Defra's Water Availability and Quality Evidence Programme

COMPARATVE COSTINGS FOR SURFACE WATER SEWERS & SuDS

Caledonian Road Housing, Islington, London.

R&D Technical Report

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Contents

1.0 Introduction

This report provides a summary of the design and cost implications of incorporating a Sustainable Drainage System (SuDS) in comparison to a conventional drainage system for a dense urban site in Islington, London. The site has been designed following both a SuDS and conventional drainage approach to meet three different quantity parameters as set out below. This provides a broad comparison of the cost implication and wider impacts of use of SuDS versus a traditional approach on such sites.

2.0 Site description

2.1 Development description

The case study scheme is a proposed major residential development on Caledonian Road in the London Borough of Islington. The development of around 150 residential units[1] is small (0.3ha) and dense, at around 500 dwellings/ha, ranging in height predominantly between 6 and 8 stories. It includes some ground floor commercial units and a small central courtyard space. The site is a redevelopment of brownfield land in a very dense part of inner London.

2.2 Drainage characteristics

The previously developed site drained to the combined sewer which is the common condition in London and most older metropolitan areas in Britain. The discharge to the sewer would have been unattenuated at between 150 – 250 litres/sec/ha. The site is surrounded by roads on 2 sides and a railway on the third although for the purposes of this exercise an element of car parking has been shown on the NW corner.

The sub-soil is presumed to be impermeable either with clay beneath or to comprise of made up ground.

2.3 Layout characteristics

The layout uses the whole site and consists of apartment accommodation facing the Caledonian Road, western boundary and most of the northern boundary to from an enclosed courtyard. The courtyard opens to the NE where a theoretical car park and pedestrian link connects to open space.

The first consideration is to confirm the discharge location and any natural flow routes that may have survived development. The drainage was historically to the combined sewer and this is still the only option for removal of runoff. No natural flow routes remain so the flow for the site is dictated by the sewer connection.

[1] This scheme was adapted from a proposed student development so the likely equivalent number of residential units has been estimated. The drainage solution would remain the same for denser developments where the buildings were taller but the same building footprint was retained, as may be expected in other inner city contexts; in this case the principle difference would be the reduced cost per unit as the number of units increased with density.

3.0 SuDS strategy

3.1 Quantity criteria

In the past the flow rate and volume from the site would probably been unattenuated with the pipe elements designed to accommodate the 1 in 30 storm event within the drainage system.

Recently it has become more common for the flow rate from the site and the return period to be determined by the Water Company to meet new criteria. This has been changing recently as the Water Companies seek to address sewer flooding issues.

The aspiration for the redevelopment will be to control peak flows to reduce the risk of unpredictable sewer discharge or the increasingly unacceptable need for 'combined sewer overflows' or CSOs.

For the purpose of this exercise the following quantity criteria have been used.

The data for the design cases for sites in Islington with a storm return period of 1:100 years +30% are:

Rainfall calculated by FSR method with r= 0.42 and M5-60 = 20mm/h

- Outflow 150 l/s/Ha, critical storm duration 17min, critical rainfall 121.3mm/h, storage required 192m3/Ha – 19mm storage for each M^2
- Outflow 50 l/s/Ha, critical storm duration 50min, critical rainfall 59.9mm/h, storage required 350m3/Ha - 35mm storage for each M^2
- Outflow 8 l/s/Ha, critical storm duration 5.02 hours, critical rainfall 15.3mm/h, storage required 624m3/Ha – 62mm storage for each M^2

The FEH method is sometimes required by the EA but is generally considered inappropriate for small sites.

The selection of soft or infiltrating SuDS features usually results in a reduction in volume requirement by at least 5mm/ M^2 as 'interception storage' This is now allowed in this calculation.

The volume of water to be stored for each sq M is therefore:

- 150 l/s/Ha - 19mm storage for each M^2 with 5mm 'interception storage' allowed for use of SUDS techniques =14mm storage for each M^2 impermeable surface
- 50 l/s/Ha - 35mm storage for each M^2 with 5mm 'interception storage' allowed for use of SUDS techniques =30mm storage for each M^2 impermeable surface
- 8 l/s/Ha - 62mm storage for each M^2 with 5mm 'interception storage' allowed for use of SUDS techniques =57mm storage for each M^2 impermeable surface

3.2 Quality

Although the SuDS philosophy requires all pollution to be intercepted and cleaned within the 'management train' it can be argued that this is relaxed when all runoff will pass through a 'treatment works' before release to the environment. Where runoff passes through permeable surfaces a full 'treatment stage' is provided anyway and these collection techniques should be preferred over conventional runoff collection methods. All surfaces should be considered as runoff collectors to reduce the dependency on a single SuDS collection mechanism.

3.3 Amenity benefits

All SuDS surface features are considered during the design process as amenity for the community, some of which have inherent value for the community and others can be enhanced by simple changes or additions to the SuDS design.

In many cases the features used to collect and convey water could be considered landscape design features and attributing costs to them must be viewed in this way.

Amenity benefits provided by the SuDS:

- the hard surfaces both permeable and impermeable are design neutral and can be selected for landscape value as required.
- the 'bioretention planters' appear like normal landscape planters.
- the underdrained grass space also appears like normal lawn although slightly lower and with a visible overflow.
- the surface collection of runoff from the roof provides an opportunity to use surface channel conveyance with ornamental pool features if desired – these are all additional landscape features which surface water collection allows but is not necessary for a basic SuDS scheme.

3.4 Biodiversity benefits

Although biodiversity in many urban situation is difficult to justify in terms of habitat creation the value as refuelling or water stops for mobile species such as birds, bats or insects cannot be dismissed. Simple water features or the use of dense urban wetland vegetation provide a disproportionately large biodiversity value. These will be described in the following design review.

4.0 The SuDS design process

4.1 Identifying flow routes

In the case of small urban development the flow route is often determined by the SuDS designer. In the case of Caledonian Road the route is determined by the need to discharge runoff to the sewer. Therefore the SuDS and Landscape Design ensure water flows to the centre of the courtyard and travels to a collection point before discharge into the combined sewer.

The discharge to the sewer at Caledonian Road has been identified as a link into the main road where most sewers are located. Therefore all runoff must flow to the SW corner of the courtyard or otherwise flow to the SW corner of the site where the sewer link is considered to be located. All flows are to be managed within the footprint of the site.

4.2 All construction and landscape surfaces are considered as SuDS collectors

The first surface to be considered as a runoff collector is the **roof** (1829M^2) as this is over 50% of the footprint of the site. The value of using **'green roofs'** in SuDS is both to control flow and volumes and for biodiversity. There is still debate over the full attenuation provided by green roofs but the CIRIA 'Building Greener' publication suggests up to 40% reduction in runoff for a 50-80mm green roof construction can be assumed. In the case of Caledonian Road this will reduce ground level storage by multiplying the roof area by the storage requirement for each sq M by 0.6.
The Courtyard at ground level offers a number of collector techniques.

The proposed **decking** allows water to pass directly below the surface and is collected on a layer of stone over the sub-grade. The use of an impermeable liner contains water in the open graded stone and in the void between the stone and the base of the decking. Assuming a minimum clearance of 100mm and a stone layer of 150mm (with 30% void space) then 150mm of storage is available below all decking areas.

Permeable hard surfaces including car spaces and amenity surfaces servicing the apartments can easily use permeable block or other small unit surfacing to collect, clean and store runoff. Assuming an average 300mm crushed stone sub-base, with a void ratio of 30%, then a storage volume of 100mm is available over the permeable pavement

It is important at this stage to identify an **impermeable service corridor and access route** to accommodate services that may be excavated or need access in some way during the life of the development. This reduces available permeable surface for SuDS collection but all impermeable surfaces should shed water onto a permeable collector whenever possible to avoid grating or gully collection.

Green space offers two SuDS opportunities on this site.

Firstly all planted areas can be **'bioretention planters'** where runoff is directed across the edge of the plant bed with a 150mm deep basin collecting water over a 300 – 450mm depth of 'engineered topsoil' into a 150-300mm drainage layer beneath. A conservative figure for storage in these structures is 300mm for each sq M.

Secondly where **underdrained grass** is used as a social space then an engineered topsoil of 150mm will provide a better surface for use and a dished surface of 50mm with a shallow drainage layer of 150mm can provide an overall storage volume of about 150mm for each sq M.

Roofwater that has passed through a 'green roof' cleaning process offers a resource for urban water features such as ornamental pools, urban wetlands and a surface channel conveyance through the courtyard. Although not strictly necessary in this courtyard they are features that can provide cost effective collection, cleaning, conveyance and storage

in other situations. They have not been included in the costing here although they may be part of the landscape scheme.

5.0 Conventional drainage strategy

The conventional drainage would collect the roof runoff in downpipes and the courtyard runoff in gullies and pipes. In this situation no petrol interceptor would be necessary due to the small number of car spaces but storage would be required as set out in the Storage Strategy below.

As the incorporation of a green roof is standard practice on major developments in Islington, principally due to their biodiversity value as well as their cooling benefits, the conventional drainage strategy is also assumed to incorporate a green roof; therefore the cost of the roof has not been included within either scenario. Green roofs are now widely required by planning policy as a result of their multiple benefits both within London (through the London Plan policy 4A.11) and in other urban areas such as Sheffield and Manchester.

6.0 Storage strategy

6.1 Storage areas and volumes

The total area of hard surface that contributes to storage includes permeable and impermeable surface but not soft 'green' areas that are deemed not to contribute runoff.

Green roof	1829M^2
Impermeable service strip and access	160M^2
Permeable hard surface	250M^2
Decking	83M^2

Not included are 'bioretention planters' 150M^2 and underdrained grass 105M^2

Total area requiring storage 2322M^2

Omitting the storage provided by the 'green roof' apart from 5mm interception storage the SuDS features provide:

Bioretention	150M^2 x 0.3 = 45M^3
Permeable hard surfaces	250M^2 x 0.1 = 25M^3
Decking	83M^2 x 0.15 = 12.45M^3
Underdrained grass	105M^2 x 0.15 = 15.75M^3

Total storage = 98.2M^3

SUDS storage required for each flow rate uses the primary figure less 5mm as all runoff is directed to a SUDS feature that allows infiltration or evaporation losses called 'interception storage'

	8L/sec/ha - 0.057	50L/sec/ha - 0.030	150L/sec/ha – 0.014
2322M^2 SuDS Storage	132.35M^3	69.66M^3	32.51M^3

Therefore the 8L/sec/ha value of 132.35M^3 - 98.2M^3 = 34.15M^3 additional storage provided by sub-base replacement storage.

The 50L and 150L flow rate volumes are provided by the SUDS storage volume.

Conventional storage for each flow rate option is the flow rate x 2332M^2:

The storage required for each flow rate uses the primary figure as no allowance can be made for 'interception storage'

	8L/sec/ha - 0.062	50L/sec/ha - 0.035	150L/sec/ha – 0.019
2322M^2 Storage required	143.96M^3	81.24M^3	44.12M^3

The pipe collection system means that all storage is underground. The storage is provided by sub-base replacement boxes in this case study as this was the type used on Red Hill and therefore for which costs are available. This type of box storage is not the cheapest type but was selected as they require less excavation and can take sufficient vehicle loadings. Their use could be reviewed to take into account the fact that cheaper options are available.

The cost of SuDS techniques can therefore be set against the storage volume costs set out above.

Although the 'green roof' offers undoubted attenuation benefits, and up to 60% in the CIRIA publication 'Building Greener' this allowance is still not accepted by all parties in the SuDS arena so has not been included here.

One possible way to look at the attenuation benefit is to reduce the storage requirement for the roof water by a coefficient of 0.4. This gives a volume reduction of 1829 x 0.4 as a benefit of green roof over conventional roof ie. a reduction of 731.6M^2 roof area for each flow rate calculation – 41.7M^3, 21.95M^3 and 10 .24M^3.

7.0 Conclusions

The table below sets out the estimated costs for both the traditional drainage and SuDS solution for the Caledonian Road site. This demonstrates the reduced cost of implementing SuDS over traditional drainage at all runoff rates examined. SuDS are considerably cheaper due to the storage provided within landscape features, which reduces the need for expensive boxed storage. The cost estimates do suggest a sharp

increase in cost for the SuDS solution to achieve greenfield runoff rate (8l/s/ha) as boxed storage is needed in this scenario; however the cost is still relatively low, being comparable to that for conventional drainage at 150l/s/ha and being shared over 150 units would be around £275 per property.

	150 l/s/ha		50 l/s/ha		8 l/s/ha	
	Traditional Drainage	S.U.D.S.	Traditional Drainage	S.U.D.S.	Traditional Drainage	S.U.D.S.
Cost	39,300	19,700	65,300	19,700	107,300	41,300
Preliminaries	3,900	2,000	6,500	2,000	10,700	4,100
Contingency	2,000	1,000	3,300	1,000	5,400	2,100
Estimated Construction Total	**45,200**	**22,700**	**75,100**	**22,700**	**123,400**	**47,500**

SuDS also provides significant opportunity to increase the value of the development through use of landscape features such as ponds and wetlands, although the cost of these has not been included within the estimate. Such features would also assist in compliance with other planning requirements such as around biodiversity. Evidence available also suggests SUDS solutions have lower maintenance costs than comparable traditional drainage solutions; this is likely to be particularly true where they are surface features which can be easily maintained as part of standard maintenance contracts (eg pavement sweeping, mowing, etc).

A green roof was not included within the cost comparison exercise as, following planning policy in Islington and many other urban areas, this would be required for reasons not relating to SuDS, such as biodiversity, and therefore can be assumed to be included in both drainage scenarios. The SuDS solution also does not rely on a green roof; the cleaning and storage benefits can be provided by other techniques such as permeable paving with additional storage. However the cost of the green roof was estimated as part of this exercise to provide additional information for consideration. The drainage benefits of green roofs have not been fully factored into the equation as a widely accepted runoff coefficient for green roofs is currently not available; however use of green roofs could reduce the storage volume required in both the SUDS and traditional drainage scenarios and therefore may become more cost effective in development terms.

The cost exercise demonstrates the potential for even dense urban sites to incorporate SUDS to meet even the most stringent quantity criteria as well as delivering benefits for biodiversity and amenity. The opportunities for, and associated costs of, achieving greenfield runoff rate would vary on similar schemes depending on the site characteristics and specifically the availability of open space. Where additional open space was available, it should be possible to provide all the required storage within the landscape without the need for boxes; conversely; where less open space/parking was included on a site, additional box storage may become necessary and therefore the cost would be likely to increase. However, this variation in costs would be balanced to some extent by

associated changes in density of a scheme which would alter the cost of the drainage solution per unit.

8.0 Lessons learnt

The incorporation of SuDS from an early stage of design is crucial to ensure costs are minimised; however this case study demonstrates it is still possible to incorporate SuDS into a scheme at a minimal cost without changes to the layout. On dense urban sites such as the Caledonian Road site, it is particularly important that every surface and landscape feature should be designed as a rainfall collector, maximising the storage within landscape features to minimise the need for more expensive box storage.

The design should also take maintenance requirements into account to ensure these are minimised and can be carried out wherever possible by existing maintenance contractors. In the case of Caledonian Road, maintenance could generally be carried out by the landscape contractor. However, maintenance of the permeable pavements would require use of a ‘brush and suction’ machine which may increase the maintenance cost at least in the short term until permeable paving becomes more widely adopted.

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6F	**DRAINAGE**				
	DISPOSAL SYSTEMS				
	R12 DRAINAGE BELOW GROUND				
	Drain runs				
	Excavating trench in soft landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with selected excavated material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
A	500 - 750 average depth	30	m	35.00	1,050.00
	Excavating trench in hard landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with imported approved granular material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
B	500 - 750 average depth	108	m	43.00	4,644.00
	Clay / aluminium accessories				
	Clayware gulley; 100 outlet; rodding eye and stopper; two 100 nominal diameter clayware bends; jointing outlet to 100 nominal diameter clay drain; cast aluminium grating; bedding and surrounding 150 thick with insitu concrete GEN3; additional excavation, necessary formwork etc.				
C	rainwater gulley	12	Nr	90.00	1,080.00
D	yard gulley	3	Nr	90.00	270.00

CARRIED TO SUMMARY £ 7,044.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
	Manholes and Interceptors				
	Brick manhole; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, channels, three quarter section branch bends, benching, building in ends of drains to walls, access covers, brick kerbs etc.				
A	900 x 600 x 750 deep to invert internal size	4	Nr	750.00	3,000.00
	Storage and Attenuation System				
	Brick chamber; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, building in ends of drains to walls, access covers, brick kerbs etc.				
B	inlet settlement chamber	1	Nr	400.00	400.00
C	outlet chamber; including stainless steel flow restrictor	1	Nr	600.00	600.00
	Storage chamber; including all necessary additional excavation, earthwork support, compacting, 150 deep permavoid geocellular boxes with prefabricated sealed Sel-flex geomembrane and Sel-tex geotextile surround, 50 mm thick clean crushed stone cover bed etc., backfilling, disposal of excavated material by removing from site				
D	150 l/s/ha; 150 mm deep (1 layer); 44 m³ storage volume (assumed 1 layer of 150 deep boxes in areas of pedestrian paving - 1 layer laid in granular sub-base no additional excavation required)	294	m²	95.00	27,930.00
	Warning sign				
F	restricted rodding in manhole	2	Nr	50.00	100.00
	Installation				
	Cleaning, testing and commissioning				
H	of complete installation		Item	200.00	200.00

CARRIED TO SUMMARY £ 32,230.00

EXTERNAL WORKS - TRADITIONAL DAINAGE 150 l/s/ha

Estimated

Ref	Description	Amount
	SUMMARY	
	Page No. 1/1	7,044.00
	Page No. 1/2	32,230.00

 CARRIED TO FINAL SUMMARY £ 39,274.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6F	**DRAINAGE**				
	DISPOSAL SYSTEMS				
	R12 DRAINAGE BELOW GROUND				
	Drain runs				
	Excavating trench in soft landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with selected excavated material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	500 - 750 average depth	30	m	35.00	1,050.00
	Excavating trench in hard landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with imported approved granular material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	500 - 750 average depth	108	m	43.00	4,644.00
	Clay / aluminium accessories				
	Clayware gulley; 100 outlet; rodding eye and stopper; two 100 nominal diameter clayware bends; jointing outlet to 100 nominal diameter clay drain; cast aluminium grating; bedding and surrounding 150 thick with insitu concrete GEN3; additional excavation, necessary formwork etc.				
	rainwater gulley	12	Nr	90.00	1,080.00
	yard gulley	3	Nr	90.00	270.00

CARRIED TO SUMMARY £ 7,044.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
	Manholes and Interceptors				
	Brick manhole; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, channels, three quarter section branch bends, benching, building in ends of drains to walls, access covers, brick kerbs etc.				
	900 x 600 x 750 deep to invert internal size	4	Nr	750.00	3,000.00
	Storage and Attenuation System				
	Brick chamber; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, building in ends of drains to walls, access covers, brick kerbs etc.				
	inlet settlement chamber	1	Nr	400.00	400.00
	outlet chamber; including stainless steel flow restrictor	1	Nr	600.00	600.00
	Storage chamber; including all necessary additional excavation, earthwork support, compacting, 150 deep permavoid geocellular boxes with prefabricated sealed Sel-flex geomembrane and Sel-tex geotextile surround, 50 mm thick clean crushed stone cover bed etc., backfilling, disposal of excavated material by removing from site				
	50 l/s/ha; 300 mm deep (2 layers); 81 m³ storage volume (assumed 2 layer of 150 deep boxes in areas of pedestrian paving - 1 layer laid in granular sub-base 1 layer requiring additional excavation 150 total depth	270	m²	200.00	54,000.00
	Warning sign				
	restricted rodding in manhole	2	Nr	50.00	100.00
	Installation				
	Cleaning, testing and commissioning				
	of complete installation		Item	200.00	200.00

CARRIED TO SUMMARY £ 58,300.00

EXTERNAL WORKS - TRADITIONAL DAINAGE 50 l/s/ha

Estimated

Ref	Description	Amount
	SUMMARY	
	Page No. 2/1	7,044.00
	Page No. 2/2	58,300.00

 CARRIED TO FINAL SUMMARY £ 65,344.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6F	**DRAINAGE**				
	DISPOSAL SYSTEMS				
	R12 DRAINAGE BELOW GROUND				
	Drain runs				
	Excavating trench in soft landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with selected excavated material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	500 - 750 average depth	30	m	35.00	1,050.00
	Excavating trench in hard landscaped area; earthwork support; 100 nominal diameter flexible jointed clayware drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with imported approved granular material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	500 - 750 average depth	108	m	43.00	4,644.00
	Clay / aluminium accessories				
	Clayware gulley; 100 outlet; rodding eye and stopper; two 100 nominal diameter clayware bends; jointing outlet to 100 nominal diameter clay drain; cast aluminium grating; bedding and surrounding 150 thick with insitu concrete GEN3; additional excavation, necessary formwork etc.				
	rainwater gulley	12	Nr	90.00	1,080.00
	yard gulley	3	Nr	90.00	270.00

CARRIED TO SUMMARY £ 7,044.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
	Manholes and Interceptors				
	Brick manhole; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, channels, three quarter section branch bends, benching, building in ends of drains to walls, access covers, brick kerbs etc.				
	900 x 600 x 750 deep to invert internal size	4	Nr	750.00	3,000.00
	Storage and Attenuation System				
	Brick chamber; including all necessary excavation, earthwork support, compacting, backfilling, disposal of excavated material by removing from site, 150 thick concrete beds, brickwork, reinforced concrete slabs, formwork, step irons, building in ends of drains to walls, access covers, brick kerbs etc.				
	inlet settlement chamber	1	Nr	400.00	400.00
	outlet chamber; including stainless steel flow restrictor	1	Nr	600.00	600.00
	Storage chamber; including all necessary additional excavation, earthwork support, compacting, 150 deep permavoid geocellular boxes with prefabricated sealed Sel-flex geomembrane and Sel-tex geotextile surround, 50 mm thick clean crushed stone cover bed etc., backfilling, disposal of excavated material by removing from site				
	8 l/s/ha; 450 mm deep (3 layers); 144 m³ storage volume (assumed 3 layers of 150 deep boxes in areas of pedestrian paving - 1 layer laid in granular sub-base 2 layers requiring additional excavation 300 total depth)	320	m²	300.00	96,000.00
	Warning sign				
	restricted rodding in manhole	2	Nr	50.00	100.00
	Installation				
	Cleaning, testing and commissioning				
	of complete installation		Item	200.00	200.00

CARRIED TO SUMMARY £ 100,300.00

EXTERNAL WORKS - TRADITIONAL DAINAGE 8 l/s/ha

Estimated

Ref	Description	Amount
	SUMMARY	
	Page No. 3/1	7,044.00
	Page No. 3/2	100,300.00

 CARRIED TO FINAL SUMMARY £ 107,344.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6B	**ROADS AND PATHS**				
	PAVING / PLANTING / FENCING / SITE FURNITURE				
	Q22 COATED MACADAM/ASPHALT ROADS/PAVINGS				
	Macadam				
	Extra over non permeable macadam (190 thick macadam and 300 thick MOT Type 1 granular sub-base) for permeable macadam (additional excavation, removing excavated material from site, 190 thick permeable macadam and 300 thick open granular sub-base material)				
	level or to falls	36	m²	25.00	900.00
	kerb - no cost difference for SUDS use	44	m		
	Q25 SLAB/BRICK/BLOCK/SETT/COBBLE PAVINGS				
	Concrete block				
	Extra over non permeable concrete block paving (80 thick blocks, 50 thick sand bed, 300 thick Type 1 granular material) for permeable concrete block paving (additional excavation, removing excavated material from site, 80 thick Aquaflow ml blocks, 50 thick bed of 5mm clean stone, Inbitex non woven geotextile separating layer, 300 thick bed of 20-5mm stone)				
	level or to falls	250	m²	8.00	2,000.00
	Storage and Attenuation System				
	Storage chamber; including all necessary additional excavation, earthwork support, compacting, 150 deep permavoid geocellular boxes with prefabricated sealed Sel-flex geomembrane and Sel-tex geotextile surround, 50 mm thick clean crushed stone cover bed etc., backfilling, disposal of excavated material by removing from site				
	not required for 50 and 150 l/s/ha				

Estimated

Ref	Description	Qty	Unit	Rate	Amount
	Q26 SPECIAL SURFACINGS/PAVINGS FOR SPORT/GENERAL AMENITY				
	Decking				
	Extra over timber decking (timber decking on bearers, 150 thick MOT Type 1 granular material) for timber decking (additional excavation, removing excavated material from site, timber decking on bearers, Inbitex non woven geotextile separating layer, 150 thick bed of 63-10mm stone, geotextile protection layer)				
	level or to falls	78	m²	3.00	234.00
	Service corridor				
	Bitumen macadam paving				
	level or to falls - no cost difference for SUDS use	159	m²		
	DISPOSAL SYSTEMS				
	R10 RAINWATER PIPEWORK/GUTTERS				
	Surface channel				
	Precast concrete channel, excavation, insitu concrete foundation, formwork etc.				
	to falls	55	m	35.00	1,925.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6E	**HORTICULTURAL WORK**				
	GROUNDWORK				
	D20 EXCAVATING AND FILLING				
	Bioretention planters - raingardens				
	Extra over planted beds (300 deep imported topsoil, bark mulch) for Bioretention area - mulch finish (additional excavation, disposal of excavated material by removing from site, geotextile layer to sides, geotextile layer to base, 300 deep imported granular material drainage layer, geotextile separating layer, 450 deep imported engineered topsoil layer, 50 deep mulch layer)				
	generally	99	m²	40.00	3,960.00
	Extra over turfed areas (150 deep imported topsoil, turf finish) for Bioretention area - turfed finish (additional excavation, disposal of excavated material by removing from site, geotextile layer to sides, geotextile layer to base, 300 deep imported granular material drainage layer, geotextile separating layer, 450 deep imported engineered topsoil layer, turf finish)				
	generally	108	m²	40.00	4,320.00
	Bioretention area; perforated plastics drain pipe laid in granular material fill (measured elsewhere)				
	150 nominal diameter	34	m	10.00	340.00
	Extra over for 150 nominal diameter x 700 long overflow / inspection pipe	3	Nr	25.00	75.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6F	**DRAINAGE**				
	DISPOSAL SYSTEMS				
	R12 DRAINAGE BELOW GROUND				
	Drain runs				
	Excavating trench in soft landscaped area; earthwork support; 150 nominal diameter perforated plastics drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with selected excavated material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	250 to 500 average depth	38	m	32.00	1,216.00
	Excavating trench in hard landscaped area; earthwork support; 150 nominal diameter perforated plastics drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with imported approved granular material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	250 to 500 average depth	12	m	37.00	444.00
	Rain collectors				
	Rain collector and water feature				
	250 to 500 average depth	2	Nr	1,000.00	2,000.00
	Chambers				
	Control chamber				
	250 to 500 average depth	3	Nr	750.00	2,250.00

EXTERNAL WORKS - SUDS SYSTEM 50 and 150 l/s/ha

Estimated

Ref	Description	Amount
	SUMMARY	
	Page No. 1/1	2,900.00
	Page No. 1/2	2,159.00
	Page No. 1/3	8,695.00
	Page No. 1/4	5,910.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6B	**ROADS AND PATHS**				
	PAVING / PLANTING / FENCING / SITE FURNITURE				
	Q22 COATED MACADAM/ASPHALT ROADS/PAVINGS				
	Macadam				
	Extra over non permeable macadam (190 thick macadam and 300 thick MOT Type 1 granular sub-base) for permeable macadam (additional excavation, removing excavated material from site, 190 thick permeable macadam and 300 thick open granular sub-base material)				
A	level or to falls	36	m²	25.00	900.00
B	kerb - no cost difference for SUDS use	44	m		
	Q25 SLAB/BRICK/BLOCK/SETT/COBBLE PAVINGS				
	Concrete block				
	Extra over non permeable concrete block paving (80 thick blocks, 50 thick sand bed, 300 thick Type 1 granular material) for permeable concrete block paving (additional excavation, removing excavated material from site, 80 thick Aquaflow ml blocks, 50 thick bed of 5mm clean stone, Inbitex non woven geotextile separating layer, 300 thick bed of 20-5mm stone)				
D	level or to falls	250	m²	8.00	2,000.00
	Storage and Attenuation System				
	Storage chamber; including all necessary additional excavation, earthwork support, compacting, 150 deep permavoid geocellular boxes with prefabricated sealed Sel-flex geomembrane and Sel-tex geotextile surround, 50 mm thick clean crushed stone cover bed etc., backfilling, disposal of excavated material by removing from site				
C	8 l/s/ha; 150 mm deep (1 layer); 34.2 m³ storage volume (assumed 1 layer of 150 deep boxes in areas of pedestrian paving - 1 layer laid in granular sub-base no additional excavation required)	228	m²	95.00	21,660.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
	Q26 SPECIAL SURFACINGS/PAVINGS FOR SPORT/GENERAL AMENITY				
	Decking				
	Extra over timber decking (timber decking on bearers, 150 thick MOT Type 1 granular material) for timber decking with collection and storage below (additional excavation, removing excavated material from site, timber decking on bearers, Inbitex non woven geotextile separating layer, 150 thick bed of 63-10mm stone, geotextile protection layer - storage measured elsewhere)				
B	level or to falls	78	m²	3.00	234.00
	Service corridor				
	Bitumen macadam paving				
C	level or to falls - no cost difference for SUDS use	159	m²		
	DISPOSAL SYSTEMS				
	R10 RAINWATER PIPEWORK/GUTTERS				
	Surface channel				
	Precast concrete channel, excavation, insitu concrete foundation, formwork etc.				
D	to falls	55	m	35.00	1,925.00

EXTERNAL WORKS - SUDS SYSTEM 8 l/s/ha

Estimated

Ref	Description	Amount
	COLLECTION - ROADS AND PATHS	
	Page No. 2/1	24,560.00
	Page No. 2/2	2,159.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6E	**HORTICULTURAL WORK**				
	GROUNDWORK				
	D20 EXCAVATING AND FILLING				
	Bioretention planters - raingardens				
	Extra over planted beds (300 deep imported topsoil, bark mulch) for Bioretention area - mulch finish (additional excavation, disposal of excavated material by removing from site, geotextile layer to sides, geotextile layer to base, 300 deep imported granular material drainage layer, geotextile separating layer, 450 deep imported engineered topsoil layer, 50 deep mulch layer)				
A	generally	99	m²	40.00	3,960.00
	Extra over turfed areas (150 deep imported topsoil, turf finish) for Bioretention area - turfed finish (additional excavation, disposal of excavated material by removing from site, geotextile layer to sides, geotextile layer to base, 300 deep imported granular material drainage layer, geotextile separating layer, 450 deep imported engineered topsoil layer, turf finish)				
B	generally	108	m²	40.00	4,320.00
	Bioretention area; perforated plastics drain pipe laid in granular material fill (measured elsewhere)				
C	150 nominal diameter	34	m	10.00	340.00
D	Extra over for 150 nominal diameter x 700 long overflow / inspection pipe	3	Nr	25.00	75.00

EXTERNAL WORKS - SUDS SYSTEM 8 l/s/ha

Estimated

Ref	Description	Amount
	COLLECTION - HORTICULTURAL WORK	
	Page No. 2/4	8,695.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
6F	**DRAINAGE**				
	DISPOSAL SYSTEMS				
	R12 DRAINAGE BELOW GROUND				
	Drain runs				
	Excavating trench in soft landscaped area; earthwork support; 150 nominal diameter perforated plastics drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with selected excavated material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	250 to 500 average depth	38	m	32.00	1,216.00
	Excavating trench in hard landscaped area; earthwork support; 150 nominal diameter perforated plastics drain pipe including all necessary fittings (e.g. bends, junctions, rocker pipes etc.); bedding and surrounding 150 thick with imported approved granular material; backfilling above beds and surrounds up to ground level with imported approved granular material compacted in layers; service warning marker tape; spreading and levelling surplus excavated material close at hand				
	250 to 500 average depth	12	m	37.00	444.00
	Rain collectors				
	Rain collector and water feature				
	250 to 500 average depth	2	Nr	1,000.00	2,000.00
	Chambers				
	Control chamber				
	250 to 500 average depth	3	Nr	750.00	2,250.00

EXTERNAL WORKS - SUDS SYSTEM 8 l/s/ha

Estimated

Ref	Description	Amount
	COLLECTION - DRAINAGE	
	Page No. 2/6	5,910.00

EXTERNAL WORKS - SUDS SYSTEM 8 l/s/ha

Estimated

Ref	Description		Amount
	SUMMARY		
	Page No. 2/3	ROADS AND PATHS	26,719.00
	Page No. 2/5	HORTICULTURAL WORK	8,695.00
	Page No. 2/7	DRAINAGE	5,910.00

 CARRIED TO FINAL SUMMARY £ 41,324.00

Estimated

Ref	Description	Qty	Unit	Rate	Amount
2C	**ROOF**				
	WATERPROOFING				
	J42 SINGLE LAYER PLASTICS ROOF COVERINGS				
	Green roof system				
	Roof coverings				
A	Extra over tradditional roof finish for green roof finish	1,829	m²	60.00	109,740.00

MAIN WORKS

Estimated

Ref	Description	Amount
	COLLECTION - ROOF	
	Page No. 3/1	109,740.00

CALEDONIAN ROAD SUDS System	Page No. 3/2	**CARRIED TO SUMMARY £**	109,740.00

MAIN WORKS

Estimated

Ref	Description	Amount
	SUMMARY	
	Page No. 3/2 ROOF	109,740.00