Appendix H: Costing information

Introduction

The information presented in this appendix has been taken from version 3 of a document titled "Structural Stormwater Quality BMP Cost / Size Relationship Information from the Literature" (Taylor, 2005b). Check the toolkit web site (www.toolkit.net.au) to ensure that this is the latest version available.

This appendix summarizes cost-related information for structural stormwater quality best management practices (BMPs) that was found in the literature.

This information has been summarized to provide guidance to urban stormwater managers who are seeking additional costing information to that provided in MUSIC’s life cycle costing module. For example, a music user may wish to estimate the total acquisition cost of a very large plastic rainwater tank (e.g. 30 kL). As the size / cost algorithm for this cost element in MUSIC’s life cycle cost module has been derived from a data set involving metal tanks that are 1 to 15 kL in size, the user is likely to use estimates from this appendix in preference to MUSIC’s default value.

Basic BMP cost / size relationships from the literature should be used with caution. The CRC for Catchment Hydrology’s work involving BMP costing has found a very high degree of variability in most cost elements. Despite this variability, very few cost-related studies report the degree of uncertainty associated with their cost estimates.

The dollar values quoted in this report have not been adjusted for inflation. For example, if the referenced source of a cost estimate is "CRC (2002)", the dollar values are in 2002 Australian dollars. At time of writing, 2% is a suggested annual inflation rate that is relevant to these types of assets.

Gross Pollutant Traps

An in-ground GPT supplier undertook a survey of its units in NSW from October 1997 to September 2000. The study looked at 334 maintenance events involving the removal of 1,345 tonnes of gross pollutants (in total). This survey found that typical annual maintenance costs ranged from $0.13/kg (in 2001 dollars) for larger units to $0.28/kg for smaller units. This range equates to approximately $0.17/ha/day to $0.78/ha/day.

The NSW EPA (2002) developed a spreadsheet that lists approximate unit prices (i.e. capital costs) for a wide range of proprietary GPTs. This spreadsheet also provides some information on typical maintenance costs associated with these units. A summary of these costs is provided below:

- Rocla Downstream defender: ~$12,000 to $36,000 capital (all costs in 2000 dollars), with maintenance cost of ~$20 per ha per month (suction cleaning).
- Stream Guard - catch basin insert: ~$290 capital plus ~$200 p.a. maintenance.
- Stream Guard - passive skimmer: ~$60 capital plus ~$200 p.a. maintenance.
- Ecosol RSF100: ~$4,300-9,000 capital plus ~$200 p.a. maintenance.
- CSR Humegard: ~$10,000-50,000 capital plus a maintenance cost of ~$20 per ha per month (suction cleaning).
- Rocla Cleansall: ~$20,000-150,000 capital plus up to ~$14,400 p.a. maintenance.
- Ecosol RSF 1000: ~$4,000-12,000 capital plus up to ~$12 per ha per month for maintenance.
- Baramy: ~$15,000-40,000 capital plus up to ~$12 per ha per month for maintenance.
- CSR Humegard: ~$18,000-51,000 capital plus up to ~$14,400 p.a. maintenance.

WBM Oceonics has undertaken a review of the capital costs, operating costs and performance of a range of proprietary stormwater treatment measures for the NSW Stormwater Trust. This material is yet to be published, but maintenance costs associated with the collection and disposal of wastes collected by various gross pollutant traps are reported within a broad range of $160 to $700 per cubic metre of waste (S. Barter, pers. comm., 2004).

In addition to this cost range, WBM have estimated a $/yr figure for typical BMP inspection costs (i.e. ~$120 - 720/yr) and an annual administration fee ($10 - 100/yr). Note these cost estimates are based on unit rates and predictions of expended time, not real expenditure.

The WBM estimates are based on summarised costing data from NSW Councils in the late 1990s and also estimates of what maintenance should be done and what it should cost (based on unit rates). It makes no allowance for the time value of money, whether GST is (or isn't) included, and does not consider parts of the life cycle (e.g. defining the need for the BMP, renewal / adaptation costs, decommissioning).

Hornsby Shire Council (2002) produced a “Catchment Remediation Capital Works Program: Annual Performance Report 2001-02” which includes some costing information for 2001-02:

- Trash racks (n = 17): average capital cost $966/ha; average annual maintenance cost $2,346; and average annual maintenance cost per ha $39.
- Large trash baskets (0.5 m³ capacity) (n = 9): average capital cost $2,117/ha; average annual maintenance cost $708; and average annual maintenance cost per ha $42.
- Proprietary in-ground devices (n = 19), not including SEPTs: average capital cost $6,122/ha; average annual maintenance cost $765; and average annual maintenance cost per ha $156.

Based on a limited data set from Brisbane, Weber (2001 and 2002) reported the following cost estimates:

- Side entry pit traps (SEPTs): The typical capital cost $1,700 - $2,900/ha (of area treated).
- Trash racks (no sediment capture): The typical annual maintenance cost 30% of construction cost. Also, typical construction cost $20,000 and typical annual maintenance cost $6,000.
- Trash racks (with sediment capture): The typical annual maintenance cost 6% of construction cost. Also, typical construction cost $120,000 and typical annual maintenance cost $7,600.
• Floating litter traps: The typical annual maintenance cost 7% of construction cost. Also typical construction cost $50,000 and typical annual maintenance cost $3,600.
• Open GPTs[2]: The typical annual maintenance cost 3% of construction cost. Also, typical construction cost $350,000 and typical annual maintenance cost $10,000.
• In-ground GPTs: The typical annual maintenance cost 10% of construction cost. Also, typical construction cost $200,000 and typical annual maintenance cost $20,000.

Walsh (2001) reported that the typical capital cost in Melbourne for vortex type in-ground GPTs that are operated by local government authorities was $100,000 per m³/sec (when the flow is at its peak treatment rate).

A ‘rule of thumb’ for BMP costing in Penrith / Blacktown (based on 10 years experience): Big GPTs $10,000 p.a. for typical maintenance (Hunter, 2003).

Information from Frankston City Council (Victoria):
• SEPTs cost approximately $200 (each) and ~$15 (each) to maintain approximately 12 times a year. Assume life span 10 years.
• CDS maintenance typically cost ~$1,000 per clean-out, and is required ~4 times a year.

A study by the NSW Department of Public Works and Services (2001) assumed typical annual maintenance costs for GPTs (e.g. CDS, Ecosol, Rocla, etc.) as being ~7% of capital cost (the rationale for this figure is not explained in the report). The study also estimated typical annual maintenance costs for nine types of GPTs (probably based on the ‘7% relationship’):
• CDS units average $10,365 (no details of BMP size were provided).
• Ecosol units average $13,059 (no details of BMP size were provided).
• CSR Humes units average $14,492 (no details of BMP size were provided).

Lloyd et al. (2002) developed some BMP size/ cost relationships for “litter and sediment traps” (combined):
• Construction cost ($) 13,703 x (Catchment area in ha)
• Annual maintenance cost ($) 311.67 x (annual volume of material removed from the trap in m³)

### Constructed Wetlands

Leinster (2004) reported the following construction costs associated with wetlands in greenfield developments within South East Queensland:

Small-scale wetland with an inlet pond, macrophyte zone, bypass weir and channel:
• Macrophyte zone: 850m²
• Inlet pond: 85m²
• Total area: 935m²
• Construction and planting cost: $88,000 - $93,000 (unit cost: $90 - $100/m²)

Larger-scale wetland to treat recirculated lake water:
• Macrophyte zone: 3,500m²
• Construction and planting cost: $227,500 (unit cost: $65/m²)


A ‘rule of thumb’ for wetland costing in Penrith / Blacktown (based on 10 years experience): ~$500,000 per ha of surface area for design and construction cost, ~$10,000 per ha (p.a.) for routine maintenance in the first 2 years (i.e. ~2% of design and construction cost, or ~1.96% of total acquisition cost) then ~$5,000 per ha p.a. for routine maintenance (i.e. ~1% of design and construction cost, or ~0.98% of total acquisition cost), then major corrective maintenance every 10 years (~5% of construction cost). (Primary source: Geoff Hunter, 2003.)

Weber (2002) reported typical construction cost $500,000 each or ~$3,400 - $17,900/ha (of area treated) or ~$730,000/ha (of wetland area). Also, typical annual maintenance cost ~$8,200. This is information from Brisbane, based upon a very limited data set.

Walsh (2001) reported typical construction cost for greenfield wetlands in Melbourne $120,000/ha of area treated.

Fletcher et al. (2005) suggested that the macrophyte zone needs to be replaced every 20-50 years at a cost of ~50% of the initial construction cost.

Melbourne Water (2003a) has a basic construction cost estimation model for large greenfield wetlands in Melbourne. It allows for typical site characteristics to be used as factors that determine overall construction cost. The cost relationships appear to be based on a limited data set (i.e. tender information for ~8 BMPs).

Lloyd et al. (2002) developed some BMP size / cost relationships for “wetlands and vegetated swales” (combined):
• Construction cost ($) 343,913 x Ln(surface area of the BMP’s treatment area in ha) + 738,607.
• Annual landscaping maintenance cost ($) 9,842.2 x (surface area of the BMP’s treatment area in ha)

A unit cost of $75/m² (of wetland area) was used for the construction of a wetland with a 1 ha catchment during a desk-top water sensitive urban design project in the Snowy Monaro region (Lane, 2004). This rate did not include any costs associated with an up-stream gross pollutant trap which was included in the design (i.e. ~$11,000 for the design and construction cost of a CDS unit), or construction work on the outlet of the wetland (estimated at $5,000).
Infiltration systems / trenches


The Centre for Watershed Protection (CWP, 1998) and US EPA (2001) reported typical annual maintenance cost 5-20% of construction cost.

Fletcher et al. (2005) suggested that the construction cost of an infiltration trench is ~$60-80/m$^3$ of trench (assuming the trench is 1 m wide and 1 m deep).

URS (2003) estimated the unit rate for the construction of a 1m wide, 1m deep infiltration trench in Sydney as $138/m. This cost estimate included: excavation, installation of geofabric liner, installation of perforated pipe, installation of gravel layer, installation of filter layer, application of top-soil, application of grass seed, application of fertiliser and watering.

Permeable Paving

Costing information from Boral (2003) in NSW for five types of design:

- Permeable paving allowing infiltration: ~$111/m
- Permeable paving over sealed sub-grade, allowing water collection: ~$119/m
- Augmentation with permeable paving (i.e. mixing permeable with normal pavers): ~$98/m
- Permeable paving with asphalt: ~$67/m
- Permeable paving with concrete slab: ~$90/m

Fletcher et al. (2005) reported that the typical annual maintenance costs of permeable paving in California (when converted from US dollars) were approximately $9,700/ha.

URS (2003) estimated the cost of supplying permeable pavement blocks to be approximately $30 to $50/m$^2$ in Sydney. The total construction cost was estimated to be $98.4/m$^2$, which includes excavation and profiling, supply of blocks, installation of blocks, installation of geofabric liners, installation of gravel and installation of sand.

Boubli and Kassim (2003) reported costs associated with the Pioneer Street project in Sydney for ‘permeable pavers’ as being approximately $120/m$ of paving. This estimate includes costs associated with supplying and placing the pavers.

Buffer / Filter strips

Walsh (2001) reported:

- Turf buffer strips cost: ~$3.50/m
- Sedge/Mulch buffer strips cost: ~$7.50/m

URS (2003) reported that the construction cost of a typical grass buffer strip would be approximately $10 to $15/m$ of the Sydney area (includes surface preparation, top-soiling and seeding with grasses). This cost estimate increases to approximately $20 to $50/m$ if native grasses and shrubs are used as vegetation.

Grassed / Vegetated swales

Lloyd et al. (2002) suggested grassed swales cost ~$2.50/m$^2$/yr to maintain (but if residents do regular mowing there is less cost to local authorities). For vegetated swales the routine maintenance cost starts at ~$9/m$^2$/yr, then after ~5 years decreases to ~1.50/m$^2$/yr.

Fletcher et al. (2005) suggested the typical construction cost of grassed swales and buffer strips (based on advice from contractors) is ~$4.50/m$ which includes earthworks, labour and hydro-mulching. If rolled turf is used the cost is ~$9.50/m$^2$. The cost of a vegetated swale system using labour, earthworks and indigenous vegetation is between ~$15 to 20/m$^2$ (based on information from Indigenous Gardens Pty Ltd in Melbourne).

Bryant (2003) reported that it cost ~$120/m$^2$ for planting (excluding trees), excavation, soil, swale cross-overs, initial maintenance and irrigation of swales.

Leinster (2004) reported the construction cost associated with ‘swale bioretention systems’ in greenfield developments within South East Queensland as approximately $100 - 120/linear metre including vegetation. For this system the filter zone / swale base has a width of 1 m and a swale top has a width of 3-4 m.

Lloyd et al. (2002) developed some BMP size / cost relationships for “wetlands and vegetated swales” (combined):

- Construction cost ($) = 343,913 x Ln(surface area of the BMP’s treatment area in ha) + 738,607.
- Annual landscaping maintenance cost ($) = 9,842.2 x (surface area of the BMP’s treatment area in ha)

URS (2003) estimated unit rate construction costs for vegetated swales:

- $10/m
- $18/m
- An additional $10/m
Beecham (2002) estimated vegetated swale maintenance costs for Sydney conditions as $3.13/m², based on the following unit rates: $1.62/100m² for mowing (required 2 - 3 times a year), $16.20/100m² for general grass care, $0.95/m² for litter removal, $0.65/m² for reseeding and fertilisation (1% of the total area is revegetated per year), and $1.35/m² for annual inspections and administration.

A unit cost of $100 per linear metre was used for the construction of a road-side grassed swale during a desk-top water sensitive urban design project in the Snowy Monaro region (Lane, 2004). Roadside swales are typically 3m wide.

Bioretention Systems

Leinster (2004) reported the following construction costs associated with bioretention systems in greenfield developments within South East Queensland:

- Bioretention systems greater than 100m
- Bioretention systems less than 100m
- Swale bioretention systems: $100 - 120/linear metre including vegetation (for this system the filter zone has a width of 1 m and the swale has a top width of 3-4 m).

The Centre for Watershed Protection (CWP, 1998) and US EPA (2001) reported the typical annual maintenance cost 5-7% of the construction cost.

Fletcher et al. (2005) suggested that a grassed bioretention system forming part of a residential nature strip costs ~$135 per linear metre to construct (based on costings from the Lynbrook Estate in SE Melbourne). The suggested maintenance cost for mature systems is reportedly similar to that of swales ~$2.50/m² for grassed systems and ~$1.50/m² for vegetated systems using native vegetation.

URS (2003) estimated unit rates for the construction of 3m wide, 1m deep bioretention trenches as $410/m or $137/m² of surface area. This estimate included: excavation and installation of geofabric liner, drainage pipe, drainage layer, filter media, sand, top-soil and vegetation.

A unit cost of $350 per linear metre was used for the construction of a road-side bioretention system during a desk-top water sensitive urban design project in the Snowy Monaro region (Lane, 2004).

Boubli and Kassim (2003) reported quotes supplied by three tenderers for the Heritage Mews project in Sydney for ‘biofiltration trenches’ as being approximately $150/m³ of trench. This estimate excludes costs associated with plants and landscaping.

Sand Filters


WBM (2003) estimated costs for supply and installation as $5,000 to $50,000 (cited in URS, 2003). Maintenance costs were estimated to range from $1,000 to $5,000 p.a. depending on the scale of the device.

Gibbs (2003) reported that a sand filter and storage basin in Sydney with a catchment area of 60,000m², a sand filter size of 32m², and a ‘storage plus filter area’ of 150m² cost $167,815 to construct (i.e. $1,500 per m² of sand filter including storage capacity).

Newcastle City Council (2002) reported that the construction cost (in 2001 Australian dollars) for a sand filter that treated a catchment approximately 5,000 m² in size was $28,004 (or $36,153 including site establishment, survey, design and supervision costs).

Sediment traps / Basins

Weber (2001 and 2002) reported in Taylor and Wong (2002): Typical annual maintenance cost 6% of construction cost. Also, typical construction cost $50,000 and typical annual maintenance cost $2,800.

Ponds

The Centre for Watershed Protection (CWP, 1998) and US EPA (2001) reported typical annual maintenance cost 3-6% of construction cost.

Fletcher et al. (2005) suggested that a rough estimate for pond construction cost (based only on 1 case study) is ~$2,000/ha of catchment.

Weber (2002) reported typical construction cost $30,000/ML of pond volume (based on limited data).

Walsh (2001) reported typical construction cost $60,000/ha of pond area.

Rainwater tanks

Kuczera and Coombes (2001) reported that the typical annual maintenance cost $70 for above ground tanks.

Gardner et al. (2003) reported that operation and maintenance costs for a 22 kL tank on the Gold Coast, where water was used for toilet flushing and garden watering, were $101.43/year (i.e. $66.43 for electricity and $35 for maintenance). Water savings from the use of the tank (for a detached residential development) was 124 kL/year or $136.40/year in avoided costs (or mains water). The purchase and installation cost was $2,600 (this includes a 1 kw pump and plumbing costs).
An estimate of rainwater tank pump electricity use is 3,000 kWh/ML (T. Gardner, pers. comm., 2004). This equates to a cost of approximately $410.40/ML (using the electricity cost provided by Grant and Hallmann, 2003).

Cardno BLH (2002) reported additional costs associated with above ground steel tanks from 2 NSW case studies (i.e. the Heritage Mews and Pioneer Street Projects):

- The associated cost to reticulate separate supply to toilets $400 (for 1 WC connection) for 1.5 kL tanks; $800 (for 2 WCs) for 3, 4 and 5 kL tanks; and $1,050 (for 3 WCs) for 9 and 10 kL tanks.

In addition, URS (2003) estimated the on-going cost of running an electric pump associated with water tanks that are plumbed into a house (e.g. for toilet flushing) would be $150 p.a. It is assumed that this estimate includes pump maintenance as well as electricity.

Boubli and Kassim (2003) reported the following plumbing costs associated with aboveground tanks for a development in Sydney's north-west:

- Supply pump: $350.
- Install tank including pipe work, fittings and slab: $750.
- Install pump including electrics and soundproof enclosure: $470
- Cost to reticulate separate supply for toilet flushing at one ground floor and two first-floor toilets: $1,050.
- Total: $2,620.

The Institute for Sustainable Futures (2002) reported estimated costs for additional plumbing that would be required to supply treated stormwater for toilet flushing at the Kogarah Town Square Redevelopment Project as $350 per apartment.

Lane (2004) estimated the cost of retrofitting rainwater tanks to existing residential properties using three case studies in Snowy Monaro region. The conclusion of this work was that a total of $3,000 to $4,000 would be adequate to fully retrofit a 9 kL above ground rainwater tank. This cost included purchase and supply of the tank (the average cost was approximately $1,288), the purchase of the pump (the average cost was approximately $577), plumbing materials (the average cost was approximately $1,010), the plumbing labour (varied greatly from $580 to $3,807) and the cost of the electrician (the average cost was approximately $187).

Coombes (2002) estimated typical rainwater tank supply costs: Aquaplate = $540 (4.5 kL) and $860 (9 kL); Galvanised iron $440 (4.5 kL) and $640 (9 kL); Polymer $670 (4.5 kL) and $1,150 (9 kL); and Concrete $1,300 (4.5 kL) and $1,800 (9 kL). Note that up-to-date purchase prices for tanks are readily available from suppliers, many of whom have web sites. The typical installation cost for 5-10 kL tanks was estimated by Coombes (2002) to be $1,800 (estimate includes pump, pressure controller, stand, fittings including float system and installation).

SIA (2004) reported cost estimates associated with Aquaplate above ground tanks, shown in Table 1:

Table 1. Cost estimates associated with Aquaplate above ground tanks

<table>
<thead>
<tr>
<th>Item</th>
<th>Approximate cost for each tank size (in $2001)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5kL</td>
</tr>
<tr>
<td>Aquaplate rainwater tank</td>
<td>540</td>
</tr>
<tr>
<td>Pump + pressure controller</td>
<td>200 + 160</td>
</tr>
<tr>
<td>Plumber and fittings</td>
<td>500</td>
</tr>
<tr>
<td>Float system</td>
<td>100</td>
</tr>
<tr>
<td>Concrete base</td>
<td>200</td>
</tr>
<tr>
<td>GST (10%)</td>
<td>170</td>
</tr>
<tr>
<td>Total (incl. GST)</td>
<td>$1,910</td>
</tr>
</tbody>
</table>

In addition, SIA (2004) reported that:

- pumps typically have a 10 year life span; and
- the operating and maintenance cost of pumps are approximately $0.1 per kL of rainwater consumed. (Note that a typical family home may use ~20 kL/year of water for toilet flushing.)

Boubli and Kassim (2003) reported the following cost estimates for supply and installation of above and below ground rainwater tanks or a single installation in Sydney (shown in Table 2):

Table 2. Cost estimates for supply and installation of above and below ground rainwater tanks or a single installation in Sydney

<table>
<thead>
<tr>
<th>Tank size</th>
<th>Tank type</th>
<th>Tank shape</th>
<th>Approximate tank supply cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5kL</td>
<td>Galvanised steel, aboveground</td>
<td>Round</td>
<td>$2,470</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rectangular / ovular</td>
<td>$2,870</td>
</tr>
</tbody>
</table>
Indicative prices for polyethylene (plastic) rainwater tanks are summarised in Table 3 (Irrigation Warehouse, 2005). These prices include GST, typically include delivery and are relevant to New South Wales, Victoria, southern Queensland and the Australian Capital Territory.

Table 3. Prices for polyethylene (plastic) rainwater tanks

<table>
<thead>
<tr>
<th>Tank size (L)</th>
<th>Tank type</th>
<th>Approximate tank supply cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>509</td>
<td>Slim line (aboveground)</td>
<td>$491</td>
</tr>
<tr>
<td>700</td>
<td>Tall round (aboveground)</td>
<td>$418</td>
</tr>
<tr>
<td>720</td>
<td>Slim (aboveground)</td>
<td>$501</td>
</tr>
<tr>
<td>758</td>
<td>Round (aboveground)</td>
<td>$511</td>
</tr>
<tr>
<td>1,074</td>
<td>Slim (aboveground)</td>
<td>$766</td>
</tr>
<tr>
<td>1,179</td>
<td>Round (aboveground)</td>
<td>$521</td>
</tr>
<tr>
<td>1,250</td>
<td>Round (aboveground)</td>
<td>$550</td>
</tr>
<tr>
<td>1,400</td>
<td>Tall slim (aboveground)</td>
<td>$792</td>
</tr>
<tr>
<td>1,615</td>
<td>Round (aboveground)</td>
<td>$551</td>
</tr>
<tr>
<td>1,800</td>
<td>Under house (aboveground)</td>
<td>$1,122</td>
</tr>
<tr>
<td>2,100</td>
<td>Tall slim (aboveground)</td>
<td>$1,144</td>
</tr>
<tr>
<td>2,281</td>
<td>Slim (aboveground)</td>
<td>$1,271</td>
</tr>
<tr>
<td>2,499</td>
<td>Squat (aboveground)</td>
<td>$601</td>
</tr>
<tr>
<td>2,500</td>
<td>Round (aboveground)</td>
<td>$682</td>
</tr>
<tr>
<td>2,500</td>
<td>Twin under-deck (aboveground)</td>
<td>$1,122</td>
</tr>
<tr>
<td>2,542</td>
<td>Tall (aboveground)</td>
<td>$601</td>
</tr>
<tr>
<td>2,800</td>
<td>Tall slim (aboveground)</td>
<td>$1,496</td>
</tr>
<tr>
<td>3,600</td>
<td>Twin rectangular under house (aboveground)</td>
<td>$2,244</td>
</tr>
<tr>
<td>4,125</td>
<td>Squat (aboveground)</td>
<td>$901</td>
</tr>
<tr>
<td>4,885</td>
<td>Medium round (aboveground)</td>
<td>$901</td>
</tr>
<tr>
<td>5,000</td>
<td>Round (aboveground)</td>
<td>$968</td>
</tr>
<tr>
<td>9,000</td>
<td>RT poly tank (aboveground)</td>
<td>$1,595</td>
</tr>
<tr>
<td>9,609</td>
<td>Large squat (aboveground)</td>
<td>$1,850</td>
</tr>
</tbody>
</table>
Grant and Hallmann (2003) estimated the costs associated with a 2,250 litre plastic tank with a life span of 30 years as: $510 purchase; $38.50 (delivery); $270 (for plumbing costs that allow toilet flushing and garden watering to use tank water); $350 (for the pump); $100 (electrician costs). They also assumed the pump would last for 15 years, and the cost of running the pump (in Melbourne) was estimated to be $0.1368/kwh.

### Additional costs and Cost break-downs

Melbourne Water (2003a) add 15% to estimated greenfield construction costs for "engineering fees" and 20% for "contingencies".

Brisbane City Council (2003) used the following assumption to break down total BMP construction costs where itemised costs were not available: 10% for design, 85% for construction and 5% for management costs.

Choi and Engel (2003) estimated that design costs for structural BMPs typically account for 30% of construction costs.

The Washington State Department of Transportation (2002) add 25% onto estimated BMP construction costs for "contingency" costs, 30% for "engineering services and permitting fees", and 10% for "mobilisation and demobilisation of equipment".

### References


Brisbane City Council (2003). Unpublished cost estimates supplied by Emma Slack-Smith, Environmental Scientist, Brisbane, Queensland, personal communication.


<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,478</td>
<td>Large tall (aboveground)</td>
<td>$1,500</td>
</tr>
<tr>
<td>10,500</td>
<td>RT poly tank (aboveground)</td>
<td>$1,705</td>
</tr>
<tr>
<td>13,500</td>
<td>RT poly tank (aboveground)</td>
<td>$2,024</td>
</tr>
<tr>
<td>15,064</td>
<td>Large (aboveground)</td>
<td>$1,850</td>
</tr>
<tr>
<td>22,500</td>
<td>Low profile (aboveground)</td>
<td>$2,376</td>
</tr>
<tr>
<td>22,500</td>
<td>RT poly tank (aboveground)</td>
<td>$2,640</td>
</tr>
<tr>
<td>24,180</td>
<td>Large tall (aboveground)</td>
<td>$2,551</td>
</tr>
<tr>
<td>25,090</td>
<td>Large low profile (aboveground)</td>
<td>$2,551</td>
</tr>
<tr>
<td>29,560</td>
<td>Very large (aboveground)</td>
<td>$2,950</td>
</tr>
<tr>
<td>38,334</td>
<td>Very large (aboveground)</td>
<td>$4,170</td>
</tr>
<tr>
<td>47,950</td>
<td>Monster (aboveground)</td>
<td>$5,152</td>
</tr>
</tbody>
</table>


[1] Note that true life cycle costing in accordance with the relevant Australian Standard (Standards Australia, 1999) considers more than just construction/purchase cost and typical annual maintenance cost. For more information see Taylor (2003). Also, these approximate costs will vary with time and location. For up-to-date costs of proprietary units, contact the GPT supplier.

[2] That is, a sediment basin with a trash rack.