Case Study

City of Belmont

City opts for innovative car park construction

(Belmont Business Talk 2019, 11)

In 2018 the City of Belmont completed the construction of two new car parks within the Belmont Business Park; Esther Street Abernethy Road and Esther Street Robinson Avenue.

Unlike conventional carparks, the City opted to use permeable paving to capture, retain and allow the infiltration of stormwater at each car park.

This results in less water being sent to stormwater drains and more water being infiltrated to groundwater. Not only does the permeable pavement allow water to infiltrate, it also assists in supporting adjacent trees that will be planted during winter 2019.

The permeable pavement allows water and oxygen to penetrate into the root zone preventing the tree roots from uplifting and damaging the pavement as they grow and seek out nutrients, air and water. This will extend the asset life of the pavement surface and allow the trees to maximise their canopy growth thus creating a fully shaded car park.

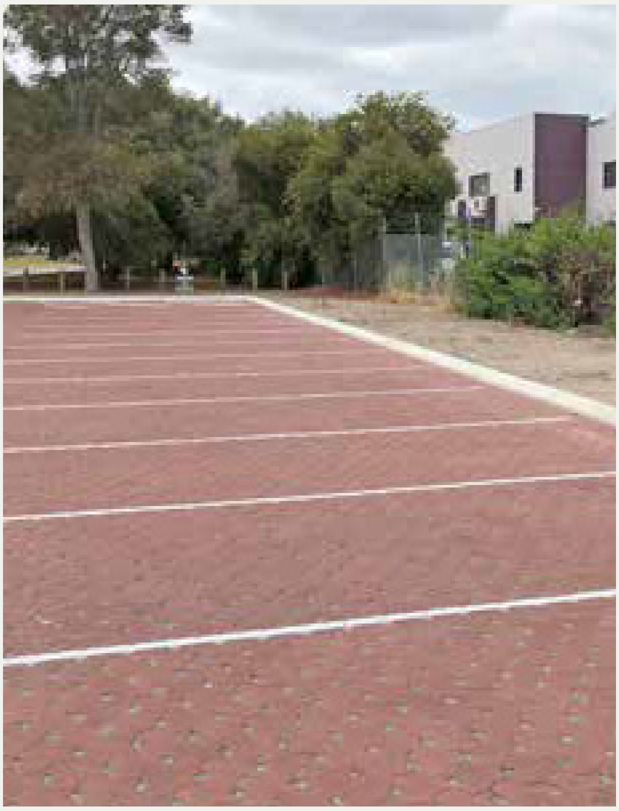
Water Sensitive Urban Design principles such as the use of permeable pavements, swales and vegetated strips to capture and retain stormwater are just some ways the City is committed to being Waterwise and protecting one of life's most valuable commodities; water.

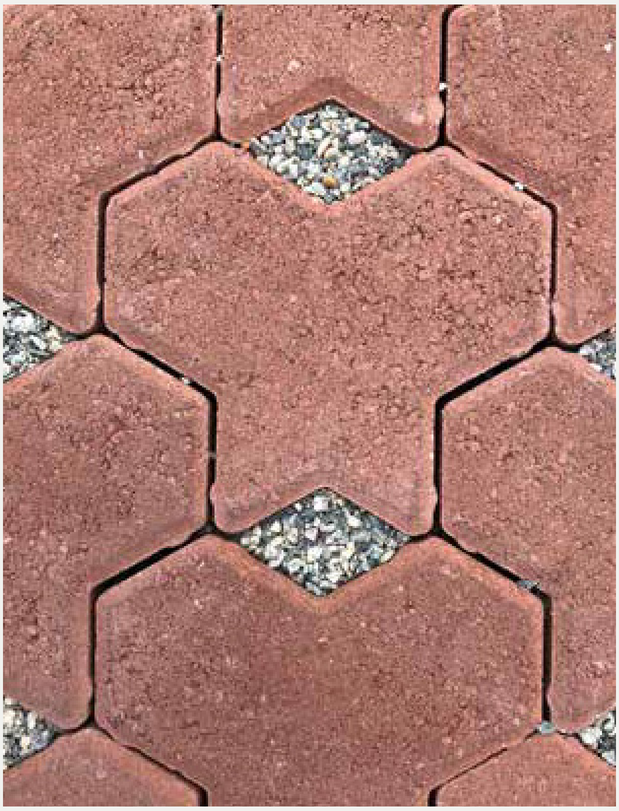
In a warm and drying climate where storm events are shorter but heavier, Water Sensitive Urban Design enables water to be captured at point source and used in the environment rather than being piped downstream into receiving waterways.

This also means water generally is cleaner and more freely available to the surrounding environment.

Maximising shade coverage on car parks is also essential in reducing the impact of the Urban Heat Island effect, particularly in areas that already have low canopy cover.

Trees will be planted adjacent to the car parks in 2019 and after a few years, due to the car park supporting the growth of the trees, will sufficiently shade parked cars making them an attractive place to park during summer.





Case Study

City of Nedlands

The City of Nedlands implemented a permeable pavement system using Aqua Tri-Pave to assist with the dispersion of stormwater at the Weld Street location adjacent to Carrington Park.

The services of Worley Parsons Engineers were engaged to design the system to cope with the structural and hydraulic requirements.

Approximately a year later, another section of permeable pavement was laid at Smyth Road adjacent to Karrakatta Cemetery.

The Weld Street paving location is a low-lying area collecting significant rainwater along with debris and silt.

In contrast, the Smyth Road site is level and elevated, compared to the road surface and is not subjected to the demands of the Weld Street site.

Midland Brick monitored the site a year later and tested the infiltration performance of both sites.

It is noteworthy that neither site had been swept and the voids were not completely filled.

INFILTRATION MEASUREMENT PROCEDURE

The method for measuring infiltration was based closely on AS 4693.5-2004 – "Surfaces for Sports Areas – Method of Test. Method 5: Determination of Water Infiltration Rate," with reference to other Australian paving articles (Beecham et al. 2009).

The steps are as follows:

1. Install permeable paving as per the engineer's design with appropriate sub-base/gravel filling for application.
2. Set up the infiltrometer over area you wish to test – the infiltrometer is a 1mx1mx300mm metal instrument which is sealed along the base with concrete foam (See Image 1). *Weight is applied to the infiltrometer before it is filled to ensure the seal is pressed hard against the paving and the edge of the instrument.*
3. Fill infiltrometer approximately half-way with water, ensuring no excessive leakage is present and let drain away before conducting any measurements. *This is to saturate the ground to give a more accurate reading.*
4. Once the first application of water has drained, place a metal rule against the base of the infiltrometer (so the height of the water can be measured) and fill the instrument up to 45mm from the base.
5. When the water reaches 45mm on the ruler – start the timer and determine how much time it takes for the water level to fall by 20mm – to 25mm mark on the ruler. Record this time and use it to calculate the filtration rate (depending on units required). The calculated filtration rates used the following equation:

$$I_B = \frac{F_{WB}\, C}{t_B}$$

6. Where:

I_B = Water infiltration rate

F_{WB} = is the fall of water level (mm)

t_B = is the time taken for the water level to fall (h)

C = is the approximate temperature correction factor given in Table 1 (Standards Australia 2004) to correct the infiltration rate to a standard temperature of 10˚C.

7. Repeat testing as necessary – one or more tests should be conducted in the same area to show variation over time and with differing amounts of water filtered through, as seen in our results.

Image 1: Filling of Infiltrometer

Image 2: Measuring Water Level after Saturation

INFILTRATION RESULTS AND PROCEDURE – WELD STREET

Weld Street has been paved with permeable paving since 2017. On inspection, there was evidence of visible accumulation of soil and dirt in the paving voids. There was also evidence of gravel between the voids, but the gravel did not fill the gaps completely or come flush with the paving surface.

The infiltrometer was set up at the lowest point of the Weld Street paving to emulate the expected infiltration rates. After the surface was flooded and saturated with water, the two tests were completed, as per the testing procedure.

The results were as follows:
Test 1 – 20mm drop/110 sec = 502mm/hr.m² or 1394 l/s.ha
Test 2 – 20mm drop/240 sec = 230mm/hr.m² or 639 l/s.ha

Results indicated that the infiltration rate was reduced in the second test; suggesting that the paving was trending towards saturation. It was evident that silt and debris were filling the voids (Image 3&4), which could have been contributing to the reduced levels of infiltration. However, the second trial infiltration rate was still well above average minimum of 70mm/hr.m² (Beecham et al. 2009, 5).

Image 3: Weld St Paving Build-up and Gravel Levels

Image 4: Weld St Soil from Void after Testing

INFILTRATION RESULTS AND PROCEDURE – SMYTH ROAD

Testing was then conducted at Smyth Road to compare the performance of the paving laid in 2018 and the Weld Street paving laid in 2017.

Smyth Road was visibly cleaner, with more gravel evident, but as with Weld Street, the gravel in the paver voids were not filled to the top – as recommended. On average the gravel was 10-15mm below the surface.

It was noted that the Smyth Road paving had a more consistent level than Weld Street and was laid higher than the road level – indicating that rainfall would be more likely to run off the permeable paving, contributing to the low levels of build-up in the voids. Testing was again set up with the infiltrometer flat on the paving, using the same method as at Weld Street.

The results were as follows:
Test 1 – 20mm drop/8 sec = 6,903mm/hr.m² or 19,175 l/s.ha
Test 2 – 20mm drop/8 sec = 6,903mm/hr.m² or 19,175 l/s.ha
Test 3 – 20mm drop/12 sec = 4,602mm/hr.m² or 12,783 l/s.ha

The above test results conducted at Smyth Road show excellent infiltration results, well above the recorded values (Beecham et al. 2009). Factors which may have contributed to the excellent infiltration results include, the age of the paving or the installation, its higher level in relation to the road and more consistent surface level (there is no low point as at Weld Street). Test results also demonstrated that the infiltration rates at Smyth Road do not decrease as rapidly when compared to Weld Street. This can again be attributed to less build-up of silt and debris and voids being alternately filled with gravel as per recommendations *(images 3 and 4).*

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