Muswellbrook Shire Council

DEVELOPMENT DESIGN SPECIFICATION

AUS-SPEC (Cot 09)

0075 Control of erosion and stormwater management

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
0	Customisation for Muswellbrook Council Local Government Area	all	AMPO		24/10/2011

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0075 CONTROL OF EROSION AND STORMWATER MANAGEMENT

1 SCOPE AND GENERAL

1.1 SCOPE

Virtually all construction activity which requires the disturbance of the soil surface and the existing vegetation, naturally predisposes the construction site to erosion. This in turn leads to sediment loss in the resultant run-off water.

Since such soil disturbance is a necessary part of construction, it is essential therefore to develop measures which reduce the erosion hazard of any particular construction activity. Having done that, it is necessary to control run-off water, which carries the sediment, in such a way as to reduce the amount of that sediment leaving the site to an acceptable level.

After construction is complete and the site fully rehabilitated, permanent water quality control structures and features commence their role. These include trash racks, gross pollutant traps, wet retention basins and the creation of, or increase in size of wetlands.

This worksection shall be read in conjunction with the council Development Control Plan – Section 20, Erosion and Sediment Control.

1.2 OBJECTIVES

The objective of this worksection is to:

- Limit/minimise the amount of site disturbance.
- Isolate the site by diverting clean upstream 'run-on' water around or through the site where possible.
- Control runoff and sediment movement as its point source rather than at one final point.
- Stage earthworks and progressively revegetate the site where possible to reduce the area contributing sediment. This in turn increases the efficiency and effectiveness of the entire sediment control system while decreasing the number and size of controls required.
- Provide an effective major stormwater system economical in terms of capital, operational and maintenance costs, incorporating water quality controls.
- Retain topsoil for effective revegetation works.
- Locate sediment control structures where they are most effective and efficient.

1.3 CROSS REFERENCES

Worksections

Associated worksections: Conform to the following worksections:

- *0160 Quality (Design).*
- *0074 Stormwater drainage (Design).*
- *0257 Landscape – Roadways and street trees.*
- *1102 Control of erosion and sedimentation.*

1.4 BIBLIOGRAPHY

State legislation

New South Wales:

Protection of the Environment Operations Act, 1997

Dams Safety Act, 1978

Soil Conservation Act, 1938

Water Act, 1912

Queensland:

Queensland Environmental Protection Act, 1994

Soil Conservation Act, 1986

Water Resources Act, 1989

Water Course Protection Regulation, 1993

South Australia:

SA Environment Protection Act (1993)

Water Resources Act, 1997

Victoria:

Environmental Protection Act, 1970

Water Act, 1989

Western Australia:

Environmental Protection Act, 1986

Waterways Conservation Act

Water and Rivers Act

Right in Water and Irrigation Act

Country Water Area Supply Act

Soil and Land Conservation Act

State and Territory Authority publications

Appropriate State Authorities as may or may not be included in the following listing:

Australian Capital Territory

Design Manual for Urban Erosion and Sediment Control—July 1988

'Protecting the Murrumbidgee from the Effects of Land Development'

'Guidelines for Erosion and Sediment Control on Building Sites'

Implications for Building Construction

Pollution Control on Residential Building Sites (Brochures)

Field Guide—Erosion and Sediment Control

Australian Journal of Soil and Water Conservation—Vol. 3, Number 1

New South Wales

- Department of Housing
- Managing Urban Stormwater, Soils and Construction, 3rd Ed. Aug. 1998.
- Roads and Traffic Authority
- Erosion and Sedimentation Design Considerations.
- Soil Conservation Service
- Erosion and Sediment Control—Model Policy and Code of Practice (Discussion Paper)
- NSW Department of Land and Water Conservation (DLWC)
- Urban Erosion and Sediment Control
- *Western Australia*
- Water and Rivers Commission
- Urban Erosion and Sediment Control: Field Guide 199
- Using Wetlands for Nutrient Stripping: Seminar Proceeding 1994
- Department of Environmental Protection, Western Australia. Land development sites and impacts on air quality: a guideline for the prevention of dust and smoke pollution from land development sites in Western Australia
- *Queensland*
- Department of Natural Resources and mines
- Dam Safety Management Guidelines, 1994
- Department of Main Roads
- Erosion and Sedimentation Control Manual, 1998

Other publications

Engineers Australia, Queensland Division (EAQ)

Soil Erosion and Sediment Control—Engineering Guidelines for Queensland Construction Sites, 1996.

Brisbane City Council (BCC)

Muswellbrook Shire Council Development Control Plan – Section 20, Erosion and Sediment Control – April 2009

Integrated Environment Management System Manual, 1997.

1.5 PLANNING AND CONCEPT DESIGN

Site characteristics

The Designer shall assess the physical characteristics and limitations of soils, landform and drainage of the proposed site and plan the works accordingly.

Approval

An erosion and sedimentation concept control plan for all projects shall be prepared and submitted to Council for approval.

The approved concept design shall be included in the Drawings for the project.

1.6 DETAILED DESIGN

Responsibility for design

The organisation responsible for the preparation of the detailed design of the Erosion and Sedimentation Control Plan will depend on whether the Works are to be constructed by Council or by Contract.

- Where Council's staff are utilised, the detailed design shall be prepared by Council, or its Consultant, in accordance with this worksection and 1102 *Control of erosion and sedimentation*.
- For Works by Contract, the Contractor is responsible for preparing, and submitting for approval, the detailed Erosion and Sedimentation Control Plan in accordance with the requirements in 1102 *Control of erosion and sedimentation* and the Contract Drawings.

Approval

These detailed Erosion and Sedimentation Control Plans shall be referred to the Designer for a concurrence report in both cases and subsequent consideration for approval by Council.

No site works shall commence prior to approval of the detailed Erosion and Sedimentation Control Plan.

All works are to be carried out in accordance with the approved erosion and sedimentation control/water management plan. Its implementation must be supervised by personnel with appropriate qualifications and/or experience in soil conservation on construction sites.

Drawings

Detailed engineering designs for the Erosion and Sedimentation Control Plan shall include scaled drawings (no larger than 1:1000) and detailed specifications/diagrams which can be readily understood and applied on site.

All Drawings shall be in accordance with the minimum drafting requirements in 0160 *Quality (Design)*.

Items to be included, but not limited to, shall be:

- existing and final contours
- the location of all earthworks including roads, areas of cut and fill and re-grading
- location of access haulage tracks and borrow pits
- location and design criteria of erosion and sediment control structures
- location and description of existing vegetation
- proposed vegetated buffer strips and 'no access' areas
- location of critical areas (vegetated buffer strips, drainage lines and structures, water bodies, unstable slopes, flood plains and seasonally wet areas)
- type and location of diversion works to direct uncontaminated run-on around areas to be disturbed
- revegetation program
- procedures for maintenance of erosion and sediment control
- details for staging of works

Additional works

The erosion and sedimentation control/water management plan and its associated control measures shall be constantly monitored, reviewed and modified as required to correct any deficiencies. Council has the right to request changes if, in its opinion, the measures that have been put in place are inadequate.

Sample design

If required, example design details of water quality structures, sediment and erosion control devices may be obtained from Council and used as a guide when preparing an erosion and sedimentation control/water management plan.

2 EROSION CONTROL

2.1 BUFFER ZONES

General

Wetlands, stream and rivers adjacent to construction sites shall be protected by buffer zones.

Buffer zones are corridors of vegetation adjacent to waterways or disturbed areas. The vegetation filters suspended solids and reduces the nutrient levels in run-off.

Performance and width

Buffer zone performance increases as catchment area and slope gradient decreases. Thirty-metre-wide buffer zones generally provide adequate protection.

Table 2.1 Buffer width (m) vs slope (%) of run-off

Slope (%)	Buffer width (m)
2	15
4	20
6	30
8	40
10	50
12	60
14	70

Contaminated water

Contaminated water in a concentrated form shall require treatment both at its sources point and final disposal. However buffer zones can reduce the need for other erosion and sediment control measures.

Fencing

A fence shall be used to exclude traffic from buffer zones to prevent damage to the vegetation, particularly during any construction phase.

2.2 'NO ACCESS' AREAS

Conserve vegetation

Existing vegetation on work sites shall be conserved as much as possible.

The landscape plan shall incorporate as much existing native vegetation as possible.

'No access' fences

Fenced areas shall be clearly signposted 'No Access Area'.

The 'no access' fence locations shall be shown on the detailed engineering design. These locations will be approximate only as machinery type, topography etc will determine actual on site location.

2.3 DIVERSION WORKS

Diversion types

Diversion works may be in the form of earth drains and banks, hay bales, sand bags or even pipelines and may be permanent or temporary.

Discharge point

Such techniques are used to divert the upstream run-on water around the site. Such flows shall discharge to a formal drainage point or open areas where level spreader banks should ensure a broad water spread.

Pipelines

Pipelines may also be used to convey such run-on through the site, and discharge the flow to a formal drainage point/dissipater if necessary. Such pipelines may also form part of the overall final drainage system.

Drain shape and pipe capacity

Diversion works are designed to carry peak flows at non-erosive velocities in bare soil, vegetated or lined drains/banks.

Design of the diversion system should suit the following:

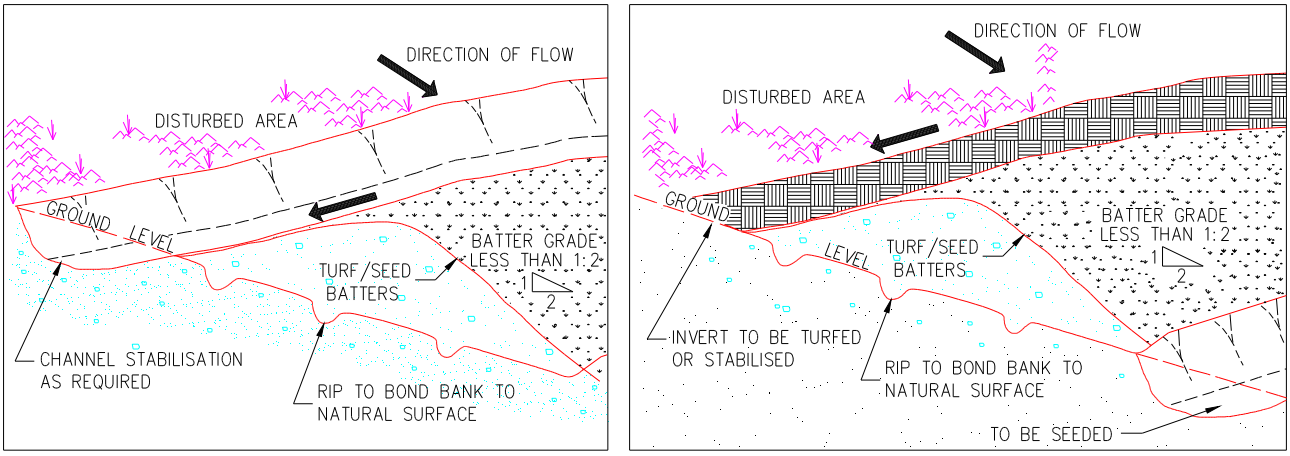
The drain should preferably be dish shaped with batter grades of less than 2:1

If a piped system is selected its design capacity shall be a minimum of the capacity nominated in 0074 *Stormwater drainage (Design)*.

Channel linings

Generally, the channel should be lined with turf. However, where velocities are designed in excess of 2 m per second, non erosive linings such as concrete, geotextiles, grouted rock etc or velocity reducers (check dams, etc.) are required.

Typical arrangements of diversion drains and banks are shown in Figure 2.1.



DIVERSION DRAIN DIVERSION BANK

Figure 2.1 Diversion drains/banks

2.4 DROP DOWN DRAINS

Dished and lined drains

These are temporary or permanent drains which divert concentrated run-off down slopes such as road batters without causing erosion.

They usually consist of a dished earth drain smoothly shaped, consolidated and lined with a variety of materials or they may be a flexible/rigid pipe or half pipe.

Piped drains

Drop down drains consisting of rigid, or flexible, pipes are very effective as a temporary measure during road construction used in association with an earth windrow (or bund wall) along the top edge of the batter.

Run-off flowing along the windrow is directed to the pipe by which water is conveyed down the batter. It is a simple matter to extend the pipe as the batter rises.

Capacity

Drop down drains shall have sufficient capacity for a minimum 1 in 5 year peak flow without eroding. Energy dissipaters may be required to reduce the flow velocity at the outlet of the drop down drain.

2.5 STOCKPILES

Location

The location of stockpiles shall be indicated on the approved engineering Drawings.

They shall be located:

- Clear of existing or proposed drainage lines.
- Clear of areas likely to be disturbed during construction.
- Clear of the drip zone of trees.
- Preferably on reasonably flat areas.

Erosion protection

Stockpiles shall be protected from erosion and sediment loss by:

- The installation of diversion works.

- The use of silt fences, hay bales etc. or other approved controls on the downstream side.
- Compaction.
- Revegetation if left exposed for longer than 30 days (refer to the 0257 *Landscape – roadways and street trees* for seed mix).
- Topsoil stockpiles
- Site topsoil shall be isolated from subsoil material in separate stockpiles.

2.6 SEDIMENT BASINS, TRAPS AND DAMS

Retention structure
Sediment basins, traps and dams are either permanent or temporary sediment control devices that intercept sediment and run-off usually at the final discharge point of the site.

Construction
They are formed by excavation and/or by constructing embankments.

Types
There are two types of basins - wet and dry.

Location
Preferably sediment traps shall not be located directly upstream of residential areas.

Design criteria
Basin design shall meet the following:

- Volume/capacity of the trap shall be 250 m^3/ha of disturbed site including the building areas.
- An allowance of 50 m^3/ha is required if diversion controls are not used to direct clean upstream water from outside the site away from construction areas.
- The capacity shall be measured below the invert of the lowest incoming flow. Otherwise pipelines and associated works will be affected.
- A secondary or emergency stabilised spillway must be provided to prevent overtopping of the structure. This shall be directed to a safe overland flow path.
- The basin shall have a minimum of 0.5 metres freeboard above the level of the spillway.
- The basin shall be surrounded by a manproof fence with lockable gates.
- An all weather access must be provided to the basin for maintenance.
- The basin shall have an arbitrary length to width ratio of between 2:1 and 3:1. This encourages soil particle settlement. The entry and exit points should be located at the opposite ends of the basin.
- If this is not possible some form of approved baffles shall be installed to minimise short circuiting of the flow.
- Discharge of the basin shall be via a perforated riser encapsulated by a filter device for a dry basin. Wet basins shall be flocculated by dosing with gypsum and pumped.
- Internal basin batters shall be a maximum of 3:1 and external batters a maximum of 2:1.
- All disturbed areas including batters shall be topsoiled and seeded.
- In areas known to be affected by high groundwater tables and/or salinity of groundwater, basins shall be designed to be water retentive so that surface drainage water does not leak to the subsurface, recharging groundwater.

Permanent wet basins
Permanent wet basin designs slightly vary from the above. Refer to the **Stormwater Management**.

2.7 SEDIMENT TRAPS AND BARRIERS FOR MINOR CATCHMENTS

Retention/filtering structure
These are silt retention/filtering structures of a temporary nature used in situations where the catchment does not exceed 0.5 ha.

Types
Such sediment traps/barriers generally consist of:

- Silt fences.
- Hay bales.
- ‘Blue metal’ groynes/sausages.
- Filter fabric located beneath stormwater grates.

- Gabions.
- Or a combination of the above.

Location
The choice of material and type of treatment will depend on the size of the catchment the location and the structure being treated such as:

- Surface inlet pits.
- Kerb inlet pits.
- Catch drain disposal areas.
- Culvert inlets and outlets.
- Minor construction/earthwork sites.
- Check dams/velocity reducers etc.

2.8 LEVEL SPREADERS

Purpose and structure
Level spreaders are outlets or 'sills' having a level cross section. They convert erosive channelised flows into non-erosive sheet flow.

Location
Level spreaders can only be used to dissipate flows from small catchments. The area below the outlet should be stable and of even cross section so that the water will not re-concentrate into channels.

Design criteria
To reduce flow velocity before the spreader, the channel grade shall not exceed 1% for a minimum of 8 metres.

The outlet or 'sill' width depends on contributing catchment, slope and ground conditions. The minimum width should be four metres, and the maximum width 25 metres.

Final discharge should be over a level surface, which may require stabilising by turfing or seeding and fertilising or perhaps lining with a geotextile fabric or something similar.

2.9 SHAKEDOWN AREAS AND ACCESS STABILISATION

Construction site access
Access to construction sites shall be limited to a maximum of two locations.

Location approval
Such access locations shall require Council approval.

Types
Shakedown areas or access stabilisation shall comprise a bed of aggregate on filter cloth or a metal bar cattle grid located at any point where traffic enters or leaves a construction site.

Stabilised accesses reduce or eliminate tracking of sediments onto public rights of way or streets. Should such tracking occur the contaminants must be swept off the road way each day or before rain. Clean off draw bars etc after dumping and before starting journey.

Shaker grids (Cattle grids)
If a shaker grid is used, this should be so placed as to ensure the vehicles when crossing the grid have sufficient speed to 'shake the mud' or other contaminants such as gravel from the vehicle.

It must not be placed where the vehicle is slowing to enter a roadway.

Shaker grids shall be a minimum length of 7 metres.

Stabilised access
A stabilised access comprises a vehicular pathway suitably constructed to facilitate the collection of any site debris in order to prevent such material leaving the site.

Stabilised accesses are generally used on small sites.

The entrance shall be at least 15 metres long with a minimum width of 3 metres for a one way entrance and 6 metres minimum width for a two way entrance.

Flow control
Surface water flowing to the street entrance/exit must be piped under the access, or a berm constructed to direct surface flow away from the exit.

2.10 WIND EROSION AND DUST CONTROL

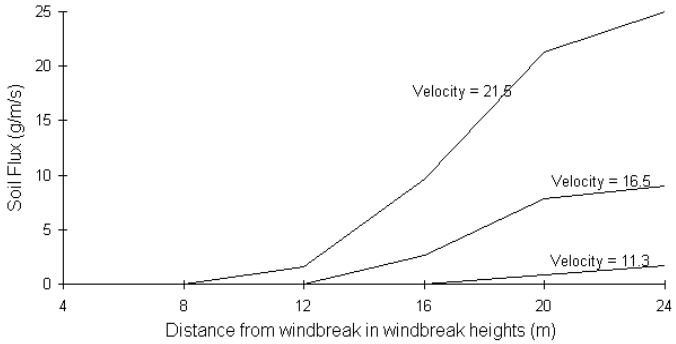
Erosion rate

Research has demonstrated average dust emission rates of over 2½ tonnes per hectare per month at urban construction sites. This erosion rate is unacceptable.

Treatments

Various measures are available to minimise such emissions, including:

- limiting the area of lands exposed to erosive forces through phasing works/progressive revegetation and/or provision of a protective ground cover and/or keeping the ground surface damp (not wet); and/or
- on building sites, installing a barrier fence on the windward side—effective to a distance of 15 times its height, assuming an acceptable soil flux of 5 g/m/sec. See Figure 2.2.



Effect of distance from windbreak on soil loss, wind blowing at less than 90 to the windbreak.

Figure 2.2 Pollution control

2.11 REQUIREMENTS FOR BUILDING SITES—INTERNAL

Site clearing

The clearing of vegetation, preparation of building pads and similar construction works are to be undertaken in the last stages of the project when the majority of the site has been effectively revegetated.

When the project calls for the construction of a number of buildings, the sediment trap/s and other appropriate sediment controls shall remain operational.

Driveway control

Cross/catch drains shall be installed on long or steep unpaved driveways, disposing run-off to stable areas.

Site controls

Where a majority of the site is disturbed the following controls or measures shall be taken:

- Silt fences, located around the downstream sides of the site.
- Sediment traps/barriers to be provided to all on-site and adjacent stormwater inlets.
- Only one site access to be provided. This may require treatment to prevent soil being tracked from the site.
- All subsurface drainage for roofing must be in place prior to the installation of the roof and gutter so downpipes can be immediately connected.

2.12 REQUIREMENTS FOR BUILDING SITES – EXTERNAL

Control devices or works

Sediment control devices or stabilising works shall be provided outside construction sites where necessary or as directed by Council.

Likely accelerated erosion

Where increased stormwater run-off is likely to accelerate erosion of any downstream watercourse, the necessary remedial work shall be provided concurrently with other sediment and erosion requirements.

Downstream controls
Where sediment is likely to be transported from the site, all immediate downstream drainage inlets shall have appropriate controls installed.

Entry to private property
If such works require entry onto private property, written permission shall be obtained prior to the entry and commencement of such works.

Reinstatement
All disturbed areas on private property to be reinstated to original condition.

3 STORMWATER MANAGEMENT

3.1 MAIN COMPONENTS OF STORMWATER QUALITY ENHANCEMENT

Council works may require a change in land use and may be accompanied by a decline in stormwater quality. This applies to the long term as well as during the short term construction phase.

The main components required to enhance stormwater quality are as follows:

- Buffer zones and filter strips, being grassed, or similarly treated areas to facilitate the natural assimilation of water pollutants and reduce run-off. Refer to **Buffer Zones**.
- Wet retention ponds are permanent sediment ponds designed to allow particulate matter to settle out. They operate under both sedimentation and macrophyte regimes. Note that a large proportion of nutrients adhere to the sediments, and therefore settle out. Other nutrients are removed by macrophytic vegetation as part of the food chain.
- Trash Racks and Gross Pollutant Traps (GPT) designed to intercept litter and debris to maintain visual quality in downstream waterways, and to reduce the coarse sediment load on downstream water management structures.
- Wetland (nutrient) filter to enhance the removal of fine sediment and nutrients from stormwater run-off, and are largely dependent on biochemical removal mechanisms (i.e. nutrients taken up as part of the plant food chain).

3.2 EXCESS NUTRIENTS

Excess nutrients nitrogen (N) and Phosphorus (P) lead to eutrophication of waterways. Eutrophication is a result of nutrient pollution, such as the release of sewage effluent, urban stormwater run-off, and run-off carrying excess fertilizers into natural waters. This can cause uncontrolled growth of algae, water weeds etc, which can deplete oxygen levels, kill resident flora and fauna, and reduce recreational appeal.

However waterways do have a natural capacity to assimilate nutrients in small to moderate amounts as initial flows have.

It is essential to treat the ‘first flush’ of stormwater as these initial flows from urban areas have relatively high pollutant loads.

Such heavy pollution results from significant areas of impervious surfaces which do not assimilate pollutants such as dust, fertilisers, pesticides, detergents, etc to the same extent as occurs in more rural environments.

3.3 WET RETENTION BASINS AND PONDS

Purpose

Basins designed for water quality control should maximise the extent of settling. In general quiescent conditions and infiltration should be maximised.

Location and size

A wet retention basin can be located either on-line or off-line as shown in Figure 3.1. Its capacity however needs to be considerably greater if it is located on-line.

The wet retention basin usually has some form of energy dissipation at the inlet or a sufficient length-to-width ratio (greater than 2:1) to prevent short circuiting of flow across the pond, although its shape may vary considerably.

It should be located such that the basin does not locally raise the subsurface water table under circumstances that might lead to a salinity problem.

The pond may vary in size, but it usually has a minimum surface area of about 1% of the total catchment area.

At a depth of 2.5 metres, this provides a storage volume approximately equal to the maximum total run-off from a 1 in 1 year storm.

Basins may be installed as smaller multiple units (in series) or as large single units.

Basin efficiency

Other designs that will make the basin efficient in removing particles and provide for public safety, include the following:

- The minimum depth should be not less than 1.5 metres with an average depth of 2.5 metres. This discourages macrophyte growth in the deeper portions of the pond and also the breeding of mosquitos.
- The basins should have side slopes of approximately 1 in 8. This provides for safety and encourages microphyte growth around edges facilitating nutrient uptake.
- The maximum velocity through the pond based on a 1 in 1 year storm should not exceed 0.3 metres per second (at 2.5 metres depth, this is the maximum practical flow velocity at which optimum sediment removal can be achieved).
- A minimum freeboard of 0.3 metres should be provided between a restricted discharge outlet for the pond and a storm overflow weir. This discharge outlet should be designed so that the weir overtops on average three times per year.
- Inlet and outlet structures should be located at extreme ends of the basin, with short circuiting of flow further minimised by the use of baffles.

Construction and maintenance

Basins should be constructed prior to the commencement of any site clearing or construction works, and should be de-silted when the level of sediment reduces the average water depth to less than 1.5 metres.

Outlet design

It may be desirable for the designer of an urban retention basin to incorporate an outlet device that enables dewatering of the basin. This simplifies de-silting, enabling earthmoving equipment to be used for de-silting operations.

Access track

An all weather access track shall be provided to the basin for maintenance works.

Trash racks

It is generally necessary to incorporate a gross solids trap and trash rack facility on major discharges into the retention basin. This prolongs the life of the basin and prevents the accumulation of litter.

Buffer zones

Basins should be surrounded by buffer zones, typically comprising grassed foreshores of not less than 20 metres between the nearest development and the basin.

This allows for some infiltration of drainage from sites, permits the drainage authority scope to develop aesthetic surrounds and reduces the likelihood of over the fence dumping of rubbish.

Settling velocity

The settling velocity of particles should service as the basis for design. This can only be found by conducting standard settling tests or from a knowledge of local soil characteristics.

The surface area of the required basin can then be determined from design settling velocities.

Dam safety requirements

Wet retention basins are regarded as impoundments and normal dam safety requirements shall be met.

The relevant State Authority responsible for dam safety shall be consulted to ascertain their requirements if the wet retention basin is:

- 10 metres or more in height and has a storage capacity of more than 10 megalitres; or
- 5 metres or more in height and has a storage capacity of 50 megalitres or more.

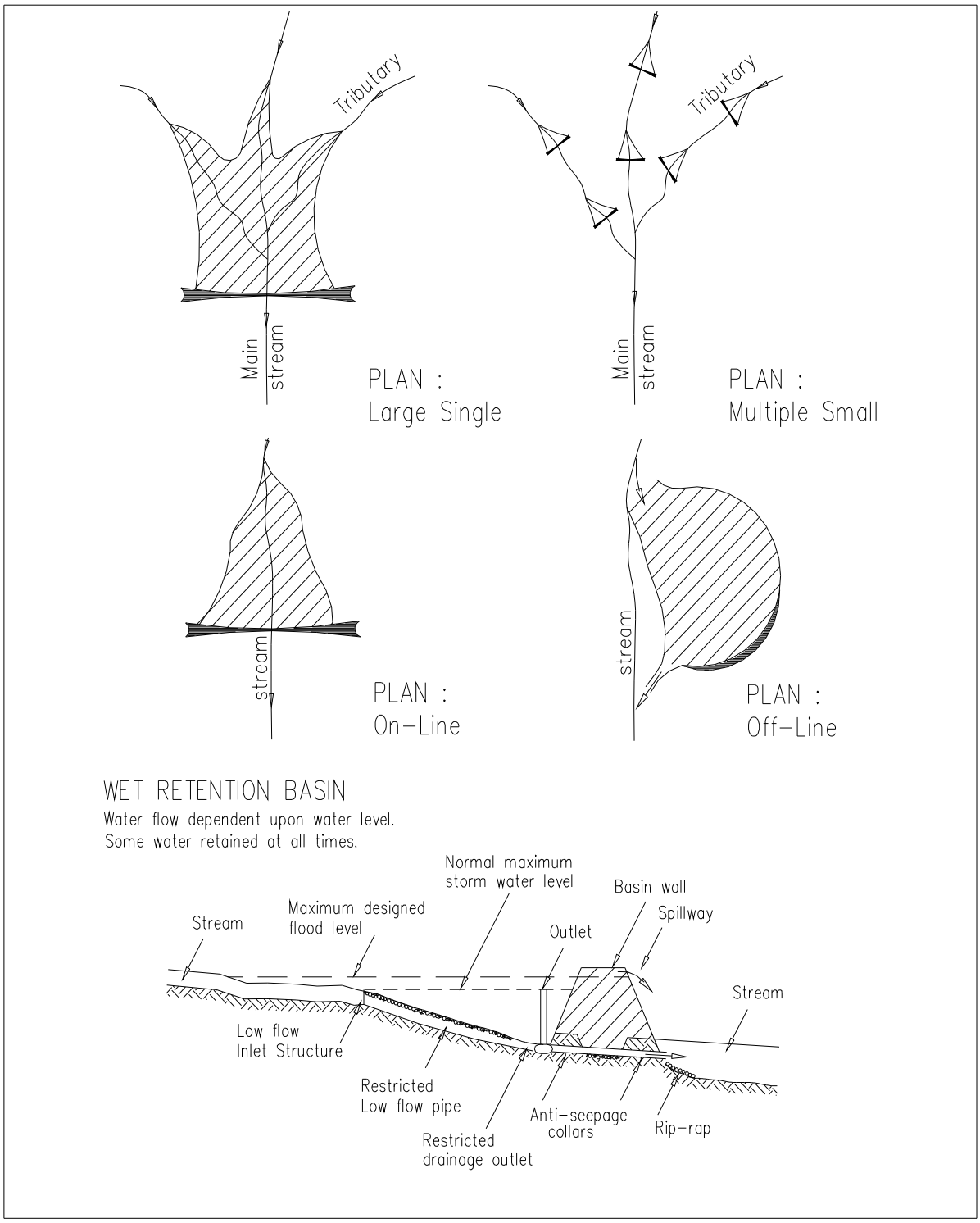


Figure 3.1 Configuration and design of wet retention basins

3.4 TRASH RACKS

Location, purpose and structure

Trash racks are usually permanent structures which intercept trash and other debris to protect the aesthetic and environmental quality of water.

Where appropriate, construct them upstream of all permanent retarding basins and/or wetlands which have a capacity greater than 5,000 cubic metres, and elsewhere as required by Council.

Design criteria

Generally, their design criteria should ensure:

- vertical bar screens with bar spacing of 65 mm clear;
- the length of the rack is consistent with the channel dimension and cause minimal damage when overtopped;
- they are as large as practicable while considering all other design criteria—a maximum height of 1.2 metres is suggested;
- a structure which remains stable in at least the 20 year ARI event, and is unlikely to cause flooding on adjacent lands as a result of the rack becoming completely blocked in the 100 year ARI event (analysis should include investigation of backwater effects and any consequent flooding);
- the structure drains by gravity to a dry condition; and
- adequate access for maintenance and which permits the use of mechanical equipment.

Associated structures
Where associated with outlet structures for small sediment basins or constructed wetlands, they can be relatively simple in design.

Gross pollutant trap
Trash racks may be incorporated in the design of gross pollutant traps.

Maintenance
Trash racks shall be checked periodically and all debris and silt removed.

3.5 GROSS POLLUTANT TRAPS

Location, purpose and structure
Gross pollutant traps (GPTs) are permanent structures used to trap coarse sediments, trash, litter, and other floating materials.

Usually, they are located upstream of constructed wetlands and receiving waters.

They consist of an energy dissipater at the upper end, concrete sediment trap and trash rack at the lower end. Sometimes a 'mini' wetland is incorporated at the downstream end.

GPTs can be defined as major or minor:

- major gross pollutant traps can be located on major floodways and waterways to intercept medium to high flows; and
- minor, enclosed gross pollutant traps can be located at heads of major floodways and/or where stormwater discharges into floodways or water bodies.

Application
Traps have restricted application and each should be justified on individual merits.

They have high construction costs and are generally unable to trap silt and clay sized particles other than in relatively small storm events (e.g. one year ARI, critical duration storm event).

Nevertheless, in some specialised situations their use might be justified, especially where a significant proportion of the bed load consists of particles coarser than 0.04 mm (sandy soils) and/or where their construction/maintenance cost can be justified when compared with more conventional sediment retention basins.

Sediment interception
Design traps to intercept at least 75% of sediment with a grain size of 0.04 mm or greater under average annual runoff conditions.

Further, ensure peak flow velocities are less than 0.3 metres per second in the 1 year ARI storm event, and taking into account any likely backwater effect from a blocked trash rack.

Capacity
The structure should have sufficient capacity and stability to discharge the inlet flow with the trash rack fully blocked without flooding adjacent properties.

Maintenance requirement
Ensure GPTs are capable of gravity drainage to a dry condition for periodic cleaning and maintenance if at all possible.

3.6 WETLANDS

Purpose and structure
Wetlands used for improvement of urban run-off quality can be either natural or artificial. They necessarily have to be shallow.

Growth of emergent aquatic plants (reeds, etc) should be encouraged by using sideslopes of very low gradient (1 in 8 or less).

A large percentage (greater than 25%) of any permanent water should be less than 1 metre deep.

The remainder of any open water should have a depth of not greater than 2 metres which will allow submerged plant growth. Figure 3.2 shows a typical wetland arrangement.

Protection of natural wetlands

Where wetlands are natural, provision shall be made for the protection of the wetlands from clearing, construction of levees, draining and filling, but does not prevent wetlands being used for run-off control, provided safeguards and operation control ensures their continued viability.

The relevant State Environment Protection Authority should also be consulted.

Efficiency

Wetlands, like retention basins, operate more effectively when higher contact time between the pollutants and the biota of the wetland is provided.

Thus, like retention basins, wetlands will be more efficient when used in conjunction with upstream flow retardation basins that will maintain run-off closer to pre-development levels.

Care shall be taken to avoid situations that recharge the groundwater and elevate the water table so as to develop local salinity problems.

Water levels

A structure should be included to allow manipulation of water levels in the wetland. This will enable control of microphyte, insect populations and facilitate dredging.

Short circuit prevention

Where possible, small islands or shoals should be constructed in the upstream areas of the wetland to reduce water velocities, prevent short circuiting and promote aquatic plant growth.

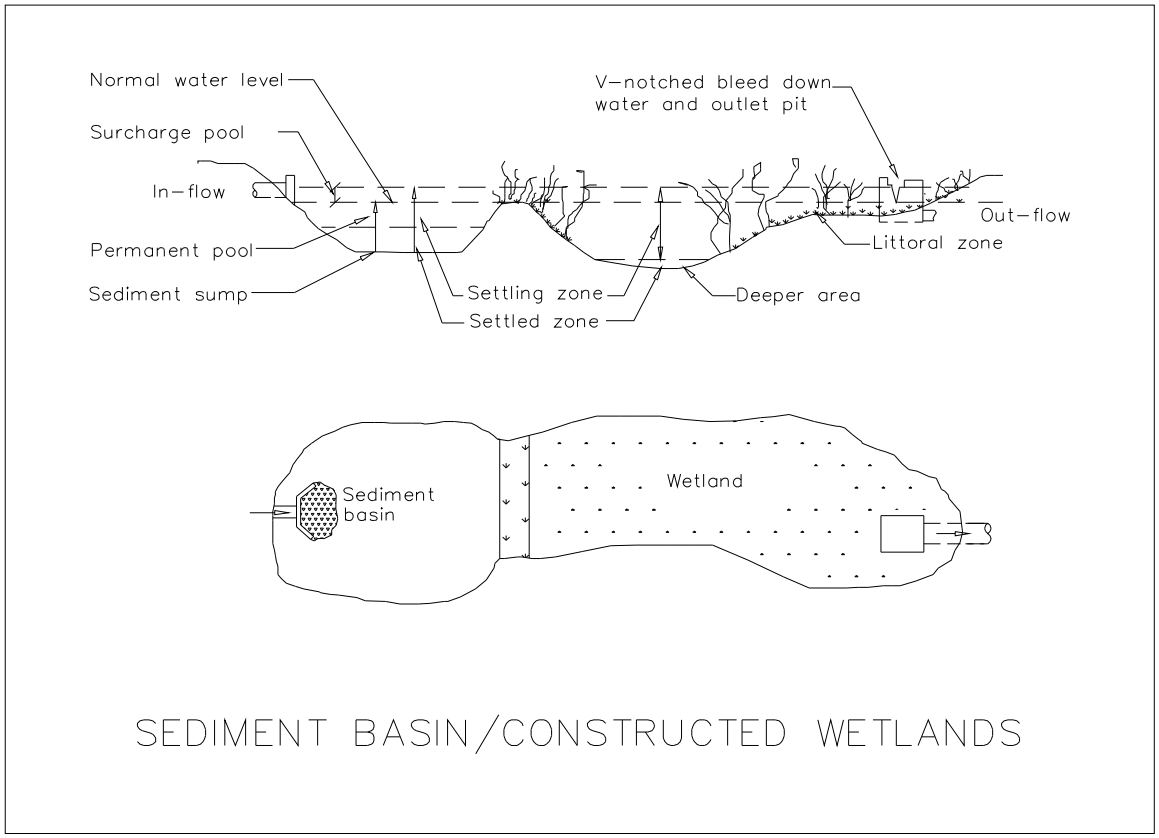


Figure 3.2 Sediment trap/constructed wetland

Protection from trash and large particles

The performance and life of wetlands, like wet retention basins, will suffer if they are not protected from trash and large particles. It is therefore recommended that trash racks/gross sediment/pollution traps be installed upstream of the wetland.

Buffer zones

Wetlands shall be surrounded by a buffer at least 20 metres wide in order to:

- Restrict access to maintenance vehicles by the installation of an all weather track with a lockable device.
- Acts as an infiltration area for surface run-off.
- Provide flood protection and secondary assimilation of pollutants.

Native vegetation

These areas are best planted with vegetation native to the area, but they can be used as grassed areas and an aesthetic feature.

The results of previous study indicates rates of removal of phosphorous and particles in wetlands are higher than for wet retention basins.

Surface area

In designing wetlands, it is recommended that, as an interim guide, the surface area of the wetlands be a minimum of 0.5% of the catchment which it serves.

If wetlands are used in conjunction with wet retention basins, this percentage can be proportionately lowered by allowing for the surface area of the installed wet retention basin.

Plant types

In open water zones, rooted emergent macrophytes appear to be more efficient than substrate microphytes (plants that are attached to the bottom of the water but which do not emerge).

This is because the emergent aquatic plants act as an oxygen pump, taking oxygen from the atmosphere into their roots and eventually into the water and so making it available for bacteria and attached algae which grow on the roots on the emergent plants.

In the crushed rock zones, emergent aquatic plants are the only types of macrophytes that will grow.

These plants will also act as oxygen pumps, and facilitate biological uptake of nutrients and the breakdown of organic matter by bacteria which grow on their roots.

A variety of plant species should be planted in artificial wetlands to achieve efficient colonisation and maximise pollutant removal. Establishment of plants should be through transplantation of seedlings during spring and early summer.

Aesthetic feature

Wetlands will serve other purposes than just improving a quality of urban run-off. They will serve to attract a large range of biota and bird habitat.

In areas where they have been installed, they have become an aesthetic feature. Indeed, this may present problems as surrounding communities may resist efforts by the controlling authority to de-silt the wetland.

Insect problems

To minimise mosquito problems, limit expanses of water with more than 50% shading and ensure no sections of water become isolated from the main body.

Wildlife refuge

Islands are highly beneficial as wildlife refuges, especially for birds. Their design should consider the effects on changes in water tables.

Native fish

Stock ponds with selected native fish to improve the water quality (not for sport), especially species which will control mosquito larvae and select zooplankton in preference to phytoplankton. Avoid use of fish which are bottom feeders.