PLANNING SCHEME POLICY

STORMWATER DRAINAGE DESIGN

Mackay Region
PLANNING SCHEME

Mackay REGIONAL COUNCIL

Planning scheme policy – stormwater drainage design

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Amendment history

This planning scheme policy commenced on 24 July 2017 as part of the Mackay Region Planning Scheme 2017. Amendments since this date are listed in the below table.

Version number	Amendment title	Summary of amendment	Date adopted and commenced
1.1	Planning scheme policy amendment 2	This amendment makes changes to reflect modern requirements.	Adopted 28 October 2020 Commenced 9 November 2020
1.0	Planning scheme administrative amendment 6, and Planning scheme policy administrative amendment 1	This amendment removed the planning scheme policies from Schedule 6 of the Mackay Region Planning Scheme 2017 and placed them in individual PDFs on Council's website. This amendment introduced standardised formatting, introductory sections and explanatory information regarding intent and legislative relationship for this planning scheme policy. It also updated numbering and cross references.	Adopted 11 December 2019 Commenced 3 February 2020

1 Introduction

1.1 Application

This planning scheme policy supports the Mackay Region Planning Scheme 2017 by providing information on:

- How to achieve compliance with assessment benchmarks;
- Supporting information/studies required; and/or
- Actions required under the development assessment process.

This planning scheme policy has been made by Mackay Regional Council (Council) in accordance with Chapter 2, Part 3, Division 2 of the *Planning Act 2016*.

1.2 Relationship with planning scheme

Mackay Region Planning Scheme 2017 refers to this planning scheme policy in assessment benchmarks in the following code/s or any other relevant part of the scheme:

(a) Table 9.4.1.3.A – General development requirements code

1.3 Purpose

This planning scheme policy is about the design of stormwater drainage systems (quantity). The policy for stormwater quality management (including erosion and sediment control and acid sulfate soil management) is the Planning scheme policy – healthy waters.

The purpose of this planning scheme policy is to:

- Set out the guidelines for the design of stormwater drainage systems for urban and rural areas.
- Ensure stormwater drainage is designed to:
  (a) provide a drainage system that will collect and convey stormwater from a catchment to its receiving waters with minimal nuisance, danger or damage and at a financial and environmental cost that is acceptable to the community as a whole;
  (b) limit flooding of public and private property, both within the catchment and downstream, to acceptable levels;
  (c) provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed velocity/depth limits; and
  (d) be in accordance with Council's flood and stormwater drainage studies.

For new projects, the Designer shall design a stormwater drainage system for the overall project in accordance with the "major/minor" system concept in accordance with Queensland Urban Design Manual (QUDM) or the TMR Road Drainage Manual whichever is applicable. 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.

For redevelopment of existing areas or transfer of external catchments, 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 Average Exceedance Probability of the receiving minor system is no greater than would be expected from the existing area. Further, it is not to be concentrated in such a way as to cause nuisance to downstream properties.

1.4 Referenced documents

(a) Council guidelines and specifications:
  (i) Mackay Regional Council - Guideline for Preparation of Flood and Stormwater Drainage Catchment Reports
  (ii) Mackay Regional Council – List of Plant Species
  (iii) Mackay Regional Council – D20 Drawings and Documentation Guideline - https://www.mackay.qld.gov.au/__data/assets/pdf_file/0005/13964/D20.pdf
  (iv) Stormwater drainage studies and flood studies - https://www.mackay.qld.gov.au/business/planning_and_development/waterway_and_coastal_hazard_planning/flood_studies
  (v) External Documents Register - https://www.mackay.qld.gov.au/__data/assets/pdf_file/0003/253380/External_Document_Registry_for_Technical_Services_2019_002.pdf
  (vi) Construction standard C220 – Stormwater drainage – general
  (vii) Construction standard C221 – Pipe drainage
  (viii) Construction standard C222 – Precast box culverts
  (ix) Construction standard C223 – Drainage structures
  (x) Construction standard C224 – Open drains including and kerb and gutter
  (xi) Mackay Regional Council (MRC) Supplementary Specifications - https://www.mackay.qld.gov.au/business/planning_and_development/design_and_construction_requirements/design_guidelines2
  (xii) ADAC Guidelines -

https://www.mackay.qld.gov.au/business/planning_and_development/design_and_construction_requirements/design_guidelines

(xiii) Standard drawings - https://www.mackay.qld.gov.au/business/planning_and_development/design_and_construction_requirements/standard_drawings/drainage

(b) Department of Transport and Main Roads (TMR) Specifications:

MRTS03 Drainage, Retaining Structures and Protective Treatments
MRTS04 General Earthworks
MRTS06 Reinforced Soil Structures
MRTS14 Road Furniture
MRTS15 Noise Fences
MRTS16 Landscape and Revegetation Works
MRTS24 Manufacture of Precast Concrete Culverts
MRTS25 Steel Reinforced Precast Concrete Pipes
MRTS26 Manufacture of Fibre Reinforced Concrete Drainage Pipes
MRTS27 Geotextiles (Separation and Filtration)
MRTS28 Contractor's Site Facilities and Camp
MRTS45 Road Surface Delineation
MRTS46 Skid Resistant Friction Coating for Steel Road Plates
MRTS51 Environmental Management
MRTS52 Erosion and Sediment Control
MRTS55 Use of Explosives in Roadworks
MRTS100 High Strength Geosynthetic Reinforcement in Road Embankments
MRTS140 Horizontal Directional Drilling (HDD)
MRTS141 Microtunnelling and Pipe Jacking
MRTS142 Thrust Boring and Auger Boring

(c) Australian Standards:

(i) AS/NZS 1254 –PVC-U pipes and fittings for stormwater and surface water applications
(ii) AS/NZS 2032 –Installation of PVC pipe systems
(iii) AS/NZS 2566.1 – Buried flexible pipelines, structural design
(iv) AS/NZS 3725 – Design for installation of buried concrete pipes
(v) AS/NZS 4058 – Precast concrete pipes (pressure and non-pressure)
(vi) AS/NZS 4139 – Fibre reinforced concrete pipes and fittings
(vii) AS/NZS 1597.1 & AS/NZS 1597.2 - Precast reinforced concrete box culverts
(viii) AS/NZS 2041 – Buried corrugated metal structures

(d) Queensland legislation:

(i) *Local Government Act 2009*
(ii) *Planning Act 2016*
(iii) *Environmental Protection Act 1994*
(iv) *Water Act 2000*
(v) *Fisheries Act 1994*
(vi) *Coastal Protection and Management Act 1995*
(vii) *Aboriginal Cultural Heritage Act 2003*

(e) Queensland and Australian Government:

(i) Commonwealth of Australia (Geoscience Australia). 2019. *Australian Rainfall and Runoff, a guide to flood estimation (ARR)*
(ii) State of Queensland (Department of Infrastructure, Local Government and Planning). 2017. State Planning Policy, State interest – natural hazards, risk and resilience
(iii) State of Queensland (Department of Transport and Main Roads). 2019. Road Drainage Manual, 3rd Edition.
(v) State of Queensland (Department of Agriculture, Fisheries and Forestry). 2013. Guide for the determination of waterways using the spatial data layer Queensland waterways for waterway barrier works.
(vi) State of Queensland (Department of Agriculture and Fisheries). 2018. Accepted development requirements for operational work that is constructing or raising waterway barrier works

(vii) State of Queensland (Department of Science, Information Technology, Innovation and the Arts). 2014. Queensland Acid Sulfate Soil Technical Manual
(viii) State of Queensland (Department of Natural Resources, Mines and Energy). 2018. Guidelines for the construction or modification of category 2 & 3 levees
(ix) State of Queensland (Department of Natural Resources, Mines and Energy). 2018. Guidelines for the construction or modification of category 1 levee
(x) State of Queensland (Department of Natural Resources and Mines). 2017. Guide for Flood Studies and Mapping in Queensland.
(xi) Queensland Government. 2007. Crime Prevention through Environmental Design, Guidelines for Queensland – Part A: Essential features for safer Places.
(xii) Queensland Government. 2007. Crime Prevention through Environmental Design, Guidelines for Queensland – Part B: Implementation Guide.

(f) Other:
(i) Austroads, Guide to Bridge Technology. 2018.
(ii) Brisbane City Council. 2000. Natural channel design guidelines. Document produced in co-operation with Grant Witheridge, Catchment and Creeks Pty Ltd

(iii) Chow, Ven Te. 1959. *Open channel hydraulics*
(iv) Concrete Pipe Association of Australia, *Concrete Pipe Guide, charts for the selection of concrete pipe to suit varying conditions*
(v) Henderson F.M.. 1966. *Open channel flow*
(vi) Institute of Public Works Engineering Australasia, Queensland (IPWEAQ), 2017 *Queensland Urban Drainage Manual (QUDM)*
(vii) Water by Design. 2012. Maintaining Vegetated Stormwater Assets

(g) Mackay Regional Council Policy
(i) Policy No 062 – Building Over or Adjacent to Constructed Council Drainage Systems and Easements
(ii) Policy No 063 – Clearances to water and sewerage assets

(h) Planning Scheme Policies
(i) Planning scheme policy – healthy waters
(ii) Planning scheme policy – structures – bridge design
(iii) Planning scheme policy – subsurface drainage design

1.5 General

A suitably qualified and experienced Professional Engineer who is certified as a Registered Professional Engineer Queensland (RPEQ) and is competent to perform stormwater drainage design shall undertake or oversee all aspects of the design. The design shall comply with all relevant requirements of:

(a) this planning scheme policy;

(b) all Reference and Source Documents listed in section 1.4;

(c) any Development Approval conditions relevant to the design;

(d) any specific relevant and reasonable request provided by Council in writing.

The RPEQ shall sign all plans associated with the drainage, certifying that the design complies with this section.

The Queensland Urban Drainage Manual (QUDM) and/or the Department of Transport and Main Roads Road Drainage Manual whichever is applicable shall be the basis for design of stormwater drainage except where amended by this Guideline.

The Designer shall ensure that Council's requirements relating to stormwater quality management, erosion and sediment control and acid sulphate soils are provided for in the stormwater design. These requirements are detailed in the Planning Scheme Policy - Healthy Waters.

Council has had prepared, or are in the process of producing, flood and stormwater drainage studies for several catchments. Where a study does not exist, the Designer may be required to prepare a stormwater drainage study as part of a development application. This should be discussed at pre-lodgement meetings. Details of drainage studies can be found on Council's website - https://www.mackay.qld.gov.au/business/planning_and_development/waterway_and_coastal_hazard_planning/flood_studies.

Access to existing flood and stormwater drainage models shall be subject to agreement via a Data Sharing Agreement. These models can be requested by contacting Strategic Planning via strategic.planning@mackay.qld.gov.au.

Requirements of the drainage study are reflected in Council's Guideline for Preparation of Flood and Stormwater Drainage Catchment Reports - https://www.mackay.qld.gov.au/__data/assets/pdf_file/0003/245487/Guideline_Flood_and_Stormwater_Reports.pdf.

The design of any stormwater drainage system shall:

(a) collect and convey stormwater from a catchment to its receiving waters with minimal nuisance, danger or damage, and at a financial and environmental cost that is acceptable to the community
(b) limit flooding of public and private property, both within the catchment and downstream, to acceptable levels
(c) provide for the safe movement of pedestrians and traffic during frequent (minor) stormwater flows by managing flow velocities and depths
(d) be consistent with any relevant flood and stormwater drainage study.

If the downstream system is not capable of carrying the modified discharge, the Designer shall indicate the measure proposed to ensure the downstream system is capable of carrying the modified discharge. This may involve negotiation with adjoining landowners to produce easements over downstream drainage paths from the development site to the legal point of discharge.

Alternatively, where the project will result in increased runoff, the stormwater drainage system may include on-site measures such as detention basins to ensure that the peak discharge from the project site is restricted to a level no greater than that discharging prior to the project.

This does not preclude the need to obtain downstream drainage easements for discharges where none currently exist.

The tests and principles of QUDM will be applied in determining if a lawful point of discharge has been achieved. If no lawful point of discharge or if no discharge approval agreement has been obtained, then the design cannot be accepted or approved.

All works proposed within creeks and natural watercourse must have the approval of all relevant authorities prior to commencing the work and evidence of such approvals shall be provided with the design submission.

The design of the stormwater drainage system shall accommodate the future developed peak flows from upstream catchments on the basis of potential development in accordance with the Planning Scheme.

The Designer shall be responsible for assessing the existing and future developed flow regime entering the development site from upstream catchments and shall provide detailed calculations with the design submission.

2 Design, construction and other criteria

2.1 Hydrology

The probability terms highlighted in Table 2.1 are the preferred terminology as adopted in Australian Rainfall and Runoff: *a guide to flood estimation* (ARR).

Table 2.1 Preferred terminology (Source: ARR Figure 1.2.1)

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	19.5
	0.02	2	50	49.5
	0.01	1	100	99.5
Very Rare	0.005	0.5	200	199.5
	0.002	0.2	500	499.5
	0.001	0.1	1000	999.5
	0.0005	0.05	2000	1999.5
Extreme	0.0002	0.02	5000	4999.5
			↓	
			PMP/ PMP Flood	

EY – Exceedances per Year
AEP – Annual Exceedance Probability
ARI – Average Recurrence Interval

2.1.1 Design rainfall data

The design rainfall intensities are to be obtained in accordance with ARR and Bureau of Meteorology (BOM) recommendations. Intensity–Frequency–Duration (IFD) data can be generated for specific locations at the BOM Design rainfall website. The link is - http://www.bom.gov.au/water/designRainfalls/ifd/.

For major events, the design AEP is the 1% AEP including climate change factor. For in-fill development, rehabilitation and reconstruction works within existing developed areas, Council may vary the design AEP to be compatible with existing conditions.

For minor events, the AEP depends on the zoning of the land being serviced by the drainage system. The minor system design AEP shall be as per Table 2.2.

Table 2.2 Minor System Annual Exceedance Probabilities

Development Category	AEP
Open space	63% (1 Exceedance per year)
Low/Medium density residential	39%
High density residential (>20 dwelling units/ha)	10%
Industrial	39%
Commercial	10%
Rural residential	39%
Principal centre	10%

For Cross-drainage requirements, refer to Section 7.3.7 & Table 7.3.1 in QUDM. Please note, a "Major" road, as defined in QUDM, is considered as a "Major Collector" road, and higher classifications, in Council's Road Hierarchy Overlay Maps (MRPS).

Where a project is designed in such a way that the major system flows involves surcharge across private property, then the underground system (both pipe and inlets) shall be designed to allow the collection and containment of flows having a 1% AEP including climate change factor flood event from the upstream catchment within an easement in the private property.

A surcharge path shall be defined for systems even where 1% AEP including climate change factor flows can be maintained within the underground system. Easements shall be provided in private property over pipe systems and surcharge paths.

2.1.2 Catchment area

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

The catchment boundary shall be determined by using the most accurate information available subject to such information being acceptable to Council as appropriate. This shall be presented to Council in a contour map along with the source of information.

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

Catchment plans shall be produced to reflect both the minor and major event catchments.

2.1.3 Rational method

Rational Method calculations to determine peak flows shall be carried out in accordance with QUDM. The rational method should only be used for small and simple rural catchments up to 25 km^2 and urban catchments up to 1km^2.

Details of percentage impervious for specific locations and for individual zonings shall be based on Table 2.3.

Table 2.3 Fraction Impervious

Planning Scheme Zone	f_i
Principal Centre	1.0
Commercial	0.9
Mixed Use	0.9
Higher Density Residential	0.7 to 0.9
Urban Residential (including roads)	0.5 to 0.7
Village (including roads)	0.5
Rural	0.0
Urban Expansion (including roads)	0.6
Rural Residential	0.2
Special Activities (Tourism)	0.75
Industry (High Impact)	0.9
Industry (Low Impact)	0.9
Sport and Recreation	0.0 – 0.9
Public Purposes	0.75
Open Space	Dependent on Use

The maximum time of concentration, to the first inlet pit, in an urban area is to be 20 minutes unless sufficient evidence is provided to justify a greater time.

Where the flow path is through areas having different flow characteristics or includes property and roadway, then the flow time of each portion of the flow path shall be calculated separately.

Where it is deemed more appropriate to determine the time of concentration for a particular area, flow paths to pits shall be representative of the fully developed catchment. The Designer shall consider such things as fencing and the likely locations of buildings with the flow path shown for each collection pit on the catchment area plan. Consideration shall be given to likely changes to individual flow paths due to the full development of the catchment.

2.1.4 Other hydraulic models

The use of hydrological models may be used as long as the requirements of ARR and QUDM are met.

Where computer analysis programs are used, copies of the final data files and details of all calculations shall be provided on submission of the design to Council along with the final drawings.

2.2 Hydraulics

2.2.1 Hydraulic grade line

The calculations shall substantiate the hydraulic grade line adopted for design of the system shown on the drawings.

The criteria for determining the downstream water surface level 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 downstream pit inlet is to be adopted;

(c) where the outlet is tidal or into other waterways the Designer shall refer to section 8.0 of QUDM;

(d) where the outlet is an open channel or natural watercourse and the design storm is the major event and the downstream flood levels are not known the top of the outlet pipe shall be the downstream control; and

(e) where the outlet is an open channel or natural watercourse, the design storm is the major event and downstream flood levels are known, the downstream control shall be the major event flood level.

The Designer shall take into consideration the following requirements during major flood events with regard to the road inundation depth:

(a) maximum depth of inundation at the kerb & channel lip to be limited to 300mm, based on the local catchment; and

(b) where the road reserve is adjacent to a trunk drain (as advised by Council) the road shall be graded such that the maximum water level from a 1% AEP including climate change event is to be less than 75mm at the kerb and channel lip.

The water surface in drainage pits shall be limited to 150mm below the kerb and channel invert for inlet pits and 150mm below the underside of the lid for junction pits.

In addition, detailed calculations shall be provided to substantiate compliance in relation to:

(a) depth of flow criteria in relation to surcharging of major system flows;

(b) flow velocities to ensure vehicle / pedestrian safety; and

(c) road reserve inundation depths.

2.2.2 Minor system criteria

The acceptable channel flow widths shall be in accordance with section 7.3.16 & 7.4 pf QUDM unless otherwise agreed by Council.

Minimum conduit sizes shall be as follows:

(a) pipes – 375mm diameter (under roads/streets); and

(b) box culverts – 600mm wide x 300mm high

Minimum and maximum velocity of flow in stormwater pipelines shall be in accordance with section 7.3.16 & Table 7.4.3 of QUDM.

2.2.3 Pits

Inlet Pits shall be spaced so that the channel flow width is limited in accordance with section 7.4 and so that the inlet efficiency is not affected by adjacent inlet openings. Preference is to be given to the location of drainage pits being centred opposite the side boundaries or centre of an allotment.

Other pits shall be provided:

(a) to enable access for maintenance;

(b) at changes in direction, grade, level or class of pipe; and

(c) at junctions.

Kerb inlet sections to gully pits are to be a preferred maximum of 2 number.

Information on pit capacities is available in the following sources:

(a) QUDM;

(b) pit relationships given in Volume 1, Chapter 14 or ARR; and

(c) pit manufacturer's charts.

The Designer is able to assume that MRC Standard gully pit has the same inlet capacity as a Bro Pit, but with no trough.

The Designer shall make allowance for a potential blockage as per the requirements of section of 7.5.2 of QUDM.

Note back inlet pits are not preferred because of conflict with services within the road verge. Lip in line lintel type pits are preferred.

2.2.4 Hydraulic losses

The pressure change co-efficient "Ke" shall be determined from the appropriate charts given in QUDM.

Allowable reduction in "Ke" due to benching is given in QUDM.

Construction of a junction without a structure should be avoided where possible. Approval to do this is required from Council prior to detailed design commencement. Where this is unavoidable, the pressure change co-efficients Ku, for the upstream pipe and KL, for the lateral pipe, shall be determined from the charts given in QUDM subclause 7.16.12 .

Going from larger upstream to small downstream conduits is to be in accordance with section 7.16.13 of QUDM.

2.2.5 Major system criteria

Surcharging of drainage systems which would provide for water depth in excess of the top of kerb will not be permitted except where the requirements of QUDM are met.

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 within the road reserve, at the lip of the kerb and channel, is 0.3 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 generally be followed or the Designer shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

Major storm flows in new developments shall be in accordance with QUDM. In situations where site earthworks or finished surface grades do not drain toward the new road frontage, the depth of the

major storm flow shall not extend above the top of the roadway kerb. Roadway flow capacity shall be determined in accordance with QUDM.

2.2.6 Open channels

Generally, open channels in urban areas 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 project site to the receiving water body, such channel shall comply with the requirements of this planning scheme policy.

The design of open channels shall be in accordance with QUDM. Council is also supportive of the approach adopted in the *Natural Channel Design Guidelines* published by Brisbane City Council. However, The Designer shall discuss this with Council and receive approval before adoption of the guideline principles.

Council has developed standard drawings for open channels to cater for a number of different settings and objectives. These include:

- Vegetated waterways
- Naturalised waterways
- Typical open channel

Council's List of Plant Species provides details of vegetation to be used in open channels. 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.
Mannings "n" Roughness Co-efficients for open channels shall generally be derived from information in ARR.

The Guideline for Preparation of Flood and Stormwater Drainage Catchment Reports (Mackay Regional Council) details the preferred catchment roughness values.

Where the product of average velocity and average flow depth for the design flow rates is greater than $0.4m^2/s$, the design will be required to be in accordance with ARR to specifically provide for safety and asset protection.

Side slopes on grassed lined open channels are to be as shown in Council's standard drawing. Channel inverts are generally to have minimum cross slopes of 1 in 20.

The clearance between the top of the side slope batter and the boundary of the reserve, or easement, shall be an absolute minimum of 1.0m as shown on Council's standard drawings.

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. Sub-surface drainage is to be provided in grass lined channels to prevent waterlogging of the channel bed.

Transitions in channel slopes are to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

Energy losses associated with channel transitions and channel bends shall be determined in accordance with section 9.3 or QUDM.

For all open drain sections provision is to be made for machinery access locations for maintenance purposes from a legal point of access to the base of the open drain. The grade and dimension of the access location shall be designed following discussions with Council as to the type & size of machinery used and the frequency and location of the machinery access required.

Where fences can possibly be designed to crossing the open channel flow paths requirements are to be put in place to ensure that fences are constructed in accordance with general standards shown on Council's standard drawings. All fencing is to allow free passage of flow.

2.2.7 Major structures

All major structures in urban areas, including all bridges and culverts of size indicated below shall be designed for the 1% AEP (including climate change factor) storm event.

Culverts specified as major structures would include:

- Metal culverts (steel and aluminium) with at least one barrel (cell) with span, height or diameter ≥ 1.2 m, or
- All other culverts:
  - pipes with at least one barrel (cell) with diameter ≥ 1.8 m, or
  - rectangular/oval/arch culverts at least one barrel (cell) with span > 1.8 and height > 1.5 m.
  - stock and pedestrian underpasses

A minimum clearance of 300mm in urban catchments and 600mm in rural catchments is required to allow for passage of debris without blockage between the 1% AEP including climate change factor flood level and the underside of any major structure superstructure, unless otherwise approved by Council. The Designer is required to liaise with Council where the proposed major structure is located in an urban area, and likely to be of piped construction, to discuss the need to provide debris clearance (to minimise the impact of flooding adjacent to the structure) and the desire to provide hydraulic efficiency in the design.

Certified structural design shall be required on bridges, major culverts and some specialised structures. Structural design shall be carried out in accordance with Planning Scheme Policy - Structures - Bridge Design.

Culverts (either pipe or box section) shall be designed in accordance with the relevant Australian Standard in relation to manufacture and installation while hydraulics shall be designed in accordance with the QUDM or Queensland Department of Main Roads Road Drainage Manual whichever is applicable to the project, with due regard being given to inlet and exit losses, inlet and outlet control and scour protection.

Certification is required from the culvert/pipe suppliers confirming compliance for manufacture with the applicable standard.

Major structures, such as bridges and culverts, need to be considered by the Designer as possible routes for fauna movements and where appropriate catered for in the design.

2.3 Stormwater detention – detention basins

Detention Basins may be provided as part of the drainage solution to limit the post development discharge to pre-development levels. Any proposed detention basin must be in conformity with Council's drainage strategy for the area and shall be designed in accordance with QUDM.

Minimum floor levels of dwellings adjacent to the detention basin shall be 0.3m above the 1% AEP (including climate change factor) flood level in the basin or the minimum floor level applying to general development of the site if higher.

Installation of stormwater detention may be required on sites where the existing downstream drainage system is under capacity, or where large increases from pre-development flows are likely.

The storm duration for the design flood downstream of the detention 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.

Detention Basins shall be designed with the following characteristics:

(a) The peak discharge resulting from a storm having an average recurrence interval of 1% AEP (including climate change factor) on the fully developed catchment shall be attenuated. The extent of attenuation will be such that the peak discharge from the detention basis is equal to, or less than, the peak discharge produced from the undeveloped catchment by a storm of 1% AEP (including climate change factor). In addition, the minor system Annual Exceedance Probability event shall be assessed to ensure downstream drainage systems can contain these flows. Where downstream easements are not in place, for development projects, the developer shall be responsible for obtaining such easements as is required to contain discharges in all events. In all circumstances the Designer is to co-ordinate proposals on downstream discharge routes with Council; and

(b) Alternatively the detention basin may be designed to alternate peak discharges from both minor system recurrence interval and 1% AEP (including climate change factor) recurrence interval events such that this discharge is equal to, or less than, the peak discharge produced from the undeveloped catchment for both the minor system recurrence interval and 1% AEP (including climate change factor) events.

The Designer of the detention basin shall check its performance during events resulting from the probable maximum precipitation to ensure that sudden catastrophic failure will not occur. A report from the Designer shall be submitted to Council immediately following such an event confirming performance of the detention basin.

The Designer shall also check that the flow paths in excess of the design discharge are provided at locations where public safety will not be endangered.

The Designer shall consider the incorporation of a number of public safety measure in the design of the detention basin. The measures will be site-specific but may include:

(a) warning notices;

(b) fencing off the basin;

(c) depth gauges;

(d) child-proofing access to inlet structures, gully pits and manholes; and

(e) having due consideration for the probable maximum discharge and the safe conveyance of this flow through downstream properties.

Without limiting the approach taken by the Designer, Council will require as part of the ‘Safety in Design’ risk assessment to consider appropriate safety measures to mitigate risk to an acceptable level to be included in the Design.

Unless prior separate approval has been given, any detention basin floor shall be graded to ensure it is self-draining.

For development projects the developer may propose that part of the detention basin is to be contributed to Council's part of their open space contribution. Prior to seeking any ‘credits’, the Designer should check that the circumstances proposed comply with the Planning Scheme Policy.

Any ‘credits’ for public open space contribution shall be at the sole discretion of Council.

On site detention designed for small development below 2,000 m^2 shall incorporate requirements as detailed in Appendix A.

2.4 Inter-allotment drainage

Inter-allotment Drainage shall be provided for every allotment in urban environments that does not drain directly to its frontage. Such drainage shall be designed to conform to Council's standard drawing.

Inter-allotment drainage shall be contained within an easement as detailed in Council's standard drawing. The easement shall be in favour of Council.

The inter-allotment drain shall be designed in accordance with Section 7.13 of QUDM to accept concentrated drainage from buildings and paved areas on each allotment. The Designer shall adopt Level III as the basis of the design for the roof and allotment drainage system – refer to Fig. 7.13.4 of QUDM.

The minimum pipe size for inter-allotment drainage shall be 225mm diameter for the first two allotment sites. Pipe sizing shall be confirmed by the Designer in the design submission

Pipes installed as part of the inter-allotment drainage shall have a minimum longitudinal gradient of 0.2%.

The inter-allotment piped drain shall be constructed from rubber ring jointed pipes of either fibre reinforced concrete drainage pipe, reinforced concrete pipe, or PVC-U pipe and shall conform respectively to the requirements of AS 4139, AS 4058 and AS 1254. In public road and recreation reserves where vehicle loads may be encountered, reinforced concrete and fibre-reinforced pipe shall be used. Should the Designer wish to propose an alternate material type, then separate Council approval must be obtained. Approval will only be given following satisfactory demonstration that the proposed alternate material will meet the performance requirements with regard to design and installation.

Inter-allotment drainage pits shall be located at all changes of direction. Pits shall be constructed in accordance with the Standard Drawing.

Where inter-allotment drainage and sewer mains are laid adjacent to each other they are to be spaced as specified in Council's standard drawing.

Where sewer mains are within 2 metres to inter-allotment drainage lines, they shall be shown on the inter-allotment drainage drawing.

2.5 Roof / allotment drainage

All roof drainage is to be conveyed to the underground drainage system.

The stormwater drainage system is to allow for underground drainage connections from the following:

(a) multi-unit developments on allotments greater than 900m^2;

(b) commercial developments;

(c) industrial developments; and

(d) other significant developments as determined by Council.

These connections are to be provided with an appropriately sized and located stub pipe extending at least 1m into the property. The designer shall provide for a minimum 600mm x 600mm drainage pit inside the private property at the end of the stub pipe.

The street inlet design capacity shall not account for the direct drainage connections.

Allotments including those adjoining drainage or park reserves are required to drain to the road frontage, unless otherwise approved.

Where allotments do not drain to the road frontage, allotment drainage shall be provided in accordance with Council's standard drawing. The outlet discharge point shall be as discussed with Council during the design phase and prior to the formal submission of the design for approval.

Roof drainage outlets shall be provided on each side of the allotments, between 0.5m and 1.5m from the side boundary. The outlet shall include an approved kerb adaptor and pipe extending 1.0m into the property. Connections to the underground system shall be undertaken on the most elevated side of lots with one-way crossfall. All roof water kerb adaptors utilised shall be compliant to Council standard Drawing A3-03871 and preferably be of extruded aluminium construction and be positioned to avoid conflict with services.

Where the underground drainage system is to be extended to provide a lawful point of discharge for 1-2 lots, then the Designer shall provide for a 600mm x 600mm drainage pit inside the private property at the end of the stub pipe.

The stub drainage pipe shall be a minimum diameter of 225mm and the pipe invert shall be suitable to allow for the future installation of an upstream Gross Pollutant Trap (GPT), if considered appropriate.

2.6 Detailed design – conduits

The Designer shall specify the material type to be used in the conduit for the underground drainage system. The material type shall be either:

(a) precast reinforced concrete pipes and culverts complying with AS/NZS 4058 & AS/NZS 1597.1 & 2;

(b) fibre reinforced concrete pipes complying with AS/NZS 4139;

(c) steel pipe and steel arches complying with AS/NZS 2041; and

(d) PVC-U pipes complying with AS/NZS 1254.

Alternate pipe material subject to satisfactory demonstration that the proposed alternate material will meet the performance requirements with regard to design and installation and specifically AS 3725 requirements.

Conduits shall be designed to take into accordance requirements detailed in the relevant construction specification.

Flexible pipes (PE and PP types) complying with AS 5065 are suitable for use in inter-allotment drainage, or in drainage reserves, where the conduit will be subject to infrequent and light traffic use.

The Designer shall ensure that any proposed use of flexible pipes confirms with the requirements of AS 2566 and the relevant construction specification.

If the Designer proposes to use reinforced concrete pipes in areas where any part of the pipe is below the potential acid sulphate zone, then the pipes shall be specified to have acid sulphate cover and the appropriate type of cement, unless otherwise approved by Council.

If the Designer proposes to use reinforced concrete pipes in areas where any part of the pipe is below the Highest Astronomical Tide (HAT), then pipes shall have saltwater cover to reinforcement, unless otherwise approved by Council.

In both situation of possible acid sulphate and below HAT usage a copy of the supplier's design certification for the materials proposed to be used shall be provided by the Designer as part of the design submission.

Where the outlet of any proposed drainage system is below HAT then the Designer shall include an approved mechanism to prevent ingress of saline water into the drain during high tide.

Council currently installs 'Tideflex TF1' check valves or approved equivalent, for surface water discharges and has a preference to maintain this unit as a standard installation/

Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the Concrete Pipe Association "Concrete Pipe Guide: or AS 3725.

For PVC-U pipes, the bedding and cover requirements are to be detailed on the drawings and shall conform to AS 2032.

In urban drainage systems, unless otherwise approved, all conduits laid under roadways or in areas of high water table and sandy soils shall be specified as rubber ring joint (RRJ) pipes.

Conduits laid along the roadway and in reserves may be flush-jointed, however where flush-jointed pipes are specified they shall be laid with "sand bands" or an approved equivalent.

Box-culverts are to be laid with approved proprietary products to prevent the egress of water and ingress of tree roots into the system.

Drainage lines in road reserves shall generally be located at the kerb line and parallel to the kerb. Drainage lines in easements shall generally be located within easements.

Minimum clear cover shall be the greater of the minimum recommended in Section 5.15 of QUDM or specified by the manufacturer, unless otherwise approved by the Council.

The minimum vertical and horizontal clearances between a stormwater pipe and any other pipe or service conduit shall be 150mm subject to sufficient clearances being available to compact backfill. If unavailable alternative backfill materials shall be required to be used to in order to maintain side and vertical support for the conduit.

Notwithstanding, the Designer shall ensure that the clearance to any water or wastewater mains complies with the requirements of Council's Policy No. 063 – *Clearances to Water and Sewerage Assets.*

Anchor blocks shall be designed on drainage lines where the pipe gradient exceeds 15 per cent. The design details shall address the size, and position in the trench as well as spacing along the line.

The penetration of the underground stormwater system with other services is generally **not permitted**. However, where no reasonable alternative is available, the Designer shall obtain Council approval to incorporate a penetration into the design. Full supporting details are to be lodged with Council, which is to include (but not limited to) service types, relevant pipe diameters, levels, hydraulic grade implications, and of angle of penetration.

If approval is granted to allow the penetration, the Designer shall incorporate into the design any requirement of the relevant Service Authority and provide a manhole around the penetration.

Stormwater conduits located within the road reserve shall be done so at an alignment indicated on Council's Standard Drawings and:

(a) where longitudinal to the road centre line on an alignment below or behind the kerb line as determined by the adopted style of kerb inlets selected; and

(b) where transverse to the road centreline on an alignment perpendicular to the road centreline.

At locations where stormwater conduit alignments conflict with other utility corridors within the verge, such as road intersections and curves, the stormwater conduit shall be laid at a grade and depth to ensure a minimum 1 metre cover to the top of the conduit from finished surface levels. If the 1-metre cover cannot be achieved, the designer shall amend the proposed pipe class or introduce suitable protection measures to ensure that the pipe operates within expected structural standards.

In all cases, the nominated pipe class is to be shown on the design (and if subsequently amended on the "as-constructed") drawings and shall be nominated by the designer after haven taken into account both construction and in-service loadings.

2.7 Pit design

Manholes are to be designed and constructed in accordance with Standard Drawings from IPWEAQ or the State Road Authority or equivalent.

Any manholes required outside these standards must be structurally certified by a RPEQ.

Benching is not recommended. However, deflection devices may be used if improved hydraulic efficiency is required.

Manholes are to be avoided in road pavements and trafficable areas wherever possible. Typically stormwater drainage systems are to be designed from gully pit to gully pit.

Precast manholes are acceptable.

The spacing of manholes is to be in accordance with QUDM.

Where stormwater manholes are located in major stormwater event flow paths or where the design hydraulic grade line is above the top of the manhole, bolt down manhole covers are required.

Council will permit the following types of gullies or catchpits (or alternative brands that meet the same specifications):-

(a) IPWEAQ Gully with cast iron bicycle-safe grate roadway type, lip in line (Refer IPWEAQ Standard Drawing D-0063); and

(b) inlets are to be provided with Max Q bicycle-safe grates only. Fluted grates and concrete filled covers will not be permitted.

Inlet capacity charts for IPWEAQ are available in QUDM. Designers should use these charts and the appropriate provisions for blockage as set out in QUDM.

All gullies or catchpits are to be designed so as to be Lip-in-line (Refer IPWEAQ Standard Drawings D-0063 and D-0067), except for "anti-ponding" gullies. The minimum outlet pipe for gullies or catchpits is to be 375mm nominal diameter, except for anti-ponding gullies where a 300mm diameter pipe may be used.

Field inlets and pipe outlets

(a) for inlets within or outlets to an overland flow path, the design should generally be in accordance with IPWEA Standard Drawing D-0080. Maintenance and amenity factors should also be considered.

Field inlets:-

(a) Council will permit the use of IPWEA Field Inlet Type 1 & 2 (Refer Standard Drawing D0050) or alternatives that meet the same specifications;

(b) field inlets (and surcharge pits) are to be designed and constructed in accordance with the above mentioned standard drawing or TMR equivalent;

(c) a 50% blockage factor is to be applied during design calculations. When debris is expected, a raised grated inlet is required with a locking device; and

(d) further design information, including appropriate bar spacing of the grate is provided in QUDM.

Pipe outlets:-

Stormwater outlets should be designed in accordance with QUDM and note the following:

(a) energy dissipaters will generally be required at all outlets to reduce velocity to acceptable levels. Refer to QUDM for permissible velocities;

(b) drowned outlets are not to be used without prior approval, except where enclosed drains outlet to a canal;

(c) for inlet headwalls where the pipe invert is located below the natural channel invert such that a standard field inlet is not warranted (e.g. the drop is less than the pipe diameter), a masonry "inverted curtain wall" is to be constructed across the headwall apron in preference to stone pitching outside the headwall; and

(d) minimise the number of stormwater outlets into open channels and consider the minimum desirable outlet setback.

Where the Designer wishes to use an alternate pit design, prior approval must be obtained from Council.

Typical pit designs and other pit design requirements are to be included in the standard drawings. Step irons shall not be detailed for inclusion within pits, unless otherwise approved by Council.

Notwithstanding the requirements of section 5.10 of this Guideline, the Designer shall locate all gully pits (including chamber and trough) opposite the boundary of abutting allotments, or at the centre of the allotment.

All roadway pits are to be provided with a 1m long formed kerb and channel transition.

Pits with troughs on horizontal curves are to be saw cut on the appropriate angle – no mortar infill is permitted.

Pit locations are to be located on a straight where possible and to be located such as to avoid clashes with other services and future driveway locations and in particular not on the apex of curves, particularly traffic calming deflected tee curves.

In areas known to be, or likely to be, affected by a high water table, all pits and manholes shall be cast in-situ and not a precast type.

The Designer shall include in the design the use of a grate, or similar device, at the upstream entrance to all open conduits to prevent the unauthorised entry by any persons, particularly children, into the drainage system. The Designer shall install a grate, or similar, on any open conduit which has a vertical height greater than 750mm.

Any grate, or similar device, to be installed shall be designed to allow for authorised access into the drainage system, easy maintenance of the grate openings, and any metal shall be hot-dipped galvanised.

2.7.1 Stormwater discharge

Stormwater discharge shall be located to avoid recharging groundwater and creating or worsening salinity degradation of adjacent land. Generally, stormwater discharge shall be located to avoid areas with high groundwater tables, groundwater discharge areas or salt affected land. The designer shall meet requirements of all relevant Statutory Authorities with regard to the salinity levels of discharge to natural watercourses.

Scour protection at culvert or pipe system outlets shall be constructed to minimise erosion. Generally, erosion protection shall, as a minimum, be designed in accordance with TMR Road Drainage Manual.

Kerb and channel shall be extended to a drainage pit or natural point of outlet. Where the outlet velocity is greater than 2 metres per second or where the kerb and channel discharge is likely to cause scour, then the Designer shall incorporate appropriate protection to prevent scour and to dissipate the velocity.

At points of discharge from gutters or stormwater drainage lines, or at any concentration of stormwater onto adjoining properties, either upstream or downstream, Council will require an easement over the property(s) to the lawful point of discharge.

The easement shall be in favour of Council.

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.

Piped stormwater drainage discharging to recreation reserves is to be taken to a natural watercourse and discharged in an approved outlet structure or alternatively taken to the nearest trunk stormwater line.

The Designer shall ensure that the quality of stormwater discharge complies with Council's Healthy Waters planning scheme policy.

2.7.2 Trench subsoil drainage

Subsoil drainage shall be provided in pipe trenches in accordance with the requirements of Planning Scheme Policy – subsurface drainage design.

2.7.3 Reserves and easements

Urban developments

All overland flow paths and open channels not located within a road reserve or park reserve shall be located within an easement or drainage reserve.

All detention basins shall be located within a drainage reserve.

Easements shall be provided through and downstream of private property over underground drains or overland paths to the lawful point of discharge. All easements shall be in Council's favour and provided free of cost to Council.

Overland flow paths between allotments may be provided within local linkage or linear parks which shall have a minimum width of 15m. Narrow reserves between allotments to cater for overland flow paths only will require specific approval and are generally not acceptable.

Any linkage of reserves is to be designed as an integral part of a development by providing access to parks, schools, shops and other community facilities.

The location and layout of any linkage of reserves shall conform to the principles of Crime Prevention through Environmental Design (CPTED).

The minimum width of the easement or reserve shall be the greater of:

(a) the outer width of the largest underground culvert plus 2.5 metres;

(b) the width of the open channel (including batters up to 1:4 slope) plus 1.0m from each batter point; and

(c) where Council has approved open channel batters steeper than 1:4, the required width shall be 1.0m from one batter point and 4.0m from the other batter point. This is required to provide for adequate and safe access for Council plant to maintain the channel.

Evidence of any Deed of Agreement necessary to be entered into to construct any part of the drainage system shall be submitted prior to the issuing of a Decision Notice for Operational Works. Easements will need to be created prior to the endorsement of the plan of survey for the subdivision.

Evidence of any Agreement reached with adjacent landowners to allow an increased flood level on their property, or otherwise adversely affect their property and witnessed by an independent person shall be submitted prior to the issuing of a Decision Notice for Operational Works.

All reserves and easement are to be vested in Council but shall only occur after written consent is obtained from the relevant stormwater asset and land custodians within Council with appropriate agreed conditions included in easement documentation.

The building of structures over or upon easements is not generally in the interests of the party that is vested in the easement. Any project that proposes to build over or on easements shall take into account all requirements of Council's Policy 062 - Building Over or Adjacent to Constructed Council Drainage Systems and Easements
https://www.mackay.qld.gov.au/__data/assets/pdf_file/0011/100532/POL-23.062.pdf

Rural residential development

Council will assess easement requirements for rural developments on an individual basis. In general, an easement, capable of containing the follow from a storm event having a 1% AEP (including climate change factor), will be required immediately downstream of the development except in the following circumstances:

(a) where a well-defined natural watercourse exists; and

(b) where the watercourse can contain the 1% AEP plus climate change flow.

Council will assess the length of any downstream easement, to its lawful point of discharge, on an individual basis.

An easement is to be provided upstream of any culvert inlet where the calculated 1% AEP headwater extends beyond the road reserve and into private property.

Evidence of any Deed of Agreement necessary to be entered into to construct any part of the drainage system will need to be submitted prior to the issuing of a Decision Notice for Operational Works. Easements will need to be created prior to endorsement of the plan of survey for the subdivision.

Evidence of any agreement reached with adjacent landowners to allow an increased flood level on their property, or otherwise adversely affect their property and witness by an independent person shall be submitted prior to the Issuing of a Decision Notice for Operational Works.

2.8 Severe Storm Impact Statements

In accordance with QUDM, a Severe Storm Impact Statement is likely to be required for the following situations:

- Proposed installation of a noise control barrier over an overland flow path where the barrier could cause unacceptable flooding or flow diversion during severe storms.
- Installation of a solid traffic-control barrier along the median of a roadway that crosses over a waterway or valley (i.e. where overland or overtopping flows would normally have occurred across the roadway).
- Subdivision of land upstream of a road or railway embankment where the occurrence of severe blockage of the culvert, or the occurrence of a discharge in excess of the major storm, would likely cause unacceptable flooding of the subdivided land.
- Design of a stormwater detention/retention basin where the potential impacts of an inflow in excess of the major storm (peak flow rate or volume) would likely cause unacceptable flooding.
- Design of a stormwater detention/retention basin where the failure of the structure, or its embankment, could potentially result in an increase in flood levels (relative to the no--failure case) of at least 300 mm through a residential or workplace building. In the latter case, such conditions are likely to make the structure a Referable Dam (refer to QUDM Section 5.13).
- Rehabilitation or revegetation of an urban waterway where the potential impacts of a discharge in excess of the major storm would likely cause unacceptable flooding.

3 Drawings and documentation

3.1 Design criteria and calculations

The design shall be submitted for consideration by Council and include all correspondence, Deeds, assumptions, reference material and calculations.

All drawings and documentation to be submitted to Council for approval shall conform to the requirements of Council's Drawings and Documentation Guideline.

Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the Drawings.

Failure to comply with Council's Drawings and Documentation Guidelines may result in the drawings and/or documentation being returned to the engineer without consideration by Council.

3.2 Summary sheets

A copy of a Hydrological Summary Sheet providing the minimum information is to be submitted by the Designer with the drawings. An example of the information required is including in QUDM.

In addition, the Designer shall submit calculations for major storm events including backwater analysis of the surface drainage flow, including the volume of flow, depth of water, maximum velocity and extent of inundation.

3.3 Computer program files and program output

The Designer shall submit to Council for review, copies of computer program output and final computer data files for both hydrological and hydraulic models.

3.4 Special requirements – overland flow

Overland flow paths shall be provided at all sag points.

Where the underground drainage system has a design capacity less than 1% AEP including climate change factor flow, then the balance surface flow up to this flood event is to be accommodated within a drainage reserve which may include a concrete invert of minimum width of 1.2 metres. Where a concrete invert is required, it shall commence from the back of the kerb. The concrete section across the footpath shall be grade away from the kerb at 1:50.

The balance of the drainage reserve shall be turfed with a maximum slope of 1:4.

Where underground drainage has a design flow of 1% AEP including climate change factor, then the underground system may be accommodated within an easement and include a positive outlet by surface drainage along the route of the easement. The inlet capacity of the sag pits is designed to capture the 1% AEP including climate change factor flow is to provide for blockage in accordance with QUDM.

Allotments adjacent to overland flow paths are to have floor levels in excess of the 1% AEP including climate change factor level shown on the relevant design drawings.

The Designer shall provide weir calculations at locations where overland flows cross the footpath adjacent to private allotments.

Appendix A

Guideline for on-site detention for small lots

1.0 Introduction

On Site Detention (OSD) refers to temporary storage of stormwater generated within a site to limit discharge from the site to a pre-determined rate. OSD is used to ensure that stormwater discharge rates do not exceed the capacity of the downstream drainage system (both underground and surface drainage).
OSD is commonly used in Mackay urban areas where a small development involves into two or more dwelling units. Such developments lead to an increase in impervious area and hence an increase in peak stormwater generation rates. The critical design elements of an OSD system are the storage volume and outlet arrangement. The combination of storage volume and outlet arrangement is designed to ensure peak post- development stormwater flows do not exceed the pre-development flows:

- the outlet arrangement is designed to ensure post-development storm flows are released from the storage at or less than the pre-development peak flow rates; and
- the storage volume is designed to be large enough to temporarily store the post development peak flows.

Detention basins may be provided as part of the drainage solution to limit the post-development discharge to pre-development levels. Any proposed detention basin must conform to MRC's stormwater plans for the area and must be designed in accordance with Section 5 of the QUDM.

A number of OSD systems will be considered by Council. The following list details some of the options that could be considered in design solutions:

1. Underground storage
2. Surface storage in landscaped areas
3. Above ground tanks

It should be noted that above ground storages in driveways and parking areas will not be accepted as an OSD. This guideline only focuses on the small developments and provides a simple methodology for developers & consultants to calculate the OSD requirements for infill developments sites with a maximum area of 2,000 m^2 and the capacity of the underground drainage of the street is less than a 20% AEP event.

2.0 Locations not requiring OSD

OSD is not required for infill developments if the proposed site is within:

1. a development designed after 2000.
2. the bottom 15% of the catchment of the drainage system or waterway.

Contact Council to confirm this.

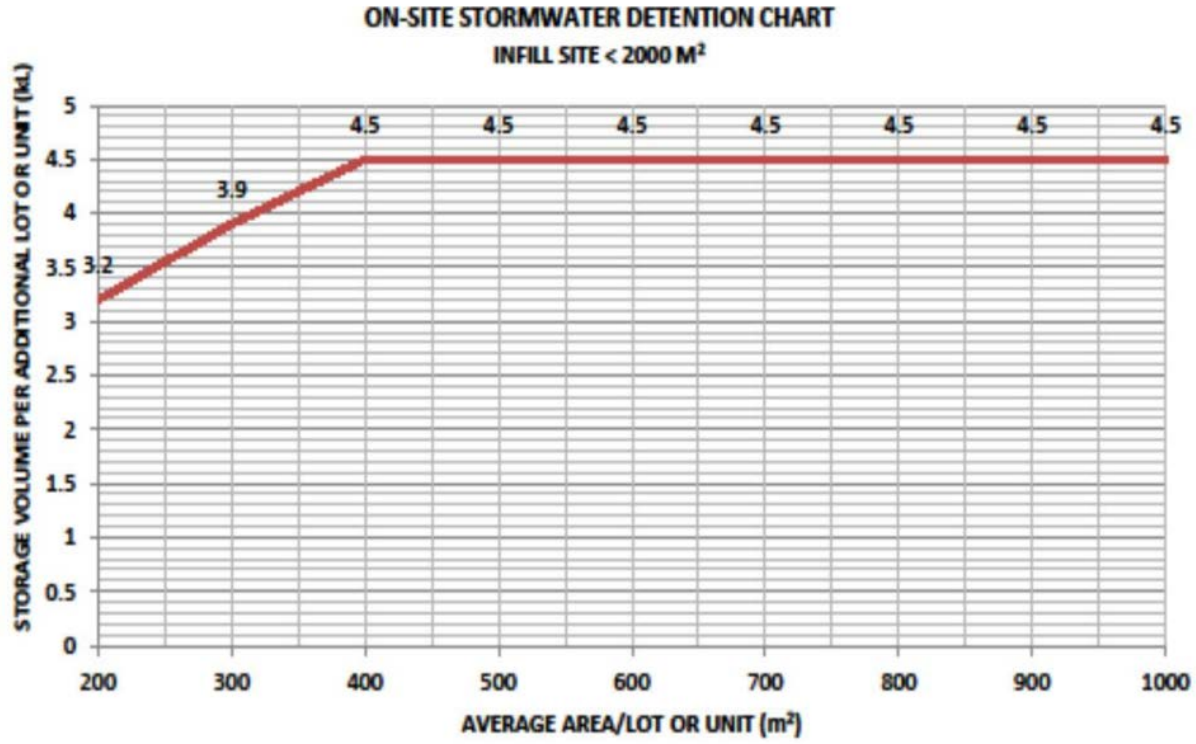
3.0 Design Considerations

1. Underground storage
    a. The invert of the underground storage must be higher than the top of the k&c.
    b. Underground outlet to be connected either to the k&c in accordance with A3-3871 or directly into a stormwater pit (preference is connection to k&c).
    c. 20% AEP event pre-developed flow calculations and outlet sizing to attenuate the post developed flows back to 20% AEP pre-developed flow must be provided.

2. Surface storage in landscaped areas
    a. Details of area(s), maximum depth(s) of storage and outlet arrangement(s) must be provided.
    b. The outlet must be connected either to the kerb and channel (k&c) in accordance with Council's standard drawing A3-3871 or directly into a stormwater pit (preference is connection to k&c).
3. Above ground tanks

a. The 20% AEP pre-developed flow must be maintained with an appropriately designed outlet or alternatively a 50mm dia. outlet for each tank must be provided.
b. Internal stormwater drainage must be connected either to the kerb and channel (k&c) in accordance with Council's standard drawing A3-3871 or directly into a stormwater pit (preference is connection to k&c).
c. Tank capacity to be calculated using Figure 1 below.

Figure 1



4.0 Procedure

1. Calculate the average area of the lot or dwelling unit. If the minimum lot/unit area is less than 200m^2 , then adopt 200m^2 as the average area.
2. Draw a line perpendicular above the average area in the chart to intersect in the OSD line.
3. Read the value of the OSD line to determine the amount of storage required per additional lots/units.
4. The total storage volume of the in-fill development will be the value in item 3 multiplied by the number of additional lots/units.

5.0 Example

Total area of development – 1,800m2
No. of existing lots – 2
Total no. of lots/units – 6
Average area of unit – 300m2
OSD capacity for 300m2 – 3.9kl
No. of additional lots/units = 6 - 2
Total storage required = 3.9kl x 4 = 15.6kl