UNITED
BY OUR
DIFFERENCE

WSP

DEFRA WT1505

Final Surface Water Drainage Report

31/07/2013 | 06/11/2013

Confidentiality: Public

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks				
Date	1 August 2013	6th November 2013		
Prepared by	R Kellagher S Wilson R J C Thomson	R Kellagher S Wilson R J C Thomson		
Signature				
Checked by	A L Atkinson	A L Atkinson		
Signature				
Authorised by	A L Atkinson	A L Atkinson		
Signature				
Project number	50600471	50600471		
Report number				
File reference	n:\50600471 - defra - wt1505 evidence costs\c documents\reports\interim swd report final working~jc.docx	n:\50600471 - defra - wt1505 evidence costs\c documents\reports\interim swd report final working~jc.docx		

Defra WT1505

Final Surface Water Drainage Report

31/07/2013

Client

Defra
Nobel House
17 Smith Square
London
SW1P 3JR

Consultant

WSP UK Ltd
Mountbatten House
Basing View
Basingstoke
RG21 4HJ
UK

Tel: +44 (0)1256 318800
Fax: +44 (0)1256 318700

www.wspgroup.co.uk

Registered Address

WSP UK Limited
01383511
WSP House, 70 Chancery Lane, London, WC2A 1AF

WSP Contacts

Chris Tyler
Alastair Atkinson
Oliver Faulkner

Table of Contents

1 Executive Summary

1.1.1 The executive summary provides the main objectives and results of this study. More detailed conclusions are provided in the report.

1.2 Commission

1.2.1 WSP Group, as part of a consortium including HR Wallingford, the Water Research Centre (WRc) and the Environmental Protection Group has been commissioned by DEFRA to provide an evidence base for drainage design and operation costs - research project WT1505 “Evidence on the Costs of 1) New Build Sewers Under Different Conditions and Standards (Objective 1) and Increasing the Uptake of Sustainable Drainage Systems in New Developments (Objective 2)”.

1.3 Aims and Objectives

1.3.1 The objective of DEFRA Project WT1505 is to provide costs associated with the construction and operation of drainage systems for three typical residential developments based on the three standards; the Building Regulations, Sewers for Adoption and the proposed SuDS Standards.

1.3.2 In order to understand the effect on costs of designing surface water drainage systems to these three standards three pilot sites, based on real locations, have been used. The selected developments comprise:

- 8 dwellings (small site),
- 32 dwellings (medium site) and
- 210 dwellings (large site).

1.4 Principal Conclusions – Capital Costs

1.4.1 The differences in the costs between each drainage Standard is scale related, with SuDS costs showing greater benefit against the other Standards at large sites, with reduced cost benefit for small sites.

1.4.2 Due to the large range of possible approaches to SuDS, the costs derived by this analysis need to be considered as one possible solution and cost. However, where possible we have tried to provide solutions with the lowest cheaper costs.

1.4.3 The B. Regs Standard has advantages over the use of SfA7 for small sites due to the outfall structure costs. There is little difference in the costs between B. Regs and SfA7 for larger sites, as the relative cost is greatly reduced.

1.4.4 SuDS have very great advantage for developments on permeable catchments where rainfall runoff can be infiltrated compared to the drainage designs based on the other Standards.

1.4.5 The “impermeable” pilot sites have assumed that the developments have soil permeabilities which are too low to base the drainage solution on the use of infiltration, but there is some degree of infiltration available for infiltrating very small events. In these situations SuDS, particularly with the use of permeable pavements, are generally advantageous over the other Standards, primarily because the Interception[1] criterion can be met using this aspect. The use of permeable pavements is an essential element of SuDS drainage to avoid large land take issues related to the use of vegetative systems. However care needs to be taken in not providing excessive area of permeable pavements as the cost advantage over other standards will reduce.

1.4.6 SuDS generally have little cost advantage for medium and large sites where ground conditions require lining (high groundwater, contaminated soils, soil strength), and small sites are likely to be significantly more expensive. This is primarily due to the additional SuDS components that are needed to meet design criteria on both Interception and treatment.

1.4.7 On these sites the costs associated with the delivery of interception storage for the roof areas comparatively has a higher capital.

1.4.8 Infiltration trenches and rainwater garden features are the least cost solution for meeting Interception criterion in addressing runoff from roofs if permeable pavements are lined.

1.4.9 The issue of whether SuDS can or cannot be considered as contributing to public open space is very important to clarify, as costs associated with loss of land for dwellings is significant where vegetated systems are used.

1.4.10 The commonly applied use of a type of tarmac, Dense Bitumen Macadam (DBM) to protect pervious pavements during construction significantly reduces the cost advantage of SuDS where permeable pavements are used extensively.

1.4.11 Sites in other hydrological locations in the UK tend to have slightly larger storage requirements than the sites designed for this study (which are assumed to be located in the south-east of England). This will tend to favour SuDS schemes. This will be most marked in the south-west and north-east of the country.

1.4.12 Where developments are on previously developed land, more generous discharge rates are often provided and the ground is more likely to be contaminated. Therefore the use of SuDS is likely to be less cost effective, but this will be very site specific.

1.4.13 There is a significant cost advantage in using SuDS for flat sites, but in contrast their use on steep sites tends to constrain site layout and may cost more than drainage schemes designed using the other Standards.

1.4.14 The study found that the approach of the design team in developing a development layout and the SuDS strategy will have a large impact on the capital costs and only small changes in both the approach will have a large impact on the cost and affordability of the SuDS scheme.

1.5 Principal conclusions – Maintenance Costs

1.5.1 The annual costs of maintenance of SuDS in the public realm are of the order of 0.5% of capital costs of drainage construction. This indicates a whole life cost (WLC) approach to SuDS would focus on capital costs.

[1] Interception is assumed to be able to take place in all conditions except when a liner is needed (to protect the groundwater or due to soil contamination), or when the soil is totally impermeable such as with blue London clay. In all other circumstances an initial rainfall depth is assumed to be prevented from being discharged from the site using appropriate SuDS techniques. It is assumed that the target rainfall amount being intercepted is 5mm, with the majority of events having this depth effectively retained in the year. It is assumed that a probabilistic approach will be developed in the SuDS national Guidance to address wetter periods when interception may not achieve the retention of the design initial rainfall depth

1.5.2 There is a limited benefit in doing WLC (irrespective of the dominant effect of the capital costs), as there are 3 different sets of stakeholders – each with their own cost interest;

- the capital cost is incurred by the developer,
- the SuDS in the public realm will be owned by the local authority, and
- the SuDS in private property will be owned by these individuals.

1.5.3 WLC indicates that there is generally little difference between traditional drainage and the use of SuDS, though this is dependent on the type of SuDS used.

1.5.4 Although the cost differences between standards are small, the advantage of one Standard over another is very dependent on the maintenance frequency for desilting structures.

1.6 Recommendations

1.6.1 A number of design assumptions have been made in the absence of guidance associated with the SuDS Standards. In general these are not controversial, but this highlights the need to have national guidance to support the SuDS Standards when the legislation is enacted.

1.6.2 It would assist in assessing this research output information by providing supporting evidence from recent planning applications of the proportion of sites by a number of categories, including:

- Size of development
- Greenfield / previously developed
- Permeable / Impermeable sites
- Sites where the ground condition requires lining

1.6.3 The design of drainage systems for pilot sites in two or three other hydrologic locations would remove some of the uncertainties on costs; south-west, north-west and north-east England.

1.6.4 Although permeable pavements are becoming common-place, not all local authorities have been prepared to adopt them or use them in certain road categories. This is a key aspect that needs clarification and for which guidance is needed. The use of permeable pavements being used for infiltration within close proximity of a property.

1.6.5 The use of geo-cellular units for attenuation storage or infiltration is not always accepted for adoption by local authorities or water companies. Clarification on this needs to be provided in SfA7 and Part H of the B. Regs.

1.6.6 The issue of whether vegetative SuDS can or cannot be considered as contributing to public open space needs to be clarified. This may be a function of:

- the type of vegetative SuDS used,
- its potential for dual use, or
- its ecological / environmental value.

1.6.7 It is suggested that explicit consideration is given to the added value of designing to the SuDS Standards in comparison to schemes designed to the other Standards.

2 Introduction

2.1 Commission

2.1.1 WSP Group, as part of a consortium including HR Wallingford, the Water Research Centre (WRc) and the Environmental Protection Group has been commissioned by DEFRA to provide an evidence base for their project WT1505, has been commissioned by the Department for Environment, Food and Rural Affairs (DEFRA) to undertake the research project:

2.1.2 WT1505 "Evidence on the Costs of 1) New Build Sewers Under Different Conditions and Standards (Objective 1) and Increasing the Uptake of Sustainable Drainage Systems in New Developments (Objective 2)".

2.1.3 This report outlines the interim findings of Sustainable Drainage Systems (SuDS) in new developments in accordance with the methodology established by WSP Group in the Inception Report.

2.2 Aims and Objectives

2.2.1 The objective of DEFRA Project WT1505 is to provide costs associated with the construction and operation of drainage systems for three typical residential developments based on the three standards; the Building Regulations, Sewers for Adoption and the proposed SuDS Standards.

2.2.2 At present in the UK, various standards apply to the design and construction of new surface water drainage systems. There have been a number of changes to standards and approaches within the water industry since Part H of the Building Regulations was published in 2002 to April 2013. The requirements for Sewers for Adoption have changed over the years with the most recent version being the 7th edition which includes the adoption of laterals and the introduction of demarcation chambers.

- The proposed draft SuDS Standards (SuDS) are available in Annexe A of the consultation document for Schedule 3 of the Flood and Water Management Act, 2010.

2.2.3 In order to understand the effect on the differences on costs of designing surface water drainage systems to these three standards, it is necessary to prepare specific drainage layouts for pilot sites. Three real sites, based on design support work prepared by WSP Group, have been chosen. To assess economies of scale as well as to allow exploration of different drainage approaches, the selected developments comprise:

- 8 dwellings (small site),
- 32 dwellings (medium site) and
- 210 dwellings (large site).

2.2.4 Specifically this report provides:

- Details of the drainage designs for the small, medium and large developments based on the three standards;
- Comparison of the design criteria used based on the standards;
- Costs for the drainage designs (including materials and labour, as well as operational expenses, regulatory fees and commuted sums).

2.2.5 A detailed description of the three sites selected for the study along with the reasons why they were selected in provided in Appendix A.

2.3 SPON's Data

2.3.1 The costs have been prepared on the basis of data contained in SPON's data base to ensure that the site would not be biased by any one contracting partnership or rates.

2.3.2 The costs in the SPON's Price Books are based on the wage rates and material costs current at June 2011 for the External Works and Landscape. They do not include any VAT. The Civil Engineering and Highway Works is based on a review of prices up to April/May 2012. The prices are adjusted to reflect what is anticipated to be the likely rate in the year 2012/2013. The prices are based on conditions in outer London or South East England. The book also includes regional variation factors. There are several pages of explanation in each book regarding how the prices are arrived at. It is suggested that DEFRA read these pages in order to understand the exact make-up of the prices.

3 Design Approach

3.1 The Three Pilot Sites

3.1.1 This Report details the three sites and their drainage designs for the three Standards to enable detailed comparison of drainage details and their costs. Each of the sites comply with current drainage criteria as defined by Defra / EA for the options based on meeting B. Regs and SfA 7 Standards, against the 'SuDS' option for the proposed SuDS Standards. This document is the DEFRA/Environment Agency technical report W5-074/A/TR/1 (TRW5) "*Preliminary rainfall runoff management for developments*". This was first issued in 2006, and has undergone several revisions since (but with no significant change in the criteria).

3.1.2 The three sites used in this study are from existing projects for which drainage designs have been prepared for developers by WSP. These sites were originally designed to current standards and normal practice and are suitably typical of modern developments for use for this project. These are briefly described here:

- The **small site** has been selected as being representative of a small 8 unit development to reflect infill development. The dwellings are at the larger end of typical standard mixed housing developments. The plot is part of a larger development layout and is currently under construction (which means that any public open space is provided on other parts of the site).
- The **medium site** layout represents a typically sized development parcel with 32 houses. Again it is a part of a larger site (which means that any strategic public open space is provide on another part of the site), but has been re-designed as necessary to be a stand-alone development. The medium site utilises layouts commonly used in the industry and contains smaller house types and gardens than the small site. The style of the development has the housing fronting onto the road and courtyard parking behind.
- The **large site** provides an example of a more extensive modern development (210 dwellings) containing both flats and houses. As for the medium site, it is part of a larger development and redesign has been carried out to ensure it acts as a stand-alone development. The site is split into a number of development blocks surrounding courtyard parking areas. Between these development blocks are the connecting highways and public open spaces.

3.1.3 Each of the characteristics of the sites in terms of layout and topography have been retained for the purposes of this report. However, the sites have been "moved" to a common theoretical location so the design is for the same rainfall characteristics and the same geology. This allows direct comparison of the costs of all the drainage systems.

3.1.4 FSR rainfall has been used for the design of the drainage systems. There is a move by many authorities to use FEH based rainfall. However as this analysis is based on the differences between the system costs, this choice has little influence on the results. As a general rule, FEH rainfall tends to be slightly more than events using FSR for much of England and Wales.

3.1.5 The three sites are all assumed to be on relatively impermeable ground for the purpose of designing the drainage for the three standards, which allowed a representative but robust worst case to be developed in terms of costs for a SuDS scheme and associated costs.

3.1.6 The small site, although 8 houses, has topographic constraints and has 2 outfalls. It is effectively 2 sites of 4 houses. Analysis has also been made on what the attenuation storage volume would need to be for 1 outfall and its cost implications.

3.1.7 The medium site is also re-analysed on the basis of it being a permeable site with a relatively low level of permeability.

3.1.8 The SuDS solutions are provided for two circumstances to address the situations where sites are affected by high groundwater or soil contamination. The first design is referred to as “**SuDS Extra**”, and the second as “**SuDS Normal**”, An explanation of the design assumption and implications of these two types of sites is given in the section on SuDS design criteria.

3.1.9 The characteristics of the sites and the rainfall and geology assumed for the three sites are given in Table 1.

Table 1: Site Attributes

Site attributes	Size of site		
	Small	Medium	Large
Units	8	32	210
Area (ha)	0.281	1.006	4.395
Assumed Geographic Location	South East England Hydrological region 5	South East England Hydrological region 5	South East England Hydrological region 5
Impermeable proportion	70%	70%	70%
Infiltration	No	Yes & No	No
Soil Type	SOIL 4 (HOST 21 sprHOST 0.472)	1) SOIL 2 (infiltration) 2) SOIL 4 (HOST 21)	SOIL 4 (HOST 21 sprHOST 0.472)
Average Annual Rainfall (SAAR)	650 mm/year	650 mm/year	650 mm/year
FSR M50:60, r	20.0 mm, 0.4	20.0 mm, 0.4	20.0 mm, 0.4
Urban creep factor	1.0	1.0	1.0

3.2 General Design Criteria

3.2.1 All sites and designs shall be assumed to be in accordance with the requirements of the National Planning Policy Framework and The EA policy document “Rainfall runoff management for developments – TR/W5-074, ed. E, 2013” (TRW5) such that:

- Run-off rates shall be reduced to pre-development rates (greenfield rates) calculated in accordance with TRW5
- No flooding shall occur on the 1 in 30 year storm event
- All overland flow for the 1 in 100 year storm event (plus climate change allowance) shall be retained within the site boundaries and away from properties

3.2.2 TRW5 also introduces other design criteria and clarification on the calculation methods. It includes consideration of the need to apply FEH rainfall, allowances for urban creep, discharge rates from outfalls limited to a minimum of 5 l/s to minimise the risk of blockage of flow control devices.

3.2.3 Stormwater needs to be managed on site for up to the 1:100 year event. Theoretically this could be “managed” flooding above the 30 year event such as on roads and car parks. However it is usual for this to be provided within storage in designed attenuation structures.

3.2.4 No allowance for urban creep has been provided. Urban creep has yet to be formalised in terms of national requirements except in Scotland.

3.3 Building Regulations Design Criteria

3.3.1 The drainage design for the three schemes complying with the Building Regulations is based on the design criteria described in this section.

3.3.2 The Building Regulations require the design of a drainage scheme to include certain parameters such as the length between inspection chambers and the requirement to discharge surface water via sustainable means through SuDS features prior to discharging to surface water sewers.

3.3.3 Similar to the requirements of the SuDS Standards, Section H3 of the Building Regulations requires that surface water must preferably be discharged to infiltration devices at source, and if this is not possible, then to a watercourse. Discharging surface water to a sewer is only permitted should the first two options not be available, but there is no explicit limitations on the discharge to an adoptable sewer. For the purposes of this study, it is assumed that discharge to a public sewer would be limited to the pre-developed rate to comply with the requirements of NPPF and TRW5. In all the three cases, it is presumed that the three options are all greenfield developments.

3.3.4 Drainage must be designed to accommodate surface water generated from hard paved areas at an intensity of 0.014 litres/second/m^2 (50mm/hr) and this runoff is collected by a mix of drains and gullies, and roof areas is collected from rainwater pipes. Flows are assumed to be attenuated using large diameter pipes and chambers and controlled by orifice plates.

3.3.5 In practice, although referred to in the Standard, SuDS methods (in their true application for hydraulic management, runoff treatment and amenity) are used to a very limited extent in current developments.

3.3.6 Where water is discharged to ground (infiltration), B. Regs state it must be done such that it does not cause problems to the foundations of nearby buildings and should be situated at least 5m from structures. This minimum distance is sometimes a constraint in modern high density developments. It should be noted that this is modified in SuDS guidance and is dependent on infiltration area and foundation depth.

3.3.7 The infiltration rate for SOIL type 2 is marginal for use for disposal of all runoff so soakaways need to be quite large.

3.3.8 Where water is discharged to drains it is routed via gravity pipes to connect to existing surface water sewers located beneath nearby carriageways.

3.3.9 Table 2 summarises the B. Regs design criteria.

Table 2: B. Regs design criteria and design values

Design criteria	Size of site		
	Small	Medium	Large
Climate change factor	1.3	1.3	1.3
Discharge rate limits - Formula - minimum rate - 1;1 year factor - 1:30 year factor - 1:100 year factor	 - IH 124 - 5/l/s 0.87 2.45 3.56	 - IH 124 - 5/l/s 0.87 2.45 3.56	 - IH 124 - 5/l/s 0.87 2.45 3.56
Discharge volume - LTS Criteria (*See notes 1 and 2*)	1:100yr 6hr event	Soil 2 – LTS does not apply Soil 4 - 1:100yr 6hr event	1:100yr 6hr event
Soil infiltration rate (m/s)	Soil 4 – 1.0 x10^{-7}	Soil 2 – 1.4 x10^{-5} Soil 4 – 1.0 x10^{-7}	Soil 4 – 1.0 x10^{-7}
Pipe sizing - No surcharging - No flooding - Minimum pipe size	 1:2 year event 1:30 year event 100mm	 1:2 year event 1:30 year event 100mm	 1:2 year event 1:30 year event 100mm
Rainfall - pipe design	 50mm/hr	 50mm/hr	 50mm/hr
Rainfall - Attenuation storage	1:100 year event	1:100 year event	1:100 year event
Overland flow routing	▪ 1:100 year, Managed on site	1:100 year, Managed on site	▪ 1:100 year, Managed on site

Note 1. LTS – The Long Term Storage (LTS) criterion requires the additional runoff volume created as a result of the development for the 1 in 100 year 6 hour event (M100:6) should preferably be addressed by remaining on site (infiltrated or non-potable use), but if discharged, the maximum flow rate for a volume which is at least equal to the additional volume for this event is limited to a discharge rate of 2 l/s/ha while the greenfield component can be discharged at the greenfield rate less the 2l/s/ha being used for the LTS volume. Alternatively the discharge from the site for the 1:100 year critical duration event should be limited to the maximum of either Qbar or 2l/s/ha. **The latter criterion option has been applied to the design of all the options.**

Note 2. As Qbar is being used (note 1) the depth of rainfall for the 100 year 6 hour event is not used.

3.4 Sewers for Adoption Design Criteria

3.4.1 Sewers for Adoption 7th Edition (SfA 7) states that the guidance document is "intended to cover any surface water sewers or lateral drains not covered by the requirements of the SUDS approval and adoption regime". This document therefore sets out the design criteria for traditional drainage systems which do not include SUDS features.

3.4.2 As per the Building Regulations compliant design, roof water is collected via rainwater pipes and routed to below ground drainage. Yards and other hard paved areas is served via gullies which connects to surface water sewers.

3.4.3 The infiltration rate assumed for SOIL type 2 or 4 is marginal for use for disposal of all runoff using soakaways and these need to be quite large.

3.4.4 Attenuation storage is provided by over-sized pipes upstream of vortex control units. These units are used rather than orifices as this allows larger diameter pipes to be used which are required by adopting water companies.

3.4.5 SfA 7 requires that all surface water drainage is designed to accommodate a 1 in 30 year rainfall event without flooding. Where flooding takes place for events greater than 1 in 30 years, this must be managed on site up to the 1 in 100 year event.

3.4.6 Table 3 summarises the SfA 7 design criteria.

Table 3: SfA 7 design criteria and design values

Design criteria	Size of site		
	Small	Medium	Large
Climate change factor	1.3	1.3	1.3
Discharge rate limits - Formula - minimum rate - 1;1 year factor - 1:30 year factor - 1:100 year factor	 - IH 124 - 5/l/s 0.87 2.45 3.56	 - IH 124 - 5/l/s 0.87 2.45 3.56	 - IH 124 - 5/l/s 0.87 2.45 3.56
Discharge volume - LTS Criteria - (*See notes 1 and 2*)	1:100yr 6hr event	Soil 2 – does not apply Soil 4 - 1:100yr 6hr event	1:100yr 6hr event
Soil infiltration rate (m/s)	Soil 4 – 1.0 x10^{-7}	Soil 2 – 1.4 x10^{-5} Soil 4 – 1.0 x10^{-7}	Soil 4 – 1.0 x10^{-7}
Pipe sizing - No surcharging - No flooding - Minimum pipe size	 1:2 year event 1:30 year event 150mm	 1:2 year event 1:30 year event 150mm	 1:2 year event 1:30 year event 150mm
Rainfall - Design storms	 FSR (summer and winter)	 FSR (summer and winter)	 FSR (summer and winter)
Attenuation storage	1:100 year event	1:100 year event	1:100 year event
Overland flow routing	1:100 year, Managed on site	1:100 year, Managed on site	1:100 year, Managed on site

Note 1. LTS – The Long Term Storage (LTS) criterion requires the additional runoff volume created as a result of the development for the 1 in 100 year 6 hour event (M100:6) should preferably be addressed by remaining on site (infiltrated or non-potable use), but if discharged, the maximum flow rate for a volume which is at least equal to the additional volume for this event is limited to a discharge rate of 2 l/s/ha while the greenfield component can be discharged at the greenfield rate less the 2l/s/ha being used for the LTS volume. Alternatively the discharge from the site for the 1:100 year critical duration event should be limited to the maximum of either Qbar or 2l/s/ha. **The latter criterion option has been applied to the design of all the options.**

Note 2. As Qbar is being used (note 1) the depth of rainfall for the 100 year 6 hour event is not used.

3.5 SuDS design criteria

3.5.1 The SuDS Standards are currently a proposal which was issued in December 2011 which can be seen on the Defra web site: (*https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82421/suds-consult-annexa-national-standards-111221.pdf*). This went to consultation and Defra are currently progressing various issues which resulted from this process; including this study.

3.5.2 The proposed SuDS Standards are built on drainage best practice in line with the SuDS Manual, TRW5 and NPPF. There are additional elements associated with drainage design criteria to that used to meet the requirements for either the B. Regs or SfA 7, but there are no contradictory requirements - only additional criteria.

3.5.3 The additional criteria for SuDS all relate to the provision of water quality protection for the environment.

3.5.4 One of the current issues is the fact that guidance is required to support the proposed Standards, as there is room for interpretation of the criteria which has been kept suitably brief in the proposed Standards document. . Where assumptions need to be made for this study, these have been detailed.

3.5.5 Table 4 summarises the structure of the proposed SuDS Standards, and Table 5 summarises the design criteria which are relevant to the design of the drainage systems for the three sites.

Table 4: The structure and principal requirements of the proposed SuDS Standards

Section	Topic	Principal Requirements
Principles	Affordability Functionality	No design related criteria in this section.
Section A. Runoff destination	Infiltration Surface water body Surface Water Sewer Combined sewer	Order of preference of stormwater disposal Criterion: A requirement to maximise infiltration even when extreme events cannot be disposed of by infiltration. (generally in line with B. Regs Standards)
Section B. Peak flow rate and volume	Discharge Flow rate options Discharge Volume options	Criterion: 5mm Interception (Assumptions have been made on how the Interception criterion is met) 2 options on rates of discharge which are linked to the volume of discharge. Criteria: Discharge rates to meet 1:1yr, and 1:100yr for either greenfield rates, or previously-developed sites subject to volume of discharge design (linked to Long term Storage (LTS) based on 1:100 year 6 hour event)
Section C. Water quality	Hazard categorisation Receiving environment	Criteria: Risk based assessment of number of levels of treatment

	categorisation Levels of treatment for: - Discharges to ground - Discharges to surface	To Ground: Roof – 1 level Road – 2 levels To surface Roof – 0 level Road - 2 levels
Section D. Function	Flood risk General guidance on O&M and other best practice.	Criterion: 1:30 year event – no flooding Criterion: 1:100 year event – flood management (on site and from external sources)

3.5.6 In the case of Soil type 4 (relatively impermeable soil) it is assumed that there is sufficient infiltration capacity in the permeable pavement to cater for the runoff for the first 5mm of a rainfall event as long as the total roof area draining to the permeable pavement is less than the plan area of the pavement.

3.5.7 In addition it is assumed that a permeable pavement can be accorded two levels of treatment if the runoff has to pass through the stone media and also can utilise the nominal infiltration capacity. Although too low a rate for assisting in managing extreme events, rates of the assumed permeability still results in the theoretical potential for up to 3500mm of infiltration through the year.

3.5.8 However the **SuDS Extra** site assumes that extra SuDS are needed to address the fact that if a permeable pavement has to be lined, then the Interception criterion for runoff from roofs has to be met by the use of other SuDS features.

3.5.9 It is also assumed that two levels of treatment should not be associated with lined permeable pavements and therefore a downstream SuDS component is needed to provide additional polishing of the runoff.

3.5.10 Table 5 summarises the design criteria used for designing the three site to meet the SuDS Standards. This is followed by the assumptions that have been used to achieve compliance with this criteria. These assumptions are needed as the guidance on implementing the Standards has yet to be issued. However they are based on information which is currently being suggested and available in drafts of guidance which have not yet been agreed.

Table 5: Proposed SuDS Standards design criteria and design values

Design criteria	Size of site		
	Small	Medium	Large
Climate change factor	1.3	1.3	1.3
Discharge rate limits - Formula - minimum rate - 1;1 year factor	- IH 124 - 5/l/s 0.87	- IH 124 - 5/l/s 0.87	- IH 124 - 5/l/s 0.87

- 1:30 year factor - 1:100 year factor	2.45 3.56	2.45 3.56	2.45 3.56
Discharge volume - LTS Criteria - (See notes 1 and 2)	1:100yr 6hr event	Soil 2 – does not apply Soil 4 - 1:100yr 6hr event	1:100yr 6hr event
Discharge volume - Interception	5mm of rainfall	5mm of rainfall	5mm of rainfall
Soil infiltration rate (m/s)	Soil 4 – 1.0 $x10^{-7}$	Soil 2 – 1.4 $x10^{-5}$ Soil 4 – 1.0 $x10^{-7}$	Soil 4 – 1.0 $x10^{-7}$
Pipe sizing - No surcharging - No flooding - Minimum pipe size	1:2 year event 1:30 year event 100mm	1:2 year event 1:30 year event 100mm	1:2 year event 1:30 year event 100mm
Rainfall - Design storms (critical duration)	FSR (summer and winter)	FSR (summer and winter)	FSR (summer and winter)
Attenuation storage	1:100 year event	1:100 year event	1:100 year event
Overland flow routing	1:100 year, Managed on site	1:100 year, Managed on site	1:100 year, Managed on site
Number of levels of treatment - Surface water discharge - Infiltration	Roof 0 / Roads 2 – SOIL 4 N/A	Roof 0 / Roads 2 – SOIL 4 Roofs 1 / Roads 2 – SOIL 2	Roof 0 / Roads 2 – SOIL 4 N/A

Note 1. LTS – The Long Term Storage (LTS) criterion requires the additional runoff volume created as a result of the development for the 1 in 100 year 6 hour event (M100:6) should preferably be addressed by remaining on site (infiltrated or non-potable use), but if discharged, the maximum flow rate for a volume which is at least equal to the additional volume for this event is limited to a discharge rate of 2 l/s/ha while the greenfield component can be discharged at the greenfield rate less the 2l/s/ha being used for the LTS volume. Alternatively the discharge from the site for the 1:100 year critical duration event should be limited to the maximum of either Qbar or 2l/s/ha. **The latter criterion option has been applied to the discharge of all the options.**

Note 2. As Qbar is being used (note 1) the depth of rainfall for the 100 year 6 hour event is not used.

3.5.11 As can be seen from Tables 4 and 5, the two elements which are additional to the criteria used for either B. Regs or SfA 7 are:

- The drainage system should not discharge any runoff from the site for the first 5 mm of a rainfall event, and
- Stormwater should pass through a number of treatment processes, the number of which is associated with the pollution hazard associated with the surface on which the rain falls.

3.5.12 The infiltration rate for SOIL type 2 is marginal for use for disposal of all runoff so soakaways need to be quite large. However due to the large plan area of permeable pavements, this rate is not a constraint when designing for SuDS schemes.

3.5.13 The infiltration rate for SOIL type 4 is too low for use for disposal of runoff so the use of soakaways is not feasible. Design of permeable pavements should not rely on the water which would be infiltrated during an extreme event and storage is sized assuming a totally impermeable base. However in compliance with the proposed SuDS Standards, maximum use of any potential infiltration is made of the limited infiltration capacity to encourage recharge.

3.6 SUDS Features

3.6.1 The SuDS Manual describes most of the SuDS elements which are available for managing and treating stormwater runoff. However there are two other SuDS management which were not included in the manual (but which will be in the 2013 revision), and these are:

- rainwater harvesting systems, and
- rain-gardens.

3.6.2 Table 6 lists the SUDS features which have been used in this study and outlines how they behave been employed to meet the requirements of the SUDS and the philosophy of TRW5. Maximum variation of use of SuDS features has been made to illustrate the possibilities that are available, their relative merits and their effect on costs.

Table 6: SuDS features used in the drainage options

Design criteria	Size of site		
	Small	Medium	Large
SuDS elements	Permeable Pavements Rain Gardens Green Roofs Rainwater Harvesting	Permeable Pavements Rainwater Harvesting Communal Rainwater Harvesting	Swales Permeable Pavements Communal Rainwater Harvesting Attenuation Storage

3.6.3 Table 7 summarises the principal attributes of each type of SuDS element and this is followed by a brief description of these units describing their characteristics, and where and when they can be used. These descriptions are the basis for their costings.

Table 7: SuDS Attributes

SUDS System	Interception	Attenuation
Oversized Pipe	×	✓
Permeable Pavement (Infiltrating)	✓	✓
Permeable Pavement (Non infiltrating)	✓	✓
Rain Garden	✓	✓
Rainwater Harvesting	✓	✓
Standard Swale	(✓)	✓
Under-drained swale	✓	✓

Attenuation Storage Design

- The hydraulic modelling of all the sites to determine the attenuation requirements and also peak flow rates through pipework has been based on the assumption that the rainwater harvesting systems, and other interception based systems, do not provide any storage. In general this assumption does not significantly affect the costs of the SuDS attenuation system where this is primarily based on the use of permeable pavements, as the provision of storage is largely is dictated by the structural depth of the pavement.

Levels of Treatment

- In general each application of a SuDS element is assumed to provide one level of treatment though, when it is not lined, two levels of treatment are assumed for permeable pavements.
- There is no specific water quality performance requirements (as yet) associated with a level of treatment or at the outfall from the site.

Permeable Pavements

- Permeable pavements are a fundamental SuDS feature for any development. This is because roads and pathways are always needed and therefore potentially provide a large for attenuation storage throughout a site without requiring additional space being allocated to storage or treatment. If they cannot form the back-bone of the SuDS in a development, additional space requirements for attenuation storage and treatment for dealing with stormwater runoff results in space being needed to accommodate SuDS drainage features.
- Permeable pavements have to specifically consider provision of corridors and crossings for utilities.
- Permeable pavements are assumed to be concrete blockwork with porous sub-bases comprising stone media wrapped in geotextiles (permeable where infiltration allows). Sometimes porous asphalt is used as this is usually cheaper to construct. This has the advantage of not having to use weedkiller, but has greater potential, in the long term, for blinding.
- Studies have shown that permeable paving provide interception storage through wetting and evaporation with no runoff taking place for the first 4 or 5mm of rainfall during normal conditions.
- The percolation of water through the sub-base significantly attenuates runoff rates for ordinary events and a large proportion of the runoff volume is removed through infiltration to ground even in clay locations if the pavement is not lined. This volume loss has not been assumed when calculating the volumes of storage requirements for managing extreme events.
- Hydraulic outlets from permeable pavements are throttled using orifice plates. Orifices can be as small as 25mm or even smaller, as blockage protection is implicitly provided by the nature of the structure.
- Permeable pavements are assumed to provide two levels of treatment; one level through percolation through the bedding and stone media, and also infiltration through the unsaturated ground below. Only when the ground has a percolation rate below $1x10^{-7}$m/s (which is ~10mm/day or ~3500mm/yr) might there be an argument for saying that less than 2 levels of treatment is provided. However experience has shown that there is very little runoff that takes place from any unlined permeable pavement, except for large rainfall events.
- Permeable pavement depths, and therefore their storage volumes, are generally dictated by structural requirements rather than the hydraulic volume requirements for storage. This means that they can also serve a proportion of the adjacent areas of runoff (roofs or impermeable pavements).
- Permeable pavements need to incorporate check bunds with throttles to manage flows and make maximum use of storage where they are built in areas with significant gradients. In addition, as the bases of pavements are usually built to be horizontal, there is a terracing effect. Both these aspects mean that there is an additional cost in their construction in this situation.

Rainwater Harvesting Systems

- Rainwater harvesting systems are designed to BS 8515.
- Rainwater harvesting systems are dual purpose SuDS systems. They save on water resources and can be also designed to provide stormwater management.
- Rainwater harvesting systems can either be provided as individual units for each property, or as communal systems for a group of houses.

- All rainwater harvesting systems can be assumed to provide Interception storage as the consumption per property (depending on roof area and occupancy).
- Rainwater harvesting systems for the small site have been designed on the basis of individual property units, while communal systems have been assumed for the medium and large sites.
- Rainwater harvesting systems can be designed for either water saving or stormwater management. The stormwater control aspect of the use of rainwater harvesting has not been utilised for stormwater design of these schemes. Although more costly than most other forms of SuDS, where water is scarce, the use of rainwater harvesting designed for stormwater control provides a useful technique for helping to meet stormwater criteria and is very space efficient.

Rain-Gardens

- Rain-gardens are designed to treat roof runoff and provide interception storage.
- Rain-gardens have been designed to incorporate engineered soil with a porosity of 10% in plots of 2m x 3m x 0.25m deep and planted with suitable vegetation. These units are designed to serve a roof area of 30m^2. Roof water is distributed into and out of the structure via perforated pipes. Provision has been made for flows from larger events to pass to the permeable pavements.

Standard Swales

- Standard swales are effectively channel conveyance systems, but incorporate the ability to also store large volumes of water cost effectively. They have been used to a limited extent on the small and medium sites. They are used extensively on the large site. The treatment is primarily achieved by sedimentation deposition, and volume loss is achieved by soil saturation, infiltration and evapotranspiration. The flatter the gradient of the swale the more effective it is. The design of the swale can specifically be used to capture the interception storage runoff. However where volume loss or enhanced treatment are important, the use of under-drained swales is a more effective SuDS unit.

Under-Drained Swales

- Under-drained swales have been used in the large development site. It is designed as a storage unit with a perforated collector pipe located in a granular media below the base of the swale and the runoff has to percolate through the soil and granular medium to exit from the swale. Design is therefore more complex and overflow bypass units are needed to address extreme events in case the actual hydraulic performance design assumptions are not quite correct. These units are assumed to provide one or two levels of treatment due to both the sedimentation and percolation aspects and infiltration losses to ground.

Green Roofs

- Green roofs are assumed to provide interception storage. They are assumed to provide one level of treatment. Green roofs are assumed to be only used on garages with flat or shallow sloping roof gradients.
- Due to the radical change in roofing style that would be needed for green roofs on houses, and the current expectations of house owners, the use of green roofs is unlikely to be used for residential dwellings. However their use in commercial and industrial properties is generally accepted.

4 Surface Water Drainage Methodology

4.1 Small Site

4.1.1 The small site comprises a total of 8 dwellings and is based on a development layout and infrastructure design support prepared for a development in Bicester, Oxfordshire.

4.1.2 As the assumed soil type for this site (Type 4) is considered to be practically impermeable, discharge from each of the three drainage networks is via a sewer and is restricted to the pre-developed (greenfield) the mean annual maximum flood flow (Qbar) rate.

4.1.3 No allowance has been made for any infiltration that is provided by the soil in carrying out the drainage design of the attenuation storage.

4.1.4 To ensure that flow control devices are not at risk of blockage where the design control discharge rate is less than 5l/s, then a minimum of 5 l/s is applied. This is applied to all runoff return periods as the mean annual maximum flood flow is less than 5l/s.

4.1.5 The site topography and the layout for this site were such that it was not possible to use a single connection point to the receiving system. This means that in the case of designing for SuDS and SfA 7, the site is effectively two sites of 4 dwellings each. For the B. Regs option, one of the garage roofs cannot be connected into either of the two systems resulting in a third connection.

4.1.6 This aspect of a 5l/s per connection is set as a practical limitation to avoid the risk of blockage and is specified in TR5. However it is a rule which is open to abuse to enable storage to be minimised. This option provides a useful indication of the implications of this rule.

4.1.7 The storage requirement for a single point of connection has also been provided for comparative purposes. It can be seen that for a single point of connection the storage for the SuDS system does not need to increase (as there is plenty of spare storage in the permeable pavement), but that the storage volume needed for the other two Standards is more than twice as much.

4.1.8 Table 8 provides an overview of the criteria used for the three drainage network methods.

Table 8: Small Site design information overview

<table>
<tr><th rowspan="2">Design Criteria</th><th colspan="3">Methodology</th></tr>
<tr><th>Building Regulations</th><th>Sewers for Adoption</th><th>SuDS</th></tr>
<tr><td>Greenfield Run-Off Limit</td><td>(Qbar = 1.25l/s)</td><td>(Qbar = 1.25l/s)</td><td>(Qbar = 1.25l/s)</td></tr>
<tr><td>Flow Control</td><td>Orifice Plate - 50 mm diameter</td><td>Vortex control unit – 75 mm diameter</td><td>Orifice Plate – min' 25 mm diameter</td></tr>
<tr><td>Maximum Discharge
(site topography)</td><td>13.0 l/s
(3 connection points)</td><td>9.5 l/s
(2 connection points)</td><td>9.8 l/s
(2 connection points)</td></tr>
<tr><td>Maximum discharge
(per connection point)</td><td>5 l/s</td><td>5 l/s</td><td>5 l/s</td></tr>
<tr><td>Attenuation Storage units</td><td>Oversized Pipes</td><td>Oversized Pipes</td><td>Permeable Paving</td></tr>
<tr><td>Other SuDS components</td><td></td><td></td><td>Swale
Green Roof
Rain Gardens
Rainwater Harvesting</td></tr>
<tr><td>Interception Storage</td><td>None</td><td>None</td><td>Yes</td></tr>
<tr><td>Attenuation storage volumes
- Required
- Provided
Two connection points</td><td>30.5 m^3
33.1m^3 available</td><td>33.4 m^3
41.0m^3 available</td><td>29.2 m^3
66.8m^3 available</td></tr>
<tr><td>Attenuation storage volumes
Provided
(single connection point)</td><td>61 m^3</td><td>67 m^3</td><td>67 m^3</td></tr>
<tr><td>Drawing Reference</td><td>0470/D/010</td><td>0470/D/011</td><td>0470/D/012</td></tr>
</table>

Building Regulations

4.1.9 As shown by Table 8 the Building Regulations compliant design utilises oversized pipes as the primary storage method and requires an orifice plate as a flow restriction device discharging at approximately 5 l/s of each point of connection.

4.1.10 Roof water is collected via rainwater pipes and is discharged through gravity fed, below ground drains to the attenuation storage system. The Building Regulations permits these feeder drains to connect directly to the main storage drains if within 22m of the property and does not require access chambers for each individual run.

SfA 7

4.1.11 The SfA 7 compliant design also uses oversized pipes as a means to provide attenuation storage, but these are slightly larger than the Building Regulations design, as a greater storage volume is required (because a 3rd connection from the site is not needed).

4.1.12 Due to the requirements of the design standards, the SfA 7 design necessitates the provision of 5 additional inspection chambers compared to the B. Regs design.

4.1.13 In order to limit the flow of surface water from the small site, the Sewers for Adoption compliant design includes the use of two vortex control units and discharges at a combined maximum rate of 9.5 l/s.

4.1.14 It should be noted that the SfA design assumes a larger minimum orifice size. To control the maximum discharge rate, vortex control units have been assumed rather than orifice plates which has significant cost implications.

SuDS

4.1.15 The design was developed for the **SuDS Extra** scenario and then elements from this design were removed to generate the **SuDS Normal** design. Information is provided for both the **SuDS Normal** and **SuDS Extra** options.

4.1.16 For the **SuDS Normal** option, it is assumed that all criteria on treatment and hydraulic control is provided by the permeable pavement.

4.1.17 For the **SuDS Extra** option the permeable pavement is assumed to be lined. In this case the interception storage for the roofs is provided by the following SuDS features.

- 8 garages using green roofs. All 8 garages have been assumed to incorporate green roofs within their structure to provide interception storage
- 3 rainwater harvesting systems serving only one side of the houses. Drainage serving Plots 104, 105 & 106 have been designed to include rainwater harvesting systems
- 13 rain-gardens each serving half the roof area of a property. Roof water from dwellings is routed to rain-gardens located at the front and rear of each property.

4.1.18 For the **SuDS Extra** option it is also assumed that there is a swale into which runoff occurs prior to discharge of the runoff from the site. It is assumed that an under-drained swale 15m long is located in the public open space area.

4.1.19 The connections from the green roofs, rainwater harvesting tanks and rain-gardens into the sub-base of the permeable pavement ensures control of all stormwater for the site for extreme events.

4.1.20 Flow limiting orifice plates have been included within the discharge manholes to ensure that the greenfield rate is not exceeded.

4.1.21 The storage volume provided by the permeable pavement far exceeds the hydraulic storage required. The volume provided is dictated by the structural requirements of the pavement and the extent of its use.

4.2 Medium Site

4.2.1 This site layout has been taken been taken from a project at Bicester, in Oxfordshire, with the selection of a section of the development of 32 dwellings. Two options have been included for the medium site for the Building Regulations compliant designs; one with a relatively impermeable underlying geology and one with a marginal infiltrating capability. This means that there are theoretically two options for the three Standards. However as the SfA 7 compliant design is so similar to the Building Regulations network only one design is provided for each of the impermeable and permeable scenarios.

4.2.2 For the infiltration design option, the soil type has been assumed to meet the criteria of a Type 2 SOIL.

4.2.3 To avoid the risk of blockage flow control devices are sized to achieve a minimum flow rate of 5 l/s. This is slightly more than Qbar so this flow rate has been used for all attenuation storage sizing.

4.2.4 Table 9 provides an overview of the criteria used for the three drainage network methods.

Table 9: Medium Site Overview

Design Criteria	**Methodolgy**			
	B. Regs & SfA 7 (Infiltration)	**B. Regs & SfA 7**	**SuDS (Infiltration)**	**SuDS Extra**
Greenfield Run-Off Limit	Qbar 4.51	Qbar 4.51	Qbar 4.51	Qbar 4.51
Flow Control	None	Vortex control unit	None	Orifice plate
Maximum Discharge	N/A Infiltration 1.4 10^{-5} m/s	4.6 l/s	N/A Infiltration 1.4 10^{-5} m/s	4.4 l/s
Attenuation Storage Method	Soakaways Geocellular crates	Geocellular crates	Permeable Paving	Permeable Paving
Interception Storage	None	None	None	Swale Communal rainwater harvesting
Attenuation Storage Volume Required Provided	333 m^3 (333 m^3 available)	350.3 m^3 (360 m^3 available)	366 m^3 (406 m^3 available)	360.2 m^3 (546 m^3 available)
Drawing Reference	0470/D/013	0470/D/014	0470/D/015	0470/D/015

4.2.5 Appendix A provides design information for the medium site infiltration calculations.

Building Regulations & SfA 7 (Infiltration)

4.2.6 As discussed in chapter 2, "*Building Regulations*" infiltration of surface water to ground is to be considered first before discharging surface water to established sewer networks. As water quality treatment is not required, standard soakaways based on geo-cellular crates have been used.

4.2.7 Roof water is collected via rainwater pipes and is discharged through gravity fed, below ground drains.

Building Regulations & SfA 7 (Impermeable)

4.2.8 With ground conditions at the medium site effectively impermeable, a common design that satisfies both the Building Regulations and Sewers for Adoption has been prepared based on geo-cellular storage for attenuation of runoff.

4.2.9 Roof water is collected by rainwater downpipes and is discharged through a below ground drainage network which also accommodates gullies serving hard paved areas. In accordance with SfA 7, part of this network is to adoptable standard in accordance with requirement C3.1, the rest being designed as private and to the standards of the Building Regulations.

SUDS (Impermeable and Infiltration)

4.2.10 The SUDS design is based on a permeable pavement serving the site for both the infiltration option and the impermeable option. Although storage requirements are different, in both cases volumes of storage required are exceeded by the volume provided by the permeable pavement. This means that no infiltration provision is needed within the property curtilage.

4.2.11 Interception storage is assumed to be provided for the roof runoff by the permeable pavement (**SuDS Normal**). However if it is lined (**SuDS Extra**), as most properties have insufficient room to use rain-gardens, a low cost option alternative to the use of rainwater harvesting is the provision of a site swale to provide both additional treatment as well as interception storage for all roof runoff. The swale is designed to retain at least 5mm of roof runoff before discharge off-site can take place.

4.2.12 This swale is assumed to also provide the second level of treatment for the permeable pavement when it is lined.

4.2.13 One section of the site (~10%) has interception provided by a communal rainwater harvesting system. This is because it cannot be served by the swale due to the topography of the site.

4.2.14 Roof water is collected from guttering and transferred to the permeable pavement through rainwater pipes.

4.2.15 10% of the site cannot drain to the swale so the pavement serving this area does not have a second level of treatment in this situation.

4.2.16 The area of land taken by the swale by the peripheral swale is 610m^2. It is 80m long with check dams specifically designed to provide interception storage for roof runoff.

4.3 Large Site

4.3.1 The large site comprises of 210 units in the form of blocks of flats and single dwellings covering a site of approximately 4.4 ha. It has public green spaces and access roads and is based on a development in Upton, Northamptonshire.

4.3.2 For the purposes of this study, the site's geology is assumed to be impermeable and all surface water generated from hard-paved areas is assumed to be discharged through surface water sewers for sizing attenuation systems and sizing pipes.

4.3.3 Flow control devices have been used for the different drainage designs, but in all cases a Qbar discharge rate has been applied to all runoff.

4.3.4 Table 10 provides an overview of the criteria used for the three drainage network methods.

Table 10: Large Site Overview

Design Criteria	Methodology	
	Sewers for Adoption & Building Regulations	**SuDS**
Greenfield Run-Off Limit	Qbar = 16.5 l/s	Qbar = 16.5 l/s
Flow Control	Vortex control units	Vortex control units + Orifice Plates
Maximum Discharge	16.3 l/s	15.9 l/s
Attenuation Storage Method	Oversized Pipes	Permeable Paving Under-drained Swales Basin Culverts
Interception Storage	None	Communal Rainwater Harvesting Permeable Paving Under-drained Swales Basin
Storage Volume Required Provided	1791 m^3 (2,170m^3 available)	1877 m^3 (5,820m^3 available)
Drawing Reference	0470/D/016	0470/D/018

Building Regulations & SfA 7

4.3.5 Similar to the medium site, a common design that satisfies both the Building Regulations and Sewers for Adoption has been prepared for the large site.

4.3.6 Roof water is collected by rainwater downpipes and is discharged through a below ground private drainage system that complies with the Building Regulations. The private system, which also gullies, then connects to adoptable infrastructure beneath access roads within the site. These surface water sewers then discharge in turn into the attenuation storage in the form of pre-cast concrete box culverts or geo-cellular storage which are located within public green spaces.

4.3.7 The systems have been designed such that Vortex control units restrict the flow from the development such that they do not exceed the calculated greenfield rates.

SuDS

4.3.8 The "**SuDS Normal**" scheme is catered for by using permeable pavements and standard swales.

4.3.9 The **SuDS Extra** scheme is catered for by using lined permeable pavements, under-drained swales and communal rainwater harvesting tanks to meet hydraulic and water quality criteria. Although Interception criterion for roofs would possibly be catered for by the swales, it is assumed that this is provided primarily by the rainwater harvesting system.

4.3.10 Roof water is routed to six communal rainwater harvesting tanks situated below access yards within each development block, providing interception storage. These range in size to serve from 9 to 50 properties.

4.3.11 Overflows from the rainwater harvesting system discharge into porous sub-base systems beneath the permeable block pavements.

4.3.12 The under-drained swales are designed to accept water from the paved roads and provide filtration into below ground perforated pipes located in granular media, with outflows restricted by vortex control unit flow controls. The under-drained swales provide additional infiltration capability and treatment compared to the standard swales.

4.3.13 The boundary for the site was defined as the existing highway ‘ Main Street’ and therefore the design had to work either within or to the north of this highway. The SuDS Extra scheme utilises storage in culverts to attenuate the runoff. Thus means that the runoff from a small section of the highway will not have a second level of treatment. However, for the SuDS Normal design we have included a dry basin area to demonstrate an alternative option which would provide the extra treatment.

4.3.14 The SuDS Normal scheme would include an attenuation area that could provide a second level treatment.

4.3.15 In reality it is likely that a scheme would use a combination of above and below storage to minimise the land required whilst provide treatment and therefore as a robust approach we have provided capital cost for the culverts and allowed additional maintenance costs for POS.

4.3.16 The area of land taken by the swales within the site is 2780m^2 and the peripheral swales and Basin area is 1945m^2 – a total of 5075 m^2.

5 Capital Costs

5.1 Introduction on Estimation of Capital Costs

5.1.1 The capital costs for all options are based on SPON'S price books (either Civil Engineering and Highway Works or External Works and Landscape, both 2013 edition) with detailed breakdown of costs for all component elements. Where rates are not published, industry sources have been contacted to obtain relevant information.

5.1.2 The costs include design costs. Design costs are proportionally higher for small sites than larger sites. Although SuDS schemes might have greater costs than those designed to the other two Standards, even a 100% increase in design costs for the SuDS schemes is still very small with respect to the capital costs.

5.1.3 The structure of this cost section is to provide the contrast in the costs between Standards, therefore each site development option is considered in terms of a comparison of the costs.

5.1.4 The costs for each site are based on the same hydrological conditions (located in the south east or centre of England), which allows a direct comparison to be made between sites.

5.1.5 The intangible benefits associated with the SuDS schemes (amenity, environmental protection, etc.) have not been valued.

5.2 Factors that Influence Capital Cost Estimation

5.2.1 There are many factors that will affect the cost difference between a traditional drainage system and a SuDS scheme. Discussion on price variability is considered in the next section.

5.2.2 Cost differences associated with site conditions (contaminated land, soil strength, high groundwater level etc.) are explicitly considered and priced as variations on the basic site assumptions.

5.2.3 Cost variation due to different hydrological conditions and soil type are only addressed on a qualitative basis using judgement. The main factor affecting cost is that of the difference in storage volume required.

5.2.4 There are other specific assumptions that have been made. These are briefly outlined here.

5.2.5 **Excavated material -** The costs assume all material that is excavated will be retained on site and reused in earthworks. Normally developers will try and design a site so that the volume of excavated soil that has to be removed from a site is minimised. The cost impact is significant for removal of excavated material for all drainage systems designed to any Standard, but the additional excavation needed for traditional drainage schemes has a greater impact on these systems. Cost information on this variable is provided in the analysis as it is a significant cost element.

5.2.6 **Road construction** – Permeable pavements have been priced as the difference between the use of standard asphalt roads with gullies and block pavements.

- Costs associated with construction using a DBM approach is provided separately. This is the provision of a temporary capping layer of tarmac which is subsequently punctured or removed. Although it is provided as an extra cost and not included in the basic cost assessments, it is commonly used to facilitate construction while protecting the permeable media. It is included in the analysis on extrapolation to national cost estimates in section 11.
- Where costs are estimated for **SuDS Extra**, this includes the cost of the permeable pavement lining as well as the additional SuDS components needed to ensure compliance with the design criteria.

5.2.7 **Green roofs** - where green roofs have been assumed, no allowance has been made for the difference in building costs associated with flat roofs as it is effectively an additional layer on top of the finished roof. They are only being considered for use on garages as the authors felt that houses with flat or shallow green roofs are unlikely to be considered as being acceptable to both the housing industry and the average householder at this time. They therefore do not play a significant role in the use of SuDS for developments.

- However where pitched tiled roofs are used over garages, the extra-over cost of green roofs would be significantly reduced.

5.2.8 **Swales** - where swales are used, under-drained swales are not assumed to have inlet and outlet structures (headwalls etc.), and include the cost of construction and materials needed for the perforated under-drain. Standard swales have costs of inlet and outlet structures included.

5.3 Uncertainty Associated with Estimation of Capital Costs

5.3.1 Just as assumptions have to be made with regard to the construction details, each of the drainage categories have their own issues with regards to uncertainties in either the unit rate used, or its variability due to location. A brief qualitative description of each category is provided to give some indication as to where uncertainty is small or significant and its relative importance with regards to the total site costs.

5.3.2 **Traditional drainage components** – although these standard components will also vary by location, these are not discussed as they are widely and extensively applied across the country and the cost variability is understood by industry.

5.3.3 **Permeable pavements** – the cost of the aggregate sub-base is the key element affecting cost. This will vary depending on proximity to a suitable quarry that can supply the open graded sub-base. This is also the case for the normal pavement materials but it is more significant for the permeable pavement sub-base because of the more limited number of suppliers. The design of the pavement for traffic loading follows industry standard practice (BS1377-13). However recently some suppliers have undertaken research that has allowed them to reduce the sub-base thickness. This could reduce costs to some extent (assuming that the volume of attenuation storage needed is not the limiting condition).

5.3.4 **Green roofs** – the specification and planting of the green roofs will affect the costs. If standard sedum based green roofs with standard shallow depths of substrate are provided using recycled aggregate, the cost can be very low. This form of green roof has been assumed. Conversely expensive planting with a thicker substrate and additional water storage built in to the structure (designed for reasons of aesthetics or stormwater runoff management), will significantly increase the cost.

Rainwater harvesting

- The small site has used rainwater harvesting tanks in the rear gardens of properties. In this case a low cost geo-cellular tank has been used for the costs which can sit directly below the patio. A conventional tank would approximately double the costs
- For the medium and large sites it has been assumed that the communal tanks are constructed using geo-cellular units to form large conventional deep tanks. The cost of these communal systems could be reduced if the permeable paving was used to store the rainwater, but this has implications for water quality and (potentially) health concerns.

5.4 Extrapolation of Capital Costs to other Locations and Site Conditions

5.4.1 Although these sites are representative of a large proportion of development planning applications, there is also a need to provide some indication of what capital costs might be for a range of other site conditions and locations.

5.4.2 At this stage this analysis has to be based on the judgement of the authors using their years of experience, of analysing different sites in different hydrological areas of the UK, and therefore, is not based upon any technical work undertaken for this project. . There are six particular situations which are important to consider which probably capture all types of developments. These are:

- Sites which are in very different hydrological locations,
- Sites with high groundwater or contaminated soils,
- Sites with greater capacity for infiltration,
- Sites which have been previously developed,
- Steep sites,
- Flat sites.

5.4.3 These six scenarios are discussed following the comparisons made for the designed site locations.

5.5 Small site capital costs

5.5.1 The size of the small site, its hydrological location and relatively impervious soil is probably representative of the majority of all minor planning submissions. The size of the site usually represents an infill development where it would come under the category of a previously developed site.

5.5.2 The small site, although officially an 8 property development for the purpose of this study, the drainage design is effectively for two separate developments as there are two outfalls serving the site due to site topography. Due to the 5l/s minimum flow rate rule, this effectively minimises the storage requirements for all small sites (Table 11).

5.5.3 As a result of the significant differences in storage volume required, information has also been provided for on the storage volumes for a single outfall for all 8 properties (Table 12). This shows that storage required approximately doubles, but the storage provision for the SuDS compliant option does not change as the permeable pavement provides sufficient storage for either option.

Table 11: Cost comparisons between Standards for small site with impervious soil – 2 outfalls

Design Standard	SuDS Normal (£44.6K)	SuDS Extra (£70.8K)
B. Regs (£54.5K)	-£9.9K 18% less	+£16.3K 30% more
SfA 7 (£64.0K)	-£19.4K 30% less	+£6.8K 11% more

Note: B. Regs option has a minor third outfall connection as explained in section 2.

Table 12: Cost comparisons between Standards for small site with impervious soil – 1 outfall

Design Standard	SuDS Basic (£44.0K)	SuDS Extra (£70.2K)
B. Regs (£59.2K)	-£15.2K 26% less	+£11.0K 19% more
SfA 7 (£65.4K)	-£21.4K 33% less	+£4.8K 7% more

5.5.4 Table 11 illustrates that the SuDS system can produce the lowest cost drainage design and still be compliant. Only in the case a lined permeable pavement (the **SuDS Extra** option) is the cost greater than the other Standards.

5.5.5 The B. Regs option is significantly cheaper than the design to the SfA 7 Standard.

5.5.6 The unit rates for SuDS serving roofs are approximately:

- £50 /m^2 for green roofs,
- £50/m^2 for rainwater harvesting for individual properties,
- £5/m^2 for rain-gardens.

5.5.7 These rates show that use of rain-gardens (or equivalent features based on using infiltration trenches) are much the cheapest approach where they can be used.

5.5.8 Unfortunately there is insufficient space to replace the three rainwater harvesting systems and green roofs with rain-gardens. If this was feasible, or some form of infiltration trench was used then the **SuDS Extra** option would be significantly reduced. This illustrates the importance of space and the constraints in can impose on the choice of drainage component.

5.5.9 The **SuDS Extra** option also includes the cost of lining of the permeable pavements. The unit rate is assumed to be £5/m^2. For the small site this amounts to £2.9K.

5.5.10 The **SuDS Extra** option includes a 15m, 1.5m deep under-drained swale. Cost for the swale is estimated at around £200/m run; a total cost of £4.1K.

5.5.11 The **SuDS Extra** option includes for three rainwater harvesting units. Cost for this SuDS element is £6.2K.

5.5.12 Table 12 shows that the increased storage requirements for B. Regs and SfA7 due to a single outfall results in further cost advantage for the **SuDS Normal** system.

5.5.13 The cost implication for other site conditions is addressed later on the basis of subjective assessment rather than explicit modelling and detailed costing. However there are two aspects of SuDS construction options which have had costs explicitly quantified.

- **Temporary wearing course of roads** – construction needs to have access roads built at an early stage in construction of the development. Usually a tarmac wearing course is applied over permeable pavement media to protect it, but this needs puncturing to allow water to pass into the media when the permeable pavement surface is completed towards the end of the construction period. A cost has been estimated as being ~£10/m^2. The cost for the small site would be £6.1K for the whole permeable pavement area.

- **Disposal of excavated material off site** – assuming the material is non-hazardous, the costs are still dominated by the landfill tax. This cost is a variation which is slightly different for each of the drainage Standards, so although a unit cost is provided here, depending on drainage assumptions for each site, the cost differences between schemes vary a little. A unit cost has been estimated as being ~£160/m^3. The cost difference for the small site is a benefit to the SuDS scheme of £8.7K for the two outfall option of the **SuDS Normal** option, but the **SuDS Extra** has a higher cost than the other drainage Standards of £19K for the single outfall due primarily to the additional volume from construction of the swale. The comparable figures for the single outfall are £3.0K cheaper for SuDS and £24.0K more expensive respectively.

5.5.14 These additional costs are used in the discussion on the variation of costs for different site conditions in the conclusions section of this chapter.

5.5.15 The unit cost per dwelling is given in Table 13, and is simply a factoring of the costs shown in Table 11 (based on the two outfalls for the site). Table 14 provides the same information for a single outfall.

Table 13: Small site - Capital cost per property of each drainage scheme (in cost rank order) – two outfalls

Costs	SuDS Normal	B. Regs	SfA 7	SuDS Extra
Total	£44.6K	£54.5K	£64.0K	£70.8K
Per property	£5.6K	£6.8K	£8.0K	£8.9K

Table 14: Small site - Capital cost per property of each drainage scheme (in cost rank order) – one outfall

Costs	SuDS Normal	B. Regs	SfA 7	SuDS Extra
Total	£44.0K	£59.2K	£65.4K	£70.2K
Per property	£5.5K	£7.4K	£8.2K	£8.8K

5.6 Medium Site (Impervious) Capital Costs

5.6.1 The medium site (32 houses) and its hydrological location and assumed relatively impervious state is probably representative of a significant proportion of planning submissions. They are significant developments and probably of greater interest to the medium and larger sized developers. This size of the site is probably predominantly greenfield development.

5.6.2 The medium site has a single outfall. As Qbar is nearly 5l/s, this sized site can benefit from the options on using the higher greenfield runoff rates for the 30 and 100 year events to minimise the storage volume, rather than to keep to the commonly used approach of using Qbar for the discharge rate at all return periods. The storage cost components of the total drainage costs can therefore been seen as being on the conservative side and could be reduced a little. However as a proportion of the total drainage costs, this saving is fairly small for the two existing standards, and may have no effect in the SuDS Standards as available storage is dictated by the permeable pavement structural requirements.

5.6.3 The same categories of SuDS cost options (Normal and Extra) are used for the medium site as that of the small site. However in the case of the medium site designs were provided for both pervious and impervious conditions so there are additional categories to report the costs for.

5.6.4 Table 15 summarises the capital costs for the three design Standards for the impervious option, and Table 16 provides the same information for the pervious soil version of the site.

Table 15: Cost comparisons between Standards for medium site with impervious location

Design Standard	SuDS Normal (£99.9K)	SuDS Extra (£144.8K)
B. Regs (£198.6K)	-£98.7K 50% less	-£53.8K 27% less
SfA 7 (£198.6K)	-£98.7K 50% less	-£53.8K 27% less

5.6.5 Table 15 shows that costs for the SuDS system produces the lowest cost drainage design. The **SuDS Normal** option is half the price of B.Regs or SfA7 and the **SuDS Extra** option is still significantly cheaper than the other Standards.

5.6.6 The communal rainwater harvesting system serving 4 properties of the site in the **SuDS Extra** scheme contributes around £13.2K of the cost.

5.6.7 The cost of the 80m standard swale for the **SuDS Extra** scheme amounts to £21.0K.

5.6.8 The lining cost for the permeable pavement, based on £5/m^2, is £15.4K.

- The cost implications of other site conditions are addressed later on the basis of subjective assessment rather than explicit modelling and detailed costing. However explicit costs have been estimated for use of a temporary wearing course and disposal excavated material off site. **Temporary wearing course of roads** – A cost has been estimated as being ~£10/m^2. For the medium site this amounts to £29.8K.
- **Disposal of excavated material off site** –A unit cost has been estimated as being ~£160/m^3. For the medium site the cost difference is quite significant at £60.5K in favour of the **SuDS Normal** option compared to SfA7, while the **SuDS Extra** cost is virtually the same cost (£-0.6K) than the other Standards.

5.6.9 These costs are used in the discussion on the variation of costs for different site conditions in the conclusions section of this chapter.

5.7 Medium Site (Pervious) Capital Costs

5.7.1 The pervious site costs do not have a SuDS Extra because, by definition, there will be no need to line the system.

5.7.2 The perviousness of the soil at 1.4 x 10^{-5} m/s is quite low for the pervious site, and therefore the costs for the infiltration units used in B. Regs and SfA 7 are relatively high compared to a more pervious location. However the SuDS design is not affected as the permeable pavement area is not dictated by the infiltration requirements

5.7.3 All runoff passes to ground for a pervious site. The only difference in approach is that permeable pavements are used for the SuDS design, while B. Regs and SfA 7 use high voids geo-cellular systems and garden soakaways.

Table 16: Cost comparisons between Standards for the medium site - pervious location

Design Standard	SuDS Normal (£44.4K)
B. Regs & SfA 7 (£221.4K)	-£177K 80% less

5.7.4 The cost difference for a pervious site shows that SuDS drainage system is much less expensive. These costs are based on a relatively low rate of infiltration, but the cost difference between SuDS and the other Standards would probably reduce a little for sites with higher rates of infiltration.

5.7.5 There are 32 properties on this site option. The unit costs per property for both an assumed impervious site and pervious site are given in Table 17.

Table 17: Medium Site - Capital cost per property of each drainage scheme (in cost rank order; Pervious and Impervious)

Costs	SuDS Normal Pervious	B. Regs & SfA 7 – Pervious	SuDS Normal Impervious	SuDS Extra Impervious	B. Regs & SfA 7 Impervious
Total	£44.4K	£221.4K	£99.9K	£144.8K	£198.6K
Per property	£1.4K	£6.9K	£3.1K	£4.5K	£6.2K

5.8 Large Site Capital Costs

5.8.1 The large site (210 houses) and its hydrological location and assumed relatively impervious state is representative of a minority of planning submissions, but they are very important developments which receive a high level of scrutiny. This type of development and even larger sites form the back-bone of the government and local authority implementation of planning to meet national housing requirements. This category is of particular interest to the large developers. This size of the site is predominantly greenfield development.

5.8.2 The large site has a property density of 48 per hectare. This is a typical high density site in terms of layout and range of property types.

5.8.3 The large site has a single outfall. As Qbar is 16.5l/s, this sized site can benefit greatly from intelligent application of the options on using the higher greenfield runoff rates for the 30 and 100 year events to minimise the storage volume, rather than to keep to the commonly used approach of using Qbar for the discharge rate at all return periods. The storage cost components of the total drainage costs can therefore be seen as being on the conservative side and could be reduced a little. As a proportion of the total drainage costs, this saving may be small, but is likely to be worthwhile designing for.

5.8.4 The main differences between the large site with the small site and medium site for the **SuDS Normal** option is that the proportion of permeable pavement used is much less and a significant storage provision using standard swales.

5.8.5 The main differences between the large site with the small site and medium site for the **SuDS Extra** option is the universal use of communal rainwater harvesting and most of the swales being under-drained.

5.8.6 The design of the site is based on it being impervious with an infiltration rate of $1x10^{-7}$m/s.

5.8.7 Table 18 summarises the capital costs for the three design Standards for the site.

Table 18: Cost comparisons between Standards for large site with impervious soil

Design Standard	SuDS Normal (£643K)	SuDS Extra (£1145K)
B. Regs / SfA 7 (£1,441K)	-£798K 55% less	-£296K 21% less

5.8.8 Table 18 show that the SuDS system costs are significantly lower than the other design Standards, even when rainwater harvesting is used. This reflects the efficient layout of the site and the cost benefits of swale storage.

5.8.9 The **SuDS Extra** option assumes the use of lining of the permeable pavements at a unit rate of £5/m^2. The cost of this is £37.8K.

5.8.10 The cost implication of other site conditions is addressed later on the basis of subjective assessment rather than explicit modelling and detailed costing. However there are two aspects of SuDS construction options which have been quantified.

- **Temporary wearing course of roads** – the unit cost is estimated as being ~£10/m^2. For the large site this amounts to £74.7K.
- **Disposal of excavated material off site** –The difference in the cost between B. Regs and the **SuDS Normal** option is £800K in favour of SuDS and a reduced advantage of £218K for the **SuDS Extra** scheme. These very large figures show how important it is to ensure that all material stays on site.

5.8.11 There are 210 properties on the large site option. The unit costs per property for both an assumed impervious site and pervious site, are given in Table 19.

Table 19: Large site - Capital cost per property of each drainage scheme (in cost rank order) - Impermeable

Costs	SuDS Normal	SuDS Extra	B. Regs & SfA 7
Total	£643K	£1145K	£1441K
Per property	£3.1K	£5.5K	£6.9K

5.9 Conclusions on Capital Costs Comparisons

5.9.1 On the basis of the design assumptions made for each pilot development and the drainage components used, the cost exercise for three sizes of development sites has shown the following trends:

- Economies of scale apply to all drainage Standards.
- Care should be taken in generalising the small site results due to high cost variability due to the shape of small sites and layout of the development.
- There are increasing cost advantages in using SuDS in preference to the other Standards as sites get larger.
- In-fill / small development sites which are greenfield are likely to cost the most using SfA 7 Standards compared to B. Regs. However as sites get bigger the differences between B. Regs and SfA 7 become minimal. The cost difference is a function of the different outfall structures and as sites increase in size, the proportion of costs associated with this element becomes very small.
- Permeable pavement based SuDS options can meet the requirements of the SuDS Standards on their own where site ground conditions are suitable (**SuDS Normal**). This results in a cost effective solution which is also very space efficient.

- In situations where **SuDS Extra** applies (lined permeable pavements due to various possible ground conditions) costs increase significantly and SuDS can be more expensive than designs based on SfA7 or B. Regs for smaller sites. However larger sites still tend to be slightly cheaper.
- In situations where **SuDS Extra** applies, additional SuDS components are to address roof runoff (to meet the Interception criterion) and also to provide a second level of treatment for road runoff.
- Where roof interception features are needed, rain-gardens or some form of equivalent using infiltration trenches are the least cost solution where space is available. Other more expensive features such as rainwater harvesting and green roofs may be necessary for certain ground conditions or due to lack of space.
- Rainwater harvesting or green roofs have additional environmental benefits which have not been valued in this study.
- Where secondary treatment is needed for runoff from roads, the provision of swales is a low cost option, but this has implications for land take. However costs escalate if swale excavation leads to disposal of material off site.
- Where temporary DBM wearing course is used, (which is probably at many sites where concrete blockwork permeable pavements are used), there is an additional cost for the use of SuDS of around 15% to the permeable pavement construction costs.
- Catchments which have the potential to use infiltration for rainfall runoff disposal favours the use of SuDS by a large margin. Where infiltration rates are high, the advantage is likely to become slightly less. Insufficient analysis has been made on pervious catchments across a range of sites to be certain of the exact cost advantage of one drainage standard over another, but it would appear that the use of SuDS will always be significantly cheaper.
- Where disposal of excavated material is required, SuDS systems generally provide major cost advantages due to the reduced volume of disposal compared to the other Standards where the predominant form of storage is with the use of permeable pavement.

Table 20: Capital cost comparison of differences for the small site – 1 and 2 outfalls

Cost difference category	Small SuDS Normal (2 outfalls)	Small SuDS Extra (2 outfalls)	Small SuDS Normal (1 outfall)	Small SuDS Extra (1 outfall)
B. Regs / SuDS	-£9.9K	+£16.3K	-£15.2K	-£11.0K
SfA 7 / SuDS	-£19.4K	+£6.8K	-£21.4K	-£4.8K
B. Regs / SuDS DBM	-£3.7K	+£22.5K	-£9K	-£4.8K
B. Regs / SuDS DBM Excavated disposal	-£15.1K	+£38.8K	-£20.4K	+£11.5K

Table 21: Capital cost comparison of differences for the Medium and Large sites Pervious and Impervious

Cost difference category	Medium SuDS Normal	Medium SuDS Extra	Medium SuDS Normal (Pervious)	Large SuDS Normal	Large SuDS Extra
B. Regs & SfA 7 / SuDS	-£98.7K	-£33.8K	-£177K	-£798K	-£296K
B. Regs & SfA 7 / SuDS DBM	-£69.0K	-£24.1K	-	-£723K	-£221K
B. Regs & SfA 7 / SuDS DBM + Excavated disposal	-£192K	-£12.5K	-	-£1531K	-£483K

Notes:

SfA 7 design is assumed to be the same as B. Regs design for the Medium and Large sites

It is assumed for SfA7 Standard that the traditional design uses geocellular crates below roads to provide infiltration for road runoff. Some authorities would not allow this, due to lack of maintenance capability.

*When the permeable pavement is lined (**SuDS Extra**), 10% of the medium site is non-compliant in not providing a second level of treatment to the road as it cannot be served by the swale.*

6 Extrapolation of Capital Costs to Other Locations

6.1.1 Although the analysis for these sites are representative of a large proportion of development planning applications, there is also a need to provide some indication of what capital costs of drainage schemes might be at other site locations and or with different characteristics.

6.1.2 This assessment has to be based on expert judgement and experience as analysis of all possible scenarios would require a great deal of effort. The reasons for the increase or decrease in costs is given along with the cost implications. Although these assessments are estimates, it is hoped that they are of value to provide a national picture. There are seven particular situations which are important to consider which probably capture all types of developments. These are:

- Sites which are in different hydrological locations
- Sites with high groundwater or contaminated soils
- Sites with greater capacity for infiltration
- Sites which have been previously developed
- Sites dominated by building(s)
- Steep sites
- Flat sites

6.2 Sites in different hydrological locations

6.2.1 Figure 1 is a coarse map of the FSR parameters which define rainfall depth across the UK. This shows how the rainfall depth for the whole of the south, east and midlands area of England is very uniform in terms of their rainfall characteristics. The rainfall depth for a 100 year 12 hour event is around 70mm, but moving west and north the rainfall depth for this event increases by up to 20% (ignoring mountainous regions). The 24 hour duration depth differences between the south-east and north-west would accentuate even further to around 30%. It is worth noting that the critical duration of events for medium and large sites are of the order of 24 hours, while small sites will have shorter durations (less than 12 hours) resulting in smaller rainfall depth differences between site locations.

6.2.2 This trend of rainfall depth across the country is largely mirrored by the increase in SAAR (annual rainfall depth) which in the IH 124 equation (the method used in this study for calculating Qbar), is raised to the power of 1.17. What this means is that the implications for storage volume differences across the country is relatively small. (This is because the allowance for the discharge rate increases with annual rainfall depth and so compensates for the increase in event rainfall depth in these wetter areas). In practice it has been found that there is some increase storage further to the north and west. However on the north-eastern side of the country and the south-west, SAAR remains relatively low. This results in attenuation storage volumes increasing significantly in these areas.

6.2.3 As soil types become less clayey in characteristics, but where infiltration is still not feasible (SOIL type 3), the calculation for storage volumes increase significantly due to Qbar becoming smaller. The differences between the south-east and the rest of the country would be accentuated.

6.2.4 For small sites below 3 ha, depending on soil type, the 5l/s limit on the minimum discharge starts to have an impact and this reduces the storage required. In these situations where Qbar is over-ruled by the minimum flow rate, the effect of SAAR is removed and thus theoretically makes it more disadvantageous for those in the north and west. However this is largely off-set by the fact that as the critical duration may be reduced to as little as 6 hours. The difference in storage requirement is therefore likely to be minimal.

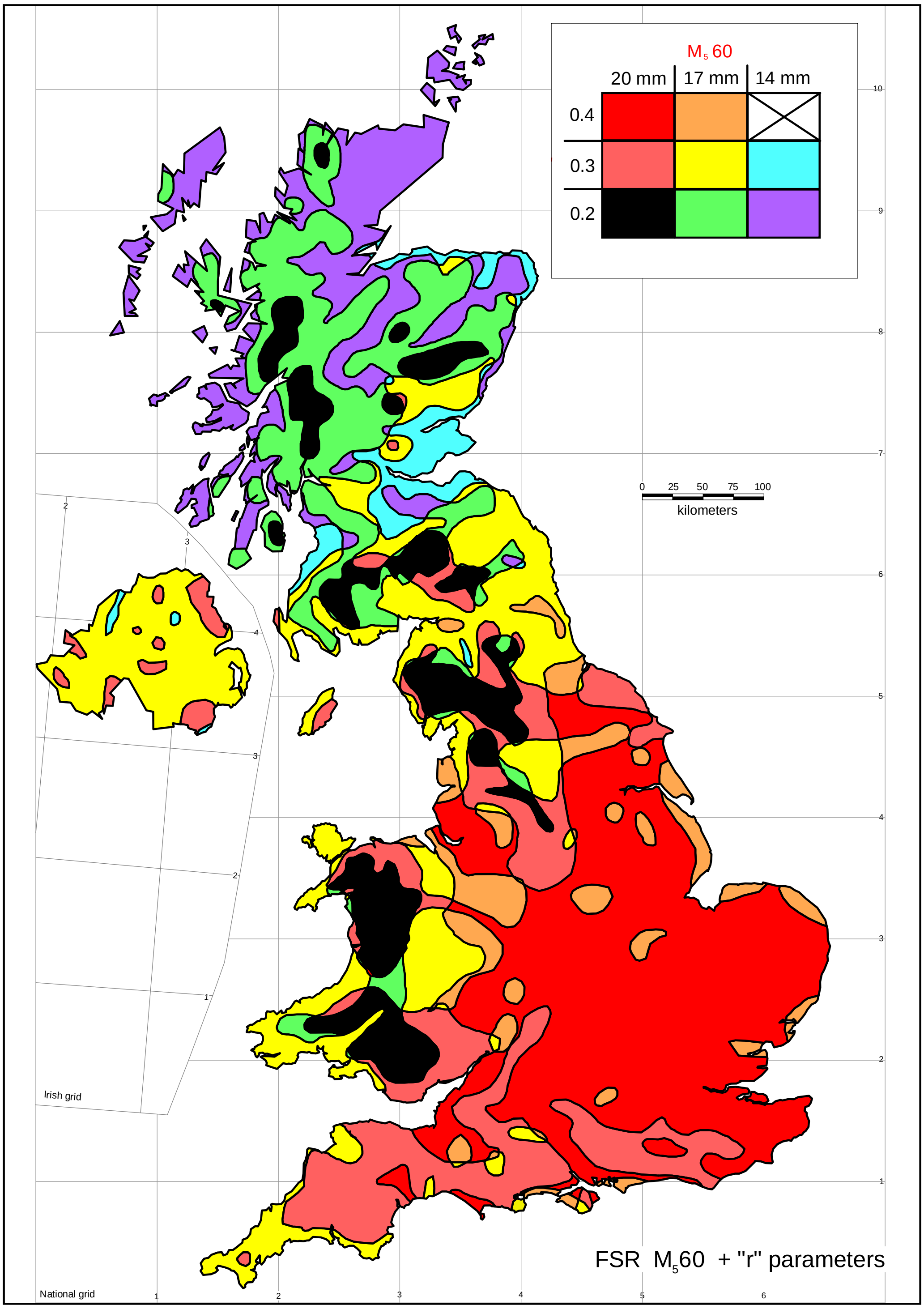
6.2.5 In summary the conclusions on costs for sites in other locations across the country are:

- Storage volume implications for site locations in different hydrological locations would appear to be quite small between the south-east compared to the north and west. The exception is probably confined to the north-east and also the south-west of England where the relatively low annual rainfall would not result in Qbar being increased to compensate for the greater rainfall depths for long critical duration events in these locations.
- For small sites less than 3ha, and particularly those less than 1 ha, the difference in storage volumes with hydrological condition is likely to be very small because critical durations of design events reduce and rainfall depth differences are small.
- Any differences in storage requirements are accentuated for soil type 3 where the soil is theoretically more pervious, but is still effectively impermeable for the purposes of drainage design and infiltration cannot be used.
- Where infiltration can be used to dispose of all runoff, the effect of other hydrological locations on storage effects will be similar to those of non-infiltrating sites. However these effects will diminish as infiltration rates increase.
- It is worth noting that highly pervious areas are largely confined to the east and south-east of England. Other areas with soil types which might be viable for stormwater disposal by infiltration tend to have lower rates of infiltration. These are largely confined to parts of Wales, the east of Scotland and the south-west of England.

6.2.6 The consequences for the differences in the costs for complying with Standards are:

- All other hydrological locations (compared to the pilot sites) will tend to favour SuDS schemes in comparison to the results of the analysis of the sites in this study. This is because, in general, the permeable pavements have spare storage capacity due to their structural minimum depth requirements, while the other Standards would result in increased costs due to requirements for larger storage volumes.
- Where permeable pavements are not used, storage volumes for all drainage standards will increase to the same degree. If this involves the use of swales and basins for SuDS schemes, their costs would be significantly cheaper than the use of underground cellular storage for standard drainage systems, but land take is likely be a significant issue. However unless adoption of permeable pavements is a problem, most schemes will tend to use this SuDS element due to its dual facility.
- For small sites where the 5l/s rule applies, critical durations of rainfall events get shorter. This results in the storage volumes for other hydrological conditions reducing to similar values as those in the south-east (as calculated in this study).
- Sites with pervious soils, especially those in marginal pervious areas (as assumed for these pilot schemes), favour SuDS schemes which use permeable pavements as the longer critical durations require larger volumes of storage for soakaways.

Figure 1: Hydrological regions of UK



6.3 Sites with High Groundwater or Contaminated Soils

6.3.1 Sites with high groundwater levels or contaminated soils make SuDS schemes more expensive and reduce their advantage over traditional drainage schemes as no advantage can be taken of utilising low level infiltration into the soil. This is because two levels of treatment may not be attributed to permeable pavements, and they cannot be used to serve the interception component of roof runoff. SuDS schemes therefore need to use SuDS specifically for the roof runoff for interception and provide a second level of treatment for the road runoff.

6.3.2 There are space implications in providing a second level of road treatment. This is addressed in Section 7.

6.4 Sites with Greater Capacity for Infiltration

6.4.1 Sites with the capability to dispose of all runoff using infiltration is highly suited to using SuDS, which has a very significant cost advantage over the use of the other two Standards.

6.4.2 Sites with high infiltration capability tend to be limited to the south-east due to the chalk catchments and the sandy areas of the Anglian region. Other areas include floodplains due to gravels laid down in the past, but high groundwater levels then come in to play; resulting in infiltration often not being possible due to inadequate depths to groundwater. Chalk is a special case; the porosity of chalk is a function of its fissured state and near the surface it tends to be weathered and acts more as a clay. In addition the construction process tends to damage the chalk unless great care is taken. Therefore chalk must treated with caution as a medium for infiltration. It can therefore be seen that highly pervious soils are fairly limited across the UK.

6.4.3 The infiltration rate used in this design is at the limits at which infiltration would be used as the main form of disposal. As infiltration rates increase, soakaway areas and permeable pavement areas can both be reduce. The cost advantage between drainage standards for sites with high rates of permeability may slightly reduce the benefits of using SuDS, But they are unlikely to ever be cheaper. Some authorities are not happy to use geocellular crates for infiltrating road runoff, (which is the cheapest approach to infiltration design for traditional drainage schemes), so more investigation is really needed to explore this issue.

6.4.4 Areas where permeability is low will strongly favour SuDS schemes as soakaway systems for drainage schemes based on SfA7 will need to be large.

6.5 Sites which have been Previously Developed

6.5.1 Sites which have previously been developed have different criteria on runoff to that used for greenfield site development. Developers are expected to try and improve on (reduce) the rate of discharge which currently takes place, and greenfield rates are usually not used. The proposed SuDS Standards takes a slightly firmer line by applying greenfield criteria as a preference, but allowing flexibility to use less onerous criteria based on the runoff rates of the previous development. This means that very little can be deduced with regards to these sites as each planning application is addressed individually depending on its circumstance.

6.5.2 Although previously developed sites may not be contaminated, due to the increased likelihood of contamination at these locations and the possible presence of existing services, the application of SuDS tends to become more difficult. In particular if it limits the use of permeable pavements, land take may become a major issue even if relatively cheap solutions can be produced based on swales and attenuation storage basins. However previously developed sites and infill development are virtually synonymous and these locations tend to make extensive use of permeable pavements.

6.6 Sites Dominated by a Single Building

6.6.1 Most sites, whether greenfield or not, tend to have building footprints which are significantly less than 50% of the site area. However where a building covers the majority of the site (city centres), the opportunity for permeable pavements to serve all the site runoff is limited. Although roof runoff does not require treatment, storage for interception and attenuation becomes more of an issue, forcing the use of green roofs or other systems. In this situation, the cost for complying with the SuDS Standards would probably increase relative to existing Standards. However the occurrence of these situations is rare and limited to the commercial and industrial sector.

6.6.2 However in contrast to the resistance to using green roofs or rainwater harvesting for residential properties, their use for commercial buildings is becoming more common place; either for reasons of cost effectiveness or due to planning requirements.

6.7 Steep Sites

6.7.1 There are several aspects about steep sites which require particular care and some of these affect the drainage design and their construction cost. These are:

- The rate of runoff
- Managing extreme events
- The layout of the site
- Infiltration risks
- Construction details

6.7.2 **The rate of runoff** analysis methodology currently used for setting discharge consents does not have a gradient function. This means that rates of runoff are under-estimated for steep sites, which in turn increases stipulated storage requirements. However as this is a conservative / precautionary position in setting a flow rate, it probably under-estimates the storage requirements. This issue is common to all drainage standards, but as the SuDS Standard tends to provide more volumetric storage and achieves greater runoff volume infiltration, the implications for attenuation storage failure is probably least for the SuDS based solution.

6.7.3 All drainage standards require **the management of the 100 year event** to be kept within the site and to also consider runoff that could enter the site from uphill areas. There are no formally agreed methods of estimating the hydraulic effects of extreme high intensity thunderstorm events which might generate this situation. What it does imply is that the storage should be provided at site low points to intercept over-land runoff. In this regard, the use of vegetative SuDS techniques (swales, basins, ponds etc.) will tend to be more effective in addressing this issue.

6.7.4 The layout of the site becomes fundamentally more important for SuDS based drainage than for traditional systems. Storage, whether provided by SuDS or geocellular methods, requires the units to be built horizontally. However as the latter are high voids units, finding space for locating these units is easier as their footprint is smaller. For SuDS systems there are a number of issues related to steep slopes. These are:

- Swales – velocity and gradient control is an essential component of using these features;
- Permeable pavements – these will require increased amounts of excavation and control features internally within the pavements to control flows.

For these reasons, SuDS costs would increase relative to drainage systems built to the other Standards.

6.7.5 Although it would appear that there are less constraints on site layout when using traditional drainage systems, the consequences of having steep roads rather making them follow contours, results in increased risk of flooding during high intensity rainfall events as flows will tend to bypass gullies and flood properties in the lower part of the site.

6.8 Flat Sites

6.8.1 Flat sites favour the use of SuDS drainage schemes. As SuDS are near the surface, and hydraulic gradients can utilise free-surface routing, the difference in excavation requirements (and therefore cost) by avoiding deep pipework and storage tanks can be very great.

6.8.2 For the same reason (managing water near the surface) schemes involving the use of SuDS may have the opportunity of using infiltration while traditional schemes may not.

7 Maintenance Costs

7.1.1 Information on the maintenance costs assumed for this study has been included in Appendix B Consideration has been given to both infrequent (refurbishment) and regular maintenance, but rehabilitation (rectification of problems) has not been considered. This is because the situations associated with the need for replacement or major rehabilitation will be quite site specific and will often be associated with poor or minimal maintenance regimes. Although industry has estimated cost values and frequencies for infrequent maintenance and refurbishment, the associated uncertainties are very high.

7.1.2 Costs have also been estimated for de-silting standard drainage systems. The frequency of this activity has been taken as needing to be every 5 years for underground storage tanks which tend to collect silt quite rapidly unless specific precautions are built in. This contrasts with only every 25 years to address surface blockage of permeable pavements. These cost assumptions are critical in assessing the relative cost advantage between drainage approaches.

7.1.3 Maintenance is considered separately for roof related SuDS (green roofs), rainwater harvesting or rain-gardens. These costs are a function of the house-holders responsibility. This analysis has not been made for rain-gardens and green roofs.

Table 22: Annualised comparison of maintenance costs between SuDS and B. Regs – Public Realm

	Maintenance Costs SuDS – B.Regs	Cost Difference	Maintenance / Capital Cost %
Small site Normal	£248 - £188	+£60	~0.6%, ~0.3%
Small site Extra	£358 - £188	+£170	~0.5%, ~0.3%
Medium site –Normal	£776 - £1598	-£822	~0.8%, ~0.8%
Medium site Extra	£1128 - £1598	-£470	~0.8%, ~0.8%
Large site –Normal	£4969 - £3282	+£1687	~0.8%, ~0.2%
Large site –Extra	£5173 – £3282	+£1891	~0.5%, ~0.2%

+ve means SuDS is more expensive on cost difference

Table 23:– Annualised SuDS maintenance costs – private ownership

Category	Small Site Annualised Cost	Medium Site Annualised Cost	Large Site Annualised Cost
Rainwater harvesting	£293	£98	£587
Green roofs	-	N/A	N/A
Rain-gardens	-	N/A	N/A

7.2 Maintenance Cost Assumptions

7.2.1 The costs assumptions used are detailed in appendix B. Unit rates have been taken from SPONS (2013), CESMM3 (2009), and information for actual local authority costs.

7.3 Un-certainties on Maintenance Cost Assumptions

7.3.1 De-silting costs dominate these maintenance calculations. Although underground storage systems served by traditional drainage are likely to silt up relatively quickly, actual practice in terms of frequency of cleaning is reactive to address a problem rather than to follow a planned maintenance routine. This is encouraged by the fact that the state of the underground systems is not seen until a problem is evident. A 5 year frequency has been used.

7.3.2 Evidence of blockage of permeable pavements is minimal. The assumption of 25 years is considered to be appropriate. Few pavements are this age, but there is little evidence to suggest more frequent refurbishment is needed.

7.3.3 Vegetative systems have much less uncertainty associated with their maintenance, although frequency of attention can vary greatly based on aesthetic requirements.

7.3.4 There is a need to deal with grass growth and accretion of sediment, or reed growth in ponds. In terms of equipment and effort required, pond vegetation, particular reeds in shallow waters or in poorly drained basins, require a high degree of maintenance.

7.3.5 Where maintenance schedules are not kept to, trees can rapidly germinate and develop in basins and the banks of ponds leading to higher costs later in rectifying unmanaged growth.

7.3.6 Roof related SuDS units maintenance is an area of significant uncertainty, both in terms of the frequency and time needed and the risk of non-maintenance of home owners. This applies to rainwater harvesting tanks, green roofs rain-gardens and infiltration units. Certain components, such as the pumps in rainwater harvesting systems, have a design life and they normally need replacing every 10 to 15 years. However, in practice, many of these systems probably receive no attention for the life time of the building.

7.3.7 Communal rainwater harvesting units have reduced risk in terms of planned maintenance and competence, but require specific management provision to address ownership and long term maintenance requirements.

7.4 Commuted Sums

7.4.1 Historically some adopting authorities have applied commuted sums for the adoption of drainage elements. The cost of commuted sums has developed historically been developed to reflect a combination of actual/projected maintenance costs and the approach of the adoption authority to risk and that type of drainage element, and therefore often costs are higher than expected.

7.4.2 The commuted sums costs have not been included within this assessment as how the costs are estimated will depend on the long term funding mechanism which is still being defined. As an example we understand that these figures may range from £3,000 - £12,000 per soakaway.

7.5 Conclusion on Maintenance Costs

7.5.1 Maintenance costs are probably best considered in two parts: the SuDS in the public realm to be adopted by the local authority, and those which will be privately owned.

7.5.2 Maintenance costs differences between drainage Standards can vary significantly depending on the SuDS units used. Where permeable pavements form the main SuDS component and there is some degree of infiltration possible, cost differences will tend to favour SuDS systems, but differences are very small. However this is very dependent on the maintenance frequency assumptions made.

7.5.3 The SuDS systems which theoretically require relatively high levels on operation and maintenance are rainwater harvesting and possibly ponds with extensive shallow margins.

7.5.4 In the case of rainwater harvesting, pump maintenance and replacement, along with aspects associated with health protection measures, probably means relatively high levels of operational involvement.

7.5.5 In the case of ponds, annual maintenance commitments dealing with high volumes of vegetation removal can demand significant equipment and time inputs.

7.5.6 The uncertainty associated with frequency of refurbishment maintenance (de-silting) is critical in determining the advantage of one type of drainage system over the other.

7.5.7 In the case of certain SuDS which are within the property curtilage, ownership will be with the householder. This reduces costs to the adopting authority, but may increase the risk of inadequate maintenance, and the resultant consequences ‘downstream’ in terms of the drainage system performance.

7.5.8 The cost of communal SuDS will still probably reside with the householder, though a formal covenant arrangement will be needed to address the management of such systems. It is unlikely that the local authority would adopt these systems.

7.5.9 Although there is some uncertainty on maintenance costs because of frequency of refurbishment activities, the annualised maintenance cost of around 0.5% means that Whole Life Costing analysis will be dominated by the capital cost and therefore design will seek to develop schemes which will minimise capital costs.

7.5.10 Maintenance issues associated with drainage design using SuDS is more likely to be an issue of the preferences of the SAB in terms of types of units they wish to adopt, and an assessment of the risks to maximise the long term effectiveness of the scheme.

8 Whole Life Costs

8.1.1 It is considered good practice to carry out whole life cost (WLC) analysis for systems to ensure that the minimum cost solution has been selected. This avoids choosing low cost schemes at the expense of long term high levels of operating costs and vice versa.

8.1.2 However in the case of drainage systems for housing developments, those building the drainage systems will not be owning them, so each stakeholder has a specific interest in only their elements of cost.

8.1.3 The discount rate for assessing maintenance investment is advised upon by government. Various arguments can be put forward as to what should be used. The discount rate commonly used for drainage studies is 3.5%.

8.1.4 Discount rates are normally applied for the design life of a scheme. In the case of developments, 80 years is often used.

8.1.5 In the case of drainage systems, decommissioning is rarely considered as the re-development of any land is considered in the context of the investment needed for the site which usually has not had any decommissioning activity.

8.1.6 The maintenance costs, as calculated in section 6, has annualised all elements of the maintenance and operation. In a WLC exercise the refurbishment activities would be added in at the time in which they need to take place; 5 and 25 years in the case of the de-silting and pavement refurbishment respectively. This would dramatically reduce the SuDS maintenance costs relative to the current standards drainage maintenance costs if a discounted approach is applied.

8.1.7 However it is felt that due to:

- The high levels of uncertainty of key elements of the costs,
- The small differences in the maintenance costs between standards,
- The relatively small costs of maintenance relative to the capital costs,
- The different stakeholder interests,

there is limited value in carrying out a WLC exercise as outturn values will be dominated by the capital costs.

9 Value of Land for SuDS

9.1.1 Land value varies widely across the UK. A figure of £600K per ha (rounded down from a figure of £631k/ha source - DCLG land statistics with last edition of DCLG data July 2010) has been chosen as being representative for use in this study.

9.1.2 A major aspect of concern usually levelled at SuDS is the land take needed. A simple assessment of costing the vegetative SuDS areas provides an indication of the opportunity cost of land that might be lost to constructing extra properties.

9.1.3 There is a need to provide a minimum area of public open space. This is a grey area in that some authorities are happy for SuDS to be considered as public open space as they have significant aesthetic value, while others do not.

9.1.4 In calculating the opportunity cost for additional dwellings it is important to note that a property requires a finite minimum space and they also need to be supported by access roads. Therefore the analysis could assume the opportunity cost could be associated with the space needed per additional property; each of which need around 100m^2 of space (including the supporting infrastructure of roads etc.). However the counter argument can be made that any additional area allows an increase in value to be gained. It is therefore decided that the potential development value associated with any green space should be calculated on the basis of £60/m^2.

9.1.5 **The small site** in its original conception specifically excluded the public space grassed area to reflect infill development. It is commonplace for infill development not to comply with requirements for public open space and to make a contribution to the local authority in compensation. **The small site** has taken opportunity of this grassed area for the purpose of costing the use of a swale to address the need for a second level of treatment if the permeable pavement was lined. A plan area of 105m^2 has been assumed. This results in an opportunity cost of £6.3K.

9.1.6 **The medium site** has a peripheral swale provided if the permeable pavement is lined. This has an area of 610m^2 and therefore an opportunity cost of £36.6K. This value does not take into account public open space requirements.

9.1.7 **The large site** has 2780m^2 of swales within the site and 1945m^2 of peripheral swales and basin. This amounts to an area of 5075m^2. This amounts to £304.5K of land take opportunity cost.

9.1.8 The actual amount of additional land which would be required for SuDS is likely to be less than the above as many schemes are required to provide green and landscape areas as part of a landscape and public open space strategy. It is envisaged that well designs SuDS strategies will form an essential part of future landscape and public open space strategies and therefore the loss of additional land will be reduced from the numbers in this report**.**

9.1.9 Table 24 summarises the costs associated with land take.

Table 24: Land take costs of SuDS – (ignoring public open space requirements)

Site	SuDS Normal	SuDS Extra
Small site	None	£6K
Medium site	None	£37K
Large site	£305K	£305K

10 Operational Risk

10.1.1 An area which is not a direct function of cost, but has to be considered in any assessment of the merits of drainage standards is the relative performance of the systems. This assessment is outside of the obvious aspects of intangible additional benefits associated with SuDS (although pollution protection provided should not really be considered as an intangible benefit in terms of cost).

10.1.2 Operational risk is associated with a range of issues:

- Hydraulic performance under extreme events (greater than that designed),
- Failure (partial) of the system due to maintenance,
- Failure (partial) of the system due to structural deterioration.

10.1.3 There are major differences in the hydraulic performance of a piped system to a surface based system. Pipe based units have a specific capacity and, when full, the excess water causes flooding. As pipe based systems are critical for very short storms, flooding risk is linked to short storms when the other storage components of the systems are still virtually empty.

10.1.4 In contrast, SuDS systems in general have much higher volumetric capacities. This results in flooding being much less likely for short extreme storms.

10.1.5 As pipe systems with traditional underground storage is not visible, there is no evidence of any problems until failure occurs. This tends to result in reduced levels of maintenance and lack of awareness that the system needs attention. The result is that the system fails when it should not have done when a large event takes place. By contrast SuDS systems are intrinsically less liable to maintenance related performance degradation, and when attention is needed, it tends to be obvious because it is visible.

10.1.6 However SuDS under private ownership have risks associated with maintenance in that the owners may not understand what is required or not accept their responsibility to maintain them. Rain-gardens may be removed, rain-water harvesting tanks disconnected, permeable pavements sealed etc.. Selection of appropriate SuDS for each development is an important aspect of the design process.

10.1.7 Structural deterioration of pipes failing or being infested with tree roots is a significant feature of minor drainage systems which are mature. Surface based SuDS systems are fundamentally less at risk of failure in this regard.

10.1.8 Costing of these issues is theoretically possible, but it is probably more appropriate to understand the various risks and make appropriate design decisions to minimise the potential for failure or performance reduction for a drainage system designed to any of the Standards.

11 Summary of Costs – Capital, Maintenance & Land-Take

11.1.1 Table 25 provides a broad indication of the cost implications comparing SuDS schemes against B. Regs and SfA 7 for various site conditions and locations. This analysis is based on the judgement of the authors using their years of experience, rather than any technical work undertaken for this project. This information is based on the actual calculated costs where they have been made, along with estimates for aspects which have not been analysed (such as the effect of steep or flat sites). This is provided in the form of percentages based on the capital cost of the B. Regs costs.

11.1.2 The range of values associated with "best guesses" for different site characteristics do not include an uncertainty allowance. It is suggested that these guesses will range in accuracy by up to 20% or more.

11.1.3 It is essential when looking at these costs to not only understand that there is estimation being made associated with certain issues which have not been explicitly calculated, but to recognise that other design arrangements, particularly with the use of SuDS, can be designed to meet the Standard.

11.1.4 As noted elsewhere, it is important to recognise there are other benefits associated with the use of SuDS over traditional drainage schemes. In particular pollution prevention, if not provided at site level, will have cost repercussions downstream.

*Table 25: Cost Comparison between the use of **SuDS Normal** and B. Regs Drainage Schemes*

Site type	Small sites < 0.2ha	Medium sites ~ 1+ha	Large sites >5 ha
Greenfield – minimal infiltration	-15% to -25%	-50%	-55+%
Greenfield – Pervious (low)	~ -40%	-80%	~ -80%
Greenfield – Pervious (high)	~ -30%	-70%	~ -70%
Greenfield – minimal infiltration (+*DBM*)	-5% to -15%	-35%	-50%
Greenfield – Pervious Low (+*DBM*)	~ -25%	-65%	~ -65%
Greenfield – Pervious High (+*DBM*)	~ -15%	-55%	~ -55%
Greenfield – minimal infiltration; North-west sites (+*DBM*)	-5% to -15%	-35%	-50%
Greenfield – minimal infiltration; North-east and South-west sites (*DBM*)	-5% to -15%	-35%	-55%
Greenfield – minimal infiltration (*DBM & land take with no allowance for public open space*)	-5% to -15%	-35%	-30%
Previously developed sites *(DBM)* *(Depends on discharge consent)*	-5% to -10%	-30%	-40%
Greenfield – minimal infiltration; Steep sites *(DBM)*	-0% to -10%	-30%	-45%
Greenfield – minimal infiltration; Flat sites *(DBM)*	-10% to -20%	-40%	-55%
Greenfield – minimal infiltration (*DBM & disposal of excavated material*)	-15% to -20%	-50%	-65%
Greenfield – minimal infiltration; Sites dominated by buildings – small sites only	-0% to -10%	N/A	N/A

*Table 26: Cost Comparison between the use of **SuDS Extra** and B. Regs Drainage Schemes*

Site type	Small sites < 0.2ha	Medium sites ~ 1+ha	Large sites >5 ha
Greenfield – No infiltration (*Lined*)	+30% to +20%	-20%	-20%
Greenfield – No infiltration (*DBM & lined*)	+40% to +30%	-10%	-15%
Greenfield – No infiltration; North-west sites (*DBM & lined*)	+40% to +25%	-15%	-15%
Greenfield – No infiltration; North-east and South-west sites (*DBM & lined*)	+40% to +25%	-15%	-20%
Greenfield – No infiltration; (*DBM & lined + land take with no allowance for public open space*)	+50% to +40%	+5%	+5%
Previously developed sites *(DBM & lined) (Depends on discharge consent)*	+40% to +35%	-5%	-10%
Greenfield – No infiltration; Steep sites *(DBM & lined)*	+45% to +35%	-5%	-10%
Greenfield – No infiltration; Flat sites *(DBM & lined)*	+30% to +25%	-15%	-20%
Greenfield – No infiltration (*DBM & lined + disposal of excavated material*)	+60% to +65%	-10%	-20%
Greenfield – No infiltration; Sites dominated by buildings – small sites only	+45% to +35%	N/A	N/A

11.1.5 The following are the principal conclusions from this estimated cost information:

- The advantage of SuDS over other drainage standards is site size dependent. Large sites are usually significantly cheaper built with SuDS than other drainage standards.
- For virtually all scenarios the use of SuDS ranges from being significantly cheaper to the same cost as traditional drainage for medium and large scale sites.
- SuDS are highly advantageous over other design Standards where sites can use infiltration for the disposal of all runoff.
- SuDS are cheaper than traditional drainage systems for all developments where lining of permeable pavements is not required.
- Where small sites require lining of permeable pavements, they are significantly more expensive to construct than traditional drainage schemes. This is not so much to do with the lining itself, but the additional SuDS features that are needed.
- Where ground conditions require protection and permeable pavements have to be lined, SuDS drainage systems require greater attention to design detail and results in more complex arrangements.
- The cost implications of land value where SuDS are not considered to be public open space is very significant and results in a major constraint on SuDS design options.
- Permeable pavements are a fundamental tool for efficient use of land and for generally meeting the SuDS design standard.
- Roof runoff management (interception and storm control) is most cost effective by utilising un-lined permeable pavements.
- If roof run-off interception cannot be provided in the permeable pavement, the most cost effective SuDS are rain-gardens or infiltration trenches in the garden of properties. However if space makes such features difficult to apply, then communal rainwater harvesting is the next best cost option.

12 Summary and Conclusions

12.1 Drainage Standards

12.1.1 This study has examined the three drainage design approaches required of the B. Regs, SfA7 and the proposed SuDS Standards for three pilot sites in order to provide evidence on this issue to Defra. The cost difference between B. Regs and SfA 7 drainage schemes is small for the medium and large sites so only one design has been produced for these. The only difference in cost is associated with the design of the outfall structure.

12.2 Selection of Sites for Analysis

12.2.1 The sites were selected to represent different typical types of planning applications, and that had SuDS as part of the original design so the layout were suitable to have an upgraded SuDS system to be compliant with the new standards (without having to make too many changes to the layout).

12.2.2 . Only the small site is likely to represent mostly infill development rather than greenfield development. However all sites have been assumed to be greenfield and located at the same location to facilitate cost comparisons. (Greenfield defines the discharge requirements imposed on the drainage system).

12.2.3 The small site, although 8 properties, has effectively been considered as two sites. Firstly it has been designed as 2 sets of 4 properties, each with their own outfall, and secondly a site of 8 properties served by one outfall. This has been done as there are significant differences in storage requirements, and therefore costs.

12.2.4 All three sites are assumed to be on relatively impervious material. In addition one of the pilot sites is also assumed to be developed on pervious soil. This emphasis on impervious sites is believed to roughly reflect the normal characteristics of most site developments.

12.3 Design Basis

12.3.1 The approach taken has been to use current common design practice in terms of design rather than optimise the solutions. However as hydraulic criteria for attenuation storage and long term storage is common to all standards, this is not a significant issue as the differences in the comparisons of costs would be small.

12.3.2 Although the infiltration rate of the 'impermeable' sites' have a marginal degree of permeability, the design approach has been conservative in estimating storage volumes required to manage extreme events. In other words, no account has been taken of the losses to ground when sizing storage systems. The SuDS system would benefit relative to the other Standards from taking advantage of this infiltration rate, but the cost benefit would be small.

12.3.3 A range of SuDS options have been used for addressing Interception storage, particularly systems serving roof runoff.

12.4 Capital costs including land take

12.4.1 **Overview** – The large majority of planning applications are likely to be for small sites with marginal infiltration conditions. There will probably be an even split in categorising them as greenfield and previously developed. Investigations to confirm this and any other breakdown of site category would assist in assessing the importance of each of the various site conditions and types.

12.4.2 **Valuing SuDS schemes compared to other drainage standards** – no valuation has been given to the environmental benefits associated with the use of SuDS; for water pollution reduction, water savings, aesthetics, or flora and fauna.

12.4.3 **Greenfield with marginal infiltration** - In general SuDS systems will be advantageous over B. Regs and SfA 7 in greenfield conditions as long as marginal infiltration ($>1x10^{-8}$m/s) can be assumed if permeable pavements are a significant feature of drainage schemes.

12.4.4 **Site scale related benefits** - The advantage in using SuDS is scale related with large sites particularly benefiting from their use.

12.4.5 **Extent of permeable pavements** - Care should be taken in providing only the necessary amount of permeable pavement for storage. An excessive amount of permeable pavement reduces the cost advantage of using SuDS.

12.4.6 **Construction of permeable pavements** – The commonly applied use of DBM techniques to protect permeable pavements during construction significantly reduces the cost advantage of SuDS where permeable pavements are used extensively.

12.4.7 **Greenfield pervious sites** – SuDS is very much more cost effective than other Standards for pervious catchments, particularly where pervious catchments have relatively low rates of permeability. This advantage would reduce to some degree where infiltration rates are high, but SuDS is always likely to be the cheapest approach..

12.4.8 **High groundwater levels and / or contaminated land** – Where pavements are lined, road runoff needs to be provided with a second level of treatment. In addition roof runoff cannot utilise the pavement for providing interception storage. This has potentially significant cost and land take implications for SuDS systems depending on what additional SuDS features are provided. The cost benefit of SuDS is marginal in these situations, particularly if rainwater harvesting is used. Medium and large sites will probably still have a cost advantage, but small sites will not.

12.4.9 **Sites located in other hydrological locations than the south-east** – Sites in other hydrological locations in the UK tend to have slightly larger storage requirements than the sites designed for this study. This will favour SuDS schemes. This is most marked in the south-west and north-east of the country.

12.4.10 **Land take** – the loss of space to build properties is only a significant issue when permeable pavements do not form the back-bone of the SuDS scheme, and when the vegetative SuDS components are not considered to be part of public open space provision.

12.4.11 **Previously developed land** – In many cases the use of infiltration may not be feasible due to previous site use and the existence of services. A more generous discharge rate may be provided for these sites and this will reduce storage volume requirements (whatever Standard is applied). For these reasons, SuDS is likely to be less cost effective, but it will be very site specific.

12.4.12 **Flat / Steep sites** – There is a significant cost advantage in using SuDS for flat sites, but their use on steep sites tends to constrain site layout and may cost more than drainage schemes designed to meet B. Regs or SfA7.

12.5 Maintenance costs

12.5.1 Costs of maintenance of SuDS in the public realm are of the order of 0.5% of capital costs of drainage construction.

12.5.2 Analysis of the maintenance costs show that the cost differences between standards are often very small, but the advantage of one Standard over another is very dependent on:

- The maintenance frequency for desilting for any type of drainage Standard;
- Whether costs of roof systems should be excluded on the basis that this is a household owner responsibility.

12.5.3 Cost estimates for maintenance are very uncertain. This is not because of the time and unit rates for work, but the actual frequency with which activities will be carried out in practice.

12.5.4 There is limited benefit in the WLC values as there are 3 different sets of stakeholders, each with their own cost element;

- the capital cost is incurred by the developer,
- the SuDS in the public realm will be owned by the local authority, and
- the SuDS in private property will be owned by these individuals.

12.6 Recommendations

12.6.1 A number of design assumptions have been made in the absence of guidance associated with the SuDS Standards. In general these are not controversial, but this highlights the need to have national guidance to support the SuDS Standards when the legislation is enacted.

12.6.2 It would assist in assessing this research output information by providing supporting evidence from recent planning applications of the proportion of sites by a number of categories, including:

- Size of development
- Greenfield / previously developed
- Permeable / Impermeable sites
- Sites where the ground condition requires lining of drainage elements.

12.6.3 The design of drainage systems for pilot sites in two or three other hydrologic locations would remove some of the uncertainties on costs; south-west, north-west and north-east England and alternative housing layouts could provide a wider variety of costs

12.6.4 Although permeable pavements are becoming common-place, not all local authorities have been prepared to adopt them or use them in certain road categories. This is a key aspect that needs clarification and for which guidance is needed.

12.6.5 The use of geo-cellular units for attenuation storage or infiltration is not always accepted for adoption by local authorities or water companies. Clarification on this needs to be provided in SfA7 and Part H of the B. Regs.

12.6.6 The issues of porous pavements for infiltration near buildings need to be reviewed and clarified.

12.6.7 The issue of whether vegetative SuDS can or cannot be considered as contributing to public open space needs to be clarified. This may be a function of:

- the type of vegetative SuDS used,
- its potential for dual use, or
- its ecological / environmental value.

12.6.8 It should be noted that these costs have not taken into account additional benefits associated with the use of SuDS compared to the other Standards.

Appendices

APPENDIX A

Hydraulic Design Summaries of Outputs

Small site

Medium site

Large site

APPENDIX A

Hydraulic design summaries of outputs

Small site (2 outfalls)

BUILDING REGULATIONS COMPLIANT DESIGN

(Refer to drawing 0471/D/010)

Design Assumptions:

- Greenfield Rates are <5l/s
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by oversized pipework
- Minimum orifice size of 50mm diameter for flow controls
- Orifice plates used as flow controls
- No surcharge up to and including the 2yr storm events
- Design rainfall to be limited to 50mm/hr
- Pipe gradients and sizes not to exceed the limits established in Approved Document H

SMALL SITE (2 outfalls)

SEWERS FOR ADOPTION 7TH Ed. COMPLIANT DESIGN

(Refer to drawing 0471/D/011)

Design Assumptions:

- Greenfield Rates are <5l/s
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by oversized pipework
- Minimum orifice size of 75mm diameter for flow controls
- Hydrobrakes used as flow controls
- No surcharge up to and including the 2yr storm events
- Pipe gradients and sizes not to exceed the limits established in Sewers for Adoption 7th ed.

Design Results

- Maximum Flow Rate = 9.5/s
- Maximum Storage Volume = 33.4m^3
- Volume of flooding (100yr event +30%) = 0.0m^3

SMALL SITE

SUDS Extra DESIGN

(Refer to drawing 0471/D/012)

Design Assumptions:

- Greenfield Rates are <5l/s
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by Green Roofs on garages, Rain Gardens for domestic roofwater, Rainwater Harvesting for larger roofwater catchments and Permeable Paving for external surfaces
- No discharge from the site for 5mm rainfall events
- 5mm storage is deemed to be provided by storage structures for their respective catchments
- Attenuation for storm events up to the 100yr (+ 30%) event to be provided by the porous paving sub-base.
- Minimum orifice size of 75mm diameter for flow controls
- Hydrobrakes to be used for flow controls

Design Results

- Maximum Flow Rate = 9.8/s
- Maximum Storage Volume = 66.8m^3
- Volume of flooding (100yr event +30%) = 0.0m^3

Medium site

BUILDING REGULATIONS COMPLIANT DESIGN

(Refer to drawing 0471/D/014)

Design Assumptions:

- Greenfield Rates are limited to QBAR. This has been calculated via two methods – ICP SUDS and the recommendations in W5-074 "Preliminary Rainfall Runoff Management for Catchments" produced by the EA (henceforth known as "EA")
  - ICP SUDS gives QBAR as 4.1/s
  - EA gives QBAR as 4.51/s
- The limiting discharge may be 5l/s, to prevent blockages and maintain flow velocity downstream of control.
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by cellular storage
- Minimum orifice size of 50mm diameter for flow controls
- Hydrobrakes to be used as flow controls
- No surcharge up to and including the 2yr storm events
- Design rainfall to be limited to 50mm/hr
- Pipe gradients and sizes not to exceed the limits established in Approved Document H

Design Results

- Maximum Flow Rate = 4.6l/s (100yr 240min Winter Storm)
- Maximum Storage Volume = 350.3m^3 (100yr 480min Winter Storm)
- Maximum Volume of flooding = 0.0m^3
- Flooding does not occur up to or including the 100yr (+30%) event.

MEDIUM SITE

INFILTRATING DESIGN

(Refer to drawing 0471/D/013)

Design Assumptions:

- Greenfield Rates are limited to QBAR. This has been calculated via two methods – ICP SUDS and the recommendations in W5-074 "Preliminary Rainfall Runoff Management for Catchments" produced by the EA (henceforth known as "EA")
  - ICP SUDS gives QBAR as 4.1/s
  - EA gives QBAR as 4.51/s
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by porous sub-base
- All flows discharged via infiltration
- A conservative infiltration rate of 1.39×10^{-6}m/s (equivalent to 5mm/hr) has been assumed

- Depth of sub-base has been calculated by comparing the hydraulic requirement to the structural requirement and taking the greater depth.
- The hydraulic requirement has been calculated by using WinDes to determine the maximum depth of water for the 100yr (+30%) storm event.
- The structural requirement has been calculated by the recommendations in the Interpave design guide "Guide to the design, construction and maintenance of concrete block pavements".

Design Results

- Maximum Flow Rate = 0.0l/s
- Maximum Required Storage Volume = 366.4m^3
- Maximum Provided Storage Volume = 406.3m^3
- Maximum Volume of flooding = 0.0m^3
- Flooding does not occur up to or including the 100yr (+30%) event.

MEDIUM SITE

SUDS Extra DESIGN

(Refer to drawing 0471/D/015)

Design Assumptions:

- Greenfield Rates are limited to QBAR. This has been calculated via two methods – ICP SUDS and the recommendations in W5-074 "Preliminary Rainfall Runoff Management for Catchments" produced by the EA (henceforth known as "EA")
    - ICP SUDS gives QBAR as 4.1/s
    - EA gives QBAR as 4.51/s
- The limiting discharge may be 5l/s, to prevent blockages and maintain flow velocity downstream of control.
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by porous paving and a communal rainwater harvesting tank for the southern area
- Interception storage is deemed to be provided by rainwater harvesting, porous paving and a dry swale for the northern area
- External surfaces to be routed through permeable paving and kept separate from the rainwater harvesting system.
- Minimum orifice size of 50mm diameter for Hydrobrakes, 25mm diameter for porous paving controls (where risk of blockages is minimal)
- Hydrobrakes and orifice plates to be used as flow controls
- No surcharge up to and including the 2yr storm events

Design Results

- Maximum Flow Rate =4.8l/s (100yr 240min Winter Storm)
- Maximum Storage Volume =360m^3 (100yr 240min Winter Storm)

- Maximum Volume of flooding = 0.0m^3
- Flooding does not occur up to or including the 100yr (+30%) event.

Large site.

BUILDING REGULATIONS COMPLIANT DESIGN

(Refer to drawing 0471/D/016)

Design Assumptions:

- Greenfield Rates are limited to QBAR. This has been calculated via two methods – ICP SUDS and the recommendations in W5-074 “Preliminary Rainfall Runoff Management for Catchments” produced by the EA (henceforth known as “EA”)
  - ICP SUDS gives QBAR as 17.7l/s
  - EA gives QBAR as 16.5/s
- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Attenuation storage provided by concrete box culverts and oversized pipes
- Minimum orifice size of 50mm diameter for flow controls
- Hydrobrakes to be used as flow controls
- No surcharge up to and including the 2yr storm events
- Design rainfall to be limited to 50mm/hr
- Pipe gradients and sizes not to exceed the limits established in Approved Document H

Design Results

- Maximum Flow Rate = 16.3/s (100yr 120min Winter Storm)
- Maximum Storage Volume = 1790.9m^3 (100yr 480min Winter Storm)
- Maximum Volume of flooding = 16.1m^3 (100yr 15min Winter Storm)
- Flooding does not occur on the 30yr event.
- Flooding occurs at various points throughout the system, and never more than 1.7m^3 at a single location. These floods are retained within the site boundary and pose no danger to properties.

LARGE SITE

SUDS Extra DESIGN

(Refer to drawing 0471/D/018)

Design Assumptions:

- Greenfield Rates are limited to QBAR. This has been calculated via two methods – ICP SUDS and the recommendations in W5-074 “Preliminary Rainfall Runoff Management for Catchments” produced by the EA (henceforth known as “EA”)
  - ICP SUDS gives QBAR as 17.7l/s
  - EA gives QBAR as 16.5/s
- The Long Term Storage Volume has been calculated using the method provided in W5-074, at 359.3m^3
- Long Term Storage is provided via rainwater harvesting (360m^3 represents 0.285m depth of water in each tank)

- Storage to be provided below ground for all storms up to and including the 100yr event (+30% climate change) to provide simple compliance with PPS25
- Communal rainwater harvesting is proposed for roofwater.
- Porous paving is proposed for courtyard areas and shared surfaces
- Overflows from the rainwater harvesting and porous paving will be fed into “Dry” swales (Ref. C697 – The SUDS Manual, chap.10) located alongside highways
- Additional attenuation is provided by online tanks located at the lower portion of the system.
- No discharge from the site for 5mm rainfall events
- 5mm interception storage is deemed to be provided by rainwater harvesting, porous paving and dry swale systems.
- Attenuation for storm events up to the 100yr (+ 30%) event to be provided by the porous paving (tanked) for external surfaces/courtyards, swales and tanks at the lower end of the system.
- Minimum orifice size of 75mm diameter for flow controls
- Hydrobrakes to be used for flow controls

Design Results

- Maximum Flow Rate = 15.9l/s (100yr 360min Winter Storm)
- Maximum Storage Volume = 1876.6m^3 (100yr 600min Winter Storm)
- Maximum Volume of flooding = 20.7m^3 (100yr 480min Winter Storm)
- Flooding occurs at various points throughout the system, and generally no more than 2m^3 at a single location. There is one point of flooding on the 480min 100yr winter storm at pipe no.42.004 of 20.7m^3. This will cause flooding of the landscaped area around the swale, and hence of no danger to persons or property and therefore an acceptable situation. All floods are retained within the site boundary and pose no danger to properties.
- Flooding does not occur on the 30yr event.

APPENDIX

Communal Rainwater Harvesting Tank design procedure

1. The design process generally follows the simplified approach established in BS 8515:2009 “Rainwater harvesting systems – Code of practice”
2. To demonstrate the procedure, the Large SUDS site has been taken as an example.
3. Table 1 shows the relative tank areas, roof areas, no of dwellings, roof/dwelling ratio and resultant storage depth
4. Dwellings have been assumed to be 3-person households across the site
5. The resultant tank depth is calculated with a required storage volume of 1.2m^3 per dwelling, as given in figure 3(b) of BS 8515. This figure relates to an average roof/dwelling ratio across the site of 51.3m^2/dwelling.
6. The communal rainwater tank systems have assumed a 400mm deep tank.
7. Table A.1 demonstrates that the capacity of the rainwater harvesting system is sufficient for the standard 650mm rainfall, according to the simplified approach
8. As the communal systems have overflows connected to positive drainage systems designed to incorporate more extreme storm events, Annexe A (sizing for integrated stormwater control) of BS 8515 is not applicable
9. The volume of required LTS divided by the area of the communal rainwater harvesting tanks gives an average depth of 285mm
10. The capacity of the tanks is therefore sufficient for the normal usage of the dwellings

Table 1 – Indicative values for the RWH sizing for the Large SUDS site

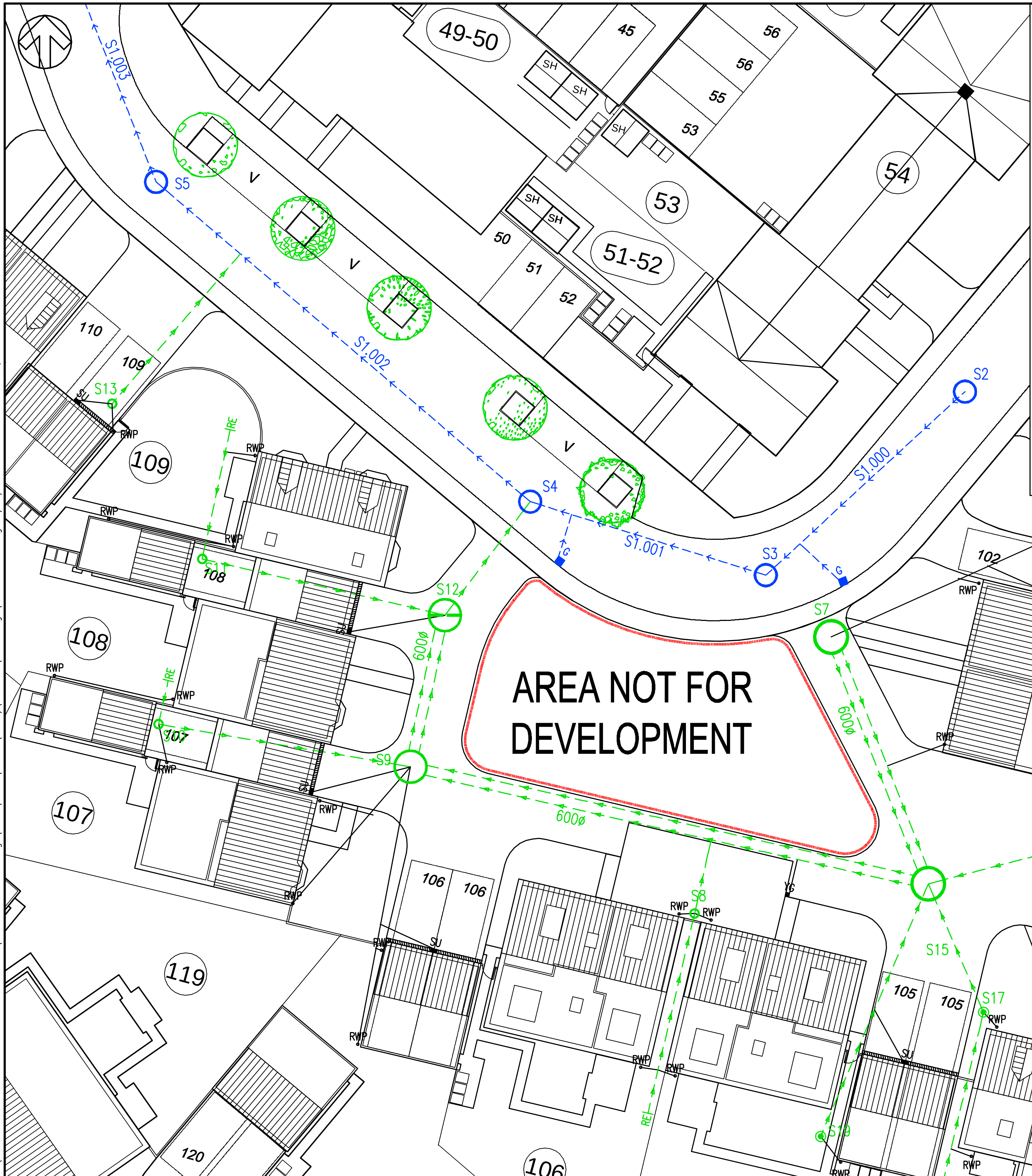
Tank Area (m^2)	Roof Area (m^2)	No. of Dwellings	Roof/Dwelling Ratio (m^2)	Storage Depth (m)
157	1590	34	46.7	0.26
169	1586	31	51.1	0.22
292	1556	35	44.4	0.14
67	580	9	64.4	0.16
137	940	16	58.7	0.14
449	2133	50	42.7	0.13
			51.3 (average	

APPENDIX B
Design drawings

Small

Medium

Large



KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC - PRIVATE (450ø min.)
- PLASTIC IC - ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+ORIFICE PLATE (1800ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU — LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G, YG — ROAD GULLY- 450x900dp (YARD GULLY- 225x585dp)
- BRICK CATCHPIT - ADOPTED (600 x 450min.)
- PERMEABLE PAVING

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS.
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 0.281ha
   IMPERMEABLE AREA = 0.121ha
   LIMITING DISCHARGE = 5l/s @each point of discharge (min. for blockages)
   MAXIMUM DISCHARGE = 13l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = 600ø PIPES
   ATTENUATION VOLUME = 15.8m^3
   ADDITIONAL STORAGE = 6.9m^3 - 3no. 1800ø CHAMBERS
   AVAILABLE STORAGE = 22.7m^3

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

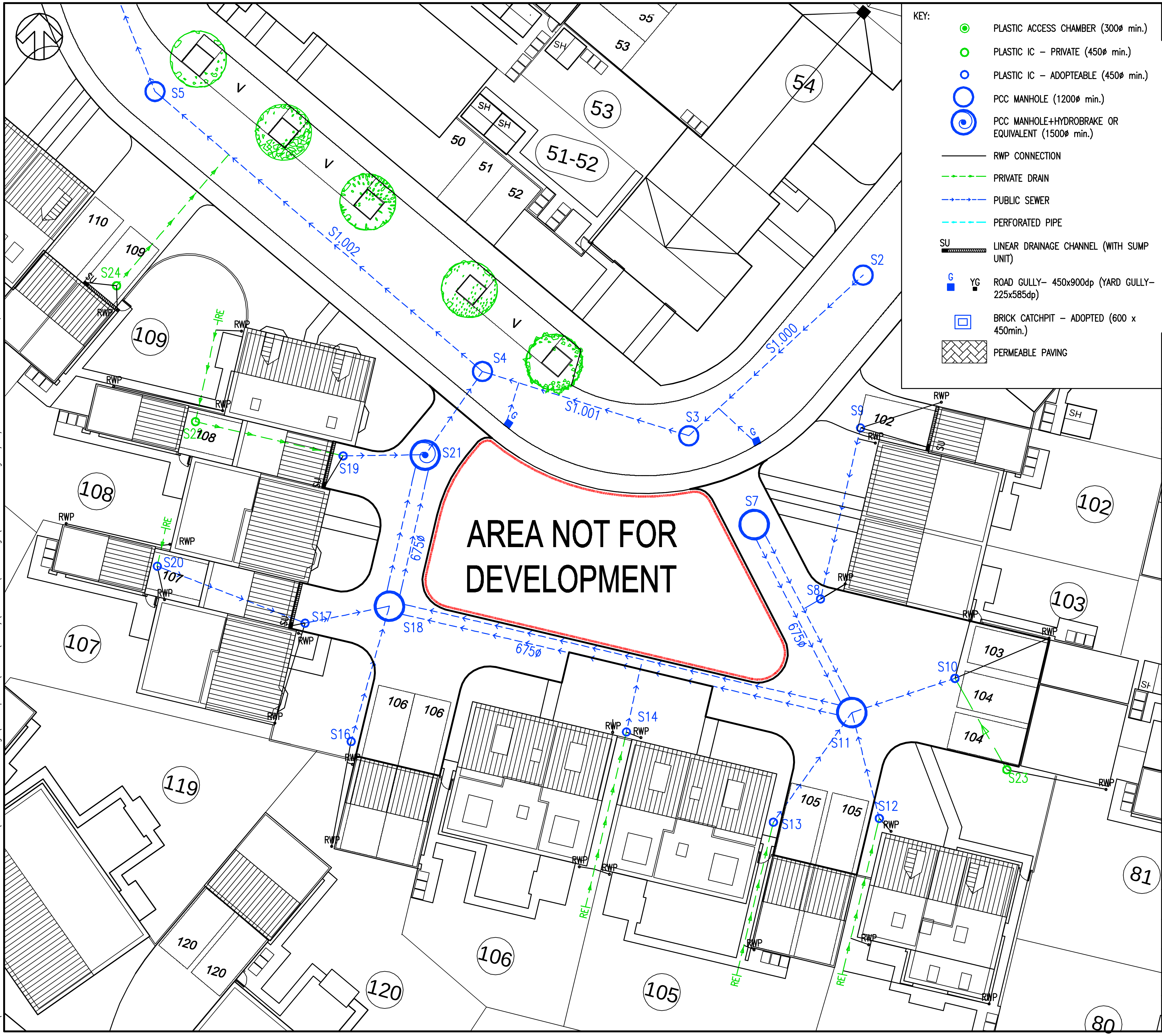
ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: SMALL SITE (KM12) SURFACE WATER DRAINAGE NETWORK - BUILDING REGULATIONS COMPLIANT

SCALE @ A3:	CHECKED:	APPROVED:
1:250	OJF	AA
CAD FILE: 0471-D-010	DESIGN-DRAWN: OJF	DATE: February 2013
PROJECT No: 50600471	DRAWING No: 0471/D/010	REV: I

N:\50600471 - DEFRA - WT1505 Evidence Costs\E Models and Drawings\Development\SMALL (KM12)\AUTOCAD\D Drainage\0471-D-011.dwg 02/07/2013 14:15:34 Sims-Harris, Theo



KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC - PRIVATE (450ø min.)
- PLASTIC IC - ADOPTEABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY- 450x900dp (YARD GULLY- 225x585dp)
- BRICK CATCHPIT - ADOPTED (600 x 450min.)
- PERMEABLE PAVING

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 0.281ha
   IMPERMEABLE AREA = 0.121ha
   LIMITING DISCHARGE = 5l/s @each point of discharge (min. for blockages)
   MAXIMUM DISCHARGE= 9.5l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = 675ø PIPES
   ATTENUATION VOLUME = 20.0m^3
   ADDITIONAL STORAGE = 6.9m^3 - 3no. 1800ø CHAMBERS
   AVAILABLE STORAGE = 26.9m^3

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

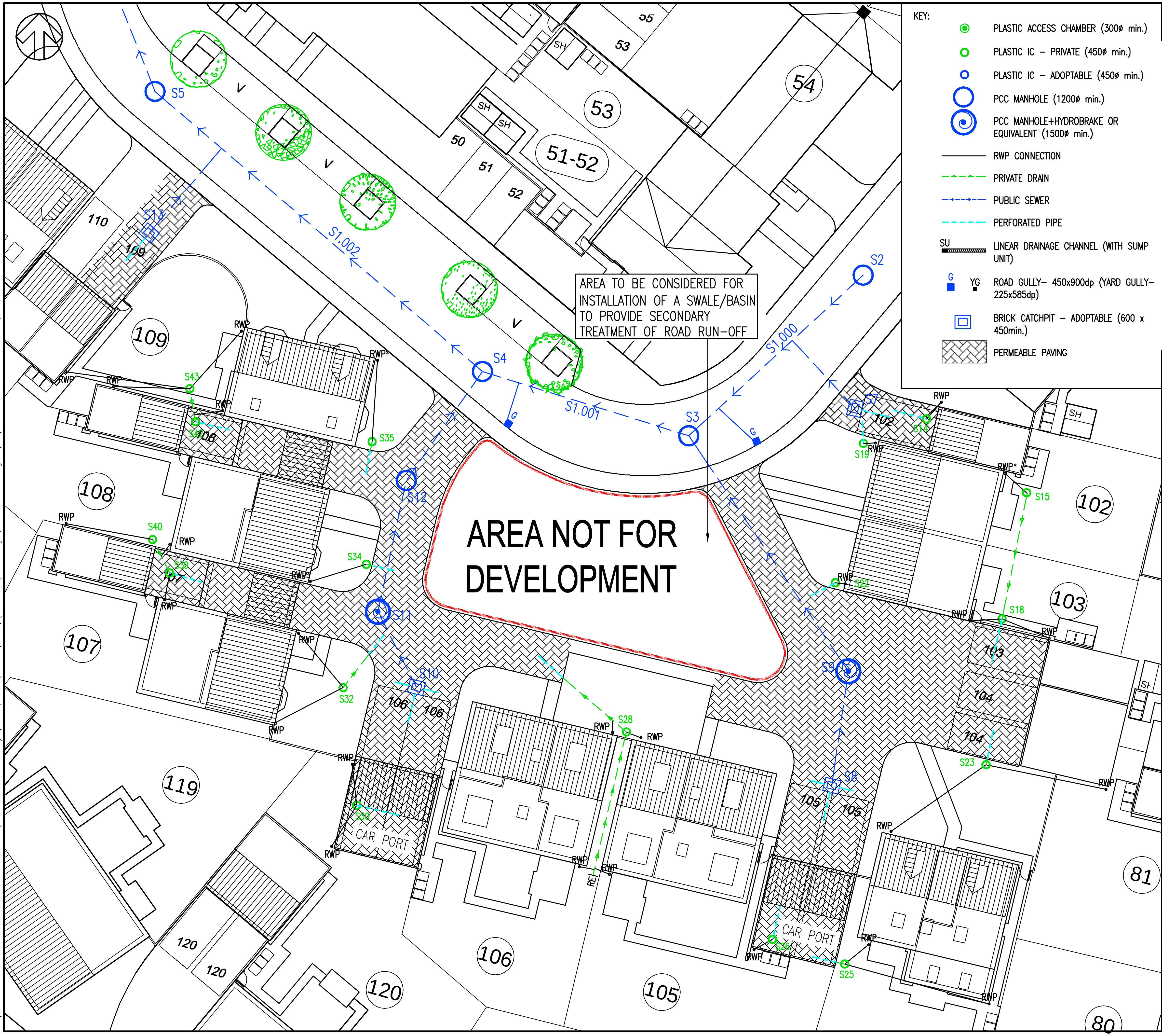
CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: SMALL SITE (KM12) SURFACE WATER DRAINAGE NETWORK - SFA 7th COMPLIANT

SCALE @ A3: 1:250	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-011	DESIGN-DRAWN: OJF	DATE: February 2013
PROJECT No: 50600471	DRAWING No: 0471/D/011	REV: I



KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT – ADOPTABLE (600 x 450min.)
- PERMEABLE PAVING

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 0.281ha
   IMPERMEABLE AREA = 0.121ha
   LIMITING DISCHARGE = 5l/s AT EACH POINT OF DISCHARGE
   MAXIMUM DISCHARGE =
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE =
   ATTENUATION VOLUME =
   ADDITIONAL STORAGE =
   AVAILABLE STORAGE =

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

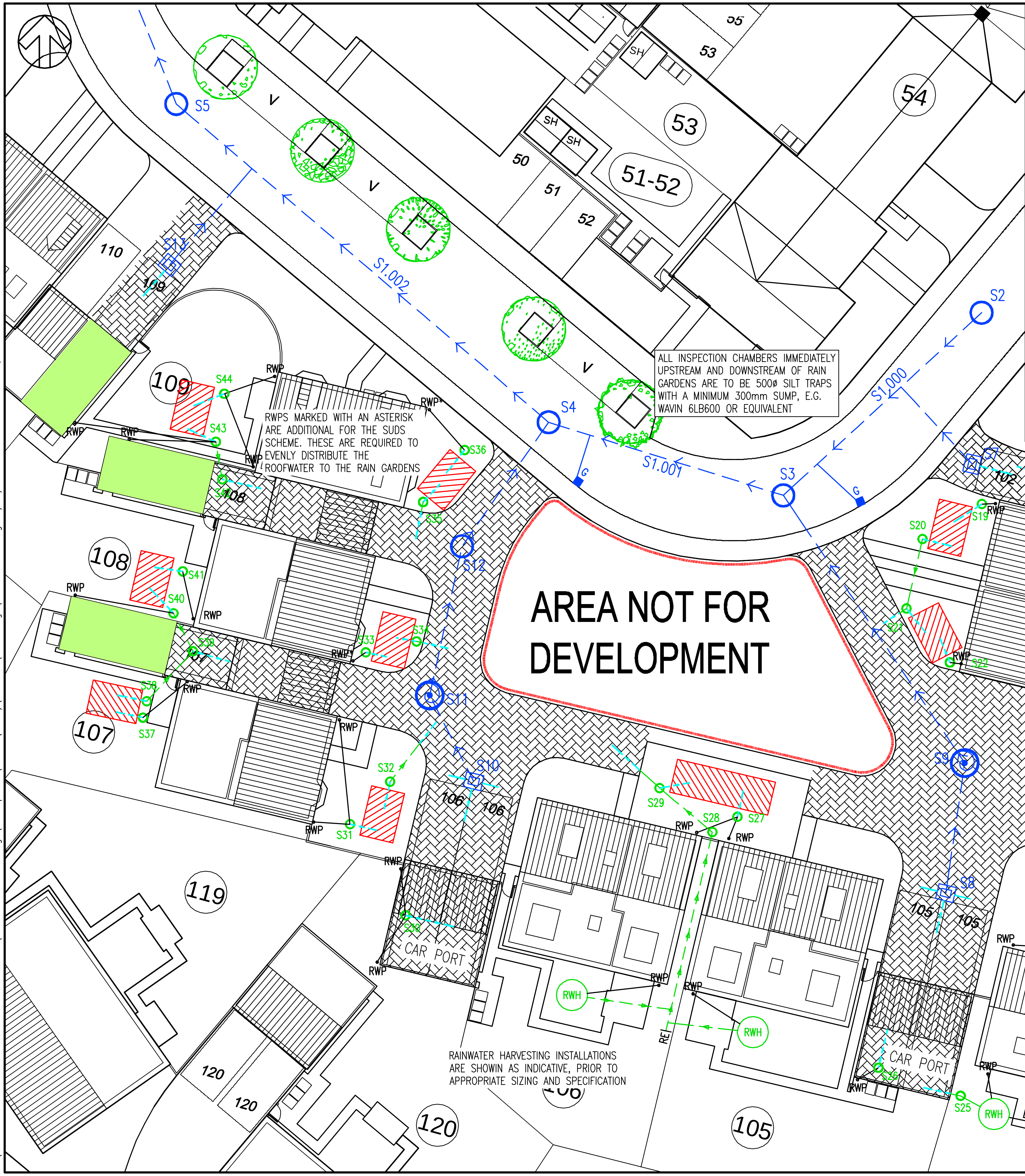
CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: SMALL SITE (KM12) SURFACE WATER DRAINAGE NETWORK - SUDS BASIC COMPLIANT

SCALE @ A3: 1:250	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-020	DESIGN-DRAWN: TSH	DATE: June 2013
PROJECT No: 50600471	DRAWING No: 0471/D/020	REV: I



KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC - PRIVATE (450ø min.)
- PLASTIC IC - ADOPTABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU — LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G / YG — ROAD GULLY- 450x900dp (YARD GULLY- 225x585dp)
- BRICK CATCHPIT - ADOPTABLE (600 x 450min.)
- PERMEABLE PAVING

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 0.281ha
   IMPERMEABLE AREA = 0.121ha
   LIMITING DISCHARGE = 5l/s AT EACH POINT OF DISCHARGE
   MAXIMUM DISCHARGE= 0.5 l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = POROUS PAVEMENT SUB-BASE
   ATTENUATION VOLUME = $59.8m^3$
   ADDITIONAL STORAGE = $7.0m^3$
   AVAILABLE STORAGE = $66.8m^3$
5. ADDITIONAL SUDS ELEMENTS
   RAIN GARDEN - 2m x 3m AREA, REFER TO DETAIL ON DRAWING 0471/SD/1
   RAINWATER HARVESTING TANK (RWH)
   GREEN ROOFS OVER GARAGES, WITH CONNECTIONS TO PERMEABLE PAVING

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

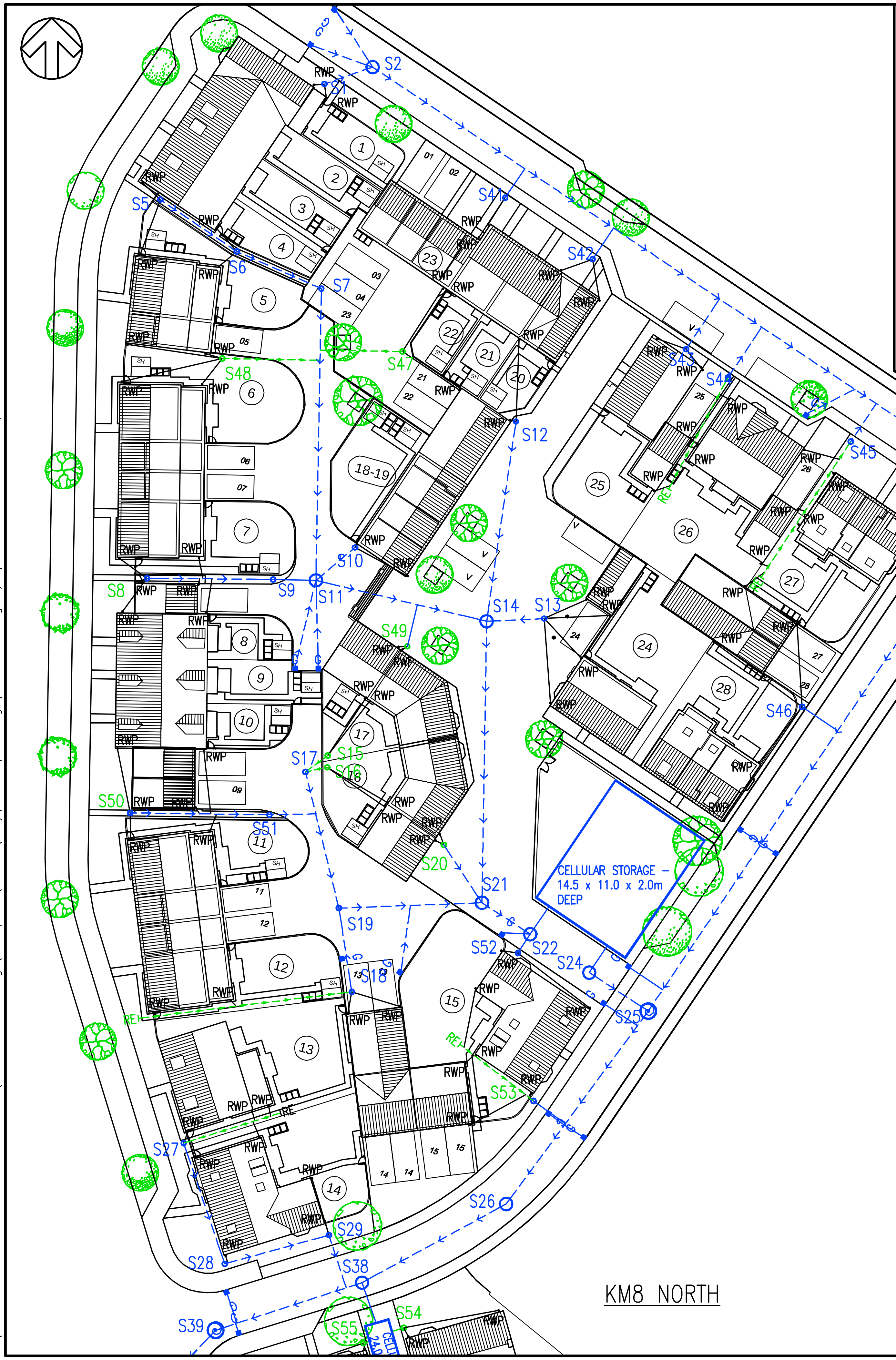
ARCHITECT: N/A

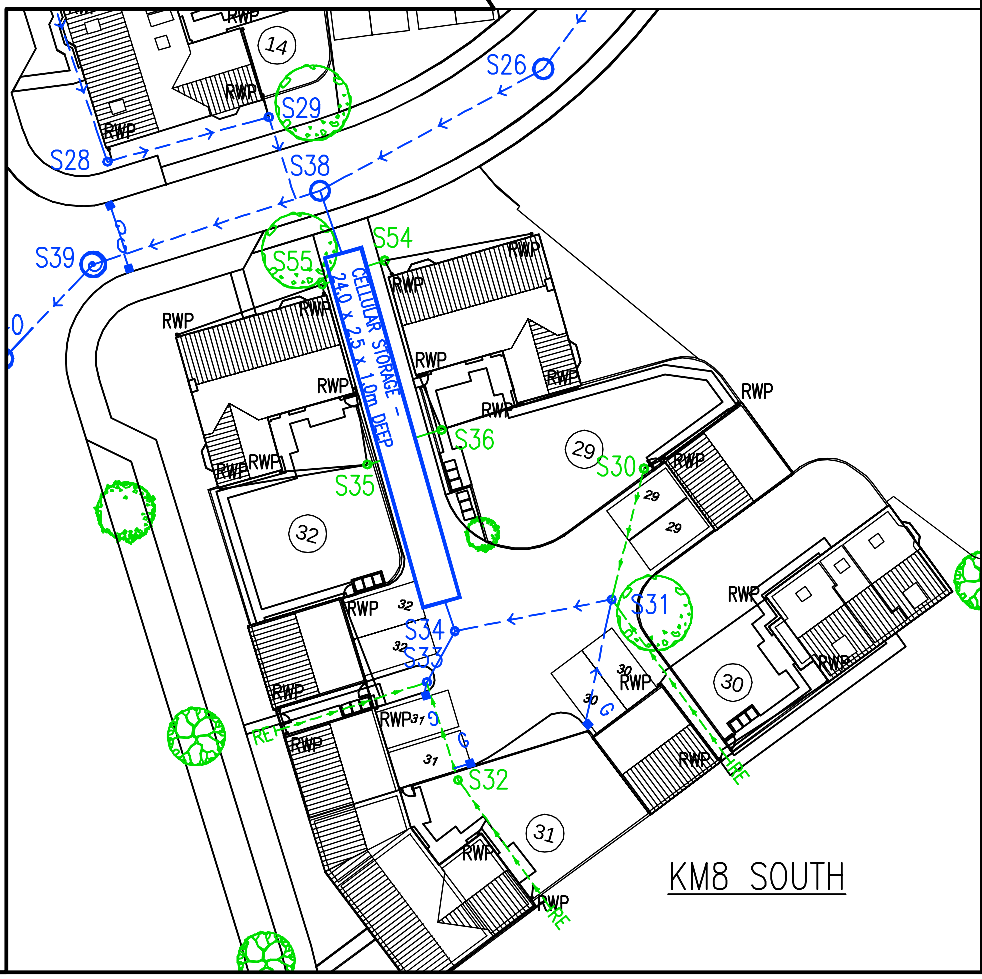
PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

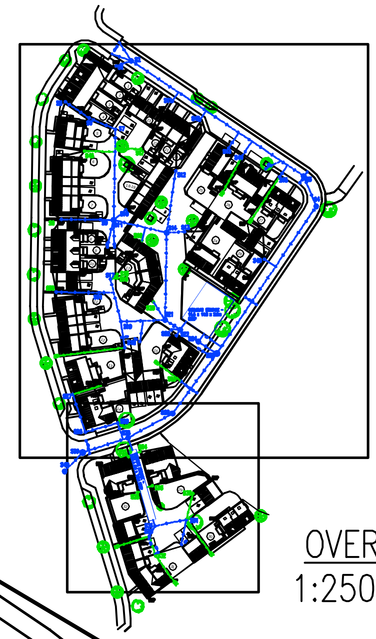
TITLE: SMALL SITE (KM12) SURFACE WATER DRAINAGE NETWORK - SUDS PLUS COMPLIANT

SCALE @ A3: 1:250	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-012	DESIGN-DRAWN: OJF	DATE: February 2013
PROJECT No: 50600471	DRAWING No: 0471/D/012	REV: I

N:\50600471 – DEFRA – WT1505 Evidence Costs\E Models and Drawings\Development\MEDIUM (KM8)\AUTOCAD\D Drainage\0471-D-014.dwg 01/08/2013 11:29:14 Sims-Harris, Theo







OVERVIEW
1:2500@A3

KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU — LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G / YG — ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT – ADOPTED (600 x 450min.)
- PERMEABLE PAVING
- CELLULAR STORAGE

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = 0.609ha
   LIMITING DISCHARGE = 5.0l/s
   MAXIMUM DISCHARGE = 4.6l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = CELLULAR STORAGE
   ATTENUATION VOLUME = 360m³
   ADDITIONAL STORAGE = 0.0m³
   AVAILABLE STORAGE = 360m³

REV	DATE	BY	DESCRIPTION	CHK	APD
J	30/07/13	TSH	CELLULAR STORAGE TANK AMENDED	AA	AA
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS:
FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

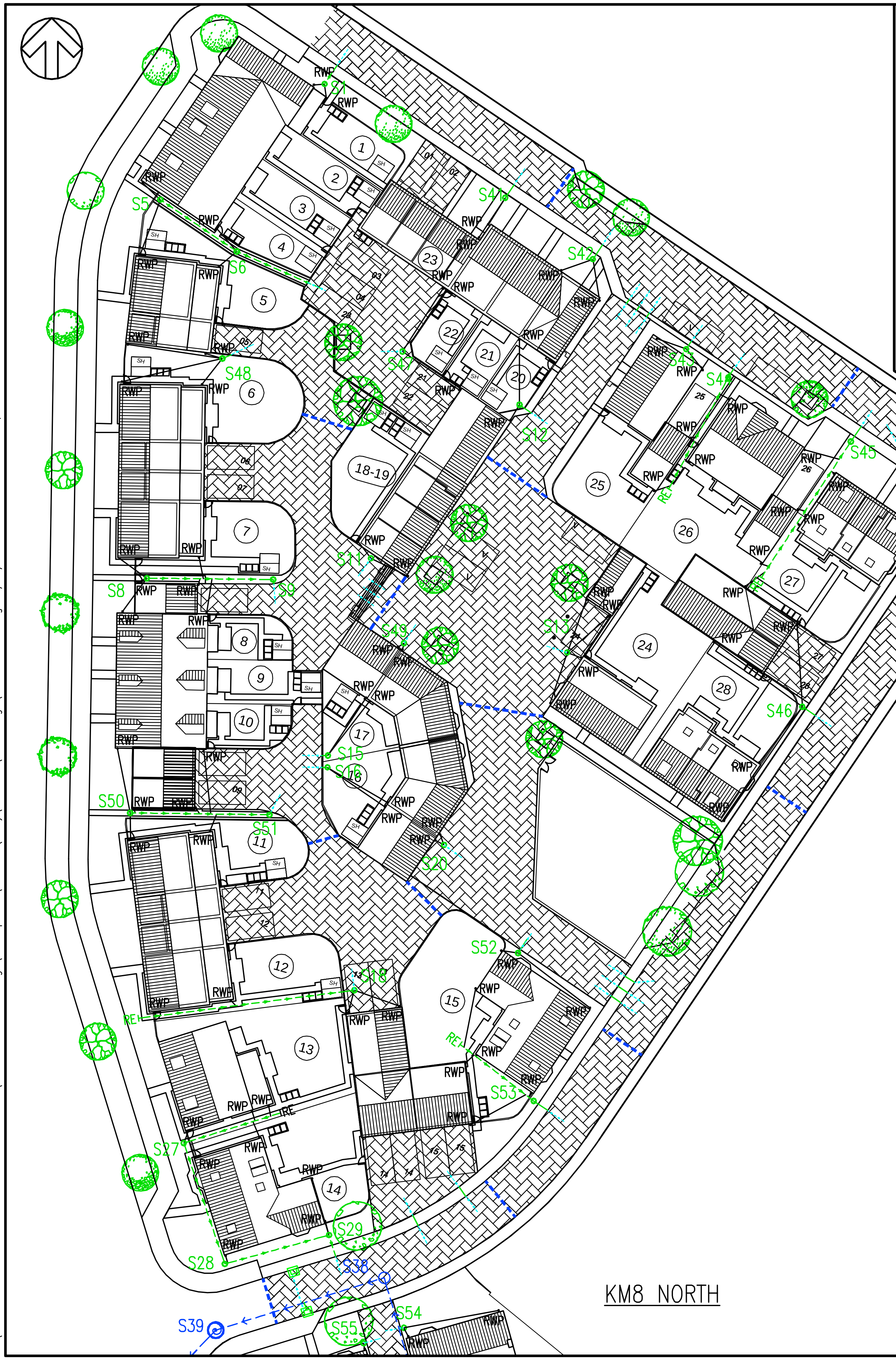
ARCHITECT: N/A

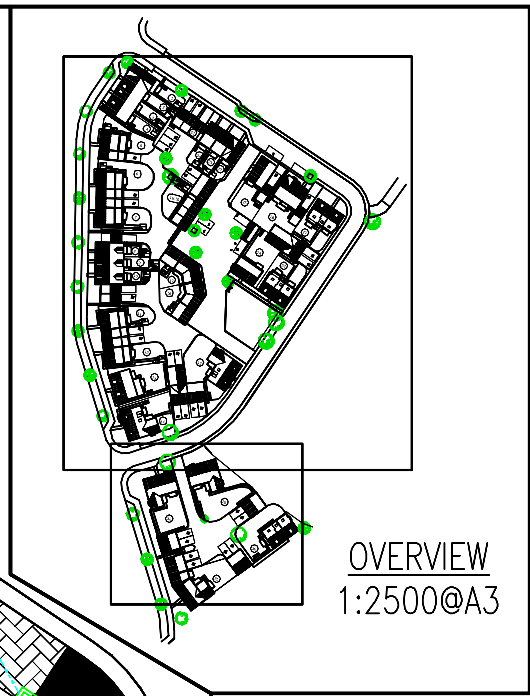
PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

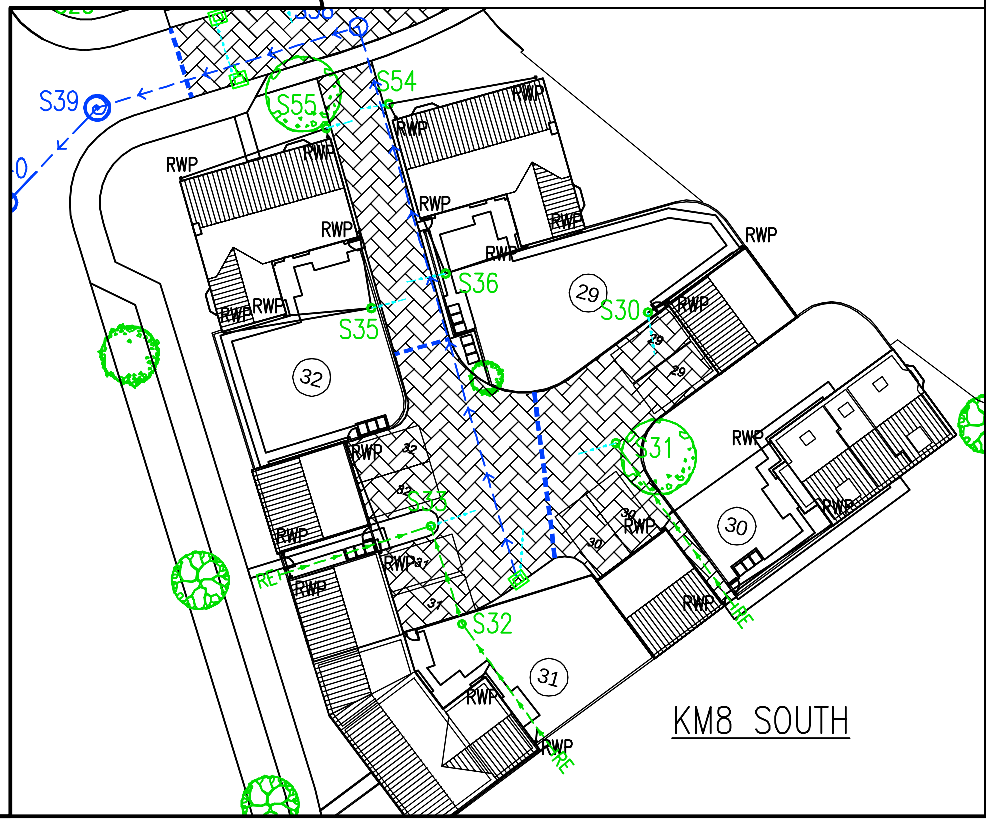
TITLE: MEDIUM SITE (KM8) SURFACE WATER DRAINAGE NETWORK - BUILDING REGULATIONS COMPLIANT & IMPERMEABLE

SCALE @ A3: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-014	DESIGN-DRAWN: OJF	DATE: April 2013
PROJECT No: 50600471	DRAWING No: 0471/D/014	REV: J

N:\50600471 - DEFRA - WT1505 Evidence Costs\E Models and Drawings\Development\MEDIUM (KM8)\AUTOCAD\D Drainage\0471-D-021.dwg 02/07/2013 14:38:33 Sims-Harris, Theo







KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- HIGHWAY DRAIN FROM PERMEABLE PAVING
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT WITH GRATED COVER AND 50mm ORIFICE PLATE AS FLOW CONTROL
- PERMEABLE PAVING
- ATTENUATION TANK

NOTES:

DO NOT SCALE

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = 0.609ha
   LIMITING DISCHARGE = 5l/s
   MAXIMUM DISCHARGE=
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE =
   ATTENUATION VOLUME =
   ADDITIONAL STORAGE =
   AVAILABLE STORAGE =

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

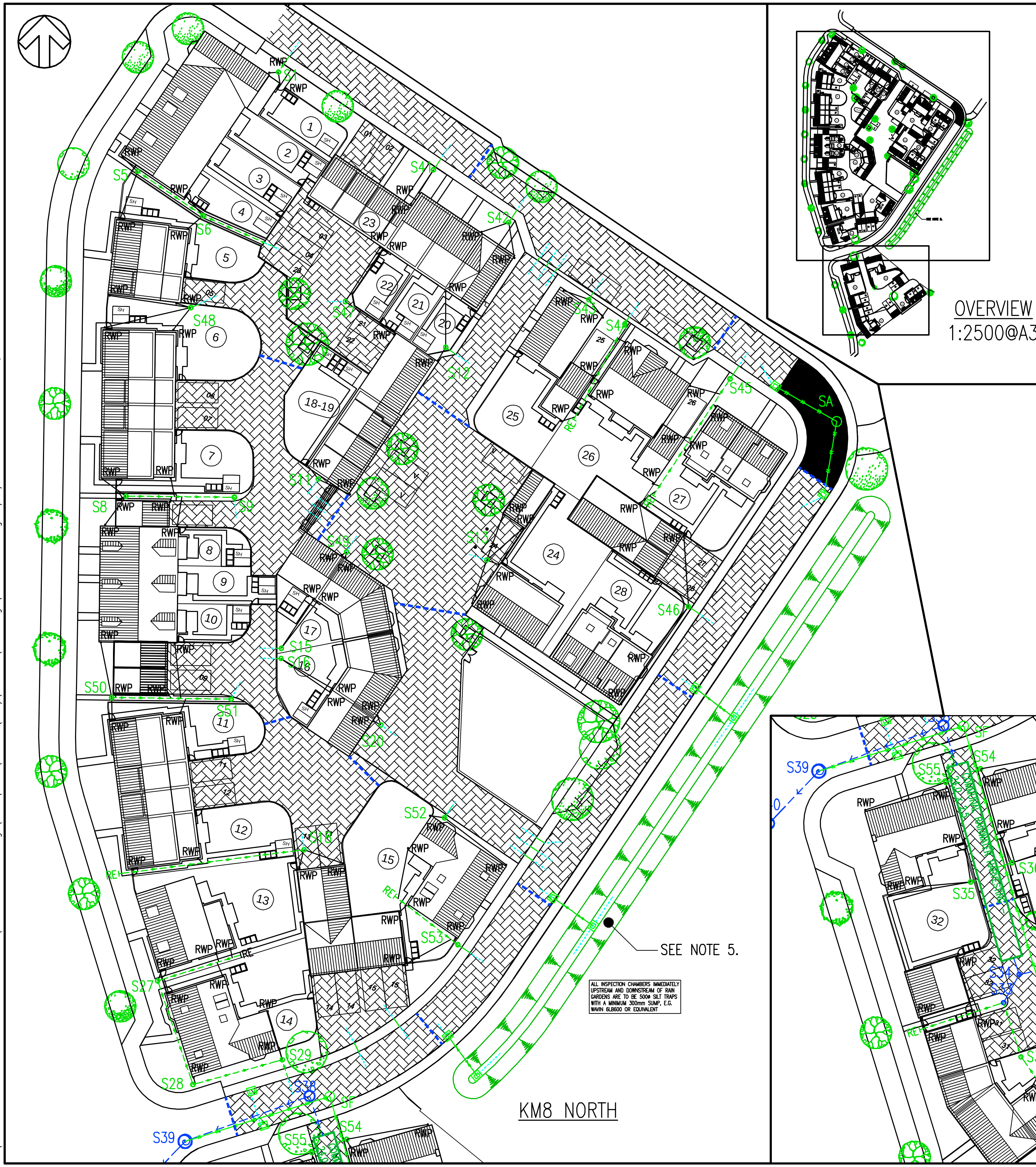
CLIENT: DEFRA

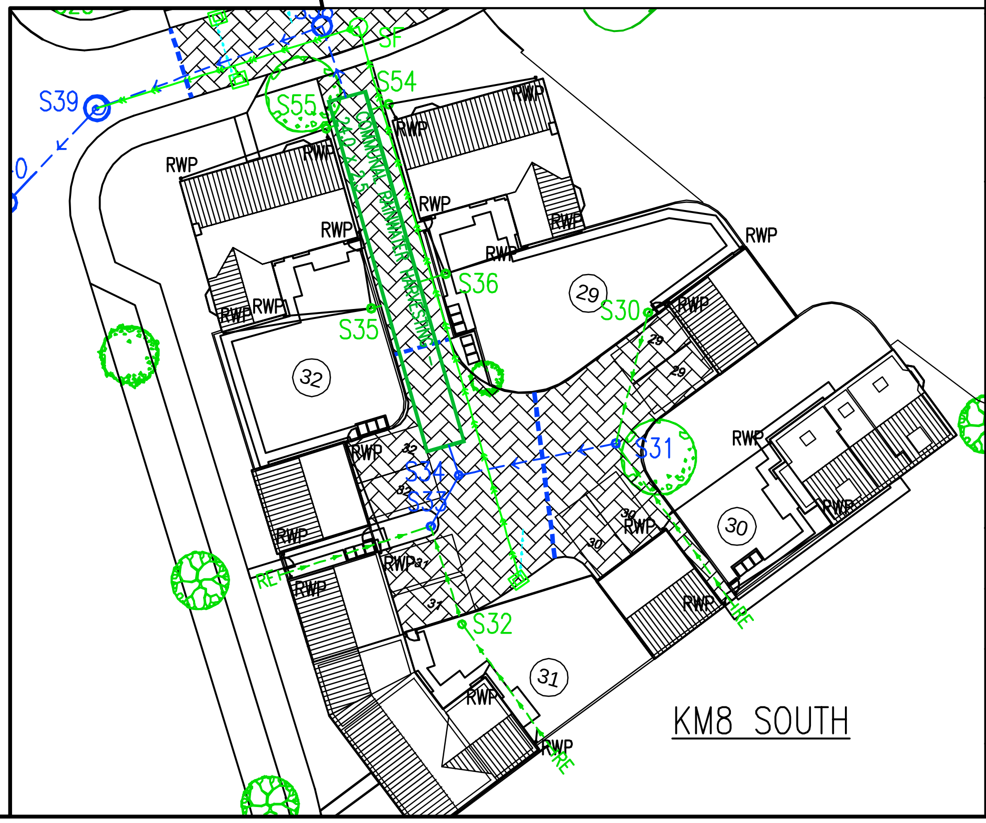
ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: MEDIUM SITE (KM8) SURFACE WATER DRAINAGE NETWORK - SoS SUDS BASIC COMPLIANT & IMPERMEABLE

SCALE @ A3: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-021	DESIGN-DRAWN: OJF	DATE: June 2013
PROJECT No: 50600471	DRAWING No: 0471/D/021	REV: I





KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- HIGHWAY DRAIN FROM PERMEABLE PAVING
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT WITH GRATED COVER AND 50mm ORIFICE PLATE AS FLOW CONTROL
- PERMEABLE PAVING
- CELLULAR STORAGE/RAINWATER HARVESTING

NOTES:

DO NOT SCALE

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = 0.609ha
   LIMITING DISCHARGE = 5l/s
   MAXIMUM DISCHARGE = 4.4l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = POROUS PAVING (300mm SUB–BASE)
   ATTENUATION VOLUME = 312.3m^3
   ADDITIONAL STORAGE = 57.0m^3 (RAINWATER HARVESTING)
   AVAILABLE STORAGE = 369.3m^3
5. DRY SWALE, APPROXIMATELY 80m IN LENGTH WITH 1m BED WIDTH AND 1:4 SIDE SLOPES. LINK PIPES TO CONNECT POROUS SUB–BASE WITH GRANULAR MEDIA BENEATH BED OF SWALE. PIPES TO HAVE 100mm OF COVER BENEATH BED OF SWALE AND INVERT LEVEL AT LEAST 150mm ABOVE BASE OF GRANULAR MEDIA. PIPES ARE TO BE LAID FLAT TO ALLOW BI–DIRECTIONAL FLOWS. LONGITUDINAL GRADIENT OF THE SWALE BED TO MATCH THAT OF ADJACENT ROAD AS NEAR AS POSSIBLE.

REV	DATE	BY	DESCRIPTION	CHK	APD
J	30/07/13	TSH	RAINWATER HARVESTING TANK AMENDED	AA	AA
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: MEDIUM SITE (KM8) SURFACE WATER DRAINAGE NETWORK - SUDS EXTRA & IMPERMEABLE

SCALE @ A3: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-015	DESIGN-DRAWN: OJF	DATE: April 2013
PROJECT No: 50600471	DRAWING No: 0471/D/015	REV: J

N:\50600471 - DEFRA - WT1505 Evidence Costs\E Models and Drawings\Development\MEDIUM (KM8)\AUTOCAD\D Drainage\0471-D-013.dwg 02/07/2013 14:19:28 Sims-Harris, Theo

KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT – ADOPTED (600 x 450min.)
- PERMEABLE PAVING
- IMPERMEABLE PAVING
- CHECK DAM WITHIN PERMEABLE PAVING

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = 0.609ha
   LIMITING DISCHARGE = N/A
   MAXIMUM DISCHARGE = 0.00l/s
4. PERMEABLE PAVING INFORMATION:
   TOTAL PAVED AREA = $3010m^2$
   DEPTH OF SUB-BASE = 0.450m (minimum depth)
   INFILTRATION RATE = 1.39x10^-6m/s
   AVAILABLE STORAGE = $406m^3$

NB: THE CONTROLLING DEPTH OF SUB-BASE IS DETERMINED BY THE STRUCTURAL REQUIREMENT AS SPECIFIED IN THE INTERPAVE GUIDE TO THE DESIGN, CONSTRUCTION AND MAINTENANCE OF CONCRETE BLOCK PERMEABLE PAVEMENTS (6th EDITION)

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP

Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

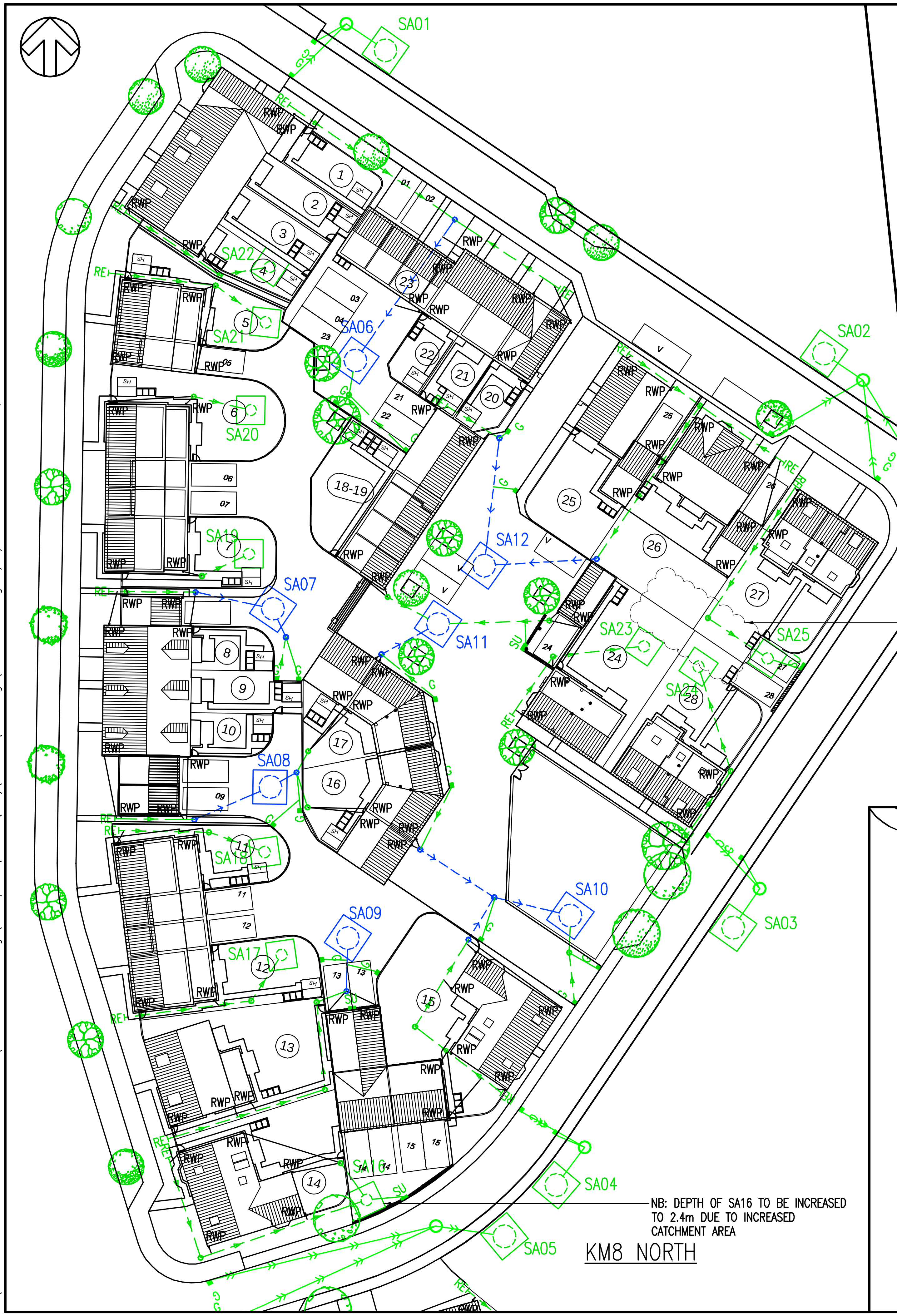
CLIENT: DEFRA

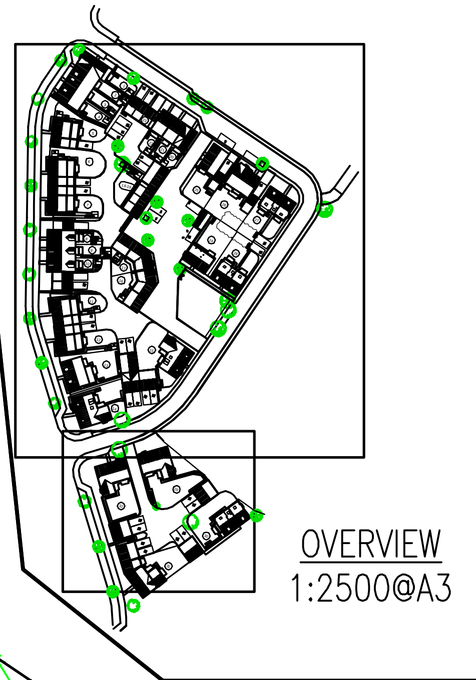
ARCHITECT: N/A

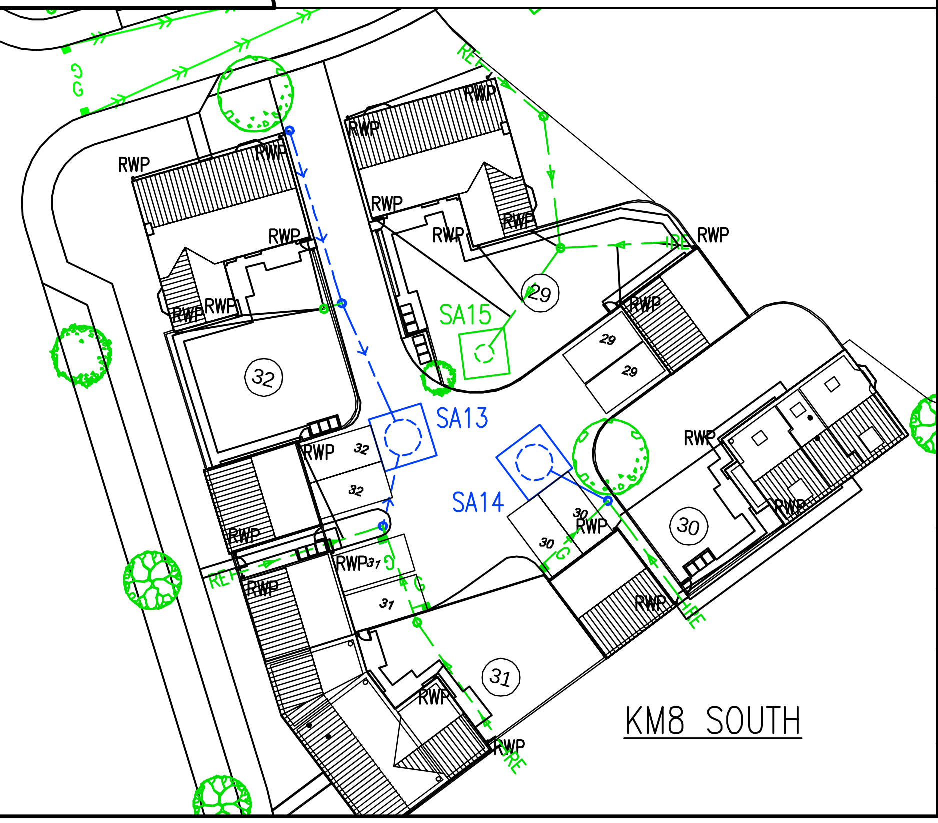
PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: MEDIUM SITE (KM8) SURFACE WATER DRAINAGE NETWORK - BUILDING REGULATIONS COMPLIANT

SCALE @ A3: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-013	DESIGN-DRAWN: OJF	DATE: February 2013
PROJECT No: 50600471	DRAWING No: 0471/D/013	REV: I







KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTABLE (450ø min.)
- PCC MANHOLE (1200ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- HIGHWAY DRAIN FROM PERMEABLE PAVING
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G ROAD GULLY– 450x900dp
- PRIVATE SOAKAWAY 1200ø PERFORATED PCC RING IN A 3.0m x 3.0m PIT. TOTAL DEPTH = 1.5m Min. EFFECTIVE DEPTH =0.7m BELOW LOWEST INCOMING PIPE
- COMMUNAL SOAKAWAY 2400ø PERFORATED PCC RING IN A 3.6m x 3.6m PIT. MAX. TOTAL DEPTH = 3.5m Min. EFFECTIVE DEPTH =1.3m BELOW LOWEST INCOMING PIPE
- HIGHWAY SOAKAWAY 2400ø PERFORATED PCC RING IN A 3.6m x 3.6m PIT. MAX. TOTAL DEPTH = 1.9m Min. EFFECTIVE DEPTH =1.3m BELOW LOWEST INCOMING PIPE

NOTES:

DO NOT SCALE

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = 0.609ha
   LIMITING DISCHARGE = 5.0l/s
   MAXIMUM DISCHARGE= 0.0l/s
4. ATTENUATION INFORMATION:
   STORAGE STRUCTURE = PCC SOAKAWAYS
   INFILTRATION RATE = 1.0x10–5 m/s
   REQUIRED VOLUME = 332.7m^3
   AVAILABLE VOLUME = 328.0m^3
   FLOODED VOLUME = 20.0m^3
5. HIGHWAY SOAKAWAYS HAVE BEEN DESIGNED TO ACCOMMODATE THE 30yr STORM EVENT +10% CLIMATE CHANGE, IN ACCORDANCE WITH NORMAL HIGHWAY AUTHORITY PRACTISE. ALL OTHER SOAKAWAYS HAVE BEEN DESIGNED TO ACCOMMODATE THE 100yr STORM EVENT +30% CLIMATE CHANGE.

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS:
FOR INFORMATION ONLY

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

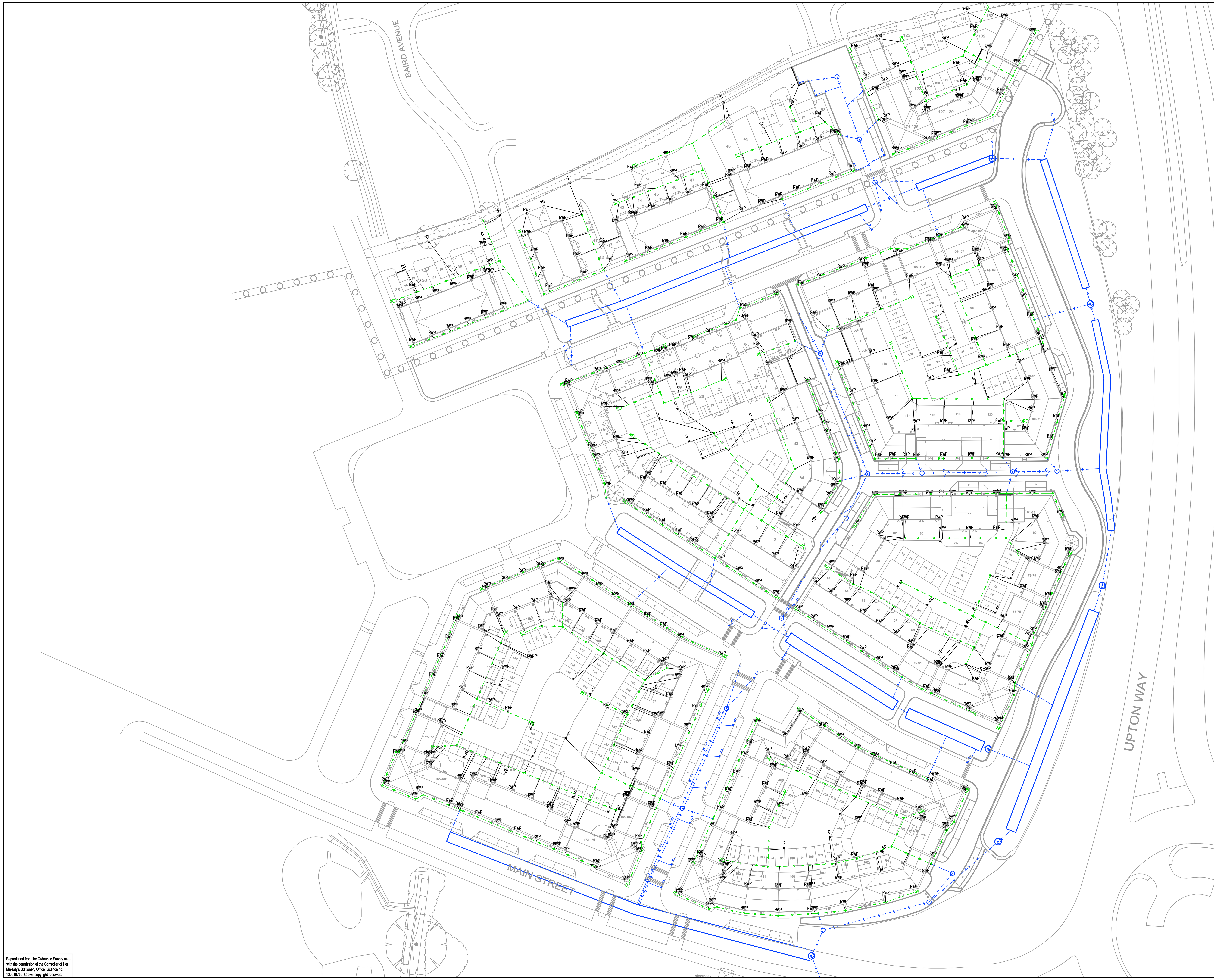
ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: MEDIUM SITE (KM8) SURFACE WATER DRAINAGE NETWORK - ALTERNATIVE INFILTRATION DESIGN

SCALE @ A3: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-019	DESIGN-DRAWN: TSH	DATE: June 2013
PROJECT No: 50600471	DRAWING No: 0471/D/019	REV: I

N:\50600471 - DEFRA - WT1505 EVIDENCE COSTS\E MODELS AND DRAWINGS\DEVELOPMENT\LARGE (UPTON)\AUTOCAD\D DRAINAGE\0471-D-016.DWG 02/07/2013 14:43:04 Sims-Harris, Theo



DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = .609ha
   LIMITING DISCHARGE = N/A
   MAXIMUM DISCHARGE = --.-l/s
4. PERMEABLE PAVING INFORMATION:
   TOTAL PAVED AREA =
   DEPTH OF SUB-BASE =
   INFILTRATION RATE =
   AVAILABLE STORAGE =

KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC – PRIVATE (450ø min.)
- PLASTIC IC – ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY– 450x900dp (YARD GULLY– 225x585dp)
- BRICK CATCHPIT – ADOPTED (600 x 450min.)
- PERMEABLE PAVING
- PRECAST CONCRETE BOX CULVERT

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

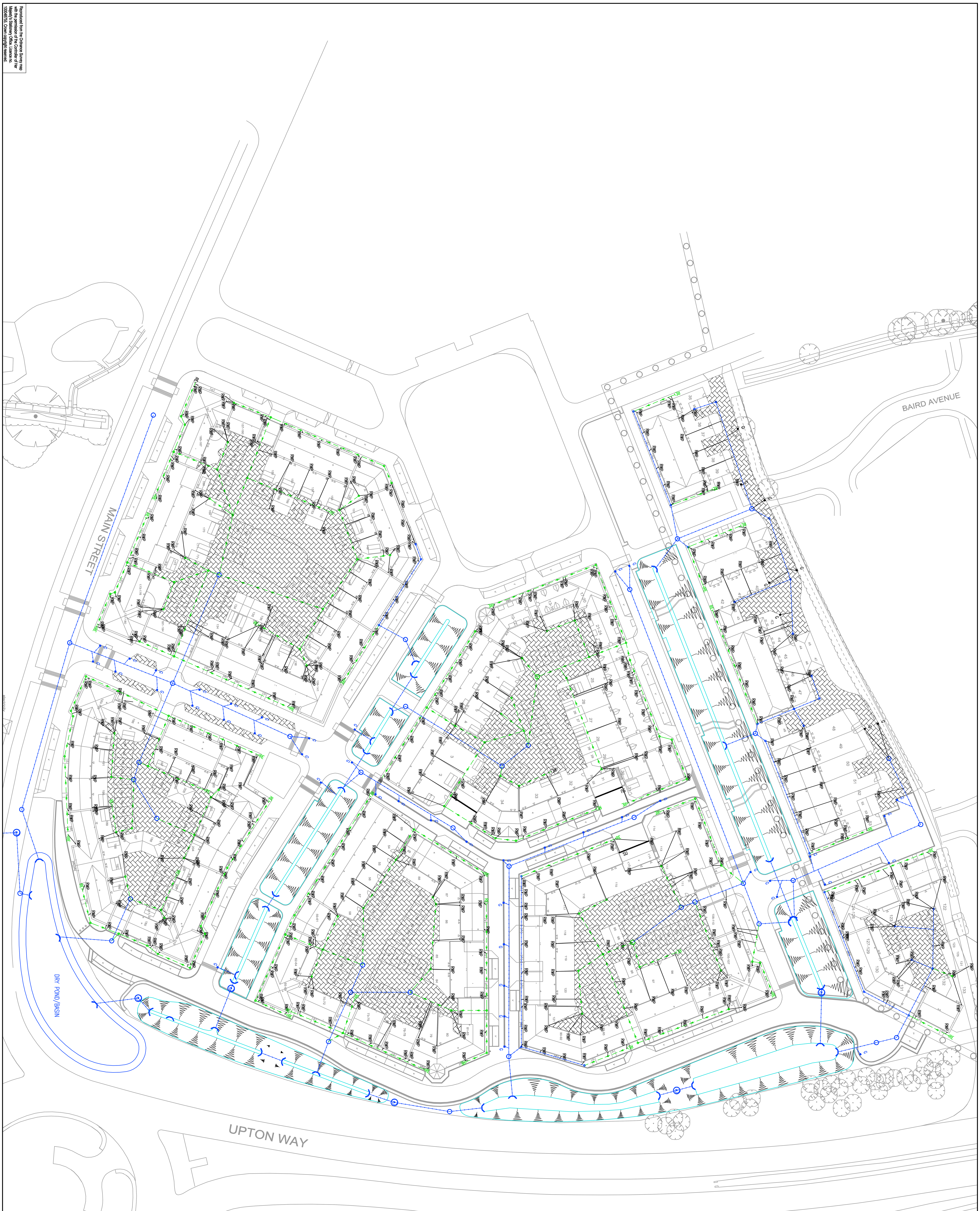
CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: LARGE SITE (UPTON) SURFACE WATER NETWORK - BUILDING REGULATIONS COMPLIANT

SCALE @ A1: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-016	DESIGN-DRAWN: OJF	DATE: February 2013
PROJECT No: 50600471	DRAWING No: 0471/D/016	REV: I



DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = .609ha
   LIMITING DISCHARGE = N/A
   MAXIMUM DISCHARGE= --.-l/s
4. PERMEABLE PAVING INFORMATION:
   TOTAL PAVED AREA =
   DEPTH OF SUB-BASE =
   INFILTRATION RATE =
   AVAILABLE STORAGE =
5. HISTORICAL SITE USED OFF-SITE POND FOR ATTENUATION. THE SOUTHERN POND/BASIN HAS BEEN USED TO REPLACE THE BOX CULVERTS AND PROVIDE INTERCEPTION STORAGE AND SECONDARY TREATMENT TO MAIN STREET AND SOUTHERN ROADS

KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC - PRIVATE (450ø min.)
- PLASTIC IC - ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY- 450x900dp (YARD GULLY- 225x585dp)
- BRICK CATCHPIT - ADOPTED (600 x 450min.)
- PERMEABLE PAVING

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

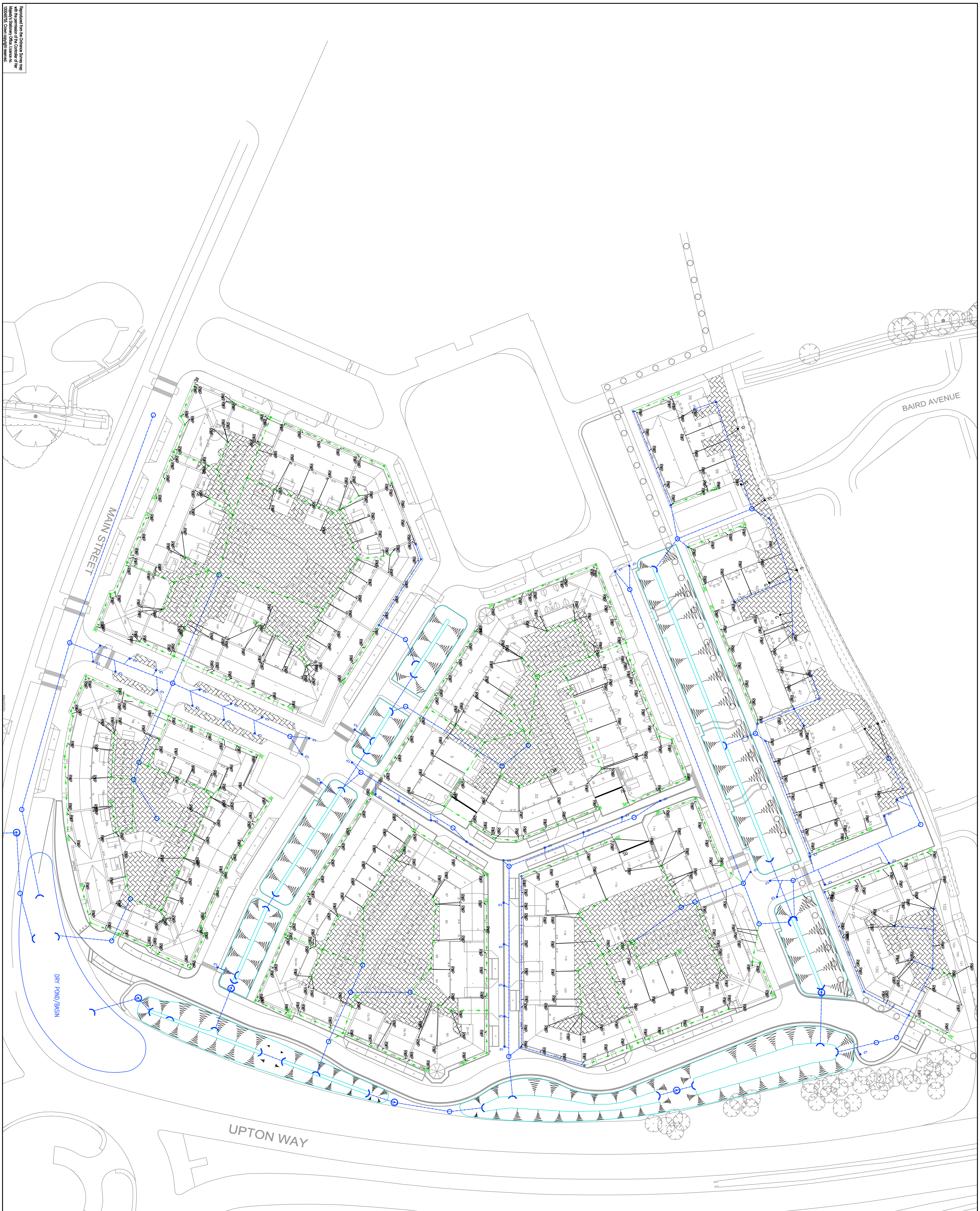
TITLE: LARGE SITE (UPTON) SURFACE WATER NETWORK - SUDS BASIC COMPLIANT

SCALE @ A1:	CHECKED:	APPROVED:
1:500	OJF	AA

CAD FILE:	DESIGN-DRAWN:	DATE:
0471-D-022	TSH	June 2013

PROJECT No:	DRAWING No:	REV:
50600471	0471/D/022	I

N:\50600471 - DEFRA - WT1505 EVIDENCE COSTS\E MODELS AND DRAWINGS\DEVELOPMENT\LARGE (UPTON)\AUTOCAD\D DRAINAGE\0471-D-022.DWG 01/08/2013 11:58:51 Sims-Harris, Theo



DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, CALCULATIONS AND SPECIFICATIONS
3. SURFACE WATER DESIGN INFORMATION:
   SITE AREA = 1.006ha
   IMPERMEABLE AREA = .609ha
   LIMITING DISCHARGE = N/A
   MAXIMUM DISCHARGE= --.-l/s
4. PERMEABLE PAVING INFORMATION:
   TOTAL PAVED AREA =
   DEPTH OF SUB-BASE =
   INFILTRATION RATE =
   AVAILABLE STORAGE =
5. HISTORICAL SITE USED OFF-SITE POND FOR ATTENUATION. THE SOUTHERN POND/BASIN HAS BEEN USED TO REPLACE THE BOX CULVERTS AND PROVIDE INTERCEPTION STORAGE AND SECONDARY TREATMENT TO MAIN STREET AND SOUTHERN ROADS

KEY:

- PLASTIC ACCESS CHAMBER (300ø min.)
- PLASTIC IC - PRIVATE (450ø min.)
- PLASTIC IC - ADOPTED (450ø min.)
- PCC MANHOLE (1200ø min.)
- PCC MANHOLE+HYDROBRAKE OR EQUIVALENT (1500ø min.)
- RWP CONNECTION
- PRIVATE DRAIN
- PUBLIC SEWER
- PERFORATED PIPE
- SU LINEAR DRAINAGE CHANNEL (WITH SUMP UNIT)
- G YG ROAD GULLY- 450x900dp (YARD GULLY- 225x585dp)
- BRICK CATCHPIT - ADOPTED (600 x 450min.)
- PERMEABLE PAVING

REV	DATE	BY	DESCRIPTION	CHK	APD
I	02/07/13	TSH	REPORT ISSUE	OJF	AA

DRAWING STATUS: FOR INFORMATION ONLY

WSP
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
http://www.wspgroup.com

CLIENT: DEFRA

ARCHITECT: N/A

PROJECT: DEFRA - WT1505 COST EVIDENCE OF NEW SEWERAGE SYSTEMS

TITLE: LARGE SITE (UPTON) SURFACE WATER NETWORK - SUDS BASIC COMPLIANT

SCALE @ A1: 1:500	CHECKED: OJF	APPROVED: AA
CAD FILE: 0471-D-022	DESIGN-DRAWN: TSH	DATE: June 2013
PROJECT No: 50600471	DRAWING No: 0471/D/022	REV: J

APPENDIX C

Costing Schedules – Capital and Maintenance

Small

Medium

Large

Small site - Building Regulations

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33

	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00
Manholes in shared access/parking	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,434.15	£1,434.15
	1500mm diameter x 2500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,443.53	£2,443.53
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	1	£2,690.85	£2,690.85
	1800mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page230	No	1	£3,070.85	£3,070.85
	Extra over for 300mm concrete surround 2000 - 1500 depth	Assume approx x 2.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	2	£211.63	£423.26
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	4	£375.60	£1,502.40
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	7	£24.35	£170.45
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	2	£24.35	£48.70
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	4	£24.35	£97.40
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00

	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25
Private drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	95	£26.36	£2,504.20
150mm dia	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2.5m deep			14	£60.82	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	60	£24.35	£1,461.00
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	57	£26.36	£1,502.52
RWP connections under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	0	£26.36	£0.00
	Extra over for backfill with Type 1		m^3	0	£24.35	£0.00
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	131	£26.36	£3,453.16
Over size pipes for storage	600mm diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page210 pro rata 525mm and 750mm	m	17	£100.28	£1,704.76
	750mm diameter diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page211	m	10	£130.82	£1,308.20
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£3.20	£905.60

	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£7.36	£655.04
	Imported granular material - 150mm deep bed for 600mm dia pipe	Civil Engineering and Highway Works Page238		17	£19.44	£330.48
	Imported granular material - 150mm deep bed for 750mm dia pipe	Civil Engineering and Highway Works Page238		10	£21.62	£216.20
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£10.49	£2,968.67
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£14.33	£1,275.37
	Imported granular material - 150mm deep surround for 600mm dia pipe	Civil Engineering and Highway Works Page238		17	£57.26	£973.42
	Imported granular material - 150mm deep surround for 750mm dia pipe	Civil Engineering and Highway Works Page238		10	£72.54	£725.40
Ancilliaries						
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	24	£170.00	£4,080.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	6	£180.00	£1,080.00
Yard gullies	Gullies PVC -U - complete inc cover and frame - Yard Gulley	External Works and Landscape Page 110	No	2	£340.00	£680.00
						£0.00
Flow controls - orifice plates	Assume it takes a drainage/pipework gang one day in total for each control to build a brickwork or simple concrete wall in the MH and bolt a steel plate to it with orifice plates	Civil Engineering and Highway Works Page 200	hours	16	£71.13	£1,138.08
		Total Cost for comparison purposes - Small site Building Regulations				£54,477.55

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Small site - Building Regulations limited to one outfall

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33

	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00
Manholes in shared access/parking	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,434.15	£1,434.15
	1500mm diameter x 2500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,443.53	£2,443.53
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	1	£2,690.85	£2,690.85
	1800mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page230	No	1	£3,070.85	£3,070.85
	Extra over for 300mm concrete surround 2000 - 1500 depth	Assume approx x 2.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	2	£211.63	£423.26
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	4	£375.60	£1,502.40
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	7	£24.35	£170.45
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	2	£24.35	£48.70
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	4	£24.35	£97.40
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00

	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25
Private drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	95	£26.36	£2,504.20
150mm dia	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2.5m deep			14	£60.82	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	60	£24.35	£1,461.00
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	57	£26.36	£1,502.52
RWP connections under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	0	£26.36	£0.00
	Extra over for backfill with Type 1		m^3	0	£24.35	£0.00
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	131	£26.36	£3,453.16
Over size pipes for storage	600mm diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page210 pro rata 525mm and 750mm	m	34	£100.28	£3,409.52
	750mm diameter diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page211	m	20	£130.82	£2,616.40
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£3.20	£905.60

	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£7.36	£655.04
	Imported granular material - 150mm deep bed for 600mm dia pipe	Civil Engineering and Highway Works Page238		34	£19.44	£660.96
	Imported granular material - 150mm deep bed for 750mm dia pipe	Civil Engineering and Highway Works Page238		20	£21.62	£432.40
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£10.49	£2,968.67
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£14.33	£1,275.37
	Imported granular material - 150mm deep surround for 600mm dia pipe	Civil Engineering and Highway Works Page238		34	£57.26	£1,946.84
	Imported granular material - 150mm deep surround for 750mm dia pipe	Civil Engineering and Highway Works Page238		20	£72.54	£1,450.80
Ancilliaries						
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	24	£170.00	£4,080.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	6	£180.00	£1,080.00
Yard gullies	Gullies PVC -U - complete inc cover and frame - Yard Gulley	External Works and Landscape Page 110	No	2	£340.00	£680.00
						£0.00
Flow controls - orifice plates	Assume it takes a drainage/pipework gang one day in total for each control to build a brickwork or simple concrete wall in the MH and bolt a steel plate to it with orifice plates	Civil Engineering and Highway Works Page 200	hours	8	£71.13	£569.04
		Total Cost for comparison purposes - Small site Building Regulations limited to one outfall				£59,166.97

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - SuDS Normal or Basic

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,351.15	£5,404.60
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	0	£1,434.15	£0.00
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	3	1816.15	£6,184.95
	1200mm diameter x 3000 depth to invert	Civil Engineering and Highway Works Page230	No	1	£2,061.65	£0.00
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	5	£62.15	£310.75
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0	£62.15	£0.00
	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6	£62.15	£372.90

	Extra over for 300mm concrete surround 3000 depth	x 2.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^4	3	£62.15	£186.45
Manholes in highway for separate highway drainage	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	3	£1,351.15	£4,053.45
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	3	£1,434.15	£4,302.45
	Extra over for 300mm concrete surround	Assume approx x 1.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3		£62.15	£0.00
Manholes in shared access	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	8	£1,351.15	£10,809.20
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	5	£1,434.15	£7,170.75
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,816.15	£1,816.15
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	8	£62.15	£497.20
	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	2	£62.15	£124.30
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					

Public sewer access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	29	£375.60	£10,892.40
Public sewer access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00
Catchpit in shared access/drive and highway for separate highway drainage- 450 x 600 min brickwork	Manhole 750 by 700 chamber brickwork 1000mm depth to invert	Civil Engineering and Highway Works Page225	No	5	£1,115.00	£5,575.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	27	£24.35	£657.45
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	22	£24.35	£535.70
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	5	£32.30	£161.50
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	80	£55.83	£4,466.40
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 3m deep	Civil Engineering and Highway Works Page206	m	25	£62.49	£1,562.25
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	42	£102.65	£4,311.30
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	70	£24.35	£1,704.50

Highway drains in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	141	£91.98	£12,969.18
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page206	m	40	£102.65	£4,106.00
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	95	£24.35	£2,313.25
Public seweres in gardens/drives	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	60	£26.36	£1,581.60
	Not on microdrainage sheets		m	174	£26.36	£4,586.64
Public sewer under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	93	£26.36	£2,451.48
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	55	£51.48	£2,831.40
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	97	£86.35	£8,375.95
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne2m deep	Civil Engineering and Highway Works Page218	m	41	£90.34	£3,703.94
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page218	m	24	£96.99	£2,327.76
Porous pipe into permeable pavement	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	76	£22.91	£1,741.16
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	277	£26.36	£7,301.72
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	332	£3.20	£1,062.40
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	160	£7.36	£1,177.60

	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	385	£9.34		
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	332	£10.49	£3,482.68	
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	160	£14.33	£2,292.80	
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	385	£18.53	£7,134.05	
Other SUDS Items							
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Normal construction						
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	770	£28.95		£22,291.50
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	462	£32.70		£15,107.40
	100mm base	Civil Engineering and Highway Works Page 280	m^2	3080	£13.92		£42,873.60
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	3080	£8.41		£25,902.80
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	3080	£9.73		£29,968.40
		Total					£136,143.70
	Permeable paving construction						
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	3080	£20.32		£62,585.60
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	3080	£27.99		£86,209.20
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£148,794.80
	Extra over cost from above for permeable pavement					£12,651.10	
Flow controls - orifice plates	Assume it takes a drainage/pipework gang one day in total for each control to build a brickwork or simple concrete wall in the MH and bolt a steel plate to it with orifice plates	Civil Engineering and Highway Works Page 200	hours	40	£71.13	£2,845.20	
Flow controls - hydro brakes		Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	2	£2,500.00	£5,000.00	
		Total Cost for comparison purposes - Medium site SuDS Normal or Basic				£163,108.26	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Small site - SfA 7 limited to one outfall

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x $1.17m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x $1.56m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33

	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00
Manholes in shared access/parking	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,434.15	£1,434.15
	1500mm diameter x 2500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,443.53	£2,443.53
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	1	£2,690.85	£2,690.85
	1800mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page230	No	1	£3,070.85	£3,070.85
	Extra over for 300mm concrete surround 2000 - 1500 depth	Assume approx x 2.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	2	£211.63	£423.26
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	7	£375.60	£2,629.20
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	6	£375.60	£2,253.60
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	13	£24.35	£316.55
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	2	£24.35	£48.70
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	9	£24.35	£219.15
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	6	£350.00	£2,100.00

	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25
Private drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	95	£26.36	£2,504.20
150mm dia	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2.5m deep			14	£60.82	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	60	£24.35	£1,461.00
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	57	£26.36	£1,502.52
RWP connections under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	0	£26.36	£0.00
	Extra over for backfill with Type 1		m^3	0	£24.35	£0.00
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	131	£26.36	£3,453.16
Over size pipes for storage	600mm diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page210 pro rata 525mm and 750mm	m	34	£100.28	£3,409.52
	750mm diameter diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page211	m	20	£130.82	£2,616.40
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£3.20	£905.60

	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£7.36	£655.04
	Imported granular material - 150mm deep bed for 600mm dia pipe	Civil Engineering and Highway Works Page238		34	£19.44	£660.96
	Imported granular material - 150mm deep bed for 750mm dia pipe	Civil Engineering and Highway Works Page238		20	£21.62	£432.40
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£10.49	£2,968.67
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£14.33	£1,275.37
	Imported granular material - 150mm deep surround for 600mm dia pipe	Civil Engineering and Highway Works Page238		34	£57.26	£1,946.84
	Imported granular material - 150mm deep surround for 750mm dia pipe	Civil Engineering and Highway Works Page238		20	£72.54	£1,450.80
Ancilliaries						
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	24	£170.00	£4,080.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	6	£180.00	£1,080.00
Yard gullies	Gullies PVC -U - complete inc cover and frame - Yard Gulley	External Works and Landscape Page 110	No	2	£340.00	£680.00
						£0.00
Flow controls - hydrobrakes	Hydro brakes	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	1	£2,500.00	£2,500.00
		Total Cost for comparison purposes - Small site SfA 7 limited to one outfall				£65,394.98

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Small site - SfA 7

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33

	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00
Manholes in shared access/parking	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,434.15	£1,434.15
	1500mm diameter x 2500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,443.53	£2,443.53
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	1	£2,690.85	£2,690.85
	1800mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page230	No	1	£3,070.85	£3,070.85
	Extra over for 300mm concrete surround 2000 - 1500 depth	Assume approx x 2.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	0	£211.63	£0.00
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	6	£375.60	£2,253.60
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	9	£375.60	£3,380.40
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	13	£24.35	£316.55
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	2	£24.35	£48.70
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	9	£24.35	£219.15
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	9	£350.00	£3,150.00

	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25
Private drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	95	£26.36	£2,504.20
150mm dia	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2.5m deep			14	£60.82	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	60	£24.35	£1,461.00
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	57	£26.36	£1,502.52
RWP connections under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	0	£26.36	£0.00
	Extra over for backfill with Type 1		m^3	0	£24.35	£0.00
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	131	£26.36	£3,453.16
Over size pipes for storage	600mm diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page210 pro rata 525mm and 750mm	m	17	£100.28	£1,704.76
	750mm diameter diameter concrete pipes to BS5911 Class 120 excavation and supports and backfilling ne 1.5m	Civil Engineering and Highway Works Page211	m	10	£130.82	£1,308.20
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£3.20	£905.60

	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£7.36	£655.04
	Imported granular material - 150mm deep bed for 600mm dia pipe	Civil Engineering and Highway Works Page238		17	£19.44	£330.48
	Imported granular material - 150mm deep bed for 750mm dia pipe	Civil Engineering and Highway Works Page238		10	£21.62	£216.20
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	283	£10.49	£2,968.67
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	89	£14.33	£1,275.37
	Imported granular material - 150mm deep surround for 600mm dia pipe	Civil Engineering and Highway Works Page238		17	£57.26	£973.42
	Imported granular material - 150mm deep surround for 750mm dia pipe	Civil Engineering and Highway Works Page238		10	£72.54	£725.40
Ancilliaries						
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	24	£170.00	£4,080.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	6	£180.00	£1,080.00
Yard gullies	Gullies PVC -U - complete inc cover and frame - Yard Gulley	External Works and Landscape Page 110	No	2	£340.00	£680.00
						£0.00
Flow controls - hydrobrakes	Hydro brakes	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	2	£2,500.00	£5,000.00
		Total Cost for comparison purposes - Small site SfA 7				£64,014.46

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Small site - SuDS Extra

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements					
	Precast concrete construction with *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels*					
	Step irons at 300mm centre, doubled if depth to invert exceeds 3m					
	Heavy duty manhole cover and frame *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33
	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00

Manholes in shared access/parking	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1500mm diameter x 1500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£1,813.53	£1,813.53
	1500mm diameter x 2000 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,062.50	£2,062.50
	Extra over for 300mm concrete surround	Assume approx x 1.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	4.5	£62.15	£279.68
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	31	£375.60	£11,643.60
Catchpit in shared access/drive - 450 x 600 min brickwork	Manhole 750 by 700 chamber brickwork 1000mm depth to invert	Civil Engineering and Highway Works Page225	No	4	£1,115.00	£4,460.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	27	£24.35	£657.45
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	22	£24.35	£535.70
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25
Main conveyance drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	64	£26.36	£1,687.04
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	30	£26.36	£790.80

Porous pipe stubs into permeable pavement and raingardens	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	89	£22.91	£2,038.99	
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	112	£26.36	£2,952.32	
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	206	£3.20	£659.20	
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	75	£7.36	£552.00	
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	206	£10.49	£2,160.94	
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	75	£14.33	£1,074.75	
Other SUDS Items							
Rain gardens	Excavate 0.5m by 2m by 3m - Excavating mechanical to reduced levels with JCB 3CX ne 1m	External works and landscape page 153	m^3	3	£3.60		£10.80
	Place topsoil/rootzone 0.25m filling obtained off site planting quality topsoil thickness less than 0.25m	External works and landscape page 155	m^3	1.5	£38.23		£57.35
	planting - herbaceous and ground cover planting 6 plants /m2	External works and landscape page 289	m^2	6	£11.10		£66.60
	Total for one raingarden						£134.75
	Rain gardens		No	13	£134.75	£1,751.69	
Swales	15m long 1.5m deep 1 in 3 slopes, 1m base, underdrain						
	Excavation up to 2m depth	Civil Engineering and Highway Works Page 162	m^3	124	£5.75	£713.00	
	Trimming	Civil Engineering and Highway Works Page 164	m^2	150	£1.80	£270.00	
	Import topsoil	External works and landscape page 246	m^3	23	£33.60	£772.80	
	Spread and lightly consolidate topsoil 150mm depth	External works and landscape page 246 rate per 100m2	m^2	150	£1.13	£169.50	
	Import turf		m^2	15	£3.04	£45.60	
	Planting - turf in base road verge quality	External works and landscape page 253	m^2	15	£0.77	£11.55	

	Planting sides - grass seed	External works and landscape page 246 rate per 100m2	m^2	135	£0.32	£43.20	
	Erosion protection	Civil Engineering and Highway Works Page 162	m^2	135	£6.39	£862.65	
	Initial maintenance etc not included as this would be required with B Regs scheme as the space is an open grassed area.						
Underdrain to swale							
Perforated pipe	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	15	£26.36	£395.40	
Pipe bedding	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	15	£7.36	£110.40	
Pipe surround	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	15	£14.33	£214.95	
	Additional excavation up to 2m depth assume 1m wide undedrain to 0.6m below base of swale	Civil Engineering and Highway Works Page 162	m^3	9	£5.75	£51.75	
	Granular material below base - assume rate for Type 1, 450mm depth (below 150mm topsoil)		m^3	9	£24.35	£219.15	
	Geotextile surround to underdrain	Civil Engineering and Highway Works Page 170	m^2	48	£3.92	£188.16	
		Total for swale					£4,068.11
Green roofs	Extensive green roof Low maintenance sedum system for flat roof - all inc rate for membranes, filters, drainage layer, substrate and sedum mat	External works and landscape page 297	m^2	126	£52.49	£6,613.74	
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Cost for normal pavement construction						
	Total depth of construction 590mm						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	367.57	£5.75		£2,113.53
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	155.75	£28.95		£4,508.96
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	93.45	£32.70		£3,055.82
	100mm base	Civil Engineering and Highway Works Page 280	m^2	623	£13.92		£8,672.16
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	623	£8.41		£5,239.43
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	623	£9.73		£6,061.79
		Total					£29,651.69
	Cost for permeable paving construction						

	Total depth of construction 480mm (ignore 150mm capping requirement - main reason for this is to act as blinding for membrane which is assumed not to be required)						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	299.04	£5.75		£1,719.48
	Bardon Drainagg for sub-base place and compact 350mm	External works and landscape page 216	m^2	623	£15.62		£9,731.26
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	623	£27.99		£17,437.77
	Base waterproof liner supply and install	Typical market rates	m^2	623	£5.00		£3,115.00
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£32,003.51
	Extra over cost from above for permeable pavement	Cost difference between normal pavement construction and permeable pavement construction				£2,351.83	
Rainwater harvesting	900 litres minimum - SEL Skeletank system - shallow rainwater harvesting tank for use below gardens, patios, driveways. 3 units inc pumps and filters	Manufacturer quote - merchants price	No	3	£1,500.00	£4,500.00	
	Installation - 2 gang hours each	Civil Engineering and Highway Works Page 200	hours	6	£71.13	£426.78	
	Excavate 0.5m by 1m by 1m - Excavating mechanical to reduced levels with JCB 3CX ne 1m	External works and landscape page 153	m^3	1.5	£3.60	£5.40	
	Gravel regulating layer 100mm thick	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	0.3	£24.35	£7.31	
	Minimal filling around sides required and patio construction direct on top of tank.						
	Additional pipework in house assume 15m per house Copper pipes to EN 1057	Civil Engineering and Highway Works Page 351	m	45	£7.53	£338.85	
	Header tank in house polyethylene cold water feed	Civil Engineering and Highway Works Page 351	No	3	£50.55	£151.65	
	Misc fittings in house	From PhD study at Bradford Uni on WLC of RWH systems	No	3	£270.00	£810.00	
		Total for rainwater harvesting					£6,239.99
Flow controls - orifice plates	Assume it takes a drainage/pipework gang one day in total for each control to build a brickwork or simple concrete wall in the MH and bolt a steel plate to it with orifice plates	Civil Engineering and Highway Works Page 200	hours	16	£71.13	£1,138.08	
Additional design costs	Assumed additional design costs of 2% of capital cost of extra items to fully comply with National Standards					£373.47	
		Total Cost for comparison purposes - Small site SuDS Extra				£70,817.70	

Note - if hydro brake used the cost for the flow controls increases to	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	2	£2,500.00	£5,000.00

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification.
The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Small site - SuDS Normal

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	0		
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	1.2	£62.15	£74.58
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6.2	£62.15	£385.33
	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	0		£0.00

Manholes in shared access/parking	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	1	£1,351.15	£1,351.15
	1500mm diameter x 1500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£1,813.53	£1,813.53
	1500mm diameter x 2000 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,062.50	£2,062.50
	Extra over for 300mm concrete surround	Assume approx x 1.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	4.5	£62.15	£279.68
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	12	£375.60	£4,507.20
Catchpit in shared access/drive - 450 x 600 min brickwork	Manhole 750 by 700 chamber brickwork 1000mm depth to invert	Civil Engineering and Highway Works Page225	No	4	£1,115.00	£4,460.00
Access Chamber in shared access/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	5	£375.60	£1,878.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	15	£24.35	£365.25
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	12	£24.35	£292.20
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	5	£350.00	£1,750.00
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	75	£55.83	£4,187.25
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	75	£24.35	£1,826.25

Main conveyance drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	64	£26.36	£1,687.04	
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	30	£26.36	£790.80	
Porous pipe stubs into permeable pavement and raingardens	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	89	£22.91	£2,038.99	
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	112	£26.36	£2,952.32	
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	206	£3.20	£659.20	
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	75	£7.36	£552.00	
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	206	£10.49	£2,160.94	
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	75	£14.33	£1,074.75	
Other SUDS Items							
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Cost for normal pavement construction						
	Total depth of construction 590mm						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	367.57	£5.75		£2,113.53
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	155.75	£28.95		£4,508.96
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	93.45	£32.70		£3,055.82
	100mm base	Civil Engineering and Highway Works Page 280	m^2	623	£13.92		£8,672.16
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	623	£8.41		£5,239.43

	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	623	£9.73		£6,061.79
		Total					£29,651.69
	Cost for permeable paving construction Total depth of construction 480mm (ignore 150mm capping requirement - main reason for this is to act as blinding for membrane which is assumed not to be required)						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	299.04	£5.75		£1,719.48
	Bardon Drainagg for sub-base place and compact 350mm	External works and landscape page 216	m^2	623	£15.62		£9,731.26
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	623	£27.99		£17,437.77
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£28,888.51
	Extra over cost from above for permeable pavement	Difference between cost for normal pavment and cost for permeable pavement				-£763.17	
Flow controls - orifice plates	Assume it takes a drainage/pipework gang one day in total for each control to build a brickwork or simple concrete wall in the MH and bolt a steel plate to it with orifice plates	Civil Engineering and Highway Works Page 200	hours	16	£71.13	£1,138.08	
		Total Cost for comparison purposes - SuDS Normal				£44,611.61	
	Note - if hydro brake used the cost for the flow controls increases to	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	2	£2,500.00	£5,000.00	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - Building Regulations and SfA 7

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	3	£1,351.15	£4,053.45
	1200mm diameter x 3000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£2,061.65	£8,246.60
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x $1.17m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	4	£62.15	£248.60
	Extra over for 300mm concrete surround 3000 depth	x $2.34m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	10	£62.15	£621.50

Manholes in shared access/parking	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,434.15	£5,736.60
	1500mm diameter x 2500 depth to invert	Pro rata between 1200mm and 1800mm	No	1	£2,443.53	£2,443.53
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	0	£2,690.85	£0.00
	1800mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page230	No	0	£3,070.85	£0.00
	Extra over for 300mm concrete surround 2000 - 1500 depth	Assume approx x 2.5m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	13	£62.15	£807.95
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	13	£211.63	£2,751.19
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	15	£375.60	£5,634.00
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	26	£24.35	£633.10
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	6	£24.35	£146.10
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	17	£24.35	£413.95
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00
	Pipes					

Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	6	£32.30	£193.80
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	9	£46.52	£418.68
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	138	£91.98	£12,693.24
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page206	m	57	£141.30	£8,054.10
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	300	£24.35	£7,305.00
Public sewers in shared access	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	69	£26.36	£1,818.84
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	58	£51.48	£2,985.84
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 3.0m deep	Civil Engineering and Highway Works Page218	m	28	£66.13	£1,851.64
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	77	£86.35	£6,648.95
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page218	m	12	£96.99	£1,163.88
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page219	m	11	£126.68	£1,393.48
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	10	£24.35	£243.50
Public sewers in gardens/drive	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	24	£26.36	£632.64

	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	42	£51.48	£2,162.16
Private drains under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	23	£26.36	£606.28
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	230	£24.35	£5,600.50
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	100	£26.36	£2,636.00
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	333	£26.36	£8,777.88
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	555	£3.20	£1,776.00
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	137	£7.36	£1,008.32
	Imported granular material - 150mm deep bed for 2250mm dia pipe	Civil Engineering and Highway Works Page238	m	226	£9.34	£2,110.84
	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	68	£11.12	£756.16
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page240	m	555	£10.49	£5,821.95
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page240	m	137	£14.33	£1,963.21
	Imported granular material - 150mm deep surround for 225mm dia pipe	Civil Engineering and Highway Works Page240	m	226	£18.53	£4,187.78
	Imported granular material - 150mm deep surround for 300mm dia pipe	Civil Engineering and Highway Works Page240	m	68	£24.38	£1,657.84
Ancilliaries						
	Attenuation tanks up to 2.5m depth.					

	Excavation up to 2.5m depth assuming 0.5m working space	Civil Engineering and Highway Works Page 162	m^3	675	£9.92	£6,696.00
	Install and wrap Geocellular tank inc membrane	Based on consultation with manufacturers	m^3	379	£125.00	£47,375.00
	Backfill around and over tank (imported granular fill Class 6F)		m^3	296	£38.41	£11,369.36
	Compact backfill		m^3	296	£1.47	£435.12
Flow controls - hydro brakes	Hydrobrake flow control	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	2	£2,500.00	£5,000.00
Gullies	Road Gulley pre cast concrete, 450mm dia by 750mm deep set in concrete	Civil Engineering and Highway Works Page 234	No	21	£479.12	£10,061.52
		Total Cost for comparison purposes - Medium site Building Regulations and SfA 7				£198,593.28

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - SuDS Extra

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,351.15	£5,404.60
	1500mm diameter x 1500 depth to invert	Pro rata between 1200mm dia and 1800mm dia	No	1	£1,813.50	£1,813.50
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6	£62.15	£372.90
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling*					

	Disposal					
Public sewer access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	1	£375.60	£375.60
Public sewer access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00
Private sewer access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	28	£375.60	£10,516.80
Privater sewer access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	6	£375.60	£2,253.60
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	6	£350.00	£2,100.00
Catchpit in shared access/drive and highway for separate highway drainage- 450 x 600 min brickwork	Manhole 750 by 700 chamber brickwork 1000mm depth to invert	Civil Engineering and Highway Works Page225	No	11	£1,115.00	£12,265.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	32	£24.35	£779.20
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	26	£24.35	£633.10
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	50	£46.52	£2,326.00

	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	23	£24.35	£560.05	
Highway drains in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	75	£46.52	£3,489.00	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	34	£24.35	£827.90	
Private sewer under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	268	£26.36	£7,064.48	
Porous pipe into permeable pavement	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	163	£22.91	£3,734.33	
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	390	£26.36	£10,280.40	
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	821	£3.20	£2,627.20	
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	125	£7.36	£920.00	
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	821	£10.49	£8,612.29	
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	125	£14.33	£1,791.25	
Other SUDS Items							
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Cost of normal construction Total depth of construction 590mm Excavation	Civil Engineering and Highway Works Page 162	m^3	1775.9	£5.75		£10,211.43

	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	752.5	£28.95		£21,784.88
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	451.5	£32.70		£14,764.05
	100mm base	Civil Engineering and Highway Works Page 280	m^2	3010	£13.92		£41,899.20
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	3010	£8.41		£25,314.10
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	3010	£9.73		£29,287.30
		Total					£143,260.95
	Cost of permeable paving construction Total depth of construction 580mm (ignore 150mm capping requirement - main reason for this is to act as blinding for membrane which is assumed not to be required)						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	1745.8	£5.75		£10,038.35
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	3010	£20.32		£61,163.20
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	3010	£27.99		£84,249.90
	Base waterproof liner supply and install	Typical market rates	m^2	3010	£5.00		£15,050.00
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£170,501.45
	Extra over cost from above for permeable pavement	Difference between cost of normal construction and cost of permeable construction				£27,240.50	
Rainwater harvesting	Assume tanks constructed using geoecellular attenuation tanks up to 2.5m depth.	1 No tank supplying 4 No houses					
	Excavation up to 2.5m depth assuming 0.5m working space	Civil Engineering and Highway Works Page 162	m^3	126	£9.92	£1,249.92	
	Install and wrap Geocellular tank inc membrane	Based on consultation with manufacturers	m^3	60	£125.00	£7,500.00	
	Backfill around and over tank (imported granular fill Class 6F)		m^3	66	£38.41	£2,535.06	
	Compact backfill		m^3	66	£1.47	£97.02	
	Pump and filters in tank	From PhD study at Bradford Uni on WLC of RWH systems	No	1	£400.00	£400.00	
	Ring main in ground from tank to supply houses 25mm MDPE cold water pipe	External works and landscape page 392	m	15	£5.42	£81.30	
	Additional pipework in house assume 15m per house Copper pipes to EN 1057	Civil Engineering and Highway Works Page 351	m	4	£7.53	£30.12	
	Header tank in house polyethylene cold water feed	Civil Engineering and Highway Works Page 351	No	4	£50.55	£202.20	
	Misc fittings in house	From PhD study at Bradford Uni on WLC of RWH systems	No	4	£270.00	£1,080.00	
		Total for RWH					£13,175.62

Swales	Excavation up to 1m depth	Civil Engineering and Highway Works Page 162	m^3	660	£4.96	£3,273.60	
	Trimming	Civil Engineering and Highway Works Page 164	m^2	800	£1.80	£1,440.00	
	Import topsoil	External works and landscape page 246	m^3	120	£33.60	£4,032.00	
	Spread and lightly consolidate topsoil 150mm depth	External works and landscape page 246 rate per 100m2	m^2	800	£1.13	£904.00	
	Import turf		m^2	80	£3.04	£243.20	
	Planting - turf in base road verge quality	External works and landscape page 253	m^2	80	£0.77	£61.60	
	Planting sides - grass seed	External works and landscape page 246 rate per 100m2	m^2	720	£0.32	£230.40	
	Erosion protection	Civil Engineering and Highway Works Page 162	m^2	720	£6.39	£4,600.80	
	Initial maintenance etc not included as this would be required with B Regs scheme as the space is an open grassed area.						
Perforated pipe for under drain	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	80	£26.36	£2,108.80	
Pipe bedding	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	80	£7.36	£588.80	
Pipe surround	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	80	£14.33	£1,146.40	
	Additional excavation up to 1m depth assume 1m wide underdrain to 0.6m below base of swale	Civil Engineering and Highway Works Page 162	m^3	48	£4.96	£238.08	
	Granular material below base - assume rate for Type 1, 450mm depth (below 150mm topsoil)		m^3	48	£24.35	£1,168.80	
	Geotextile surround to underdrain	Civil Engineering and Highway Works Page 170	m^2	256	£3.92	£1,003.52	
		Total for swale					£21,040.00
Flow controls - hydro brakes		Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	1	£2,500.00	£2,500.00	
Additional design costs	Assumed additional design costs of 2% of capital cost of extra items to fully comply with National Standards					£684.31	
		Total Cost for comparison purposes - Medium site SuDS Extra				£144,838.83	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - SuDS basic

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	Foul manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	4	£1,351.15	£5,404.60
	1500mm diameter x 1500 depth to invert	Pro rata between 1200mm dia and 1800mm dia	No	1	£1,813.50	£1,813.50
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	6	£62.15	£372.90
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling*					

	Disposal					
Public sewer access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	1	£375.60	£375.60
Public sewer access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	2	£375.60	£751.20
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	2	£350.00	£700.00
Private sewer access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	28	£375.60	£10,516.80
Privater sewer access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	6	£375.60	£2,253.60
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	6	£350.00	£2,100.00
Catchpit in shared access/drive and highway for separate highway drainage- 450 x 600 min brickwork	Manhole 750 by 700 chamber brickwork 1000mm depth to invert	Civil Engineering and Highway Works Page225	No	2	£1,115.00	£2,230.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	32	£24.35	£779.20
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	26	£24.35	£633.10
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	50	£46.52	£2,326.00

	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	23	£24.35	£560.05	
Highway drains in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	75	£46.52	£3,489.00	
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	34	£24.35	£827.90	
Private sewer under shared access 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	268	£26.36	£7,064.48	
Porous pipe into permeable pavement	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	163	£22.91	£3,734.33	
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	390	£26.36	£10,280.40	
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	821	£3.20	£2,627.20	
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	125	£7.36	£920.00	
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	821	£10.49	£8,612.29	
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	125	£14.33	£1,791.25	
Other SUDS Items							
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Cost of normal construction Total depth of construction 590mm Excavation	Civil Engineering and Highway Works Page 162	m^3	1775.9	£5.75		£10,211.43

	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	752.5	£28.95		£21,784.88
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	451.5	£32.70		£14,764.05
	100mm base	Civil Engineering and Highway Works Page 280	m^2	3010	£13.92		£41,899.20
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	3010	£8.41		£25,314.10
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	3010	£9.73		£29,287.30
		Total					£143,260.95
	Cost of permeable paving construction Total depth of construction 580mm (ignore 150mm capping requirement - main reason for this is to act as blinding for membrane which is assumed not to be required)						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	1745.8	£5.75		£10,038.35
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	3010	£20.32		£61,163.20
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	3010	£27.99		£84,249.90
	Base waterproof liner supply and install	Typical market rates	m^2	3010	£5.00		£15,050.00
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£170,501.45
	Extra over cost from above for permeable pavement	Difference between cost of normal construction and cost of permeable construction				£27,240.50	
Flow controls - hydro brakes		Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	1	£2,500.00	£2,500.00	
		Total Cost for comparison purposes - Medium site SuDS basic				£99,903.90	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7^{th} - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7^{th} or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7^{th}.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - Building Regulations Infiltration

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Manholes connecting to Highway soakaways	Foul manhole in public highway - Assume this has to meet SfA 7 requirements					
	Precast concrete construction with *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels*					
	Step irons at 300mm centre, doubled if depth to invert exceeds 3m					
	Heavy duty manhole cover and frame *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	900mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	5	£941.82	£4,709.10
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 300mm concrete surround 1500 depth	x 0.75m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	3.75	£62.15	£233.06
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					

Public sewer access chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	7	£375.60	£2,629.20
Public sewer access chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	9	£375.60	£3,380.40
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	9	£350.00	£3,150.00
Private access chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	18	£375.60	£6,760.80
Private access chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	5	£375.60	£1,878.00
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	5	£350.00	£1,750.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	34	£24.35	£827.90
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1.5m.	m^3	28	£24.35	£681.80
	Pipes					
Highway drainage pipes	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	133		£0.00
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	90	£24.35	£2,191.50

Public sewers in shared access	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	127	£51.48	£6,537.96
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	86	£24.35	£2,094.10
Private drains under gardens/paths 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	474	£26.36	£12,494.64
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	295	£26.36	£7,776.20
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	260	£3.20	£832.00
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	769	£7.36	£5,659.84
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	260	£10.49	£2,727.40
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	769	£14.33	£11,019.77
Other SUDS Items						
Individual soakaways	PCC concrete MH 1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	11	£1,816.15	£19,977.65
	Excavation up to 2m to 5m depth	Civil Engineering and Highway Works Page 162	m^3	218	£9.92	£2,162.56
	Filling french and rubble drains with graded material 20mm stone aggregate	Civil Engineering and Highway Works Page 235	m^3	190	£58.05	£0.00
	Geotextiles drainage applications Typar SF10 - use rate for inclined at 10 - 45deg	Civil Engineering and Highway Works Page 170	m^2	389	£2.41	£937.49
Communal soakaways	PCC concrete MH 2400mm diameter x 3000 depth to invert	Civil Engineering and Highway Works Page229	No	9	£6,135.00	£55,215.00
	Excavation up to 2m to 5m depth	Civil Engineering and Highway Works Page 162	m^3	328	£9.92	£3,253.76
	Filling french and rubble drains with graded material 20mm stone aggregate	Civil Engineering and Highway Works Page 235	m^3	214	£58.05	£12,422.70
	Geotextiles drainage applications Typar SF10 - use rate for inclined at 10 - 45deg	Civil Engineering and Highway Works Page 170	m^2	480	£2.41	£1,156.80
Highway soakaways	PCC concrete MH 2400mm diameter x 4500 depth to invert	Civil Engineering and Highway Works Page229	No	5	£8,622.00	£43,110.00

	Excavation up to 2m to 5m depth	Civil Engineering and Highway Works Page 162	m^3	221	£9.92	£2,192.32
	Filling french and rubble drains with graded material 20mm stone aggregate	Civil Engineering and Highway Works Page 235	m^3	144	£58.05	£8,359.20
	Geotextiles drainage applications Typar SF10 - use rate for inclined at 10 - 45deg	Civil Engineering and Highway Works Page 170	m^2	310	£2.41	£747.10
Road Gullies	Vitrified clay set in concrete 450mm dia by 750mm deep	Civil Engineering and Highway Works Page 234	No	25	£479.12	£11,978.00
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	25	£170.00	£4,250.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	3	£180.00	£540.00
		Total Cost for comparison purposes - Medium site Building Regulations infiltration				£243,636.25
Cost if soakaways constructed using geocellular tanks (Not including Highway Soakaways)	Assume tanks constructed using geoecellular attenuation tanks up to 3.4m depth.					
	Excavation up to 2m to 5m depth	Civil Engineering and Highway Works Page 162	m^3	546	£9.92	£5,416.32
	Install and wrap Geocellular tank inc geotextile	Based on consultation with manufacturers	m^3	546	£100.00	£54,600.00
	Backfill over tank (imported granular fill Class 6F)		m^3	324	£38.41	£12,444.84
	Compact backfill		m^3	324	£1.47	£476.28
		Total cost if soakaways constructed usign geocellular tanks				£221,447.73

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Medium site - SuDS, infiltration

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden/Drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	32	£375.60	£12,019.20
Access Chamber in shared access - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	4	£375.60	£1,502.40
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	4	£350.00	£1,400.00
	Pipes					
Private drain in gardens/drives	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	169	£26.36	£4,454.84
Porous pipe into permeable pavement	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	76	£22.91	£1,741.16
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	277	£26.36	£7,301.72

Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	245	£3.20	£784.00	
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	245	£10.49	£2,570.05	
Other SUDS Items							
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Normal construction						
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	770	£28.95		£22,291.50
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	462	£32.70		£15,107.40
	100mm base	Civil Engineering and Highway Works Page 280	m^2	3080	£13.92		£42,873.60
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	3080	£8.41		£25,902.80
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	3080	£9.73		£29,968.40
		Total					£136,143.70
	Permeable paving construction						
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	3080	£20.32		£62,585.60
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	3080	£27.99		£86,209.20
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£148,794.80
	Extra over cost from above for permeable pavement					£12,651.10	
		Total Cost for comparison purposes - Medium site SuDS, infiltration				£44,424.47	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification.
The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Large site - Building Regulations

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway	SW manhole in public highway - Assume this has to meet SfA 7 requirements *Precast concrete construction with* *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels* *Step irons at 300mm centre, doubled if depth to invert exceeds 3m* *Heavy duty manhole cover and frame* *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	11	£1,351.15	£14,862.65
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	3	£1,816.15	£5,448.45
	1200mm diameter x 3500 depth to invert	Civil Engineering and Highway Works Page229	No	4	£2,061.65	£8,246.60
	1200mm diameter x 4500 depth to invert	Pro rata estimate	No	1	£2,651.00	£2,651.00
	1800mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page230	No	3	£2,690.85	£8,072.55
	1800mm diameter x 3500 depth to invert	Civil Engineering and Highway Works Page230	No	1	£4,446.85	£4,446.85
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 300mm concrete surround average 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	45	£62.15	£2,796.75
Private manholes in shared access/parking	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	11	£1,351.15	£14,862.65
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	8	£1,434.15	£11,473.20

	Extra over for 300mm concrete surround average 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	22	£62.15	£1,367.30
Access shafts to culverts	1200mm diameter x 1500 depth to invert (ie to top of culvert)	Civil Engineering and Highway Works Page 229 excluding excn, backfill, concrete based.	No	34	£906.15	£30,809.10
Private manholes in gardens/paths - deep	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	12	£1,351.15	£16,213.80
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	5	£1,434.15	£7,170.75
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	2	£1,816.15	£3,632.30
	1200mm diameter x 3500 depth to invert	Civil Engineering and Highway Works Page229	No	2	£2,061.65	£4,123.30
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	15	£211.63	£3,174.45
Access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	60	£375.60	£22,536.00
Access chamber in shared access/drive - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	16	£375.60	£6,009.60
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	78	£24.35	£1,899.30
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	5	£24.35	£121.75
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	54	£24.35	£1,314.90
	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No	16	£350.00	£5,600.00

Pipes

Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	153	£32.30	£4,941.90
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page206	m	14	£37.78	£528.92
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 3.5m deep	Civil Engineering and Highway Works Page205	m	22	£60.38	£1,328.36
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	104	£46.52	£4,838.08
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 3.5m deep	Civil Engineering and Highway Works Page206	m	26	£75.76	£1,969.76
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	64	£91.98	£5,886.72
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 3.5m deep	Civil Engineering and Highway Works Page206	m	19	£122.58	£2,329.02
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	29	£129.32	£3,750.28
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 3m deep	Civil Engineering and Highway Works Page206	m	98	£146.62	£14,368.76
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 4.5m deep	Civil Engineering and Highway Works Page206	m	35	£197.18	£6,901.30
	Concrete pipes to BS 5911 rebated flexible joints 525mm pipes in trenches ne 3m deep	Civil Engineering and Highway Works Page 210	m	48	£89.72	£4,306.56
	Concrete pipes to BS 5911 rebated flexible joints 750mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page 211	m	32	£130.82	£4,186.24
	Concrete pipes to BS 5911 rebated flexible joints 900mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page 211	m	32	£164.68	£5,269.76
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	836	£24.35	£20,356.60

Private sewers in shared access	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	252	£26.36	£6,642.72
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	147	£51.48	£7,567.56
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	115	£86.35	£9,930.25
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page219	m	10	£126.68	£1,266.80
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	311	£24.35	£7,572.85
Private drains under garden/drive 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	1574	£26.36	£41,490.64
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 2m deep		m	70	£30.35	£2,124.50
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 3.5m deep		m	13	£42.32	£550.16
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	134	£51.48	£6,898.32
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 3.5m deep		m	9	£67.45	£607.05
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	44	£86.35	£3,799.40
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page219	m	7	£126.68	£886.76
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 4.5m deep		m	32	£154.65	£4,948.80

RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	2018	£26.36	£53,194.48
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	4118	£3.20	£13,177.60
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	419	£7.36	£3,083.84
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	242	£9.34	£2,260.28
	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	209	£11.12	£2,324.08
	Imported granular material - 150mm deep bed for 525mm dia pipe	Civil Engineering and Highway Works Page238	m	48	£19.44	£933.12
	Imported granular material - 150mm deep bed for 750mm dia pipe	Civil Engineering and Highway Works Page238	m	32	£21.62	£691.84
	Imported granular material - 150mm deep bed for 900mm dia pipe	Civil Engineering and Highway Works Page238	m	32	£24.21	£774.72
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page240	m	4118	£10.49	£43,197.82
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page240	m	419	£14.33	£6,004.27
	Imported granular material - 150mm deep surround for 225mm dia pipe	Civil Engineering and Highway Works Page240	m	242	£18.53	£4,484.26
	Imported granular material - 150mm deep surround for 300mm dia pipe	Civil Engineering and Highway Works Page240	m	209	£24.38	£5,095.42
	Imported granular material - 150mm deep surround for 525mm dia pipe	Civil Engineering and Highway Works Page240	m	48	£57.26	£2,748.48
	Imported granular material - 150mm deep surround for 750mm dia pipe	Civil Engineering and Highway Works Page240	m	32	£72.54	£2,321.28
	Imported granular material - 150mm deep surround for 900mm dia pipe	Civil Engineering and Highway Works Page240	m	32	£92.36	£2,955.52
Concrete culverts						
	Concrete culverts					
	Excavation up to 2.5m depth assuming 0.5m working space	Civil Engineering and Highway Works Page 162	m^3	1616	£9.92	£16,030.72
	Excavation up to 3m depth assuming 0.5m working space		m^3	3599	£9.92	£35,702.08
	Excavation up to 4m depth assuming 0.5m working space		m^3	1968	£9.92	£19,522.56

	Type 1 blinding layer 100mm thick		m^3	126	£24.35	£3,068.10
	Culverts inc delivery and installation	Based on consultation with manufacturers and page 472				
	2m by 1.5m		m	113	£800.00	£90,400.00
	2m by 2.1m		m	129	£1,000.00	£129,000.00
	3m by 1.5m		m	140	£1,664.83	£233,076.20
	3m by 2.1m		m	99	£1,750.00	£173,250.00
	Backfill around and over culvert (imported granular fill Class 6F)		m^3	3895	£38.41	£149,606.95
	Compact backfill		m^3	3895	£1.47	£5,725.65
	Rodding eyes	Use rate for 100mm dia backdrop to manhole Page 233	No	70	£110.00	£7,700.00
Linear channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	102	£170.00	£17,340.00
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	12	£180.00	£2,160.00
Flow controls - hydro brakes	Hydrobrake flow control	Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf - increase for larger site	No	6	£3,500.00	£21,000.00
Gullies	Road Gulley pre cast concrete, 450mm dia by 750mm deep set in concrete	Civil Engineering and Highway Works Page 234	No	87	£479.12	£41,683.44
		Total Cost for comparison purposes - Large site Building Regulations				£1,440,594.03
	If used geocellular tanks instread of concrete culverts	Total volume of tank to replace culverts inc wrapping and installation, acess etc	m^3	3285	£125.00	£410,625.00
		Cost with Geocellular tanks instead of concrete culverts			Total	£1,225,492.83

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification. The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Large site - SuDS Extra

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway/access	Foul manhole in public highway - Assume this has to meet SfA 7 requirements					
	Precast concrete construction with *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels*					
	Step irons at 300mm centre, doubled if depth to invert exceeds 3m					
	Heavy duty manhole cover and frame *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	15	£1,351.15	£20,267.25
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	10	£1,434.15	£14,341.50
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	7	1816.15	£12,713.05
	1200mm diameter x 3000 depth to invert	Civil Engineering and Highway Works Page230	No	5	£2,061.65	£10,308.25
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	18	£62.15	£1,118.70
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	16	£62.15	£994.40

	Extra over for 300mm concrete surround 2500 depth	x $1.94m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	14	£62.15	£870.10
	Extra over for 300mm concrete surround 3000 depth	x $2.56m^3$ Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^4	13	£62.15	£807.95
Private manholes in gardens/paths	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	23	£1,351.15	£31,076.45
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	11	£1,434.15	£15,775.65
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	6	£1,816.15	£10,896.90
	1200mm diameter x 3000 depth to invert		No	1	£2,061.65	£2,061.65
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Private access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	65	£211.63	£13,755.95
Private access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	52	£375.60	£19,531.20
Sewer access chamber in permeable paving - 450	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	13	£211.63	£2,751.19
	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	10	£375.60	£3,756.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	120	£24.35	£2,922.00
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	26	£24.35	£633.10
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	44	£24.35	£1,071.40

	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No		£350.00	£0.00
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	57	£32.30	£1,841.10
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	121	£46.52	£5,628.92
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	182	£91.98	£16,740.36
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	83	£129.32	£10,733.56
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page206	m	71	£135.99	£9,655.29
	Concrete pipes to BS 5911 rebated flexible joints 375mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page 210	m	33	£65.74	£2,169.42
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	430	£24.35	£10,470.50
Public sewer under shared access	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	262	£26.36	£6,906.32
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	189	£51.48	£9,729.72
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2m deep		m	40	£55.51	£2,220.40
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne2m deep	Civil Engineering and Highway Works Page218	m	27	£90.34	£2,439.18
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page219	m	100	£130.67	£13,067.00

	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 3m deep	Civil Engineering and Highway Works Page219	m	18	£139.97	£2,519.46
Private drains in gardens/paths or below permeable paving	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	1318	£22.91	£30,195.38
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	141	£51.48	£7,258.68
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2m deep		m	110	£55.51	£6,106.10
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	16	£86.35	£1,381.60
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 2m deep		m	64	£90.34	£5,781.76
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page219	m	44	£126.68	£5,573.92
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	1697	£26.36	£44,732.92
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	3334	£3.20	£10,668.80
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	601	£7.36	£4,423.36
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	288	£9.34	£2,689.92
	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	315	£11.12	£3,502.80
	Imported granular material - 150mm deep bed for 375mm dia pipe	Civil Engineering and Highway Works Page238	m	33	£13.90	£458.70
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	3334	£10.49	£34,973.66
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	601	£14.33	£8,612.33
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	288	£18.53	£5,336.64

	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	315	£24.38	£7,679.70	
	Imported granular material - 150mm deep surround for 375mm dia pipe	Civil Engineering and Highway Works Page238	m	33	£33.78	£1,114.74	
Other SUDS Items							
Swales	Excavation up to 5m depth	Civil Engineering and Highway Works Page 162	m^3	2578	£9.92	£25,573.76	
	Trimming	Civil Engineering and Highway Works Page 164	m^2	3471	£1.80	£6,247.80	
	Import topsoil	External works and landscape page 246	m^3	521	£33.60	£17,505.60	
	Spread and lightly consolidate topsoil 150mm depth	External works and landscape page 246 rate per 100m2	m^2	3471	£1.13	£3,922.23	
	Import turf		m^2	3471	£3.04	£10,551.84	
	Planting - turf in base road verge quality	External works and landscape page 253	m^2	708	£0.77	£545.16	
	Planting sides - grass seed	External works and landscape page 246 rate per 100m2	m^2	2763	£0.32	£884.16	
	Erosion protection	Civil Engineering and Highway Works Page 162	m^2	2763	£6.39	£17,655.57	
	Initial maintenance etc not included as this would be required with B Regs scheme as the space is an open grassed area.						
Underdrain to swale							
Perforated pipe	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	355	£26.36	£9,357.80	
Pipe bedding	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	355	£7.36	£2,612.80	
Pipe surround	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	355	£14.33	£5,087.15	
	Additional excavation up to 5m depth assume 1m wide undedrain to 0.6m below base of swale	Civil Engineering and Highway Works Page 162	m^3	213	£9.92	£2,112.96	
	Granular material below base - assume rate for Type 1, 450mm depth (below 150mm topsoil)		m^3	159.75	£24.35	£3,889.91	
	Geotextile surround to underdrain	Civil Engineering and Highway Works Page 170	m^2	1029.5	£3.92	£4,035.64	
		Total for swale					£109,982.38
Gullies	Road Gulley pre cast concrete, 450mm dia by 750mm deep set in concrete	Civil Engineering and Highway Works Page 234	No	41	£479.12	£19,643.92	
Headwalls	Use rate for brick manhole without excavation and cover 1000m dpeth	Civil Engineering and Highway Works Page 225	No	28	£620.00	£17,360.00	

Concrete culverts							
	Concrete culverts						
	Excavation up to 2.5m depth assuming 0.5m working space	Civil Engineering and Highway Works Page 162	m^3	1220	£9.92	£12,102.40	
	Type 1 blinding layer 100mm thick		m^3	35	£24.35	£852.25	
	Culverts inc delivery and installation	Based on consultation with manufacturers and page 472					
	3m by 1.5m		m	60	£1,664.83	£99,889.80	
	3m by 1.8m		m	55	£1,750.00	£96,250.00	
	Backfill around and over culvert (imported granular fill Class 6F)		m^3	357	£38.41	£13,712.37	
	Compact backfill		m^3	357	£1.47	£524.79	
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Cost of normal pavement construction						
	Total depth of construction 590mm						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	4462.17	£5.75		£25,657.48
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	1891	£28.95		£54,744.45
	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	1134	£32.70		£37,081.80
	100mm base	Civil Engineering and Highway Works Page 280	m^2	7563	£13.92		£105,276.96
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	7563	£8.41		£63,604.83
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	7563	£9.73		£73,587.99
		Total					£359,953.51
	Cost of permeable paving construction						
	Total depth of construction 580mm (ignore 150mm capping requirement - main reason for this is to act as blinding for membrane which is assumed not to be required)						
	Excavation	Civil Engineering and Highway Works Page 162	m^3	4386.54	£5.75		£25,222.61
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	7563	£20.32		£153,680.16
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	7563	£27.99		£211,688.37
	Base waterproof liner supply and install	Typical market rates	m^2	7563	£5.00		£37,815.00
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£403,183.53
	Extra over cost from above for permeable pavement					£43,230.02	

Rainwater harvesting	6No tanks supplying 175No houses						
	Assume tanks constructed using geoecellular attenuation tanks up to 300m height at average depth 2000mm top base.	Based on consultation with manufacturers					
	Excavation up to 0.5m depth assuming 0.5m working space	Civil Engineering and Highway Works Page 162	m^3	3126	£5.75	£17,974.50	
	Install and wrap Geocellular tank inc membrane 300mm high tank and pump	Based on consultation with manufacturers	m^3	469	£125.00	£58,625.00	
	Backfill around tank (imported granular fill Class 6F)		m^3	2657	£38.41	£102,055.37	
	Compact backfill		m^3	2657	£1.47	£3,905.79	
	Pump and filters in tank	From PhD study at Bradford Uni on WLC of RWH systems	No	6	£400.00	£2,400.00	
	Ring main in ground from tank to supply houses 25mm MDPE cold water pipe	External works and landscape page 392	m	1000	£5.42	£5,420.00	
	Additional pipework in house assume 15m per house Copper pipes to EN 1057	Civil Engineering and Highway Works Page 351	m	2625	£7.53	£19,766.25	
	Header tank in house polyethylene cold water feed	Civil Engineering and Highway Works Page 351	No	175	£50.55	£8,846.25	
	Misc fittings in house	From PhD study at Bradford Uni on WLC of RWH systems	No	175	£270.00	£47,250.00	
		Total for rainwater harvesting					£266,243.16
Flow controls - hydro brakes		Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	6	£2,500.00	£15,000.00	
Linear drainage channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	12	£170.00	£2,040.00	
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	3	£180.00	£540.00	
Additional design costs	Assumed additional design costs of 2% of capital cost of extra items to fully comply with National Standards					£7,524.51	
		Total Cost for comparison purposes - Large site SuDS Extra				£1,145,160.54	
	If used geocellular tanks instread of concrete culverts	Total volume of tank to replace culverts inc wrapping and installation, acess etc	m^3	862	£125.00	£107,750.00	
		Cost with Geocellular tanks instead of concrete culverts - SuDS Extra				£1,029,578.93	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification.
The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Large site - SuDS normal

Item No	Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
	Manholes					
Main sewer manholes in highway/access	Foul manhole in public highway - Assume this has to meet SfA 7 requirements					
	Precast concrete construction with *Circular shafts* *150mm plain concrete C15/20 surround* *225mm plain concrete C20/20 base slab* *Precast reducing slab* *Precast top slab* *Maximum ht of working chamber 2m above benching* *750mm diameter access shaft* *Plain concrete C15/20 benching, 150mm clay main channel longitudinally and two 100mm branch channels*					
	Step irons at 300mm centre, doubled if depth to invert exceeds 3m					
	Heavy duty manhole cover and frame *In manholes over 6m deep, landings at maximum intervals* *Includes excavation, support, backfilling and disposal*					
	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	18	£1,351.15	£24,320.70
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	10	£1,434.15	£14,341.50
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	7	1816.15	£12,713.05
	1200mm diameter x 3000 depth to invert	Civil Engineering and Highway Works Page230	No	5	£2,061.65	£10,308.25
	Extra over for concrete surround to meet SfA 7 requirement to GEN3 aggresive ground conditions	None - this is a typical foundation mix.				
	Extra over for 1200mm min dia access shaft to meet SfA 7 requirements	No difference as depths are too shallow to require access shaft				
	Extra over for 300mm concrete surround 1500 depth	x 1.17m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	18	£62.15	£1,118.70
	Extra over for 300mm concrete surround 2000 depth	x 1.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	16	£62.15	£994.40

	Extra over for 300mm concrete surround 2500 depth	x 1.94m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^3	14	£62.15	£870.10
	Extra over for 300mm concrete surround 3000 depth	x 2.56m^3 Rate for mass concrete PC for concrete stool and thrust blocks Page 241. Only materials allowed for - extra cost of placing wider concrete surround is marginal.	m^4	13	£62.15	£807.95
Private manholes in gardens/paths	1200mm diameter x 1500 depth to invert	Civil Engineering and Highway Works Page229	No	23	£1,351.15	£31,076.45
	1200mm diameter x 2000 depth to invert	Civil Engineering and Highway Works Page229	No	11	£1,434.15	£15,775.65
	1200mm diameter x 2500 depth to invert	Civil Engineering and Highway Works Page229	No	6	£1,816.15	£10,896.90
	1200mm diameter x 3000 depth to invert		No	1	£2,061.65	£2,061.65
	Inspection chambers *Inspection chambers polypropylene (Hepworth plc)* *Up to 1.2m deep including polymer chamber and cover and frame with screw down lid* *Excavation* *Backfilling* *Disposal*					
Private access Chamber in Garden - 300	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	65	£211.63	£13,755.95
Private access Chamber in Garden - 450	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	52	£375.60	£19,531.20
Sewer access chamber in permeable paving - 450	Inspection chamber 300mm diameter, 600mm deep	Landscaping and external works Page 365	No	13	£211.63	£2,751.19
	Inspection chamber 450mm diameter, 1200mm deep	Landscaping and external works Page 365, 475mm dia chamber	No	10	£375.60	£3,756.00
	Extra over for granular base	Page 279 Type 1 use material cost only as cost of laying is marginal.	m^3	120	£24.35	£2,922.00
	Extra over for 300mm Type 1 surround 600mm deep	Assume average depth of ICs is 0.6m.	m^3	26	£24.35	£633.10
	Extra over for 300mm Type 1 surround 1200mm deep	Assume average depth of ICs is 1m.	m^3	44	£24.35	£1,071.40

	Extra over for inspection chamber located in area subject to vehicle loading. Iron frame and cover	Those in shared access driveway and parking use rate for access cover and frame for concrete manholes (£350). Note a few ICs exceed 1200mm deep but this will not signficantly affect costs	No		£350.00	£0.00
	Pipes					
Public sewers in road	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 100mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	57	£32.30	£1,841.10
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 150mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	121	£46.52	£5,628.92
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page205	m	282	£91.98	£25,938.36
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page206	m	83	£129.32	£10,733.56
	Vitrified clay pipes to BSEN295 plain ends with push fit polypropylene couplings 300mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page206	m	71	£135.99	£9,655.29
	Concrete pipes to BS 5911 rebated flexible joints 375mm pipes in trenches ne 2.5m deep	Civil Engineering and Highway Works Page 210	m	33	£65.74	£2,169.42
	Extra over for backfill with Type 1	Use material cost only as compaction, etc remains the same.	m^3	430	£24.35	£10,470.50
Public sewer under shared access	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	262	£26.36	£6,906.32
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	189	£51.48	£9,729.72
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2m deep		m	40	£55.51	£2,220.40
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne2m deep	Civil Engineering and Highway Works Page218	m	27	£90.34	£2,439.18
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 2m deep	Civil Engineering and Highway Works Page219	m	100	£130.67	£13,067.00

	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 3m deep	Civil Engineering and Highway Works Page219	m	18	£139.97	£2,519.46
Private drains in gardens/paths or below permeable paving	Unplasticized PVC perforated pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page217	m	1318	£22.91	£30,195.38
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	141	£51.48	£7,258.68
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 160mm pipes in trenches ne 2m deep		m	110	£55.51	£6,106.10
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	16	£86.35	£1,381.60
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 225mm pipes in trenches ne 2m deep		m	64	£90.34	£5,781.76
	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 300mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page219	m	44	£126.68	£5,573.92
RWP connections predominantly in gardens or under slabs 100mm	Unplasticized PVC pipes ring seal sockets excavation and supports backfilling 6m ppe lengths 110mm pipes in trenches ne 1.5m deep	Civil Engineering and Highway Works Page218	m	1718	£26.36	£45,286.48
Pipe bedding	Imported granular material - 100mm deep bed for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	3355	£3.20	£10,736.00
	Imported granular material - 150mm deep bed for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	601	£7.36	£4,423.36
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	388	£9.34	£3,623.92
	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	315	£11.12	£3,502.80
	Imported granular material - 150mm deep bed for 375mm dia pipe	Civil Engineering and Highway Works Page238	m	33	£13.90	£458.70
Pipe surround	Imported granular material - 100mm deep surround for 100mm dia pipe	Civil Engineering and Highway Works Page238	m	3355	£10.49	£35,193.95
	Imported granular material - 150mm deep surround for 150mm dia pipe	Civil Engineering and Highway Works Page238	m	601	£14.33	£8,612.33
	Imported granular material - 150mm deep bed for 225mm dia pipe	Civil Engineering and Highway Works Page238	m	388	£18.53	£7,189.64

	Imported granular material - 150mm deep bed for 300mm dia pipe	Civil Engineering and Highway Works Page238	m	315	£24.38	£7,679.70	
	Imported granular material - 150mm deep surround for 375mm dia pipe	Civil Engineering and Highway Works Page238	m	33	£33.78	£1,114.74	
Other SUDS Items							
Swales	Excavation up to 5m depth	Civil Engineering and Highway Works Page 162	m^3	2578	£9.92	£25,573.76	
	Trimming	Civil Engineering and Highway Works Page 164	m^2	3471	£1.80	£6,247.80	
	Import topsoil	External works and landscape page 246	m^3	521	£33.60	£17,505.60	
	Spread and lightly consolidate topsoil 150mm depth	External works and landscape page 246 rate per 100m2	m^2	3471	£1.13	£3,922.23	
	Import turf		m^2	3471	£3.04	£10,551.84	
	Planting - turf in base road verge quality	External works and landscape page 253	m^2	708	£0.77	£545.16	
	Planting sides - grass seed	External works and landscape page 246 rate per 100m2	m^2	2763	£0.32	£884.16	
	Erosion protection	Civil Engineering and Highway Works Page 162	m^2	2763	£6.39	£17,655.57	
	Initial maintenance etc not included as this would be required with B Regs scheme as the space is an open grassed area.						
Dry pond/basin	Excavation up to 2m depth	Civil Engineering and Highway Works Page 162	m^3	941	£5.75	£5,410.75	
	Trimming	Civil Engineering and Highway Works Page 164	m^2	724	£1.80	£1,303.20	
	Import topsoil	External works and landscape page 246	m^3	109	£33.60	£3,662.40	
	Spread and lightly consolidate topsoil 150mm depth	External works and landscape page 246 rate per 100m2	m^2	724	£1.13	£818.12	
	Planting - grass seed	External works and landscape page 246 rate per 100m2	m^2	724	£0.32	£231.68	
	Erosion protection	Civil Engineering and Highway Works Page 162	m^2	724	£6.39	£4,626.36	
	Initial maintenance etc not included as this would be required with B Regs scheme as the space is an open grassed area.						
Gullies	Road Gulley pre cast concrete, 450mm dia by 750mm deep set in concrete	Civil Engineering and Highway Works Page 234	No	41	£479.12	£19,643.92	
Headwalls	Use rate for brick manhole without excavation and cover 1000m dpeth	Civil Engineering and Highway Works Page 225	No	31	£620.00	£19,220.00	
Permeable paving	Extra over cost of permeable paving over the cost of construction of normal pavement. Assume CBR >5%						
	Normal construction						
	Capping layer 250mm place and compact - hardcore spread and graded	Civil Engineering and Highway Works Page 280	m^3	1891	£28.95		£54,744.45

	Type 1 subbase 150mm place and compact - subbase spread and graded	Civil Engineering and Highway Works Page 279	m^3	1134	£32.70		£37,081.80
	100mm base	Civil Engineering and Highway Works Page 280	m^2	7563	£13.92		£105,276.96
	50mm dense binder	Civil Engineering and Highway Works Page 280	m^2	7563	£8.41		£63,604.83
	40mm close surf	Civil Engineering and Highway Works Page 281	m^2	7563	£9.73		£73,587.99
		Total					£334,296.03
	Permeable paving construction						
	Bardon Drainagg for sub-base place and compact 450mm	External works and landscape page 216	m^2	7563	£20.32		£153,680.16
	Permeable blocks Charcon Infilta 80mm inc laying course	External works and landscape page 217	m^2	7563	£27.99		£211,688.37
	Note edgings, basal geotextile assumed to be provided in both pavements so not costed.						
		Total					£365,368.53
	Extra over cost from above for permeable pavement					£31,072.50	
Flow controls - hydro brakes		Cost from http://www.building.co.uk/Journals/Builder_Group/Building/2006_issue_46/attachments/Cost-breakdown.pdf	No	6	£2,500.00	£15,000.00	
Linear drainage channels	Linear drainage to light vehicular area - inc Excavation channel on conrete base and surround to falls Heel guard composite black	External Works and Landscape Page 111	m	12	£170.00	£2,040.00	
Linear drainage sumps	Sump unit with sediment bucket	External Works and Landscape Page 111	No	3	£180.00	£540.00	
		Total Cost for comparison purposes - Large site SuDS normal				£643,059.48	

Assumptions

Note these comments relate to surfacewater systems in accordance with Part H and as such the pipes are no greater than 150mm and thus all manholes to be min 1200 diameter PCC Ring chambers, with 300mm of concrete surround. This is based on the common practise of over excavating the void for the manhole, and allows proper compaction of the concrete in compliance with the specification.
The cost of correct materials and methods for larger voids is likely to be similar to the notional 300 of concrete.

ICs are to be 450 plastic chambers with 300mm surround of type 1 material. Again, this thickness of surround is specified to allow proper compaction of the granular material.

All backfill to pipe runs beneath carriageways to be compacted Type 1 material.

Backfill to pipes within landscaped areas may be as-dug material

All pipe bedding assumed to be class S (full granular bed and surround)

Pipework may be clay or plastic, as long as it is compliant with the standards set out in SFA 7th - assume plastic off highway and clay in highway

Cover sizes to be in accordance with the relevant guidance document – SFA 7th or Building Regs Doc H. Note the access restriction to 450 plastic chambers in SFA 7th.

Surplus material is able to be disposed within the site

Connections to existing manhole not included - same for both options

Variation - disposal of excavagted material off site

Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
Small site					
Building regulations					
Volume of excavated material from pipe trenches		m^3	171.45		
Volume of excavated material from pavement construction		m^3	340.43		
Volume of excavated material from oversize pipes		m^3	26.52		
Total volume of excavated material		m^3	538.4		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	538	£18.63	£10,022.94
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	538	£46.50	£25,017.00
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	538	£96.00	£51,648.00
				Total	£86,687.94
SuDS Normal					
Volume of excavated material from pipe trenches		m^3	207		
Volume of excavated material from permeable pavement construction		m^3	276.96		
Total volume of excavated material		m^3	483.96		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	484	£18.63	£9,016.92
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	484	£46.50	£22,506.00
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	484	£96.00	£46,464.00
				Total	£77,986.92
	Difference SuDS Normal				-£8,701.02

Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
SuDS Extra					
Volume of excavated material from pipe trenches		m^3	207		
Volume of excavated material from permeable pavement construction		m^3	276.96		
Volume of excavated material from rain gardens		m^3	39		
Volume of excavated material from swale		m^3	133		
Total volume of excavated material		m^3	655.96		
Disposal of excavated material other than rock or artificial hard materi	SPON's Civil Engineering and Highway Works Page 164	m^3	656	18.63	12221.28
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164	m^3	656	46.5	30504
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164	m^3	656	96	62976
				Total	£105,701.28
	Difference SuDS Extra				£19,013.34

Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
Medium site					
Building regulations					
Volume of excavated material from pipe trenches		m^3	736.2		
Volume of excavated material from pavement construction		m^3	1817.2		
Volume of excavated material from geocellular tanks		m^3	379		
Total volume of excavated material		m^3	2932.4		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2932	£18.63	£54,623.16
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2932	£46.50	£136,338.00
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2932	£96.00	£281,472.00
				Total	£472,433.16
SuDS					
Volume of excavated material from pipe trenches		m^3	769.85		
Volume of excavated material from permeable pavement construction		m^3	1786.4		
		m^3			
Total volume of excavated material		m^3	2556.25		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2556	£18.63	£47,618.28
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2556	£46.50	£118,854.00
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	2556	£96.00	£245,376.00
				Total	£411,848.28
	Difference				-£60,584.88

	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
SuDS Extra					
Volume of excavated material from pipe trenches		m^3	769.85		
Volume of excavated material from permeable pavement construction		m^3	1324.4		
Volume of excavated material from RWH		m^3	126		
Volume of excavated material from swale		m^3	708		
Total volume of excavated material		m^3	2928.25		
Disposal of excavated material other than rock or artificial hard materi	SPON's Civil Engineering and Highway Works Page 164	m^3	2928	18.63	54548.64
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164	m^3	2928	46.5	136152
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164	m^3	2928	96	281088
				Total	£471,788.64
	Difference SuDS Extra				-£644.52

Assumed item from SPONs Price Book	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
Large site					
Building regulations					
Volume of excavated material from pipe trenches		m^3	3230.1		
Volume of excavated material from pavement construction		m^3	4462.17		
Volume of excavated material from culverts or geocellular tanks		m^3	7183		
Total volume of excavated material		m^3	14875.27		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	14875	£18.63	£277,121.25

Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	14875	£46.50	£691,687.50
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	14875	£96.00	£1,428,000.00
				Total	£2,396,808.75
SuDS					
Volume of excavated material from pipe trenches		m^3	2001.65		
Volume of excavated material from permeable pavement construction		m^3	4386.54		
Volume of material excavated from swales and basin		m^3	3519		
Total volume of excavated material		m^3	9907.19		
Disposal of excavated material other than rock or artificial hard material removal 15km distance by tipper	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	9907	£18.63	£184,567.41
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	9907	£46.50	£460,675.50
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164 and 165	m^3	9907	£96.00	£951,072.00
				Total	£1,596,314.91
	Difference				-£800,493.84

	SPONS Reference	Unit	Quantity	Rate (£)	Total (£)
SuDS Extra					
Volume of excavated material from pipe trenches and culverts		m^3	3221		
Volume of excavated material from permeable pavement construction		m^3	4386.54		
Volume of excavated material from RWH		m^3	3126		
Volume of excavated material from swale		m^3	2791		
Total volume of excavated material		m^3	13524.54		
Disposal of excavated material other than rock or artificial hard materia	SPON's Civil Engineering and Highway Works Page 164	m^3	13524	18.63	251952.12
Extra over for tipping charges non hazardous waste	SPON's Civil Engineering and Highway Works Page 164	m^3	13524	46.5	628866
Extra over for Landfill Tax - other material	SPON's Civil Engineering and Highway Works Page 164	m^3	13524	96	1298304
				Total	£2,179,122.12
	Difference SuDS Extra				-£217,686.63

SuDS operation and maintenance costs

	Field	Units	Default	Frequency per years	Cost per year	Data Source & Assumptions	Year that price applies to
Gullies/linear channels	Gully cleaning	nr	£9.40	0.2	£1.88	*Cost from Swindon Borough Council estimate*	*2010*
Catchpit/manholes	Catch pit cleaning	nr	£9.40	0.2	£1.88	*Cost from Swindon Borough Council estimate*	*2010*
Pipes	Pipe cleaning	£/m	£1.78	0.2	£0.36	*CESMM3 Price Database 2009, not exceeding 35% siltation, p462*	*2010*
Culverts/geocellular tanks	Cleaning	£/m^2	£5.00	0.2	£1.00		*2010*
Swales	**Annual maintenance**						
	Inspection and monitoring	nr	£51.00	1	£51.00	*SPONS External Works and Landscape 2013 2 hours x genral labour rate for maintenance (page 35) plus vehicle costs (£18 per half day)*	*2013*
	Grass mowing (dispose off site)	/100m^2	£2.36	4	£9.44	*SPONS External Works and Landscape 2013 Page313 Pedestrian operated equipment and strimming 91cm cut width removing and depositing arisings not exceeding 30 deg from horizontal*	*2013*
	Litter removal	/100m^2	£0.78	12	£9.36	*SPONS External Works and Landscape 2013 p315 collection and disposal of litter from isolated grassed area*	*2013*
	Scrub clearance (dispose off site)	/100m^2	£10.32	1	£10.32	*SPONS External Works and Landscape 2013 p315 use rate for clearing leaf and other debris from verges by hand and p315 removal of arisings from areas containing trees and shrub beds*	*2013*
	Periodic maintenance						
	Clear vegetation from swale & dispose of arisings off site	/100m	£213.79	0.2	£42.76	*SPONS External Works and Landscape 2013 p388 Ditching clear only vegetation from ditch not exceeding 1.5m deep. Dispose to soil heaps width at top 2.5m to 4m. Allow extra for disposal off site by truck. Use rate from page 315 for disposal of arisings from leaf clearance based on plan area typically if shallow. Deeper swales will be more expensive.*	*2013*
	De-silting swale	/100m	£213.79	0	£42.76	*SPONS External Works and Landscape 2013 p388 Ditching clear silt and bottom from ditch not exceeding 1.5m deep; strim back vegetation; disposing to spoil heaps; by machine. Assume 1.5-.25m wide at top*	*2013*
	Dispose silt off site	m^3	£25.89	0	£5.18	*SPONS External Works and Landscape 2013 p156 Disposal; mechanical; for rubbish mixed loads*	*2013*
Basin	**Annual maintenance**						
	Inspection and monitoring	nr	£51.00	1	£51.00	*SPONS External Works and Landscape 2013 2 hours x genral labour rate for maintenance (page 35) plus vehicle costs (£18 per half day)*	*2013*
	Grass mowing (dispose off site)	/100m^2	£2.36	4	£9.44	*SPONS External Works and Landscape 2013 Page313 Pedestrian operated equipment and strimming 91cm cut width removing and depositing arisings not exceeding 30 deg from horizontal*	*2013*
	Litter removal	/100m^2	£0.78	12	£9.36	*SPONS External Works and Landscape 2013 p315 collection and disposal of litter from isolated grassed area*	*2013*
	Scrub clearance (dispose off site)	/100m^2	£10.32	1	£10.32	*SPONS External Works and Landscape 2013 p315 use rate for clearing leaf and other debris from verges by hand and p315 removal of arisings from areas containing trees and shrub beds*	*2013*
	Periodic maintenance						
	Clear vegetation from swale & dispose of arisings off site	/100m	£213.79	0.2	£42.76	*SPONS External Works and Landscape 2013 p388 Ditching clear only vegetation from ditch not exceeding 1.5m deep. Dispose to soil heaps width at top 2.5m to 4m. Allow extra for disposal off site by truck. Use rate from page 315 for disposal of arisings from leaf clearance based on plan area typically if shallow. Deeper swales will be more expensive.*	*2013*
	De-silting swale	/100m	£213.79	0	£42.76	*SPONS External Works and Landscape 2013 p388 Ditching clear silt and bottom from ditch not exceeding 1.5m deep; strim back vegetation; disposing to spoil heaps; by machine. Assume 1.5-.25m wide at top*	*2013*
	Dispose silt off site	m^3	£25.89	0	£5.18	*SPONS External Works and Landscape 2013 p156 Disposal; mechanical; for rubbish mixed loads*	*2013*
Green roof/rain gardens	**Annual maintenance**						
	It is assumed that all maintenance on green roof would be undertaken by the householder as part of gardening/gneral maintenace activities						
RWH	**Annual maintenance**						
	Inspection and monitoring	nr	£51.00	1	£51.00	*SPONS External Works and Landscape 2013 2 hours x genral labour rate for maintenance (page 35) plus vehicle costs (£18 per half day)*	*2013*
	Periodic maintenance						
	Replace pumps		£350.00	0.1	£35.00	*Replace pump every 10 years (inc labour - £50)*	*2009*
	Replace electronic controls		£170.00	0.07	£11.90	*Replace electronic controls every 15 years (inc labour - £50)*	*2009*
Permeable paving	**Annual maintenance**						
	Weed control	/100m^2	£1.10	0.5	£0.55	*SPONS External Works and Landscape 2013 p309 mass spraying hard areas plus chemical costs page*	*2013*
	Vacuum sweeping of paving	ha	£48.48	1	£48.48	*Cost from Swindon Borough Council estimate*	*2010*
	Periodic maintenance						
	Heavy duty sweeping to remove clogged jointing material	ha	£75.00	0.04	£3.00	*Note it was previously believed that the blocks would have to be lifted, cleaned and relaid every 25 years. More recent experience has shown that the silt is trapped mainly in the upper parts of the joints and that clogged pavements can be restored using heavy duty cleaners*	*2013*
	Re apply new jointing material and vibrate into joints	m^2	£1.33	0.04	£0.05	*3mm quartzite grit at a rate of 6kg/m^2 (25kg bag will do 4m^2) and blocks vibrated after grit is placed. I ganger and 1 skilled operative plus whacker plate - re joint 100m2 per hour*	*2013*
						Annual maintenance costs	

	Small site						Medium site						Large site						
	Building Regs		SuDS Normal		SuDS Extra		Building Regs		SuDS Normal		SuDS Extra		Building Regs		SuDS Normal		SuDS Extra		
Item	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
Gully cleaning	8	£15.04					21	£39.48					99	£186.12	44	£82.72	44	£82.72	
Catch pit cleaning	17	£31.96	42	£78.96	42	£78.96	42	£78.96	64	£120.32	64	£120.32	154	£289.52	218	£409.84	218	£409.84	
Pipe cleaning	397	£141.33	370	£131.72	370	£131.72	1066	£379.50	1288	£458.53	1288	£458.53	4501	£1,602.36	4125	£1,468.50	4125	£1,468.50	
Culverts/geocellular tanks – Cleaning							220	£1,100.00					1204	£1,204.00			184	£184.00	
Swales – Inspection and monitoring					1	£51.00					1	£51.00			1	£51.00	1	£51.00	
Swales – Grass mowing (dispose off site)					150	£14.16					800	£75.52			3471	£327.66	3471	£327.66	
Swales – Litter removal					150	£14.04					800	£74.88			3471	£324.89	3471	£324.89	
Swales – Scrub clearance (dispose off site)					150	£15.48					800	£82.56			3471	£358.21	3471	£358.21	
Swales – Clear vegetation from swale & dispose of arisings off site					15	£6.41					80	£34.21			355	£151.79	355	£151.79	
Swales – De-silting swale					15	£6.41					80	£34.21			355	£151.79	355	£151.79	This would be done at the same time as clearing vegetation - so no additional cost allowed for
Swales – Dispose silt off site					0.75	£3.88					4	£0.21			17.75	£91.91	17.75	£91.91	Note it is assumed that silt would be reapplied to areas withn the site and over seeded if necessary - following Environment Agency Regulatory Position Statement - http://www.environment-agency.gov.uk/static/documents/Business/MWRP_RPS_055_Deposit_of_silt_from_SUDS_v2_Mar_2011l.
Basin – Inspection and monitoring															1	£51.00			
Basin – Grass mowing (dispose off site)															724	£68.35			
Basin – Litter removal															724	£67.77			
Basin – Scrub clearance (dispose off site)															724	£74.72			
Basin – Clear vegetation from swale & dispose of arisings off site															724	£309.57			
Basin – De-silting swale															724	£309.57			This would be done at the same time as clearing vegetation - so no additional cost allowed for
Basin – Dispose silt off site															36	£186.41			Note it is assumed that silt would be reapplied to areas withn the site and over seeded if necessary - following Environment Agency Regulatory Position Statement - http://www.environment-agency.gov.uk/static/documents/Business/MWRP_RPS_055_Deposit_of_silt_from_SUDS_v2_Mar_2011l. pdf
RWH – Inspection and monitoring					3	£153.00					1	£51.00					6	£306.00	Inspect stated number of tanks
RWH – Periodic maintenance												£0.00							
RWH – Replace pumps					3	£105.00					1	£35.00					6	£210.00	Replace in stated number of tanks
RWH – Replace electronic controls					3	£35.70					1	£11.90					6	£71.40	Replace in stated number of tanks
Permeable paving – Weed control			577	£3.17	577	£3.17			3080	£16.94	3080	£16.94			7563	£41.60	7563	£41.60	
Permeable paving – Vacuum sweeping of paving			577	£2.80	577	£2.80			3080	£14.93	3080	£14.93			7563	£36.67	7563	£36.67	
Permeable paving – Heavy duty sweeping to remove clogged jointing material			577	£0.17	577	£0.17			3080	£0.92	3080	£0.92			7563	£2.27	7563	£2.27	
Permeable paving – Re apply new jointing material and vibrate into joints			577	£30.74	577	£30.74			3080	£164.07	3080	£164.07			7563	£402.87	7563	£402.87	
Total annual cost		£188.33		£247.56		£652.65		£1,597.94		£775.71		£1,226.19		£3,282.00		£4,969.08		£4,673.10	

Frequency per year - where interval is greater than one year value in column above is 1/frequency

Note that evidence from Hopwood Park MSA is that where an observational approach is adopted the maintenance activities can be reduced in frequency from those stated.

Note for infiltration site with reduced length of pipes and number of manholes SuDS will be cheaper

Klicka här för att ange text.
Tel: +44 (0)1256 318800
Fax: +44 (0)1256 318700
www.wspgroup.co.uk