Ponds and Sedimentation Basins (Costing)

The process for undertaking a life cycle costing analysis for ponds and sediment basins is the same as described in Life-Cycle Costing - Constructed Wetlands and Life-Cycle Costing - Bioretention Systems.

The origin of all of the ‘expected’ values and algorithms in MUSIC’s costing module, as well as the statistical operations used to generate ‘upper’ and ‘lower’ estimates for ponds and sediment basins are explained in Table 1.

Tip Box

Worked Example -

To Manually Adjust the Estimate of *V* for Sediment Basins and Ponds

One of the alternative algorithms in Table 7-4. allows users to estimate the typical annual maintenance cost using the size attribute *V*, where *V* is the volume of material removed from the basin / pond (in m^3/year). Currently, MUSIC calculates *V* by adding the estimated volume of gross pollutants, coarse sediment and total suspended solids (TSS) that are trapped in the basin / pond per year.

A worked example is given below showing how to manually calculate an estimate of *V* that includes TSS, coarse sediment and/or gross pollutants. For example, an estimate may be required of the volume of only trapped coarse sediment and TSS, as these materials could potentially be reused.

Consider an urban catchment in Melbourne 20 ha in size with 50% impervious area that generates stormwater that is to be treated by a 194 m^2 sediment basin (sized to trap 80% of the TSS load).

The load of trapped TSS is calculated by right-clicking on the basin’s treatment node icon and examining the Statistics » Mean Annual Loads section of MUSIC. In this example, the inflow load is 11,700 (kg/year) and the outflow load is 2,340 kg/year, so the trapped load is 9,360 kg/year. Using a mass to volume conversion factor of 1,800 kg/m^3 for sediment, this equates to a volume of 5.20 m^3/year.

Using the same procedure for gross pollutants, the inflow load is 2,550 kg/year and the outflow load is 0 kg/year (as MUSIC assumes 100% is captured). Using a mass to volume conversion factor of 260 kg/m^3 for gross pollutants, this equates to a volume of 9.81 m^3/year.

For coarse sediment, it is known that in gross pollutant traps that capture nearly all coarse sediment and gross pollutants, approximately 29% of the volume is sediment (on average). So the load of coarse sediment (m3/year) = the volume of trapped gross pollutants (i.e. 9.81 m^3/year) • 0.4085 = 4.01 m^3/year.

Now the three elements of the total trapped volume are known, the user can choose which of these should be added to estimate V.

Table 1 Summary of cost-related relationships for ponds and sediment basins.

Element of Life Cycle Costing Model	Default Option for Estimation in MUSIC	Alternative(s)	Notes
Life cycle	50 years (From collected survey data, *n* = 3)	No alternative in music.	One could convincingly argue the life cycle is infinite for well-maintained ponds / basins, but we need to set the LC to a finite number to calculate a life cycle cost. Upper and lower estimates derived using a 84th and 16th percentile, respectively.
Total acquisition cost (TAC)	TAC ($2004) = 685.1•(A)0.7893 $R^2 = 0.99$; $p < 0.01$; $n = 4$ Where: A = surface area of treatment zone in m^2	No alternative size / cost relationships in MUSIC. For literature values, see Taylor (2005b) – included in Appendix H.	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Note that a linear equation (TAC = 96.15•(A) + 16,200) produced a slightly higher R^2 value, but due to the behaviour of the relationship when the treatment device size is small, the power relationship was preferred.

Typical annual maintenance (TAM) cost	TAM ($2004) = $185.4 \cdot (A)^{0.4780}$ $R^2 = 0.92$; $p = 0.04$; $n = 4$ Where: A = surface area of the basin /pond in m^2	TAM ($2004) = $698.3 \cdot (A)^{0.7766}$ $R^2 = 0.72$; $p < 0.01$; $n = 57$ Where: V = average annual volume of removed material in m^3 (were “removed material” includes trapped gross pollutants, coarse sediment and TSS). For literature values, see Taylor (2005b)	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. **Warning**: The alternative cost / size relationship is based on an “open gross pollutant trap” data set, as these treatment devices are essentially a pond / basin with a trash rack. In addition, currently music estimates V using the combined estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the basin / pond. To adjust this man ually (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within this section. Estimates from the North American and Australian literature (see Taylor, 2005b) suggest that ponds typically cost ~3% - 6% of the construction cost to maintain per year (equates to ~5.5% of the TAC, based on the CRCCH data set for sediment basins and ponds). Note however that the CRCCH data set for these types of device does not support the hypothesis that a strong correlation exists between TAM and TAC (albeit based on limited data).
Annualised renewal / adaptation cost (RC)	RC ($2004) = 1.4% of TAC p. a. $n = 4$	No alternative size / cost relationships in MUSIC. For literature values, see Taylor (2005b)	Upper and lower estimates derived using a 84th and 16th percentile, respectively.
Renewal period	1 year (Default position due to lack of high quality data supporting an alternative period)	10 years	There is *weak evidence* that major renewal / adaptation costs occur every 10 years on average (e.g. costs associated with access ramps, re-contouring), but this is likely to vary significantly on a site-by-site basis.
Decommissioning cost (DC)	DC ($2004) = 38% of TAC $n = 3$	No alternative size / cost relationships in MUSIC.	
General caveats / notes for this type of device	* There are several estimates of capital and maintenance costs reported in the literature for sediment ponds and basins (see Taylor, 2005b or Appendix H: Costing information for a summary).		