SuDS and Water Quality

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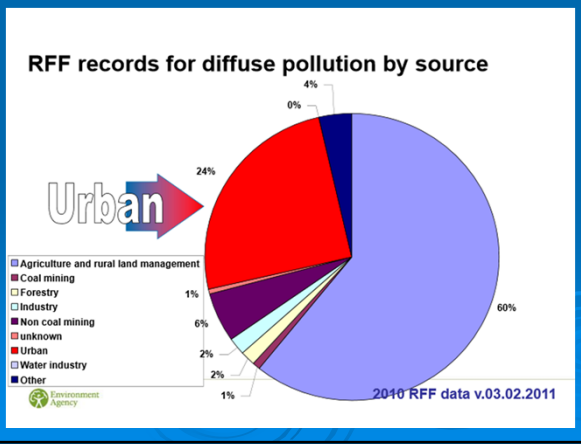
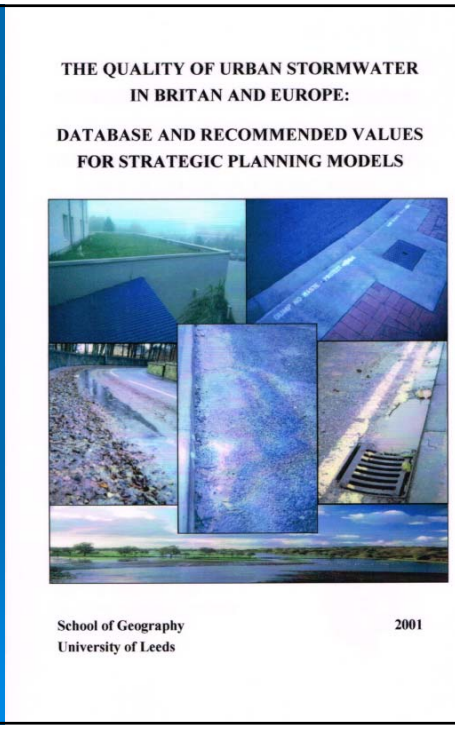
Is pollution from urban surfaces a problem?

- Yes – 25% of pollution in rivers is from diffuse sources



Can it be quantified?

- Yes
- An impact assessment methodology for urban surface runoff quality following best practice treatment - Ellis et al, 2012, Science of the Total Environment
- 71 separate UK studies for a total of 205 individual storm events (Mitchell, 2001)
- Similar findings from international studies
- There will always be variation – as designers we have to deal with it



Diffuse pollution

- Example of key pollutants and Event Mean Concentrations

Table 4-3. Recommended site mean EMC values for N. European screening applications

Pollutant	Land use category	Mean	1st Quartile	3rd Quartile	Data source [1]
TSS mg/l	Urban Open	126.3	57.0	279.8	All (N=18)
	Ind./Comm.	50.4 (*33.3*)[4]	18.1 (*13.9*)	140.4 (*80.0*)	Europe & (UK N=28)[2]
	Residential	85.1 (*46.9*)	37.6 (*19.7*)	192.5 (*111.6*)	Europe & (UK N=17)
	Motorways	194.5	110.1	343.5	Europe (N=16)
	Other Main Roads	**156.9**	**62.2**	**396.3**	Europe (N=6)

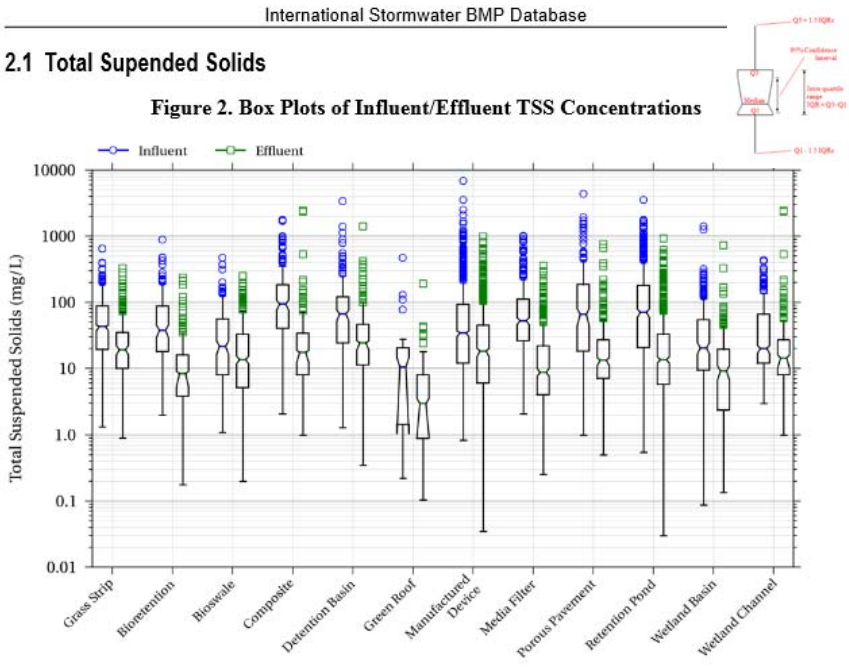
- In terms of diffuse pollution residential is just as much of a problem as other uses – for some pollutants more so

Numbers

- Lamb Drove, Cambourne control site (housing), TSS = 130 mg/l EMC
- M42 Hopwood Park MSA – HGV parking, TSS = 429mg/l EMC
- Standard for minimal impairment = 19.1 mg/l for TSS (Woods Ballard, 2005)
- Both require treatment – supports treatment train concept

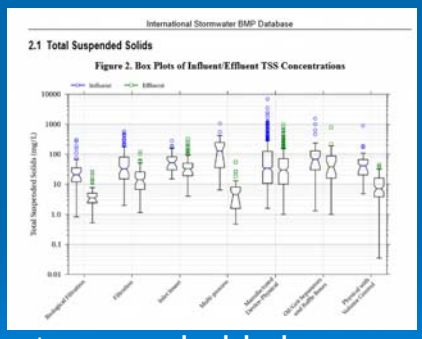
Are we confident SuDS can remove pollution?

- Yes – BMP database has over 530 studies
- Interpave literature review of pollution removal by permeable pavements and impact of geotextiles - 25 studies
- CIRIA Report C609 – pollution removal by swales - 11 Studies
- Can proprietary systems demonstrate this level of testing?



Variability

- There is variability in all systems including proprietary



- All these systems probably have very good lab results - need to test insitu for a true indication of performance

What are we trying to achieve

- For water quality:
- Interception – reducing frequency and volume is very important. Prevent run off for majority of events up to 5mm rainfall depth
- Overall robustness of system – need redundancy
- Prevent re-entrainment of pollution in larger events

- Different removal mechanisms/processes for different pollutants
- Greater concentration of flow – higher risk of build up of toxic levels of pollutants
- Source control works because pollution load/unit area is low compared to proprietary devices
- This all leads to the concept of the treatment train rather than one device

Which approach is best

- It depends on the site and the constraints
- Whichever methods are used the principles should be the same – meet the design objectives

Porous asphalt to car park – Little Eaton Recreation Ground

It was not practical to use green methods here

Lamb Drove, Cambourne

Figure 2.1: Monitoring locations at the Study Site

Monitoring data (Royal Haskoning)

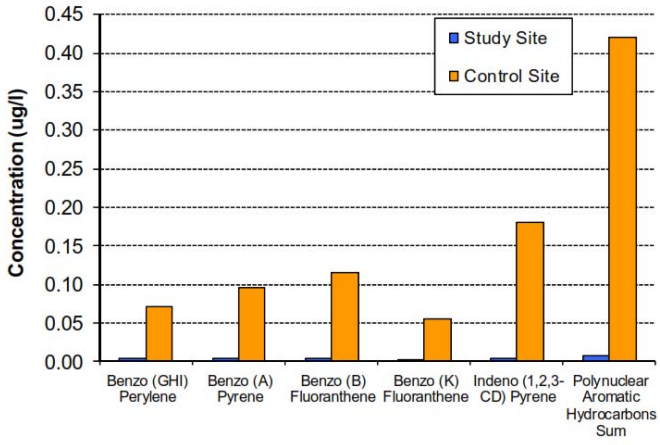


Figure 4.4: Comparison of hydrocarbon concentrations at the Study Site and Control Site (2008 – 2011)

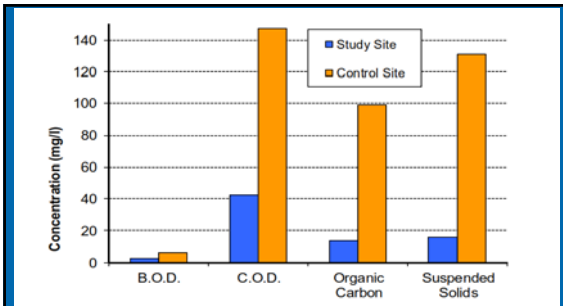


Figure 4.6: Comparison of BOD, COD, organic carbon and suspended solids at the Study Site and Control Site (2008 – 2011)

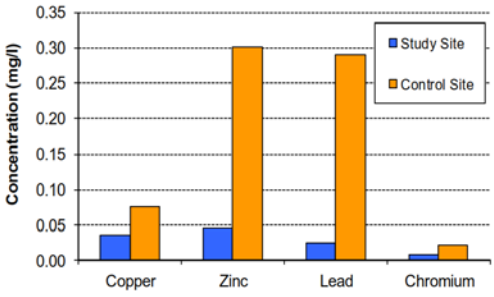


Figure 4.5: Comparison of heavy metal concentrations at the Study Site and Control Site (2008 – 2011)

Treatment train is effective

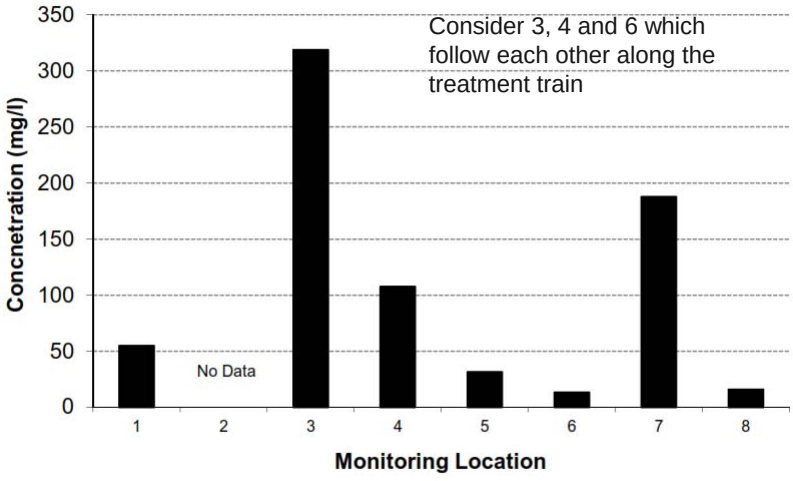
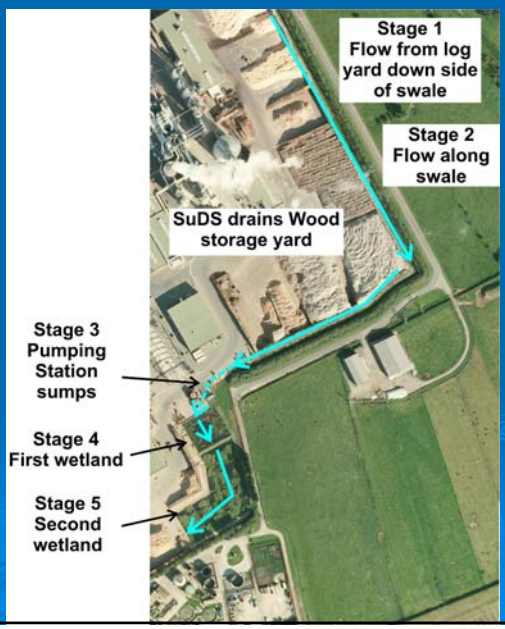


Figure 4.8: Concentration of Total Suspended Solids at the Study Site (2008-2011)

Chipboard Factory

- Designed using guidance in CIRIA C609
- Plus a little bit of research
- Plus engineering judgement
- Risk based approach



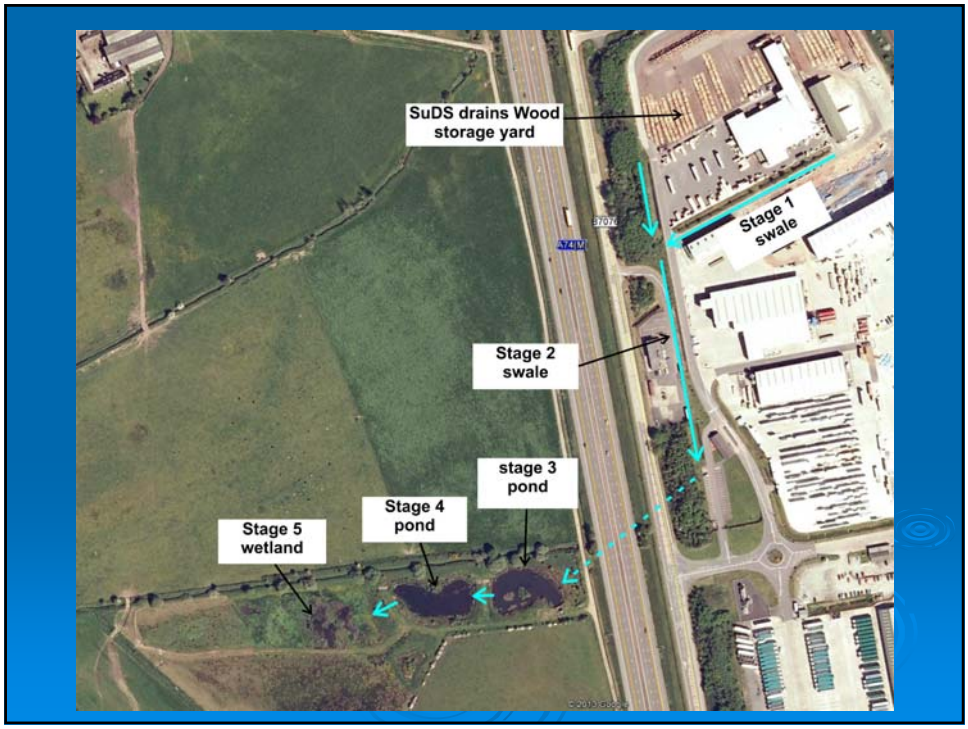
Swale

Wetlands

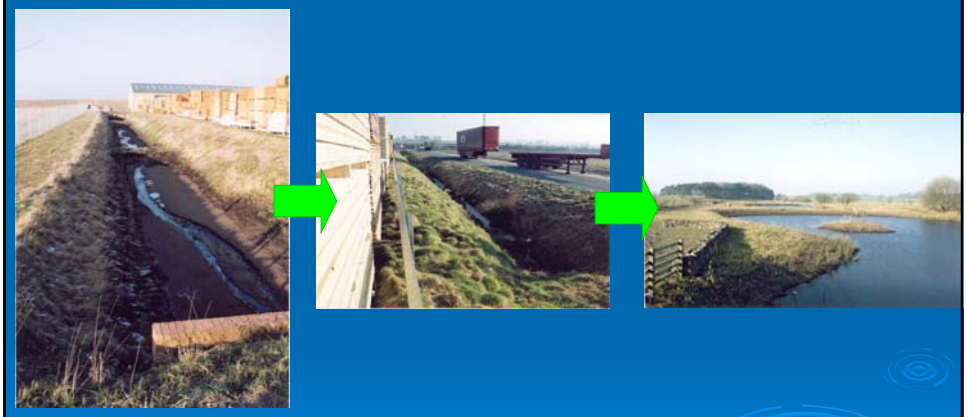



Design criteria

- EA Discharge consent:
- pH >5, <9
- <5mg/l ammoniacal nitrogen
- <2mg/l formaldehyde
- Temp < 25^{o}C
- No significant trace of visible oil or grease
- System design achieves this:
- Reduces NH_3- N by 90% and meets consent (from 10mg/l)
- Reduces formaldehyde by 95% and meets consent (from 60mg/l)



Treatment train



Treatment train

Picture provided by Neil McLean - SEPA

Conclusions

- Urban diffuse pollution from all sites is a problem
- We know enough to understand the inputs into SuDS design
- Lots of evidence on performance of SuDS
- The treatment train is a vital part of water quality design in SuDS