

# Research to ascertain the proportion of block paving sales in England that are permeable

## Final report for the Adaptation Sub-Committee

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### Executive summary

This research provides the ASC with a better understanding of trends in the use of permeable and impermeable block paving in England's built environment and should enable it to establish a more robust estimate of the area serviced by permeable paving as a proportion of the total paved area.

Over the last 10 years (2004-2013), national block paving sales have been dominated by standard 'impermeable' paving, with permeable paving showing a much lower level of market penetration. Permeable paving accounted for nearly 6% of block paving sales in 2009 and nearly 10% in 2013. Regional sales of standard and permeable paving showed no significant changes in trends in recent years. It is estimated that a total of 5,100,000m<sup>2</sup> (510ha) of permeable paving was installed in England between 2009 and 2013; this represents 8% of the total area of block paving installed in that time (55,000,000m<sup>2</sup>/5,500ha).

A lack of effective implementation and enforcement of legislation and regulation relating to development and flood risk management is seen by the 'industry' as the single biggest barrier to increased market penetration of permeable paving. The perception amongst customers that the costs associated with purchasing, installing and maintaining permeable paving are higher than with standard block paving is also a significant barrier to increased market penetration. In addition, very few local authorities in England have adopted permeable paving and associated sustainable drainage systems because, despite evidence to the contrary, they believe the costs to be too high.

The 'industry' also recognises the need for better understanding and acceptance of the technical and financial arguments for using permeable paving and sustainable drainage systems in flood risk management. The relative costs of installing such systems by comparison with post-event flood remediation could be used to clearly state the cost-benefit case.

## 1. Introduction

The Adaptation Sub-Committee (ASC) of the UK's Committee on Climate Change has a statutory duty under the Climate Change Act (2008)<sup>1</sup> to report to Parliament with an independent assessment of Government's progress in implementing its National Adaptation Programme (NAP)<sup>2</sup>. The programme (published in July 2013) sets out Government's objectives and policies for adaptation, and addresses the risks and opportunities identified in the UK's first Climate Change Risk Assessment<sup>3</sup> (published in January 2012).

The ASC is required to deliver its first progress report on the NAP in 2015 (two years after the programme's publication) - and then every two years thereafter. The report will assess whether the NAP is preparing the UK for the key climate change risks that it faces. As a precursor to this, the ASC is producing a series of reports on the preparedness of key sectors for climate change. Those completed so far include reports on the built environment (2012) and the natural environment, agriculture and forestry (2013), with infrastructure, public health and business being due in 2014.

The report on preparedness of the built environment<sup>4</sup> includes an assessment of vulnerability to surface water flooding in England. An indicator to monitor trends in hard surfacing within all built-up areas was developed in an accompanying technical report<sup>5</sup>. This found that the proportion of gardens with a hard surface (i.e. paved or asphalted) had increased from under one-third in 2001 to nearly half in 2011, and led to the conclusion that vulnerability to surface water flooding was likely to be increasing. A limitation of the indicator was that it was unable to distinguish between the proportion of the area paved with permeable and impermeable materials, the former of which would allow surface water to infiltrate and be captured and/or stored in sustainable drainage systems (SuDS). In an attempt to address this limitation, the authors of the technical report carried out a confidential survey of block paving manufacturers, which suggested that only 2.5% of total sales in 2011 were of permeable material (although this had increased from less than 1% in 2001).

In order to better understand the trends in hard surfacing (both permeable and impermeable) within England's built environment, the ASC recognised that the results of the 2012 survey and, therefore, the performance of its indicator, needed to be further improved. The survey needed to be extended to cover a wider range of manufacturers and/or suppliers. This would enable more robust quantification of changing sales patterns of permeable and impermeable materials and provide a more reliable estimate of the relative areas paved by these materials over time. The ASC commissioned Climate Resilience Ltd and Jenco Consultancy Ltd to undertake the necessary research. This report captures the findings of that research and provides further evidence to support the ASC's 2015 assessment.

## 2. Technical and policy context

Impermeable manufactured landscaping and surfacing (e.g. concrete block paving, concrete flags, asphalt, reinforced and pavement-quality concrete) is often used to replace naturally occurring permeable surfaces within the built environment. The use of these materials, when combined with

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<sup>1</sup><http://www.legislation.gov.uk/ukpga/2008/27/contents>

<sup>2</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/209866/pb13942-nap-20130701.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209866/pb13942-nap-20130701.pdf)

<sup>3</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/69487/pb13698-climate-risk-assessment.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69487/pb13698-climate-risk-assessment.pdf)

<sup>4</sup><http://www.theccc.org.uk/publication/climate-change-is-the-uk-preparing-for-flooding-and-water-scarcity-3rd-progress-report-2012/>

<sup>5</sup><http://archive.theccc.org.uk/aws/ASC/2012%20report/HR%20Wallingford%20flooding%20indicators%20technical%20report.pdf>

the increasing frequency of heavy rainfall events, is resulting in greater surface water run-off and over-loading of existing drainage systems, leading to increases in urban flooding. Methods of water attenuation, both to create temporary (surge) water storage and for (possible) rainwater harvesting are being developed and increasingly employed in urban settings; these are collectively termed Sustainable Drainage Systems (SuDS).

Concrete block permeable paving (CBPP) is an essential, yet not exclusive (see below), often load-bearing construction material used in SuDS. CBPP forms part of a generic concrete block paving (CBP) product line and is virtually identical to the standard 'impermeable' block paving that is sold widely throughout the UK. However, it differs in that it has distinct 'spacing' elements that allow rainwater to permeate between the blocks and into pre-designed water capture or attenuation systems below ground. The inter-block space is subsequently filled with suitable natural grit to allow water to pass downwards into below-ground water storage systems. Manufacturers often package CBPP product sales with bespoke SuDS design solutions and will often 'on-sell' associated water storage systems. However, certain widely-available graded aggregate materials can be used as a suitable water storage reservoir and standard block paving together with linear drainage can also be used in SuDS.

The principal legislation controlling surface water drainage in England and Wales is the Flood and Water Management Act (2010)<sup>6</sup>, the SuDS provisions of which will take effect after the publication and implementation of national standards later this year (2014). Until this time, the use of SuDS in developments is essentially only a 'recommendation', unless specific conditions are explicitly attached by planning authorities. In this respect, Government's Planning Policy Guidance 25: Development and Flood Risk (PPG 25, 2001) and the subsequent Planning Policy Statement: Development and Flood Risk (PPS 25, 2006)<sup>7</sup> both acknowledge that mitigation of flood risk from increased surface water run-off due to development should be a material planning consideration, whilst PPS 25 also emphasises the use of SuDS in the management of surface water arising from development. These considerations are echoed in the National Planning Policy Framework (2012)<sup>8</sup>, which replaced PPS 25.

In addition, the Planning Act (2008)<sup>9</sup> introduced changes to permitted development rights. Specific rules now apply to householders wanting to pave-over their front gardens. Planning permission is not needed if a new or replacement driveway of any size uses permeable surfacing (e.g. CBPP, gravel, porous asphalt), or if rainwater is directed to a lawn or border to drain naturally. However, planning permission is needed for laying traditional impermeable driveways - if the surface to be covered is more than 5m<sup>2</sup> and if water is unable to drain to a permeable area.

### 3. Methodology

The ASC required this research to provide a comprehensive assessment of the quantities of impermeable and permeable paving sold annually in England (and, subject to data availability, by region) over a suggested maximum period of 10 years (2004-2013). This would enable the ASC to use its surfacing indicator to establish a more robust estimate of the area serviced by CBPP as a proportion of the total paved area in England's built environment.

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<sup>6</sup><http://www.legislation.gov.uk/ukpga/2010/29/contents>

<sup>7</sup><http://webarchive.nationalarchives.gov.uk/20100520022021/http://www.communities.gov.uk/planningandbuilding/planning/policyguidance/planningpolicystatements/planningpolicystatements/pps25/>

<sup>8</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/6077/2116950.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf)

<sup>9</sup><http://www.legislation.gov.uk/ukpga/2008/29/contents>

If possible, the research was also to ascertain: the proportion of CBPP used in commercial (e.g. residential and commercial developments and estate roads) and domestic (e.g. private driveways and front gardens) settings; the proportion of CBPP used as a surface treatment in SuDS; and other types of surface treatment associated with SuDS (e.g. natural aggregate, porous asphalt or ready mix concrete).

The ASC also required the research to explore the reasons for the levels of market penetration by CBPP to date. Identification of the barriers to greater market penetration required a subjective appraisal of: the use of CBPP in comparison to standard paving (e.g. price differentials, installation and maintenance requirements, and life expectancy); the use of other SuDS solutions (e.g. non-construction materials), as these can act as a direct substitute for CBPP; and the whole life cost of CBPP in relation to conventional paving and other SuDS solutions.

Block paving manufacture and sales in the UK is led by six national companies, all of which are members of the trade association 'Interpave'. In addition, there are some important regional manufacturers and suppliers, at least one of which is an importer of CBP and CBPP from Ireland. Contact was made with key individuals in these companies and support for the research obtained.

Recent research experience within the sector has shown that the key to obtaining robust data from which meaningful conclusions can be drawn is to gain access to the individuals responsible for controlling the confidential sales data held in company Enterprise Resource Planning (ERP) systems. These commercial data sets can only be interrogated by sophisticated data mining tools, so identifying the correct parameters for data retrieval is vital. They should, at least, be able to provide data pertaining to CBP and CBPP sales (by m<sup>2</sup> sold) and, in some instances, to end-use location by region/county.

Having identified and gained access to the relevant individuals within the block paving companies, a confidential data request, comprising a set of standard questions relating to the project's data needs, was emailed to these individuals in preparation for subsequent telephone interviews. The questions sought data on sales of CBP and CPBB within the last 10 years (2004-2013), with a particular focus on identifying trends in the 'domestic' and 'commercial' CBPP markets. Data was also sought, where available, on other porous or permeable SuDS construction materials. These questions, which were discussed and agreed with the ASC prior to submission, enabled data controllers to pre-load search parameters into their ERP systems, seeking clarification where necessary, and then to engage in meaningful bilateral discussions from which quantitative and qualitative evidence was obtained. Where further qualitative feedback was required, particularly in understanding the barriers to market penetration and product/cost switching, commercial/sales staff within these companies were engaged in discussion (including tele-conferences and round-table meetings with key providers). The draft research report (notably the results, discussion and conclusions) was then reviewed by Interpave, before finalisation and submission to the ASC.

#### **4. Results**

The confidential data request, which was sent to the six national companies involved in manufacturing and selling block paving products, yielded a range of results. Feedback from the data request was determined by the availability of the required data within individual company ERP systems and the ability of data controllers to extract the data, if available, within the short time-scale dictated by this project. Data covering a 10 year time-frame was only available from two companies (one of which was 10 year average data, split into two five year periods), with others providing data for the last two to six years. Detailed regional/national data were provided by two

companies, whilst others provided more general national data. Of the two regional suppliers and importer, those that provided data were unable to provide anything other than very basic data on their recent trading activities.

An overview of the types of data provided in response to the data request by each company is given in Table 1 and a summary of the feedback provided by national companies is given in Box 1 below. Tables capturing the data provided by all companies are annexed to a separate confidential report. It is important to note that, as much of the data provided is commercially sensitive and anonymity has to be assured, data providers are not identified in this research.

**Table 1: Overview of responses to data requests received from individual companies**

	National companies						Regional companies
	A	B	C	D	E	F	
<b>CBP (m<sup>2</sup>)</b>	✓	✓	✓	✓	✓	✓	✓
Domestic	✓	✓					
Commercial	✓	✓					
<b>CBPP (m<sup>2</sup>)</b>	✓	✓	✓	✓	✓	✓	✓
Domestic	✓	✓		✓	✓		
Commercial	✓	✓		✓	✓		
<b>National</b>	✓	✓	✓	✓	✓		✓
<b>Regional</b>		✓	✓				✓
<b>10 years</b>	✓				✓		
<b>6 years</b>		✓					
<b>5 years</b>				✓			
<b>4 years</b>			✓				
<b>2 years</b>						✓	
<b>1 year</b>							✓

Sample size: over 95% of England's manufacturers and suppliers.

**Box 1: Summary of feedback provided by national companies**

**Company A** provided average annual sales data for domestic and commercial CBP and CBPP for the last 10 years (2004-2013). Sales of CBPP in the 'domestic' market were extremely weak (<1%), whilst sales in the 'commercial' market were slightly stronger (>9%). Over the 10 year period, CBPP accounted for less than 5% of all CBP sales.

**Company B** provided a breakdown of domestic and commercial CBP and CBPP sales for each Economic Planning Region for the last six years (2008-2013). Commercial CBPP sales were mostly greater (often significantly) than domestic CBPP sales. Over the six year period, CBPP accounted for around 10% of all CBP sales.

**Company C** provided CBP and CBPP sales data by county for the last four years (2010-2013). These data were aggregated to give a figure for CBP and CBPP sales in each Economic Planning Region and for England as a whole. Sales of CBPP in England were broadly similar (around 35% of all CBP sales) over this time.

**Company D** provided data on CBP and domestic and commercial CBPP sales in England for the last five years (2009-2013). CBPP sales increased from just over 2% to nearly 10% of all CBP sales in this time. Sales of domestic CBPP increased from being slightly less than commercial CBPP in 2009-2010 to increasingly more than commercial CBPP in 2011-2013.

**Company E** provided data on CBP and domestic and commercial CBPP sales in England for the last 10 years (2004-2013). The amount of CBP sold fell by over 60% in this time. Whilst CBPP accounted for less than 5% of all CBP sales, domestic CBPP sales increased in relation to total CBPP sales from less than 12% in 2008 to over 20% in 2013.

**Company F** provided data on CBP and domestic CBPP sales in England for the last two years (2012-2013). Sales of CBPP increased from 2% to 4% of all CBP sales in this time.

Sample size: over 90% of England's manufacturers and suppliers.

Following the preliminary assessment of feedback from the confidential data requests sent to the national companies, and where clarification and further qualitative feedback was required, bilateral discussions were held with relevant individuals within these companies. In addition, a tele-conference with one company and a round-table meeting with another explored issues and patterns identified in the data assessments and provided a better understanding of the barriers to further market penetration by CBPP. Also, anecdotal insights into issues surrounding the use of alternative porous or permeable materials in conjunction with SuDS were sought from these and other companies. The learning from these iterations is reflected in the discussion and conclusions below.

## 5. Discussion

The ASC's report on the preparedness of the built environment for climate change<sup>10</sup> includes an assessment of its vulnerability to surface water flooding and an indicator to monitor trends in the use of hard surfacing in England. The underpinning data for the indicator was OS Mastermap - which is limited in that it is unable to distinguish between impermeable and permeable paved surfaces. A confidential survey of block paving manufacturers<sup>11</sup> was carried out to address this limitation and estimated the growth in permeable surfacing sales between 2001 and 2011. The survey was coordinated through Interpave and involved direct contact with two companies. It suggested that, in 2011, only 2.5% of total sales (<800,000m<sup>2</sup>/80ha) were of CBPP, although this had increased from less than 1% in 2001. The purpose of this research was to improve on the results of the above survey and provide a better understanding of trends in the use of hard surfacing in England's built environment, thereby improving the performance of the ASC's surfacing indicator.

This research covers a wider range of manufacturers/suppliers and provides more robust data on CBP and CBPP sales over time. This will enable the ASC to establish a reliable estimate of the relative areas paved by impermeable and permeable materials and provide further evidence to support its 2015 assessment. The discussion and conclusions presented here draw on the feedback from the confidential data requests sent to manufactures/suppliers and on subsequent follow-up iterations. The results of the research are discussed under the following headings:

### Recent national trends in CBP and CBPP sales

This research sought data on the quantities of CBP and CBPP sold annually in England over a maximum period of 10 years (2004-2013). Of the six national companies involved in the confidential data request, only two were able to provide sales data for both CBP and CBPP for the last 10 years (one of which was 10 year average data, split into two five year periods). Others provided data for 2008-2013, 2009-2013, 2010-2013 and 2012-2013. These data are set out in the summary table (Table 2) below.

The data show an extremely low level of market penetration by CBPP in the period 2004-2008 (around 2%) and a low but increasing level of penetration in the period 2009-2013 (6%-10%). It is important to note, however, that the 2004-2007 totals are based on data provided by just two companies and the 2008 data by three companies, whilst the 2009-2013 totals are based on data from over 90% of England's manufacturers and suppliers. Nonetheless, it is reasonable to conclude that, over the last 10 years, sales of CBPP have been and remain a small proportion of all block

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<sup>10</sup><http://www.theccc.org.uk/publication/climate-change-is-the-uk-preparing-for-flooding-and-water-scarcity-3rd-progress-report-2012/>

<sup>11</sup><http://archive.theccc.org.uk/aws/ASC/2012%20report/HR%20Wallingford%20flooding%20indicators%20technical%20report.pdf>

paving sales. By 2013, sales of CBPP accounted for nearly 10% of the block paving market, with over 1,000,000m<sup>2</sup> (100ha) of permeable paving being installed. Over the last five years (2009-2013), it is estimated that a total of 5,100,000m<sup>2</sup> (510ha) of CBPP was installed in England, this representing 8% of the total area of block paving installed in that period of time.

**Table 2: Summary of England trend data**

	Product	2004 <sup>1</sup>		2005 <sup>1</sup>		2006 <sup>1</sup>		2007 <sup>1</sup>		2008 <sup>2</sup>		
England totals	CBP m <sup>2</sup>	Data withheld for reasons of confidentiality										11352571
	CBPP (D) m <sup>2</sup>											5429
	CBPP (C) m <sup>2</sup>											261609
	CBPP (D+C) m <sup>2</sup>											267038
	CBPP D/C %	0	100	0	100	0	100	0	100	2.0	98.0	
	CBPP %	2.1		2.2		2.2		2.1		2.4		

	Product	2009 <sup>3</sup>		2010 <sup>4</sup>		2011 <sup>4</sup>		2012 <sup>5</sup>		2013 <sup>5</sup>					
England totals	CBP m <sup>2</sup>	11230587										11441936	11416967	11205532	11142978
	CBPP (D) m <sup>2</sup>	66972										93850	133578	172464	223054
	CBPP (C) m <sup>2</sup>	587394										761752	870826	822674	861529
	CBPP (D+C) m <sup>2</sup>	654366										855602	1004404	995138	1084583
	CBPP D/C %	10.2	89.8	11.0	89.0	13.3	86.7	17.3	82.7	20.6	79.4				
	CBPP %	5.8		7.5		8.8		8.9		9.7					

Based on data provided by: <sup>1</sup> two companies; <sup>2</sup> three companies; <sup>3</sup> four companies; <sup>4</sup> five companies; and <sup>5</sup> six companies. CBPP (D) = Domestic; CBPP (C) = Commercial.

From these data, it was possible to estimate, at current levels of market share, the total area of block paving installed in England each year (see Table 3, below). Demand fell significantly from the start of the recessionary downturn in 2008, since when over 11,000,000m<sup>2</sup> (1,100ha) of paving has been installed annually - over 90% of which used standard 'impermeable' blocks.

The headline figures also demonstrate differences in the end-user market. In 2013, domestic applications (predominantly private driveways) accounted for around 5,000,000m<sup>2</sup> (500ha) of block paving sales, of which less than 5% were CBPP. Commercial applications accounted for 6,000,000m<sup>2</sup> (600ha) of sales in 2013, of which around 85% (>5,000,000m<sup>2</sup>/500ha) were standard 'impermeable' blocks. Effectively, impermeable concrete block paving accounts for nearly 10,000,000m<sup>2</sup> (1000ha) of the total area paved in England each year.

**Table 3: Total block paving sales in England for 2004-2013 - disaggregated into domestic/commercial totals for 2013**

Block paving totals	2004	2005	2006	2007	2008
England (D+C)	19680270m <sup>2</sup>	19517314m <sup>2</sup>	19153616m <sup>2</sup>	19853481m <sup>2</sup>	16834356m <sup>2</sup>
Domestic (D)					
Commercial (C)					

Block paving totals	2009	2010	2011	2012	2013
England (D+C)	11515279m <sup>2</sup>	11915874m <sup>2</sup>	11781000m <sup>2</sup>	11138762m <sup>2</sup>	11049263m <sup>2</sup>
Domestic (D)					4972168m <sup>2</sup> /45%
Commercial (C)					6077095m <sup>2</sup> /55%

Total market for 2013 estimated by combining data from Table 2 with additional data and feedback from other regional suppliers and importers. Data collected for 2004-2012 represent varying sub-sets of England market. Estimate of total England market for 2004-2012 based on assumption that individual market share known for 2013 was stable in previous years. Domestic/commercial split based on 2013 data and feedback.

## Recent regional trends in CBP and CBPP sales

The research also sought data on the quantities of CBP and CBPP sold annually by region over a suggested maximum period of 10 years (2004-2013). Of the six national companies involved in the confidential data request, only two were able to provide regional sales data for both CBP and CBPP - one for 2008-2013 and the other for 2010-2013 (aggregated from county-level). These data are combined in the summary table (Table 4) below and provide an indication of trends. It is important to note, however, that these data are provided as illustrative examples and should not be viewed as representative of the wider regional market. A third company provided qualitative observations for 2012-2013.

**Table 4: Summary of regional sales trends**

Economic Planning Region		2008		2009		2010	
		CBP	CBPP	CBP	CBPP	CBP	CBPP
East Anglia	Total m <sup>2</sup>	197431	7496	139672	23015	175284	23405
	CBPP %		3.8		16.5		13.5
East Midlands	Total m <sup>2</sup>	370973	7717	271906	18696	262766	20322
	CBPP %		2.1		6.9		7.7
North West	Total m <sup>2</sup>	176970	4225	105545	1898	112798	11034
	CBPP %		2.4		1.8		9.8
Northern	Total m <sup>2</sup>	113708	1906	104453	5937	79325	10396
	CBPP %		1.7		5.7		13.1
South East	Total m <sup>2</sup>	681909	25462	534211	24683	842381	103049
	CBPP %		3.7		4.6		12.2
South West	Total m <sup>2</sup>	313263	8291	199587	16586	496711	77082
	CBPP %		2.7		8.3		15.5
West Midlands	Total m <sup>2</sup>	332454	2214	273014	9315	371477	28827
	CBPP %		0.7		3.4		7.8
Yorkshire & Humber	Total m <sup>2</sup>	157086	704	120724	3537	107423	16722
	CBPP %		0.4		2.9		15.6

Economic Planning Region	Company	2011		2012		2013	
		CBP	CBPP	CBP	CBPP	CBP	CBPP
East Anglia	Total m <sup>2</sup>	211370	30762	208261	32836	183072	31430
	CBPP %		14.5		15.8		17.2
East Midlands	Total m <sup>2</sup>	346754	32453	287993	18706	294190	31870
	CBPP %		9.4		6.5		10.8
North West	Total m <sup>2</sup>	87484	10005	84485	12969	72994	10719
	CBPP %		11.4		15.4		13.3
Northern	Total m <sup>2</sup>	75203	19528	79408	3860	86474	4269
	CBPP %		26.0		4.9		4.9
South East	Total m <sup>2</sup>	933803	131433	962391	138925	1037234	118692
	CBPP %		14.1		14.4		11.4
South West	Total m <sup>2</sup>	514276	95558	503502	72871	503073	90375
	CBPP %		18.6		14.5		18.0
West Midlands	Total m <sup>2</sup>	402805	51340	319768	37270	334597	44416
	CBPP %		12.8		11.7		13.3
Yorkshire & Humber	Total m <sup>2</sup>	118765	16282	104866	11182	78449	12103
	CBPP %		13.7		10.7		15.4

Based on datasets from two national companies - one for 2008-2013 and the other for 2010-2013.

Slight regional variations in relative sales of CBP and CBPP within and between regions were evident from the data provided by the first company. Despite this, sales of CBPP were consistently low and accounted for less than 10% of all block paving sales, with the data showing no significant changes in



sales' trends over time. A notable anomaly was seen in 2011, where CBPP accounted for nearly a quarter of sales in one (the Northern) region.

The second company's data showed significant variations in paving sales between regions. Sales were dominated by CBPP in the east and north east and by standard block paving in the south and west (this broadly accords with observations made by the third company, which sold more CBPP in the north of England and to the east of the Pennines). Sales of both paving types were broadly similar in the North West. The data also show marked variations in the amount (m<sup>2</sup>) of block paving sold within regions, with that sold in the south and west being significantly greater than in the north and east (a south-north gradation is apparent). Other than slight variations in annual paving sales within regions, the data do not show any significant changes in trends over time. These data also reflect the company's market position with a dedicated CBPP/SuDS solution.

### **Proportion of CBPP used in domestic and commercial settings**

Five of the national companies provided data on the proportion of CBPP sold for domestic and commercial purposes. This varied considerably between these companies. It was not possible to obtain data to identify the location or specific end use of CBPP as part of this research. As such, it was impossible to determine whether CBPP had been deployed in urban or rural areas. However, feedback from these companies indicated that, from their experience, SuDS are very rarely considered in rural areas, where natural run-off and attenuation options prevail. It is, therefore, safe to assume that the use of CBPP is essentially exclusive to the built environment.

Summary data from Table 2 (above) suggest that CBPP was not introduced into the 'domestic' market until 2008. This coincided with publication of the Pitt review of the 2007 summer floods<sup>12</sup> and the introduction of new planning legislation (Planning Act, 2008<sup>13</sup>). The Planning Act introduced changes to permitted development rights and includes specific rules for householders wanting to pave-over their front gardens. Some companies saw the introduction of this legislation as a significant market opportunity for domestic CBPP, particularly as planning permission is not now needed if a new or replacement driveway of any size uses permeable surfacing. However, there is a perception within the 'industry' that the legislation has not been properly enforced, resulting in the continued use of standard paving in many domestic situations. Furthermore, the skills of those that lay domestic paving are often low and, without the necessary training, they are not equipped to install a more technical product like CBPP. Nonetheless, sales of domestic CBPP increased in relation to commercial CBPP from around 10% (67,000m<sup>2</sup>/6.7ha) in 2009 to over 20% (>220,000m<sup>2</sup>/22ha) by 2013.

For one company, commercial CBPP sales between 2008 and 2013 were mostly greater (often significantly greater) than domestic CBPP sales, both within regions and for England as a whole. Since its introduction by a second company in 2008, sales of domestic CBPP increased in relation to total CBPP sales from less than 12% in 2008 to over 21% in 2013. A third company's sales of domestic CBPP increased from being slightly less than commercial CBPP in 2009-2010 to increasingly more than commercial CBPP from 2011-2013. A fourth company, which provided average annual sales data for domestic and commercial CBP and CBPP for the last 10 years (2004-2013), took the decision to create a permeable paving option for every one of its paving products. However, it has seen very little activity in the 'domestic' market and, while the 'commercial' market seems to be embracing SuDS, the sales of CBPP are still a long way short of the anticipated 50-60%.

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<sup>12</sup><http://www.environment-agency.gov.uk/research/library/publications/33889.aspx>

<sup>13</sup><http://www.legislation.gov.uk/ukpga/2008/29/contents>

For competitive reasons, two companies have intentionally chosen to focus on one or other market. One operates predominantly in the 'commercial' market and sells very little CBPP for domestic use. The second operates exclusively in the 'domestic' market, although market penetration is very low and very little is sold. The company chooses not to compete in the 'commercial' market, where it perceives there to be increasing demand for CBPP from larger house-builders.

### **Reasons for level of market penetration by CBPP to date**

It is clear from the above data that, throughout England, the levels of market penetration by CBPP are low. Sales of domestic CBPP relative to commercial CBPP are also low, but are showing a steady increase. In order to identify and understand the barriers to greater market penetration of CBPP, subjective appraisals of the key areas of influence were carried out through iterations with product specialists in national companies.

#### *1. Lack of effective legislation*

There is widespread acknowledgement amongst planners and developers of the need to mitigate and manage flood risk from increased surface water run-off due to development. However, the inclusion of CBPP and SuDS in new developments is currently only a 'recommendation', unless specific conditions are attached to planning permissions. Government's National Planning Policy Framework (2012)<sup>14</sup> reflects the earlier policy advice and guidance on development and flood risk given in PPG 25 (2001) and PPS 25 (2006)<sup>15</sup>. The Planning Act (2008)<sup>16</sup> introduced changes to permitted development rights and includes specific rules for householders wanting to pave-over their front gardens. The principal legislation controlling surface water drainage in England and Wales is the Flood and Water Management Act (2010)<sup>17</sup>, the SuDS provisions of which will only take effect once national standards have been agreed and implemented. The 'industry' sees the lack of effective implementation and enforcement of legislation and regulation as being the single biggest barrier to increased market penetration of CBPP. There is, therefore, a clear need for lobbying by individual companies and, perhaps, a dedicated campaign by Interpave.

#### *2. Perceptions of cost: customers*

There is a perception amongst customers that the costs associated with the purchase, installation and maintenance of CBPP are higher than for standard block paving. In reality, CBPP systems are easier to design and, in many cases, are more cost-effective and offer better value for money. Whilst the cost of CBPP blocks are similar to or slightly more than standard blocks, and associated aggregates for use with SuDS add an extra cost (around £8/m<sup>2</sup>), the total cost of a CBPP system is nonetheless cheaper. SuDS do not require connection into existing drainage systems or installation of new off-site systems, thereby saving time and costs associated with often complex negotiations with third parties. Obtaining the necessary planning consents is, therefore, straightforward. CBPP is not always suitable for steep slopes, on hard rock surfaces, or in space-constrained locations. In these situations, however, it might be still possible to install a sustainable solution. CBPP can be accommodated on sloping sites by including dams and terraces within the pavement, whereas on impermeable subgrades and in constrained locations, a suitable means of water attenuation and pollutant removal prior to discharge to drains or water-courses would be required.

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<sup>14</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/6077/2116950.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf)

<sup>15</sup><http://webarchive.nationalarchives.gov.uk/20100520022021/http://www.communities.gov.uk/planningandbuilding/planning/policyguidance/planningpolicystatements/planningpolicystatements/pps25/>

<sup>16</sup><http://www.legislation.gov.uk/ukpga/2008/29/contents>

<sup>17</sup><http://www.legislation.gov.uk/ukpga/2010/29/contents>

Interpave commissioned research into the whole life costs of CBPP. The research compared the cost of three CBPP options and five 'traditional' impermeable pavement types (including block paving) in a range of domestic and commercial applications<sup>18</sup>. The CBPP options comprised: System A, which allowed full infiltration of water to the ground; System B, which allowed partial infiltration; and System C, which involved full containment and transfer to piped drainage. The research showed each CBPP option to be competitive in all applications where ground conditions allowed (with System A providing the lowest initial costs) and that CBPP was the most cost-effective paving solution for all applications.

CBPP systems have a design life of 20 years. Routine maintenance is simple; the block surface requires sweeping twice a year, with new joint grit being added as the surface beds-down for the first five years. Technical research suggests that major maintenance, including some block replacement, will not be required for 34 years - if the specified regular maintenance is carried out. One company offers a complete design and build service for CBPP systems, including a maintenance guide, a six year warranty and professional indemnity insurance for 12 years (which together cover the design life of the build). Another company offers a 10 year warranty. Manufacturers also host technical workshops on CBPP and SuDS for architects and developers; one company has undertaken an extensive training programme for over 750 paving installers.

### *3. Perceptions of cost: manufacturers and suppliers*

Whilst the majority of companies engaged in this research have embraced the CBPP market, some are less positive about its value. One national company that operates exclusively in the 'domestic' market does not promote CBPP, as the product fails to command a premium price in this market. A regional supplier was concerned about the costs to his business (a small operation) of entering the CBPP market and, as such, made a deliberate decision not to do so. He also questioned whether CBPP would become accepted as an alternative to standard block paving, the ability of block layers to construct SuDS, and the viability of SuDS in areas with high water tables. Conversely, an importer (again a small operation) saw an increase in enquiries for CBPP in 2013 and is looking to double sales in 2014, as CBPP presents a better profit margin than standard block paving for the company.

### *4. Institutional constraints*

The majority of local authorities in England have been unwilling to adopt CBPP and SuDS because, despite evidence to the contrary, highways and planning departments believe maintenance costs to be too high. Historically, local authorities have been very conservative in switching to new construction materials. This has been seen many times with new road paving materials. National authorities, such as the Highways Agency, are more likely to test and adapt to new technologies. However, a few local authorities are more enlightened in this respect (e.g. Oxfordshire County Council) and are pioneering the use of CBPP and SuDS to counter the effects of urban flooding.

Highway maintenance across England is currently suffering due to pressures on local authority budgets. It is, therefore, becoming increasingly difficult to make cost comparisons between existing maintenance regimes, which include some linear drains, and the maintenance of potential CBPP/SuDS solutions. This is further complicated by water companies having responsibility for maintaining certain drainage systems, whereas local authorities would have full responsibility for CBPP/SuDS. Unsurprisingly, local authorities are reluctant, in the current economic climate, to take on additional responsibilities without cost-benefits being clearly and unequivocally demonstrated.

Despite accepting the compelling technical arguments in favour of CBPP and SuDS, some developers

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<sup>18</sup>See [www.paving.org.uk](http://www.paving.org.uk)

are concerned about initial capital costs (rather than the whole life costs). They are also nervous about being forced by law into installing CBPP and SuDS.

### *5. Installation of SuDS in new developments*

Land-take can be an issue for SuDS associated with the use of CBPP in new developments. Some developers see SuDS as a selling tool, particularly in smaller high value housing developments where 'green profile' is important for some buyers. But for larger budget schemes where building density is the key commercial imperative, this is not the case. Ponds and other surface water storage mechanisms are unlikely to be included as design elements in such developments. However, it has been demonstrated that below-ground water storage built into access roads can be just as effective as a SuDS solution and should be considered in such circumstances. A product combination of CBPP and open-graded crushed rock, for example, complies with the highway design criteria stipulated for post-development adoption by local authorities. It may be necessary to convince the client that the total cost of building a conventional road, with a trenched drainage system, is more than building a road with a SuDS solution and slightly more expensive paving.

Currently, so-called plastic 'milk crates' and open-graded crushed rock are most commonly used for below-ground water storage, although concrete culverts are also manufactured for this purpose. One company offers two CBPP/SuDS options: a naturally draining 'infiltration system' and a non-infiltration 'tanked system', both of which use two crushed rock layers of different grades.

Other types of porous or permeable surface treatments (e.g. natural aggregate, porous asphalt and ready mix concrete) are less effective than CBPP and, therefore, have not been widely used in conjunction with SuDS. However, recent technological advances have resulted in porous asphalt being promoted by some companies.

### **Validation of CBPP/SuDS as a cost-effective solution to urban flood risk**

In the last five years, the block paving 'industry' has invested heavily in developing permeable paving products in response to environmental, legislative and policy drivers and made considerable efforts to prove the cost-effectiveness case for CBPP and SuDS. Despite this, sales of CBPP in England have been very low. The key reasons underlying the market performance of CBPP to date are identified and assessed above, and some associated ways of improving market penetration suggested.

These ideas would form part of an overarching exercise to improve understanding and acceptance of the technical and financial arguments for using CBPP and SuDS, which the 'industry' recognises as being needed to ramp-up their use in mitigating and managing flood risk from increasing surface water run-off in the built environment. One approach might be to use the extreme rainfall events of winter 2014 to demonstrate the relative costs of installing permeable surfacing and SuDS by comparison with the post-event remediation costs associated with catastrophic flooding. Other environmental benefits associated with SuDS can also be demonstrated (e.g. bacteriological breakdown of waterborne pollutants).

## **6. Conclusions**

The following conclusions were drawn from the results of the research and the discussion above:

1. This research provides a better understanding of trends in the use of permeable and standard block paving in England's built environment; the data provided should enable the ASC to use its

surfacing indicator to establish a more robust estimate of the area serviced by CBPP as a proportion of the total paved area in England's built environment.

2. Over the last 10 years (2004-2013), national sales were dominated by standard block paving, with CBPP showing a low yet increasing level of market penetration; CBPP sales accounted for nearly 6% of the paving market (<700,000m<sup>2</sup>/70ha) in 2009 and nearly 10% (>1,000,000m<sup>2</sup>/100ha) in 2013.
3. Regional sales data provided by two companies indicated no significant changes in trends over time (the sample size is not representative of the market as a whole); CBPP accounted for less than 10% of block paving sales in all regions for one company, whilst sales for the other were dominated by CBPP in the east and north east and by standard block paving in the south and west.
4. Sales of domestic CBPP increased in relation to commercial CBPP from around 10% (67,000m<sup>2</sup>/6.7ha) in 2009 to over 20% (>220,000m<sup>2</sup>/22ha) by 2013; the proportion of CBPP sold for domestic and commercial purposes varied considerably between companies.
5. The lack of effective implementation and enforcement of legislation and regulation relating to development and flood risk management is seen by the 'industry' as the single biggest barrier to increased market penetration of CBPP; this should be the primary focus for lobbying by the 'industry' and its trade association Interpave.
6. The perception amongst customers that the costs associated with purchasing, installing and maintaining CBPP are higher than with standard block paving is also a significant barrier to increased market penetration of CBPP; this needs addressing through more effective promotion, marketing and technical product support by the 'industry'.
7. Very few local authorities in England have adopted CBPP and SuDS because, despite evidence to the contrary, they believe maintenance costs to be too high - particularly in the current economic climate; again, more effective promotion, marketing and technical product support by the 'industry' is needed to address this misconception.
8. Land-take can be an issue for the use of CBPP and SuDS in space-constrained developments; below-ground water storage built into access roads has proved to be a cost-effective SuDS solution in such situations, although it may be necessary to convince developers of the benefits.
9. The 'industry' recognises the need for better understanding and acceptance of the technical and financial arguments for using permeable paving and sustainable drainage systems in flood risk management; the relative costs of installing CBPP/SuDS by comparison with post-event flood remediation could be used as a clear statement of the cost-benefit case.