Executive Summary

This Report describes the main tasks carried out in the present study on the effectiveness of porous pavements (PP) in reducing surface runoff in Hong Kong. The key findings of the site trials and the laboratory experiments are described.

The literature review of PP studies and applications in other countries and regions finds that PP is definitely beneficial in mitigating both the quantity and the quality of stormwater runoff. PP is well accepted as a practical LID (low impact development) device in developed countries and there are useful fact sheets, guidelines and manuals for PP design, installation and maintenance from government organisations, trade institutes and manufacturers. PP is widely used for pavements in low to medium traffic roadways, pedestrian paths, courtyards and similar areas.

For applications in Hong Kong, block pavers are recommended for study in the site trials and laboratory experiments. Three forms of block pavers, namely PICP (permeable interlocking concrete pavers), OCP (open-cell pavers) and PB (permeable paver blocks), are tested in this study.

PP works on the principles of stormwater retention and infiltration into subsoil. For Hong Kong with severe design rainfalls, PP is recommended to have a base course for stormwater storage. The base course uses washed uniformly graded coarse aggregates and the void ratio is about 0.4. For the site trials, an ambitious hydraulic design is made for the base course depth and aims at full retention of 10-year rainstorms. As a result, a physical depth of 500 mm, or an effective storage of 200 mm water depth, is recommended and used in the site trials.

Three PP test panels and a control panel of impervious surface are constructed and installed in a test site on Stonecutters Island for the site trials. Each test panel has a surface area of 4 m ´ 3 m. Hydrologic data including surface runoff rates, water levels inside the base course and infiltration rates into the subsoil are measured on the test panels at 1-minute intervals. These field data and rainfall depths at the test site are monitored and recorded continuously for over 17 months from June 2014 to November 2015.

In field monitoring, there are inevitably some problems such as instrumentation malfunctioning, missing data and unexpected events. In general, the monitoring tasks are satisfactory except that data on a few rainy days are missed. Extreme rainfall events do not occur during the monitoring period. There are only 10 days on which daily rainfall depths are above 50 mm. The highest recorded daily rainfall depth is 200.9 mm and the greatest minute rainfall intensity is 198 mm/h which is below the 2-year return value of Hong Kong. Due to the large base course depth for the ambitious design, the PP panels are found to retain all rainfall events during the whole monitoring period.

The results of laboratory experiments at HKU show that the hydraulic conductivity of the subsoil plays an important role in the hydrologic performance of the PP test cell. With highly permeable subsoil, a PP cell with a 100-mm thick base course is able to fully retain design rainfall events in Hong Kong with a 2-year return period.

After the site trials, PP systems using PICP and PB are recommended for applications in Hong Kong targeted at reduction of stormwater runoff. A slight preference is given to PB in view of its similar installation method as the current block paving of pedestrian pavements in Hong Kong and no requirement of wide gaps between adjacent blocks.

The original design depth for the base course at 500 mm is found to be on the conservative side given the extra exfiltration of the stored stormwater from the base course into the subsoil. A more realistic design goal may be complete retention of 2-year return rainstorms and significant reduction of peak runoff flowrates during 10-year return rainstorms, for which a base course depth of 100 to 200 mm is found to be generally adequate.

Further field trials are desirable to test the hydrologic performance of the finally recommended PP systems. There are also needs for different types of studies to investigate other aspects of PP such as pavement loading capacity.