



**MARRICKVILLE COUNCIL
STORMWATER AND ON SITE DETENTION
CODE**

16 February 1999

Note:

At its meeting of 20 May 1997, Council resolved to insert the following statement into this policy:

This policy of itself does not operate to restrict development of any land within the Council's area. The policy is intended to be applied on a discretionary basis by the council in the circumstances of each case. The policy operates to provide a framework for the Council to consider stormwater discharge from new developments and the likely effects on existing developments under the legislation administered by the Council. The policy may result in the Council restricting the development of land on a case by case basis though the imposition of appropriate conditions relating to stormwater discharge.

**MARRICKVILLE COUNCIL
STORMWATER, DETENTION & SEDIMENT CONTROL
CODE**

POLICY

The following Policy for Stormwater drainage for developments/building works was adopted by resolution of Marrickville Council on 20 May 1997

Policy Statement

1. *Council will control the flow of stormwater from developments so as to negate or reduce to an acceptable frequency the possibility of flooding buildings and/or the danger to life at any location by:*
 - *requiring the storage of stormwater where appropriate in developments;*
 - *the control of development surface and floor levels; and*
 - *the control of major development drainage systems.*
2. *Council will control the removal of sediment from development sites by the imposition of conditions on developments requiring appropriate sediment control practices to be in place at all times during works.*

Objectives

- * *to protect the urban environment from the effects of otherwise uncontrolled surface stormwater flows resulting from infrequent (and lesser) storm events.*
- * *To minimise or negate disruption and/or danger to both pedestrian and vehicular traffic that may be caused by otherwise uncontrolled surface stormwater flows resulting from frequent storm events.*
- * *to protect the quality of receiving waters, adjacent and downstream land-use and the rights of adjacent and downstream landowners.*

Administration

All development / building activities within the area of Marrickville Council affecting stormwater runoff will be regulated to achieve the objectives.

Development / building submissions and activities will need to be in accordance with the procedures and requirements contained in Council's "Stormwater, Detention & Sediment Control Code" to comply with this policy.

This Policy and the Code will be administered by Council's Technical Services and Development & Environmental Services Divisions, and will be reviewed regularly and revised as appropriate.

The authority to enforce the requirements of the code is available to Council under the following legislation :

- * Local Government Act 1993 - Chapter 7 "What are the regulatory functions of Council?" Sections 68 to 157
- * Local Government (Water Sewerage & Drainage) Regulations 1993 -Sections 42, 43, 45, 49, 53 & 55

- * Roads Act 1993
 - Part 2 "Opening public roads" Sections 8 to 17
 - Part 7 "Protection of public roads and traffic" Sections 91 to 107
 - Part 14 "Enforcement of act" Sections 237 to 247

- * Environmental Planning & Assessment Act 1979
 - Part 4 "Environmental Planning Control" Section 79C
 - Part 5 "Environmental Assessment" Section 111

ACKNOWLEDGEMENT

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SAMPLE DRAWINGS

1 PURPOSE

As a consent authority, Council requires all developers to demonstrate that any development / building work proposed will comply with all relevant codes, standards and policies.

This code is intended to provide a clear statement of policy, requirements and methods relating to stormwater drainage for residential, commercial, industrial and all other types of development. The Code will assist in the submission of the necessary information required to expedite Council approvals, and to comply with Council's On-Site Detention code.

Technical information is provided only in the supplements as designs are to be prepared by suitably qualified and experienced designers.

The Code should be read by all developers prior to lodging applications for Council approval.

1.1 General

The costs of all works and restoration involved in the development, including that within public roads and other properties, utility adjustments, easement acquisition and legal costs are to be borne by the developer.

The responsibility for the submission of satisfactory details as required by this Code and any consent conditions, rests with the applicant.

2 CHECKLIST

CODE REQUIREMENT	LANDUSE						
	Single Residential	Dual Occupancy	Villa, Flats, Town Houses etc	Commercial Industrial Institutional	Tennis Courts	Drainage Works Only	Paving
On Site Detention	Yes (3,6)	Yes (3,6)	Yes	Yes	Yes	No	(1)
Rainwater tank in lieu of OSD	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
Gravity Pipe System Required	Yes (4)	Yes (4)	Yes	Yes	Yes	Yes	Yes
Pump System Permitted	No (4)	No (4)	No	No	No	No	No
Drainage Easement over downstream property (2)	If site doesn't drain to street (4)	If site doesn't drain to street (4)	If site doesn't drain to street	If site doesn't drain to street	If site doesn't drain to street	(1)	(1)
Qualified Engineer Required to prepare drainage design	Yes (3,6)	Yes(3,6)	Yes	Yes	Yes	Yes	(1)
Sediment Control Plan Required.	Yes (1)	Yes	Yes(7)	Yes(7)	Yes	Yes	Yes
Positive Covenant Required (ie. 88E(3) Instrument)	No (5)	No (5)	Yes	Yes	Yes	No	No
Payment in lieu of OSD	No	No	No	No	No	No	No
Rainwater Tanks permitted	Yes(8)	Yes(8)	Yes(8)	Yes(8)	N/A	N/A	N/A

1. Depends on details of development.
2. Alternatively, the applicant may construct a pipeline within the road reserve until a connection point with Council's system is reached that allows gravity drainage.
3. Except for cases where increased roof & paved areas are less than 40m².
4. Except where genuine attempts to acquire an easement at reasonable costs have failed. documentary evidence of these attempts will be required.
5. Unless in a landscaped area.
6. Where OSD is required and the increased roof and paved areas is less than 100m² Council's standard OSD design from Supplement 6 can be adopted.
7. Sediment Control Plans to be prepared by an Engineer.
8. Provided additional storage volume is allowed for in the tank and an overflow to Council's drainage system is installed

3 SCOPE & APPLICATION

The Code applies to all development/building works requiring Council consent under the Environmental Planning and Assessment Act, 1979 or approval under the Local Government Act, 1993 within the Marrickville Council area, and will be administered by Council's Director, Technical Services and Director, Development & Environmental Services as appropriate.

Development activities that are covered by the Code are those requiring written consent from Council. This covers & is not limited to:-

Residential

- Single dwelling - New (including replacement)
- Single dwelling - Extensions, garages, carports etc
- Dual Occupancy
- Medium Density - Villa, Townhouses etc
- High Density - Units, Apartments etc
- Tennis Courts

Commercial

Industrial

Institutional Buildings - Schools, Hospitals etc

Paving, Driveways and Roadworks

Subdivisions

Drainage works

- in public lands
- piping or lining of open watercourses
- modification to existing systems excluding roofwater lines

All other developments

4 PLANNING ISSUES

4.1 Adverse Impact & Controlling Site Runoff

Development activities must not cause an adverse impact on adjoining or any other properties. This includes preserving surface flow paths and not increasing water levels.

Site discharges will need to be restricted to pre development discharges using On-site Stormwater Detention.

4.2 On-site Detention (OSD) of Stormwater

OSD of stormwater is required to limit discharges from developments to pre - development conditions. Council's OSD requirements have been formulated to ensure there is no increase in discharges adjacent to the site or elsewhere in the catchment for virtually all rainfall events through to 100 years ARI. For Developments greater than 1000 sqm m in area, allowable discharges will be limited to the equivalent fully pervious discharges for the site area.

OSD will be required for all developments except for:

- * extensions where the proposed extended roof or paved area is less than 40m².
- * for sites that discharge directly to the Cooks River or into a major Sydney Water Corporation controlled trunk drainage system.

All OSD systems will require full hydraulic design in accordance with the details in Supplement 2, except for single residential dwellings where:-

- * the building works are an extension of an existing house/garage, and
- * the total proposed extended roof and paved area is less than 100m².

In these exceptions the OSD required can be constructed in accordance with the standard detail in Supplement 6 without requiring a full design.

The Development Application is to include as a minimum a Stormwater Drainage Concept Plan (SDCP - see 4.7) which will outline the OSD proposed. A detailed design will be required before the issue of a Construction Certificate.

Where separate titles are to be created (by subdivision) with the development, separate OSD storages are generally to be provided. Storages can be amalgamated or omitted for some lots providing the storage proposed for the overall development can meet the permitted site discharge and storage requirements in accordance with Supplement 2, and the pipework draining to the storage is wholly within the lot with the storage.

Storage outflows are to be controlled to ensure the full range of ARI protection occurs. This will require the OSD to incorporate a range of storage-discharge values for various ARI's.

OSD storages should be located as close as possible to the lowest point of the site, with paved areas and pipes to drain to it. Storages are encouraged to be above ground and incorporated into driveway / parking areas. Storages in landscaping areas will

require additional measures to discourage later modifications, as well as extra volume to compensate for vegetation growth.

Storages should not be located in overland flow paths which convey catchment flows through the site. Storages are to be in common areas (rather than privately controlled areas such as courtyards) for developments with multiple dwellings or units.

4.2.1 Rainwater Tanks

Part or all of the storage required as part of the OSD may be stored by the use of a rainwater tank provided that additional volume is provided in the tank for this purpose. Also the Rainwater tank must have an over flow system which connects to Council's stormwater system.

4.3 Surface Flow Paths

Surface flow paths are an integral part of the drainage system. They are to be preserved, or alternatives provided, wherever they pass through or affect the development site. Site discharges are not to be concentrated to a degree greater than that which naturally occurs. Redirection of flows including to other sub catchments is not permitted unless appropriate counter measures are undertaken. Flows to the receiving system or sub-catchment are not to be increased. Flow paths are to be retained within easements.

4.4 Floor & Ground Levels

Building floor levels need to be set above surrounding ground levels with an adequate freeboard to surface runoff flows or ponding levels (see 5.3). Where re-contouring of the site is proposed the existing ground levels at the boundaries are to be retained with maximum 1 in 4 finished ground level slopes. Retaining walls are not to be constructed closer than 0.9m to the boundary unless approved by Council. Similarly, existing ground surface levels are to be retained within 0.9m of any property boundary.

4.5 Gravity Drainage

All stormwater drainage connecting to Council's drainage systems is to be by gravity means. Mechanical means (ie. pumps) for disposal of stormwater runoff will generally not be permitted (see checklist on page 7). Subsoil and basement seepage systems where separate from the stormwater drainage may be exempted from this requirement.

The acquisition of an easement over any intervening downstream properties (at the developers cost) will normally be required for sites that do not drain to

- * the street,
- * council land containing a drainage line, or
- * an existing council pipeline within the development site.

Without a gravity stormwater drainage system being provided, development consent will generally not be granted. Written consent for the piping and acquisition of an easement is to be obtained from adjoining owners and provided to Council with the development application. In such cases a transfer granting easement or a linen plan and section 88B instrument must be registered with the Land Titles Office prior to the operation of any consent.

Exception to acquiring an easement may be given at the discretion of Council's Director, Technical Services for sites that do not drain to the street, *only* where extensions to an existing residential building or replacement of an existing house or dual occupancy is proposed, and genuine attempts at acquiring a downstream easement have failed. Written documentation of these attempts, including reasonable financial consideration, must be included in any application for exception. If an exception is granted a pump/sump system may be provided.

Any proposal for a pump/sump drainage system for part or all of the site shall require the prior approval of the Director, Technical Services. Formal plans and associated details shall be submitted for the approval of the Director, Technical Services in conjunction with the development application. The pump/sump system shall consist of two (2) pumps and a storage tank. The pumps shall be arranged for staggered starts (duty and stand-by) with an automatic switch-over facility to change the duty pump.

For minor extensions (ie. approximately less than 25m²) to existing single residential buildings, connections may be made direct to the existing site drainage system where one exists.

4.6 Relationship to Other Properties

Where surface runoff from adjoining properties flows onto the development site, such flows are to be catered for within the development. Obstructions that cause damming and backwater effects on upstream properties will not be permitted. Similarly, surface runoff from the site that is conveyed through the site is not to be concentrated onto downstream properties, or diverted from existing discharge points unless into Council's drainage system. Diverting flows from one catchment to another will not normally be permitted.

4.7 Stormwater Drainage Concept Plans (SDCP)

All development applications (DA's), will be required to submit a SDCP demonstrating the feasibility of the proposed drainage systems within the site and connection to Council's system. This plan is also to show surface flow path treatment, any easements required, On Site Detention storages as well as internal piped systems. The application will not be processed without such a plan. Detailed design plans and calculations will be required to be submitted before the issue of a Construction Certificate.

Where easements are necessary over any adjoining or downstream property to achieve gravity drainage, a written agreement from the adjoining owners is to be submitted with the SDCP.

4.8 Easements

For sites that have existing Council pipelines through them that are not covered by an easement, or where an existing pipeline is not within the easement, Council will require the creation of an easement in favour of itself over the pipeline. The easement width is to be the pipe, box, or channel section width plus 1.5m, with an overall minimum width of 2.5m.

Site drainage systems will require inter-allotment easements over downstream properties where the drainage traverses any other private property to connect to Council's drainage system. These easements are to be a minimum of 0.9m wide.

Dual occupancies, where separate title is created over each unit, will require an inter-allotment drainage easement over the downstream lot in favour of the other lot for any drainage lines or structures affecting the former.

The process for obtaining easements is :-

- Registered Surveyor to prepare plan of survey.
- plan to be submitted to Council for approval.
- plan and application to be lodged with owners approval at Land Titles Office and fees paid.
- Council to be advised of lodgement details.
- Land Titles Office advises applicant / owner and Council of registration.

4.9 Site Discharge & Connection to Council System

The Maximum discharge allowable for connection to Council's street gutter is 25 l/s if a Council pipeline is not nearby.

If the discharge is greater than 25 l/s then connection directly to Council pipe or Channel system will be required. The point of connection will be the closest suitable point as determined by Council's Director, Technical Services. An access pit will be required at the point of connection, with one to be constructed if none exists.

Where the piped drainage system extends beyond the site to connect to Council's system, an access pit is to be provided at the boundary within the development site.

Where the connection point is not in front of the site, the site drainage line is to be run to the kerb line and then to the nearest Council pit. A standard Council pit is to be constructed at the kerb in accordance with the Council's requirements. The pipeline from the kerb pit to Council's pit is to be constructed under the kerb and gutter.

Alternatively, the pipeline may be located behind the kerb or under the road pavement if approved by Council's Director, Technical Services. Any pavement or kerb and gutter disturbed is to be replaced. The pipes within the road or public lands are to be rubber ring jointed reinforced concrete with a minimum 375mm diameter. All costs for the connection are to be borne by the developer.

4.10 Studies/Analyses

In situations where flooding problems have occurred, or there is a risk of such occurrence, a flood study or drainage system analysis of the catchment containing the development site will be required. Where such a study is to be carried out, the calculation methods required to demonstrate satisfactory treatment of the development will generally be in accordance with current practice as outlined in Australian Rainfall & Runoff (1998), and subject to the satisfaction of Council's Director, Technical Services.

4.11 Standards

Pipe systems draining the development site are to be designed to a minimum ARI standard shown in the table below, with suitable treatment of all surface flows to a 100yr ARI standard. All pipe and surface flows to the 100yr ARI standard are to be routed through any OSD required.

Developments with higher potential damage risks from surface flows will require higher design standards. Where surface flow paths are not available, the pipe standard will rise to 100yr ARI.

Where the site or buildings are at or below the level of a downstream road or embankment, Probable Maximum Precipitation events are to be considered. OSD will require all ARI's to be examined to ensure no adverse effect for any size storm.

PIPED SYSTEMS- ARI STANDARDS	
Development Case	ARI
Residential Low & Medium High Density	10yrs 20yrs
Commercial/Industrial Heavy Industry	20yrs 50yrs
Hospital & Emergency Services	100yrs
OSD Range	5 to 100yrs

4.12 Safety & Consideration of Failure

Open drainage system components are to be designed to meet relevant safety criteria. Storage basins are to have battered slopes for egress, maximum ponding depths, and appropriate signage and fencing. Specific reference is made to Figure 6 Appendix B of the Floodplain Development Manual for velocity and depth limits, and to Supplement 2 for the design of OSD storages.

The possibility of failure of components of the system must be considered, and provision made for the safe conveyance of flows should failure occur. For OSD basins emergency spillways must be provided. The potential for obstructions to overland flow paths is to be minimised.

4.13 Visual Impact

All drainage structures and measures are to be designed to be visually unobtrusive and sympathetic with the development. This requirement is necessary to ensure future occupants do not adjust or remove facilities for aesthetic reasons without understanding the functional impact of such actions.

4.14 Sediment Control

Sediment control measures will be required during the construction of all developments, including all residential construction. Where the development has an on going risk of erosion, permanent measures will also be required. The measures are to be in accordance with the "Urban Erosion And Sediment Control" Handbook, available from the NSW Department of Conservation and Land Management (CALM).

A plan of the proposed measures will be required with the application. Where off site disposal of excavated material will occur, a truck cleaning area will be required. The plan is to comply with the details given in section 5 of the CALM handbook. A summary of these is given in Supplement 8. For guidance on the preparation of the plan refer to the Soil and Water Management for Urban Development Guidelines produced by the Southern Sydney Regional Organisation of Councils. Copies of the Guidelines are available from Council.

The Construction Certificate will not be released until the sediment control plan and details have been approved.

4.15 Restrictions As To User - Positive Covenants

The potential for modification or adjustment to OSD storages and / or surface flow paths through the property is significant enough to warrant extra protection. Future owners of properties also need to be aware of their presence and purpose. Consequently, a Restriction As To User / Positive Covenant may be required on the property title as part of the development.

The restriction is created as a Positive Covenant using Form 55A for an Instrument Pursuant To Section 88E(3) of the Conveyancing Act, 1919. The Instrument is to ensure the continued functioning and maintenance of the items detailed in the consent condition. A bond will be required against the creation of the restriction, the value of which will be determined by Council's Director, Technical Services.

Positive Covenants for OSD will be required where the development includes :-

- medium and high density residential housing.
- commercial or industrial structures.
- tennis courts.

- * For dual occupancy dwellings a positive Covenant will only be required if OSD is in a landscaped area. No covenant will be required for single residential dwellings.

4.16 Structures Over or Near Drainage Lines and Easements

New buildings and structures will not be permitted over drainage lines or within easements. Paving over any drainage line or easement is acceptable, but will require appropriate jointing at the easement boundary, and to be in a material approved by Council's Director, Technical Services.

Clearances to easement boundaries are required to prevent structural loads on drainage structures or encroachment within the angle of repose of the soil. Piering is an acceptable technique to achieve this.

If there is an existing structure over the drainage line or easement within the site that is part of the application, then an access pit is required to be provided upstream and downstream of the structure.

4.17 Natural Watercourses and Open Channels

The straightening, widening, lining, or piping of open channels will require the creation of inlet structures and surface flow paths to convey all flows to the 100 year ARI standard. Additionally, emergency flow paths are required in case of obstruction. Depending upon channel conditions on properties adjacent to the site, inlet training and outlet scour controls will be required. Approval for enclosing or lining natural channels may be refused in areas where such work is not consistent with the character of the watercourse in the vicinity.

4.18 Cooks River Flood Plain

Council at its meeting of 17 February 1995 adopted the 1994 Floodplain Management Study by McKeown Webb & Associates. The Study provides flood contours for the 1% Annual Exceedance Probability (AEP) Flood from the Cooks River. Flood levels are available from Council's Technical Services Division. The flood maps developed from this study became effective from 27/3/95. Subsequently Council adopted a Cooks River Floodplain Management plan in May 1997.

All new developments affected by the 1% AEP Cooks River Flood Level or within the 500mm freeboard fringe will be required to have the floor levels of habitable and storage areas set at a minimum of 500mm above the 1% AEP Cooks River Flood Level as set out in the above Study.

4.19 **Development within the Cooks River Floodplain:**

In September 1998 Council adopted Development Control Plan N0.30-Cooks River Floodplain. Any proposed development or building works affected by the 1% AEP Cooks River Flood Level or within the 500mm freeboard fringe must be in accordance with this plan.

Once only extensions with a habitable floor area up to 35square metres may be approved with floor levels below the standard, if the applicant can demonstrate that no practicable alternatives exist for constructing the extension above the 1% Flood Level. All developments so effected are to be constructed in Flood Compatible materials and have all electrical services and switches located above the 1% Flood Level.

Floor Levels for enclosed garages and carparking areas (other than single residential dwellings) must be set at or above the 1% Flood Level. Carports and open carparking areas may be constructed below the 1% Flood Level. Underground garages and parking areas must be protected by a minimum freeboard of 500mm above the 1% Flood Level.

Non habitable extensions, out buildings and garages for single residential properties may be constructed below the 1% Flood Level provided that electrical services and flood sensitive equipment including electric motors and switches are located 500mm above the 1% Flood level.

Extensions greater than 35 square metres will be treated as a new development.

5 DESIGN REQUIREMENTS

5.1 Calculation Requirements

Calculations are to be prepared by an acceptable practitioner (see 7.2), and in accordance with current practices and principles outlined in "Australian Rainfall & Runoff" and other relevant sources.

Hydrologic calculations for internal systems can be prepared using a rational method basis. Hydraulic grade line calculations are required for any pipe systems where flows are in excess of 100 l/s.

Where external catchment analysis is required, hydrologic calculations using time-area methods or a suitable equivalent are to be undertaken, with water surface profiles determined using grade line or backwater calculations as appropriate.

On Site Detention storage systems are to be sized and designed in accordance with Supplement 2. Where sites that require OSD can't drain the whole site through the single or multiple storages to be installed, additional attenuation of flows through the storage and extra volume are required to compensate.

Areas likely to be paved after completion of the development at any point in the future based on the function of the development (eg. driveways), will be determined as part of the impervious area and included as such in any calculations.

5.2 Tailwater Conditions and Downstream Controls

Water surface level calculations are to recognise the effect of any downstream controls, whether on the development site or external to the site. Where downstream water levels vary depending upon tide or channel flows, 100 year ARI levels of the external system being connected to are to be used unless joint probability calculations are performed.

5.3 Freeboard

* This clause applies to all areas except for those areas affected by the Cooks River 1% Annual Exceedance Probability (AEP) Flood Level and freeboard (see clause 4.18)

Freeboard for floor levels above top water level (TWL) of OSD storages is required for buildings near OSD storages, of at least 0.2m above the maximum spillway operating level for habitable areas.

A building floor level freeboard of 0.3m to 0.5m will be required against channel or mainstream flows, or in areas where significant overland flow occurs. In all other circumstances a minimum freeboard of 0.2m is required above surrounding finished ground levels.

5.4 Structural Requirements

The design of any structures to be constructed as part of the drainage system excepting manufacturers pre-cast units such as pits, pipelines, and box culverts, are to be certified by a suitable experienced professional structural or civil engineer.

5.5 Practicalities, Physical Limits, Maintenance

OSD design is to provide for minimum maintenance and be as tamper proof as possible. If located in landscaping areas, nominally twice the volume will be required to allow for vegetation growth and saltation, the actual value to be determined by Council's Director, Technical Services (design of the hydraulic controls is to be based on the normal volume).

Pits are to be a minimum of 0.6m by 0.6m, with the longer side parallel to the pipes. Step irons are required for pits over 1.2m deep. Pipe junctions are to be configured for minimum hydraulic losses. Pits are to be located wherever drainage lines bend greater than 5 degrees, enter public lands from private property, or connect to Council's system.

Access grates in road gutters are to be bicycle safe, with hinged grates. Where the pit is located in a roadway (other than the gutter), pit lids are to withstand T44 traffic loadings and be of a lock down type.

Pipes within public lands are to be reinforced concrete, spigot and socket, rubber ring type. Alternative pipe materials and joints may be approved at the discretion of Council's Director, Technical Services.

6 CONSTRUCTION & DEVELOPMENT ACTIVITIES

6.1 Bank Guarantee

Where works are carried out on Council or public lands (ie. roads, parks etc) by or on behalf of the developer, a Bank Guarantee will be required to cover the cost of potential rectification works. The value of the Bank Guarantee will depend on the works proposed, and be determined by Council's Director, Technical Services.

A Bank Guarantee may also be required to cover the provision of OSD systems and the creation of easements and Positive Covenants. Any Bank Guarantee required will need to be submitted before the issue of a Construction Certificate.

6.2 Contractors Insurance and Road Opening Permits

Where works are carried out by parties other than Council on Council or public lands, the person or company carrying out the works will be required to carry public liability insurance, the minimum value of such coverage to be specified by Council's Director, Technical Services but not less than \$10,000,000. Proof of the coverage will be required before works commence. Where such works are within a public roadway, a road opening permit is to be obtained before commencing works.

6.3 Inspections

Where works are to be carried out on a public roadway, or involve Council owned / operated structures, then advance notice and inspections will be required at specified stages during the works to ensure compliance with any requirements or conditions. The developer will be required to pay for inspections in accordance with Council's Fees & Charges.

The specified stages for inspections normally are :-

- i After the excavation of pipeline trenches.
- ii after the laying of all pipes, prior to backfilling.
- iii after the completion of all pits and connection points.

A minimum of twenty-four (24) hours notice shall be given to Council to obtain an inspection. Work is not to proceed until the works or activity covered by the inspection is approved.

6.4 Certification and Works-As-Executed (WAE) Plans

Certification and / or WAE plans may be required demonstrating that the site drainage system including any OSD, drainage structures, and overland flow paths have been provided according to the submitted calculations or approved plans. This will normally be when the correct construction of these is critical to the functioning of the drainage system. Such certification will be either from an acceptable practitioner or a registered surveyor, as appropriate.

6.5 Traffic Control & Safety

Where works are undertaken on public roads, the applicant or contractor is to provide adequate traffic control and directions to motorists. Where such measures are not satisfactorily provided, Council may provide such and recover the costs from any bonds held. Traffic control is to be in accordance with Australian Standard 1742.3 - Traffic Control Devices For Works On Roads, or any directions issued by Council's Director, Technical Services during the works.

If driveway access to properties is to be disrupted, residents are to be advised in writing a minimum of 24 hours prior to the works. Access is to be restored outside normal working hours

6.6 Connection to Council System

Where drainage works to connect to Council's system are to be carried out within public roads or lands, the applicant or any contractors performing the work are to ensure public safety at all times. The works are to be secured, sign posted and lit whenever the site is unattended.

If Council deems public safety to be at risk, it will provide all necessary measures to secure the site. The costs of such measures will be recovered by Council from any security deposits or Bank Guarantee held and a further Bank Guarantee will be required to cover the cost of such measures.

6.7 Restoration

Any disturbed areas within public roads or lands are to be restored to original or better condition, including landscaping, in accordance with Council's Restorations Code. All restoration costs are to be borne by the developer.

Where other utilities or services require restoration as a result of works for the development, the restoration is to be to the relevant authorities requirements.

Where sections of kerb are to be replaced, including driveways, an integral kerb and gutter profile is to be used. Existing concrete structures are to be saw cut and contraction / expansion joints provided.

Road pavement restorations will be carried out by Council using the road restoration fees paid with the road opening permit, or using any bonds held. Where restoration works are permitted to be carried out by approved contractors, inspections and compaction testing will be conducted to the requirements of Council's Director, Technical Services.

6.8 Pipe Laying & Materials

All pipe laying and construction works are to comply with the requirements of any relevant Australian standards and codes, as well as the manufacturer's specifications. Occupational Health & Safety legislation requirements are to be adhered to at all times.

For reinforced concrete (RC) and fibre reinforced concrete (FRC) pipes, spigot and socket rubber ring joints are required. All other materials are to be to the manufacturers specifications for jointing. Where bolts or similar are required, stainless steel is to be used. PVC and HDPE pipes will not be permitted in load bearing situations.

All pits in public roads are to be constructed in reinforced concrete, and kerb inlet pits in accordance with the Council's standard.

7 DOCUMENTATION REQUIRED

7.1 All Submissions

All applications are to include plans and calculations prepared by an acceptable practitioner which adequately demonstrate compliance with the policy and this Code.

7.2 Acceptable Practitioners

Any hydrologic, hydraulic or structural calculations submitted to Council are to be performed by a suitably qualified professional civil engineer. Similarly, any certification of works carried out that rely on these calculations are to be certified by an equally qualified person.

Registered surveyors may be recognised as suitable practitioners for drainage calculations at the discretion of Council's Director, Technical Services, and subject to satisfactory demonstration of capability and experience.

7.3 Works-As-Executed Details (WAE)

Certification from a registered surveyor that all drainage works and structures have been constructed in accordance with the approved plans may be required before permission to occupy is granted. Such certification is to include WAE plans. Any bonds held will not be released until all required certification has been received.

7.4 Details To Be Submitted With Applications

A Stormwater Drainage Concept Plan (SDCP) is to be submitted with any Development Application, outlining the treatment and disposal of all stormwater from the site (See 4.7). This plan is to demonstrate that the methods proposed are feasible and comply with the Code.

Design plans and calculations will be required before the issue of a Construction Certificate, to demonstrate all measures and structures will function as claimed, and comply with relevant codes and/or practice. This should also include survey information about structures, surface flow paths, and ground levels extending at least 5m beyond the property boundaries. The latter is particularly important where re-contouring of the site is proposed or the development has the potential to affect other properties.

Plans of the layout and dimensions of all drainage structures and treatments is required. Any Benchmark used to determine levels is to be shown, with levels to AHD wherever a PM or SSM is available within 250m.

8 OTHER AUTHORITIES

8.1 Sydney Water

Applications may be referred to Sydney Water where it is responsible for any channel being connected to downstream of the development. Any requirements of Sydney Water will need to be met before approval can be granted.

8.2 Services

Wherever any public utility service is affected by the developer, it is the responsibility of the developer to ensure the development complies with the requirements of the relevant authority. All costs associated with any works required are to be borne by the developer.

9 INFORMATION AVAILABLE FROM COUNCIL

9.1 Drainage System Information

Council will make available information on its drainage system where it is available, on the express understanding that Council is not liable for the accuracy of the information or the consequences of it being used. Results from drainage studies carried out for Council, which have been reported to the Council, may also be made available.

Information provided to Council by other parties may be released at the discretion of Council's Director, Technical Services subject to copyright and privacy restrictions, and on the understanding Council makes no guarantees as to its validity.

9.2 Location and Details of Pipelines

The developer and / or designer will need to confirm, by inspection and survey, any information affecting designs. This includes confirmation of pit and pipe locations and sizes, and any utility authority services location and dimensions.

10 GLOSSARY

Australian Rainfall & Runoff (AR&R)

A technical publication from the Institution of Engineers Australia providing guidance on current drainage design practice.

Average Recurrence Interval (ARI)

A statistical likelihood of a storm event of at least a designated average rainfall intensity occurring. The probability is a long term average, and not a period between events (eg. 10 years ARI indicates 10 events over 100 years).

Hydrology & Hydraulic

Hydrology is the estimation of the runoff and flow rates of rainfall once on the ground. The term hydraulic refers to calculating the capacity or characteristics of flow control devices and conduits (pipes).

On-site Detention (OSD)

Restricting the outflow of stormwater runoff from a site by draining collected surface flows from paved and roof areas through a storage with an outflow control device.

Probable Maximum Precipitation (PMP)

An estimate of the maximum amount of rainfall that could possibly occur.

Stormwater Drainage Concept Plan (SDCP)

A site plan of a development showing buildings and proposed drainage measures and structures. This should include existing and proposed ground and floor levels, as well as approximate sizes of drainage structures and surface flow path treatments.

Preliminary hydrologic and hydraulic calculations should accompany the plan.

11 REFERENCES

- "Australian Rainfall & Runoff", (AR&R) 1987, Institution Of Engineers, Australia.
- "Urban Erosion & Sediment Control", NSW Department Of Conservation And Land Management, Draft 1992.
- "Floodplain Development Manual", December 1986, Department of Planning, NSW Government.
- "The Estimation of Probable Maximum Precipitation in Australia for Short Durations and Small Areas", Bulletin 51, August 1984, Bureau of Meteorology, Department of Science & Technology.
- "Storm drainage design in small urban catchments", 1986, ARRB Special Report No. 34, John Argue.
- "Pressure Changes at Storm Drain Junctions", Engineering Services Bulletin 41, 1958, University of Missouri, Sangster et al.
- "Magnitude of Head Losses at Junctions in Piped Drainage Systems.", 1983, Civil Engineering Transactions, C.Hare.

SUPPLEMENT 1

Intensity Frequency Duration (IFD) Rainfall Data*Marrickville*

<i>2 year</i>	<i>50 year</i>
<i>I₁ hr : 40.0</i>	<i>I₁ hr : 85.0</i>
<i>I₁₂ hr : 8.0</i>	<i>I₁₂ hr : 16.0</i>
<i>I₇₂ hr : 2.5</i>	<i>I₇₂ hr : 5.0</i>

TIME	AVERAGE RECURRENCE INTERVAL (ARI) years					
	2	5	10	20	50	100
5 mins	126.5	160.8	180.4	206.6	240.6	266.3
6 mins	118.7	151.3	170	194.8	227.1	251.6
7 mins	112.1	143.3	161.2	184.9	215.8	239.3
8 mins	106.6	136.4	153.6	176.4	206.1	228.7
9 mins	101.7	130.5	147.1	169	197.6	219.4
10 mins	97.5	125.2	141.3	162.5	190.1	211.2
12 mins	90.3	116.3	131.4	151.3	177.4	197.2
14 mins	84.3	109	123.3	142.1	166.8	185.6
15 mins	81.8	105.8	119.7	138.1	162.2	180.5
16 mins	79.4	102.8	116.5	134.4	157.9	175.8
18 mins	75.1	97.5	110.6	127.7	150.3	167.4
20 mins	71.4	92.9	105.5	121.9	143.6	160.1
25 mins	64	83.6	95.1	110.2	130	145.1
30 mins	58.3	76.4	87.1	101.1	119.5	133.5
40 mins	50.1	66	75.5	87.8	104.1	116.6
50 mins	44.3	58.7	67.3	78.4	93.2	104.6
1 hours	40	53.2	61.1	71.4	85	95.5
1.5 hrs	31	41	47.1	54.9	65.2	73.1
2 hours	25.7	34	38.9	45.3	53.8	60.3
3 hours	19.8	26	29.7	34.5	40.9	45.8
4.5 hrs	15.2	19.9	22.7	26.3	31.1	34.7
6 hours	12.6	16.4	18.7	21.7	25.6	28.5
9 hours	9.6	12.6	14.3	16.5	19.4	21.7
12 hours	8	10.4	11.8	13.6	16	17.8
15 hours	7	9.1	10.3	11.9	14	15.6
18 hours	6.2	8.1	9.2	10.6	12.5	13.9
24 hours	5.2	6.8	7.7	8.9	10.5	11.7
30 hours	4.5	5.9	6.7	7.7	9.1	10.1
36 hours	4	5.2	5.9	6.9	8.1	9
48 hours	3.3	4.3	4.9	5.7	6.7	7.4
72 hours	2.5	3.2	3.7	4.3	5	5.6

Co-efficient G : 0.00 F₂ : 4.29 F₅₀ : 15.80

SUPPLEMENT 2

On Site Stormwater Detention (OSD) Storage Requirements

S2.1 Design Values

Hydrologic calculations are required to demonstrate the post development site runoff does not exceed that prior to development for all recurrence intervals over the range 5 to 100 years ARI. Calculation methods considered acceptable for this demonstration are:-

- a Triangular Hydrographs
- b Volumetric Procedure - Technical Note 1 AR&R
- c Swinburne
- d Time Area models such as Ilsax.

Other methods may be accepted at the discretion of Council's Director, Technical Services.

Times of concentration are to be calculated using the kinematic wave equation from page 300 of AR&R.

S2.2 Other Design Requirements

- * The outflow control structure is to be designed to control variable outflow rate in accordance with the storage-discharge relationship from S4.1
- * All roof and paved areas are to drain through the storage.
- * Storages are to be located separate from any external surface flow paths.
- * Finished ground levels are to be constructed so that impervious area runoff, in excess of the pipe system capacity, drains to the storages.
- * The maximum storage level is to be such that floor levels are at least 0.2m above the maximum water level.
- * An emergency overflow with flowpaths is to be provided, and is to be free of obstructions such as fences.
- * Maximum ponding depths for above ground storages are to be 0.2m in parking areas, 0.3m in landscaping.
- * Storage volumes in landscaping areas are to be doubled to allow for vegetation growth.
- * Surface storage areas in strata or community title developments are not to be in privately controlled areas such as courtyards.
- * Hydraulic control devices are to be constructed to be non removable.
- * Existing stormwater storages can be incorporated into the new design

SUPPLEMENT 3

Requirements For Hydrologic Calculations & Modelling

S3.1 Rational Method Calculations

Rational method calculations are generally acceptable to determine stormwater runoff quantities to design piped drainage systems. However, where multiple storages are proposed then a time based model is required to account for variable timing of storage outflow peaks. Also, if a pipe system requires a capacity greater than 250 l/s or the development site area exceeds 0.5 Ha, a model is required to design the system.

The Rational Method formula is $Q=C.I.A.K$, where

Q=discharge

I=Intensity for T_c

T_c =Time of overland flow concentration

A=Area

K=constant dependant upon units used

Intensity is determined using Supplement 3

T_c can be calculated using the kinematic wave formula from AR&R page 300.

Note L= is pre existing flow path that is modified by the development by piping, paving or redirecting.

n is per AR&R page 300 with minimum of 0.25 for non paved areas

A= area of catchment affected, not just the development site.

S3.2 Modelling Drainage Systems & Flooding

The preferred model for urban pipe systems is ILSAX. Other acceptable models are RORB,RAFTS,EXTRAN,MIKE11-UD,MOUSE.

Council may not have the models referred to or expertise in their use, excepting ILSAX. Calculations based on these models may cause delays in checking. Also full model details, data and calculation results will be required.

Parameters for the preferred model :

- * Soil=3
- * AMC=3
- * Infiltration Initial Paved=1
Grassed=5mm
- * Storms. As per AR&R 1987.
25min & 2hr are the expected worst case due to temporal patterns. Other storm durations should be checked to confirm the worst case adopted.
- * Time of Entry (T_e) uses the Kinematic Wave formula - see rational method calculations for details.
- * No stored bypass or surcharge. Either redirect or determine storage behaviour.

SUPPLEMENT 4

Examples of Hydrologic Calculations For OSD

S4.1 Triangular Hydrographs

This method is that presented by Wollongong City Council. Runoff calculations are based on the Rational Method, with runoff coefficients calculated using the chart or formula from AR&R 1987. Times of concentration for the site prior to development are to be based on the kinematic wave equation from AR&R 1987 pages 300-301. A minimum time of 5 minutes is to be used for the post development state.

The maximum storage volume required for a given ARI is that calculated from the area under the developed site hydrograph above a line drawn from the origin to the point on the falling limb corresponding to the maximum pre development discharge. The time of concentration for the developed site hydrograph is to be taken from 5 minutes through to the pre development time of concentration to determine the time giving maximum volume. The diagrams show the formation of the hydrographs and areas.

Example: Site Area = 0.12 Ha.
Existing 100% grassed - 120m at 3% with $n=0.15$
Developed 100% paved

Rainfall Data to construct IFD table		I_2 mm/hr	I_{50} mm/hr
1 hour		35	70
12 hour		7.5	15
72 hour		2.45	5.1
		$G=0$	$F_2=4.29$ $F_{50}=15.8$

Overland flow times	ARI (yrs)	Pre-dev. T_c	Post-dev. T_c (Min)
	5	19	5
	10	18	5
	20	17	5
	50	16	5
	100	15	5

Figure 2.1

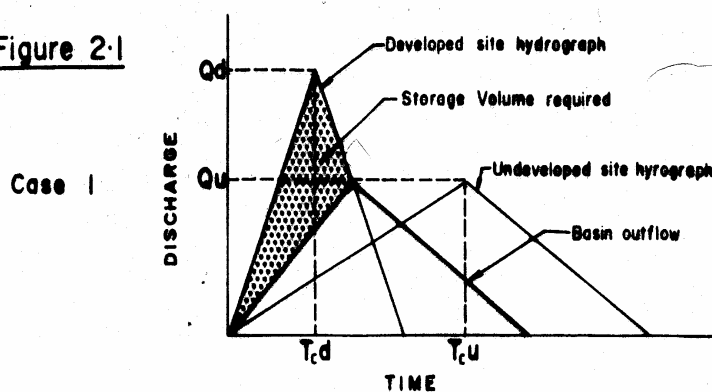


Figure 2:2

Case 2

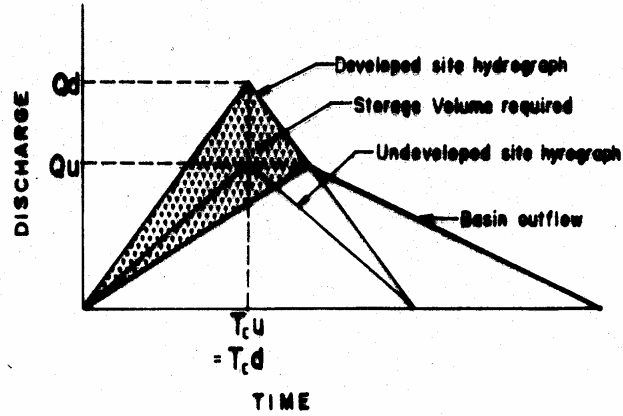
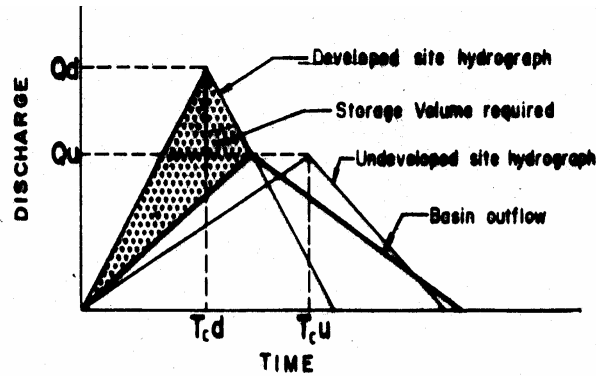


Figure 2:3

Case 3



Volume = (Qd - Qu) T_{c,d} = 60sec.

ARI (yrs)		5	10	20	50	100
C pre dev		0.54	0.57	0.59	0.65	0.68
C post-dev		0.86	0.9	0.95	1.04	1.08
Pre-development		L Qu Vol mm/hr l/s m ³	L Qu Vol mm/hr l/s m ³	L Qu Vol mm/hr l/s m ³	L Qu Vol mm/hr l/s m ³	L Qu Vol mm/hr l/s m ³
		110 20	124 23	143 28	167 36	185 42
Post-dev	Tc Min	Q l/s	Q l/s	Q l/s	Q l/s	Q l/s
Case 1	5	143 41 6	161 48 7	184 58 9	215 74 11	238 86 13
Case 3	7	127 36 7	143 43 8	164 52 10	191 66 12	112 76 14
	8	121 34 7	136 41 8	156 49 10	182 63 13	202 73 15
	9	115 33 7	130 39 8	149 47 10	174 60 13	193 69 15
	10	110 31 7	124 37 8	143 45 10	167 58 13	185 67 15
	11	106 30 7	120 36 8	138 43 10	161 56 13	179 64 15
	12	102 29 7	115 35 8	132 42 10	155 53 12	172 62 14
	13	99 28 7	112 34 8	128 40 9	150 52 12	167 60 14
	14	96 27 6	108 32 8	124 39 9	145 50 12	161 58 14
	15	93 27 6	105 32 7	121 38 9	141 49 11	
	16	90 26 6	102 31 7	117 37 8	137 47 11	
	17	88 25 5	99 30 6			
Case 2	18	85 24 5	96 29 6			

4.2 Time Area Hydrographs

Runoff is to be calculated using a computer model using appropriate time area calculations, such as ILSAX or compatible programs.

The storage required is that which 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 is to be for all ARI's for the range of 5 to 100 yrs ARI.

The effects of both the 2 hour and 25 minute temporal pattern are to be examined.

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

Example : same site details as appendix A.

AMC=3 ; Soil=3 ; Initial Loss/Storage - Paved 1mm Grassed 5mm

	Q l/s Pre	Q l/s Post	
5 yr	129	393	
10 yr	171	444	
20 yr	229	511	
50 yr	295	538	
100 yr	350	598	(note: say set storage to commence at 75% 5 yr Q)

Basin relationship

Vol m ³	Q l/s
1	100
150	130
195	230
235	350
240	350 + overflow gives

	Q l/s Pre-Dev	Basin outflow
5 yr	129	128
10 yr	171	167
20 yr	229	227
50 yr	295	288
100 yr	350	343

SUPPLEMENT 5

Hydraulic Designs & Details

S5.1 Pit Inlet Capacities Design Values

For standard grated inlet pits with an extended kerb inlet, the capacity shall be as per section 9.2 of Department of Housing Road Manual June 1987.

S5.2 Hydraulic Grade Line (HGL)

HGL calculations are required where pipe flows exceed 100 l/s, the drainage system crosses properties external to the development, or where Council's Director, Technical Services determines that the connection to Council's system warrants such calculations.

Pit Losses.

- * Use Missouri charts (Sangster et al), Hare charts or relevant derivations of these.
- * Ensure the pit loss factor (K) used matches the pit design. The pit configuration should ensure the projection of the incoming pipe is within the outgoing conduit on the downstream pit face. *(NB this generally requires rectangular pits to be built parallel / square to the upstream line, with the downstream pipe cut at an angle where it joins the pit. This is the opposite of typical construction patterns. Therefore the worst case assumption will be used by council in checking K factors unless construction plans have pit layout diagrams.)*
- * Drop pits are discouraged as there is no acceptable determination of loss factors, as well as empirical results indicating drop pits behave as surcharge points generally having a capacity less than the nominal system capacity. Invert matching is recommended in preference to obverts.
- * Use Colebrook White roughness values
- * Use the surface level as the downstream HGL for connections to existing pit.
- * Backwater calculations to the downstream control are required for open channels. Subcritical regime is to be adopted in open channels. HGL is to be adjusted to obverts to maintain the pipe full assumption.
- * Outflow control devices. Use orifice formula if the assumption / requirements can be met for expansion / contraction, edge type etc. Otherwise, HEC-5 and HEC-10 empirical results or equivalent formulae of Body replicating the curves are to be used.

SUPPLEMENT 6

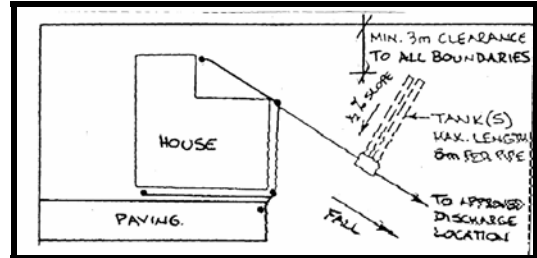
Standard Drawings & Details

*Detention Storage & Infiltration Tank - Single Residential Dwellings
where the increase in the impervious area is less than 100 square metres*

Check if the use of this design is permitted.

1. Determine new roof and paving area.
2. If Area 40m^2 then OSD may be omitted

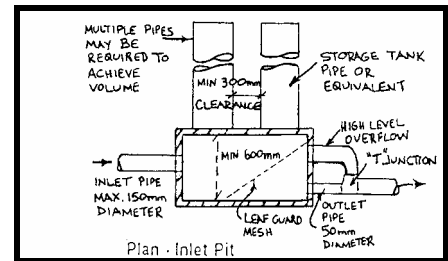
Tank Volume = 1m^3 minimum



Site Plan

Modifications

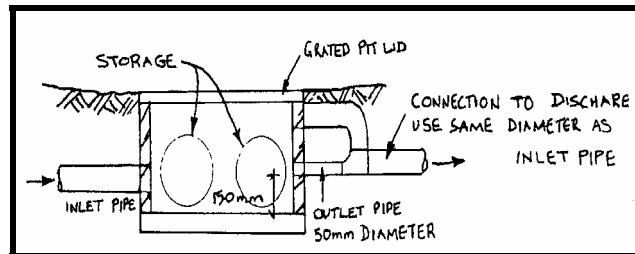
1. The elevated inlet to achieve infiltration may be waived at the discretion of Council's Director, Technical Services if problems are likely to occur.
2. If the fall of the property is away from the street, it is acceptable for the roof lines to drain to the street provided the driveway drains to the tank.



Plan - Inlet Pit

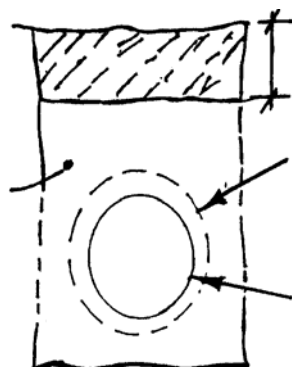
If using pipes for the storage :

Diameter (mm)	Length (metres) for 1m^3 volume.
300	13.3
375	9.1
450	5.9



Section - Through Pit

Sand or granular backfill. Nominal 100mm clearance all round.



Minimum 300mm topsoil

Geotextile or equivalent permeable membrane.

Perforated pipe or equivalent arrangement

Section - Through Storage

SUPPLEMENT 7

Wordings For Restrictions As To User & Easements

Restriction As To User - Positive Covenant Form 55A Instrument Pursuant To Section 88E(3), Conveyancing Act, 1919

On Site Detention

"The stormwater detention facility as described by the plan of {Name} Council Building Consent and the conditions of such consent, shall not be altered or removed in whole or in part without written approval of {Name} Council.

The registered proprietor is to maintain the stormwater detention facility in working condition.

Authorised {Name} Council employees are to be allowed access for inspection upon reasonable notice. The registered proprietor is to comply with any notices issued by Council regarding rectification or maintenance works to be carried out for compliance.

In the event of the registered proprietor not complying with the notice, Council or its authorised agents may enter and carry out the specified work, and recover the costs due."

Stormwater Surface Flow Path

"The stormwater surface flow path defined shall not be obstructed or have the *{finished ground (and/or) pavement levels}* within the defined area modified in whole or in part without written approval of {Name} Council. It shall be the responsibility of the registered proprietor to ensure the stormwater surface flow path is kept unobstructed by fences or any physical structures or barriers (whether temporary or not) at all times.

Authorised {Name} Council employees are to be allowed access for inspection upon reasonable notice. The registered proprietor is to comply with any notices issued by Council regarding rectification or maintenance works to be carried out for compliance.

In the event of the registered proprietor not complying with the notice, Council or its authorised agents may enter and carry out the specified work, and recover the costs due."

SUPPLEMENT 8

Sediment Control Plans

Preparation of the Plan

The following is a brief summary of the details involved in preparing a control plan taken from chapter 5 of the "Urban Erosion and Sediment Control" handbook by the Department of Conservation and Land Management. The Soil & Water Management for Urban Development Guidelines produced by the Southern Sydney Regional Organisation of Councils should also be referred to in the preparation of the plan.

The points under each item give the details required to be submitted as part of the control plan. Some details listed will already be provided to meet other requirements.

- 1 Investigate site characteristics ie. Topography, soils, vegetation. The plan should include :
 - Locality plan
 - Plan of site and surrounding area with contours and catchment boundaries.
 - Soil and vegetation types and coverage
 - Any other relevant features

- 2 Integrate clearing and grading with site layout plan, including consideration of staging of works. The plan should include areas to be exposed and the type and extent of the earthworks.

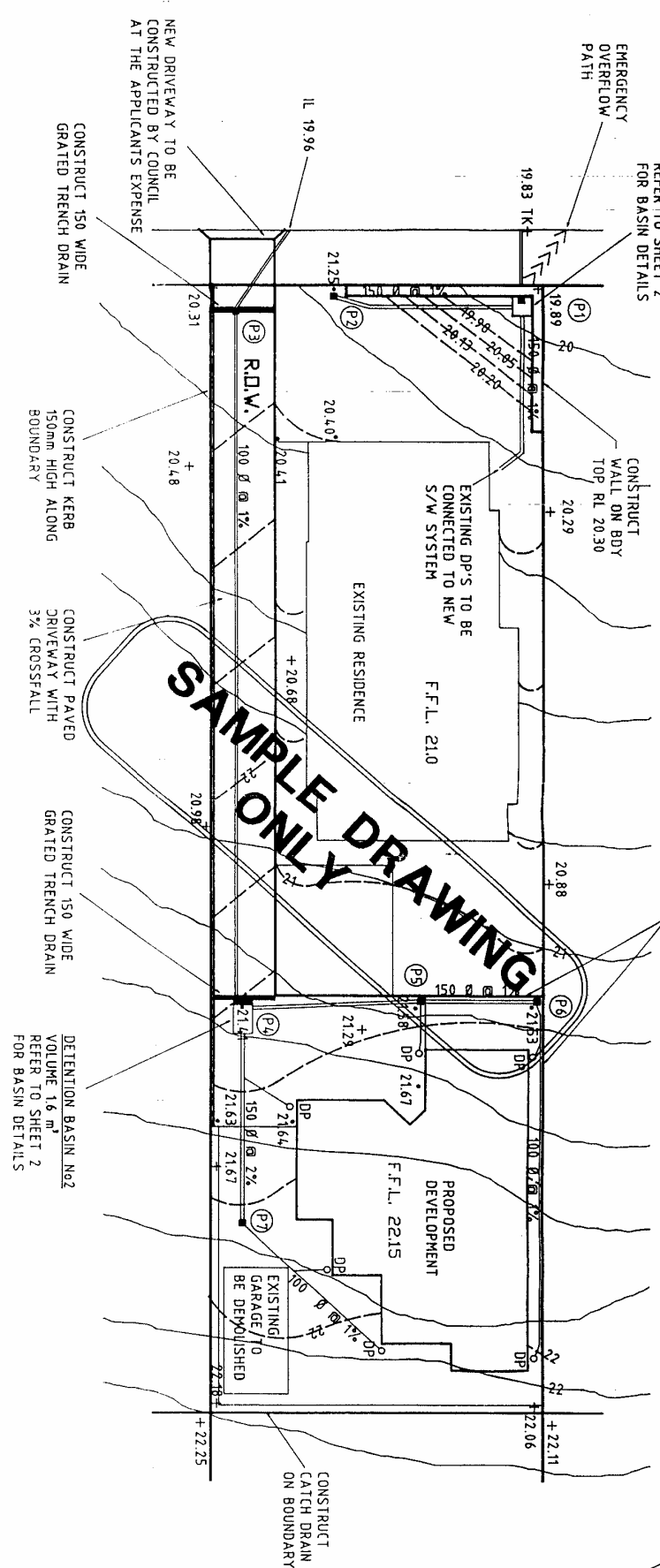
- 3 Determine existing and proposed drainage patterns, including diversion of flows entering the property from upstream, and impact of development on flow paths. Much of this information should be detailed as part of the stormwater design.

- 4 Select erosion control practices. Details of the proposed measures should include
 - Location and design criteria of structural and vegetative erosion control measures needed to control the volume, direction and velocity of runoff.
 - Scheduling of construction / implementation of the measures.
 - Maintenance of the measures.

- 5 Outline the rehabilitation program, including :
 - areas where temporary and permanent revegetation is to be employed
 - details of stabilising of exposed soils
 - types of planting materials or ground coverings

DETENTION BASIN No1
 VOLUME 3.1 m³
 REFER TO SHEET 2
 FOR BASIN DETAILS

CONSTRUCT RETAINING
 WALL 150mm ABOVE
 PROPOSED SURFACE LEVELS



PIT No.	SURFACE RL	INVERT	DEPTH	SIZE	TYPE
P1	19.90	19.59	0.31	900x900	LD GRATE
P2	20.25	19.70	0.55	450x450	HD GRATE
P3	20.23	20.03	0.20	450x450	HD GRATE
P4	21.41	20.25	1.16	900x600	HD GRATE
P5	21.58	21.13	0.45	450x450	HD GRATE
P6	21.53	21.18	0.35	450x450	LD GRATE
P7	21.82	21.29	0.53	450x450	LD GRATE

-22- EXISTING CONTOURS
 -21- PROPOSED CONTOURS
 +20.68 EXISTING SURFACE LEVELS
 •21.65 PROPOSED SURFACE LEVELS

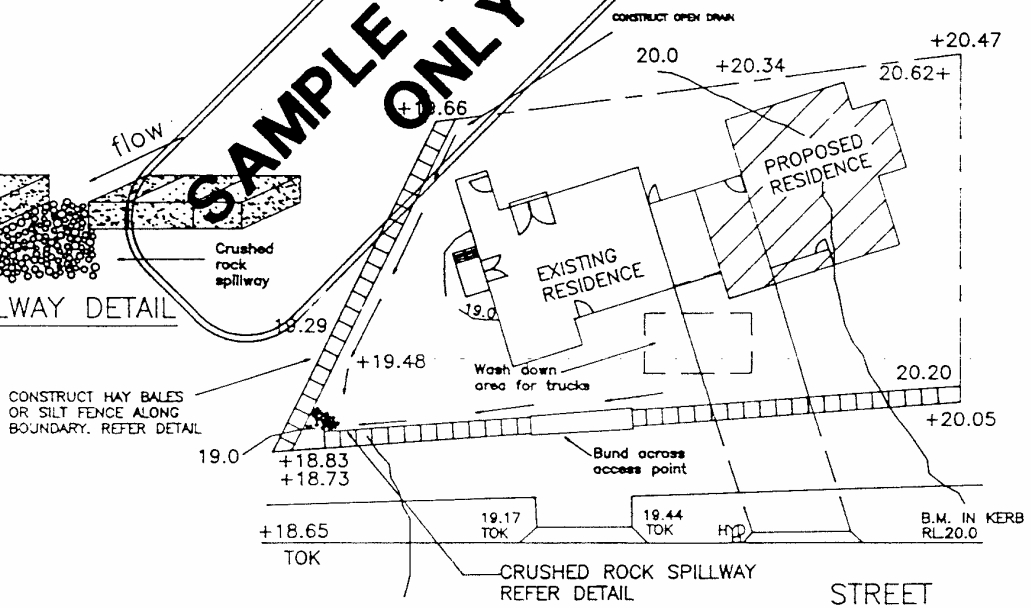
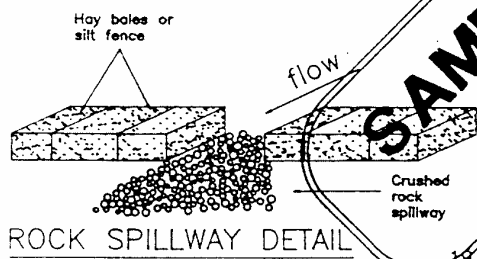
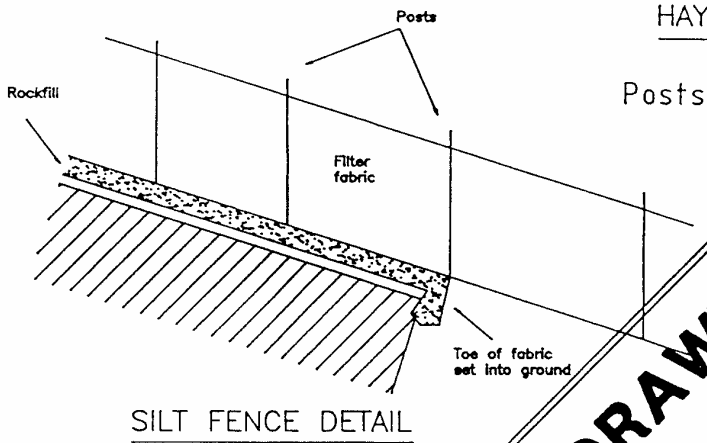
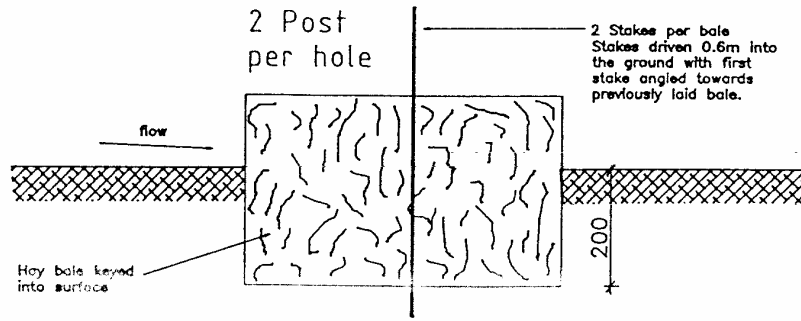
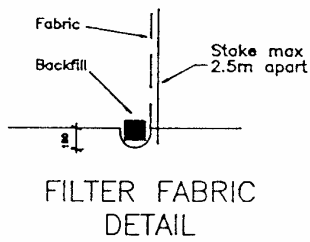
**TORRENS TITLE
 SUBDIVISION**

SAMPLE ONLY DRAWING

**ON - SITE DETENTION
 SAMPLE DRAWING**

Scale	As Shown	As Shown	As Shown
Vertical	1:1	1:1	1:1
Horizontal	1:1	1:1	1:1
Section	1:1	1:1	1:1
Grid	1:1	1:1	1:1
Other	1:1	1:1	1:1

SHEET No. 1
 No. of SHEETS 3
 PLAN No. E3163



SEDIMENT CONTROL DETAILS

SAMPLE DRAWING SHOWING TYPICAL SEDIMENT CONTROL DETAILS FOR DEVELOPMENT SITES