WQPN 6, February 2006

Vegetation buffers to sensitive water resources

Purpose

Native vegetation buffers to estuaries, reservoirs, watercourses, wetlands and production wells (drawing from the water table aquifer) provide the following environmental benefits:

- A filter that helps protect surface waters from pathogens, turbidity, nutrient-enriched run-off and waterborne spread of weed species. Buffers are particularly important down gradient of erosive soil such as disturbed land and unpaved roadways.
- Slow water movement into waterbodies, allowing time for remedial action in the event of chemical spills.
- Vegetation roots protect waterway banks from erosion and slow the progress of floodwaters.
- Provide a physical and visual barrier to limit unnecessary human and domestic animal access to sensitive waterways.
- Support waterway ecology by shading waters, providing food and habitat for aquatic fauna eg a natural source of food from leaf litter and shelter provided by fallen branches.
- Provide a home and migration corridors for native fauna.

Clean water resources used for drinking water, support to local ecology and social or commercial benefits, along with breathable air, rank as the most fundamental and important requirements to sustain communities. These water resources need to remain within defined quality limits to retain their value, and therefore need adequate protection. Many wetlands and waterways in WA have lost native vegetation margins, which increases the risk of contaminants entering the waterbody and causing fish deaths, turbidity, degraded water quality and algal blooms. This department supports retention, protection and where necessary restoration of adequate vegetated buffers between any land use activities that may pose a contamination risk and the margins of the State's surface and groundwater resources, as part of the State's water quality management strategy. A further aim of this note is to improve people's awareness of the need for vegetated buffers to both surface waterbodies and groundwater extraction points as an essential protective contaminant barrier to sustain the quality of these waters and maintain their values.

Vegetated buffers are key strategic elements among a series of protection barrier options that reduce the risk of contaminant impact on water quality. Other barriers include risk-awareness programs, risk avoidance (less contaminating materials used), land use activity constraints, spill containment facilities, best practice application controls for agricultural chemicals, spill-related intervention strategies, soil amendment to attenuate contaminants in the environment, wastewater treatment accompanied by monitoring, and isolation of contaminated waters.

The buffer retention objective may conflict with existing approved land uses, and raise social and economic challenges that present difficulties in the short term. This note aims to present technical information on buffer issues and help to define appropriate buffers to land use activities that may pose a threat to water quality.

The Department of Water is responsible for managing and protecting the State's water resources. It is also a lead agency for water conservation and reuse. This note offers:

- the Department's current views on establishing and maintaining protective vegetated buffers to vulnerable surface waterbodies to help sustain their values;
- guidance on acceptable practices used to protect the quality of Western Australian water resources; and
- a basis for the development of a multi-agency code or guideline designed to balance the views of industry, government and the community, while sustaining a healthy environment.

This note provides guidance on issues of environmental concern, and offers potential solutions based on professional judgement and precedent. Its use does not override any statutory obligation or Government policy statement. Alternative practical environmental solutions suited to local conditions may be considered. Recommendations provided should not be used by regulators in place of a site-specific assessment of any project's environmental risks. Any conditions set should consider the values of the surrounding environment, the safeguards in place, and take a precautionary approach. This note shall not be used as this Department policy position on a specific matter, unless confirmed in writing by the Department. The note may also be varied at our discretion, as new data becomes available.

Where a conflict arises between this Department recommendations and any proposed activity within a sensitive environment, the note may be used to assist negotiations with stakeholders. This Department's position is that the project proponent must demonstrate for diminished buffers that other protection measures ensure there is a lesser risk to water resource quality and the sustainability of downstream ecosystems, than if the recommended buffers were used.

Scope

This note provides guidance on retaining, maintaining and where necessary re-establishing vegetated buffers between land use activities (ie commercial, industrial, recreational, rural or residential uses) and sensitive water resources managed to retain their value for the community. Sensitive water resources are described in Appendix C.

Recommendations

Form of buffers

This Department aims to promote and progressively foster the re-establishment and maintenance of vegetated buffers to waterbodies and gain broad acceptance of their value within the community. Buffer dimension selection tends to be controversial and may require a balanced outcome negotiated between competing interests. Buffer re-establishment within freehold land could affect land values and productivity in both rural and urban settings. Buffer form and dimensions may vary from site to site and sometimes within a particular site, depending on local conditions, risk mitigation measures proposed for projects, relative resource and community-driven values, length of time that the buffer needs to be effective and availability of resources. This leads to a range of buffer options which are discussed in this note.

1. *Vegetation retention* of existing undisturbed local provenance native plants should be standard practice beside waterways, wetlands and estuaries, where practical.
2. *Restoration of native vegetated buffers* which have been degraded or removed, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the area prior to land development. Planted buffers should consist of a mix of native trees, shrubs and groundcover. These buffers should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove exotic weeds, for hazard reduction to prevent wild-fires and ensure public safety. More information on this topic is provided later under *Restoration of degraded buffers.*

3. *Buffer performance as a contaminant filter* should be effective and matched to the local conditions. Where practical buffer dimensions should be set using a scientific evaluation of the contamination pathways and expected attenuation, whilst considering:
    a. the water resource's value to the community;
    b. the scale of water quality risk and vulnerability;
    c. extent of contaminant pressure on water quality;
    d. maintenance of low stormwater travel velocities (typically less than half a metre/ second for a one year recurrence interval storm event);
    e. other protective measures in place; and
    f. the practicality of establishing and retaining effective vegetated buffers.
4. *Horizontal buffer distances* are measured at right angles to the margins of streams or waterbodies, while buffers are normally circular for water supply wellheads. Where margins to ephemeral waterways are unclear, buffers should be measured outward from grade changes defining run-off channels. Their form should provide for ease of field definition and plotting on geographic information systems (GIS).
5. *Riparian vegetation provides a natural boundary.* Buffers should be measured outward from any scientifically recognised dampland vegetation fringing the water resource or where the margins of missing riparian vegetation are uncertain, the wet season banks of the waterbody (excluding flood events). Typical riparian vegetation in south-west WA includes flooded gum, casuarina, bullich, blackbutt, melaleuca species (paper barks and tea trees), rushes and sedges.
6. *Buffer composition* should comprise under-storey vegetation (grasses and sedges), over-storey (tall shrubs, trees) and carbon-rich litter matching the density and diversity of undisturbed local native vegetation. Local, native grass filter strips upstream of buffers can improve nutrient, pathogen and sediment attenuation from wastewater spills or polluted run-off.
7. *Contamination prevention* is important with land use activities set up and operated to have minimal impact on buffers and associated water resources. Precautionary strategies to protect buffers from harm, erosion or smothering may include:
    a. restricting land disturbance activities to the low rainfall seasons;
    b. managing stock numbers and location to lower risks;
    c. isolating potentially harmful chemicals;
    d. immediate and effective chemical spill clean-up;
    e. use of structural stormwater retention/ detention/ treatment systems (see Chapter 9 of *Stormwater Management Manual for Western Australia*);
    f. preparation and implementation of environmental management plans; and
    g. training of staff and contractors in good operational practice.
8. *Land slope* should influence the setting of buffers widths. Buffers should be progressively increased where land slopes exceed one in ten. Buffers should be widened by five metres for each stepped increase in slope above a gradient of one in ten, until the slope reaches a gradient of one in seven. Slopes exceeding one in seven are generally considered too steep for development unless effective engineered erosion control systems are in place (see diagram at Appendix D).
9. *Vegetation density* should influence buffer dimensions. Buffers should be progressively widened in proportion to reduced vegetation cover (ie doubled if only half of natural groundcover remains). Where less than half of the original vegetation cover remains on erosive soils, the site should be rehabilitated then effectively revegetated prior to resuming any land use to avoid the growth of erosion channels.

10. *Roads or service corridors* may cross buffer zones, but these should occupy the minimum practical area of the buffer. Necessary measures should be installed eg fencing to limit human and livestock intrusion, and stormwater management systems to limit deterioration of the buffer and the protected waters.
11. *Unpaved roads* pose a risk to waterbodies due to stormwater causing surface erosion and associated water channelling which increases the rate of contaminated water movement. Unpaved roads include public and private roads, logging tracks, mining roads, road-work deviations, and access tracks for surveillance and fire-fighting purposes. Roads (where essential) should cross buffers at right angles to the stream alignment and include run-off distribution channels to drain turbid water into filter vegetation. Appendix D displays a typical layout of protective drainage measures. Pedestrian and bridle trails normally do not require drainage controls unless containing long runs with steep gradients.
12. *Turf buffers* to waterbodies (while preferred to bare soil), in rural settings are not well suited as filters for protecting surface water resource quality because:
    a. shallow turf root systems offer a low level of stability to waterway banks;
    b. significant maintenance effort is needed ie seasonal watering and mowing;
    c. periodic application of nutrients and pesticides is needed to maintain visual appeal, with the resultant risk of leaching harmful residues into waterbodies;
    d. they encourage human and animal access into surface waterbodies which may pose risks to water quality principally from litter, pathogens and turbidity; and
    e. they don't offer shading, protective habitat or detritus needed to support diversity of aquatic life.

    Constructed or rehabilitated natural wetlands adjacent to waterways or within the floodplain can assist with contaminant attenuation.

13. Factors influencing selection of buffer dimensions
    a. *Current environmental values* of the water resource requiring protection should be defined using the recommendations given in *National Water Quality Management Strategy* (see Appendix A, reference 1). These values are progressively being defined in regional Natural Resource Management Strategies (see www.nrm.org.au). Definition of values should consider present dependencies, their local prevalence, water resource condition, potential implications of water pollution incidents, costs of corrective action and social needs. If the resource has been historically degraded and is subject to a restoration strategy, the target environmental values and buffer restoration may be influenced by the needs of both the local and wider community. Where water values have not yet been determined, the minimum default buffer dimensions described in this note should be used.
    b. *For waters with multiple environmental values*, the largest buffer dimension determined should prevail.
    c. *The nature and significance of risks to waters* posed to water values by land use activities should be determined. The type of contaminant (eg harmful pathogens, turbidity, nutrients, agricultural chemicals, petroleum hydrocarbons, and surfactants), the projected chemical contaminant load (normally expressed as kilograms /hectare/year), travel paths, seasonal variability of contaminant movement, and the level of control on contaminant loss exerted by the activity operator should be assessed.
    d. *Flooded margin variability* for the surface waters being protected. For surface waters, the edge of the flooded area may vary seasonally or in response to stormwater management systems. Groundwater levels also rise and fall seasonally in response to rainfall, evapo-transpiration and water extraction.

e. *Significance of any contaminant discharge* to the water resource. Effects may be both environmental (ie affect the wellbeing of humans, animals or plants), social (eg people may lose confidence in the management of the resource) and economic (eg result in the loss of the resource to agricultural or industrial users).

f. *Local practicalities* may influence the buffer form and dimensions eg poorly defined water values, local site constraints, economics, restoration timelines and practicality of measures necessary to restore a waterbody should contaminant loads cause harm. In remote areas of the State (eg the North West) where cyclonic event rainfall may periodically flood large areas, buffers should match natural riparian conditions that would prevail if human activity were not present. Intervention may only be necessary where water values are defined and land use pressures on waters are evident.

g. *Effects of water contamination* on individuals and the community in the event of short term or permanent loss of downstream water resource values (eg disruption to ecosystems, harm to people, animals or crops, economic loss – production or land values, or reduced aesthetic appeal).

h. *Technical considerations* including local meteorology, hydrology, topography, vegetation types, soil stratigraphy (including ion exchange particles linked to contaminant attenuation) and relevant physical, chemical or biological factors at the site, may influence the rate of travel or access of contaminants to the water resource. These factors are often described collectively as the *biophysical characteristics* of a site (see Appendix A, reference 5).

i. *Land slopes* beside surface water resources exceeding one in ten are likely to increase the risk of water contamination, as stormwater run-off tends to aggregate into streams causing soil erosion and stream turbidity, especially on poorly vegetated and erosive soils.

j. *Slope length for run-off* is important. Engineered drainage controls should be considered for erosive land slopes more than 80 metres long. Department of Agriculture publications cover this topic, see internet site www.agric.wa.gov.au, then search *Turbidity control*.

k. *Natural vegetation type and density* (ie surface cover grasses and shrubs) remaining near waterbodies. Higher density vegetation with associated carbon-rich topsoil slows water movement and is likely to increase filtering of contaminants in any surface run-off.

l. *History of land activity operators* in effectively containing contaminants on site. The extent and perceived effectiveness of risk mitigation measures at any contaminant source should be considered. Where uncertainty exists, a precautionary buffer dimension should be set.

m. *Travel time* anticipated between the release of contaminants and effect on a water resource. A conservative travel time should be assumed on the basis of the maximum probable time to detect that a contaminant spill has occurred, and undertake remedial activities to effectively deal with the contaminant. A minimum of 12 hours effective response time should apply, unless the site is continuously supervised and on-site quick response and remedial resources are available.

n. *Attenuation of stormwater or irrigation water run-off contaminants* within the buffer is likely to influence the discharge concentration of specific contaminants into waters eg soil particles, pathogens and nutrients.

o. *Economic effects* of the buffer on the current land-holder or tenant's land use and viability. Where a diminished buffer is requested, other risk-lowering offsets may be warranted.

p. *Wildfire control* measures for the buffer (eg fuel reduction) should be prepared and implemented in accordance with the *Bush Fires Act 1954.*

q. *Maintenance of the buffer* to ensure the integrity, quality and effectiveness of its vegetation cover and its attendant ecosystems, when subject to normal environmental factors, should be considered. Too narrow a buffer is likely to limit seed distribution for regeneration and encourage weed invasion. Measures to prevent smothering of the buffer by stormwater eroded soils may also be necessary.

r. *Planning or other environmental functions* that the buffer may need to perform including air quality (dust), aesthetic, bio-security or noise barrier, water access deterrent, community lifestyle benefit, terrestrial ecosystem maintenance function or native fauna shelter belts.

s. *Precedents for buffers* set at similar sites and for similar land uses, and other buffers or setbacks present at the site.

14. If exotic vegetation of significant commercial value (eg crops or plantation timber) presently occupies a buffer, local provenance native vegetation buffer as described should be re-established as soon as practical following harvest. This Department's advice should be sought prior to the use of any chemicals (eg fertilisers or pesticides) near sensitive waters.
15. Default buffer dimensions may be varied at this Department's discretion, based on water resource management data, local environmental factors, perceived operator performance and the assessed level of risk to the water resource. Intermittent breaks in the continuity of buffers (typically around 20 metres in width) are acceptable to allow for road and services access/ crossings and wildfire control.
16. Stormwater management systems should be used where overland run-off of waters with suspended particles is likely to occur, eg vegetated filter strips or constructed flow velocity controls such as sedimentation structures/ areas, should be installed and maintained upstream of the buffers to control sediment flow and deter smothering of buffer vegetation.
17. Further research is desirable on buffer form, dimensions, and efficiency in various climatic conditions, soils, vegetation types and terrains. Monitoring of water quality to assess buffer performance in attenuating pathogens, sediment, nutrients and toxic residues is recommended. This may lead to revised guidance on buffer form and dimensions for maintenance of defined environmental values.
18. Decisions on buffer extent and placement may be determined in the field by experienced environmental personnel after considering local conditions. A written record of the factors leading to variations to accepted buffer protocols should support such decisions.

Buffer definition to suit specific water values

Water supply source protection buffers are ideally determined using local scientific studies. Where these are impractical, empirical practice (as described in this note) may be used to define buffer dimensions. Minimum default water source buffers are proposed in Table 1. This data should assist negotiations, allow for consideration of local environmental and social factors, focus on the relationship between buffer benefits to water resource quality versus the costs of loss of productive land at individual sites, foster timely decisions and alleviate disputes.

Within Public Drinking Water Source Areas

Public Drinking Water Source Area (PDWSA) is the collective name given to catchments declared to manage and protect any water source used for public drinking water supplies. PDWSAs describe areas defined under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*. PDWSAs include Underground Water Pollution Control Areas, Water Reserves (other than those declared under the *Land Administration Act* 1997) and Catchment Areas. For more data on related statutes and regulatory measures, see Appendix B.

Land within PDWSAs, is allocated one of three classifications of land areas (called Priority 1, 2 and 3). The priority classification is based on present land use, zoning, strategic importance and vulnerability of the waterbody to harm. These areas are each managed in a different way to provide for effective protection of water quality.

Priority classifications are defined via site-specific *Drinking Water Source Protection Plans*, that are prepared in consultation with State government agencies, land-owners, local government, local industries and community stakeholders.

Additional constraints may apply in protection zones closer to the point where drinking water is harvested or stored. Unconfined aquifer bores have a *Wellhead Protection Zone* (WHPZ) and surface storages have a *Reservoir Protection Zones*. For additional explanatory information on PDWSAs, see this Department's Water Quality Protection Notes *Land use compatibility in Public Drinking Water Source Areas* and *Protecting Public Drinking Water Source Areas.* Protective buffers are not normally required for wells properly constructed into deep confined aquifers.

Land clearing controls apply under the *Environmental Protection Act 1986*. Application to clear native vegetation in riparian zones and associated buffers will normally be refused. In the Collie, Harris, Mundaring, Denmark, Kent and Warren river catchments additional clearing constraints under Part IIA of the *Country Areas Water Supply Act 1947* may affect buffers.

19. *Within Reservoir Protection Zones, Type A* (the largest) buffers are retained or restored by planning agencies and land users (see Table 1 and Appendix D). All activities should be excluded from these buffers except scientific research, buffer management and hazard reduction. Apart from essential services crossings, accessible areas within these zones should be fenced or signposted (if practical) to exclude unauthorised human and livestock access. RPZ areas are normally owned or managed by government agencies.
20. *Within Priority 1 and 2 managed areas, and adjoining perennial surface waters, Type B* (middle ranking) buffers as a minimum should be retained or restored (where practical) and maintained (see Table 1 and Appendix D). Priority 1 areas are managed to deter land development and avoid risk. Priority 2 areas are generally managed for continuity of low intensity rural activity and similar low contaminant risk land uses. In many areas native vegetation buffers have been historically removed to provide for water access, pastoral or cropping use. Incentives may be considered to encourage buffer restoration, or offset measures applied for any resultant loss of prior land use rights.
21. *Wellhead Protection Zones, Priority 3 managed areas and adjoining ephemeral surface waters* are areas of existing or planned intensive land use that co-exist with water extraction for public supplies. Vegetated buffers are desirable measures to lower contamination risks to water resources and may form part of a suite of protective measures. Protective measures include hazard reduction and containment, community awareness, monitoring and surveillance. *Type C* buffers should be retained in these areas, and supported by other barriers designed to protect water quality (see Table 1 and Appendix D).
22. Advice on best environmental management practice within PDWSAs for various land uses is given in documents on the web page http://drinkingwater.water.wa.gov.au, select *Publications> Guidelines* or *Water Quality Protection Notes,* or via project-specific conditions for subdivision or land development set by regulatory authorities.

Private water supply sources

23. It may be impractical to carry out detailed scientific studies to define site-specific buffers, eg for small-scale developments or where a potential vegetated buffer has been severely disturbed. Type B buffers (as a minimum) should be used by default for all drinking water sources (with associated water treatment and routine quality monitoring). Type C buffers (minimum) should be used by default for irrigation and other non-consumptive sources (see Table 1). These buffers should run from the top water level of surface water sources, the margins of their primary feeder streams, the infrastructure perimeter of production bores or wells; and outer bank of any aquaculture ponds receiving catchment run-off or seepage, to the external boundary of developed areas.

Buffer dimensions for water supply sources

24. Where detailed site-specific scientific studies are not used to define buffers, default buffers should be used for water sources (see Table 1 for those recommended as suited to the South West of WA.). These have been set as a range rather than a single value, to offer practical flexibility in implementation. The default buffer dimensions have not been derived from rigorous local scientific studies, however information accessed in scientific literature search on the topic was considered during preparation of this note.

25. The diagrammatic representation of typical buffer configurations linked to stream order (ie number of stream tributaries) is provided at Appendix D.

26. Specific buffer dimensions may consider the number of stream tributaries and their relative proximity to water sources, the anticipated need for protection of water-based biota and perceived difficulty of effective intervention if contaminants do cross the buffer. Recommended buffer widths may reduce according to the risk level of contamination to water resources. Any buffer reduction should consider the distance from the protected waterbody, extent of protective measures employed and the ability to detect hazards and effectively intervene prior to a significant contamination event.

Waterways and within defined Waterways Management Areas

27. Five Waterways Management Areas have been declared to provide special protection to estuaries and their associated waterways considered especially vulnerable to degradation. These are the Albany Waterways, Avon River, Leschenault Inlet, Peel–Harvey, and Wilson Inlet Management Areas. Wetland and waterway ecology protection buffers should be determined scientifically, based on an evaluation of local biophysical criteria. Information on establishing such buffers is described in the policy, position statements and guidelines described in Appendix A, reference 5a. For further information, contact this Department's Catchment Management Branch.

28. Adequate vegetated separation buffers should be maintained between developed land areas and waterways to minimise the risk of degradation to water quality. These separation distances should be determined in accordance with the department's *Foreshore Policy No. 1,* with consideration of the waterway values, vulnerability and local biophysical criteria.

29. If a development is located within a Waterways Management Area, approval is required in accordance with the *Waterways Conservation Act 1976.* Information on waterway values and the location of these management areas can be obtained by contacting this Department's local regional office.

30. Local or regional natural resource management (NRM) strategies may apply to specific waterways where defined environmental protection measures such as buffer restoration are in progress and funding sources have been defined. For more information see the internet site www.nrm.org.au.

Swan River Trust Management Area

31. The Swan-Canning estuary and abutting reserves are managed by the Swan River Trust in accordance with the *Swan River Trust Act 1988*. Written approval from the Trust is necessary for any land or water-based development that may affect the estuary or its fringing vegetation.

32. *The Swan Canning Clean-up Program Action Plan 1999* encourages the use of fringing vegetation adjacent to waterways to limit turbidity and nutrient input into waterways that enter the estuary. Buffers should be defined as provided in the recommendations for waterways.

Table 1 - Default buffer dimensions to protect water supply sources

Buffer type	Application in PDWSAs	Buffer start point inside PDWSAs	Siting information outside of PDWSAs	Minimum buffer distance (metres)	
				Buffer the main protective barrier [a]	Multiple contaminant barriers used [b]
A	In Reservoir Protection Zones	• Water-body margin of the reservoir when full. • Flood fringe of feeder streams within 600 metres upstream of reservoir margins.	• Not applicable	200 metres	100 metres
B	In Priority 1 or 2 areas	• Riparian vegetation margin for perennial flow waterways. • From the margins of surface waterbodies where water is used for human consumption.	• Flood fringe of 3rd order or greater ephemeral streams. • Margin of dampland vegetation for all wetlands.	50 metres	30 metres
C	In Wellhead Protection Zones, P3 areas	• Exterior of wellheads drawing from the water table aquifer. • Banks of first and second order ephemeral streams.	• Margins of water supply sources and drains. • Banks of first and second order ephemeral streams and wetlands.	30 metres	20 metres

Explanatory notes on determining minimum buffer dimensions:

a. *Buffer as prime barrier* ie the dominant (primary) barrier to protect the waterbody from harm. This involves uncertain or reactive risk minimisation of water contamination, hazard containment and intervention capability by upstream land-use operators.

b. *Multiple contaminant barriers used* by land owner eg quality-assured contaminant containment processes, an environmental management system, effectively trained operators; routine supervision of land use activities, has demonstrated spill intervention capability, and an industrial track record of environmental contamination avoidance. Where other barriers are expected to be partially effective, a proportional increase of minimum buffer dimension towards the recommended main protective barrier dimension is recommended.

Wetlands

This Department aims to ensure that human disturbance, water extraction or contaminated waters do not harm sensitive environments. Wetlands (both perennial and seasonal) are susceptible to contamination both by poorly managed surface water run-off and polluted groundwater. Many important wetlands have been given a conservation status under Ramsar, Australian Department of Environment and Heritage or State Environmental Protection Policy. Wetland ecology protection buffers should be determined scientifically, based on an evaluation of local biophysical criteria. Information on establishing these buffers is described in the policy, position statements and guidelines described in Appendix A, reference 5b. For further information, contact this Department's Catchment Management Branch.

33. Any land development or subdivision proposed within 500 metres of a wetland (including lakes, swamps, marshes and dampland) should be referred to this Department's regional office for assessment, and include supporting information on management of the environmental risks. Information on protection of wetlands is provided in the WA Planning Commission's *A land use planning guideline for determination of wetland buffer requirements*, and this department's *Position Statement: Wetlands.*

34. Separation buffers should be devised based on wetland values, their vulnerability, local bio-physical factors and environmental management techniques employed to provide for adequate protection of the quality of water resources and adjoining wetland vegetation.

Buffers to the groundwater table

35. A vertical soil separation buffer of at least two metres from the surface to the highest groundwater table (end of wet season) should be maintained for free-draining soils. This vertical buffer limits soil waterlogging, aids installation of buried services eg septic tanks and water pipelines, and supports dryland agriculture. It allows for soil filtration and aerobic microbial degradation of leached organic contaminants prior to their reaching the water table.

36. Where irrigation of crops or landscape exists or is planned, a minimum vertical separation buffer of two metres should apply between the irrigated land surface and the maximum level of any groundwater mounding that surcharges the natural water table.

37. Care should also be taken that groundwater drawdown doesn't expose normally drowned peat beds to air which may generate acid sulphate soils. The Department of Environment's Land and Water Quality Branch can provide advice on susceptible areas.

Restoration of degraded buffers

38. Where a vegetation buffer has been removed, lost or become severely degraded as a result of land development, natural disaster (eg wild-fire) or emergency response, and is unlikely to recover during the following wet season, the land manager should undertake the following actions as soon as practical after event:

    a. Record the extent and circumstances of the buffer loss.

    b. Develop a plan to restore the vegetation eg replacement of any lost topsoil and seed-stock, (see Appendix A, reference 5a). Restoration of the buffer should take into account the guidance provided in this note and any site specific advice given by this Department. Restoration actions should be complete within 24 months following the degradation event.

    c. Contact the Department of Environment for information on native vegetation clearing controls (see Appendix A, reference 5e). Special provisions may apply in six South West clearing control catchments described in Part IIA of the *Country Areas Water Supply Act 1947.*

    d. Final completion of buffer restoration should be reported to this Department's local regional office.

39. Where this Department has a decision-making role, and infrastructure, silviculture or intensive farming are proposed to be constructed or upgraded within a buffer zone described in this note, then proponents should supply a notice of intent to our local regional office, including the following details:
    a. Name of site owner and activity operator, address and contact details.
    b. A site plan showing the location of the planned facility.
    c. Description of the type and scale of activities that will be carried out.
    d. The nature and approximate quantity of materials stored, handled or annually discharged on site.
    e. Data on the soils, land contours, vegetation cover, existing infrastructure, and historical land usage that may be affected by the project facilities or their operation.
    f. The extent of natural vegetation buffers to any water features or sources on the property and how they may be affected by the development proposal.
    g. Description of the types and quantities of any waste that will be generated at the facility.
    h. Proposals for chemical containment, material management and disposal (with design sketches).
    i. Details of any contingency measures to minimise the impacts of chemical spills, and disposal of contaminated waters from fire, flood or other emergency.
40. For summary data on Government agency regulatory measures, and regulatory bodies, see Appendix B.

More Information

We welcome your views on this note. Feedback provided on this topic is held on Departmental file No. 13194. This note will be updated periodically as new information is received or industry/activity standards change. Updates are placed on our web page http://drinkingwater.water.wa.gov.au select *Publications> Water Quality Protection Notes.*To comment on this note or for more information, please contact the Water Source Protection Branch at our Atrium offices in Perth, phone (08) 6364 7600 (business hours), fax 6364 6525 or use *Contact us* at the Department's internet site www.water.wa.gov.au, or email drinkingwater@water.wa.gov.au citing the note topic and version.

Where a conflict arises between the Department of Water's recommendations and any proposed activity that may affect a sensitive water resource, this note may be used to assist negotiations with stakeholders. The negotiated outcome should not result in a greater risk to water quality than if the department's recommended protection measures were used.

The State Government in October 2005 announced the formation of the Department of Water. From January 2006, the Department of Water has assumed primary responsibility for managing the State's water resources. Once the Department of Water is legally established, it will replace many of the present functions of the present Water and Rivers Commission and operate in parallel (with separate powers) to the Department of Environment. The custodian and recommendations made in this note will then change to match the assigned responsibilities of the departments of Environment or Water.

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Appendices

Appendix A – References and further reading

1. Australian Government - National Water Quality Management Strategy

   a. ANZECC, ARMCANZ- *Australian and New Zealand Guidelines For Fresh and Marine Water Quality,* 2000*;*
   b. ANZECC, ARMCANZ- *Australian Guidelines for Water Quality Monitoring and Reporting,* 2000*;*
      see web page www.deh.gov.au/water/quality/nwqms/index.html.

   c. *ARMCANZ, NHMRC- Australian Drinking Water Guidelines 2004;.*
      see web page www.health.gov.au/nhmrc/publications/synopses/eh19syn.htm.

   d. ANZECC, ARMCANZ- *Policies and Principles,*1994;
   e. ANZECC, ARMCANZ- *Implementation guidelines*, 1998*;*
   f. ANZECC, ARMCANZ- *Rural land uses and water quality- a community resource,* 2000
      To obtain copies, see internet site bookshop@awa.asn.au, or request from a library service.

   g. NRMMC - *Managing Natural Resources in Rural Australia for a Sustainable Future,* discussion paper1999. See www.napswq.gov.au/publications/nrm-discussion.html

   Acronyms
   ANZECC : Australian and New Zealand Environment and Conservation Council,
   ARMCANZ: Agriculture and Resource Management Council of Australia and New Zealand
   NRMMC : Natural Resource Management Ministerial Council
   NHMRC : National Health and Medical Research Council

2. Land and Water Resources Research and Development Corporation

   *Riparian Land Management Technical Guidelines,*1999;
   see internet site www.lwa.gov.au, select *Publications.*

3. Environmental Protection Authority (WA)

   Guidelines for Environment and Planning 1997;
   see internet site www.epa.wa.gov.au, select *Guidance statements*.

4. WA Planning Commission/ Department for Planning and Infrastructure (WA)

   a. Statements of Planning Policy (5AA):
      - *SPP 2 Environment and Natural Resources Policy,* 2003;
      - *SPP 2.7 Public Drinking Water Source Policy,* 2003*;*
      - *SPP2.9 Water Resource Policy,* Draft April 2004;
      - *SPP4.1 State industrial buffer policy,* 1997*.*

   b. A land use planning guideline for the determination of wetland buffer requirements 2004.
   see internet site www.wapc.wa.gov.au, select *Publications.*

5. Department of Environment (WA)

   a. Waterways policy and guidelines
      - Foreshore Policy 1 - Identifying the Foreshore Area, November 2002;
      - *Water Note 10 - Protecting riparian vegetation;*
      - *Water Note 11 - Identifying the riparian zone;*
      - *Water Note 17 - Sediment in streams;*
      - *Water Note 23 - Determining foreshore reserves;*
      - *Water Note 29 - Long term management of riparian vegetation;*
      - *River Restoration Report 4 - Revegetating riparian zones in south-west WA,* 1999.

      see internet site http://waterways.environment.wa.gov.au, select *Publications>Policies* or *Fact sheets.*

   b. Wetlands policy and guidelines
      - *Encouraging Wise Use of Perth's Wetlands, (broadsheet) 1995;*
      - *Position statement: Wetlands,* 2001;
      - *A Guide to Viewing Wetland Information on the WALIS website;*
      - *Wetlands of the Swan Coastal Plain*, 1996;

      see web page http://wetlands.environment.wa.gov.au, select *Publications.*

   c. Stormwater
      - *Stormwater Management Manual for Western Australia*

      see web page http://stormwater.environment.wa.gov.au**,** select *Publications>Manuals.*

   d. Native vegetation protection - legal framework and guidance
      see web page http://nvp.environment.wa.gov.au, select *Publications>Brochures.*

6. Department of Water (WA)

   a. Water source protection policy, and Water Quality Protection Notes
      - Policy: *Pesticide Use in Public Drinking Water Source Areas*, 2000
      - *Irrigation of vegetated land with nutrient-rich wastewater;*
      - *Land use compatibility in Public Drinking Water Source Areas;*
      - *Nutrient and irrigation management plans;*

      see web site: http://drinkingwater.environment.wa.gov.au, select *Publications>Policy* or *Water Quality Protection Notes.*

   b. For the following Departmental data not presently available on the internet site, contact this Department's Water Source Protection Branch to obtain copies:
      - *Proposals to update the current stream reserve system in the South West forest region of Western Australia*, (WRC 1999);
      - *A review of stream and river logging buffers in Western Australia to ensure their adequacy in protecting waterways from salinity and turbidity* supplied to the WA Conservation Commission (WRC 2001);

   c. For the location of Public Drinking Water Source Areas see http://apostle.environment.wa.gov.au/idelve/dowdataext/index.jsp under *Environment* select *Public Drinking Water Source Areas*

7. Department of Conservation and Land Management (WA)

   a. *W.A. Forest Management Plan 2004;*
   b. *Manual of Management Guidelines for Timber Harvesting in Western Australia, 1999.*

   see the web page www.naturebase.net/forest_facts/sy_review/manuals/index.html*.*

8. Forest Products Commission (WA)
   Contractors timber harvesting manual – southwest native forests 2003;
   see web page www.fpc.wa.gov.au/content/about_us/publications.asp .

9. Strahler, A. N. (1952). *Dynamic basis of geomorphology*. Geological Society of America Bulletin, 63, 923-938. See web page www.geog.soton.ac.uk/users/WheatonJ/Definitions/QD0109.htm.

Appendix B - Statutory requirements and approvals covering this topic may include:

What's regulated	Statute	Regulatory body/ agency
Subdivision of land	*Town Planning and Development Act 1928*	WA Planning Commission, Department for Planning and Infrastructure
Land zoning and development approval		Local Government (Council), Department for Planning and Infrastructure
Impact on the values and ecology of land or natural waters	*Environmental Protection Act, 1986,* Part IV Environmental Impact assessment	Minister for the Environment advised by the EPA;
Licensing of prescribed premises that pollute	*Environmental Protection Act 1986,* Part V Environmental Regulation	Department of Environment– regional office
Environmental impact on waters into managed waterways.	*Waterways Conservation Act 1976*	
Vegetation clearing controls	*Environmental Protection (Clearing of Native Vegetation) Regulations 2004;*	
	Country Areas Water Supply Act 1947, Section 12AA	Department of Water– regional office
Buffers in existing public drinking water source areas	*Metropolitan Water Supply, Sewerage & Drainage Act, 1909*	
	Country Areas Water Supply Act 1947	
Environmental impact on the Swan-Canning Estuary	*Swan River Trust Act 1988*	Swan River Trust
Management and protection of indigenous fauna and flora and lands vested in CALM	*Conservation and Land Management Act 1984*	Conservation Commission;
	Wildlife Conservation Act 1950	Department of Conservation and Land Management (CALM)
Petroleum, minerals and basic raw materials extraction	*Mining Act, 1978* *State Agreement Acts*	Department of Industry and Resources
Emergency response planning	*Fire and Emergency Services Authority of WA Act 1998*	Fire and Emergency Services Authority

Appendix C - Sensitive water resources

Clean water resources, used for drinking water, sustaining aquatic and terrestrial ecology, industry and aesthetic values, along with breathable air, rank as the most fundamental and important needs for viable communities. These water resources should remain within specific quality limits, and therefore require stringent and conservative protection measures. Guidance on water quality parameters necessary to maintain water values are published in the *National Water Quality Management Strategy Guidelines* (see web site www.deh.gov.au/water/quality/nwqms/index.html).

This Department strives to improve community awareness of catchment protection measures for surface water and groundwater aquifers as part of a multi-barrier protection approach to maintain the quality of water resources and their values.

To be considered sensitive, water resources must support one or more of the environmental values described below. Any activity or a land use will pose a risk to water quality if contaminants are able to be washed or leached into sensitive water resources in discernible quantities. These water resources include shallow groundwater accessed by water supply wells, surface waterways, estuaries, or wetlands. Community support for these values, setting of management objectives for water resources and implementation of a practical attainment strategy are seen as key elements in protecting and restoring the values of these water resources.

Sensitive water resources include:

a. Those proclaimed or assigned as Public Drinking Water Source Areas (ie Water Reserves, Catchment Areas or Underground Water Pollution Control Areas) via the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, the *Country Areas Water supply Act 1947* or the *Health Act 1911.*

b. Those used as private drinking water supply sources (ie for human or stock consumption).

c. Waters with specific quality necessary to support commercial or industrial activities eg aquaculture, food processing or crop irrigation.

d. Wetlands and waterways – pristine or conservation-valued, detailed as follows:
   - areas covering water resources defined via the *Environmental Protection Act 1986,* Part III eg *Environmental Protection (Swan Coastal Plain Lakes) Policy1992;.*
   - waterways managed under the *Waterways Conservation Act 1976*, ie the Avon, Peel-Harvey, Leschenault, Wilson Inlet and Albany Waterways Management Areas;
   - the Swan-Canning Estuary and adjoining lands managed via the *Swan River Trust Act 1988*;
   - wetlands of regional, national and international importance, including but not limited to: Conservation category wetlands and Resource Enhancement category wetlands and wetlands listed within *A Directory of Important Wetlands in Australia* (see the Australian Department of Environment and Heritage web site which also provides information on Ramsar convention sites) www.deh.gov.au/water/wetlands/database/directory; and
   - groundwater aquifers that sustain important ecological functions.

e. Locations where surface water or groundwater from the water table may be consumed or inhaled affecting people's health or well-being, eg garden, recreation or irrigation sources.

f. Surface waterbodies and wetlands meeting recognised cultural or social needs, eg water resources used for community swimming, fishing or valued for their visual appeal.

Appendix D - Pictorial depiction of buffers to water supply sources