QPRC

QUEANBEYAN PALERANG REGIONAL COUNCIL

DEVELOPMENT DESIGN SPECIFICATION

D5

STORMWATER DRAINAGE DESIGN

VERSION 2 – MARCH 2018

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments for development.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
VERSION 1	Development types altered	D5.01.1	M	KD	19/04/10
	Standards updated	D5.03	M		
	Development types altered	D5.04.5	M		
	Runoff co-efficients altered	D5.06.9	M		
	Conduit size for single residences specified	D5.09	A		
	Central pipe alignment in easement	D5.17.2	A		
	Development types and standard impervious % altered	D5.17.4	M		
	Standard updated	D5.17.8	M		
	Standard updated. Required grade for bulkheads increased to 7%.	D5.18	M		
	Lot connections specified	D5.27	A	KD	17/8/10
	Standard Drawings added	D5-A	A	KD	30/06/11
VERSION 2	References to AR&R 2016 & AEP rather than ARI updated throughout	Various	M	CS	26/03/18
	IFD reference updated to BOM source data	D5.04	M		
	Minor System Design AEP varied at Council discretion added	D5.04.5	A		
	Rationale Method omitted, Regional Flood Frequency Model Added	D5.06	O/A		
	Other Models Omitted, Urban Hydrological models added	D5.07	O/A		

	D5.10 PITS incorporated into D5.09, subsequent section renumbered	D5.09	M		
	Open channel roughness coefficients omitted	D5.12.3	O		
	Culvert Crossing Design AEP levels added	D5.13.4	A		
	50% of rainwater tanks allowed to contribute to OSD capacity	D5.15.7	A		
	OSD detail to be submitted at DA Stage	D5.15.10	A		
	OSD detail to be submitted prior to Occupation Certificate or Subdivision Certificate	D5.15.11	A		
	Impervious Area Percentages Updated	D5.16.4	M		
	Pump out requirements added	D5.17			
	Pipe material & Class amended	D5.18.1	M		
	Minimum Easement width revised to 2.5m	D5.20.6	M		
	Summary Sheets Updated	D5.24	M		
	Deemed to Comply omitted	D5.26	O		
	Lot Connection re-numbered from D5.27, additional requirements added	D5.26	A/M		
	Hydrology Summary Sheet Added	D5-B	A		
	Hydraulic Summary Sheet Added	D5-C	A		

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DEVELOPMENT DESIGN SPECIFICATION D5
STORMWATER DRAINAGE DESIGN – VERSION 2

GENERAL

D5.01 SCOPE

1) The work to be executed under this Specification consists of the design of stormwater drainage systems for development within the LGA. It includes, but is not limited to, the development of:

- Torrens and Strata title Subdivisions;
- Dwellings, buildings, structures and surrounds; and
- Road works, car parks, site works, landscaping, earthworks, dams and lakes;

D5.02 OBJECTIVES

1. The objectives of stormwater drainage design are as follows:

(a) To ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits.

(b) To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits.

(c) Retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.

(d) To mitigate the flow of stormwater to achieve acceptable standards prior to discharge to receiving waters.

2. In pursuit of these objectives, the following principles shall apply:

Design Principles

(a) New Developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in Book 9 of Australian Rainfall & Runoff, 2016 (AR&R); that is, the "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.

(b) Redevelopment - Where the proposed development replaces an existing development, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the site for the design annual exceedance probability (AEP) of the receiving minor system is no greater than that which would be expected from the existing development.

(c) Water Sensitive Urban Design (WSUD) methods shall be incorporated in all developments in accordance with the Australian Runoff Quality manual (ARQ) and Design Specification D7 EROSION CONTROL AND STORMWATER MANAGEMENT.

D5.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

- C220 - Stormwater Drainage – General – Version 2
- C221 - Pipe Drainage – Version 2
- C222 - Precast Box Culverts – Version 2
- C223 - Drainage Structures – Version 2
- C224 - Open Drains including Kerb & Gutter – Version 2
- D7 - Erosion Control and Stormwater Management

(b) Australian Standards

- AS/NZS 1254:2002 - Unplasticised PVC (uPVC) pipes and fittings for stormwater or surface water applications.
- AS/NZS 1260 - PVC-U pipes and fittings for drain, waste and vent applications
- AS 1289 - Methods of testing soils for engineering purposes
- AS 1289.4.2.1-1997 - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
- AS 1289.4.3.1-1997 - Soil chemical tests - Determination of the pH value of a soil - Electrometric method
- AS 1289.4.4.1-1997 - Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials
- AS/NZS 2032:2006 - Code of practice for installation of uPVC pipe systems
- AS/NZS 2033 - Installation of polyethylene pipe systems
- AS/NZS 2566.1-1998 - Buried flexible pipelines, structural design.
- AS/NZS 3500 - Plumbing and drainage
- AS/NZS 3500.3: 2003 - Stormwater drainage
- AS/NZS 3725:2007 - Design for installation of buried concrete pipes
- AS 4058:2007 - Precast concrete pipes.(pressure and non-pressure)
- AS 4139:2003 - Fibre reinforced concrete pipes and fittings
- AS/NZS 5065 - Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

(c) State Authorities

- RMS (NSW) - Model Analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings, 1979.
- ACT Transport Canberra and City Services Design Standards for Urban Infrastructure, Part 1 Stormwater

(d) Other

- AUSTROADS - Bridge Design Code.
- Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2016
- Institute of Engineers Australia - Australian Runoff Quality 2006
- Concrete Pipe Association of Australia
  - 1985, Concrete Pipe Guide, charts for the selection of concrete pipes to suit varying conditions.
  - 1986, Hydraulics of Precast Concrete Conduits, Pipes and Box

Culverts, Hydraulic Design Manual.

- Australian National Conference On Large Dams, Leederville WA. - ANCOLD 1986, Guidelines on Design Floods for Dams

HYDROLOGY

D5.04 DESIGN RAINFALL DATA

I-F-D Relationships

1. The rainfall intensities for any design shall be obtained from the *Intensity-Frequency-Duration* (IFD) page on the Australian Bureau of Meteorology's website. This page is available at the following link: http://www.bom.gov.au/water/designRainfalls/ifd/

Annual Exceedance Probability

2. Design Annual Exceedance Probability (AEP) - For design under the "major/minor" concept, the design AEPs to be used are given below.

AEPs

5. AEPs for minor events depend on the zoning of the land being serviced by the drainage system. The minor system design AEPs are detailed below though maybe altered by Council on a case by case basis due depending on location of development within the network:-

URBAN:

- 10% for commercial area "minor" systems
- 20% for General Residential and Large Lot Residential area "minor" systems
- 1 Exceedance per Year (1EY) for parks and recreation area "minor" systems.

RURAL:

- 50 years for Major culvert structure with effective waterway area >3 m^2 < 30 m^2
- 20 years for Minor culvert structure with effective waterway area < 3 m^2
- 5 years for large lot and rural residential area's "minor" systems
- 2 years minimum for catch drains and all minor structures on private access road.

Easements in Private Property

6. In addition, where a development is designed in such a way that the major system flows involve surcharge across private property, then the underground system (both pipes and inlets) shall be designed to permit flows into and contain flows having an AEP of 1% from the upstream catchment which would otherwise flow across the property. A surcharge path shall be defined for systems even where 1% AEP flows can be maintained within the system. Easements are to be provided in private property over pipe systems and surcharge paths.

D5.05 CATCHMENT AREA

Catchment Definition

1. The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or manmade paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.

2. Where no detailed survey of the catchment is available, 1:4000 orthophoto maps, or GIS data approved by Council, are to be used to determine the catchments and to measure areas. Catchment boundaries and characteristics are to be confirmed by site inspection.

3. Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

D5.06 REGIONAL FLOOD FREQUENCY ESTIMATION MODEL – NON URBAN CATCHMENTS

RFFE Model – Non Urban Catchments

1. Calculations to determine peak flows for non-urban catchment shall be carried out in accordance with *Chapter 3 Regional Flood Methods* of *Book* 3 Peak Flow Estimation of *Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2016* (AR&R) and the requirements of this Specification. The Regional Flood Frequency Estimation Model referred to in this chapter of the AR&R is available at the following link: http://rffe.arr-software.org/

D5.07 HYDROLOGICAL MODELS – URBAN CATCHMENTS

Urban Catchment Modelling

1. Urban Catchments are to be modelled in accordance with of *Book 9 Runoff in Urban Areas* of AR&R. The appropriate model to be used for urban catchments is up to the discretion of the designer, as long as the requirements of AR&R are met.

HYDRAULICS

D5.08 HYDRAULIC GRADE LINE

Qualified Person

Calculations

1. Hydraulic calculations shall generally be carried out in accordance with AR&R and shall be undertaken by a qualified person experienced in hydrologic and hydraulic design. The calculations shall substantiate the hydraulic grade line adopted for design of the system and shown on the drawings. Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output.

Major/Minor systems

2. The "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.

Downstream Control

3. Downstream water surface level requirements are given below:-

   (a) Known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event.

   (b) Where the downstream starting point is a pit and the hydraulic grade line is unknown, a level of 0.15m below the invert of the pit inlet in the downstream pit is to be adopted.

   (c) Where the outlet is an open channel and the design storm is the minor event, the top of the outlet pipe shall be the downstream control.

   (d) Where the outlet is an open channel, the design storm is the major event and downstream flood levels are not known, the top of the outlet pipe shall be the downstream control.

   (e) Where the outlet is an open channel, the design storm is the major event and downstream flood levels are known, the downstream control shall be the 1% AEP flood level.

Water Surface Limits

4. The water surface in drainage pits shall be limited to 0.150m below the gutter invert for inlet pits and 0.150m below the underside of the lid for junction pits.

D5.09 MINOR SYSTEM CRITERIA

Gutter Flow Widths

1. The acceptable gutter flow widths for the minor system design AEP event, as set out in D5.04.5, is 2.5 metres maximum.

2. Minimum conduit sizes shall be as follows: ***Conduit Sizes***

- Pipes: 375mm diameter.
- Box culverts: 600mm wide x 300mm high.
- Individual Lot Connections: 100 mm (minimum).

3. Minimum and maximum velocity of flow in stormwater pipelines shall be 0.6m/sec and 6m/sec respectively. ***Velocity Limits***

4. Stormwater pipelines shall not be located directly above or below other underground services. ***Clearance from Services***

Where a stormwater pipeline crosses or is constructed adjacent to an underground service minimum clearances between the stormwater pipelines and other services is given in Table D5.1 below:-.

Service	Clearance (mm)
Horizontal	
All Services	600
Vertical	
Sewer	150
Water main	75
Communication	75
High Pressure Gas	300
Low Pressure Gas	75
High Voltage Electricity	300
Low Voltage Electricity	75

Table D5.1 Minimum Clearances

5. Requirements for private pipes entering Council's system are given below:-

(a) All pipe inlets, including roof and subsoil pipes, shall where possible, enter the main pipe system at junction pits. These shall be finished off flush with and be grouted into the pit wall.

(b) If a junction has to be added which is larger than 225mm then a junction pit shall be built at this location in accordance with this Specification

(c) For smaller inlets, the drainage pipes may be connected into the main line provided:

i. adequate structural strength can be achieved at the junction;

ii. the centre line of the branch shall intersect centre line of the main;

iii. a manhole or inspection opening shall be located on the branch within 20m of the main;

iv. the connection angle between the branch and the upstream leg of the main shall be between 45° and 90°

6. The maximum recommended spacing of pits where flow widths are not critical are given in Table D5.2 below:

	Pipe Size (mm)	Spacing (m)
Generally	less than 1200	100
	1200 or larger	150

Table D5.2 Pit Spacing

Inlet Capacity

7. Kerb inlet lengths to side entry pits are to be a preferred maximum of 3.0m, with an absolute maximum of 5.0m where the grade is 10% or more, and an absolute maximum of 4.0m where the grade is less than 10%.

8. Information on pit capacities is available in the following sources:-

- Roads and Traffic Authority's "Model analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings", with due allowance to inlet bypass due to grade, for grade inlet pits, and recognised orifice or weir formulae for sag inlet pits.
- Pit relationships given in *Book 9 Runoff In Urban Areas, Chapter 5 Stormwater Conveyance* of AR&R.

Allowance for Inlet Blockage

9. The percentage of theoretical capacity (due to blockage factors) allowed in relation to type of pit is given in Table D5.2 below:-

Condition	Inlet Type	Percentage of Theoretical Capacity Allowed
Sag	Side entry	80%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	"Letterbox"	50%
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%
Sag or Grade	Inlet headwall	70%

Table D5.3 Allowable Pit Capacities

D5.10 HYDRAULIC LOSSES

Pit Losses

1. Hydraulic losses at pits and junctions shall be included using the pressure change co-efficient, determined from *Book 9 Runoff In Urban Areas, Chapter 5 Stormwater Conveyance* of AR&R.

2. Pipeline systems are to be streamlined where possible, including benching in pits,

to reduce head losses through the pits.

3. Computer program default pressure change co-efficients shall not be acceptable unless they are consistent with those from the approved head loss charts. The chart used and relevant co-efficients adopted shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

Bend Losses

4. Bends may be permissible in certain circumstances and a discussion with Council regarding their use is required prior to detailed design.

Pipe Junction Losses

7. Construction of a junction without a structure should be avoided where possible. Permission to do this is required by Council prior to detailed design.

Contraction/ Expansion Losses

8. Going from larger upstream to smaller downstream conduits is not permitted without approval of Council prior to detailed design. In going from smaller to larger pipes benching shall be provided in pits to enable a smooth flow transition. Losses in sudden expansions and contractions are given in the approved head loss charts.

Pipe Friction Losses

9. Drainage pipe systems shall be designed as an overall system, with due regard to the upstream and downstream system and not as individual pipe lengths. Drainage pipeline systems shall generally be designed as gravity systems flowing full at design discharge, but may be pressurised with the use of appropriate pits and joints.

D5.11 MAJOR SYSTEM CRITERIA

Surcharging

1. Surcharging of drainage systems which would provide for water depth above the top of kerb will not be permitted except:

(a) Surcharging of drainage system for storm frequencies greater than 5% AEP may be permitted across the road centreline where the road pavement is below the natural surface of the adjoining private property.

(b) Flow across footpaths will only be permitted in situations specifically approved by Council, where this will not cause flooding of private property.

Velocity/ Depth Criteria

2. The velocity x depth product of flow across the footpath and within the road reserve shall be such that safety of children and vehicles is considered. The maximum allowable depth of water is 0.2 metres and the maximum velocity x depth product of $0.4m^2/s$ is permitted. Where the safety of only vehicles can be affected, a maximum velocity x depth product of $0.6m^2/s$ is permitted. In open channels the above velocity x depth product criteria will be followed where possible or the design shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

Freeboard

3. Freeboard requirements for floor levels and levee bank levels from flood levels in roadways, stormwater surcharge paths and open channels are given below:

In Roadways:-

(a) A minimum freeboard of 0.5m shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car parks. A higher freeboard may be required in certain circumstances.

(b) Where the road is in fill or overtopping of kerbs and flow through properties may occur a 100mm freeboard shall be provided between the ponding level of water in the road and the high point in the footpath. Driveway construction in these instances needs to consider this requirement.

In Stormwater Surcharge Paths:-

(c) A minimum freeboard of 0.5 shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car

parks.

In Open Channels:-

(d) A minimum freeboard of 0.5m shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car parks.

4. Flow capacities of roads shall be calculated in accordance with *Book 9 Runoff In Urban Areas, Chapter 5 Stormwater Conveyance* of *AR&R*.. ***Roadway Capacities***

D5.12 OPEN CHANNELS

1. Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where Council permits the use of an open channel to convey flows from a development site to the receiving water body, such a channel shall comply with the requirements of this Specification. ***Safety***

2. Design of open channels shall be in accordance with *Book 6, Chapter 2 Open Channel Hydraulics of AR&R*. Open channels will be designed to contain the major system flow less any flow that is contained in the minor system, with an appropriate allowance for blockage of the minor system. ***Open Channel Design***

4. Where the product of average Velocity and average flow Depth for the design flow rate is greater than 0.4m^2/s, the design will be required to specifically provide for the safety of persons who may enter the channel in accordance with *Book 6, Chapter 7 Safety Design Criteria, of AR&R*.

5. Maximum side slopes on grassed lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 20. ***Side Slopes***

6. Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel. Subsurface drainage shall be provided in grass lined channels to prevent waterlogging of the channel bed. The width of the concrete lined channel section shall be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor. ***Low Flows***

7. Transition in channel slopes to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition. ***Hydraulic Jumps***

D5.13 MAJOR STRUCTURES

1. All major structures in urban areas, including bridges and culverts, shall be designed for the 1% AEP storm event without afflux. Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding is minimal and does not inundate private property. ***Afflux***

2. A minimum clearance of 0.3m between the 1% AEP flood level and the underside of any major structure superstructure is required to allow for passage of debris without blockage. ***Freeboard***

3. Certified structural design shall be required on bridges and other major culvert structures and may be required on some specialised structures. Structural design shall be carried out in accordance with the Specification for STRUCTURES BRIDGE DESIGN.

4. Culverts (either pipe or box section) shall be designed using established design techniques in AR&R. Design charts from Concrete Pipe Association, 1986, *Hydraulic* ***Culverts***

Design Manual may be used, with due regard being given to inlet and exit losses, inlet and outlet control and scour protection.

Culvert crossings in urban areas shall be designed for a 1% AEP flow with an upstream freeboard of at least 0.6m.

Culverts shall be sized in accordance with Section 3 Culverts, of the Concrete Pipe Association of Australia, *Hydraulics of Precast Concrete Conduits*.

STORMWATER DETENTION

D5.14 DETENTION BASINS (DRY BASINS)

1. This section applies to all developments other than an individual dwelling, multi-unit development or commercial development on existing lots of land. Typically included are multiple allotments, subdivisions and areas greater than 2500m^2.

. General Requirements: ***Detention Basin requirements***

- Detention storages are to be designed to meet the Permissible Site Discharge as indicated in Table D5.4;
- The use of natural and existing flood storage is preferred;
- Engineered detention systems are not to be placed over natural water bodies. Engineered detention systems should not create artificial ponding of water body buffer areas as defined in section D7.09 Buffer Zones; and
- Detention areas should be dual purpose, where possible and make use of existing open space and storage opportunities.

Location	Permissible Site Discharge
Non urban catchments	Predevelopment peak discharge rates for 20% and 1% AEPs not to be exceeded.
Previously developed catchments	Peak discharge rate for the existing development for 20% and 1% AEPs not to be exceeded.

Table D5.4 Permissible Site Discharges for Detention Basins

3. Stormwater detention facilities shall be combined with Retention structures to maintain the water cycle regimes within each catchment area. Refer to Specification D7 EROSION CONTROL AND STORMWATER MANAGEMENT for details of infiltration and bioretention systems. ***Detention and Retention Structures***

4. For each AEP a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin. Design temporal patterns shall be derived from methods set out in AR&R. Sensitivity to storm pattern should be checked by reversing these storm patterns. ***Critical Storm Duration***

5. The critical storm duration with the retarding basin is likely to be longer than without the basin. A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

6. Flood Routing should be modelled by methods outlined in AR&R. ***Routing***

7. The high level outlet to any retarding basin shall have capacity to contain a minimum of the 1% AEP flood event. Additional spillway capacity may be required due to the hazard category of the structure. The hazard category should be determined by reference to ANCOLD.

High Level Outlet

8. The spillway design shall generally be in accordance with the requirements for Open Channel Design in this Specification.

9. Wherever practical and certainly in areas known to be affected by high water tables and/or salinity of groundwater, retarding basins shall be designed to be water retentive so that surface drainage water does not leak to the subsurface, recharging groundwater.

Salinity Prevention

10. Pipe systems shall contain the minor flow through the Retarding Basin wall. Outlet pipes shall be rubber ring jointed with lifting holes securely sealed. Pipe and culvert bedding shall be specified to minimise its permeability, and cut off walls and anti-seepage collars installed where appropriate.

Low Flow Provision

11. The low flow pipe intake shall be protected to prevent blockages.

12. Freeboard - Minimum floor levels of dwellings shall be 0.5m above the 1% AEP flood level in the basin.

Freeboard at Dwellings

13. Public Safety Issues - Basin design is to consider the following aspects relating to public safety.

Safety Issues

- Side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress.
- Water depths shall be, where possible, less than 1.2m in the 5% AEP storm event. Where neither practical nor economic greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered.
- The depth indicators should be provided indicating maximum depth in the basin.
- Protection of the low flow intake pipe shall be undertaken to reduce hazards for people trapped in the basin.
- Signage of the spillway is necessary to indicate the additional hazard.
- Basins shall be designed so that no ponding of water occurs on to private property or roads.
- No planting of trees in basin walls is allowed.
- No basin spillway is to be located directly upstream of urban areas.
- Submission of design Drawings to the Dam Safety Committee is required where any of these guidelines are not met or Council specifically requires such submission.

D5.15 ON SITE STORMWATER DETENTION

1. This section applies to individual dwellings, multi-unit developments, commercial and industrial developments .

2. General Requirements:

On Site Detention Requirements

- On Site Detention (OSD) systems are to be designed to meet the Permissible Site Discharge as indicated in table D5.5.
- OSD systems may be combined with retention and reuse facilities to provide water balance and water supply reduction criteria.
- All OSD facilities must be fitted with an overflow, which drains to a drainage discharge point approved by Council and designed to permit flows of at least an 1% AEP with a freeboard requirement to floor levels as required by section D5.12

Location	Permissible Site Discharge
Vacant or previously undeveloped land within an existing subdivision.	Predevelopment peak discharge rates for AEPs of 20% and 1% not to be exceeded. Predevelopment impervious area of not more than 40% to be adopted
Redevelopment	Peak discharge rate for the existing development for AEPs of 20% and 1% not to be exceeded.

Table D5.5 Permissible Site Discharges for On Site Detention

3. OSD systems may consist of the following:

OSD Types

- Above ground grassed or landscaped areas;
- Above ground shallow ponding on driveways and parking areas;
- Roofwater/Rainwater storage tank;
- Underground storage tank; and/or
- Combinations of the above.

4. An OSD system must discharge through a control pit or similar comprising:

Discharge Requirements

- Orifice plates that are corrosion resistant stainless steel. Where the orifice is less than 150mm the plate will be a minimum of 3mm thick. Where the orifice is 150mm or larger, the plate will be a minimum of 5mm thick;
- Have an outlet opening designed so as to avoid the likelihood of being blocked;
- Have a discharge control pit that is fitted with an internal screen to protect the orifice from blockage;
- Be marked by a plate in a prominent position which states *"This is an onsite detention system. Do not reduce the volume of the storage tank and basin or interfere with the orifice plate that controls the outflow"*.

5. Above ground landscaped area OSD shall meet the following requirements:

Above Ground Landscaped OSD

- Will not be constructed across lot boundaries;
- Depth of OSD storage will be no greater than
    - o 300mm if stepped

- 1200mm with side slopes of less than 6 horizontal to 1 vertical
- 1500mm with a childproof fence to all sides if side slopes are steeper than 6 horizontal to 1 vertical.

- The base of the OSD is to be permeable to allow infiltration, subject to salinity prevention concerns as set out in section D5.16 (4); and
- Storage walls of the OSD must be impermeable.

6. Above ground paved surface OSD shall meet the following requirements:

Above Ground Paved Area OSD

- The base of the storage must be graded so that the storage empties and water does not pool;
- Water storage depths will not exceed 150mm in vehicle parking areas and 180mm in other areas; and
- The storage area including the base and walls will be impermeable.

7. Roofwater/Rainwater Storage Tanks and Combined Systems shall meet the following requirements:

Roof water and Combined OSD

- If roof water is to be reused then it must be kept separate to any surface runoff water and only 50% of the tank volume may contribute to the overall OSD storage capacity;
- Details of freeboard, additional storage and overflow from the roof water storage tanks are to be submitted with the Design calculations; and
- Roof water storage tanks discharging to other OSD types will then meet the requirements of the other type.

8. Underground OSD storage tanks will meet the following requirements:

Underground OSD

- Access to underground storage tanks must be secured with an approved grate or cover and be fastened to prevent unauthorised access to the tank;
- The access is to remain accessible and no works carried out which will cover the access undertaken, including concreting or paving over or covering with landscaping material or plants;
- Access pit openings shall be:

  600mm x 600mm for depths up to 600mm

  900mm x 900mm for depths greater than 600mm

- The floor of the storage must be graded so that the storage empties and water does not pool in the tank;
- Tank materials must be structurally adequate and corrosion resistant. Details are to be provided to and approved by Council prior to construction commencing. The tank must not be installed over or immediately adjacent to a water main , sewer main or other service authority's infrastructure;
- The storage shall not be installed adjacent to large trees or the roots of large trees; and
- Storage tanks shall not be installed into the groundwater zone without the

approval of Council.

9. Location of basins for stormwater detention, stormwater treatment or sedimentation purposes shall avoid areas that are known to be permanent or seasonal groundwater discharge areas. This action reduces the likelihood of recharge into the groundwater.

Salinity Prevention

10. Any development requiring on site detention is to provide but not limited to the following minimum data requirements prior to development consent being granted

Details to be submitted to Council at DA Stage

- Calculation sheet in accordance with *AR&R 2016* for the 20% and 1% AEP flows for the site for the pre and post development states. An example calculation sheet is provided in Council's *Handbook of Drainage Design Criteria*;
- Calculations for required storage volume and discharge rates, flow paths and overflow capacities;
- Where WSUD is required or proposed, calculations and details of both OSD & WSUD components demonstrating the two components are integrated systems;
- Design plans with include:
  - Existing and final design layout & contours;
  - Internal drainage system;
  - Location of storage(s) (must be wholly within site property boundary);
  - Location and details of outlets & discharge control device including levels;
  - Catchment area discharging to each storage;
  - Max surface water level for each storage;
  - Overflow structures and/or surcharge path(s);
  - Cross Section of storages & discharge control; and
  - Design Checklist & Certification from Designer.

11. Following construction of on site detention system, prior to subdivision certificate or Occupation certificate being issued Work as Executed Plans with certification of construction from the designing engineering is to be submitted to Council as well as evidence of a restriction of use of the land and positive covenant (Section 88E of the Conveyancing Act) over the lot in favour of Council registered. A sample Restriction on Use of Land and Covenant is provided in D5-D.

Details to be submitted to Council following Construction

INTERALLOTMENT DRAINAGE

D5.16 INTERALLOTMENT DRAINAGE

1. Interallotment Drainage shall be provided for every allotment which does not drain directly to its frontage street or a natural watercourse.

2. Interallotment drainage shall be contained within an easement not less than 2.5m wide and the easement shall be in favour of the upstream allotments and also Council where the interallotment drainage system serves more than one upstream lot. The interallotment drainage pipes shall be laid centrally in the easement and parallel to the allotment boundary.

3. Pipe Capacity - The interallotment drain shall be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design AEP the same as the "minor" street drainage system.

4. The following areas of impervious surface areaassumed to be contributing runoff to the interallotment drain:

Impervious Area

Area/Zoning Type	Proposed % Impervious
Large Lot Residential	20 %
Residential	
400 - 600 m^2	70 %
600 - 800 m^2	65 %
800 - 1000 m^2	60 %
> 1000 m^2	40 %
Multi-dwelling	75 %
Commercial	85 %
Playing fields/Parks	10 %
Rural/Open country < 10 % slope	40 %
Steep rocky country > 10 % slope	70 %

Table D5.6 Percentage of Impervious Areas

5. Pipes shall be designed to flow full at the design discharge without surcharging of inspection pits.

6. Interallotment drainage pits shall be located at all changes of direction. Pits shall be constructed of concrete, with 100mm thick walls and floor and have a minimum 600 x 600 internal dimensions. Pits shall be fitted with a 100mm concrete lid finished flush with the surface of works. Depressed grated inlets are also acceptable.

Pits

7. Pipes - Minimum Grade - The interallotment drainage shall have a minimum longitudinal gradient of 0.5%.

Grade

8. Where interallotment drainage and sewer mains are laid adjacent to each other they are to be spaced 1.0 metre between pipe centrelines (where the pipe inverts are approximately equal) and contained within a 3.0 metre wide easement.

Relationship to Sewer

PUMP OUTS

D5.17 STORMWATER PUMP OUTS

1. Stormwater pump out systems are not encouraged by Council and will only be considered as a last resort option for any development.

Applicability

2. Pump outs will only be considered from draining driveways, paved areas and car parks. Pump outs cannot be used in lieu of On Site Detention or to drain On Site Detention.

3. Pump lines must terminate within the property boundary to a stilling pit from which drainage is by gravity to Council's Stormwater System.

Drainage to Council infrastructure

4. An Inspection and Maintenance schedule shall be incorporated into the Strata By-Laws or Management Statement of the development.

On-going Maintenance

DETAILED DESIGN

D5.18 CONDUITS

1. Stormwater pipelines shall be constructed with either of the following: ***Materials and Pipe Class***

- Class 4 steel reinforced concrete pipe (RCP) complying with AS/NZS 4058 and AS 3725; or
- SN8 (minimum rating) twin-wall, corrugated polypropylene pipes complying with AS/NZS 5065.

The use of two or more types of pipe material on a single length of pipeline is not acceptable.

2. Installation, pipe bedding and cover requirements for reinforced concrete pipes shall be determined from the Concrete Pipe Association "*Concrete Pipe Guide*" or AS 3725. ***Bedding and Cover***

Installation, pipe bedding and cover requirements for twin-wall, corrugated polypropylene pipes shall be determined from AS/NZ 2033.

3. Pipes need to be capable of resisting root intrusion, hydraulic pressure and soil loading. Joints shall preferably have a degree of flexibility. ***Jointing***

RCP jointing shall be as follows:

- 100mm to 375mm diameter pipes shall be rubber ring jointed;
- Greater than 375mm diameter shall be rubber ring jointed or flush jointed with an external proprietary band.
- 450mm to 675mm diameter pipes located under roadways shall have rubber ring joints.
- Pipes designed to operate under hydraulic conditions that exceed 2.0m pressure head shall have rubber ring joints.

Locations of various joint types shall be shown on the drawings.

The maximum allowable head for all pipes shall be in accordance with the appropriate Australian Standard.

4. Drainage lines in road reserves shall be located behind the kerb line and parallel to the kerb. In easements, drainage lines shall generally be centrally located. ***Location***

5. Bulkheads shall be designed on drainage lines where the pipe gradient exceeds 7%. The design details shall address the size, and position in the trench as well as spacing along the line. ***Bulkheads***

D5.19 PIT DESIGN

1. Pits shall be designed with benching to improve hydraulic efficiency and reduce water ponding. Safety and safe access are important considerations in pit design. Step irons shall be detailed where required and grates shall be of “bicycle safe” design. ***Pit Design***

D5.20 STORMWATER DISCHARGE

1. Stormwater discharge shall be located so as to avoid recharging groundwater and creating or worsening salinity degradation of adjacent land. Stormwater discharge shall ***Salinity Prevention***

be located to avoid areas with high groundwater tables, groundwater discharge areas or salt affected land. The Designer shall meet requirements of the appropriate land and water resources authority with regard to the salinity levels of discharge to natural watercourses.

2. Scour protection at culvert or pipe system outlets shall be provided and include energy dissipation arrangements. ***Scour Protection***

3. The kerb and gutter shall be extended to a drainage pit or natural point of outlet. Where outlet velocity is greater than 2.5m per second or where the kerb and gutter discharge causes scour, then protection shall be provided to prevent scour and dissipate the flow. ***Kerb & Gutter Termination***

4. At points of discharge of gutters or stormwater drainage lines or at any concentration of stormwater from one or on to adjoining properties, either upstream or downstream, Council will require the Developer to enter into a Deed of Agreement with the adjoining owner(s) to gain written permission to discharge stormwater and create any necessary easements with the cost of the easement being met by the Developer. ***Easements, Adjoining Owners***

5. Where the drainage is to discharge to an area under the control of another statutory authority, the design requirements of that Statutory Authority are also to be met. ***Other Authorities' Requirements***

6. The minimum drainage easement width shall be 2.5m for drainage systems that pass through existing or proposed allotments. The overall width of the easement in Council's favour will be such as to contain the full width of overland flow or open channel flow in the major system design event. ***Council Easement***

7. Piped stormwater drainage discharging to recreation reserves is to be taken to a natural water course and discharged in an approved outlet structure or alternatively taken to the nearest trunk stormwater line. ***Recreation Reserves***

D5.21 TRENCH SUBSOIL DRAINAGE

1. In cases where pipe trenches are backfilled with sand or other pervious material, a 3m length of subsoil drain shall be constructed in the bottom of the trench immediately upstream from each pit or headwall. The subsoil drain shall conform to materials specified in Specification D4, SUBSURFACE DRAINAGE DESIGN. The upstream end of the subsoil drain shall be sealed with cement mortar or other approved method, and the downstream end shall discharge through the wall of the pit or headwall. ***Trench Subsoil Drains***

DOCUMENTATION

D5.22 DRAWINGS

1. Catchment Area Plans shall be drawn to scales of 1:500, 1:4000 or 1:25000, unless alternative scales are specifically approved by Council and shall show contours, direction of grading of kerb and gutter, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system. ***Catchment Areas***

2. The Drainage System Layout Plan shall be drawn to a scale of 1:500 and shall show drainage pipeline location, drainage pit location and number and road centreline chainage, size of opening and any other information necessary for the design and construction of the drainage system. ***Drainage System Layout***

3. The plan shall also show all drainage easements, reserves and natural water courses. The plan shall be combined with the water reticulation and sewerage system plan where applicable.

4. The Drainage System Longitudinal Section shall be drawn to a scale of 1:500 horizontally and 1:100 vertically and shall show pipe size, class and type, pipe support type in accordance with AS 3725, pipeline and road chainages, pipeline grade, hydraulic grade line, existing and proposed other services crossing the stormwater pipe and any other information necessary for the design and construction of the drainage system. ***Longitudinal Section***

5. Open Channel Cross Sections shall be drawn to a scale of 1:100 natural and shall show the direction in which the cross sections should be viewed. ***Open Channels***

6. Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the Drawings to scales appropriate to the type and complexity of the detail being shown. ***Details***

7. Reduced levels are to be to Australian Height Datum (AHD). Survey Coordinates are to be to MGA94. ***Survey System Requirements***

8. Work-as-Executed Drawings shall be submitted to Council upon completion of the drainage construction and prior to the issue of the subdivision certificate. The detailed Drawings may form the basis of this information; however, any changes must be noted on these Drawings. ***Work-as-Executed Drawings***

D5.23 EASEMENTS AND AGREEMENTS

1. Evidence of any Deed of Agreement necessary to be entered into as part of the drainage system will need to be submitted prior to any approval of the engineering Drawings. Easements will need to be created prior to the issue of the Subdivision Certificate.

2. Where an agreement is reached with adjacent landowners to increase flood levels on their property or otherwise adversely affect their property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to any approval of the engineering Drawings.

D5.24 SUMMARY SHEETS

1. A copy of a Hydrology Summary Sheet providing the minimum information set out in Annexure D5-B is to be included with the final detailed design. ***Hydrology Summary Sheet***

2. A copy of a Hydraulic Summary Sheet providing the minimum information set out in Annexure D5-C is to be included with the final detailed design. ***Hydraulics Summary Sheet***

D5.25 COMPUTER PROGRAM FILES AND PROGRAM OUTPUT

1. Computer program output need not be provided as long as summary sheets for Hydrological and Hydraulic calculations in accordance with this Specification are provided with plans submitted for checking and with final Drawings.

2. Copies of final computer data files, for both hydrological and hydraulic models shall be provided for Council's data base of flooding and drainage information in formats previously agreed with Council.

SPECIAL REQUIREMENTS

D5.26 LOT CONNECTIONS

1. Where a stormwater tie needs to connect to the street drainage and a stormwater main is located on the same side of the street as the lot connection, the connection is to be made directly to the stormwater main using a saddle junction.

Connection to stormwater mains

2. Where a stormwater tie needs to connect to the street drainage and a stormwater main is not located on the same side of the street as the lot connection, a stormwater sub-main is to be constructed in the verge fronting the proposed allotments for the purposes of capturing the stormwater from these allotments. The sub-mains are to be appropriately sized and shall be connected to a street drainage stormwater pit.

Connection to Stormwater sub-mains

Lot connections to sub-mains are to be made using a saddle junction.

3. The use of kerb outlets for lot connections will only be considered by Council when the connection to stormwater main or the installation of a sub-main is considered unfeasible by Council.

Kerb Outlets

All kerb outlets are to be fitted with an approved metal kerb adaptor, the details of which are to be provided with the design submission. The kerb adaptor is to be the full height of the kerb and conform to the kerb profile. The inverts of the adaptor and kerb are to match. The installation of the kerb adaptor are to be undertaken in accordance with the manufacturer's specifications.

4. All pipes for kerb outlet connections are to be a minimum of SN10 and comply with the requirements of AS/NZ1260.

Lot Connection Materials

Pipes for lot connections to stormwater mains or sub-mains are able to be of a lower stiffness rating, provided they comply with the requirements of AS/NZ1260.

5. Lot Connections (Stormwater pipes connecting lots to Council's stormwater system) do not form part of the Council's system, except where Council deems that the pipe forms part of a trunk drainage system or interallotment drainage system.

Lot Connections

6. All lot connections remain the responsibility of the lot owner to maintain,

Maintenance

ANNEXURE D5-A

STANDARD DRAWINGS

The following ACT Transport Canberra and City Services standard drawings, as amended by Council, are deemed to comply for the purposes of this specification.

DRAWING NUMBER	DATE / REVISION	TITLE	QCC AMENDMENT / COMMENT
DS1 STORMWATER			
ST-0001	Mar 98 / Rev 02	Pipe Junctions	Only permissible for connection to street drainage network. Not suitable for interallotment drainage. Branch connection >150 dia not used by QPRC.
ST-0002	Mar 98 / Rev 02	Pipe Details	QPRC concurrence required before use – generally not used by QPRC.
ST-0011	Mar 98 / Rev 04	Sump Inlets on Kerbs and Gutters	Adopted by QPRC.
ST-0012	Mar 98 / Rev 02	Type R and QS Sumps	Adopted by QPRC.
ST-0013	Mar 98 / Rev 02	Plantation and Grated Sumps	Adopted by QPRC.
ST-0014	Mar 98 / Rev 02	1050 ND Manholes	Precast Maintenance Holes should comply with WSA 02 – 2002-2.3, drawings SEW-1300 to SEW-1312 as applicable, rather than NSWGSS Drg 1380.
ST-0015	Mar 98 / Rev 02	Special Chambered Manholes	Adopted by QPRC.
ST-0016	Mar 98 / Rev 02	Surcharge Structures	Adopted by QPRC.
ST-0017	Mar 98, Rev 02	Structures – Miscellaneous Details	Adopted by QPRC.
ST-0018	Mar 98, Rev 02	Pipe Connections to Structures	Adopted by QPRC.
ST-0019	Mar 02 / Rev 01	Multiple Type R Sumps on Kerb and Gutter	Adopted by QPRC.
ST-0021	Mar 98 / Rev 02	Pipe Culverts 300 – 675 Dia – Endwalls	Adopted by QPRC.
ST0022	Mar 98 / Rev 02	Pipe Culverts 750 – 1200 Dia – Headwalls	Adopted by QPRC.
ST-0023	Mar 98 / Rev 02	Precast Box Culverts - Endwalls	Adopted by QPRC.
ST-0024	Mar 98 / Rev 02	Precast Box Culverts - Headwalls	Adopted by QPRC.
ST-0025	Mar 98 / Rev 02	Floodway Low Flow Provisions	Adopted by QPRC.
ST-0026	Mar 98 / Rev 02	At-Grade Floodway Crossings	Adopted by QPRC.
ST-0031	Mar 98 / Rev 02	Minor GPT Layout – Parallel to Floodway	Adopted by QPRC.
ST-0032	Mar 98 / Rev 02	Minor GPT Layout – Perpendicular to Floodway	Adopted by QPRC.
ST-0033	Mar 98 / Rev 02	Major GPT Layout	Adopted by QPRC.
ST-0034	Mar 98 / Rev 02	GPT Trash Racks	Adopted by QPRC.
ST-0041	Mar 98 / Rev 02	Floodway Advisory Sign	Adopted by QPRC.
DS3 ROAD DESIGN			
DS3-01	Aug 02	Kerb & Gutter Standard Details – Sheet 1	Adopted by QPRC.
DS3-02	Aug 02	Kerb & Gutter Standard Details – Sheet 2	Adopted by QPRC.
DS7 BRIDGES AND ASSOCIATED STRUCTURES			

DRAWING NUMBER	DATE / REVISION	TITLE	QCC AMENDMENT / COMMENT
DS7-05	Aug 02	Bridge Identification Plate	Not used by QPRC.
DS7-06	Aug 02	Pedestrian Bridge Barrier Railings	Adopted by QPRC.

ANNEXURE D5-B

HYDROLOGY SUMMARY SHEET

HYDROLOGY DATA AND RESULTS

		TIME OF CONCENRATION						AREA		FLOWS							CRITICAL AREA DATA		
		IMPERVIOUS			PERVIOUS							SURFACE FLOWS							
															PRIMARY PATH				
NODE NAME	RETURN PERIOD	LENGTH	SLOPE	Tc	LENGTH	SLOPE	Tc	TOTAL	IMPERVIOUS	TOTAL FLOW	PIPE FLOW	CATCHMENT CONTRIBUTIC	TOTAL GUTTER FLOW	CAPTURED FLOW	DESTINATION	FLOW	CRITICAL AREA Tc	INTENSITY	EQ. IMPERVIOUS AREA
		m	%	min	m	%	min	ha	ha	cms	cms	cms	cms	cms		cms	min	mm/hr	ha

ANNEXURE D5-C

HYDRAULIC SUMMARY SHEET

HYDRAULIC DATA AND RESULTS

				CONDUIT DATA											DATA AT UPSTREAM MANHOLE							
															MANHOLE LOSSES							
UPSTREAM PIT NAME	DOWNSTREAM PIT NAM	NUMBER OF CONDUITS	RETURN PERIOD	TOTAL LENGTH	DIAMETER OR HEIGHT	PIPE CLASS	UPSTREAM INVERT	DOWNSTREAM INVERT	CONDUIT GRADE	UPSTREAM HGL	DOWNSTREAM HGL	FRICTION GRADE	FLOW	VELOCITY	Ku	Kw	INLET CAPACITY	INLET INFLOW	PONDING LEVEL LIMIT	MANHOLE COVER LEVE	WATER SURFACE LEVEI	FREEBOARD
				m	m		m	m	%	m	m		cms	m/s			cumec	cms	m	m	m	