ROCKDALE
CITY COUNCIL
On Historic Botany Bay

Rockdale Technical Specification **Stormwater Management**

Adopted 4 May 2011
Effective 5 December 2011

Contents

List of Figures

List of Tables

1 Preliminary

1.1 Introduction

Part 4.1.3 of Rockdale City Development Control Plan ("the DCP") contains general principles for water management. This Technical Specification is developed to provide further detailed information in relation to the design and installation of stormwater drainage systems and their connections to the external stormwater network, as well as some other design considerations.

This Technical Specification must be read in conjunction with Rockdale City Development Control Plan ("the DCP"), the DA Guide and any environmental planning instruments that apply to the land.

1.2 Objectives

To provide further details and assist the DCP:

a. To reduce the peak flows from the site to Council's drainage system.
b. To reduce the probability of downstream flooding.
c. To minimise run-off volumes and replenish ground water.
d. To provide drainage systems that integrates into Councils existing drainage network with minimal impact on existing users.
e. To provide drainage systems that are low maintenance and long lasting.
f. To prevent, or at worst minimise release of pollutants from the developed area.
g. To provide drainage systems that incorporate rainwater tanks, or other systems to reduce the development's reliance on mains supplied water.
h. To encourage the production of high quality drainage plans that can be quickly assessed.
i. To provide clear understanding of the information and documents that must be submitted with the drainage plans.
j. To provide drainage systems that improve the natural environment, or at worst have nil, or minimal impact on the surrounding environment.

1.3 Application of the Technical Specification

This Technical Specification shall be applied to the design and installation of stormwater drainage systems associated with development within the area of Rockdale City Council.

This Technical Specification applies to development specified in State Environmental Planing Policy (Exempt and Complying Development Codes) 2008.

1.4 Definitions

Absorption Area means an area with typically sandy soils of medium to high permeability that satisfies the nominal absorption rate requirements specified in Section 5. An indication of the Absorption Area is shown on Map B.1.

Absorption System means a device for temporary storage of stormwater, above or below ground, to permit infiltration into the soil.

Charged System means a system consisting of sealed PVC stormwater pipes and down pipes that provides for the discharge of roof water to a termination point (eg kerb outlet/water tank inlet) at a level that is higher than the ground level.

External Stormwater Drainage Network has the same meaning as Australian Standard AS/NZS3500.3.

Gravity Fed System means a system consisting of stormwater piping that provides for discharge to a termination at a level that is lower than all preceding inlet pits.

Inter-allotment Drainage System means a stormwater pipes that receives stormwater from two or more *Stormwater Drainage Systems* before connecting to the External *Stormwater Drainage Network*.

Low Absorption Area means an area that does not satisfy the nominal absorption rate requirements specified in Section 5. An indication of the Low Absorption Area is shown on Map B.1.

Low Level Driveway means a driveway that is lower than the front boundary level, that leads to either a garage, a carport, or any other trapped lowpoint where the depth of ponding will exceed 200 mm

Low Level Property means a property that is located in a low absorption area that has levels that grade away from the kerb and gutter and there is no Council pipe, inter-allotment drainage scheme or private drainage easement available.

On-Site Detention System has the same meaning as On-site Stormwater Detention from Australian Standard AS/NZS3500.3.

On-site Disposal System (as referenced by various State Environmental Planning Policies) has the same meaning as Absorption System.

On-site Retention System has the same meaning as Absorption System.

Point of Connection has the same meaning as Australian Standard AS/NZS3500.3.

Rainwater Tank means a tank collecting and storing stormwater from no-trafficable roof areas, intended for reuse.

Roof Drainage System means the system for collection of stormwater on a roof and discharge to a surface drainage system, and includes the eaves gutters, box gutters, valley gutters, gutter overflows, and down pipes.

Stormwater Drainage System has the same meaning as Australian Standard AS/NZS3500.3.

Stormwater Tank means a tank collecting and storing stormwater from trafficable surfaces, including paved or ground surfaces, intended for reuse.

Subsoil Drainage System means a trench filled with filter material or enhanced by using slotted pipes for the purpose of conveying subsoil water.

Surface Drainage System means the system for conveyance of stormwater from the roof drainage and stormwater collected from other areas to the discharge point, and includes stormwater drains, channels, inlets and other surfaces that convey overflows.

1.5 Referenced Documents

The following documents are referred to in this Technical Specification:

1.5.1 Council Documents

Rockdale City Development Control Plan

Rockdale Council, AUS-SPEC

1.5.2 Standards

Note: Where a reference is made in this Technical Specification to a publication of a Standard the reference shall be to the most recent edition.

AS/NZS

2865 Safe working in a confined space

3500 Plumbing and Drainage
3500.3 Part 3: Stormwater drainage

HB

230 Rainwater Tank Design and Installation Handbook

ISO

9001 Quality management systems – Requirements

31000 Risk management – Principles and guidelines

1.5.3 Other References

Building Code of Australia
Australian Rainfall and Runoff (AR&R)
NSW Code of Practice: Plumbing & Drainage
Sydney Coastal Councils Group, Groundwater Management Handbook, 2006
State Environmental Planning Policy (Exempt and Complying Development Codes) 2008
Water Sensitive Urban Design for the Sydney Region website: www.wsud.org
Department of environment and Conservation, Managing Urban Stormwater; Harvesting and Re-use, April 2006

2 Drainage Requirements for Developments

2.1 Introduction

Much of the eastern half of the Rockdale Council area is underlain by sand, with soil permeability rates that are suitable for infiltration of stormwater. This enables stormwater to be discharged by absorption systems. As much of these same areas have significant flood problems, Council requires absorption to be used for all developments where practical. A guide to areas that are a suitable for absorption are shown in Map B.1. Where absorption is not practical other disposal methods are required.

The general requirements are detailed in this Section for various development types. Reference is also made to other general requirements later in this document.

Generally, the design and installation of stormwater drainage systems shall be in accordance with the relevant Australian Standards, primarily AS/NZS3500.3, except where varied by this Technical Specification. The variations contained in this Technical Specification are designed to ensure that the objectives of Section 4.1.3 of the DCP in relation to stormwater management are achieved.

2.1.1 General Standards for all Development Types (1)

All development (2) is required to provide a stormwater drainage system, comprising a roof drainage system(s), and a surface drainage system. Subsoil drainage systems shall be provided where advised by a suitably qualified competent person, such as a professional engineer. A silt/litter arrestor pit is required for all development, except where the stormwater drainage system drains to an absorption system.

Notes
(1) This general standard is also considered to be the standard applying to existing developments.
(2) Exceptions apply to change of use development. Refer to Section 2.8.3.

2.1.2 General Restrictions for Drainage Systems

The following general restrictions apply to the design of stormwater drainage systems, unless there are specific directions made elsewhere in this Technical Specification:

a. Absorption systems shall not be provided in the low absorption area, except where specified for dwelling houses.
b. Pumped discharge drainage systems shall not be provided, except where specified for low density residential development (single dwelling houses, secondary dwellings and dual occupancies) and other permissible locations.

2.2 Single Dwelling House Developments

2.2.1 New Single Dwelling Houses

a. All areas
   (i) The dwelling house shall comply with the general standards in Section 2.1.1.
   (ii) The dwelling house shall comply with Water Sensitive Urban Design standards.

b. Absorption Areas

In the absorption area the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System.

c. Low Absorption Areas

In the low absorption area:

(i) The new single dwelling house shall provide on-site detention, or a minimum 9500 litres rainwater tank. The rainwater tank catchment shall be at least 75% of the roof area.

(ii) The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement; or

(iii) If the property is a low level property and there is no Council stormwater pipe, inter-allotment drainage scheme or private drainage easement available, the roof drainage system shall discharge by charged pipe system to the kerb and gutter and the surface drainage system shall be in accordance with Section 4. Where a charged pipe system cannot be installed, the roof drainage system shall discharge into a surface drainage system and shall be in accordance with Section 4.

2.2.2 Additions to Single Dwelling Houses

a. Minor additions (increase to impervious area of less than 60m^2)

For additions to existing single dwelling houses that result in increases in the impervious area of less than 60 m^2, the additions are permitted to be connected to an existing stormwater drainage system, provided that the existing stormwater drainage system includes a roof drainage system and a surface drainage system. The roof drainage system and surface drainage system are required to be functional, but need not meet the standards of this Technical Specification. Where the existing stormwater drainage system has non-functional roof drainage or surface drainage systems, or non-existent roof drainage or surface drainage systems, the requirements of major additions apply.

b. Major additions (increase to impervious area of 60m^2 or more)

For additions to existing single dwelling houses that result in increases in the impervious area of more than 60 m^2, or as specified by 2.2.2(a), the dwelling house shall comply with the general standards in Section 2.1.1. On-site detention, absorption systems or Water Sensitive Urban Design requirements do not apply for additions to existing single dwelling houses.

2.3 Secondary Dwellings

2.3.1 New Secondary Dwellings

a. All areas

(i) The secondary dwelling and the associated single dwelling house shall comply with the general standards in Section 2.1.1.

(ii) The secondary dwelling and the associated single dwelling house shall comply with Water Sensitive Urban Design standards.

b. Absorption Areas

In the absorption area the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System.

c. Low Absorption Areas

In the low absorption area:

(i) The secondary dwelling, and the associated single dwelling house, shall provide on-site detention, or a minimum 9500 litres rainwater tank. The rainwater tank catchment shall be at least 75% of the roof area. The secondary dwelling and the associated single dwelling house is exempted from providing on-site detention or the 9,500 litre rainwater tank if the secondary dwelling involves the conversion of an existing outbuilding that was approved by Council for construction prior to 23 March 1993.

(ii) The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement; or
(iii) If the property is a low level property and there is no Council stormwater pipe, inter-allotment drainage scheme or private drainage easement available, the roof drainage system shall discharge by charged pipe system to the kerb and gutter and the surface drainage system shall be in accordance with Section 4. Where a charged pipe system cannot be installed, the roof drainage system shall discharge into a surface drainage system and shall be in accordance with Section 4.

2.3.2 Additions to Secondary Dwellings

a. Absorption Areas
(i) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved prior to March 1993, the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System (designed using a nominal absorption rate supplied by Council).
(ii) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved after March 1993, the stormwater shall discharge by gravity fed stormwater drainage system to either a new independent absorption system, or alternatively the existing working absorption system capacity shall be assessed for compliance with Section 5 and the system modified to accommodate the additions.

b. Low Absorption Areas
(i) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved after March 1993 with additional impervious areas less than 60 m^2, the impervious areas shall connect to the a detention system, however if no detention system exists the additional impervious area may connect to the existing surface drainage stormwater system.
(ii) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved after March 1993 with additional impervious areas greater than 60 m^2, the existing working on-site detention system capacity shall be assessed for compliance with Section 6 and the system modified to accommodate the additions, however if no detention system exists a 9,500 litre rainwater tank is to be installed as per 2.3(c)(i).
(iii) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved prior to March 1993 with additional impervious areas less than 60 m^2, the impervious areas shall connect to the existing stormwater drainage system.
(iv) For additions to existing secondary dwellings, or the associated single dwelling house, where the secondary dwelling was approved prior to March 1993 with additional impervious areas greater than 60 m^2, on-site detention, or a minimum 9500 litres rainwater tank, shall be provided.

2.4 Dual Occupancies

2.4.1 New Dual Occupancies

a. All areas
(i) The dual occupancy shall comply with the general standards in Section 2.1.1.
(ii) The dual occupancy shall comply with Water Sensitive Urban Design

b. Absorption Areas
In the absorption area the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System.

c. Low Absorption Areas

In the low absorption area:

(i) The dual occupancy shall provide on-site detention.
(ii) The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement.
(iii) The use of pumped systems is only permitted where directed by Council following a private drainage easement review.

These provisions apply to the whole site, regardless of whether there is an existing dwelling that is proposed to be retained or whether the development the involves the construction of both new dwellings.

2.4.2 Additions to Dual Occupancies

a. Absorption Areas

(i) For additions to existing dual occupancies that were approved prior to March 1993, the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System (designed using a nominal absorption rate supplied by Council).
(ii) For additions to existing dual occupancies that were approved after March 1993, the stormwater shall discharge by gravity fed stormwater drainage system to either a new independent absorption system, or alternatively the existing working absorption system capacity shall be assessed for compliance with Section 5 and the system modified to accommodate the additions.

b. Low Absorption Areas

(i) For additions to existing dual occupancies that were approved after March 1993 with additional impervious areas less than 60 m^2, the impervious areas shall connect to the existing approved detention system.
(ii) For additions to existing dual occupancies that were approved after March 1993 with additional impervious areas greater than 60 m^2, the existing working on-site detention system capacity shall be assessed for compliance with Section 6 and the system modified to accommodate the additions.
(iii) For additions to existing dual occupancies that were approved prior to March 1993 with additional impervious areas less than 60 m^2, the impervious areas shall connect to the existing stormwater drainage system.
(iv) For additions to existing dual occupancies that were approved prior to March 1993 with additional impervious areas greater than 60 m^2, on site detention is to be applied to the redeveloping dwelling of the dual occupancy.

2.5 Child Care Centres

a. All areas

(i) The child care centre shall comply with the general standards in Section 2.1.1.
(ii) The child care centre shall comply with Water Sensitive Urban Design standards.
(iii) All pits within the site must have child proof locks on all the grates.

b. Absorption Areas

In the absorption area the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System. No above ground storage is permitted within the children's play area in any form and above ground storage is discouraged elsewhere on site.

c. Low Absorption Areas

In the low absorption area:

(i) The child care centre shall provide on-site detention. No above ground storage is permitted within the children's play area in any form and above ground storage is discouraged elsewhere on site.
(ii) The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement.

2.6 Special Precincts

2.6.1 Application

This Section applies to precincts where there are requirements that override the controls listed elsewhere in Section 2.

2.6.2 Wolli Creek Redevelopment Area

a. On-site retention or detention is not required. A section 94 contribution is required to provide for drainage augmentation.
b. The internal pipe drainage system (typically provided on a podium) is to be designed to collect and discharge the flows from the 100 year ARI storm, or be designed to collect and discharge the flows from the 20 year ARI storm with provision for the difference in flow between the 20 and 100 year ARI storms for the site to be carried as overland flow across the podium with a minimum of 200 mm freeboard between this flow level and any habitable areas.
c. The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement.
d. Much of the new drainage infrastructure in Wolli Creek is subject to flood levels and overland flows and this will require minimum weir levels for overflow from the rainwater tank and/or discharge treatment pit. Details are available from Council's Project Management and Design Section.
e. The pipe connection to the Council system shall have sufficient capacity to convey the peak 20 year ARI flow (assuming any rainwater or stormwater tank is already full). Provision needs to be made for the safe escape to the street of flows in excess of the 20 year ARI flow.
f. The development shall comply with the general standards in Section 2.1.1.
g. The development shall comply with Water Sensitive Urban Design standards.

2.6.3 Bonar Street Precinct

a. On-site detention is required.
b. The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement.
c. The development of the precinct must be in accordance with the Stormwater Management Plans contained in the DCP.
d. Drainage easements shall be created over the land supporting the stormwater system in conjunction with new development and subdivision in the precinct.
e. The development shall comply with the general standards in Section 2.1.1.
f. The development shall comply with Water Sensitive Urban Design standards.

2.7 Subdivisions

2.7.1 Application

This Section applies to subdivisions under Torrens Title that result in the creation of additional allotments, and does not apply to Strata Title Developments. Exemptions also apply as follows:

a. Boundary adjustments where the adjustment does not result in an increase in the number of allotments.
b. Subdivision of existing dual occupancy developments.

2.7.2 Stormwater Servicing

a. Absorption Areas
   (i) Stormwater servicing of the new allotments from the subdivision will be adequately catered for by the future development on those allotments (using Absorption Systems), and there are no stormwater servicing requirements.

b. Low Absorption Areas
   (i) Where the site falls to the street the stormwater servicing of the new allotments from the subdivision will be adequately catered for by the future development on those allotments, and there are no stormwater servicing requirements.
   (ii) Where the site is a low level property, the allotments shall be provided with an inter-allotment drainage scheme and/or private drainage easement, so that future developments discharge by gravity fed stormwater drainage system.

2.7.3 On-site Detention and On-site Retention

a. Absorption Areas
   (i) Absorption systems for the new allotments from the subdivision will be adequately catered for by the future development on those allotments (using Absorption Systems).

b. Low Absorption Areas
   (i) Development on allotments from the subdivision will be required to provide on-site detention.

2.8 All Other Development Types

2.8.1 Application

This Section applies to development types not specified by Section 2.2, 2.3, 2.4, 2.5, 2.6, and 2.7, and includes multi dwelling housing, residential flat buildings, mixed use developments (including shop top housing), commercial and industrial developments.

2.8.2 New Development

a. All areas
   (i) The development shall comply with the general standards in Section 2.1.1.
   (ii) The development shall comply with Water Sensitive Urban Design standards.

b. Absorption Areas

In the absorption area the stormwater shall discharge by gravity fed stormwater drainage system to an Absorption System.

c. Low Absorption Areas

In the low absorption area:

   (i) The development shall provide on-site detention.

(ii) The stormwater drainage system shall discharge by gravity fed stormwater drainage system to a kerb and gutter, Council stormwater pipe, Council stormwater pit, inter-allotment drainage scheme or private drainage easement.

2.8.3 Alterations and Additions to Existing Development

a. Absorption Areas
   (i) Where less than 50% of the site is affected by new development, a separate onsite retention system may be provided that is independent of the existing drainage system, or
   (ii) Where more than 50% of the site is affected by new development onsite retention is to be applied to the whole site.

b. Low Absorption Areas
   (i) Where less than 50% of the site is affected by new development, a separate onsite detention system may be provided that is independent of the existing drainage system, or
   (ii) Where more than 50% of the site is affected by new development onsite detention is to be applied to the whole site.

2.8.4 Change of use development

A change of use with no changes to the building or impervious areas of the site will generally not require any modifications to the drainage system except as required to comply with the Building Code of Australia.

2.9 Construction Tolerance

The tolerance for construction in all development types is listed as follows:

Pit size	-10% to + no limit
Grate size	-15% to + no limit
Pipe grade	-10% to + no limit
Rainwater tank volume	-5% to + no limit
Stormwater reuse volume	-10% to + no limit
OSD and OSR volume	-10% to + no limit
OSR base area	-10% to + no limit
Orifice diameter	-20% to + 5%
Design orifice depth	-15% to +15%
Freeboard to overland flow path	-30mm to + no limit, except as required by the BCA

3 Stormwater Drainage Systems

This Section details the design and installation requirements for stormwater drainage systems, comprising roof drainage systems, surface drainage systems, and subsoil drainage systems. The Section also provides further details on the connection at the point of discharge.

3.1 Connections

This Section details the design and installation of discharge connections from a stormwater drainage system to the point of connection, with reference to Australian Standard AS/NZS3500.3. The design and installation of connections shall be in accordance with Australian Standard AS/NZS3500.3 except where specified below.

3.1.1 Kerb and Gutter Connections

Connection to the kerb and gutter must be within 15 m of the property boundary and the discharge must be less than 50 l/s for the combined discharge of the site for the 50 year ARI event. Where multiple conduits are required across the footpath, the conduits shall be separated by a minimum of 150 mm at the kerb and provide a 150 mm gap at each end to ensure an integral concrete unit. The new kerb over the multiple openings shall be strengthened by a 10 or 12 mm galvanised reinforcing bar across the top of the openings centrally located. The discharge line is to be set at an angle of 45° to the kerbline for a minimum of 0.5 m from the kerb. Where the line extends in front of an adjoining property the line is to be within 0.5 m of and parallel to the kerb and access for cleaning (screw cap) provided at any bend greater than 40°. Size of conduits is as follows:

a. 150 mm High Concrete Kerb and all Brick/Sandstone Kerbs
   Drainage conduits across the footpath areas discharging to the kerb shall be:
   (i) sewer grade PVC pipe, maximum diameter 100 mm, The kerb outlet from the 100 mm PVC pipe shall have a plastic Kerb Adaptor Socket, either 150 mm wide by 55 mm high (Vinidex Code 60872), or 130 mm wide by 60 mm high inserted in the kerb; or
   (ii) galvanised Rectangular Hollow Section (RHS), maximum 75 high, typically 125 x 75 (minimum 5 mm thick).
   Concrete restorations over the conduits in brick or sandstone kerbs are to be coloured to match the adjoining material.

b. 200 mm High Concrete Kerb
   Drainage conduits across the footpath areas discharging to the kerb shall be:
   (i) sewer grade PVC pipe, maximum diameter 100 mm, directly connected to the kerb; or
   (ii) sewer grade PVC pipe, maximum diameter 150 mm. The kerb outlet from the 150 mm PVC pipe shall have a plastic Kerb Adaptor Socket, 150 mm wide by 100 mm high (Vindex Code 60879); or
   (iii) galvanised Rectangular Hollow Section (RHS), maximum 100 high (minimum 5 mm thick).
   Concrete restorations over the conduits in brick or sandstone kerbs are to be coloured to match the adjoining material.

The use of sewer grade PVC is restricted to low density residential developments (single dwelling houses, secondary dwellings, and dual occupancies).

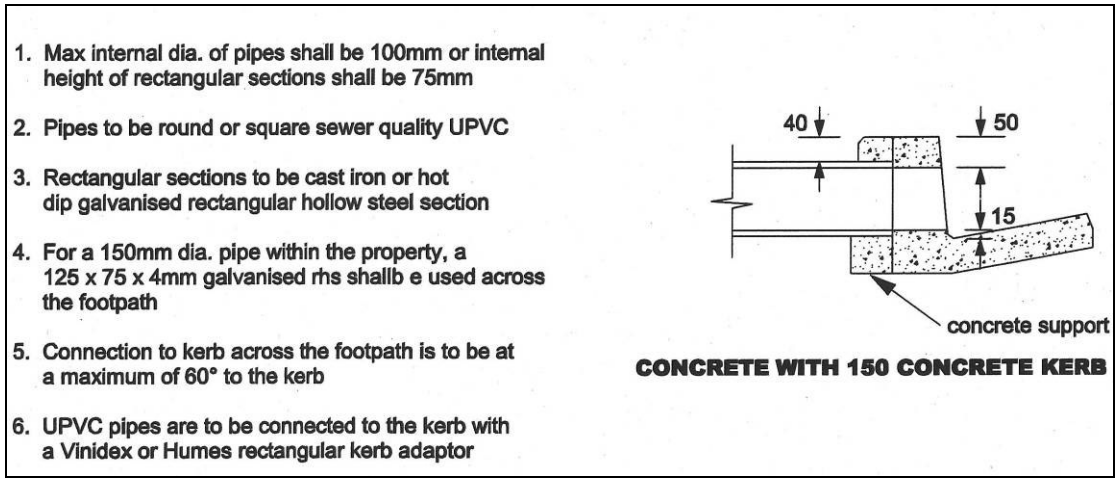


Figure 3.1 - Kerb and Gutter Connection

3.1.2 Council Stormwater Pipe Connections

This refers to direct connection to a Council pipe within the property, or a Council pipe in the street, and is referred to in Australian Standard AS/NZS3500.3 as a junction or cut-in. Direct connection into the Council pipe is permitted where:

a. The diameter of the connecting pipe is 150 mm or less, and
b. Only one connection per property is permitted (dual occupancies are considered as two properties for this Section), and
c. The connection is made in accordance with Figure 3.2.

Where the diameter of the connecting pipe is greater than 150 mm diameter, or the connection cannot be made in accordance with Figure 3.2, a stormwater pit will be required to be constructed over the existing pipe to facilitate the connection.

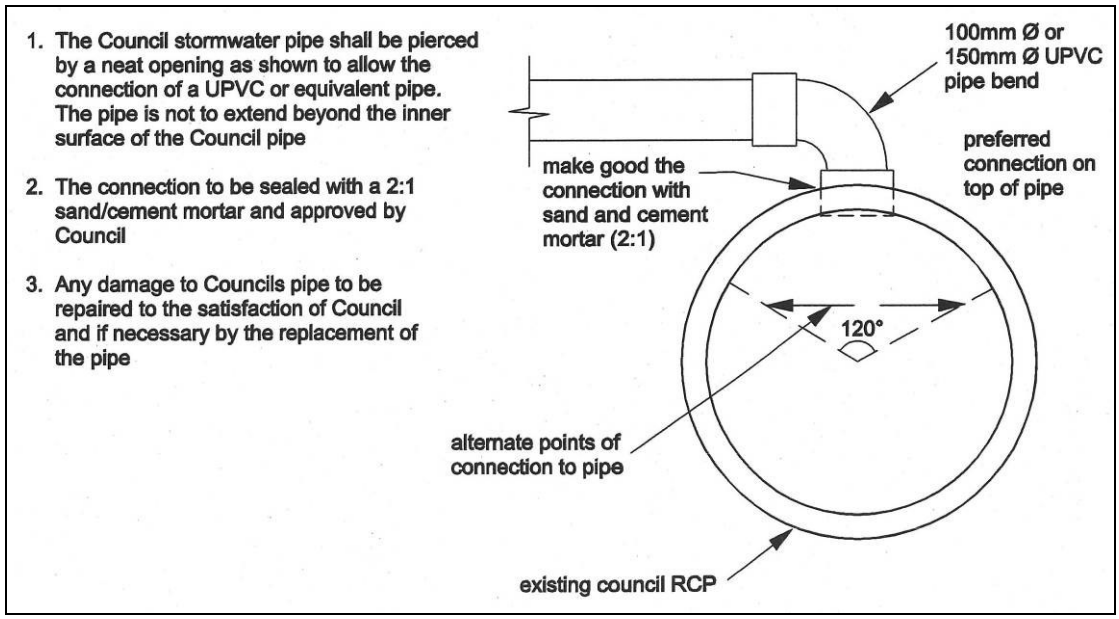


Figure 3.2 - Council Stormwater Pipe Connection

3.1.3 Council Stormwater Pit Connections

This refers to connection to a Council pit located within the Council road reserve, or on public land. Connection to a Council stormwater pit is permitted except where:

a. The Council pit is further than 15 m away from the subject property (1), or
b. The new inflow pipe flow exceeds 1/3 capacity of the existing Council pipe (2), or
c. The new inflow pipe flow exceeds 1/5 capacity of the existing Council pipe with the flow from an area that was previously directed to another catchment (2).

Notes:
(1) This requires an extension of the existing Council pipe system to outside the subject property and the construction of a Double Grated Gully Pit and lintel (typically 2.4 m overall, or as directed by Council) to connect the discharge pipe from the development into it.
(2) These connections may still be permitted, however they require more detailed investigation to determine the impacts, or optimum pipe configuration. In some instances the solution may require upgrading the Council pipes further downstream.

3.1.4 Inter-allotment Drainage System Connections

Connections to an inter-allotment drainage system require the construction of a junction pit over the inter-allotment drainage system pipe to facilitate the connection.

3.2 Roof Drainage Systems

The design and installation of the roof drainage system shall be in accordance with Australian Standard AS/NZS3500.3.

3.3 Surface Drainage Systems

This Section details the design and installation of surface drainage systems. The design and installation of the surface drainage system shall be in accordance with Australian Standard AS/NZS3500.3, except where specified below.

3.3.1 Pits

a. Child proof J-Locks or similar shall be fitted to all pits deeper than 1 m and larger than 600 mm x 600 mm, and locks are encouraged to be fitted to the grates of the smaller size pits as well. Where the pit type does allow the use of J-Locks the grate is to be bolted down with removable elements that still allow reasonable access for maintenance. Step irons (synthetic preferred) are to be provided for pits deeper than 1.2 m.
b. The minimum internal dimensions for stormwater and inlet pits shall be in accordance with Table 3.1.

Minimum Pit Size (mm)	Maximum Allowable Depth for Pit (m)
300 x 300	0.55
450 x 450	0.75
600 x 600	1
600 x 900	1.5
900 x 900	2
1200 x 1200	> 2

Table 3.1 - Minimum Internal Dimensions For Stormwater and Inlet Pits

c. The blocking factor (b_f) shall be 0.5 for the design of sag pits and 0.3 for the design of on-grade pits.
d. For podium areas exposed to rain the 250 mm x 250 mm Flo-way Gully top (Everdrain, or similar) is recommended with the allowable minimum being the 150 mm diameter

grate. Calculations are required to justify the size and spacing of all inflow grates in podiums allowing for a blocking factor of 0.5.

e. Trench grates shall comply with the following:
   (i) Where the site falls to the street a trench grate is to be provided at the boundary across the driveway and any pedestrian paths.
   (ii) For a driveway with a maximum width of 5 m and a maximum driveway slope of 10%, the trench grate width shall be determined by Table 3.2. Smaller grate widths may be achievable in some circumstances however more detailed calculations would need to be supplied to account for inflow capacity and capacity of the trench to convey the flows. In addition this table assumes uniform distribution of flows against the trench. Where driveway slope concentrates the flow at a particular location a larger inlet pit may be required to capture the flow in addition to the trench Grate.

Trench Grate Width (mm)	Maximum Contributing Area per m Length of Trench Grate (m^2)
100	9
150	14
200	21
300	30

Table 3.2 – Trench Grate widths

   (iii) To provide greater protection to low level garages, carports, or car parks the trench grate is to be a minimum of 300mm wide at the entrance to the structure.
   (iv) Additional trench grates are to be provided for long driveways at spacings not greater than 20m.
   (v) For commercial or industrial sites the trench grate style in areas subject to high pedestrian movements shall be designed to minimise tripping or conflicts with high heels. Where the available inlet area is reduced as a result of safety requirements the trench grate width is to be increased beyond the minimum to compensate.
   (vi) Trench grates in major residential, commercial and industrial applications are to be bolted down and modified as necessary to reduce noise levels.

f. Pits located in roadways or on Council pipes shall be in accordance with Section 8.4. Pits located on Inter-allotment Drainage Schemes shall be in accordance with Section 8.5.

3.3.2 Pipe Drains - General

a. Pipes shall be designed to convey the 5 minute 20 year ARI design rainfall (I = 204 mm/hr).
b. The minimum pipe size for single dwellings and residential buildings shall be DN 100. For all other development the minimum pipe size shall be DN 150.
c. Internal drainage system design for sites less than 3,000m^2 can be based on "pipes running full but not under pressure" unless there are backwater issues. Sites greater than 3000m^2 are to use Hydraulic Grade Line Analysis (HGL) for the internal drainage system.
d. The nominal method specified in Australian Standard AS.NZS3500.3 may be used for single dwelling developments on less than 1,000m2, but shall not be used for the design of pipe drains for all other developments.

3.3.3 Charged Pipe Systems

a. General Requirements for Charged Pipe Systems

(i) Where the boundary level is above any kerb within 15 m of the site or a Council pipe is available, the roof water is to drain by gravity from the boundary to the Council system via a silt/litter arrestor pit. Where a gravity discharge to the Council system is not viable the charged pipe may connect directly to the kerb.
(ii) Flap (reflux) valves are to be installed on the outlet pipes from the charge system that discharge to the silt/litter arrestor pit to minimise mosquito nuisance.
(iii) The lowest level of the charged system shall drain by gravity to a small inspection pit (350 mm x 350 mm min) with sump for cleaning. There shall be a minimum of one metre of pipe from the last downpipe to the inspection pit. The connection to the pit is to have a sealed screw cap to allow for periodic cleaning and removal of rubbish. The cap is to have a 5 mm dribble hole to allow trapped water to discharge slowly. See Figure 3.3.

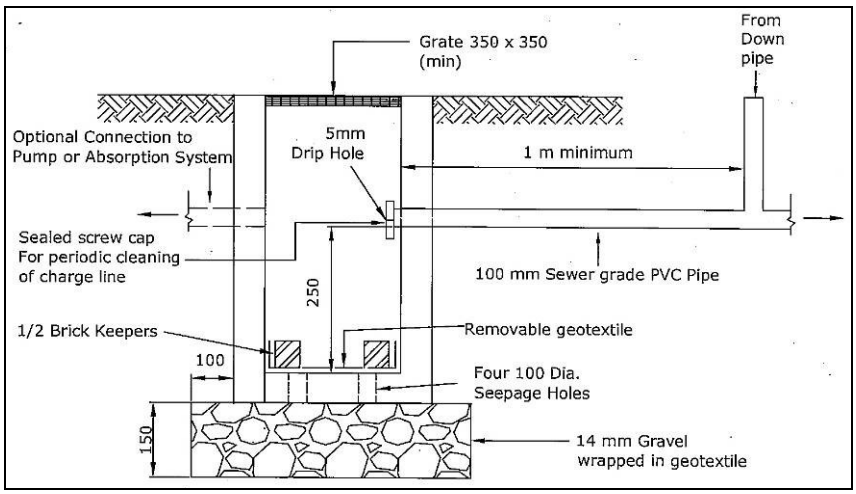


Figure 3.3 – Charged Pipe Cleanout Pit

(iv) Only sewer grade PVC or pressure pipes are to be used to convey charged flows.
(v) All pipes and downpipes are to be sealed to a minimum of 0.5 m above the maximum water level in the system. The system shall be pressure tested prior to backfilling. The use of exposed pipeline shall be minimised.
(vi) All gutters must have leaf gutter guards installed and undertake regularly cleaning of the downpipes to ensure effectiveness of the system.

b. Requirements for Charged Pipe Systems for Roof Systems
(i) The eave gutter level shall be a minimum of 0.8 m and preferably 1.5m above the higher of the top of the kerb outlet or the top storage level (e.g. Rainwater Tank). Where the height is between 0.5m and 1.5m an analysis of head losses shall be provided.

c. Requirements for Charged Pipe Systems for Aboveground Rainwater Tanks
(i) The overflow from the rainwater tank is to be a minimum of 0.5m and preferably 1.5m above the top of the kerb outlet. Where the height is between 0.5m and 1.5m an analysis of head losses shall be provided.
(ii) The inlet pipes from the roof system to the rainwater tank may enter directly, or through a charge system. Where a charge system is used each line will have a cleanout pit.
(iii) Flap valves are to be installed on the inlet pipes to the rainwater tank from the charge system to minimise mosquito nuisance.
(iv) The design and installation shall comply with HB 230.- Rainwater Tank Design and Installation Handbook.

3.3.4 Internal Overland Flow

This Section applies to flows generated from within the site and does not apply where the site is subject to external flows.

Particular attention is to be directed to 'L' or 'U' shaped developments that may trap surface flows. Though the pipe system is designed to convey the 5 minute 50 yr ARI, an overland flow path is required to convey flows in excess of the 50 year ARI design standard, or where the pipe drains are blocked.

Development is required to comply with the BCA regarding prevention of stormwater entering a building. To assist in achieving this requirement all habitable floor levels are to be a minimum of 200 mm above finished ground level in all areas.

a. Design of flow routes
   (i) The route that the flow takes is to be designed to cater for the 1 in 100 year ARI flow, either through pipes, or as surface flows, or a combination of both. The water level of surface flow routes and ponding at sag pits shall be at least 100 mm below the floor level of any adjacent building.
   (ii) The applicant shall not concentrate or divert overland flow onto, nor increase the hazard on a neighbouring property.
   (iii) The design of flow routes and open channels to convey internal overland flows shall be checked for hydraulic capacity using the Equation 3.1 - Manning Equation.

$Q = 1000 \times (A / n) \times R^{2/3} \times S^{1/2}$

Where A = area of cross section (m^2)
R = Hydraulic radius (m) = A / WP
WP = wetted perimeter (m)
S = gradient (m/m)
n = manning roughness coefficient (1)

Notes:
(1) For the Manning Roughness Coefficient refer to Table 5.5 of Australian Standard AS/NZS3500.3:2003.

Equation 3.1 - Manning Equation

   (iv) Where overland flows are directed towards private property the escape route for overland flow at boundaries shall be over a level weir to provide sheet flow. The length of weir shall be the downstream easement width (if available), or a minimum of 5 m where there is no easement.
   (v) Equation 3.2 - Weir Equation is to be used to check emergency overflows and overland flow situations.

$Q = 1.67 \times L \times H^{1.5}$

Where Q = discharge (m^3/sec)
L = length of the weir (m)
H = depth of water flowing over the weir (m)

Equation 3.2 – Weir Equation

   (vi) Provision shall be made for the harmless of escape of overflows from on-site detention and on-site retention (absorption) systems, in the case of malfunction of

the system, such as blockage of the outlet, or the exceedance of the design storm rainfall.

3.3.5 Overland Flow from Rear, or Side Neighbours

This Section applies to minor flows that enter a property from adjoining property. The extent of flow can only be determined by a catchment assessment and contour plan and an inspection of the drainage system on the adjoining properties. The requirements, in addition to the requirements specified in Section 3.3.4, are as follows:

a. Where there are minor surface flows from neighbouring properties these can be accepted into a properly designed internal drainage system and conveyed to the discharge point. It is essential however that these upstream flows are assessed and the proposed development is protected from them. Where an OSD system is required there is no need to increase the storage or PSD requirements due to minor upstream flows.
b. The habitable floor levels shall be the greater of 200 mm above finished ground level or 100 mm above the water surface level.

3.3.6 Installations Near Buildings

This Section applies equally to the installation of pipe drains near / under buildings, and to the construction of buildings near / over existing pipe drain installations.

Where the installation is a domestic pipe drain the installation shall comply with Australian Standard AS/NZS3500.3, or as specified by the Building Code of Australia.

Where the installation is a Council stormwater pipe or inter-allotment drainage pipe refer to Section 8.

3.4 Subsoil Drainage Systems

The design and installation of subsoil drainage shall comply with Australian Standard AS/NZS3500.3.

3.5 Pumped Systems

The design and installation of pumped systems is subject to the requirements of Section 4 of this Technical Specification.

4 Drainage of Low Level Properties

4.1 Private Drainage Easements

Where a site falls away from the street and the site is not suitable for absorption, and there is no Council pipe or interallotment drainage scheme to connect to, or an approved alternative drainage system, then the preferred and best method is for the developer to negotiate for a private drainage easement and construct a private drainage line. A private drainage easement, though preferred, is not a Council requirement for Additions to Single Dwellings of for new Single Dwellings where less than 200 m^2 of the site falls to the rear/side. See the Drainage of Low Level Properties in Appendix D for Council's recommended procedure for obtaining a private drainage easement, or what are considered approved alternative drainage systems.

4.1.1 Requirements for Private Drainage Easements

a. Drainage easements are to be a minimum of 900 mm wide unless the existing building offset is less than this. In this case the absolute minimum easement width is 600 mm immediately adjacent to the building.
b. The easement pipe is to be designed to carry the unrestricted 1 in 100 year flow (without detention where detention is required) from all properties benefiting from it. This includes any intermediate properties that the pipe travels through.
c. The minimum pipe size is to be a 150 mm diameter PVC pipe. For pipe diameters greater than 300 mm the easement width is to be increased above 900 mm (see Section 8.4).
d. The last pit on the developing property before connecting into the private drainage line shall be designed to accept all pipe and surface flows (ignoring any detention if required) from the 1% AEP storm event. Where there is an above ground detention system adjacent to the last pit, the last pit is to be raised so that the grate level matches the storage level and any weir overflow is set a minimum of 100 mm above this grate level.
e. Where the private drainage easement pipe discharges to the kerb and gutter in the street a grated pit is required just inside the front boundary of the burdened property to provide access for future maintenance and convert the easement pipe to multiple conduits, either 100 mm diameter sewer grade PVC, or 125 x 75 high (minimum 5 mm thick) galvanised RHS. Connection to the kerb may not be permitted where the discharge is greater than 50 l/s for a 50 year ARI event (see Section 3.1.1.

4.2 Allowable Pump Systems

Pumps (other than pumps for rainwater tanks) are only permitted:

a. To drain the driveways leading to basement garages, or
b. To drain Existing Buildings in areas unsuitable for absorption, or
c. To drain Additions to Single Dwellings in areas unsuitable for absorption, or
d. To drain parts of New Single Dwellings in areas unsuitable for absorption where less than 200 m^2 of surface area drains to the pump, or
e. For temporary drainage of Council Interallotment Drainage Schemes that are awaiting connection of the interallotment pipe, or
f. Where directly authorised by Council letter as part of Council's policy on the Drainage of Low Level Properties in Appendix D.

4.2.2 General Pump Requirements

The pump system shall be in accordance with Australian Standard AS/NZS3500.3 except as follows:

a. For single dwelling developments the pump may be a single pump only.

b. The pump rate is to be determined by the design engineer for a wide range of storm durations. Note pump rates greater than 5 l/s will generally require three phase power which may be expensive if not currently available.
c. The minimum clear internal height of the tank is to be 1 m.
d. A minimum of 20 % of the required pump storage is to be below ground (excluding basement areas which require 100% or otherwise directed by Council) , however above ground storages in private courtyard areas or rear yards shall not be allowed unless at least 30% of the required storage is below ground, or there is a minimum area of 10 m^2 immediately adjacent to the rear access of each dwelling that is above the 1 in 50 year storage level.
e. The rising main shall connect to a stormwater pit in order to achieve a gravity feed to the gutter. Where a gravity feed to the gutter is physically impossible the rising main shall connect to the gutter and be angled at 45 degrees to the gutter and the pipe enlarged across the footpath to a 100 mm diameter to minimise velocity and spray.
f. A positive covenant is required over the pump system to ensure long term maintenance. See Appendix I. The exception to this is for additions to single dwellings and new single dwelling houses where less than 200 m^2 of area drains to the pump.

4.2.3 Pumps for Single Dwellings

Pumps for additions to single dwellings, and new single dwellings in areas unsuitable for absorption where less than 200 m^2 of surface area drains to the pump, shall be as follows:
a. A stormwater reuse system, sized at 2.0 m^3 per 100 m^2 of site area being drained, shall be provided with overflow from the reuse system directed to the pump system,
b. The storage in the pump system shall be provided at the minimum rate of 1.0 m^3 below ground, or 1.2 m^3 above ground, per 100 m^2 of site area being drained. A minimum 40% of the storage is to be below ground.

4.2.4 Pumps for Driveways to Basement Garages And Underground Carparks

a. Single Unit Dwellings and Dual Occupancies
   (i) The pump storage shall be sized to contain the total volume of runoff generated by the one hour 1 in 20 year storm assuming the pumps are not operating. This is equivalent to 7.0 m^3 per 100 m^2 of area being drained.
b. All Other Development
   (i) The pump storage shall be sized to contain the total volume of runoff generated by the two hour 1 in 50 year storm assuming the pumps are not operating. This is equivalent to 10.6 m^3 per 100 m^2 of area being drained. All the pump storage volume is to be underground.

4.2.5 Pumps for Detention Systems

a. These details are subject to the requirements of Appendix D.
b. Where there is a gravity discharge available within 15 m of the site as much roof and surface area as practical is to be directed to an above ground detention basin in the front yard. The rear pump volume that collects the runoff from the remaining site area may then be used as detention storage.
c. Where there is no gravity discharge available from the site within 15 m of the property the pump storage volume may be used to satisfy the detention storage requirements that apply to the whole site.
d. The pump storage is to be separate to the pump pit and two stage orifices used to control discharge to the pumps. The orifices are to be protected with a silt trap and maximesh screen. The base of the pump pit is to be a minimum of 500 mm below the centreline of the orifice to allow a free discharge from the pump storage tank.
   (i) The pump discharge rate of each pump that forms part of a detention system is to be the 50 year ARI permissible site discharge (PSD) plus 10%.

4.2.6 Risk Assessment

Where pumps are to be used in accordance with 4.2 (d) and 4.2 (f) a risk assessment is to be prepared by a suitably qualified and experienced person. This assessment shall assume pump failure and be based on the 100 year ARI event with freeboard. The aim of the assessment is to identify properties that may be particularly vulnerable to even small local surface flows. This could include a lack of downstream escape routes or where natural or man made features direct flows into dwellings or outbuildings. The applicable standard for risk assessment and management is ISO 31000: Risk Management-Principles and Guidelines.. The risk assessment is to be in a report form and must accompany the drainage plans submitted to Council. Figure 4.1 outlines a suggested process for risk management.

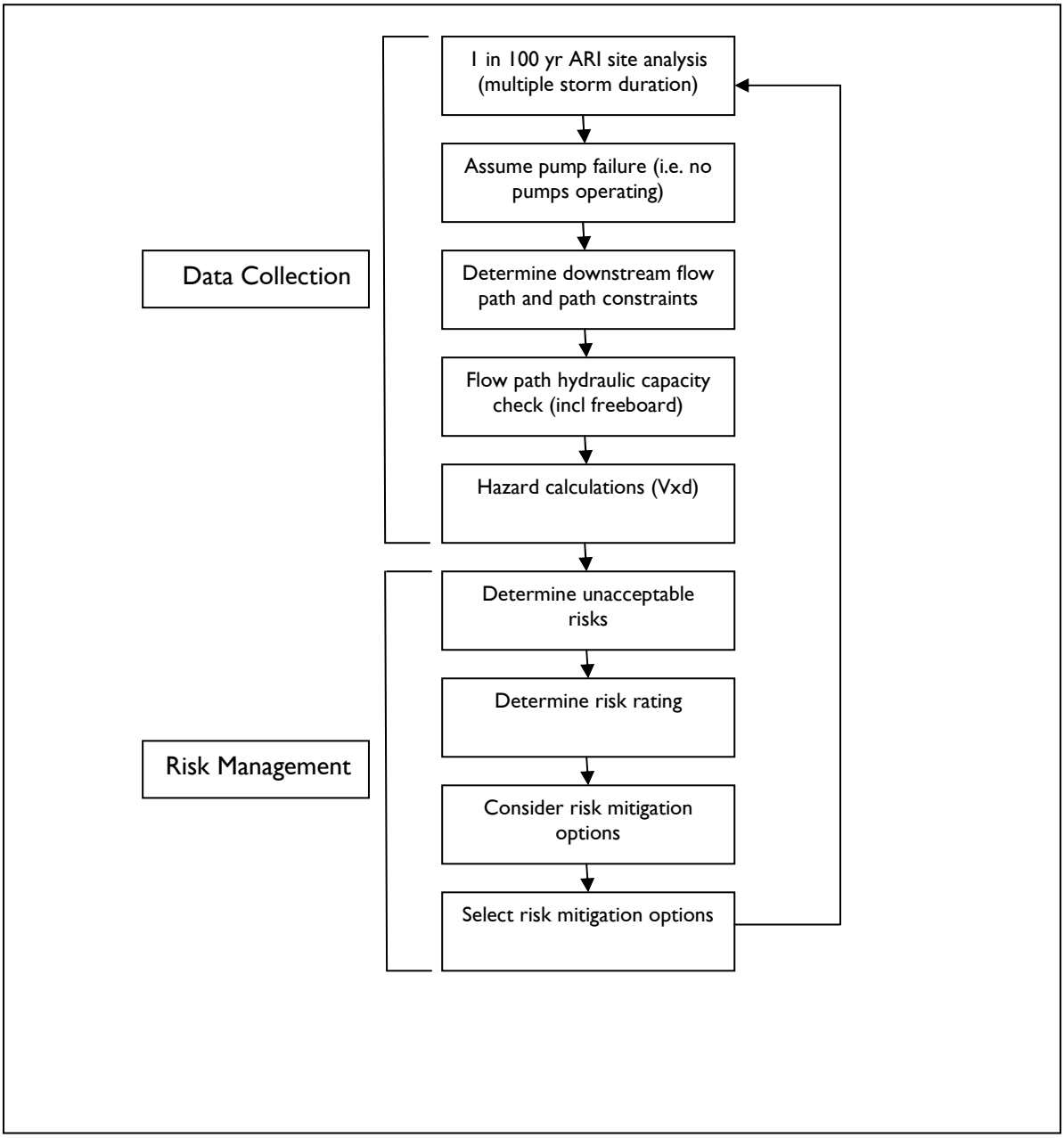
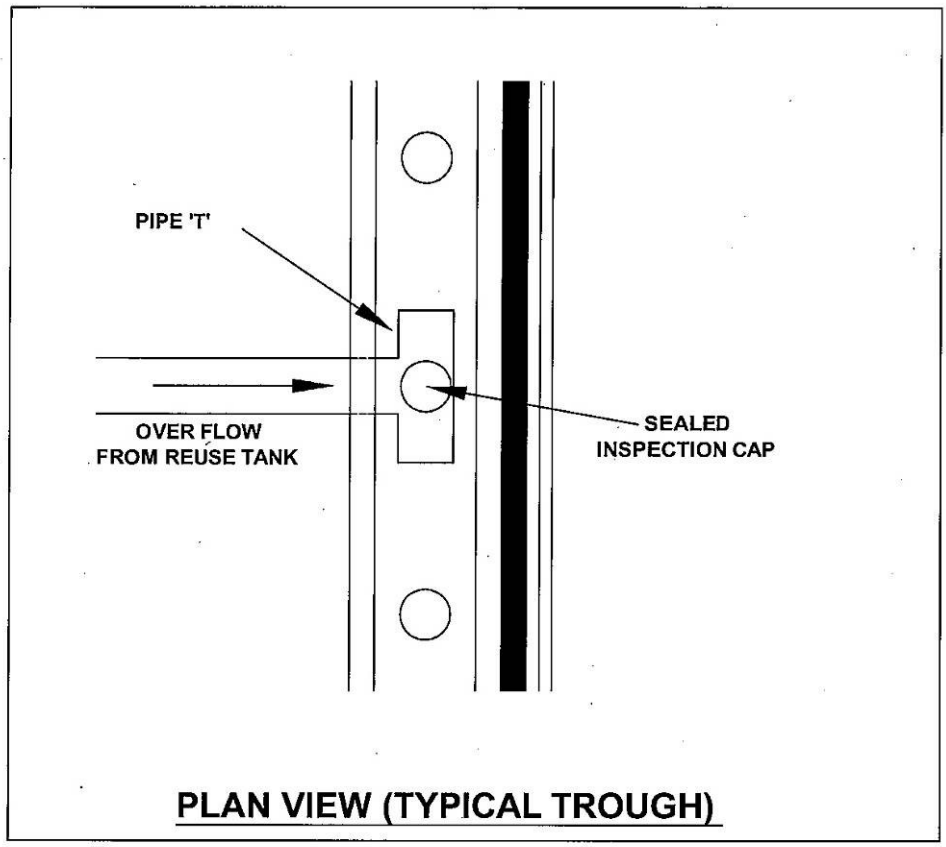


Figure 4.1 – Risk Management Process

4.3 Sites Falling to a Council Park, Reserve, or Bushland

This Section applies to areas that are not suitable for onsite absorption. For Additions to Single Dwellings see Section 2.2.2. For all other developments see Appendix D Drainage of Low Level Properties.

a. Firstly liaise with Council's Corporate Asset Coordinator after payment of the appropriate fee to determine whether Council will grant, or require an easement (not required for additions to single dwellings) through the Council park or reserve and comply with all requirements including any fees and charges that may be applicable. Final approval may need to be advertised and be subject to public review. The developer is also responsible for all construction costs of the new pipe. Council may impose minimum pipe sizes to allow for future flows and avoid further disturbance to the park or reserve.
b. A pump may be required where the risk (sensitivity to scour, impact of pollutants, etc) to the park, bushland or reserve is too great to allow continual discharge through a trough.
c. Pumps (where required) are to have the site discharge directed to a silt litter arrestor pit and a stormwater reuse system (sized at 2.0m^3 per 100m^2 of area being drained)(more information Section 4.2). The overflow from the reuse system is to discharge to the front street via a pump system. Pump storage is to be provided at the minimum rate of 1.0 m^3 below ground (or 1.2m^3 above ground) per 100m^2 of site area that cannot be drained by charge line, or gravity to the street. Higher storage requirements may apply to more intense use developments such as dual occupancies and above. Minimum 40% of the storage is to be below ground. The silt litter arrestor pit is to be located as close to the rear low point to collect as much of the site flow as possible and the pump sized accordingly for the 50 year ARI. The level of the access grate to the pumps is to be a minimum of 150 mm below the level of the emergency overflow weir. For general pump requirements see Section 4.2.
d. Where pumps are required and where practical, direct the majority of roofwater to the street via a gravity, or charged system and if applicable an onsite detention system.
e. A level weir, 100mm above the pump storage / OSD discharge pit grate level, is to be provided across the majority of the property where the cross-slope is relatively level, or a minimum of 6 m long in steeply sloping blocks, to minimise downstream scour.
f. A minimum 50 mm gap is to be provided between the weir overflow and the underside of the rear fence.
g. The trough, if required, is to be fully contained within the property for future maintenance access and is to be a minimum of 0.2 m wide and 0.15 m deep. The base of the trough shall have 100 mm seepage holes filled with geotextile at 1 m centres connected to a gravel seepage system set below natural ground level that will allow the trough to drain after the storm has finished. The discharge from the upstream drainage system is to first go through a silt/litter arrestor pit and should connect towards the middle of the trough through a 'T' fitting to minimise spill and concentrated overflow.
h. Stormwater Reuse Protection Systems (Section 7.3) are required to protect all bushland areas, all areas where a trough is required and in other areas as required by Council.



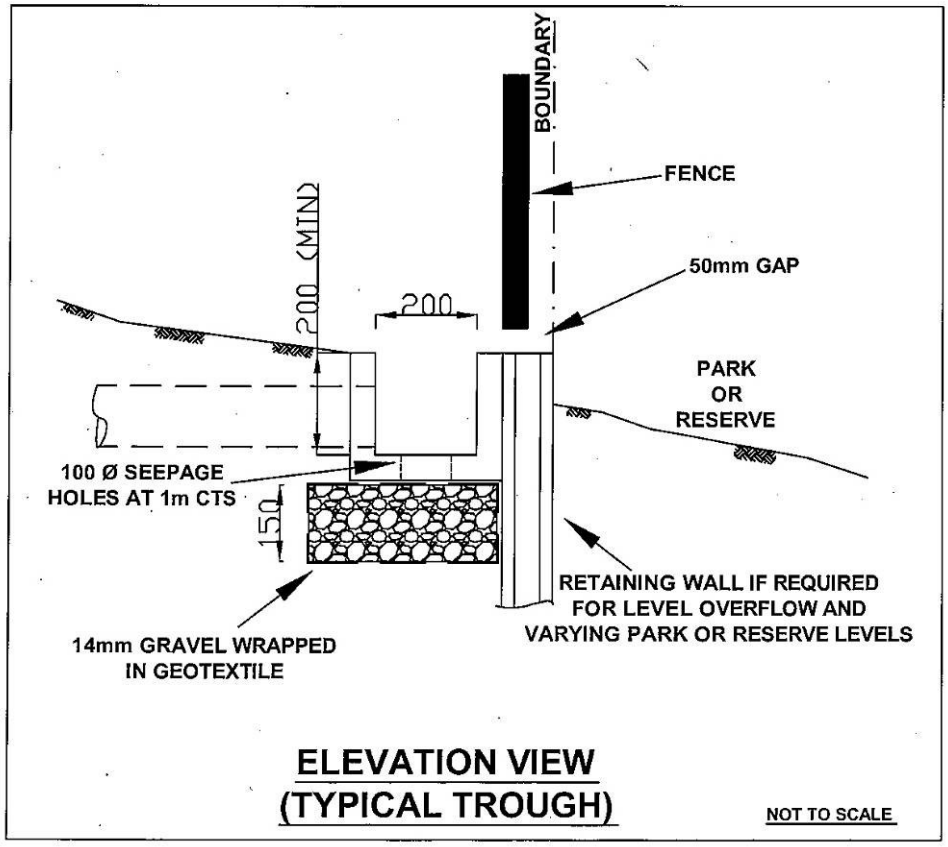


Figure 4.2 – Typical Trough Arrangement

5 On-Site Retention (Absorption)

5.1 Application

On-site stormwater retention aims to retain stormwater on the site through the use of an absorption system. This method applies to sites that have typically sandy soils with acceptable permeability rates. The *Botany Bay Sand Aquifer*, identified by the shaded area in Map B.1, is indicative of sand strata through the Council area and is a general guide to locations suitable for absorption systems.

5.2 Establishing the Nominal Absorption Rate

For additions to single dwellings or the construction of new single dwellings Council can supply a Nominal Absorption Rate (AR_n). All other developments the Nominal Absorption Rate shall be determined by a geotechnical engineer, and compiled into a report, in accordance with the following;

a. The Nominal Absorption Rate, in the units litres/square metre/sec, shall be determined at each proposed absorption pit location with a recognised falling head or constant head test (a double ring infiltrometer is preferred). The sand shall be fully saturated when the test is carried out. The test shall be repeated until there is less than a 5% difference in results. Multiple tests will be required for larger sites at the minimum rate of one test per 900 m^2 of site area or part thereof.
b. One borehole log to a minimum depth of 2.0 metres below existing ground level, or to 1.0 m below the proposed absorption pit base (whichever is greater) shall be supplied detailing all soil types present, the bed rock level and the water table level if applicable. Developments with a below ground garage, basement, or other development that would intercept the groundwater within the *Botany Bay Sands Aquifer* are required to establish the actual water table level to Australian Height Datum.
c. An assessment of the suitability of the site for absorption detailing any impact on adjoining properties and a determination of required piering depths for adjacent buildings, brick fences or other structures.
d. Absorption may not be practical in some locations due to the physical limitations of the soil, or where the nominal absorption rate is less than 0.05 l/sec/m^2. Physical limitations are a high water table, rock close to the surface, or contaminated soils. Clay or silty clay soils are typically unsuitable and give absorption rates below the accepted level.

5.3 Absorption System Design Requirements

a. Absorption systems must be maintainable and each design has its strengths and weaknesses. Council's assessment of various designs on the basis of long term maintenance from easiest to hardest is:

Easiest	1. Open Single Style Absorption Pit (Drawing C.5)
	2. Tank Type Absorption Pit (Drawing C.4)
	3. Maintainable Trench Type Absorption Pit (Drawing C.3)
	4. Covered Void Type Absorption Pit (Drawing C.2)
Hardest	5. Atlantis Cells

b. Where alternate systems are possible Council's preference is for installations that are easier to maintain.

c. The absorption pit shall be designed to accept all the flows off the impervious areas for an Average Recurrence Interval (A.R.I.) storm of 50 years (see Appendix A Tables A.1 and A.2 for rainfall intensities). The runoff coefficients are shown in Table A.3.
d. All impervious areas shall be accounted for including roofs, paving, driveways and paths. The surface area of any pool is considered as impervious except where overflows are permitted by Sydney Water to directly connect to the sewer. Landscaping/turfing that is constructed over basement car park areas, or over concrete podiums shall be considered impervious. The total calculated impervious area shall be increased by a minimum of 30 m^2 or 20%, whichever is greater (but not so that the actual site area is exceeded), to account for future increases in impervious surfaces.
e. When calculating the available storage volume allow for a maximum of 20% voids in the base aggregate. The standard pipe network shall not be considered as storage volume. Rainwater tanks offsets may contribute to the available storage volume.
f. The base of the absorption trench shall be a minimum of 0.5 metres above any rock level.
g. The base of the absorption trench shall be a minimum of 1.0 metre above any water table to allow for fluctuations in water levels unless a smaller figure can be justified. Where specific information indicates higher fluctuations than 1 m the base of the absorption pit is to be the higher of 1 m above the existing water table, or 0.5 m above the highest known water level.
h. In sandy areas the onsite absorption pit shall not be located within 2.0 metres of the side, or rear boundary, nor 2.5 metres from any existing building or structure. Absorption pits are permitted within 2.5 m of new buildings where special provisions are made in the footing design (typically piers) by the structural engineer. The absorption pit is permitted up to 0.5 m from the front boundary. In non sandy areas the building offset above is to be a minimum of 3 m.
i. In the covered void type absorption systems Council will allow the gravel bed to be replaced with an drainage cell (Atlantis or similar) minimum 52 mm thick. Allow for a design void content of 80% of the cell volume.
j. Where absorption systems (gravel beds) are located within 5 m of any retaining walls the base level of the gravel bed of the absorption system located on the high side of the wall is to be constructed a minimum of 300 mm lower than the surface level at the bottom of the retaining wall. Special provisions in the footing design (typically piers) are required by the structural engineer for systems closer than 2.5 m to the footing. On the low side of the retaining wall the absorption system is to be no closer than 2.5 m from the front of the retaining wall footing unless special provisions are made in the footing design (typically piers) by the structural engineer.
k. If multiple Everglas Plastic Trenches, box culverts or pipes are used as part of a single absorption trench system they shall each have full access from an end pit to facilitate cleaning and be interconnected at the end pits to provide an even distribution of flows.
l. Basement garages shall not be permitted to drain to an absorption system that has no emergency overflow provision.
m. Where an interallotment drainage scheme is available the overflow from the absorption system shall be directed to it.
n. Where drainage cells (Atlantis or similar) are used for storage, all discharge to the cells is to go firstly through the manufacturers recommended and correctly sized filtration unit before being piped directly into the drainage cells. Allow for a design void content of 90% of the cell volume. Where a conventional pit is proposed after the special filtration unit, but adjacent to the sides of the cells, the side of the pit is to be left open. A removable geotextile flap is to be hung over the opening to filter any material prior to water entry to the drainage cells. The permanent geotextile that totally surrounds the cells is still required.

5.4 Method of Sizing Absorption Pits.

5.4.1 Design Absorption Rate (AR_D)

The Design Absorption Rate (AR_D) is determined by the application of a Reduction Factor (F_R) to the Nominal Absorption Rate (AR_N) to account for clogging of filters, variability of sands and likelihood of multiple storms, in accordance with Equation 5.1.

$AR_D = AR_N \times F_R$

Where F_R is determined in accordance with the following:

Nominal Absorption Rate (AR_N)	Reduction Factor (F_R)
$0.1 \leq AR_N \leq 1.0$	0.75
$AR_N < 0.1$	0.50

Equation 5.1 – Design Absorption Rate (AR_D)

The maximum nominal absorption rate accepted by Council is 1.0 litre/square metre/second.

5.4.2 Storage Method with Average Rainfall Intensity

The method requires the designer to decide on some preliminary dimensions and proceed through a process of trial and error.

Base Area (BA) = Width * Length.

Calculate the rate of discharge to the sand using AR_D * BA in litres per second.
Then calculate the required storage for a number of storms by calculating the difference between the runoff volume and the absorbed volume. Compare the required storage to the available storage in the proposed system. Where the available storage is greater than the required storage for all time steps the proposed system is viable.

To design the most economical solution it is suggested that the designer create a spread sheet so multiple sizes and configurations can be tested. A design spreadsheet is available from Council, which utilises this method.

5.4.3 Storage Method with Temporal Effects

This method is similar to above but uses mass curve techniques to determine the inflow from the site. Using the temporal patterns derived from Chapter 3 of Australian Rainfall and Runoff 1987 (A.R.R.) various storm durations are chosen to determine the maximum storage required. This technique is similar to that proposed in Technical Note 1 on Page 299 of A.R.R. but using discharge from the absorption pit rather than a pump. A graphical plot or computer printout should be supplied for the various temporal patterns and the cumulative discharge to the absorption pit.

5.5 Above Ground Storage

Absorption systems may utilise above ground storage provided the design and installation is in accordance with the following:

a. The design and installation of the above ground storage must comply with the criteria under Section 6.8.3, as if the above ground storages were for an On-Site Detention System.
b. The design and installation must also make provision for an overflow in accordance with Section 6.7, as if the above ground storages were for an On-Site Detention System.

c. All driveway grates and surface inlet pits not within the storage area shall be a minimum of 50mm above the design water surface level.
d. The location of all onsite above ground storage systems shall be marked by the permanent fixing of a marker plate of minimum size 200 mm by 150 mm to the nearest permanent surface. The plate shall be non-corrosive metal, or 4 mm thick laminated plastic that contains the following wording:
"This is an onsite stormwater absorption system that will pond water during heavy storms. The owner is to clear the absorption pit regularly."
e. Retaining walls shall be able to withstand all hydrostatic loads generated by the 100 year ARI event. This is the depth of maximum storage plus the depth of flow overtopping the weir.
f. All gas meters, sewer vents, electricity outlets and other services shall be located outside or above the limits of the storage and overflow weir.
g. Bark chips and other loose floatable landscaping materials shall not be used in the above ground storage area.

5.6 Absorption System Design Solutions

The design of absorption system shall be in accordance with the standard designs in Appendix C. Alternative designs will only be considered provided they match or exceed the performance and ease of maintenance requirements of the standard designs.

5.7 Positive Covenants for Retention Systems

The Retention (Absorption) System is intended to control site discharges over the entire life of the development. To guarantee the system's continued operation, it needs to be protected from alteration and regularly maintained.

For all developments other than Single Dwellings, (except where above ground storage is required), or Additions to Single Dwellings, the Absorption System shall be protected by a positive covenant in favour of Council. The covenant is to be in the form of an Instrument under the Conveyancing Act, and use standard wording as set out in Appendix E.

6 On-site Stormwater Detention

6.1 Application

On-site stormwater detention (OSD) applies to development in low absorption areas, or where other physical limitations prevent effective absorption.

6.2 50 Year Permissible Site Discharge and Detention Storage Volumes

The maximum Permissible Site Discharge (PSD) and corresponding minimum storage volumes shall be determined from the Table 6.1 for the 50 year ARI event.

Catchment Name (Refer to Map B.2)	Permitted Site Discharge (PSD) 50 Year ARI (l/s/ha)	On Site Detention (OSD) 50 Year ARI Volume (m^3/ha)
Wolli Creek	160	350
Bardwell Creek	150	365
Bonnie Doon	210	285
Spring Street	190	305
Muddy Creek	180	320
Eve Street / Cahill Park	240	245
Scarborough Ponds	110	415
Waradiel Creek (SS1)	190	305
Bado-Berong Creek (SS2)	160	350
Goomum Creek (SS3)	180	320

Table 6.1 – Permitted Site Discharge and OSD Volume Rates

The 50 year ARI control pit shall limit the discharge through an orifice, or choke pipe protected by a maximesh screen and silt trap to the limits specified in Table 6.1.

6.3 Control of the 2 year ARI Storm (Nested Storages)

Much of the existing Council piped drainage system has a capacity of the 2 year ARI storm or less. The detention system is to be a two stage process that initially limits the discharge from the site in smaller storms to the 2 year ARI event. The PSD for the 2 year ARI event can be considered to be 35% (0.35) of the 50 year ARI PSD. The corresponding 2 year ARI volume can be considered to be 45% (0.45) of the 50 year ARI detention volume.

e.g. Consider a site in Muddy Creek with a site area of 1000 m^2.
The 2 year discharge is 180 * (1000 / 10,000) * 0.35 = 6.3 l/s
The 2 year volume is 325 * (1000 / 10,000) * 0.45 = 14.6 m^3

The discharge from the 2 year storage is to be through an orifice or choke pipe protected by a maximesh screen and silt trap. The orifice is to be sized to provide the design 2 year PSD at the design depth of the 2 year storage. The controlled discharge from the 2 year ARI control pit is to connect to the control pit for the 50 year event by a pipe with the overflow also directed to this control pit, but at a height above the 2 year storage level typically as weir flow.

The balance of the 50 year storage volume (55%) is to be provided above the 2 year storage level. In a tank this can be achieved through a weir around the 50 year control set to the 2 year storage requirements. In an above ground system the overflow will be achieved by setting the grate for the 50 year ARI control pit at the 2 year storage level, or by an opening (slot width minimum 0.1 m) in the side of the 50 year control pit set at the 2 year storage level designed to convey a minimum of 3 times the 50 year PSD flow as weir flow. Refer to Appendix C for standard design for detention systems.

6.4 OSD on Flood Affected and Overland Flow Affected Sites

a. Overland Flow Affected Sites
   (i) A floodway/overland flow path shall be provided if overland flow exists on the site. The OSD system is not to interfere with this flowpath.
   (ii) The overland flow path should be designed to allow the on-site detention system to function without hindrance for events up to the 2% AEP (1 in 50 year) event
   (iii) See also Section 3.3 and Section 8.3.
   (iv) The OSD system is permitted to accept normal surface flows from the overland flow path or flood affected area for flow generated within the site, where practical. The discharge to the OSD system from these areas shall be limited to normal surface flows through the use of appropriately sized connecting pipes.
   (v) Where it is impractical to direct these flows generated from within the site to the OSD system, pits and pipes shall be designed to accept normal surface flows from the overland flow path or flood affected area and discharge these to the Council or other appropriate system after treatment. These bypass flows shall then be allowed for in the OSD design.
   (vi) It is not necessary to increase the size of the OSD system to provide for flows external to the site that may enter from upstream.
b. Flood Affected Sites
   (i) In the rare instance that the entire site in inundated with floodwaters in the 2% AEP event the OSD system shall be designed as a minimum depth (1.05 m) tank with a 25 mm orifice collecting runoff from only the roof. Lower depths are permitted with the use of Atlantis cells or similar. The tank is to be located under the garage with the access/surcharge pits positioned just in the driveway. The tank volume is to be proportioned on the basis that 100 m^2 of roof area requires 7.0 m3 of storage.

6.5 Areas Not Directed to the OSD Storages (Bypass)

Where possible, the roof and surface system shall be designed to direct runoff from the entire site to the OSD system. However, up to 20% of the site area will be permitted to bypass the OSD system. Though this bypass area does not drain to the OSD system, this flow still has to be collected and discharged in an appropriate and safe manner that does not impact on adjoining properties.

To compensate for the bypass flows the calculated storage volume is increased by half the percentage of the area not draining the storage. The P.S.D. is to be adjusted downward proportionally by two and a half times the percentage of area not draining to storage, eg. for a site where 10% of the area does not drain to the storage, the storage volume will be increased by 5% and the P.S.D. will be reduced by 25%.

6.6 Discharge Control

The discharge from the OSD system is to be via an orifice plate or choke pipe protected from blocking by a maximesh screen. High early discharge systems are not permitted. The maximesh screen shall typically have an area 50 times greater than the orifice. A typical layout is shown in Figure 6.1. For orifices larger than 150 mm, a grid mesh such as Weldlok

A40/203 may be used providing a proprietary GPT is installed prior to discharge to the Council system to collect litter and rubbish. The Weldlok grid should have an area 20 times the orifice area. The discharge is considered to be a free discharge. If this is not the case and the orifice is drowned refer to Section 6.7.

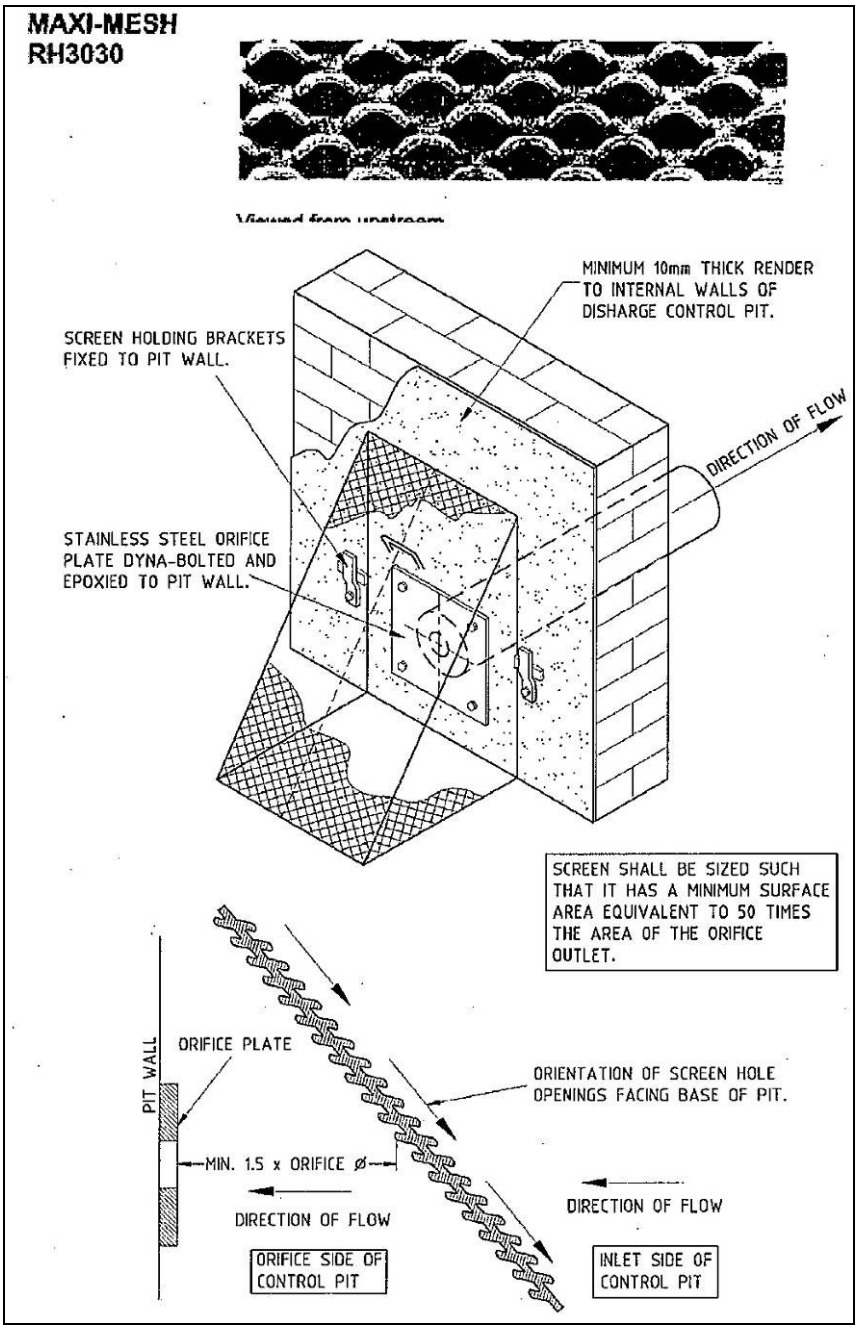


Figure 6.1 – Discharge Control

6.6.1 Orifice Control

The orifice plate is to be stainless steel, a minimum of 3 mm thick for orifices up to 150 mm and a minimum of 5 mm thick for orifices over 150 mm. The orifice plate is to be fixed to the pit wall with epoxy glue and stainless steel dynabolts or epoxy/chemical anchors. The plate is to be sealed around the perimeter after fixing. The minimum orifice diameter is 25mm. The connecting discharge pipe is to a capacity in excess of the design discharge assuming the pipe is flowing full, but not under pressure.

$Q = 2.123 \times D^2 \times h^{1/2}$ or $D^2 = 0.471 \times Q / h^{1/2}$

Where Q = discharge (m^3/sec)
h = depth of water above the centre of the orifice (m).
D = orifice diameter (m)

Note: This formula assumes a coefficient of discharge of 0.61.

Equation 6.1 – Orifice Discharge Equation

6.6.2 Choke Pipe Control

The choke pipe is to be a minimum of 1 m in length, unless connecting to an adjacent pit. The determined choke pipe diameter is to be within 2 mm of a standard pipe size, or the invert varied to adjust the height over the orifice 'h' to match. The downstream discharge pipe is to a capacity in excess of the design discharge assuming the pipe is flowing full, but not under pressure.

$Q = 2.786 \times D^2 \times h^{1/2}$ or $D^2 = 0.359 \times Q / h^{1/2}$

Where Q = discharge (m^3/sec)
h = depth of water above the centre of the orifice (m).
D = choke pipe diameter (m)
Notes: This formula assumes a coefficient of discharge of 0.8.

Equation 6.2 – Choke Pipe Discharge Equation

6.6.3 Drowned Orifices and Free Discharge

Council's aim wherever possible is for the discharge from the OSD system to be a free discharge such that the invert of the orifice is a minimum of 100 mm above the Hydraulic Grade Line (HGL) of the receiving system for the 50 year ARI event. In the absence of more detailed information the HGL could be considered as the top of kerb, the grate level of a pit, or 300 mm above the obvert level of a pipe. To allow a free discharge, above ground rather than below ground detention may be required.

For some sites a free discharge may be difficult to achieve and the following guide will assist where an orifice is restricted or drowned by the downstream water (HGL) level. Consider "h" as the depth of storage over the orifice centreline in metres. Note for a tank this shall be the underside of the tank roof rather than the grate level. Consider "h_o" as the height of the downstream HGL level over the orifice centreline in metres within 15 m of the orifice. Expressing ho / h as a percentage gives a measure of how much the orifice is restricted. In the absence of more detailed information Table 6.2 gives a guide as to how much the detention volumes from Section 6.2 have to be increased to compensate for the restricted outlet assuming a static downstream water level.

Percentage Restriction (h_o/h *100)	Additional Detention Volumes (%)
10	5
20	15
40	35
60	60
75	90

Table 6.2 – Drowned Orifice Adjustment

A flood flap, reflux valve, or backflow prevention device is required downstream of the orifice control.

Alternative assessment using an appropriate computer program is permitted provided the orifice size is not to be increased above what is required to achieve the PSD assuming a free discharge and all discharge through the orifice. Where $h_o/h > 75\%$, a computer program assessment is required to determine the adjustment to the storage volume.

6.7 Overflow

Provision needs to be made when designing a storage for storms more severe than the design storm or for blockages in the system. With most storages it is relatively easy to provide a weir capable of passing the entire discharge from a very large storm event with only a few centimetres depth of water over the weir. See also Section 3.3.4.

6.7.1 Design process

The following design method should be used to check the adequacy of overflow structures, such as weirs or spillways, and freeboards to finished floor levels. Overflow and weir flow calculations must be included in the detailed design information submitted to the consent authority:

a. Assume the outlet is blocked and the storage full.
b. Calculate the approximate maximum 100-year ARI discharge to the storage (See Equation 8.1 – Rational Method);
c. Calculate the maximum depth over the spillway/weir assuming the entire 100-year ARI discharge passes over the spillway/weir (See Equation 3.2 – Weir Equation);
d. Check the floor levels of any buildings upstream of the storage to ensure that these buildings are not inundated for suitable freeboards; and
e. Overflows should be directed to a flowpath through the development so that buildings are not inundated nor are flows concentrated on an adjoining property.

6.8 Detention Requirements

6.8.1 General

a. The design of OSD shall comply with the general criteria from Australian Standard AS/NZS3500.3, except as follows:
   (i) Ponding levels shall be not less than 300 mm below any adjacent timber habitable floor levels, not less than 200 mm below any adjacent concrete habitable floor levels, and not less than 100 mm below non-habitable floor levels. Ponding levels shall also be not less than 50 mm below surface level of pits and grates within the surface drainage system.

b. Additional requirements are as follows:
   (i) Dual occupancies that are to be subdivided under Torrens Title are to have separate OSD systems. Multi dwelling housing developments, residential flat buildings, mixed use premises and other buildings that may be subdivided under strata are permitted to have a combined OSD system.

6.8.2 Below Ground Storage Design Requirements

a. The design and installation of the above ground storage shall be as follows:
   (i) The grade of the floor of the tank shall be a minimum of 1%.
   (ii) When preparing a design for, designers shall be aware of the provisions of AS/NZS 2865 and shall identify any entry to an enclosed space with a plate. The plate shall be non-corrosive metal, or 4 mm thick laminated plastic that contains the following

wording: "Warning Enclosed Space. entry prohibited without workcover approved procedure"

(iii) The storage shall be able to be inspected from the surface without having to remove heavy access covers. All openings shall be 600 mm x 900 mm. Access grates shall be clear of the driveway where possible. Openings shall be positioned to allow flow through ventilation. All grates are to be fitted with child proof "J - Locks". A minimum of two openings shall be provided for pits longer than 3 m and pits longer than 9 m shall have additional openings at maximum 5m spacing. The minimum internal pit depth for safe accessibility is 1.0 m.

(iv) The storage shall have a sump adjacent to the orifice with a minimum depth of 250 mm below the orifice centreline. The sump volume shall not be considered in storage calculations.

(v) Bondek may only be used as permanent formwork and not as a structural component. i.e. bottom reinforcing is still required. Extra trimmer rods and top reinforcement may also be required for an appropriate structural design.

(vi) All openings to the below ground storage should be grated unless there are exceptional circumstances as determined by Council. Such circumstances may include tanks incorporated into balconies where the second access point could be covered with a gatic lid providing an alternative ventilation point is provided. The main access point over the orifice must remain grated however a finer mesh could be used to improve pedestrian safety.

(vii) Internal supporting walls for pits will not be permitted unless the pit is wider than 3m. If supporting walls used 0.9 m by 0.9 m minimum openings at 1.8 m centres shall be provided within the supporting wall to allow free access.

(viii) The storage shall be designed to be structurally sound allowing for all loads including earth, traffic and hydrostatic loads generated by a full storage. The storage shall be designed to prevent floatation particularly during the construction phase.

(ix) Limits of excavation shall not fall within the influence lines of any footings or structures, unless allowance for piering has been made in the relevant footing design.

(x) Where drainage cells (atlantis or similar) are used for storage, all piped discharge to the control pit is to firstly go through the manufacturers recommended and correctly sized filtration unit. The side of the control pit adjacent to the side of the cells is to be left open and a removable geotextile flap hung over the opening to filter any material prior to water entry to the drainage cells. The opening is to be as large as possible to minimise clogging. In addition permanent geotextile is to be attached to the cells over the opening to the pit. Drainage cells must not to be used where is there free groundwater that may cause the crates to heave, or be displaced due to buoyancy effects.

(xi) Pipes are permitted to provide underground storage however the principles of accessibility and good maintenance apply. Maximum pipe length is 10 m between pit access points with a preferable minimum pipe slope of 1% and absolute minimum slope of 0.35%. Access pits (typically 600 mm by 600 mm) with minimum 250 mm deep silt traps are to be provided at each end. Where multiple pipes are to be used the pit size is to be increased to enable full access to each pipe end or multiple pits provided.

(xii) Corrosion resistant (preferably synthetic) step irons are to be provided for pits deeper than 1.2 m in a staggered pattern at 300 mm centres.

6.8.3 Above Ground Storage design requirements

a. The design and installation of the above ground storage must comply with Australian Standard AS/NZS3500.3 except as follows:

(i) The maximum depth of ponded water that shall be permitted is:

Parking & driveways	200 mm
Courtyards, grass & landscaped	600 mm
Covered or restricted access	no limit

(ii) Protection of entry to ponded areas shall be in accordance with the Building Code of Australia.

b. Additional requirements are as follows:

(i) The location of all onsite above ground storage systems shall be marked by the permanent fixing of a marker plate of minimum size 200 mm by 150 mm to the nearest permanent surface. The plate shall be non-corrosive metal, or 4 mm thick laminated plastic that contains the following wording:
"This onsite stormwater detention system will pond after heavy rain. The outlet pit must be cleared of debris regularly."

(ii) Retaining walls shall be able to withstand all hydrostatic loads generated by the 100 year ARI event. This is the depth of maximum storage plus the depth of flow overtopping the weir.

(iii) All gas meters, sewer vents, electricity outlets and other services shall be located outside or above the limits of the storage and overflow weir.

(iv) Bark chips and other loose floatable landscaping materials shall not be used in the above ground storage area.

6.9 Positive Covenant for Detention Systems

Stormwater Detention Systems are intended to control site discharges over the entire life of the development. To guarantee the system's continued operation, it needs to be protected from alteration and regularly maintained.

The Detention system shall be protected by a positive covenant in favour of Council.
The covenant is to be in he form of an 88B or 88E Instrument under the Conveyancing Act.
See Appendix E for the required wording.

7 Water Sensitive Urban Design Requirements

7.1 Introduction

Current trends in urban development seek to address the issue of creating a more sustainable urban environment. Global warming and climate change are now seen as issues to be addressed in the present not just the future. Droughts and dry land salinity have highlighted the need to review our national approach to water usage, while the increasing population in major cities has increased attention on the supply of potable water and the disposal of wastewater. Water supply authorities are reviewing the appropriateness and cost implications of using treated, potable water for domestic or industrial uses that are predominantly non-potable.

As the driest continent in the world, Australia must conserve water, which is one of its most precious resources, if the country is to prosper in the long term. As well as conserving the quantity of water we must also protect the quality of water. Action now will give future generations an opportunity to enjoy the quality of life we currently enjoy. Failure to act could create enormous problems within the next generation. This general approach is called Water Sensitive Urban Design (WSUD).

As a consequence Council recognises the need to:

a. Protect and enhance natural water systems within urban developments.
b. Integrate stormwater treatment into the landscape.
c. Protect water quality.
d. Reduce runoff and peak flows, and
e. Conserve water by reducing demand on potable water supplies.

More information on this topic can be obtained from www.wsud.org.

7.2 Rainwater Tank Requirements

7.2.1 Development Subject to the Building and Sustainability Index (BASIX)

Under the *Environmental Planning and Assessment Act 1979* and accompanying *Regulations* most residential development involving dwellings must include a BASIX certificate. The BASIX certificate may include the provision of a minimum rainwater tank volume to reduce potable water demand.

7.2.2 Other Development

For developments that do not require a BASIX certificate (i.e. development that is not BASIX affected development, BASIX optional development or BASIX excluded development), the minimum mandatory rainwater tank volumes are specified in Table 7.1, or as determined by a water balance demand model shall be in accordance with the Department of Environment and Conservations *Managing Urban Stormwater, Harvesting and Re-use*, April 2006.

Residential care facility, Hostel, etc	0.5 m^3 per bed
Boarding House, Group Home, etc	1.5 m^3 per room
Hotel / Motel, Serviced Apartments, etc	0.5m^3 per room/suite plus 1.5 m^3 per 100 m^2 GFA restaurant/function areas
Shops, Business, Commercial, etc	1.5 m^3 per 100 m^2 GFA
Light Industry, Industry, Automotive, etc	1.0 m^3 per 100 m^2 GFA

Table 7.1 – Minimum Rainwater Tank Volumes

7.2.3 Drainage Offsets for Rainwater Tanks

A rainwater tank provided in accordance with Section 7.2.1 or 7.2.2 may be available for offsets against drainage volumes required for On-site Detention (OSD) and absorption systems. This offset is only provided where the required rainwater use from Section 7.2.4 is achieved. The offsets are only available for rainwater tanks and are unavailable for stormwater tanks.

a. OSD Offsets (1 in 3)

Council will allow an offset of 1 m^3 from the OSD volume for every 3 m^3 of rainwater tank, providing the final OSD volume does not fall below 50% of the original design volume.

NOTE: For new Single Unit Dwellings Council allows a complete offset to OSD requirements where a rainwater tank of minimum 9500 litres is specified, providing it collects water from at least 75% of the main roof and the use complies with Section 7.2.4. This rainwater tank can also be used to satisfy the BASIX assessment.

Examples of OSD Offsets

Consider a requirement for an OSD volume of 10 m^3.

%OSD	OSD m^3	Rainwater Tank m^3	Total Storage m^3
100	10	0	10
90	9	3	12
80	8	6	14
70	7	9	16
60	6	12	18
50 (minimum)	5	15	20

Note in the example above rainwater tanks with a capacity greater than 15 m^3 are permitted but no further offset against the OSD is available. The above relationships are scalable, e.g. for a required OSD volume of 30 m^3 multiply the above figures by 3.

b. Absorption Systems Offsets (1 in 4)

1 m^3 of design storage for the absorption system for every 4 m^3 of Rainwater Tank providing a minimum storage of 3.0 m^3 is maintained in the absorption system itself. This minimum storage is based on a site area of 1000 m^2 or less. For larger sites the minimum storage volume of 3.0 m^3 is to be proportionally increased e.g. for a site area of 1500 m^2 the minimum absorption system storage volume is 3.0 x 1500 / 1000 = 4.5 m^3 before rainwater tank offsets will be available.

Examples of Absorption System Offsets

Consider a requirement for an absorption system volume of 5 m^3 and a site area of 800 m^2. As the site area is less than 1000 m^2 no adjustment to the minimum volume is required. The following alternatives are all acceptable.

Absorption Design Requirement m^3	Absorption System m^3	Rainwater Tank m^3	Total Storage m^3
5	5	0	5
5	4	4	8
5	3 (minimum)	8	11

Note in the example above rainwater tanks with a capacity greater than 10 m^3 are permitted, but no further offset against the absorption system volume is available.

To obtain the offset at least 75% of the roof area is to connect to the rainwater tank. Rainwater tanks can be above ground or below ground. A single above ground tank may not be achievable as it will be generally impossible to direct the bulk of the roof water to it unless the downpipes connect through a charged system. Where multiple above ground tanks are used they shall be connected by underground pipes to allow the stored water to be fully utilised.

7.2.4 Uses of Rainwater

a. Where an exemption to OSD, reduction in OSD volume, or reduction in absorption system design volume is sought the use of the rainwater tank must comply with the following:.

   (i) Garden watering, including connection to the majority of external taps, and
   (ii) All toilet flushing, and
   (iii) The cold water supply to the washing machine (preferably sourced only from roof water), and
   (iv) For multi-unit developments that require car washing bays, supply water for car washing, unless the car wash water is recycled through a proprietary system.

   (These uses must be clearly identifiable on the BASIX certificate.)

b. Where a rainwater tank is determined in accordance with Section 7.2.2 the use of the rainwater tank must be as follows:

   (i) Garden watering, including connection to the majority of external landscape taps, and
   (ii) All toilet flushing, and
   (iii) For light industry or industry, provision of a dedicated tap for each industrial unit or multiple taps for a single use development, for non potable industrial uses.
   (iv) Where car/truck washing bays are required the rainwater tank is also to supply water for car /truck washing, unless the wash water is recycled through a proprietary system.

7.2.5 Rainwater Tank Design and Installation

The design and installation requirements for rainwater tanks are as follows.

a. All taps connected to the rainwater tank shall be clearly marked ‘Rainwater’ or ‘Not For Drinking’.
b. The tank shall meet all current Sydney Water requirements and be constructed to satisfy HB230 and NSW Code of Practise :Plumbing and Drainage.
c. Atlantis cells, or similar are not permitted as rainwater tanks.
d. Roof gutters should have leaf guards or similar fitted to minimise entry of debris to the tank. Rainwater should be screened prior to entering the tank, or a first flush device fitted. Fit flaps on all inlet pipes. No openings are permitted that would allow insects to enter.
e. Tanks shall have a suitable pump fitted (dual pumps are not required) to ensure adequate pressure, except where the tank is less than 1200 litres and only used for garden watering.
f. Rainwater tanks provided as part of a charge system are to comply with Section XX.
g. To maintain the integrity of the stored rainwater, any discharge from a driveway, or carpark (even if treated) should discharge downstream of the rainwater storage.
h. The overflow from the rainwater tank shall be directed to the internal drainage system.
i. The inflow capacity of the rainwater tank mains top-up shall match or exceed the rainwater pump capacity. Typically the mains inflow pipe diameter shall match the pump

pipe diameter. Alternatively a solenoid switching mains water bypass system can be utilised.

j. The offtake to the pump shall be a minimum of 100 mm above the base of the tank to avoid uptake of any settled material. Alternatively a floatable offtake could also be used.
k. Where the development is to be subdivided under Torrens Title each dwelling shall have its own tank and pump. For Strata Developments a single tank and pump is permitted.
l. A buoyancy check needs to be undertaken to ensure that an inground tank will not pop out of the ground if the tank is empty and there is a high water table or low permeability ground (e.g. clay, silty sand). Particular care needs to be taken during construction if the tank is left in the open hole while fitting the pipes and the hole could fill up with surface water from rain on the site prior to backfilling.
m. Below ground tanks installed within the zone of influence of an existing building shall adequately support the building's footings to prevent movement during construction.

7.3 Stormwater Reuse Systems

This Section applies to areas that are not suitable for onsite absorption and applies to the containment of surface flows that originate within the site. The collection and reuse of stormwater from outside the site is considered in 7.4.3. Stormwater Reuse Systems may be applied to properties that slope or fall to the rear to further protect downstream bushland areas, reserves, parks or private properties from flows that may adversely affect them. This system is different to the Stormwater systems under BASIX. Where required the following conditions need to be met:

a. All flow is to go through a silt/litter arrestor pit before discharge to the stormwater reuse system.
b. The stormwater reuse is to be connected to a pump and then a cartridge filter prior to use.
c. The pumped reuse water is to be connected to a landscape watering system within the site, preferably as subsoil irrigation. Alternate uses on site may be considered, however additional treatment may be required to bring it to a suitable standard.
d. The offtake to the pump shall be a minimum of 100 mm above the base of the tank to avoid uptake of any settled material.
e. This storage must not have a connection that allows mains water top up or solenoid controlled bypass. No top up from the mains water or mains bypass avoids any watering restrictions from Sydney Water and ensures the water can be fully used. Alternative watering systems need to be available if the reuse pit runs dry.
f. As this is a flood and/or environmental protection device this storage is to be separate to and in addition to any other rainwater reuse requirements due to building including BASIX and any pump storage for discharge off site, or onsite detention (OSD) requirements.
g. The reuse storage is to be provided at the minimum rate of 2.0 m^3 per 100 m^2 of site area that cannot discharge to the street, or Council system by a gravity or charge system. Note that the site area excludes roof areas that drain to an approved rainwater tank. For single dwellings this volume can be limited to a maximum of 10 m^3.

7.4 Grey Water Reuse, or Alternative Water Sources

Greywater for diversion and reuse is all household wastewater from baths, showers, basins and laundries. Kitchen wastewater is excluded because it contains large amounts of grease, fat, food waste and detergent. Greywater does not include wastewater from toilets, or bidets. Grey water reuse should generally be referred to Sydney Water for the latest information and requirements.

7.4.1 Grey Water Diversion

Untreated greywater can be diverted directly to an sub-surface irrigation system as part of a single residence. Such use does not require local approval providing the system complies with Clause 75A of the Local Government (General) Regulation 2005.

7.4.2 Treated Grey Water Reuse

For greywater to be reused in multi-occupancy developments it must be treated to a sufficient standard to satisfy Sydney Water and Department of Health requirements.

7.4.3 Council Stormwater Harvesting

Where additional water is to be sourced to meet water reuse requirements under BASIX, Council encourages water harvesting from Council's stormwater network where available. Should this be a realistic option please contact Council's Corporate Assets Coordinator for approval.

7.5 Stormwater Treatment

7.5.1 Introduction

The Botany Bay catchment consists of two major waterways: the Georges and cooks Rivers, as well as substantial foreshore areas to the Bay itself. To reduce the stormwater pollution loads coming from urban development on the waterways in the Botany Bay catchment all new development and redevelopment must meet stormwater pollution reduction targets.

7.5.2 Design Requirements

Table 7.2 outlines the stormwater pollution reduction targets for development and redevelopment, as outlined in the Draft Botany Bay Catchment Water Quality Improvement Plan, November 2010, prepared by Sydney Metropolitan Catchment Management Authority.

Stormwater Pollutant	Greenfield Development, & Large Re-development	Multi-unit Dwellings, Commercial Developments, Industrial Developments, & Small Re-developments
Gross pollutants	90%	90%
Total suspended solids (TSS)	85%	80%
Total phosphorous (TP)	60%	55%
Total nitrogen (TN)	45%	40%

Table 7.2 - Stormwater Pollution Reduction Targets

For Greenfield developments, large re-developments, and significant multi-dwelling units, commercial developments and industrial developments the conformance to the targets for stormwater pollution reduction shall be justified by an analysis using MUSIC. Smaller developments are exempted from analysis using MUSIC provided that the application demonstrates that the design meets water quality objectives.

7.5.3 Minimum Requirements for Low Absorption Areas

In low absorption areas all developments require a silt/litter arrestor pit fitted with a maximesh screen prior to discharge to the kerb and gutter, Council pipe or interallotment drainage scheme in accordance with Figure C.1. The maximesh screen should have an area 40 times the area of the discharge pipe. A silt/litter arrestor is not required where a detention system includes a maximesh screen at orifice control in accordance with Section 6.6. The minimum size for an individual pit is 350 mm square. As the area draining through the silt/litter arrestor pit increases so does the size of the silt/litter arrestor pit.

7.5.4 Carpark Requirements

Developments with 10 or more car spaces shall also incorporate into the drainage system a device capable of removing oil from the driveway and carpark stormwater run-off. The device shall be manufactured by a Quality Endorsed Company to the requirements of ISO 9001 and shall have a minimum oil storage capacity of 20 litres for every 10 car spaces proposed or part thereof. A cleaning and maintenance schedule is to be supplied with the Construction Certificate.

7.5.5 Carwashing Requirements

To reduce the impact of soapy water on receiving waters, residential developments with more than 9 dwellings are to provide car wash bays (each 3.5 m wide minimum by 5.5 m). Car wash bays are either to discharge to the sewer in accordance with Sydney Water requirements, or be designed to treat and re-circulate the car wash water with a proprietary treatment system maintained by the owner, or body corporate. Each car wash bay is to be covered, appropriately signposted, have a cold water tap (typically connected to the rainwater tank) and a waterproof power outlet. Car wash bays are not permitted that discharge directly to the Council stormwater system, or to an absorption system.

For developments between 10 and 16 dwellings the car wash bay may be provided in one of the visitor car spaces (dual signage), or in a dedicated car wash bay. For developments with more than 16 dwellings a dedicated carwash bay is to be provided at the rate of one carwash bay per 60 dwellings or part thereof. In this case the car wash bay in the visitor space is not required.

7.6 Landscaping

A wide variety of landscape measures can be used to manage stormwater flows, utilise stormwater within the site, and minimise supplementary watering of landscaping. The careful design and placement of landscape measures can have many benefits for the water cycle, including reduced peak stormwater discharges, increased groundwater recharge, reduced erosion and sedimentation, increased retention of soil moisture and lower water costs. This is in addition to likely aesthetic and ecological benefits.

For more information refer to the Water Sensitive Urban Design is Sydney Region website: www.wsud.org

7.6.1 Raingardens

Raingardens are a specific landscaping features that may be designed for stormwater quality treatment without foregoing aesthetic or ornamental values. Stormwater runoff can be filtered, typically, through a sand/organic mulch medium, which subsequently drains to a conventional stormwater conveyance pipe. Raingardens can also provide some detention and/or retardation of stormwater flows reducing the risk of flooding, while providing an

aesthetic water/pond/landscape feature. Raingardens can be designed with any soil type and are typically planted with native vegetation.

Plants for raingardens should have the following qualities:

a. Tolerate short periods of inundation followed by longer dry periods,
b. Have spreading rather than clumped growth forms,
c. Are perennial rather than annual,
d. Have deep fibrous root systems.

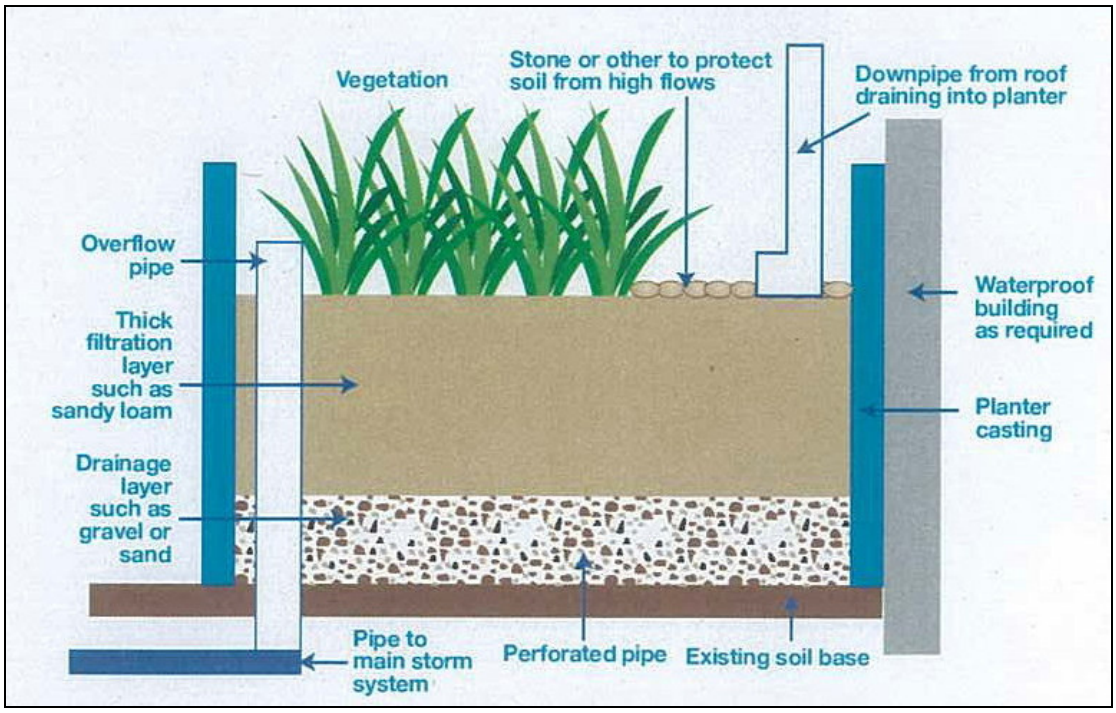


Figure 7.1 – Typical Raingarden layout

Raingardens may be applicable for downpipes from isolated outbuildings, downpipes that are not connected to rainwater tanks, or for the overflow from a rainwater tank. Raingardens are not suitable for the downpipes directly connected to a rainwater tank due to the risk of contamination. Downpipes into rainwater gardens should discharge a minimum of 2.5 m from most structures unless specific waterproofing techniques are used to prevent water ponding against the structure and overflows are directed clear of the adjacent footings. .

7.7 Groundwater Management

Groundwater, in a broad sense, is all water that occurs below the land surface. It is an integral part of the water cycle or hydrologic cycle, and interacts directly with surface water. It provides significant contributions to rivers and other water bodies, and maintains the dynamics of the estuarine and near-shore marine water bodies, contributing inflows of fresh water to otherwise saline environments. It is an invaluable resource.

7.7.1 Botany Bay Sands Aquifer

The area suitable for absorption in the Rockdale LGA generally lies in an area of a shallow water table, or aquifer. It is identified as the *Botany Sands Aquifer*, and Map B.1 generally identifies the location of the aquifer. The impacts to the groundwater regime resulting from development should be minimised to protect the aquifer, as follows:.

a. Development in this area that requires dewatering (either temporary or otherwise), or intrudes into the water table (e.g. basements, or underground car parking) may require, in addition to development consent, parallel approval by the NSW State Government agency administering the Water Act 1912 and the Water Management Act 2000.
b. Proposals that require permanent or semi-permanent pumping of the groundwater are not permitted. Alternatives must be ought to eliminate reliance on mechanical systems to deal with groundwater inflows into below ground areas. To facilitate this requirement, the construction of the below ground structure will require a water proof retention system (i.e. a fully tanked structure) with an adequate provision for future fluctuations of the watertable level.
c. Some requirements, although not directly related to the issuing of a Water Licence can have impacts upon the proposal, such that the project may need to be modified.
d. Developments impacting on the *Botany Sands Aquifer* will be required to submit with any development proposal;

    (i) A plan showing the extent and depth of all excavations.
    (ii) The existing water table level.
    (iii) The method of dewatering.
    (iv) The amount the local water table is proposed to be lowered.
    (v) An estimate of the volume of groundwater to be pumped from the site, the maximum pump rate, and duration of dewatering.
    (vi) The location of water discharge point.
    (vii) An assessment of impacts on surrounding structures and on surrounding ground water extractors by a geotechnical consultant,
    (viii) An assessment on the quality of groundwater, and how it will be treated prior to discharge.

7.7.2 General requirements:

a. All structures that are fully or significantly below ground shall be fully tanked to finished ground level.
b. Structures that are partially below ground may be fully tanked to finished ground level subject to groundwater levels and expected fluctuations.
c. Subsoil drainage shall be provided and designed to allow the free movement of groundwater around any proposed structure, but is not to be connected to the internal drainage system.
d. After construction is completed no seepage water is to discharge to the kerb. Permanent dewatering will not be permitted.
e. Continuous monitoring of ground water levels may be required.

7.7.3 Tailwater Discharge

Council requires a permit to be obtained prior to discharging tailwater from temporary dewatering, or pumping out of flooded sites, into Council's Stormwater Drainage network. The permit is available through Customer Service for an approved fee. Any such permit will include strict conditions for water quality standards and water quality monitoring, and any breach of the conditions will be prosecuted in accordance with environmental protection legislation. Ponded water, particularly in clay areas, may require significant treatment prior to discharge to the Council system.

7.7.4 Areas Outside the Botany Sands Aquifer

Council will allow temporary dewatering during construction in areas outside the Botany Sands Aquifer, however permanent dewatering, or long term seepage is not permitted to discharge to Council's system. Department of Natural resources do not want to be involved. Specialist subsoil drainage and structural design may be required due to the likely fluctuation

of the water and construction influence. Such design may require at least waterproofing, but may also include tanking.

7.7.5 Springs or Intercepted Groundwater Flow During Construction

Where during site excavation a spring or groundwater is intercepted Council will not permit the water to discharge to the kerb and gutter. The developer will be required to:

a. Capture and store the flow and reuse it on site (preferred), and/or
b. Discharge the flow back into the soil through an absorption system, and/or
c. In non absorption areas connect the flow direct to the Council piped drainage system. If there is no system available a new pit and stormwater pipe (minimum 375) is to be connected to Council's requirements.

7.7.6 Groundwater Recharge Trench

To reduce the impact of continued urbanisation and increased imperviousness for areas not generally suitable for absorption, development needs to allow for some form of stormwater infiltration, particularly for small storms. This is achieved through a Groundwater Recharge Trench. This trench consists of a minimum 800 mm wide by 200 mm high section of 14, or 20 mm gravel wrapped in geotextile filter fabric with a slotted PVC pipe (minimum diameter 100 mm) running through the middle. This trench would be located downstream of the silt/litter arrestor pit on private property, but prior to discharge to the street, pipe, or pump system. The trench is to be a minimum of 1.0 m long for each 100 m^2 of impervious site area draining to the system. Where ground levels and slopes make positioning the Groundwater Recharge Trench downstream of the typical silt/litter arrestor pit location it is permissible to place the Groundwater Recharge Trench along a major pipe section providing an additional silt/litter arrestor pit is provided upstream of the Trench and the Trench is not located within 1.5 m of a neighbour's boundary, or 0.25 m to the front boundary. A section through the Groundwater Recharge Trench is shown in Figure 7.2. Typical layouts are shown in Figures 7.3 (fall to the street) and Figure 7.4 (fall to a pump at the rear). This trench is not required for Additions to Single Dwellings, or for the Wolli Creek area. Alternative designs may be used subject to meeting the intended objective.

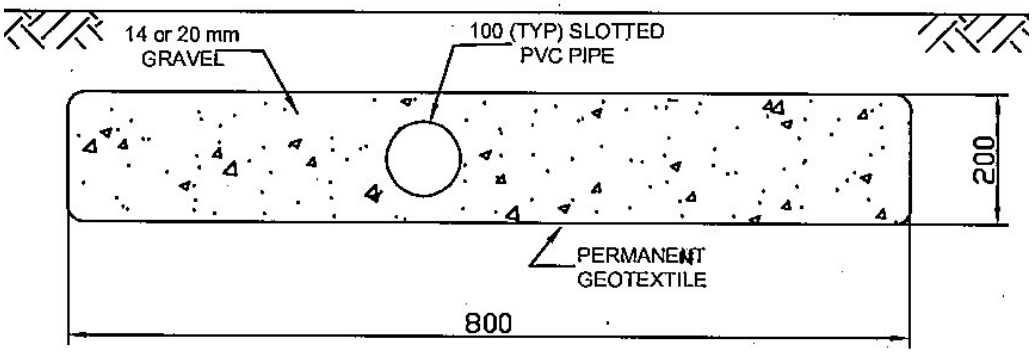


Figure 7.2 – Groundwater Recharge Trench, Section

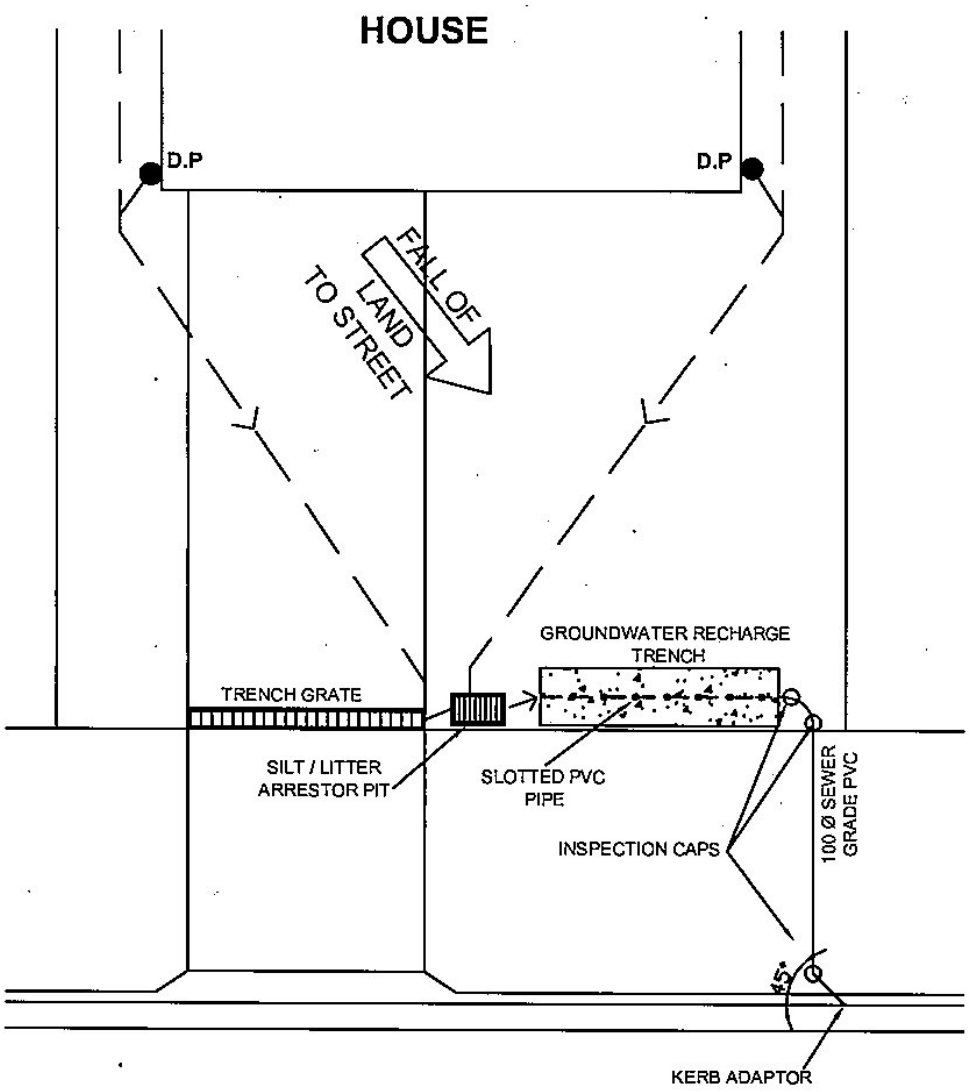


Figure 7.3 – Groundwater Recharge Trench Layout, Fall to Street

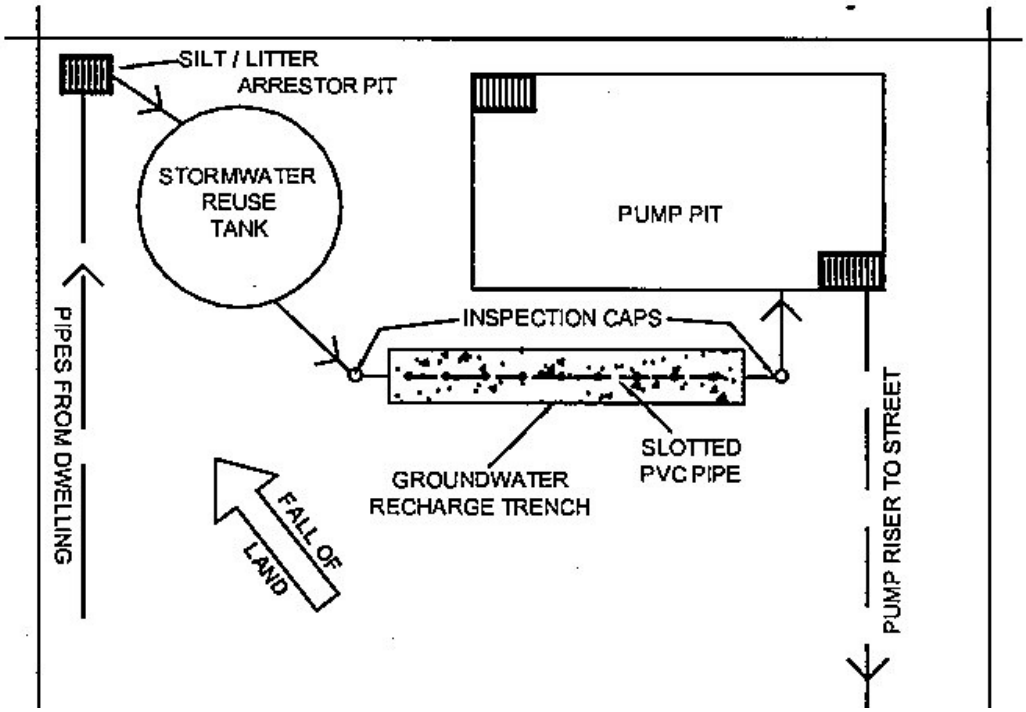


Figure 7.4 – Groundwater Recharge Trench Layout, Fall to Street

7.8 Porous Paving

In urban environments, paved surfaces such as driveways and courtyards cover a significant area of a typical house block. These "impervious" areas do not allow rainfall to soak through them to the underlying soil and as a result more stormwater enters our creeks and rivers and at a faster rate than would otherwise naturally occur. These stormwater flows carry pollution and contribute to creek bank erosion and habitat removal.

To protect our streams from this occurring, we need to reduce the amount of "impervious" surfaces in our urban areas so that less water and pollutants are washed off and delivered quickly to the creek.

Installation of porous pavements instead of traditional concrete pavements reduces the amount of runoff by allowing water to soak through the surface and into the underlying soil.

Porous paving is highly effective when first installed however its performance will deteriorate over time as foreign material is washed into joints and/or paving openings creating a barrier. Ongoing maintenance is required to keep joints and openings clear of debris.

Porous paving can be used subject to the following guidelines.

a. Council considers pervious pavement to be, on average, 50 % impervious and will allow a reduction of 50 % in the long term design impervious area of any area paved with porous paving.
b. Council preferred porous paving is constructed from precast porous concrete paving units supplied by a quality assured company. Hot laid porous asphalt paving (open graded) is not considered impervious due to it high probability of clogging. Council experience with individual asphalt porous paving units indicated that they are unsuitable as porous paving in the long term.
c. All porous paving shall be installed in accordance with the manufacturers recommendations.

d. To protect local structures such as a garage from the variability of the porous paving performance, surface drainage systems collecting the runoff from the porous paving (such as a trench grate) shall be designed to cater for the 5 min 50 year ARI design rainfall (I=238mm/hr) assuming the paving to be fully impervious.
e. Porous paving shall not be positioned in areas liable to receive high sediment loads.
f. Porous paving shall not be used on slopes greater than 5% in grade.

8 External Stormwater Drainage Network

8.1 Introduction

Rockdale City Council is an older urban Council area that had much of its stormwater infrastructure constructed more than 100 years ago. At that time the residential grid subdivision pattern was popular, with lots developed on mainly right angles. This rigid pattern did not recognise natural topographical features such as natural streams and water courses which crossed these grids at various angles. The early pipe designs were based on a very limited understanding of rainfall behaviour and an aim of conveying relatively small frequent storms from the low density development of the day. The historical development patterns and pipe design have resulted in reasonably frequent overland flows at low spots. Given that many houses are built over, or directly adjacent to the existing stormwater network, considerable damage has and may still occur.

Flood modelling and stormwater volume calculations are now more sophisticated. The concept of on-site stormwater detention, which is designed to retain a proportion of the flow higher up in the catchment for longer periods, has been introduced relatively recently. On-site detention only applies to new high density developments and only accounts for proportionately few properties. It cannot be used to overcome the increased stormwater flows from past development over several generations. Consequently Council endeavours to augment priority and stormwater problems within a very limited budget.

When a property is due for redevelopment and a pipe runs under, or near to the building (which is happening more and more frequently) a value judgement is required as to what action Council and the Developer should take.

8.2 Protection for low level driveways from street flows

A low level driveway is a driveway that is lower than the front boundary level, that leads to either a garage, a carport, or any other trapped lowpoint where the depth of ponding will exceed 200 mm.

When a layback is constructed in association with a driveway, the layback height can allow for stormwater flows in the kerb and gutter to escape down the driveway. Council requires the 1 in 100 year street flows to be prevented from flowing down the driveway and entering these areas. This procedure determines minimum driveway crest levels to contain these flows in the street.

Though protection is not specifically required for carports or carspaces (other than for the above ponding depth) or the property generally, it is encouraged. Each owner, engineer or developer should undertake their own assessment as to whether their carport or carspace or property should be protected from such flows. To provide protection to the whole property a solid masonry front fence needs to be provided and driveways and pedestrian accesses raised to the appropriate protection level.

8.2.1 Calculating flows and depths for low level driveways:

a. For properties not identified as affected by mainstream flooding, or overland flows, the driveway crest level is to be a minimum of 100 mm above the 1 in 100 year flow level. The driveway shall also be protected from lateral flows and flows from other sources by incorporating side returns.
b. For properties identified as affected by mainstream flooding or in areas immediately adjacent to mainstream flooding, the driveway crest level is to be the higher of a minimum of 500 mm above the 1 in 100 year flow level ,or 8.2.1(a).

c. For properties identified as affected by overland flows, the driveway crest level is to be the higher of 300 mm above the 1 in 100 year flow level, or 8.2.1(a). However where the property is considered by Council as part of the overland flow path with flows travelling from front to rear, or rear to front (which must not be blocked) alternate protection to the garage will be required.
d. The flow discharge is to be determined using the Equation 8.1 - Rational Method and assuming the Council drainage pipes (if present) are flowing at 50% capacity. When calculating the contributing area, in addition to all the area that naturally drains to the street, include in the catchment all the properties on the low side assuming they have redirected their stormwater via pumps or charge lines. The travel time (time of concentration) is to be assessed allowing for a combination of surface flow using kinematic wave equation and the faster gutter flow travel time. If alternative route times available use the lower travel time.

$Q = (C \times I \times A) / 360$

Where Q = Runoff (m^3/s)
C = Runoff Coefficient (refer Table 8.1)
I = Rainfall Intensity (mm/hr) based on time of concentration (Appendix A).
A = Catchment Area (Ha)

Equation 8.1 – Rational Method

Land Use	General Urban	Villas/Units	Commercial Industrial	Roads	Parks	Schools
% Impervious	65	75	100	96	15	60
C100	0.93	0.97	1	1	0.73	0.91

Note
(1) The percentage impervious in Table 8.1 is based on generalised information. Where a higher percentage is known, use the runoff coefficient based on that higher figure.

Table 8.1 Runoff Coefficients for 1 in 100 year ARI Storm (1)

e. The depth of flow in the street is to be estimated using Equation 8.1 - Manning Equation, or standard nomographs such as those in Sutherland Shire Council's Urban Drainage Design Manual, or HEC-RAS. Particular care needs to be taken where there is a low level footpath as the street capacity may be limited to the level of the laybacks (typically 100 mm high or less) and overflows travel along the footpath.

8.3 Major Overland Flow

Major overland flows are those flows previously identified by Council, or identified as part of the design of this site, that are significant and generally arise from a considerable catchment area. These flows are generally stormwater flows that are unable to enter the pipe network as it is already at capacity. The usual design standard is the 1 in 100 year flow though it is important that flows in excess of this up to the PMF have a viable escape route. Refer also to Council's Policy for the Management of Flood Risk.

a. If the Velocity (m/s) of flowing water multiplied by the Depth (m) of water is greater than 0.4 in a 1 in 100 year flow, the applicant shall refer to Council's Policy for the Management of Flood Risk and liaise with Council's Floodplain & Stormwater Engineer.
b. For depths of flow up to 0.1 m in the 1% AEP flow provide a gap under the fence to that depth (minimum 50 mm). For depths of flow greater than 0.1 m provide a fence with louvres at the bottom where the fence adjoins private property, or louvres, or pool

fencing where the fence adjoins public property. Where the fence is between properties that have or may have a dog on one side and young children on the other, 'arrow head' (^) louvres must be used to provide better protection.

c. The applicant shall not concentrate, or divert overland flow onto, nor increase the hazard on a neighbouring property.
d. The route that the flows may take is to be designed to cater for the 1 in 100 year flow while maintaining minimum freeboard requirements. For overland flow the adjacent floor levels are to have a 300mm freeboard above the flow level. Alternatively where it is possible to capture the 1 in 100 year flow and convey it through pipes, the habitable floor levels are to be a minimum of 200 mm above finished ground level.
e. An easement for drainage will be required over the extent of the overland flow in favour of Council.
f. Flood studies are required to document the analysis process and include (for the pre-development and post-development case) sections, profiles, data tables and a plan of the flood extent.

8.4 Design and construction of pit and pipe drainage systems

New Council stormwater drainage lines are generally designed for the 20 year ARI (5% AEP) design standard and a Hydraulic Grade Line analysis undertaken. The minimum Council pipe size is a 375 mm diameter RRJ concrete pipe, unless there are special circumstances. All construction shall be in accordance with AUS-SPEC. Other standards are set out in AS3500 except where varied by this DCP or AUS-SPEC. Council's Project Management and Design Section is able to provide additional information.

All pits are to be Double Grated Gully Pit and with a minimum 2.4 m (overall length) lintel, or as required for inflow capacity.

Some of the trunk drainage system in Rockdale is owned by Sydney Water, who shall be consulted in these cases.

8.4.1 Nominal Drainage Easement Widths

Many of the Council pipes do not have drainage easements over them. Where there is no existing easement the zone of influence for any pier and footing design is to be undertaken from the outside of the Nominal Drainage Easement Widths detailed below. Where the pipeline runs parallel to the side boundary the nominal easement width may include part of the adjoining property. Generally the nominal easement will be located equally both sides of the pipe centreline.

Nominal Pipe Diameter	Nominal Easement Width (minimum)
Up to 150 mm	600 mm (900 mm preferred)
225 mm	900 mm
375 mm	1200 mm
450 mm	1300 mm
525 mm	1400 mm
600 mm	1600 mm
825 mm	1800 mm
900 mm or greater	Greater of 2500 mm or 1500 mm + Nominal Pipe Diameter

Table 8.2 - Nominal Minimum Drainage Easement Widths

8.5 Interallotment Drainage Schemes

Interallotment drainage schemes provide a connection point for stormwater where the property would otherwise be a low level property. These schemes allow a number of properties to drain through a common drainage line.

8.5.1 Design and Installation of new Interallotment Drainage Schemes

The design and installation of new private interallotment drainage schemes shall be in accordance with AUS-SPEC.

8.5.2 Connection to Interallotment Drainage Schemes

The last pit on the property before connecting into the interallotment drainage line shall be designed to accept all pipe and surface flows from the 1% AEP storm event. Where there is an above ground detention system adjacent to the last pit, the last pit is to be raised so that the grate level matches the storage level and any weir overflow is set a minimum of 100 mm above this grate level. Where above ground detention is required, the storage is not permitted over the easement along the line of the interallotment pipe where such storage interferes with the natural overland flow path.

8.5.3 Council Interallotment Drainage Schemes

Council has a number of interallotment drainage schemes that have been constructed, or approved for construction. Council's Customer Service Centre is able to provide details of any interallotment drainage schemes applicable to the site.

For sites that have a Council approved interallotment scheme, but the interallotment pipe has not reached the property as yet and it is not economically viable for Council to extend the scheme at that time (following discussions with Council's Project Management and Design Section) a pump system is required as a temporary measure.

The temporary pump system is required to meet the minimum pump requirements in Section 4.2. Where connection to the interallotment scheme is expected within the foreseeable future (typically less than 2 years) there is no specific minimum storage requirements. Where connection to the interallotment scheme is not expected until after 2 years the pump pit shall be sized at 2.0 m^3 per 100 m^2 of area being drained. Where onsite detention (OSD) is required the pump storage volume can be used to offset any required storage. The developer is required to pay the scheme contribution and the future owners are required to disconnect the pumps and connect to the scheme when the interallotment pipe reaches them. For developments that do not require OSD the temporary pump pit can be designed to be converted to a stormwater reuse system once the outlet is connected to the interallotment pipe.

8.6 Construction near Council Stormwater Pipes and Inter-allotment Drainage Pipes

This Section is applicable to properties where the proposed construction is in close proximity to the stormwater pipe, drainage easement., or drainage reserve, but not in direct conflict. The stormwater pipe, or drainage easement may either be on the adjoining property, or alternatively on the subject property, but not in direct conflict with the construction. The proposed construction may be close enough to require protection through piering if the adjacent stormwater pipe, drainage easement, or drainage reserve is excavated for reconstruction of stormwater pipes, or for maintenance.

8.6.1 Stormwater Pipe to be Located

It is necessary for the owner /developer to arrange for the stormwater pipe to be physically located on site, including the depth of the pipe. Council has some drainage plans which give the approximate location of the stormwater pipe which are available for a small fee, or there may be an easement over it which will assist in locating it. Unfortunately not all stormwater pipes have easements over them and even where there are easements the stormwater pipes are not always fully located within the easement. The stormwater pipe needs to be found and exposed. A registered surveyor needs to peg the easement and prepare location plans. This will determine the proximity of the proposed development to the stormwater pipe and/or drainage easement.

Where the pipe is located on an adjacent private property this stormwater pipe may not be able to be physically located and the best conservative estimate can be used based on available information.

8.6.2 Angle of Repose

The angle of repose of soil should be advised by a recognised geotechnical consultant, or as specified by the BCA.

8.6.3 Footing and Pier Design and Construction

Footings and piers including all foundations for buildings, walls, retaining walls, the underside of pools and slabs located adjacent to enclosed drainage systems, shall be designed and located outside the zone of influence so that no load is applied onto the drainage pipe, or channel and the footing support is not compromised by reconstruction of the stormwater pipe.

Footings, or piers shall be located outside the easement, beginning 500 mm (minimum) below the invert of the pipeline at the easement boundary and continuing upwards to the surface at the angle of repose of the soil. The area above the angle of repose is considered as the zone of influence.

General guidelines for footing design and construction are:

a. The natural surface within the easement boundaries shall not be filled, or excavated without Council approval.
b. Where footings are proposed within the zone of influence these are to be supported fully on piers that extend below the zone of influence.
c. At the time of footing inspection, the edge of the easement (including nominal easement) is to be pegged and the pipe exposed adjacent to each end of the proposed construction and at any change of grade, or direction.
d. Where footings are proposed to be founded on rock, the soundness and depth shall be proved by excavation adjacent to the pipe and through an engineer's certificate.
e. The standard angle of repose detailed above is based on dry soil conditions. Where the water table is located higher than 500 mm below the pipe invert generally the angle of repose will decrease, adopt V = 1 and H = 4 for sand unless more specialised technical advice is obtained. The use of the flatter zone of influence is still required for the design of footings even where dewatering techniques (including spearpoints) are used to assist construction.

8.7 Permanent Excavation Adjacent to Stormwater Pipes

This Section applies where there is permanent excavation proposed adjacent to the stormwater pipe such as a basement garage or low level driveway.

The structural design of the supporting wall shall be designed as a tanked structure and shall include the worst case from a range of scenarios including all soil loads together with free water to the surface due to escape of stormwater from the pipe and all soil and construction vehicle loadings allowing for pipe reconstruction. Council will not accept any liability for seepage flows.

Such excavation within the zone of influence is only permitted with Council approval. A submission to Council to obtain such approval must detail whether the developer will either:

a. Reconstruct the pipe at the end of the project with a new pipe (without concrete encasement) to a standard advised by Council (typically 5% AEP) while making reasonable provision for the continued operation of the pipe during the construction period, or

b. Retain the existing pipe (unless advised otherwise by Council) and undertake the following:
   (i) A CCTV camera recording and condition report of the pipe is to be provided to Council prior to release of the construction certificate.
   (ii) Details of how the pipe and surrounding soil is to be protected and supported during excavation is to be provided to Council prior to release of the construction certificate.
   (iii) Concrete encasement of the stormwater pipe prior to excavation for the wall.
   (iv) A CCTV camera recording and condition report of the pipe after construction of the wall is to be provided to Council prior to occupation. Should the pipe be damaged it is to be repaired at the developer's cost.

8.8 Construction Over Council Stormwater Pipes and Inter-allotment Drainage Pipes

This Section is applicable to properties where the proposed construction is directly over the stormwater pipe, or drainage easement.

8.8.1 Stormwater Pipe to be Located

This Section applies where the proposed construction is over, or in conflict with the drainage easement either actual (existing), or nominal.

It is necessary for the owner /developer to arrange for the stormwater pipe to be physically located on site. Council has some drainage plans which give the approximate location of the stormwater pipe which are available for a small fee, or there may be an easement over it which will assist in locating it. Unfortunately not all stormwater pipes have easements over them and even where there are easements the stormwater pipes sometimes stray from them. The stormwater pipe needs to be found and exposed. A registered surveyor needs to peg the easement (actual, or nominal from 8.4.1) and prepare location plans. This will determine the proximity of the proposed development to the stormwater pipe and/or drainage easement.

8.8.2 Minimisation of Conflict

Concrete stormwater pipes are assets that in general have a very long service life (minimum of 80 years). The existing stormwater pipes have usually been located in the easiest and the most direct route. In addition once the stormwater pipes are built they are very expensive to move, or alter. Consequently, Council's preference is that the existing stormwater pipe remain in it's current position and the proposed construction be modified to be completely clear of the easement, or the alteration to be minimal.

Council will consider allowing the stormwater pipe to be relocated where the owner/developer can demonstrate there is a substantial benefit. This will not be agreed to where in Council's view, relatively simple modifications to the construction would reduce the impact on the pipe.

Where Council agrees that the construction cannot be simply modified, an assessment will be made by Council Officers to determine whether the pipe can be effectively routed around the proposed development. In rare instances where the pipe cannot be relocated Council may approve building over the pipe in certain special circumstances. See Section 8.8.3.

8.8.3 Development Over Council Pipes and Drainage Easements

Council's aim is to provide continuous access to the Council pipe system for maintenance requirements and will generally not permit new building work over Council pipes (other than detailed below).

a. General Allowable Construction

Providing that existing ground levels are not raised, Council will generally permit the construction over Council pipes and easements of:

(i) Most types of lawns and landscaping, except where raised planter beds are used,
(ii) Planting of trees, except for large trees (> 4 m in height), or invasive trees,
(iii) Paving of driveways and paths, however for villas and more intense development the driveway is to be supported on piers for pipes with less than 1 m of cover,
(iv) Fences and gates (but not masonry fences) providing louvres or pool fencing is constructed at the bottom of the fence, or gate to a minimum of 0.1 m above the depth of the 1 in 100 year flow,

b. Additions to Single Dwellings

Providing the building work has no adverse overland flow impacts, Council may approve the building over a Council pipe where:

(i) The work only involves a steel/timber framed and skillion steel/fibreglass roofed pergola providing the footings are outside the easement (or not within 0.5 m of the pipe), there are no solid elements that restrict surface flows and the structure is bolted together in sections not exceeding 2 m by 3 m that weigh less than 80 kg,
(ii) The work only involves a steel/timber framed decks providing the footings are outside the easement (or not within 0.5 m of the pipe), the overland flow is not significant and there are no solid elements that restrict surface flows and the structure is bolted together in sections not exceeding 2 m by 3 m that weigh less than 80 kg,
(iii) The work only involves a steel/timber framed and skillion steel/fibreglass roofed carports over existing driveways providing the footings are outside the easement (or not within 0.5 m of the pipe), there are no solid elements that restrict surface flows and the structure is bolted together in sections not exceeding 2 m by 3 m. (Note new carports on new driveways will not normally be permitted because of the impact of overland flows.),
(iv) There are major practical construction problems in routing the pipe around the proposed additions to single dwelling and the redesign of the additions to avoid the pipe is considered by Council's Project Management and Design Team to be unworkable; or,
(v) The dwelling is already built over the pipe and the impact of extending the building further over the pipe is not considered significant by Council's Project Management and Design Team.

In cases 4 and 5 above an assessment is made by Council's Corporate Asset Management Team of the condition of the existing pipe. There may be a fee for this assessment process. Where the pipe condition is good, but no upgrade planned Council may allow the existing pipe to be retained and built over with conditions, or where the pipe is in poor condition the existing pipe replaced with a similar sized pipe. All new construction adjacent to the pipe is to be piered to protect it.

c. New Single Unit Dwellings

Providing the building work has no adverse overland flow impacts, Council may approve the building over a Council pipe where there are major practical construction problems in routing the pipe around the proposed new single dwelling and the redesign of the dwelling to avoid the pipe is considered by Council's Project Management and Design Team to be unworkable. In this instance an assessment is made by Council's Corporate Asset Management Team of the condition of the existing pipe and whether it is intended to replace/upgrade the pipe within the next twenty years. There may be a fee for this assessment process. Where the pipe condition is good, but no upgrade planned, Council may allow the existing pipe to be retained and built over with conditions, but an additional pipe must be laid parallel to the existing pipe with sufficient capacity to carry the 20 year ARI flow between the two pipes. Where the pipe is in poor condition the existing pipe is to be replaced either as a two pipe system as above, or as a single 20 year ARI standard. All construction adjacent to the pipe is to be piered to protect it and an easement provided in Council's favour if none currently exists, or needs to be adjusted.

d. Commercial and Industrial Development

Providing the building work has no adverse overland flow impacts, Council may approve the building over a Council pipe where:

(i) The nature of the development allows future access for Council plant and equipment. For pipes up to 1050 mm in diameter and up to 1.7 m deep a minimum clear access 3.5 m wide and 4.0 m high is required along the full length of the pipe. Larger areas are required for bigger diameter and deeper pipes, or if the pipe has bends. An assessment is made by Council's Corporate Asset Management Team of the condition of the existing pipe and whether it is intended to replace/upgrade the pipe. There may be a fee for this assessment process. Council may require the pipe to be upgraded to the 20 year ARI standard as part of the development approval.

(ii) The existing commercial, or industrial building is already built over the pipe and the impact of a small extension over the pipe is not considered significant by Council's Project Management and Design Team. An assessment is then made by Council's Corporate Asset Management Team of the condition of the existing pipe. There may be a fee for this assessment process. Where the pipe condition is good, but no upgrade planned, Council may allow the existing pipe to be retained and built over with conditions, or where the pipe is in poor condition the existing pipe replaced with a similar sized pipe. All new construction adjacent to the pipe is to be piered to protect it and an easement provided in Council's favour if none currently exists, or needs to be adjusted.

8.8.4 Covering of Open Channels and Culverts

Council will not permit the covering of open channels as it:

a. Restricts entry of flood flows during major events
b. Limits access for inspection with significantly greater risk to personnel leading to higher costs to satisfy OH&S obligations with less effective assessment
c. Increases Council's maintenance costs for cleaning the channel due to restricted and difficult access

d. Increases Council's long term maintenance costs due to the additional cost of maintaining the new concrete cover slab as well as restricted access to the channel walls and base. This is particularly true in tidal flow areas that are subject to salt attack. These increased costs may also include the reinstatement of surface finishes that would otherwise not exist;
e. Leads to lower environmental outcomes through reduced biodiversity and possible environmental sterilisation.

9 Design Documentation for Stormwater Management

This section sets out the minimum documentation standards for design of stormwater management.

9.1 Plans

Plans are the principle document in the design of stormwater management. There are two types of plans based on two levels of detail that are typically required through a development.

9.1.1 Stormwater Concept Plan

The Stormwater Concept Plan (SCP) is the plan that supports a Development Application. The purpose of the SCP is not to provide all the detailed design, but to identify the drainage constraints and to clearly demonstrate that the drainage system can be integrated into the site's overall water management and proposed layout.

The drainage system is an integral part of the entire development and can be expensive to retrofit once the site layout has been established. To avoid this developers and architects should involve their drainage designer(s) in developing the initial site layout.

a. Objectives of the SCP
   (i) Emphasise that the drainage requirements need to be considered, as part of an overall site water management plan, in the initial planning stages of the development;
   (ii) Ensure compliance with BASIX;
   (iii) Simplify the detailed design by identifying adequate areas for the drainage elements in the planning stage
   (iv) Determine what WSUD components are required;
   (v) Reduce project costs by maximising the use of proposed landscape and architectural features as part of the drainage system;
   (vi) Assure Council that the necessary drainage requirements from this DCP can be satisfactorily incorporated into the proposed development;
   (vii) Allow the cost of development consent conditions relating to drainage requirements to be determined at the planning stage; and to
   (viii) Assist in addressing the concerns of local residents regarding drainage and flooding issues.

b. Minimum SCP Requirements
   (i) Is drawn at a scale of 1:100, except for sites over 2000 m^2 where a scale of 1:200 is permitted. The various drainage elements are to be drawn at a more detailed scale to assist in understanding.
   (ii) Includes a north point.
   (iii) Includes BASIX and/or rainwater tank requirements together with other WSUD details.
   (iv) Clearly indicates the size and location of the drainage elements including detention, or absorption as applicable.
   (v) Includes an amendment list to keep track of the various versions of the plans.
   (vi) Includes company name, postal address, email address, contact name and phone numbers.

9.1.2 Detailed Stormwater Plan

The detailed stormwater plan is the plan that supports a Construction Certificate or Complying Development Certificate. The purpose of the detailed stormwater plan is to finalise the design of all components of the drainage system, provide a set of plans and details for construction of the system, and detail the maintenance procedures necessary to ensure the long-term effectiveness of the system. This design will also ensure that all components of the drainage system are functional, and include structural certification for components of the drainage system.

9.2 Calculations

Calculations are required in order to support the information contained on the SCP or detailed stormwater plan. Calculation sheets for the design of on-site retention and on-site detention systems are included in Appendix F. Other types of calculation should be based on Australian Rainfall and Runoff (AR&R).

9.3 Certification

All designs for stormwater management are required to be certified for compliance against the standards outlined in this Technical Specification, as follows:

a. The SCP must be accompanied by the *Stormwater Concept Plan Certification* and *Stormwater Concept Plan Checklist*.
b. The detailed stormwater plan must be accompanied by the *Detailed Drainage Design Certification* and *Detailed Drainage Design Checklist*. (For the detailed stormwater plan the Detailed Drainage Design Checklist must identify whether the design relates to a Construction Certificate, Subdivision Certificate or Complying Development Certificate).

Copies of standard forms for certification may be obtained from Council.

9.4 Qualifications and Accreditation

Minimum qualification and accreditation standards apply for the preparation of plans and certification of plans regarding stormwater management.

9.4.1 Additions to Single Dwellings & New Single Dwellings

The following are considered to be the minimum acceptable qualification and accreditation standards for the purpose of drainage design and certification for Additions to Single Dwellings & New Single Dwellings:

a. Graduate Membership of the Institution of Engineers Australia;
b. All those eligible under 9.4.2.

9.4.2 All other Development

The following are considered to be the minimum acceptable qualification and accreditation standards for the purpose of drainage design and certification for development other than Additions to Single Dwellings & New Single Dwellings:

a. A Civil Engineer on the National Professional Engineers Register (NPER).
b. A Civil Engineer accredited with the Building Professionals Board to Category C1, C3, C14 or C15.
c. A Registered Surveyor with a Surveyors Certificate of Accreditation in On-Site Detention and Drainage Design (from the Institution of Surveyors, NSW and the Association of Consulting Surveyors, NSW);
d. An engineer with membership of the Association of Hydraulic Services Consultants, Australia.
e. An engineer employed by Rockdale City Council.

Appendices

APPENDIX A – RAINFALL AND RUNOFF DATA

TABLE A.1

RAINFALL INTENSITY IN mm/hr FOR VARIOUS DURATIONS AND RETURN PERIODS

DURATION (MIN)	DURATION (HOURS)	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5	0.083	96.1	123	158	178	204	238	264
6	0.100	90.0	116	148	167	191	223	248
7	0.117	84.9	109	140	158	181	211	235
8	0.133	80.7	104	133	150	173	202	224
9	0.150	77.0	99.0	127	144	165	194	215
10	0.167	73.7	95.0	122	138	159	186	207
12	0.200	68.2	88.0	114	129	149	174	194
15	0.250	61.8	79.8	104	118	136	160	178
20	0.333	53..9	69.8	91.3	104	120	142	159
25	0.417	48.2	62.6	82.2	93.8	108.8	129	144
30	0.500	43.9	57.0	75.1	85.8	99.7	118	132
40	0.667	37.5	48.8	64.6	73.9	86.1	102	114.6
45	0.750	35.1	45.7	60.5	69.4	80.8	96.0	107.6
50	0.833	33.1	43.1	57.1	65.4	76.2	90.6	101.6
55	0.917	31.3	40.7	54.0	62.0	72.2	85.8	96.3
60	1.000	29.7	38.7	51.4	58.9	68.7	81.7	91.7
65	1.083	28.4	36.9	49.0	56.2	65.6	77.9	87.5
70	1.167	27.1	35.3	46.9	53.8	62.7	74.6	83.7
75	1.250	26.0	33.9	45.0	51.6	60.2	71.5	80.3
80	1.333	25.0	32.6	43.2	49.6	57.8	68.7	77.1
85	1.417	24.1	31.4	41.6	47.8	55.7	66.2	74.3
90	1.500	23.3	30.3	40.2	46.1	53.8	63.9	71.7
100	1.667	21.8	28.4	37.6	43.1	50.3	59.8	67.1
120	2.000	19.4	25.3	33.5	38.4	44.7	53.1	59.6
	3.000	15.0	19.5	25.7	29.4	34.2	40.5	45.4
	6.000	9.60	12.4	16.2	18.5	21.4	25.3	28.2
	12.000	6.19	7.99	10.4	11.7	13.6	16.0	17.8

Notes:
1 Location: Paine Street, Kogarah (33.975 S 151.125E)
2 Source: Bureau of Meteorology lst August, 1989

TABLE A.2

RAINFALL INTENSITY FOR VARIOUS DURATIONS AND RETURN PERIODS

LIST OF COEFFICIENTS TO EQUATIONS OF THE FORM

ln (I) = a + b* (ln(T)) + c* (ln(T)) **2 + d* (ln(T)) **3 + e* (ln(T))**4 + f* (ln(T)) **5 + g* (ln(T)) **6

T = Time in Hours I = Intensity in Millimetres Per Hour

Return Period (Years)	a	b	c	d	e	f	g
1	3.3923	-0.5913	-0.0379	0.00773	0.001128	-0.0002177	-0.0000313
2	3.6563	-0.5894	-0.0414	0.00754	0.001486	-0.0002077	-0.0000425
5	3.9391	-0.5861	-0.0510	0.00806	0.002275	-0.0003081	-0.0000463
10	4.0761	-0.5839	-0.0562	0.00798	0.002803	-0.0003144	-0.0000601
20	4.2298	-0.5821	-0.0602	0.00807	0.003147	-0.0003426	-0.0000647
50	4.4025	-0.5802	-0.0650	0.00816	0.003591	-0.0003693	-0.0000724
100	4.5180	-0.5793	-0.0683	0.00833	0.003893	-0.0003974	-0.0000765

Notes:
1 Location: Paine Street, Kogarah (33.975 S 151.125E)
2 Source: Bureau of Meteorology Ist August, 1989
3 The coefficients are for use by Consultants in developing their own computer programmes where required.

TABLE A.3

RUNOFF COEFFICIENTS (C)

	AVERAGE RECURRENCE INTERVAL (A.R.I.)						
F	1	2	5	10	20	50	100
0.0	0.44	0.47	0.52	0.55	0.58	0.63	0.66
0.1	0.47	0.50	0.56	0.59	0.62	0.68	0.70
0.2	0.50	0.53	0.59	0.62	0.65	0.72	0.75
0.3	0.53	0.56	0.62	0.66	0.69	0.75	0.79
0.4	0.55	0.59	0.66	0.69	0.73	0.80	0.83
0.5	0.58	0.62	0.69	0.73	0.76	0.83	0.87
0.6	0.61	0.65	0.72	0.76	0.80	0.87	0.91
0.7	0.64	0.68	0.76	0.80	0.84	0.91	0.95
0.8	0.66	0.71	0.79	0.83	0.87	0.95	1.0
0.9	0.70	0.74	0.82	0.87	0.91	1.0	1.0
1.0	0.72	0.77	0.86	0.90	0.95	1.0	1.0

Notes:

1 Where F is fraction impervious.

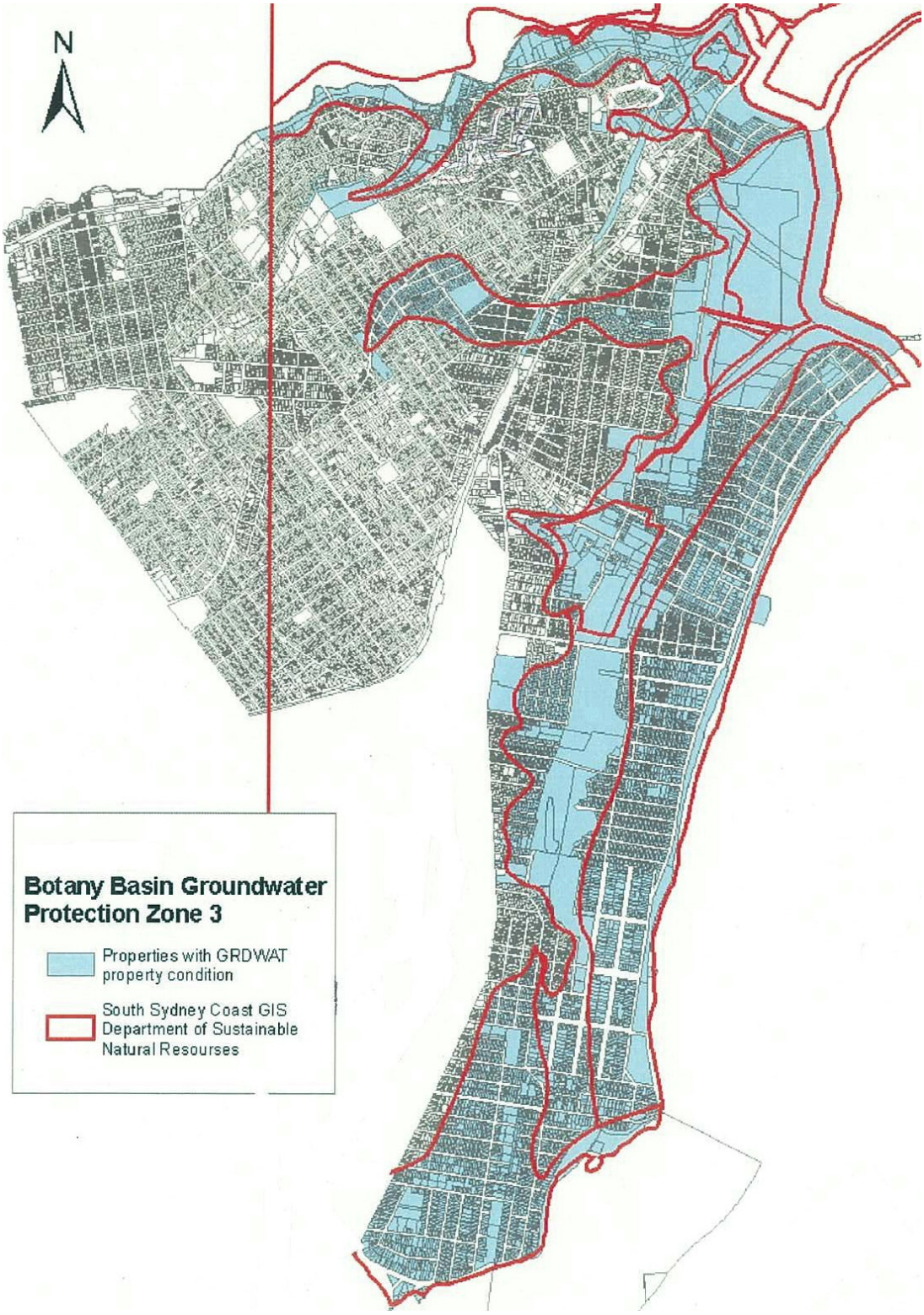
2 Based on Australian Rainfall and Runoff 1987 p.307.

3 For use in the calculation of sub-catchment flows and pipe sizes only. Not for use in the calculation of OSR or OSD.

APPENDIX B – MAPs

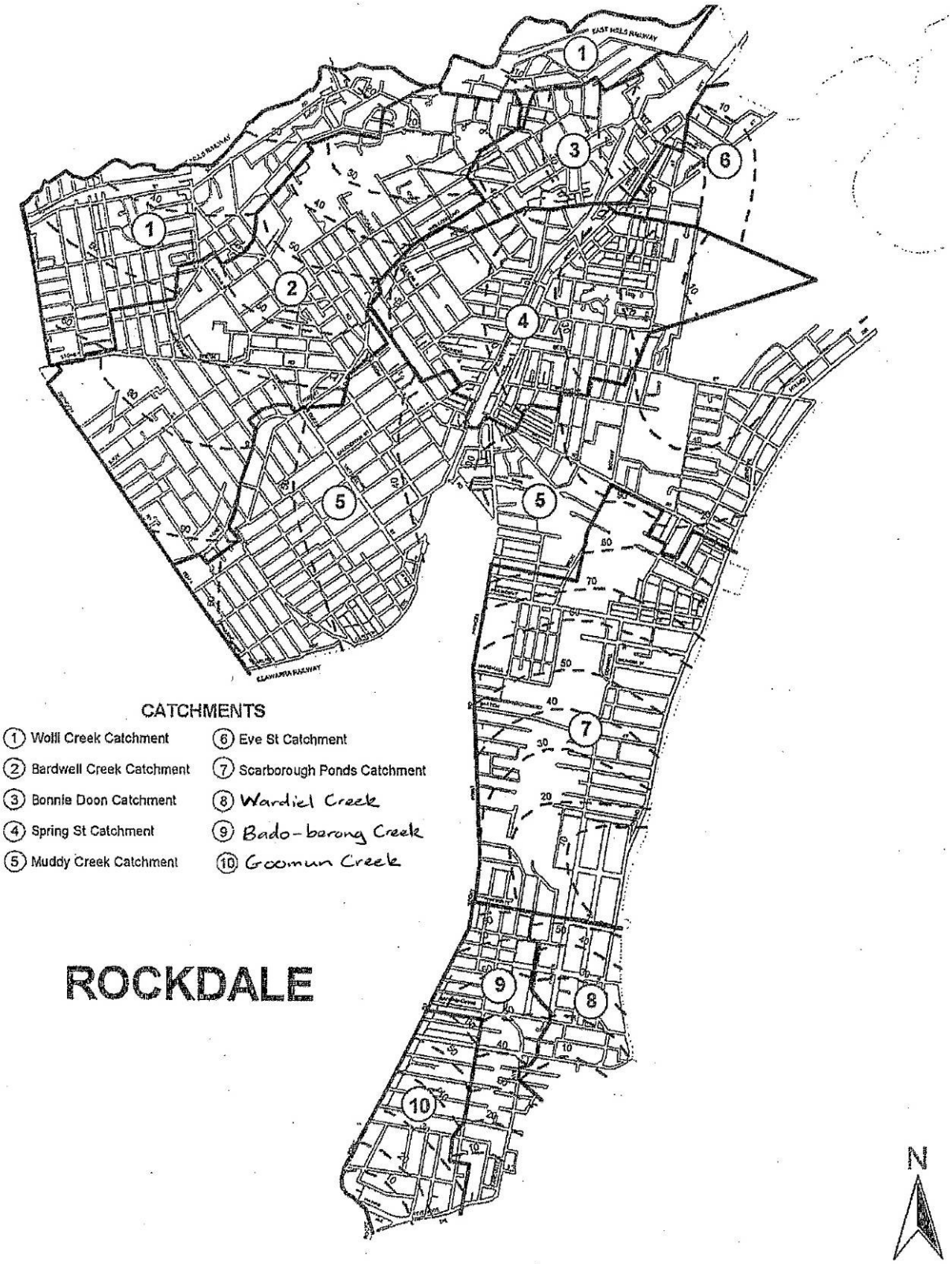
MAP B.1

GROUNDWATER PROTECTION ZONE (INDICATIVE LOCATION OF ABSORPTION AREAS AND LOW ABSORPTION AREAS)



MAP B.2

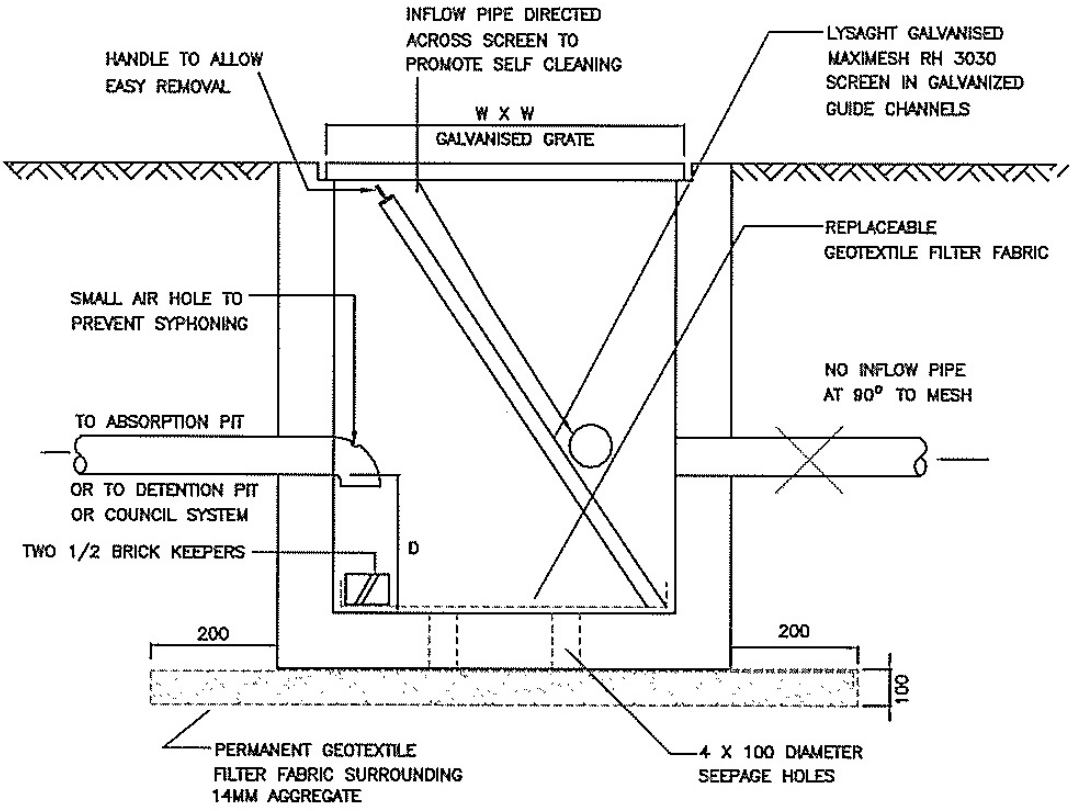
CATCHMENT BOUNDARIES



APPENDIX C – DRAWINGS

DRAWING C.1

SILT/LITTER ARRESTOR PIT



PIT DIMENSIONS

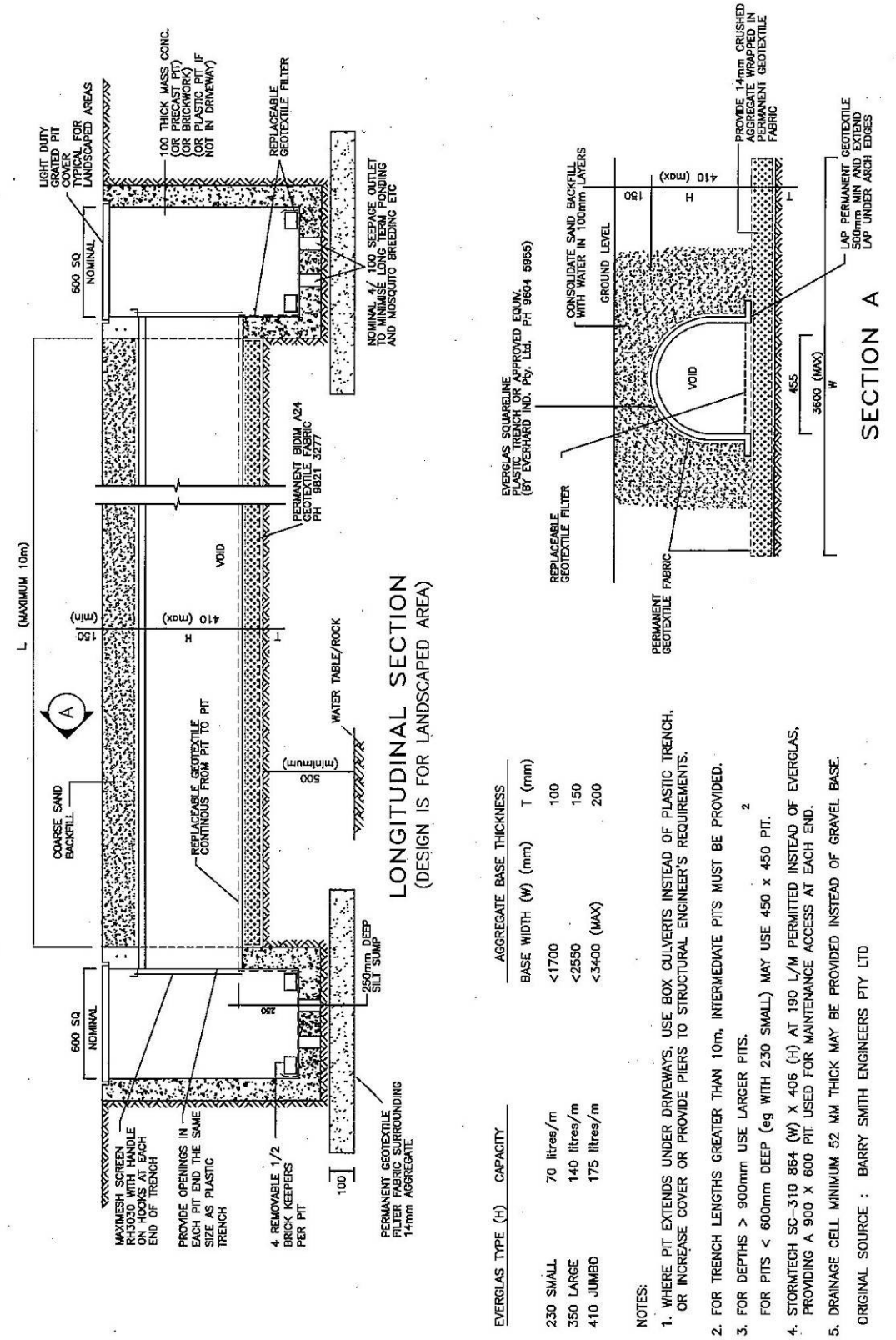
SITE AREA DRAINING (M^2)	WIDTH (W)	DEPTH (D) SANDY SOIL	DEPTH (D) POOR SOIL/CLAY
AREA < 100	350	300	200
100 < AREA < 400	450	300	200
400 ≤ AREA < 800	600	350	250
800 ≤ AREA < 1200	900	400	300
1200 ≤ AREA ≤ 1600	1200	450	350

NOTES :

1. AREAS IN EXCESS OF 1600 M^2 SHOULD HAVE THE FLOWS SPLIT AND ADDITIONAL PITS PROVIDED OR AN ALTERNATIVE DESIGN SUBMITTED
2. PITS MAY BE CONSTRUCTED OF BRICK OR CONCRETE (PRECAST OR CAST IN-SITU) OR CONCRETE BLOCKS OR PLASTIC IF NOT SUBJECT TO VEHICLE LOADS
3. IN SOLID ROCK THE WIDTH OF THE AGGREGATE BASE MAY BE REDUCED TO THE WIDTH OF THE PIT AND DEPTH D REDUCED TO 100mm FOR ALL PIT SIZES
4. FOR PITS WITH W GREATER THAN 900mm
   A) THE GRATES ARE TO BE CONSTRUCTED IN COMPONENTS NOT EXCEEDING 600 x 600 FOR EASY LIFTING AND PREFERABLY LIGHT DUTY WHERE POSSIBLE
   B) THE MAXIMESH SCREEN IS TO BE SUPPORTED ON ITS OWN FRAME
   C) INCREASE THE NUMBER OF SEEPAGE HOLES

DRAWING C.2

COVERED VOID TYPE ABSORPTION PIT



EVERGLAS TYPE (H)	CAPACITY	AGGREGATE BASE THICKNESS	
		BASE WIDTH (W) (mm)	T (mm)
230 SMALL	70 litres/m	<1700	100
350 LARGE	140 litres/m	<2550	150
410 JUMBO	175 litres/m	<3400 (MAX)	200

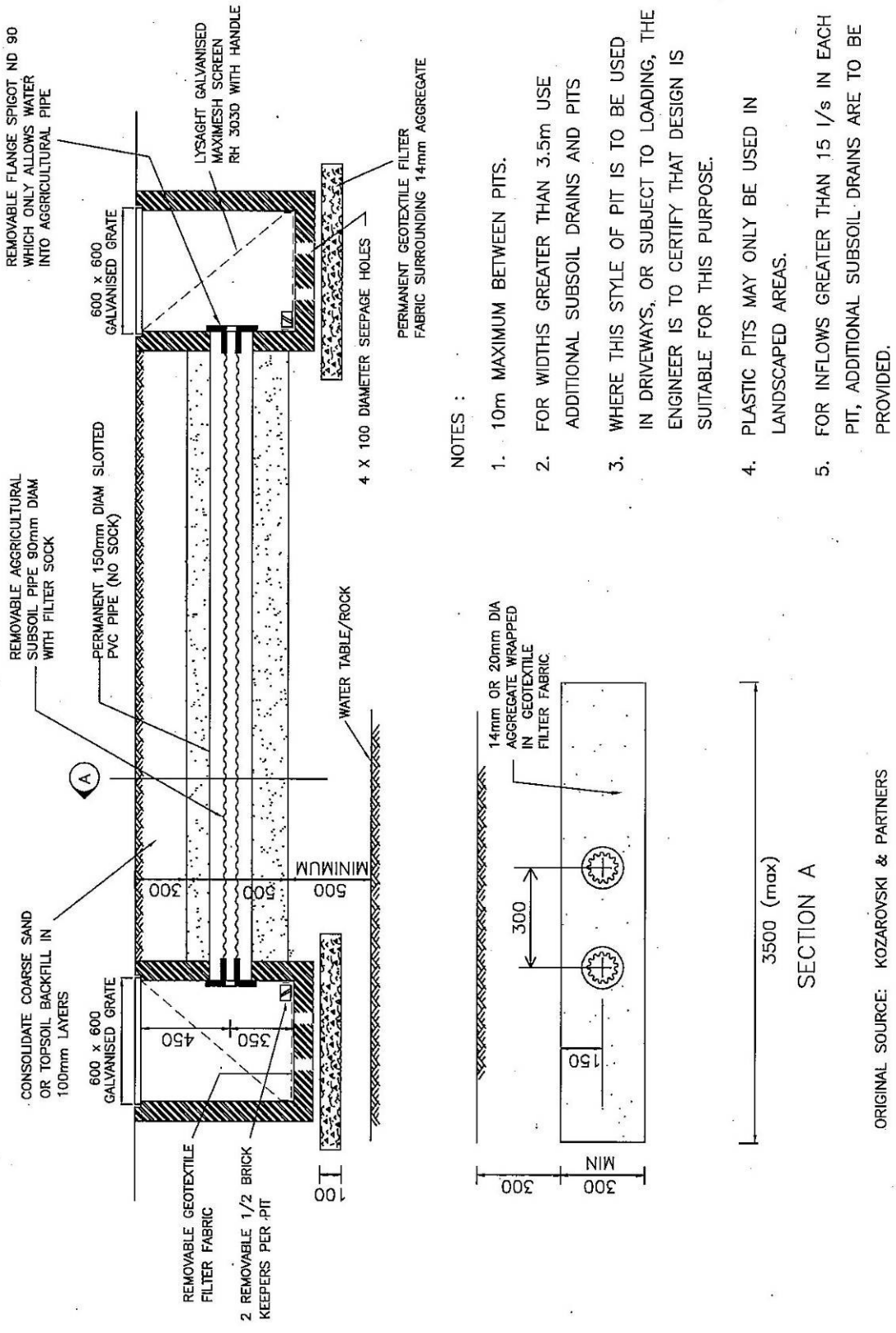
NOTES:

1. WHERE PIT EXTENDS UNDER DRIVEWAYS, USE BOX CULVERTS INSTEAD OF PLASTIC TRENCH, OR INCREASE COVER OR PROVIDE PIERS TO STRUCTURAL ENGINEER'S REQUIREMENTS.
2. FOR TRENCH LENGTHS GREATER THAN 10m, INTERMEDIATE PITS MUST BE PROVIDED.
3. FOR DEPTHS > 900mm USE LARGER PITS.
   FOR PITS < 600mm DEEP (eg WITH 230 SMALL) MAY USE 450 x 450 PIT. ^{2}
4. STORMTECH SC-310 864 (W) X 406 (H) AT 190 L/M PERMITTED INSTEAD OF EVERGLAS, PROVIDING A 900 X 600 PIT USED FOR MAINTENANCE ACCESS AT EACH END.
5. DRAINAGE CELL MINIMUM 52 MM THICK MAY BE PROVIDED INSTEAD OF GRAVEL BASE.

ORIGINAL SOURCE : BARRY SMITH ENGINEERS PTY LTD

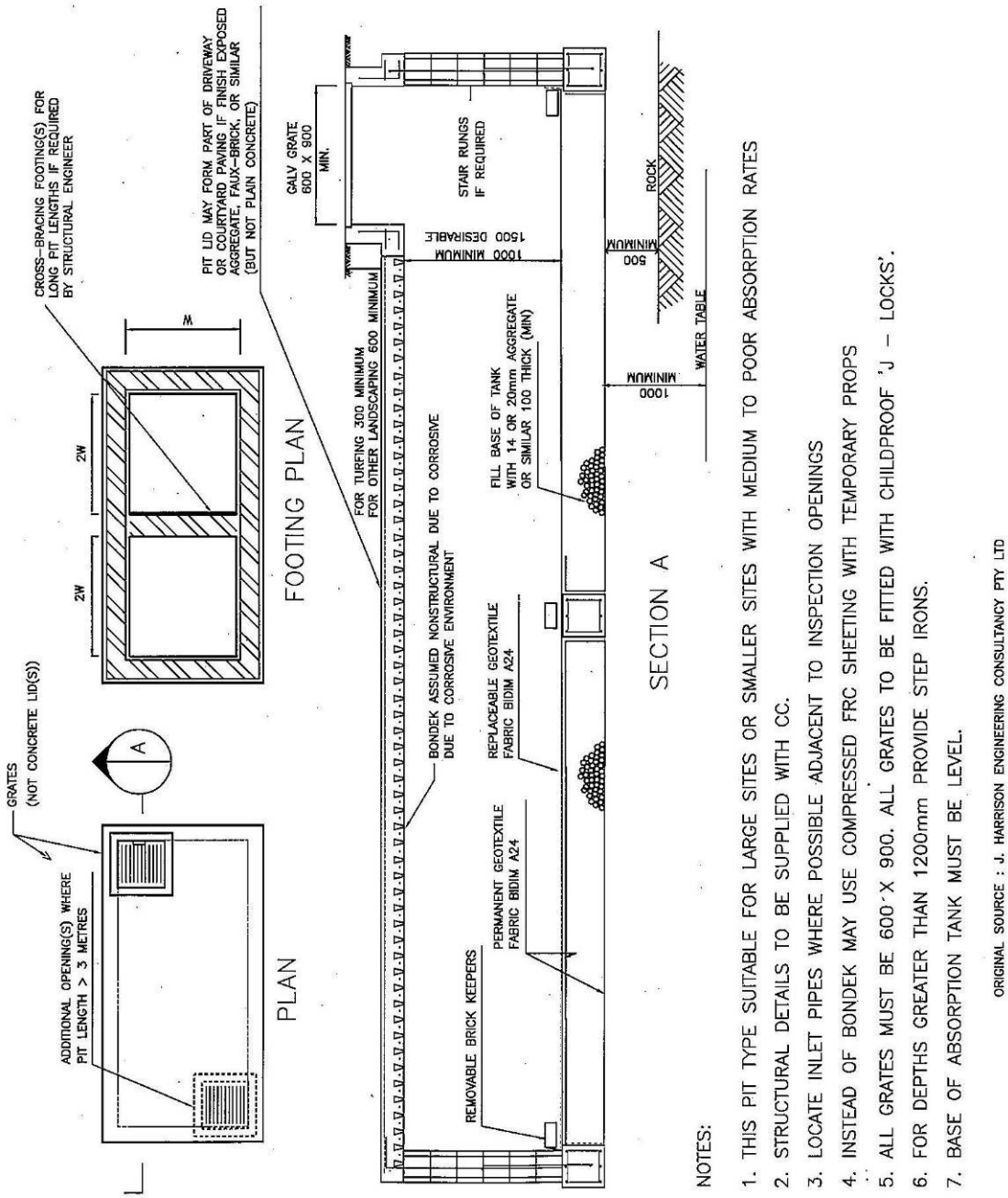
DRAWING C.3

MAINTAINABLE TRENCH TYPE ABSORPTION PIT



DRAWING C.4

COVERED TANK TYPE ABSORPTION PIT



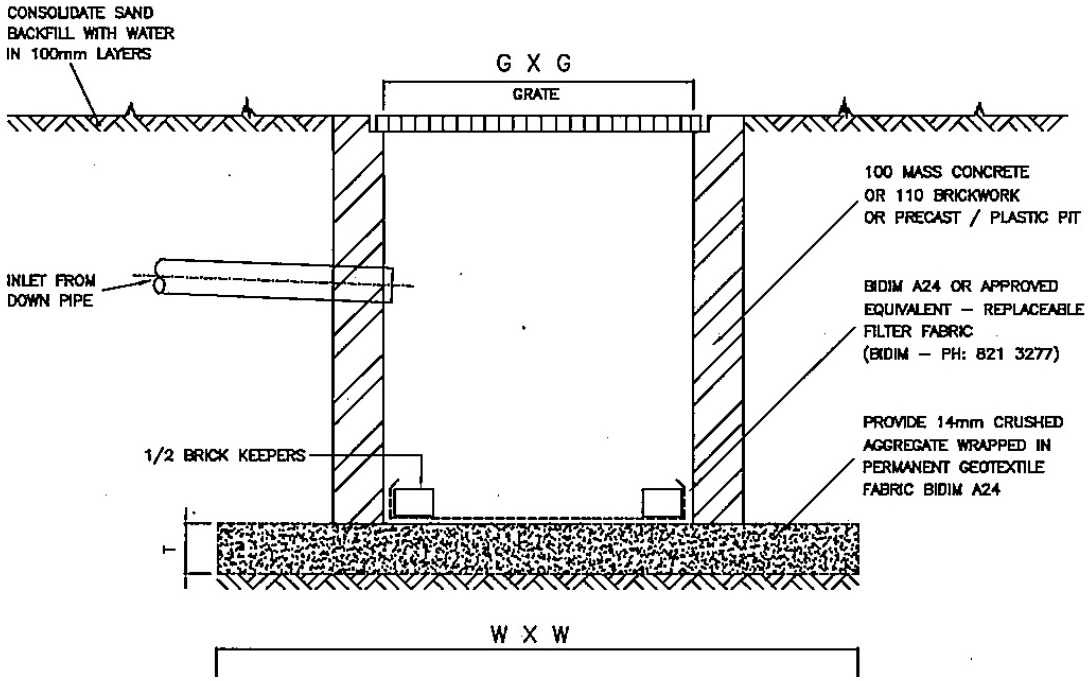
NOTES:

1. THIS PIT TYPE SUITABLE FOR LARGE SITES OR SMALLER SITES WITH MEDIUM TO POOR ABSORPTION RATES
2. STRUCTURAL DETAILS TO BE SUPPLIED WITH CC.
3. LOCATE INLET PIPES WHERE POSSIBLE ADJACENT TO INSPECTION OPENINGS
4. INSTEAD OF BONDEK MAY USE COMPRESSED FRC SHEETING WITH TEMPORARY PROPS
5. ALL GRATES MUST BE 600'X 900. ALL GRATES TO BE FITTED WITH CHILDPROOF 'J – LOCKS'.
6. FOR DEPTHS GREATER THAN 1200mm PROVIDE STEP IRONS.
7. BASE OF ABSORPTION TANK MUST BE LEVEL.

ORIGINAL SOURCE : J. HARRISON ENGINEERING CONSULTANCY PTY LTD

DRAWING C.5

OPEN SINGLE ABSORPTION PIT



OPEN SINGLE ABSORPTION PIT DETAIL

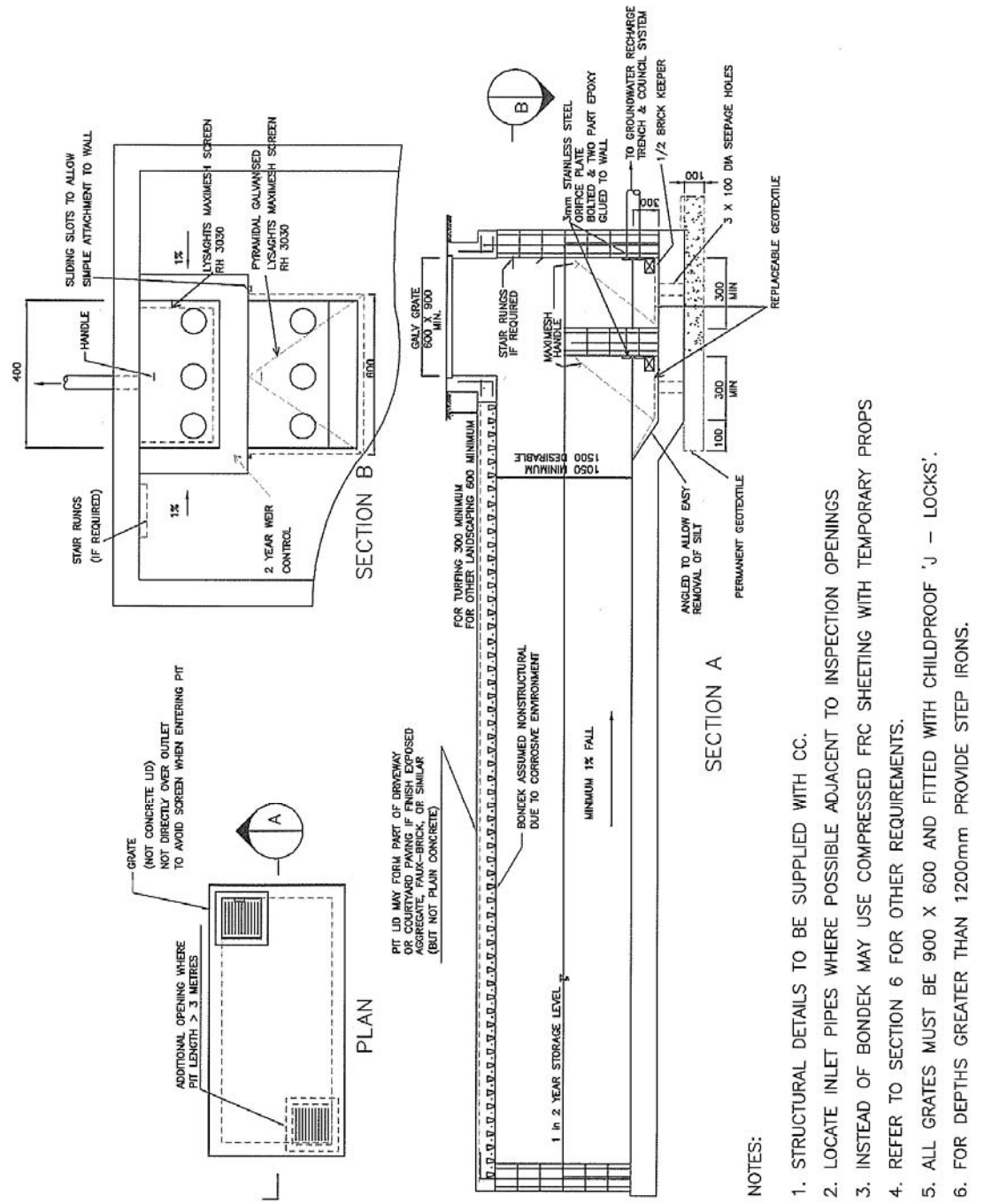
NOTES :

1. SUITABLE FOR SMALL AREAS, COURTYARDS, ETC. IN HIGHLY PERMEABLE SOILS OR IN CONJUNCTION WITH ABOVE GROUND DETENTION
2. PLASTIC PIT MUST NOT BE USED IN DRIVEWAY OR PARKING AREAS.
3. FOR W LESS THAN 1500, G = 600 and T=100mm
   FOR W LESS THAN 2250, G = 600 and T=150mm
   FOR W LESS THAN 3000, G = 900 and T=200mm
   FOR W LESS THAN 3600(max), G = 1200 and T=200mm
4. IT IS POSSIBLE TO COMBINE A SERIES OF SINGLE ABSORPTION PITS INTO A LARGER ABSORPTION SYSTEM LINKED WITH CONNECTING PIPES.

SOURCE: BARRY SMITH ENGINEERS PTY LTD.

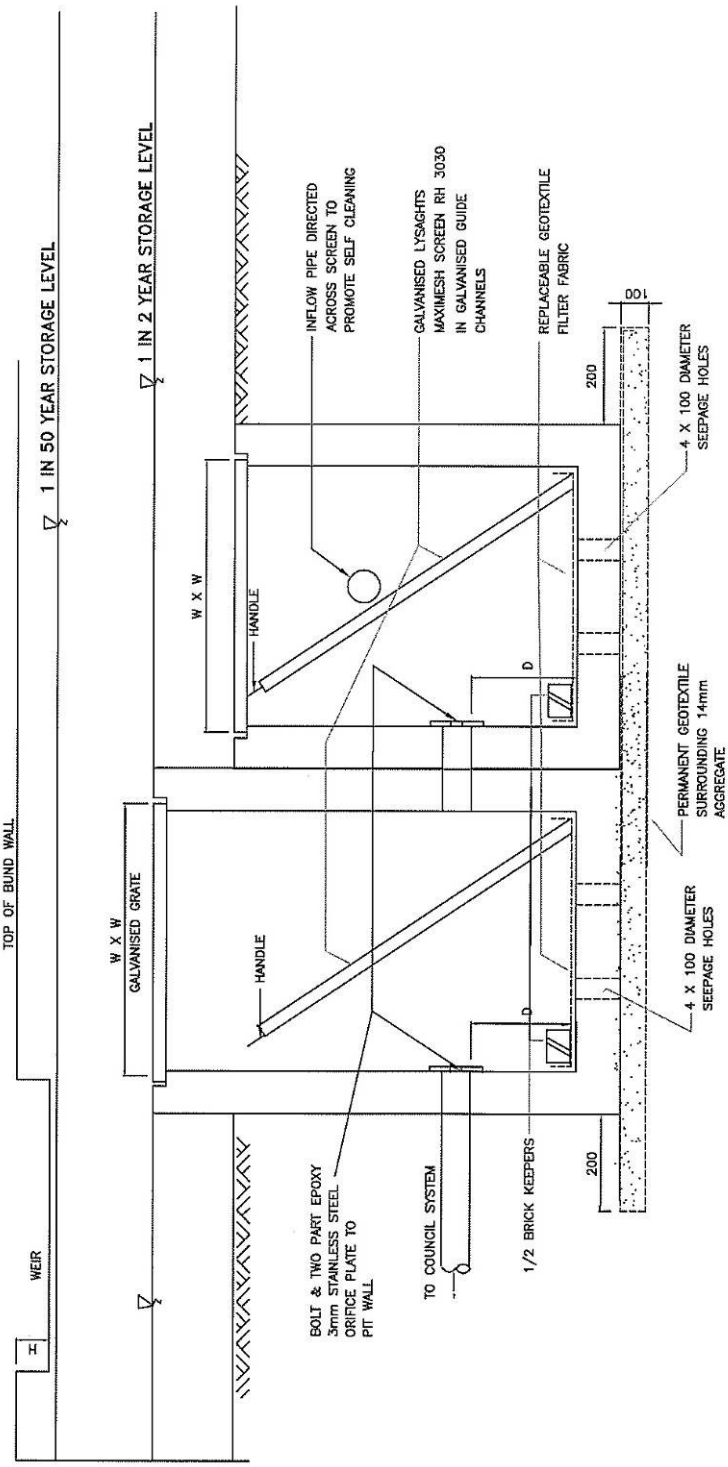
DRAWING C.6

COVERED TANK TYPE DETENTION PIT



DRAWING C.7

ABOVE GROUND TYPE DETENTION – DISCHARGE CONTROL PIT



NOTES :

1. PIT TYPE FOR USE IN ABOVE GROUND SYSTEM
2. H TO BE A MINIMUM OF 1 IN 100 YEAR DEPTH OF OVERFLOW OVER WEIR
3. VARIABLES W AND D REFER FIGURE C.1
4. FOR LANDSCAPED/TURFED AREAS PROVIDE 20% EXTRA STORAGE
5. REFER TO SECTION 6.11 FOR OTHER REQUIREMENTS
6. CONTROL PITS TO BE CONSTRUCTED OF CONCRETE (PRECAST OR CAST-INSITU), OR BRICK/BLOCKS PLASTIC IS NOT PERMITTED.
7. ALL INFLOW PIPES ARE TO BE DIRECTED TO THE 2 YEAR FLOW CONTROL PIT.

APPENDIX D - DRAINGE OF LOW LEVEL PROPERTIES PROCEDURE

Introduction

Where a property falls away from the street, the flow that comes off this property may be directed towards a neighbour's property to the side or rear. With continuing development there is considerably more flow off these properties potentially causing increased impacts such as flooding, or damage to the neighbour's property and/or inconvenience. These flows need to be controlled.

Council adopted a policy on 17 March 2004 for the use of pump systems and the drainage of low level properties. Council determined that a private drainage easement provides the best solution, but considered alternatives in certain situations for differing development types. This procedure is designed to provide guidance for consultants, developers and/or owners of properties in determining the appropriate drainage system where a property falls away from the street in areas generally not suitable for absorption.

Application

This procedure is to apply to all developments other than developments in areas subject to onsite absorption or where there are only internal alterations. Figure A.1 in Council's Stormwater Development Control Plan (DCP) provides guidance to locate the areas that are generally suitable for absorption, areas that are generally unsuitable for absorption and other areas where absorption may be suitable depending on the site.
This procedure applies to sites in all areas that are generally unsuitable for absorption and assumes that:

- for single dwellings, or additions to single dwellings Council has been contacted to provide nominal absorption rates in areas that are generally or marginally suitable for absorption and been advised that the area is unsuitable for absorption, or
- for all other developments a geotechnical engineer has been engaged to determine the soil absorption rate and other information as required in Council's Stormwater DCP for areas that are generally or marginally suitable for absorption and the nominal absorption rate is less than 0.05 l/s/m^2, or the developer advised that absorption is not suitable.

Where the site is suitable for absorption exit this procedure and undertake the absorption design process detailed in Council's Stormwater DCP.

Requirements Prior To Lodging The Development Application

A number of the procedures outlined in this document may take some time to resolve and are outside Council's control. If these procedures were initiated as part of the development application process they would cause delays to applicants and the development application process.

Consequently for all developments Council will not accept development applications for properties that fall away from the street unless the drainage plans are accompanied by either:

- The completed 'Drainage of Low Level Property Checklist' (Appendix 5), where 'yes' has been answered to at least one of the questions on that list, with all attachments or
- A letter from Council's Technical Services Division authorising lodgement.

Overview of Procedures

There are a range of alternative drainage options that may be applicable to drain a low level property. To determine what is an appropriate system for each development, you must undertake the following steps. Where an alternative drainage system can be achieved the information necessary to complete the design of the internal elements of the adopted drainage system is available in Council's Stormwater DCP.

The steps involved are:
Step 1 - Are there only internal alterations to an existing building with no alterations to the roof or guttering?
Step 2 - Can you drain to a Council/Sydney Water drainage pipe within the property?
Step 3 - Can you drain to a Council/Sydney Water drainage pipe within the adjoining property?
Step 4- Can you drain to an available Council approved interallotment drainage scheme?
Step 5 - Can you drain through a private easement already available for the site?
Step 6 - Does the site fall to a Council park or reserve?
Step 7 - Is this an addition to an existing single unit dwelling?
Step 8 - Is this a new single unit dwelling where less than 200 m2 of the site cannot drain to the street?
Step 9 - Have you obtained a Geotechnical Report that indicates a workable absorption rate?
Step 10 - Can you modify the existing street drainage system?
Step 11 - Can you drain to an SRA railway corridor?
Step 12 - Is it physically impossible for you to drain through any adjoining property?
Step 13 - Have you obtained a private drainage easement?
You cannot proceed to step 14, 15 or 16 unless steps 1 to 13 and a private drainage easement have been completed.
Step 14 - New Single Dwellings or Granny Flats (but not Dual Occupancies)
Step 15 - Dual Occupancies
Step 16 - Villas, Townhouses, Home Units, Mixed Use, Subdivisions, Commercial and Industrial Development

Steps needed for different Development Types

Development Type	Steps
Additions to single dwellings.	Steps 1, 2, 3, 4, 5, 6 and 7
New Single Dwellings or Granny Flat	Steps 2, 3, 4, 5, 6, 8, 9, 10, 11, 12 and 13. Try and obtain private easement and step 14.
Dual Occupancy	Steps 2, 3, 4, 5, 6, 9, 10, 11,12 and 13. Try and obtain private easement and step 15.
Villas, Townhouses, Home Units, Mixed Use, Subdivisions, Commercial and Industrial Development	Steps 2, 3, 4, 5, 6, 9, 10, 11, 12 and 13. Try and obtain private easement, then step 16 and possibly step 15.

Steps for all Developments to Determine an Appropriate System

The steps are provided in a sequence to assist in considering all the options available to you for draining the property. Many of the options can be answered quickly eg does the site fall to the railway corridor? Other questions are more complex and it may be beneficial to engage a consultant engineer to assist in their assessment. If a viable drainage option has been determined you can go straight to the design process in Council's Stormwater DCP.

Step 1 - Are there only internal alterations to an existing building with no alterations to the roof or guttering?
No - go to step 2
Yes - Where there are no changes to the external structure (additional storeys or extra rooms are included as changes, but minor works such as re-skinning or bay windows are excluded), or where the development only involves a change of development use, drainage plans are typically not required and you can exit this procedure here.

Step 2 - Can you drain to a Council/Sydney Water drainage pipe within the property?
No - go to Step 3. Council's Customer Service Centre is able to provide a plan of the location of Council, or Sydney Water stormwater drainage pipes within the site.
Yes - Investigate whether at least 80% of the site can drain to the pipe and if so develop a drainage system appropriate to the type of development. Where connection is proposed to a Sydney Water conduit contact Sydney Water to obtain their approval in writing and any conditions. Exit to Council's Stormwater DCP and prepare drainage plans. If not go to Step 3.

Step 3 - Can you drain to a Council/Sydney Water drainage pipe within the adjoining property?
No - go to step 4. Council's Customer Service Centre is able to provide a plan of the location of Council, or Sydney Water stormwater drainage pipes adjacent to the site. Note that some pipes are within Council drainage reserves. Council is unable to provide details of easements. Phone the State Government's Land and Property Information section on 02 9228 6666 for information regarding easement locations and to obtain any certificates of title.
Yes - Investigate whether there is an easement over the pipe and whether the easement abuts the subject site to provide a legal connection. If so determine whether at least 80% of the site can drain to the pipe and if so develop a drainage system appropriate to the type of development. Where connection is proposed to a Sydney Water conduit contact Sydney Water to obtain their approval in writing and any conditions. If there is a Council pipe, but no easement approach Council to determine whether Council would consider obtaining an easement over the Council pipe and so provide a legal connection. If approved drainage can be achieved exit to Council's Stormwater DCP and prepare drainage plans. If not successful with Council, or no legal connection, go to step 4.

Step 4- Can you drain to an available interallotment drainage scheme?
No - go to step 5. An interallotment drainage line is a system constructed by Council to allow a number of properties to drain through a common drainage line. Council's Customer Service Centre is able to provide details of any interallotment drainage schemes applicable to the site.
Yes - and the pipeline is available, design the drainage system to connect into the scheme. For sites that have a Council approved interallotment scheme, but the interallotment pipe has not reached the property as yet and it is not economically viable for Council to extend the scheme at that time (following discussions with Council's Technical Services Division) a

pump system is required as a temporary measure. Exit to Council's Stormwater DCP and prepare drainage plans.

Step 5 - Can you drain to a private easement already available for the site?
No - go to step 6.
Yes - Obtain a copy of the certificate of title for the subject site. This should indicate what easements on adjoining properties (if any) benefits the subject site. For more information phone the State Government's Land and Property Information section on 02 9228 6666 regarding easements on adjoining properties that may benefit the subject site. Note these easements are very rare.
Develop a drainage system appropriate to the type of development. Exit to Council's Stormwater DCP and prepare drainage plans. If not go to step 6.

Step 6 - Does the site fall to a Council park or reserve?
No - go to step 7.
Yes - Liaise with Council's Corporate Asset Coordinator in writing to determine whether Council will either:
allow or require a drainage pipe to be constructed within the reserve or park and whether an easement is required. If an easement is necessary compensation to Council will be required as well as various costs including survey and Land Title fees as well as construction costs. Due to the scale of development this is not required for additions to single dwellings.
allow, depending on the risk to the park, reserve, or adjoining properties, all discharge to go to the park through a full width weir, or trough that is designed to minimise downstream scour, together with any other requirements or conditions.
refuse any form of discharge to the park or reserve and require a pump system, or some other alternative.
Exit to Council's Stormwater DCP and prepare drainage plans.

Step 7 - Is this an addition to an existing single unit dwelling?
No - go to step 8.
Yes - Exit to Council's Stormwater DCP and prepare drainage plans.

Step 8 - Is this a new single unit dwelling where less than 200 m2 of the site cannot drain to the street?
No - go to step 9.
Yes - Providing a maximum of 200 m2 of the site (pervious and impervious) cannot drain directly to the kerb and gutter in the street. This 200 m2 area excludes any roof water of the main dwelling that can be directed to the kerb and gutter at the front of the property via gravity or a charged (pressurised) drainage system. Exit to Council's Stormwater DCP and prepare drainage plans.

Step 9 - Have you obtained a Geotechnical Report that indicates a workable absorption rate?
No - go to step 10. The Geotechnical Report needs to be determined by a Geotechnical Engineer. A workable absorption rate is a minimum of 0.05 litres/s/m2 and preferably greater than 0.1 litres/s/m2 that will allow a reasonably sized absorption system to be designed. Figure A.1 of Council's Stormwater DCP provides guidance to approximately locate areas that are generally suitable for absorption, areas that are generally unsuitable for absorption and other areas where absorption may be suitable depending on the site. Refer to the 'Application' section of this document. This procedure assumes that the site is located in an area that is generally considered unsuitable for absorption, or is in an area that would normally be considered suitable or marginally suitable for absorption, but the information generally available indicates that absorption is not appropriate in this case. In areas that are generally considered unsuitable or marginally suitable for absorption, there still may be

isolated pockets of suitable soil that may provide a workable absorption rate for a site (unless a geotechnical test result has already been undertaken and an unsatisfactory absorption rate obtained). The absorption rate can only be confirmed through a test undertaken by a Geotechnical Engineer. As these tests can be expensive, a preliminary inspection of the soil by your drainage consultant may provide you with an initial assessment. If absorption is not practical go to step 10.
Yes - Having engaged a geotechnical engineer to undertake a soil absorption test obtain a workable absorption rate. A workable absorption rate is a minimum of 0.05 litres/s/m2 and preferably greater than 0.1 litres/s/m2. If a workable absorption rate is determined exit to Council's Stormwater DCP and prepare drainage plans.

Step 10 - Can you modify the existing street drainage system?
No - go to step 11.
Yes - Obtain a copy of Council's pipe and drainage plan showing all available pipe systems within a 100 m of the site. Discuss with the Development Engineer the viability of extending and/or lowering the existing street drainage system to allow the rear of the site to connect to the street system. The cost of this work is at the applicant's expense. Please note - where the Council pipe is within say 35 m, the cost of pipe construction is usually of a similar scale to the compensation costs payable to downstream property owners for an easement, but avoids the period of time spent on negotiation. If viable preliminary street drainage plans with levels are required in conjunction with the detailed internal drainage system, prior to release of the DA. More detailed street drainage plans with service details are required with the construction certificate. If viable exit to Council's Stormwater DCP and prepare drainage plans.

Step 11 - Can you drain to an SRA railway corridor?
No - go to step 12.
Yes - The State Rail Authority (SRA) have indicated in the past that they may be agreeable to allowing private pipelines within the railway corridor subject to appropriate compensation and possibly an ongoing maintenance fee. If successful get the agreement from the SRA in writing and refer to Council's Stormwater DCP. Where agreement cannot be reached provide details of all correspondence and go to step 12. Excessive costs from SRA may be reasonable grounds for disagreement in the case of Single Dwellings or Dual Occupancies. Please write to Council's Floodplain and Stormwater Engineer for a determination if this is an issue.

Step 12 - Is it physically impossible for you to drain through any adjoining property?
No - go to step 13.
Yes - This situation would apply to a either a commercial development that has been developed on all three sides with 100% site coverage, or a site is within a depression that may be natural, or man-made such as an old quarry. You need to clearly demonstrate that there is no alternate route for the pipe through survey, or contour plans and/or site photos. Please write to Council's Floodplain and Stormwater Engineer for a determination if this is an issue. Contact City Development to determine whether filling may be appropriate in this instance depending on the impact on adjoining properties, alternatively a pump system may be approved. For a new single dwelling it is considered physically impossible to drain the site where the drainage would need to go through four or more properties.
Step 13 - Have you obtained a private drainage easement?
No - See the 'Procedure to Obtain a Private Drainage Easement' section in this document.
Yes - Exit to Council's Stormwater DCP and prepare drainage plans.
Step 14 - New Single Dwellings or Granny Flats (but not Dual Occupancies)
Only take this step if advised by Council in writing to do so following the Private Drainage Easement Review. Engage an experienced hydraulic engineer to design a drainage system and

undertake a risk assessment with at least 85% of the roof water of the main dwelling being directed to the kerb and gutter at the front of the property via gravity or a charged (pressurised) drainage system. The runoff from any surface areas, or the roof water from any building(s) that cannot drain to the street through the gravity or charged system, is to be directed to either a pump system to direct flow to the street (or detention system for a granny flat), or if advised by Council, to an onsite absorption system that may be applicable in some marginal soil absorption areas.
Exit to Council's Stormwater DCP and prepare drainage plans.

Step 15 - Dual Occupancies
Only take this step if advised by Council in writing to do so following the Private Drainage Easement Review. Engage an experienced hydraulic engineer to design a drainage system and undertake a risk assessment with at least 85% of the roof water of the main dwelling being directed to the onsite detention system in the front yard via gravity or a charged (pressurised) drainage system and then discharge to the kerb and gutter at the front of the property. The runoff from any surface areas, or the roof water from any building(s) that cannot drain to the street through the gravity or charged system, is to be directed firstly to an onsite surface stormwater reuse system. The overflow from the surface stormwater reuse system is to flow to either a pump system to direct flow to the detention system, or if advised by Council, to an onsite absorption system that may be applicable in some marginal soil absorption areas.
Exit to Council's Stormwater DCP and prepare drainage plans.

Step 16 - Villas, Townhouses, Home Units, Mixed Use, Subdivisions, Commercial and Industrial Development
Only take this step if advised by Council in writing to do so following the Private Drainage Easement Review. This step applies where none of the previous steps have produced a workable drainage system and the downstream owners have not agreed to a private drainage easement as detailed in this document. It is proposed that the development be initially approved (subject to all other planning issues being satisfied) with a drainage plan designed for the probable best route for the private pipeline and a deferred commencement condition requiring the provision of a private drainage easement.
The applicant can then use Section 88K of the Conveyancing Act 1919 for the court to make an order imposing an easement over the downstream land. Alternatively, subject to legal advice, an application to the Land and Environment Court may achieve the same result.
Where an application to the court was successful in obtaining an easement, submit to Council the easement details to satisfy the deferred commencement conditions and revised drainage plans for approval if required.
Where an application to the court was unsuccessful in obtaining an easement but the court's judgement specifically allowed pumps, undertake the procedures outlined in step 15 as if the development was a dual occupancy and submit revised drainage plans. Include a copy of the court proceedings.

Procedure to Obtain a Private Drainage Easement

The following procedures need to be undertaken to obtain a private drainage easement for all developments other than Additions to Single Unit Dwellings and New Single Unit Dwellings where most of the site drains to the street:

- Review the layout of the adjoining lots and determine alternative routes that the pipeline may take. There is usually at least one adjoining property that provides a direct connection to the next street and at least one and possibly more alternate paths where the pipe could travel through say a neighbour's property to the side before flowing through a property to its rear.
- Undertake a site inspection from within the development site, or from the street to determine the best route within each respective property taking into account any obstructions.
- Drainage easements are to be a minimum of 900 mm wide unless the existing building offset is less than this. In this case the absolute minimum easement width is 600 mm immediately adjacent to the building.
- Prepare a sketch plan for each property clearly showing the preferred easement location and all critical features such as buildings and trees. Websites such as maps.google.com may be of assistance in providing some details. Search on "Sydney", click on "Satellite", reposition and zoom in over the property.
- Contact Council's Customer Service Centre to obtain the owner's name and address (as the property may be rented) of each property. Note: Under Council's Privacy Procedures, the owner will be advised of the name of the applicant requesting the details and the reason for providing the information.
- In obtaining the easement you need to offer the owner(s) reasonable compensation. This is best achieved by having a registered valuer prepare a valuation of the easement over each property, or if possible obtain a single rate per square metre of easement from the valuer that can be applied for all easement width and length combinations.
- Complete a copy of the standard Council letter from Appendix 1 or 2.
- Complete two copies of the response form from Appendix 4.
- Complete a stamped self addressed envelope.
- Forward a copy of the completed standard Council letter, two copies of the response form, the self addressed envelope, and sketch plan by registered mail to each property determined above. Keep copies of all information forwarded as well as the registered mail receipts.

There are four possible outcomes from this standard letter.

1. Positive Response
   If the downstream owner accepts the offer, enter into final negotiations and arrange for preparation of the linen plan and legal documents, which will be at your cost as set out in the letter of request. The signed letter from the neighbour provides sufficient evidence to allow the lodgement of the Development Application (DA) with Council. Where the drainage easement is not able to be registered prior to issue of the DA consent, the DA will be issued with a deferred commencement condition requiring registration of the easement prior to the consent operating.

2. Conditional Response
   In this response the downstream owner may be interested in providing the easement, but has some questions, or concerns, possibly with the amount of compensation being offered, or the impacts of the pipeline on their properties, or for some other reason. Liaise with the owner to clarify any concerns.:

Where agreement is finally reached follow through the process as for a positive response. Where agreement could not be reached by the parties obtain a written refusal by the owner and documentary evidence of the processes involved, including both valuations and any mediation process and follow through the process as for a negative response.

3. No Response
   If no response is received within 21 days of the date of issue of the registered letter, forward by registered mail the Council's standard follow-up letter from Appendix 3. If no response is received within 21 days of the date of issue of the second registered letter proceed as if a negative response, keeping copies of all correspondence.

4. Negative Response
   Where negative responses are obtained for all alternate flow paths the applicant is to complete Council's Private Drainage Easement Review (Appendix 6), attach all necessary information and pay to Council the Private Drainage Easement Review Fee. This will allow Council staff to review alternative flow paths and liaise directly with the downstream owners to ensure they clearly understand the options being considered. Following discussions with Council staff:
   - If the downstream owners then agree to provide the easement Council will forward the agreement to the applicant who shall then proceed as for a positive response (i.e. as for 1 above).
   - If the downstream owners continue to refuse to provide the easement Council will provide a letter to the owner/developer acknowledging the above process and giving approval for the Development Application to be lodged with Council together with any design requirements.

Procedure for use of the Standard Letters

- Photocopy the letter on the following page excluding the header and footer to delete references to Council, dates, etc...
- Date and sign the letter
- Include the owner's name and address (include all owners if more than one)
- Include your name, address and phone numbers
- Include the valuation figure.
- Enclose two copies of the Drainage Easement Response Form from Appendix 4
- Include a stamped self addressed envelope.

Standard Letter I
Easement Request – Single Property Scheme

___ / ___ / ____
_____
_____
_____

Dear _____
Request for Drainage Easement at
_____
I am seeking to obtain a drainage easement through your property to allow the stormwater from my proposed development at _____ to connect to Council's drainage system. Please see the attached location plan.
A drainage easement is a legal arrangement that is registered on the title of the land that provides certain benefits to another party (your neighbour in this case). The drainage easement allows the beneficiary to direct stormwater through a property, typically with underground pipes.
The land containing the easement still belongs to you as owner, but has some restrictions. The landowner is not able to build on the easement, or restrict the flow of water through it. As most easements are along the side or rear boundaries where you cannot generally build anyway, the restriction preventing building over the easement is normally not significant. Paths, driveways, lawns and gardens are all permitted over the easement, though large trees should be excluded. Notwithstanding this the owner in providing the easement is entitled to reasonable compensation.
Council views an easement as the best method of draining my development and requires me to make every effort to obtain one. Pumps are sometimes considered, but these can be unreliable due to breakdowns, or blackouts. Council receives many complaints from downstream owners like yourself when pump systems fail. An easement provides the best long term solution. Some larger developments are not permitted to have pumps because of the likelihood of significant drainage problems.
If you agree to the easement and the system is viable you are entitled to compensation. By investigation of local values it is recommended that $ is a reasonable amount of compensation for this easement. If you are agreeable to this amount please include your solicitor's details so that the legal paperwork can be processed. I will pay all survey and registration costs. I will also pay any reasonable legal costs of your solicitor (up to $_____) if your offer is accepted.
Every effort will be taken to protect your property from unnecessary damage during construction. Where it is impossible to avoid damaging paving or gardens it is agreed that these will be restored at my cost to at least a similar standard.
I hope that this letter has answered any concerns you may have and encourage you to accept my offer. If you have any questions I can be contacted on (h) _____ (w) _____. If you would like to contact Rockdale City Council's Floodplain and Stormwater Engineer for advice please phone 02 9562 1652.
It would be appreciated if you could complete and return the response form within two weeks.

Yours sincerely

_____
_____
_____
_____

Standard Letter 2
Easement Request - Multi Property Scheme

___ / ___ / ____
_____
_____
_____

Dear _____

Request for Drainage Easement at
_____
I am seeking to obtain a drainage easement through your property to allow the stormwater from my proposed development at _____ to connect to Council's drainage system. Please refer to the attached sketch plan to indicate the proposed location of the drainage easement.
This request to has been made to you as part of a proposed multi-property scheme. This means that I have to drain through your property and an additional property to get the drainage system to work. Because of this, the easement will only have a very minor impact on your property and several advantages that I will detail later.
A drainage easement is a legal arrangement that is registered on the title of the land that provides certain benefits to another party, (your neighbour in this case). The drainage easement allows the neighbour to direct stormwater through the property, typically with underground pipes.
The land containing the drainage easement still belongs to you as owner, but has some restrictions. The owner is not able to build over the easement, or restrict the flow of water through it. As most easements are along the side or rear boundaries where you cannot generally build anyway, the restriction preventing building over the easement is not significant. Paths, driveways, lawns and gardens are all permitted over the easement, though large trees should be excluded. Notwithstanding this the owner in providing the easement is entitled to reasonable compensation.
Council views an easement as the best method of draining my development and requires me to make every effort to obtain one. Pumps are sometimes considered, but these can be unreliable due to breakdowns, or blackouts. Council receives many complaints from downstream owners like yourself when pump systems fail. An easement provides the best long term solution. Some larger developments are not permitted to have pumps because of the likelihood of significant drainage problems.
If you agree to the easement and the system is viable you are entitled to compensation. By investigation of local values it is recommended that $ is a reasonable amount of compensation for this easement. If you are agreeable to this amount please include your solicitor's details so that the legal paperwork can be processed. I will pay all survey and registration costs. I will also pay any reasonable legal costs of your solicitor (up to $_____) if your offer is accepted.
Every effort will be taken to protect your property from unnecessary damage during construction. Where it is impossible to avoid damaging paving or gardens it is agreed that these will be restored at my cost to at least a similar standard.
There are additional benefits to you in providing the drainage easement to me. I will design the drainage system in the property downstream of you to be big enough to convey all your water as well as the water from my proposed development and provide you with an inlet pit so that your stormwater can be connected to it once completed. I will also ensure that you have a benefit in the downstream easement so that if you need to undertake extensions or build a new house in the future you won't have problems with Council in draining your water. This could also improve the resale value of your property.

I hope that this letter has answered any concerns you may have and encourage you to accept my offer. If you have any questions I can be contacted on (h) _____ (w) _____. If you would like to contact Rockdale City Council's Floodplain and Stormwater Engineer for advice please phone 02 9562 1652.
It would be appreciated if you could complete and return the response form within two weeks.

Yours sincerely

_____
_____
_____
_____

Standard Letter 3
Easement Request Follow Up Letter

___ / ___ / ____
_____
_____
_____
_____

Dear _____

Request for Drainage Easement at
_____

I refer to my previous letter dated ___ / ___ / ____ that requested permission for a drainage easement at the above address - copy enclosed. This previous letter may have gone astray or misplaced, or perhaps you are still thinking through your options.
As this letter states I am prepared to offer an amount of $ in compensation to you for granting the easement as well as covering all other costs.
I would appreciate if you would give this matter your earliest consideration. If possible could you complete the attached response form and return it within two weeks.
I would encourage you to accept my offer for the easement. Once again if you have any questions I can be contacted on (h) _____ (w) _____.
If you would like to contact Rockdale City Council's Floodplain and Stormwater Engineer for advice please phone 02 9562 1652.

Yours sincerely
_____
_____
_____
_____
_____

Standard Letter 4
Response Letter

Response to Drainage Easement Request

Please tick one or more of the following boxes to indicate your position in relation to providing the easement for the benefit of the development at:
(insert address)

_____
_____

Being the registered owner/s of the property at:
(insert address)

_____
_____

I/We agree to provide the easement for the compensation figure offered on the previous page and accept that you will be responsible for all other costs.
I am/We are considering the easement, but I have some concerns regarding the location of the easement, or it's impact on my property.
I am/We are considering the easement, but I have some concerns regarding the amount of compensation being offered.
I/We do not agree to provide the easement.

Owners (all owners need to sign this form)

Name	Name
Date _____ / _____ / _____	Date _____ / _____ /_____
Tel (Home/Work/Mobile)	Tel (Home/Work/Mobile)
Tel (Home/Work/Mobile)	Tel (Home/Work/Mobile)
Tel (Home/Work/Mobile)	Tel (Home/Work/Mobile)
Signature	Signature

Solicitor Details

Name	
Address	
Company Name (if applicable)	
Mailing Address (if different)	
Tel (Work/Mobile)	Fax

Two copies of this response form have been forwarded to you. One copy is for your records. Please return the completed second copy in the enclosed envelope within two weeks.

Thank you again for your assistance.

APPENDIX E – INSTRUMENTS

INSTRUMENT E.1

POSITIVE COVENANT FOR ON-SITE RETENTION SYSTEMS

The retention (absorption) system needs to be protected by a positive covenant in favour of Council. The covenant is to be in the form of an 88B or 88E Instrument under the Conveyancing Act. The covenant should be applied to the whole site and not just the area occupied by the absorption pits .

The registered proprietor covenants as follows with the Council in respect to the structure erected on the land described as "on site stormwater retention system" (which expression includes all ancillary gutters, pipes, drains, pumps, walls, kerbs, pits, grates, tanks, rainwater tanks, chambers, basins and surfaces designed to retain stormwater) shown on plans approved by the Council (hereinafter called 'the system').

1. The Registered Proprietor will

a) permit stormwater to be retained by the system;
b) keep the system clean and free of silt, rubbish and debris;
c) maintain, renew and repair the whole or parts of the system so that it functions in a safe and efficient manner;
d) carry out the matters referred to in paragraphs (b) and (c) at the proprietor's expense;
e) not make any alterations to the system or elements thereof without prior consent in writing of the Council;
f) permit the Council or its authorised agents from time to time upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for compliance with the requirements of this clause;
g) comply with the terms of any written notice issued by the Council in respect to the requirements of this clause within the time stated in the notice.

2 In the event of the registered proprietor failing to comply with the terms of any written notice served in respect of the matters in Clause 1 the Council or its authorised agents may enter with all necessary equipment and carry out any work required to ensure the safe and efficient operation of the system and recover from the registered proprietor the cost of liaison with the proprietor and the cost of carrying out the work, and if necessary, recover the amount due by legal proceedings (including legal costs and fees) and entry of a covenant charge on the land under Section 88F of the Conveyancing Act 1919. In carrying out any work under this clause, the Council shall take reasonable precautions to ensure that the land is disturbed as little as possible.

Name of Authority Empowered to Release, Vary or Modify Covenant.

Rockdale City Council

INSTRUMENT E.2

POSITIVE COVENANT FOR ON-SITE DETENTION SYSTEMS

The On-site Detention (OSD) System needs to be protected by a positive covenant in favour of Council. The covenant is to be in the form of an 88B or 88E Instrument under the Conveyancing Act. The covenant should be applied to the whole site and not just the area occupied by the basin or tank.

The registered proprietor covenants as follows with the Council in respect to the structure erected on the land described as "on site stormwater detention system" (which expression includes all ancillary gutters, pipes, drains, pumps, walls, kerbs, pits, grates, tanks, rainwater tanks, chambers, basins and surfaces designed to temporarily detain stormwater) shown on plans approved by the Council (hereinafter called 'the system').

1. The Registered Proprietor will

a) permit stormwater to be temporarily detained by the system;
b) keep the system clean and free of silt, rubbish and debris;
c) maintain, renew and repair the whole or parts of the system so that it functions in a safe and efficient manner;
d) carry out the matters referred to in paragraphs (b) and (c) at the proprietor's expense;
e) not make any alterations to the system or elements thereof without prior consent in writing of the Council;
f) permit the Council or its authorised agents from time to time upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for compliance with the requirements of this clause;
g) comply with the terms of any written notice issued by the Council in respect to the requirements of this clause within the time stated in the notice.

2 In the event of the registered proprietor failing to comply with the terms of any written notice served in respect of the matters in Clause 1 the Council or its authorised agents may enter with all necessary equipment and carry out any work required to ensure the safe and efficient operation of the system and recover from the registered proprietor the cost of liaison with the proprietor and the cost of carrying out the work, and if necessary, recover the amount due by legal proceedings (including legal costs and fees) and entry of a covenant charge on the land under Section 88F of the Conveyancing Act 1919. In carrying out any work under this clause, the Council shall take reasonable precautions to ensure that the land is disturbed as little as possible.

Name of Authority Empowered to Release, Vary or Modify Covenant.

Rockdale City Council

INSTRUMENT E.3

POSITIVE COVENANT FOR PUMP SYSTEMS

The pump system needs to be protected by a positive covenant in favour of Council. The covenant is to be in the form of an 88B or 88E Instrument under the Conveyancing Act.

The registered proprietor covenants as follows with the Council in respect to the structure erected on the land described as "onsite stormwater pump system" (which expression includes all ancillary gutters, pipes, drains, pumps, walls, kerbs, pits, grates, tanks, rainwater tanks, chambers, basins and surfaces designed to collect and temporarily detain stormwater) shown on plans approved by the Council (hereinafter called 'the system').

1. The Registered Proprietor will

a) permit stormwater to be temporarily detained by the system;
b) keep the system clean and free of silt, rubbish and debris;
c) arrange for regular inspections and maintenance of the pump system, at not more than 6 monthly intervals, by a recognised pump maintenance specialist to ensure the pump(s), associated alarms and system generally is working effectively. The pump maintenance specialist is to prepare a written report detailing whether the pump system is working effectively and if not what actions need to be undertaken to ensure it is working effectively;
d) undertake the rectification works as specified by the pump maintenance specialist's report as soon as practical, but within 14 days of the report being prepared. Obtain a follow-up report to detail that the pump system is now working effectively;
e) maintain written records of all reports and make available to Council such records where requested including details of any rectification works;
f) maintain, renew and repair the whole or parts of the system so that it functions in a safe and efficient manner;
g) carry out the matters referred to in paragraphs (b), (c), (d), (e) and (f) at the proprietor's expense;
h) not make any alterations to the system or elements thereof without prior consent in writing of the Council;
i) permit the Council or its authorised agents from time to time upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land and review the records for compliance with the requirements of this clause;
j) comply with the terms of any written notice issued by the Council in respect to the requirements of this clause within the time stated in the notice.

2 In the event of the registered proprietor failing to comply with the terms of any written notice served in respect of the matters in Clause 1 the Council or its authorised agents may enter with all necessary equipment and carry out any work required to ensure the safe and efficient operation of the system and recover from the registered proprietor the cost of liaison with the proprietor and the cost of carrying out the work, and if necessary, recover the amount due by legal proceedings (including legal costs and fees) and entry of a covenant charge on the land under Section 88F of the Conveyancing Act 1919. In carrying out any work under this clause, the Council shall take reasonable precautions to ensure that the land is disturbed as little as possible.

Name of Authority Empowered to Release, Vary or Modify Covenant.

Rockdale City Council

INSTRUMENT E.4

POSITIVE COVENANT FOR OVERLAND FLOW PATHS

The overland flow path and flow through fencing needs to be protected by a positive covenant in favour of Council. The covenant is to be in the form of an 88B or 88E Instrument under the Conveyancing Act.

The registered proprietor covenants as follows with the Council in respect to the "overland flow path and flow through fencing" (which expression includes all fences, openings, steps, lawns, gardens, paving and Council approved structures along the overland flow route) shown on plans approved by the Council (hereinafter called 'the system'). Flow through fencing includes fences and gates that have pool fencing and/or louvres from the base (ground) up to the 1 in 100 year flow depth to allow flood flows through.

1. The Registered Proprietor will

a) permit stormwater to be temporarily conveyed across the land and through the system;
b) keep the system clean and free of silt, rubbish and debris;
c) maintain, renew and repair the whole or parts of the system so that it functions in a safe and efficient manner;
d) not place or store items within the system, temporary or otherwise, that would block or partly block the system;
e) not erect, or construct a fence or gate (that is not flow through fencing), raised planter garden or any other structure within the flowpath that would block or restrict the system;
f) carry out the matters referred to in paragraphs (b), (c), (d) and (e) at the proprietor's expense;
g) not make any alterations to the system or elements thereof without prior consent in writing of the Council;
h) permit the Council or its authorised agents from time to time upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land and review the records for compliance with the requirements of this clause;
i) comply with the terms of any written notice issued by the Council in respect to the requirements of this clause within the time stated in the notice.

2 In the event of the registered proprietor failing to comply with the terms of any written notice served in respect of the matters in Clause 1 the Council or its authorised agents may enter with all necessary equipment and carry out any work required to ensure the safe and efficient operation of the system and recover from the registered proprietor the cost of liaison with the proprietor and the cost of carrying out the work, and if necessary, recover the amount due by legal proceedings (including legal costs and fees) and entry of a covenant charge on the land under Section 88F of the Conveyancing Act 1919. In carrying out any work under this clause, the Council shall take reasonable precautions to ensure that the land is disturbed as little as possible.

Name of Authority Empowered to Release, Vary or Modify Covenant.

Rockdale City Council

APPENDIX F – DESIGN CALCULATION SHEETS

CALCULATION SHEET F.1

ABSORPTION PIT DESIGN CALCULATION SHEET (WITH WORKED EXAMPLE)

Site Details

Address	Example Site	
Site Area	550	m^2
Impervious Area	300	m^2
Nominal Absorption Rate (AR_N)	0.5	$l/m^2/sec$
Reduction Factor (F_R)	0.75	

Design Details

Design Impervious Area (DA)	(see Clause 5.3.10)	360	m^2
Design Absorption Rate (AR_d)	= AR_N x F_R =	0.375	$l/m^2/sec$
Base Area of Absorption Pit (BA)		32.4	m^2

Required Absorption System Volume Calculation for 50 Year ARI Storm

Time (min) T	Rainfall Intensity (mm/hr) I	Runoff (l/s) R = I x DA / 3600	Runoff Volume (m^3) RV = R x T x 60 / 1000	Infiltration Vol (m^3) IV = BA x AR_d x T x 60 / 1000	Required Absorption System Volume (m^3) RV-IV
5	238	23.80	7.14	3.65	3.50
6	223	22.30	8.03	4.37	3.65
7	211	21.10	8.86	5.10	3.76
8	202	20.20	9.70	5.83	3.86
9	194	19.40	10.48	6.56	3.92
10	186	18.60	11.16	7.29	3.87
11	180	18.00	11.88	8.02	3.86
12	174	17.40	12.53	8.75	3.78
13	169	16.90	13.18	9.48	3.71
14	164	16.40	13.78	10.21	3.57
15	160	16.00	14.40	10.94	3.47
20	142	14.20	17.04	14.58	2.46
25	129	12.90	19.35	18.23	1.13
30	118	11.80	21.24	21.87	-0.63
40	102	10.20	24.48	29.16	-4.68
45	96	9.60	25.92	32.81	-6.88
50	90.6	9.06	27.18	36.45	-9.27
55	85.8	8.58	28.31	40.10	-11.78
60	81.7	8.17	29.41	43.74	-14.33
Maximum Required Absorption System Volume (MRASV)(m^3)					3.92

Proposed Absorption System Volume Calculation Sheet

Total Volume of pits (above top of base level)(m^3)	0.4
Volume of half round pipes (m3)(Evergals Jumbo Trench 410 - Voume 175 litres/m)	1.6
Gravel Void Volume (20% of gravel volume)(m^3)	1.3
Above Ground Storage (m^3)	0
Other Volume (details)(m^3)……..	0
Subtotal Proposed Absorption System Volume (m3)	3.3
Allowable Rainwater Tank Offset (1m^3 offset for 4m^3 of rainwater tank) where subtotal system volume is greater than 3m^3 **and the minimum volumes and uses of rainwater are in accordance with section 7.2 (m^3)**	1
Total Proposed Absorption System Volume (TPASV)(m^3)	4.3
TPASV must be greater than MRASV	Satisfactory

An electronic version of this calculation sheet may be obtained from Council upon request.

The worked example considers a site, area 550 m^2, where a dwelling is proposed to be constructed with a roof and surrounding paved impervious area of 300 m^2.

Council advised the nominal absorption rate of 0.5 $l/m^2/sec$.

The proposed absorption system has dimensions as follows:

Gravel base

Length	9 m
Width	3.6 m
Thickness	0.2 m

Void Type

Everglas 410 "Jumbo" 0.175 l/m

End Pits

600 mm x 600 mm, 800 mm deep, with 200mm silt trap.

Rainwater tank

4,000 litres

The proposed system volume (TPASV = 4.30 m^3) is greater than the required volume (MRASV = 3.92 m^3) so the design is acceptable providing the rainwater tank is connected to the appropriate uses. Further refinement could produce a more economical design.

Notes:

1. Using the absorption pit types in Drawing C.2, C.3 and C.5 will result in the critical storm usually being fairly short, between 5 and 20 minutes, due to the limited storage available in this type of design (except where additional above ground storage is used).

2. When using pit configurations as Drawing C.4 with increased storage, the critical storm duration will generally increase.

3. The designer is able to adjust the relative capacity of the storage and absorption area by trialing different configurations. If the 5 minute storm is critical there may be an opportunity to reduce the size of the absorption system.

CALCULATION SHEET F.2

DETENTION DESIGN CALCULATION SHEET (WITH WORKED EXAMPLE)

Site details

Address			
Catchment Name	Muddy Creek		
Site area (A_s)	355 m^2		
Bypass area (A_b)	15 m^2	A_b / A_s =	4.2%

Designer details	123 Smith Street, Smith Town
Designer Name	John Citizen
Company name (if applicable)	John Citizen Engineering
Contact phone numbers(s)	8765 4321

Adjusted Design 50 Year ARI storage Volume

Total Design Storage (V_d)	= A_s x 320 m^3/ha =	11.4 m^3
Adjusted Design Storage (V_a)	= V_d x[(100 + %Bypass / 2) /100] =	11.60 m^3

Total storage volume

Below ground Storage					0.2 m^3
Above ground storage	width (m) =	5	length (m)=	9	
	depth (m)	0.3	landscaped	yes	11.25 m^3
Rainwater tank offset volume Offset = Rainwater tank volume 3 m^3 / 3 = (Rainwater tank offsets are only available where the minimum Rainwater Tank volumes and uses are undertaken in accordance with section 7.2. maximum 50% of the Adjusted Design Storage Volume)					1.0 m^3
Total storage volume					12.5 m^3
Total Storage Volume must be greater than or equal to the Adjusted Design Storage Volume					**True**

Adjusted Design 2 Year ARI Storage

2 Year Design Storage (V_2)	= Vd x 0.45 =	5.2 m^3

Adjusted Permitted 50 Year ARI Site Discharge (PSD)

Design Permitted Site Discharge (Q_d)	= As x	180 m^3/ha =	6.4 l/s
Adjusted Permitted Site Discharge (PSD_{50})	= Q_d x[(100 - %Bypass x 2) /100] =		5.9 l/s

Outlet Control for 50 Year ARI Storm

Control type	orifice			
50 year ARI TWL =	20.7	m		
orifice centreline RL =	20	m	h_{50} =	0.7 m
50 year diameter = [	0.471 x (PSD_{50} / 1000) / $h_{50}^{1/2}$] $^{1/2}$ x 1000 =			57 mm

Outlet Control for 2 Year ARI Storm

2 year Permitted Site Discharge (PSD_2)	= PSD_{50} x 0.35 =			2.0 l/s
Control type	orifice			
2 year ARI TWL =	20.535	m		
orifice centreline RL =	20	m	h_2 =	0.535 m
2 year diameter = [	0.471 x (PSD_2 / 1000) / $h_2^{1/2}$] $^{1/2}$ x 1000 =			36 mm

An electronic version of this calculation sheet may be obtained from Council upon request.

The worked example considers an allotment, area 355 m^2, within a dual occupancy site in the Muddy Creek Catchment, with an area bypassing the OSD of 15 m^2.

The proposed system is a landscaped above ground system, having an area 5 m x 9 m, and an average ponding depth for the 50 yr ARI storm of 300 mm.

The control type is an orifice for both the 2yr ARI and 50 yr ARI, with a pit arrangement as per Drawing C.7.

Notes:

1. If a drowned orifice condition is required to be considered then the OSD volumes (2yr and 50yr) shall be adjusted using Table 6.2.