Western Australian environmental guidelines for the establishment and maintenance of turf grass areas

Prepared by the Swan River Trust with support from organisations represented on the Fertiliser Partnership Urban Users Working Group

Department of **Agriculture and Food**
State Natural Resource Management Office
Department of **Water**

Acknowledgements

The *Environmental Guidelines for the establishment and maintenance of turf and grassed areas* were originally published by the Department of Environmental Protection and Water and Rivers Commission in 2001.

The Swan River Trust with the support of the Department of Water and the Urban Users Working Group completed a review of the guidelines in 2014. The Urban Users Working Group consists of representatives from the fertiliser industry, fertiliser user organisations, community led NRM groups, local government, other urban land managers and State Government Agencies.

The Trust acknowledges those working group members that contributed a very significant amount of time and effort towards this review including Peter Ruscoe, John Forrest and Christa Loos.

Funding for the review was provided to the State NRM Program as part of the State Government's investment in the Fertiliser Partnership 2012-16.

FOREWORD

The Fertiliser Partnership 2012–16 is an important initiative to protect the health of waterways of the Swan and Scott Coastal Plains by reducing nutrient loss from fertilisers in urban and rural areas. This is being done through a range of activities including improved fertiliser efficiency, enhanced use of soil amendments and the management of soil acidity.

The strategies used to achieve the above objectives are through the:

- development and promotion of low-phosphorus fertiliser products;
- development and promotion of 'best practice' fertiliser use and management in broad scale agriculture (grazing), horticulture and other related commercial activities and urban land use applications;
- development and promotion of best practice based on relevant accredited programs and advisors; and
- research, development and trials of nutrient-binding soil amendment products to improve nutrient use efficiency and reduce nutrient loss to waterways.

The state government recognises that these strategies will only be achieved through collaborative effort with, and involvement of, the broader community. Several working groups involving the fertiliser industry, fertiliser user groups and peak non-government organisations have been established. The Urban Users Working Group (UUWG) is supporting the Fertiliser Partnership through a number of activities relating to improving fertiliser management in urban areas.

The *Environmental Guidelines for the establishment and maintenance of turf and grassed areas* (2001) have been important for the turf and irrigation industry for more than a decade in Western Australia, and are strongly aligned to the Fertiliser Partnership.

To ensure the guidelines continue to be a valuable resource into the future, the Swan River Trust with support from the UUWG has updated and made improvements to the guidelines, particularly for reflecting the most recent best management practices for fertiliser and water use for turf and grassed areas.

Further information on the activities of the Fertiliser Partnership and initiatives of the UUWG is available at www.fertiliserpartnership.agric.wa.gov.au.

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LIST OF SHORTENED FORMS

GL	gigalitre
ha	hectare
kg	kilogram
kL	kilolitre
km	kilometre
km^2	square kilometre
m	metre
mg/L	milligram per litre
mL	millilitre
ML	megalitre
mm	millimetre
NIMP	Nutrient Irrigation Management Plan
PDWSAs	Public Drinking Water Source Areas
PRI	Phosphorus Retention Index

1. INTRODUCTION

Turf grass areas have many benefits that improve the health and wellbeing of our communities. They provide recreational opportunities on local and regional scales, promoting physical health and social interaction. They are also important amenity areas which add value to the urban form; as they have a cooling effect in urban settings. Environmental benefits include reducing erosion through stabilising of soil on steep slopes, and removing sediment and filtering nutrients from runoff water.

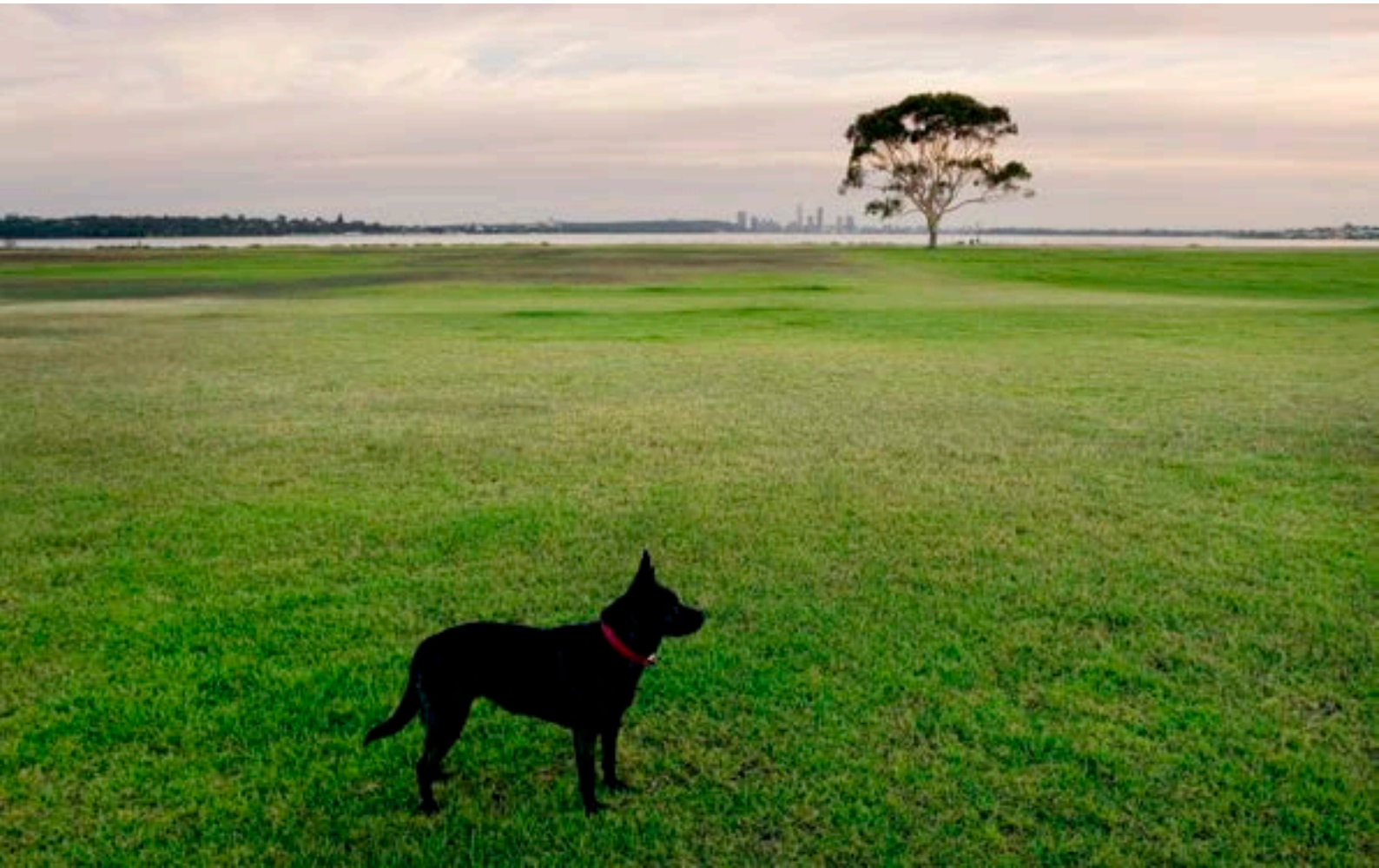
The sustainable management of turf grass areas is more crucial than ever, as a result of variable climate, availability of fresh water, and more stringent environmental requirements. Turf grass areas have the potential to contribute to environmental degradation if they are inappropriately managed.

Nutrients are essential for plant growth and establishing and maintaining turf grass areas. However, excess nutrients in soil and irrigation water can leach into our surface water and groundwater. This has the potential to cause eutrophication (nutrient enrichment), algal blooms and fish kills in rivers, estuaries, lakes and wetlands, and can affect aquatic life and water users. High levels of nutrients in groundwater can also prevent its use as a domestic or agricultural water supply. Chemicals such as pesticides and wetting agents are sometimes required to maintain adequate turf, however, if they are used inappropriately, they can affect ecosystem functioning.

1.1 Purpose of these guidelines

This document provides industry best management practice guidelines for turf grass areas in Western Australia. It is not intended to be a guide on how to grow turf, rather provide information on environmental issues associated with the establishment and maintenance of turf grass areas. Highlighting potential environmental problems associated with inefficient practices encourages improved industry practice which then improves outcomes for public health and protection of the environment.

Various sectors and practitioners in the turf industry have developed codes of practice and industry certification frameworks (e.g. Irrigation Australia) and this is commendable. These guidelines are intended to complement existing frameworks. Turf industry and irrigation sectors that do not have best management practice standards should consider adopting the guidance provided in this document.



These guidelines are designed to improve the management of turf to avoid negative impacts of turf management and are not intended to restrict the role of the use of turf grasses for beneficial uses.

The guidelines:

- promote responsible use of fertiliser and water on irrigated turf grass areas in accordance with sustainable best management practices to provide benefits to environmental, social, cultural and economic values;
- protect public health and the environment by ensuring adequate management measures are in place;
- support the objectives of the Fertiliser Partnership 2012–16 in terms of reducing nutrient loss into aquatic ecosystems from fertilisers;
- provide advice on best management practices that can be implemented by the turf industry to meet relevant legislation and follow approval processes;
- promote consistent and sustainable practices throughout the turf industry;
- protect the interests of turf managers, industry and other fertiliser user groups by outlining their obligations and responsibilities while establishing and managing irrigated turf grass areas; and
- provide guidance on best management practices to local and state government agencies and other interested fertiliser user groups.

1.2 Scope

These guidelines provide advice on fertiliser and water use on irrigated turf grass areas in Western Australia and should be used by:

- the turf and irrigation industry
- land developers and their contractors
- state and local government and their contractors
- administrators and managers of large irrigated turf grass areas.

Irrigated turf grass areas may include:

- parks and other public open spaces (e.g. recreation and nature spaces)
- sports and recreational grounds (e.g. playing fields, golf courses, bowling greens and tennis courts)
- commercial landscapes (e.g. building, shopping and tourist complexes)
- turf farms.

These guidelines provide advice on best management practices and considerations for irrigated turf grass area management, but they are not legally enforceable.

The guidelines are not intended to provide comprehensive advice on the use or management of recycled wastewater, compost or green waste. Although these topics are referred to in this document, contact the relevant local government authority or industry association for further guidance (Appendix 6).

New developments, redevelopments and proposals to change land uses are dealt with by the Department of Planning and the relevant local government.

The Swan River Trust is responsible for managing and approving development in the Trust's Development Control Area (section 3.2.2).

The Department of Water is responsible for managing the state's water resources such as our waterways and public drinking water source areas. Specific requirements apply for irrigated turf grass areas in public drinking water source areas. These requirements are outlined in section 3.2.1.

The Department of Water also issues permits for constructing dams and licences for drilling bores and abstracting groundwater and surface water within areas proclaimed under the *Rights in Water and Irrigation Act 1914*. Turf grass areas greater than 0.2 ha generally require a licence. Areas smaller than this are

exempt from licensing, unless the bore is artesian. This exemption commonly applies to lawns and gardens for domestic or household use.

Local water supply strategies (e.g. North West Corridor Water Supply Strategy) have been developed by the Department of Water in consultation with the community to efficiently use available water resources and to ensure the orderly and equitable allocation of water in areas where groundwater availability is limited. Specific public open space design criteria and reduced irrigation rates commonly apply in these areas.

More information regarding water licensing, exemptions and local water supply strategies can be found on the Department of Water's website at www.water.wa.gov.au.

The Department of Environment Regulation is responsible for protecting the environment under the *Environmental Protection Act 1986*. This department may license premises where prescribed activities are undertaken. The requirements for siting irrigated turf grass areas in environmentally sensitive areas are outlined in section 3.2.

1.3 Fertiliser Partnership

On 1 January 2011 the Environmental Protection (Packaged Fertiliser) Regulations 2010 came into effect, limiting the amount of phosphorus in domestic use lawn fertilisers to a maximum of 1% (previously up to 5%) and domestic use garden fertilisers to a maximum of 2.5%. The amount of phosphorus in garden fertilisers was further reduced to 2% from 1 January 2013.

Limiting the phosphorus content in domestic use fertilisers is one part of the overarching Fertiliser Partnership, launched by the Western Australian Government in 2012. The Fertiliser Partnership recognises:

1. the value and importance of maintaining and improving the health of aquatic environments for the benefit of current and future generations of Western Australians;
2. that the production of agricultural goods and services is essential to society; and
3. that the enjoyment of household gardens, parks and recreational grounds is central to the lifestyle of Western Australians.

These guidelines are strongly aligned to the Fertiliser Partnership and the collaborative effort being taken with the fertiliser industry, fertiliser user groups and peak non-government organisations to foster a cooperative working relationship to reduce fertiliser nutrient loss to aquatic environments.

1.4 Turf research

Information contained within these guidelines is supported by scientific research undertaken in Western Australia.

The Chemistry Centre of Western Australia was influential in developing guidelines for the use of phosphorus in fertilisers, based on the investigation by David Allen and Bob Jeffery titled 'Methods of Analysis of Phosphorus in Western Australian Soils', released in 1990. From this research, the Phosphorus Retention Index was developed and it remains an important benchmark for phosphorus fertilising on sandy soils.

The Turf Irrigation and Nutrient Study (TINS) was initiated in 1990 and culminated in the publication of a reference manual by the Royal Australian Institute of Parks and Recreation in 1996. This was based on a three-year research project led by Ken Johnston into the nutrient and irrigation requirements of turf on the Swan Coastal Plain. The TINS project developed important guidelines to minimise the environmental impact of turf management.

In 1995, the University of Western Australia established the UWA Turf Industries Research Steering Committee to guide their turf research program, led by Professor Tim Colmer. The UWA Turf Research Facility was established at Shenton Park in 1997. The first major research project was 'Water Use and Drought Tolerance in Turf Grasses' by Digby Short, completed in 2001. The findings of this research are still used as the benchmark for turf water requirements in the Perth region. Other notable turf research at UWA

related to nutrient and irrigation management has been undertaken by Associate Professor Louise Barton. These projects include ‘Turf Grass Production on Sandy Soils’, completed in 2005, and the ‘Kikuyu Turf Research Project’, completed in 2008.

1.5 Guideline review

These guidelines are dynamic and will be reviewed as emerging information and research into cultivation techniques is expanded and the environmental impacts from turf growing are further understood.

2. HOW TO SEEK APPROVAL FOR NEW OR EXPANDING TURF FARMS AND IRRIGATED TURF

2.1 Seeking approval

A proponent seeking approval for a new turf farm or other irrigated turf or the expansion of an area should contact the relevant local and state government agencies, or other relevant agencies if required, to establish the specific requirements for the proposed development (see Table 1). The proposed development must be consistent with the local planning scheme and local laws, and comply with relevant state government legislation and policy.

The contact details for the state government agencies listed in Table 1 are provided in Appendix 5.

Irrigated turf is commonly used in public parklands. The land and water use planning requirements for and definitions of parklands are provided in the Public Parkland Planning and Design Guide (WA), which was released by the Department of Sport and Recreation in March 2014. This guide provides information on:

- land and water use planning in relation to parkland planning;
- objectives and guiding principles in land allocation and water planning (e.g. water allocation, water use options and efficiency, and community needs); and
- parkland design.

Case studies demonstrating how these objectives and principles are applied in Western Australia, and a list of relevant policies, strategies and other guidelines, are also provided in the 2014 guide. This may also be relevant to the turf industry.

The Public Parkland Planning and Design Guide (WA) also provides information on sourcing water for irrigation of parklands. This includes fit-for-purpose water supply options such as stormwater harvesting, use of treated wastewater, and managed aquifer recharge, and obtaining approval for the use of non-drinking water schemes.

Table 1: Approvals required when establishing and/or maintaining turf

Approval required	Comments	Agency	Relevant Acts (there may be others)
Development	Will require approval under the relevant local planning scheme (including special control areas) and local by-laws	Local government	*Planning and Development Act 2005* *Swan Valley Planning Act 1995*
	May require approval under the relevant state government planning legislation and policies	Department of Planning/ Western Australian Planning Commission	*Planning and Development Act 2005* and relevant policies
	Relevant if the development is in the Swan River Trust's special control area, which is known as the Trust Development Control Area	Swan River Trust	*Swan and Canning Rivers Management Act 2006*
	Redevelopment projects in Armadale, Midland, Subiaco and East Perth	Metropolitan Redevelopment Authority	*Metropolitan Redevelopment Authority Act 2011*
Environment	Development on sites that are classified as part of the *Contaminated Site Act 2003*	Department of Environment Regulation	*Environmental Protection Act 1986* *Contaminated Sites Act 2003*
	Native vegetation protection (native vegetation clearing permits)	Department of Environment Regulation	Part V of the *Environmental Protection Act 1986* and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004
	Development of a site within a mapped acid sulphate soil risk area	Local government or Western Australian Planning Commission (on advice from Department of Environment Regulation)	*Contaminated Sites Act 2003*
Development near proclaimed water resources such as public drinking water source areas or waterways	Turf farms and irrigated turf areas are in general considered incompatible in Priority 1 and Priority 2 areas, and compatible with conditions in Priority 3 areas (see for more detail in section 3.2.1)	Department of Water	M*etropolitan Water Supply Sewerage and Drainage Act 1909* *Country Areas Water Supply Act 1947* *Water Agencies (Powers) Act 1984* *Waterways Conservation Act 1976* *Water Services Act 2012* *Rights in Water and Irrigation Act 1914*
	Turf farms and irrigated turf areas are in general unacceptable within buffers to waterways		

Approval required	Comments	Agency	Relevant Acts (there may be others)
	Through the *Water Agencies (Powers) Act 1984,* the Department of Water leads water management in Western Australia by coordinating cross-government efforts to protect and manage water resources		
	Pesticide use in public drinking water source areas needs to be assessed by the Department of Water, unless undertaken in accordance with the Department of Health Public Sector Circular (PSC) 88: Use of Herbicides in Water Catchment Areas		
Development near wetlands	Turf farms and irrigated turf areas are generally not acceptable within vegetated buffers to wetlands	Department of Environment Regulation	Part V of the *Environmental Protection Act 1986* and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004
Permit to drill a bore or licence to draw water from proclaimed surface water and groundwater resources	Required to drill a bore and draw water from a proclaimed groundwater area or if drawing from an artesian aquifer	Department of Water	*Rights in Water and Irrigation Act 1914* *Water Services Act 2012*
	Required to draw water from a proclaimed surface water catchment		
Land clearing	Clearing of native vegetation is regulated under the *Environmental Protection Act 1986*	Department of Environment Regulation	Part V of the *Environmental Protection Act 1986* and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004
	Special native vegetation clearing controls exist for the Wellington Dam Catchment Area, Harris River Dam Catchment Area, Mundaring Weir Catchment Area, Denmark River Catchment Area, Kent River Water Reserve, and Warren River Water Reserve	Department of Water	*Country Areas Water Supply Act 1947*
Aboriginal heritage (especially in high risk areas such as native bush or near watercourses)	Aboriginal sites must be protected	Department of Aboriginal Affairs	*Aboriginal Heritage Act 1972*

2.2 Lodging an application form

2.2.1 Local government

The development applications, forms and support documents should be submitted to your local government authority for consideration and distribution to the relevant state government agencies. Visit your local government authority's website to obtain the required application forms, or contact them directly.

2.2.2 State government agency

Contact the relevant state government agency when seeking approval for:

- clearing native vegetation;
- abstracting water from a proclaimed surface or groundwater resource;
- applying for a beds and banks permit;
- applying for a permit to construct or alter a bore or well; or
- establishing a turf farm or irrigated turf grass areas in or near an environmentally sensitive area; for example:
  - public drinking source area
  - Swan River Trust Development Control Area
  - wetland
  - managed waterway
  - contaminated site
  - Aboriginal significant site
  - heritage listed site
  - other special control area.

The relevant application forms are provided on the website of the relevant state government agency (see Appendix 5).

2.2.3 Information to support an application

To assist in a timely application assessment process, information in addition to the completed application to local and state government (unless already provided in the application form) should also include:

1. location, size of area, and type of turf area;
2. existing development and activities on site;
3. information on if the site is located in a special control area (e.g. Trust Development Control Area, public drinking water source area, clearing control area, or protected wetland area);
4. a map to scale of the property on which the turf farm or turf grass area is to be located. This map should include (drawn to scale):
   - a the lot and house number(s);
   - b lot size;
   - c road names;
   - d applicant's details;
   - e the area and measurements/size of the proposed turf farm or irrigated turf grass area, and areas of initial and ultimate planting;

f distance to any nearby wetlands, surface streams, waterbodies and drains of the proposed farm or grassed area;

g any existing or proposed new bore, well or excavation to access groundwater;

h any existing or proposed draw point for abstracting surface water;

i any areas of remnant native vegetation;

j proposed land clearing;

k areas for any proposed storage of fertilisers/chemicals/machinery;

l scale;

m legend; and

n north point.

5. if the site is located in a public drinking water source area, provide information on the priority area (priority 1, priority 2 or priority 3), and the location of any known public production bores, reservoirs, dams, wellhead protection zones or reservoir protection zones in proximity of the proposed farm or turf grass area (see section 4).
6. soil types;
7. fertiliser application rates (type and frequency of application);
8. proposed pesticide use on the irrigated turf grass area;
9. possible land clearing;
10. depth to groundwater table underneath the proposed site;
11. any intention for groundwater abstraction or installation of drainage; and
12. identification of any Aboriginal archaeological sites or other cultural or scientifically significant areas.

Additional information may be required during the assessment process by the relevant agency.

A proposed turf farm that appears likely to have a significant impact on the environment may be referred, by local government, members of the public, or other bodies, to the Office of Environmental Protection Authority and may be assessed under Part IV of the *Environmental Protection Act 1986*.

2.3 Requirements for turf farms or irrigated turf areas

Depending on the location and extent of the proposal, the proponent may be required to prepare the following documents or information to the relevant department when submitting an application:

- **Nutrient and irrigation management plan (NIMP)**. A NIMP may be required for large-scale developments or developments in environmentally sensitive sites (e.g. in a public drinking water source area). A NIMP can assist in minimising water wastage and fertiliser losses when establishing or growing turf grass areas. Detailed information about NIMPs is provided in the Department of Water's Water Quality Protection Note No. 33: Nutrient and Irrigation Management Plans and Water Quality Information Sheet No. 4: Nutrient and Irrigation Management Plan Checklist. These documents are available from the Department of Water's website.
- **Constructing or altering a bore or well.** A permit will be required to construct or alter a bore, well or excavation to access groundwater from a proclaimed or artesian groundwater source. The applicant should visit the Department of Water's website, or contact their regional office to find out their statutory obligations in constructing the bore or well.
- **Abstracting groundwater and surface water.** A licence will be required to abstract water from a proclaimed surface water source or from a proclaimed or artesian groundwater source. The applicant should visit the Department of Water's website, or contact their regional office to find out their statutory obligations and if sufficient water is available.

- **Disturbing or interfering with the bed or banks of a watercourse**. Under the *Rights in Water and Irrigation Act 1914*, permits are required for all activities that modify bed and banks of watercourses in proclaimed water resource management areas and in unproclaimed areas where access to a watercourse is via a public road or reserve. These activities have the potential to alter the flow regime, cause erosion and adversely impact on other users and the local vegetation and faunal communities relying upon it. The applicant should contact the Department of Water to determine if a permit is required.
- **Clearing of native vegetation**. Clearing of native vegetation and removal of natural habitats for fauna is a significant environmental issue in Western Australia. The clearing of native vegetation is primarily authorised by the granting of a permit under the *Environmental Protection Act 1986* administered by Department of Environment Regulation. Special clearing controls also exist in six water catchments under the *Country Areas Water Supply Act 1947* (see Table 1). A licence may be required for the clearing of native vegetation in these catchments. Proponents should contact the Department of Environment Regulation or Department of Water to ascertain whether a permit or licence is required.
- **Establishing a turf farm or irrigated turf area on land that has been (or is proposed to be) classified under the *Contaminated Site Act 2003*.** This may require the submission of site specific reports with the development application form. Contact the Department of Environment Regulation for further advice.

3. SITE SELECTION

Appropriate siting is an essential part of minimising the environmental and social impact of turf growing. Turf that has regular inputs of water, fertiliser or pesticides should be sited away from environmentally sensitive areas such as public drinking water source areas (PDWSAs), Swan River Trust's Development Control Area (DCA), stock water supply areas, waterways and wetlands, and social areas such as housing.

The most important site selection factors that should be considered are:

- location of turf grass area, as limitations may exist in environmentally sensitive areas or special control areas;
- soil type, as this affects the amount of nutrients and other chemicals required to establish and maintain the turf and grassed area; and
- separation distances between the site and sensitive environment (where turf farms and irrigated turf is supported) to provide a buffer that will help minimise any impacts on the environment.

3.1 Soil types

Many of the sandy soils on the Swan Coastal Plain and in south-west Western Australia have a low Phosphorus Retention Index (PRI). This is a measure of the soil's ability to hold on to phosphorus. When making decisions on turf nutrition it is important to undertake a soils test which will indicate how much plant-available phosphorus is in the soil for the plant to access. If the phosphorus soil results are low, then a leaf tissue analysis, as detailed in Section 6.4, can be used to determine whether the plant is accessing enough phosphorus to maintain sufficiency levels.

Sandy soils generally have a low PRI so if a soil analysis shows the soil phosphorus is below the sufficiency level or close to it, then a small amount of phosphorus can be added safely as detailed in Section 6.5. If a soil is very sandy, then the phosphorus will need to be in the soil solution around the root system (mixture of solutes and water) for the plant to take it up. Inert sand has little or no ability to hold on to nutrients; as a result, nutrients not held in the free water at field capacity will not be taken up by the plant. Soil amendments that enhance the water holding capacity of the soil also increase the PRI.

Soils such as sandy loams and clay loams contain greater amounts of iron and aluminium oxides and have greater PRIs. Ideally, soils should have a PRI above 10. Sandy soils on the Swan Coastal Plain often have levels far lower than 10 and the only way that these levels can be increased without soil amendments is through organic matter accumulating over time, forming what is known as a mat layer. Mat is a layer of humus under the turf surface, increasing the nutrient and water holding capacity of the soil and therefore increasing phosphorus retention. In a park with a thick mat layer, the PRI may get up to 10 or just above.

Heavy soils such as clay have a slow infiltration rate and, when the precipitation rate (rainfall or irrigation) is higher than the infiltration rate, water will run off the surface taking soil particles with it; a process called erosion. Attached to the soil particles are nutrients including phosphorus, which can enter surface water and cause eutrophication.

PRI is calculated in the laboratory by simply adding a known amount of phosphorus prior to extracting the soil and measuring the amount of phosphorus in solution.

There are many different phosphorus extracting methods. Therefore, it is a matter of selecting the most appropriate method for your site for recording the phosphorus trends over time. Different methods will have different results; that is why it is important to use the same method to establish the phosphorus trend over time. Tissue analysis should be used to support the results and decisions in phosphorus applications.

Documented evidence shows nitrogen has an impact on groundwater (aquifers) and surface water, and can contribute to outbreaks of algal blooms (Swan River Trust 2005). Nitrogen, in particular nitrate, is prone to leaching on the coarse sandy soils of the Swan Coastal Plain. In similarity to phosphorus, high application rates of nitrogen and over-watering combine to increase the detrimental impact on the environment. Unnecessary nitrogen application rates have an almost immediate visual impact on the turf.

However, excessive leaf growth requires additional management resources for activities such as mowing, turf renovation and watering to keep the turf in suitable condition for its purposes. Such management activities have a direct impact on operational labour skills, fuel and power costs, and contribute carbon emissions and fossil fuel pollutants to the environment.

When selecting sources of nitrogen to apply, it is important to understand that organic and inorganic nitrogen have the potential to leach and it is essential to know how much nitrogen is being applied as a percentage of weight of the product applied.

Barton and Colmer (2008) stated in their final report that during leaching trials, if they had only measured inorganic nitrogen, leaching losses would have been underestimated by up to 57% for the older turf grass and 48% for the younger turf grass.

3.2 Environmentally sensitive areas

3.2.1 Public drinking water source areas

Public drinking water source areas include the catchment area of surface water sources (including reservoirs) and the recharge area of groundwater sources (including borefields) that are used for public drinking water supplies. These areas are proclaimed as water reserves, catchment areas or underground water pollution control areas under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, or water reserves or catchment areas under the *Country Areas Water Supply Act 1947*. These Acts provide the foundation necessary to legally define the boundary of the drinking water source. They also provide by-laws which allow the state to protect the water quality of these sources.

The Department of Water prepares drinking water source protection reports for all PDWSAs in the state. The reports provide information about the contamination risks within PDWSAs and recommend protection strategies (within priority P1, P2 and P3 areas and protection zones) to control those risks. Land planners, owners and developers need to be aware of the location of and risks to water quality in PDWSAs when selecting a site for the establishment of turf.

According to the department's policy and Water Quality Protection Note No. 25: Land Use Compatibility in Public Drinking Water Source Areas 2004, turf farms are:

- incompatible in P1 and P2 areas; and
- considered compatible with conditions in P3 areas.

Turf farms and irrigated turf grass areas are not considered compatible in any wellhead protection zone or reservoir protection zone in a PDWSA.

Turf grass areas not exceeding 500 m^2 for a rural or semi-rural residence in a P2 area is considered acceptable, in keeping with the ability to have a garden. Special requirements for the Jandakot Underground Pollution Control Area are provided in the WA Planning Commission's State Planning Policy 2.3: Jandakot Groundwater Protection Policy.

The proclaimed PDWSAs in Western Australia are listed in Water Quality Protection Note No. 75: Proclaimed Public Drinking Water Source Areas. PDWSAs and their assigned priority areas can be viewed on the Department of Water's Geographic Data Atlas. Information on priority areas and protection zones and the compatibility of different land uses and activities within PDWSAs is provided in Water Quality Protection Note No. 25: Land Use Compatibility in Public Drinking Water Source Areas. All this information is available on the Geographic Data Atlas, and relevant drinking water source protection reports are available from the Department of Water's website (see contact details in Appendix 5).

3.2.2 Development Control Area — Swan River Trust

The Development Control Area (DCA) administered by the Swan River Trust includes the waters of the Swan and Canning rivers and adjoining parks and recreation reservation areas. Land planners, owners and developers need to be aware of the locations and the appropriate approval process for proposed development in the DCA.

The Trust has overall planning, protection and management responsibility for the Swan and Canning river system under Part 5 of the *Swan and Canning Rivers Management Act 2006*. The Trust provides advice, makes recommendations to and comes under the jurisdiction of the Minister for the Environment.

The Swan River Trust Development Control Procedures (2007) provide guidance to local government, public authorities and other stakeholders on the statutory planning changes in the *Swan and Canning Rivers Management Act 2006*, and the consequential effects on other planning legislation.

A map of the DCA can be viewed on the Swan River Trust's website at www.swanrivertrust.wa.gov.au.

3.2.3 Other Development Control Areas

Other state and local government agencies may administer similar Development Control Areas. Land planners, owners and developers should contact the relevant agencies (e.g. local government agency, Department of Environment Regulation, or Department of Fisheries) or visit their websites to ensure all relevant information is taken into consideration when completing a development application.

3.2.4 Separation distances to environmentally sensitive areas

Water resources can be contaminated from materials including sediment (soil particles), nutrients, salt, litter, chemicals and microbes. These can be carried via surface runoff into reservoirs, waterways and wetlands and soluble components can also move through the soil profile and contaminate groundwater.

Well vegetated filter strips such as native grasses and reeds along waterways downstream of irrigated turf can reduce the impact of nutrients, microbes and sediment losses from surface runoff. The selection of suitable native plants for the vegetation strips will determine the effectiveness of filtering the sediments and nutrients.

Separation distances are established for a number of purposes including:

- maintenance of ecological processes and major food webs and habitats for native fauna;
- protection from nutrient inputs that could lead to eutrophication or lower water quality in the water resource;
- protection from increased salinity, turbidity, pathogens or chemicals that could affect the quality of water;
- flood and erosion control; and
- prevention of livestock grazing and trampling of vegetation which increases the likelihood of weed invasion and suppresses regeneration of native species.

The size of the separation distance depends on the purpose for its establishment and will be influenced by factors such as:

- soil type and infiltration rate of the soil;
- types of fertilisers and chemicals used;
- type and density of vegetation and how effective it is at stabilising the ground;
- slope of area;
- nutrient retention ability (e.g. PRI of the soil);
- travel time (for groundwater systems);
- intensity of development;
- environmental values of the water resource (water quality required to be maintained for downstream uses); and
- purpose that the resource is used for (i.e. public drinking water source area as opposed to water used for irrigation).

Sites located on sandy soils with low nutrient retention ability (a low PRI) or on steep slopes are likely to have an increased amount of nutrient runoff. In these situations separation distances need to be greater to reduce the amount of nutrients entering waterbodies. Similarly, if the environmental values of the water resource are significant, separation distances are likely to be greater to ensure that nutrients are assimilated prior to entering the waterbody.

Separation distances may not be a consistent strip of set width along a watercourse, estuary or wetland as they will vary according to their function and the above factors.

The required separation distances are generally recommended by the Department of Planning, Department of Water, Swan River Trust and local government authorities through the land planning process, and/or the Department of Environment Regulation through the land planning process or works approvals issued under Part V of the *Environmental Protection Act 1986*, or the Office of the Environmental Protection Authority via the environmental impact assessment process under *Part IV of the Environmental Protection Act 1986*.

Retaining and using low water use plantings of local native species, grouped according to water requirements (hydrozone) and nutrient requirements, can serve as a separation between turf and environmentally sensitive areas to improve water use efficiency and reduce nutrient losses.

3.2.5 Native vegetation

Native vegetation is an important component of aquatic ecosystems. This vegetation has an important role in nutrient stripping, bank stabilisation and wildlife habitat. Generally, native vegetation that is selected for the specific site conditions will provide long-term and environmental benefits, require little to no supplementary nutrients or water, and contribute to local biodiversity and amenity. Over time these landscapes can also establish a local ecosystem without further maintenance.

Existing native vegetation should be retained to protect environmental values of waterways, wetlands and environmentally sensitive areas.

Native vegetation buffers can be used as a protective measure between drinking water resources and land use activities. The retention and, where practical, re establishment of these buffers is recommended in environmentally sensitive areas.

Additional information on establishing native vegetation and managing buffers is available from references listed in Appendix 4: Further reading.

4. TURF ESTABLISHMENT METHODS

Establishment of turf grass areas can take several months. This is a critical stage for both the turf and the environment because the root system is immature and has minimal water and nutrient collection capacity. It is important to apply the correct balance of water and nutrients so that a suitable root system can be quickly established without having nutrients leach past the root system. Grass or other vegetation coverage is also very important to minimise the runoff from bare earth areas that may carry soil particles, resulting in turbidity in our surface waters.

4.1 Seeding and stolonisation

Seeding and stolonisation involves the establishment of grass from scratch using either seed or vegetative material in the form of shredded turf. These methods offer substantial cost savings compared to instant turf; however, the establishment period is much longer and there are greater potential risks to the environment. The typical establishment period for seeding and stolonisation is from four to six months to obtain full grass coverage, but may be longer depending on the conditions. As a result, these methods have significantly higher water and fertiliser requirements than instant turf, and are far more prone to nutrient leaching. There is also the risk of weed invasion and the loss of surface levels before the turf has covered the land area.

4.2 Instant turf

Instant turf is laid in rolls of well developed grass. This method provides an immediate grass cover and has a short establishment period of less than one month for the root system to stabilise the turf roll. Instant turf will take up water and nutrients at an earlier stage than with seeding or stolonisation, because the leaf and root development is more advanced. Turf rolls also contain nutrients in the organic soil layer; the level of phosphorus in this layer should generally be sufficient to meet the needs of the turf in the first months following placement.

5. TURF IRRIGATION

Irrigation is essential for turf maintenance in Western Australia, due to the strongly seasonal rainfall pattern and high evaporation rates. For example, in the Perth region, about 80% of the annual rainfall occurs generally between May and September, while the average total net evapotranspiration from October to April is almost 1500 mm. Irrigation is usually applied in all but the winter months (June to August). Good irrigation management will make the most efficient and effective use of the available water resource that still allows maximum nutrient uptake by the turf.

5.1 Factors affecting water requirements

The following factors influence the water requirements of turf:

- evapotranspiration rate
- rainfall
- shade
- turf wear
- desired turf quality
- turf species
- mowing height
- soil structure
- soil nutrient levels.

Research shows that there is a direct correlation between grass shoot length and plant water demand, and raising the mowing height increases turf water use (Colmer 2011). Mowing heights between 10 and 20 mm are best from a water conservation perspective. There is also a relationship between turf growth rate and water demand, with higher nutrient levels in the turf leading to increased water uptake (Barton 2008).

5.2 Irrigation scheduling

The quantity and frequency of the water application to a turf area should reflect the moisture lost through the day by evapotranspiration. Average daily evapotranspiration rates for Perth are shown in Table 2. In the period May to August in Perth, rainfall normally exceeds evaporation. Turf water requirements for warm season grasses are typically 50–60% of the evaporation rate, although this is site specific.

Table 2: Average daily evaporation rates for each month in Perth (in millimetres)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
10.1	9.6	7.8	5.0	3.0	2.2	2.1	2.6	3.6	5.3	7.4	9.0

Source: Bureau of Meteorology data for Perth Airport (Site 009021) extracted 8 April 2014

The physical structure of the soil dictates the water holding capacity and therefore the reserve of water that is available to the plants. Irrigation should aim to provide water to the root mass, most of which is located in the upper 200 mm of soil. Water that penetrates below this depth is effectively not available to the plant. The application rate should be such that the turf uses all the water applied to produce the required surface.

Water should be applied between 6 pm and 9 am to minimise evaporative losses. The optimum timing of watering is early in the morning, just as the turf starts to take up water after sunrise; however, wind conditions at the time of watering are an important consideration to obtain the most uniform distribution of water. Turf managers should incorporate efficient watering practices into their operations as a primary consideration. Water requirements should be determined for each location as each will have site specific variations. The following points provide general guidance on water requirements.

1. Create a monthly water budget based on:
    - turf type and micro-climate factors;
    - water holding capacity of the soil; and
    - effective root zone depth of the turf.

    The water budget needs to remain within the limits of the licensed water allocation.
2. Create a monthly base irrigation schedule where the frequency of irrigation is informed by soil moisture content, water infiltration rate and historical evapotranspiration data.
3. Compare actual water use to the budgeted amount for the month and modify the schedule to stay within the monthly budget.
4. Monitoring of the soil moisture content will detect excess or insufficient water application and can guide the irrigation schedule. Probes that measure at several depths give an understanding of the entire soil moisture profile.
5. The effect of moisture on turf surface condition can also be assessed by factors such as appearance (discolouration, dry patches, wilting), quantity or weight of clippings removed and frequency of mowing needed to maintain a specific grass length.
6. Rainfall should be deducted from the amount of water applied and, on some occasions, the irrigation system may be switched off. A rain shut-off device can be installed to stop irrigation during and directly after a considerable rainfall event (>5 mm). This can save water (and money), and reduce the leaching of nutrients to the environment.

5.3 Irrigation system design

Correct calculations on performance are important considerations in the design of the irrigation system. The following points provide guidance on irrigation design.

The irrigation system should:

- be designed by an irrigation designer certified by Irrigation Australia Limited;
- be installed according to design specifications;
- be designed specific to the site;
- be efficient by distributing water evenly (a lower quarter distribution uniformity of greater than 75% or greater is recommended);
- be designed to eliminate overspray;
- apply water at different rates to different areas (hydrozoning); for example, to each different type of turf area separate to garden beds and tree plantings. This means that all plantings with the same water requirement would be grouped to common stations and watered at their appropriate frequency;
- apply large water droplets to reduce evaporation and wind effects but not so coarse as to compact soil and damage plants;
- use a flow meter to measure both water flow rate and cumulative volume. A meter with a flow rate output signal that can link to the controller will help detect leaks and manage water use. Master valves can be used to stop unscheduled flow of irrigation water;
- have defined precipitation rates for each station;
- use the selection and placement of sprinklers guided by the expected size and type of turf use;
- consider site specific irrigation intervals and irrigation duration requirements (e.g. public playing fields);
- use filtration to remove particulate matter;
- keep the sprinkler precipitation rate less than the infiltration rate of the soil;

- use a site map showing the location of each point of connection, meter, backflow prevention device, controller, station/zone valves, and area served by each valve;
- avoid a mix of sprinkler types, brands or precipitation rates and operating pressures within any sector of an irrigation system; and
- be maintained so that the hydraulic balance is not compromised and the precipitation rate, on which the system has been designed, is maintained.

5.4 Maintenance of the irrigation system

Irrigation systems need to be regularly maintained to preserve the integrity of the design and to sustain efficient operation. The following points address maintenance issues that need to be routinely checked.

- Establish an inspection schedule for maintenance:
  - Verify that the controller is operating properly.
  - Verify that sensors are working properly and are calibrated.
  - Verify that emitters are properly adjusted.
  - Repair or replace broken hardware; restore the system to its design.
  - Complete repairs as soon as possible to minimise water wastage.
  - Test all repairs.
- The flow and operation of each sprinkler should be checked for deposit, build-up or wear, rotation speed, water flow adjustment and direction of throw.
- Operational pressures for each station should be checked and accurately recorded. Inspecting water distribution lines when they are under pressure will help find ruptures in the pipes.
- Test run each segment of the system for the minimum extent necessary while the irrigation system is being installed, maintained, tested or repaired. The recommended run time is two minutes per station over the winter sprinkler ban period for maintenance purposes. Signage that states that testing is in progress should be displayed.
- Complete a full audit every three to five years to ensure the system is working efficiently with the desired distribution uniformity and precipitation rate. Irrigation system performance should be audited by an irrigation professional certified by Irrigation Australia Limited.
- Replace hardware to match the existing hardware to ensure distribution uniformity and precipitation rates are maintained.

5.5 Alternative water sources

There should be a re-appraisal of irrigation water source opportunities every few years as water needs, availability and technology changes occur. Turf irrigators must be proactive in this regard, and be aware of what is happening within and outside their areas of management.

Groundwater is the most common water source for irrigation. Other alternatives, even used on a temporary basis, may prove to be cheaper, more productive and more environmentally friendly (e.g. re-use of treated wastewater outside environmentally sensitive areas). Collection of nutrient-enriched water on site or nearby may be an alternative to consider. High nutrient water must be used in conjunction with a comprehensive nutrient irrigation management plan developed for each site.

When using alternative water resources, also known as fit-for-purpose water supply options, such as stormwater harvesting, use of treated wastewater, and managed aquifer recharge, a number of regulatory requirements need to be considered prior to using non-drinking water systems for irrigating turf. Guidance on fit-for-purpose supply options is provided in the Department of Water's Guideline for the Approval of Non-drinking Water Systems in Western Australia: Urban Development. This document is available on the Department of Water's website www.water.wa.gov.au.

5.6 Use of soil wetting agents

Turf grown on sandy soil types is prone to becoming extremely water repellent. Wetting agents overcome hydrophobic conditions by reducing the surface tension of water and increasing the adsorption of water on soil particles. This improves the infiltration rate into the soil and will reduce ponding and the surface runoff of applied water. Research has found that applying a soil wetting agent that reduced the severity of water repellency in summer also improved turf colour and growth with the same amount of irrigation (Barton & Colmer 2011).

To reduce the severity of soil water repellence over the course of the irrigation season, a soil wetting agent should be applied at the commencement of the season, with a follow-up application made three to four months later in the middle of the season.

Wetting agents come in both granular and liquid forms. The granular forms may be applied to dry turf and irrigated at a later stage, whereas liquid forms should be soaked thoroughly into the soil at the time of application.

The recommended application rates will vary between products and label requirements should always be checked.

5.7 Irrigation during establishment

A common mistake made by turf managers during establishment is to over-water. Care must be taken with sandy soils to ensure the correct amount of water is applied. The ‘little and often’ rule should apply to ensure water percolation below the root zone does not occur. Regardless of the establishment technique, the propagation material and new roots should not be allowed to dry out. The water regime should be relatively constant and at a level the developing roots can collect.

6. TURF FERTILISATION

6.1 Understanding fertiliser requirements

Soils of the Swan Coastal Plain are often deficient in the nutrients required for growing turf grass. Nitrogen, phosphorus and potassium are generally applied in the largest quantities with fertilising. Most of the established turf soils contain sufficient phosphorus to sustain normal turf growth, due to a history of fertiliser application. Therefore, phosphorus fertilising is generally not required in mature turf grass situations. Nitrogen fertilising is required for suitable turf growth and colour.

Trace element deficiencies can be a major problem, causing pale coloured and poor turf. Deficiencies occur most often on alkaline sandy soils near to the coast. The elements that are most affected are iron, manganese, and to a lesser extent copper and zinc. Magnesium deficiency may occasionally be a problem. If these elements are deficient, there is no point in adding the major elements of nitrogen and phosphorus as the plants cannot effectively use them. Correcting trace element deficiency on alkaline soils can be difficult due to the poor solubility of these nutrients at high pH. For this reason, trace elements are best applied as foliar sprays on alkaline soils.

Leaf tissue analysis is a management tool that indicates the nutritional needs of a plant and is the only certain way of identifying nutrient deficiencies. Care must be taken with the method of sampling to ensure that results are accurate and comparable. The interpretation of results from leaf tissue analysis is site-specific and it is recommended that a competent professional be consulted to assist in making fertilising decisions.

The following points should be addressed when identifying the nutrient requirements for a site:

1. Visual inspection (colour, density and growth rate) of the turf can often indicate the nutrient status of the turf. For example, turf that is low in nitrogen will appear a pale yellow-green. Leaf tissue analysis can provide accurate data as to the nutrient levels in the turf.
2. Leaf tissue, soil and water should be regularly sampled, analysed and interpreted using accepted guidelines to obtain a complete picture of the status of the nutrient program and turf requirements.
3. It is important to understand the characteristics of fertilisers when determining the appropriate form and rate of nutrients to apply; attention should be given to the turf species, turf use, weather conditions, water availability and soil type.
4. Fertilisers are best applied on the basis of ‘little and often’, when the turf is actively growing and able to absorb the nutrients. This is particularly the case for nitrogen and potassium, as they are more readily leached from the soil due to their high solubility and low retention.

6.2 Types of fertilisers

6.2.1 Inorganic fertilisers

Inorganic fertilisers are manufactured in granular, powdered and liquid formulations. Soluble fertilisers provide a quick release of nutrients into the soil solution and cause a rapid response by the turf. Controlled release fertilisers are not entirely plant available immediately after application, and release nutrients over an extended period of time. It is important to understand the composition of the fertiliser being used and the nutrient release characteristics. The product labels carry important information, including the nutrient analysis, the forms of nutrients, the recommended application rate and directions for usage. Table 3 shows some examples of commonly used inorganic fertilisers.

Table 3: Nutrient analysis of common inorganic fertilisers

Fertiliser	Nitrogen (N) %	Phosphorus (P) %	Potassium (K) %
Sulphate of ammonia	21		
Urea	46		
Superphosphate		9	
Diammonium phosphate	21	23	
Monoammonium phosphate	12	27	
Muriate of potash			50
Potassium nitrate	13		38
Potassium sulphate			41
NK granulated product	15		9
NPK granulated product	12	2	6

6.2.2 Organic fertilisers

Organic fertilisers are derived from plant, animal and human waste, such as mature compost or processed manures. Organic sources undergo microbial breakdown to release nutrients, which is influenced by environmental factors such as moisture and heat. Consequently their rate of nutrient release can be unpredictable.

Mature compost is used as a soil amendment to condition the soil by adding humus and nutrients. The nutrient loading from compost must be included when considering the total amount of nutrients applied to the site. These materials tend to have variable nutrient content depending on the types of ingredients and the level of compost maturity. It is important to know the nutrient analysis of compost, especially the soluble nitrogen and phosphorus. The nutrient content of some organic fertilisers is shown in Table 4.

Table 4: Nutrient content of some organic fertilisers

Fertiliser	Nitrogen (N) %	Phosphorus (P) %	Potassium (K) %
Pelletised poultry manure	3	2	2
Mature fine compost	2.3	0.9	0.4

Note: the nutrient content of organic fertilisers can be variable

6.3 Nitrogen application

Nitrogen is best applied on the basis of ‘little and often’. Table 5 shows guidelines for the nitrogen requirements of various turf grass situations.

The amount of nitrogen applied will depend on the desired turf condition, wear level of the turf, whether soil amendments are used and whether grass clippings are removed or not.

The following factors should be considered when determining the form and timing of nitrogen application:

a Leaf tissue analysis should be used when determining nitrogen requirements. Leaf tissue nitrogen levels should be maintained between 1.7% and 2% for couch and kikuyu on recreational turf situations (Johnston 1996). For sports turf, leaf tissue levels of nitrogen should be maintained between 2% and 3%.

b As the sandy soils of the Swan Coastal Plain are very permeable, the quantity of nitrogen applied in any one application should not exceed 40 kg/ha (Johnston 1996).

c Caution should be used when applying fertilisers in winter due to high leaching with rainfall events. In cool temperatures the rate of uptake by the turf is lower and application rates should be adjusted accordingly.

d Application of nitrogen when the soil is too cold to support active grass growth is wasted. Nitrogen is highly mobile in the soil, so applications not absorbed by the turf may be lost from the root zone.

e The amount of nitrogen applied should reflect the quality and density of turf grass surface required. In general, the better the surface condition needed for a particular use, the more frequent the mowing and the more nitrogen that is needed.

f Nitrogen leaching from turf is low for all fertiliser types when the irrigation matches turf water use and the nitrogen is applied at a rate and frequency that approximates the turf's requirements (Barton 2006).

Table 5: Annual nitrogen requirements

Turf Category	Nitrogen (kg/ha/year)
Grass buffers	0
Minor passive turf	0-50
Low use active and premium passive turf	50-100
High use active turf	100-200

Note: the annual rates of nitrogen should be used as a guide only. The maximum rate of nitrogen in a single application should not exceed 40 kg/ha

6.4 Phosphorus application

To achieve the optimum effect from phosphorus as a turf nutrient, consideration must be given to:

- the level of available phosphorus in the soil;
- the PRI (Phosphorus Retention Index) of the soil; and
- leaf tissue analysis.

Leaf tissue analysis should be used to determine whether phosphorus is needed by the turf. Table 6 indicates the required phosphorus levels as determined by leaf analysis. The maximum amount of phosphorus that can be applied prior to leaching depends on the soil available phosphorus and the PRI (see Table 7). However, the amount required to sustain the turf grass may be a lower level. Established turf grasses are very efficient at using phosphorus and may require no more than 5 mg/kg of phosphorus in the soil.

Table 6: Required leaf phosphorus concentrations (Johnston 1996)

Turf species	Phosphorus concentrations (%) based on leaf analysis		
	Low	Sufficient	High
Kikuyu & Couch	0.15-0.20	0.20-0.40	>0.40

The method used to determine available phosphorus in the soil is important as results from different methods of analysis are quite variable. The recommended technique is the Colwell method. Table 7 gives guidelines for interpreting the Colwell test.

Table 7: Phosphorus application guidelines (Johnston 1996)

PRI (Allen & Jeffery method)	**Available P (Colwell test)**	**Recommendation**
0 or negative	Recommended not to apply P	Do not apply P
0.1 to 0.5	< 5 ppm	Apply up to 5 kg P/ha
	> 5 ppm	Do not apply P
0.5 to 2.0	< 7 ppm	Apply up to 5 kg P/ha
	> 7 ppm	Do not apply P
3.0 to 5.0	< 10 ppm	Apply up to 10 kg P/ha
	> 10 ppm	Do not apply P
> 5.0	< 10 ppm	Apply up to 20 kg P/ha

Each site must be individually assessed to determine the phosphorus needs of the turf. Because of the complexity of the results of leaf tissue analysis, soil analysis and the PRI interaction, it is recommended that a competent professional be consulted to assist in interpreting the results. This will determine the correct use of phosphorus to nourish the turf and minimise waste and subsequent potential for pollution. In any case, phosphorus applications should not exceed 5 kg/ha on soils with a low PRI.

It is important to note that most existing turf soils already contain a surplus of phosphorus (Chemistry Centre 1990). Therefore, phosphorus should only be applied following soil and/or tissue testing. Only as much phosphorus should be applied as is needed to maintain the grass in a healthy state.

6.5 Fertiliser rates

Fertiliser should be applied by a suitably qualified and experienced practitioner, with appropriate training in fertiliser selection, calculating the application rate based on nutrient content, and accurate fertiliser application technique.

6.5.1 Recommended nutrient application rates

The recommended annual rates of nutrient application for different turf grass situations are shown in Tables 5 and 7, taking into account the guidelines for nitrogen and phosphorus application in sections 6.3 and 6.4. These assume adequate buffers to environmentally sensitive areas (see section 3.2).

6.5.2 Guide to applying fertiliser

The following equations can be used to calculate the amount of nutrient in a particular fertiliser:

CALCULATING THE FERTILISER APPLICATION RATE

R = T / F x 100

R: rate of fertiliser (kg/ha)

T: target rate of actual nutrient (kg/ha)

F: fertiliser percentage of actual nutrient

Example:

Apply 40 kg **(T)** nitrogen/ha using a fertiliser containing 20% **(F)** nitrogen.

Rate = 40/20 x 100 = 200 kg/ha

Many fertilisers contain both N and P so it is important to understand the composition of the fertiliser to ensure the appropriate rates of nutrients are applied.

6.6 Fertilisation during establishment

Nutrient requirements during the establishment phase are often higher than for mature turf. However, young roots have limited nutrient collection capacity and this, combined with increased water and nutrient application, increases the potential for nutrient leaching.

6.6.1 Nitrogen application

Nutrient loss is minimised by frequent applications of low rates of fertiliser. All nitrogenous fertilisers should be applied at rates of between 10 to 40 kg N/ha (e.g. if N is 46% in urea, it could be applied at rates of 22–87 kg/ha). The frequency of application may be higher during the initial establishment phase but, as the turf develops, less frequent applications are required. Addition of an organic fertiliser will provide a steady source of nutrients during establishment; however, excessive rates may cause nitrogen leaching and the above mentioned guidelines still apply to the soluble nitrogen content of the organic fertiliser.

6.6.2 Phosphorus application

Most virgin, sandy soils have a deficiency in phosphorus. These soils also have a low PRI. When establishing a site, it is important to undertake soil testing to see if soil amendment is required to improve the PRI. If soils have a low PRI, phosphorus should be applied frequently and at low rates. Organic fertilisers contain a high phosphorus to nitrogen ratio and are a slow release source of phosphorus. However, such fertilisers often contain a high proportion of readily available phosphorus and this must be considered when determining fertiliser programs. Soil testing should be used to establish the PRI and the levels of available phosphorus in the soil. The level of phosphorus in the soil should not exceed 10 mg/kg as this level is sufficient to maintain healthy turf grass growth. Leaf tissue analysis can also be used to determine the phosphorus needs of the turf. Application rates of fertiliser will depend on the PRI of the soil and the timing of application should be based on leaf tissue analysis of phosphorus levels in the turf.

7 OTHER ENVIRONMENTAL ISSUES

7.1 Drainage

Any surface water runoff and groundwater infiltration from turf grass areas need to be carefully considered and managed for the following reasons:

- applied irrigation water infiltration and runoff typically indicates that irrigation management is inefficient and needs adjustment; and
- nutrients, applied as fertiliser, can be transported by infiltration to groundwater or by rainfall runoff to underlying groundwater, waterways and wetlands.

Groundwater nutrient enrichment and stormwater runoff from irrigated and fertilised turfed grass areas can cause environmental problems. Runoff from fertilised turfed areas is often contaminated with nutrients that can cause eutrophication in waterbodies. Runoff from newly established areas that do not have an extensive ground cover mobilises sediment and can lead to turbidity problems in waterbodies.

The harvesting of stormwater runoff to supplement water supply sources and prevent nutrient escape into the environment can be a consideration in suitable locations.

Managers of irrigated turf areas, such as golf courses, must be particularly aware of the infiltration transport risks and runoff issues and aim to manage runoff from irrigation and small rainfall events on-site. The landscape design should direct runoff to 'non-turfed' vegetated areas to facilitate opportunities for infiltration, nutrient uptake, sediment deposition and water recycling, if a water harvesting opportunity exists. This will maintain the area in good condition and minimise the off-site transport of nutrients and contaminants in surface water or groundwater.

Off-site flows of stormwater runoff should be via overland flow paths or swales wherever possible. Vegetated buffers should be established prior to runoff entering any drains, watercourses or waterbodies that take water from the site or exist on the property. The size of the buffer will depend on the characteristics of the surface water catchment and receiving waterbody (refer to section 3.2.4 'Separation distances').

7.2 Green waste recycling and disposal

The intensive management of irrigated turf grass has the capacity to generate enormous volumes of green waste from mowing and renovation activities. The green waste can take the form of grass clippings removed by mowing, thatch removed by verti-mowing, or thatch and soil removed by scarifying and coring. This material must be handled appropriately to avoid any potential environmental impacts from nutrient leaching out of stockpiles. Where possible green waste should be recycled by composting rather than disposed of in landfill. Properly composted green waste can be re-used on turf and landscaped areas as a source of organic matter and plant nutrients. However, the green waste taken from turf areas contaminated with sting nematodes must not be recycled due to the risk of spreading the pest.

There are a number of approved commercial and local government green waste recycling facilities available to the turf industry. If turf managers undertake green waste recycling 'in house', appropriate measures are required to contain nutrient runoff from stockpiles of green waste. Turf managers should also consider strategies to minimise the amount of green waste disposal from turf areas. For example, grass clippings from mowing do not have to be removed in most broad-area turf situations, provided that the mowing frequency is appropriate for the growth rate of the turf, so that grass clippings are easily dispersed into the turf surface.

7.3 Pesticide use

Pesticides include fungicides, insecticides, herbicides and similar chemicals. The use of pesticides should be considered the last option for pest control programs. Physical control, biological control, or an integrated pest management (IPM) technique can be used to help alleviate the need for chemicals. For example, IPM utilises cultural and nutritional practices to manage the turf. In some situations, the presence of some pests is desirable as turf managers try to achieve a 'biological balance' within the turf.

Excessive and repeated pesticide application can build up resistance in the pest. The fundamental principle of IPM is for the turf manager to allow pest populations to exist at levels within which any damage caused can be tolerated, dependent on the turf condition required. Wherever possible, turf varieties that are resistant to pest attack should be selected.

The turf manager should physically monitor the pest population and associated predators, and, where the application of chemicals is necessary, the chemicals that will have minimum impact on the predators and the environment should be chosen. Biological control methods are often used; for example, the release of specially bred wasps to attack some insect pests. Pest control is most effective when non-chemical and chemical control methods are integrated.

It is important to read the label and Material Safety Data Sheet for the pesticide and follow the instructions prior to use.

Guidance on pesticide use in Western Australia is provided in a number of documents. Some of the key documents are:

Department of Health

- *A Guide to the Use of Pesticides in Western Australia;*
- *Circular No. PSC 88: Use of Herbicides in Water Catchment Areas;*
- *Using Pesticides Safely;*
- *Reading and Understanding Pesticide Labels;*
- *Guidelines for Separation of Agricultural and Residential Land Uses: Establishment of Buffer Areas;*
- *A Guide to the Management of Pesticides in Local Government Pest Control Programs in Western Australia;*
- *Signage on Vehicles Required When Involved with the Spraying of Verges and Parks;*
- *Guidelines for the Safe Use of Pesticides in Non-agricultural Workplaces.*

Department of Water

- *Pesticide Use in Public Drinking Water Source Areas (Water and Rivers Commission 2000)*
- *Herbicide Use in Wetlands (Water and Rivers Commission 2001).*

The publication *Quick Contacts for the Use of Pesticides in WA: A Webpage Resource* (Department of Health 2011) provides an overview of pesticide management and roles of government in Western Australia.

Specific guidance on controlling pests in turf grass areas is available from the Department of Agriculture and Food's website at www.agric.wa.gov.au.

Policy and legislation prepared by other government agencies in WA (e.g. Department of Agriculture and Food, Department of Mines and Petroleum (Dangerous Goods), and Department of Commerce (WorkSafe)) may also need to be considered.

7.3.1 Pesticide selection

If it is determined that pesticides are required, preference should be given to those pesticides with a biological action and those that are readily biodegradable. The use of long-life residual pesticides is discouraged and these should not be used on areas near residential houses, sensitive groundwater sources, reservoirs, waterways, wetlands or bushland. Residual chemicals can easily contaminate ecosystems and accumulate in areas outside the target site.

All effective non-chemical methods of pest control should be explored before considering the use of pesticides. When selecting a pesticide, the following factors should be considered:

- location and environment of turf (e.g. public drinking water source area, Swan Trust Development Control Area, or other special control area);
- proximity to any surface water or groundwater source (e.g. reservoir, waterway, estuary, wetland, drainage lines or groundwater bore);
- protection of the turf user and environment, including people and animals that may come into contact with the turf area; and
- impacts on neighbouring properties from fumes and drift spray from the target area (e.g. buffer zone requirements).

Requirements for pesticide use are:

- registration of pesticide in Western Australia for its intended use (pesticides are registered by the Australian Pesticide and Veterinary Medical Authority (APVMA);
- label requirements of the pesticide (including active ingredient, application rates and methods, specific information on mixing, transporting and use, and disposal of product containers);
- information provided in the Material Data Safety Sheet for the product (e.g. physical and chemical properties, accidental release measures, product handling, mixing, transporting and storage, disposal of containers, and personal protective equipment);
- any licences or permit requirements to use the pesticide;
- use of the least toxic/mobile, but most effective pesticide for the target pests; and
- appropriate disposal of any unused pesticides and containers.

Personal protection requirements are:

- protective equipment and clothing needed for the person applying the chemical; and
- requirement of appropriate signage to advise of pesticide use on the turf.

A software program that can assess the potential risk of a pesticide to the environment, taking into account the characteristics of the chemical and the environment, should preferably be used prior to applying a pesticide. For example, the Pesticide Impact Rating Index (PIRI) software is considered a simple-to-use decision support tool that predicts the off-site migration of pesticides. This software considers vegetation cover as a significant parameter to assess the risk of the toxicity and mobility of a pesticide intended to be used in a surface or groundwater resource. The PIRI software is available on the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) website at www.csiro.au.

Some herbicides are used in conjunction with adjuvants (e.g. wetting agents, surfactants, or acidifying/buffering agents) to increase the effectiveness of the herbicide. Adjuvants are added to a herbicide formulation in order to change the application characteristics (e.g. achieve a better adhesion to the leaf surface of the target weeds, reduce herbicide selectivity and help breaking up waxy cuticles. Check the herbicide's product label to confirm the correct adjuvant is being used, if required.

More detailed guidance on the use of pesticides is provided in the documents listed above.

7.3.2 Pesticide application

Excess application of pesticides has the potential to leach into groundwater or be carried in surface runoff. Pesticides work best when applied at the rates and frequency specified on the label. When all label instructions are followed carefully, the potential for adverse effects on people, animals and the environment is reduced.

The prevailing weather conditions (e.g. windy or rainy) at the time of application will influence the effectiveness of the pesticide and its potential to impact on the environment. Windy conditions or air conditions created by temperature inversion (cold air trapped between the soil surface and warm air above) contribute to pesticide drift. The application of pesticides before rainfall events can result in pesticide losses, and therefore should be avoided.

Only appropriately trained operators should apply pesticides. Professional pesticide operators may require an appropriate licence, registration or accreditation that is associated with appropriate training through accredited training organisations; for example, TAFE or a private training provider. Information on the appropriate licence, registration or accreditation requirements is available from the Department of Health's website at www.public.health.wa.gov.au/3/1137/2/pesticide_licenses.pm.

7.3.3 Mixing and diluting pesticides

Mixing of chemicals in close proximity to water supply bores, reservoirs, rivers, streams or drainage lines poses a risk to these water sources. Appropriate buffer distances should be maintained from these sources to reduce the risk of water contamination. The specific requirements for the buffer distances are provided in the listed documents above.

Areas where chemicals are mixed or diluted should be contained to ensure any spilt substances can be collected for recycling, or treatment and safe disposal.

Careful handling of chemicals during mixing or dilution will reduce the environmental risk of accidental spillage as well as the safety risk of handling pesticides. Only enough pesticide should be prepared for immediate use.

7.3.4 Disposal of concentrates and containers

Pesticides in their concentrated form pose the greatest risk of contamination of water resources and the environment, if they are not disposed of in an appropriate manner. They become a problem particularly when leakage occurs through the loss of container integrity.

Labels may wear off, making the proper method of clean up difficult to determine when leakage occurs. If this occurs, refer to the Material Safety Data Sheets which should be available on all sites where pesticides are stored. The options for the disposal of containers are as follows:

- Advice is generally provided on the product label.
- Unwanted pesticide concentrates and containers from commercial sources may also be disposed of through the chemical industry ChemClear scheme or drumMuster (see contact details in Appendix 6).
- Information on disposing of empty pesticide containers is provided in A Guide to the Use of Pesticides in Western Australia, 2013. These guidelines are available from the Department of Health's website (see Appendix 5).

7.3.5 Pesticide storage

Chemicals should be stored in a lockable, well-ventilated storeroom that has sufficient measures in place to ensure any spillage is contained within the storeroom. This would include containing the area with bunding and suitable spill response equipment (i.e. absorbent litter and a sealed container). The integrity of

pesticide containers and secondary containment should be routinely checked and maintained at regular intervals.

Pesticides should not be stored in close proximity to bores, reservoirs, rivers, streams or drains. Appropriate separation distances should be maintained from these sources to reduce the risk of water contamination (see section 3). Advice from relevant government agencies should be obtained, if required (Appendix 5).

7.3.6 Emergency response plan

Turf managers should prepare and implement an effective emergency response plan (ERP) to address any emergencies arising from the storage, handling, mixing, transport and use of pesticides or other substances that have the potential to contaminate environmentally sensitive areas or water resources. Emergencies may arise as a result of equipment malfunctions, accidental spillage, leakages from the container, or any unforeseen event (e.g. accidents, fires or storm events).

The Department of Water's Water Quality Protection Note No. 10: Contaminant Spills — Emergency Response provides guidance on the requirements of ERPs for sensitive water resources (e.g. public drinking water source area, proclaimed Waterway Management Areas, and other protected water resources).

7.3.7 Maintenance and cleaning of equipment

Sprayer calibration and nozzle maintenance have large effects on application efficiency. Equipment should be regularly tested and calibrated to ensure it is in proper working order. This will help ensure chemicals are applied uniformly and effectively and that under- or over-application is avoided.

Cleaning application equipment can produce a large quantity of washdown and rinsate that can adversely impact on the environment. Washdown from turf areas contains grass clippings, detergents, grease, oil and other chemicals (e.g. pesticides, wetting agents). Turf has a high organic component resulting in a high biochemical oxygen demand (BOD).

The following principles should be applied when designing and operating a washdown area:

- All washdown should be contained.
- Stormwater runoff from the washdown area should be avoided.
- Uncontaminated stormwater should be kept separate from contaminated water.
- Washdown water should be collected and treated to an appropriate standard before disposal.

Consideration must be given to the disposal of waste generated from the washdown process. The disposal options available will depend on the nature of the receiving environment and quality of the washdown water. It is preferable to re-use the treated washdown water on-site if this is possible. Options for disposal of treated washdown water include:

- recycling for future washdown. Recycling is preferred even if low-cost water is available. Advice on the use of treated wastewater from a washdown facility is provided in the Department of Health's *Guidance Note for Wash Down Facilities Using Recycled Water* (2011);
- irrigation of turf or gardens either directly or diversion to an irrigation dam for later use (if appropriate); and
- discharge to sewer, provided the water quality meets the requirements of the water service provider.

The washdown process for mowing equipment produces a large quantity of solid waste, mainly consisting of grass clippings and soil. These solids should be collected and composted on site or dispersed over a turf area (if appropriate). Care should be taken with the storage and placement of this material so it is not washed into local wetlands, rivers or drains.

Sometimes the solids will need to be disposed offsite and may be recycled (e.g. for use in soil blends). Oils, grease and hydrocarbons recovered by an oil–water separator should be collected and securely stored for recycling or disposal at an approved site. Waste disposal contractors will take this waste to an approved facility for a fee.

The treatment facility should be regularly maintained to ensure it functions in accordance with its design. Regular testing of the quality of both washdown water and treated water should be undertaken to determine the effectiveness of the treatment system.

Additional best management advice for washdown areas in environmentally sensitive areas are provided in the Department of Water's Water Quality Protection Note No. 68: *Mechanical Equipment Wash Down* (2013).

8. MONITORING AND REPORTING

8.1 Monitoring

Monitoring is an important component of managing irrigated turf. It allows the efficiency of management practices and their environmental effects to be evaluated and helps identify areas where further improvements can be made. A monitoring program can demonstrate good environmental management of an irrigated turf area.

The size, scale and nature of the turf area and proximity to any sensitive environments will determine the extent of monitoring.

The preparation of a nutrient and irrigation management plan (NIMP) for large developments, or those in sensitive environments, will set out an easy format for obtaining and recording the information necessary to monitor the efficiency of management practices (see Water Quality Protection Note No. 33: *Nutrient and Irrigation Management Plans* (Department of Water 2010) and Water Quality Information Sheet No. 4: *Nutrient and Irrigation Management Plan Checklist* (Department of Water 2010). Preparing a NIMP will also help document the presence and extent of environmental impacts occurring as a result of turf operations and the actions taken to remediate the problems.

Monitoring to ensure that 'best practice' management is being achieved should include:

1. installation of monitoring bores for groundwater sampling to assess pH, electrical conductivity (salinity), temperature, dissolved oxygen, nutrient concentrations changes in standing water levels, and other parameters as required;
2. periodic soil sampling for soil moisture content and the presence and quality of leachate. This should be done at the base of the root horizon level and also 100 millimetres below the root mass (see Farmnote 26/1990 (Department of Agriculture 1990) and Water Quality Protection Note No. 33: Nutrient and Irrigation Management Plans (Department of Water 2010)). This sampling may also detect salt accumulation due to evaporation and water extracted by plants;
3. leaf tissue analysis to determine the nutrient needs of the plant prior to fertiliser applications. Adjustments can then be made to the fertilisation program. A suitable representative sample of leaves should be taken from the site. For example, it would be unsuitable to take samples from a mower catch bin, as this will often contain a mixture of leaf maturity levels as well as sand and dirt and iron from the cylinder;
4. water consumption at the site;
5. each turf manager establishing a database of information on the effects of mowing, watering and fertilising relevant to their particular site and the turf use;
6. water quality monitoring of open water within and next to irrigated turf to help identify the likelihood of a change in water quality (e.g. from fertiliser and pesticide use, or soil erosion). During hot, still weather, regular testing of oxygen content will help identify the chance of algal blooms and allow for remedial action;
7. installation of lysimeters to monitor the leachate passing below the turf root zone. The volume of leachate should be measured on a regular basis and the leachate analysed for nitrogen and phosphorus concentrations.

Where intensive turf-related activities are undertaken within a mapped acid sulphate soils risk area, acidity levels in underlying soils and groundwater should be regularly monitored to enable timely mitigation measures such as reduction in groundwater abstraction or application of liming agents to minimise acidity-related impacts on the environment.

8.2 Reporting

Reporting of monitoring data will depend on whether there is a reporting requirement in an approval from local government or state government agencies.

Where there is no requirement for reporting, monitoring data records should be maintained for up to five years, to allow audits as necessary. Maintaining a long-term record of monitoring data can also help the turf manager evaluate the best response to variations in environmental conditions in the future.

Data should be filed safely and, when required, presented in a tabular or graphical form. Each report should include an explanation of any anomaly in monitoring or reporting and any procedures used to fix the error. Any missing data should be noted along with possible explanations for its absence. Clarification is needed if it was not possible to take the relevant sample. Any other problems that may have been encountered should be explained.

Monitoring and reporting requirements will often be set out in a NIMP or any approval, licence or permit.

Appendix 1: Glossary of terms

Adsorption	The attraction of ions or compounds to the surface of a solid e.g. soil particles adsorb nutrients and water.
Area of high conservation significance	An area, other than an environmentally sensitive waterbody, of a kind identified in Guidance Statement No. 33: *Environmental Guidance for Planning and Development* (Environmental Protection Authority 2008).
Capture zone	In connection with an environmentally sensitive waterbody, means the area surrounding the waterbody within which surface water and/or groundwater flows into the waterbody.
Catchment	The physical area of land that intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Development Control Area	Land and waters identified in Schedule 4 to the *Swan and Canning Rivers Management Act 2006.*
Environmentally Sensitive Area	An environmentally sensitive waterbody (including its capture zone) or an area of high conservation significance. Environmental sensitive water sources include (but may not be limited to): • public drinking water source areas • waterways • estuaries • marine environments • sites identified in the Ramsar Convention • sites identified in the Directory of Important Wetlands in Australia • National Estate listings • environmental Protection Policy wetlands • conservation Category Wetlands • resource enhancement wetlands • other wetlands
Evapotranspiration rate	The rate of water loss from an area with vegetation, including a turf surface, to the atmosphere by the combined processes of soil evaporation and plant transpiration.
Foreshore reserve	All or part of a foreshore area that is publicly owned and vested with a local government or state government department. It may be reserved for purposes such as foreshore protection or public recreation.
Instant turf	Well-developed grass that is laid in rolls to provide an immediate grass cover.
Leachate	Water that in passing through soil, extracts solutes or suspended solids.
Priority P1 area	Priority P1 areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of high quality public drinking water is the prime beneficial land use. P1 areas typically include land under public ownership. P1 areas are protected in accordance with the objective of *risk avoidance.*

Priority P2 area	Priority P2 areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as pasture and dry-land cropping) exists. Protection of public water supply sources is also a high priority relative to other land use values in these areas. P2 areas are protected in accordance with the objective of *risk minimisation.*
Priority P3 area	Priority P3 areas are defined where it is necessary to manage the risk of pollution to the water source, and where water supply sources need to co-exist with other existing land uses such as residential, commercial and light industrial developments. P3 areas generally include the requirement for use of best available environmental management practice and connection to deep sewerage. P3 areas are protected in accordance with the objective of *risk management*.
Public drinking water source area	The area from which water is captured to supply drinking water. It includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.
Reservoir	A reservoir, dam, tank, pond or lake that forms any part of a public water-supply works.
Setback	A horizontal distance between a turf grass area and a watercourse, wetland, estuary or marine environment to protect ecological health.
Stolonisation	The process of growing one or more stolons or stems, usually at the soil surface or just below the ground.
Turbidity	A measure of the relative cloudiness or haziness of a liquid, caused by fine suspended particles that are generally invisible to the naked eye.
Turf	The upper layer of ground that is made up of grass and plant roots. This includes all species of grass and their cultivars.
Turf farms	An area where grass is intensively produced as a sod for commercial or domestic use. Usually confined to areas zoned rural.
Waterway	Any river, creek, stream or brook, including its floodplain and estuary. This includes systems that flow permanently, for part of the year or occasionally, and parts of the waterway which have been artificially modified. It does not include constructed drains, except where constructed drains form a reach of a natural waterway.
Wellhead	The top of a well (or bore) used to draw groundwater is referred to as a wellhead.
Wetland	An area of seasonally, intermittently or permanently waterlogged or inundated land, whether natural or otherwise; for example, a lake, swamp, marsh, spring, or dampland. Department of Parks and Wildlife is the relevant advice-giving agency and custodian of wetland mapping used for decision-making purposes.

Appendix 2: Overview of relevant legislation

Planning and Development Act 2005

The *Planning and Development Act 2005* and related legislation commenced operation on 9 April 2006. This legislation consolidated and repealed the *Town Planning and Development Act 1928,* the *Metropolitan Region Scheme Act 1959* and the *Western Australian Planning Commission Act 1985*.

This Act ensures that an efficient and effective land use planning system can be implemented in Western Australia while promoting the sustainable use and development of land. It also gives local government authorities the responsibility to prepare and amend town planning schemes for areas within their municipal boundaries.

Recreational turf grass areas including foreshore reserves, ovals, golf courses and bowling greens are located in areas zoned for parks and recreation. Turf farms are usually confined to areas zoned rural.

Environmental Protection Act 1986

The Environmental Protection Act 1986 (EP Act) is the primary legislation for the protection of the environment and control of pollution. It is specifically 'an Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing'.

A proposal that appears likely, if implemented, to have a significant effect on the environment, or a proposal of a prescribed class, may be referred to the Authority and assessed under Part IV of the Act.

Swan and Canning Rivers Management Act 2006

The Swan River Trust (the Trust) was established in 1989 with planning, protection and management functions for the Swan and Canning rivers and associated land. *The Swan and Canning Rivers Management Act 2006* strengthened the role of the Trust and enhanced coordination of government and community efforts to protect the rivers.

The legislation recognises the importance of the rivers as a West Australian icon by establishing the Swan Canning Riverpark. The Riverpark consists of the waterways and adjacent Crown Land reserves of the Swan, Canning, Helena and Southern rivers. Private property is not included in the Riverpark.

The Trust, through this legislation, is responsible for the waterways, establishing joint management arrangements for shorelines, and development of the River Protection Strategy to integrate management of the waterways and the adjacent reserves along the foreshore.

Water Resources Legislation Amendment Act 2007

The Department of Water is a department established under the *Water Resources Legislation Amendment Act 2007*, with primary responsibility to ensure that the state's water resources are planned and managed to meet community requirements now and in the future.

The department operates in an environment involving the administration of a number of pieces of legislation; for example:

- *Country Areas Water Supply Act 1947*
- *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*
- *Rights in Water and Irrigation Act 1914*
- *Water Agencies (Powers) Act 1984*
- *Water Services Act 2012*
- *Waterways Conservation Act 197*6.

Public Drinking Water Source Areas

The quality of public drinking water sources is protected by proclaiming underground water pollution control areas, catchment areas and water reserves under the *Country Areas Water Supply Act 1947* and *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*. The by-laws under these Acts enable the Department of Water to control potentially polluting activities, to regulate land use, inspect premises and to take steps to prevent or clean up pollution.

In public drinking water source areas, the Department of Water has defined three levels of priority areas:

Priority 1 (P1) areas are managed in accordance with the principle of risk avoidance. The source protection objective for P1 areas is to ensure no degradation of source water quality. Land is generally in public ownership and development is generally precluded from P1 areas.

Priority 2 (P2) areas are managed in accordance with the principle of risk minimisation. The source protection objective for P2 areas is to maintain existing water quality. Land is generally in private ownership and typically supports low intensity rural and rural lifestyle uses. Urban and industrial land uses are precluded.

Priority 3 (P3) areas are managed in accordance with the principle of risk management. The source protection objective for P3 areas is to maintain water quality within health guidelines. Land is generally in private ownership and may include urban, light industrial and rural uses. Heavy industry and processing/ treatment of animal wastes are precluded.

In addition to priority areas, wellhead protection zones and reservoir protection zones are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Additional restrictions apply within these zones.

Waterways Conservation

Under the provisions of the *Waterways Conservation Act 1976*, the Department of Water has a waterways management and protection function and associated powers in respect of designated waterways (e.g. Avon River, Peel Inlet, Leschenault Inlet, Albany Waterways, and Wilson Inlet) and adjoining land in management areas declared under the Act. This adjoining land extends to the entire catchments of the Avon River, Albany Waterways and Wilson Inlet.

Water Allocation

The Rights in Water and Irrigation Act 1914 covers the licensing of bores for water table aquifers and abstraction of water from proclaimed rivers and streams. Licenses are required in proclaimed groundwater areas and for artesian bores. For surface water, licences are required in proclaimed surface water areas except for stock and domestic use.

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Appendix 4: Further reading

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Department of Water 2006. *Vegetated Buffers to Sensitive Water Resources*, Water Quality Protection Note No. 6. Perth, Western Australia.

Water and Rivers Commission 2000. *Wetland Buffers*, Water Note No. 4. Perth, Western Australia.

Appendix 5: Useful contacts

The following details were correct at the time of publishing.

Government agencies in Western Australia

Swan River Trust Head Office 17 Dick Perry Avenue Technology Park, Western Precinct KENSINGTON WA 6151 Telephone: + 61 (8) 9278 0900 General enquiries: info@swanrivertrust.wa.gov.au Website: www.swanrivertrust.wa.gov.au	**Department of Water** Head Office The Atrium, Level 6 168 St Georges Terrace PERTH WA 6000 PO Box K822 PERTH WA 6842 Telephone: + 61 (8) 6364 7600 Facsimile: + 61 (8) 6364 7601 Email: Atrium.Reception@water.wa.gov.au For regional offices, see www.water.wa.gov.au
Department of Environment Regulation Head Office The Atrium, Level 4 168 St Georges Terrace PERTH WA 6000 Telephone: + 61 (8) 6467 5000 Facsimile: + 61 (8) 6467 5562 Emergency pollution response: 1300 784 782 General enquiries: info@der.wa.gov.au For regional offices, see www.der.wa.gov.au	**Office of Environmental Protection Authority** Head Office The Atrium, Level 4 168 St Georges Terrace PERTH WA 6000 Telephone: + 61 (8) 6145 0800 Facsimile: + 61 (8) 6145 0895 General enquiries: Email: info@epa.wa.gov.au Website: www.epa.wa.gov.au
Department of Health Grace Vaughan House 227 Stubbs Terrace SHENTON PARK WA 6008 Telephone: + 61 (8) 9388 4999 Facsimile: + 61 (8) 9388 4902 General enquiries: ehinfo@health.wa.gov.au Website: www.health.wa.gov.au	**Department of Agriculture and Food** 3 Baron-Hay Court SOUTH PERTH WA 6151 Telephone: + 61 (8) 9368 3333 Facsimile: + 61 (8) 9368 1205 General enquiries: enquiries@agric.wa.gov.au For regional offices, see www.agric.wa.gov.au

Department of Planning Western Australian Planning Commission 140 William Street PERTH WA 6000 Telephone: + 61 (8) 6551 9040 Facsimile: + 61 (8) 6551 9001 General enquires: corporate@planning.wa.gov.au Website: www.planning.wa.gov.au	**Metropolitan Redevelopment Authority** 12 Lindsay Street PERTH WA 6000 Telephone: + 61 (8) 6557 0700 Facsimile: + 61 (8) 9281 6020 General enquires: reception@mra.wa.gov.au Website: www.mra.wa.gov.au
Department of Aboriginal Affairs Ground Floor, 151 Royal Street EAST PERTH WA 6004 Telephone: 1300 651 077 + 61 (8) 6551 8004 Facsimile: + 61 (8) 6551 8088 General enquiries: info2@dia.wa.gov.au Website: www.dia.wa.gov.au	**Western Australian Local Government Association (WALGA)** 15 Altona Street WEST PERTH WA 6005 Telephone: + 61 (8) 9213 2000 Facsimile: + 61 (8) 9322 2611 General enquires: info@walga.asn.au Website: www.walga.asn.au
Department of Sports and Recreation 246 Vincent Street LEEDERVILLE WA 6007 Telephone: + 61 (8) 9492 9700 Facsimile: + 61 (8) 9492 9711 General enquiries: info@dsr.wa.gov.au Website: www.dsr.wa.gov.au	**Department of Parks and Wildlife** Head Office 17 Dick Perry Avenue Technology Park, Western Precinct KENSINGTON WA 6151 Telephone: + 61 (8) 9219 9000 Facsimile: + 61 (8) 9334 0498 General enquiries: info@dpaw.wa.gov.au Website: www.dpaw.wa.gov.au

Appendix 6: Industry associations and other useful contacts

Turf Growers Association of WA 25 Shields Crescent BOORAGOON WA 6154 Telephone: + 61 (8) 9437 2180 Mobile: 0422 120 990 Facsimile: + 61 (8) 9317 1686 Email: info@tgawa.com.au	**Water Corporation** 629 Newcastle Street LEEDERVILLE WA 6007 Waterwise helpline Telephone: + 61 (8) 131039 General enquires: customer@watercorporation.com.au Website: www.watercorporation.com.au
Golf Course Superintendents Association PO Box 289, KARRINYUP WA 6921	**Irrigation Australia** Unit 12, 56 Church Avenue MASCOT NSW 2020 Telephone: + 61 (2) 8335 4000 Free call: 1300 949 891 Facsimile: + 61 (8) 8335 4099 General enquiries: info@irrigation.org.au
Sports Turf Association (WA) PO Box 8492 Perth BC WA 6849 Website: www.sportsturf.asn.au	**Parks and Leisure (WA)** PO Box 1110 WEST LEEDERVILLE WA 6007 General enquiries: plawa@parksleisure.com.au Website: www.parksleisure.com.au
drumMUSTER or ChemClear Level 4 AMP Building 1 Hobart Place CANBERRA CITY ACT 2601 Telephone: + 61 (2) 62306712 Free call: 1800 008 707 Facsimile: + 61 (8) 6230 6710 General enquiries: info@drummuster.com.au Website: www.drummuster.com.au www.chemclear.com.au	

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Caring for the Swan Canning Riverpark