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Infrastructure corridors near sensitive water resources

Purpose

Infrastructure corridors comprise easements or service corridors for electricity and telecommunication lines, drainage, gas, sewerage and water conduits, rail and road links and private infrastructure such as process water conduits, ore conveyors, fuel and mineral slurry pipelines.

These corridors provide vital links in the social and economic life of the community. Significant environmental benefits can be achieved by appropriate planning, design, construction and operation to ensure that the corridors are managed to avoid harm to sensitive water resources ([see description in Appendix C](#)).

Issues needing consideration include:

- Selection of corridor routes that avoid sensitive environmental features.
- Minimising land clearing.
- Avoiding disturbance to surface water bodies.
- Preventing construction impacts e.g. chemical spillage and depot discharges.
- Control of erosion and sediment transport.
- Disruption of natural water movement via drainage barriers or dewatering.
- Contingency planning to limit the impacts of equipment malfunctions and contaminant discharges.
- Waste management, including disposal of pipeline test waters.
- Increased access to sensitive water resources via service tracks and roads.
- Environmentally sensitive maintenance procedures.

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:

- Views on minimising impacts from infrastructure corridors on water resources.
- Guidance on acceptable practices employed to protect the quality of water resources.
- A basis for developing a multi-agency code or guideline designed to balance the views of industry, government and the community, while sustaining a healthy environment.

The recommendations made in this note do not override any statutory obligation or government policy statement. Alternative practical environmental solutions suited to local conditions may be considered. This note shall not be used as this department's policy position on a specific matter, unless confirmed in writing. The note may be amended at the department's discretion, as new data becomes available.

Regulatory agencies should not use this note's recommendations in lieu of site-specific conditions based on a project's environmental risks. Such conditions should consider the values of the surrounding environment, the safeguards in place, and take a precautionary approach.

Scope

This note applies to all new or upgraded infrastructure corridors and associated works such as access roads and drainage systems, where the development could harm the quality of any sensitive water resources. The note aims to cover all phases of the life cycle of an infrastructure corridor from initial planning and design, through to construction, operation and maintenance, to potential closure.

Advice on roads, tracks and trails is provided in separate Water Quality Protection Notes *Roads in sensitive environments* and *Tracks and trails in sensitive environments* (see [Appendix A, Reference 11b](#)).

Background

Contamination risks

Infrastructure corridors pose the following water contamination risks:

- Soil erosion and resultant turbidity in surface water bodies.
- Disturbance of contaminated sites and acid sulphate soils.
- Contaminant emissions during corridor construction.
- Pollution resulting from equipment malfunctions and conduit damage.
- Waste dumping and vandalism resulting from increased catchment access.
- Use of chemicals including paints, solvents and pesticides for service maintenance.

Planning

Risks from infrastructure corridor development to sensitive water resources can be reduced through careful siting. Planning should consider the proximity of aquatic ecosystems, flora and fauna associations, social water 'values' and sources that may be affected, together with any restrictions imposed by state or national legislation. Avoiding sensitive water resources in the initial siting phase for the infrastructure corridor can result in decreased costs, simplified regulatory conditions and expedited project approvals.

Consultation

This department and the community should be consulted when infrastructure corridors are proposed near any sensitive water resources. The objective is to ensure that the infrastructure corridor's location and design, together with the construction and maintenance programs, apply best management practice that includes environmental controls along with social and economic considerations.

Preliminary consultation can improve public understanding and acceptance of the project by involving stakeholders in an open process to identify potential problems and negotiating an acceptable outcome.

Approval of infrastructure corridor development or upgrades

All infrastructure corridor development and subsequent upgrades should receive approval by the agencies that administer the relevant state statutes or government policies.

A summary of approvals comprising relevant state government legislation and managing agencies is provided at [Appendix B](#).

Landscape

The landscape forms an important environmental, cultural and community asset valued for ecological, social and economic attributes. Infrastructure corridor planning should recognise these attributes and minimise visual and environmental impacts. Landscape features include landform, vegetation cover, drainage patterns, catchment hydrology, groundwater recharge zones, soil and bedrock characteristics, climatic factors, local ecology and land use.

Public drinking water source areas

Public drinking water source area (PDWSA) is the collective description for *water reserves*, *catchment areas* and *underground water pollution control areas* (UWPCA) declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or *Country Areas Water Supply Act 1947*. PDWSA provide for the management and protection of water used for public drinking supplies. A list of gazetted PDWSA is provided in the water quality protection note *Gazetted public drinking water source areas* (see [Appendix B, Reference 11b](#)). Land use restrictions may apply to areas gazetted as a PDWSA. This department's PDWSA management strategy provides for protection areas designated P1, P2 or P3, well-head protection zones and reservoir protection zones.

For more information on PDWSA, see this department's water quality protection notes: *Overview on protecting public drinking water source areas*, *Land use compatibility in public drinking water source areas* and *Risk assessment of public drinking water source areas* (see [Appendix B, Reference 11 b](#)). PDWSA locations can be viewed at Internet site www.water.wa.gov.au select *Maps, data and atlases* > *Geographic Data Atlas*, then click *Environment* > *public drinking water source areas*.

Private water sources

Private water supplies are drawn from water bodies including waterways, soaks, dams and groundwater for uses that include garden, agricultural and aquaculture supplies. Surface water bodies or groundwater wells need protection from physical, chemical and microbial contamination. Protection of private water supplies is fostered via the department's allocation licensing and water quality guidance program which includes recommendations for adequate separation buffers to restrict the movement of contaminants into water resources. For more information, see the department's water quality protection notes *Private drinking water supplies* and *Vegetation buffers to sensitive water resources* ([Appendix A, Reference 11b](#)).

Conservation wetlands

Infrastructure corridor developments near wetlands may pose a risk to ecological values. Ramsar, conservation valued or resource enhancement wetlands are identified on published datasets e.g. *Geomorphic wetlands Swan coastal plain* (see [Appendix C](#)). Such wetlands have protective measures provided by environmental protection policies (EPP) see Internet sites <www.epa.wa.gov.au> select *Environmental protection policies* or <www.dec.wa.gov.au> then *Department of Environment > water > wetlands*.

Infrastructure corridor development that affects conservation wetlands may require a formal environmental impact assessment. This assessment will evaluate risks posed to the local environment and determine best management practices and techniques needed to minimise impacts on the wetland, including hydrological regimes and biodiversity. Proposed corridor developments that may impact on any EPP wetland should be referred to the Environmental Protection Authority (see [Appendix A, Reference 7](#)).

Near waterways

Waterway management areas are declared under the *Waterways and Conservation Act 1976* to provide special protection to estuaries and associated waterways considered most vulnerable to degradation. The currently listed areas comprise the Albany Waterways, Avon River, Leschenault Inlet, Peel-Harvey and Wilson Inlet management areas. For information on these waterways contact the local regional office of the Department of Water. The Swan-Canning River, estuary and adjoining reserves are managed by the Swan River Trust via the *Swan and Canning Rivers Management Act 2006*.

Native vegetation protection and plant disease risk

The Department of Environment and Conservation should be consulted for advice on clearing of native vegetation and protection of native vegetation from disease threats (see [Appendix A, Reference 8](#) and [Appendix B](#)).

Groundwater

Groundwater levels i.e. the standing water level (SWL) in the water table aquifer will fluctuate seasonally over the year, with the highest level generally occurring at the end of the wet season. Groundwater movement and SWL fluctuation is controlled by rainfall patterns, together with the soil and rock conditions underlying the area. Sandy coastal environments, such as the Swan Coastal Plain and Scott Coastal Plain near Augusta, have more uniform shallow groundwater systems with SWL commonly following a subdued profile of the land surface. Waterlogging can occur in low-lying areas within the coastal plain, such as land adjacent to surface topographic highs or within depressions, following periods of intense or prolonged rainfall. Areas of low relief where clay or peat forms a substantial portion of the surface soil horizon are commonly more susceptible to waterlogging. Lower valley regions within areas underlain by granitoid bedrock are prone to waterlogging.

Groundwater levels in sandy coastal environments with uniform continuous groundwater systems can be estimated from the measurement of the SWL via site-specific piezometers (small diameter boreholes). This data may be compared to hydrographs of monitored boreholes within similar hydrogeological settings (see [Appendix B, Reference 11c](#)).

The calculation of SWL for areas underlain by granitoid bedrock requires localised analysis of the infrastructure corridor's relationship to the characteristics of the landforms and the intersected sub-catchments.

Erosion and sedimentation

Stormwater movement or run-off may cause a range of land degradation processes including sheet, gully and tunnel erosion. Infrequent, severe storms usually cause most erosion where rainfall intensity exceeds soil infiltration rates, leading to run-off on sloping land. Run-off water carries soil particles, through a process referred to as sheet erosion. Sheet erosion is essentially the uniform removal of surface material from an extensive area of gently sloping land, by broad continuous sheets of running water rather than by streams flowing in well-defined channels. Rills, shallow trafficable gutters (less than 30 centimetres deep), and gullies (greater than 30 centimetres deep) are formed in areas where landform patterns concentrate water run-off and subsequent erosion. The Revised Universal Soil Loss Equation (*Wischmeier and Smith 1978, Renard and others 1997*) can be used to calculate the potential mean annual soil loss (see [Appendix A, Reference 4](#)). A guide to erosion and sedimentation risk is provided in [Appendix E](#).

Climate variability

In Australia, economic losses can result from extreme weather-related events, such as drought, wildfire, floods, severe storms and cyclones. A significant increase in the frequency of extreme weather events has been documented since the 1960s. This increase has been attributed to climate variability arising from amplification in the concentration of atmospheric greenhouse gases. Global climatic modelling (GCM) by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Indian Ocean Climate Initiative (IOCI) has predicted an escalation of climate variability with associated extreme events following projected increases in global concentrations of greenhouse gases. Therefore, assessing potential development impacts and planning adaptive responses are high priorities.

The south-west of Western Australia is an area highlighted by CSIRO and IOCI models to be susceptible to increased climate variability. Therefore, weather patterns for the last 50 years may not be reliable for predicting one in 50 and one in 100-year rainfall and storm frequencies. While it is understood that climate change and variability are difficult to manage, it is important to factor the increased risk related to the occurrence of extreme events into contingency planning so that protective measures are not breached (see [Appendix A, Reference 6](#)).

Pesticide use

The use of pesticides, including insecticides, termiticides, herbicides and fungicides, creates a contamination risk to water source quality and to ecological systems. Pesticides are often water-soluble chemicals that are highly mobile within the environment. Inappropriate application, and use contrary to the manufacturer's advice or by inexperienced operators increases the risk of water contamination. The Department of Agriculture and Food's bulletin 4648 *Code of Practice for the use of agricultural and veterinary chemicals in Western Australia* presents a guide to best practice use and management of pesticides (see [Appendix A, Reference 10](#)).

The main legislation for the control and use of pesticides in Western Australia is the *Health Act 1911* and the Health (Pesticides) Regulations 1956.

Hydrostatic test water

Pipelines commonly require hydrostatic pressure testing prior to commissioning to confirm their integrity. The water resulting from this testing often contains contaminants such as construction litter, petroleum hydrocarbons, soil, oxygen scavengers, disinfectants, dyes and metal residues. Test water quality may also vary between the point of entry and release e.g. pH, colour, temperature and salinity.

Advice and recommendations

The following information promotes the use of best management practice during the life of infrastructure corridors.

Typical examples of best management practice for drainage can be found in the Department of Water's *Stormwater Management Manual for Western Australia* (see [Appendix A, Reference 11d](#)). The application of best management practices can significantly reduce regulatory conditions placed on infrastructure corridor developments. Benefits gained can include expedited approval processes and simplified conditions set for infrastructure construction and operation.

Corridor planning

Landform modification

- 1 Infrastructure corridors should be designed and constructed to reduce the impact on the natural landscape and surrounding environment. The re-contouring of landforms (by cutting or filling) adjacent to sensitive water resources should be minimised.

Near sensitive water resources

- 2 Any infrastructure corridor proposal located within 500 metres of a sensitive water resource should be referred to this department's regional office for assessment and written response.

Precautions near acid sulphate soils

- 3 Development proposals that are likely to disturb acid sulphate soils (ASS) or change groundwater levels in an area of ASS risk should identify the potential implication of generating acidic leachate by conducting a preliminary site investigation and develop an acid sulphate soil management plan (see [Appendix A, Reference 8c](#)).

Near waterways

- 4 Works that cause obstruction or interference to any natural watercourse or its bed or banks are prohibited unless authorised by a permit granted under section 11 of the *Rights in Water and Irrigation Act 1914*. Application for authorisation should be made to this department's nearest regional office.

- 5 Where practical, infrastructure corridors should be placed sufficiently high in the landscape to permit the retention of any natural waterway vegetation. To protect waterway margins and associated riparian areas, the size and shape of the foreshore area or waterway buffer should be based on an assessment of the biophysical features associated with the waterway, together with the economic and social values and pressures. It is the responsibility of the corridor developer and/or planner to demonstrate and justify the process and protection outcomes for the foreshore buffer.
- 6 A practical guide to determining the foreshore area is provided in this department's *Foreshore Policy 1 - Identifying the foreshore area 2002* (see [Appendix A, Reference 11e](#)). Development conditions, such as the buffer distances necessary to protect fringing vegetation and waterway features, are negotiated to accommodate local conditions. More information about definitions for the biophysical criteria used in determining the waterway buffer location and width is available from Water Note 23 *Determining foreshore reserves 2001* ([Appendix A, Reference 11e](#)).
- 7 Riparian vegetation provides significant water quality benefits by sustaining aquatic ecosystems and filtering of waterborne sediments and contaminants. For more information, see this department's water note no.10 *Protecting riparian vegetation* ([Appendix A, Reference 11e](#)).
- 8 Where an infrastructure corridor may harm areas of waterway-dependent vegetation, the corridor should be relocated, where practical.

Within waterways management areas

- 9 If a development is located within a proclaimed *waterways management area* (see [Appendix B](#)), written approval from this department is required prior to project commencement. For detailed information, contact our local regional office. If corridor relocation is impractical, then the impact should be minimised using negotiated best environmental management practices.

Near conservation-valued wetlands

- 10 Infrastructure corridors should (where practical) not impact on conservation category wetlands and their surrounding dependent vegetation.
- 11 Wetlands should have an adequate buffer to protect them from potential harm and to maintain ecological processes and functions. The width of the buffer should be based on the importance of the wetland and the threats posed by the adjacent land use. Buffer distances should be negotiated based on these considerations, together with local biophysical factors and protective management techniques used to maintain or restore the wetland. For more information, see the Department of Environment and Conservation policy position on wetland protection and management - *Position Statement: wetlands 2001* (see [Appendix A, Reference 8a](#)). Additional information on the delineation of wetland buffers is provided in Part B, Chapter B4, of the Environmental Protection Authority's draft guidance statement no. 33 *Environmental Guidance for Planning and Development* (see [Appendix A, Reference 7a](#)).

Passage through wetlands

- 12 When an infrastructure corridor must be placed within a wetland and the potential environmental impacts cannot be effectively avoided, mitigated or managed, a target of no net loss to wetland functions should be achieved through negotiated offsets.
- 13 Infrastructure and associated facilities, such as parking bays and access tracks, affecting conservation wetlands or their associated buffer vegetation, should be referred to the Environment Protection Authority in accordance with Part IV of the *Environmental Protection Act 1986*.
- 14 Development proposed within 200 metres of any wetland margin (e.g. lake, estuary, marsh, swamp, sump-land, damp-land or palusplain) should be forwarded to the Department of Environment and Conservation's nearest regional office for assessment (see Internet site <www.dec.wa.gov.au> select *regional information*).

Wetland impacts

- 15 Where infrastructure corridors may affect a wetland system, the use of the following principles will minimise impact and reduce risk:
 - a Avoid altering the natural hydrological regime of the wetland (such as by filling or drainage).
 - b Avoid clearing and degrading wetland vegetation, including the introduction of weed species.
 - c Avoid creating barriers that may impede the migration of native aquatic and terrestrial fauna.
 - d Corridor services should be constructed during the dry periods of the year (such as the end of summer and during autumn) when the groundwater table is lowest.

Development on wetland fringes

- 16 The installation of any works on the fringe of a wetland for taking water that causes obstruction or interference to the wetland, is regulated under the *Rights in Water and Irrigation Act 1914 (RIWI Act)*. This department is responsible for administering the *RIWI Act* (see [Appendix A, Reference 11c](#) and [Appendix B](#)).

Vegetated buffers

- 17 Perennial indigenous vegetation buffers should be retained or be restored between any infrastructure corridor and associated water supply wells, surface drainage channels, waterways and wetlands. These buffers will reduce the immediate contamination risk to water, act as contaminant filters and allow time for effective remedial action in the event of a chemical spill incident. Infrastructure corridor definition should involve biophysical evaluation, scientific methodology and contaminant movement modelling to define protective buffers to sensitive water resources. For detailed information, see this department's water quality protection note *Vegetation buffers to sensitive water resources* (see [Appendix A, Reference 11b](#)).

Maintenance of buffers

18 A plan that details the maintenance of buffers and verges should be developed and implemented. Preventive measures should be used to minimise buffer and verge erosion and subsequent contamination of water resources.

Buffer and verge construction

- 19 Creation of vegetated buffers and verges near water resources should ensure:
- a Use of local native plants in disturbed land revegetation projects.
 - b Removal of introduced deciduous and exotic plants to reduce the risk of disrupting the local natural ecology through seed distribution into waterways and wetlands, and increased nutrient loads via leaf litter.
 - c Repair of damaged vegetated areas and slopes via application of mulch or topsoil, limited fertiliser and the use of perennial native plants to restrict erosion and accelerate regrowth.
 - d Use of environmentally safe programs for pesticide application in compliance with state government policy.
 - e Development of a nutrient management program to ensure buffer and verge vegetation vigour until these systems become self-sustaining.
 - f Use of supplier's recommendations for appropriate application rates for chemical additives such as soil stabilisers, dust palliatives, pesticides and plant growth inhibitors.
 - g Regular inspection, cleaning, reshaping and management of vegetation within drains, ditches and swales to maintain their intended function and operation in protecting water resources, and as an effective drainage and contaminant filter system.

Fences

20 The use of fencing should be considered where stock intrusion and human impact might reduce the effectiveness of protective buffers.

Within public drinking water source areas

21 Within P1 protection areas this department normally opposes creation or expansion of infrastructure corridors, as they are incompatible with our policy of risk avoidance. Corridors may occasionally be approved with conditions, where it is demonstrated that alternative siting is impractical and the corridor is vital to the state's interests. In these circumstances, the risks associated with the construction and operation of the corridor must be demonstrated to be manageable and comply with this department's protection objectives for the P1 area.

22 Within P2 protection areas, this department normally gives approval with conditions to infrastructure corridors provided that the development, construction and operational plans demonstrate that the services will not cause an unacceptable increase in the contamination risk to the water resource's functions and 'values'.

23 Within P3 protected areas, infrastructure corridors are compatible land uses, provided best management practice is used to mitigate impacts and lessen risk.

- 24 Within wellhead protection zone (WHPZ) land-use constraints are used to protect water table sources of drinking water. These zones are circular (unless hydrogeological information defines a different shape), with a radius of 500 metres in P1 areas, and 300 metres in P2 and P3 areas. WHPZ do not extend outside PDWSA boundaries. Special conditions, e.g. restrictions on storage and use of chemicals, may apply within those zones. Protection measures are applied via bylaws of the *Metropolitan Water Supply, Sewerage and Drainage Act* and the *Country Areas Water Supply Act*.
- 25 Within Reservoir Protection Zones (RPZ) specific protection measures are defined to protect drinking water sources from physical, chemical or biological contamination in the vicinity of drinking water source reservoirs. RPZ (termed a *prohibited zone* in the present bylaws) consist of proclaimed buffer areas of up to two kilometres radius around the top water level of storage reservoirs and include the reservoir water body. Specific protection measures apply; these are set out in bylaws made under the Acts described in the previous clause. Special conditions, such as restrictions on storage and use of chemicals, apply within these zones (see [Appendix B](#)).
- 26 The minimum separation distance from the external boundary of an infrastructure corridor (where compatible or approved with conditions) should be 100 metres to the top water level of surface drinking water source reservoirs, their primary feeder streams and water supply production bores or wells. For all private supply sources and aquaculture ponds, the minimum separation distance should be 50 metres.

Environmental protection policy (EPP) areas

- 27 EPPs are proclaimed via the provisions of Part III of the *Environmental Protection Act 1986*. Guidance on the location and provisions applying is available from the Department of Environment and Conservation.
- 28 The *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* prohibits the unauthorised filling, mining, drainage and effluent discharge into wetlands identified by this EPP. This policy has been updated as the *Revised environmental protection (Swan coastal plain wetlands) policy and regulations 2004* (see [Appendix A, Reference 7b](#)).

Within the Swan River Trust area

- 29 Written approval from the Swan River Trust is needed for any development that may impact on land or water managed under the *Swan and Canning Rivers Management Act 2006*.

Water taken from the environment

- 30 The installation of any works or objects for the purpose of taking water, that causes obstruction of or interference to a waterway's bed or bank is regulated under the *Rights in Water and Irrigation Act 1914 (RIWI Act)*. The Department of Water is responsible for administering the *RIWI Act*, which prohibits development adjacent to any waterway, unless for an exempt purpose or if a permit has been granted (see [Appendix A, Reference 11c and Appendix B](#)). Water taken from within managed areas or from artesian sources requires a licence issued by this department. For information on licences contact the department's nearest regional office.

Waterway crossings

- 31 The number of waterway crossings should be minimised, with the least practical interference with the natural flow and aquatic ecology of the waterway. Interference to waterway flow regimes and aquatic environments can be reduced by the use of bridges rather than fords, buried pipe-work or box culverts. Infrastructure corridors that cross waterways should:
- a Replicate the natural cross-sectional area and shape of the waterway so that flows are not constrained or upstream flooding risk increased.
 - b Follow the natural ground contours where practical.
 - c Be scheduled to avoid storm events and during low flow periods.
 - d Minimise impacts on aquatic habitats.
 - e Permit the migration of aquatic fauna, including fish.
 - f Be well signposted to prevent or lessen the risk of disturbance.
 - g Ensure summary information on waterway crossing hydraulics and backwater impacts is provided with the development submission.
 - h Avoid alteration of the natural waterway bed and banks as required by the *Rights in Water and Irrigation Act 1914* (see [Appendix B](#)).
 - i Incorporate construction measures to minimise the risk of erosion of stream banks.
 - j Avoid crossings at waterway bends and ensure they are made at 90 degrees to the flow channel (see [Infrastructure corridor crossing - waterway buffers diagram, Appendix E](#)).
 - k Avoid crossing of meandering or dynamic waterways, especially where there is a high risk of meander progression and increased channel erosion.

Groundwater

- 32 A minimum vertical separation of two metres should be maintained from the highest seasonal standing groundwater level to avoid waterlogging, allow for the filtration of potential contaminants and enhance the aerobic degradation of microbial agents prior to entry into the aquifer.

Climate variability

- 33 The occurrence of extreme climatic events comprising storms cells, flooding and cyclonic activity should be considered within the scope of planning, construction and maintenance of infrastructure corridors near water resources.

Erosion and sedimentation

- 34 Infrastructure corridors should, where practical, avoid areas of significant erosion risk near water resources. Areas of erosion potential include steep landscapes (slopes exceeding one in ten), poorly vegetated land and undulating landforms with fine textured soils which have relatively low water infiltration rates (see [Appendix A, Reference 4](#)).
- 35 The exposure of erosive soil such as loess and sandy silt should be limited. Erosion control techniques should be employed where exposure of erosive soil is unavoidable (see [Appendix A, Reference 4](#)).

- 36 Assessment of water erosion and sedimentation risk should be based on data for seasonal daily rainfall in association with soil texture and slope. The risk assessment should consider local experience and conditions. Soil texture should be classified using the 'Unified soil classification' provided in *Australian Standard 1726* (see [Appendix A, Reference 2](#)).
- 37 The corridor design should include a site-specific erosion and sediment risk management plan to minimise environmental impacts of stormwater run-off. The plan should define construction methods and best environmental practice that manage project operations to minimise erosion and sediment export.
- 38 Erosion and sediment controls should encompass:
- Minimisation of the area that affects sensitive water resources, that is cleared and exposed during the construction and operational phase of the corridor.
 - Design and placement of silt fences and sediment traps to prevent the export of sediments into water resources.
 - Development of site-specific erosion and sediment controls.
- 39 Infrastructure corridor projects should employ measures to control short-term erosion that may develop prior to maturity of effective perennial erosion and sediment risk strategies. Short-term measures for the control of erosion and sedimentation may include straw bale barriers, brush cover, silt fences, grassed swales, filter strips, sedimentation basins or stormwater infiltration areas.
- 40 Land stabilisation processes may employ cereal crop cover or paper mash stabilisation preceding permanent vegetation seeding help to intercept and slow rainfall run-off generated during infrastructure corridor construction.
- 41 Temporary entry or exit roads should be provided with a coarse rock surface to reduce erosion to construction sites and infrastructure corridors located near water resources or drainage channels.

Stormwater drainage

- 42 Drainage systems that interact with water resources should incorporate the principles of water-sensitive design. These principles include kerbless easements in flat terrain, vegetated easements and corridor buffers, soakage swales, contaminant bio-filters and local stormwater disposal. For more information, see the department's *Stormwater Management Manual for Western Australia* ([Appendix A, Reference 11d](#)).
- 43 The drainage of stormwater and run-off directly into surface water resources with recognised social and ecological values should be avoided.
- 44 Where the risk from direct drainage is unavoidable, effective measures should be implemented to control litter, sediment export and chemical discharge. Management strategies to reduce sediment load and turbidity include detention in settling ponds, constructed wetlands and diversion of run-off into vegetated areas utilising earth banks.

45 Batters and ditches should be constructed to support protective measures that capture sediment and rainfall run-off in areas of defined risk. The design and location of batters and ditches should consider other buffers and planning constraints to maximise the structure's efficiency within the overall objective of minimising risk and impacts to water resources.

Construction and infrastructure

46 A notice of intent should be provided to this department's regional office when construction or storage depots are proposed or upgraded near sensitive water resources (see [Appendix D, Development proposals near sensitive water resources](#), and [Appendix A, Reference 11b](#) for relevant *Water quality protection notes*).

47 The location of all buried services in the corridor should be accurately mapped and signposted.

48 Buffers should be applied to site wastewater management and disposal facilities, materials storage and surface water systems. Information on the appropriate buffer distance for on-site disposal facilities can be obtained from this department's water quality protection note *Wastewater treatment – onsite domestic systems* (see [Appendix A, Reference 11b](#)).

49 The corridor construction workforce should comply with any regulatory conditions imposed to limit risk and impacts to sensitive water resources. Training and induction programs should be developed to ensure that contractors employed in the construction and maintenance of corridors adhere to the project approval conditions.

50 Wash down facilities for mechanical plant or vehicles should avoid areas where water or sediment can migrate into water resources. Wash down facilities employed to remove excess soil from vehicles exiting construction sites should be constructed and operated as recommended in this department's water quality protection note *Wash down of mechanical equipment* (see [Appendix A, Reference 11b](#)).

51 All facilities and operations near sensitive water resources should be compatible with the recommendations in this department's water quality protection note *Mechanical servicing and workshops* (see [Appendix A, Reference 11b](#)). Routine plant and vehicle servicing areas should be located away from sensitive water resources. They should be constructed with appropriate buffers and controls to reduce the risk of drainage or release into the environment of fuel, oil, and other harmful chemicals (waste liquids).

52 Construction and storage depots should be situated with buffers to sensitive water resources. They should not be located in areas with steep slopes (greater than one in ten) or those generating high rainfall run-off.

53 Raw material storage depots should not be placed in areas prone to flooding.

54 Water taken from surface or groundwater sources will generally require a licence under the *Rights in Water and Irrigation Act 1914*. Information on regulated waters and licence requirements can be obtained from this department's nearest regional office.

Contaminant/waste management

- 55 Contaminant movement models should be used to estimate the potential impact on water resources of the range of contaminants associated with infrastructure corridor projects. The model should consider the risk of release of the individual contaminant, together with its potential to move into surface water and groundwater systems. Issues that should be considered within the model include:
- a Contaminant concentration, solubility, and potential for degradation.
 - b Pollutant transport pathways.
 - c Distance and probable duration between the release point and entry to water resource.
 - d Meteorological effects and patterns.
 - e Vegetation cover and soil filtering.
 - f Biochemical attenuation processes in the water travel pathway.
 - g Synergistic effects in the environment.
 - h Receiving water quality constraints to sustain its present values and usage.
- 60 All waste, including sewage and effluent from employee amenities such as toilets and showers, should be controlled and disposed in accordance with the *Health Act 1911*, and the requirements of the local government authority (council). The Department of Environment and Conservation regulates the transport of controlled wastes (see [Appendix B](#)). Controlled waste includes all liquid waste, chemical toilet products, sewage, solvents and oil, waste that is not permitted at a Class I and some putrescible waste accepted at specific landfill sites, such as tyres.
- 61 Effective systems for the capture of waste liquids should be installed and maintained where there is a risk of drainage or release into the environment of fuel, oil, and associated chemicals. A strategy for the removal and approved recycling or disposal of waste liquids should be implemented.
- 62 Hydrostatic test water should be analysed following pipeline testing, and treated and disposed of in accordance with state legislation and project conditions. Where discharged to soakage, water quality should be compatible with maintenance of local environmental values (see [Appendix A, References 1a and 1c](#)).

Pesticide use

- 63 In public drinking water source areas, pesticides should be managed in accordance with the state-wide pesticide policy no. 2 *Pesticide use in public drinking water source areas 2000* (see [Appendix B, Reference 11a](#)). With the exception of specific herbicides (refer to later recommendations), approval for the use of pesticides is given through negotiation with the departments of Health, Environment and Conservation and Water.
- 64 Near any wetland, herbicides should be used only where unavoidable and in accordance with the Department of Environment and Conservation's water note no.22 *Herbicide use in wetlands* (see [Appendix A, Reference 8](#)).

- 65 Other than with the written approval from the Department of Health, the only herbicides that may be used near a waterway or in a water catchment area are described in the Department of Health's circular PSC 88 *Use of herbicides in water catchment areas*. Hexazinone (triclopyr) can harm native vegetation, hence application advice should also be sought from the Department of Environment and Conservation. Metsulfuron methyl may only be used for spot spraying of weeds, such as blackberry and cape tulip. With written approval from the departments of Health, Environment and Conservation or Water, the following constraints on the use of these herbicides should be observed:
- a Specified herbicides should only be used when no other practical means for the control of weeds.
 - b The herbicide 2,4-D (amitrole) should only be used where the weeds are resistant to the fluazifop-p-butyl (glyphosate).
 - c Approved herbicides may be used provided that appropriate precautions are taken to avoid spray drift or contaminated run-off from treated areas near sensitive water resources.
 - d Herbicide application is limited to injection techniques or direct spraying of individual weeds or clumps by low pressure apparatus producing a large droplet spray.
 - e Herbicide should be applied by trained operators accredited by the Department of Health.
 - f Mixing or storage of herbicides should not occur near any waterway, wetland or in any proclaimed drinking water source area.
 - g Herbicide application should not occur within 100 metres of a reservoir or a flowing waterway without written approval with conditions from this department.
 - h Washing of equipment should not occur near any waterway or in any public drinking water source area.
 - i All herbicide containers and waste should be removed for approved disposal.
 - j Records of the herbicide type, amount, area of application and date should be retained for a period of two years after application.
- 66 Incidents of pesticide contamination or spillage should be referred to the Department of Environment and Conservation's environmental management branch in Perth.

Chemical management

- 67 Chemical management and use within or adjacent to water resources should comply with recommendations provided in this department's water quality protection note *Toxic and hazardous substances – storage and use* (see [Appendix A, Reference 11b](#)).
- 68 Best management practice for agricultural chemicals should follow the recommendations in the Department of Agriculture and Food's bulletin 4648 *Code of practice for the use of agricultural and veterinary chemicals in Western Australia* (see [Appendix A, Reference 10](#)).

Chemical storage

69 Chemicals (including fuel, oil, degreasers, antifreeze, solvents, paints, fertilisers, pesticides and contaminated wash-water) should be stored, handled and contained to prevent run-off and infiltration into surface water or groundwater resources. Temporary containment compounds should be utilised to provide protection where these products are used frequently, such as fuelling areas and equipment washing areas. More information on the storage and use of chemicals near water resources is available in this department's water quality protection notes *Tanks for temporary above ground chemical storage* and *Toxic and hazardous substances – storage and use* (see [Appendix A, Reference 11b](#)).

Awareness training

70 Awareness training and induction programs covering the protection of water resources should be prepared and implemented for all contractors and construction crews.

Signage

71 Signage should be installed and maintained to inform employees and contractors of appropriate practices to protect water resources in areas of enhanced risk, such as chemical transfer or storage, and vehicle wash-down facilities.

Chemical spills

72 Infrastructure corridors potentially affecting water resources should include the design and construction of measures for the initial capture and containment of chemical spills including those from pipeline failures, where practical.

Nutrient management

Fertiliser use

73 Fertilisers, where necessary to promote the growth of revegetation of disturbed land, should be applied to match the results of soil testing, the seasonal needs of the vegetation and the supplier's instructions. The use of slow-release fertilisers is recommended so that nutrients can be delivered progressively according to the needs of vegetation, and to minimise the risk of nutrients leaching into water resources.

74 More information on the development of fertiliser management plans and application of fertilisers near water resources is available in this department's water quality protection notes *Nutrient and irrigation management plans* and *Irrigating vegetated land with nutrient-rich wastewater* (see [Appendix A, Reference 11b](#)).

Fertiliser application

75 Fertilisers should be applied by qualified and experienced contractors to reduce the risk of excess application and resultant fertiliser leaching and loss into the environment.

Environmental management

76 Environmental restoration measures for disturbed land should include:

- a Deep ripping of compacted access road bases and construction depot areas.
- b Replanting with local provenance native vegetation.
- c Restoration of natural waterways and wetlands in accordance with best practice management as outlined in the department's *River Restoration Manual* (see [Appendix A, Reference 11e](#));
- d Soil stabilisation, import of topsoil, and the limited application of fertiliser may be required depending upon the location and degree of impact.
- e Establishment watering may be required in circumstances where the growth of vegetation root base is needed to ensure survival through a dry season.

77 Waterway slopes should (where practical) be covered with native vegetation or a durable, bio-degraded, non-erosive material to assist in the regrowth of vegetation.

78 When an infrastructure corridor in a sensitive water resource is decommissioned, conduits, temporary depots, tracks and structures should be removed and these areas should be restored to match natural vegetation communities or intended land use.

79 Native plant species endemic to the area should be used to revegetated disturbed land. The use of these plants will reduce the need to apply water, pesticides and fertilisers after initial establishment.

Operation and maintenance

80 The operation and maintenance of infrastructure corridors should ensure:

- a Workforce awareness and observance of project environmental approval conditions.
- b Vegetation growth is managed to avoid wildfire risks.
- c Permanent barriers and fences to sensitive water resources are maintained to secure them from unrestricted public access.
- d Litter, deposited rubbish and dead animals are collected and removed regularly.
- e Retaining walls are inspected regularly, remain stable and are not compromised by cracking and water damage.
- f Erosion and sediment control devices are in good working order.
- g Stormwater energy dissipaters and velocity controls on open drains are in good working order to minimise water run-off velocity and subsequent erosion.
- h Sediment accumulated within detention ponds, drainage systems and pollution control structures is removed and disposed off in accordance with appropriate local and state controls.
- i Drainage ditches and turnouts are kept free from accumulated debris.
- j Access barriers are maintained in good condition to deter vandalism and waste dumping.
- k Cut or poisoned vegetation is effectively managed to control wildfire risk.

- 81 The design and construction of infrastructure corridors near sensitive water resources should limit the risk and effects of transport accidents through the incorporation, where appropriate, of the following measures:
- a Installation of advisory and hazard warning signs.
 - b Regular maintenance of access tracks.
 - c Development of suitable buffers separating vehicle/road traffic from the infrastructure corridor.
- 82 Culverts and gravity pipe-work, where employed, should be maintained free of debris and sediment, matched to the design of the crossing and hydraulic conditions.
- 83 Corridor crossings of waterways, drains and wetlands should be routinely inspected. Maintenance should occur immediately if these structures are compromised by damage from flooding, concrete cancer, foundation undermining or erosion.
- 84 The risk and consequence of natural and human induced damage, such as flood and fire, should be defined at the corridor planning stage. Planning should include the proximity of the infrastructure corridor to emergency response facilities and an overall incident risk assessment.
- 85 Assessment of the appropriate fire and emergency response should involve consultation with government agencies that manage the natural resource and supply the support mechanisms to manage and alleviate the risk. Where the infrastructure corridor is located in a remote region, response to a potential contamination incident may be delayed. More information on appropriate responses to chemical spillage can be obtained from this department's water quality protection note *Contaminant spills – emergency response planning* (see [Appendix A, Reference 11b](#)).

Contingency systems

- 86 A contingency plan should be prepared to address foreseeable emergencies that may arise. The plan should address the following issues:
- a Soil erosion due to major storm events.
 - b Spillage of chemicals.
 - c Construction depot wastewater treatment plant malfunctions and breakdowns;
 - d Damage to existing services in the infrastructure corridor due to construction or maintenance activities.
 - e Maintenance of service roads and their associated stormwater drainage.
 - f Vandalism.

Performance audit

- 87 The operation and performance of infrastructure corridors should be reviewed periodically to ensure compliance with environmental protection requirements and project planning approval conditions (performance audit). Compliance with agreed and documented operational conditions is essential to restrict risks to water resources, ensure ecological sustainability of the sensitive water resource and limit operator's liability.

88 Review intervals for the performance audit should be negotiated between the operator and appropriate government agencies. Areas of poor compliance should be documented and remedial strategies and deadlines determined with regard to documented risk and through negotiations with the operator. Failure of the operator to rectify problems involving infrastructure corridor impacts on water resources should be reported to the appropriate government regulatory agency (see Appendix B).

More information

We welcome your views on this note. Feedback provided on this topic is held on department's file **18609**. This note will be updated periodically as new information is received or industry/activity standards change. Updates are placed on this department's Internet site <www.water.wa.gov.au> select *water quality > publications > water quality protection notes*.

To comment on this note or for more information, please contact the department's Water Source Protection Branch at our Atrium office in Perth, phone (08) 6364 7600 (business hours), fax 6364 6516 or use *contact us* at the department's Internet site, citing the note topic and version.



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Appendices

Appendix A - References and further reading

- 1 Australian Government – National Water Quality Management Strategy:
 - a *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000
 - b *Australian Guidelines for Water Quality Monitoring and Reporting* 2000
see web page <www.environment.gov.au/water/quality/nwqms/index.html>
 - c *Australian Drinking Water Guidelines* 2004
see web page <www.health.gov.au/nhmrc/publications/synopses/eh19syn.htm>
 - d *Policies and Principles* 1994
 - e *Implementation guidelines* 1998
see <www.awa.asn.au>, email <bookshop@awa.asn.au> or request from a library service

f *Minimum construction requirements for water bores in Australia* 2nd edition, September 2003; see web page <www.iah.asn.au/pdfs/mcrwba.pdf>

2 Standards Australia:

- a AS 5667 Water Quality - Sampling
 - b AS/NZS 4360 Risk Management 2004
 - c HB 203 Environmental Risk Management 2004
 - d AS 1726 Geotechnical site investigation 1993
 - e AS 2507 The storage and handling of agricultural and veterinary chemicals 1998
- see web page <www.saiglobal.com/shop/script/Provider.asp?Db=AS>

3 Institution of Engineers Australia

Australian Rainfall and Run-off

see web page <<http://www.engaustralia.com.au/bookshop/ebookspub.html>>

4 Soil erosion prediction by utilising the revised universal soil loss equation:

- a Wischmeier, W.H. & Smith D.D. 1978, *Predicting rainfall erosion losses: A guide to conservation planning*, United States Department of Agriculture, Agriculture Handbook 537, United States Government Printing Office, Washington DC.
- b Renard, K.G., Foster G.A., Weesies D.K., McCool D.K. & Yoder D.C. 1997, *Predicting soil erosion by water: A guide to conservation planning with the revised universal soil loss equation*, United States Department of Agriculture, Agriculture Handbook 703, United States Government Printing Office, Washington DC.

5 Estimation of rainfall

Durrant, J.M. & Bowman, S. 2004, *Estimation of Rare Design Rainfalls for Western Australia: Application of the CRC-FORGE Method*, Department of Environment, Government of Western Australia, Surface Water Hydrology Report Series Report No. HY17.

6 Climate change

- a *Climatic Change, Catchment Run-off and Risks to Water Supply in the South West of Western Australia – Part 1, 2, 3 & 4*, Department of Environment, 2004
- b *Climate variability and predictability for south-west Western Australia, Indian Ocean Climate Initiative*, see Internet site<<http://www.ioci.org.au>>

7 Environmental Protection Authority (WA)

- a Draft Guidance Statement No. 33 - *Environmental Guidance for Planning and Development* June 2005
- b *Revised Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy and Regulations* 2004
- c *Environmental Protection (Gnangara Mound Crown Land) Policy* 1992
- d *Environmental Protection (Swan Coastal Plain Lakes) Policy* 1992
- e *Environmental Protection (South West Agriculture Zone Wetlands) Policy* 1998
- f *Environmental Protection (Swan and Canning Rivers) Policy* 1998
- g *State Environmental Policies (SEPs), an Explanatory Document* November 2004

- h *Environmental Protection of Native Vegetation in Western Australia*
 - i *Environmental Offsets (Preliminary Version 2)* June 2005
 - j *Position Statement No. 4 - Environmental Protection of Wetlands* November 2004
 - k *Position Statement No. 8 - Environmental Protection in Natural Resource Management*
 - m *Environmental Protection (Western Swamp Tortoise Habitat)* 2002
- see Internet site <www.epa.wa.gov.au> select *Environmental protection policies or position statements*.

8 Department of Environment and Conservation (WA)

a Wetlands policy and guidelines

- *Position Statement - Wetlands 2001*
- *Water Note 22 - Herbicide use in wetlands 2001*

see Internet site <www.dec.wa.gov.au> select *Department of Environment > Water > Wetlands > Publications > Policy*.

b Vegetation protection

- *A guide for local government clearing native vegetation under the Environmental Protection Act, 2005*
- *A guide to clearing permits under the Environmental Protection Act, 2005*
- *A guide to the exemptions and regulation for clearing native vegetation, 2005*

see Internet site <www.dec.wa.gov.au> select *Department of Environment > Land > Native Vegetation Protection > Legislation*.

c Acid sulphate soils

- *Treatment and management of disturbed acid sulfate soils 2004*
- *Acid sulfate soils guideline series 2003 to 2006*

see Internet site <www.dec.wa.gov.au> select *Department of Environment > Land > Acid sulphate soils*.

d Dieback disease management

Policy statement no.3 *Management of Phytophthora and disease caused by it*, December 1998; see Internet site <www.dec.wa.gov.au> select *Naturebase > search phytophthora management*.

9 Western Australian Planning Commission

Planning bulletin number 64 *Acid Sulfate Soils*, ISSN 1324-9142, 2003

see Internet site <www.wapc.wa.gov.au>

10 Department of Agriculture and Food (WA)

Code of Practice for the Use of Agricultural and Veterinary Chemicals in Western Australia (3rd Edition), Bulletin 4648, ISSN 1448-0352, February 2005

see Internet site <www.agric.wa.gov.au> search *topic*.

11 Department of Water (WA)

a Water source protection policies

- State-wide policy no. 2 *Pesticide use in public drinking water source areas 2000*
- Public drinking water resource policy no.1 *Land use compatibility in public drinking water source areas*
see Internet site <www.water.wa.gov.au> select *water quality* > *policies*.

b Water Quality Protection Notes

- *Contaminant spills – emergency response strategy*
- *Gazetted public drinking water source areas*
- *Industrial sites near sensitive environments*
- *Irrigation with nutrient-rich wastewater*
- *Land filling with inert materials*
- *Land use compatibility in public drinking water source areas*
- *Mechanical servicing and workshop facilities*
- *Nutrient and irrigation management plans*
- *Overview on protection public drinking water source areas*
- *Private water supplies*
- *Risk assessment of public drinking water source areas*
- *Roads in sensitive environments*
- *Tanks for above ground chemical storage*
- *Tanks for temporary above ground chemical storage*
- *Toxic and hazardous substances – storage and use*
- *Tracks and trails in sensitive environments*
- *Wash down of mechanical equipment*
- *Vegetation buffers to sensitive water resources*
- *Wastewater treatment – onsite domestic systems*
see Internet site <www.water.wa.gov.au> select *water quality* > *publications* > *water quality protection notes*.

c Groundwater information for the Swan Coastal Plain

see *Perth Groundwater Atlas, second edition* or view at Internet site
<www.water.wa.gov.au> select *maps, data and atlases* > *Perth groundwater atlas*.

d Stormwater management manual for Western Australia

see <www.water.wa.gov.au> select *water quality* > *stormwater* > *management manual*.

e Waterways

- *Foreshore policy 1 - Identifying the foreshore area 2002*
- *Water Note 08 - Habitat of rivers and creeks*
- *Water Note 10 - Protecting riparian vegetation*
- *Water Note 11 - Identifying the riparian zone*
- *Water Note 23 - Determining foreshore reserves*
- *Water Note 26 - Simple fish-ways*

- *River restoration manual*, report numbers RR1 to RR19
see web page <www.water.wa.gov.au> select *Policies* or *Water quality* > *Publications* > *Water Notes*.

Appendix B - Statutory requirements and approvals relevant to this note include:

What's regulated?	Statute	Regulatory body or agency
Subdivision of land	<i>Planning and Development Act 2005</i>	Western Australian Planning Commission
Land zoning and development approval		Department for Planning and Infrastructure
Impact of significant development proposals on the values and ecology of land or natural waters		Local Government Authority
Regulation of prescribed premises that could pollute; Prohibited discharge of specified contaminants	<i>Environmental Protection Act 1986, Part IV</i> Environmental Impact Assessment	Minister for the Environment as advised by the Environmental Protection Authority
Native Vegetation Clearing (Clearing Permit)	<i>Environmental Protection Act 1986, Part V</i> Environmental Regulation; Unauthorised discharge Regulations 2004	Department of Environment and Conservation's regional office
Transport of controlled wastes (all liquid waste and any waste that can not be disposed of at a Class I, II or III landfill site).	Section 51E Environmental Protection (Clearing of Native Vegetation) Regulations 2004	
Licence to take surface water and groundwater; Riparian rights; Obstruction of flow	Environmental Protection (Controlled Waste) Regulations 2004	
Industrial sites in existing public drinking water source areas; Control of drainage	<i>Rights in Water and Irrigation Act 1914</i>	Department of Water's regional office
Licence to discharge waters into managed waterways.	<i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i>	
Discharges into the Swan-Canning estuary	<i>Country Areas Water Supply Act 1947</i>	
Storage of fuels, solvents and explosive and dangerous goods	<i>Waterways Conservation Act 1976</i>	Swan River Trust
Management of human wastes; Community health issues	<i>Explosive and Dangerous Goods Act 1961;</i> EDG Regulations	Department of Consumer and Employment Protection
	<i>Health Act 1911;</i> <i>Planning and Development Act 2005</i>	Department of Health
		Local government authority

What's regulated?	Statute	Regulatory body or agency
Pesticide use	<i>Health Act 1911;</i> Health (Pesticide) Regulations 1956; <i>Environmental Protection Act 1986</i>	Department of Health
		Department of Environment and Conservation
Emergency response planning	<i>Fire and Emergency Services Authority of WA Act 1998</i>	Fire and Emergency Services Authority
Discharge to sewer (industrial waste permit) or to main drain	<i>Metropolitan Water Supply Sewerage and Drainage Act 1909;</i> <i>Country Towns Sewerage Act 1948</i>	Water Corporation
		Designated water services provider

For copies of Acts and Regulations, see Internet site <www.slp.wa.gov.au> select *Online publications > Acts and Regulations*.

Appendix C - Sensitive water resources

Clean water resources used for drinking, sustaining aquatic and terrestrial ecology, industry, and aesthetic values, along with breathable air, rank as the most fundamental and important needs for viable communities. Water resources should remain within specific quality limits to retain their values, and therefore require stringent and conservative protection measures. Guidance on water quality parameters necessary to maintain water values are published in the Australian government's *National Water Quality Management Strategy guidelines*, see Internet page <www.environment.gov.au/water/quality/nwqms/index.html>.

The Department of Water strives to improve community awareness of catchment protection measures for both surface water and groundwater as part of a multi-barrier protection approach to maintain the quality of water resources.

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

Sensitive water resource values include:

- a Public drinking water source areas (i.e. *water reserves, catchment areas* or *underground water pollution control areas*) proclaimed or assigned under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, the *Country Areas Water Supply Act 1947* or the *Health Act 1911*.
- b Private water supply sources, including the following uses:
 - Human or stock consumption.

- Commercial or industrial water supplies (with specific qualities that support the activities e.g. aquaculture, cooling, food or mineral processing or crop irrigation).
 - Urban water supplies (which can affect people's health or wellbeing).
- c Groundwater aquifers that sustain important ecological functions e.g. cave ecology.
- d Waterways (excluding engineered drains or constructed features) with ecological and/or social values such as aesthetic appeal, boating, fishing, tourism and swimming, including:
- High conservation significance waterways described in the Environmental Protection Authority's draft guidance statement 33 *Environmental Guidance for Planning and Development* (section B5.2.2), see <www.epa.wa.gov.au> select EIA > *guidance statements*.
 - *Waterways Conservation Act 1976* managed waterways, i.e. the Avon, Peel-Harvey, Leschenault, Wilson Inlet and Albany waterways management areas.
 - *Swan and Canning Rivers Management Act 2006* managed waterways.
- e Wetlands possessing recognised or probable conservation values (generally excluding those highly disturbed unless subject to active management to restore specified environmental values), and including:
- RAMSAR wetlands, see Internet site <www.ramsar.org>
 - High conservation significance wetlands as described in the Environmental Protection Authority's draft guidance statement 33 *Environmental Guidance for Planning and Development* (section B4.2.2), see Internet site <www.epa.wa.gov.au> select EIA > *guidance statements*
 - Wetlands described by the Department of the Environment and Water Resources (Australia) in *A Directory of important wetlands in Australia*, (see Internet page <www.deh.gov.au/water/wetlands/databases.html> or the Department of Environment and Conservation web page <www.naturebase.net/content/view/813/861/>)
 - Conservation valued and resource enhancement category wetlands identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, all wetlands identified in the *South Coast Significant Wetlands* dataset and high value wetlands identified in the *Geomorphic Wetlands Augusta to Walpole* dataset. The Augusta to Walpole wetland dataset has not yet been subject to a detailed evaluation process.

Note: many waterways and wetlands in the state still need to be scientifically evaluated and their value classified. Any such waters that are generally undisturbed by human activity, should be considered to have high conservation value, unless proven otherwise.

The Department of Conservation and Environment is the custodian of wetland datasets and is responsible for maintaining and updating the information within them. The datasets can be viewed or downloaded from the Internet site <www.dec.wa.gov.au> select *Department of Environment > tools, systems and data > Geographic Data Atlas > inland waters > wetlands*. Guidance on viewing the wetlands is provided on the same website at *water > wetlands > data > wetland mapping > how to view wetland mapping* or phone the department on 9334 0333.

Appendix D - Development proposals near sensitive water resources

Where facilities are to be constructed or upgraded near a sensitive water resource, including PDWSA, waterways management areas, the Swan River Trust area or within 500 metres of any Conservation category wetland, proponents should supply a notice of intent (NOI) to the Department of Water and other appropriate government agencies. The notice of intent should include the following details:

- a Site owner or operating tenant's contact name and address details.
- b Site plan showing the location of the facility.
- c Description of the activities that will be carried out.
- d Description of materials/chemicals stored or handled on site.
- e Description of the types and quantities of waste that will be generated at the facility.
- f Proposals for chemical containment waste management and disposal (with design sketches).
- g Details of any contingency measures to minimise the impacts of chemical spills, and disposal of contaminated waters from fire, flood or other emergency.

Appendix E - Erosion and sedimentation risk

Soil texture	Soil classification ²	Sedimentation risk			
		Steep slope ³	Moderate slope ⁴	Gentle slope ⁵	Flat ground ⁶
sand, loamy sand	S Smc	high	moderate	low	slight
sandy loam, silty loam	Msc Mcs	very high (high) ¹	high (moderate) ¹	moderate (low) ¹	slight
clayey or sandy loam	Mcs	high (moderate) ¹	moderate	low	slight
silty or sandy clay	Cms/Csm	low	slight	slight	slight

Legend

- 1 Where average rainfall is less than 800 millimetres/year, the risk class in brackets applies
- 2 Soil classification (Unified soil classification) as defined in AS 1726 – 1993
- 3 more than one in eight slope
- 4 one in eight to one in 19 slope
- 5 one in 19 to one in 29 slope
- 6 less than one in 29 slope

Adapted from the *Environmental stewardship farm environment plan guidance 002*, published March 2005, Rural Development Service, UK.

Erosion risk in the context of the preceding table has been defined as:

very high	Rills form in most years, gullies may develop in very wet periods
high	Rills develop in wet periods
moderate	Sediment is deposited on roads, in ditches and watercourses during wet periods
low	Discoloured run-off may enter and pollute waterways
slight	Run-off water is rarely discoloured

Appendix F - Infrastructure corridor crossing diagram - waterway buffers

