



Bankstown City Council

Development Engineering Standards

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For all standard plans go to Bankstown City Council website:

Living in Bankstown/ Roads, Traffic & Transport/ Bankstown Roads / Council road-related standards

PART A – PRELIMINARY

1 INTRODUCTION

Bankstown City Council has responsibility for managing public infrastructure assets valued in excess of \$500m. Council aims to keep the maintenance of these assets to a high standard, in order to maintain public safety and amenity and to minimise the long-term cost of these assets.

This guideline is designed to protect the integrity of the City's infrastructure in situations where it is impacted upon by building and subdivision development.

This guideline applies to all building and subdivision works for development on privately owned land and Council owned land within the City of Bankstown except for Sections 6.2.1 and 9.5 which apply to the Stormwater System register of lots, held in the office of Council.

This guideline is not intended to act as a barrier to innovation and the adoption of improved techniques. Where it is desirable to deviate from the guideline, the circumstances of the situation and alternate design techniques can be presented to the Council for consideration. Variations to this guideline may be accepted where Council is satisfied that the outcome is consistent with the general objectives of this guideline, is reasonable in terms of public safety and property, protecting Council infrastructure, and reduce long term maintenance costs.

2 GENERAL OBJECTIVES

The general objectives of this DCP are:

- To ensure that developments, on privately owned land within the City of Bankstown, provide a satisfactory level of engineering infrastructure.
- To ensure that the impacts of these developments on surrounding environment, properties, roads, and the existing stormwater systems are minimised.
- To ensure that the interface between developments on privately owned land and Council's assets including footways, roadways and drainage systems, is protected and constructed under Council supervision and to Council's satisfaction.

3 RELATIONSHIP OF THIS GUIDELINE TO OTHER LEP'S POLICIES, CODES AND DCP'S

This guideline should be read in conjunction with Council's Local Environmental Plan (LEP 2001), AUS-SPEC 1 and AUS-SPEC 2 and the Bankstown Development Control Plan 2005 relating to the land use(s) referred to in this document. Any discrepancies between these documents shall be referred to Council for clarification or direction.

4 VARIATIONS OF REQUIREMENTS

This guideline sets out a range of objectives and specific standards aimed at achieving these objectives. Council requires that developers generally comply with the objectives and standards in this guideline. However, due to special circumstances, a developer may deviate from this guideline when sound engineering principles and innovation, supported by an engineered design are documented and submitted to Council for consideration and approval.

PART B. DEVELOPMENT STANDARDS

5 DEFINITIONS

"Annual Exceedence Probability (AEP)" is the statistical chance of having a flood of a given or larger size occurring in any given year. For example, a 1% AEP flood discharge has a 1% [1 in 100] chance of occurring or being exceeded in any one year.

"Applicant" is the person or company, also referred to in this guide as the "Developer", who is responsible for meeting all of the requirements associated with a development application on a property. The applicant must have all owners' written consent to make application for development on any particular property. The applicant is generally the person to whom all correspondence from Council will be directed.

"Australian Rainfall and Runoff (AR&R)" is the publication by Engineers Australia, which describes the industry standards for estimating rainfall and runoff for the purpose of designing stormwater drainage systems.

"Average Recurrence Interval (ARI)" is the long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with discharge as great as, or greater than, the 20-year ARI flood event will occur on average once every 20 years. A flood with a discharge as great as or greater than the 100 year ARI flood will occur on average once every 100 years.

"Carriageway" is the portion of a public road reserve intended for the use of vehicles to travel, usually measured from kerb face to kerb face. This area is also referred to as roadway. In private land, the carriageway is the driveway surface, within an access corridor, intended for the use of vehicles to travel.

"Catchment" is the source area from which stormwater runoff flows to a nominated location.

"Common Drainage Easement" is known as an Easement to Drain Water created over a nominated portion of an allotment for the purpose of legally benefiting and draining stormwater collected from upstream allotments.

"Common Drainage Line (CDL)" also referred to as IAD "Inter-Allotment Drainage" is the existing or proposed drainage pipes located within and through private property for the drainage of stormwater from upstream allotments and catchments. The drainage pipes are usually, but not always, located within a Common Drainage Easement, and are owned and maintained by the property owners who benefit from the Common Drainage Line.

"Construction Certificate (CC)" The certificate issued by a PCA which states that construction drawings have complied with the requirements of the development consent. The CC must be issued prior to any works commencing on the site.

"Council Drainage Easement or Easement to Drain Water" is an easement that has been or is to be created, through privately owned land, to benefit the Council for the

purpose of maintaining or constructing stormwater infrastructure for draining stormwater through or over the land.

"Council infrastructure" refers to the physical improvements of Council's road and drainage assets.

"Development Application (DA)" is the process by which Council assesses a developer's application for the purpose of granting or not granting consent to the change of use or form of the land for which the application is requested.

"Drainage Reserve" is a parcel of land owned by Council for the purpose of draining Council's stormwater either in open channels, in underground pipes or over land.

"Dual Occupancy" has the same meaning as in Residential DCP No. 31. For the purposes of this guideline, it refers to a single building containing two dwellings—either sub-divided or not.

"Easement" is the portion of land where a beneficiary has legal entitlement to utilise for nominated use such as but not limited to draining stormwater, providing services, electricity water, gas and draining sewage. The easement width, location and terms are noted on the Deposited Plan and 88B instrument or transfer documents and registered with Land and Property Information.

"Floodway" is the area of a floodplain, generally related to large open channels, creeks or rivers, where a significant discharge of water occurs during floods. A floodway, if partially or fully blocked, would cause a significant redistribution of flood flow, and or a significant increase in flood levels.

"Foot paving" is the formalised surface, generally constructed of concrete, for the use of footway pedestrian traffic.

"Footway" is the portion of the Council road reserve between the road reserve boundary and the face of kerb or edge of road shoulder if there is no kerb.

"Footway Damage Inspection Report (FDI)" is the report, including the footway damage inspection results, required to be conducted by Council prior to any demolition and/or non-exempt development occurring on a site.

"Land and Property Information (LPI)" is the NSW government body within the Lands Department who records and maintains property title information.

"Multi Residential" development includes Residential Flat Buildings, Villas, Row Houses, Town Houses, and Terraces.

"Occupation Certificate (OC)" is the certificate, issued by a PCA, stating the development, as constructed, complies with all of the relevant conditions of the DA Consent relating to the occupation of the site, and the development site is suitable for occupation for its approved use.

“On-site Detention (OSD)” refers to the temporary storage of stormwater to reduce peak stormwater discharge rates during major storm events. OSD is intended to limit the stormwater discharge rates from a development site to at or below stormwater discharge rates of the existing site.

“Overland Flow path” (OLFP) is the natural or formed route that stormwater runoff will take when it cannot enter the below ground, stormwater system.

“Owner” is the person or corporation registered with Land and Property Information as nominated on Certificate of Title.

“Principal Certifying Authority, (PCA)” means an accredited certifier appointed by an applicant to perform certain functions as defined in DCP 35 titled ‘Development System’.

“Public Road” means any area of road reserve, form or unformed, that is opened or dedicated to the public as road.

“Road Authority” is the body, typically Council or the Roads and Traffic Authority (RTA), authorised under the Roads Act 1993, with powers and responsibilities for ownership and maintenance of roads under its control. Bankstown City Council is the Road Authority for all local and regional roads in Bankstown Local Government Area and the RTA is the Road Authority for all State Roads. See Section 8.6.2 for a list of Regional and State Roads.

“Road Reserve” is the publicly or privately owned area between allotments of land generally intended for vehicular and footway traffic providing access to and from those allotments of land. Road Reserve is usually comprised of the carriageway or roadway and the footway on both sides. The terms road reserve, road and Public Road are deemed to have the same meaning in this guideline.

“Row houses” has the same meaning as in Bankstown Development Control Plan 2005.

“Single Dwelling” has the same meaning as in Bankstown Development Control Plan 2005. In this document Single Dwelling also refers to “Family Housing”.

“State Road” is a roadway under the control of the RTA. Council, however, controls footways along State Roads, except the M5 Motorway. (The State Roads within the Bankstown Local Government Area are listed in Section 8.6.2.

“Stormwater System” comprises all components of stormwater infrastructure, both privately and or publicly owned, including but not limited to, rivers, natural creeks, channels, pipelines, OLFP, surface inlet pits, culverts, table drains, roadways, kerb and gutters. OSD, downpipes and roof gutters.

“Stormwater System Report (SSR)” is the Council provided report, issued to a developer upon application to Council, for the information pertaining to the existing stormwater systems in the vicinity of the development site. These stormwater systems

are usually owned by Council, but may also be owned by Sydney Water, other authorities, or privately owned.

"Street Boundary Alignment Levels" (SBAL's) are the Council provided levels issued upon application to Council for the required design finished surface levels of the footway area in front of a development. They include design levels at the property boundary.

"Subdivision Certificate (SC)" is the certificate required to be issued by the Council, or in some circumstances, a PCA that states that all of the conditions of the development consent, pertaining to the subdivision of the land, have been complied with. This certificate must be issued prior to submitting plans for registration at LPI.

"Vehicular Footway Crossing" (VFC) is the concrete pavement constructed across the footway for vehicular traffic to access the property driveway.

"Villas" has the same meaning as in Residential DCP No. 1.

"Work Permit (WP)" Is the required permit that a developer must obtain, from Council, for any works to be constructed on any Council land, Council road and/or Council infrastructure. A Work Permit Part D is generally required for most developments which incorporates the Footway Damage Inspection, VFC Plans & Specification, SBAL's, Road Opening Permit, approval of stormwater connection plan to Council's systems and all associated inspections.

6 SUMMARY OF ENGINEERING INVOLVEMENT AND PROCESSES

6.1 Council's Engineering Involvement

Council's Engineer will utilise this guideline and be involved in the assessment process in the following areas:

- Site civil engineering requirements;
- Protection of Council infrastructure;
- Vehicular and pedestrian access to development sites;
- Stormwater management and conveyance
- Stormwater flooding
- Land Subdivision

6.2 Engineering Requirements Relating To The Development Process

Engineering issues play a major role in most developments. It is usually wise for a developer to seek input from the engineering staff at Council prior to embarking on any development proposal where access to the site, drainage of stormwater from the site and site terrain are potential issues that may restrict the potential of developing the site. This section attempts to explain the necessary steps for assessing the development proposal from an engineering aspect. The following is a list of steps to follow when considering a site for development.

6.2.1 Stormwater System Report (SSR) Application Process

Council maintains a register of lots, within the Bankstown City Council area, which may be affected by a publicly controlled and some privately maintained drainage systems. All development proposals involving lots noted on this register must obtain advice, by way of an application to Council for a SSR, prior to lodgement of the DA to Council for assessment. The SSR is likely to include the following information:

- The nominal location and size of any Council or Sydney Water stormwater system within or near the site.
- The Council stormwater system to which the site stormwater system is to be connected.
- 100 Year ARI Georges River Flood levels and other mainstream and major stormwater flood levels, if applicable and available.
- Whether Council requires a flood study, to be provided, by the applicant, to determine the depth and extent of the 100 year ARI overland stormwater flow within the site.

An application for the SSR can be made on Council's standard form and lodged with Council's Customer Service Counter together with payment of the current fee at least three weeks prior to the information being required for lodgement of the DA. Site plans; including existing and proposed building footprint, and a site survey should be submitted with the application to enable a complete assessment.

The information and recommendations contained in the SSR must be incorporated into the Architectural, Drainage and Civil Works Plans lodged with the DA.

Council may require the location, size and relative levels of any nominated Council drainage infrastructure to be verified by a Registered Surveyor, engaged by the applicant for the development, and shown on the Concept Drainage and Civil Works Plan lodged with the DA.

The SSR does not give details of internal site stormwater systems or the existence of CDL's on the site. Locating the existence of CDL's is the responsibility of the applicant and this information must be included with the Concept Drainage and Civil Works Plan lodged with the DA.

A copy of the issued SSR and any required flood studies must be lodged with the DA. The DA plans are to incorporate any recommendations of the flood study.

6.2.2 Development Application (DA) Assessment Process

When the DA is ready to be lodged at the Customer Service Counter at Bankstown City Council the application must be accompanied by engineering documentation suitable for purposes of assessing whether the development proposal is a viable proposal from an engineering aspect. For Council's Engineer to suitably assess the proposal, Concept Drainage and Civil Works Plans must be submitted along with any SSR, flood studies and engineering reports that may be required for the development to proceed.

The level and quality of the detail presented on the concept engineering plans and reports will determine the time necessary to review and assess the application from an engineering aspect.

Concept engineering plans must be prepared by a suitably qualified Civil Engineer and presented at a scale suitable for the size and complexity of the information required for the development proposal. In general, residential type developments should be drawn at 1 to 100 scale. Concept engineering plans for larger scale developments may be presented at 1 to 200 scale. Other scales for drawing presentation are not preferred.

The level of detail for the concept earthworks and drainage plan acceptance is dependant on the degree of difficulty of the site to achieve the desired outcomes for site levels and drainage connection to the Council drainage system. If it can be easily determined that the site has ample slope to an existing legal drainage system within the bounds of the site then not much information is required to assess the development proposal. If the site has very little fall and no legal access to an existing drainage system then Council will require much more survey information and design detail to assess the viability of the development proposal. It is better to have more existing and design information at the assessment stage than not enough information. If Council deems there is not enough existing or design information, the concept plans will be rejected for further information and delays to the assessment process will occur.

The following is a list of information of which all or some may be required for the DA assessment process:

- Site benchmark and origin of datum; specify either AHD or assumed. AHD is required if a flood study has been carried out, or flood levels to AHD have been issued.
- Extent of flooding and relevant information from the flood study
- Site and development layout and proposed finished floor and garage levels.
- Location and levels of drainage infrastructure on and adjacent to the development.
- Location and levels of existing road infrastructure, traffic facilities, stormwater pits, street trees, existing utilities including power poles and Telstra pits, and vehicular footway crossings in front of the site and in front of adjacent properties
- Layout and approximate sizing of the proposed onsite and offsite drainage system including concept design surface and invert levels.
- Location of all existing and proposed drainage easements.
- Location, depth and extent of any proposed OSD system, when applicable.
- Approximate volume of OSD storage proposed and method used to estimate the OSD storage required.
- Proposed site discharge control method.
- Location and concept levels of the proposed discharge point to the Council's or private drainage system.
- Location of proposed OLFP routes for the development.
- Existing and proposed ground levels and contours extending a minimum distance 1 metre into adjoining properties.
- Location of any overland flow paths from upstream areas through the site.

- Location of trees on the site

Any changes required by the Council engineer must be shown on amended concept engineering plans prior to final stamping of the DA plans for approval.

6.2.3 Work Permit (WP) Assessment Process

A Work Permit, commonly called a permit to carry out works, is required for any proposed construction activities occurring within Council owned or maintained land or infrastructure including Council infrastructure on privately owned Land. The WP applied for, is a requirement of Section 138 of the Roads Act 1993 for any construction activities within the road reserve or of Section 68 of the Local Government Act 1993 for any construction activities within Council land or to infrastructure maintained by Council.

The developer is to apply for the WP at Council's Customer Service Counter with the payment of the appropriate fees.

The developer should apply for the WP as soon as practicable after the DA has been approved, as the CC cannot be issued until Council has issued an approved Work Permit.

A RTA WP Approval will be required for works and a Road Occupancy License will be required for roadway occupancy, on Regional or State Roads or within 100m of a traffic facility including roundabouts and traffic signals. Refer to Section 8.6.2 for a list of Regional and State Roads. Council will not issue a Work Permit until relevant RTA licenses are submitted to Council.

On State Roads and/or where the RTA is the road authority, all WP applications for permits to carry out works on the roadway, or to occupy the roadway, shall be directed to the RTA for approval. Application can be made to the RTA Network Planning Engineer in the Blacktown, NSW office.

A Traffic Control Plan (TCP), prepared by an RTA authorised person, is to be submitted with the WP application where impact on pedestrian or vehicular traffic will be long term or significant or where road works are being carried out and traffic must be diverted, or where a trafficable kerbside lane is blocked.

Bankstown City Council shall supervise construction works, associated with the WP application, with the exception of works being constructed within State Road roadways under the jurisdiction of the RTA. Council will inspect works on State Road footways.

6.2.4 Construction Certificate (CC) Assessment Process

The construction certificate application is the process by which the developer is granted approval to commence construction. This requires the construction documentation to incorporate all of the conditions of consent relating to the construction of a development. Once the DA Consent is issued a developer may proceed to apply for a CC. If required by the DA consent, the CC for the development must include the following list of engineering documentation before the CC may be issued:

- An approved Work Permit from Council
- Site benchmark and origin of datum; specify either AHD or assumed. AHD is required if a flood study has been carried out, or flood levels to AHD have been issued.
- Site and development layout including proposed finished floor levels, garage levels, driveway levels, and all other necessary proposed finished ground level for earthworks.
- Approved SBAL's and VFC design shall be shown on the final Drainage and Civil Works Plan.
- Location and levels of existing pipes, pits and other drainage infrastructure on and adjacent to the development site. The developer is responsible to locate pipes and pits.
- Layout, pipe sizes, pipe grades and pipe invert levels necessary to construct the proposed drainage system, including all computations.
- Location of all existing and proposed drainage easements.
- Location, depth and extent of all OSD storage areas – where applicable.
- Actual volume of OSD storage required and calculations used to size the OSD storage required, where applicable.
- Provide cross sections for detention storage system showing surface levels, invert levels, structural details and materials used, preferably to a scale of 1:20, where applicable.
- Proposed site discharge control method; for example sharp edge orifice plate, choke pipe, weir, and materials and levels required, where applicable.
- Designed discharge point to the Council's drainage system including all levels of proposed pipelines and existing levels at the point of discharge.
- Design OLFP routes and proposed ground levels for the development.
- Existing and proposed ground levels and contours extending a minimum distance 1 meter into adjoining properties.
- Show the extent of any upstream catchment draining through the site.
- Design levels and location of any overland flow paths from upstream areas through the site.
- Hydraulic analysis of existing drainage system, where required, if redirecting stormwater drainage runoff from one catchment to another
- Location and diameter of trees on the site and within 3.0 metres of the any proposed work.

6.2.5 Subdivision Certificate (SC) Assessment Process

The subdivision certificate application is the process by which the developer receives Council's final authorisation of a subdivision plan or an instrument to create easements, restrictions and/or positive covenants. Land and Property Information require the authorisation, prior to registering the subdivision or instruments. The authorisation to subdivide the development will only be issued if the development is completed in accordance with Council's policies and the conditions of the DA consent with respect to the subdivision requirements for the development. The developer may want to discuss the particular details of the subdivision with Council prior to the granting of the final DA so the DA can be issued with the particulars in mind. The developer may apply for a SC upon completion of all development works required for the subdivision. Development works may include, but are not limited to, road and drainage work, installation of CDL's,

construction of common use driveway surfaces, common use OSD systems and earthworks required for the subdivision.

6.3 Application Fees and Charges

Council's Application Fees and Charges are updated annually and apply to the various approvals and certificates associated with the engineering requirements.

7 WORK PERMITS

A Work Permit, issued by Council, is required under Section 138 of The Roads Act and Section 68 of The Local Government Act for any work to be carried out by a developer on Council's Road Reserve, within Public Land, or on Council Assets including stormwater pipes and pits. It is very important to apply for the WP as early as possible in the Construction Certificate process because the outcomes of the WP approval may affect the civil and stormwater design of the development.

7.1 Work Permits for Work in Council's Road Reserve, within Public Land, and/or on Council Assets.

- Where construction of new Council infrastructure, excavation for VFC's, and/or works for utilities including stormwater, water, sewer, gas, electricity, communication cables, occurs adjacent to or within the road reserve, the work must be carried out with an approved Council issued Work Permit (Part D) and under the supervision of Council. The developer must apply to Council for a Work Permit (Part D) to be assessed and approved after payment of the appropriate fees and charges.
- Utility installations must be constructed in accordance with the relevant utility company's authorisation and to their satisfaction. The restoration of the Council assets must be carried out in accordance with the requirements of the issued Work Permit and to Council's satisfaction.
- For any other works in the Road Reserve, not associated with development work, a Work Permit (Part C) for Road Openings or VFC must be obtained and associated fees paid prior to commencement of any work.

7.2 Traffic Management In Council Roads

For any work within the Council Road Reserve and involving temporary partial road closure and/or closure of the footway, the developer must provide a Traffic Management Plan and/or a Certified Traffic Control Plan prepared in accordance with RTA guidelines "Traffic Control at Work Sites" and AS1742.3, titled "Traffic Control Devices for Works on Roads".

An application for lane closure and/or partial road closure on Regional Roads, RTA State Roads, and within 100m of a traffic facility, must be submitted to the RTA for issue of a Road Occupation Licence. Traffic facilities include traffic signals, roundabouts, speed humps, kerb islands and extensions, pedestrian signals, pedestrian crossings, etc. Application can be made to the RTA Transport Management Centre, Eveleigh, NSW.

The Traffic management Plan and the Traffic Control Plan must be prepared and signed by a RTA accredited traffic consultant.

A copy of the Traffic Management Plan, Traffic Control Plan, and any RTA Occupation Licence, if required, is to be lodged with Council prior to issue of the Work Permit.

Full closure of any road is generally not permitted unless approved as a condition of development consent and done in accordance with the requirements of the Roads Act.

7.2.1 Traffic Management Plan (TMP)

For any development where site work will interrupt or have a significant impact on road and footway activities on a regular basis, the developer must submit a Traffic Management Plan to Council.

The TMP is often included in a construction management plan and provides details of how the construction activities related to a development will integrate into the operation of the road network. The plan is to assess impacts on traffic flow, cyclists, pedestrians, local residents, businesses, parking stations, schools, hospitals, public transport, and emergency services as applicable.

7.2.2 Traffic Control Plan (TCP)

The Traffic Control Plan is a plan that is intended to ensure the safety of road users and road workers at the work site. The TCP specifies the signs, devices, and illumination, to be used to warn, instruct and guide road users in the safe negotiation of work sites on road reserves, and to provide a safe work area.

The TCP must include proposed timelines of the above matters.

Traffic Control Plans must be prepared in accordance with RTA's guidelines "Traffic Control at Work Sites" and comply with AS1742.3.

TCP's must only be prepared by persons who are qualified, authorised and have passed an RTA approved training course.

8 CIVIL ENGINEERING REQUIREMENTS

8.1 General Requirements

It is recommended that the developer and design engineer consult with Council early in the development process. Developers should incorporate any recommendations and requirements from the early consultation process before the site design is submitted to Council for a Development Application.

Developments should be designed to utilise the existing infrastructure, whenever possible, and to minimise impacts on Council's and privately owned assets.

Design and construction shall be carried out generally in accordance with these guidelines and any conditions as set out in the DA consent.

The design of development sites should utilise and consider all of the following:

- Existing Public Road and drainage infrastructure and levels, including OLFP's.
- Location of existing and proposed vehicular access with regard to avoiding existing drainage structures, traffic control devices, street infrastructure, existing utilities and street trees.
- The location and levels of existing onsite private and public drainage infrastructure.
- Adjoining property land levels and features, including fence types and building footprints.

8.2 Preparation of Drainage & Civil Works Plans

The Civil Engineering site plan, showing proposed drainage and civil works, should be developed in two phases. One phase should be conceptual for the purposes of the DA assessment process and the second phase should be more detailed for the purposes of the CC assessment and construction documentation.

8.2.1 DA Plans

In general, the Concept Drainage and Civil Works Plan for DA submission require less information to be shown than the Final Drainage and Civil Works Plan for CC submission. However, the more information provided in the concept stage of the development, the more thoroughly Council can assess the design for compliance with this guideline or agree with any proposed deviation from the guidelines. The plans must also be legible or they may be rejected causing delays to the assessment process. The following is a list of minimum required information to be shown on the plans:

- Sheet size shall be a maximum A1 or a minimum of A3 size.
- Plan scale shall be preferably 1 to 100, 1 to 200 or as otherwise noted.
- Datum, preferably to AHD.
- Bench Mark location and level.
- North arrow
- Legend
- General Notes
- Site location map
- Title Block
- Qualified Engineer's Signature
- Date of latest revision
- Existing contours, spot levels, buildings and fences.
- Existing pipe and inlet pit locations and levels
- Conceptual proposed contours, spot levels, buildings and fences.
- Conceptual pipe and inlet pit locations
- Any recommended flood levels as included in the flood study.

8.2.2 Construction Certificate (CC) Plans

All developments involving site construction works must be constructed in accordance with an approved CC for the development. Detailed plans and calculations, suitable for construction purposes must be prepared by a qualified practising Civil Engineer and submitted to the Principal Certifying Authority for approval with the CC. An Accredited Civil Certifier must supply a compliance certificate, under Section 109(c) of the EP&A Act, to Council, for internal site earthworks and stormwater drainage system design. This clause excludes any approval for works related to Council's infrastructure that may be located within or external to the development site. For approvals to do any work on Council infrastructure or land see "Work Permits" Section 7.

The plans must include existing contours at suitable intervals to define site topography, and spot levels at critical points such as boundary levels, adjacent building levels, changes of grade, surface levels at the base of existing trees, levels on the surface of existing utility structures and along the base of any existing structures intended to remain on the property.

The plans must include all proposed contour levels and spot levels at critical points such as the edge of proposed buildings, the surface level of proposed utility structures, top and toe of proposed retaining walls, at all grade changes, at the surface of all proposed drainage inlet structures, building finished floor and garage levels and finished surface levels of landscaping.

The following is a list of required information to be shown on the CC Plans:

- Sheet size shall be a maximum A1 or a minimum of A3 size.
- Plan scale shall be preferably 1 to 100, 1 to 200 or as otherwise noted. Odd scale plans may be rejected.
- Datum, preferably to AHD.
- Bench Mark location and level.
- North arrow
- Legend
- General Notes
- Site location map
- Title Block
- Qualified Engineer's Signature
- Date of latest revision
- Existing contours, spot levels, buildings and fences.
- Existing pipe and pit locations and levels
- Proposed contours, spot levels, buildings and fences.
- Proposed pipe and pit locations and levels
- Any recommended flood levels as included in the flood study.

8.3 Earthworks

Earthworks may include bulk excavation or filling of sites to make general grades before final site levels are constructed. Earthworks also include design-finished levels for pavements and kerbs. Proposed earthworks, including excavation, fill or retaining walls, must not obstruct any overland flow from upstream properties or divert flow onto other properties.

8.3.1 Cut and Fill

Cut and fill levels exceeding 500mm in depth, must be constructed under the supervision of a NATA registered Geotechnical Testing Consultant and in accordance with the latest edition of AS 2870. A NATA Registered Geotechnical Testing company must be engaged, by the developer, to provide Compaction testing and certification of the compaction results for submission to Council for acceptance.

The proposed cut and fill levels should be designed so as to not require any soil to have to be transported to or away from the site.

8.3.2 Retaining Walls

Where approved cut or fill exceeds 200mm and a stable batter of 1:3 maximum grade cannot be achieved on the site, a retaining wall shall be constructed to support the embankment.

Retaining walls must be constructed of masonry or other proprietary material intended and suitable for the purpose. Retaining wall structures must include a sub-soil drainage system, behind the wall, connected to the site drainage system. All elements of the retaining wall shall be fully contained within boundaries of the development site.

Any proposed retaining walls exceeding 600mm in height shall be designed by a practising Civil/Structural Engineer and certified to be able to withstand all of the anticipated loads. In all cases, Council may request supporting documentation, from the proprietor of the retaining wall material, to be submitted as evidence of its suitability for the purpose intended.

8.4 Flooding Assessment, Internal Site Drainage, OSD Design Requirements And Stormwater Disposal

Requirements for flood assessment, overland flow paths, stormwater disposal from the site, and design of internal drainage and OSD systems are detailed in the relevant later sections of this Guideline.

8.5 Erosion and Sediment Control

Measures shall be adopted, to prevent eroded soil or soil laden water from leaving any part of the construction site, in accordance with Bankstown Development Control Plan 2005 Part E1 and the latest edition of "Managing Urban Stormwater (Soils and Construction)" commonly known as "The Blue Book" by Landcom.

All measures shall be installed prior to the commencement of site surface disturbance and, where necessary, modified as the project continues. The function and integrity of the measures shall be cleaned after each storm event and maintained at all times.

Sediment and Erosion Control Plans and details for the whole construction site, prepared in accordance with the above requirements, must be lodged with the PCA for approval prior to issue of the Construction Certificate.

8.6 Site Vehicular Access

In general, any proposed site vehicular access must comply with Council's Vehicular Footway Crossing (VFC) Criteria. Developers must apply for a Work Permit to construct a new VFC. The Work Permit Approval will include all of the relevant criteria for geometry and construction of the VFC. The VFC location shall be located to comply with the latest edition of AS 2890.1. Site vehicular access, not complying with this requirement will require specific approval from Council's Traffic Engineer, or the Bankstown Traffic Committee and the RTA.

8.6.1 Location and Width of Site Vehicular Access

Vehicular access is to be sized and located to maximise the retention of on street parking. Design with regard to the following criteria will ensure this objective is met.

Wherever possible, vehicular access must be located to avoid conflict with existing infrastructure. Where the proposed vehicular access is located in conflict with an existing drainage structure and/or other utility authority structures in the street, gutter, or footway, the applicant must bear all costs associated with adjusting such structures only after the relevant authority has given approval.

If the VFC conflicts with a Council stormwater pit then another stormwater pit with equivalent or greater capacity lintel is to be reconstructed clear of the VFC. If the affected structure is a Council stormwater pit at a sag then another two stormwater pits with equivalent capacity lintel may be required to be reconstructed on either side of the VFC. The existing stormwater pit is to be retained and a double grate installed over the existing pit, in accordance with Standard Drawing S-118. Council will have the final determination of the location and size of the new pit/s.

8.6.2 Site Vehicular Access And Traffic Impacts on Roads

When designing the site layout and site access, the developer must consider impacts on existing traffic flow and volumes, and existing and future traffic control facilities such as, but not limited to, road intersections, roundabouts, wombat crossings, pedestrian crossings, traffic signals, regulatory signs, traffic calming devices, roadside parking facilities and line marking controls.

Any changes to traffic facilities are strongly discouraged. Developers should make every attempt to avoid conflict with existing traffic facilities when designing the layout of the proposed development. Any proposed changes to these facilities must be submitted to the Bankstown City Traffic Committee for review and comment as a part of the DA process. Any construction design documents requesting change or addition of these facilities must be reviewed and approved by the traffic Committee prior to any work commencing on the change being made.

Council will require traffic studies for large traffic generating developments. Compensatory traffic control works may be required to offset impacts generated by the development.

It should be noted that the Bankstown Traffic Committee meets monthly and that sufficient lead-time should be allowed for the required approvals prior to any works being carried out on site.

When designing any development with access onto State Roads, application must be made to the RTA for consideration and approval regarding the location and width of the proposed vehicular access. The following is a list of **State and Regional Roads in the Bankstown area**.

STATE ROADS			
ITEM NO.	ROAD	FROM	TO
1	ALFORDS POINT ROAD	DAVIES ROAD	CITY BOUNDARY
2	BORONIA ROAD	HUME HIGHWAY	JUNO PARADE
3	BRUNKER ROAD	ROOKWOOD ROAD	HUME HIGHWAY
4	CANTERBURY ROAD	MILPERRA ROAD	PUNCHBOWL RD
5	DAVIES ROAD	FAIRPORTD ROAD	ALFORDS POINT RD
6	FAIRFORD ROAD	STACEY STREET	DAVIES ROAD
7	HENRY LAWSON DRIVE	HUME HIGHWAY	CITY BOUNDARY
8	HUME HIGHWAY	CITY COUNDARY	CITY BOUNDARY
9	JUNO PARADE	BORONIA ROAD	PUNCHBOWL RD
10	M5	CITY BOUNDARY	CITY BOUNDARY
11	MILPERRA ROAD	NEWBRIDGE ROAD	CANTERBURY ROAD
12	NEWBRIDGE ROAD	CITY BOUNDARY	MILPERRA ROAD
13	PUNCHBOWL ROAD	CANTERBURY RD	CITY BOUNDARY
14	ROBERTS ROAD	HUME HIGHWAY	WILEY AVENUE
15	ROOKWOOD ROAD	HUME HIGHWAY	CITY BOUNDARY
16	STACEY STREET	HUME HIGHWAY	FAIRFORD ROAD
17	WILEY AVENUE	ROBERTS ROAD	KING GEORGES rd
18	WOODVILLE ROAD	HUME HIGHWAY	CITY BOUNDARY
PROPOSED STATE ROAD			
1	THE RIVER ROAD	MILPERRA ROAD	M5

CURRENT REGIONAL ROADS			
ITEM NO.	ROAD	FROM	TO
1	ALLDER STREET	BRUNKER ROAD	RAILWAY BRIDGE
2	ALMA ROAD	DAVIES ROAD	FARADAY ROAD
3	ASHFORD AVENUE	BULLECOURT AVE	MILPERRA ROAD
4	AUBURN ROAD	WATER PIPELINE	HUME HIGHWAY
5	BEACONSFIELD STREET	THE RIVER ROAD	HORSLEY ROAD
6	BIRDWOOD ROAD	OWEN ROAD	GEORGES CRES
7	BRAESMERE ROAD	TOWER STREET	PARK ROAD
8	BRANDON AVENUE	CHAPEL ROAD	GREENWOOD AVE
9	BRUNKER ROAD	ROOKWOOD ROAD	ALLDER STREET
10	BULLECOURT AVENUE	HORSLEY ROAD	ASHFORD AVENUE
11	CARLINGFORD ROAD	WATER PIPELINE	WALDRON ROAD
12	CHAPEL ROAD	CANTERBURY ROAD	BRANDON AVENUE
13	CHAPEL ROAD	RICKARD ROAD	HUME HIGHWAY
14	CHRISTINA ROAD	WALDRON ROAD	RIVER AVE
15	EDGAR STREET	MILPERRA ROAD	HUME HIGHWAY
16	FARADAY ROAD	ALMA ROAD	URANUS ROAD
17	FERRIER ROAD	RAILWAY BRIDGE	AUBURN ROAD
18	GIBSON AVENUE	WATSON ROAD	CANTERBURY ROAD
19	GREENWOOD AVENUE	BRANDON AVENUE	MARION STREET
20	HAIG AVENUE	GEORGES CRESCENT	HENRY LAWSON DR
21	HECTOR STREET	HUME HIGHWAY	WATER PIPELINE
22	HORSLEY ROAD	BEACONSFIELD RD	BULLECOURT AVE
23	KOALA ROAD	WATTLE STREET	WILEY AVE
24	MACAULEY AVENUE	STACEY STREET	CHAPEL ROAD
25	MACLAURIN AVENUE	PARK ROAD	HENRY LAWSON DR

26	MARION STREET	GREENWOOD AVE	OWEN ROAD
27	MARION STREET	GREENWOOD AVE	MEREDITH STREET
28	MEREDITH STREET	MARION AVENUE	RICKARD ROAD
29	MILLER ROAD	HUME HIGHWAY	WALDRON ROAD
30	OWEN ROAD	MARION STREET	BIRDWOOD ROAD
31	PARK ROAD	BRAESMERE ROAD	MACLAURIN AVE
32	QUEEN STREET	BEACONSFIELD ROAD	MILPERRA ROAD
33	RICKARD ROAD	MEREDITH STREET	CHAPEL ROAD
34	RICKARD ROAD	STACEY STREET	CHAPEL ROAD
35	ROBERTS ROAD	WILEY AVENUE	WATTLE STREET
36	SPHINX AVENUE	GIBSON AVENUE	THE RIVER RD
37	THE RIVER ROAD	HENRY LAWSON DR	M5
38	TOWER STREET	THE RIVER ROAD	BRAESMERE ROAD
39	URANUS ROAD	FARADAY ROAD	THE RIVER ROAD
40	WALDRON ROAD	CARLINGFORD ROAD	CHRISTINA ROAD
41	WATERLOO ROAD	WATTLE STREET	HUME HIGHWAY
42	WATSON ROAD	FAIRFORD ROAD	GIBSON ROAD
43	WATTLE STREET	KOALA ROAD	STACEY STREET
44	WELLINGTON ROAD	AUBURN ROAD	WOODS ROAD
45	WOODS ROAD	WELLINGTON ROAD	CARLINGFORD ROAD
PROPOSED REGIONAL ROADS			
1	BULLECOURT AVENUE	HENRY LAWSON DRIVE	ASHFORD
2	MUIR ROAD	ROOKWOOD ROAD	HUME

8.7 Vehicular Footway Crossing (VFC) Design and Construction

This clause applies to the following types of development:

- Residential and Dual Occupancy
- Medium Density Residential (row houses and villas)
- High Density Residential (flats)
- Commercial, Industrial and Institutional Development

Table of VFC Widths

Developments requiring vehicular access across the Council footpath area must provide a VFC with maximum and minimum widths in accordance with the following table. Maximum size is dependent on providing at least 6.0 m separation between wings, at the kerb, to adjoining VFC's. Minimum widths will apply in areas with high on street parking demands, and where on street time restrictions are in place.

Table 8.1

USE	Minimum width of VFC @ Boundary	Maximum width of VFC @ Boundary	Minimum Standard of VFC
Residential	2.75 m *	5.5 m	Light Duty
Dual Occupancy (with single access to both dwellings)	3.5 m	5.5 m	Medium Duty
Dual Occupancy (with separate access to each dwelling)	2.75 m *	3.5 m *	Light Duty
Medium and High Density	3.5 m	6.0 m **	Heavy Duty

Residential Developments			
Commercial Developments	3.5 m RTA Guidelines	RTA Guidelines	Heavy Duty
Industrial Developments	RTA Guidelines	RTA Guidelines	Heavy Duty

* A second vehicular crossing will be permitted if a minimum 6.0m long parking bay can be provided between the wings of the crossings. Council may vary this requirement under special circumstances, based on technical assessments of the merits of the situation.

** A second 3.5 m wide crossing will be permitted for disabled access or garbage bay access.

8.7.1 VFC Design Criteria

For any VFC application, approval may depend upon the impact of the VFC on existing infrastructure. The VFC's should be designed and located to:

- Maintain clear distances of at least 6.0 metres, and multiples of 6.0 metres between proposed VFC's.
- Maintain 6.0m minimum distance from adjoining existing VFC wings. Kerb lengths of 3m-5.9m between crossing wings should be avoided to reduce the potential for parked vehicles obstructing other vehicular crossings.
- Maintain a minimum separation of 1.8m between VFC's at the road boundary. This will provide a minimum of 0.2m kerb length between laybacks.
- Avoid services such as Telstra, Sydney Water, Council stormwater drainage pits and any other existing structures. The cost of relocating any services shall be borne by the applicant.
- Be 0.6m clear of power poles to satisfy the electricity authorities requirements.
- So the wing of the crossing is a minimum of 0.5m clear of the lintel of any street drainage pit.
- Be at least 1.0m minimum from property boundaries at the road boundary.
- Be no closer to the intersection of the side road than the tangent points of the kerb returns of the intersection in accordance with AS 2890.1.
- Maintain adequate sight lines to pedestrians and traffic as required by AS 2890.1.
- Avoid existing street and regulatory signs. Existing street signs may be relocated with prior approval from Council's Traffic Section.
- Avoid existing bus shelters and consider sight distance problems associated with the walls of the bus shelter. Any relocations of the bus shelter must be approved by Council's Traffic Committee, The relevant local bus company and, if applicable, the bus shelter owner, if not Council. The cost to relocate the bus shelter shall be borne by the developer.

Due to demand for on street parking around sites such as Hospitals, Railway Stations, Bankstown CBD and the Urban Villages of Chester Hill, Greenacre, Condell Park, Padstow, Revesby, Panania and East Hill, a second crossing should not be proposed where the development site is within 200m to these types of facilities or services. If on street parking is subjected to a time limit along the frontage of the development site,

then the number of VFC's will be restricted to one only. In general, all developments are required to retain at least one on-street parking space adjacent to the site.

8.7.2 VFC's and Impact on Street Trees

Street trees represent an important Council and environmental asset. Every effort should be made to protect the existing street trees.

With the exception of utilising existing VFC's for access to new developments, all new VFC's should be located 2.0m clear of any tree trunk for sight distance and reduction of potential root damage to the existing tree. For any variation, an application should be made to Council for consideration. Any approval will be based on an assessment having regard to the potential size of the street tree and the amount of excavation involved.

The Tree Preservation Officer must assess any impact to trees affected by the development proposal. Developers will be required to replace any removed trees with other suitable tree(s) as approved by Council's Tree Preservation Officer. Developers will be liable for the cost of replacement of removed trees.

8.7.3 SBAL's and VFC Design Levels

Council has developed and adopted set criteria for determining the shape of the footway area within the existing and proposed road reserves. Council's desire to have a consistent approach to the reshaping of the footway area requires that site levels at the Street Boundary Alignment SBAL must be compatible with profiles designed by Council.

The developer must make application to Council to obtain a Work Permit [Part D] for SBAL's and VFC's and pay the standard application fee at Council's Customer Service Centre prior to the issue of the CC for the development. The levels must be incorporated in the designs of the internal pavement, car park, landscaping and stormwater drainage.

8.7.4 VFC And Foot paving Construction

The VFC and foot paving must be constructed in accordance with plans, design levels and specification issued by Council's Civic Design Unit. A Work Permit [Part D] must be applied for and an application fee is applicable for Council to provide the design, construction specifications, and inspections.

All VFC and foot paving pavement surfaces must be constructed to be a slip resistant finish in accordance with Council's VFC and foot paving design and specification by Council.

- VFC finish is to be broom, stencilled, or cove finish only to ensure compliance with slip resistance requirements.
- Sealing of VFC is not permitted as the surface becomes excessively slippery.
- Only one colour may be applied to non-grey finishes if a colour finish is approved.
- The VFC layback must be in plain broom finish concrete.

- Foot paving finish is to be plain concrete broom finish unless specified otherwise by Council. Council may specify decorative paving in designated areas such as shopping centres.

Council may reconstruct any construction not complying with these requirements, at the owner or developer's expense.

Any form of paving strip across the footway, between the street boundary and kerb and gutter, for pedestrian or vehicular access other than the approved vehicular crossing will not be permitted without Council Approval. Council may remove any unauthorised construction of such work, at the owner or developer's expense.

8.8 Restoration Works Within The Footway

Council may require the following works within the road reserve to be carried out by the developer in the roadway adjacent to a new development at the developer's expense.

- Reconstruction of any existing VFC to be retained, if previously damaged or not meeting Council's current specification.
- Reconstruction of damaged foot paving.
- Removal of redundant VFC or laybacks and reinstatement of the footway and kerb and gutter.
- Any adjustment and/or provision of new kerb and gutter, drainage facilities, road pavement, utility services, adjacent foot paving and/or footway.
- Adjustment and reconstruction of adjoining VFC and foot paving as required due to difference in grades and levels and to provide 1.0 metre transitions or clearance to existing infrastructure.
- Remove any unauthorised VFC and restore the footway to Council's satisfaction.

8.9 Improvement Works Required Within The Road Reserve

For the categories of development listed below, developers may be required to upgrade Council's infrastructure in accordance with the DA Consent. The works must be carried out at the developer's expense where these improvements do not exist, are in need of replacement due to damage or are sub-standard for its intended purpose. This clause usually does not apply to single-family residential, dual occupancy types of development and where no onsite works are proposed such as change of use. The following is a list of the types of developments and the required frontage improvements to be installed in front of those developments.

8.9.1 Multi-unit Residential, Institutional, and Industrial Development

- Concrete Kerb and gutter over the full road frontage(s) of the site.
- Road shoulder pavement over the full road frontage(s) of the site.
- Concrete foot paving 1.2m wide adjoining the full road frontage(s) of the site.
- Reconstruction of damaged concrete foot paving, kerb and gutter and/or road pavement.

- Reconstruction of stormwater pits including replacing old and damaged grates and lintels.

8.9.2 Commercial Developments

- Concrete Kerb and gutter over the full road frontage(s) of the site.
- Road shoulder pavement over the full road frontage(s) of the site.
- Foot paving must be provided over the full width of the footway. The foot paving must be in accordance with Council's requirements for the area.
- Developments, within the Bankstown CBD, must be built to comply with the foot paving requirements of the "CBD Paving Guidelines".
- Reconstruction of damaged concrete foot paving, kerb and gutter and/or road pavement.
- Reconstruction of stormwater pits including replacing old and damaged grates and lintels.

8.10 Works By Private Contractors

The opportunity exists for the applicant to have the necessary works in Council's footway to be carried out by a suitably qualified private contractor, under Council's supervision, subject to the approval of the Work Permit by Council. Developers should make early applications to Council for the issue of Work Permits. A contractor must provide proof of Public Liability Insurance, to the value specified by Council, for any works or activities on public land.

8.11 Internal Driveway Requirements

The onsite driveway layout must be designed so that a car may be able to access and exit all required car spaces in one motion. Also, a required car parking space must be located so as to be outside and clear of any vehicular manoeuvring area or right of carriage way. Austroads standard turning path templates are to be used to determine acceptability.

8.11.1 Internal Driveway Profile

The vehicular driveway profile within the development site shall be designed to prevent vehicles from scraping and must satisfy the following requirements:

- The maximum allowable grade is to comply with AS 2890.1 & AS 2890.2.
- Transition grades will be required for changes in grade in excess of 12.5%.
- Maximum allowable limits and vertical transitions must comply with Council's Standard Drawing No. S-005.
- Council's Standard Car Clearance Profile on Drawing No. S-006 shall be used to determine acceptable grades to prevent scraping on residential development. The 99% profile in AS 2890 is to be used for commercial, and industrial developments and all developments where more than 25 parking spaces are provided.

8.11.2 Driveway Pavement Surface Requirements

The developer must construct the driveway pavement surface of a durable, slip resistant, all weather material such as concrete or pavers intended for the use as a driveway surface. The minimum pavement thickness design for the driveway within the development must be in accordance with Council's VFC Standard Drawings S-007 to S-009, whichever is required by the development consent. A Structural Engineer shall be engaged to design any driveway shared by more than two dwellings. The following driveway requirements also apply:

- Concrete finish is to be broom, stencilled, or cove trowel finish to achieve a slip resistant surface finish.
- Sealing of coloured concrete is not recommended as the surface may become slippery when wet.
- Driveways with a grade in excess of 15% are to be constructed with an enhanced skid resistant surface treatment such as grooving.
- If pavers are proposed as a driveway surface the pavers must be laid on a sand covered concrete base.

8.12 Car-Wash Bays

Where residential developments are required to provide a car wash bay as a condition of development consent, the following requirements apply:

- The car wash bay pavement must be bunded and isolated from the stormwater drainage system so the car wash runoff discharges into the Sydney Water sewer system.
- The car wash bay must be covered or located in the basement and protected so that stormwater does not collect in the wash bay and discharge into the sewer system.
- The car-wash bay space may also be used as a visitor parking space.

8.13 Sight Distance Requirements

For all developments, adequate sight distance must be provided for vehicles exiting driveways. Clear sight lines are to be provided at the street boundary to ensure adequate visibility between vehicles on the driveway and pedestrians on the footway and vehicles on the roadway. Refer to the Australian Standard AS 2890.1 for minimum sight distance requirements.

If adequate sight distance for the access to any development cannot be achieved and considered a concern, the Applicant may be required to install regulatory signs, at the boundary of the development, as agreed with Council.

8.14 Certification Of Driveway Design And Construction

The developer must provide a design prepared by a qualified Engineer for all driveways, parking bays and service areas that are to be subjected to vehicular movement. The type and thickness of pavement must be designed to accommodate the anticipated wheel loads, over the sub grade concerned, in accordance with current relevant Australian Standards.

The developer must provide certification by a qualified Engineer that all driveways, parking bays and service areas for villas, high density, commercial and industrial developments, have been constructed in accordance with the approved plans and specifications. Such certification will be required prior to the issue of the Occupation Certificate or occupation of the site.

9 SITE STORMWATER DRAINAGE

9.1 General

The requirements of this section apply to all new site stormwater drainage systems within subdivisions, development sites for buildings, structures requiring drainage improvements, building additions and site works. A suitably qualified Civil Engineer must be engaged to design and certify the stormwater drainage plans for all developments. Where special circumstances occur, the requirements of this section may be varied at the discretion of Council or its engineers. In some cases, where a commercial type development is situated in and resembles a residential environment, the stormwater drainage system may be designed to meet the residential requirements.

These requirements are intended to ensure that:

- A high standard of stormwater drainage infrastructure is established within the development site.
- The proposed and constructed stormwater drainage system has no adverse impact on Council's stormwater drainage system, the development itself and adjoining properties.
- Buildings are not affected by inundation from stormwater runoff resulting from the 100 year ARI storm event
- Any proposed stormwater drainage works are designed to minimise any nuisance caused by stormwater drainage flows from local catchment flooding or mainstream flooding from the Georges River.
- Special consideration will be given to developments requiring the submission of BASIX Certificate where domestic water supply may be supplemented by the use of rainwater storage tanks fitted into stormwater drainage systems.

The following standards are to be implemented to manage stormwater runoff and prevent damage to buildings and property and reduce hazardous flows.

9.1.1 Development Impacted by Stormwater Systems

A developer must apply to Council for an SSR, prior to DA submission, if the proposed development site is noted on Council's SSR register as affected by Council's stormwater drainage pipelines and/or affected by potential local stormwater flooding. The development must be designed to consider the recommendations of the SSR and satisfy the requirements of this guideline.

It is the developer's responsibility to locate and verify Council's stormwater drainage system as shown on the SSR or other information given by Council, including OLFP's where the stormwater system is located within the development site.

All developments must be designed and constructed to make provision for over land flow from stormwater runoff generated by external upstream catchments.

9.1.2 Disposal of Stormwater Runoff From A Development Site

In general, site stormwater drainage systems should be designed to flow under gravity, and be connected to Council's stormwater drainage system at the nearest suitable location or CDL benefiting the site. Site drainage design should follow the natural fall of the catchment to a pipeline connection point that has been designed for the runoff. Catchment redirections may be permitted subject to compliance with requirements outlined below. A separate approval to connect to Council's stormwater drainage system must be obtained from Council. Permission to carry out the works must be obtained by applying for the relevant Work Permit.

The final number of drainage outlets will be determined by Council through the WP process and the Storm Water Connection Plan Approval.

Pipelines constructed across the footway must generally be confined to within the development site frontage. In certain circumstances Council may consider allowing the pipeline to extend a maximum of 20m along the footway in front of adjoining property. The Applicant must demonstrate that the development potential of the adjoining property, including construction of VFC's, will not be adversely affected.

9.1.3 Council Stormwater System Availability

It is the developer's responsibility to investigate the availability of Council's stormwater drainage system, in accordance with the provisions of this guideline, prior to submitting a Development Application. Where the stormwater drainage system is unavailable or the Council stormwater drainage system must be extended to the development site, it is the developer's responsibility to undertake all acquisitions and construction required to extend the Council system to the site. The minimum pipe size Council will maintain is 375mm diameter Reinforced Concrete. Council does not undertake to provide or assist in providing stormwater drainage infrastructure to facilitate proposed developments.

9.1.4 Redirecting Stormwater Runoff to Another Catchment

Sub-Catchment redirection of stormwater results in stormwater being directed to a drainage system that may not have been designed to receive it. This redirection of stormwater may increase flows to part of that system and increase chances of flooding of an OLFP upstream of where the stormwater would normally flow. Where additional properties are affected by the redirected flows, Council may require a drainage study to assess the impact of the redirected catchment to the part of the drainage system that will receive increased flows. This may generally be along the receiving street gutter, existing stormwater drainage system and the adjoining properties to the low point in the subject street then to the OLFP through to the next street drainage system downstream. If the engineer requires a drainage study then the following criteria should be assessed before the redirected stormwater will be permitted:

- The additional flows should not increase the water surface levels in the OLFP

to a point where dwellings are adversely affected by the increased flows.

- Existing dwellings adjoining the OLFP should have habitable floor levels at least 300mm above the computed 100 year flood level. No freeboard is required for non-habitable buildings such as sheds and garages.
- Velocity depth product [Vxd] should remain unchanged or as in accordance with Section 9.5.1.

9.2 Stormwater Disposal Requirements:

9.2.1 Stormwater Connection To The Kerb and Gutter

Any drainage connection to Council's kerb and gutter requires the developer to apply to Council for a **Work Permit** to carry out work within the road reserve. The permit must be issued under section 138 of the Roads Act prior to the issue of any other CC. All costs associated with the application and construction for the work shall be borne by the developer.

The minimum pipeline connection to the street kerb and gutter must be made via a suitably sized galvanised steel rectangular or circular outlet. A 100mm diameter heavy-duty sewer grade pipe may be substituted as the minimum drainage outlet in areas where it is unlikely to be damaged by heavy vehicular movements over the footpath area. Typically, sewer grade pipe may be used in single-family residential and dual occupancy situations where the design flow doesn't warrant a larger pipe size.

The 100mm Sewer grade pipe may be installed for drainage of a Single Dwelling or for drainage of a Dual Occupancy where two separate outlets, one for each dwelling, are proposed for discharge to the kerb and gutter. The 100mm diameter sewer grade pipe must be connected to the kerb by using a 150mm x 50mm galvanised RHS kerb outlet and a proprietary uPVC adaptor inserted into the back of the RHS. The minimum cover over any kerb outlet is to be 40mm. If multiple pipes are installed to meet the capacity requirements of the site discharge, the pipes are to be separated by a minimum distance of 300mm at the kerb face and the kerb is to be reinstated to Council's satisfaction in accordance with Council's Standard Drawing S-107.

The angle of the kerb outlet from the drainage pipes should be installed between 45° and 90° to the gutter flow.

The existing kerb height must be checked to ensure it is high enough to accept the proposed pipe dimension. The kerb must be a minimum of 150_{mm} high to accept a 100_{mm} high RHS. If the kerb is less than 150_{mm} high then an adaptor of suitable height is to be manufactured and installed to connect the outlet to the kerb and gutter.

9.2.2 Maximum Stormwater Discharge To The Kerb and Gutter

The maximum direct discharge from the site to the kerb and gutter must be limited to 30 litres per second, at any one discharge point, for the 10 year ARI storm. It may be required that multiple RHS's be installed to meet the capacity requirements of the discharge from the site. If this is the case they must be installed in accordance with Council's Standard Drawing S-107. If the site discharge is greater than 30 l/s, a

connection to Council's underground pipe system may be required. OSD may be provided, or increased to limit the discharge to permissible flows. All underground direct connections to Council pipelines are to be constructed in accordance with Council Standard Drawing S-107 and inspected by Council prior to backfilling.

9.2.3 Connection To Council's Piped Drainage System

Where a development has legal access to Council's piped drainage system a connection to the system will be permitted, only after the design is approved by Council under the Work Permit Process, by means of directly connecting to an existing pit or construction of a new pit over the existing pipeline.

Pits constructed over existing pipelines and in line with the kerb and gutter must be constructed as gully pits with minimum 450mm x 900mm grated inlet in the gutter. A lintel may be required to be installed where the gutter flows are considered to be high enough to warrant the installation of an additional lintel. Junction pits may be constructed in other locations along the footway. Proprietary cast iron lids or grates are permitted in the footway area. No concrete lid will be permitted.

All pits must be designed and constructed in accordance with Council's Standard Drawings S-103 to S-106, whichever applies to the proposed situation, and as required by Council.

Council will permit a direct connection to its pipeline for discharge pipes up to 150mm diameter and where a direct connection to a Council pit is not feasible. A 225mm diameter pipelines can be directly connected to a 600mm diameter or greater Council pipeline. Connections are to be made in accordance with Council's Standard drawing S-107. A cleaning eye or pit must be constructed within the development lot at the nearest convenient location adjacent to the connection of the Council pipeline.

An existing Council drainage pipeline may be extended, along the kerb alignment, to the development site to enable a connection to be made. The minimum pipe size of the extended Council pipeline is to be 375mm diameter.

9.2.4 Connection to Stormwater Channels

Site stormwater runoff may be discharged into a Council or Sydney Water stormwater drainage channels subject to approval from the relevant authorities. Any approval is subject to issue of a Part 3A Permit under the Rivers and Foreshores Improvement Act. The developer must apply to the relevant state department for this approval.

Any proposed site stormwater drainage connection to Council or Sydney Water's channel must be made into an existing pipe connection if one is available near the development site. If one is not available, adjacent to the development site, then the connection must be made via a single connection point to the channel adjacent to the site.

For Council channels the pipe connection is to be at 45° to the channel. The pipe invert is to be a minimum of 150mm above the channel invert at the connection. For Sydney Water channels, an application must be made to Sydney Water for permission to connect.

For lined channels, the proposed connection to the channel must be made using a reinforced concrete pipe or FRC pipe from the channel to the boundary of the development site. The developer must reinstate the lining of the channel, at the connection point, to Council or Sydney Water's satisfaction.

For unlined channels the channel is to be protected against erosion at the point of discharge into the channel. The protection must be in the form of a sandstone or durable rock apron to Council's satisfaction. Pipes should be RCP or FRC only. Connections to an unlined channel will also require approval under the Rivers and Foreshores Improvement Act.

9.2.5 Piping Stormwater Drainage Through Council Parks And Reserves

Council may consider an application by a developer to lay pipes within public land such as Public Reserves and parkland. Any proposal to drain stormwater to or through a public reserve must first obtain approval from Council's Recreation and Open Space Unit prior to submitting the DA to the Council for assessment.

The decision, as to whether such a proposal is allowable, will also depend on the classification of the land, whether any plan of management, that may apply to the land, permits the laying of such pipes and the intended future use of the Reserve.

To prevent multiple pipelines from passing through the public land, the pipeline must be sized to allow for adjoining properties, in future, to connect to it. The minimum pipe size for the pipe must be 375mm diameter and constructed of RC or FRC pipe.

Council is likely to seek compensation for granting of easements and laying of the pipelines through publicly owned land. All cost incurred for the granting of easements, design of the pipeline and laying of the pipeline in publicly owned land must be borne by the developer.

9.2.6 Stormwater Discharge to Bushland

Where stormwater is to drain to Council owned bushland, pipe outlet energy dissipaters are to be provided to reduce energy and to spread or direct the flow, as the location requires. For velocities up to 1 m/s the dissipater shall be constructed of sandstone or harder rock riprap of nominal size 200-400mm placed on geotextile filter fabric to achieve a compact rock blanket, with a downstream length of 6 metres. Where flow velocities are higher than 1m/s, or where a significant drop occurs at the structure the outlet is to be designed by a qualified Civil Engineer.

Where stormwater is to drain to bushland not owned by Council the applicant must apply to and obtain written approval from the relevant authority that owns and controls the bushland prior to lodging any DA for development requiring stormwater drainage works.

9.2.7 Common Drainage Line

For sites where the drainage of stormwater involves the construction of a stormwater drainage system across land owned by others, an easement to drain water must be created over the downstream properties, in favour of the lot(s) being developed.

The minimum pipe size contained within a Drainage Easement for a single dwelling, including half of a Dual Occupancy development, shall be 100mm and connected to the kerb and gutter via an approved connection method.

The minimum pipe size contained within a Drainage Easement for any other form of development shall be 150mm and connected to the Council system via an approved connection method.

Rigid wall pipes (RCP or FRC) may be required in trafficable areas or as deemed necessary by the engineer.

9.2.8 Drainage Line Easement Widths

The creation of an easement to drain water must be agreed to, in writing, by the burdened property owners, prior to an operational DA Consent being issued by Council.

Documents relative to the creation of an easement to drain water are to be lodged and registered with Land and Property Information (LPI) prior to issue of the Construction Certificate. All costs must be borne by the developer.

The following table shows the required minimum easement widths:

Table 9.1

Pipe Diameter (mm)	Width of Easement to Drain Water (m)
100, 150	1.0*
225	1.2 *
300	1.5
375, 450	2.0
525, 600, 675	2.5
750, 825, 900	3.0
1050, 1200	3.5
1350, 1500	4.0
1650, 1800	4.5

* The easement width may be reduced to 0.9m between existing dwellings & boundary.

Where an easement has not been registered over a Council stormwater system an easement to drain water, located centrally about the pipe and drainage system, shall be created in favour of Council. The minimum easement widths required are shown in the table above. When a lot is to be developed the developer may be required to extend or widen and existing easement to suit Council's or other authority's requirements as a condition of the Development Application

The above table is only an indication of easement widths for shallow pipe systems. Council may consider reducing the required easement widths where it is demonstrated that the full easement width cannot be obtained and the proposed pipe and an OLFP can be installed, maintained and replaced satisfactorily.

Where multiple pipes are proposed, a larger easement width may be required. The proposed easement width should be at least the external width of the laid pipes plus 2 times diameter.

Where the depth of pipes becomes excessive then Council may require a wider easement.

9.3 Site Stormwater System Design

9.3.1 General

Stormwater runoff from all areas within the property shall be collected, in a system of gutters, downpipes, pits and pipelines located within the site, and drained to a Council receiving stormwater system.

All site stormwater drainage systems, including OLFP's, are to be designed generally in accordance with the requirements detailed in this document, the most current and relevant editions of Australian Rainfall and Runoff, AS3500 and **Table 9-2**, provided below.

9.3.2 Determining Stormwater Flow Rates (Hydrology)

The Rational Method, in association with the Kinematic Wave Equation, is an acceptable method for determining flow rates where the site catchment is less than 2 hectares, has fairly uniform characteristics and the level of accuracy is not critical. A maximum time of concentration $t_c = 20$ min and a minimum coefficient of $C_{100} = .84$, for all sub-catchments, must be used when determining flow rates.

The following roughness factors should be used when determining times of concentration for use in the Kinematic Wave equation.

Table 9-2

SURFACE TYPES	ROUGHNESS COEFFICIENT (n) for sheet flow only
Concrete or Asphalt	0.01 - 0.013
Bare Sand	0.01 - 0.016
Gravelled Surface	0.012 - 0.03
Bare Clay - Loam Soil (eroded)	0.012 - 0.033
Sparse Vegetation	0.053 - 0.13
Short Prairie Grass	0.10 - 0.20
Lawns	0.17 - 0.48

Where the site catchments are greater than 2 hectares, and / or an accurate level of flow rate prediction is necessary, peak flow rates must be determined using a recognised runoff routing computer model such as ILSAX OR DRAINS. Council may need additional assessment time if other hydrology programs are used.

Table 9-3

AUSTRALIAN RAINFALL INTENSITY FOR BANKSTOWN CITY COUNCIL AREA

BASE DATA TO CONSTRUCT IFD CURVES:

	111	1212	7212	1150	1150	1150	F2	F50	G
	35.5	7.6	2.5	72	15.1	5.2	4.29	15.8	0
					ARI(y)				
TIME	1	2	5	10	20	50	100	200	500
1.1									
				(mm/hr)					
5 mins	88.5	114	145	163	187	219	242	266	299
6 mins	83.0	107	136	153	176	206	228	251	281
7 mins	78.3	101	129	145	167	195	216	238	266
8 mins	74.4	95.6	123	138	159	185	206	226	254
9 mins	70.9	91.2	117	132	152	177	197	216	243
10 mins	67.9	87.4	112	126	145	170	189	208	233
12 mins	62.8	80.8	104	117	135	158	175	193	217
14 mins	58.6	75.5	97.1	110	126	148	164	181	203
15 mins	56.8	73.1	94.2	106	122	144	160	176	198
16 mins	55.1	71.0	91.5	103	119	139	155	171	192
18 mins	52.1	67.1	86.6	97.9	113	132	147	162	182
20 mins	49.5	63.8	82.4	93.2	107	126	140	155	174
25 mins	44.2	57.1	73.8	83.6	96.5	113	126	139	157
30 mins	40.2	51.9	67.3	76.3	88.1	104	115	127	143
40 mins	34.5	44.5	57.9	65.7	75.9	89.4	99.6	110	124
50 mins	30.4	39.4	51.3	58.3	67.4	79.4	88.6	98.0	111
1 hour	27.4	35.5	46.3	52.7	61.0	72.0	80.4	88.9	100
1.5 hour	21.5	27.8	36.2	41.2	47.7	56.2	62.7	69.3	78.3
2 hour	18.0	23.3	30.3	34.4	39.8	46.9	52.4	57.9	65.3
3 hour	14	18.1	23.5	26.7	30.8	36.3	40.5	44.7	50.5
4.5 hour	10.8	14.0	18.2	20.7	23.9	28.1	31.3	34.6	39.0
6 hour	9.1	11.7	15.2	17.2	19.9	23.4	26.1	28.8	32.4
9 hour	7.0	9.1	11.8	13.3	15.4	18.1	20.2	22.3	25.1
12 hour	5.9	7.6	9.8	11.1	12.9	15.1	16.8	18.5	20.9
15 hour	5.2	6.7	8.7	9.8	11.3	13.3	14.9	16.4	18.5
18 hour	4.6	6.0	7.8	8.8	10.2	12.0	13.4	14.8	16.7
24 hour	3.9	5.1	6.6	7.5	8.7	10.2	11.4	12.6	14.2
30 hour	3.4	4.4	5.8	6.6	7.6	9.0	10.0	11.1	12.6
36 hour	3.1	4.0	5.2	5.9	6.8	8.1	9.0	10.0	11.3
48 hour	2.5	3.3	4.3	4.9	5.7	6.8	7.6	8.4	9.5
72 hour	1.9	2.5	3.3	3.8	4.4	5.2	5.8	6.5	7.3

9.3.3 Stormwater System ARI Design Criteria

The following design ARI's should be applied to the relevant components of the stormwater drainage system:

Table 9-4

STORMWATER DESIGN ELEMENT	DESIGN AVERAGE RECURRENCE INTERVAL (Years)
Site Piped Drainage (Residential)	10
Eave Gutters and Downpipes (Residential)	10
Site Piped Drainage (Commercial & Industrial)	20
Eave Gutters and Downpipes (Commercial & Industrial)	20
Box Gutters and Downpipes	100
Common Drainage Line (Residential) *	10
Common Drainage Line (Com & Ind)*	20
Inter-allotment Drainage no OLFP	100
Outlet to Natural Watercourse **	5

* Where an OLFP for flows in excess of the pipe capacity has been provided.

** See OSD Section

Council may vary the required ARI in instances where personal safety or the potential for property damage warrants such a variation.

9.3.4 Stormwater Drainage Pipe Design

Stormwater drainage pipes must be designed and sized to be sufficient to cater for stormwater run-off from the site and naturally draining to it.

A Hydraulic Grade Line (HGL) Analysis may be required, at Council's discretion, for the piped stormwater drainage design in the following cases:

- Inter-allotment drainage lines servicing more than two properties.
- Low-level property drainage systems connecting into a Council pit or street stormwater drainage system.
- Where the proposed pipe discharge exceeds 100 l/s.
- Where the catchment is being redirected
- In situations where determination of hydraulic control is critical as determined by Council's Development Engineer.

In cases where the HGL is critical to the successful implementation into the design of the development, the calculations will be required to be submitted with the DA.

In general, friction losses in pipes must be calculated using the Darcy Weisbach Equation. The design Coefficients of Roughness must be in accordance with the following table:

Table 9-5

PIPE MATERIAL	COLEBROOK WHITE "K"
uPVC Pipe	0.03
RC or FRC Pipe	0.30

For stormwater drainage systems, where HGL analysis is required, energy losses at pits, slope junctions, bends, transitions structures, inlets and outlets, shall be incorporated into the design of the drainage system. The Hydraulic Engineer must select "K" values, to determine energy losses, using "Missouri Charts", Hare equations, US Army Corp of Engineers mitre bend charts or other recognised method. "Drains", or other recognised computer programs, may be used to determine the HGL.

The following requirements shall apply for site stormwater pipelines:

- Minimum stormwater pipe sizes, materials and cover requirements must be in accordance with the latest edition of AS 3500 and manufacturers recommendations.
- Pipes shall be specified for likely construction loads and where cover during construction may be less than finished cover.
- Anchor blocks at 3.0m maximum spacing are to be provided for pipes with a gradient greater than 20%.

9.3.5 Stormwater Drainage Pipes Under Buildings

Site stormwater drainage pipes proposed under residential buildings, will be discouraged by Council with the exception of circumstances where the site constraints require alternate solutions to drainage layout. These alternate solutions must be considered at the DA stage and approved by Council on their merits. Short-circuiting the pipe layout, to save costs, is not considered grounds for a merit-based approval.

For other developments, stormwater drainage pipes may be placed under building slabs and will be approved subject to compliance with the requirements of AS 3500 and subject to pressure testing. The pipelines must be designed in accordance with the following criteria:

- Structural foundation design must account for the stormwater drainage pipes in the details. The proposed flooring system and foundation design must be suitable for any proposed stormwater pipes beneath the building. Details of penetrations and expansion material must be included in the foundation design.
- Stormwater pipes beneath the building are to be fully water tight and protected against mechanical movement and damage from the foundation system.
- Stormwater pipes must be sewer grade or better.

- Pipes must exit from under the building under ground or within carefully designed garden beds between the front building line and the front boundary.
- Any minor filling required in the front yard does not obstruct or divert the natural flow of stormwater from the adjoining upstream properties.

Gravity fall should be provided across the Council footway area, where possible. The developer may propose minor filling of the footway area, to achieve pipe cover, with Council approved changes to footway levels.

9.3.6 Onsite Stormwater Drainage Pits

Inlet pits and grates are to be installed in locations such that:

- All runoff from roofed and paved areas should be collected to prevent excessive flows from accumulating and discharging across the footpath or downstream properties.
- Storm water runoff does not enter garages or buildings.
- Excessive overland flow from upstream catchment and adjoining property is collected or safely diverted around buildings through the site.
- Long-term surface ponding of stormwater does not occur.
- Excessive depths of flow do not affect pedestrian safety or movements.

Junction pits or Inspection Openings (IO's) must be provided at the following locations or where appropriate to provide access for pipe maintenance purposes.

- At multiple pipe junctions
- At change of pipe gradient
- At change of pipe diameter
- At change in pipe direction for all developments other than single family and dual occupancy types of developments
- Bolt down, sealed, cast iron IO's or bolt down, sealed cast iron lid, pits should be located within commercial or industrial buildings where an external line runs under the slab of the building.
- Maximum spacing of 60 meters for maintenance access.

All internal pit dimensions must take into account the pipe dimensions and angle of the pipe entering and exiting the pit. The pit wall dimensions shall be 150 mm larger on each side than the outside diameter of the pipe in the wall. All pit lids must be constructed as square or rectangular, for the purposes of convention, to differentiate from Sydney Water sewer pit lids.

All Council pits and site stormwater drainage inlet pits proposed for trafficable areas shall be constructed generally in accordance with Council's Standard Drawing Number S-106 unless noted otherwise and approved on the plans. Pits in non-trafficable areas may be constructed of a material suitable for the intended purpose and flow proposed for the pit. The pits must be installed in accordance with the manufactures recommendations.

The following minimum internal pit dimensions must be constructed as per the requirements of AS 3500. Pit wall dimensions shall not be smaller than the pipeline entering it or as specified in the table below, whichever is the larger.

Table 9-6

Depth to Invert of Outlet (mm)	Minimum Internal Dimensions		
	Rectangular		Circular
	Width (mm)	Length (mm)	Diameter (mm)
≤ 600	450	450	600
> 600 & ≤ 900	600	600	900
> 900 & ≤ 1200	600	900	1000
> 1200	900	900	1000

Step rungs must be provided in pits deeper than 1.2 meters.

Pit floors must be benched or shaped so that water will not pond in them. The lowest part of the floor should match the outlet pipe invert. This does not apply to debris, sump or soakage pits.

9.3.7 Roof Gutter Design

In general, roof, eave and/or box gutters and downpipes must be sized using the formulas and tables provided in accordance with AS 3500 and Table 9-4. In the case of OSD design, where overflow of the roof system cannot be directed to the OSD system, the roof stormwater drainage system must be designed for the 100 year ARI storm.

9.3.8 Stormwater Quality and Pollution Controls

To meet stormwater quality objectives set out in Council's Catchment Stormwater Management Plans, new developments will need to install permanent stormwater pollution controls.

The minimum pollution control requirements for all development other than single-family and dual occupancy, residential housing are given in Council's standard drawing No. S-106 titled 'Standard Pollution Control Pit'.

A developer should refer to the following publications to determine the appropriate stormwater pollution control system for the proposed development:

- The EPA's manual on Managing Urban Stormwater (Treatment Techniques)
- Stormwater Treatment Devices User Guide (NSW Supply) - Government Contract No.019, July 1999, Department of Public Works and Services
- The relevant Australian Standards for pollution control devices

The following is a list of stormwater quality control requirements in addition to temporary sediment and erosion control design requirements for construction works:

- **Silt arrestors and trash screens** must be placed at the last storm water drainage pit before discharging into Council's drainage system, except for single or dual occupancy type residential development. The silt arrestor and

trash screen must be designed generally in accordance with Council's Standard Drawing S-106. Trash screens must be constructed of a suitable galvanized steel mesh. The size of the openings must be such that the screen will trap the design litter and in accordance with AS3500.

- **Oil arrestors** must be installed in the drainage system for industrial and large commercial developments where required by Council and the DA Consent.
- **Car wash bays** may be required on residential developments that comprise 6 or more dwellings, in accordance with the DA Consent. The car wash bay pavement must be bunded and isolated from the storm water drainage system so the car wash runoff discharges into the Sydney Water sewer system. The car wash bay must be covered or located in the basement and protected so that storm water does not collect in the wash bay and discharge into the sewer system. This space may be also used as a visitor parking space.
- **Stormwater Discharges into Bushland and Natural Waterways** must have greater controls on stormwater quality and individual pollution controls shall be constructed as required and specified by the DA Consent.

9.3.9 Subsoil Drainage Pipes

Where subsoil drainage is required, the pipes are to be located wholly within the site and connected to the onsite stormwater drainage system. If no system exists then direct connection to kerb and gutter shall be in accordance with these guidelines. Details of the connection to the system or kerb are required to be shown on the CC engineering plans.

9.4 Alternative Solutions For Stormwater Disposal From Single Dwellings And Dual Occupancies

Council will consider alternative drainage system solutions for Single Dwellings and Dual Occupancies, at the DA stage, for developments where piped drainage to a Council drainage system cannot be achieved under gravity in accordance with the above guidelines and in the case of Dual Occupancy developments where evidence is provided, to Council, to show that offers, to adjoining property owners, to acquire a drainage easement have been made and failed. This evidence must be provided, to Council, at the DA Stage of the development. This is further explained in Section 9.4.2.

Some acceptable alternative drainage solutions are listed below. Please note that OSD storage may be required, at Council's discretion, depending on site impervious area and downstream conditions.

9.4.1 Alternative Drainage of Single Dwellings: General

For single dwellings only, alternative methods for stormwater disposal are listed below and shall be in accordance with the following guidelines.

- Filling of the site to increase fall to the street where the site already falls to the street.

- Filling of the site that results in redirection of the stormwater to a catchment that would not have received it previously. Where this option is used in the design, in some circumstances Council may require rainwater tank storage of 3000 litres.
- Charged drainage pipeline to the kerb where the site already falls to the street.
- Charged drainage pipeline to the kerb that results in redirection of the stormwater to a catchment that would not have received it previously. Where this option is used in the design, in some circumstances Council may require rainwater tank storage of 3000 litres.
- Absorption system incorporating overflow pump-out to the kerb.
- Pump-out drainage systems from basement garages and non-habitable building areas of development only, discharging to the kerb.

9.4.2 Alternative Drainage of Dual Occupancies: General

Alternative drainage solutions for Dual Occupancies will only be considered if drainage easements over downstream properties cannot be obtained.

The applicant must provide documentary evidence, to Council, that a Solicitor representing the Applicant has made a bona fide offer to all of the downstream property owners to acquire and construct an easement to benefit the proposed development.

The offer must include the following:

- Offers of compensation for the easement based on reasonable market rates as determined by a licensed land valuer,
- Offers to restore all disturbed areas as a result of the construction of the drainage easement.
- Offers to bear the costs of all legal fees necessary to acquire and construct the easement.

Documentary evidence of the offers, and all refusals, must be submitted to Council before alternative drainage solutions will be considered for development consent.

Please note: under certain circumstances the Land And Environment Court / Supreme Court of NSW may exercise the power, under Section 88K of the Conveyancing Act, to issue an order imposing an Easement to Drain Water over downstream properties.

For dual occupancies only, alternative methods for disposal of stormwater are listed below and shall be in accordance with the following guidelines.

- Filling of the site to increase fall to the street where the site already falls to the street.
- Filling of the site that results in redirection of the stormwater to a catchment that would not have received it previously. Where this option is used in the design, in some circumstances Council may require OSD and/or rainwater tank storage of 3000 litres.
- Charged drainage pipeline to the kerb where the site already falls to the street.

- Charged drainage pipeline to the kerb that results in redirection of the stormwater to a catchment that would not have received it previously. Where this option is used in the design, in some circumstances Council may require OSD and/or rainwater tank storage of 3000 litres.
- OSD incorporated with rainwater tank, transpiration bed and energy dissipation system draining onto downstream adjoining property.
- Pump-out drainage systems from basement garages and non-habitable building areas of development only, discharging to the kerb.

9.4.3 Requirements For Filling Of Sites To Drain To Streets

Council may consider filling of sites, up to a maximum depth of 0.5m, where it will not impact on the privacy of the adjoining property or result in obstruction of surface stormwater runoff from adjoining properties or footway. Any proposals for deeper fill for reasons other than drainage may be considered on their individual merits. The design for the fill must include any necessary retaining walls showing heights, locations and materials for construction.

Filling of the footway may be permitted by Council to allow site overland flow to drain to the street kerb. For filling of the footway to be approved, the level of the fill must be shown on the DA Application concept engineering plans, together with necessary adjustments to public utility pits and plant. Council must only be the approval body, under the Work Permit process, for filling of the footway.

9.4.4 Requirements for Charged Lines

Charged lines will be permitted for single dwellings and dual occupancy dwellings. In the case of dual occupancy type developments the charged lines will be permitted where the drainage systems can be separated so as to not require a drainage easement over one half of the dual occupancy to benefit the other half. Where there is no subdivision proposed of the dual occupancy the system must be designed as though subdivision will be proposed. In other words, each half of the dual occupancy must have its own outlet to the kerb in accordance with these guidelines.

Charged lines are permissible where a gravity fall cannot be achieved from the roof drainage system to the kerb, and cover can be achieved on the pipeline across the footway. Filling of the footway may be permitted by Council to allow piped drainage to be discharged to a settling pit at the boundary prior to flowing to the street kerb. For filling of the footway to be approved, the level of the fill must be shown on the DA Application concept engineering plans, together with necessary adjustments to public utility pits and plant. Council must be the only approval body, under the Work Permit process, for filling of the footway.

Charged lines must be designed in accordance with the following criteria.

- The charged portion of the drainage system, rising out of the ground, must be sealed to a minimum height above the ground, which allows the calculated flow of roof stormwater drainage to be hydraulically pushed to the outlet at the kerb and gutter plus 0.5 metres. The sealed height must be nominated on the engineering plans for the stormwater drainage system.

- The sealed portion of the downpipes must be painted, in a colour to compliment the development and to protect them against ultra- violet light damage from the sun. The design HGL of the charged system must be calculated and shown on the CC plans for approval. Roof gutters, downpipes and pipelines shall be sized for the 100-year ARI design storm.
- Sealed cleaning eyes must be placed at 30-meter intervals, critical bends in the pipeline and at the lowest point in the drainage system.
- It may be desirable to place a pipe with a screw cap on the end and a hole in the cap, downstream of the building, designed to drain the charged line to an approved drainage system or pit large enough to capture the volume of water within the charged pipes. The location of the drain caps and pits is to be shown on the engineering plans.
- No surface inlet pits can be connected to the charged line.
- Surface inlet pits, if necessary, must be drained to an approved drainage system in accordance with this guideline.
- Gravity fall should be provided across the Council footway area, where possible. If the footway falls towards the property then the pipeline shall remain sealed to the kerb outlet with a sealed cleaning eye installed wholly within the property near the boundary of the road.
- The sealed downpipes should be constructed of one material to the underside of the roof gutter for aesthetics reasons.

9.4.5 Requirements for Absorption Systems

Absorption trenches with an overflow pump out system will be permitted for draining stormwater runoff from Single Dwellings where other conventional or alternative methods of stormwater drainage cannot be achieved. Council will not approve the use of absorption trenches where the substratum is impermeable to the migration of water.

The absorption trench system shall be designed and sized in accordance with the following criteria:

- The absorption system must be designed by a qualified engineer and based on geotechnical investigations of the soil's percolation rate. The developer must provide Council with a recommendation from a Geotechnical Engineer that the substratum is suitable for Absorption type drainage trenches. Overflow pump out will not be required if the Geotechnical Engineer advises the substratum is suitable for infiltration of the stormwater.
- Alternately the absorption trench may be sized at the rate of 0.015 m³ void volume per 1.0m² of drained impervious area. The developer must provide an overflow pump out system connected to the Kerb in front of the property where this design is used for the construction of the absorption trench system.
- Absorption trenches must be located a minimum of 3.0m from any property boundary, dwelling, garage, or structure.
- A sediment and rubbish arrestor must be placed in the drainage system immediately upstream of the absorption trench.
- The trenching must be located parallel to the proposed or existing site contours.

- If a pump is used in the system, it must be installed so that any surcharge from the absorption system can be pumped to a junction pit at the property street boundary. Gravity fall should be provided across the Council footway area, where possible. If the footway falls towards the property then the pipeline shall remain sealed to the kerb outlet with a sealed cleaning eye installed wholly within the property near the boundary of the road.
- Absorption trenches may be constructed of proprietary trenches designed for this purpose or gravel aggregate where the void ratios have been calculated to match that of the above requirements.

9.4.6 Requirements for Rainwater Tank Storage and Infiltration / Transpiration System Overflow

Since the introduction of BASIX to the development approval process there is a need for the design of overflow drainage systems from rainwater tanks used to store rainwater for flushing of toilets and irrigating gardens in single family residential developments. Not all developments require rainwater tanks to be installed on the drainage system, however, a large majority of them do. Council will allow the implementation of a combination of rainwater storage; OSD and/or infiltration to dispose of overflow rainwater from the development. Where a rainwater tank only or a rainwater tank, OSD and infiltration / transpiration is incorporated in the stormwater drainage system, the following guidelines will apply:

- The Rainwater Tank must not compromise compliance with Council's other development standards, including the provision of private open space.
- An elevation and site plan, showing location, setback from boundaries and overflow disposal, for the rainwater tank must be included in the Development Application and submitted to Council for approval.
- The system must be designed to include the re-use of water, from the Rainwater Tank, within the site.
- The rainwater tank must be designed and installed in accordance with AS 3500.3.2 and Sydney Water requirements.
- The developer must make application to Sydney Water for an *Indirect Connection* to Sydney Water drinking water supply for "Top Up" supply to the Rainwater Tank.
- The rainwater tank must not be located in an overland flow path, floodway or flood plain, over an existing or proposed site of an easement or right of carriageway, over any Sydney Water infrastructure or any other utility company infrastructure.
- The rainwater tank must incorporate sediment and rubbish removal within a first flush system to prevent debris from entering the tank.
- It is recommended that proprietary leaf guards be installed and maintained on roof gutters.
- The rainwater tank overflow must be connected to the downstream drainage system approved for the development or connected to the street kerb and gutter via a gravity line or charged line, if gravity is not possible, in accordance with these guidelines.
- If the overflow discharge is designed to flow in the natural direction of the flow across a rear property boundary, the proposed stormwater drainage system

discharge must not exceed the undeveloped, green field flows from the development for 5min to 2 hour storms up to the 100 year ARI storm

- Roof gutters, downpipes and drainage pipes must be sized for the 100-year ARI design storm.
- If the rainwater tank is used for OSD, the tank volume must be sized so the OSD volume requirements are in accordance these guidelines. The OSD volume must be calculated over and above the required rainwater storage volume from BASIX.
- If stormwater infiltration / transpiration method is used to dissipate the energy from the overflow runoff, the infiltration / transpiration bed must be no closer than 3 metres to any permanent structure and must be no closer than 2 metres to any downstream boundary to the edge of the gravel bedding.
- The outlet to the infiltration / transpiration bed must have a water level spreading device such as a trench grate which will spread the overflow discharge across the downstream boundaries to emulate existing sheet flows from the property.
- The level spreader must be constructed generally level and must not deviate more than 5mm at any one point over the spreader.
- Any variation of these guidelines for alternative stormwater disposal must be approved at the concept stage as a part of the DA assessment process.
- For the dual Occupancy type developments the underground portion of the drainage system must be registered as a Positive Covenant on the title, when the lot is subdivided.
- A **Positive Covenant**, for the **underground and OSD** portion of the drainage system, shall be registered on title, under Section 88B of the Conveyancing Act, and written generally in accordance with Section 10.6.2.

9.4.7 Requirements for Basement Pump Out Drainage Systems

Pump out systems will be permitted for approved basement garages, car parks and non-habitable areas of a development, when all other conventional methods or alternative methods have been examined and stormwater runoff cannot adequately be disposed of, by gravity, to a Council system. Approval, by Council, of a pump out stormwater drainage system is subject to the following criteria:

- The contributing catchment area to the pump out system must be limited to the basement access ramps and subsoil drainage only. No more than 50m² of access ramp, in the case of single dwelling or dual occupancies, or 100m² in the case of other development, will be allowed to drain to the sump and pump out system. Surface stormwater runoff from the remainder of site must be diverted away from the basement area and the drainage systems are to be isolated from each other hydraulically. The areas may be varied at the discretion of Council.
- The basement car parking area shall be graded to fall to the sump and pump system.
- Dual submersible type pump units, with capacity to pump subsoil drainage and any stormwater falling on or draining to the access ramp, must be installed. The engineer must size the sump and pump system to have a pump out capacity for the 100 year ARI design storm of duration five (5) minutes.

- The storage sump and twin pumps must be located in the basement of the car park, under cover, and installed with a grated cover for visual inspection and must be designed so that a minimum volume of water is retained in the sump to cover the pump when the pump float is in the “off” position.
- It must also be shown that the basement will not rise to more than 200mm in depth of stormwater in the event of a power outage or pump failure. The designer must assume a rainfall of 200mm in a 24-hour period over the catchment draining to the basement or non-habitable area sump and pump.
- The pump-out system must be independent of any gravity drainage lines except at the site boundary inspection pit where a junction pit may be constructed, from which a connection will be permitted to the gravity stormwater system provided they are isolated hydraulically.
- Storage areas and areas used for purposes other than car parking or access aisles are to be constructed a minimum of 200mm above the level of the surrounding area to achieve additional freeboard above the water level.
- Engineering details and manufacturers specifications for the sump, pump and switching system must be submitted for approval prior to issue of the construction certificate.

9.5 Overland Flow Paths (OLFP) for Stormwater From Upstream Catchments

Overland Flow paths must be considered and designed where stormwater runoff, in excess of the design capacity of the pipelines for the upstream catchment, has the potential to flow through a development site. Overland flow paths must be considered and designed for the stormwater runoff developed from within the site as well.

The developer may be required to provide Council with a flood study to determine the OLFP requirements, for assessment with the DA plans.

If a development site has all of or part of a natural depression forming an OLFP within it, then Council may require an unobstructed OLFP, of adequate capacity, be maintained or constructed within the development site. Often the natural depression coincides with a drainage easement, over a pipeline within the development site. If the drainage easement is not coincidental to the natural depression where overland flow may occur, then Council may require a depression be created over the easement or an easement for overland flow be created over the natural depression area. In general, Council does not allow structures that will obstruct, block or adversely divert overland flow to be placed or constructed in the OLFP.

Developers should plan a development so OLFP's are directed along driveways, through common grassed areas and where fencing requirements are minimised or limited. OLFP's through courtyard areas are discouraged and should not be proposed on new development sites. Redirection of OLFP is permitted within the property provided there is no adverse effect on adjacent properties.

9.5.1 Requirements For OLFP's

A suitably qualified engineer experienced in hydraulic analysis must be engaged to prepare a hydraulic analysis of the overland flows within existing and proposed OLFP in accordance with the following guidelines.

- The engineer must determine the 100-year ARI water surface level and boundaries of the OLFP.
- For development sites where existing Council stormwater drainage systems occur, the piped stormwater drainage system and OLFP combined, shall be designed to carry stormwater runoff from a 100 year A.R.I. design storm for the contributing catchment. The OLFP may be distributed over adjoining properties where this naturally occurs.
- The minimum capacity of the OLFP shall be 50% of the 100 year A.R.I. design stormwater flow from the contributing catchment unless alternative ratios can be demonstrated as acceptable.
- The Velocity Depth product (VxD) must generally be kept below 0.4m²/sec for flows in an OLFP where there is high pedestrian use and/or vehicular use, however, higher values of (VxD) may be considered in accordance with AR&R, based on their merits. A Hydraulic Engineer must assess the situation and consult with Council on the potential for hazard within the OLFP. The Hydraulic Engineer may propose, with Council concurrence, a higher design value of VxD, in certain circumstances on private property, where the higher value is deemed acceptable.
- Council may consider a rise up to 100mm in upstream or downstream, water surface level from the previous developed condition provided there is no significant adverse affect on adjoining properties with respect to existing levels of houses, garages, outbuildings, in-ground pools and other water-sensitive installations. The minimum freeboard between proposed water surface level and existing house floor level must be maintained in accordance with this guideline.

9.5.2 Requirements For Calculating Flow Rates For OLFP's

Council will provide flow rates where a Catchment Study has been completed. Where this is not available, the runoff from the upstream catchment must be computed by a time-area hydrograph method such as ILSAX, DRAINS, RAFTS, MIKESTORM, or other Council accepted method for catchment area in excess of 10 hectares. For a catchment area up to 10 hectares, the Rational Method may be used to calculate the runoff from the upstream catchment. If the Rational Method is used, the design runoff shall be taken as the calculated runoff multiplied by a factor of 1.2. The analysis shall ensure that the catchment area is subdivided into sub catchments that are generally no larger than 20% of the total catchment. Starting at the site, the first hectare sub-catchment upstream of the site shall be modelled in detail.

When determining design flows a blockage factor of 50% shall be applied to the upstream side of road culverts where the stormwater drainage system is a lined or natural open channel through or adjacent to a development site.

A Blockage factor is to be applied, in accordance with the following table, to the hydraulic geometry of all inlet pits in an upstream catchment, when determining the overland flow through a development.

Table 9-7

PIT LOCATION	INLET TYPE	BLOCKAGE FACTOR
Sag	Side Entry	20%
Sag	Grated	50%
Sag	Combination	0%
On Grade	Combination	20%
On Grade	Grated	50%

9.5.3 Requirements For Calculating Hydraulics For OLFP's

In determining the capacity of the OLFP the Manning's equation may be used where the upstream catchment is less than 2 hectares. Computer based models such as HEC-RAS, EXTRAN-SWMM or other approved models may be used for catchments greater than 2 hectares.

All submitted OLFP modelling data may be retained and used, by Council, to assist in further developing future Council stormwater drainage systems and OLFP strategies.

9.5.4 Requirements For Site Boundary Fencing

All boundary fencing must be elevated at least 50 mm from the finished ground level to the bottom of the fence panel or pailings to allow for overland flow. Boundary fencing crossing Council's drainage easement or OLFP, if required by Council, must incorporate provision for the passage of overland flow from stormwater runoff. Council may require the fence to be raised higher off of the finished ground level or openings be placed in the bottom of the fence where necessary to achieve acceptable overland flow path levels as recommended in an approved flood study for new developments.

9.5.5 Earthworks Within OLFP

Any earthworks or alteration to existing surface levels in a Council drainage easement, drainage reserve, or constructed OLFP, shall be carried out in accordance with the approved design of the OLFP or as directed by Council.

9.5.6 Requirements For Flood Freeboard And Minimum Floor Levels

Minimum Flood Freeboard is the height above the design flood level for a finished floor level of a structure adjacent to an OLFP or flood plain of a stream, creek or river. The design flood level is determined by a flood study for the particular flows and storm event.

Minimum flood freeboard and Flood Planning Levels (FPL) are specified within Bankstown City Council DCP 2005 Flood Risk Management Part E3. In cases where different freeboard requirements apply to the same site, the highest freeboard shall be adopted.

Finished Floor levels for buildings on lands, subject to OLFP flows, shall also be set in accordance with Bankstown City Council's DCP 2005 "Flood Risk Management".

Finished Floor Levels for buildings on lands not affected by any known form of flooding must be set in accordance with the guidelines in the BCA.

9.5.7 Standard Restriction On The Use Of Land For OLFP

A developer may be required to register a Restriction On The Use of Land with Land and Property Information (LPI), on the title of the subject property, to advise the owners of the property of their obligation to maintain unobstructed overland flow through the property.

The standard terms of the **Restriction On The Use Of Land** for an **OLFP** to be created under the Conveyancing Act is as follows:

- *An unobstructed flow path for overland stormwater runoff from upstream catchments shall not be allowed to fall into disrepair by the owner of the property burdened within the boundaries shown as "x" on the plan.*
- *Trees or shrubs shall not be planted within the boundaries shown as "x" on the plan.*
- *Changes to approved levels and/or the construction of walls and landscaping shall not occur within the boundaries shown as "x" on the plan unless approved, in writing, by Council."*
- *Any special fencing requirements, as required by Council across the overland flow path, shall not be allowed to fall into disrepair and shall not block the free passage of overland flow of stormwater runoff.*

10 ON-SITE DETENTION (OSD) SYSTEMS

10.1 General

10.1.1 Applicability

On Site Detention (OSD) is required where an increase in stormwater runoff, from a new development site, has an adverse affect to the receiving stormwater system. Provision of OSD is intended to reduce the potential for local flooding and damage to existing properties by limiting runoff from new developments, to pre-developed levels. A suitably qualified Civil Engineer shall be engaged to prepare calculations and designs in accordance with these requirements. Notwithstanding the following criteria, Council may consider the need for OSD on a case-by-case basis where justified by sound engineering principles.

10.1.2 Exemption To OSD

OSD will not be required where:

- It is proven to Council's satisfaction that the lack of OSD will not have an adverse effect on downstream drainage systems. A full local catchment analysis may be required. Developers are advised to contact Council's

Development Engineer to find out specific OSD requirements for each catchment,

- single dwellings, family housing, outbuildings, have a combined impervious area of no more than 75% of the site area,
- dual occupancies have an impervious area of no more than 66% of the site area,
- development / redevelopment is proposed which does not significantly increase the post development stormwater run off from the site.
- A subdivision of land is proposed that does not involve the creation of a road reserve. Council may require OSD as part of the future development on the new lots at the building construction stage and may do so by placing a restriction on the use of land on the title of the new lots when created.

10.2 Specific Objectives

10.2.1 Peak And Pre-development Stormwater Discharges

OSD must be designed and constructed to control stormwater runoff from development sites such that, for 5 to 100 year ARI events, peak stormwater discharges from the site do not exceed pre-development stormwater discharges.

10.2.2 Location Of OSD System

OSD is to be located away from any natural watercourses and OLFP's from catchments external to the site, and are not to be inundated by a natural watercourse or externally sourced OLFP in any events up to and including the 100-year ARI event. Developers and designers shall use principles of good aesthetics and landscaping and consider long-term viability and maintenance when locating the OSD system.

10.2.3 Storage Volume Of OSD System

OSD storage volume shall be provided such that the total OSD discharge and bypass flow from the site does not exceed the maximum permissible site discharge determined using one of the Council approved calculation methods.

10.3 Design Requirements Of OSD System

10.3.1 Minimum Flow To OSD System

A minimum of 70% of the site piped stormwater system and 70% of the site's overland flow must drain through the OSD system. Stormwater from the catchment upstream of the Development shall be collected separately and conveyed around the site without detention. Council may vary this requirement where site constraints do not warrant it and objection is supported by sound engineering principles.

If only part of the site is drained through the OSD system, the maximum allowable discharge shall be reduced so that the discharge from the OSD system plus the discharge from the remainder of the site does not exceed that from the site prior to development.

10.3.2 Emergency Overflow Spillway

An emergency overflow spillway, free of obstructions such as buildings, must be provided in a location not having an impact on adjoining properties. Where runoff from such a spillway would flow over private property external to the site, a piped overflow system with 100 year ARI capacity shall be provided within a suitable drainage easement, except where an alternative drainage system for dual occupancies has been approved.

10.3.3 Freeboard To Finished Floor Levels

Finished floor levels of existing and new buildings are to be set so they are a minimum of 0.3m above the OSD storage's maximum design water surface level and the spillway water level.

Garage floor levels are to be set so they are a minimum of 0.1m above the OSD storage's maximum design water surface level.

10.3.4 Ponding Depths

In the interests of safety and amenity, ponding water in OSD must not exceed depths as follows:

Table 10.1

Use	Desirable Maximum Depth	Absolute Maximum
Pedestrian Ways	0.05m	0.05m
Parking/Paved Areas	0.15m	0.2m
Landscaping-Residential	0.3m	0.3m
Fenced Storage	1.0m	1.5m
Underground with lockable access	No limit	No Limit

10.3.5 Above Ground OSD In Landscaped Areas

OSD storages provided in common landscaping areas should have required storage volumes increased by a factor of 1.2 to allow for construction irregularities and vegetative growth. The surface of the landscaped area where OSD storage is proposed must be limited to grass only or other materials, approved by Council, on their merits. In addition, where the maximum depth will exceed 0.3m, a minimum setback of 1.0m from boundary lines shall be provided where landscaping is required adjacent to the boundary. The location of the OSD shall be consistent with the Landscape Plan and located clear of areas containing mulched garden beds. Watertight masonry walls and a maximum depth of 0.3m must retain any OSD storage proposed above the

surrounding ground level. Above ground OSD must not be located in private open space areas of residential development sites.

10.3.6 Design Parameters For OSD

Rainfall Intensities must be in accordance with the table shown in this guideline. Design calculations for determining OSD storage volumes and permissible site discharges are to be in accordance with one of the calculation methods detailed in this guideline.

Design flow rates from all development sites requiring (OSD) shall be computed by a time-area hydrograph method such as ILSAX, DRAINS or other industry-accepted method. The simplified method, given below, may be used for single dwellings and dual occupancies where required.

SIMPLIFIED METHOD

The following design parameters shall apply:

- Permitted site discharge = 0.026 L/s for each square metre of impervious area
- Permitted OSD discharge = (Permitted site discharge – site runoff unrouted through OSD)
- Storage volume = 0.025 cubic metre for each square metre of impervious area

TIME-AREA HYDROGRAPHS METHOD

The storage required is a volume that will restrict total flows from the development site to match the site runoff prior to development, for a given ARI. The volume/discharge relationship determined shall be for all ARI's for the range of 5 to 100 years ARI. The effects of all storms from 10, 20, 30 and 45 minutes are to be examined.

For sites affected by floodway from Council's and / or Sydney Water drainage systems, the portion of the site area affected by the floodway may be excluded from the total site area for the purpose of determining detention storage and permissible site discharge requirements.

When accounting for existing storages, the peak discharge prior to development is to be determined including the characteristics of that storage.

The use of triangular hydrograph methods, such as RARE, are not permitted.

Runoff times of concentration for pervious areas should be calculated using the Kinematic Wave Equation in accordance with AR&R or the "Friend" equation. A minimum time of concentration of 5 minutes is acceptable for paved or impervious areas where suitable.

10.4 OSD Controls And Structures

10.4.1 Stormwater Discharge Control Methods

Acceptable methods for discharge control from OSD systems are the use of orifice plates installed over the outlet pipe, broad crested weir or choke pipe installed in the outlet pipe.

As it is normally impractical to use a single outlet of fixed diameter to restrict flows for the range of events from 5 years to 100 years ARI, the discharge control pit should be designed to have a two-stage outlet. The first stage outlet should limit discharge to pre-development 5-year ARI flow (Q_{p5}) and the second stage outlet should be designed to restrict flows for larger events up to and including Q_{p100} .

This can be achieved using a dual chamber pit with the required diameter choke pipe or orifice plate between the two and the top of the dividing wall forming a weir. This design may also act as an emergency overflow in the event the first stage outlet becomes blocked by debris.

The design of the detention storage shall take into consideration of any backwater effects, drowned orifice and dead storage.

The formulae, for the relevant discharge control methods, are listed below.

10.4.2 Discharge Control Pits (DCP's)

DCP's are to be designed and constructed to minimise or prevent future modification or removal by unauthorised persons and should have the following characteristics:

- Self cleansing as possible
- Located in a suitable position from an aesthetics point of view.
- Readily accessible for inspection and cleaning.
- Minimum potential for overflow onto private property.
- Reduced confined space hazard
- Tamper resistant
- Minimum inside dimensions of pits are to be 900 x 600mm for pits up to 1200mm depth and 900 x 900mm for pits greater than 1200mm depth.
- Large enough to fit required trash screens
- Pit covers should be capable of being opened, by one person, in accordance with OH&S requirements.
- Step irons are required for pits greater than 1200mm depth. The step irons shall be placed in a wall clear of the flow if possible.
- Subsoil drainage may be required around control pits in aboveground storages, to prevent the ground becoming saturated during prolonged wet weather.

10.4.3 Orifice Plates and Choke Pipes

DCP's fitted with orifice plates; choke pipes and/or broad crested weirs shall comply with the following requirements:

Orifice plates are to have the following characteristics:

- Manufactured from corrosion resistant stainless steel plate with a minimum thickness of 3mm (5mm where orifice diameter exceeds 150mm), with a central circular hole machined to 0.5mm accuracy.
- Machined hole must be a sharp edge.
- Plate is permanently fixed to the pit wall over the pipe outlet and epoxy sealed to prevent the leakage of water around the edges.
- Have an orifice diameter not less than 50mm.
- The plates are to be engraved with the orifice diameter. The orifice diameters are to be certified by the manufacturers.

Orifice Plate Discharge Control Formula

The maximum outflow rates can be determined from the following formula:

$$Q_{\max} = A C_d \sqrt{2gh}$$

Where:

- Q_{\max} = Stormwater discharge rate (m^3/s)
- A = Area of orifice opening
- h = Depth to centreline of orifice opening
- C_d = 0.61
- g = Acceleration of gravity = $9.8m/s^2$

Choke pipes are to have the following characteristics:

- Opening shall be square-edged, with no bell-mouth.
- The centre of the choke pipe shall be in line with the centre of the outlet pipe.

Choke Pipe Discharge Control Formula

The maximum outflow rates can be determined from the following formula:

$$Q_{\max} = A C_d \sqrt{2gh}$$

Where:

- Q_{\max} = Stormwater discharge rate (m^3/s)
- A = Cross sectional area of the choke pipe
- C_d = 0.8 for pipe lengths between 1.3 and 3.1m
- g = Acceleration of gravity = $9.8m/s^2$
- h = Height of water level over the centre of choke pipe

For this formula, the outlet pipe must have a minimum diameter of 1.5 times the choke pipe diameter.

Broad Crested Weirs are to have the following characteristics:

- Opening shall be rectangular in shape and square edged

- The weir shall not discharge directly onto the ground or footpath area. It must discharge into an outlet pit structure before draining to the Council drainage system.
- The weir must be constructed of masonry materials and constructed level.

Broad Crested Weir Discharge Control Formula

The maximum outflow rates can be determined from the following formula:

$$Q_{\max} = Cwh^{1.5}$$

Where:

- Q_{\max} = Stormwater discharge rate (m^3/s)
- C = Weir co-efficient = 1.67
- w = Width of weir
- h = Height of water level over the weir

10.4.4 Trash Screens

DCP's are to be fitted with an internal trash screen, which shall have the following characteristics:

- Manufactured from galvanised Lysaght RH3030 Maxi-mesh (or approved equivalent) with galvanised angle steel frame where necessary.
- Screen all pit inflows to the orifice or choke pipe.
- Shall be 50 times the orifice or choke pipe area.
- Located a minimum distance of 150mm from the outlet orifice or choke pipe.
- Positioned as close to vertical as possible. Pits up to 600mm deep should have screens no flatter than 45 degrees. In pits over 600mm deep or in remote positions, this should be increased to 60 degrees from the horizontal surface.
- Include handle(s) for easy removal.

10.4.5 Debris Sump

A sump is required in the base of the DCP to assist in avoiding turbulence near the pit floor from affecting the hydraulic performance of the orifice or choke pipe outlet, and to prevent silt and debris from blocking the orifice or choke pipe. The sump also allows a simpler installation of the orifice plate.

To ensure drainage of the control pit sump, the following are to be provided:

- The invert of the sump shall be 1.5 times the orifice or choke pipe diameter or 200mm, whichever is greater, below the centre of the outlet.
- The control pit shall be constructed on an aggregate base wrapped in geotextile fabric and drained to the outlet pipe trench.
- Sufficient weepholes in the sump floor that are to be kept unblocked by construction debris.

10.4.6 Underground OSD Storage Tanks

The engineer shall design the underground storages tanks to meet the following criteria:

- The storage is self-cleaning. The base of the tank must be graded toward the outlet of the tank at a minimum fall of 0.7% and is appropriately shaped.
- All stormwater must be drained from the storage tank by gravity.
- The storage tank and DCP must be fitted with grates to allow ready inspection, of the inlet and outlet, from the surface. Grates are to be provided so that no point in the tank is greater than 3 meters from an access point and at least one over each separate chamber.
- For storages over 1200mm deep, step irons are to be provided.
- The access grates and covers must be secured to prevent public access.
- A sealed storage tank should be ventilated so as to not cause the accumulation of noxious gases.

10.5 Final Certification Of OSD System

10.5.1 Work-As-Executed Plans

On completion of the OSD system and drainage works, the developer must supply Works-As-Executed (WAE) plans, to the Council, to verify that the works have been completed in accordance with the approved design. The WAE plans are to be prepared by a Registered Surveyor and include the following:

- The WAE information should be shown in red and on a stamped copy of the approved civil works drawings. Verification of all critical design information shown on the approved drawings would ensure a suitably detailed submission.
- Sufficient levels and dimensions to verify the On-Site Detention storage volumes.
- Location, invert levels and surface levels of all drainage pits.
- Invert levels of the internal drainage lines at each pit.
- Location and pipe diameters of each pipe as installed.
- Centreline or invert level of the orifice plates or choke pipes.
- Weir dimensions and levels as constructed.
- Finished floor and garage levels of all building structures within the completed development.
- Verify the orifice plate or choke pipe has been installed and the machined diameter of the orifice plate, diameter of the choke pipe is in accordance with the approved design.
- Verification that the trash screen is installed.
- Location and levels of any overland flow paths formed through the site.
- Levels of surface flow paths on site that direct flow to the OSD
- Note any variations or omissions made from the approved plans.

10.5.2 Certification Of The OSD System As Constructed

The original drainage design consultant is required to provide this certification in conjunction with the work-as-executed plans.

The objective of the OSD policy is to mitigate the effects of increased runoff from redevelopment. Provided the discharge limits and other control standards are satisfied, changes in the drainage layout for construction purposes need only be approved by the Consulting Engineer.

The certificate must be provided on completion of the drainage works and prior to issue of the occupation certificate, occupation of the site or subdivision of the development, whichever comes first. This certification may be carried out on the standard forms supplied and must include:

- Certification that the OSD system will function in accordance with the approved design, or
- Identification of any deviations from the approved design and their impact on the performance of the OSD system. If there is detrimental impact on the performance of the OSD system then the steps to mitigate the impacts must be stated in a letter by the certifying consultant. The mitigating measures must be put in place and the system certified as above.
- Or certification that the deviations from the approved design will not impair the performance of the OSD system.

If the standard form is not used for the certification then the certifying engineer must include the same statements and information as shown on the supplied certificate forms.

10.6 Registration Of OSD On Title

Sites requiring an OSD system be installed must have the existence of such OSD system permanently registered on title with Land and Property Information to ensure the owners are aware of the system's design parameters, location and their obligation to maintain it.

Council requires that the design parameters, location and maintenance requirements are registered in the form of both a Restriction On The Use Of Land and a Positive Covenant on the title of the land prior to occupation of the development, issue of an occupation certificate or issue of a subdivision certificate for the development, whichever comes first.

The developer must supply Council with evidence the Instrument setting out the terms of the Restriction On The Use Of Land and Positive Covenant have been created pursuant to Section 88B or Section 88E of the Conveyancing Act, 1919. The location of the "Onsite Stormwater Detention System" shall be shown on the Deposited Plan or included as a site plan attached to the appropriate documents, which may be obtained from the LPI.

10.6.1 Standard Restriction On The Use Of Land for OSD Systems

The standard terms of the **Restriction On The Use Of Land** Under (s) 88B shall benefit Bankstown City Council or under (s) 88E shall nominate Bankstown City Council the Prescribed Authority and shall read as follows:

The Proprietor of the lot burdened must not:

- a) *Erect, construct or place any building or other structure and/or,*
- b) *Make alterations to the ground surface levels, grates, pits, kerbs, tanks gutters or any other structure associated with the on-site stormwater detention system.*

within the land so burdened, without the prior written consent of Bankstown City Council.

10.6.2 Standard Positive Covenant for OSD Systems

The standard terms of the **Positive Covenant** Under (s) 88B shall benefit Bankstown City Council or under (s) 88E shall nominate Bankstown City Council the Prescribed Authority and shall read as follows:

1. *The registered proprietor, in respect to the On-Site Stormwater Detention System (which expressions include; all ancillary gutters pipes, drains, walls, safety fences, kerbs, pits, grates, tanks, chambers, basins, and surfaces designed to temporarily detain stormwater, hereinafter called "the system") erected on the land so burdened, will:*
 - a) *Permit stormwater runoff to be temporarily detained by the system.*
 - b) *Keep the system clean and free from silt, rubbish and debris.*
 - c) *Maintain and repair the system so that it functions in a safe and efficient manner.*
 - d) *Replace, maintain, repair, alter and renew the whole or parts of the system within the time and in the manner, if directed in a written notice issued by Council.*
 - e) *Carry out the matters referred to in paragraphs (b), (c) and (d) at the registered proprietor's expense.*
 - f) *Permit the Council or its authorised agents from time to time upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for compliance with the requirements of this clause.*
 - g) *Comply with the terms of any written notice by the Council in respect to the requirements of this clause and within the time stated in the notice.*
2. *In the event the registered proprietor fails to comply with the terms of any written notice served in respect of the matters in clause 1, the Council or its authorised agents may enter with all necessary equipment and carry out any work required to ensure the safe and efficient operations of the system and recover from the registered proprietor the cost of carrying out the work, and if necessary, recover any costs of legal proceedings and entry of a covenant charge on the land under Section 88F of the Conveyancing Act 1919. In carrying out any work under this*

clause, the Council must take reasonable precautions to ensure the land will be disturbed as little as possible.

11 DEVELOPMENT ADJACENT TO COUNCIL AND/OR PRIVATE STORMWATER DRAINAGE SYSTEMS

Developments having an impact on or affected by Council's, or other authority's, stormwater drainage system should have received a SSR, from Council, describing the drainage infrastructure and recommendations from Council regarding requirements for the development adjacent to the infrastructure.

It is the developer's responsibility to locate and verify the existing stormwater drainage system as described in the SSR or other information given by Council, and make provisions in the design and construction of the development according to those recommendations.

Existing drainage structures on a development site must be integrated into finished surface levels and features to allow for maintenance access. Existing and/or new drainage access structures must be adjusted to suit and be flush with the proposed surrounding levels within the development. If an access structure has been buried in the past then the access lid must be adjusted to suit the proposed surrounding levels. Adjusted pits are to be provided with Council approved proprietary covers with appropriate lifting fixtures. All work on access structures shall be supervised by Council and to Council's satisfaction.

11.1 Proposed Structures Adjoining Stormwater Drainage Systems

Council prohibits the construction of most types of structures over drainage easements and stormwater pipelines. The following is a list of extremely light demountable structures Council will consider for approval:

- Paving
- Carports
- Open type awnings
- Pergolas
- Garden sheds

Construction of the above structures is always subject to the approval of Council and shall consider any impact to potential overland flow from upstream catchments. Council may consider applications for structures, other than those listed above, based on their merits and subject to full engineering assessment prior to the issue of the development consent.

Where a pipeline or easement conflicts with a development proposal Council generally requires a developer to relocate the existing pipeline and/or easement for drainage as a requirement of the development consent. The approval is subject to full engineering assessment prior to the issue of the development consent.

11.2 Footing Requirements For Structures Adjacent To Pipelines Or Easements

Where Council has approved a structure adjacent to an easement or existing pipeline, the following conditions apply:

- The footings shall be located clear of the easement, or any proposed easement,
- The footings shall be constructed below the zone of influence of the existing pipeline.
- Details of the design of piers, beams and footings shall be submitted to Council for approval with the Development Application. An inspection by Council will be required to verify depth and location of piers prior to pouring concrete.
- The depth of the structure's footings shall be equal to 300mm plus the depth to the invert of the existing pipe, or any proposed pipe. The footing depth may be reduced by the distance the proposed structure is from the edge of the pipe or as required by the Structural Engineer for the structure. The footing depth may be reduced where the footing is founded on sound bedrock.
- Where a structure is proposed adjacent to an open, unlined stormwater channel conditions will be imposed, on the development consent, in accordance with the situation encountered in each individual case.
- In very rare circumstances approval may be given to build over an easement or existing pipeline. In this situation, a suitably qualified Structural Engineer shall design pier and beam type construction, to suit the individual case. The underside of the footing beams is to be a minimum clear distance of 0.6m from the top of the pipe with all piers located in accordance with the above guide.

11.3 Additional Footing Requirements For Demountable Structures

Where an approval is given for the construction of one of the above demountable structure over a drainage easement or pipeline, the following requirements shall apply:

- The demountable structure shall be lightweight, easily demountable, and shall be removed by the owner, at their expense, if required by Council, to allow work to be carried out within the easement.
- The existing overland flow path for stormwater runoff shall be maintained if so required by the existing fall of the land and upstream catchment characteristics.
- If a concrete floor is proposed for the demountable structure it shall be a minimum 100mm thick, reinforced with F62 steel fabric with 40mm top cover, and laid on a 50mm compacted road base material.
- If other than a concrete floor is required, then the structural supports founded on concrete piers in accordance with the above requirements and isolated from any pavement by expansion joint material.
- Channels under control of Sydney Water are not included in the above, and applications in respect thereto should be referred to that authority.

Documentary evidence of compliance with Sydney Water requirements must be submitted with application.

11.4 Relocating Stormwater Drainage Pipeline And/or Easement

A developer may request to relocate an existing stormwater drainage pipe conflicting with development proposals. The approval of the request is subject to the developer demonstrating the proposed stormwater drainage system will not have an adverse impact on the existing upstream or downstream stormwater drainage system and adjoining properties. The developer must provide Council with a hydraulic analysis prepared by a qualified engineer, demonstrating any impact of the proposed relocated pipe system and how that impact will be mitigated. The relocated pipe is to be designed to have the capacity specified in this guideline for a new pipeline in the same location.

OLFP's through the site, for runoff in excess of the capacity of the pipeline, must be designed and relocated in accordance with guidelines in Section 9.5.

12 REQUIREMENTS FOR LAND SUBDIVISION

12.1 General

For all land subdivisions, except strata type subdivisions, Council must be the PCA for the subdivisional works and for the Subdivision Certificate (SC) for the final plan of subdivision.

Any new land subdivision, creating one or more vacant lots, shall provide any shared drainage infrastructure, roads and access driveways in accordance with this Guide.

12.2 Land Subdivisions Including Public Road Dedication

Where a subdivision of land is proposed, including dedication of public road, the engineering requirements for the design and construction of public infrastructure and works must be in accordance with Bankstown City Council's Aus-Spec No. 1, for design and Aus-Spec No. 2, for construction, or as otherwise specified by Council.

The developer must contact Bankstown City Council and apply for a CC, through the Council, for the earthworks, drainage works and road works required by the DA consent, to create the road(s) within the subdivision, for the development. The developer may apply for a SC upon completion of all development works required for the subdivision.

12.3 Land Subdivisions Not Including Public Road Dedication

Where subdivision of land is proposed, and there is no dedication of public infrastructure, the engineering requirements for the design and construction of the earthworks and site works must be in accordance with this engineering guideline. All shared civil site and drainage work, intended to benefit more than one lot or where the civil site and drainage work must cross one or more lots to benefit another lot, must be constructed in accordance with these guidelines and prior to issue of the subdivision certificate. Development works may include, but are not limited to, installation of CDL's,

construction of common use driveway surfaces, common use OSD systems and earthworks required for the subdivision. Council will assess the SC for compliance with all of the associated requirements of the DA consent and also compliance with Council's requirements for easements, restrictions and positive covenants. Also, Council requires that BCC be empowered to be the authority to release, vary or modify the above easements, restrictions and positive covenants, where BCC is not the beneficiary. The developer may apply for a SC upon completion of all development works required for the subdivision.

12.4 Connection To Council Roads

Where subdivision road works are proposed, those works will connect onto Council owned roads requiring the issue of a Work Permit by Council. In the circumstances where roads are being dedicated or created a Work Permit is required for all of the future Council owned infrastructure.

13 PROTECTION OF COUNCIL INFRASTRUCTURE:

A developer must protect all Council infrastructure when carrying out works and activities to a development site.

13.1 Protection Of Public Footway

Council's footway shall be protected from damage caused by construction activities and vehicles while entering and existing a development site. Provision must be made for the safe passage of pedestrians along the footway adjoining the site at all times during construction. If hoardings are to be installed around a development site, then approval must be sought from Council to do so. The developer must apply for a Works Permit to do any work within the Council Road Reserve.

13.2 Storage Of Material In Public Footway

In areas of high pedestrian use, construction materials are generally not to be stored within Council's Road Reserve. Should removal of any construction materials or debris, or clearing of any part of the road reserve be necessary to provide safe pedestrian access along the footway or for environmental, or asset protections reasons, Council may carry out the above work at the applicant's expense.

13.3 Access Over Public Reserves

Construction access over Public Reserves and Parks is prohibited without specific written approval of Council. Due to legislative restrictions such access is generally denied.

13.4 Builders Damage

The developer is responsible for the full cost of rectification of any damage to public infrastructure and assets resulting from the development's building and site works.

13.4.1 Footway Damage Inspection (FDI)

A Work Permit for an Infrastructure Footway Damage Inspection Report (FDI) shall be applied for and fees paid, to Council, in accordance with the DA Consent and Council's latest fees and charges, prior to issue of the construction certificate.

13.4.2 Preventing Damage Due To Transport Of Materials And Plant

All bulk, demolition, earthworks and/or delivery of construction related materials and plant, associated with the development must be transported in suitably covered and designed vehicles for the intended purpose and on suitable roads intended for the transportation of heavy loads.

13.4.3 Material and Plant Transport Route

In general the transport route must be by the shortest possible route to the nearest "Regional Road" and with every effort made to avoid school zones on local roads and weight limited roads. The developer must nominate the transport route, for consideration by Council, prior to the commencement of any development works.

The developer may be required to provide Council with a dilapidation report in respect to the proposed transport route to and from the site. The report must be completed and submitted to Council prior to the commencement of the development works. Otherwise the developer may be held responsible for damage to a road that may have occurred prior to the development works commencing.

13.4.4 Damage Rectification

All prior damage and/or damage resulting from the development works, must be rectified prior to issue of the Final Occupation Certificate for the development. Prior damage rectification may not be required for single dwellings and dual occupancy developments where a damage inspection by Council shows exiting damage to the infrastructure.

PART C - STANDARD PLANS

For all standard plans go to Bankstown City Council website:

Living in Bankstown/ Roads, Traffic & Transport/ Bankstown Roads / Council road-related standards

