SYDNEY METROPOLITAN CATCHMENT MANAGEMENT AUTHORITY
TYPCIAL DRAWINGS FOR WSUD

SCHEDULE OF DRAWINGS	
D01	COVER SHEET AND DRAWING LIST
D02	BIORETENTION SYSTEM - FLAT SITE
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D10	SWALE - FLAT SITE
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ABBREVIATIONS

NSL - NATURAL SURFACE LEVEL
FSL - FINISHED SURFACE LEVEL
U/S - UP STREAM
D/S - DOWN STREAM
IL - INVERT LEVEL
CL- COVER LEVEL
RL - REDUCED LEVEL
RCP - REINFORCED CONCRETE PIPE

GENERAL NOTES

A. THESE DRAWINGS HAVE BEEN DEVELOPED AS EXAMPLES AND REPRESENT TYPICAL WSUD TREATMENT SYSTEMS.

B. THE PURPOSE OF THESE DRAWINGS IS TO PROVIDE DESIGN GUIDANCE ON KEY DETAILS; HOWEVER THEY ARE NOT A STAND-ALONE DESIGN RESOURCE. THEY SHOUD BE READ IN CONJUNCTION WITH OTHER DESIGN GUIDELINES INLCUDING:
- WSUD.ORG "WSUD INTERIM REFERENCE GUIDELINE – CONCEPT DESIGN"
- WSUD.ORG "WSUD INTERIM REFERENCE GUIDELINE – TECHNICAL DESIGN" (WHEN AVAILABLE)
- WSUD.ORG "WSUD INTERIM REFERENCE GUIDELINE – CONSTRUCTION AND ESTABLISHMENT FOR SWALES, BIORETENTION SYSTEMS AND WETLANDS"
- WATER BY DESIGN "CONCEPT DESIGN GUIDELINES FOR WSUD"
- WATER BY DESIGN "TECHNICAL DESIGN GUIDELINES"
- WATER BY DESIGN "CONSTRUCTION AND ESTABLISHMENT GUIDELINES FOR SWALES, BIORETENTION SYSTEMS AND WETLANDS"

C. THESE DRAWINGS ARE INTENDED FOR A TECHNICAL AUDIENCE INCLUDING CIVIL/ENVIRONMENTAL ENGINEERS AND OTHER DESIGN PROFESSIONALS.

D. WSUD SYSTEMS REQUIRE SITE-SPECIFIC ANALYSIS, DESIGN AND DRAWINGS PRIOR TO CONSTRUCTION.

E. SITE-SPECIFIC INVESTIGATIONS NEED TO INCLUDE LOCAL TOPOGRAPHY, SOILS, LANDSCAPE, SERVICES AND OTHER RELEVANT SITE FEATURES.

F. WSUD SYSTEMS WITH STRUCTURAL ELEMENTS (E.G. RETAINING WALLS) REQUIRE SITE-SPECIFIC STRUCTURAL DESIGN INPUT.

G. WSUD SYSTEMS REQUIRE INTEGRATION WITH SURROUNDING OPEN SPACE, BASED ON SITE-SPECIFIC ANALYSIS.

H. WSUD SYSTEMS ALSO REQUIRE APPROPRIATE PLANT SPECIES TO FUNCTION CORRECTLY. THESE DRAWINGS DO NOT SPECIFY PLANT SPECIES.

I. WSUD SYSTEM DESIGN NEEDS TO ACCOUNT FOR MAINTENANCE AND OHS REQUIREMENTS OF ASSET OWNER

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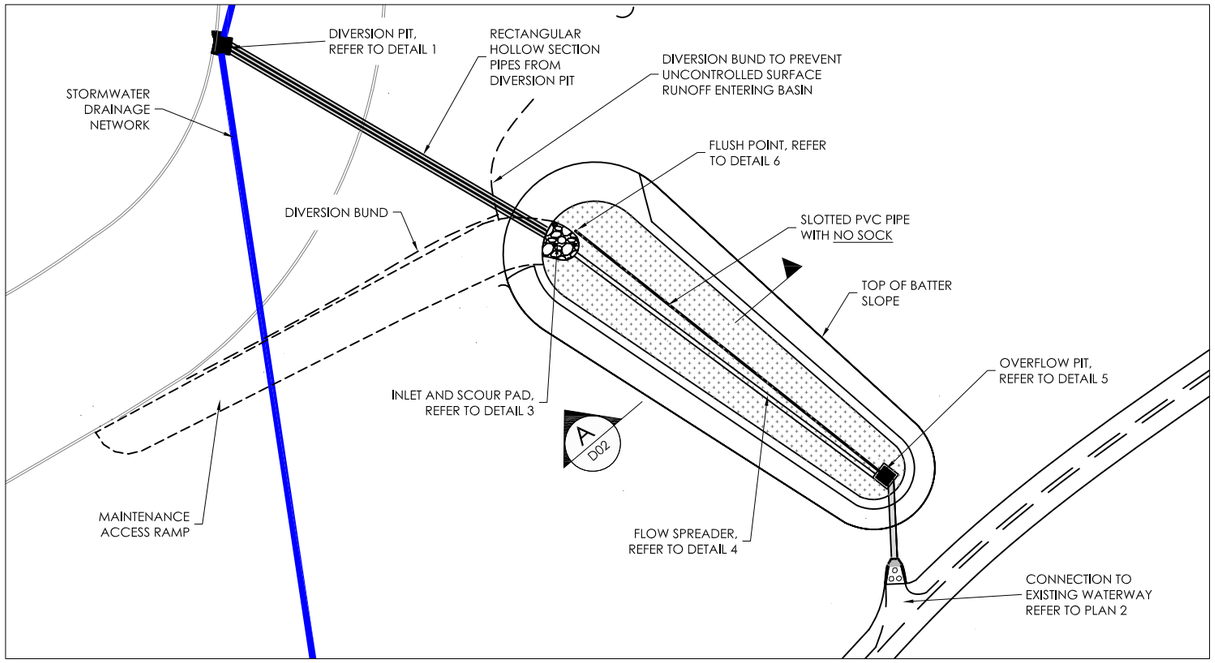
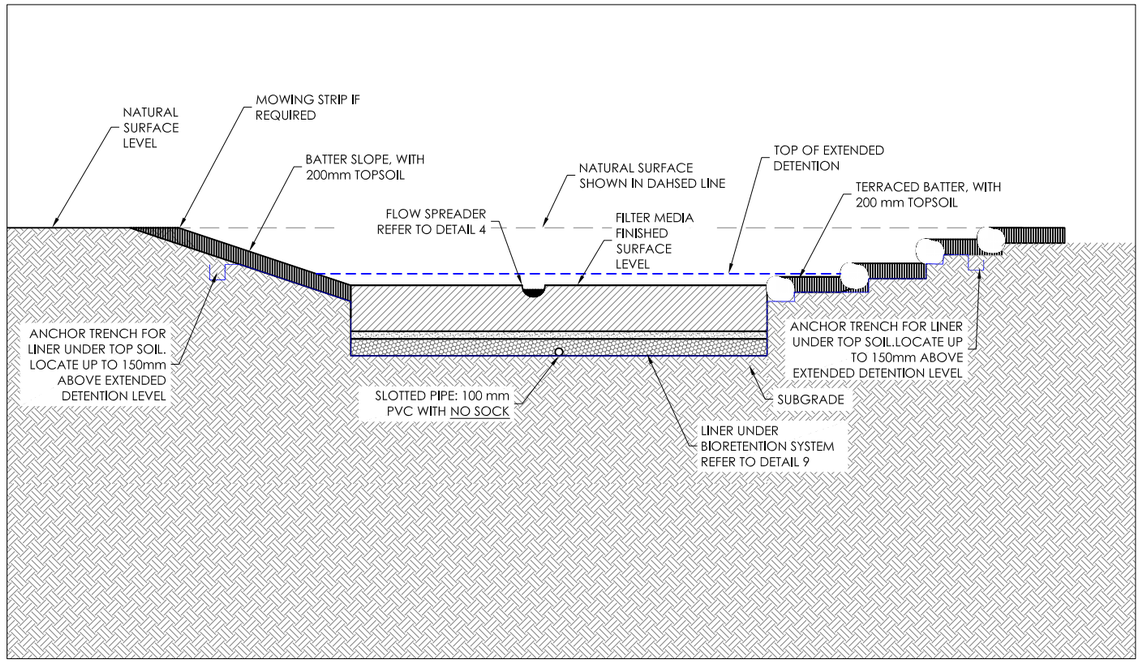
DRAWINGS PREPARED BY
aquatica

TITLE
WSUD TYPICAL DRAWINGS
COVER SHEET AND
DRAWING LIST

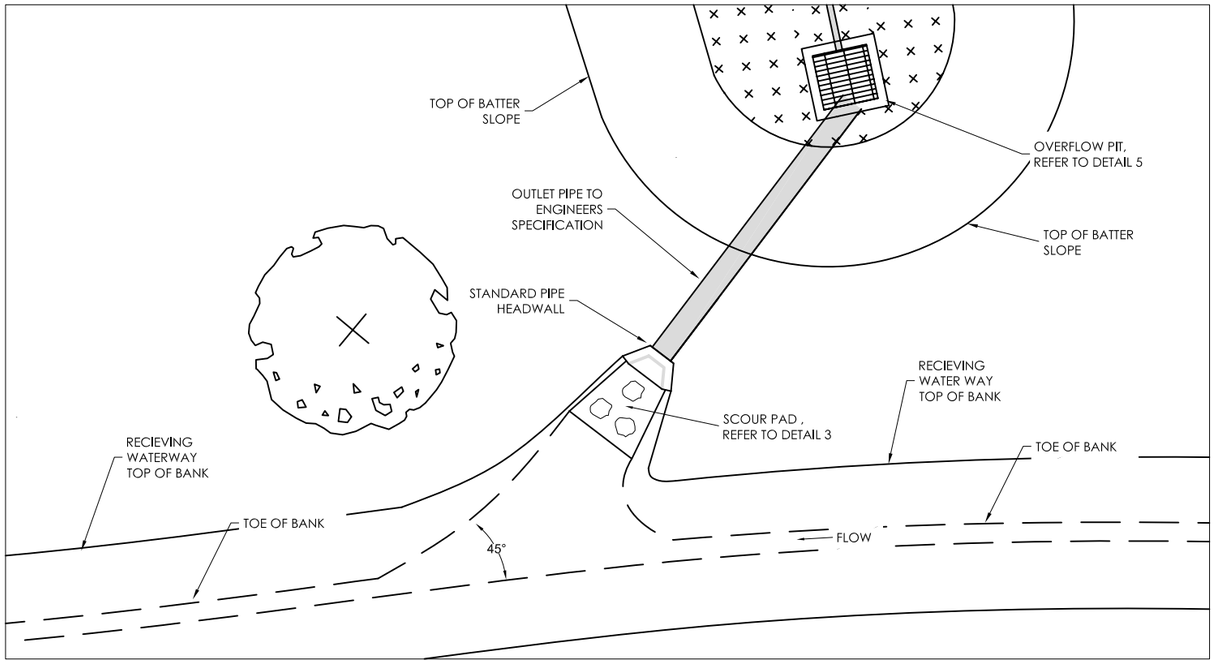
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D01	A3
SHEET 1 OF 12	DATUM N/A		



PLAN 1
TYPICAL BIORETENTION SYSTEM - FLAT SITE
SCALE 1:200



SECTION A D02
SCALE 1:40



PLAN 2
OUTLET TO A WATERWAY
SCALE 1:50

Design notes:

- At flat sites, keep inlet systems as shallow as possible to avoid basin or outlet structures becoming too deep
- Where treated flows drain to a natural waterway, ensure that the outlet can connect into the stream without lowering the bed level. Refer BCC (2003) for waterway outlet structure design guidelines
- In some cases it may be possible to "chase grade" upstream or downstream of the bioretention system. Keep pipe slopes to minimum 0.5% grade (preferably 1%)
- To minimise the depth of inlets:
  - Optimise diversion rate to deliver only low flows to the treatment system, bypassing high flows
  - Consider swales instead of pits and pipes
  - Consider box culverts instead of circular pipes and consider RHS's for small inflows
- To minimise the depth of outlets:
  - Keep filter media to 400 mm minimum depth
  - Expand filter area to compensate for shallower depth
  - Consider the use of a saturated zone (not shown here) to minimise the depth of the outlet pipe. Refer FAWB (2009) for details of saturated zone configurations
- Batter slopes should be consistent with local Council maintenance requirements and guidelines
- Long slopes may be prone to erosion. Consider bunds to controll local runoff and erosion protection on internal batters
- Consider a flow spreader in long and large systems to evenly distribute flows across the filter surface

References:

- Facility for Advancing Water Biofiltration (FAWB) 2009 "Stormwater Biofiltration Systems Adoption Guidelines" Monash University
- Brisbane City Council (BCC) 2003 "Stormwater Outlets in Parks and Waterways"

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DRAWINGS PREPARED BY
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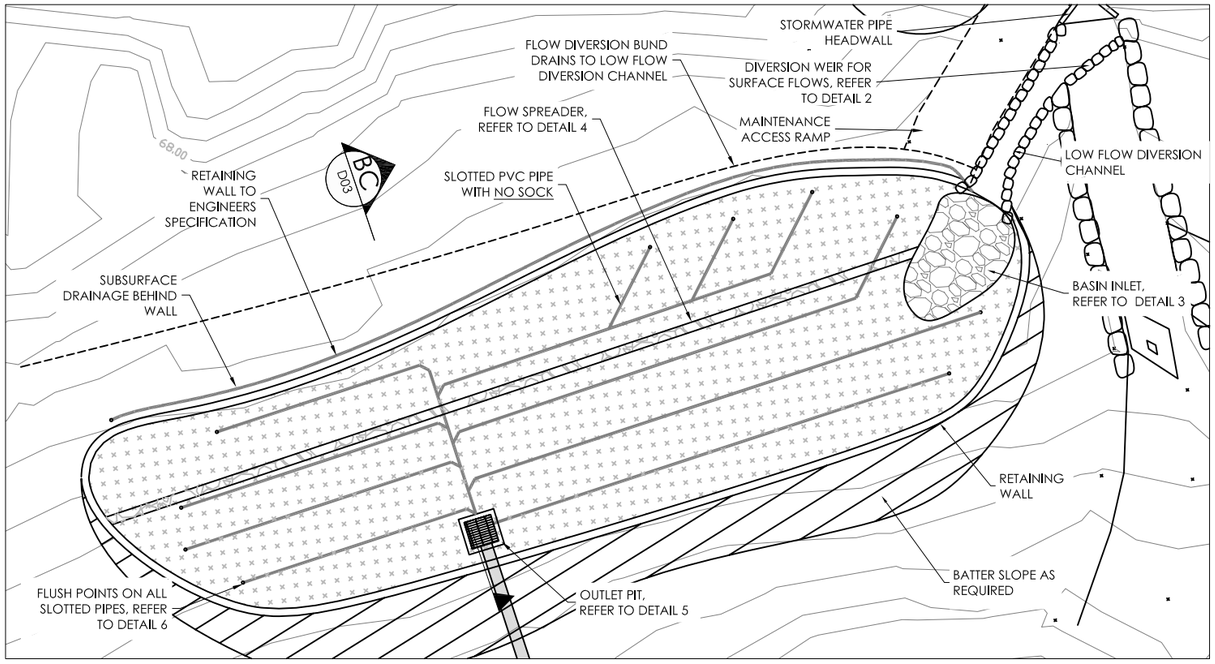
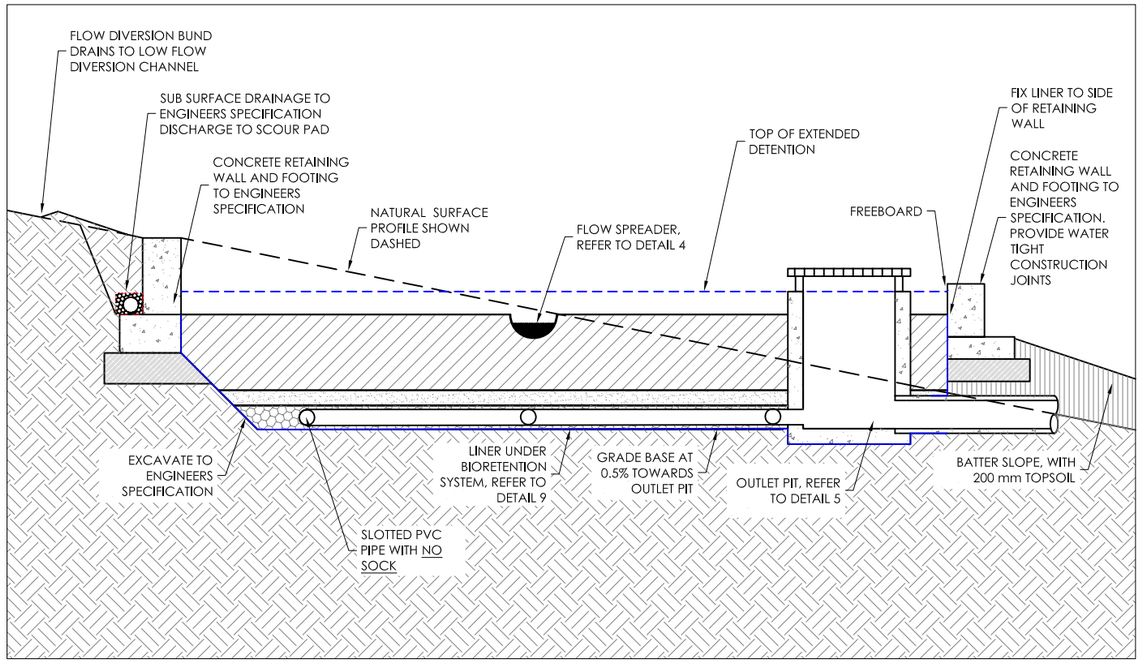
TITLE
WSUD TYPICAL DRAWINGS
BIORETENTION SYSTEM
- FLAT SITE

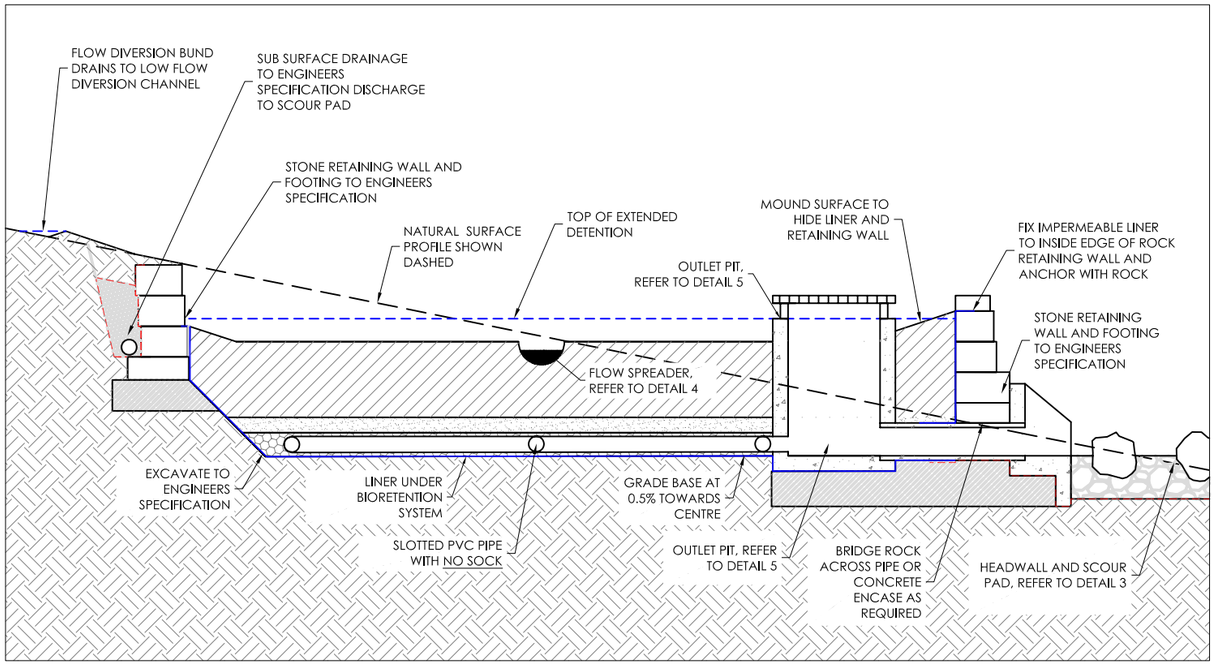
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D02	A3
SHEET 2 OF 12	DATUM N/A		



PLAN 3
TYPICAL BIORETENTION SYSTEM - STEEP SITE
SCALE 1:100



SECTION B D03
SCALE 1:20



SECTION C D03
SCALE 1:20

Design notes:

- At steep sites, high velocity flows can easily cause scour and erosion. Energy dissipation and scour protection are key considerations. Refer BCC (2003) for energy dissipater and scour pad design guidelines
- To minimise velocities in the bioretention system:
  - Consider the use of drop structures upstream
  - Include scour protection at all inlets
- Where revegetation is required on steep slopes, use jute mesh pinned in place to retain mulch and protect the slope during vegetation establishment
- Minimise wall heights to 900 mm (to soft fall) for public safety
- Retaining walls require design input from a structural engineer
- It should be possible to avoid exporting excess spoil from site. Consider the cut/fill balance and adjust system levels to achieve desired result
- Construction and maintenance access can be difficult - consider early in the design stage
- Batter slopes should be consistent with local Council maintenance requirements and guidelines
- Long batter slopes may be prone to erosion. Consider bunds to controll local runoff and erosion protection on external batters
- Consider a flow spreader in long and large systems to evenly distribute flows across the basin
- Freeboard is recommended as 50mm above the maximum water level in the basin required to convey the peak inflow into the outlet pit when the outlet pit grate is 50% blocked.
- In large systems, consider an emergency overflow weir in case of outlet blockage. Locate at cut/fill interface where possible
- Also bring maintenance access in at cut/fill interface where possible

References:

- Brisbane City Council (BCC) 2003 "Stormwater Outlets in Parks and Waterways"

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TITLE
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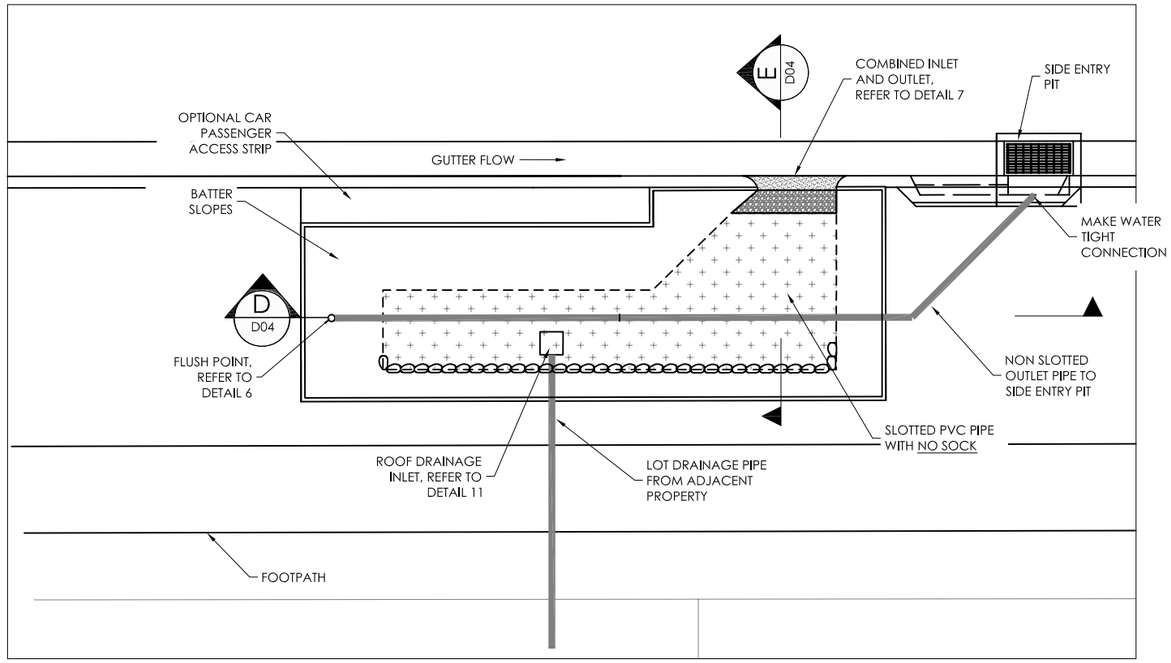
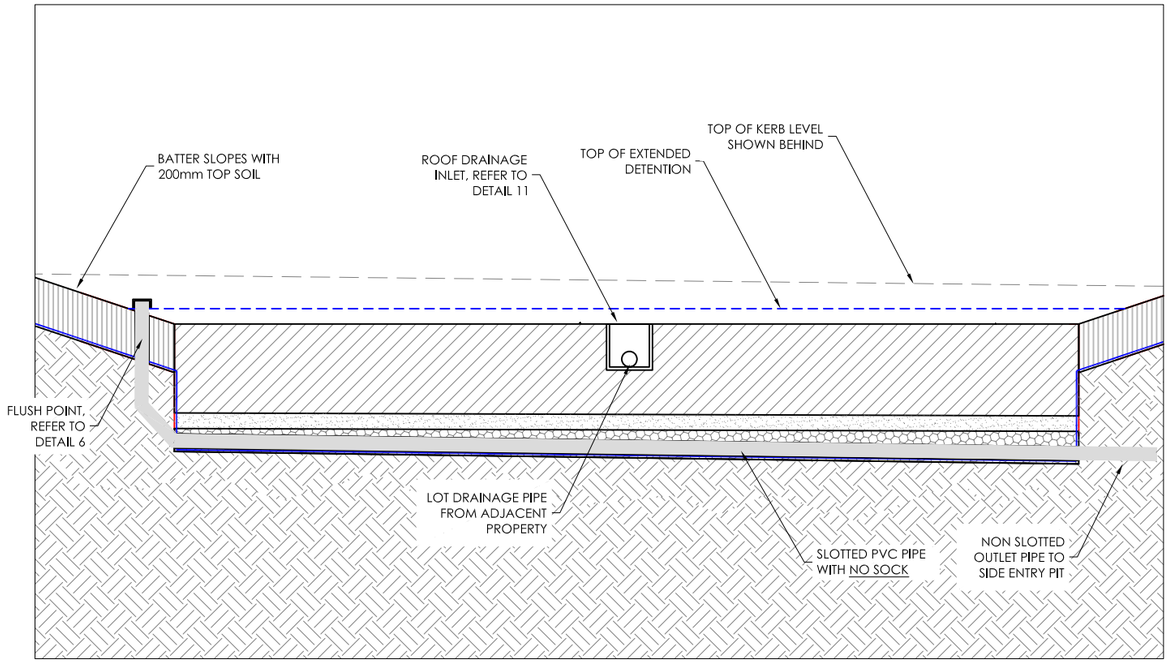
BIORETENTION SYSTEM
- STEEP SITE

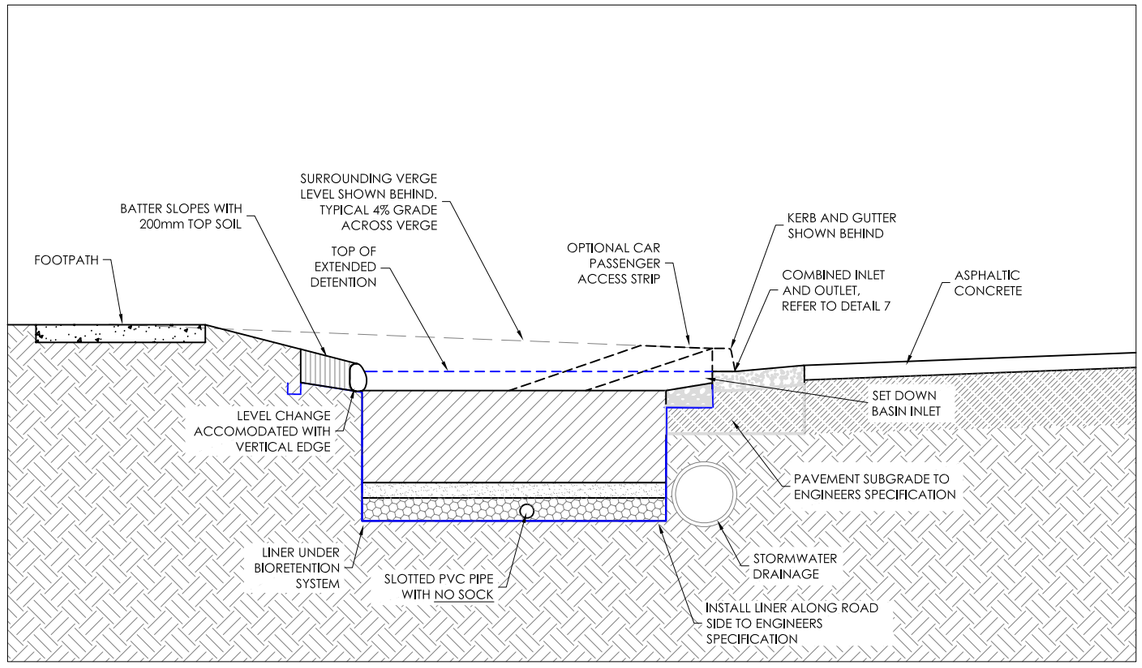
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D03	A3
SHEET 3 OF 12	DATUM N/A		



PLAN 4
TYPICAL BIORETENTION SYSTEM - FOOTPATH
SCALE 1:40



SECTION D D04
SCALE 1:20



SECTION E D04
SCALE 1:20

Design notes:

- Services are often located within the road verge. Consider existing utility locations and/or allocations for future works when locating WSUD measures
- In the footpath, pedestrian safety and amenity are key considerations. Minimise trip hazards by clearly delineating sudden level changes. Delineate edges with features such as bollards or dense planting to discourage pedestrian access
- Consider where people need to cross the verge - for example where there is parallel parking
- Specify appropriate vegetation in streetscapes for traffic/pedestrian visibility
- Where trees are specified, use a minimum filter depth of 800 mm
- Next to roads and other structures, a liner is normally recommended to prevent exfiltration
- Allow for extended detention. To minimise the drop to the system surface, the extended detention zone could be filled with coarse gravel or rock mulch.
- Small inlets can clog easily. Make inlets as large as possible and provide space for accumulation of sediment and leaf litter
- Where streets are 5% and steeper, the designer needs to carefully consider level changes across the basin
- Where batter slopes occupy a large part of the basin footprint consider opther options such as a step down to the basin surface to maximise the filter area

References:

- Parramatta City Council's WSUD Standard Drawings include several more examples of streetscape bioretention systems

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DRAWINGS PREPARED BY
aquatica

TITLE
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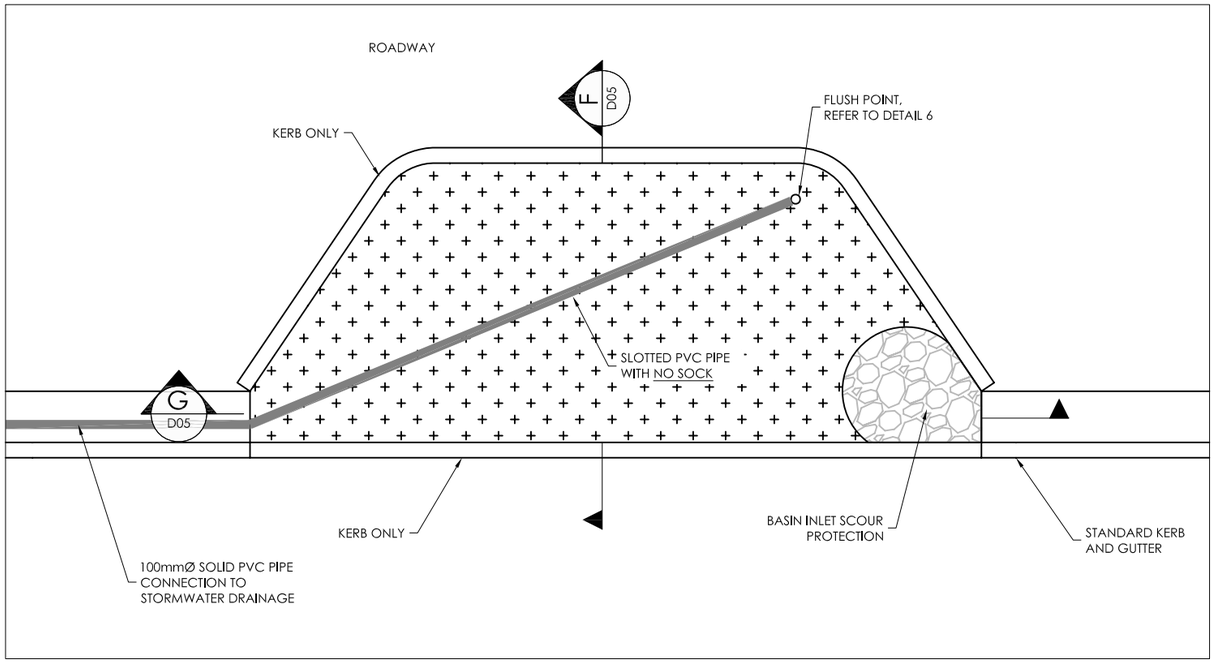
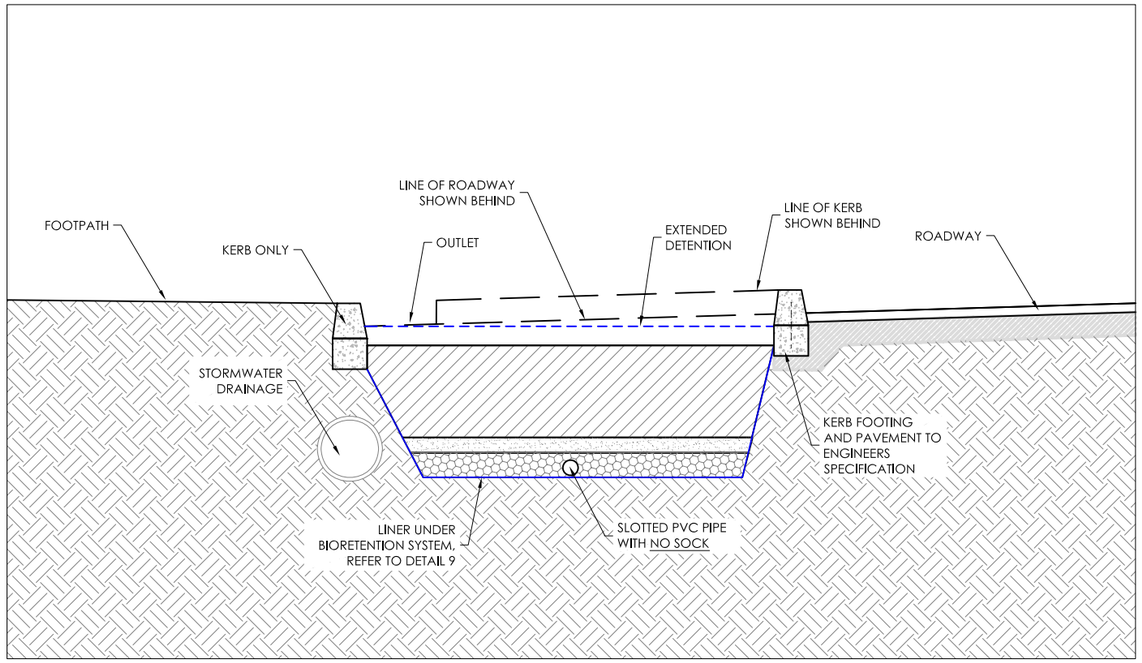
BIORETENTION SYSTEM
- FOOTPATH

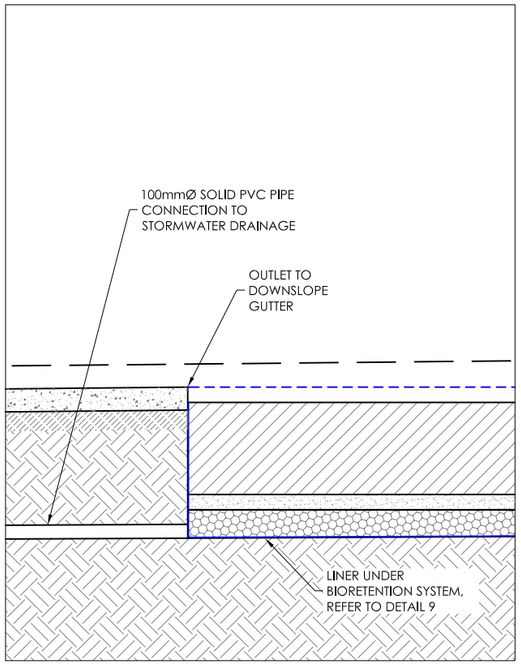
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D04	A3
SHEET 4 OF 12	DATUM N/A		

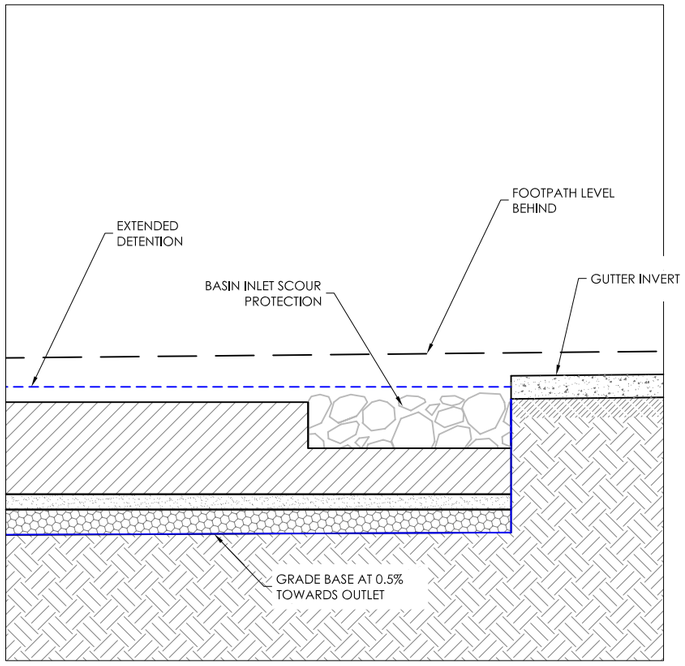


PLAN 5
TYPICAL BIORETENTION SYSTEM - ROADWAY
SCALE 1:30



SECTION F D05
SCALE 1:20





SECTION G D05
SCALE 1:10

Design notes:

- In the roadway, key considerations are traffic and drainage
- Road edges need to be designed to exclude cars and prevent traffic damage
- Remember that the road is often a flowpath in major storm events. Estimate design flows and velocities and consider how these flows will be accommodated
- Specify appropriate vegetation in streetscapes for traffic/pedestrian visibility
- The drawings show the typical location of stormwater drainage pipes within the street, however other services are also often located within the roadway. Consider existing utility locations and/or allocations for future works when locating WSUD measures.
- Next to roads and other structures, a liner is normally recommended to prevent exfiltration
- Allow for extended detention. To minimise the drop to the system surface, the extended detention zone could be filled with coarse gravel or rock mulch
- Small inlets can clog easily. Make inlets as large as possible and provide space for accumulation of sediment and leaf litter
- Employ bicycle-friendly design principles. Refer RTA (2005)
- Kerbs and footings in the roadway must be designed to withstand vehicle impact

References:

- Parramatta Council's WSUD Standard Drawings include several more examples of streetscape bioretention systems
- NSW Roads and Traffic Authority (RTA) 2005 "NSW Bicycle Guidelines"

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DRAWINGS PREPARED BY
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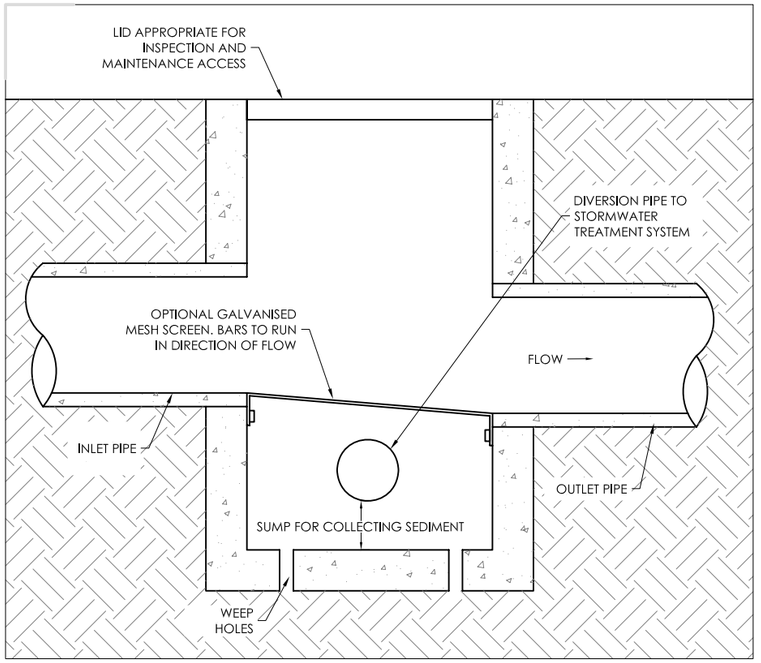
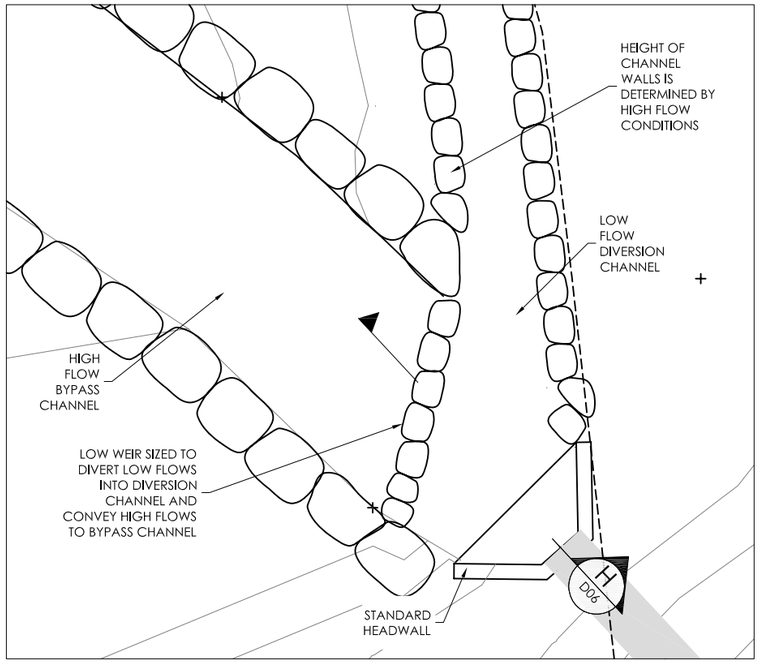
TITLE
WSUD TYPICAL DRAWINGS
BIORETENTION SYSTEM
- ROADWAY

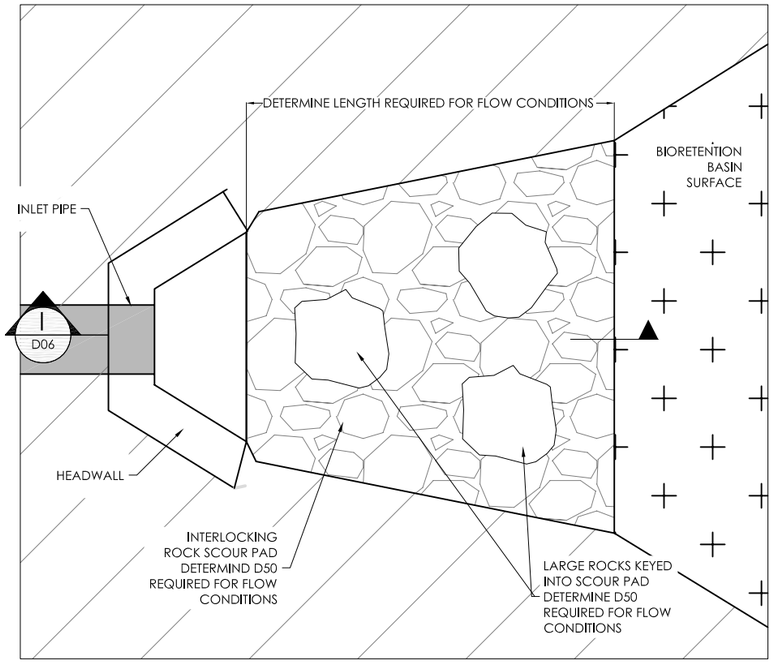
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D05	A3
SHEET 5 OF 12	DATUM N/A		



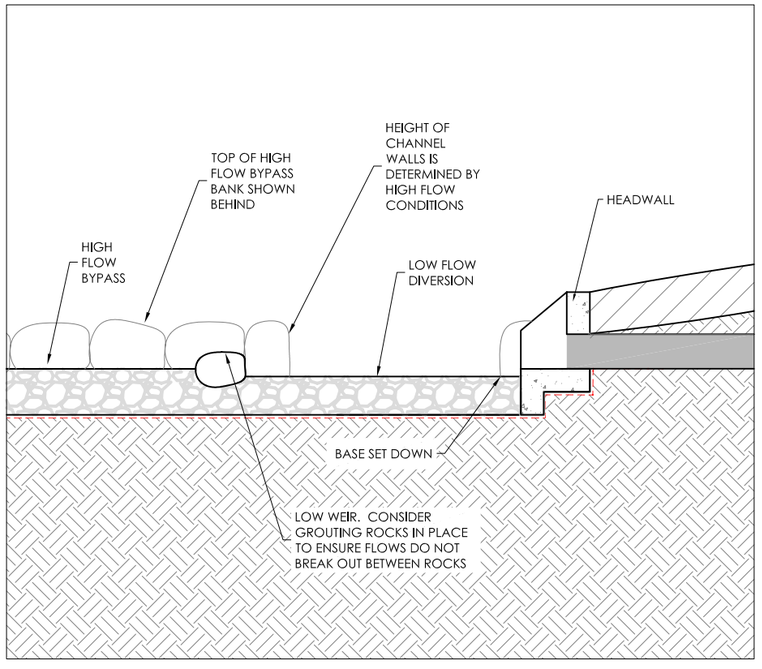
DETAIL 1
TYPICAL DIVERSION SYSTEM FOR PIPED FLOWS
NTS



DETAIL 2
TYPICAL DIVERSION SYSTEM FOR SURFACE FLOWS
NTS



DETAIL 3
TYPICAL INLET FOR A LARGE SYSTEM
SCALE 1:10



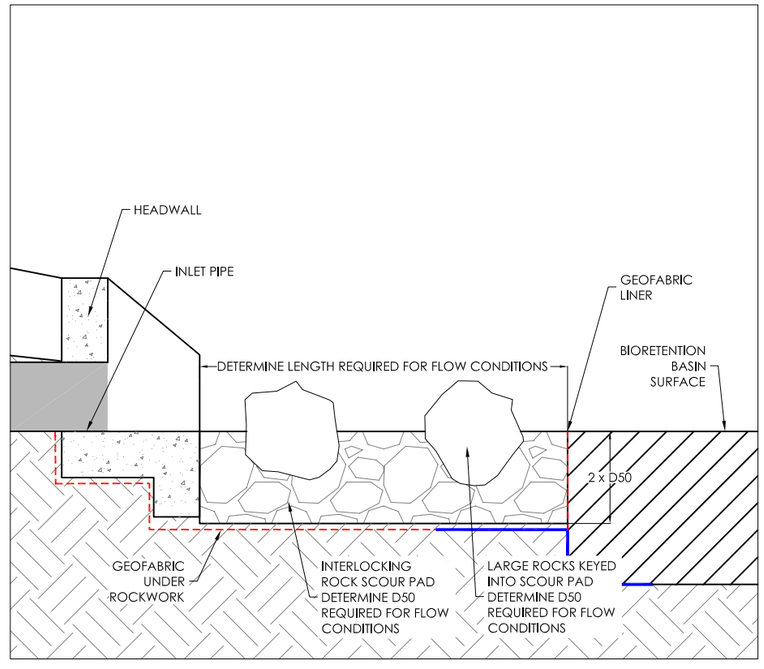
SECTION H D06
SCALE 1:20

Design notes:

- Wherever possible, divert low flows into bioretention systems and bypass high flows
- Optimise the diversion flowrate to balance treatment performance with design flow. A low design flow may reduce the treatment performance (due to significant bypass); however a high design flow will increase the size of all structures.
- Diversion pits are key points where maintenance is often required - consider access and maintenance techniques. Galvanised mesh screens and sumps will require period maintenance to remove accumulated material
- Weirs can also be used to divert low flows within stormwater pits; however check the hydraulic grade line to avoid flooding impacts upstream
- For scour pad design guidelines, refer BCC (2003)
- In large systems where the scour pad depth (2 x D50) approaches the filter depth, consider the interface between the scour pad and the filter to minimise flows short-circuiting through the scour pad

References:

- Brisbane City Council (BCC) 2003 "Stormwater Outlets in Parks and Waterways".



SECTION I D06
SCALE 1:10

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BIORETENTION SYSTEM
DETAILS (1)

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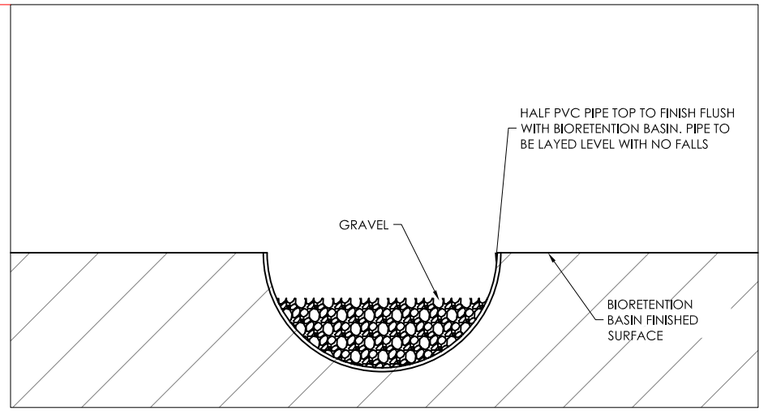
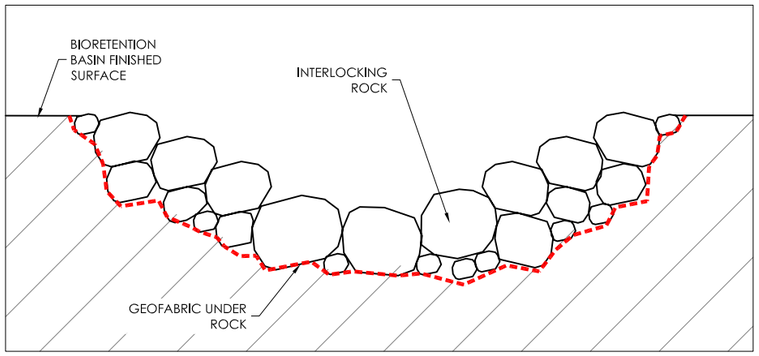
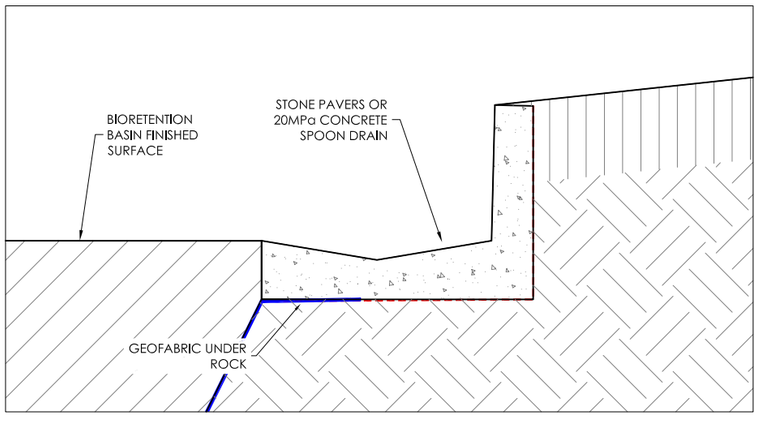


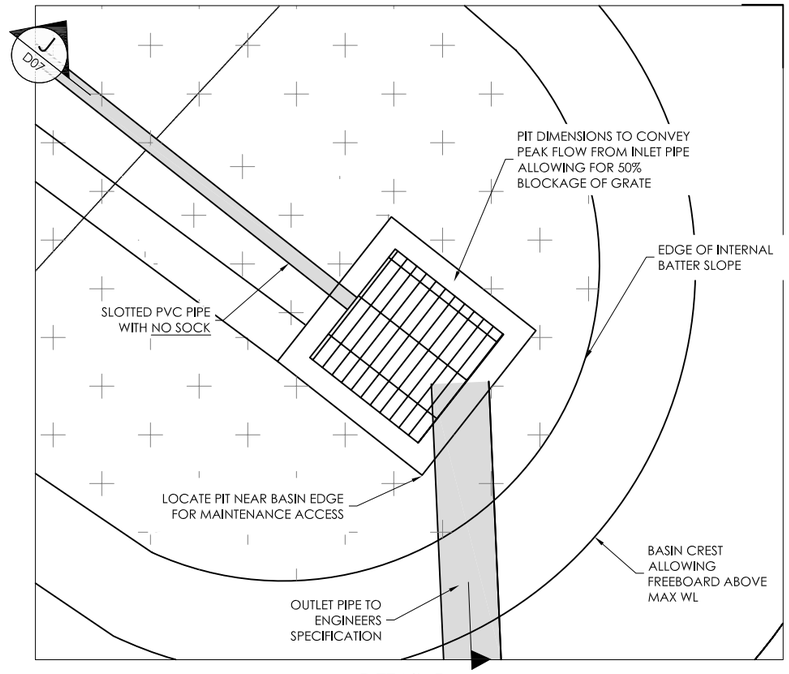
DETAIL 4A
TYPICAL FLOW SPREADER OPTION 1
SCALE 1:4



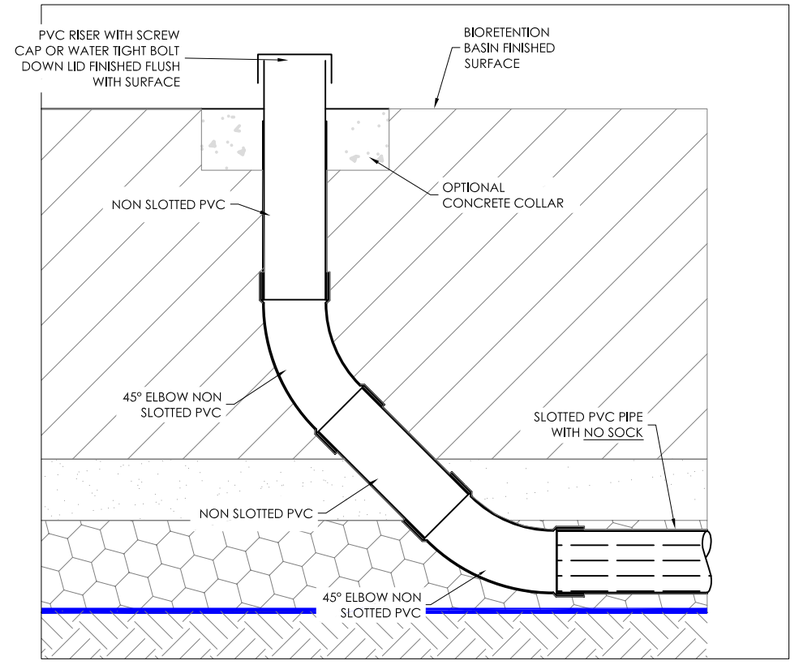
DETAIL 4B
TYPICAL FLOW SPREADER - OPTION 2
SCALE 1:4



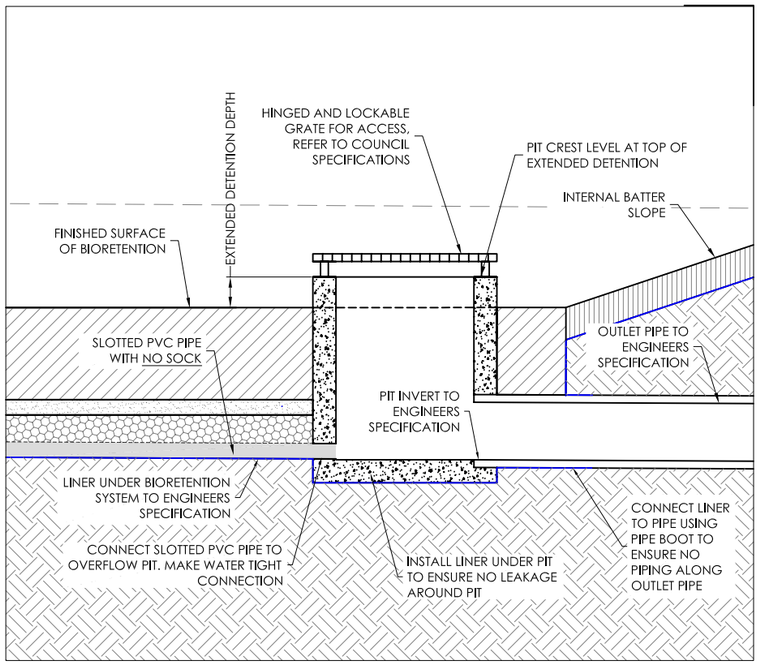
DETAIL 4C
TYPICAL FLOW SPREADER - OPTION 3
SCALE 1:4



DETAIL 5
TYPICAL OVERFLOW PIT FOR A LARGE SYSTEM
SCALE 1: 50



DETAIL 6
TYPICAL FLUSHING POINT AND SUBSOIL DRAIN
SCALE 1: 20



SECTION J D07
SCALE 1:10

Design notes:

- Flow spreader channels are recommended in large systems to help distribute inflows over the whole filter area
- Size flow spreader channels to convey approximately 10% of the design flow
- For calculating design flows through the filter and into the slotted pipes, refer HWP (2006)
- Flushing points are recommended on all subsoil drains
- Consider the preferences of the asset owner in desigining flushing points, including the preferred location, type of cap and use of concrete surround
- Slotted pipes are recommended at a minimum spacing of 5 m. Where a system requires a large number of slotted pipes, use a collection pipe (e.g. 225 mm non-slotted) to pick up all the slotted pipes and connect into the outlet pit
- The floor of the basin can be contoured to drain towards the slotted pipes
- For sizing overflow pits, refer HWP (2006)
- In large systems, consider multiple overflow pits to convey design flows
- Freeboard is recommended as 50mm above the maximum water level in the basin required to convey the peak inflow into the outlet pit when the outlet pit grate is 50% blocked.
- If there is no liner, or if a stabilised clay liner is used instead of a sheet membrane liner, two cut off collars should be formed around the outlet pipe

References:

- Healthy Waterways Partnership (HWP) 2006 "Water Sensitive Urban Design Technical Design Guidelines for South East Queensland". Check Water by Design website (www.waterbydesign.com.au) for latest update.

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DETAILS (2)

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AS SHOWN	2310	D07	A3
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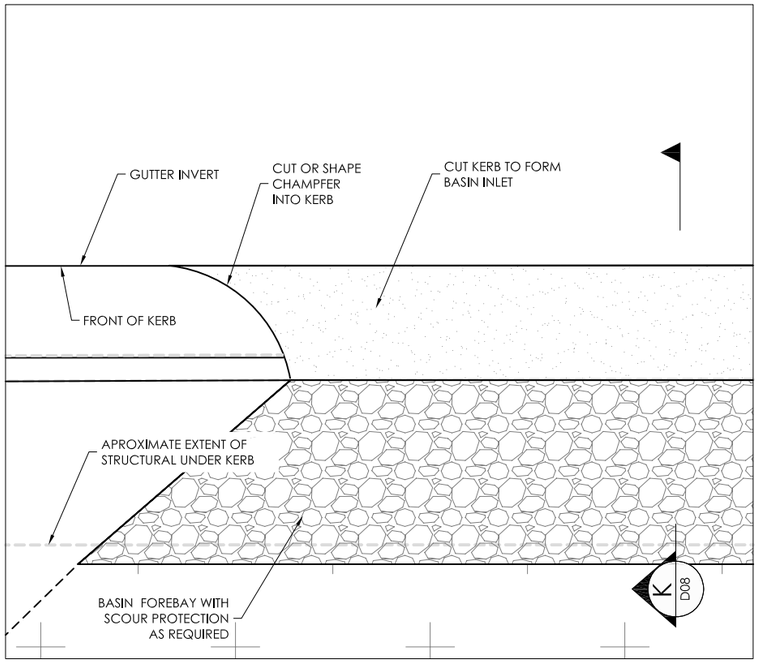
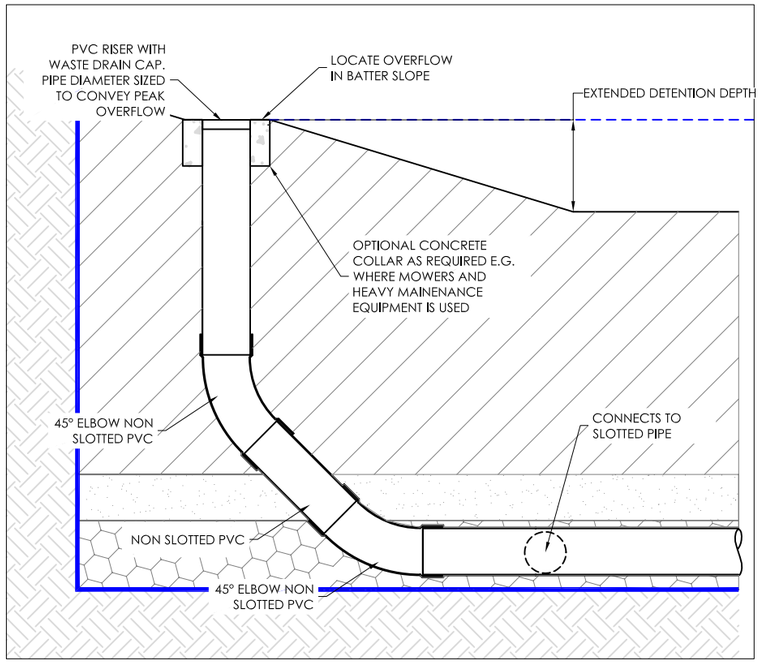
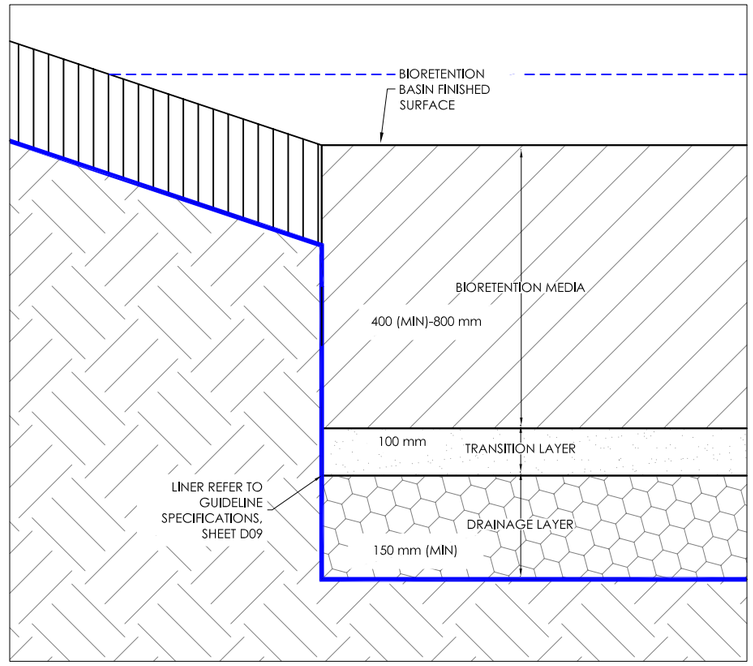


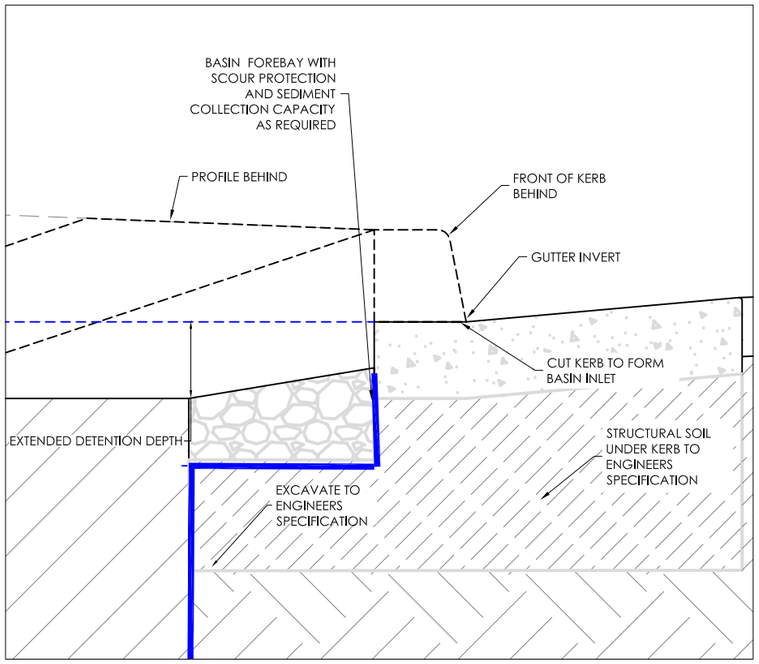
DETAIL 7
TYPICAL COMBINED INLET/OUTLET FOR STREETSCAPE SYSTEM
SCALE 1:5



DETAIL 8
TYPICAL OVERFLOW PIT FOR A SMALL SYSTEM
NTS



DETAIL 9
TYPICAL SOIL PROFILE
NTS



SECTION K D08
SCALE 1: 5

Design notes:

- Use a liner where it is important to exclude exfiltration. Refer D09 for more information
- Where surrounding soils are highly impermeable or exfiltration is acceptable, liners are generally not required
- Install a layer of geotextile under the liner, to minimise the risk of liner damage (e.g. by angular rocks in the subsoil)
- Also install a layer of geotextile before laying soil media layers where there is no impermeable liner, to prevent in-situ soil from mixing into the bioretention system, particularly fine material which may be washed out
- Geotextile fabrics should not be used between the filter media, transition and drainage layers in bioretention systems due to the risk of clogging. The soil specifications are designed to limit the migration of particles through the system.
- Geotextile socks should also never be installed on the slotted drainage pipes
- Filter media should be installed in two lifts unless the depth is less than 500 mm.
- Filter media can be lightly compacted - maximum one pass with a vibrating plate or equivalent. Under no circumstance should heavy compaction or multiple-passes be made. Refer FAWB (2008) for more information.

References:

- Facility for Advancing Water Biofiltration (FAWB) 2008 “Guidelines for soil filter media in bioretention systems”. Check FAWB website () for latest revision.

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DRAWINGS PREPARED BY
aquatica

TITLE
WSUD TYPICAL DRAWINGS
BIORETENTION SYSTEM
DETAILS (3)

SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D08	A3
SHEET 8 OF 12	DATUM N/A		

SOIL MEDIA
Soil media for bioretention systems should meet the *Facility for Advanced Biofiltration Guidelines for Soil Filter Media in Bioretention Systems*. These guidelines can be downloaded from http://www.monash.edu.au/fawb/products/obtain.html. Please download the latest version, as the guidelines are periodically updated to reflect recent research findings.

A summary of FAWB's current specifications, (Version 2.01, March 2008), is provided here for reference:

Filter Media Specification:
In general the filter media should be a loamy sand with an appropriately high permeability under compaction and should be free of rubbish, deleterious material, toxicants, declared plants and local weeds, and should not be hydrophobic. The filter media should contain some organic matter for increased water holding capacity but be low in nutrient content.

Hydraulic conductivity = 100-300 mm/hr, as measured using the ASTM F1815-06 method. Note that when modelling in MUSIC the modelled hydraulic conductivity should be be 50% of the specified hydraulic conductivity.

The filter media should be well-graded i.e., it should have all particle size ranges present from the 0.075 mm to the 4.75 mm sieve (as defined by AS1289.3.6.1 - 1995). There should be no gap in the particle size grading, and the composition should not be dominated by a small particle size range. An ideal particle size distribution is as follows:

- Clay & Silt (<0.05 mm) <3%
- Very Fine Sand (0.05-0.15 mm) 5-30%
- Fine Sand (0.15-0.25 mm) 10-30%
- Medium to Coarse Sand (0.25-1.0 mm) 40-60%
- Coarse Sand (1.0-2.0 mm) 7-10%
- Fine Gravel <3% (2.0-3.4 mm)

Organic Matter Content – less than 5% (w/w).

pH – as specified for "natural soils and soil blends" 5.5 – 7.5 (pH 1:5 in water).

Electrical Conductivity (EC) – as specified for "natural soils and soil blends" <1.2 dS/m.

Phosphorus - <100 mg/kg

Transition Layer Specification:
Transition layer material should be a clean, well-graded sand/coarse sand material containing little or no fines

Drainage Layer Specification:
The drainage layer should be a clean, fine gravel, such as 2-5 mm washed screenings

Note that the filter media, transition layer and drainage layer specifications are designed to minimise the migration of fines through the bioretention system, without the use of geotextiles.

MULCH
Mulch is not essential in bioretention systems, but can assist with moisture retention and weed suppression, particularly during plant establishment. Where the depth to the system surface is an issue, mulch can also be used to raise the effective surface level, while still allowing for extended detention within its void spaces. Note that the mulch layer will reduce the extended detention storage volume and reduce the treatable volume of stormwater.

The most appropriate mulch in a biroetention system is a non-floating material such as crushed rock, gravel or hardwood chips.

In large systems established off-line, floating mulch could be used during the establishment phase, providing that it breaks down quickly before the system is placed on-line.

DRAINAGE PIPES
In bioretention systems, the recommended material for subsoil drainage pipes is slotted 100 mm PVC-U (consistent with AS/NZS 1254). Joints should be solvent cement glued to ensure stability, and wherever possible, bends should be 45 degrees, to ensure that the pipe can be effectively flushed in the event of a blockage.

Perforated plastic pipe ("ag" pipe) is not recommended due to the risk of compression and blockage.

LINERS
Not all bioretention systems need to be lined, however where the system needs to be water-tight, a pond liner is recommended: 0.75 mm (30 mil) polyethylene or equivalent.

Builders plastic (standard 200 micron) can also be used to line a small system where some exfiltration is tolerable.

SCOUR PROTECTION
Scour protection is usually constructed in rock, with the rock size specified according to the expected flow velocity.

Place a non-woven geotextile fabric beneath all rock work. Grout rock in place to ensure stability.

VEGETATION
Vegetation for bioretention systems needs to be able to withstand periodic inundation, as well as dry conditions between rain events. The filter media is a sandy, well-drained soil.

The vegetation in a bioretention system plays an important role in pollutant removal and in maintaining the hydraulic conductivity of the filter media. Dense vegetation is important to maintain treatment performance. Ideal plants for bioretention systems are those with extensive fibrous root networks.

Suitable plants may include trees, shrubs, sedges, grasses and groundcovers. Note that trees generally require a greater depth of filter media than smaller plants. Vegetation selection should consider the points above, as well as site-specific issues such as sun/shade, exposure and aesthetics. Locally native species are recommended where possible.

Plants in 50 mm tubes or hiko cells are generally suitable for planting in bioretention systems. Smaller seedlings may require a longer establishment period. The recommended planting density is a minimum of 6-8 plants per sqm.

KEY INSPECTION/HOLD POINTS
During construction, it is recommended that the designer undertake inspections at key points, to ensure that bioretention systems are installed according to their design intent. The following hold points are recommended for inclusion in design drawings/specifications (subject to site-specific requirements):

- Completion of bulk earthworks and inspection of subgrade
- Installation of geotextile and/or liner as appropriate
- Installation of diversion pits and pipes
- Installation of overflow pit and pipe
- Installation of slotted pipes and flushing points
- Installation of drainage layer
- Installation of transition layer
- Installation of filter media
- Completed works, including scour pads, mulch and planting

At each stage, check the finished levels as well as the quality of completed work.

ESTABLISHMENT
It is recommended that bioretention systems be established off-line wherever possible. This allows vegetation to establish without being impacted by high stormwater flows.

Design drawings need to show temporary works for the establishment phase, such as a temporary cover on a diversion inlet, temporary irrigation and temporary erosion control.

Further information on the establishment phase is available in the Water by Design "Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands" and the wsud.org "WSUD Interim Reference Guideline – Construction and Establishment for Swales, Bioretention Systems and Wetlands".

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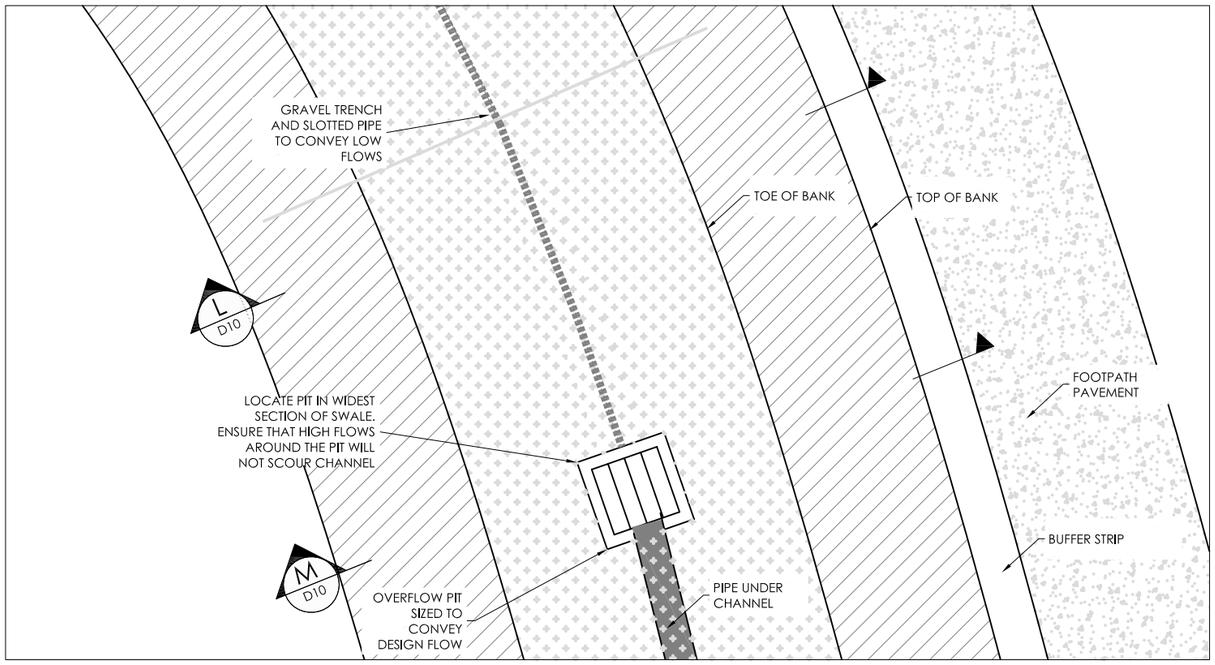
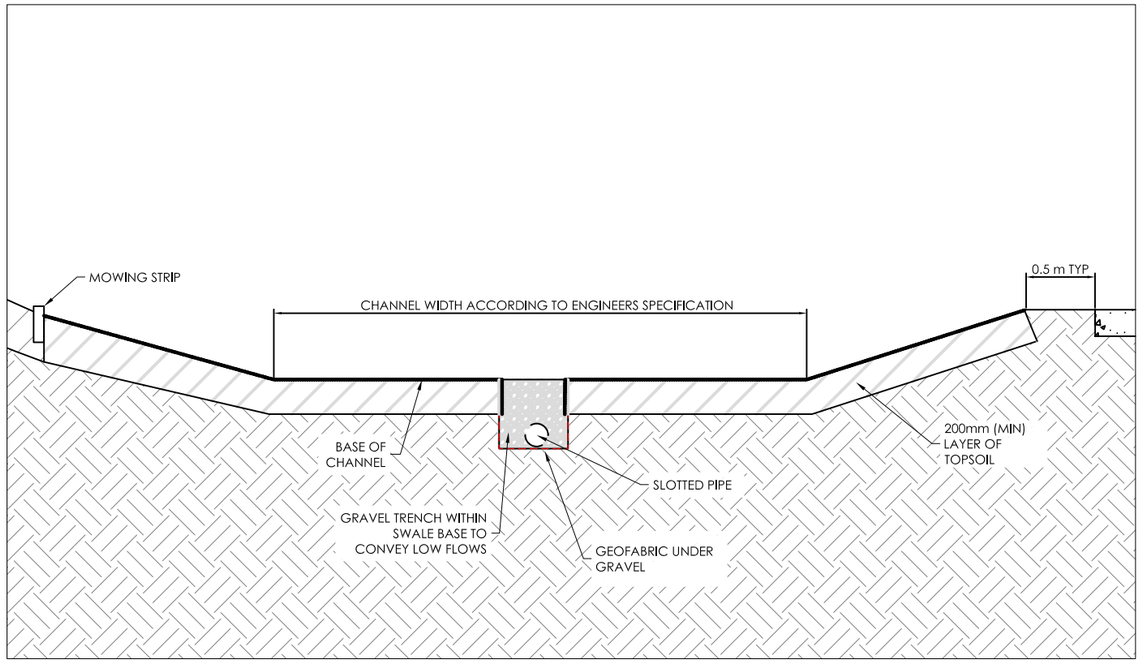
DRAWINGS PREPARED BY
aquatica

TITLE
WSUD TYPICAL DRAWINGS
BIORETENTION
GUIDELINE SPECIFICATIONS

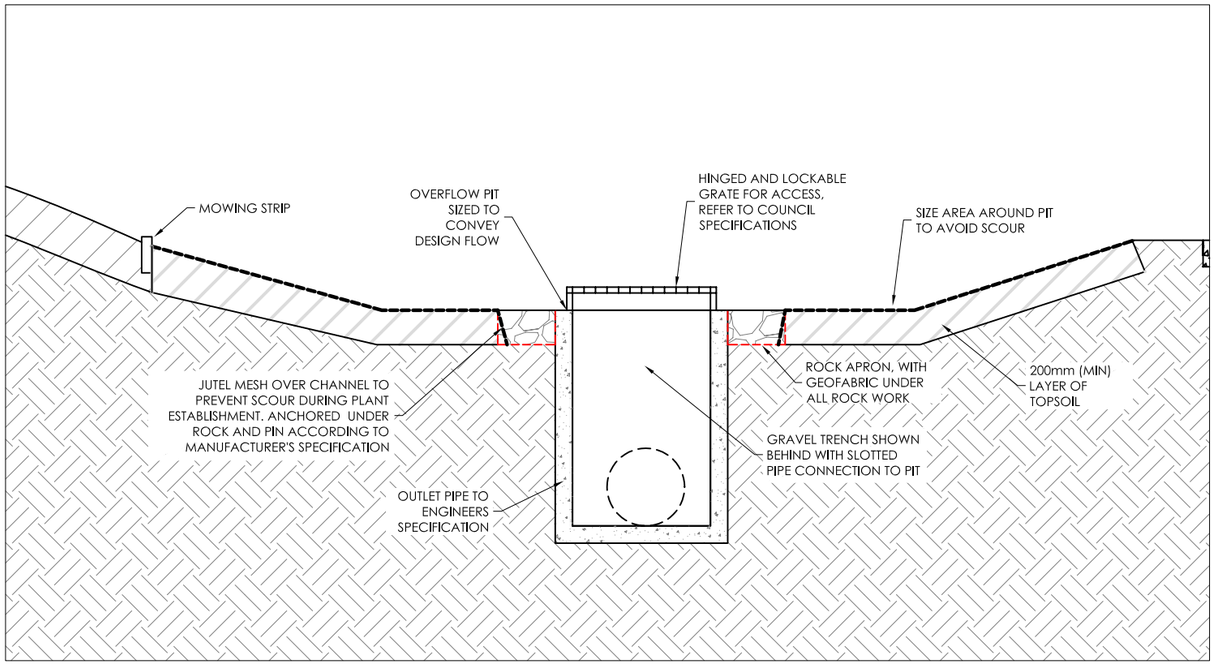
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D09	A3
SHEET 9 OF 12	DATUM N/A		



PLAN 5
TYPICAL SWALE FOR A FLAT SITE
NTS



SECTION L D10
NTS



SECTION M D10
NTS

Design notes:

- Permanent ponding and waterlogging can be an issue in flat swales, where the longitudinal slope is 1% or less.
- Low flow drainage (as shown) is recommended to minimise this problem. Consider multiple slotted pipes in large swales or where the grade is less than 0.5%
- Where swales are incorporated in street verges, other key issues include:
  - cross-sectional dimensions need to accommodate pathways, etc. to meet local authority guidelines
  - crossing points - refer D12 for driveway crossing detail
  - inflows from neighbouring allotments - refer D12 for detail of a surcharge pit, appropriate for connecting allotment drainage pipes into swales
  - protection from vehicular damage. Consider bollards or other barriers to prevent vehicle entry
  - a root barrier may be required where the swale includes trees planted next to roadways or other infrastructure
- Refer HWP (2006) for further design guidance

References:

- Healthy Waterways Partnership (HWP) 2006 "Water Sensitive Urban Design Technical Design Guidelines for South East Queensland". Check Water by Design website (www.waterbydesign.com.au) for latest update.

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DRAWINGS PREPARED BY
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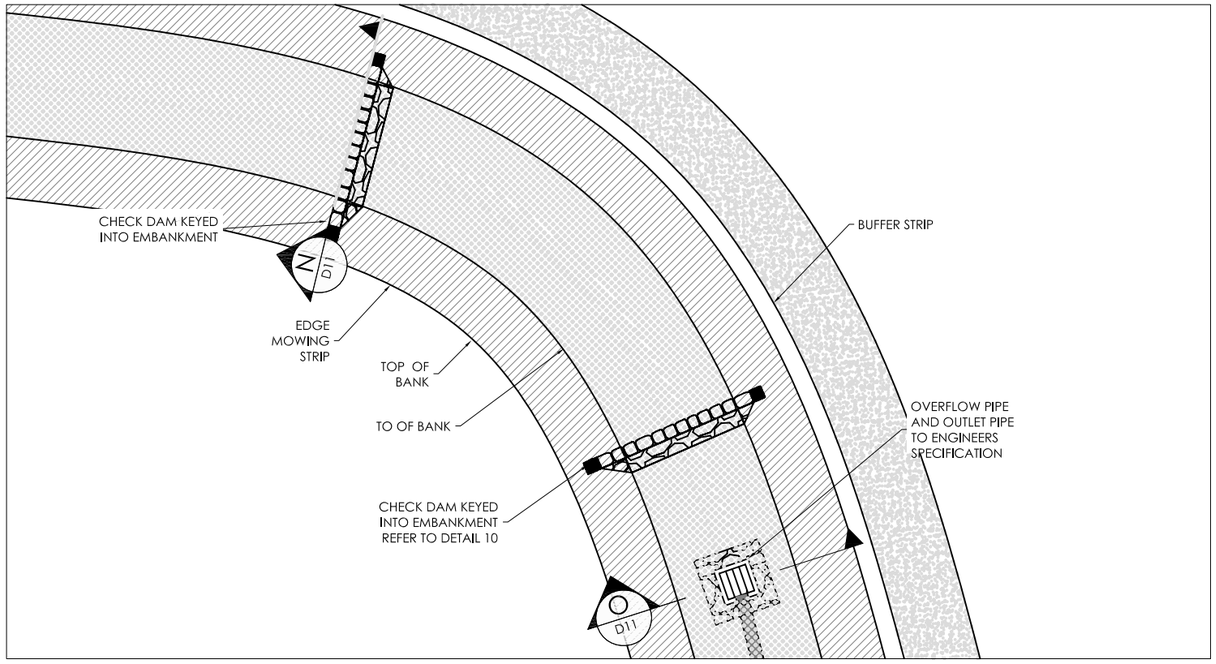
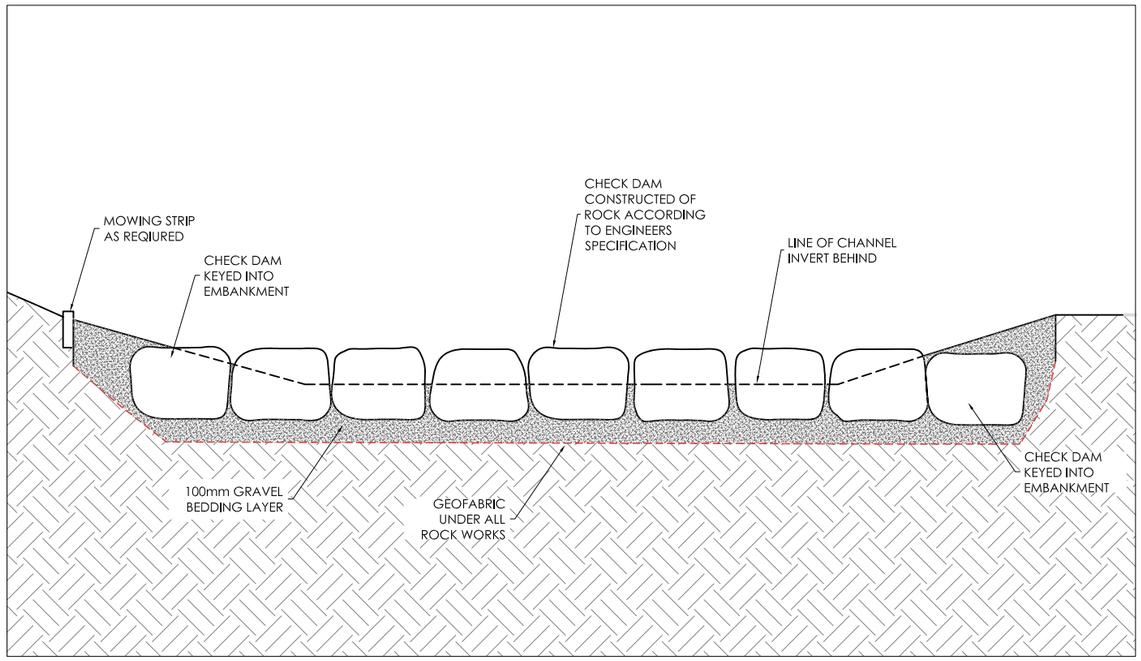
TITLE
WSUD TYPICAL DRAWINGS
SWALE FOR A FLAT SITE

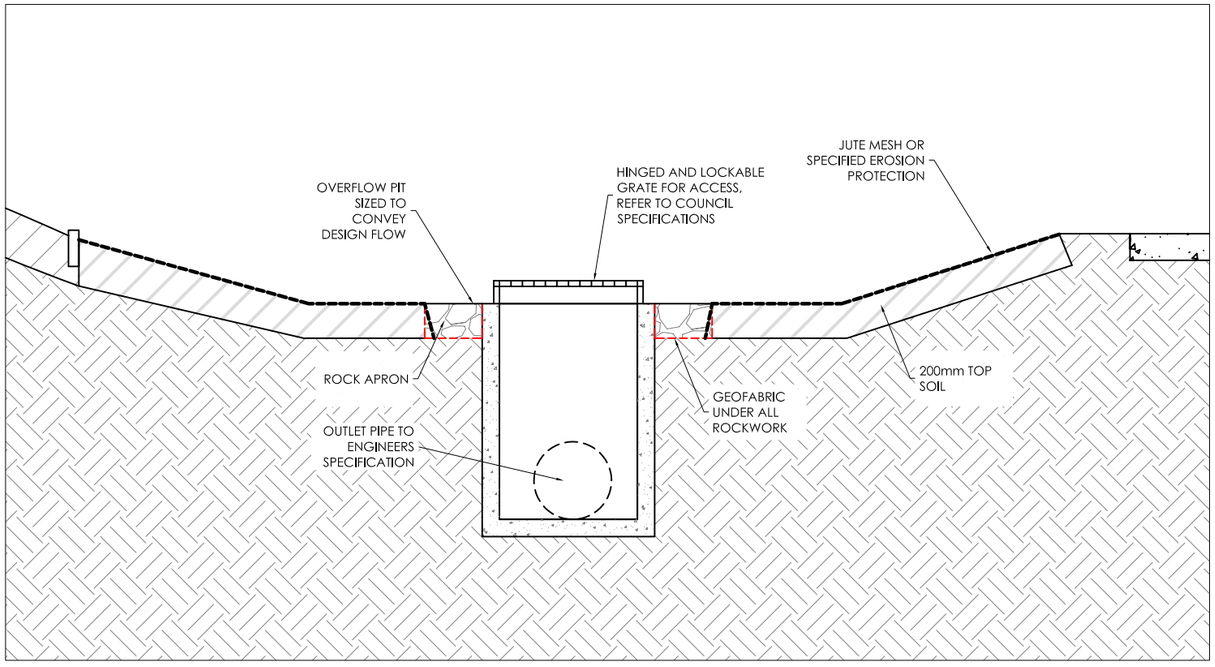
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D10	A3
SHEET 10 OF 12	DATUM N/A		



PLAN 6
TYPICAL SWALE FOR A STEEP SITE
NTS



SECTION N D11
NTS



SECTION O D11
NTS

Design notes:

- Scour and erosion can be an issue in steep swales, where the longitudinal slope is 4% or greater.
- Check dams (as shown) are recommended to minimise this problem
- In steep swales, scour and erosion can also occur around overflow pits and other structures - scour protection is recommended as shown
- Refer HWP (2006) for further design guidance

References:

- Healthy Waterways Partnership (HWP) 2006 "Water Sensitive Urban Design Technical Design Guidelines for South East Queensland". Check Water by Design website (www.waterbydesign.com.au) for latest update.

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TITLE
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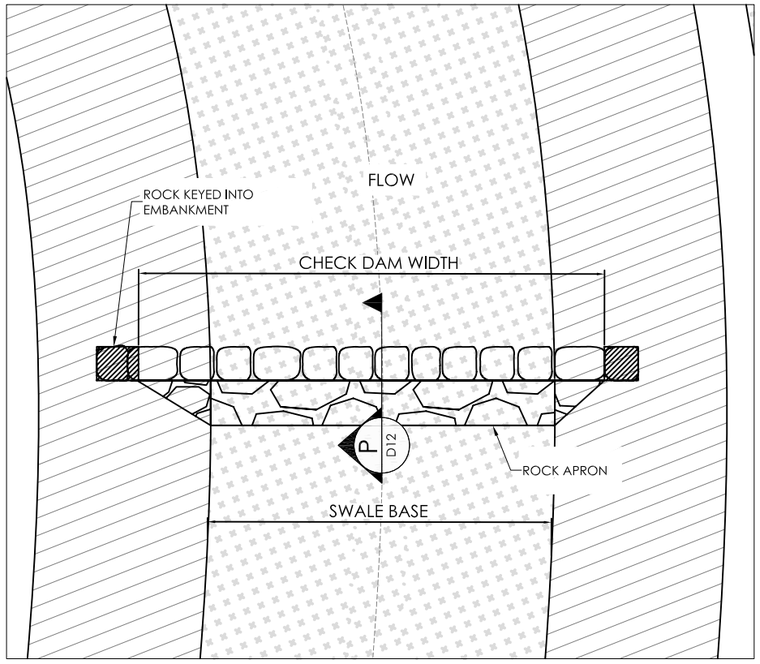
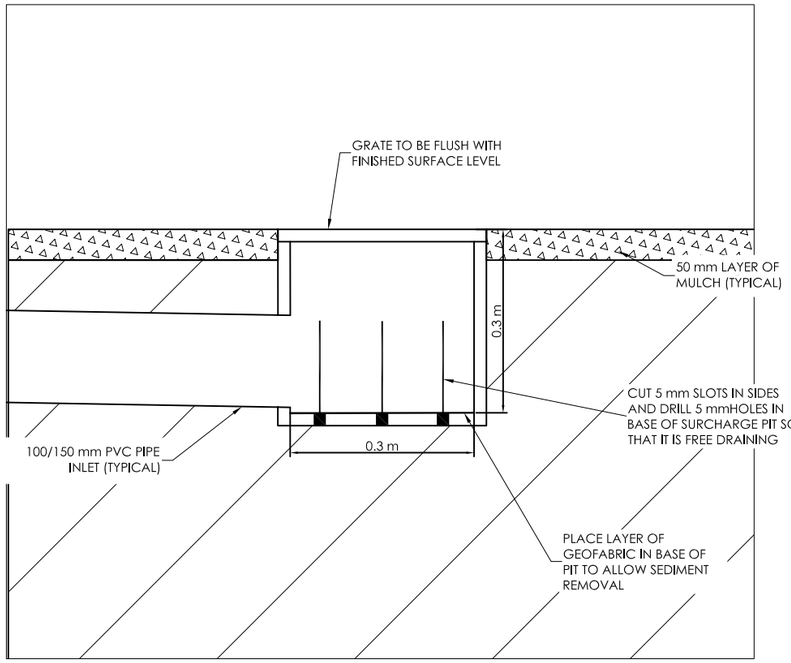
SWALE FOR A STEEP SITE

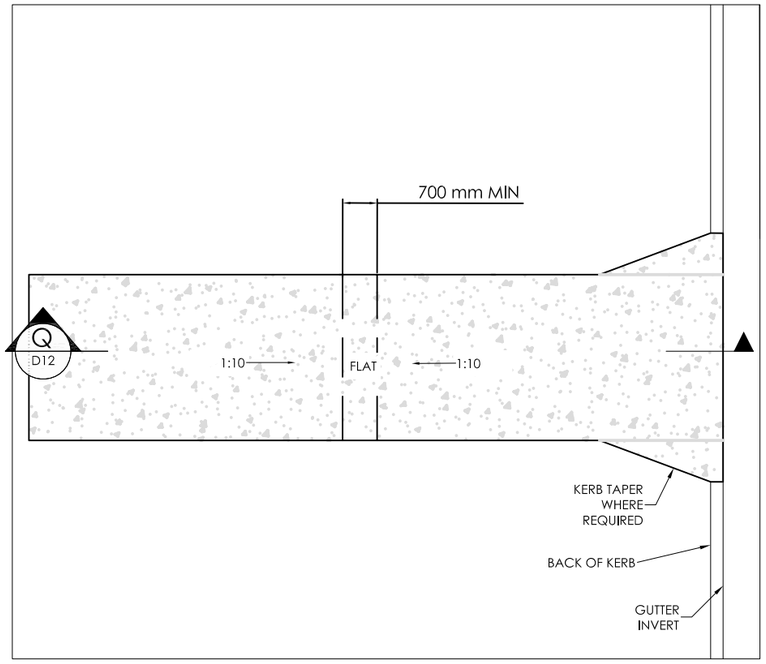
SCALE	PROJECT No	DRAWING No	
AS SHOWN	2310	D11	A3
SHEET 11 OF 12	DATUM N/A		



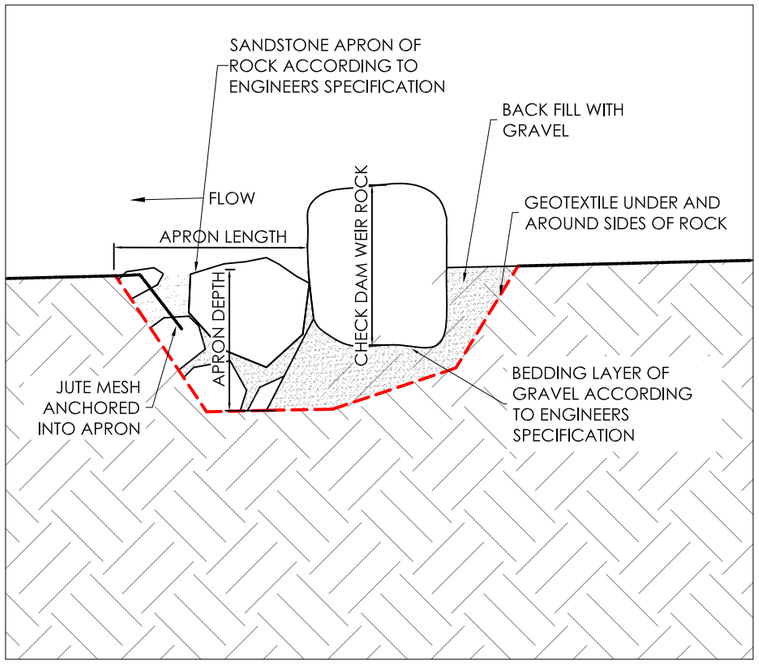
DETAIL 10
TYPICAL CHECK DAM
NTS



DETAIL 11
TYPICAL SURCHARGE INLET FOR ROOF DRAINAGE
SCALE 1: 5



DETAIL 12
TYPICAL DRIVEWAY CROSSING
NTS



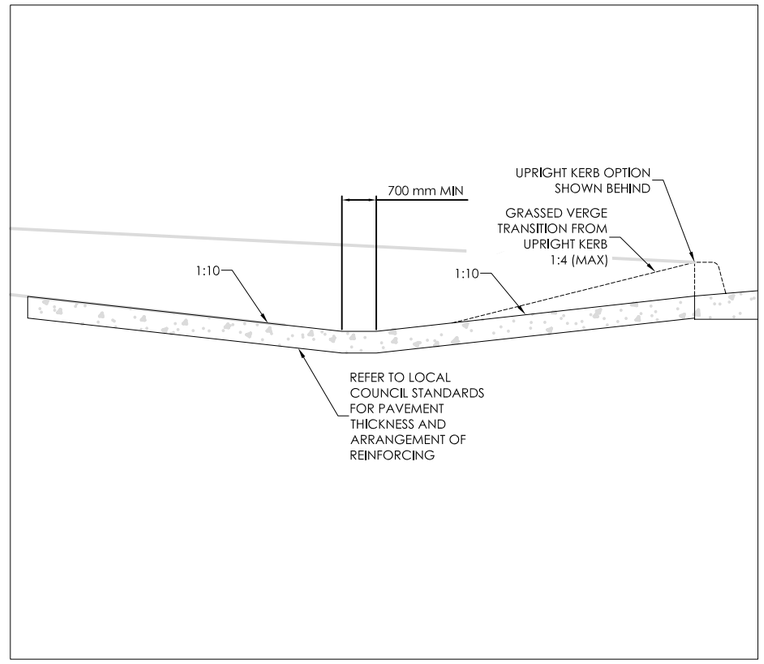
SECTION P D12
NTS

Design notes:

- For guidance on sizing and spacing of check dams, refer HWP (2006)
- Check dams can also be constructed from other materials - e.g. logs, wood or concrete
- All check dams require careful installation to ensure they are built to the correct levels and will be stable under design flow conditions
- Surcharge inlets are suited to runoff that is from roofs and free from debris. Surface water should be drained via a different method.
- A relief point should be provided where there is a risk that the surcharge inelt blocks and causes ponding on the upstream property
- HWP (2006) recommends a maximum slope of approximately 1 in 9 for an at-grade driveway crossing
- Refer to Australian Standard 2890 for driveway design standards

References:

- Healthy Waterways Partnership (HWP) 2006 "Water Sensitive Urban Design Technical Design Guidelines for South East Queensland". Check Water by Design website (www.waterbydesign.com.au) for latest update.



SECTION Q D12
NTS

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TITLE
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SWALE DETAILS

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