tanks can be used in with porous pavements to collect filtered stormwater, which can then be used for other purposes. This also reduces the area of land required for stormwater management. Usually consisting of a single continuous porous medium or individual paving blocks, a wide range of materials can be uses, including asphalts, concrete grids and ceramic or plastic modular pavements.



Rain gardens

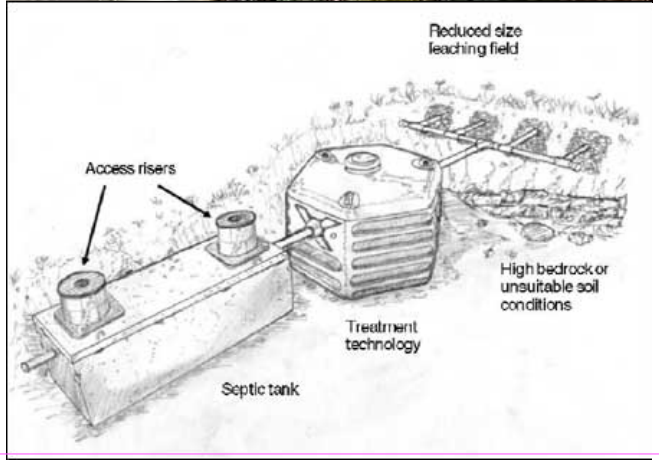
Rain gardens are generally a planted depression with a sand base that takes rainwater directly from a roof and other hard surfaces. The water can then be used to reduce peak-flows and irrigate the garden. It can also be directed through the filtering system and released into the drainage system. They can be planted with a range of species.

Aerobic Treatment Unit (ATU)

An Aerobic Treatment Unit (ATU) may be required or encouraged as opposed to a conventional septic system .

ATUs would be required or encourage when:

- Local Government makes it a requirement;
- Site conditions are unfavourable for conventional systems.(soil types, contour, natural ground water levels, Environmental sensitive areas)
- High volumes of wastewater needs to be treated;



05 GREEN INFRASTRUCTURE

Green Roofs

Green roofs can provide a wide range of benefits, including reduced stormwater run-off rates, reduced carbon dioxide emissions, energy savings and longer roof life. They can make a positive contribution to aesthetically pleasing streetscapes, and can provide interesting tourist attractions. The roofs need to be designed to cope with the extra loads and can be more expensive to construct than conventional roofs. However, over the lifespan of a Green Roof the cost may only be ½ of that for a conventional roof.

Swales

Vegetated swales can replace pipes to filter stormwater and, more importantly, provide a pre-treatment stage for other downstream measures (e.g. bio-retention systems). They can be created on longitudinal slopes between 1% and 4% in order to maintain flow capacity without excessive water surges and potential erosion. In steeper areas check dams can flatten the longitudinal grade. Robustly vegetated swales that require minimal maintenance and can become attractive landscape features.

Buffer strips

Buffer strips take water from hard surfaces in a distributed manner, regulate flows, and filter run-off. Buffers help to manage the flow and quality of water by retaining coarse sediments from run-off. They can be used as pre-treatment measures for other stormwater management systems. Regular maintenance is required to ensure healthy vegetation and adequate cover.

06 GREEN INFRASTRUCTURE

On-site infiltration systems

Stormwater infiltration systems generally discharge treated water into surrounding soils. Their efficiency is dependent on the characteristics of local soils. They are best suited to sandy-loam soils with deep groundwater. However, the provision of sufficient detention basins have enabled some Australian systems to be implemented in low permeability soils. The systems can reduce run-off and retain pollutants, but require pre-treatment to prevent clogging over time. They are generally the final element of a WSUD system and can be vegetated to provide landscape values for the area.

Gross pollutants traps

Gross pollutant traps prohibit large pollutants from entering water courses through screening and rapid sedimentation, without significantly retarding flows. They can retain litter, organic matter, soil and other debris. Requiring regular maintenance, they can be installed in open channels, pipe systems and drain entrances.

Bioretention systems

Bioretention systems control the flow of water while removing contaminants and other particulates. Generally smaller than wetlands, large basins are frequently used as part of a development-wide WSUD strategy. However, they can also be utilised on lots where there are several buildings and the lot is under single ownership. Bioretention systems can treat stormwater effectively in urban areas where there significant areas of hard surfaces.

07 GREEN INFRASTRUCTURE

Ecozones for public open space

Ecozones are generally public open space areas that are primarily aimed at maintaining the attractiveness of parks while reducing water consumption. They replace turf with gardens that are less water depended; replace existing water dependent species in gardens with species that are much less water dependent; and disconnect irrigation systems from landscaping that can survive without it. Ecozones are generally utilised in large scale developments where there are significant areas of public open space.

Retarding basins

Retarding basins protect downstream properties from flooding and reduce flood frequency. Including a retarding basin as part of a WSUD scheme can weaken the force or intensity of regular floods. They require significant areas of land and are generally utilised in large-scale developments.

Sediment basins

Sediment basins help to control the flow and quality of water by retaining coarse sediments from run-off. The basins should be designed with sufficient capacity to cope with peak volumes and particle size. They are best utilised as a pre-treatment to a wetland or bio-retention system in medium to large sized industrial or mixed use developments.

08 GREEN INFRASTRUCTURE

Wetlands

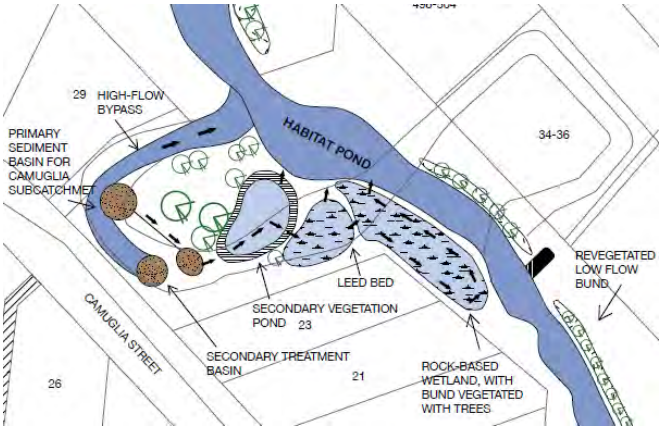
Constructed wetland systems extend detention of stormwater and utilised fine filtration and biological pollutant uptake processes to remove pollutants from stormwater. They are usually shallow and extensively vegetated water bodies that incorporate an inlet zone (to remove coarse sediments) and a high-flow by-pass channel. Wetlands can provide wildlife habitats and recreational opportunities. Consideration needs to be given to mosquito and midge management. They can be constructed on large urban and regional scales.

Ponds and lakes

Ponds and lakes are can be created by excavating below the natural surface level, or by developing a dam wall with a weir outlet structure. Used for stormwater storage they often form part of a flood detention system and the water can be re-used for irrigation. By promoting sedimentation, adsorption of nutrients and ultraviolet disinfection, they can remove pollutants. They can be used within residential, mixed-use and industrial developments to create focal points for recreation and habitats for wildlife.

Pollution Control Systems

Pollution Control Systems can incorporate primary sediment and gross pollutant basins, secondary treatment basins and ponds, wetlands. The systems can be designed so that during low flows, water moves slowly through the gross pollutant basins and wetlands, depositing sediment and debris. During more intense water surges, stormwater flows through the gross pollutant basins and straight over the top of the wetland systems.



09 GREEN INFRASTRUCTURE

Footpaths

Footpaths can be designed to incorporate various WSUD principles, including permeable paving and buffer strips. They can provide attractive links between parks, green spaces and other popular destinations. Footpaths are key elements for all forms of development and can play an important role in community health strategies.

Cycleways

Cycleways also provide important Green Infrastructure connections. They give people another transport option that will make a difference. They can improve the health of communities and while helping the environment by avoiding car use. Cycleways are a great way to save time, have fun and meet new people.

Green Corridors

Green corridors play a crucial role in maintaining connections between wildlife (insect, birds etc) and plant populations that would otherwise be isolated and at greater risk of local extinction. They can mitigate the adverse effects of habitat fragmentation by facilitating the dispersal of individuals between areas of remaining habitat. include remnant habitat, regenerated habitat or artificially created habitat that connect larger areas of wildlife habitats. They can provide supplementary feeding habitats for wildlife.

Street Trees

Established trees play a significant roll in all forms of stormwater management and landscaping. An established tree can act as a focal point of landscaping, a local landmark, or gathering point.

10 GREEN INFRASTRUCTURE

Community Gardens

Community gardens are places where people meet and work together to grow food and bond. Community gardens incorporate high quality, productive, creative and accessible open spaces. The gardens have considerable benefits in terms of health and wellbeing, environmental sustainability, food security, education and training, social inclusion, cultural vitality, community resilience and economic development. The two main types of gardens are communal or shared gardens (where people work together and share produce) and allotment gardens (where plot of land to garden is leased for a fee).

Photovoltaic Systems (Solar Panels)

Photovoltaic systems provide green energy by using solar panels to convert sunlight into electricity. Small system may provide energy to a single consumer, or to an isolated device like a lamp or a weather instrument. Larger grid-connected systems can provide the energy needed by many customers.

Wind Turbines

Wind Turbines are a cheap and efficient source of reliable renewable energy sources. Small wind turbines may be used for a wide range of development including small or large scale residential, commercial and industrial, telecom towers, schools and clinics. The location and design of wind turbines requires careful consideration, to ascertain their potential visual and noise impacts.

Local Planning Policy: Wind Turbines is available from http://www.esperance.wa.gov.au/cproot/1259/3/LPP%20Wind%20Turbines.pdf

Sustainable Building Design

Sustainable building design aims to minimise the overall impact of a building on the environment. It does this by encouraging biodiversity, clean air and water, energy efficiency, recycling, selecting appropriate building materials and minimising noise. It also aims to reduce CO^2 emissions and waste. A number of site layout and design elements are used, including passive solar gain, landscaping for shelter and shade, insulation, photovoltaic systems, wind turbines, rainwater collection and re-use, LED lighting and double glazing.