Government of **Western Australia**
Department of **Water**

Decision process for stormwater management in WA

A component of Chapter 4: Integrating stormwater management approaches, Stormwater management manual for Western Australia (Department of Water 2004–07)

Looking after all our water needs

Department of Water

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Introduction

The *Decision process for stormwater management in WA* provides a decision framework for the planning and design of stormwater management systems. The desired outcome of the decision process methodology is to minimise potential changes in the volume of surface water flows and peak flows resulting from the urbanisation of an area (i.e. residential, rural-residential, commercial and industrial development). If these changes are not managed, they can lead to adverse impacts on the water regime, water quality, habitat diversity and biodiversity in receiving water bodies[1] and affect public health and amenity.

The decision process also addresses the management of flood events to protect properties. It sits within the objectives, principles and delivery approach outlined in the *Stormwater management manual for Western Australia* (Department of Water 2004–07). These objectives include:

- minimising risk to public health and amenity
- implementing systems that are economically viable in the long term
- retaining natural drainage systems and protecting ecosystem health
- ensuring that social, aesthetic and cultural values are maintained.

The stormwater management design for a site should be consistent with the approved urban water management plan and/or the district or local water management strategy for the area, which should be prepared in accordance with *Better urban water management* (Western Australian Planning Commission 2008), *Urban water management plans – guidelines for preparation and compliance with subdivision conditions* (Department of Water 2008a) and/or *Interim: Developing a local water management strategy* (Department of Water 2008b). These planning documents have been developed to assist the land development industry to demonstrate compliance with the policies and principles of *State planning policy no. 2.9: water resources* (Western Australian Planning Commission 2006).

A significant stormwater management measure is to minimise the 'effective imperviousness' of a development area. Effective imperviousness is defined as the combined effect of the proportion of constructed impervious surfaces in the catchment, and the connectivity of these impervious surfaces to receiving water bodies. The purpose of minimising effective imperviousness is to reduce the transportation of pollutants to receiving water bodies and for post development hydrology to mimic pre-development hydrology as closely as possible. This is achieved by disconnecting constructed impervious areas from receiving water bodies (preventing direct discharge) and by reducing the amount of constructed impervious areas.

To retain the pre-development hydrology of a site, the order of management priorities is:

- the magnitude of peak flows
- the volume of catchment runoff
- the seasonality of catchment runoff.

[1] Water bodies are defined as waterways, wetlands, coastal marine areas and shallow groundwater aquifers.

Rainfall, for the majority of events occurring each year, should be retained[2] or detained[3] on-site (i.e. as high in the catchment and as close to the source as possible, subject to adequate site conditions). Runoff from constructed impervious areas (e.g. roofs and paved areas) should be retained or detained through the use of devices such as soakwells, pervious paving, vegetated swales, gardens or rainwater tanks. For detention systems, the pre-development critical 1-year average recurrence interval (ARI[4]) peak flow rate and discharge volume from constructed impervious areas should be preserved. Events larger than 1-year ARI can overflow off-site via an appropriate flowpath.

For larger rainfall events (i.e. greater than 1-year ARI events), runoff from constructed impervious areas should be retained or detained to the required design storm event in landscaped retention or detention areas in road reserves, public open space or linear multiple use corridors. Any overflow of runoff towards waterways and wetlands should be by overland flow paths across vegetated surfaces. Further detention may be required to ensure that the pre-development hydrologic regime of the receiving water bodies is largely unaltered, particularly in relation to peak flow rates and, where practical, discharge volume.

Urban pollutants, whether in particulate or soluble forms, are conveyed by stormwater almost every time a storm event occurs. Studies in urban areas have shown that there is no general trend of increased concentrations of contaminants such as nutrients and metals with increasing storm sizes. Wong *et al*. (1999) found that most hydraulic structures can be expected to treat over 99 per cent of the expected annual runoff volume when designed for a 1-year ARI peak discharge. Unlike flood mitigation measures, stormwater quality treatment devices do not need to be designed for rainfall events of high ARI to achieve high hydrologic effectiveness (i.e. the percentage of mean annual runoff volume subjected to treatment).

The design of stormwater management systems should be based on adequate field investigations to determine the conditions of the site. Prior to design, developers should consult with the Department of Water, local government authorities and other relevant stakeholders. Please refer to the flow chart for more detailed guidance.

[2] Retention is defined as the process of preventing rainfall runoff from being discharged into receiving water bodies by holding it in a storage area. The water may then infiltrate into groundwater, evaporate or be removed by evapotranspiration of vegetation. Retention systems are designed to prevent off-site discharges of surface water runoff, up to the design ARI event. It is the difference between total precipitation and total runoff.

[3] Detention is defined as the process of reducing the rate of off-site stormwater discharge by temporarily holding rainfall runoff (up to the design ARI event) and then releasing it slowly, to reduce the impact on downstream water bodies and to attenuate urban runoff peaks for flood protection of downstream areas.

[4] Average recurrence interval (ARI) is defined as the average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration. For further information, refer to *Australian rainfall and runoff* (Engineers Australia 2001) and the Bureau of Meteorology website via <www.bom.gov.au/hydro/has/ari_aep.shtml>.

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The following process should be used to guide all stages of planning and designing stormwater management systems

1. Prior to and throughout the design process (including during structure planning), proponents shall consult with the Department of Water, Department of Environment and Conservation, local government authorities, the Swan River Trust (where applicable) and other relevant stakeholders.
2. Development should be planned in accordance with *Better urban water management* (Western Australian Planning Commission 2008) and applicable land and water planning guidance documents.
3. Stormwater management systems shall be designed in accordance with the objectives, principles and delivery approach outlined in the *Stormwater management manual for Western Australia* (Department of Water 2004–07). The objectives include: minimising risk to public health and amenity; protecting the built environment from flooding and waterlogging; retaining natural drainage systems and protecting ecosystem health; implementing systems that are economically viable in the long term; ensuring that social, aesthetic and cultural values are maintained; maximising the reuse of stormwater; maintaining or improving surface and ground water quality; and maintaining the total water cycle balance.
4. Adequate field investigations shall be undertaken to determine the appropriate hydrologic regime for the site and potential site constraints, such as contaminated sites, acid sulfate soils or highly elevated nutrient levels in groundwater. Baseline and/or ongoing monitoring of groundwater and surface water quality and quantity may be required.
5. Stormwater management systems may be subject to additional design and performance criteria if they have the potential to impact on sensitive receiving environments. Sensitive receiving environments include the following environments, as defined in *Environmental guidance for planning and development – guidance statement no. 33* (Environmental Protection Authority 2008): natural areas of high conservation significance (chapter B1.2.1); native vegetation and flora of high conservation significance (chapter B2.2.2); areas of high conservation significance for native fauna (chapter B3.2.2); wetlands of high conservation significance (chapter B4.2.2); waterways of high conservation significance (chapter B5.2.2); waterways management areas (attachment B5-5); Swan and Canning Rivers Development Control Area (attachment B5-5); public drinking water source area wellhead protection zones and reservoir protection zones (chapter B6-1); landscapes and landforms of high conservation significance (chapter B8.2.1); and karst areas of high conservation significance (chapter B9.2.2).

Water quantity management

1. Is the proposal completely or partly within a known contaminated site (i.e. a contaminated site listed on the contaminated sites register, or identified through adequate field investigations) or a high acid sulfate soil risk area?
2. Does the soil or groundwater contain highly elevated nutrient levels? A definition for highly elevated nutrient levels has not been provided, as nutrient breakthrough is highly variable and is dependent on the soil type (e.g. organic, clay and iron oxyhydroxide content) and local wetting and drying cycles.

Yes (to either question) →

Avoid mobilisation or disturbance of the in-situ contaminants

If yes to question 1 – seek further advice from the Department of Environment and Conservation.

If yes to question 2 – consult with the Department of Water about best management practices to minimise nutrient leaching through the soil profile (i.e. structural and non-structural controls suitable to the site conditions) and the Swan River Trust where the waters in the Trust Development Control Area are likely to be affected.

No (most situations) ↓

1. Maintain the pre-development annual discharge volume and peak flow, unless otherwise established through determination of ecological water requirements for sensitive receiving environments. For more information, see the *Guidelines for ecological water requirements for urban water management* (Department of Water, in preparation).
2. Hydrologic and hydraulic analyses, modelling and design shall incorporate the recommendations and methodology of *Australian rainfall and runoff – a guide to flood estimation* (Engineers Australia 2001).
3. The effective imperviousness of a development shall be minimised. The process for achieving this is outlined below:

Less than and equal to 1-year ARI events: →

Retain or detain stormwater runoff from constructed impervious surfaces generated by up to 1-year, 1-hour average recurrence interval (ARI) events on-site (i.e. as high in the catchment and as close to the source as possible).

Generally, detention systems should preserve the pre-development critical 1-year ARI peak flow rate and discharge volume for the catchment.

Greater than 1-year and up to 100-year ARI events: →

Manage runoff from constructed impervious areas for greater than 1-year, 1-hour ARI events in landscaped retention or detention areas in road reserves, public open space or linear multiple use corridors. Runoff into waterways and wetlands shall be by overland flow paths across vegetated surfaces.

Design for greater than 1-year and less than/equal to 5-year (residential/rural-residential) or 10-year (commercial/ industrial) ARI events →

Minor system conveyance
(e.g. via swales and overflow pipes)

Design for greater than 5/10-year and up to 100-year ARI events →

Major system conveyance
(i.e. via overland flow paths)

Water quality management

1. On-site field investigations are required to determine the appropriate water quality management measures for the site, including consideration of potential pathways of pollutants toward receiving water bodies. Receiving water bodies are defined as waterways, wetlands, coastal marine areas and shallow groundwater aquifers.
2. The components of the water quality treatment train must be designed so that their combined effect contributes to meeting the water quality management objectives of the catchment. The objectives may be defined in a water quality improvement plan, regional water plan, drainage and water management plan, district or local water management strategy, urban water management plan, local government stormwater management plan, regional natural resource management strategy, the *Healthy rivers action plan* (Swan River Trust 2008), or the *Environmental protection (Peel Inlet–Harvey Estuary) policy 1992* (Environmental Protection Authority 1992). The requirements for demonstration of compliance shall depend upon the scale of the proposed land development. Demonstration of compliance may be achieved by the use of appropriate assessment methods, to the satisfaction of the Department of Water.
3. Practices to achieve water quality management objectives should be a combination of structural and non-structural controls.

Protect waterways and wetlands

1. Retain and restore waterways and wetlands. For waterways, the approach to protection and management should be consistent with the *River restoration manual* (Water and Rivers Commission/Department of Environment 1999–2003), *Foreshore policy 1 – identifying the foreshore area* (Water and Rivers Commission 2002), *Environmental guidance for planning and development – guidance statement no. 33* (Environmental Protection Authority 2008) and, in the Swan and Canning catchments, *Riverplan* (Government of Western Australia 2004) as a guideline until completion of the *River protection strategy* (Swan River Trust, in preparation) and *Best management practices for shoreline stabilisation* (Swan River Trust, in publication). For wetlands, the approach to protection and management should be consistent with *A guide to managing and restoring wetlands in Western Australia* (Department of Environment and Conservation, in preparation), *Environmental protection of wetlands position statement no. 4* (Environmental Protection Authority 2004), *Wetlands conservation policy for Western Australia* (Government of Western Australia 1997), *Environmental guidance for planning and development – guidance statement no. 33* (Environmental Protection Authority 2008), *Position statement: wetlands* (Water and Rivers Commission 2001) and relevant environmental protection policies.
2. There shall be no new constructed stormwater infrastructure (e.g. no pipes or constructed channels) within conservation category wetlands and their buffers, or other wetlands of high conservation significance and their buffers (as defined in Environmental Protection Authority 2008), or resource enhancement category wetlands and their buffers, unless authorised by the Department of Environment and Conservation or the Environmental Protection Authority. For multiple use category wetlands, stormwater management shall be consistent with *Environmental guidance for planning and development – guidance statement no. 33* (Environmental Protection Authority 2008). There shall be no new constructed stormwater infrastructure within a waterway foreshore area, unless authorised by the Department of Water or the Environmental Protection Authority or, where applicable, the Swan River Trust.
3. The creation of artificial lakes or permanent open water bodies generally will not be supported when they involve the artificial exposure of groundwater (e.g. through excavation, or lined lakes that require groundwater to maintain water levels in summer), or the modification of wetland type (e.g. converting a dampland into a lake). Where water conservation (e.g. summer water supply) and environmental and health concerns (e.g. hydrology, water quality, mosquitoes, midges, algal blooms, acid sulfate soils and iron monosulfide minerals) can be shown to be addressed adequately through design and maintenance, consideration may be given to the creation of artificial lakes/ponds. Ephemeral detention or infiltration areas, or approved constructed waterways (i.e. ephemeral living streams) are preferred options. For further guidance, refer to the *Interim position statement: constructed lakes* (Department of Water 2007).

Management of groundwater levels

1. Any proposals to control the seasonal or long-term maximum groundwater levels through controlled groundwater levels (CGL) shall demonstrate (through adequate field investigation and to the satisfaction of the Department of Water) that local and regional environmental impacts are managed adequately.
2. The CGL is defined as the controlled (i.e. modified) groundwater level (measured in metres Australian height datum) at which the Department of Water will permit drainage inverts to be set. The CGL must be based on local and regional ecological water requirements determined in accordance with the *Environmental water provisions policy for Western Australia* (Water and Rivers Commission 2000) and the *Guidelines for ecological water requirements for urban water management* (Department of Water, in preparation). If groundwater levels are proposed to be controlled using a subsoil drainage system, the proposal to determine and implement a CGL is to be described in a district water management strategy and the estimated CGL level may be proposed at this stage. The CGL calculation will then need to be refined in a local water management strategy and further refined in an urban water management plan. The Department of Water is preparing guidelines on determining groundwater drainage levels.
3. Where appropriate, field investigations must be undertaken to identify acid sulfate soils (ASS). Any reduction in groundwater levels via drainage should not expose ASS to the air, as this may cause groundwater contamination. Refer to the Department of Environment and Conservation ASS guideline series, including *Policy position - acid sulfate soils and the Contaminated Sites Act 2003* (Department of Environment and Conservation 2007) and the Western Australian Planning Commission ASS planning guidelines. If field investigations identify ASS, seek further advice from the Department of Environment and Conservation.