Water Management

Technical Manual

July 2014

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KEY ACRONYMS

ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ANZECC	Australia and New Zealand Environment and Conservation Council
AS	Australian Standard
BASIX	Building and Sustainability Index
BOD	Biological Oxygen Demand
cfu	colony forming units
COD	Chemical Oxygen Demand
DCP	Development Control Plan
DEC	Former NSW Department of Environment and Conservation*
DEUS	Former NSW Department of Energy, Utilities and Sustainability*
DGTS	Domestic Greywater Treatment System
DLG	NSW Department of Local Government
DNR	Former NSW Department of Natural Resources*
EPA	NSW Environment Protection Authority
EPHC	Environment Protection and Heritage Council
EHPG	Environment and Health Protection Guidelines
ESCP	Erosion and Sediment Control Plan
GDD	Gravity Diversion Device
hr	hour
kL	kilolitres
l	litres
LGA	Local Government Area
m	metres
mg	milligrams
mm	millimetres
NATA	National Association of Testing Authorities

OSD	On site detention
OSR	On site retention
PSD	Permissible site discharge
SCCG	Sydney Coastal Councils Group
SEPP	State Environmental Planning Policy
SS	Suspended Solids
SWMP	Soil and Water Management Plan
WSUD	Water Sensitive Urban Design

* These functions are currently undertaken by the NSW Department of Environment and Climate Change (DECC) and the NSW Department of Water and Energy (DWE).

1.0 INTRODUCTION

The Water Management Technical Guidelines serves to provide stand alone technical guidelines to community, developers and Council for matters relating to water management. It contains planning controls relating to the management of all aspects of the water cycle in an integrated and consistent manner. The planning controls promote the need for long-term sustainable social, ecological and economic outcomes.

This applies to all residential, mixed use and commercial development

1.1 Objectives

These Technical Guidelines stipulate:

(a) Ensure that an integrated and consistent approach to water cycle management is achieved;

(b) Preserve and protect the health, amenity and property of residents and the community;

(c) Protect and conserve the environment, specifically the receiving waters of catchments;

(d) Plan, implement and maintain the storm water system in accordance with the principles of Ecologically Sustainable Development (ESD); and

(e) Support best planning management practices.

(f) how calculations are to be undertaken; and

(g) performance measures including minimum setbacks, minimum volumes/sizes etc, proving periods, the need to demonstrate system performance, ongoing monitoring requirements, etc.

(h) relevant Government policy and guidelines.

1.2 What sections apply to my development?

Table 1 provides an overview of the application and is intended to direct the reader to the relevant sections in the WM Technical Manual. WM Technical Manual can be found on Councils website from 'Publications, Policies and Major Reports'.

	Application	**Technical Guideline Ref**
Stormwater Disposal Methods	**Type of Development**	**Reference**
Infiltration	Any development application identified on the Infiltration Map Annexure B, or on a merit basis.	3.1, 3.1.1

Gravity	Any development application	3.1 3.1.2
Charged	Single dwelling residential development or where the increase in impervious area is less than 10m2.	3.1, 3.1.3,
Pump	Any development application where: gravity system or infiltration system cannot be used, and **downstream easement cannot be obtained.**	3.1, 3.14
Stormwater Systems		
On-site detention (OSD)	• New development or • Increase in impervious area ≥ 50m2 or • Additional storey or part of or • Total cost of Development is more than $100,000	5.0
Roofwater harvesting	Where roofwater harvesting is proposed.	6.0
Stormwater re-use	Where stormwater re-use is proposed.	7.0
Permeable paving	Where permeable paving is proposed.	8.0
Stormwater quality	All development applications.	9.0
Floor level control	All development applications except exempt development or where the increase in impervious area is less than 10m2.	4.5
Seepage / dewatering	All development applications.	10.1 & 10.2
Other Systems		
Groundwater extraction & use	Where groundwater extraction and use is proposed.	10.3
Greywater & blackwater re-use	Where greywater or blackwater re-use is proposed.	11 & 12

1.3 Relationship with the BASIX SEPP

The introduction of the Building and Sustainability Index (BASIX) State Environmental Planning Policy (SEPP) which applied to all residential development from 1 July 2006 means that any 'competing provision' in a development control plan (i.e. a provision aimed at reducing potable water supply) has no effect.

This document however provides guidelines to assist applicants who want to make informed decisions on the issue of water cycle management. It can apply, therefore, to all development in the Waverley Local Government Area.

2.0 DRAINAGE

2.1 Stormwater management system

The provision of a stormwater management system is often required together with on-site detention, on-site retention and water quality measures. Stormwater management system requirements are as follows:

(a) The roof and property drainage system shall be constructed to manage the relevant design storm.

(b) Overland stormwater flows from the property boundary to the street drainage system are not permitted. Stormwater overflows must be piped from the property boundary to the back of the kerb.

(c) Stormwater pits or cleaning eyes shall be installed to facilitate maintenance of stormwater pipes, orifice plates, debris screens and reflux valves:

(i) At all junctions, changes of gradient and changes of direction of stormwater pipes;

(ii) With a maximum spacing of 30 metres along a length of pipe; and

(iii) Directly above any reflux values, orifice plates, or debris screens.

(d) The minimum pit size shall be as specified in Table 1 below and in the following text.

Table 1: Minimum Pit size for varying depths

Depth of pit (mm)	Minimum Pit Size (mm)
D ≤ 300	300 x 300
300 < D ≤ 600	450 x 450
600 < D ≤ 900	600 x 600
900 < D ≤ 1200	900 x 900
1200 < D	900 x 900 (with step irons)

(e) Where multi-unit developments have private courtyards, the private courtyard of each residence must contain at least one stormwater drainage pit of dimensions not less than 300 x 300 mm and the ground shall be suitably graded to this pit.

(f) Stormwater pits should be located in a manner that will ensure sheet stormwater flow between buildings or between buildings and boundary fences is minimised.

(g) All pipes should be cut flush with the wall of the pit.

(h) The grated covers of pits larger than 600 x 600 mm are to be hinged to prevent the grate from falling into the pit.

(i) The base of the drainage pits should be at the same level as the invert of the outlet pipe.

(j) Continuous trench drains are to be of width not less than 150 mm and depth not less than 100 mm. The bars of the grating are to be parallel to the direction of surface flow.

(k) Pits with depths between 1.2 metres and 6 metres are to have step irons in accordance with *AS 1657-1992 Fixed platforms, walkways, stairways and ladders – Design, construction and installation*. For pits greater than 6 metres other means of access must be provided.

(l) PVC pits will only be permitted if they are not greater size than 450 x 450 mm (maximum depth 450 mm) and are heavy duty.

(m) In-situ pits are to be constructed on a concrete bed of at least 150 mm thickness. Pits deeper than 1.8m are to be reinforced concrete. The walls are to be designed to meet the minimum requirements of *Clause 8.6.5* of *AS 3500.3 – 2003 Plumbing and Drainage – Stormwater Drainage*.

(n) Grates are to be galvanised steel grid type. Grates are to be of heavy-duty type in areas where they may be subject to vehicle loading.

2.2 Connection to street kerb & gutter

(a) Where the stormwater discharge from the site during a design storm is equal to or less than 25 litres per second, stormwater may be connected to the street kerb and gutter in accordance with the following requirements:

(i) The minimum internal diameter of stormwater pipes on private property connected to the kerb is 90mm.

(ii) Connections discharge limits and pipe material as per Table 2.

(iii) Ag pipe is to connect to street pit or Table 2 below if applicable.

Table 2: Street kerb & gutter connection requirements

Design feature	Requirements
Maximum no. of connections	2 per site connected to the street gutter
Discharge limits	< PSD for the combined discharges < 25 litres per second per site.
Pipe Material	Ag pipe should be used under the nature strip in areas where infiltration is permissible according to the Infiltration Map (Annexure B).

2.2.1 Connection to below ground drainage system

Where the stormwater discharge from the site during the design storm exceeds 25 litres per second, all stormwater must be connected direct to a below ground system (and not to the kerb) in accordance with the following:

(a) The design and construction of any direct connection to the Sydney Water below ground drainage system must be approved by Sydney Water.

(b) All connections to Council's below ground drainage system shall occur at a stormwater pit for pipe diameters greater than 150mm. If no such pit exists adjacent to the site then a new grated gully pit will need to be installed over the existing Council pipeline at the applicant's expense.

(c) Where required, any extension of Council's existing below ground drainage system will be undertaken at the applicant's expense.

2.2.2 Design requirements

Drainage system design requirements are outlined in Table 3.

Table 3: Drainage system design requirements

Design feature	Requirements
Minimum pipe size	375mm
Minimum pipe grade	1.0%
Pipe class	Minimum Class 2
Pipe material	Reinforced Concrete Pipe to AS4058-1992 Precast concrete pipes (pressure and non-pressure) with rubber ring joint. Note: Fibre reinforced concrete (FRC) or other materials will not be accepted.
Minimum pipe cover	To be in accordance with pipe class, materials and the manufacturer's recommendations.
Velocity	The minimum pipe velocity should be 0.6 m/s and a maximum velocity of 6.0 m/s during the design storm in order to be self cleansing and prevent silt accumulation.
Extended kerb inlet	2.4m overall length (1.8m clear internal opening)

(a) Standard Council grated gully pits are required:

(i) Every 30m along the extended system;

(ii) At every change in direction along the extended system, where it can also collect water; and

(iii) Prior to each road intersection.

(b) Standard Council junction pits are required:

(i) At every change in direction along the extended system, where a grated gully pit is not required; and

(ii) Where a drop pit is required and a grated gully pit is not required.

(c) The maximum number of stormwater connections direct to the below ground stormwater system is 1 per site.

The combined maximum discharge from all connections to the street kerb and gutter and to the below ground stormwater system is not to exceed the Permissible Site Discharge (PSD) (refer to table 2 Section 2.2).

2.3 Vehicle crossings impacting upon existing Council drainage pits

Where it is proposed to modify an existing vehicle crossing or construct a new vehicle crossing and this work requires the alteration of an existing Council drainage pit, then:

(a) The existing inlet capacity to Council's below ground drainage system is to be maintained, if not improved.

(b) A standard Council grated gully pit with a 2.4m overall length extended kerb inlet (or a longer kerb inlet if it is needed so as to maintain inlet capacity), is to be constructed upstream of the proposed vehicle crossing.

(c) Existing on grade drain pits affected by the crossing shall be converted into a junction pit. If the existing drainage pit affected by the crossing is in sag (in a low point), it shall be converted into a grated gully pit.

(d) The newly constructed gully pit will either:

(i) be constructed over the existing below ground drainage system if one is present; or

(ii) will require the extension of the existing below ground drainage system;

(e) All costs associated with providing the vehicle crossing and altering the stormwater system are to be paid for by the applicant.

2.4 Interallotment drainage

Interallotment drainage, i.e. an easement, is required to convey stormwater from individual properties that cannot drain directly to the street stormwater management system.

(a) Design of interallotment drainage shall be undertaken in accordance with the relevant Australian Standard and the requirements outlined in Table 4.

Table 4: Interallotment drainage design requirements

Design feature	Requirements
Easements	Easements will be created over the interallotment drainage line in favour of all upstream lots.
Minimum pipe size	90 mm
Pipe class	Minimum Class 2
Minimum pipe grade	1.0% for all pipes. Pipes with a gradient greater than 20% may require anchor blocks and cut-off collars. Refer to relevant Australian Standards for design criteria.
Velocity	The minimum pipe velocity should be 0.6 m/s and a maximum velocity of 6.0 m/s during the design storm in order to be self cleansing and prevent silt accumulation.
Pipe materials	Materials in accordance with Australian Standards.
Minimum pipe cover	To be in accordance with pipe class, materials and the manufacturer's recommendations.

3.0 STORMWATER WATER SYSTEMS

Disposal of stormwater from the site must be provided using one or a combination of the following methods:

(a) Infiltration;

(b) Gravity connection to Council's stormwater system;

(c) Charged system;

(d) Pump out system.

3.1 Stormwater Disposal Methods

Methods of disposal of stormwater from the site must be provided using one or a combination of the following (listed in order of preference):

(a) Infiltration;

(b) Gravity connection to Council's stormwater system;

(c) Charged system; and / or

(d) Pump system.

A stormwater system must be constructed in accordance with AS/NZS 3500:2003 National Plumbing & Drainage and WM Technical Guidelines.

3.1.1 Infiltration

Infiltration systems such as gravel filled trenches and sand filters may be used to retain and infiltrate stormwater on site. These systems are most effective in areas where the soil has a high infiltration rate. If the underlying soil is found to have very low infiltration capacity, the use of infiltration systems is discouraged:

(a) Infiltration may be proposed in areas:
  (i) where infiltration is permissible according to the Infiltration Map (Annexure B).
  (ii) outside those shown as permissible on the Infiltration Map. These will be assessed on their merits.

(b) Infiltration systems are NOT permitted in areas with:
  (i) land slip or geotechnical problems associated with reactive soils;
  (ii) existing seepage problems;
  (iii) where contamination of ground water is possible;
  (iv) where the site is known or suspected of being contaminated;
  (v) exposed bedrock at surface;
  (vi) shallow soil over rock or shale;
  (vii) steep terrain (>10%); or
  (viii) high water table.

(a) The storage volume of an infiltration system may be used to reduce the on-site detention storage volume.

(b) Infiltration systems are to be designed in accordance with Australian Runoff Quality Guidelines (Institution of Engineers) and WM Technical Guidelines.

(c) A full hydraulic design is required to determine the necessary storage requirements for a range of storm events up to and including the 1 in 100 ARI.

(d) The infiltration rate of the soil is to be determined by a Geotechnical Engineer using an appropriate field or laboratory test. Assumed infiltration rates are not acceptable.

(e) A factor of safety of 2 shall be applied to all infiltration rates for the infiltration calculations.

(f) The minimum depth of soil required below the base of the infiltration system is to be 1m.

(g) The device is to be kept clear of large trees, stormwater flow paths, vehicle pathways or heavy traffic pedestrian areas.

(h) Sediment traps, vegetated filter strips or similar treatment systems are to be installed upstream to reduce sediment inputs and minimise likelihood of clogging.

(i) Distance from buildings and site boundaries must satisfy the minimum separations as indicated in Table 4, or as specified by a suitably qualified practitioner.

(j) Overflow discharges are to be directed to a swale, landscaping or a stormwater drain without affecting adjoining properties.

(k) Distance to footings given the soil infiltration shall comply with Table 5.

Table 5: Distance to Footings given the Soil Infiltration

Soil Type	Infiltration Rate	Distance to Footings / Site Boundaries
Sandstone	Assumed to be negligible	Do not infiltrate on these soils
Sand	>180 mm/hr	1 m
Sandy Clay	36-180 mm/hr	2 m
Medium Clay	3.6-36 mm/hr	4m
Reactive Clay	0.36 –3.6 mm/hr	5 m

3.1.2 Gravity system

Gravity systems allow for the discharge of stormwater from the site directly to the Council kerb or underground drainage system via gravity:

(a) Gravity systems are encouraged where feasible

(b) Gravity systems must be designed in accordance with *AS3500.3 – 2003 Plumbing and Drainage – Stormwater Drainage, and.*, installed and maintained in accordance with the WM Technical Guidelines.

3.1.3 Charged Systems

Where all reasonable efforts to establish a gravity drained system have been unsuccessful, charged (or pressure) lines may be permitted, subject to:

(a) Charged systems may be proposed for single dwelling residential development only.

(b) Charged systems being designed, installed and maintained in accordance with the WM Technical Guidelines.

(c) All gutters and pipes in the system must be designed for a 1 in 100 year ARI storm event;

(d) All gutters must have an overflow point or pressure relief to ensure that flooding within the roof cavity or eaves of a building does not occur;

(e) There must be a minimum difference in height between the roof gutter and the discharge pit at the property boundary of 1.8 metres;

(f) There must be a gravity flow across the footpath from an isolating pit within the property – this pit must be sealed with a bolt down lid;

(g) All services within the footpath must be located prior to submitting the plans and all details must be shown on the plans;

(h) All pipes must be a minimum of 90mm with all joints to be solvent welded;

(i) A cleaning eye must be provided at the low point in the system within a pit that can be drained to an onsite dispersal system;

(j) Gutter guards must be installed on all roof gutters to minimise debris entering the system;

(k) Normal On-site Stormwater Detention requirements will still apply.

3.1.4 Pump Systems

Pump systems are used where discharge from the site via gravity cannot be achieved.

A pump system will only be considered where the applicant can prove that all reasonable efforts have been made to implement a gravity drained system i.e. obtain an easement for downstream properties and / or that an alternative stormwater system has been investigated and deemed unsuitable.

Where a pump system is proposed as part of a development it shall comply with the following requirements:

(a) The pump system must be designed by a suitably qualified practitioner.

(b) As a minimum, the pump system must consist of one duty and one standby pump.

(c) The collection system for the pump system must be designed in accordance with the design criteria for gravity drainage and must incorporate adequate buffer storage as recommended by the pump manufacturer or a suitably qualified practitioner.

(d) Consideration of the consequences of a power failure must be made when sizing the buffer storage.

(e) The discharge rate from the site should not exceed the PSD. A full hydraulic design is required to determine the necessary storage requirements for a range of events up to and including the 1 in 100 ARI.

(f) It may be acceptable for the duty and standby pumps to function at the same time for storms in excess of the 1 in 100 ARI event or in the event of a blockage.

(g) The pump rising main must be installed in accordance with *AS3500 National Plumbing and Drainage Code*, other relevant codes for pressure pipe systems and the manufacturer's specification.

(h) Discharge from the system must pass through a stilling pit located within the site boundary prior to discharging to Council's drainage system.

(i) In some instances, connection to Council's kerb and gutter may be allowed, and a stilling pit will need to be provided within the site boundary prior to discharging to Council's kerb and gutter. If it is proposed to discharge to Council's kerb and gutter:

  (i) the pump must not operate continuously and;

  (ii) 3 hours must be allowed for the gutter to dry out between dry weather discharge events.

(j) Discharge from the site to Council's below ground drainage system must be protected by a non-return valve or flap located within the property.

(k) The pump must be located in an accessible and easily maintainable location.

(l) In the event of the failure of both the duty and standby pumps, an overland flow path and/or surcharge and pondage in a suitably visible area must be provided.

(m) In circumstances where no overland path exists, pondage may be approved in a suitable area. These areas must be sited with a view to minimising the cost of damage to occupiers of the property and include signage warning residents that inundation of the area may occur in the event of a pump failure.

(n) An audible alarm should be set to activate when water level in the storage area reaches a pre-determined level.

(o) The pump units selected should be suitable for stormwater containing silt and grit as a minimum with appropriate screening for small and large solids.

(p) Screening details must be provided. All electrical fittings and supply must be located to have at least 300 mm freeboard above the maximum water level and/or any overland flow paths.

(q) Where a pump system includes a significant portion of above ground storage, a means by which the pump rating can be locked to prevent adjustment of the site discharge will be required.

(r) The pump system and associated works must be installed, operated and maintained in accordance with development approval.

(s) Council officers may inspect the pump system at any time.

4.0 DESIGN PARAMETERS

4.1 Design rainfall intensity

Intensity-frequency-duration rainfall data collected by the Bureau of Meteorology for Waverley Bowling Club is used for all hydrological calculations in the Waverley LGA (refer Annexure A).

4.2 Design storms

A stormwater management system is to be installed on each new development to comply with Table 6.

Table 6: System Design Storm

Will water flow onto neighboring property if the system surcharges?	System design storm annual recurrence interval to adopt for design (ARI)
If yes	100 year
If no	20 year

4.3 Overland flow paths

(a) Overland flow paths are to be designed to provide a fail-safe system of drainage for all development. Overland flow paths are designed to function when the stormwater system fails (due to blockage or capacity constraints).

(b) Overland flow paths designed to contain a 1 in 100 year ARI storm flow are to be provided for all stormwater systems.

(c) Must comply with the velocity depth hazard requirements of the overland flow path (see Section 4.4.1 & 4.4.2);

(d) Minimum freeboard requirements will apply (see Section 4.5);

(e) Must be kept free of obstructions and must not be landscaped with loose material that could be removed during a storm event, such as wood chip or pine bark; and

(f) Overland flow paths must be provided in preference to the piping of major storm flows.

(g) Where an overland flow path cannot be provided, Council will permit the piping of flows up to the 100 year ARI. In such a case a blockage factor of 50% must be applied to all inlet pits and a hydraulic grade line analysis shall be submitted to Council for approval. A freeboard of 100mm shall be provided to the grate surface from the 100 year ARI predicted maximum water surface level within the pit.

4.4 Velocity depth hazard

During floods, the potential hazard to pedestrians can be expressed as the product of the velocity (m/s) times the depth (m), referred to as VxD product. A higher VxD product indicates an increased risk. To satisfy restrictions related to flood hazard, both the VxD product and limits to a maximum water depth should be observed. These limits must be strictly observed when designing overland flow paths on residential property developments.

4.4.1 Velocity x depth as a measure of hazard

(a) The peak velocity x depth product of stormwater runoff through areas accessible to children shall be kept below the limiting stability values provided in Table 7 below. Such areas include driveways, road gutters, car parking spaces, pathways and courtyards.

Table 7: Velocity depth ratios

Depth of Flow (m)	Limiting Stability Value of Velocity x Depth for 100 year ARI storm event
0.05 or less	0.15
0.1	0.22
0.2	0.29
0.3	0.33
0.4	0.35
0.5	0.33
0.6	0.31
0.7	0.26
0.8	0.16

(b) Suitable fences or other appropriate measures will need to be used to restrict access by children to areas where the peak velocity x depth product exceeds the limiting stability value.

(c) The velocity x depth limit may be increased up to a maximum of 0.40 for pedestrian areas not easily accessible to children.

4.4.2 Water depth as a measure of hazard

(a) The degree of hazard resulting from relatively deep, slow moving or still water depends upon the grades of the land adjacent to the water's edge, and progressing into deeper water.

(b) Acceptable water depths are outlined in Table 8. Child-proof fences shall be erected to restrict access where these criteria cannot be satisfied.

Table 8: Safe depth of flow for various approach grades

Approach Grade to Maximum Depth	Maximum Depth (m)
Greater than 1:5	0.3
1:5 to 1:15	0.8
Less than 1:15	No Maximum

4.5 Floor level control and freeboard levels

(a) For areas identified as potential stormwater ponding areas and water flow paths in ponding Areas Map (Annexure C), habitable floor levels must be set at a minimum of 300mm above the predicted design flood level.

(b) For all other areas, the habitable floor levels must be set at a minimum of 150mm above the level of adjacent ground.

4.6 Council easements and stormwater pipeline

Irrespective of whether an easement is registered over a Council below ground drainage system or not, if there is physical pipeline or other infrastructure in the ground, a number of building restrictions will apply to the property:

(a) Council will not approve the construction of any new structure over an existing below ground drainage system or within the confines of an easement. Council may, at its discretion, permit hard paving and or landscaping to be constructed over an easement or an existing below ground drainage system.

(b) The landscaping shall be restricted to ground covers and shrubs and shall not include trees. Any landscaping shall allow access to the below ground drainage infrastructure for future maintenance.

(c) Where a structure is within the zone of influence of the drainage infrastructure or easement then the structure shall be self supporting to allow for excavation of Council's pipe or land within the easement without the need to support any adjacent structures.

(d) The minimum width of a Council easement is to be 900mm

The zone of influence is to be defined as:

(a) Where Physical Infrastructure exists – the area 300mm below the underside of the infrastructure, extended to the easement boundaries and battered to the natural surface level, at the angle of repose, for the saturated in-situ soil. As a maximum the angle of repose shall be no steeper than 45 degrees.

(b) Where No Physical Infrastructure exists – the same definition for where physical infrastructure exists excepting that the underside of the infrastructure is to be assumed to be 1.5m below the existing natural surface level.

5.0 ON-SITE DETENTION (OSD)

On site detention systems ensure that stormwater flow from the site is temporarily detained on site and the discharge is restricted to a rate that can be accommodated by Council's existing stormwater drainage system.

5.1 General requirements

(a) An example OSD system Positive Covenant and Restriction as to User template is included as Annexure E.

(b) OSD storage must generally, be located as close as possible to the lowest point of the site and be designed to collect all piped and surface stormwater runoff from all impervious areas of the site. The location and design of the OSD storage must not have a detrimental impact on upstream or adjacent properties.

(c) Flows generated from adjacent properties that run onto the property must bypass the OSD system. This is to prevent flows, external to the site, entering the OSD storage, filling it more frequently with increased surcharging and nuisance to residents.

(d) OSD storage must be located above the 1 in 100 ARI floodplain and not be located in drainage easements and/or overland flow paths that convey flows from external catchments.

(e) The OSD structure must not be established across property boundaries.

(f) The catchment area used when determining the permissible site discharge (PSD) and OSD storage volume requirement shall include the entire site area not just the additional impervious area.

(g) All storage areas for multi unit and commercial developments must be located in common areas (not in private courtyards etc).

(h) The facility shall be designed to safely convey all possible overflows to an adequate Council street gutter or below ground stormwater drainage system.

(i) A spillway or overflow outlet is to be provided in all on-site stormwater detention systems as part of the operation of the system to cater for system failure or extreme storm events. This is to ensure that overflows are conveyed to the downstream drainage system and away from other property. Suitable armour is to be fixed over the overflow to protect the spillway.

5.2 Storage volume

(a) Detention systems may provide stormwater storage in the following ways:

  (ii) above ground in a grassed or landscaped area where it can be provided with minimal adjustment to ground levels and existing vegetation or in a shallow pond in a driveway or carpark;

  (iii) below ground in tanks or oversized pipes;

  (iv) as a combination of the above.

(b) The OSD storage volume requirement must allow for the detention of stormwater runoff resulting from a storm with an average recurrence interval (ARI) of:

  (i) 20 years where overland paths are not through private properties;

(ii) 100 years where overland paths are through private properties; or

(iii) 100 years where known flooding problems occur (at the discretion of Council).

(c) The Permissible Site Discharge (PSD) is limited to the maximum discharge from the site during a 1 in 5 year ARI storm event under the existing site conditions (pre-development).

5.2.1 Above ground storage

(a) Graded at a minimum of 1% to drain completely. Long term ponding of water over the floor of the basin will not be acceptable;

(b) Contain an overflow outlet with overflows directed away from private property;

(c) Contain an inspection/access grate 600 x 600mm directly over the outlet;

(d) Ponding depth to be less than 150mm in areas where vehicles will be parked and less than 200mm in other areas;

(e) Not restrict pedestrian access from the public road to buildings;

(f) Above ground storage facilities on surfaces other than paved driveways, when permitted by Council, should possess the following characteristics:

(i) the storage volume is to be increased by 20% to allow for the growth of vegetation and minor variations to the ground level that will occur as part of the general maintenance.

(ii) not restrict pedestrian access from the public road to buildings;

(iii) if an earth mound is used to retain the water, the minimum crest width is to be 1.0 metres wide;

(iv) if a structure other than earth mounds is to be used to retain water, it shall be certified by a suitably qualified practitioner to be structurally adequate to retain the design volume of water;

(v) designed in a manner which minimises inconvenience caused by the basin;

(vi) not be unsightly or hazardous; and

(vii) totally impermeable apart from infiltration into the ground.

(g) Be designed in a manner minimising inconvenience caused by the basin.

5.2.2 Below ground storage

(a) Be structurally designed to adequately withstand all service loads and provide adequate service life (50 years);

(b) Contain a minimum of two 600 x 600 mm access grates where the clear internal height of the tank is less than 600 mm and additional pits where required to ensure the distance between pits does not exceed 10 metres. This is to facilitate cleaning of the tank;

(c) A high level outlet is to be provided at the discharge control pit to cater for surcharge during major storm events

(d) A stainless steel or galvanised mesh screen (maxi-mesh RH3030 or equivalent), fitted with a lifting handle shall be provided.

(e) Contain step irons where the tank depth is in excess of 1.2 metres;

(f) Be located outside the root zone of trees that must be retained; and

(g) Have a child proof locking system for the surface grate where the depth of the tank is greater than 1.2 metres.

5.3 Permissible site discharge

The permissible site discharge (PSD) is limited to the maximum discharge from the site during the 1 in 5 year ARI for a 5 minute storm event under the existing site conditions (pre-development).

5.3.1 Discharge control using an orifice plate

The PSD can be regulated using an orifice plate. The cross sectional area of the orifice control is to be calculated as follows:

$$A_o = Q / C_d \sqrt{2gh} \ (m^2).$$

where A_o = Cross Sectional Area of orifice (m^2)

Q = Permissible Site Discharge (m^3/s)

C_d = Discharge Co-efficient = 0.6

g = Acceleration due to Gravity = 9.8 m/s^2

h = Head of Water (m) above the orifice, i.e. the vertical distance from the centre of the orifice to the maximum water storage level.

5.4 Calculation methods

OSD calculations are to be undertaken in accordance with The Mass Curve Method described in *Australian Rainfall and Runoff* (Institution of Engineers, 1987). Other methods including use of models such as DRAINS or RAFTS may be used.

5.5 Mandatory Information to be Provided - O.S.D Check List

The information requested in the On Site Detention check list is to be provided with the Stormwater Management proposal.

Failure to provide this information will render the submission incomplete.

WAVERLEY COUNCIL DEVELOPMENT APPLICATION - STORMWATER ON-SITE DETENTION CHECK LIST

DEVELOPMENT APPLICATION NUMBER IF KNOWN: _____

PROPERTY ADDRESS: _____

_____

STORMWATER PLANS DESIGNED BY:

CONTACT DETAILS (NAME & PHONE No.)

TOTAL SITE AREA: _____ m^2

TOTAL IMPERVIOUS AREA - PRE DEVELOPMENT: _____ m^2

TOTAL IMPERVIOUS AREA - POST DEVELOPMENT: _____

CALCULATED PERMISSIBLE SITE DISCHARGE: _____ l/s

METHOD OF STORMWATER DISPOSAL

☐ Gravity ☐ Infiltration

☐ Pump ☐ Charged Line

VOLUME OF RAINWATER TANK WITH PROVIDED: _____ m^3

UNCONTROLLED DISHARGE-

TOTAL AREA NOT DRAINING TO OSD TANK: _____ m^2

TOTAL IMPERVIOUS AREA NOT DRAINING TO OSD TANK: _____ m^2

IS UNCONTROLLED FLOW DIRECTED TO THE STREET YES / NO

OSD TANK DETAILS-

TOTAL AREA DRAINING TO OSD TANK: _____ m^2

TOTAL IMPERVIOUS AREA DRAINING TO OSD TANK: _____ m^2

PROPOSED VOLUME: _____ m^3

IS OVERFLOW FLOW DIRECTED TO THE STREET YES / NO

FOR GRAVITY / CHARGED SYSTEMS-

ORIFICE PLATE DIAMETER: _____ mm

DEPTH FROM TOP WATER LEVEL TO CENTRE OF ORIFICE: _____ mm

FOR PUMP SYSTEMS-

PUMP CAPACITY (per Pump): _____ l/s

INFILTRATION SYSTEM-

IS LOCATION FOUND WITHIN THE INFILTRATION ZONE: YES / NO
(ANNEXURE B WATER MANAGEMENT TECHNICAL GUIDELINES)

INFILTRATION RATE OF THE SOIL _____ l/s
(AS CONFIRMED BY CURRENT GEOTECHNICAL REPORT)

VOLUME OF INFILTRATION PIT: _____ m^3

CALCULATED TOTAL SITE DISCHARGE RATE: _____ l/s
(CONTROLLED + UNCONTROLLED FLOW RATE)

6.0 ROOFWATER HARVESTING

Roofwater harvesting systems keep the rainwater on site (retained) to be reused again for such things as irrigation, toilet flushing etc

Maximising the use of rainwater reduces the water level inside the tank in order to capture the greatest amount of water possible at the time of a rainfall event, and reduces overflow from the rainwater tank to the stormwater system. Harvested roofwater is to be used for:

(a) Toilet flushing water;

(b) Laundry washing water;

(c) Outdoor water uses such as garden watering and car washing;

(d) Topping up and/or filling up pools and spas; or

(e) As specified by BASIX.

6.1.1 Installation requirements

Any rainwater tank that is to be installed in the Waverley LGA must comply with the following installation requirements:

(a) all rainwater tanks must be installed in accordance with the manufacturer's recommendations;

(b) rainwater tank installation must be undertaken in accordance with relevant Australian Standards, Cords and Industry Guidelines (e.g. *AS3500:2003 National Plumbing and Drainage*, *HB 230-2006 Rainwater Tank Design and Installation Handbook*);

(c) the system must be designed to collect roof water only. Roofwater shall not be sourced from roofs coated with lead or bitumen-based paints, or from asbestos-cement roofs;

(d) be fitted with a first flush device to prevent potential contaminants from entering the tank;

(e) if supply is supplemented with a top up system by interconnection with a reticulated water system, backflow prevention must be provided in accordance with *Australian Standard AS 3500.1.2 (2003)* or subsequent update;

(f) the tank must be enclosed and inlets screened, so as to prevent the entry of foreign matter and to prevent mosquito breeding;

(g) tank overflow must be connected to a detention/infiltration device, stormwater drain such that it does not cause nuisance to neighboring properties;

(h) all fixtures connected to the supply system are marked 'RAINWATER';

(i) above ground tanks must be located wholly within the building setbacks.

(j) above ground tanks shall not require excavation of more than 1 metre from natural ground level to be installed;

(k) below ground tanks may be located outside the building setback provided they are not visible from the street and do not rise above the surrounding ground. The tank must not be installed within the zone of influence of any foundation of any structure (or a minimum of three metres) unless the tank design is certified by a suitably qualified practitioner;

(l) all roofwater pipe designs shall ensure that an overflow point located lower than the gutters is provided to ensure that flooding of eaves from gutters overflowing does not occur;

(m) all below ground tanks must have sufficient means in place to prevent the backflow of stormwater from the street system into the tank during a storm event;

(n) all below ground tanks must be 100% water tight and fully sealed to prevent any ingress of groundwater. All tank openings must be located so that debris and groundwater does not enter the tank;

(o) the tank shall not exceed a height of 2.0 metres from ground level (including the stand for the tank);

(p) the tank shall be located at least 450mm from any property boundary;

(q) pumps are to be covered or screened to avoid noise nuisances to neighbouring properties;

(r) pumps are to comply with *NSW Department of Environment and Conservation (DEC) (2004) Noise Guide for Local Government*;

(s) maintain pressure levels in the pressure vessels to minimise noise disturbance to neighbouring properties;

(t) the tank is to be maintained by the property owner to ensure adequate functioning and compliance with accepted health requirements including *NSW Health Guidelines GL2005-033 Rainwater Tanks where a reticulated potable water supply is available*;

(u) all plumbing work shall be undertaken by a licensed plumber; and

(v) the installation shall comply with Sydney Water requirements. See *http://www.sydneywater.com.au/sw/plumbing-building-developing/plumbing/rainwater-tanks/index.htm Maintenance*

Recommended maintenance requirements include:

(a) Regular maintenance of first flush diverters by removing the filter screen in the bottom of the diverter and cleaning. The drip outlet should be monitored for the first 3 rainfall events and adjusted to ensure the diverter is completely drained over a 24 hour period;

(b) Annually check performance of the float valve or switch assembly to ensure correct operation at bottom water level as specified;

(c) Check the tank overflow outlet every six months to ensure that it is clear of weeds/sediment and other debris;

(d) Regularly clean roof gutters to remove leaves, sediment and other debris;

(e) The accumulation of sludge at the bottom of the rainwater tank should be checked every two years. The removal of which may be required about once every ten years depending on the amount of sediment entering the tank. This can be undertaken by either pumping or siphoning the sludge or the tank can be drained and then cleaned; and

(f) The required frequency of cleaning will depend upon several factors such as local environmental conditions, the condition of the tank inlet and regular performing of other maintenance duties by the owner.

Note: tanks are considered confined spaces. Access within the tank is to be restricted to personnel with confined spaces training.

7.0 STORMWATER HARVESTING AND RE-USE

It is recommended that development applications for stormwater harvesting and re-use refer to *Managing Urban Stormwater – Harvesting and Re-use* (Department of Environment and Conservation 2006) and the *ANZECC and ARMCANZ Australian and New Zealand Guidelines for Recreational Water Quality and Aesthetics*. Further Government guidelines are currently under development.

Development applications for stormwater harvesting and re-use may be assessed in consultation with the relevant government agencies.

8.0 PERMEABLE SURFACES/PAVING

Permeable paving is an alternative to typical impermeable paving. It allows runoff to percolate through to an underlying reservoir for temporary storage until the water is either re-used, infiltrates into the ground or discharges to the stormwater system. Permeable paving provides a number of functions including:

(a) Removing some sediments and attached pollutants by infiltration through an underlying sand/gravel layer;

(b) Reducing runoff volumes (by infiltration to the sub-soils); and

(c) Delaying runoff peaks by providing retention/detention storage capacity and reducing flow velocities.

Commercially available permeable pavements include pervious/open-graded asphalt, no fines concrete, modular concrete blocks and modular flexible block pavements.

9.0 STORMWATER QUALITY

9.1 During construction

Erosion and sedimentation control measures are to be installed and maintained until construction activities have been completed and the site is fully stabilised.

Depending on the extent of disturbed area, one of the following plans to manage erosion and sedimentation must be submitted with the development application.

9.1.1 Basic controls plan

(a) For small areas of disturbance (i.e. <250m^2 of disturbed area), Council requires at least a hand marked up plan of proposed works and control measures (for example, refer to Annexure D).

(b) Basic erosion and sediment controls should be put in place in accordance with the "Blue Book" (Landcom, 2004).

9.1.2 Erosion and sediment control plan (ESCP)

(a) For disturbed areas between 250m^2 and 2,500m^2, an ESCP must first be prepared for approval and then executed in accordance with the requirements of the Blue Book.

(b) All ESCPs should show:

(i) Site layout;

(ii) Approximate location of best management practices (i.e. programs, systems or structures used to mitigate or prevent pollution of receiving waters) where appropriate;

(iii) Where drawings are to scale, show scale at 1:500 or larger;

(iv) Narrative describing how erosion control and soil and water management will be achieved on site, including ongoing maintenance of structures;

(v) Location of site boundaries and adjoining roads;

(vi) Approximate grades and indications of direction(s) of fall;

(vii) Approximate location of trees and other vegetation, showing items for removal or retention;

(viii) Location of site access, proposed roads and other impervious areas (e.g. parking areas and site facilities);

(ix) Existing and proposed drainage patterns with stormwater discharge points; and

(x) North point and scale (if to scale).

(c) On the drawing or in a separate commentary, show how the various soil conservation measures will be carried out on site, including:

(i) Timing of works;

(ii) Locations of lands where a protective ground cover will, as far as is practicable, be maintained;

(iii) Access protection measures;

(iv) Nature and extent of earthworks, including the amount of any cut and fill;

(v) Where applicable, the diversion of runoff from upslope lands around the disturbed areas;

(vi) Location of all soil and other material stockpiles including topsoil storage, protection and reuse methodology;

(vii) Location and type of proposed erosion and sediment control measures;

(viii) Site rehabilitation proposals, including schedules;

(ix) Frequency and nature of any maintenance program;

(x) Other site-specific soil or water conservation structures.

9.1.3 Soil and water management plans (SWMP)

(a) For disturbed areas >2,500m^2, a SWMP must first be prepared for approval and then executed in accordance with the requirements of The Blue Book. In addition to the data requirements for an ESCP (as listed above), further data requirements for the SWMP include:

(i) Location of lots, public open space, stormwater drainage systems, nearby schools, shopping/community centres (to assess potential public safety risk);

(ii) The location of land designated or zoned for special uses;

(iii) Existing site contours (recommended contour interval is 0.5m on gradients of <15%, 1 metre on gradients of 15 to 30% and 2 metres for slopes >30%);

(iv) All necessary erosion and sediment control best management practices (BMPs) (location and general diagrammatic representations);

(v) Location and engineering details with supporting design calculations for all necessary sediment basins. This must include soil testing to determine the type of basin required and whether flocculation will be required;

(vi) Location and basic details of any other facilities proposed to be included as part of the development or works such as:

- constructed wetlands
- gross pollutant traps
- trash racks or trash collection/separator units
- "water sensitive" stormwater treatment measures such as bioretention systems,
- vegetated swales and infiltration measures

(vii) Inspection and Test Plans (ITPs) should be presented as an element of the SWMP identifying:

- the activity to be undertaken
- the standard or specification compliance that is being sought
- the relevant acceptance criteria the method of inspection and/or test and the frequency at which it is to be performed
- who is responsible for carrying out the inspection and/or test
- what documentation is to be produced as a record of the inspection and/or test

(viii) Any "witness" or "hold points" required during the works should be identified.

(b) The procedures for preparing the SWMPs are set out in the manual prepared by the NSW Department of Housing *'Managing Urban Stormwater, Soils and Construction'* and must be prepared by a suitably experienced person.

9.1.4 Additional notes

(a) All material deliveries and waste collection should occur on-site. A lease is required from Council prior to storing materials or waste on the footpath.

(b) Waste water cannot be discharged to the stormwater system unless it is visually free from grease, oil, solids and unnatural discolouration and free from settleable matter under the *Protection of the Environment Operations Act 1997*.

(c) Sediment laden runoff from excavations must be first pumped to an adequately sized sediment basin and treated before discharge.

(d) Where non-compliant water is to be pumped from a site, a Trade Waste Permit must be obtained from Sydney Water to dispose of it to the sewer.

(e) A copy of the SWMP plan must be kept on the site at all times and be provided to Council Officers on request.

9.2 Stormwater treatment design measures

Council strongly encourages that stormwater treatment measures as outlined in the 'Managing Urban Stormwater: Treatment Techniques' (NSW EPA 1997) be incorporated into the design of a development.

10.0 SEEPAGE WATER, DEWATERING, GROUNDWATER EXTRACTION AND USE

Seepage water is water percolating through the soil and along rock strata.

Dewatering is the process of removing groundwater from the soil to lower the level of the water table in the area.

Groundwater is water that exists beneath the surface of the property in underground streams and aquifers.

10.1 Seepage

Seepage water from basement car parks and sub surface flows from structures that intersect high ground water flows:

(a) Shall be harvested and reused on site; or

(b) Piped to the underground stormwater drainage system. Piped connections to Council's kerb are not permitted.

(c) A pump system may be allowed to remove the seepage water from the site.

(d) A suitably qualified practitioner must provide an estimate of the expected seepage or sub-surface flow rate, for the development for use in the design.

10.2 Dewatering

Temporary dewatering involves the removal of groundwater from the site to enable construction works to be undertaken.

Permanent dewatering involves the continual removal of groundwater from the site after construction works have been completed.

10.2.1 Information Requirements

If a proposal involves temporary or permanent dewatering then approval from the relevant NSW Government department will need to be obtained and the development will be considered an integrated development.

The following information shall be supplied to Council for all dewatering proposals. Council will forward the information onto the relevant NSW Government department:

(a) The proposed method of construction;

(b) The method of dewatering, e.g. pumping from the excavation or a battery of spearpoints around the perimeter of the development site;

(c) A plan to scale showing accurately the location of the work(s) in relation to portion and property boundaries;

(d) The amount of lowering of the local water table proposed;

(e) An estimate of the total volume of groundwater to be pumped from the site (number of kilolitres/megalitres) as well as the instantaneous pumping rate (litres per second) and duration (number of days/weeks/months);

(f) Prediction of the impacts of the extraction on any licensed groundwater users or groundwater dependent ecosystems;

(g) An assessment of the quality of the groundwater including advice on the presence of any contaminants, testing in a NATA registered laboratory is required;

(h) The method of disposal of the tailwater e.g. via street drainage to stormwater system (if so, whether this method of disposal is acceptable to the relevant authority);

(i) The compatibility of pumped water and intrinsic groundwater if reinjection is proposed, including advice on the treatment to be applied to remove extant contamination;

(j) Geotechnical report identifying risks of off-site impact as a result of the proposed dewatering, i.e. cracks in surrounding buildings or infrastructure as a result of differential sediment compaction and surface settlement following pumping;

(k) Treatment/screening; and

(l) Hydrogeological and/or geotechnical reports prepared for the development site in support of the Development Application and application for a bore licence.

10.3 Groundwater Extraction & Use

Groundwater is a potential alternative water source provided it is utilised in a safe and sustainable manner. However, groundwater can be readily contaminated from a variety of sources in urban areas.

10.3.1 Investigations

It is recommended that groundwater investigations, including sampling and testing, be undertaken by a suitably qualified practitioner. Investigation requirements include:

(a) Consult local soils (including Acid Sulphate Soils) and geology maps.

(b) Undertake a visual historical (recommended 40-60 years) aerial photographic analysis to determine past and present land use, noting any significant land use changes (i.e. removal of vegetation, industry location) that may have affected groundwater in the area.

(c) Contact the relevant NSW Government department to identify registered bores in the area.

(d) Contact the relevant NSW Government department and request an assessment of local groundwater conditions (i.e. groundwater flow direction, known sustainable yield capacity etc.).

(e) Undertake a thorough site inspection.

(f) Verify any known groundwater bores. If any unknown bores are located during site investigation, contact the relevant NSW Government department so the bore can be recorded.

(g) Undertake an assessment of sustainable yield

(h) Undertake water quality sampling against ANZECC guidelines for recreation/irrigation.

(i) Verify any known or likely locations of Acid Sulphate Soils or other contaminated lands.

(j) Undertake an assessment of potential drawdown of known surrounding bores.

(k) Where relevant, assess groundwater dependent ecosystems.

(l) Identify bore drilling costs and design.

10.3.2 Installation

Recommended groundwater bore installation checklist for proponents:

10.3.3 Before commencing work

(a) Development consent obtained from Council.

(b) Bore licence obtained

(c) Below ground services locations checked (call 1100)

(d) Drillers licence viewed, classification appropriate

10.3.4 During work

(a) Bore designed and constructed in accordance with *Minimum Construction Requirements for Water Bores in Australia - 2nd Edition.*

(b) Water quality sample collected *

(c) Tailwater (discharge water) controlled on-site and disposed of appropriately.

10.3.5 After completing work

(a) 'Form A – Particulars of Completed Work', completed and signed and copy forwarded to the relevant NSW Government department office.

(b) Water quality sample submitted to NATA registered laboratory and copy of results forwarded to the relevant NSW Government department office.

(c) Bore hydraulic testing carried out in accordance with *AS2358-1900 Test Pumping of Water Wells*.

(d) Bore decommissioned in accordance with *Minimum Construction Requirements for Water Bores in Australia – 2nd Edition* if decision is made to abandon the work.

* It is recommended that the natural background levels of the groundwater be tested against the appropriate guidelines such as the **ANZECC and ARMCANZ *Australian and New Zealand Guidelines for Recreational Water Quality and Aesthetics* or based on independent consultant's advice**. Follow up testing (e.g. seasonal testing) should be undertaken to ensure that the groundwater resource is not deteriorating in quality or quantity.

11.0 GREYWATER RE-USE

Greywater is increasingly recognised as a water resource for household use. Greywater reuse can have significant health and environmental risks and must be managed appropriately.

11.1 Health and environmental risks of greywater

Greywater contains a variety of types and concentrations of waste materials that pose risks to human health and the environment. A brief summary of greywater characteristics is outlined below in Table 9.

Table 9: Summary of Greywater Characteristics

Greywater Sources	Physical pollution	Chemical pollution	Microbial contamination
Kitchen	Heavily polluted with physical materials, such as particulate matter, food scraps, fats and oils	Polluted with detergents and household chemicals. Possibly highly alkaline and high in phosphorous	High in microbiological organisms which may be pathogenic (disease carrying).
Laundry	Polluted with lint and particulate matter	Possibly high in salts, phosphates, nitrates and ammonia.	High level of microbial organisms if used for nappy washing, or from first rinse. Second rinse is cleaner.
Bathroom (shower/hand basin only)	Polluted with particulate matter, hair and skin.	Contaminated with soaps, shampoo, toothpaste and hair dyes	Microorganism count can be high. Urine may be present, but transmission of infectious organisms is remote.

High levels of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in greywater have the potential to cause anaerobic conditions resulting in offensive odours. Nutrients (phosphates, nitrates and ammonia), salts and other chemicals disposed of in greywater have significant impacts on the environment, including ecological impacts such as contamination of waterways and groundwater and detrimental impacts on organisms and their habitat. High nutrient loads and water loads can create advantageous conditions for weed invasion. Additionally, high levels of salts can prevent plant growth and destroy soil structure, leading to loss of water holding capacity and leaching of organic matter.

The minimum levels of treatment and appropriate end users are shown in Table 10.

Table 10: Minimum Treatment Levels and Suitable Greywater Reuse Application

Application	Treatment System	Treatment Level
▪ sub-surface irrigation	Greywater diversion device	Coarsely filtered untreated greywater (excluding kitchen greywater)
▪ sub-surface irrigation ▪ surface irrigation	Greywater treatment system	Treated and disinfected greywater ▪ 20 mg/L BOD5 ▪ 30 mg/L SS ▪ 30 cfu/ 100mL thermotolerant coliforms
▪ sub-surface irrigation ▪ surface irrigation ▪ toilet flushing ▪ laundry use	Greywater treatment system	Treated and disinfected greywater ▪ 20 mg/L BOD5 ▪ 30 mg/L SS ▪ 10 cfu/100mL thermotolerant coliforms

Note: Greywater sourced from laundry systems may contain high concentrations of salt. Utilisation of low salt laundry detergent or occasional discharge to the sewer may be required in order to prevent build up of salt concentrations.

General installation, operation and maintenance requirements for greywater diversion devices and greywater treatment systems are outlined in Table 11.

Table 11: Greywater Installation, Operation and Maintenance Requirements.

Requirement	Manual Greywater Bucketing	Greywater Diversion Device		Greywater Treatment System			
		Gravity Diversion Device	Pump Diversion Device	Single Dwellings	Land Application	Multi-Unit Dwellings	Commercial & Industrial Sites
Must comply with Council approval		Council approval required if NOT compliant with *Local Government (General) Regulation 2005 (75A)*	Council approval required if NOT compliant with *Local Government (General) Regulation 2005 (75A)*	✓	✓	✓	✓
Must be installed by a licensed plumber		✓	✓	✓	✓	✓	✓
Must comply with Sydney Water requirements	✓	✓	✓	✓	✓	✓	✓
Approved Types		WaterMark Licensed Device (formerly a Plumbing Safety License) & NSW Health listed	WaterMark Licensed Device (formerly a Plumbing Safety License) & NSW Health listed	NSW Health Greywater Treatment System Certificate of Accreditation	NSW Health Greywater Treatment System Certificate of Accreditation	NSW Health Greywater Treatment System Certificate of Accreditation	NSW Health Greywater Treatment System Certificate of Accreditation
Must comply with government policy	*'Guidelines for Greywater Reuse in Sewered Single Household Residential Premises'* (NSW DEUS 2007)	*'Guidelines for Greywater Reuse in Sewered Single Household Residential Premises'* (NSW DEUS 2007)	*'Guidelines for Greywater Reuse in Sewered Single Household Residential Premises '*(NSW DEUS 2007) *'On-site Sewage Management for Single Households'* (Environment & Health Protection Guidelines 1998)	'*Greywater Re-use in Sewered Single Domestic Premises*' (NSW Health 2000) *'On-site Sewage Management for Single Households'* (Environment & Health Protection Guidelines 1998)	'*Use of Effluent by Irrigation'* (NSW DEC 1998)	*'Greywater and Sewage Recycling in Multi-Unit Dwellings and Commercial Premises - Interim Guidance*' (NSW Health Department Circular 2005)	*'Greywater and Sewage Recycling in Multi-Unit Dwellings and Commercial Premises - Interim Guidance*' (NSW Health Department Circular 2005)

11.2 Manual bucketing

Small quantities of greywater (sourced from shower and laundry water) may be manually utilized (using a bucket or similar) to irrigate gardens, lawns and outdoor pot plants.

11.3 Greywater diversion devices

Greywater Diversion Devices (GDD) must divert all greywater to a subsurface irrigation system. GDD include gravity diversion devices and pump diversion devices.

To find out if you need to submit a development application to Council refer to Part G4 – Water Management in Waverley DCP 2006. The following applies to all greywater diversion devices:

(a) Greywater must be used immediately and not stored.

(b) Must be installed, operated and maintained in accordance with the requirements outlined in Table 11.

(c) Reuse of greywater using a diversion device is only permitted for single residential dwellings.

11.3.1 Gravity diversion devices

A gravity diversion device incorporates a hand activated valve, switch or tap which is fitted to the outlet of the waste pipe of the plumbing fixture such as a laundry tub.

Gravity diversion devices must not be installed above the “S” bend on any plumbing fitting as this would allow sewer gases to enter the home with potentially fatal consequences.

11.3.2 Pump diversion devices

A pump diversion device incorporates a surge tank to cope with sudden influxes of greywater for distribution by a pump to a sub-surface land application system.

(a) Kitchen greywater is not suitable for collection in a pump diversion device because it will clog the device with fats, oils and food particles. Residues in the device cause foul odours and provide attraction for vermin.

(b) The surge tank must not operate as a storage tank.

(c) The greywater should be screened as it enters a surge tank for distribution by a pump to the sub-surface land application system.

11.4 Greywater treatment systems

A greywater treatment system collects, stores, treats and may disinfect all or any of the sources of greywater. The following applies to all greywater treatment systems:

(a) An example greywater treatment system Positive Covenant template is included as Annexure F.

(b) Must be installed, operated and maintained in accordance with the requirements outlined in Table 11. Note that the NSW Government greywater policy and regulatory framework is currently under review.

(c) A development application is required by Council to install and operate a greywater treatment system.

(d) It is not permissible to store untreated or raw greywater for greater than 24 hours before treatment.

(e) An environmental health risk assessment may be required where there are potential public health risks.

(f) An overflow to the Sydney Water sewerage system must be maintained at all times to enable the grey water device to be maintained or turned off if required. In this regard, Council may require an emergency contact in case of malfunction.

(g) Any grey water treatment system must be approved by NSW Health.

(h) All plumbing and drainage must be undertaken in accordance with Sydney Water requirements.

(i) Cross connection control and backflow prevention with the potable reticulated water supply must be installed in accordance with Sydney Water requirements.

(j) A strategy to demonstrate effective performance of the greywater treatment system must be submitted with the development application.

(k) Owners must arrange for annual inspections to be undertaken by the manufacturer to ensure that the greywater treatment system is working in accordance with NSW Government requirements. This will be undertaken at the owners' expense.

(l) A greywater system may be inspected by an appropriate Council officer at any time.

11.4.1 Single dwellings

Domestic greywater treatment systems (DGTS) for single dwellings:

(a) Are permitted on single premises of a domestic nature normally occupied by less than 10 persons or have an average daily flow of sewage of less than 2,000 litres.

(b) Require a NSW Health Certificate of Accreditation.

11.4.2 Multi-unit dwellings

Applies to greywater recycling systems with a processing capacity of less than 2,500 persons equivalent capacity or 750 kilolitres per day. A system that exceeds this processing capacity or volume, and that involve the discharge of wastes or by-products to land or waters are subject to the NSW Government requirements under the Protection of the Environment Operations Act 1997.

11.4.3 Commercial and industrial settings

Greywater and sewage recycling systems in commercial and industrial settings will be assessed on a merit basis in accordance with current government policy and in consultation with relevant government agencies.

11.4.4 Land application system

A land application system is the area to be used, either for sub-surface or surface irrigation of treated or untreated greywater.

An assessment of the potential for groundwater contamination must be submitted with the development application. A long term decline in the ground water quality will not be accepted.

11.4.5 Miscellaneous reuse

Council will consider other proposals for greywater re-use (e.g. re-use on playing fields, reuse of swimming pool back wash, and reuse of water in cooling towers) on a merit basis, in consultation with relevant government agencies.

12.0 BLACKWATER RE-USE

Blackwater reuse can have significant health and environmental risks and must be managed appropriately.

(a) An example blackwater treatment system Positive Covenant template is included as Annexure G.

(b) Blackwater treatment systems must be NSW Health Accredited.

(c) Must be installed, operated and maintained in accordance with the requirements outlined in Table 12. Note that the NSW Government blackwater policy and regulatory framework is currently under review.

Table 12: Blackwater Policy Requirements

Single Dwelling	Land Application System	Multi-Unit Dwellings	Commercial and Industrial Sites
'Environment and Health Protection Guidelines: On-site Sewage Management for Single Households' (NSW DLG 1998)	*'Environmental Guidelines: Use of Effluent by Irrigation' (*NSW DEC 2004) *'Effluent Treatment Standard Required for Land Application Systems: Advisory Note 4 – Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission'* (NSW Health 2006)	*'Interim Guidance for Greywater and Sewage Recycling in Multi-Unit Dwellings and Commercial Premises'* (NSW Health 2004) *'Draft Management of Private Decentralised Recycled Water Systems Regulatory Framework'* (NSW DEUS 2006)	*'Interim Guidance for Greywater and Sewage Recycling in Multi-Unit Dwellings and Commercial Premises'* (NSW Health 2004) *'Draft Management of Private Decentralised Recycled Water Systems Regulatory Framework' (*NSW DEUS 2006)
'National Water Quality Management Strategy Guidelines for Water Recycling: Managing Health and Environmental Risks' (EPHC-NRMCC 2006)	*'National Water Quality Management Strategy Guidelines for Water Recycling: Managing Health and Environmental Risks'* (EPHC-NRMCC 2006)	*'National Water Quality Management Strategy Guidelines for Water Recycling: Managing Health and Environmental Risks'* (EPHC-NRMCC 2006)	*'National Water Quality Management Strategy Guidelines for Water Recycling: Managing Health and Environmental Risks'* (EPHC-NRMCC 2006)

(d) A water meter must be installed at the discharge point of the STP to monitor daily wastewater loads.

(e) It is recommended that two flow meters (or a tipping bucket for the sewer) be installed to measure effluent volumes, one on the effluent irrigation line and one on the overflow to the sewage system. These meters must be:

(i) read and recorded quarterly; and

(ii) analysed by the manufacturer in accordance with the monitoring regime outlined in 12(i) to ensure the system is adequate to treat effluent volumes being produced.

(f) A dedicated pipe to remove sludge must be:

(i) installed and fitted at the base of the waste treatment tank;

(ii) no higher than 150mm from the base and running to the front of the house;

(iii) no further than 0.5m from the front boundary alignment; and

(iv) fitted with an airtight Kamlock, or similar, to enable sludge to be removed by pump out vehicles as needed or required by Council.

(g) The overflow from the waste system shall be and remain connected to the existing mains sewage system.

(h) Should the system fail to remove sludge or should the irrigation water quality not meet the required standards then Council may, at its discretion, direct the owner to:

(i) cease using the system; and

(ii) direct all sewage to the existing mains sewer; and

(iii) to completely remove all sludge and sewage from the waste system.

(i) Owners must arrange for monitoring to be undertaken by the manufacturer to ensure that the blackwater treatment system is working in accordance with the target effluent quality outlined in Table 13. Quarterly monitoring must be undertaken for the first 12 months and, subject to the results being to the satisfaction of Council, annual monitoring thereafter. This will be undertaken at the owners' expense.

Table 13: Blackwater system monitoring targets

Parameter for monitoring	Target
BOD5	< 10 mg/L
Suspended Solids	< 10 mg/L
pH	6.5 to 8.5
Total Nitrogen	< 15 mg/L
Total Phosphorus	< 5 mg/L
Total Coliforms	< 10 cfu/100 mL

(j) Monitoring data, including copies of the laboratory results, must be provided to Council. A copy of each result must be kept on site in chronological order in a bound, waterproof site book which is kept in a weatherproof cabinet located externally to the dwelling within 5 metres of the blackwater treatment system and accessible to Council Officers for inspection.

13.0 REFERENCES

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Standards Australia (1997) Australian Standard: *Installation of UPVC Pipes AS 2032:1997*

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URS Australia (2004) *Water Sensitive Urban Design Technical Guidelines for Western Sydney.*

14.0 ANNEXURE A - INTENSITY FREQUENCY DURATION DATA

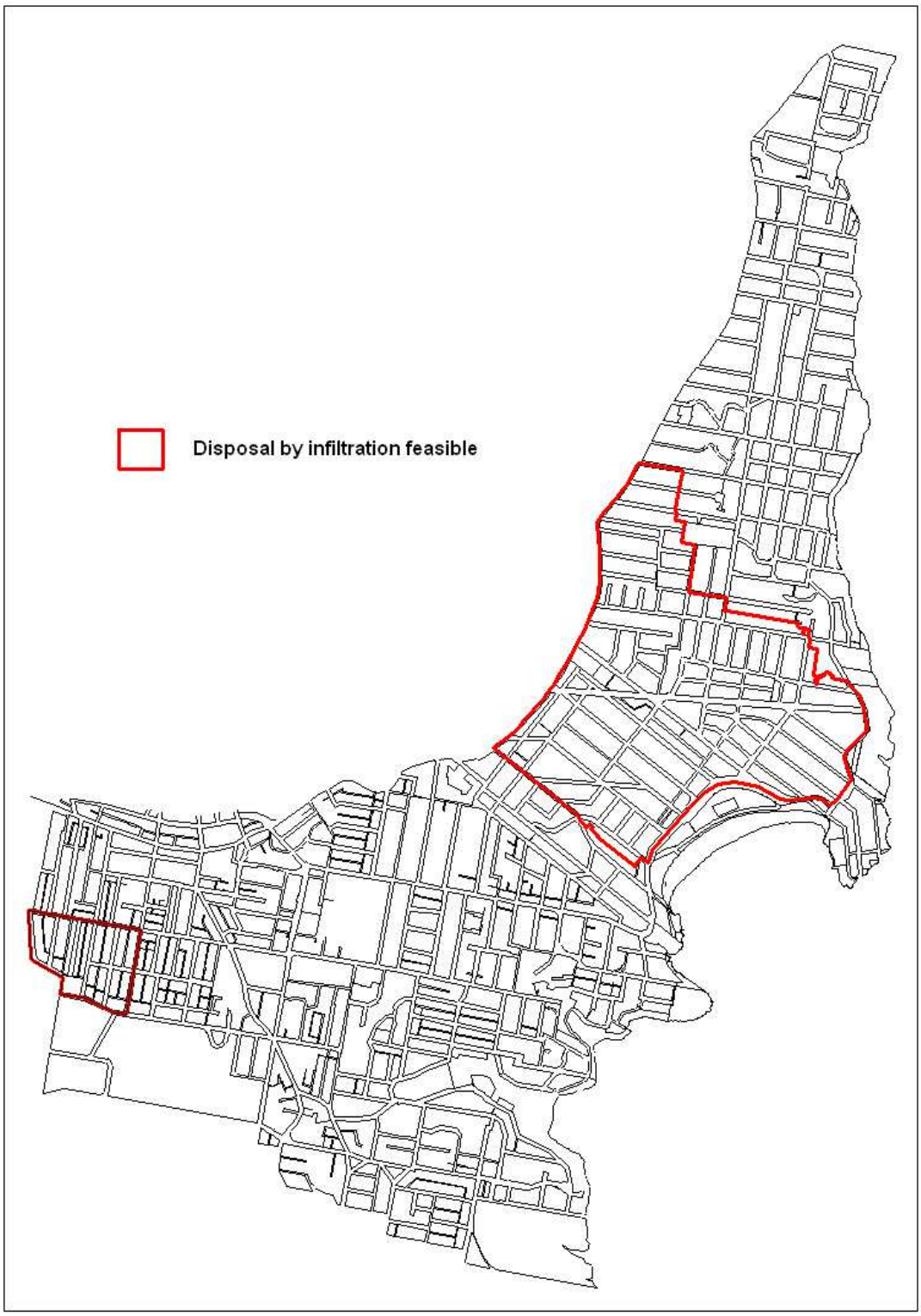
TITLE: Waverley Bowling Club DATE: 05/05/99

Site data: 2I1=42.5 2I12=8.22 2I72=2.50 50I1=88.1 50I12=16.6
50I72=5.03 REGSKEW=0.00 F2=4.29 F50=15.86 C10=0.81

Storm Duration		Average Storm Recurrence Interval (years) Rainfall Intensities in millimetres/hour						
		1	2	5	10	20	50	100
2	min	138.41	175.87	218.47	242.16	274.50	316.08	347.23
3		123.20	156.82	195.73	217.50	247.04	285.11	313.69
4		112.59	143.51	179.77	200.15	227.70	263.26	289.99
5		104.49	133.34	167.54	186.82	212.81	246.41	271.70
6		98.04	125.23	157.76	176.15	200.88	232.89	257.01
7		92.60	118.39	149.48	167.11	190.76	221.41	244.52
8		87.94	112.52	142.37	159.34	182.05	211.51	233.75
9		83.88	107.41	136.16	152.54	174.43	202.85	224.31
10		80.37	102.97	130.76	146.63	167.80	195.30	216.09
11		77.25	99.04	125.97	141.38	161.90	188.58	208.76
12		74.34	95.36	121.48	136.45	156.36	182.27	201.87
13		71.77	92.12	117.52	132.09	151.46	176.68	195.78
14		69.44	89.18	113.92	128.14	147.01	171.60	190.23
15		67.27	86.42	110.54	124.43	142.83	166.83	185.02
16		65.30	83.94	107.49	121.07	139.05	162.50	180.29
17		63.46	81.61	104.63	117.92	135.50	158.45	175.86
18		61.81	79.52	102.06	115.09	123.31	154.79	171.86
20		58.70	75.58	97.21	109.73	126.27	147.87	164.29
25		52.54	67.76	87.54	99.06	114.20	134.04	149.13
30		47.81	61.74	80.08	90.79	104.84	123.28	137.34
35		44.07	56.99	74.16	84.23	97.41	114.72	127.94
40		40.99	53.07	69.26	78.78	91.22	107.59	120.10
45		38.42	49.79	65.15	74.20	86.02	101.59	113.50
50		36.25	47.01	61.66	70.32	81.61	96.48	107.88
60		32.69	42.47	55.94	63.93	74.32	88.05	98.58
90		25.20	32.71	43.00	49.10	57.03	67.51	75.54
2	hours	20.87	27.08	35.55	40.56	47.09	55.71	62.30
3		15.95	20.68	27.10	30.89	35.84	42.35	47.34
4		13.17	17.07	22.33	25.44	29.49	34.83	38.91
4.5		12.17	15.77	20.63	23.49	27.23	32.15	35.91
6		10.05	13.01	17.00	19.34	22.41	26.44	29.52
9		7.68	9.94	12.96	14.73	17.05	20.10	22.43
12		6.35	8.22	10.70	12.15	14.06	16.56	18.47
14		5.77	7.46	9.71	11.03	12.76	15.03	16.77
16		5.31	6.87	8.94	10.15	11.74	13.83	15.43
18		4.93	6.38	8.30	9.43	10.91	12.85	14.33
20		4.62	5.97	7.77	8.83	10.21	12.03	13.42
22		4.35	5.62	7.32	8.31	9.61	11.32	12.63
24		4.12	5.32	6.93	7.87	9.10	10.72	11.95
30		3.56	4.60	5.98	6.80	7.86	9.26	10.32
36		3.16	4.09	5.32	6.04	6.99	8.23	9.17
48		2.60	3.36	4.38	4.97	5.75	6.77	7.55
60		2.22	2.87	3.73	4.24	4.90	5.77	6.43
72		1.93	2.50	3.25	3.69	4.27	5.03	5.61

Note: The above rainfall intensities were derived using the procedures described in Chapter 2 of the Institute of Engineers Australia, publication, 'Australian Rainfall & Runoff', 1987 ed.

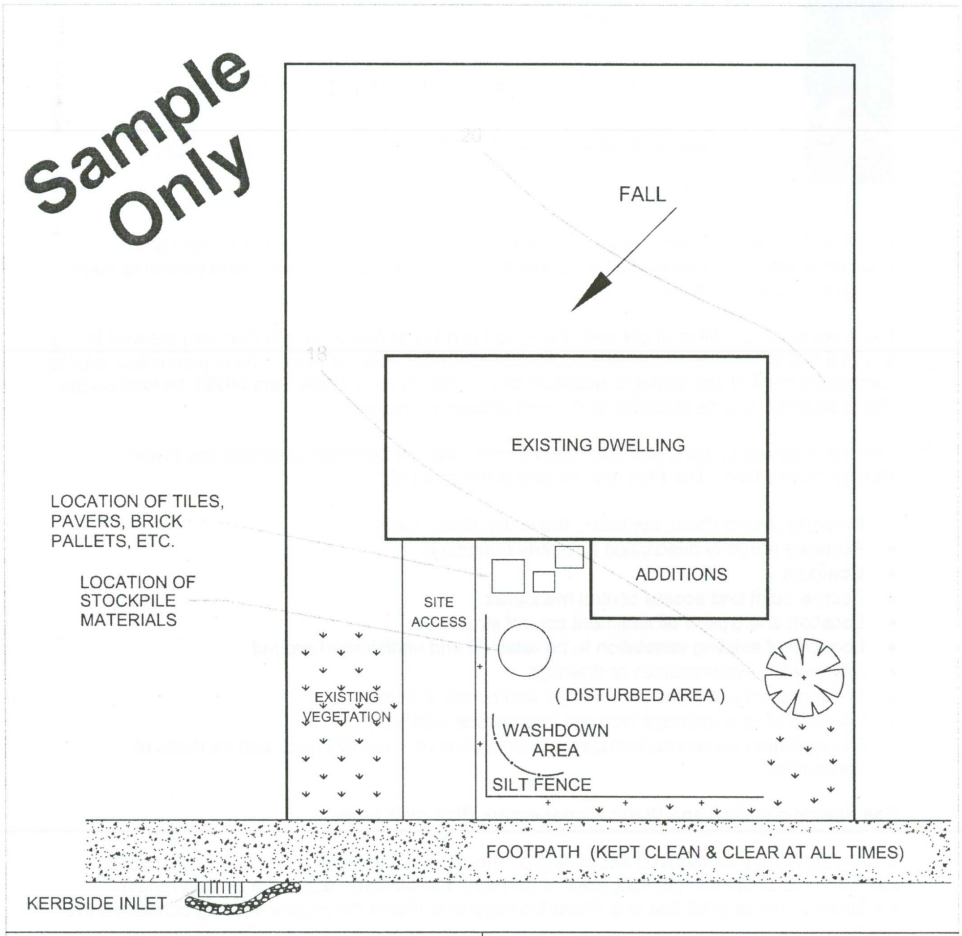
15.0 ANNEXURE B - INFILTRATION MAP



16.0 ANNEXURE C – PONDING AREAS MAP

Refer to last page of this document for Ponding Area Map

17.0 ANNEXURE D - EXAMPLE EROSION & SEDIMENT CONTROL PLAN



Note

1. All erosion and sediment control measures to be inspected and maintained daily by site manager.
2. Minimise disturbed areas.
3. All stockpiles to be clear from drains, gutters and footpaths.
4. Drainage is to be connected to stormwater system as soon as possible.
5. Roads and footpath to be swept daily.
6. If you do not comply you may be liable to a $600 fine.

Legend

- Undisturbed vegetation
- Silt Fence
- Stockpiles
- Geotextile Fabric
- Fabric filled with gravel
- Stormwater pit

Drawn By: Date:	Location:	Scale:	Applicant:

(*Source: Landcom, 2004)*

18.0 ANNEXURE E – AN EXAMPLE POSITIVE COVENANT/RESTRICTION AS TO USER FOR AN ON SITE DETENTION SYSTEM TEMPLATE

1. Terms on the Restriction on the Use of Land firstly referred to in the abovementioned plan.

1.1 The registered proprietor shall not make or permit or suffer the making of any alterations to any on-site stormwater detention system which is, or shall be, constructed on the lot(s) burdened without the prior consent in writing of Waverley Council. The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to the temporary storage. The on-site stormwater determination system is detailed on the plans approved by_____as Construction Certificate No._____ . A copy of this Construction Certificate is held on Council file No. _____.

Any on-site stormwater detention system constructed on the lot(s) burdened is hereafter referred to as "the system".

Name of Authority having the power to release, vary or modify the Restriction referred to is Waverley Council.

2. Terms of the Positive Covenant secondly referred to in the abovementioned plan.

2.1 The registered proprietor of the lot(s) hereby burdened will in respect of the system:

(a) keep the system clean and free from silt, rubbish and debris;

(b) maintain and repair at the sole expense of the registered proprietors the whole of the system so that it functions in a safe and efficient manner;

(c) permit the Council or its authorised agents from time to time and upon giving reasonable notice (but at a time and without notice in the case of an emergency) to enter and inspect the land for the compliance with the requirements of this covenant; and

(d) comply with the terms of any written notice issued by the Council in respect of the requirements of this covenant within the time stated in the notice.

2.2 Pursuant to Section 88F (3) of the Conveyancing Act 1919 the Council shall have the following additional powers:

(a) in the event that the registered proprietor fails to comply with the terms of any written notice issued by the Council as set out above the Council or its authorised agents may enter the land with all necessary materials and equipment and carry out any work which the Council in its discretion considers reasonable to comply with said notice referred to in part 2.1 (d) above; and

(b) the Council may recover from the registered proprietor in a Court of competent jurisdiction:

(i) any expenses reasonably incurred by it exercising its power under sub-paragraph 2.2 (a) hereof. Such expense shall include reasonable wages for Council's employees engaged in effecting the work referred to 2.2 (a) above, supervising

and administering the said work together with costs reasonably estimated by the Council, for the use of materials, machinery, tools and equipment in conjunction with the said work.

(ii) legal costs on an indemnity basis for issue of the said notices and recovery of the said costs and expenses together with the costs and expenses of registration of a covenant charge pursuant to section 88F of the Act of providing any certificate required pursuant to section 88G of the Act or obtaining any injunction pursuant to section 88H of the Act.

Name of Authority having the power to release, vary or modify the Positive Covenant referred to is Waverley Council.

19.0 ANNEXURE F – AN EXAMPLE POSITIVE COVENANT GREYWATER TREATMENT SYSTEMS TEMPLATE

Instrument setting out the terms of Easements or Profits ă Prendre intended to be created or released and of Restrictions on the Use of Land or Positive Covenants intended to be created pursuant to Section 88B and Section 88E of the Conveyancing Act 1919.

Plan: Plan of Subdivision of Lot…….
DP……covered by Council's
Clerk Certificate No. of

Full name and address
of the owner of the land:

Part 1 (Creation)

Number of item in the intention panel on the plan	Identity of easement, profit ă prendre, restriction or positive covenant to be created and referred to in the plan	Burdened lot(s) or parcel(s):	Benefited lot(s), road(s), bodies or Prescribed Authorities:
1	Public Positive Covenant	…….	Waverley Council

Part 2 (Terms)

Terms of easement, profit ă prendre, restriction, or positive covenant numbered 1 in the plan:

Positive Covenant

Pursuant to section 88E of the Conveyancing Act 1919 the registered proprietor(s) of the lot(s) burdened with respect to Greywater Treatment Systems ("the System") described in Plan No…….. dated……. (Council's File Ref……. Held in the offices of Waverley Council ("the Council"), 55 Spring Street, Bondi Junction, NSW, shall at the sole expense of the registered proprietor of the burdened lot:

(a) Maintain, repair and take all necessary measures as to the System for the continued safe and efficient operation of the System including but not limited to those referred to in the Water Management Technical Guidelines prepared and published by Council from time to time so far as they relate to Blackwater Treatment Systems to provide that the system functions in a safe and efficient manner;
(b) Comply with any requirements of Sydney Water as to the maintenance and repair of the System and all necessary measures to prevent inefficient operation of the System;
(c) Comply with the requirements of Government policies and protocols as to the installation, maintenance and repair of the System including requirements of the Department of Health NSW;
(d) Comply with the terms of any written notice issued by Waverley Council in respect of the requirements of this Covenant within the stated in such notice;
(e) Obtain and maintain Department of Health NSW Accreditation as is applicable to the system from time to time.
(f) Allow for the Council to require the system to cease operating and direct all wastewater to the sewer in the event of a systems failure;
(g) Allow upon reasonable notice the Council to access the burdened land and inspect the system and if necessary carry out works that are required.
(h) Pursuant to section 88(F) of the Conveyancing Act 1919 allow the Council to have the following additional powers pursuant to this covenant:

(i) In the event that the registered proprietor fails to comply with the terms of any written notice issued by the Council in respect of the requirements of this covenant the Council or its authorised agents may enter the land with all necessary equipment and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in (d);

(ii) The Council may recover from the registered proprietor in a Court of competent jurisdiction:

a. Any expense reasonably incurred by it in exercising its powers under clause (i) such expense shall include reasonable wages for the Council's own employees engaged in effecting the said work, supervising the said work and administering the said work together with costs, reasonably estimated by the Council, for the use of machinery, tools and equipment in conjunction with the said work.

b. Legal costs on an indemnity basis for issue of the said notices and recovery of the said costs and expenses together with the costs and expenses of registration of a covenant charge pursuant to section 88F of the Conveyancing Act 1919 or providing any certificate required pursuant to section 88G of the Conveyancing Act 1919 or obtaining any injunction pursuant to section 88H of the Conveyancing Act 1919.

(i) This covenant shall bind all persons who claim under the registered proprietor(s) as stipulated in section 88E(5) of the Conveyancing Act 1919.

NAME OF AUTHORITY EMPOWERED TO RELEASE, VARY OR MODIFY THE POSITIVE COVENANT REFERRED TO IS WAVERLEY COUNCIL

Signature of Witness

Waverley Council by its Attorney pursuant to Power of Attorney Book No

(Full name of Witness)
(BLOCK LETTERS)

Signature

Address of Witness

20.0 ANNEXURE G – AN EXAMPLE POSITIVE COVENANT BLACKWATER TREATMENT SYSTEM TEMPLATE

Instrument setting out the terms of Easements or Profits ă Prendre intended to be created or released and of Restrictions on the Use of Land or Positive Covenants intended to be created pursuant to Section 88B and Section 88E of the Conveyancing Act 1919.

Plan: Plan of Subdivision of Lot…….
DP……covered by Council's
Clerk Certificate No. of

Full name and address
of the owner of the land:

Part 1 (Creation)

Number of item in the intention panel on the plan	Identity of easement, profit ă prendre, restriction or positive covenant to be created and referred to in the plan	Burdened lot(s) or parcel(s):	Benefited lot(s), road(s), bodies or Prescribed Authorities:
1	Public Positive Covenant	……	Waverley Council

Part 2 (Terms)

Terms of easement, profit ă prendre, restriction, or positive covenant numbered 1 in the plan:

Positive Covenant

Pursuant to section 88E of the Conveyancing Act 1919 the registered proprietor(s) of the lot(s) burdened with respect to Blackwater Treatment Systems ("the System") described in Plan No…….. dated…… (Council's File Ref…… Held in the offices of Waverley Council ("the Council"), 55 Spring Street, Bondi Junction, NSW, shall at the sole expense of the registered proprietor of the burdened lot:

(a) Maintain, repair and take all necessary measures as to the System for the continued safe and efficient operation of the System including but not limited to those referred to in the Water Management Technical Guidelines prepared and published by Council from time to time so far as they relate to Blackwater Treatment Systems to provide that the system functions in a safe and efficient manner;
(b) Comply with any requirements of Sydney Water as to the maintenance and repair of the System and all necessary measures to prevent inefficient operation of the System;
(c) Comply with the requirements of Government policies and protocols as to the installation, maintenance and repair of the System;
(d) Comply with the terms of any written notice issued by Waverley Council in respect of the requirements of this Covenant within the stated in such notice;
(e) Allow for the Council to require the system to cease operating and direct all wastewater to the sewer in the event of a systems failure;
(f) Allow upon reasonable notice the Council to access the burdened land and inspect the system and if necessary carry out works that are required.
(g) Pursuant to section 88(F) of the Conveyancing Act 1919 allow the Council to have the following additional powers pursuant to this covenant:
    (i) In the event that the registered proprietor fails to comply with the terms of any written notice issued by the Council in respect of the requirements of this covenant the Council or its authorised agents may enter the land with all

necessary equipment and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in (d);

(ii) The Council may recover from the registered proprietor in a Court of competent jurisdiction:

a. Any expense reasonably incurred by it in exercising its powers under clause (i) such expense shall include reasonable wages for the Council's own employees engaged in effecting the said work, supervising the said work and administering the said work together with costs, reasonably estimated by the Council, for the use of machinery, tools and equipment in conjunction with the said work.

b. Legal costs on an indemnity basis for issue of the said notices and recovery of the said costs and expenses together with the costs and expenses of registration of a covenant charge pursuant to section 88F of the Conveyancing Act 1919 or providing any certificate required pursuant to section 88G of the Conveyancing Act 1919 or obtaining any injunction pursuant to section 88H of the Conveyancing Act 1919.

(h) This covenant shall bind all persons who claim under the registered proprietor(s) as stipulated in section 88E(5) of the Conveyancing Act 1919.

NAME OF AUTHORITY EMPOWERED TO RELEASE, VARY OR MODIFY THE POSITIVE COVENANT REFERRED TO IS WAVERLEY COUNCIL

Signature of Witness

Waverley Council by its Attorney pursuant to Power of Attorney Book No

(Full name of Witness)
(BLOCK LETTERS)

Signature

Address of Witness

21.0 ANNEXURE H - GLOSSARY OF TERMS

Average Recurrence Interval (ARI) - the average time interval (expressed in years or fraction of years) between recurrences of a rainfall event of a given intensity and duration.

Best Management Practice – the design of a stormwater treatment measure in accordance with most current best practice guidelines.

Blackwater – wastewater generated from toilets.

Detention – refers to the holding of stormwater for short time periods aimed at reducing peak flows. The detained stormwater is released to the stormwater system following the peak flow event.

Freeboard – A margin of safety applied to calculations that estimate the water surface during a storm event. The freeboard accounts for the inaccuracies in calculation methods. The height between water level and the underside of a structure or top of an embankment/channel wall is referred to as freeboard.

Greywater – wastewater generated from hand basins, showers, laundries and kitchens.

Groundwater – water contained within the voids and spaces in rocks or soils

Impervious – a surface that does not allow water to infiltrate into the ground, including roofs, roads, pavements, hard surfaced sports courts, any "sealed" areas and permanent water bodies such as swimming pools.

Infiltration – the downward movement of water from the surface to the subsoil.

Interallotment Drainage – common stormwater drainage system that serves one or more private properties.

Land Application System - an ecologically sustainable method of applying treated or untreated wastewater to land which also does not cause an additional public health risk nor detracts from the local amenity of the area.

Non potable water – water that is to be used for non drinking purposes such as toilet flushing, laundry use, garden watering, car washing, etc.

On-site Detention (OSD) – detention of water on-site (refer to Detention).

On-site Retention (OSR) – retention of water on-site (refer to Retention).

Overland flow path –the path that stormwater may take if the piped or channeled stormwater system becomes blocked or its capacity exceeded. Overland flow paths provide a fail safe system to ensure that stormwater is not likely to cause flood damage.

Peak Flows – the maximum instantaneous outflow from a catchment during a storm event.

Permeable Paving – paving materials that allow infiltration into the soil.

Permissible Site Discharge – the maximum discharge from the site during a 1 in 5 year ARI storm event under pre-development (existing) site conditions.

Pervious - a surface that permits water to infiltrate into the ground.

Potable water – water that may be consumed.

Pump-out systems – a system comprising pumps and pipes to convey stormwater from a stormwater sump or storage to a gravity draining stormwater system.

Roofwater – rain (water) that falls on the roof of a building.

Retention – the storing of a form of water for beneficial use. Can apply to all forms of water including rainwater, stormwater and recycled water. May occur by storing water in a tank or by infiltration.

Runoff – interchangeable with stormwater (see Stormwater).

Sewage – any form of wastewater (refer to Wastewater) connected to the sewerage system.

Soil & Water Management Plan (SWMP) - strategies and controls for a development or site to prevent pollution of the environment from all pollutants during the construction stage.

Stormwater – rainfall that is concentrated after it runs off all urban surfaces such as roofs, pavements, carparks, roads, gardens and vegetated open space and includes water in stormwater pipes and channels.

Subsurface irrigation – application of water below the soil surface.

Sump – a cavity or depression where water drains to and which may then be pumped out.

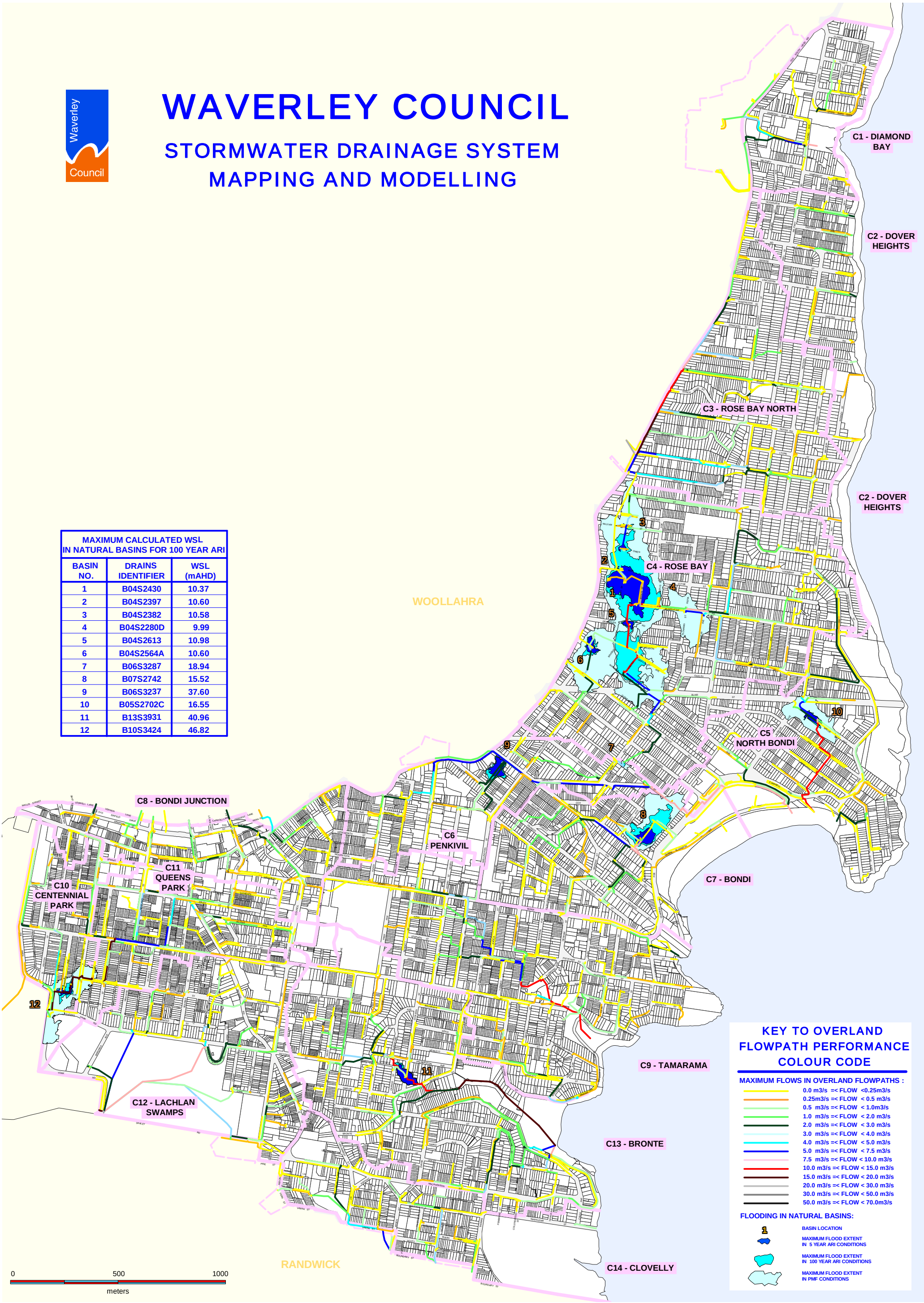
Water Sensitive Urban Design – a design approach promoting sustainable management of the total water cycle through the ecologically sensitive design of homes, streets (and their drainage systems) and whole suburbs.

Wastewater – greywater and blackwater (see Blackwater).

WAVERLEY COUNCIL

STORMWATER DRAINAGE SYSTEM MAPPING AND MODELLING

MAXIMUM CALCULATED WSL IN NATURAL BASINS FOR 100 YEAR ARI		
BASIN NO.	DRAINS IDENTIFIER	WSL (mAHD)
1	B04S2430	10.37
2	B04S2397	10.60
3	B04S2382	10.58
4	B04S2280D	9.99
5	B04S2613	10.98
6	B04S2564A	10.60
7	B06S3287	18.94
8	B07S2742	15.52
9	B06S3237	37.60
10	B05S2702C	16.55
11	B13S3931	40.96
12	B10S3424	46.82



KEY TO OVERLAND FLOWPATH PERFORMANCE COLOUR CODE

MAXIMUM FLOWS IN OVERLAND FLOWPATHS :

- 0.0 m3/s =< FLOW <0.25m3/s
- 0.25m3/s =< FLOW < 0.5 m3/s
- 0.5 m3/s =< FLOW < 1.0m3/s
- 1.0 m3/s =< FLOW < 2.0 m3/s
- 2.0 m3/s =< FLOW < 3.0 m3/s
- 3.0 m3/s =< FLOW < 4.0 m3/s
- 4.0 m3/s =< FLOW < 5.0 m3/s
- 5.0 m3/s =< FLOW < 7.5 m3/s
- 7.5 m3/s =< FLOW < 10.0 m3/s
- 10.0 m3/s =< FLOW < 15.0 m3/s
- 15.0 m3/s =< FLOW < 20.0 m3/s
- 20.0 m3/s =< FLOW < 30.0 m3/s
- 30.0 m3/s =< FLOW < 50.0 m3/s
- 50.0 m3/s =< FLOW < 70.0m3/s

FLOODING IN NATURAL BASINS:

- 1 BASIN LOCATION
- MAXIMUM FLOOD EXTENT IN 5 YEAR ARI CONDITIONS
- MAXIMUM FLOOD EXTENT IN 100 YEAR ARI CONDITIONS
- MAXIMUM FLOOD EXTENT IN PMF CONDITIONS

N W E S

PROJECT NUMBER: 06-07-123

APPROX. SCALE: 1:15,850 AT A3

OVERLAND FLOWPATHS PERFORMANCE - 100 YR ARI

MAP NUMBER: C14

ISSUED: AUGUST 2007

CIVIC DESIGN