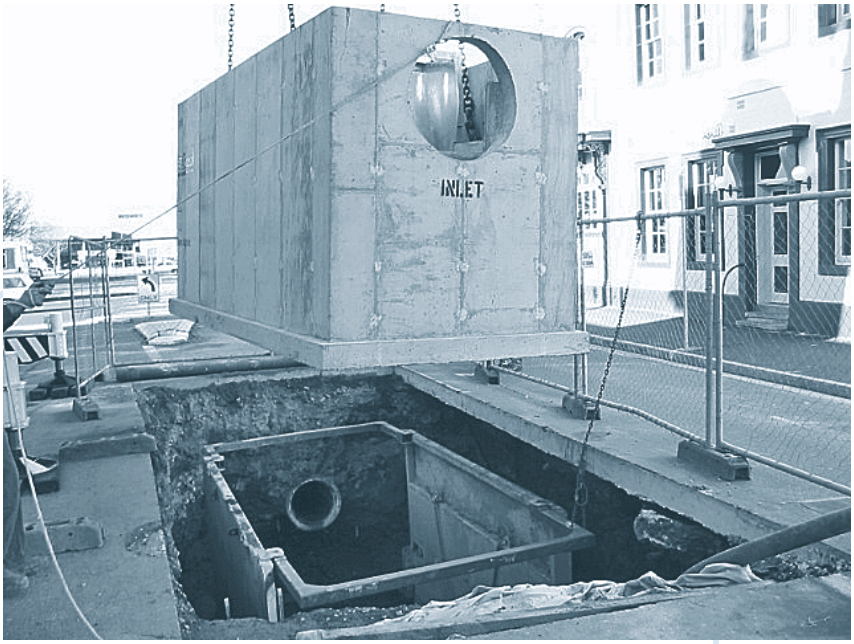
Practice Notes *12 "Hard" engineering systems*



Installation of a GPT in Hobart City

1.1 Introduction

Whilst WSUD generally involves moving away from 'hard' engineering approaches, there is often a place for such systems within a WSUD development. 'Hard' engineering, in this practice note, refers to gross pollutant traps, sedimentation basins and sand filters. These systems usually fit into a WSUD treatment train as pre-treatment devices for other WSUD techniques such as ponds and wetlands.

Many WSUD systems require removal of coarse sediments and gross litter to ensure effective performance and operational longevity.

GPTs and sand filters are also commonly utilised in retrofit scenarios where space and budgetary constraints usually preclude larger WSUD elements.

1.2 Common techniques

1.2.1 In-line GPTs

There are numerous proprietary in-line GPTs on the market. These devices are designed to target gross pollution, coarse sediments and sometimes free oils. They remove pollutants via two main processes, filtration and separation. Filtration units employ a screen to filter flow through, thereby removing any material larger than the screen's aperture. Separator units use hydrodynamic separation, baffles and gravity to remove pollutants from flow.

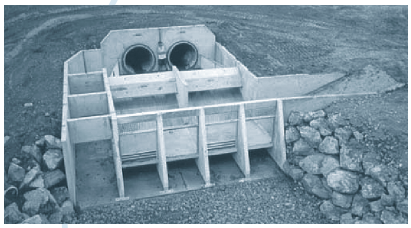
Advantages of in-line devices are the ability to retrofit them to heavily built-up environments and there small footprint.

In-line GPTs are installed underground within a stretch of stormwater pipe.

Gross Polutant Trap Beach Road (Source: Hobart City Council)

1.2.2 Outlet GPTs

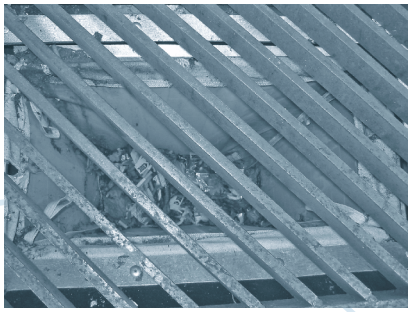
These devices usually employ a screen to filter flows of gross pollutants. They are installed on the end of stormwater pipes where stormwater is discharged to a receiving waterway. Outlet GPTs usually involve significant head loss through the trap, however have a strong advantage in that captured material is stored dry between rainfall events.



Outlet GPT
[Source: Baramy Engineering, 2002]

1.2.3 Stormwater entry-pity traps

Stormwater entry-pit traps are filtration and storage baskets that are installed into existing stormwater entry-pits. As stormwater enters a drainage entrance, it is first filtered through a filtration basket that captures all gross pollutants, allowing the filtered water to carry on to the stormwater network. They have also been found to be effective in the removal of coarse sediments These devices have numerous advantages such as relatively cheap installation costs and dry pollutant storage.



Stormwater entry-pit trap installed in Hobart

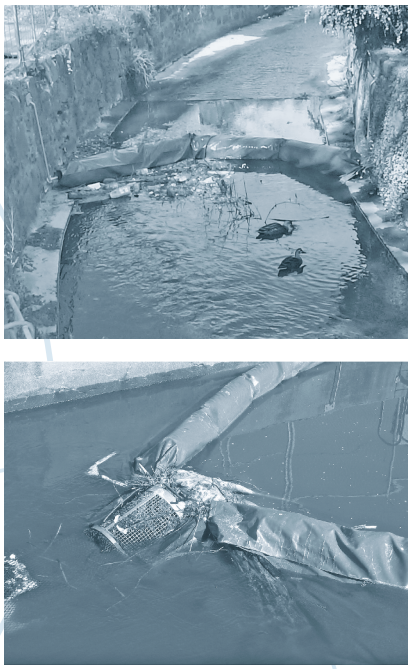
1.2.4 Media filtration systems

Sand filters and proprietary 'filter cartridge' devices rely on water percolating through a filter media, such as sand or pearlite to filter pollutants. They have been found to be extremely effective in the removal of coarse and medium sediments from stormwater, however they are relatively maintenance intensive. They may be installed at the ground surface or underground. Because some medium and fine sediments are trapped by these filters (proportion governed by filter media) they are also effective in trapping a significant proportion of nutrient, heavy metal and hydrocarbon pollution.

1.2.5 Sedimentation basins

Sedimentation basins are effective for the removal of coarse to medium sediments. These systems utilise a reduction in flow velocity to allow sediment particles to fall from suspension under the force of gravity. Sedimentation basins provide some removal of other pollutants that are adsorbed to sediment particles.

Sedimentation basins can be designed in various forms, from hard, concrete structures to landscape features incorporating vegetated surrounds.



Floating litter boom installed in Hobart

1.2.6 Floating booms

Floating litter booms are installed in open channels to remove floatable pollutants. The stormwater treatment capacity of these devices is limited to the capture of floating gross pollutants in low to moderate flow. Where high velocity and volume flows occur, floating booms usually bypass or reach a design break point, whereby one arm of the boom detaches and the captured pollutant load is released.

This is a flood protection measure.

Floating booms can incorporate a capture, storage device (see below right) to retain a higher volume of captured material between cleanouts or to make maintenance easier.

1.2.7 Litter socks

Litter socks are simply nets attached to stormwater outlets designed to capture gross pollutants. Some manufacturers also claim sediment trapping performance via 'secondary filtration', suggesting that accumulated material in the sock effectively creates a smaller aperture filter. Litter socks may have a place within a treatment train to remove litter prior to stormwater entering a wetland (or, more appropriately, prior to a sedimentation basin prior to a wetland).

1.3 Design considerations

1.3.1 In-line GPTs

- Effective under situations where above-ground space is limited and in established, heavily built environments
- Minimal head loss means devices may be installed in almost any situation
- Can be expensive to install models large enough to treat design flows greater than 3 month ARI storms
- When installed beneath roads (commonly where stormwater pipes are laid) maintenance and installation can lead to significant disruption to traffic
- Wet captured material storage sumps may lead to deoxygenation of water and remobilisation of dissolved pollutants to the water column
- Care should be taken to ensure hydraulic capacity of stormwater system is not restricted
- Small to medium footprint

1.3.1 Outlet GPTs

- Limited application as installation must only be on stormwater outlet
- Must not restrict hydraulic capacity of outlet
- May be aesthetically inappropriate for outlets in 'natural' waterways
- Dry storage of captured material prevents anaerobic conditions mobilising sediment-bound pollutants

1.3.1 Stormwater entry-pity traps

- Low capital cost
- Potentially high maintenance costs
- High visibility may have some educational benefit in that people see the impact of littering
- Pollution 'hot spots' may be specifically targeted without treating entire catchment
- Beneficial dry storage of captured material
- Small catchments only.
- Can be targeted to focus on small hot-spot catchments receiving overland flow only, thereby avoiding a large volume of 'clean' flow such as that from roof surfaces.
- Easily 'retrofit-able'

1.3.1 Media filtration systems

- High pollutant removal performance
- Generally require pre-treatment to remove litter and other gross pollutants
- Must be located where access for maintenance is not restricted
- Medium to large footprint
- Suitable for small to medium catchments

1.3.1 Sedimentation basins

- Maintenance requirements must be considered in design phase
- Effective in sediment removal for design flows and design target particle size. These parameters are widely published
- May require pre-treatment to remove litter etc.
- Large footprint
- Suitable for most catchment sizes

(if basin sized accordingly)

- Often unsuitable on steep slopes
- May be designed to drain completely or to maintain a permanent water body
- Can have soft (vegetated) or hard (concrete/rock) edges
- Design should include measures for dewatering to facilitate cleaning

1.3.1 Floating booms

- Very low capital cost
- Maintenance considerations should be considered during design (how will it be cleaned?)
- Can be viewed as an eyesore in natural channels
- If tied to channel bed, may be a barrier to fish passage

1.3.1 Litter socks

- Half pipe systems preferable to prevent potential flooding associated with blocked/full socks.
- Very low capital cost
- Aesthetic implications in high-value recreation or conservation areas
- May suffer back-flushing in tidal environments
- High maintenance – heavy lifting equipment required

1.1 Maintenance

1.1.1 In-line GPTs

- Require regular maintenance
- May require more frequent maintenance than storage volume suggests due to dissolved pollutant mobilisation in wet sump system
- Often requires expensive plant, e.g. inductor trucks, crane trucks
- Captured load requires dewatering prior to disposal – added cost
- Potential of captured material to be classed as 'low level contaminated waste'

1.1.1 Outlet GPTs

- High maintenance (dependant on catchment)
- Usually requires manual labour and lifting equipment

1.1.1 Stormwater entry-pity traps

- High maintenance frequency
- Relatively fast and simple cleaning by hand or inductor truck
- Filter bags may need replacing/ repairing due to damage
- Filter bags may need flushing where oil or fine sediment load is high
- Traffic control required

1.1.1 Media filtration systems

- Filter media requires replacing
- Failure/blockage of media usually not apparent in enclosed systems
- Spent filter media may be contaminated waste - implications for disposal

1.1.1 Sedimentation basins

- Maintenance may be expensive
- Maintenance operations involved
- Systems without hard edges or floors may suffer damage during maintenance

1.1.1 Floating booms

- Regular maintenance required (sometimes weekly)
- Susceptible to damage during high flows
- Maintenance can be difficult in waterways
- Can be prone to vandalism

1.1.1 Litter socks

- Full socks may impede hydraulic capacity of system
- Cleaning requires heavy lifting (usually crane truck)
- Access to site by truck important
- Can encourage vermin (feeding on captured material)

1.1 References

Chrispijn, J. & Milne, T. 2005. Hobart CBD Stormwater Improvement Program, Paper 1 - Assessing Different Structural Approaches To Improve Urban Stormwater Quality. 4th South Pacific Stormwater Conference, Auckland, May 2005.

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