STORMWATER AND GROUNDWATER MANAGEMENT

DCP 2015 CHAPTER 38

SUTHERLAND SHIRE

Contents

a. Stormwater Management

The sustainable management of stormwater helps to protect and improve the quality of waterways and maintain the health of its ecosystems. This results in a better urban environment for residents of the Shire.

Historically, stormwater runoff from development was collected and discharged via pipes to a natural water system. The contemporary approach is to regard stormwater as a resource to be harnessed and utilised rather than being disposed of. The re-use of stormwater should therefore be a priority when designing any new development.

All development applications which seek approval for the construction of buildings or the carrying out of other works, including subdivision, will need to demonstrate that an appropriate stormwater management system is proposed which includes the re-use of water and controls the rate of flow of discharge from the site.

State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004 sets the minimum water conservation targets for most residential development. However, additional storage capacity and re-use options are encouraged by Council to meet appropriate stormwater management outcomes.

As the best environmental outcome is achieved by a stormwater management system that retains and re-uses stormwater on site, this is Council's preferred option. However, on-site detention systems may be allowed under this Plan where appropriate and where they are tailored to suit local conditions.

1. Permitted Off-Site Disposal

1.1 Objectives

1. Minimise the impacts of excessive stormwater runoff and flooding of downstream properties.

2. Control the volume of stormwater runoff from any site to reasonable pre-development levels.

3. Preserve and enhance water bodies and riparian zones as natural systems.

1.2 Controls for Dwelling Houses, Alterations and Additions to Existing Dwelling Houses and Dual Occupancies

1. The peak rate of stormwater runoff flow for any site shall be calculated on the basis of catering for all storm events up to and including the 5% AEP event. For the purpose of this Chapter, 'stormwater runoff' includes both piped and overland flows.

2. The post development rate of stormwater runoff from the site shall not exceed the rate of stormwater runoff from the site prior to the subject development occurring, with the following exceptions:
   a. for vacant sites or new dwellings, the stormwater runoff generated by development with a minimum landscaped area of at least 65% is allowed;
   b. for alterations and additions to existing dwelling houses, dual occupancies, the stormwater runoff generated from development with a minimum landscaped area of at least 55% is allowed provided the overflow is managed in a manner that will not cause a nuisance to others or the environment;
   c. for minor alterations and additions to existing dwelling houses, dual occupancies, the stormwater runoff generated where the landscaped area proposed is less than 55%, the following additional development may be allowed:
      i. development that provides a landscaped area of 55% minus 20 square metres, provided it can be demonstrated that stormwater will be managed in a manner that will not cause a nuisance to others or the environment;
      ii. development that provides a landscaped area of 55% minus 40 square metres, where a rainwater tank no smaller than 1,000 litres capacity harvesting rainwater for toilet flushing or laundry purposes where an addition to a dwelling includes a bathroom, toilet, or laundry or otherwise for outdoor use is provided and the overflow is managed in a manner that will not cause a nuisance to others or the environment;
   d. development may be permitted to increase the rate of stormwater runoff from the site prior to the subject development occurring, where it can be shown that the discharge from a property does not pass through Council stormwater drainage infrastructure (e.g. a pipe, culvert, bridge, overland flow path or other control source) or a sensitive natural environment (e.g. natural systems such as mangroves or creeks).

Note:

On site disposal methods that may not cause a nuisance to others or the environment, such as storage pits and dispersion, are further discussed in the Sutherland Shire *Environmental Specification – Stormwater Management*.

3. Where the post development rate of stormwater runoff from the site will exceed the rate of stormwater runoff from the site prior to the subject development occurring and the exceptions set out above do not apply, the stormwater must be managed on-site by a strategy utilising one or a combination of on-site retention and reuse, infiltration systems and on-site detention techniques.

4. Where rainwater tanks are relied upon for stormwater management, rainwater tanks shall be assumed to be two-thirds full for the purposes of calculating peak flow and discharge.

1.3 Controls for All Other Built Development, Subdivision and Works

1. The post development rate of stormwater runoff (both piped and overland) from the site shall not exceed the rate of flow of runoff from the site than would exist prior to the subject development occurring.

2. The peak rate of flow for any site shall be calculated on the basis of catering for all storm events up to and including the 1% AEP event.

3. Where a site has a greater impervious area than the required landscaped area under SSLEP2015, the rate of stormwater runoff will be based upon a rate of flow of runoff that would occur from a site developed to its minimum required landscaped area. Where the LEP does not prescribe a minimum landscaped area, the rate of flow of stormwater runoff for any site shall be no greater than would be generated by a site having a maximum impervious area of 75%.

4. Where the post development rate of flow would exceed the predevelopment rate, or the rate established in accordance with subclause 2, the stormwater must be managed on site by a strategy utilising one or a combination of on-site retention and reuse, infiltration systems and on-site detention techniques. Where rainwater tanks are relied upon for stormwater management, rainwater tanks shall be assumed to be two-thirds full for the purposes of calculating peak flow and discharge.

5. Despite subclause 4 properties may be permitted to exceed the permissible site discharge, where it can be shown that the discharge from a property:
   a. does not pass through Council stormwater drainage infrastructure e.g. natural systems such as mangroves, creeks, a pipe, culvert, bridge, overland flow path or other control source or,
   b. the peak rate of flow is equal to or less than the PSD in all storm events up to and including the 1% AEP event.

2. Methods of Off-Site Disposal

2.1 Objectives

1. Responsibly manage rainfall runoff from a site in a manner that does not increase the risk of flooding, risk to life, property damage, water pollution, sedimentation, environmental degradation or result in adverse visual impacts.

2. Enhance the long-term health and quality of waterways and aquifers.

2.2 Controls for Development Associated with Dwelling Houses and Dual Occupancies that Increases Impervious Surfaces On-site

1. Having satisfied the controls in Clause 1.2, any stormwater permitted to be discharged off-site will require a legally created easement and associated formal drainage systems if it is directed across other lands.

2. Direct discharge to the kerb and gutter is acceptable if it is limited to a single piped stormwater discharge point with a peak flow of not more than 30 litres/second.

3. Overland flow paths shall remain safe for vehicles, people, and in particular, children and the less mobile in all storms up to and including the 5% AEP event. The velocity and depth of overland flow paths shall not exceed a velocity depth product of 0.4.

4. Any exposed pipe work shall be designed and treated so as to minimise its visual impact.

5. Diverting flows from one drainage sub-catchment to another is not permitted. The levels of a site may not be changed to redirect stormwater to another drainage sub-catchment.

6. Charged stormwater drainage systems are not permitted.

7. Overland flow paths shall not be obstructed by development.

8. Water quality control devices shall be designed, constructed and maintained in accordance with the provisions of the *Sutherland Shire Environmental Specification – Stormwater Management*.

9. Seepage water from basement car parks shall be managed through harvesting and reuse on-site, otherwise a formal piped connection to Council's stormwater drainage network is required.

10. Pump-out systems for disposal of stormwater are not permitted except to drain basement car parks and the runoff from the driveway of a basement car park.

11. Sub-surface flows from retaining walls are to be managed on-site or by a formal piped connection to Council's stormwater drainage network.

12. All development shall demonstrate compliance with each of the water quality objectives and to the fullest extent possible, all of the long-term goals prescribed in *Sutherland Shire Environmental Specification – Stormwater Management*.

2.3 Controls for All Other Built Development or Works that Increase Impervious Surfaces On-site

1. Having satisfied Clause 1.2, any stormwater permitted to be discharged off-site will require either :
   i. a legally created easement and associated formal drainage systems if it is to be directed across other lands, or
   ii. a formal piped connection to Council's stormwater drainage network.

2. Overland flow paths shall remain safe for vehicles, people, and in particular, children and the less mobile in all storms up to and including the 1% AEP event. The velocity and depth of overland flow paths shall not exceed a velocity depth product of 0.4.

3. Any exposed pipe work shall be designed and treated so as to minimise its visual impact.

4. Diverting flows from one drainage sub-catchment to another is not permitted. The levels of a site may not be changed to redirect stormwater to another drainage sub-catchment.

5. Charged stormwater drainage systems are not permitted.

6. Overland flow paths shall not be obstructed by development.

7. Residual stormwater shall be discharged within the same drainage sub-catchment as the site. Formal piped connection to the public stormwater drainage network is required where a pipeline or pit exists within 35m of the site, or an easement exists adjacent to the site.

8. Despite subclause 7, Council may require formal piped connection to a greater distance if it can reasonably be achieved having regard to the scale of the project, the extent of work required, or where direct connection to the kerb and gutter would result in adverse impacts.

9. The design of a formal piped connection shall prevent damage to street trees, infrastructure or impacts to public stormwater drainage infrastructure. It shall comply with Council's engineering and construction requirements. If this cannot be achieved Council may specify alternative disposal methods.

10. Water quality control devices shall be designed, constructed and maintained in accordance with the provisions of the *Sutherland Shire Environmental Specification – Stormwater Management*.

11. Seepage water from basement car parks shall be managed through harvesting and reuse on-site, otherwise a formal piped connection to Council's stormwater drainage network is required.

12. Pump-out systems for disposal of stormwater are not permitted except to drain basement car parks and the runoff from the driveway of a basement car park.

13. Sub-surface flows from retaining walls are to be managed on-site or by a formal piped connection to Council's stormwater drainage network.

14. All development shall demonstrate compliance with each of the water quality objectives prescribed in *Sutherland Shire Environmental Specification - Stormwater Management*.

2.4 Specific Controls for All Built Development in B3 Commercial Core

1. Stormwater shall be discharged to the public stormwater drainage network by a formal piped connection. If necessary, an extension of Council's stormwater drainage system may be required.

2. Having satisfied Clause 1.2, any stormwater permitted to be discharged off-site will require either:
   i. a legally created easement and associated formal drainage systems if it is to be directed across other lands, or
   ii. a formal piped connection to Council's stormwater drainage network.

3. Overland flow paths shall remain safe for vehicles, people, and in particular, children and the less mobile in all storms up to and including the 1% AEP event. The velocity and depth of overland flow paths shall not exceed a velocity depth product of 0.4.

4. Any exposed pipe work shall be designed and treated so as to minimise its visual impact.

5. Diverting flows from one drainage sub-catchment to another shall not be permitted. The levels of a site may not be changed to redirect stormwater to another drainage sub-catchment.

6. Charged stormwater drainage systems are not permitted.

7. Overland flow paths shall not be obstructed by development.

8. The design of a formal piped connection shall prevent damage to street trees, infrastructure or impacts to public stormwater drainage infrastructure. It shall comply with Council's engineering and construction requirements. If this cannot be achieved Council may specify alternative disposal methods.

9. Water quality control devices shall be designed, constructed and maintained in accordance with the provisions of the *Sutherland Shire Environmental Specification – Stormwater Management*.

10. Seepage water from basement car parks shall be managed through harvesting and reuse on-site, otherwise a formal piped connection to Council's stormwater drainage network is required.

11. Pump-out systems for disposal of stormwater are not permitted except to drain basement car parks and the runoff from the driveway of a basement car park.

12. Sub-surface flows from retaining walls are to be managed on-site or by a formal piped connection to Council's stormwater drainage network.

13. All development shall demonstrate compliance with each of the water quality objectives prescribed in *Sutherland Shire Environmental Specification – Stormwater Management*.

3. On-Site Rainwater Retention and Reuse

3.1 Objectives for Development that Involves the Construction of Buildings

1. Ensure that Water Sensitive Urban Design techniques are incorporated into development proposals.

2. Limit the volume of stormwater runoff from any site.

3. Promote water conservation and reuse.

4. Ensure that stormwater management is integrated with the design of development.

3.2 Controls for All Residential Accommodation

1. An applicant may choose to include greater rainwater tank capacity than is required by BASIX, provided the rainwater tank is permanently connected to toilets and is used for laundry, irrigation and other beneficial uses.

2. Any greywater reuse systems shall comply with the *National Guidelines for Water Recycling* published by the Environment Protection and Heritage Council and Natural Resource Management Council – November 2006, or the most recent version.

3.3 Controls for All Non-residential Development that Involves the Construction of Buildings

1. All development is to provide a rainwater tank(s) to collect run-off from the primary roof of the development. The size of the tank is to be as specified by the *Sutherland Shire Environmental Specification – Stormwater Management*.

2. All development must use harvested rainwater for the purposes of irrigation, toilet flushing, laundry use, car washing or similar beneficial purposes.

3. Any greywater reuse systems shall comply with the *National Guidelines for Water Recycling* published by the Environment Protection and Heritage Council and Natural Resource Management Council – November 2006, or the most recent version.

4. Infiltration Systems

Infiltration systems (sometimes known as on-site absorption systems) are constructed systems which temporarily store run-off from storm events and then release it by percolation to the surrounding soil. The rate of stormwater release and the effectiveness of the infiltration system are limited by the permeability of the soil.

The permeability of soil for lands across the Shire has been classified into areas of high, medium and low soil infiltration potential. The locations of these areas are indicated on the map titled Soil Infiltration Potential which is included in this Development Control Plan 2015.

There are a range of types of infiltration systems which can be used. These options are specified in Sutherland Shire Environmental Specification – Stormwater Management.

4.1 Objectives for All Development that Involves the Construction of Buildings or Work that Increases Impervious Surfaces on Site

1. Promote the recharge of groundwater resources.

2. Maintain stormwater runoff in its natural catchment.

3. Ensure that Water Sensitive Urban Design techniques are incorporated into development proposals.

4. Limit the volume of stormwater runoff from any site.

5. Ensure that stormwater management is integrated with the design of development.

4.2 Controls for All Residential Accommodation in Areas of High Soil Infiltration Potential

1. Within areas of high infiltration potential (as shown on the *Soil Infiltration Potential* map), these sites are best suited to infiltration systems. In these areas, infiltration systems are a cost-effective and desirable environmental solution which can be explored before on-site detention is considered.

2. Within areas of high infiltration potential, a soil infiltration field test must be carried out to determine the exact rate of infiltration which exists on the site. This test must be carried out in accordance with the *Soil Infiltration Field Test* which is reproduced in Appendix A of the *Sutherland Shire Environmental Specification– Stormwater Management*. The results of the soil infiltration field test shall be used to determine the design and capacity of the on-site infiltration system.

3. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

4. Any overflow from storm events greater than the 5% AEP event is not to be concentrated across a boundary.

5. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.
6. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

7. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

4.3 Controls for All Residential Accommodation in Areas of Medium Soil Infiltration Potential

1. Within areas of medium infiltration potential (as shown on the *Soil Infiltration Potential* map), infiltration may be considered where it is established that the site has adequate permeability by a *Soil Infiltration Field Test* as reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management*.

2. On sites where infiltration systems are to be utilised, a soil infiltration field test must be carried out to determine the exact rate of infiltration which exists on the site. This test must be carried out in accordance with the *Soil Infiltration Field Test* which is reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management*. The results of the soil infiltration field test shall be used to determine the design and capacity of the on-site infiltration system.

3. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

4. Any overflow from storm events greater than the 5% AEP event is not to be concentrated across a boundary.

5. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.

6. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

7. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

4.4 Controls for All Residential Accommodation in Areas of Low Soil Infiltration Potential

1. Within areas of low infiltration potential (as shown on the *Soil Infiltration Potential* map), infiltration is not mandatory. However, a stormwater management solution that relies on infiltration is permissible where it is established that the site has adequate permeability by a *Soil Infiltration Field Test* as reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management.*

2. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

3. Any overflow from storm events greater than the 5% AEP event is not to be concentrated across a boundary.

4. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.

5. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

6. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

4.5 Controls for All Other Development that Involves the Construction of Buildings or Work that Increases Impervious Surfaces on Site in Areas of High Soil Infiltration Potential

1. Within areas of high infiltration potential (as shown on the *Soil Infiltration Potential* map), these sites are best suited to infiltration systems. In these areas, infiltration systems are a cost-effective and desirable environmental solution which can be explored before on-site detention is considered.

2. Within areas of high infiltration potential, a soil infiltration field test must be carried out to determine the exact rate of infiltration which exists on the site. This test must be carried out in accordance with the *Soil Infiltration Field Test* which is reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management*. The results of the soil infiltration field test shall be used to determine the design and capacity of the on-site infiltration system.

3. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

4. Any overflow from storm events greater than the 1% AEP event is not to be concentrated across a boundary.

5. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.

6. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

7. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

4.6 Controls for All Other Development that Involves the Construction of Buildings or Work that Increases Impervious Surfaces on Site in Areas of Medium Soil Infiltration Potential

1. Within areas of medium infiltration potential (as shown on the *Soil Infiltration Potential* map*)*, infiltration may be proposed where it is established that the site has adequate permeability by a *Soil Infiltration Field Test* as reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management.*

2. On sites where infiltration systems are to be utilised, a soil infiltration field test must be carried out to determine the exact rate of infiltration which exists on the site. This test must be carried out in accordance with *the Soil Infiltration Field Test* which is reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management.* The results of the soil infiltration field test shall be used to determine the design and capacity of the on-site infiltration system.

3. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

4. Any overflow from storm events greater than the 1% AEP event is not to be concentrated across a boundary.

5. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.

6. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

7. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

4.7 Controls for All Other Development that Involves the Construction of Buildings or Work that Increases Impervious Surfaces on Site in Areas of Low Soil Infiltration Potential

1. Within areas of low infiltration potential (as shown on the *Soil Infiltration Potential Map*), infiltration is not mandatory. However, a stormwater management solution that relies on infiltration is permissible where it is established that the site has adequate permeability by a Soil Infiltration Field Test as reproduced in Appendix A of the *Sutherland Shire Environmental Specification – Stormwater Management*.

2. Infiltration systems may only be proposed on sites with adequate soil permeability, which is defined as over 15mm/hour.

3. Any overflow from storm events greater than the 1% AEP event is not to be concentrated across a boundary.

4. Infiltration is to be maximised by utilising natural surfaces and landforms to act as natural controls on overland flow paths.

5. Non-porous paving shall be graded to direct runoff onto adjoining grassed or landscaped areas.

6. Where porous paving forms part of an infiltration strategy, sediment traps, vegetated filter strips or similar control mechanisms are to be installed upstream of the porous paving to reduce sediment inputs and minimise likelihood of clogging.

5. On-Site Detention

On-site Detention systems temporarily detain stormwater on-site, restricting the discharge to a rate that can be accommodated by Council's drainage system.

5.1 Objectives

1. Ensure that the peak discharge rate of stormwater flow from development is no greater than that of the Permissible Site Discharge rate established by Clause 1.2 or Clause 1.3.

2. Reduce the impacts of stormwater discharge on down stream properties and natural systems.

5.2 Controls for All Residential Accommodation

1. For single dwellings, no on-site detention is required where a rainwater tank of minimum 5000 Litres is to be provided and the rainwater tank is connected to toilets, laundry, irrigation and used for other beneficial uses. Alternatively, the on-site detention requirement as calculated in subclause (4) is to be met.

2. For dual occupancy, an offset of $1m^3$ of the required on-site detention is permitted for every $3m^3$ of rainwater tank installed and the rainwater tank is connected to toilets, laundry, irrigation and used for other beneficial uses. The on-site detention requirement is to be calculated in accordance with subclause (4).

3. For all other residential development, an offset of $1m^3$ of the required on-site detention is permitted for every $3m^3$ of rainwater tank installed, providing the final OSD volume does not fall below 50% of the original design volume. This must be provided as a single rainwater tank connected to toilets, laundry, irrigation and used for other beneficial uses. The on-site detention requirement is to be calculated in accordance with subclause (4).

Note to Subclause 2 and 3:

As an example, to offset $3m^3$ of on-site detention, the applicant would be required to provide $9m^3$ of rainwater retention. This rainwater tank can also be used to satisfy the BASIX assessment.

4. The volume of stormwater to be detained on-site shall be calculated from the volume of water from a 5% AEP event less the volume of runoff established by Clause 1.2, less any volume infiltrated on-site and a third of the volume of any tanks used for rainwater reuse.

5.3 Controls for All other Built Development

1. For all other development, an offset of $1m^3$ of the required on-site detention is permitted for every $3m^3$ of rainwater tank installed, providing the final OSD volume does not fall below 50% of the original design volume. This must be provided as a single rainwater tank connected to toilets, laundry, irrigation and used for other beneficial uses. The on-site detention requirement is to be calculated in accordance with subclause (4).
2.

Note:

As an example, to offset $3m^3$ of on-site detention, the applicant would be required to provide $9m^3$ of rainwater retention. This rainwater tank can also be used to satisfy BASIX.

3. The volume of stormwater to be detained on-site shall be calculated from the volume of water from a 1% AEP event less the volume of runoff established by Clause 1.2, less any volume infiltrated on-site and a third of the volume of any tanks used for rainwater reuse.

5.4 Relationship with BASIX

1. Where a rainwater tank is proposed to offset an on-site detention requirement, the size of the rainwater tank required is the greater of the BASIX retention requirement and the proposed detention offset requirement.

Note:

As an example, where $2m^3$ retention is required for BASIX and the retention offset requirement is $9m^3$, the requirement would be $9m^3$ in total.

6. Water Quality Control

6.1 Objectives for All Development Excluding Dwelling Houses and Dual Occupancies

1. Reduce pollutants and sediments in stormwater discharge from development sites.

2. Minimise the effect of stormwater on the receiving environment.

6.2 Controls for all Development Excluding Dwelling Houses and Dual Occupancies

1. Development must achieve a minimum of 80% retention of the Suspended Solids (SS) average annual load.

2. Development must achieve a minimum of 40% retention of the Total Phosphorus (TP) average annual load.

3. Development must achieve a minimum of 40% retention of the Total Nitrogen (TN) average annual load.

4. Development must achieve a total retention of litter and organic matter greater than 50mm for storm events of up to 1 in 3 month ARI.

5. Development must achieve a total retention of oil and grease for storm events of up to 1 in 3 month ARI.

6. Where trash racks are installed, the gaps between the bars shall be 60mm.

7. Where litter booms are installed, they are to be placed only where normal flow velocities are low and must incorporate a trap where they are used in tidal waterways.

8. Where stormwater pit litter baskets are installed, they shall not exacerbate flooding and must incorporate a bypass.

9. Where sand filters are used they shall be restricted to urbanised catchments smaller than 2 hectares. The entry of sediment and oil to the filtration media shall be controlled and a sediment trap provided upstream for pre-treatment. Developments with large concentrations of oil and litter, which could potentially block the sand filter, should be avoided. A suitable grain size, which maintains percolation rates, shall be used. Sand replacement schedules shall be provided.

10. Provision must be made for convenient and safe regular inspection and periodic cleaning of water quality control measures

b. Groundwater Management

Groundwater is derived from rain which percolates down through the soil or fractures in rock, so filling up the pores between sand grains or the fissures in rocks. Anything from half of the rainfall in a given area to none at all in dense urban areas, may reach the water table and thus recharge the groundwater. Geological formations such as those composed of sand, sandstone and limestone which contain useable quantities of groundwater are called aquifers. The aquifer closest to the ground surface is called the shallow, or unconfined, aquifer (its upper surface is the water table) but there are also deeper confined (sometimes called artesian) aquifers where the water is confined under pressure between relatively impervious layers. Managing groundwater sustainability improves the quality of the Shire's waterways and ecosystems.

Development affects the infiltration of rainwater into a site, which will in turn impact on groundwater recharge and flows from the site to adjacent wetlands and ecosystems. Surface runoff may be required to be directed to treatment facilities prior to infiltration to the groundwater via wetland infiltration basins.

Maintenance and protection of groundwater hydrology is an important environmental requirement in low lying areas where groundwater is close to the surface, such as land identified as 'wetland' and/or 'prone to flood'. In these areas groundwater contamination also represents a significant risk to ecological receptors off-site. ANZECC (Australia and New Zealand Environment and Conservation Council) has set guidelines for limits for contaminants for the protection of aquatic ecosystems. These guidelines are set conservatively and site specific studies are recommended in most instances.

1. Objectives for All Built Development

1. Maintain the natural groundwater hydrology.
2. Protect the quality of existing groundwater.
3. Maximise the quality of water recharging the groundwater/water table.
4. Control and regulate landfill operations and leachates.
5. Control and regulate groundwater usage.
6. Control and limit impervious areas.
7. Minimise disturbances to ground water flows from cut and fill.

2. Controls for All Development in Areas Identified Wetland and/or Flood Prone Land

1. Development shall not adversely impact on groundwater on site and in the vicinity.

2. To ensure that there is no adverse impact on the environment and no threat to human health, a precautionary approach is to be taken and an *Environmental Controls and Management Plan* developed for all developments where groundwater is intercepted, extracted or where discharge to groundwater is proposed.

3. Water discharged from a development shall be treated appropriately to avoid adverse impacts on receiving surface waters and groundwater.

4. Development shall comply with the requirements of *ANZECC (Australia and New Zealand Environment and Conservation Council)* set guidelines for limits for contaminants for the protection of aquatic ecosystems.

5. Ground water monitoring may be required to be undertaken where a redevelopment requires a stormwater quality improvement device, including infiltration ponds and/or constructed wetlands, monitoring bores are required to demonstrate the effectiveness of controls. Provision shall be made for quarterly monitoring of groundwater level and quality determination for the first two (2) years, then annually thereafter. Monitoring shall be undertaken for the following analytical suite at a minimum:
   - Electrical conductivity, total dissolved solids, pH, alkalinity, turbidity, dissolved oxygen, iron, manganese, major cations / anions, heavy metals, oil and grease, nutrients, total petroleum hydrocarbons.

   Copies of the results of this monitoring are to be provided to Council within two months of each round of monitoring.

6. Remaining indigenous vegetation shall be protected to enhance water quality of groundwater resources. Clearing of indigenous vegetation is not permitted within the wetland buffer areas and riparian zones.

7. Developments shall maintain groundwater hydrology so as to not detrimentally impact on the location and nature of the freshwater, saline water interface that exists along the foreshores.