# Appendix E: Case studies

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## Monash University stormwater harvesting system

This project was undertaken by FAWB and Monash University's Water Conservation Committee to capture and treat stormwater runoff from a multi-level carpark (4500 $m^2$) on the Clayton campus of Monash University. The treated water is then used to irrigate an adjacent sports ground and there is an existing ornamental pond to store the treated water.

The system is small relative to its catchment area and as a result overflow occurs frequently. This is not particularly problematic for harvesting (because the water is always pre-treated in two sedimentation tanks, where heavy metal concentrations are reduced, and high nutrient levels are not detrimental for this irrigation application) and, since overflows discharge to the storage pond, load reductions will still be achieved, provided overflow from the pond to the conventional stormwater drainage system is minimised. This can be achieved by keeping the pond slightly drawn down. The system has the following elements:

- Surface area 45 m2, ponding depth 25 cm and filter depth of 70 cm.
- 50 cm loamy sand above a 10 cm transition and 10 cm drainage layer Fully lined to prevent exfiltration
- Densely planted with indigenous plants to a.) maximise the volume of treated water (plants help to maintain infiltration capacity) and b.) maximise pollutant removal.

The system is currently being renewed with new media compositions, different plant species selection and layout.

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**Little Stringybark Creek biofiltration project**

This project was undertaken as part of a large-scale catchment retrofit project to restore the Little Stringybark Creek by reducing the impacts from stormwater runoff. A study of this catchment had demonstrated that the frequency of urban runoff was a key driver of degradation.

The system is built to treat a house (265 $m^2$) and surrounding paved area (200 $m^2$). The site has the benefits of a large available area and a large lawn below the proposed biofilter location for infiltration of overflows before runoff reaches the street drainage. As it is a private property safety considerations are important and the ponding depth must be kept shallow. In addition, a nearby swimming pool necessitated lining the system on the closest side.

At this site reducing the runoff frequency to the desired level was more challenging than reducing the pollutant load to meet the set targets. The design had the following characteristics:

- Surface area 11 m2, ponding depth 20cm and filter depth of 80 cm.
- Bottom 35 cm of media comprised scoria to maximise the available storage, with loamy sand and two transition layers (a fine gravel and a medium sand) overlying this.
- System unlined except for the side closest to the swimming pool, with no underdrain – designed entirely for infiltration in order to minimise runoff frequency.
- System was densely planted with indigenous plants to
    a. maximise evapotranspiration and
    b. meet biodiversity objectives.

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**Kelvin Road biofilter in the City of Gosnells, Western Australia (Source: Toby Rees, City of Gosnells)**

Two biofilters have been installed along Kelvin Road in the City of Gosnells. The vegetation planted in December 2012 includes Juncus subsecundus, Ficinia nodosa, Baumea juncea and Melaleuca lateritia. The biofilters have a 600mm deep saturated zone, which significantly helps buffer against summer droughts. However, three deep waterings were required over the very long summer drought in 2013/14, which replenished the saturated zone. Gingin Loam was used for the filter media.

**Road median biofilters installed along Mead Street in The Glades urban development in Byford (Source: Department of Water, WA)**

**Biofilter integrated into public open space, Meadow Springs, Mandurah (Source: Department of Water, WA)**

**Biofilter on Barlee Street in the light industrial area of Busselton, Western Australia (Source: Department of Water, WA)**

The Barlee Street biofilter was built in June 2009 in the Busselton light industrial area of Western Australia. The biofilter was designed as a retrofitted system to treat stormwater runoff from the road, roof and car park in the surrounding catchment. The biofilter is sized at approximately 2% of the impervious catchment area, providing management of the design inflows to improve the runoff water quality before entry into the Lower Vasse River. Due to shallow winter groundwater levels the biofilter was constructed with a liner. A 150 mm deep saturated zone was created in the biofilter using a raised slotted pipe outlet that is connected to the piped stormwater network. Spearwood red sand/loam was used as the filter media. Further information about the design, construction costs and monitoring of the Barlee Street biofilter is available at

http://www.newwaterways.org.au/page/Research/Advancing-Biofilters-in-Western-Australia-Research-Seminar.

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**Biofilter on Stephen Street in the central business district of the City of Bunbury, Western Australia (Source: Department of Water, WA)**

The stormwater drainage system on Stephen Street in the City of Bunbury, in Western Australia was retrofitted in 2009. This included a series of biofilters designed to fit in with the required parking bays and existing side entry pits. The piped conveyance system was also modified to include StormTech cells to enhance local infiltration. The biofilters were sized at approximately 2% of the impervious catchment area, providing management of the design inflows to improve the runoff water quality before entry into the Leschenault Inlet. They incorporated both groundcover and upper storey planting, with the inclusion of a 580 mm deep, open based root director around trees to protect adjacent infrastructure. Filter media was placed to a depth of 600mm, underlain by 600mm of clean sand allowing infiltrated runoff to enter the underlying groundwater system.

**Biofilter on Queens Street roundabout in the town centre of the City of Busselton, Western Australia (Source: Department of Water, WA)**

The roundabout on the junction of Queens Street and Prince Street in the City of Busselton, Western Australia was upgraded in July 2009 to include treatment of small events using biofilter, prior to entry into the existing piped stormwater system. The upgrade enhanced the street landscaping and also included artwork incorporated into required infrastructure). The unlined biofilters were sized at approximately 4% of the impervious catchment area, providing management of the design inflows to improve the runoff water quality before entry into the Geographe Bay. Due to constraints of the existing stormwater system a filter media depth of 200 mm was viable. The systems were initially planted with Ficinia nodosa, which was later replaced by City of Busselton with Lomandra species. Due to the requirement for kerbs at a junction, breaks in the kerb were used as entry points.

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**Large scale biofilter in Margaret River, Western Australia (Source: Cape to Cape Catchments Group, WA)**

The Margaret River Rain Garden was completed in July 2008 and comprised a large scale multi-layered biofilter system. The system receives untreated runoff, via a piped stormwater system, from the Margaret River central business district that includes commercial areas, roads, carparks and pavements. Due to limited space within the urban area the end of line biofilter system was constructed within an 'A Class' reserve, with the support of the reserve manager and community of Margaret River. As the system receives flows from a large catchment on a steep slope a bypass channel takes larger flows while low flows are passed through a gross pollutant trap and sediment settlement basin prior to entry into the biofilter. The biofilter has been sized at approximately 2% of the impervious catchment area, providing management of the design inflows to improve the runoff water quality before entry into the Margaret River. It comprises an upper and lower biofilter of 750 m² and 340 m² respectively, with an option of an additional future biofilter of 1025 m². Due to the clayey nature of the soils the 600 mm deep filter media is underlain with a sub-soil system that directs treated water back into the bypass channel.


**Biofilter in the Cultural Precinct on Queens Street in the town centre of the City of Busselton, Western Australia**

The stormwater drainage system on Queens Street was retrofitted during a major upgrade and facelift of the streetscape in the area of the Cultural Precinct in City of Busselton, Western Australia. This included inclusion of biofilters sized at approximately 2% of the impervious catchment area, providing management of the design inflows to improve the runoff water quality before entry into the Geographe Bay. The biofilters were specifically designed to mould into and add aesthetic value to the streetscape with consideration of shape, location, vegetation and shade being considered. The biofilters included trees, with the inclusion of a 580 mm deep, open based root director around trees to protect adjacent infrastructure. These trees provide a more relaxing environment and also shade for strategically placed benches. The street is completely kerb less and as such bollards have been installed, making use of timber to ensure provide less of a visual impact. The biofilter includes filter media to a depth of 1000mm, underlain by 600mm of clean sand allowing infiltrated runoff to enter the underlying groundwater system.

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**Biofilter with information board in carpark in the town centre of the City of Busselton, Western Australia (Source: Department of Water, WA)**

Two existing raised garden beds in a carpark in in the town centre of the City of Busselton, Western Australia were retrofitted as biofilters as part of a demonstration project in April 2011. The biofilter sizes were pre-set by the existing garden footprint, which resulted in the size of the biofilters being approximately 2% and 1% of the impervious catchment area. They provide management of the design inflows to improve the runoff water quality before entry into the Geographe Bay. Filter media was placed to a depth of 500 mm, underlain with a 100 mm thick clay layer. The purpose of the clay layer below filter media was to assist in capturing pollutants and retaining water for absorption by the plants. The systems were initially planted with Ficinia nodosa, Melaleuca incana and Beaufortia sparsa.

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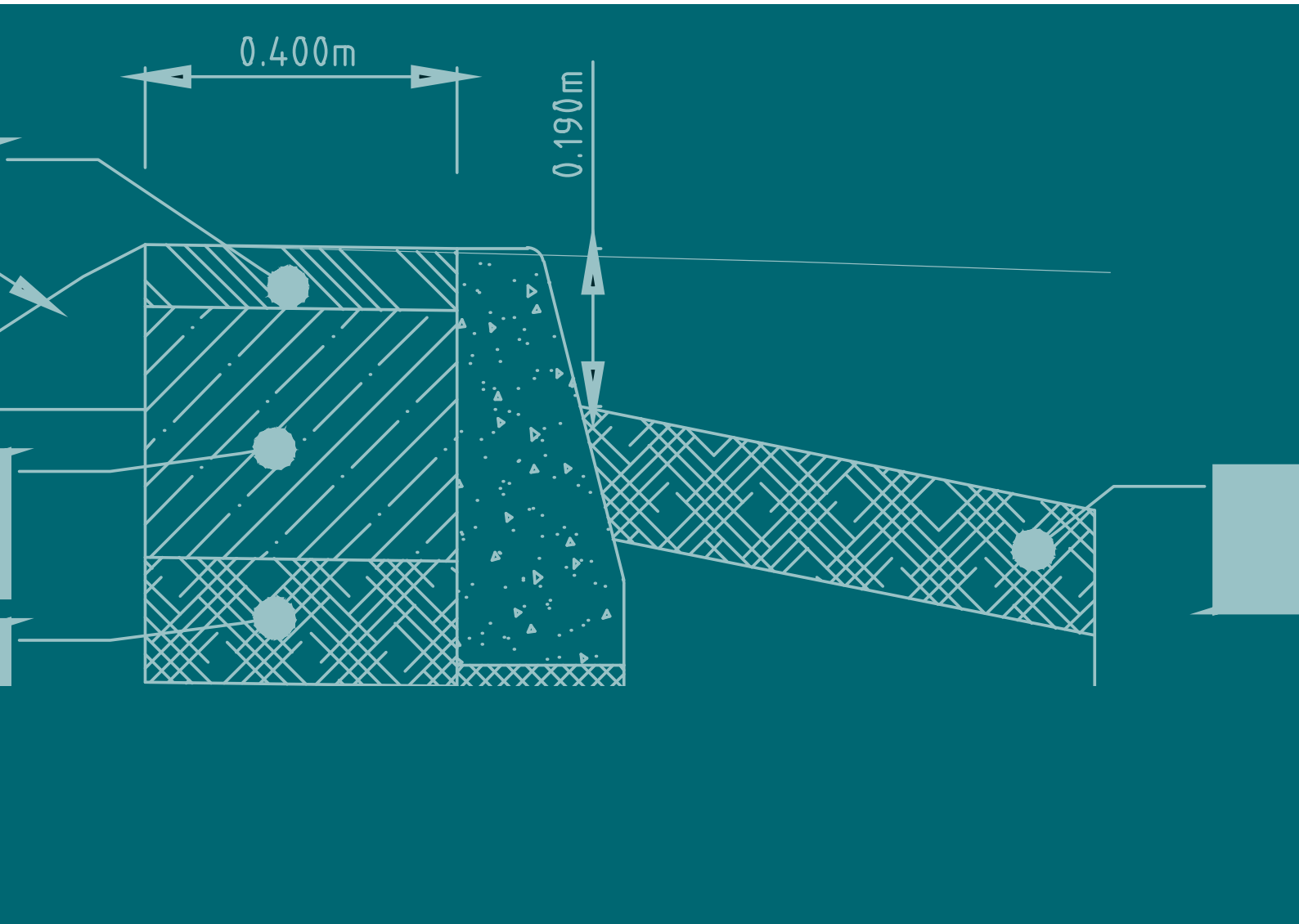
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