The volume of a permanent pool in a sedimentation basin should have sufficient capacity to ensure that desilting of the basin is not more frequent than once every five years (unless it is to be used for temporary sediment control when cleaning every six-months may be appropriate). A developing catchment can be expected to discharge between 50 m$^3$/ha and 200 m$^3$/ha of sediment each year. In a developed catchment, the annual sediment export is generally one to two orders of magnitude lower with an expected mean annual rate of 1.60 m$^3$/ha. There are different methods used to estimate sediment loads and some authorities have produced charts of sediment loading rates (ACT Department of Urban Services 1994; NSW Department of Housing 1998). Desilting should be required when the permanent pool is half full with deposited sediment.

### 4.3 Design procedure: sedimentation basins

#### 4.3.1 Estimating design flows

**4.3.1.1 Design discharges**

Two, possibly three, design flows are required for sedimentation basins:
Bioretention swales crossings can significantly affect the required width of the swale/bioretention system. Driveway crossings can either be ‘elevated’ or ‘at-grade’. Elevated crossings provide a culvert along the swale to allow flows to continue downstream, whereas at-grade crossings act as small fords and flows pass over the crossings. The slope of at-grade crossings (and therefore the swale) are governed by the trafficability of the change in slope across the base of the swale. Typically 1:9 side slopes, with a small flat base, will provide sufficient transitions to allow for suitable traffic movement.

Where narrower swales are required, elevated crossings can be used (with side slopes typically of 1:5) which will require provision for drainage under the crossings with a culvert or similar structure.

Crossings can provide good locations for promoting extended detention within the bioretention swale and also for providing overflow points in the bioretention swale that can also be used to achieve ponding over a bioretention system (e.g. Figure 5.2). The distance between crossings will determine the feasibility of having overflow points at each one.

Selection of an appropriate crossing type should be made in consultation with urban and landscape designers.

5.3.2.2 Selection of Manning’s $n$

Manning’s $n$ is a critical variable in the Manning’s equation relating to roughness of the channel. It varies with flow depth, channel dimensions and the vegetation type. For constructed swale systems, the values are recommended to be between 0.15 and 0.4 for flow depths shallower than the vegetation height (preferable for treatment) and significantly lower (e.g. 0.03) for flows with greater depth than the vegetation. It is considered reasonable for Manning’s $n$ to have a maximum at the vegetation height and then sharply reduce as depths increase. Figure 5.7 shows a plot of varying Manning’s $n$ with flow depth for a grass swale. It is reasonable to expect the shape of the Manning’s $n$ relation with flow depth to be consistent with other swale configurations, with the vegetation height at the boundary between ‘Low flows’ and

![Figure 5.7 The effect of flow depth on hydraulic roughness (after Barling and Moore 1993).](image-url)
down a swale. Creating distributed flows can be achieved either by having a flush kerb (Figure 8.11) or by using kerbs with regular breaks in them to allow for even flows across the buffer surface (Figure 8.12).

For distributed flows, it is important to provide an area for coarse sediments to accumulate (i.e. off the road surface). Sediment will accumulate on a street surface where the vegetation is the same level as the road (Figure 8.11). To avoid this accumulation, a tapered flush kerb can be used that sets the top of the vegetation between 40 mm and -50 mm lower than the road surface (Figure 8.11, diagram), which requires the top of the ground surface (before turf is placed) to be between 80 mm and -100 mm below the road surface. This allows sediments to accumulate off any trafficable surface.

Figure 8.10 The effect of flow depth on hydraulic roughness (after Barling and Moore 1993).

Flow depth (% of vegetation height)

<table>
<thead>
<tr>
<th>Flow depth (% of vegetation height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low flows</td>
</tr>
<tr>
<td>Intermediate flows</td>
</tr>
<tr>
<td>High flows</td>
</tr>
<tr>
<td>Submergence starting*</td>
</tr>
<tr>
<td>3% submergence</td>
</tr>
<tr>
<td>Complete submergence</td>
</tr>
</tbody>
</table>

*Point where channeling or complete inundating of vegetation is beginning

Medium-length sod-forming grass (Bermuda) tested in channels having 5% bed slope. Order of flows from low to high.

Figure 8.11 A flush kerb without setdown that shows accumulation of sediment on the street surface, and edge detail showing a recommended amount of setdown.