

CAPRICORN MUNICIPAL DEVELOPMENT GUIDELINES

EROSION CONTROL AND STORMWATER MANAGEMENT

D7

DESIGN GUIDELINE

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Keeping the Capricorn Municipal Development Guidelines up-to-date

The Capricorn Municipal Development Guidelines are living documents which reflect progress of municipal works in the Capricorn Region. To maintain a high level of currency that reflects the current municipal environment, all guidelines are periodically reviewed with new editions published and the possibility of some editions to be removed. Between the publishing of these editions, amendments may be issued. It is important that readers assure themselves they are using the current guideline, which should include any amendments which may have been published since the guideline was printed. A guideline will be deemed current at the date of development approval for construction works.

GENERAL

D07.01. SCOPE

- | | |
|---|------------------------------------|
| D07.01.01. 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. | <i>Erosion</i> |
| D07.01.02. Since such soil disturbance is a necessary part of development, 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. | <i>Reduce Sedimentation</i> |
| D07.01.03. 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. | <i>Water Quality</i> |
| D07.01.04. The following order of priority for interpretation of documents will apply: (Please note that reference to a Guideline or Standard, is reference to the latest version of the relevant document, unless specifically a version number is specifically stated) | |
| <ul style="list-style-type: none"> 1. CMDG D7 – Erosion Control and Stormwater Management Design Specification 2. Water Sensitive Urban Design (WSUD) 3. MRTS52 Erosion and Sediment Control 2016 4. Engineers Australia, Queensland Division: Soil Erosion and Sediment Control - Engineering Guidelines | <i>Order of Priority</i> |

D07.02. AIMS

- | | |
|--|--|
| D07.02.01. Limit/minimise the amount of site disturbance. | <i>Site Disturbance</i> |
| D07.02.02. Isolate the site by diverting clean upstream "run-on" water around or through the development where possible. | <i>Diversion Works</i> |
| D07.02.03. Control runoff and sediment movement at its point source rather than at one final point. | <i>Point Source</i> |
| D07.02.04. 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. | <i>Progressive Revegetation</i> |
| D07.02.05. Provide an effective major stormwater system economical in terms of capital, operational and maintenance costs, incorporating water quality controls. | <i>Major Stormwater</i> |

D07.02.06. Retain topsoil for effective revegetation works. **Topsoil**

D07.02.07. Locate sediment control structures where they are most effective and efficient. **Sediment Structures**

D07.03. REFERENCE AND SOURCE DOCUMENTS

(a) CMDG Specifications

- D5 - Stormwater Drainage Design
- C211 - Control of Erosion and Sedimentation
- C273 - Landscaping

(b) QLD Government Legislation

- Queensland Environmental Protection Act, 1994
- Soil Conservation Act, 1986
- Water Resources Act, 1989
- Water Course Protection Regulation, 1993
- Queensland Urban Drainage Manual (QUDM), latest edition
- Water Sensitive Urban Design (WSUD)

(c) State Authorities

- Queensland Department of Energy & Water Supply
 - Dam Safety Management Guidelines, 2002.
- Queensland Department of Main Roads and Transport
 - MRTS52 Erosion and Sediment Control, 2016.

(d) Other

- Institution of Engineers Australia, Queensland Division (IEAQ)
 - Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites, 1996.
- Brisbane City Council (BCC)
 - Integrated Environmental Management System Manual, 1997.
- Healthy Waterways
 - WSUD Technical Design Manual for South East Queensland (2006)
- Water By Design
 - Bio-retention Technical Design Guidelines (2014)
 - Maintaining Vegetated Stormwater Assets (2012)
 - Rectifying Vegetated Stormwater Assets Guideline (2012)
 - Transferring Ownership of Vegetated Assets (2012)
- International Erosion Control Association – Australasia (IECA)
 - Best Practice Erosion and Sediment Control (BPESC) document

D07.04. PLANNING & CONCEPT DESIGN

D07.04.01. Assess the physical characteristics and limitations of soils, landform and drainage of the site and plan the subdivision accordingly. **Site Characteristics**

D07.04.02. A site based stormwater management plan shall be submitted with the operational works application or submitted as part of the previous development approval processes.

D07.05. DETAILED DESIGN

D07.05.01. After a development permit for reconfiguration of a lot is given, an erosion control and stormwater management plan shall be submitted to Local Government as part of the detailed engineering design. This plan must give all details for erosion, sediment and pollution controls. Note: **This design shall be site specific** and not a generalisation of erosion control philosophy. It shall also form part of the contract specifications for a contractor to comply with during construction.

Site Specific

D07.05.02. Local Government will require a minimum 800mm wide turf strip to be placed behind all kerb and channel and returns at appropriate intervals depending on grade.

Minimum Requirements

D07.05.03. Detailed designs shall include scaled drawings (no larger than 1:1000) and detailed specifications/diagrams which can be readily understood and applied on site by supervisory staff.

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; and
- revegetation requirements.

D07.05.04. No site works shall commence prior to approval of the detailed engineering design. All works are to be carried out in accordance with the approved management plan. Its implementation must be supervised by personnel with appropriate qualifications and/or experience in soil conservation on construction sites.

Approval

D07.05.05. Notwithstanding the foregoing, Local Government may require erosion or sediment control works to be carried out additional to or instead of those works specified in the approved plan, should circumstances change during construction or unforeseen circumstances arise.

Additional Works

EROSION CONTROL

D07.06. BUFFER ZONES

D07.06.01. 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. Wetlands, stream and rivers adjacent to construction sites shall be protected by buffer zones. ***Filters***

D07.06.02. Buffer zone performance increases as catchment area and slope gradient decreases. Thirty-metre-wide buffer zones generally provide adequate protection. ***Performance***

Table D07. 06.1 - Buffer zone widths in regards to slopes.

Slope %	Buffer Width in Metres
2	15
4	20
6	30
8	40
10	50
12	60
14	70

D07.06.03. Buffer zones can reduce the need for other erosion and sediment control measures. However, contaminated water in a concentrated form will require treatment both at its source point and final disposal. ***Contaminated Water***

D07.06.04. A fence shall be used to exclude traffic from buffer zones to prevent damage to the vegetation, particularly during any construction phase. ***Fencing***

D07.07. "NO ACCESS" AREAS

D07.07.01. It is Local Government's Policy to conserve as much existing vegetation in new developments as possible. ***Conserve Vegetation***

D07.07.02. The landscape plan shall therefore incorporate as much existing native vegetation as possible.

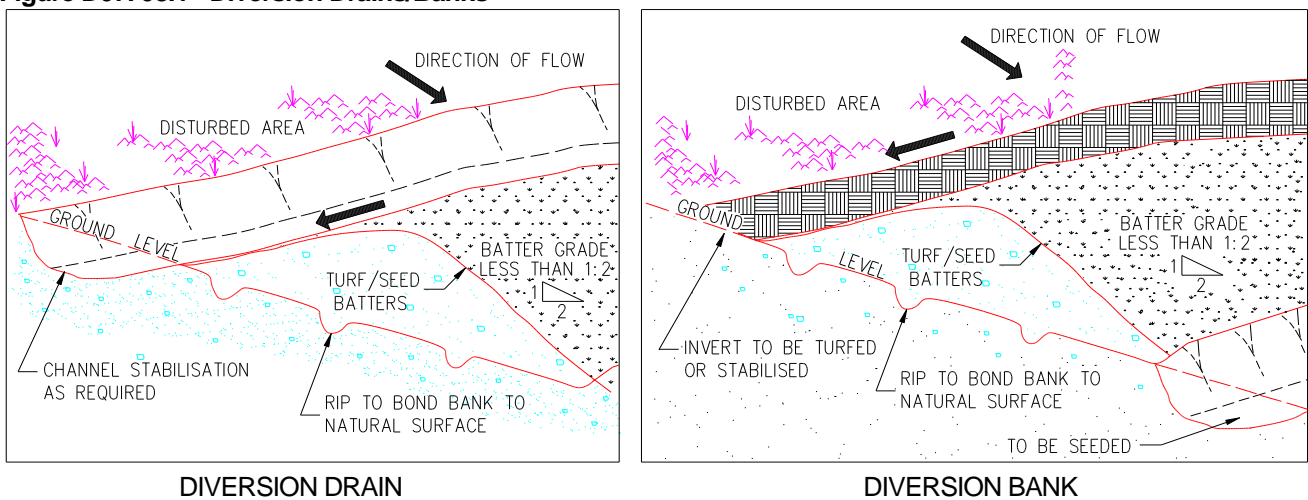
D07.07.03. The "no access" fence locations shall be shown on the detailed design. These locations will be approximate only as machinery type, topography etc. will determine actual on site location. ***No Access***

D07.07.04. Fenced areas shall be delineated with an appropriate level of fencing and clearly signposted "No Access Area".

D07.08. DIVERSION WORKS

- D07.08.01. Diversion works may be in the form of earth drains and banks, straw bales, sand bags or even pipelines and may be permanent or temporary. ***Diversion Types***
- D07.08.02. 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 to be dispersed in a manner which does not cause concentration of flows ***Discharge Point***
- D07.08.03. Pipelines may also be used to convey such run-on through the development 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. ***Pipelines***
- D07.08.04. Design of the diversion system should suit the following:-
- (a) The drain should preferably be dish shaped with batter grades of less than 1 in 2 for temporary works. Batter grades for permanent works should preferably be not steeper than 1 in 4. ***Drain Shape***
 - (b) If a piped system is selected its design capacity shall be a minimum of the capacity nominated in the design Specification STORMWATER DRAINAGE. ***Pipe Capacity***
- D07.08.05. Diversion works are designed to carry peak flows at non-erosive velocities in bare soil, vegetated or lined drains/banks. ***Peak Flows***
- D07.08.06. Generally, the channel should be lined with turf. However, where velocities are designed in excess of 2m per second, non-erosive linings such as concrete, geotextiles, grouted rock or velocity reducers (check dams etc.) are required. ***Non-Erosive Linings***
- D07.08.07. Typical arrangements of diversion drains and banks are shown in Figure D07.08.1 - Diversion Drains/Banks.

Figure D07.08.1 - Diversion Drains/Banks



D07.09. DROP DOWN DRAINS

D07.09.01. 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. **Lined Drains**

D07.09.02. 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. **Piped Drains**

D07.09.03. 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. **Capacity**

D07.10. STOCKPILES

D07.10.01. Location of stockpiles shall be indicated on the approved engineering plans. **Approved Plan**

D07.10.02. Stockpile sites shall be located:

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

Location

D07.10.03. Stockpiles must be protected from erosion and sediment loss by:

- (a) The installation of diversion works on the upstream side.
- (b) The use of silt fences, straw bales etc. or other approved controls on the downstream side.
- (c) Compaction.
- (d) Revegetation if left exposed for longer than 30 days (refer to Landscaping Construction Specification for seed mix).

Erosion Protection

D07.10.04. Site topsoil shall be isolated from subsoil material in separate stockpiles.

Separate Stockpiles

D07.11. SEDIMENT BASINS/TRAPS/DAMS

D07.11.01. Sediment traps are either permanent or temporary sediment control devices that intercept sediment and run-off usually at the final discharge point of the site. **Sediment Control**

D07.11.02. Refer also to the Local Government requirements and or QUDM

- D07.11.03. They are formed by excavation and/or by constructing embankments. **Construction**
- D07.11.04. There are two types, wet and dry basins. Generally Local Government would prefer a dry basin. **Types**
- D07.11.05. Preferably sediment traps shall not be located directly upstream of residential areas. **Location**
- D07.11.06. Basin design must meet the following:
- (a) Volume/capacity of the trap shall be 250m³/ha of disturbed site including the building areas.
 - (b) An allowance of 50m³/ha is required if diversion controls are not used to direct clean upstream water from outside the site away from construction areas.
 - (c) The capacity shall be measured below the invert of the lowest incoming flow. Otherwise pipelines and associated works will be affected.
 - (d) 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.
 - (e) The basin shall have a minimum of 0.5 metres freeboard above the level of the spillway.
 - (f) A temporary wet basin shall be surrounded by a man-proof fence with lockable gates.
 - (g) An all-weather gravel access must be provided to the basin for maintenance. **Design Criteria**
 - (h) The basin shall have an arbitrary length to width ratio of between 2 and 3:1. This encourages soil particle settlement. The entry and exit points should be located at the opposite ends of the basin.
 - (i) 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, as nominated by Local Government.
 - (j) Internal basin batters shall be a maximum of 3:1 and external batters a maximum of 2:1. For permanent dry basins a maximum external batter of 1 in 3 shall apply.
 - (k) All disturbed areas including batters shall be revegetated. In this regard topsoil and seeding is considered the minimum treatment.
 - (l) Hydromulching to disturbed surfaces is acceptable.
 - (m) Other disturbed surface stabilisation measures such as mesh treatments, straw mulching etc. may be approved by the Local Government.
- D07.11.07. Permanent wet basin designs slightly vary from the above. Refer to the Stormwater Management Section of this Specification. **Permanent Wet Basins**

D07.12. SEDIMENT TRAPS/ BARRIERS FOR MINOR CATCHMENTS

- D07.12.01. These are silt retention/filtering structures of a temporary nature used in situations where the catchment does not exceed 0.5ha. **Filtering Structures**

D07.12.02. Such sediment traps/barriers generally consist of:

- (a) silt fences
- (b) straw bales
- (c) blue metal groynes/sausages
- (d) filter fabric located beneath stormwater grates
- (e) gabions
- (f) or a combination of the above.

***Barrier
Types***

D07.12.03. 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:

- (a) surface inlet pits
- (b) kerb inlet pits
- (c) catch drain disposal areas
- (d) culvert inlets and outlets
- (e) minor construction/earthwork sites
- (f) check dams/velocity reducers etc.

***Location of
Structure***

D07.13. THE LOCATION OF SHAKEDOWN AREAS AND ACCESS STABILISATION

D07.13.01. Access to construction sites shall be limited to a maximum of two locations.

***Number of
Accesses***

D07.13.02. Such access locations and treatment shall require Local Government approval and shall form part of the Contractor's Erosion Control and Stormwater Management Strategy.

***Location
Approval***

D07.13.03. 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 of the road way each day or before rain. Clean off draw bars etc after dumping and before starting journey.

Types

D07.13.04. 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. Cattle grids shall be a minimum length of 7 metres.

Cattle Grid

D07.13.05. 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 for a two way entrance.

***Stabilised
Access***

D07.13.06. 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.

Flow Control

D07.14. WIND EROSION/DUST CONTROL

D07.14.01. There shall be no visible dust emissions from the site.

**Dust
emission**

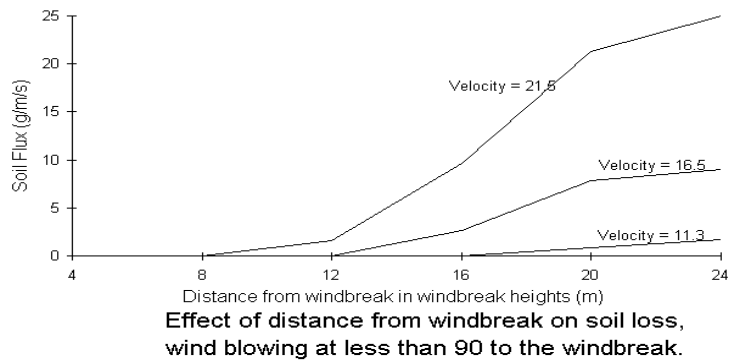
D07.14.02. Various measures are available to minimise such emissions, including:-

- (a) 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
- (b) 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 grams per metre per second. See Figure D07. 14.1 - Pollution Control.

Treatments

D07.14.03. All works within the site shall be dampened to suppress nuisance dust emissions from the site during construction activities.

Figure D07. 14.1 - Pollution Control



D07.15. REQUIREMENTS FOR BUILDING SITES

D07.15.01. The clearing of vegetation and preparation of building pads is to be undertaken in the last stages of the development when the majority of the site has been effectively revegetated.

Site Clearing

D07.15.02. When the development calls for the construction of a number of buildings, the sediment trap/s and other appropriate sediment controls shall remain operational.

**Development
Control**

D07.15.03. Cross/catch drains shall be installed on long or steep unpaved driveways, disposing run-off to stable areas.

**Driveway
Control**

- D07.15.04. Where a majority of the lot is disturbed the following controls or measures shall be undertaken: ***Lot Control***
- (a) Silt fences, located around the downstream sides of the lot.
 - (b) Sediment traps/barriers to be provided to all on-site and adjacent stormwater inlets.
 - (c) Only one site access to be provided. This may require treatment to prevent soil being tracked from the site.
 - (d) All subsurface drainage for roofing must be in place prior to the installation of the roof and gutter so downpipes can be immediately connected.

D07.16. EXTERNAL SITE REQUIREMENTS

- D07.16.01. Sediment control devices or stabilising works shall be provided outside construction sites where necessary. ***Necessary Controls***
- D07.16.02. 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. ***Accelerate Erosion***
- D07.16.03. Where sediment is likely to be transported from the site, all immediate downstream drainage inlets shall have appropriate controls installed. ***Downstream Controls***
- D07.16.04. If such works require entry onto private property, written permission shall be obtained prior to the entry and commencement of such works. ***Written Permission***
- D07.16.05. All disturbed areas on private property to be reinstated to original condition and to the satisfaction of the owner. ***Reinstated***

STORMWATER MANAGEMENT

D07.17. GENERAL

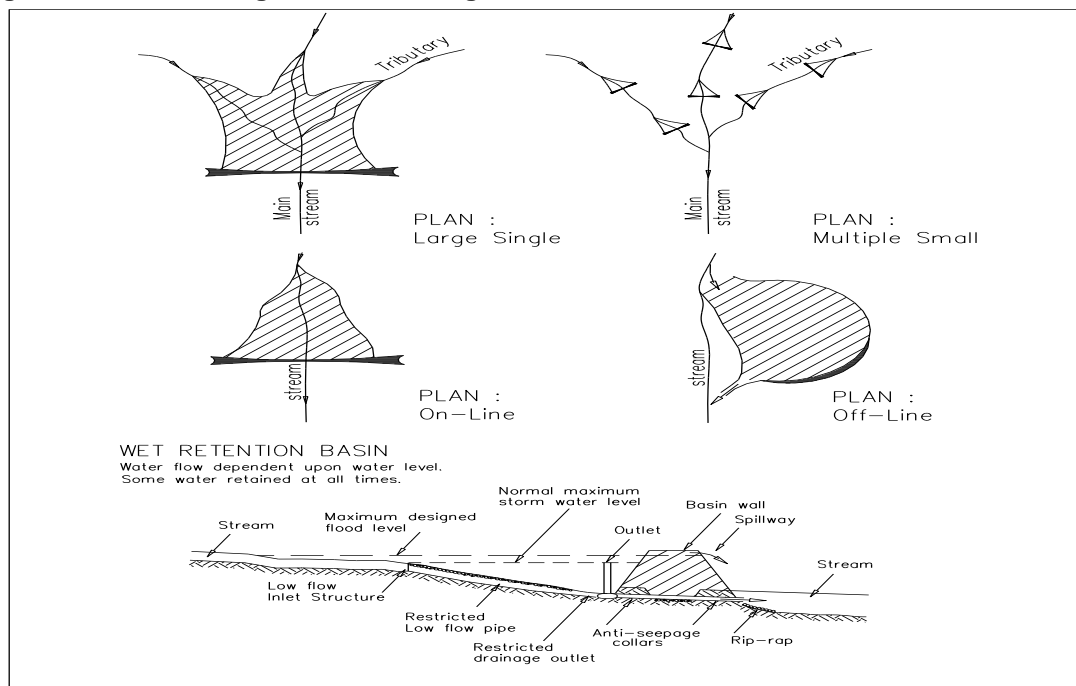
- D07.17.01. Most developments mean a change in land use and is usually accompanied by a decline in stormwater quality. This applies to the long term as well as during the short term construction phase. The main components required to enhance stormwater quality are as follows:- **Main Components**
- (a) The applicant must demonstrate how they are to meet the Department of Environment and Heritage Protection (DEHP) water guidelines before the Operation Works Approval
 - (b) Buffer Zones and Filter Strips, being grassed, or similarly treated areas to facilitate the natural assimilation of water pollutants and reduce run-off.
 - (c) 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.
 - (d) 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 adheres to the sediments, and therefore settle out. Other nutrients are removed by macrophytic vegetation as part of the food chain.
 - (e) 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).
- D07.17.02. Excess nutrients (N, P) lead to eutrophication of waterways. 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. **Excess Nutrients**
- D07.17.03. 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. **First Flush**

D07.18.

D07.18. WET RETENTION BASINS/PONDS

- D07.18.01. Basins designed for water quality control should maximise the extent of settling. In general quiescent conditions infiltration should be maximised. **Maximise Infiltration**
- D07.18.02. A wet retention basin can be located either on-line or off-line as shown in **Error! Reference source not found.** Basins should be designed in accordance with Healthy Waterways WSUD Technical Design Manual. **Location and Size**
- (a)
 - (a) **Basin Efficiency**

Figure D07. 18.1 - Configuration and Design of Wet Retention Basins



- D07.18.03. 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.

Construction and Maintenance
- D07.18.04. 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.

Outlet Design
- D07.18.05. An all-weather access track shall be provided to the basin for maintenance works.

Access Track
- D07.18.06. It is generally necessary to incorporate a gross pollutant trap and/or trash rack facility on major discharges into the retention basin. This prolongs the life of the basin and prevents the accumulation of litter.

Trash Racks
- D07.18.07. 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 developments, permits the drainage authority scope to develop aesthetic surrounds and reduces the likelihood of over the fence dumping of rubbish.

Buffer Zones
- D07.18.08. The settling velocity of particles should service as the basis for design. This, of course, 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 (Randall et al 1982).

Particle Settling

- D07.18.09. Wet retention basins are regarded as impoundments and normal dam safety requirements should be met. A dam must be referred to the Department of Natural Resources and Mines (DNRM) if it is:
- (a) 10 metres or more in height and has a storage capacity of more than 10 mega litres; or
 - (b) 5 metres or more in height and has a storage capacity of 50 mega litres or more.
- D07.18.10. If the wet retention basin is within the above categories it must be referred to the DNRM.
- D07.19.**
- D07.19. TRASH RACKS**
- D07.19.01. 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 Local Government. ***Environmental Quality***
- D07.19.02. Generally, their design should be in accordance with QUDM. ***Design Criteria***
- D07.19.03. Where associated with outlet structures for small sediment basins or constructed wetlands, they can be relatively simple in design. ***Associated Structures***
- D07.19.04. Trash racks may be incorporated in the design of gross pollutant traps. ***Gross Pollutant Trap***
- D07.19.05. Trash racks shall be checked periodically and all debris and silt removed. ***Maintenance***
- D07.20. GROSS POLLUTANT TRAPS**
- D07.20.01. 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. ***Description***
- D07.20.02. These 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 (eg, 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 0.04mm (sandy soils) and/or where their construction/maintenance cost can be justified when compared with more conventional sediment retention basins. ***Applications***

D07.20.03. GPTs can be defined as major or minor:

Definition

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

D07.20.04. Design traps to intercept at least 75 per cent of sediment with a grain size of 0.04mm 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.

Sediment Interception

D07.20.05. The structure should have sufficient capacity and stability to discharge the inlet flow with the trash rack fully blocked without flooding adjacent properties.

Capacity

D07.20.06. Ensure GPTs are capable of gravity drainage to a dry condition for periodic cleaning and maintenance if at all possible.

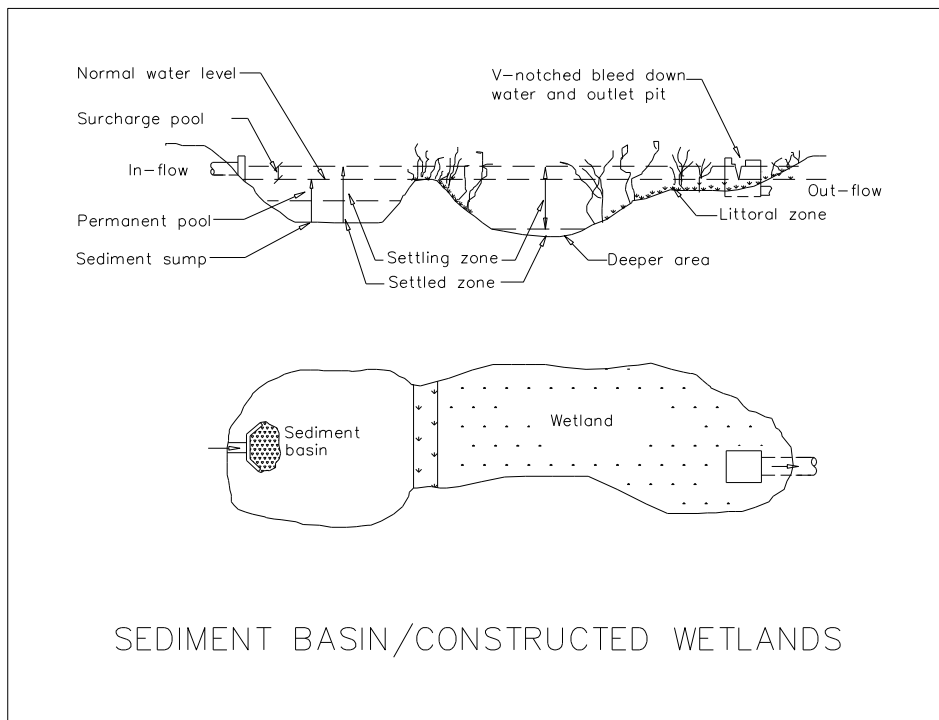
Maintenance Requirement

D07.21. WETLANDS

D07.21.01. Wetlands used for improvement of urban run-off quality can be either natural or artificial. They necessarily have to be shallow. Design of Constructed Stormwater Wetlands shall be in accordance with WSUD. shows a typical wetland arrangement.

Depth and Batters

Figure D07. 21.1 - Sediment Trap/Constructed Wetland



- D07.21.02. Where wetlands are natural, the DEHP should be consulted. **Natural Wetlands**
- D07.21.03. 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. **Efficiency**
- D07.21.04. 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. **Water Levels**
- D07.21.05. 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. **Short Circuiting**
- D07.21.06. 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. **Wetland Protection**
- D07.21.07. Wetlands need to be surrounded by a buffer at least 20 metres wide in order to:- **Buffer Zones**
- (a) Restrict access to maintenance vehicles by the installation of an all-weather track with a lockable device.
 - (b) Acts as an infiltration area for surface run-off.
 - (c) Provide flood protection and secondary assimilation of pollutants.
- D07.21.08. These areas are best planted with vegetation native to the area, but they can be used as grassed areas and an aesthetic feature. **Native Vegetation**
- D07.21.09. In designing wetlands, it is recommended that, as an interim guide, the surface area of the wetlands be a minimum of 0.5 per cent 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. **Surface Area**
- D07.21.10. 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. **Microphyte Types**
- D07.21.11. 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. **Revegetation**

EROSION CONTROL AND STORMWATER MANAGEMENT

- D07.21.12. 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. ***Aesthetic Feature***
- D07.21.13. To minimise mosquito problems, limit expanses of water with more than 50 per cent shading and ensure no sections of water become isolated from the main body. ***Insect Problems***
- D07.21.14. Islands are highly beneficial as wildlife refuges, especially for birds. Their design should consider the effects on changes in water tables. ***Wildlife Refuge***
- D07.21.15. 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. ***Native Fish***