

This version of the ***Using the integrated water management provisions of Clause 56 – Residential subdivision*** VPP Practice Note has been prepared for use with screen reader software. The printed publication contains various photographs, captions and design features that have been necessarily omitted from this version. In other respects this document contains identical text to that in the PDF version of the document which is available at www.dpcd.vic.gov.au/planning.

VPP Practice Note

Using the integrated water management provisions of Clause 56 – Residential subdivision

October 2006

Victoria's population will increase by another 1 million people by 2030, placing additional demand on our water resources and environment.

To conserve our potable water resources and ensure the sustainability of our waterways, the Victorian Government has introduced integrated water management provisions for the design and assessment of residential subdivisions in the *Victoria Planning Provisions*.

The residential subdivision planning requirements are contained in Clause 56 of the *Victoria Planning Provisions*.

Clause 56 provides sustainable water management requirements that aim to:

- integrate use of all water resources including rainwater, reused water, recycled water and stormwater
- conserve the supply and reduce the use of potable water
- use alternative water supplies where potable water quality is not required
- use best practice water sensitive design techniques to conserve, reuse and recycle water and manage the quality of stormwater run-off.

The purpose of this practice note is to provide supporting technical information about the integrated water management provisions of Clause 56 and explains:

- how Clause 56.07 operates
- the water management provisions of Clause 56.07
- how the requirements of Clause 56.07 can be met.

How does Clause 56.07 operate?

Clause 56.07 sets out the integrated water management requirements that must be met for residential subdivision proposals in an urban area.

The objectives of Clause 56.07 describe the outcomes to be achieved in a completed residential subdivision. The associated standards contain the requirements or measures that meet the objectives. A standard should normally be met. However, if the responsible authority (normally council) is satisfied that an application for an alternative design solution meets the objective, the alternative design solution may be considered.

When does Clause 56.07 apply?

The requirements of Clause 56.07 apply in a Residential 1, Residential 2, Residential 3, Mixed Use and Township Zone and any Comprehensive Development Zone or Priority Development Zone that

provides for residential development. They do not apply to the subdivision of land into lots each containing an existing dwelling or car parking space.

All subdivisions, excluding subdivisions of existing buildings and car parking spaces, in these zones must meet the integrated water management objectives.

For a residential subdivision application in a Low Density Residential Zone, the responsible authority (council) must consider the relevant standards of Clause 56.07 before making its decision.

What does Clause 56.07 require?

Clause 56.07 requires the provision of:

- drinking water systems, waste water systems and urban stormwater management systems to the boundaries of all lots, where required by the relevant water authority, sewerage authority or drainage authority
- reused and recycled water systems to the boundary of all lots, where a site is in one of the areas where the water authority requires a dual water reticulation system. (Reused and recycled water systems could be provided in other locations where agreed by the relevant water authority.)

The responsible authority will require written evidence that the requirements of the water authority, sewerage authority, Environment Protection Authority, drainage authority or flood plain management authority, as relevant, have been met.

Generally matters relating to the location of the drinking water supply, reused and recycled water, waste water and urban run-off systems can influence the layout of a residential subdivision and should be submitted as part of the design response. Assessment of matters of design detail and construction may be appropriately deferred until later in the design process using permit conditions. This would assist in avoiding unnecessary delays and costs for developers and help provide more affordable housing.

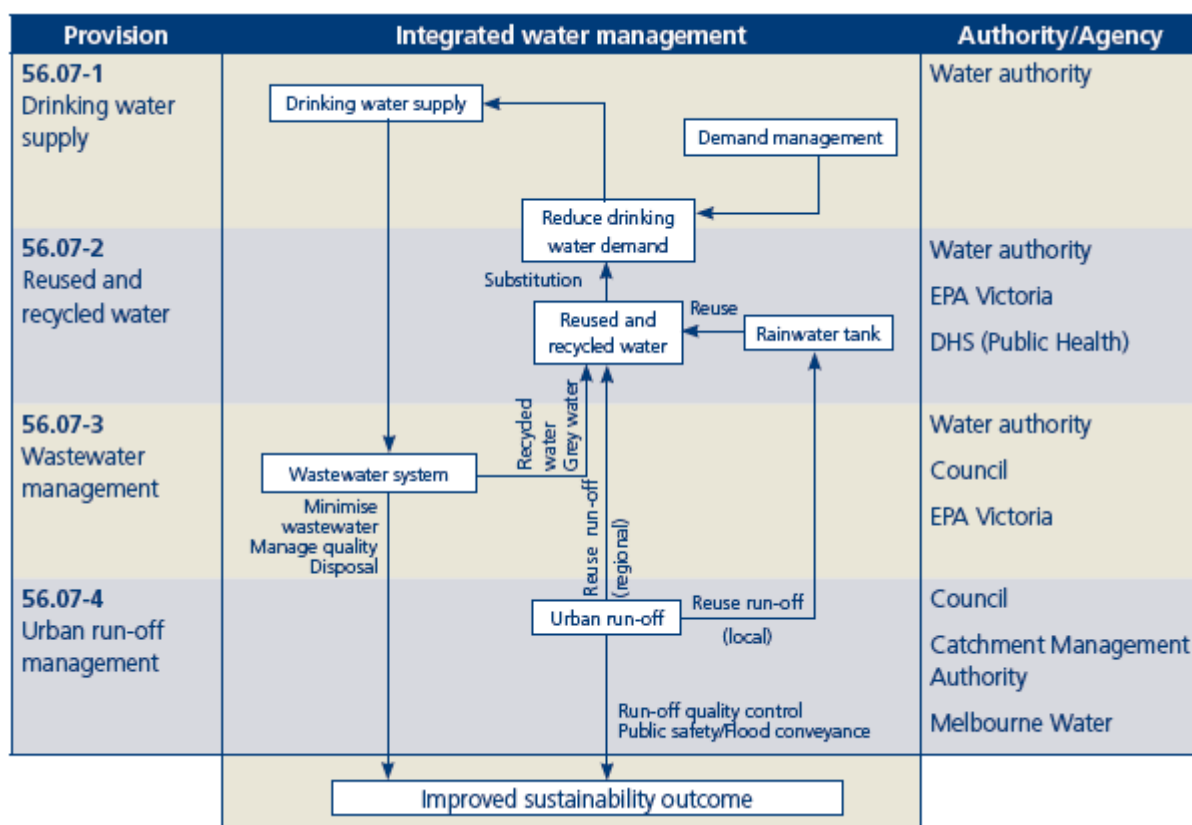
Clause 56.07 comprises the following provisions:

- 56.07-1 Drinking water supply objectives and Standard C22
- 56.07-2 Reused and recycled water objective and Standard C23
- 56.07-3 Waste water management objective and Standard C24
- 56.07-4 Urban run-off management objectives and Standard C25

The provisions cannot be applied to introduce arbitrary water management measures for the construction of dwellings and other buildings, water efficiency of fixtures or fittings, or provision of site works on proposed lots. These are matters for the building or plumbing regulations.

Figure 1 outlines the integrated water management provisions of clause 56.07.

Figure 1 – Clause 56.07 Integrated water management planning provisions, Overview



What is integrated water management?

Integrated water management involves the appropriate use of all available water sources on the basis that the water is fit for the purpose for which it is to be used. Residential subdivisions may contribute to conserving drinking water supplies by reusing or recycling waste water and urban run-off for non-drinking purposes. The demand for drinking water is thereby reduced.

What is a water supply-demand strategy?

Water authorities are required by the Victorian Government to progressively prepare water supply-demand strategies that include drinking water savings targets. The first target to be set was for a 15 per cent per capita reduction in drinking water use by 2010 for Melbourne.

New urban development has a role to play in water conservation, particularly through the plumbing and building regulations and with the progressive introduction of more water efficient fixtures and appliances. Higher savings may be required by a water authority's supply-demand strategy or be a voluntary initiative of a land developer agreed by the water authority.

What is the *State Environment Protection Policy (Waters of Victoria)*?

The *State Environment Protection Policy (Waters of Victoria)* sets the legal framework for government agencies, businesses and the community to work together, to protect and rehabilitate Victoria's surface water environments. The purpose of the Policy is to protect the environmental values and beneficial uses of water, the environmental management required to protect them and the means by which they can be met.

Who are the authorities?

The water authority is responsible for delivering some or all of the following services to towns and cities across Victoria: potable water storage, treatment and supply; sewerage reticulation and waste water treatment; recycled water supply; diversion of water from waterways; and extraction of groundwater.

The drainage authority may be local government and/or Melbourne Water and is responsible for managing drainage assets and ensuring that the quality of stormwater meets river health objectives

and satisfies broad community aesthetic and amenity values. Councils are generally responsible for catchments of less than 60 hectares within the Melbourne Water region.

Catchment Management Authorities (CMAs) manage river health; are responsible for regional and catchment planning and coordination and waterway, floodplain, salinity and water quality management.

Flood Plain Management Authorities control developments proposed for land adjoining waterways, and provide advice about flooding and controls on development to councils and the community. The main floodplain management authorities are Melbourne Water and regional Catchment Management Authorities.

The Environment Protection Authority (EPA) has a responsibility to enable the protection of the beneficial uses of Victoria's water environments consistent with its responsibilities under the *Environment Protection Act 1970* and *State Environment Protection Policy (Waters of Victoria)*. EPA will approve waste water and recycled water systems, and provide guidance on meeting best practice stormwater quality objectives.

Councils can provide advice on the relevant authorities for a particular site and their contact details.

Using the integrated water management provisions of Clause 56 and how they can be met.

Clause 56.07-1 Drinking water supply objectives and Standard C22

The objectives require a residential subdivision to reduce the use of drinking water and to provide an adequate, cost-effective supply of drinking water.

The normal way of achieving this is set out in Standard C22 which requires that the supply of drinking water must be:

- Designed and constructed in accordance with the requirements and to the satisfaction of the relevant water authority.
- Provided to the boundary of all lots in the subdivision to the satisfaction of the relevant water authority.

In most areas, reticulated drinking water supply will be available within or adjacent to established urban areas. In some cases, an extension of the reticulated water supply system will be required to service the proposed subdivision. In these cases, advice and the approval of the local water authority to extend the service will be required.

Contact the local water authority for:

- the location of the nearest reticulated drinking water supply of appropriate capacity to serve the proposed subdivision
- connection requirements
- the design and construction standards for the proposed reticulated drinking water supply system
- any requirement of the water authority for an owner to enter into a separate agreement with the water authority relating to the works.

The reticulated drinking water supply must be provided to the boundary of all lots maximising use of shared trenching (as provided for in Clause 56.09-1 and Standard C27).

It is recommended that contact is made with the relevant water authority before applying for a planning permit.

Compliance with the requirements of the water authority would be demonstrated by a letter from the water authority confirming that the information submitted as part of the design response complies with its requirements.

56.07-2 Reused and recycled water objective and Standard C23

The objective is to provide for the substitution of drinking water for non-drinking purposes with reused and recycled water.

The normal way of meeting this is set out in Standard C23 which requires that reused and recycled water supply systems must be:

- Designed, constructed and managed in accordance with the requirements and to the satisfaction of the relevant water authority, the Environment Protection Authority and Department of Human Services.
- Provided to the boundary of all lots in the subdivision where required by the relevant water authority.

Substitution of reused and recycled water, where fit for the purpose enables high levels of water savings, by reducing the demand and use for drinking water. Water savings may form part of a water authority's water supply and demand strategy.

Sources of reused and recycled water include waste water, when suitably treated, and urban run-off which is principally stormwater. Where a dual reticulation system is provided, households that are connected to the drinking water supply must also connect to the reused and recycled water supply where required by the relevant water authority.

The appropriateness of reused and recycled water supply systems is determined by the water authority. They are not suitable everywhere.

A water authority may specify an area for mandatory installation of the dual water reticulation system. Provision of dual water reticulation systems must be to the agreement of the water authority.

Reuse of run-off may be inappropriate in areas where the source water has been identified to provide minimum environmental flows in downstream waterways.

Recycled water must meet high quality standards and is managed and controlled by the water authority within the regulatory framework of the EPA and Department of Human Services (DHS). Where a recycled water scheme is proposed, contact must be made with the water authority. A detailed plan must be prepared by a suitably qualified person in accordance with guidance from the EPA, showing how the recycled water system will be implemented and managed. This must be approved by the EPA and, where necessary, endorsed by the DHS prior to a recycled water scheme proceeding.

Contact the water authority for advice on:

- *whether the subdivision site is in an area identified for a dual reticulation water system*
- *design and construction requirements.*

Contact EPA for:

- EPA publications to assist councils and individuals better manage recycled water systems. They are:
 - EPA Publication 464.2 – Guidelines for environmental management – Use of reclaimed water
 - EPA Publication 1015 – Guidelines for environmental management – Dual pipe water recycling schemes – health and environmental risk management
- Electronic copies of these documents, go to www.epa.vic.gov.au for:
 - Water
 - Controlling Waste Water
 - Advice to industry

- Environmental guidelines

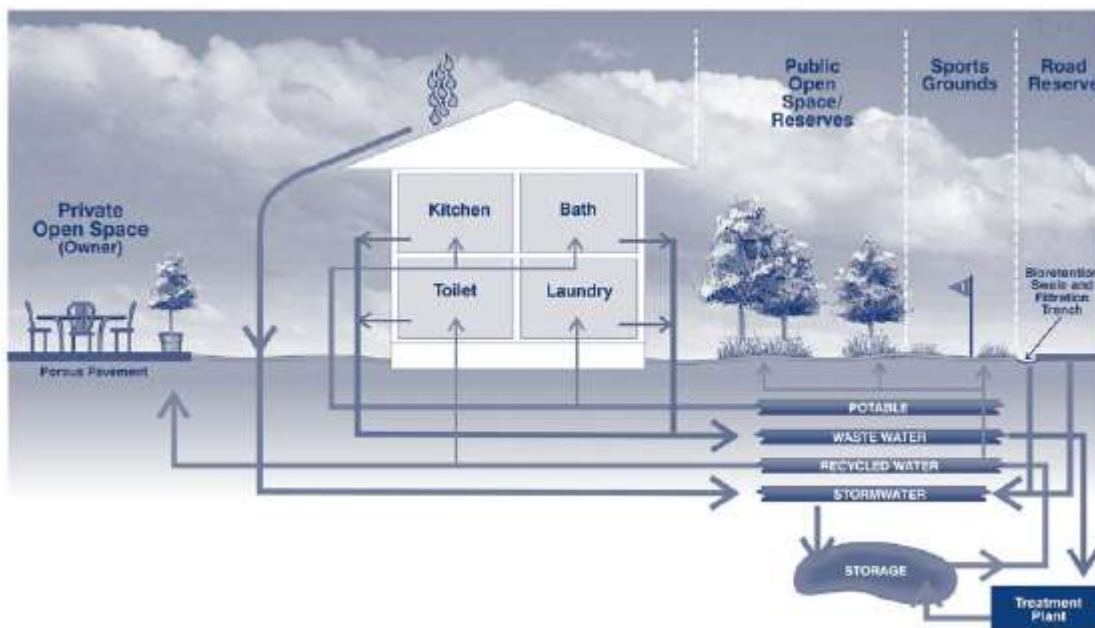
It is recommended that contact be made with the relevant water authority before applying for a planning permit.

Compliance with the requirements of the water authority, EPA and DHS would be demonstrated by approval of the recycled water scheme by the water authority and EPA. The EPA manages referrals to the DHS.

The dual water reticulation system must be provided to the boundary of all lots. Associated issues include the use of shared trenching (as provided for in Clause 56.09-1 and Standard C27) and provision of areas for water treatment and storage (as provided for in Clause 56.05-2 Public open space provision and Standard C13).

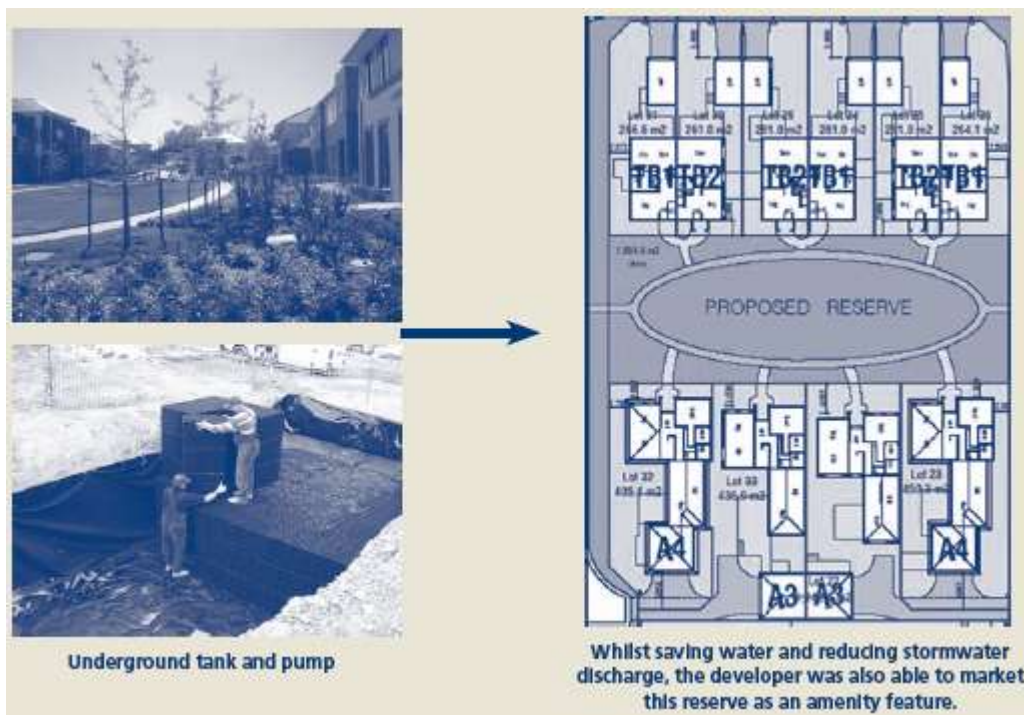
Conceptual diagram: Recycled water system

- This type of waste water management system can save a substantial proportion of a development's drinking water use.
- Further savings are possible if the above scenario is used with rainwater tanks to capture roof run-off for hot water use.
- Where recycled water ('dual water reticulation system') systems are not used, other fixtures such as rainwater tanks can provide an alternative source for reuse in the home (toilet flushing and garden watering). Rainwater tanks are an option provided for under the building regulations. It is not appropriate that they be required as a condition of a residential subdivision permit.



Example – Irrigation of Public Open Space with Reused Water

This is an example of a neighbourhood reuse system within a residential subdivision. Stormwater is collected from the residential allotments in a 50kL underground tank within the public open space reserve. The stored water is used to irrigate the landscape, which results in an average annual drinking water use saving of around 350kL (approximately 13% saving of drinking water for 10 lots).



56.07- 3 Waste water management objective and Standard C24

The objective is to provide a waste water system that is adequate for the maintenance of public health and the management of effluent in an environmentally friendly manner.

The normal way of meeting this is set out in Standard C24 which requires that waste water systems be:

- Designed, constructed and managed in accordance with the requirements and to the satisfaction of the relevant water authority and the Environment Protection Authority.
- Consistent with any relevant approved domestic waste water management plan.

Reticulated waste water systems must be provided to the boundary of all lots in the subdivision where required by the water authority.

Councils are responsible for ensuring the provision of appropriate waste water systems to all lots in a subdivision.

In most cases, reticulated sewerage systems for waste water disposal will be available within or adjacent to urban areas. Connection to the sewerage network is arranged through the relevant water authority.

It may be necessary to extend the existing network to service the subdivision. In these cases, advice and the approval of the water authority to extend the service will be required.

Where reticulated systems are not available, council will require on-site waste water treatment that takes account of land capability, the requirements of the water authority and the EPA.

Reticulated waste water systems

These systems:

- are generally the most effective method for removing and treating waste water in an urban area
- convey waste water to centralised or local treatment facilities
- must meet the requirements of the water authority
- are provided to all lots within a subdivision where access to a sewerage system is available.

On-site waste water systems

These systems:

- are generally provided where waste water can be safely and sustainably managed and retained onsite and where reticulated systems are not available
- collect, treat and reuse or dispose of waste water on-site
- must meet the requirements of the EPA and council
- must be consistent with any relevant approved council Domestic Waste Water Management Plan.

Compliance would be demonstrated by:

- EPA Certificate of Approval and Council-issued septic tank permit (less than 5000 litres per day), or
- EPA approved Works Approval of Licence (greater than 5000 litres per day).

For further information refer to:

EPA

EPA publications to assist councils and individuals better manage on-site waste water systems are:

- EPA Publication 891 – *Septic Tanks – Code of Practice*
- EPA Publication 629 – *Development Approvals in Sewered and Unsewered Areas*
- EPA Publication 746.1 – *Land Capability Assessment for Onsite Domestic Wastewater Management*

Visit: www.epa.vic.gov.au and go to Water / Wastewater / On-site wastewater treatment systems

Department of Human Services

Visit www.dhs.vic.gov.au and go to www.health.vic.gov.au/environment/water/recycle / see Greywater / *Appropriate use of greywater*, October 2003.

Municipal Association of Victoria

Provides a range of planning and management tools to assist councils and applicants with their management of domestic waste water.

Visit: www.mav.asn.au and go to Policy & Projects / Environment / Environment projects and policy issues / Water Management.

Clearwater Program

Is a joint initiative of local government, industry groups, government agencies, non-government organisations & research institutions. See the comprehensive database of tools, resources, technical guidelines, training manuals, information sheets, research papers and web links available regarding on-site waste water systems.

Visit: www.clearwater.asn.au and go to Domestic Wastewater.

56.07-4 Urban run-off management objectives and Standard C25

The objectives are:

- To minimise damage to properties and inconvenience to residents from urban run-off.
- To ensure that the street operates adequately during major storm events and provides for public safety.
- To minimise increases in stormwater run-off and protect the environmental values and physical characteristics of receiving waters from degradation by urban run-off.

The normal way of meeting this is set out in Standard C25. The standard provides design and management measures for urban stormwater systems, quality and flows. Refer to the local planning scheme and Standard C25 for the detailed wording.

Surface run-off occurs when the capacity of the land to retain water is exceeded. This run-off can be produced by rainfall or by the application of water for outdoor purposes (for example, irrigation, car washing). As the density of urban development in an area intensifies, so does the proportion of impervious areas, which in turn increases the volume of surface run-off from a rainfall event. Run-off rates become much higher and concentrated over shorter periods of time. These peak flows may be evident even after small, frequent rainfalls and have the potential to cause flooding and significant erosion in downstream waterways.

Urban development is also a significant generator of stormwater pollutants such as sediments, hydrocarbons, heavy metals, nutrients, pathogens and litter. Stormwater pollutants and peak flows can threaten the health of waterways by degrading aquatic habitats, disturbing riparian vegetation or modifying their physical form.

Urban run-off needs to be managed to minimise the risk of flooding and protect receiving waters and the environment. The receiving waters can be either surface water (creeks, rivers, bays) or groundwater.

Standard C25 provides that urban stormwater management systems must be designed and managed to the requirements of the relevant drainage authority. In Melbourne, this is either Melbourne Water (the water authority) or the local council where a catchment is 60 ha or less. In regional areas council is the local drainage authority.

Where reuse of urban stormwater is proposed, the urban run-off system must be designed and managed to the requirements and to the satisfaction of the water authority and/or drainage authority.

Stormwater run-off must meet the *Urban Stormwater – Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee 1999), as amended. The current water quality objectives are:

- 80 per cent retention of typical urban annual suspended solids load
- 45 per cent retention of typical urban annual total phosphorus load
- 45 per cent retention of typical urban annual total nitrogen load.

In addition, the guidelines require a 70 per cent reduction of typical urban annual litter load. Flows in waterways that are downstream of a proposed subdivision must be designed to ensure that flows downstream of the subdivision site are restricted to predevelopment levels unless increased flows are approved by the relevant drainage authority and there are no detrimental downstream impacts.

Drainage schemes

Drainage schemes are drainage strategies that:

- are prepared and implemented by the relevant drainage authority
- identify drainage infrastructure requirements for new developments and re-developments
- provide a mechanism for equitable funding of infrastructure between developers within a catchment.

For further information refer to:

- Melbourne Water's *Land Development Manual* at: <http://ldm.melbournewater.com.au/> for more specific information relating to drainage schemes in the Melbourne region and Melbourne Water's offsets strategy.
- In other regions refer to your council for specific information regarding drainage schemes.

Stormwater quality and residential subdivision

All sites must comply with the stormwater quality objectives of the *Urban Stormwater – Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee 1999), as amended. To

achieve this, treatment may be distributed throughout the subdivision. A range of treatment options exists. If a site is located within a drainage scheme then additional works may not be required on-site. Instead, a financial contribution may be made towards providing offsite urban run-off management infrastructure. The drainage authority should be contacted to obtain information about possible “off-set” provisions. Melbourne Water has a Stormwater Offsets strategy for the Melbourne region. All developments are encouraged to incorporate water sensitive urban design elements.

The stormwater quality performance of development proposals can be assessed using specialist modelling software. The MUSIC and STORM software programs, or equivalent, are suitable to use for residential subdivisions.

The MUSIC software

The MUSIC (*Model for Urban Stormwater Improvement Conceptualisation*) software was developed to operate at a subdivision, neighbourhood or regional level. The MUSIC software can assist with modelling the stormwater solution for the development.

MUSIC was developed by the Cooperative Research Centre for Catchment Hydrology, now known as the eWater Cooperative Research Centre, as a decision support system for stormwater management.

Further information:

Visit www.toolkit.net.au for further information and to purchase the current version of the software.

Example – Stormwater quality assessment using MUSIC

Catchment input details:

- Residential site: 3.5ha in area
- Site use: Residential
- Rainfall station: Melbourne

Land use details:

Front draining lots and road reserve	Area 1.55ha	Fraction impervious 0.52
Road reserve treatment only	Area 0.51ha	Fraction impervious 0.65
Rear draining lots	Area 1.44ha	Fraction impervious 0.45

Stormwater treatment provided:

- One way cross-fall roads with bio-retention swale provided – treatment area of 210m²
- Neighbourhood rain garden – treatment area of 60m²

MUSIC results:

Mean Annual Loads – Rain Garden

Flow (ML/yr)	Inflow 9.95	Outflow 9.34	% Reduction 6.2
Total Suspended Solids (kg/yr)	Inflow 2.00E3	Outflow 193	% Reduction 90.3
Total Phosphorus (kg/yr)	Inflow 3.95	Outflow 0.878	% Reduction 77.8
Total Nitrogen (kg/yr)	Inflow 28.8	Outflow 15.0	% Reduction 47.7
Gross Pollutants (kg/yr)	Inflow 446	Outflow 0.00	% Reduction 100.0

The STORM software

STORM (*Stormwater Treatment Objective – Relative Measure*) is a simplified method for rating the stormwater quality performance of a development proposal. It is most appropriate for assessing smallscale subdivisions of typically less than 1 hectare in area. While it can be used for large developments, the results will be more conservative than more sophisticated models such as MUSIC software. It is intended for use by applicants without access to specialist expertise.

STORM is a software tool that calculates the performance of a design using a series of curves to measure the effectiveness of nominated stormwater retention features for treating the quality of urban runoff from hard surfaces.

It allows for a stormwater quality treatment area to be provided to meet the best practice performance objectives provided in Standard C25 of Clause 56.07-4. A rating of 100 per cent implies that the water quality requirements have been satisfied.

The initial curves were prepared for member Councils of the Association of Bayside Municipalities (*Clean Stormwater Planning Framework*, ABM 2004). Adjustment factors have been developed to allow the tool to be used anywhere in Victoria. They are presented in Chapter 2 of *WSUD Engineering Procedures: Stormwater* (Melbourne Water, 2005) available from CSIRO Publishing.

Should any WSUD (Water Sensitive Urban Design) elements be required on lots to meet urban run-off objectives, this may be provided by agreement.

It is inappropriate to use a planning permit to require or prescribe on-lot works, where works are appropriately provided for in the building or plumbing regulations. For example, rain water tanks on dwellings are appropriately provided for under the 5-Star standard of the Building Regulations.

Residential subdivision planning permit conditions should not be used to require water sensitive urban design measures, such as rain gardens, on proposed lots. Permeability requirements on lots are appropriately provided for under the Building Regulations and Clauses 54.03-4 or 55.03-4 of planning schemes.

What if the STORMWATER quality requirements cannot be achieved?

Where a residential subdivision site is less than 1 ha in area, site conditions may make it difficult to meet the stormwater quality treatment requirements. Where all reasonable actions have been taken to achieve the performance objectives within the development site and 100 per cent treatment is not achieved, the following options apply:

- the developer may achieve water quality objectives through works on adjoining land with agreement of the drainage authority
- a charge may be sought for off-site works where the drainage authority applies an off-set provision under a drainage scheme
- a charge may be sought for off-site works where a relevant development contribution plan is part of the relevant planning scheme
- the drainage authority may exercise discretion to accept a lesser level of stormwater treatment
- the drainage authority may conclude that Objective 56.07-4 has not been met and determine not to issue a permit.

STORM is available on Melbourne Water's web site www.wsud.melbournewater.com.au

Stormwater flows and residential subdivision

Best practice in stormwater management is a distributed system for stormwater that encompasses WSUD elements at the lot, precinct and regional levels. Standard C13 (56.05-2 Public open space provision objectives) provides that where public open space is used it should:

- include land used for drainage control or stream and floodway purposes if generally available for recreational use
- be integrated with urban water management systems including watercourses and water bodies.

Minor or local drainage system

The minor drainage system will generally consist of a gutter and pipe network or a swale system to contain run-off from minor storms to prevent nuisance flooding of pavements. Requirements include that:

- the network should be designed for flows up to 1 in 5 year rainfall events (20% Average Exceedence Probability standard)
- peak run-off rates should be designed to ensure that existing downstream flows are restricted to predevelopment levels unless increased flows are agreed to by the relevant drainage authority
- every lot should be provided with drainage which allows capture, reuse, or discharge to the street drainage system or to a legal point of discharge
- the system should take account of the effects of obstruction and debris build up at the street level with associated safe, predetermined overland stormwater flows
- the system include WSUD. An application must describe maintenance responsibilities, requirements and costs to ensure that associated recurrent costs are acceptable to a council
- flood mitigation works to the requirements of the flood plain management authority.

For further information refer to:

• *Australian Rainfall & Run-off 1987* (published by Engineers Australia) and the local drainage authority standards.

Major drainage system

The objective of the major drainage system is to provide for the safe and effective passage of stormwater flows and minimise damage to property.

The system should operate when capacity of the minor drainage system is exceeded. This will usually consist of overland flow paths via roadways or drainage reserves.

Other requirements include that:

- a factor of safety (freeboard or height above flood level) provision will be also be determined by the relevant drainage authority, based on a risk evaluation
- peak run-off rates should be designed to ensure that existing downstream flows are restricted to predevelopment levels unless increased flows are agreed to by the relevant drainage authority
- for 1 in 5 year to 1 in 100 year rainfall events (20% to 1% Average Exceedence Probability standard) stormwater flows must be safely and effectively managed without inundating new lots unless otherwise agreed by the flood plain management authority
- streets, pedestrian and bicycle access ways subject to flooding must meet the safety criteria. Safety is measured and designed around velocity and depth parameters.

For further information refer to:

- *Australian Rainfall & Run-off 1987* (published by Engineers Australia) and the local drainage authority standards.

For safety criteria:

- *Australian Rainfall & Run-off* (Engineers Australia 1987) provides some guidance.
- Melbourne Water has produced detailed guidelines for safety criteria as part of its *Land Development Manual*. Recommended safety criteria and limits are provided for a range of different circumstances and flow conditions.
- Visit <http://ldm.melbournewater.com.au/default.asp> for further information.

Water sensitive urban design (WSUD)

WSUD provides an alternative to the traditional approach of conveying stormwater to a downstream destination for disposal into the environment. It integrates urban planning and development with the management, protection and conservation of available water sources including urban run-off.

WSUD can be applied at a subdivision, neighbourhood or regional scale.

The aim of WSUD is to:

- protect downstream aquatic ecosystems and remove contaminants
- integrate stormwater elements as part of the urban form
- recognise stormwater as a resource
- provide a conveyance system for the safe passage of stormwater run-off to avoid nuisance flooding and damage to public and private property.

WSUD treatment measures:

- gross pollutant traps
- bio-retention systems; swales, rain gardens, tree planters and basins
- vegetated swales
- buffer strips
- infiltration measures
- porous paving
- rainwater tanks
- sediment ponds
- wetlands.

For further information refer to:

- *Australian Run-off Quality* (Engineers Australia 2006)
- *WSUD Engineering Procedures: Stormwater* (CSIRO Publishing 2005) for explanation of the above terms and technical advice on detailed design and procedures associated with WSUD
- Visit <http://wsud.melbournewater.com.au>

Urban Design Tips for WSUD:

Road layout considerations:

- vary width of reserve to facilitate integrated design of stormwater management
- one-way cross fall.

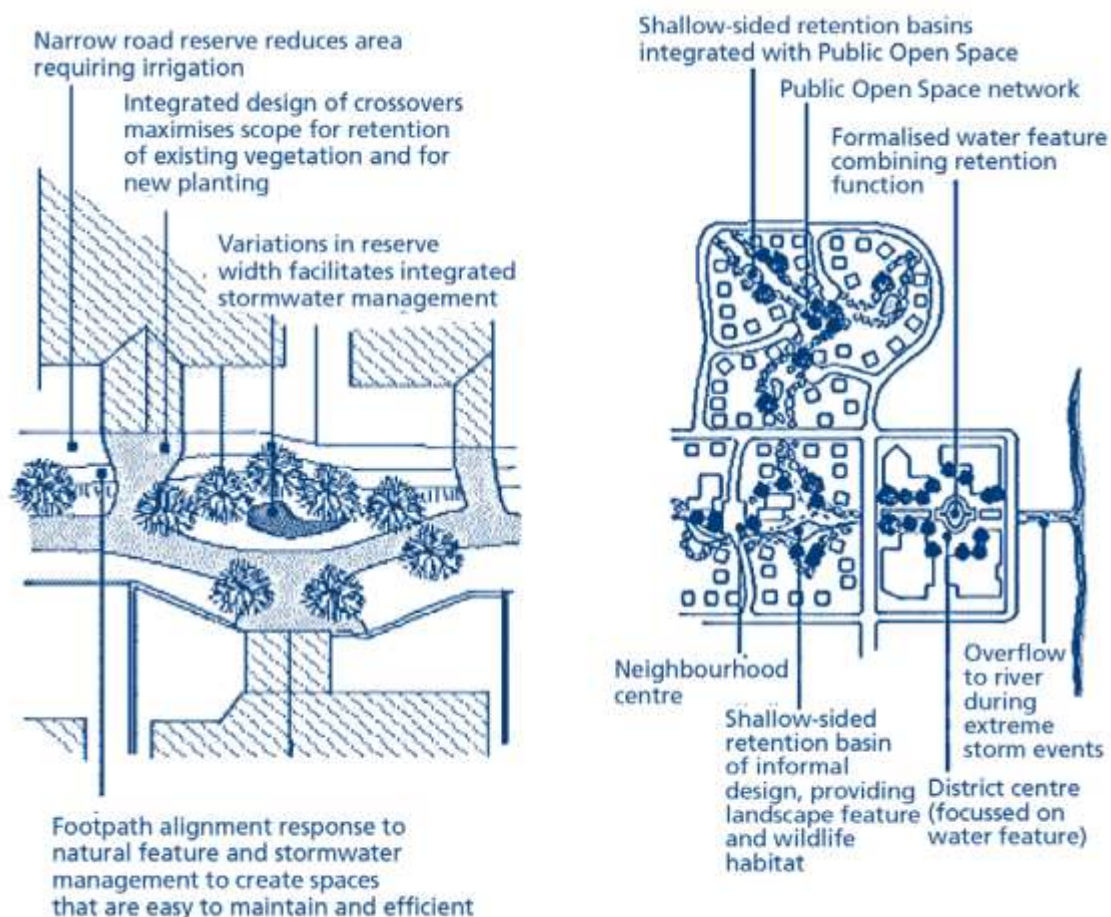
Streetscape layout:

- integrate public open space within the streetscape with the stormwater system (including reuse)
- opportunities for swales, rain gardens and the use of street trees
- minimise impervious services.

For further information refer to:

- *Urban Stormwater – Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee 1999) – Chapter 5.

Example: Integrated Stormwater Management System



Further information

Victorian Stormwater Committee

Urban Stormwater – Best Practice Environmental Management Guidelines www.publish.csiro.au and go to Science access

Engineers Australia

Australian Rainfall & Runoff 1987 (Booklet 8 revised 1999) ISBN 1 85825 6878

Australian Run-off Quality (2006) ISBN 0 85825 8528 www.engaust.com.au/bookshop

Association of Bayside Municipalities (ABM)

Clean Stormwater – a planning framework www.abmonline.asn.au and go to Information Site

Melbourne Water

Water Sensitive Urban Design (WSUD) information, tools and references site www.wsud.melbournewater.com.au

Melbourne Water

WSUD Engineering Procedures: Stormwater (2005) www.publish.csiro.au (Available for purchase)

Clearwater Program (Local Government, industry groups, government agencies, non-government organisations, research institutions & media)

Wide range of tools and background information regarding stormwater issues www.clearwater.asn.au and go to Stormwater

Stormwater Industry Association of Victoria (SIAV)

Information on industry stakeholders and available stormwater management and quality technologies www.stormwater.asn.au/vic/ and go to WSUD/Clearwater

Melbourne Water Land Development Manual

Information about general requirements to be complied with by developers when providing Melbourne Water's drainage facilities to new subdivisions www.ldm.melbournewater.com.au