A wide range of species is at the designer’s disposal depending on the desired scheme. *Growing Native Plants in Brisbane* (BCC 2005 on-line), *Successful Gardening in Warm Climates* (McFarlane 1997) and other contemporary publications give further guidance.

4.4.3 Specific Landscape Considerations

Opportunities are available for creative design solutions to specific elements. Close collaboration between the landscape designer, ecologist, hydraulic designer, civil/structural engineer and maintenance personnel is essential. In parklands and residential areas, a key aim is to ensure elements are sympathetic to their surroundings and are not overly engineered or industrial in style and appearance whilst achieving their desired functions. Additionally, landscape design to specific elements should aim to create places where local residents and visitors will come to enjoy and regard as an asset.

4.4.3.1 Basin Shape

The length to width ratio of the basin should be determined by the hydraulic designer working within the site constraints (refer to section 4.3.2). Once the overall shape has been determined, one of the first considerations should be if a formal or informal style is required depending on setting. Figure 4.8 illustrates formal and informal options for a given length to width ratio.

![Figure 4.8: Informal and Formal Basin Configuration Given Length to Width Ratio](image)

4.4.3.2 Basin Embankment

Where a natural look is required, the designer should explore opportunities for landform grading to the embankment to create variation in the slope. Geometric planar batters should be avoided. The grading approach also creates a diversity of habitat niches along the slope and can assist in reducing erosion. Figure 4.9 illustrates this technique. It is important that shaping to the slope does not allow areas for mosquitos to breed such as isolated areas of stagnant water. Designing to avoid mosquitos is discussed in detail in Chapter 6 (Section 6.2.8) with respect to constructed wetlands.
4.4.3.3 Basin Inlet

The basin inlet is an important place to experience the confluence of fast flowing water with still water and is a dynamic place within the local landscape. Designers have scope to approach this element in a variety of ways provided the hydraulic design is not compromised. Options to consider include:

- Using salvaged site rocks or patterned and coloured concrete to emphasise the feature and create niche habitats.
- Enhancing the microclimate created by cool running water by adding shade trees.
- Creating places to view running water. Where suitable, this can be achieved with footbridges located above the water. Such structures should be designed appropriately with consideration of life cycle costs (i.e. timber piers should not be used where contact with water occurs). Alternatively, views from the side will provide a different experience. Viewing areas should be located a minimum of 5 m from the open water body to discourage wildlife feeding.

4.4.3.4 Sediment Removal Access

Access to the basin floor to remove sediments requires either the installation of a ramp/ramps, or an access track around the perimeter for smaller basins (refer section 4.2.7). These elements are crucial to the operation of a sedimentation basin, but should be designed sensitively so they do not become visually prominent.

For both ramps and perimeter access tracks, reinforced turfing pavers should be considered as the pavement to create a green surface that blends with the surrounding plantings. Surfaces of concrete or rock should be avoided where possible. Consideration must be given to the size and weight of machinery likely to utilise the access ramp. Reinforced vegetated surfaces should be able to respond to impacts given that desilting of the basin will only be required approximately every 5 years.

Consider incorporating the sediment removal access into other landscape elements. For example, perimeter access tracks could also be used as recreational trails (in this case part of the track width could be paved using reinforced concrete). Investigate if the weir could become part of this access way. Ramps may potentially be integrated with viewing areas.
Trees and shrubs can be employed to screen these elements. The shadow cast by trees also assists in breaking up the form of linear structures so that they blend into formally designed landscapes.

Where gates and fences are required, it is important to use materials and styles that are sensitive to the setting. Products aimed for industrial applications should generally be avoided in parkland spaces, as should products designed for domestic garden situations.

4.4.3.5 Overflow Pit

The grate above the overflow pit can become an interesting local landmark, particularly if it is sited within the open water surface. Provided that the grate performs its intended function of preventing blockages by debris (refer section 4.3.5) and is structurally sound, there are opportunities for creative design solutions to this component.

An important consideration is to prevent local fauna (e.g. ducks) from entering the overflow pit and becoming trapped. Investigate installing 200 mm wide perforated plates (holes to 20 mm) or similar at the base of the grate.

4.4.3.6 Weir Outlets

Weir outlets may be large items that can potentially add character to the design. Grouted rock wall or off-form concrete finishes should be investigated rather than loose dumped rocks, particularly where the weir is visible. Loose rock fill structures also create glare, weed and cane toad issues. Use plants to screen the weir if required.

4.4.3.7 Viewing Area

In parkland areas, turfed spaces within barrier fencing offer a simple low maintenance solution. Figure 4.10 provides illustrations. Constructed decks may be appropriate in more urbanised areas. Hardwood timber construction should generally be avoided due to its inherent life-cycle costs.

Viewing areas should be located with a minimum distance of 5 m separating the viewing area from the waterbody, so that wildlife feeding is discouraged.

4.4.3.8 Fencing

If fences are used, consider styles suitable for parkland and urban/suburban contexts. Products designed for domestic gardens or industrial applications should generally be avoided. The types of fences recommended are:

- pool fences – where there drowning or potential from contact with the water exists and adjacent areas are intended for use by children (e.g. playground, sports field)
- galvanised tubular handrails (in accordance with BCC standard drawing UMS 241) without chain wire. These should be used in all other areas where access by children is not likely.

The safety requirements for fencing are discussed further in Section 4.4.7.
4.4.3.9 Signage and Interpretation

Signage should be kept simple and easy to interpret by the general public. Detailed design plans and system flow charts should be avoided, as these are often difficult to understand. Text should be kept to a minimum. Annotated photographs or sketches are a more effective way of explaining processes.

An alternative approach is to use artistic illustrations to explain processes in a more subtle way over time. All signage and artwork proposed for public information must be approved by BCC.
4.4.3.10 Baffles and Flow Spreaders

Within highly visible parkland and urban settings, investigate the use of interesting forms, patterns and colours that still achieve the desired function. For example, off-form concrete patterning, artwork to downstream side, coloured concrete, or organic shapes could be employed.

4.4.4 Plant Stock Sourcing

In the majority of cases, the sedimentation basin will form an inlet pond to a constructed wetland or bioretention basin. In such cases, the landscape and vegetation design of the sedimentation basin will be undertaken in conjunction with the vegetation design of the other treatment measures and hence ordering of plant stock can be combined into one order. The species listed in Table 12.2 (Chapter 12) are generally available commercially from local native plant nurseries. Availability is however, dependent upon many factors including demand, season and seed availability. To ensure the planting specification can be accommodated, the minimum recommended lead-time for ordering plants is 3-6 months. This generally allows adequate time for plants to be grown to the required size, so they are completely inundated by water for extended times. The following sizes are recommended as the minimum:

- Viro Tubes 50 mm wide x 85 mm deep
- 50 mm Tubes 50 mm wide x 75 mm deep
- Native Tubes 50 mm wide x 125 mm deep
4.4.5 Topsoil Specification and Preparation

During the sedimentation basin construction process, topsoil is to be stripped and stockpiled for possible reuse as a plant growth medium. It is important to test the quality of the local topsoil, which is likely to have changed from its pre-European native state due to prior land uses such as farming and industry, to determine the soils suitability for reuse as a plant growth medium. Remediation may be necessary to improve the soils capacity to support plant growth and to suit the intended plant species. Soils applied to the littoral zones of sedimentation basins must also be free from significant weed seed banks as labour intensive weeding can incur large costs in the initial plant establishment phase. On some sites, topsoils may be nonexistent and material will need to be imported. It is important that imported soil does not contain Fire Ants. A visual assessment of the soils is required and any machinery should be free of clumped dirt. Soils must not be brought in from Fire Ant restricted areas.

The installation of horticultural soils should follow environmental best practices and include:

- Preparation of soil survey reports including maps and test results at the design phase.
- Stripping and stockpiling of existing site topsoils prior to commencement of civil works.
- Deep ripping of subsoils using a non-inversion plough.
- Reapplication of stockpiled topsoils and, if necessary, remedial works to suit the intended plant species.
- Addition where necessary, of imported topsoils (certified to AS 4419-2003).

The following minimum topsoil depths are required:

- 150 mm for turf species
- 300 mm for groundcovers and small shrubs
- 450 mm for large shrubs
- 600 mm for trees

4.4.6 Vegetation Establishment

To ensure successful plant establishment, the following weed control measures and watering regime is recommended, in addition to regular general maintenance as outlined in the Section 4.5.

4.4.6.1 Weed Control

Conventional surface mulching of sedimentation basin batters with organic material like tanbark is not recommended. Most organic mulch floats and water level fluctuations and runoff typically causes this material to be washed into the basin with a risk of causing blockages to outlet structures. Mulch can also increase the organic load, potentially increasing nutrient concentrations and the risk of algal blooms. Adopting high planting density rates and if necessary, applying a suitable biodegradable erosion control matting to the basin batters (where appropriate), will help to combat weed invasion and will reduce maintenance requirements for weed removal. If the use of mulch on the littoral zones is preferred, it must be secured with appropriate mesh or netting (e.g. jute mesh).

4.4.6.2 Watering

Regular watering of littoral and ephemeral marsh zone vegetation during the plant establishment phase is essential for successful establishment and healthy growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water level within the sedimentation basin. While, the following watering program is generally adequate, it should be adjusted
(increased) to suit the site conditions:

- Week 1-2  3 visits/ week
- Week 3-6  2 visits/ week
- Week 7-12 1 visit/ week

After this initial three month period, watering may still be required, particularly during the first winter (dry period). Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

4.4.7 Safety Issues

4.4.7.1 Crime Prevention Through Environmental Design (CPTED)

The standard principles of informal surveillance, exclusion of places of concealment and open visible areas apply to the landscape design of sedimentation basins. Where planting may create places of concealment or hinder informal surveillance, groundcovers and shrubs should not generally exceed 1 m in height. Refer to BCC’s CPTED Planning Scheme Policy in *Brisbane City Plan 2000* (BCC 2000a, vol. 2, app. 2, pp. 68a – 68f)) for further guidance.

4.4.7.2 Restricting Access to Open Water

Fences or vegetation barriers to restrict access should be incorporated into sediment basin areas, particularly on top of concrete or stone walls where:

- there is risk of serious injury in the event of a fall (over 0.5 m high and too steep to comfortably walk up/ down or the lower surface or has sharp or jagged edges)
- there is a high pedestrian or vehicular exposure (on footpaths, near bikeways, near playing/ sporting fields, near swings and playgrounds etc)
- where water ponds to a depth of greater than 300 mm on a constructed surface of concrete or stone. Natural water features are exempt.
- where the water is expected to contain concentrated pollutants
- where grassed areas requiring mowing abut the asset.

Fences considered appropriate are:

- pool fences (for areas adjacent to playgrounds/ sports fields where a child drowning or infection hazard is present)
- galvanised tubular handrails (without chain wire) in other areas
- dense vegetative hedges.

Dense littoral planting around the sedimentation basin (with the exception of any maintenance access and dewatering areas) will deter public access to the open water and create a barrier to improve public safety. Careful selection of plant species (e.g. tall, dense or spiky species) and planting layouts can improve safety as well as preventing damage to the vegetation by trampling.

Dense vegetation (hedge) at least 2 m wide and 1.2 m high (minimum) may be suitable if vandalism is not a demonstrated concern (this may be shown during the initial 12 month maintenance period). A temporary fence (e.g. 1.2 m high silt fence) will be required until the vegetation has established and becomes a deterrent to pedestrians/ cyclists.
An alternative to the adoption of a barrier/fence is to provide a 2.4 m ‘safety bench’ that is less than 0.2 m deep below the permanent pool level around the waterbody. This is discussed in Section 4.3.3 with respect to appropriate batter slopes.

4.5 Maintenance Requirements

Sediment basins treat runoff by slowing flow velocities and promoting settlement of coarse to medium sized sediments. Maintenance revolves around ensuring inlet erosion protection is operating as designed, monitoring sediment accumulation and ensuring that the outlet is not blocked with debris. The outlets from sedimentation basins are to be designed such that access to the outlet does not require a water vessel. Maintenance of the littoral vegetation including watering and weeding is also required, particularly during the plant establishment period (first two years).

Inspections of the inlet configuration following storm events should be made soon after construction to check for erosion. In addition, regular checks of sediment build up will be required as sediment loads from developing catchments vary significantly. The basins must be cleaned out if more than half full of accumulated sediment.

Similar to other types of WSUD elements, debris removal is an ongoing maintenance requirement. Debris, if not removed, can block inlets or outlets, and can be unsightly if deposited in a visible location. Inspection and removal of debris should be done regularly and debris removed whenever it is observed on the site.

Typical maintenance of sedimentation basins will involve:

- routine inspection of the sedimentation basin to identify depth of sediment accumulation, damage to vegetation, scouring or litter and debris build up (after first 3 significant storm events and then at least every 3 months)
- routine inspection of inlet and outlet points to identify any areas of scour, litter build up and blockages
- removal of litter and debris
- removal and management of invasive weeds (both terrestrial and aquatic)
- periodic (usually every 5 years) draining and desilting which will require excavation and dewatering of removed sediment (and disposal to an approved location)
- regular watering of littoral vegetation during plant establishment (refer section 4.4.6)
- replacement of plants that have died (from any cause) with plants of equivalent size and species as detailed in the planting schedule

Inspections are also recommended following large storm events to check for scour and damage.

All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design process (Step 7). Maintenance personnel and asset managers will use this plan to ensure the sediment basins continue to function as designed.

In accordance with the Subdivision and Development Guidelines (BCC 2000b), the maintenance plans and forms must address the following:

- Inspection Frequency
- Maintenance Frequency
- Data Collection/ Storage Requirements (i.e. during inspections)
- Detailed Clean Out Procedures (main element of the plans) including:
  - equipment needs
Erosion and Sedimentation

− maintenance techniques
− occupational health and safety
− public safety
− environmental management considerations
− disposal requirements (of material removed)
− access issues
− stakeholder notification requirements
− data collection requirements (if any)

• Design Details.

For further details relating to maintenance plans, refer to Part C of the Subdivision and Development Guidelines (BCC 2000b). An approved maintenance plan is required prior to asset transfer to BCC.

An example operation and maintenance inspection form is included in the checking tools provided in Section 4.6. These forms must be developed on a site specific basis as the configuration and nature of sediment basins varies significantly.

4.6 Checking Tools

This section provides a number of checking aids for designers and Council development assessment officers. In addition, Section 4.6.5 provides general advice for the construction and establishment of sedimentation basins and key issues to be considered to ensure their successful establishment and operation based on observations from construction projects around Australia.

Checking tools include:

• Design Assessment Checklist
• Construction Checklist (during and post)
• Operation and Maintenance Inspection Form
• Asset Transfer Checklist (following ‘on-maintenance’ period)
• Construction and Establishment Advice.
### 4.6.1 Design Assessment Checklist

The checklist below presents the key design features that are to be reviewed when assessing a design of a sedimentation basin. These considerations include (but not limited to) configuration, safety, maintenance and operational issues that should be addressed during the design phase. Where an item receives a ‘N’ from the review process, referral should be made back to the design procedure to determine the impact of the omission or error.

In addition to the checklist, a proposed design should have all necessary permits for its installation. Development proponents will need to ensure that all relevant permits are in place. These can include permits to clear vegetation, to dredge, create a waterbody, divert flows or disturb habitat.

<table>
<thead>
<tr>
<th>Sedimentation Basin Design Assessment Checklist</th>
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<tbody>
<tr>
<td><strong>Basin Location:</strong></td>
</tr>
<tr>
<td><strong>Hydraulics:</strong></td>
</tr>
<tr>
<td>Design operational flow (m³/s):</td>
</tr>
<tr>
<td>Above design flow (m³/s):</td>
</tr>
<tr>
<td><strong>Area:</strong></td>
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<tr>
<td>Catchment Area (ha):</td>
</tr>
<tr>
<td>Basin Area (ha):</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>Treatment performance verified from curves?</td>
</tr>
<tr>
<td><strong>Basin Configuration</strong></td>
</tr>
<tr>
<td>Discharge pipe/structure to sedimentation basin sufficient for design flow?</td>
</tr>
<tr>
<td>Scour protection provided at inlet?</td>
</tr>
<tr>
<td>Basin located upstream of treatment system (i.e., macrophyte zone of wetland)?</td>
</tr>
<tr>
<td>Configuration of basin (aspect, depth and flows) allows settling of particles &gt;125 µm?</td>
</tr>
<tr>
<td>Basin capacity sufficient for desilting period &gt;=5 years?</td>
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<tr>
<td>Maintenance access allowed for into base of sediment basin?</td>
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<tr>
<td>Public access to basin prevented through dense vegetation or other means?</td>
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<tr>
<td>Gross pollutant protection measures provided on inlet structures where required?</td>
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<tr>
<td>Freeboard provided to top of embankment?</td>
</tr>
<tr>
<td>Public safety design considerations included in design and safety audit of publicly accessible areas undertaken?</td>
</tr>
<tr>
<td>Overall shape, form, edge treatment and planting integrate well (visually) with host landscape?</td>
</tr>
<tr>
<td><strong>Outlet Structures</strong></td>
</tr>
<tr>
<td>'Control' outlet structure required?</td>
</tr>
<tr>
<td>'Control' outlet structure sized to convey the design operation flow?</td>
</tr>
<tr>
<td>Designed to prevent clogging of outlet structures (i.e. provision of appropriate grate structures)?</td>
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<tr>
<td>'Spillway' outlet control (weir) sufficient to convey ‘above design flow’?</td>
</tr>
<tr>
<td>'Spillway' outlet has sufficient scour protection?</td>
</tr>
<tr>
<td>Visual impact of outlet structures has been considered?</td>
</tr>
</tbody>
</table>