Humes

Strength. Performance. Passion.

StormTrap® stormwater detention and infiltration

Issue 5

Contents

WSUD and stormwater detention

As the environment continues to feel the impact of population growth, the Australian stormwater industry is tackling the issue of balancing stormwater hydrology with the demands of urbanisation.

Water Sensitive Urban Design principles are becoming increasingly important in addressing these issues with on-site detention and infiltration playing a greater role in urban design. The StormTrap® system from Humes has been developed to meet the needs of the environment without compromising valuable land.

The water cycle and urban development

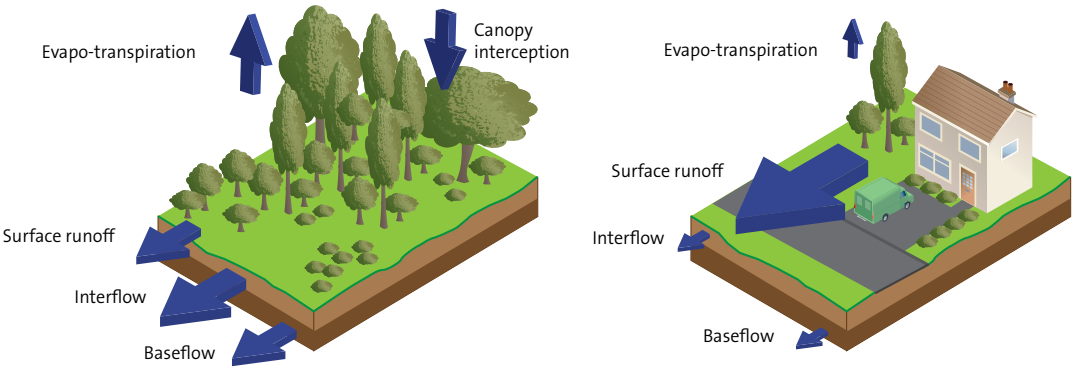
Urban developments influence and impact on nature's water cycle by creating hard surfaces, such as roofs, roads, driveways and car parks, which prevent water from infiltrating the soil and being taken up by vegetation.

Instead, extra runoff feeds into streams, rivers and ultimately the ocean, resulting in higher peak flows during storm events, more frequent flooding, erosion and the degradation of ecosystems in local waterways (refer to Figure 1).

Traditionally, stormwater was managed by drainage, using pipes and engineered channels to transport runoff to the nearest creek or waterway as quickly as possible. The next stage in stormwater management was implementing detention basins, which capture and slowly release the runoff at or below the pre-development flows. However, if too many detention basins are constructed in the sub-catchment areas their controlled flows can coincide at the major catchment outlet, resulting in higher overall peak flows and flooding. As detention basins eventually return all stormwater to local waterways, they are also not designed to reduce the total volume of runoff from developments.

These factors have driven a trend towards Water Sensitive Urban Design measures that allow stormwater runoff to infiltrate the soil.

Figure 1 – Urban hydrology cycle



Pre-development hydrology

Post-development hydrology

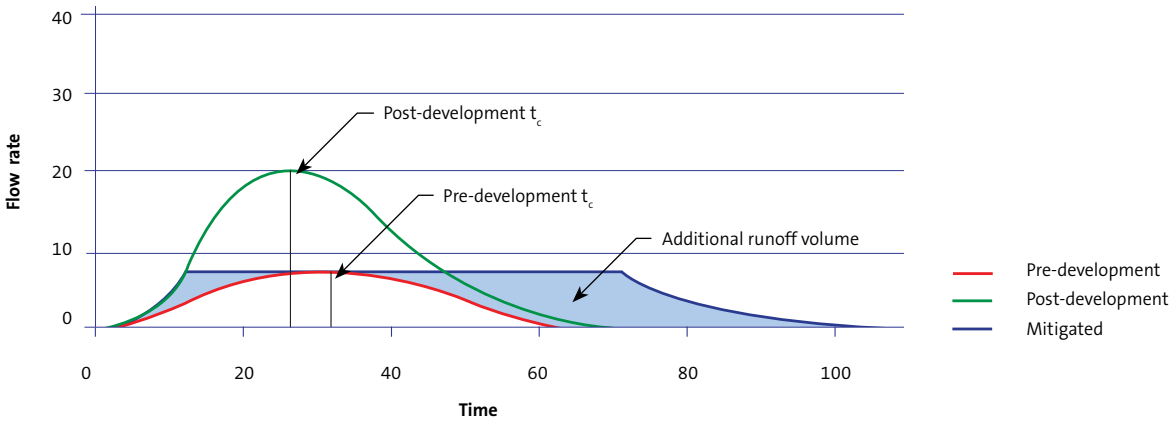
On-site detention and infiltration – the way forward

Most authorities have developed guidelines for stormwater detention and/or volume reduction in new developments. The objectives are generally to:

- reduce post-development peak flows to pre-development conditions
- reduce overall flow volumes by encouraging the reuse or infiltration of runoff to return hydrologic conditions to a more sustainable state.

As these objectives can lock up land that potentially has significant capital value, particularly for industrial and commercial sites, many designers are looking for a solution that meets the guidelines without compromising the above ground land use (refer to Figure 2).

Figure 2 – Typical hydrologic regimes



StormTrap® system – a complete solution

Below:
A complete StormTrap® system ready for backfilling

The StormTrap® system is a purpose-built stormwater detention and infiltration solution that meets regulatory requirements yet minimises impact on usable land. Its flexible design and simple installation makes it a cost effective solution for residential, commercial or industrial projects.

The StormTrap® system connects individual precast concrete modules into a configuration that can be customised to meet project-specific requirements. It is an ideal solution for sites needing a safe, low risk structural system for below car parks, hardstands, sports fields and roadways.

The StormTrap® system's benefits can deliver significant results for your project:

- **Flexible footprint and design**
  The impressive flexibility of the StormTrap® system enables us to design a system to best suit your project. We easily work around trees, building piles and existing services to minimise your project costs and maximise land use and detention volumes. The system is ideal for constrained sites and odd-shaped footprints, and modules can be varied to cope with sloping sites or other constraints.
- **Maximum detention volume for the smallest footprint**
  The relatively open structure of the StormTrap® modules enables maximum storage volume for the system over the smallest possible footprint. This is of great benefit where existing services and site constraints prevent a large footprint.
- **High infiltration capacity**
  The unique design of the StormTrap® system delivers a large available surface area in any given footprint and supports WSUD objectives to manage frequent flows and overall runoff volumes. It also supports conventional fill and slow release detention.

- **Trafficability and reduced risk**

  As the system is made from precast concrete it is extremely strong and durable, and is trafficable to a range of SM 1600 traffic loadings (see page 9 for details). It can be used under pavements and car parks, and can withstand the impact of heavy vehicles that may load the system during construction or operation. Once the system has been installed, there is no need for any further structural work in the trafficable pavement. The structural integrity and durability of the precast system will reduce any risk of system failure.

- **Cost savings**

  The system delivers significant time and cost savings with a fast and simplified design process, the delivery of maximum detention volume from the smallest possible footprint, the elimination of additional cover to achieve a SM 1600 trafficable system, and a fully accessible and maintainable system.

Top:
Example of an odd-shaped footprint

Bottom:
SingleTrap™ system founded on strip footings

Top:
DoubleTrap™ system configured with openings in base units to provide infiltration

Bottom:
Installation of a SingleTrap™ module

- **Quick installation**
  The modular design and simple installation process means that large volumes can be installed in minimal time using traditional construction processes. Individual StormTrap® modules can be set in position in around 10 minutes. The system offers significant installation economies when compared with box culverts or pipes, and delivers large detention volumes with each module installed.
- **Full access and maintainability**
  The StormTrap® system features unobstructed open void spaces, a design feature which is less likely to clog with litter, sediment and debris than other systems. The StormTrap® system also integrates maintenance access points through the crown of the modules should maintenance be necessary. Their location and number will be subject to the specific needs of the project.
- **Compliance with local detention requirements**
  The StormTrap® system helps to address the requirements of sustainability, flood mitigation, public safety and ecological protection without sacrificing valuable land and compromising the bottom line of the project.

System operation

StormTrap® systems are available in two configurations to provide conventional detention, high early discharge or infiltration to groundwater.

SingleTrap™ system

SingleTrap™ systems are made up of a single layer of modules. It can be founded on a conventional concrete slab, a strip footing, or even an aggregate bedding with a suitably compacted subbase. High early discharge elements such as weirs and orifices can be cast into the modules in the factory so there isn't a need for additional on site in-situ works (refer to Figure 3).

DoubleTrap™ system

DoubleTrap™ systems are made up of two layers of precast pieces which together form one StormTrap® module. The DoubleTrap™ system is founded on a compacted aggregate base and can be configured to provide infiltration of detained runoff to groundwater or conventional detention, either with or without high early discharge.

The lower pieces include a low flow port (refer to Figure 4) which interlinks every module in the system. This fills and draws down the detention volume evenly, ensuring the full capacity is always available for subsequent rain events.

The upper and lower pieces lock together during installation using a key joint. This ensures the full transfer of both vertical and lateral loads throughout the system, without movement of the individual pieces.

The StormTrap® system is for detention purposes and is not designed to be watertight. The StormTrap® system, while primarily designed for stormwater detention purposes, can be made watertight if required. If watertight systems are required, Humes also offers a range of award-winning stormwater and rainwater harvesting solutions that are purpose-built for these applications.

Figure 3 – A standard SingleTrap™ module and an example of a high early discharge arrangement

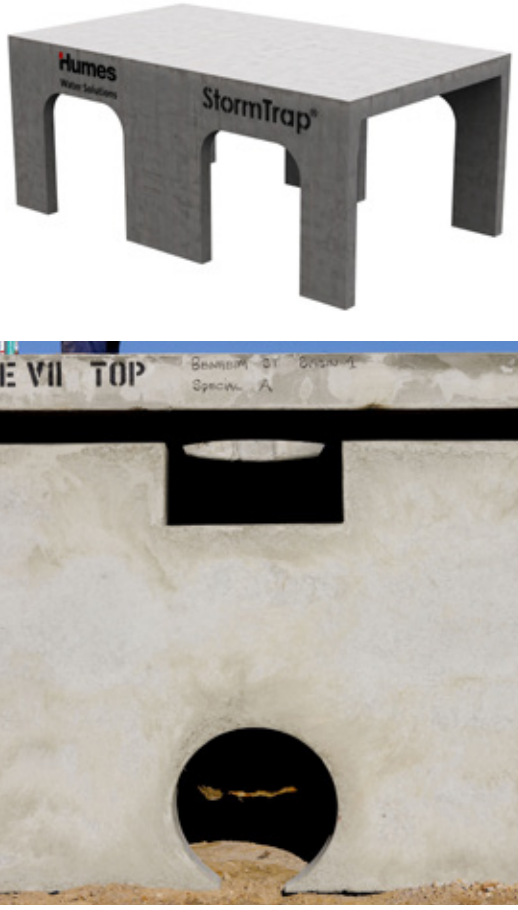


Figure 4 – A standard DoubleTrap™ module and system

Key specifications

The tables below summarise the key specifications of the StormTrap® system, although many can be modified to meet project requirements. Inlet and outlet openings can be placed at varying inverts and positions around the structure's perimeter. Our expert engineers can assess your project to provide a design that meets your needs.

Table 1 – StormTrap® system footprints

Module type	Dimensions	Comment
I, III and VI	2,350 mm wide x 4,000 mm long [1]	Multiples of 2,350 mm wide and 4,000 mm long are the most cost effective.
II, IV, V and VII	2,350 mm wide x 2,000 mm long	

1. Half length modules for types I, III and VI are also available to ensure the volume to footprint ratio can be optimised.

Table 2 – StormTrap® system heights

System type	Leg height	Comment
SingleTrap™ module	600 - 1,500 mm max	Leg heights are adjustable at 50 mm increments to ensure the optimal volume to footprint ratio. Internal depths closer to the maximum are the most cost effective.
DoubleTrap™ module	1,200 - 3,000 mm max	

Figure 5 – A sample StormTrap® system layout and standard module types

IV	III	III	V
II	I	I	II
II	I	I	II
V	III	III	IV

Standard type I

Standard type II

Standard type III

Standard type IV

Standard type V

Standard type VI

Standard type VII

Table 3 – Technical specifications

StormTrap® model	Heavy duty	Standard	Light duty
Standard for vehicle loading	AS5100 - 2017	AS5100 - 2017	AS/NZS 1170.1:2002 Rec:2016
Design life	100 years	50 years	50 years
Load factor and allowances	1.8 Load factor 1.35 Dynamic allowance	1.5 Load factor 1.25 Dynamic allowance	1.5 Ultimate load factor 1.25 Dynamic Allowance
Fill heights	0.2 m to 3.0 m	0.2 m to 3.0 m	0.2 m to 1.0 m
Vehicles	All road legal vehicles at full highway speed limits and traffic densities	All road legal vehicles at minor roads and car park speed limits and traffic densities	5.0 kPa loading for vehicles up to 10T – (Medium traffic area AS1170.1), and occasionally traversed by a 28T specialist fire appliance
Installation location	Any	Minor roads and car parks	Car parks, sports fields/parks
Bedding	Concrete slab on a compacted bedding to 150kPa	Concrete slab on a compacted bedding to 150kPa, or aggregate bedding (for more detail discuss with your local Humes rep)	Concrete slab on a compacted bedding to 150kPa, or aggregate bedding (for more detail discuss with your local Humes rep)

Cover

- Recommended minimum 200 mm (the 200 mm can be pavement).
- Maximum fill height 3 m above the roof.
- Light Duty cover limits are 200 mm minimum to 1,000 mm maximum.

Access openings

Placed in each corner of system crown.
Access can be designed to fit with specific site requirements (e.g. 900 mm x 900 mm grates) 600 mm or 1,050 mm diameter. Surcharge points can also be incorporated into the crown of the system if required.

Geotechnical considerations

Minimum subbase compaction of 150 kPa for installation on a concrete slab.

Minimum subbase compaction of 200 kPa for installation on an aggregate bedding.

Australian standards

The StormTrap® system is designed in accordance with the following Australian standards:

- AS 3600-2018 – Concrete Structures Code
- AS 5100-2017 – Bridge Design Code
- AS 5100.2-2017 – Bridge Design – Design Loads
- AS 1597.2-2013 – Precast Reinforced Concrete Box Culverts – Large Culverts
- AS/NZS 1170.1-2002 – Structural design actions – Part 1: Permanent, imposed and other actions.

Design and installation

Right:
Installing a
SingleTrap™ system

There are three key stages in the design and installation of a StormTrap® system.

1. Preliminary design

One of our experienced engineers can assist to provide a concept design to meet the volume requirements and footprint constraints. We can also provide additional advice - such as how to deal with clashes with other services. We can then provide drawings for the concept design suitable for development applications.

2. Final design/approval drawings

At this time we confirm all of the inputs into the preliminary design and determine the location of the inlet and outlet pipes and access openings. We then supply you with a set of detailed engineering design drawings and specifications, and a final budget estimate for the supply and delivery. This information can be used to submit to relevant authorities for operational works approval or for inclusion in tender documents. Final approval from the consulting engineer and civil contractor is required on placement of the order before manufacturing can commence.

There are two options for including the StormTrap® system in your tender documents:

i) You can refer to the system on your drawings, and append our detailed designs and specifications to your tender package. Our design drawings will have everything required for the local authority to understand the proposed system and for a contractor to provide the final installation price.

ii) We can provide a copy of our CAD drawings in block form to allow you to overlay our designs into your drawings. Our drawings will include the precise dimensions and any other relevant important details.

3. Logistics, shipping and installation

Humes will arrange a pre-installation site meeting with the civil contractor to finalise shipping plans, logistics and sequencing; a shipping plan will be provided to the specifying engineer and contractor before delivery. A Humes engineer or representative can be present on site to oversee delivery and installation.

StormTrap® modules can be set in position quickly and easily. Refer to our SingleTrap™ system or DoubleTrap™ system installation guides for full information on the installation process.

There are also a number of time-lapse videos available at humes.com.au which demonstrate the construction sequence and methodologies undertaken during the installation of a StormTrap® system. The library of videos includes a variety of project sizes and configurations.

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Appendix 1 – StormTrap® system - preliminary bid/design request

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Holcim (Australia) Pty Ltd
ABN 87 099 732 297
humes.com.au

Consultant/project engineer information					
First name		**Last name**			
Position					
Company					
Address					
City		**State**		**Post code**	
Phone		**Fax**			
Mobile		**Email**			

Project information					
Project name					
Site address					
Project city		**State**		**Post code**	

Design inputs

System 1			Footprint constraint (choose only one)				
Storage (cu.m)	Height (mm)	System invert (IL)	Length (m)	Width (m)	Optimise Y/N	DoubleTrap™/ SingleTrap™ system	Infiltration, detention or storage

Inlets		**Outlets**			
Ø	IL	Ø	IL	**Cover**	mm
				Access diameter	
				Lid class	D
				Surface RL	

System 2			Footprint constraint (choose only one)				
Storage (cu.m)	Height (mm)	System invert (IL)	Length (m)	Width (m)	Optimise Y/N	DoubleTrap™/ SingleTrap™ system	Infiltration, detention or storage

Inlets		**Outlets**			
Ø	IL	Ø	IL	**Cover**	mm
				Access diameter	
				Lid class	D
				Surface RL	

Additional notes

For office use only			
Requested by		**Date**	
Phone		**Date required**	
Fax		**Signature**	
Cost centre			
Plant			

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