

Conceptual SuDS strategy report

For the proposed re-development at
**18 Parkside Road, Reading,
RG30 2DB**

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Disclaimer

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Scope

Note: this report can only be assessed under the scope it is intended for as set out below:

Town and Country Planning Act 1990

The scope of this report includes the provision of supplementary information in relation to a planning application set under the provision of this Act and is intended to meet the requirements for “particulars” under Section 62; (3) & (4A) of same.

Building Act 1984

Building Regulations 2010 and Statute control

This report **is not** provided in support of any application made under the Building Act 1984 or related Regulations.

Statement of conformity

While this report cannot therefore be lawfully assessed by any persons, in any capacity, for compliance with the above Building Regulations all drainage on this private site, both foul and SW will be subject to full compliance with Part H of the Building Regulations 2010 (as amended 2013).

Hence all construction details, SW runs, pipe diameters etc. as detailed in this report are designed to comply in full with the “Adequate provision” Requirement of Part H and are to be checked, inspected, tested and approved by the Building Control Body of the clients choice at the time of detailed design and construction.

SuDS design additional standards

All SuDS (Sustainable drainage system) on site will also be designed and installed in accordance with CIRIA 753 & CIRIA 768, para 163 of the NPPF, its supporting technical guidance and the DEFRA Non-Statutory Technical standards for sustainable drainage systems (2015).

1 Executive Summary

- A All surface water arising can be managed on site.
- B All surface water arising from roofed areas is controlled by direct infiltration through soakaways.
- C Water butts will reduce potable water demand provide additional SuDS on site.
- D An alternative blue roof based SuDS option is provided.
- D All areas of hard standing on the site will be constructed using a permeable medium.
- E There is no design exceedance outfall away from the site.
- F All SuDS on site will be installed with full consideration to long term maintenance.
- G The use of SuDS techniques on site will mitigate and treat the run-off volumes.

2 Introduction

2.1 Site location

The proposed development is on land at 18 Parkside Road, Reading, RG30 2DB (see Figure 1).



Figure 1: Site location plan, as indicated (source: Client)

2.2 Development description

The proposal is for the erection of a residential block containing apartments, as extracts of proposal plans at Appendix A.

2.3 Site geology

With reference to BGS data and the Geo-insight report at Appendix E, the site is shown to be on Lynch Hill Gravel Member over the Lambeth Group.

“Worked ground” is also shown with in the Geo-insight report together with “natural cavity”.

2.3.1 Infiltration rates

Preliminary infiltration rates for the site based on initial infiltration testing on site, are found to be $8.4 \times 10^{-6} \text{ ms}^{-1}$ in the worst case at soakaway depth and $9.7 \times 10^{-6} \text{ ms}^{-1}$ at sub-base formation level. Refer to data at Appendix D.

Further testing will however be required to establish the rate at each soakaway location since made ground was seen initially in the soakaway trial hole.

This is also confirmed within the Geo-insight report, as Appendix E, and the extent and depth of made ground elsewhere is at this stage uncertain.

2.3.2 Water table

Ground water was not encountered in the trial holes.

2.4 Existing flow paths

The existing building on the site drains surface water to a network sewer.

2.5 Estimation of existing peak run-off rate pre site clearance

The Wallingford Procedure^[3] is used as the basis for the following calculation by using a site specific IDF curve to establish i_1 and i_{100} rainfall intensities. Hence for the upper limit on flow from the site:

2.5.1 Variables

$$i_1 = 50.4^1 \text{ mm hr}^{-1}$$

$$i_{100} = 153 \text{ mm hr}^{-1}$$

$$A = 201 \text{ m}^2$$

$$Cr = 1$$

$$Cv = 0.9$$

2.5.2 Impermeable area run-off rate for pre-developed site

$$\begin{aligned} Q_{BF1} &= \frac{0.9 * 50.4 * 201}{3600} \\ &= 2.5 \text{ l s}^{-1} \end{aligned}$$

¹50.4mm hr⁻¹ is the mean intensity of a 1 in 1yr 6min duration summer storm, calculated to be the worst case, using standard IDF formula.

$$Q_{BF100} = \frac{0.9 * 153 * 201}{3600}$$

$$= 7.7 \text{ l s}^{-1}$$

Existing runoff rates from the impermeable areas of the site are calculated as 2.53 l s^{-1} (based on 50.4 mm hr^{-1} , 1 in 1 yr summer storm).

2.6 Estimation of existing Green field rates

This site is less than 50 ha (site area taken as 1ha) therefore runoff rate calculations have been carried out in accordance with the IH Report 124 'Flood estimation for small catchments'^[1]. The pro rata method on the size of catchment detailed in table 4.2 of the SuDS manual^[2] has been used.

2.6.1 Formula

For catchments less than 50ha:

$$Q_{BAR50ha} = 1.08 (50/100)^{0.89} * SAAR^{1.17} * SPR^{2.17} \quad (1)$$

$$Q_{BAR} D = Q_{BAR50ha} * \frac{A}{50} \quad (2)$$

$$Q_{1yr} = Q_{BAR} * 0.85 \quad (3)$$

$$Q_{100yr} = Q_{BAR} * GC_{100} \quad (4)$$

2.6.2 Variables

$Q_{bar}/Q_{med} = 0.85$

$SAAR = 641 \text{ mm}$

Hydrological Region 6

Growth curve factors: 30 yr = 2.3; 100 yr = 3.19

$SPR = 0.3$

2.6.3 Calculations

$$\begin{aligned}Q_{BAR50ha} &= 1.08 * 0.5^{0.89} * 641^{1.17} * 0.3^{2.17} \\&= 0.58 * 1923.20 * 0.07 \\&= 82.20\end{aligned}$$

Using Equation 2:

$$\begin{aligned}Q_{BAR} &= \frac{82.20 * 0.14}{50} \\&= 0.24 \text{ l s}^{-1}\end{aligned}$$

Using Equation 3:

$$\begin{aligned}Q_1 &= 0.24 * 0.85 \\&= 0.20 \text{ l s}^{-1}\end{aligned}$$

Using Equation 4:

$$\begin{aligned}Q_{100} &= 0.24 * 3.19 \\&= 0.76 \text{ l s}^{-1}\end{aligned}$$

2.6.4 Peak run-off rates

For the 1 year Return Period event the peak runoff calculates to 0.20 l s^{-1}

For the 30 year Return Period event the peak runoff calculates to 0.54 l s^{-1}

For the 100 year Return Period event the peak runoff calculates to 0.76 l s^{-1}

3 SuDS Principles

In line with the SuDS management train, the following hierarchy has been considered in applying the use of SuDS into the proposed development scheme.

3.1 SuDS design philosophy

The CIRIA SuDS^[2] manual provides the design philosophy:

“SuDS design should, as much as possible, be based around the following:

- using surface water runoff as a resource
- managing rainwater close to where it falls
- managing runoff at the surface
- allowing rainwater to soak into the ground
- promoting evapotranspiration
- slowing and storing run-off to mimic natural runoff characteristics
- reducing contamination of runoff through pollution prevention and controlling the runoff at source
- treating runoff to reduce the risk of urban contaminants causing environmental pollution.”

3.2 Source control

- Sedum roofing.
- Infiltration devices. Typically soakaways.
- Rainwater harvesting.
- Bio-retention planting, rain gardens.
- Permeable paving, porous asphalt. These provide both infiltration and short term storage volumes thus reducing overall un-mitigated run-off volumes.

3.3 “End of pipe” solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means to limiting discharge rates and volumes to discharge to existing SW flow pathways.

Sections 4.2 to 4.7 consider the viability of a range of these SuDS devices.

4 Appraisal of SuDS options

The primary aim is to meet the requirements of the Local Plan core policies and the SuDS hierarchy so as to manage SW on site.

4.1 Site constraints impacting on SuDS

- No access to an adjacent water course;
- Possible made or “worked” ground across the site (subject to further investigation);
- Possible cavities on site (subject to further investigation);
- Root protection zones on site.

4.2 Infiltration devices

With reference to Section 3.1, soakaways promote the following SuDS design criteria:

- manages rainwater close to where it falls;
- allows rainwater to soak into the ground;
- slows and stores run-off to mimic natural run-off characteristics;
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

Infiltration rates identified with the local geology, Section 2.3, are just about high enough to allow infiltration devices to be used on this site and as such these can be designed to accommodate design rainfall events (designed in line with BRE365 and Part H of the Building Regulations and at least 5m away from any structure).

4.3 Expansive planting

With reference to Section 3.1, expansive planting promotes the following SuDS design criteria:

- manages rainwater close to where it falls;
- slows and stores run-off to mimic natural run-off characteristics;
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

4.4 Permeable hard standing

With reference to Section 3.1, permeable paving promotes the following SuDS design criteria:

- manages rainwater close to where it falls;
- manages runoff at the surface;
- allows rainwater to soak into the ground;
- slows and stores run-off to mimic natural runoff characteristics;
- treats runoff to reduce the risk of urban contaminants causing environmental pollution.

4.4.1 Permeable paving

A 30% void ratio is assumed through a 350mm sub-base. This is appropriate for a DOT Type 3 Sub-base hence the storage capacity equates to circa 105mm per 1m² therefore based on a M6 100hr + cc storm of 87mm rainfall the paving offers, without any allowance for infiltration, a circa 1:1.2 drained volume:storage volume capacity. Hence there is no anticipated exceedance flow from the areas of permeable paving.

TSS 0.7, Metals 0.6, Hydrocarbons 0.7 = suitable for trafficked areas

All permeable paving offers sufficient storage volume to accommodate the 5mm event.

4.5 Rainwater harvesting

With reference to Section 3.1, Rainwater harvesting promotes the following SuDS design criteria:

- uses surface water runoff as a resource;
- manages rainwater close to where it falls

and:

- stores rainwater for later use.

4.5.1 For external use

Rain water harvesting / water butts: These provide additional, “off line”² SuDS, and are deemed a suitable SuDS component for small plots^[2], extract at Figure 2. The image shows a water butt in “off-line” configuration using a standard diverter.

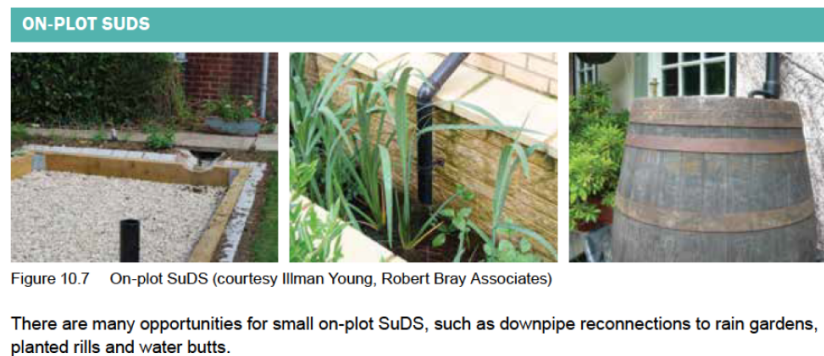


Figure 2: Use of water butts as provided in the SuDS manual

The collection and re-use of water can reduce run off volumes arising from roofs. The collected water, via readily available diverters (e.g. Web link: [Standard diverter example](#), as per Figure 3), being used for external uses.

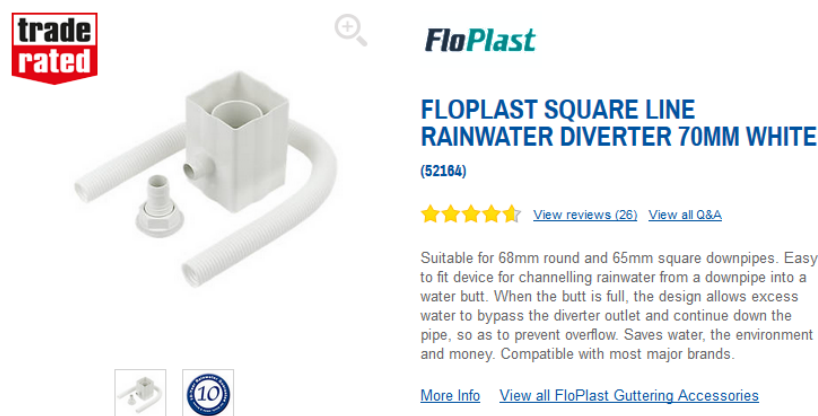


Figure 3: Standard rainwater diverter

Rainwater butts can, in part, accommodate the 5mm event dependent on manual drawdown and evaporation.

²The term “off-line” refers to the fact that a water butt is a harvesting device that is not “in-line” in the same manner that a pipe is in-line. Water is collected (harvested) until the water butt is full. When full, the rainwater continues down the rainwater pipe. Outflow from the tank is not “automatic” since this would negate the reason to harvest rainwater. Instead, manual drawdown occurs with the harvested water being used for external uses. Since a water butt may be full, the useful volume is not accounted for in storage and run-off calculations.

4.6 Sedum/blue roofs.

Subject to site constraints these may need consideration in the event that soakaways are not found suitable.

The use of Sedum and blue roofs can significantly reduce run-off volumes from roofs [4]. These are found to be ideally suited to this site as an alternative option to soakaways.

With reference to Section 3.1, sedum roofs promote the following SuDS design criteria:

- manages rainwater close to where it falls
- promotes evapotranspiration
- slows and stores run-off to mimic natural run-off characteristics
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

and also

- Promotes bio-diversity

4.7 “End of pipe” solutions

Not required.

5 Proposed surface water disposal strategy

The following sections consider the strategy for water arising from the roof areas, driveways and hard standing and areas of landscaping.

5.1 Domestic roofs

Note: the primary SuDS strategy is that of utilising infiltration potential around the site. This is shown below as Option 1. In the event that further ground investigations show soakaways are no longer viable then a blue roof strategy will be used as an alternative SuDS solution, this is Option 2 below.

With Reference to Table 26.2 of the SuDS Manual, pollution hazard indices for:

Domestic Roofs are 0.2 (TSS), 0.2 Metals & 0.05 Hydrocarbons.

5.1.1 Option 1 - Soakaways

All surface water arising from the area of new roofing is controlled by direct infiltration through soakaways. Notes:

- For this report the drained area to the soakaway(s) arises from the area of soakaways. plus a 1 allowance for urban creep.
- The soakaways are designed for all events up to and including the M100 6hr event.
- An allowance of x1.4 is made for climate change in line with current best practice.

Designed to BRE365, and to accommodate all surface water arising from a drained area of 390m² requires 4 , concrete ring soakaway(s) of 2.1m internal diameter in a minimum 2.6m by 2.6m excavation (allows a minimum 100mm stone surround) with a 2m effective depth. See Table 1 and Figure 4.

Permeability	8.40E-06	ms ⁻¹
Urban Creep	1	
Drained area	390	m ²
Designed drained area	390	m ²
Return Period	100	yr
Climate change	1.4	

Design diameter, m	2.1
Design Depth _{eff} , m	2
Design Qty	4

Duration, mins	5	10	15	30	60	120	240	360	600	1440
Rainfall, mm	19.1	28.6	34.5	45.4	56.7	68.5	80.3	87.5	97.4	116.1
Volume in, m ³	1.9	2.8	3.4	4.4	5.5	6.7	7.8	8.5	9.5	11.3
Volume out, m ³	0	0.1	0.1	0.2	0.3	0.6	1.3	1.9	3.1	7.5
Balance vol req'd, m ³	1.9	2.7	3.3	4.2	5.2	6.1	6.5	6.6	6.4	3.8

Crit balance vol req'd, m ³	6.6
Vol in core, m ³	6.9
Vol in stone surround, m ³	1.4
Balance vol provided, m ³	8.4
Crit Duration, mins	360
Empty to 50%, hrs	10.49

Table 1: BRE 365 Calculation results

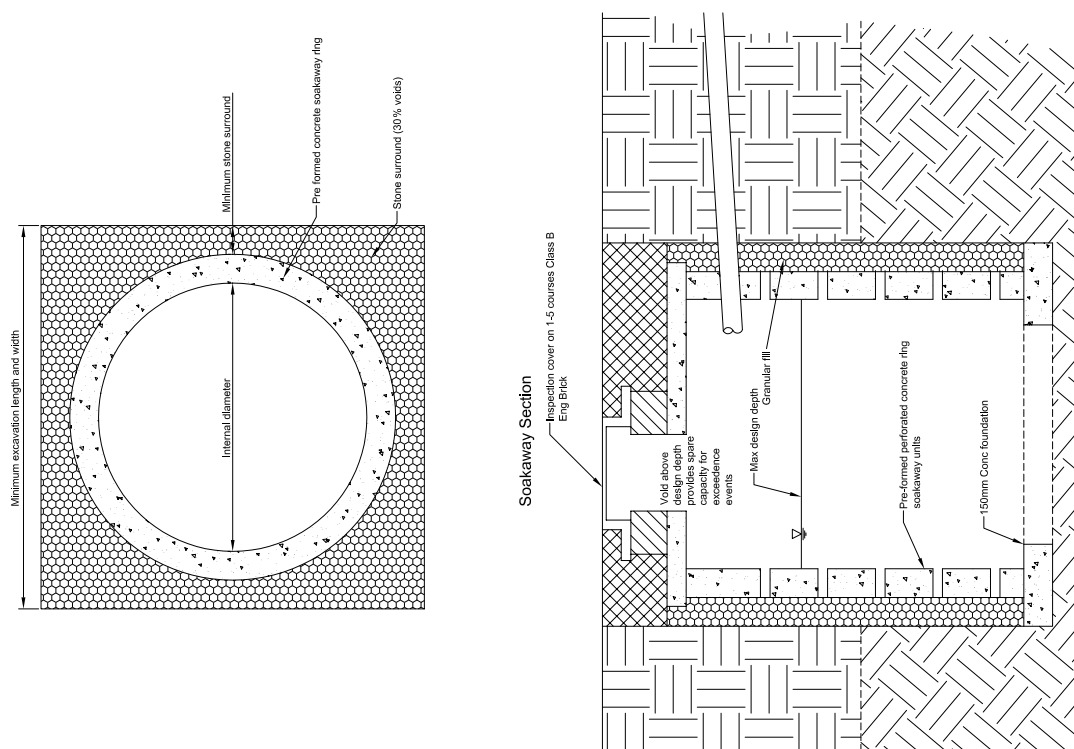


Figure 4: Preformed concrete soakaway setting out

5.1.2 Sedimentation risk

Generally, roofing carries a very low sediment loading. Worst case 216 kg.ha⁻¹.yr⁻¹ - so for this site that equates to circa 8.4kg.yr⁻¹ in the worst case. Generally this would reduce the attenuation capacity by circa 2% over 50yrs (all data from the SuDS maunual).

The design allows for this amount with extra capacity provided to a 100yr design life. The BRE 365 method acknowledges this sedimentation and hence the base area is not considered in the sizing calculations.

5.1.3 Minimising sedimentation risk

The developer will fit accessible sumped rainwater gulleys at the base of all RWP's so as to reduce the amount of any sediment entering the soakaway.

The developer will also fit downpipe leaf guards to all outfalls from the roof (or "hedgehog" gutter guards).

Preformed soakaway ring size chart at Appendix B.1.

Worst case drainage run capacity check (2/3 designed roof area + 30%);

Flow will be conveyed to the soakaways via 100mm diameter drainage runs laid at no less than 1:80 falls giving a maximum design capacity of 6.6ls^{-1} (Part H design chart, Figure 5).

1 in 100yr max mean intensity storm = 153mmhr^{-1}

Drained area to one pipe = 127m^2

Required pipe capacity = $127 \times 0.153 / 3.6 = 5.4\text{ls}^{-1}$

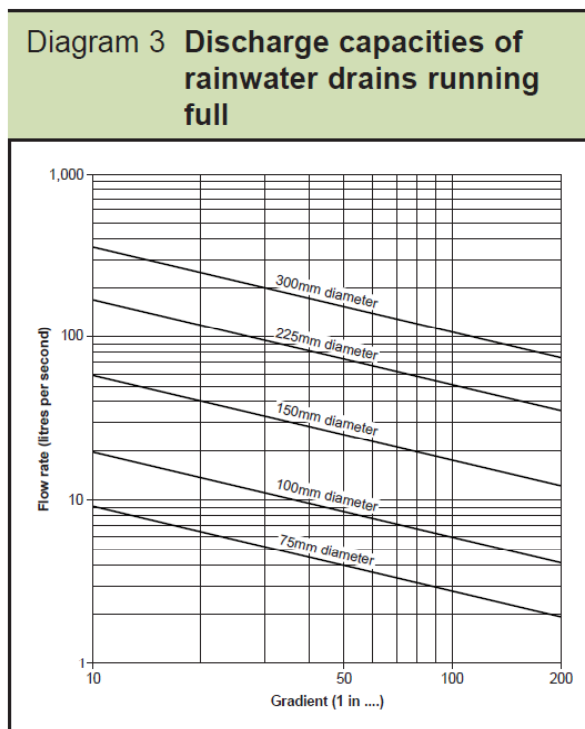


Figure 5: Part H drainage design chart

5.1.4 Option 2 - Blue roofs

All water arising from the new roof area could, as an alternative option to soakaways, be managed on site via a bespoke “blue roof” system. This is a vegetative based system that also incorporates attenuation and hydraulic control as per details provided at Appendix C.3.

The residual outfall from the roof is then directed to the existing SW network serving the site via where practicable raised rain-garden planters and water butts.

5.1.5 Blue roof design calculations

- Individual roof outlets considered here are designed to drain a plan area of up to 30m².
- Each outlet has a designed array of four orifices within the control device.
- Each orifice in the outfall array is of 10mm diameter.
- The calculations below are based on a single orifice per outlet with equivalent CSA of 314mm². CD = 0.7.

Hence for a single outlet and SWB65 Geo-cells (details at Appendix C.4) the following applies:

Designed to accomodate all surface water arising from a design drained area of 30m^2 requires a minimum attenuation volume of 1 m^3 . This can be achieved using an overall cell volume of 2 m^3 formed with 0.065m deep units. See Table 2.

Drained area	30m ²	
Urban Creep	1	
Designed drained area	30m ²	
Return periods considered	1yr, 30yr, 100yr	
Storm profiles used	50% Summer	75% Winter
Storm coeffs	a = 0.1, b = 0.815	a = 0.06, b = 1.026
Storm range, storm increments	From 5 minutes duration in further 2 min. intervals until critical storm reached	
M5-60	20mm	
r	0.4	
Rainfall model	FSR	
Critical design storm	107 mins, Summer	
Climate change	1.4	
Storm mean intensity	26.6mm.hr ⁻¹	
Design mean intensity	37.3mm.hr ⁻¹	
Storm peak intensity	116.7mm.hr ⁻¹	
Design peak intensity	163.4mm.hr ⁻¹	
Design maximum head	0.05m	
Calculated maximum head	0.04m	
Minimum attenuation volume required	1.20m ³	
Void ratio	95%	
Design attenuation volume	1.4m ³	(0.05m x 28.5m ²)
Provided attenuation volume	1.9m ³	(0.95 x 30m ² x 0.065m)
Factor of Safety	1.30	
1 in 1yr maximum outfall rate	0.1ls ⁻¹	(See Figure 10.)
1 in 30yr maximum outfall rate	0.2ls ⁻¹	(See Figure 11.)
1 in 100yr maximum outfall rate	0.2ls ⁻¹	(See Figure 12.)
1 in 100yr Time to peak	79 mins	
1 in 100yr Max head: Time to drop to 50%	0.98 hrs	
Outfall control method	20mm Orifice	CD = 0.7

Table 2: Storage volume design summary

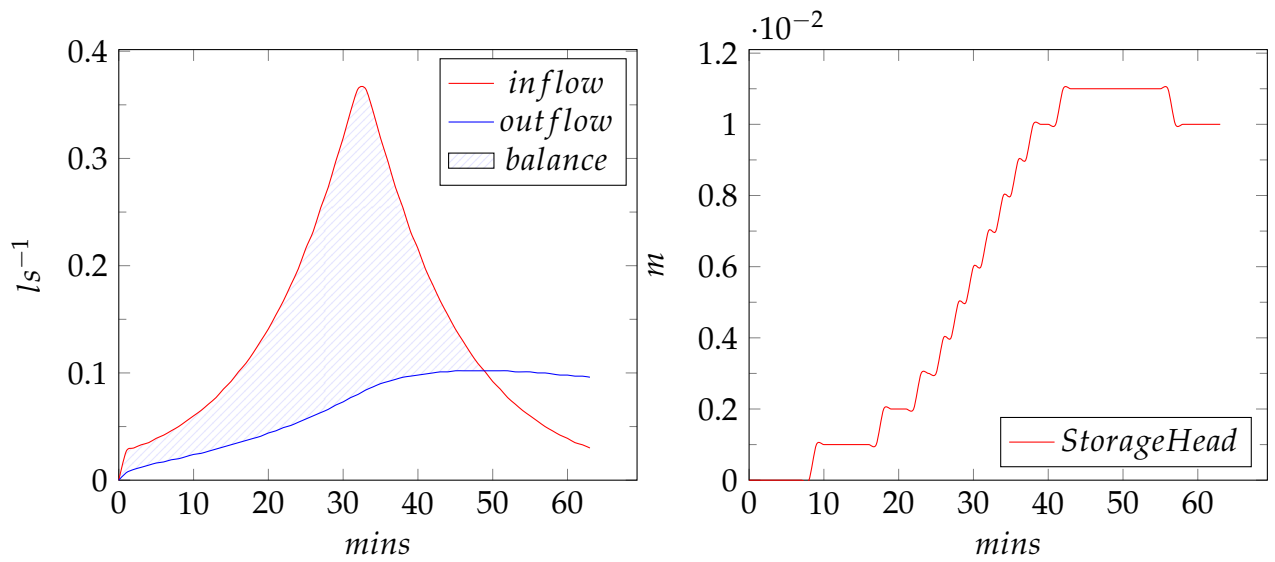


Figure 6: 1 in 1 year critical storm event

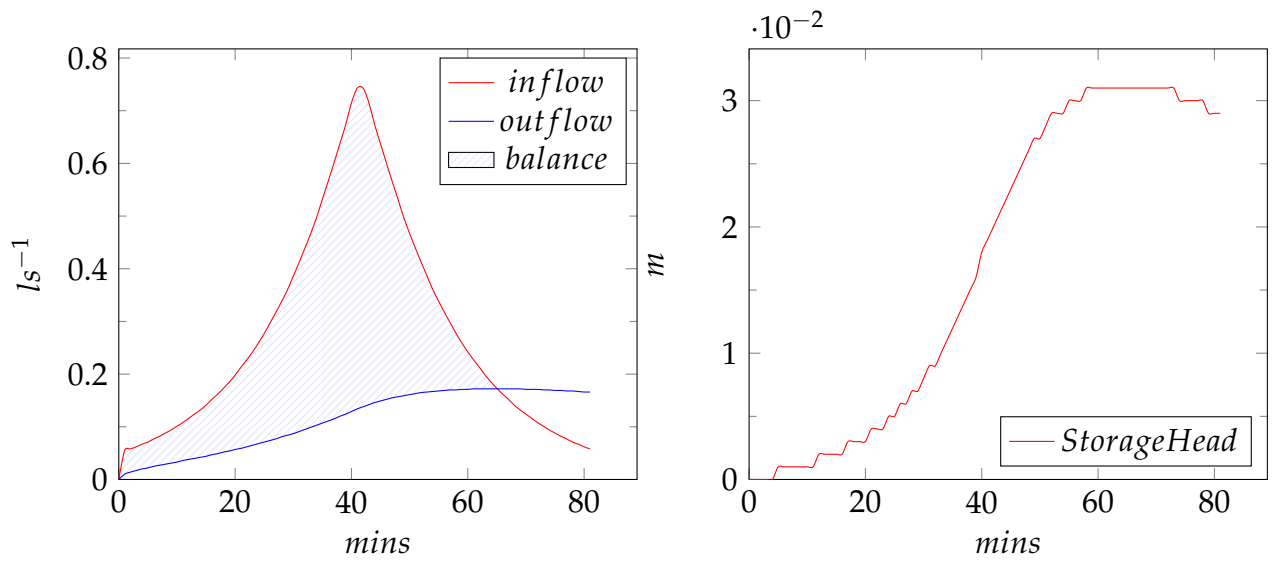


Figure 7: 1 in 30 year critical storm event

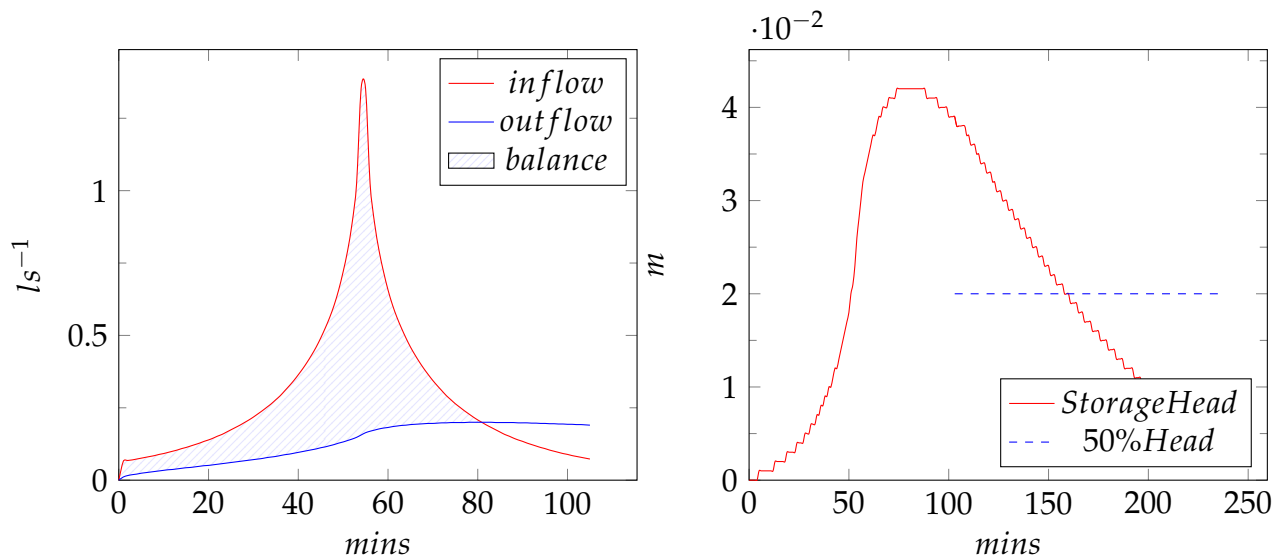


Figure 8: 1 in 100 year critical storm event

4th Floor roof

Drained area = $80m^2$

Roof outlets required = 3 (or total 12 x 10mm orifices)

Combined outfall rates:

1 in 1yr = $0.1 \times 3 = 0.3l s^{-1}$

1 in 100yr = $0.2 \times 3 = 0.6l s^{-1}$

3rd Floor roof

Drained area = $230m^2$

Roof outlets required = 8 (or total 24 x 10mm orifices)

Combined outfall rates:

1 in 1yr = $0.1 \times 8 = 0.8l s^{-1}$

1 in 100yr = $0.2 \times 8 = 1.6l s^{-1}$

Total outfall rates from roof area

1 in 1yr = $0.3 + 0.8 = 1.1l s^{-1}$

1 in 100yr = $0.6 + 1.6 = 2.2l s^{-1}$

Note; The above calculations make no allowance for any attenuation, control or retention offered by the sedum medium placed over the crate system and hence is designed for system failure or removal of the cover medium.

5.1.6 Raised rain garden planter

Where practicable within the landscaping, under this option, residual water from the two roof areas together with any arising from the 3rd floor balcony area (circa 20m²) will flow to raised rainwater planter “rain gardens” to offer a level of pre-treatment, further attenuation and flow control at the base of rainwater pipes, Figure 9 (with planting and soil guide at Appendix C.1). Any residual outfall from the planters will be taken to the a new SW drainage provision on site and where possible sustainably retain any existing connections.

All planters will need to maintain a gap between the buildings and the planters to allow a free flow of air to any sub-floor air vents.

The under drains, and exceedance overflow pipes will re-connect directly with the SW infrastructure at ground level.

All planters offer sufficient storage volume to accommodate the 1 in 1yr, 5mm event. Each planter delays the peak run-off event for the drainage area served (the drain down times and critical storm duration are provided in the following calculations) such that it does not coincide with the peak of runoff from elsewhere either on or off site.

Run-off via the under-drain will only occur under saturation, or exceedance flows.

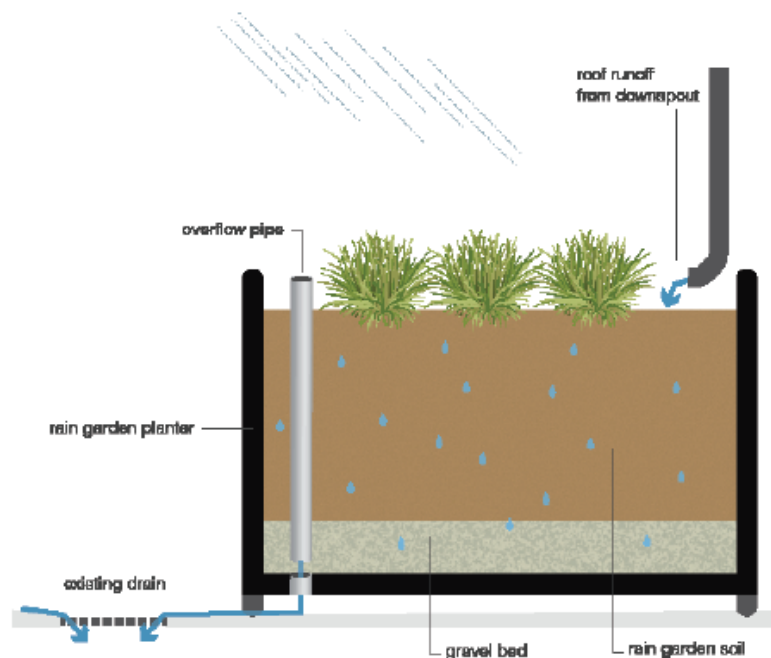


Figure 9: Typical rain garden raised planter

5.2 Rainwater Harvesting

The project team have also detailed “off line” rainwater butts to collect water for external use primarily to reduce potable water demand. These also serve as an additional SuDS feature. Since these are in off-line configuration any exceedance flows are automatically directed back to the downpipes.

5.3 Hard standing

All areas of hard standing on the site will be constructed using a permeable medium on a DOT/MOT 3 sub-base of a minimum 300mm depth (refer to Section 4.4).

Note: The depth requirement above satisfies hydraulic criteria only. Structural loading may require greater hardcore depths.

The perimeter of these areas will be considered for expansive planting to accommodate any exceedance flows.

For a check on the capacity of the permeable paving to function an infiltration rate of 5mm.hr^{-1} has been used below. Infiltration rates on the site have been found to be $9.7 \times 10^{-6} \text{ ms}^{-1}$ (in the worst case at sub-base level) which equals 35mm.hr^{-1} hence the rate of 5mm.hr^{-1} is considered conservative being circa 7 times lower. A nominal 100m^2 is checked here (so as to provide meaningful results given the small drained areas) but the results can be scaled up or down pro rata.

Over 100m^2 plan area, 5mm.hr^{-1} equates to a total outflow rate of 0.138ls^{-1}

Designed to accommodate all surface water arising from a design drained area of 100m^2 requires a minimum attenuation volume of 6 m^3 . This can be achieved using an overall storage volume of 35.0 m^3 formed within a $100\text{m}^2 \times 0.35\text{m}$ deep 30% void ratio sub-base. See Table 3.

Drained area	100m ²	
Urban Creep	1	
Designed drained area	100m ²	
Return periods considered	1yr, 30yr, 100yr	
Storm profiles used	50% Summer	75% Winter
Storm coeffs	a = 0.1, b = 0.815	a = 0.06, b = 1.026
Storm range, storm increments	From 5 minutes duration in further 2 min. intervals until critical storm reached	
M5-60	20mm	
r	0.4	
Rainfall model	FSR	
Critical design storm	225 mins, Summer	
Climate change	1.4	
Storm mean intensity	15.1mm.hr ⁻¹	
Design mean intensity	21.1mm.hr ⁻¹	
Storm peak intensity	76.0mm.hr ⁻¹	
Design peak intensity	106.3mm.hr ⁻¹	
Design maximum head	0.25m	
Calculated maximum head	0.20m	
Minimum attenuation volume required	5.90m ³	
Void ratio	30%	
Design attenuation volume	8m ³	(0.3 x 100m ² x 0.25m)
Provided attenuation volume	11m ³	(0.3 x 100m ² x 0.35m)
Factor of Safety	1.40	
1 in 1yr maximum outfall rate	0.1ls ⁻¹	(See Figure 10.)
1 in 30yr maximum outfall rate	0.1ls ⁻¹	(See Figure 11.)
1 in 100yr maximum outfall rate	0.1ls ⁻¹	(See Figure 12.)
1 in 100yr Time to peak	217 mins	
1 in 100yr Max head: Time to drop to 50%	5.94 hrs	
Outfall control method	Nominal GF outflow	

Table 3: Storage volume design summary

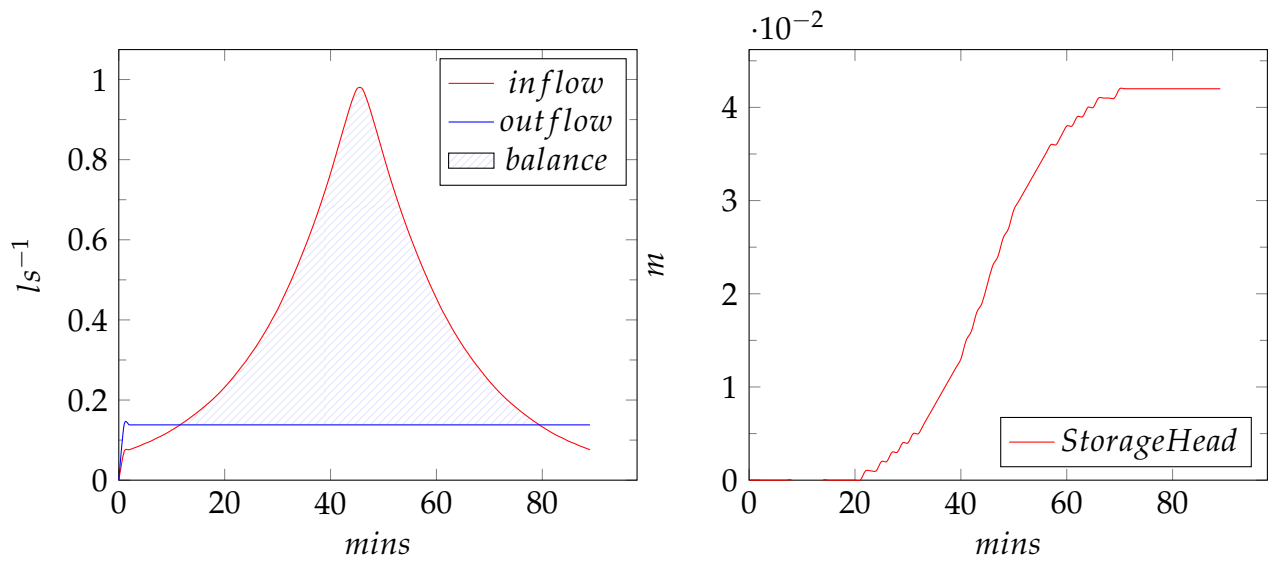


Figure 10: 1 in 1 year critical storm event

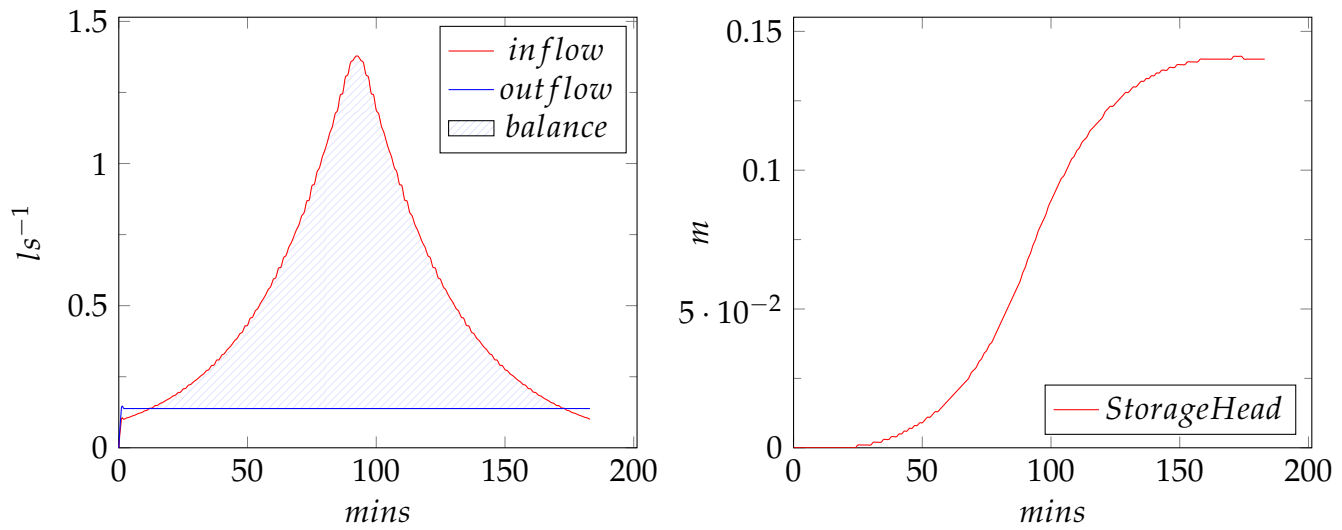


Figure 11: 1 in 30 year critical storm event

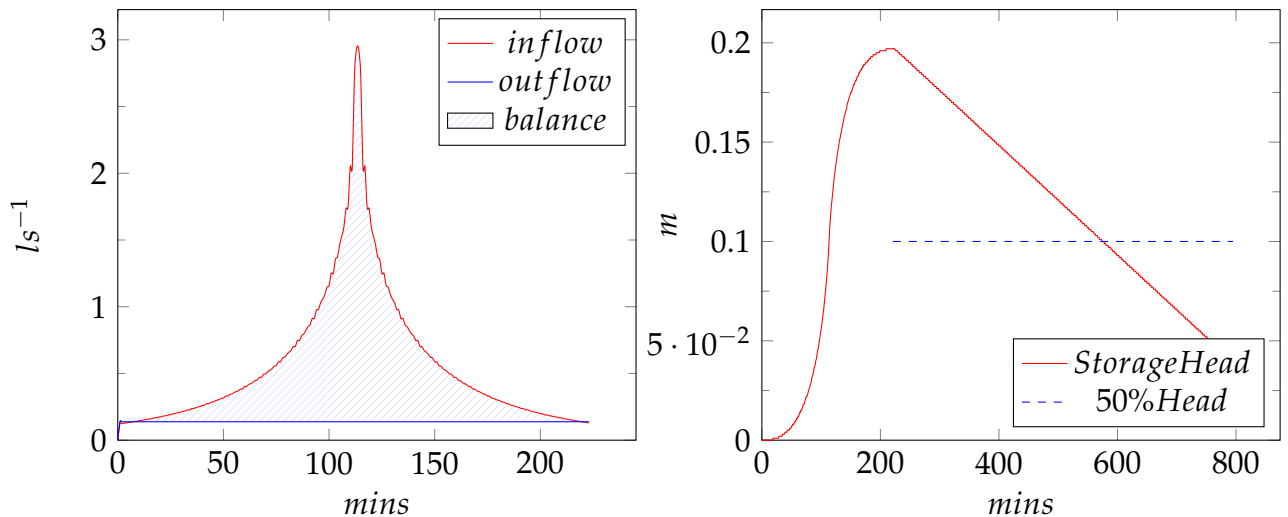


Figure 12: 1 in 100 year critical storm event

The areas of permeable paving are primarily disconnected from the proposed SW network on site, i.e. they are not primarily designed to drain to the soakaway. Surface water retained in the sub-base matrix is lost through evaporation and infiltration at or greater than $9.7 \times 10^{-6} \text{ ms}^{-1}$, at shallow depths, into the surrounding naturally fissured sub-soils (due to action of freeze-thaw, roots, earthworms and the proposed local re-grading following any site clearance). In doing so it mimics as close as possible the natural hydrological process of water falling onto the ground and finding natural flow paths for dispersion.

Exceedance flows (flows over the $1.2 \times \text{M1006hr} + \text{CC}$ event) will be conveyed at the surface via channels (e.g. ACO channels) towards a nominal sized soakaway pit.

5.4 Landscaped areas

Typical domestic planting.

5.5 Drainage layout

Please refer to the drainage layout showing SuDS features at Appendix A.

5.6 Exceedance flow routes

These follow the natural site gradients.

5.7 Overland flow

There is no other overland flow other than the exceedance routes noted above.

5.8 Timetable for implementation

5.8.1 Construction phase

Soakaways chambers will be installed early in the project under the remit of the ground-works operations. These will be provided with access covers to allow for post construction inspection and cleaning.

Areas of landscaping and boundary planting will be undertaken as the project nears completion.

Permeable paving will only be installed when all construction activities are either complete, or near completion so as to minimise blockage of the surface.

5.8.2 Construction Phase Drainage Requirements

Given that:

- The developers legally required CDM documentation will include all site activity, including drainage.
- The contractor will be contractually obliged to clean, maintain and repair as required, any existing retained drainage infrastructure affected by the works, during and immediately after construction.

then the construction phase and immediate post construction phase will be adequately managed.

5.8.3 Post construction phase

Water butts will be installed prior to final completion as part of the final landscaping.

Inspection chambers pumped and cleaned out.

Soakaway cells checked and cleaned of any construction debris and final cover placed over to allow completion of landscaping.

Any areas of Sedum installed.

6 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the land owner/management company.

Given that:

- The site is not adopted by the Council,
- Individual property owners and users are responsible for managing the drainage of their land so that they do not adversely impact neighbouring land ,

then a site management scheme will be drafted that will include the following SuDS related operations:

6.1 Soakaways (and pre treatment sediment sumps)

Figure 13^[2] provides details maintenance operations required for a soakaway system.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Figure 13: Maintenance operations for soakaway

6.2 Permeable pavements

The maintenance plan for permeable pavements will include:

- Monthly litter removal;

- Bi-Annual suction sweeping;
- Annual inspection and repairs as/if required.

6.3 Water butts

A maintenance plan for water butts should include:

- Regular inspection of silt traps and filters;
- Removal of sediments and debris as required.

6.4 Vegetation expansion

The maintenance plan for any garden planting will include:

- Monthly inspections until vegetation is established;
- Six monthly inspections after the vegetation has become established;
- Monthly litter removal.

6.5 Raised planter rain gardens

The maintenance plan for any raised planter devices will include:

- Occasional weeding during the first two years;
- Removal of any dead or unwanted plants in winter (other than leaving seed heads for wildlife).

6.6 Blue roof systems and control devices

The maintenance plan for the blue roof systems will include:

- Regular inspection of silt traps, outlets, IC's and pipework (safe access provision required);
- Removal of sediments and debris as required.

6.7 Sedum roofing

See Appendix C.6 for details.

7 Summary

All surface water arising can be managed on site. All surface water arising from roofed areas is controlled by direct infiltration through soakaways. Water butts will reduce potable water demand provide additional SuDS on site. All areas of hard standing on the site will be constructed using a permeable medium.

A second alternative option using blue roofs to attenuate and control flows is also provided in the event that further site investigation prevents the primary infiltration strategy.

There is no design exceedance outfall away from the site. Exceedance flows and flows arising from system failure can be accommodated on site within areas of landscape planting, soakaway crates and the sub-base to the hard standing.

The use of SuDS techniques on site, as detailed above and when installed in line with best practice (I.e. CIRIA 753 & CIRIA 768), will reduce and treat the run-off volumes in line with the core policies.

Signed: 

Dr Robin Saunders CEng, C. Build E, MCABE, BEng(Hons), PhD

Date: 25th November, 2020

References

- [1] DCW Marshall & AC Bayliss. Flood estimation for small catchments. Technical Report No. 124, Institute of Hydrology, June 1994.
- [2] CIRIA. The SUDS manual. Technical report, CIRIA, 2015.
- [3] H R Wallingford, Howbery Park, Wallingford, Oxfordshire. *The Wallingford Procedure*, volume 1 edition, 1981.
- [4] C Hassell and B Coombes. Green roofs. Technical report, CIBSE, 2007.

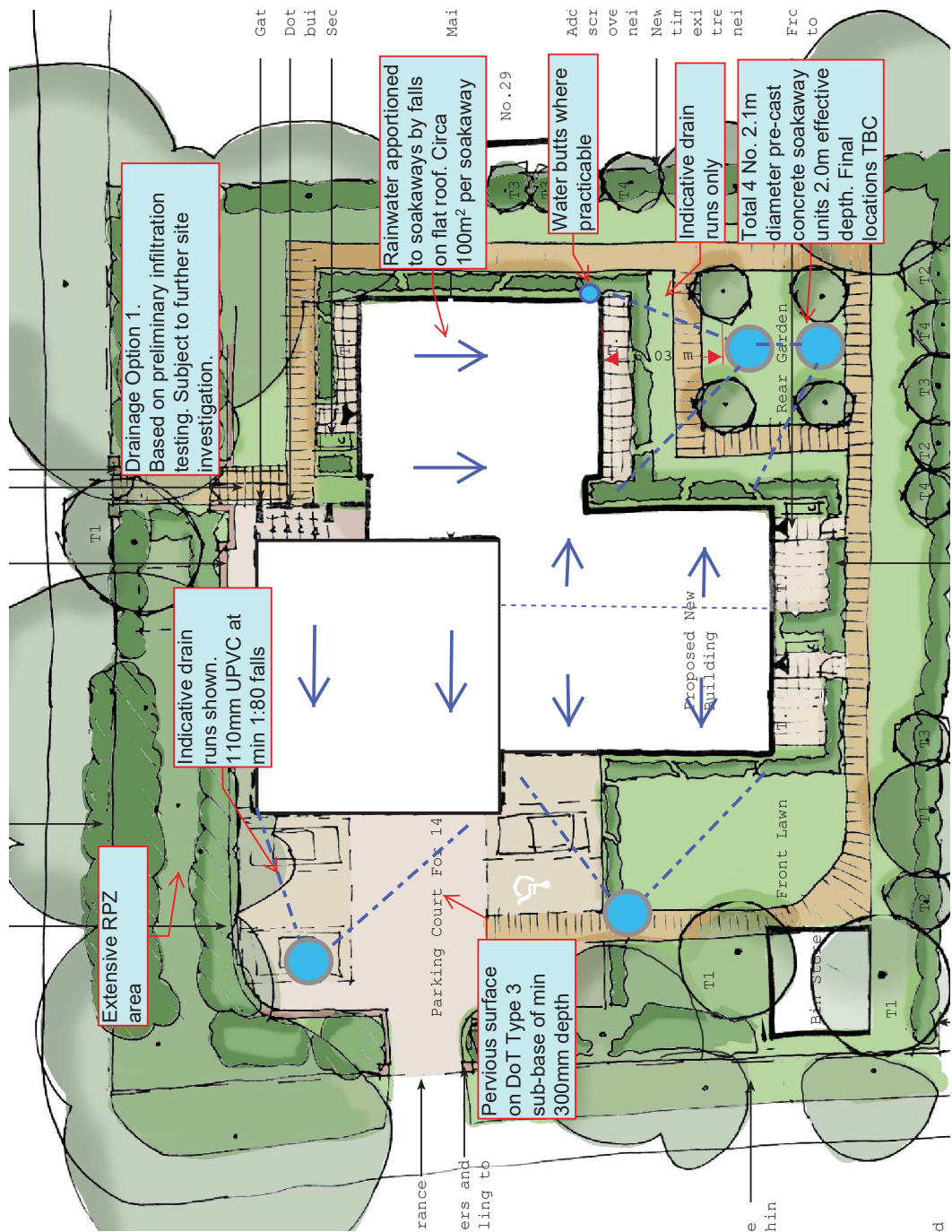
A Proposal plans

A.1 Proposed site layout



		Collaborating with:			
Colony		Job:			
1000, 1000, 1000		Drawing:			
500		02-10			
Revision:		-			
Project:					
The New Home, Newbury Court, Newbury, RG13 2BB					
Drawing Name:					
Proposed Block Plan					
Scale:					
1:100					
Drawn By:					
100					
Checked By:					
100					
RIBA					
Colony Architects Ltd.					
The New Home, Newbury Court, Newbury, RG13 2BB					
Tel: 0113 20 1324					
info@colonyarchitects.com					

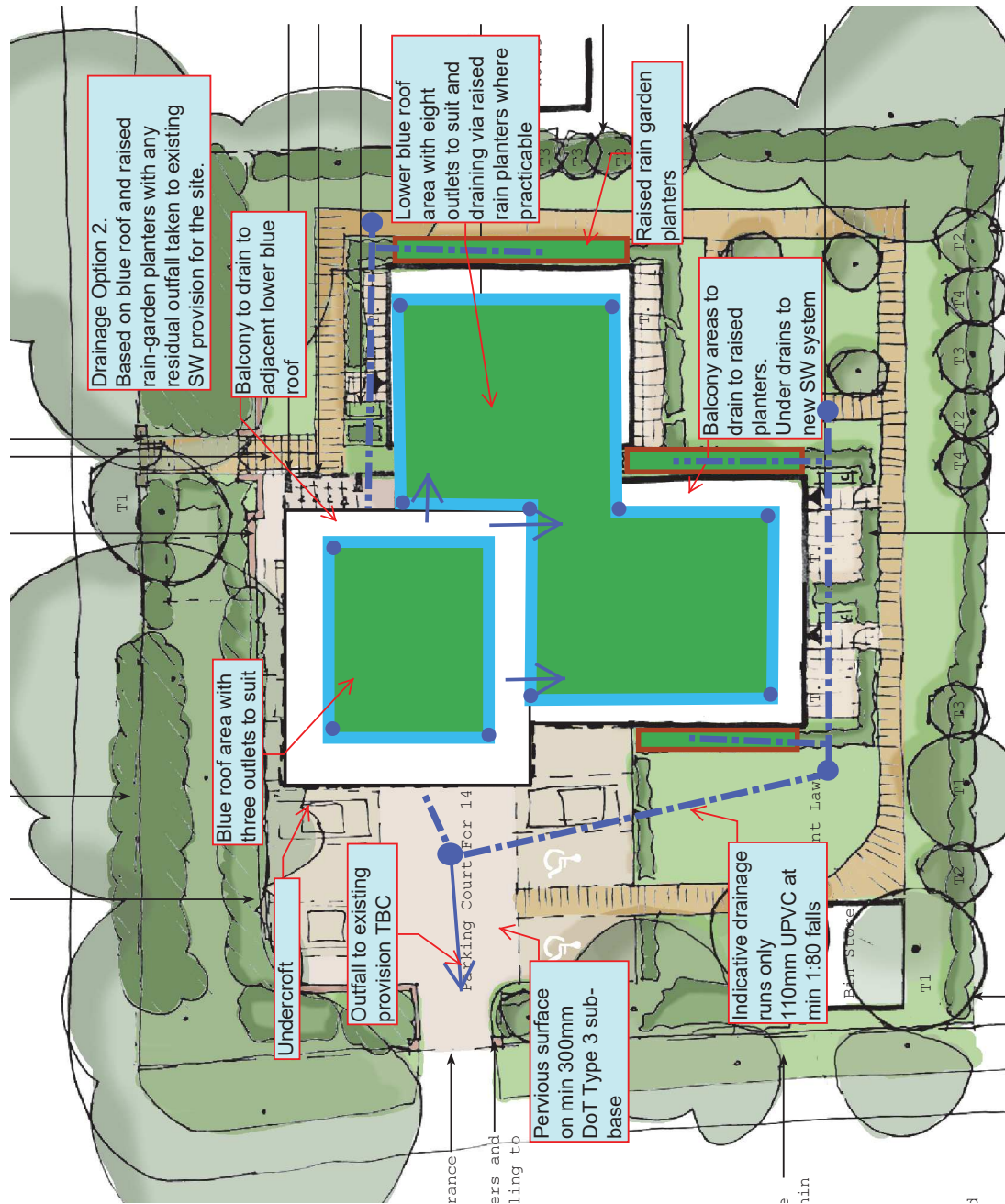
B Indicative drainage layout - Option 1



B.1 Soakaway ring size chart

DN	Depth Available				Wall Thickness	Outside Diameter	Approx Weight p/m depth	Soakaway Holes p/m depth
	250mm	500mm	750mm	1000mm				
mm					mm	mm	kgs	Number
900	•	•	•	•	70	1040	530	12
1050	•	•	•	•	80	1210	710	16
1200	•	•	•	•	90	1380	912	16
1350		•	•	•	95	1540	1080	16
1500		•	•	•	105	1710	1330	20
1800		•	•	•	115	2030	1760	24
2100		•	•	•	125	2350	2140	24
2400		•	•	•	140	2680	2740	28
2700		•	•	•	150	3000	3400	32
3000		•	•	•	165	3330	4140	36
3660+			•	•	185	4030	5300	44
4000+			•	•	200	4400	6360	48

C Indicative drainage layout - Option 2



C.1 Rain garden planter

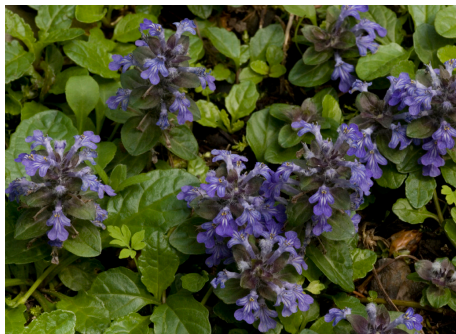
C.1.1 Planting guide

Planting

Your rain garden is designed to slow surface water run-off and improve water quality. However it is a garden feature and should work for you in terms of the overall design of your property. Like any garden, there is range of possible planting styles: your rain garden might have ornamental, low maintenance ground cover, designed to provide a habitat for wildlife or quirky, perhaps, with stone, gravels or even sculpture – the choice is yours. The English cottage, American prairie or ornamental grass styles are particularly well suited to rain gardens. In larger planters, you may be able to grow fruit and vegetables.

When choosing plants you may want to consider height, colour and flowering period. Taller plants tend to be situated at the centre of the garden and shorter ones around the edges, so that all can be seen and so that deeper-rooted plants can benefit from the deeper soil in the middle of the bed. By grouping plants of various size and texture you will be able to create an interesting looking garden even when few flowers are in bloom. If you wish to create habitat for wildlife, plant native species or plants that are known to attract insects like bees and butterflies and other wildlife. For further information on plants for pollinators see the Royal Horticultural Society's list, and for general advice on wildlife gardening see the Wild About Gardens website (see the Resources section).

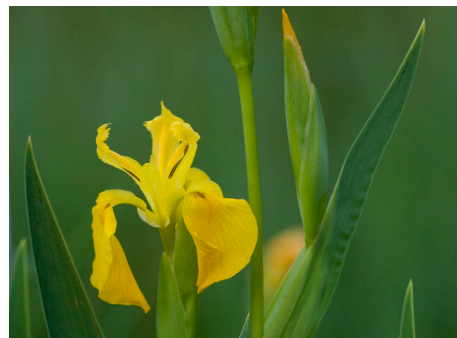
It is recommended that your rain garden is planted with a wide range of species in order to create a densely vegetated, stable and thriving bed with dense and thick root systems which will thrive without frequent maintenance. A typical rain garden is planted with about 10 species planted in 2 to 3 clumps per square metre. By planting several species, you will be creating a rain garden that can still succeed even if one or two species do not thrive. A typical planting density is 6-10 plants per square metre, but you may wish to vary this, depending on the size and nature of the plants chosen.



Bugle, *Ajuga reptans* | Bob Gibbons

Plant the rain garden with nursery-grown stock. Good results have been achieved with one or two year old plugs or potted

plants, which have a strong root system. Before you plant, it is advisable to have a good idea of what goes where, by preparing a planting plan. Excavate a hole for each plant about twice the size of the root ball, place the plant in the hole and press the soil firmly around the roots. The stem should be at the same level relative to the ground as it was in the growing container. Once the garden is planted, you may consider spreading bark mulch across bare soil to suppress weed growth.



Yellow flag iris, *Iris pseudocorus* | Bob Gibbons

The perimeter berm can be seeded with a general purpose wildflower grassland mix, which can be left to grow, or mown as required, in order to match the adjacent garden. Unless it rains, plants should be watered during establishment. During hot weather, the soil loses about 3 litres per square metre per day by evaporation, so it is advisable to replace this if possible. Once established, the plants will not need to be watered unless the weather has been exceptionally dry. Plants can be planted anytime during the growing season, as long as they are watered. If watering is difficult, it may be advisable to plant in autumn.

A very wide range of plants can be planted in rain gardens, however you should avoid using plants that do not withstand occasional flooding - for example species which are usually associated with dry Mediterranean style gardens, like Lavender. Other plants to avoid include those susceptible to root rot including Azalea, Juniper and Chinese privet.

The frequency that the rain garden is inundated will depend on the size of the rain garden and the weather, so it is important to keep an eye on the rain garden, replace any failures and adjust the planting palette to suit the actual conditions. A selection of suggested plants is included in the table. There are many others that will be suitable which are not listed, so feel free to experiment and apply your own plant knowledge if you are a keen gardener. If you have success or notice problems with particular species, please let us know at: www.raingardens.info.

Planting Suggestions

Common name	Scientific name	Habit	Sunlight and Aspect	Origin
Guelder rose	<i>Viburnum opulus</i>	Perennial shrub	Any	Native. Flowers attract insects and berries are eaten by birds.
Dogwood	<i>Cornus sanguinea</i>	Perennial shrub	Any	Native. Leaves are larval food for vase bearer moth and berries eaten by birds. Often planted for attractive winter stems.
Culvers root	<i>Veronicastrum virginicum</i>	Herbaceous perennial	Full sun or partial shade	Non-native. Tall with long terminal blue flower spikes. On the RHS 'plants for pollinators' list.
Aster	<i>Aster spp.</i>	Herbaceous perennial	Full sun or partial shade	Non-native. Often late flowering. Clump forming. Several species on the RHS 'plants for pollinators' list.
Black eyed susan	<i>Rudbeckia hirta</i>	Herbaceous annual or biennial	Full sun or partial shade	Non-native. Spectacular yellow and black flowers. On RHS 'plants for pollinators' list.
Stinking hellebore	<i>Helleborus foetidus</i>	Herbaceous perennial	Full sun or partial shade	Native. Winter flowers.
Montbretia	<i>Crocsmia spp.</i>	Deciduous rhizomatous perennial	Partial shade	Naturalised. Red flowers. Thrives in most conditions.
Bugle	<i>Ajuga reptans</i>	Rhizomatous perennial	Partial shade	Native. Low growing and will form a mat.
Columbine	<i>Aquilegia spp.</i>	Herbaceous perennial	Full sun or partial shade	Non-native. Clump forming with tall flower spikes. On RHS 'plants for pollinators' list.
Inula	<i>Inula hookeri</i>	Herbaceous perennial	Partial shade	Tall clump forming with yellow flowers. On RHS 'plants for pollinators' list.
Hemp agrimony	<i>Eupatorium cannabinum</i>	Herbaceous perennial	Full sun or partial shade	Native. Sub-shrubs with pink flowers.
Bellflower	<i>Campanula glomerata</i>	Herbaceous perennial	Full sun or partial shade	Native. Clumps bearing violet-blue bell shaped flowers.
Sneezeweed	<i>Helenium sp.</i>	Herbaceous perennial	Full sun	Non-native. Clump forming with red flowers. On RHS 'plants for pollinators' list.
Lesser periwinkle	<i>Vinca minor</i>	Perennial sub-shrub	Any	Non-native. Ground cover with blue flowers.
Elephants ear	<i>Bergenia sp.</i>	Rhizomatous perennial	Full sun or partial shade	Non-native. Large leaves and pink flowers.
Plantain lilies	<i>Hosta spp.</i>	Herbaceous perennial	Part shade	Non-native. Attractive light coloured flowers.
Yellow flag	<i>Iris pseudocorus</i>	Rhizomatous perennial	Full sun or partial shade	Native. Likely to prefer wetter areas near inlet.
Siberian flag	<i>Iris sibirica</i>	Rhizomatous perennial	Full sun or partial shade	Non-native. Blue flowers. Prefers moist but well drained soil.
Garlic and onions	<i>Allium spp.</i>	Bulbous perennials	Full sun	Non-native. On RHS 'plants for pollinators' list.
Soft rush	<i>Juncus effusus</i>	Evergreen perennial	Full sun or partial shade	Native. Form tussocks – likely to prefer wetter areas.
Pendulous sedge	<i>Carex pendula</i>	Rhizomatous perennial	Full sun or partial shade	Native. Nodding flower spikes. Likely to prefer wetter areas near inlet.
Zebra grass	<i>Miscanthus sinensis</i>	Perennial, deciduous grass	Full sun	Non-native. Tussock forming ornamental grass with silky flowers.
Switch grass	<i>Panicum virgatum</i>	Deciduous perennial grass	Full sun	Non-native. Tussock forming ornamental grass.
Royal fern	<i>Osmunda regalis</i>	Deciduous fern	Any	Native. Large clump-forming plants.
Male fern	<i>Dryopteris felix-mas</i>	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.
Broad buckler fern	<i>Dryopteris dilatata</i>	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.

C.2 Design parameters for soil filter medium

C.2.1 Saturated hydraulic conductivity

100mmhr⁻¹. This to be checked in-situ using the single ring test method or tested in bulk prior to delivery to ASTM F1815-06.

C.2.2 Porosity

Should be > 30% when tested in accordance with BS1377-2:1990 (design porosity set lower at 25%).

C.2.3 Matrix

Indicative PSD or landscapers specification

Sieve size, mm	% passing	equivalent %	
6	100	fine gravel (2.0 - 6.0mm)	>10
2	90 - 100	coarse sand (0.6 - 2mm)	50 - 60
0.6	40 - 70	medium sand (0.2 - 0.6mm)	35 - 65
0.2	5 - 20	fine sand (0.063 - 0.2mm)	< 20
0.063	< 5	clay and silts (< 0.063mm)	< 5
Organic matter	3 - 5% (w/w)		
pH	5.5 - 8.5		
Salinity	EC < μ 3300 Scm ⁻¹		

C.3 Blue roof options

BAUDER BLUE ROOF SYSTEM

The BauderBLUE Roof System is a sustainable drainage method designed to attenuate and manage stormwater on a flat roof over a 24-hour period via a restrictive flow outlet.

When to specify

Development and expansion of towns and cities has seen exponential use of impervious surfaces causing artificially high rates of rainwater runoff. In measures to prevent flooding, planners are restricting the amount of rainwater leaving a site via the drainage system which can be limited to 5-10 litres per second per hectare, the same flow rates for regional greenfield sites.

A Bauder blue roof is a solution for urban areas where options for ground-based attenuation systems are limited, and in particular, where construction is being carried out within flood sensitive areas. This rooftop sustainable urban drainage system (SuDS) has weight load implications and the project's structural engineer will need to be engaged with the design process from an early stage.

How it works

The specifically engineered outlet restricts the discharge of stormwater to a calculated and predesigned flow rate to significantly slow down the volume of water leaving the site. As the storm passes, water continues to discharge from the roof at a controlled rate which helps to avoid downstream or localised flooding.

The Bauder Blue Roof system can be constructed at either rooftop or podium level. The designed void space between the flat roof waterproofing membrane and hard or soft landscaping finish allows the stormwater to attenuate.

Key Features

- Simple low maintenance design
- Bespoke, project specific discharge rates to match the requirement of the SuDS report for the site.
- Can be created on zero falls or up to 1:40 pitch
- Correct volume and weight of water storage with built in overflow to ensure the maximum water level (HMax) is never exceeded and a tell-tail parapet overflow is utilised to visibly identify if water levels rise close to the HMax.
- Variants designed to work in conjunction with the Bauder Total Green Roof System and Bauder Hot Melt System.



Technical Credentials

- Full range of guarantees.
- BBA Certificate 10/4744 for Bauder Total Green Roof System and 06/4350 for Bauder Hot Melt System.
- Follows the National Federation of Roofing Contractors blue roof guidelines.
- Overflow outlets designed in accordance with BS EN 12056-3:2000.



Benefits

- Aid to planning and meets SuDS requirements when other systems are impractical or unable to be employed.
- Typically a blue roof attenuates up to 120mm of stormwater and the outlets give predicted rainwater discharge rates.
- No moving parts, simple to install and easy to maintain.
- Attenuates stormwater to alleviate localised or downstream flooding.
- All products covered within the Bauder guarantee.



Environmental Credentials

- BauderBLUE Roof Outlet manufactured from HDPE, classification 2, which is widely recycled.
- Rooftop solutions form part of the CIRIA SuDS design guide.
- Reduces the discharge rate of rainwater, mitigating the risk of localised or downstream flooding.

BLUE ROOF DESIGN

Engineered Design and Specification

The Bauder Blue Roof is designed for use with either the Bauder Total Green Roof System as a warm roof construction or the Bauder Hot Melt cold roof construction.

The design of the void space requires free-flowing water movement to the specifically engineered outlets.

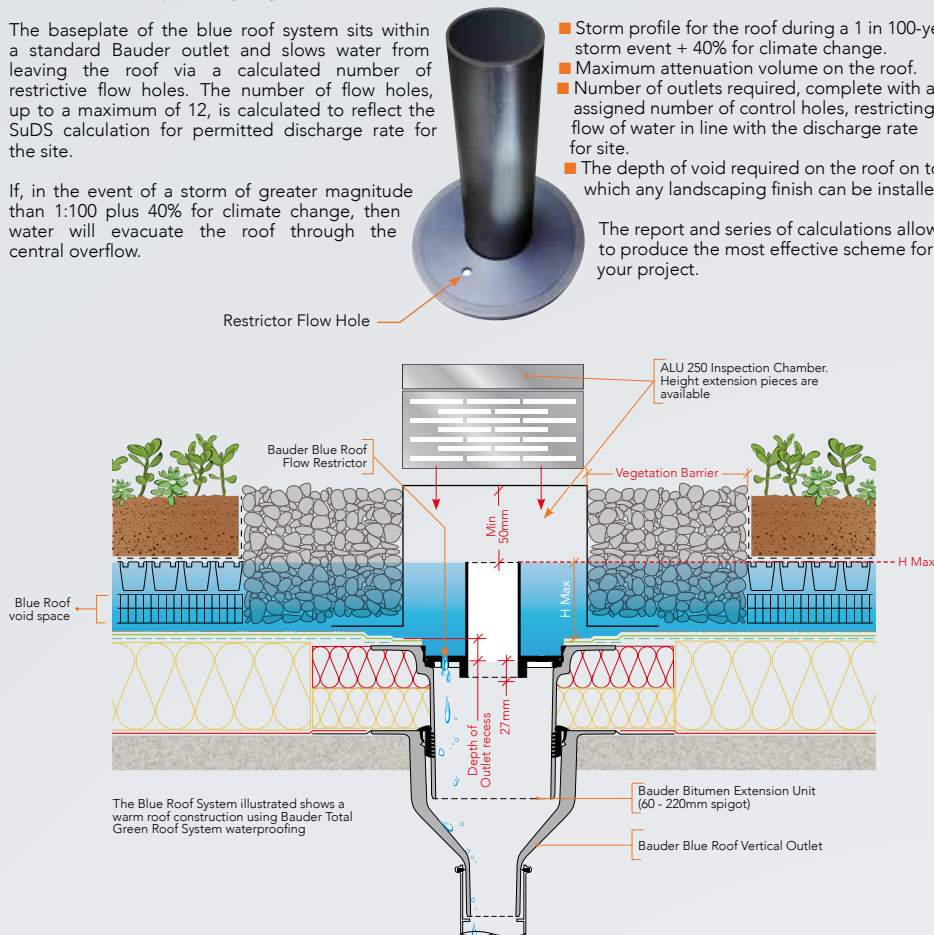
The baseplate of the blue roof system sits within a standard Bauder outlet and slows water from leaving the roof via a calculated number of restrictive flow holes. The number of flow holes, up to a maximum of 12, is calculated to reflect the SuDS calculation for permitted discharge rate for the site.

If, in the event of a storm of greater magnitude than 1:100 plus 40% for climate change, then water will evacuate the roof through the central overflow.

The design of every Bauder blue roof is individual to the project and geographical location. The Roof should have minimal penetrations in the construction. We use details of the roof area and the drainage requirements for the site to produce a roof specific discharge report to show the following:

- Storm profile for the roof during a 1 in 100-year storm event + 40% for climate change.
- Maximum attenuation volume on the roof.
- Number of outlets required, complete with an assigned number of control holes, restricting the flow of water in line with the discharge rate for site.
- The depth of void required on the roof on to which any landscaping finish can be installed.

The report and series of calculations allows us to produce the most effective scheme for your project.



Installation

The Bauder blue roof outlet overflow is inserted into the baseplate and measured, marked and cut to the specified Hmax for the roof.

The entire blue roof outlet is protected with the Bauder ALU250 Inspection Chamber which allows for ease of access during regular maintenance.

Maintenance

Blue roofs require regular maintenance and inspection of the outlets to ensure the drainage holes are free of debris or blockages.

Inspections should take place following any significant storm event, any notable traffic or remedial works that take place on or around the roof, and following leaf fall during the autumn months to ensure leaf litter is not causing obstruction.

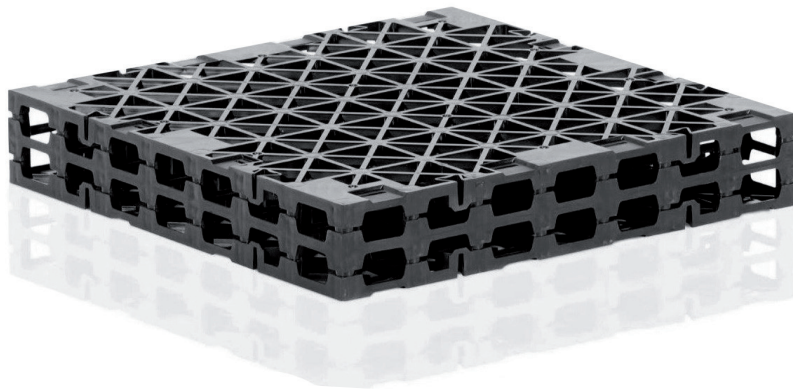
C.4 Attenuation cells (available option)



Specialists in Roofing
and Waterproofing

BlueRoof SWB Geocells

Product Data Sheet



SWB Geocells provide attenuation as part of a Blue Roof system that is designed to manage and control incident rainfall at a rate in line with the SuDS strategy or attenuation for a development.

BlueRoof

SWB Geocells



General Information

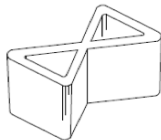
The Radmat range of **SWB Blue Roof Geocells** provides attenuation as part of a Blue Roof system that is designed to manage and control incident rainfall at a rate in line with the SuDS strategy or the attenuation requirements for a development.

Manufactured from Polypropylene SWB Blue Roof Geocells are load bearing modular units that are clipped together to form a single or double layer attenuation cell that is wrapped in **Radmat G12 Geotextile Filter Fleece**. Used in conjunction with rainwater outlet restrictors to control discharge, the Blue Roof is designed to be half empty within 24 hours.

PROPERTY	UNIT	SWB50	SWB65	SWB80	SWB100	SWB150	SWB200
Length	mm	500	600	600	600	600	600
Width	mm	500	600	600	600	600	600
Height	mm	50	65	80	100	150	200
Structure volume	m ³	0.018	0.023	0.029	0.036	0.054	0.072
Storage volume	m ³	0.0162	0.0211	0.0259	0.0324	0.0513	0.0684
Weight	kg	1.0	1.21	1.4	1.8	2.7	3.6
Short term compressive strength							
	Vertical	125	700	700	700	700	700
	Lateral	125	200	200	200	200	200
Long term compressive strength							
Vertical*	kN/m ²	45	254	254	254	254	254
Volume Void Ratio	%	96	90	90	90	90	95

*Based on a 2.75 Material Safety Factor in accordance with CIRIA c630 guidance.

Ancillaries



Cross Connector



Twin Connector



Control End Plate



Radmat Building Products Ltd Holland House, Valley Way, Rockingham Road, Market Harborough, Leicestershire, LE16 7PS T : 01858 410 372 E : technquiries@radmat.com

BlueRoof

SWB Geocells



Installation

1. Install Radmat G12 Geotextile Filter Fleece over the roof surface and up all upstands, ensuring enough length is left around the installation for the G12 to wrap up the sides of the SWB Geocells, and enough to overlap a minimum 150mm onto the top of the SWB Geocells.

2. Lay SWB Blue Roof Geocells, clipping adjacent panels to each other using the SW Cross Connectors ensuring each SWB Blue Roof Geocell is correctly oriented for the clips to meet.

This is also the jointing method for a 2nd layer of SWB, SWG are connected with a shear connector.

3. Cover with Radmat G12 Geotextile Filter Fleece ensuring minimum 150mm overlaps.

4. Immediately cover with the specified roof finish (green roof/paviors/ballast).

This information given in good faith and is based on the latest knowledge available to Radmat Building products Ltd. Whilst every effort has been made to ensure that the contents of the publication are current while going to press, customers are advised that products, techniques and codes of practice are under constant review and liable to change without notice. For further information on Radmat products and services please call 01858 410372, email techinquiries@radmat.com or visit our website www.radmat.com **JUNE 2019**



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C.5 Sedum option



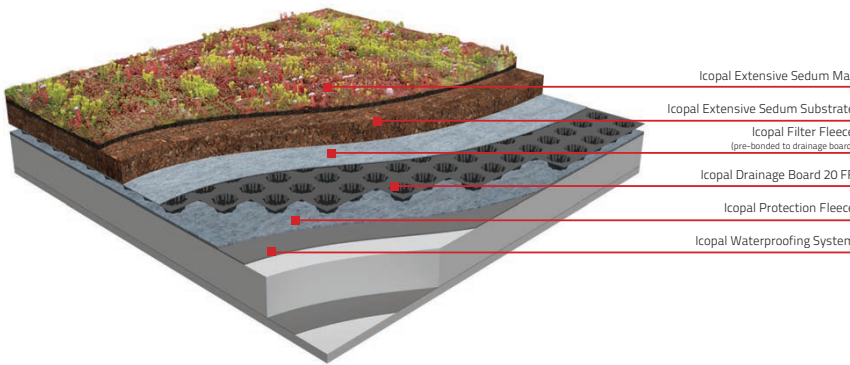
Icopal ST Sedum Mat System



GREEN ROOF SYSTEMS

Code: 3101062

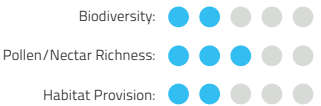
An extensive lightweight green roof system utilising a pre-grown vegetation mat of 8 – 12 sedum species. Provides an immediate green planting scheme for instant impact. The vegetation mat is installed on a shallow depth of specially formulated free-draining substrate and drainage board.



System Properties

The following data relates to the green roof element only.

System Dry Weight:	80 kg/m ²
System Saturated Weight:	100 kg/m ²
System Typical Depth:	104 mm
Growing Substrate Depth:	50 mm (settled)
Contouring:	Flat/level



Key Features

- A lightweight system suitable for a range of roof construction types.
- System type allows for shallower substrate depths.
- Attractive mix of sedum species.
- Sedum plants are low-growing.
- Moderate range of bio-diversity.
- Moderate provision of Nectar and Pollen to attract insects.
- Suitable for flat and pitched roofs.
- Versatile system; quick and easy to install.
- Low maintenance and drought tolerant.
- Pre-grown mat provides an instant green coverage.



Icopal ST Sedum Mat System



Plant Species

The sedum family of flowering plants are succulents and therefore have leaves which are able to store water. The majority grow naturally in arid, well drained areas, often on shallow substrate depths. Therefore they are drought tolerant, and able to survive in extremes of conditions. They generally flower from early summer to autumn.

General Notes

The system is suitable for both new build and refurbishment projects. Roof pitches up to 45° may be used, but for slopes over 9° a retention system is required. All slopes over 5° will require a mechanically fixed eaves edge restraint.

Detailing

A border with a recommended width of 300 – 500 mm of washed river stones (20 – 40 mm diameter) should be used around all roof penetrations, outlets, perimeters and system edges to provide a vegetation free zone.

Irrigation

Initial: Irrigation required immediately after installation for up to 8 – 12 months until fully established. Recommended irrigation period: 12 months. Pitched roofs retain less water and therefore a permanent irrigation system should be considered.

Once established: Irrigation is only generally required during prolonged periods of hot dry weather.

Water Source: A roof top source with a pressure of 2.5 – 3 bar and a flow rate of 60 L/min is recommended to connect a temporary system if required.

Maintenance:

Sedum systems are designed to be low maintenance. Species selection ensures that the roof will evolve naturally, however weeds should be removed periodically through the year to reduce the likelihood that they become dominant. It is recommended that a suitable fertiliser is applied to keep the plants healthy. This may be a spring feed of slow/controlled release fertiliser to last the growing season, or more regular granular/liquid feeds throughout the growing season.



Flowering Period: May – August.

Typical Colours: Seasonal variation of yellows, whites, and pinks. Foliage turns from green to red in periods of plant stress.

N° of Species Sown: 8 – 12.

Typical Species: (subject to season variation)

- Sedum acre, Sedum album, Sedum ellacombianum, Sedum floriferum, Sedum forsterianum, Sedum hybridum, Sedum kamtschaticum, Sedum montanum, Sedum oreganum, Sedum reflexum, Sedum rupestre, Sedum selskianum, Sedum sexangulare, Sedum spirium.

Flower Attraction

Low-moderate mixed pollen source, applicable to Bees – Mason, Honey Bombus spp; Insects – Chrysoperla (Lacewing), hoverfly (Episyrphus), Ladybird (Harmonia), Aphidius, Aphelinus, Aphidoletes (beneficial parasitic wasps).

Establishment Period: 6 – 8 months.



For more information please visit

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Issue 01

IC03012

C.6 Maintenance guide for sedum roofs

Extensive roof maintenance - < 100mm low nutrition substrate

- Irrigation: Post-establishment, irrigation should not be required for most extensive green roofs, although the water storage capacity of the system and the plants' water demands should be appropriately assessed.
- Fertilization: Extensive green roofs typically have low nutrient requirements and are therefore often fertilized on an annual basis, each spring, using a slow-release fertilizer.
- Plant management: Removal of undesirable plant species and fallen leaves should take place twice each year
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation, twice yearly

Biodiverse – very low to low nutrition substrate

- Irrigation: Typically not required
- Fertilization: Generally not required, particularly where indigenous species are being encouraged to replicate native habitats. Whilst a low vegetative density is common, zero vegetation is generally undesirable
- Plant Management: A maintenance programme should be drawn up to follow the biodiversity hypothesis, ensuring that no materials are removed from the roof that may adversely affect the biodiversity potential of the roof
- General: Drainage outlets (with inspection chambers) and gravel/shingle perimeters should be inspected twice yearly and cleared of any living or dead vegetation

Semi intensive – 100mm to 200mm low to medium nutrition substrate

- Irrigation: Periodic irrigation is expected, depending upon the plant specification and the climatic and microclimatic conditions prevailing at roof level.
- Fertilization: With a wider range of planting, using a more fertile growing medium, more regular fertilization is required.

- Plant management: Removal of undesirable vegetation on the greened area twice yearly.
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation, twice yearly

Intensive – 200mm + medium nutrition substrates and top soils

- Irrigation: Regular irrigation is often required, subject to the plant specification and the climatic and microclimatic conditions prevailing at roof level.
- Fertilization: With a wider range of planting, using a more fertile growing medium, more regular fertilization is required.
- Plant management: The intensive maintenance of lawns, hedges, borders etc. is required on a regular basis, so as to maintain the roof aesthetics. Undesirable vegetation should be removed from the green areas at least twice yearly. Failed plants in excess of 5% of the plants installed should be replaced.
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation twice yearly. Where excessive substrate settlement has occurred, this should be replaced.

D Site Investigation

Soakage testing to BRE 365 will be conducted with a 0.8 x 0.4m deep test hole at soakaway operational depth.

Permeability Test Data

Site details: **PARKSIDE ROAD** **RENOV.** **17th JULY 2016** **100 Rain, Cloudy, overcast**

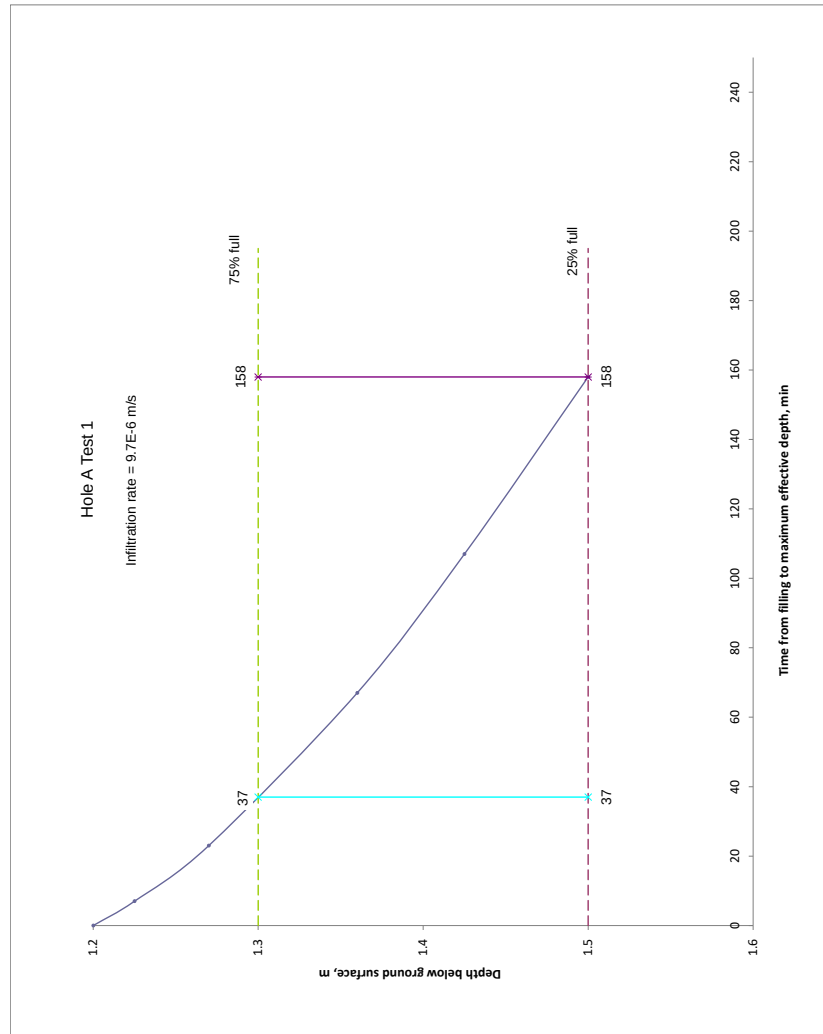
Trial Hole location or reference: **B** **A + 1.5m** **annotated site plan**

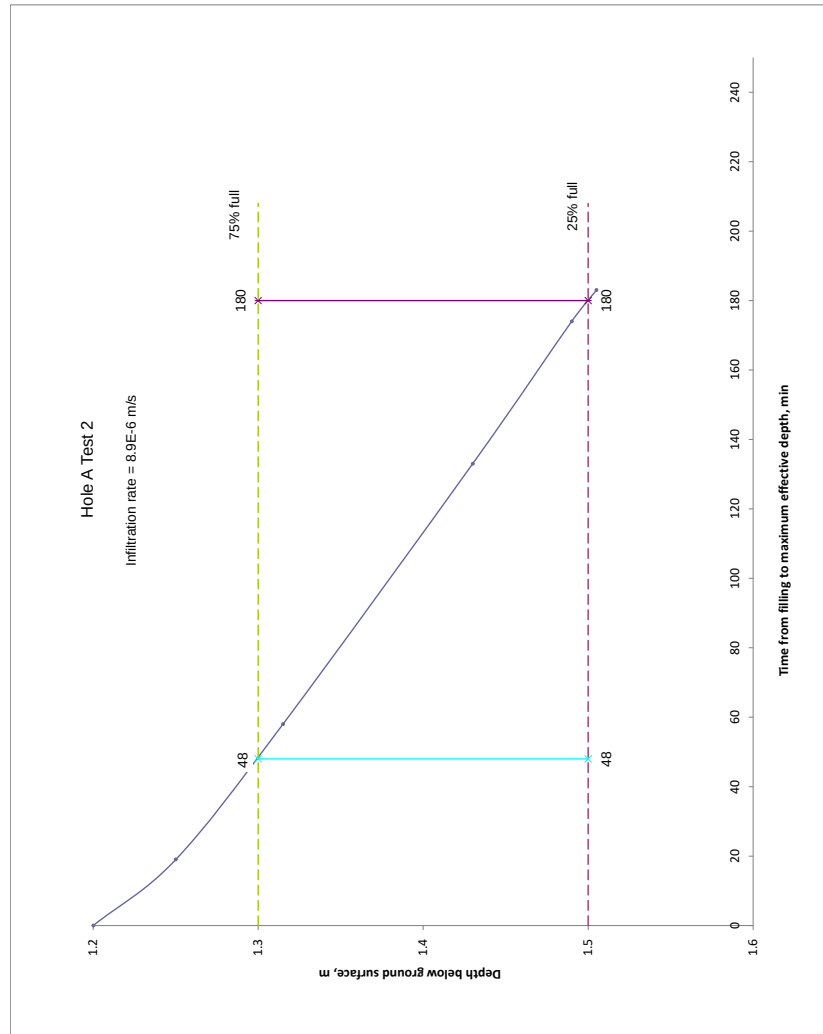
Trial Hole (actual test hole that is filled)	
Width	mm 300mm
Length	mm 800mm
Depth b.g.l.	mm 1200mm
Depth of water	mm 400mm

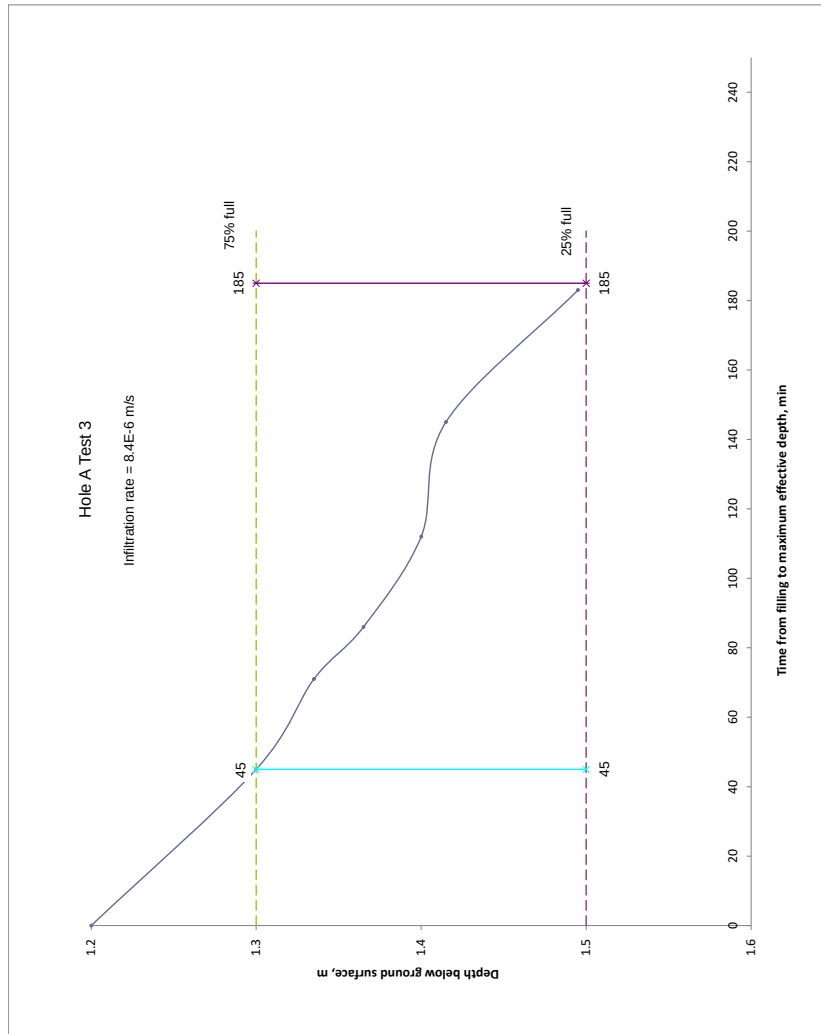
Start	Test 1		Test 2		Test 3		Example!!
	Time	Depth of water	Time	Depth of water	Time	Depth of water	
Reading 1	A 08:45	08:46	A 11:32	11:34	A 14:42	14:40	400
Reading 2	B 08:52	08:54	B 11:51	11:53	B 14:42	14:40	350
Reading 3	A 09:08	09:10	A 12:30	12:31	A 15:57	15:57	325
Reading 4	B 09:15	09:18	B 13:45	13:46	B 16:17	16:17	290
Reading 5	A 10:32	10:28	A 14:26	14:27	A 16:33	16:33	198
Reading 6	B 11:25	11:25	B 14:35	14:35	B 17:04	17:04	130
Finish							115
							85

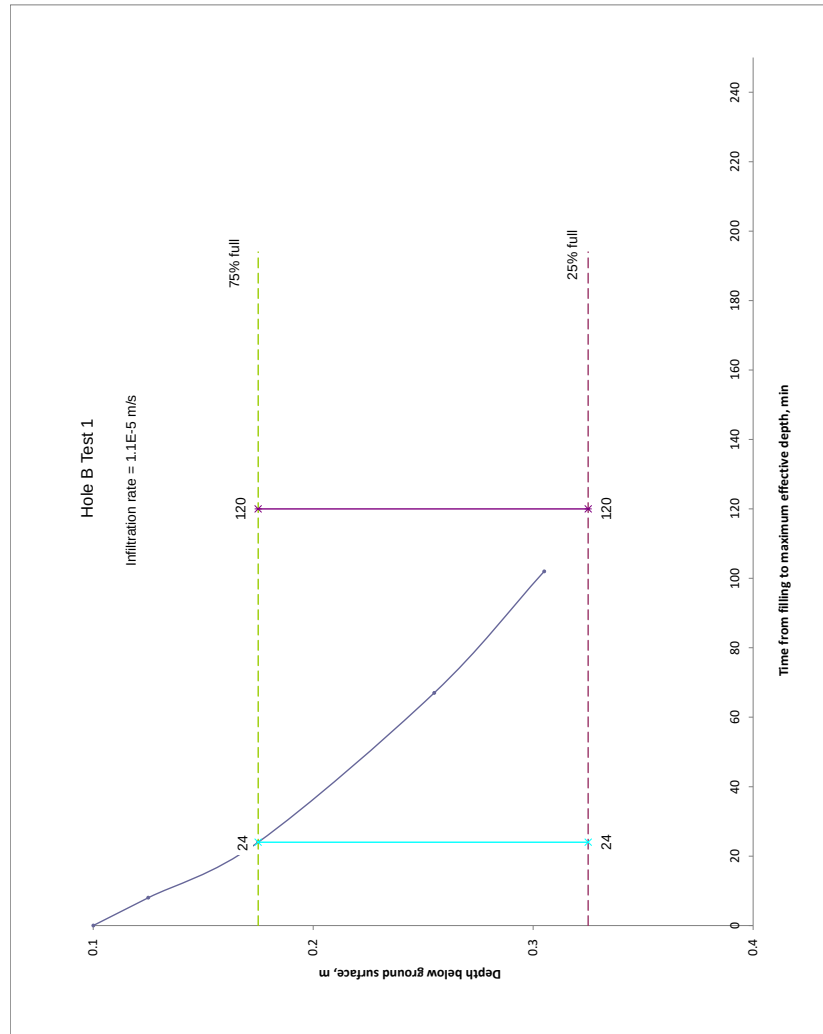
Notes: Use one sheet per test hole. Conduct three tests per hole. Email copy of completed sheet(s) to rob@innervision-design.co.uk
The last reading MUST be below 75% of start depth (e.g. less than 100mm in a 400mm test hole)

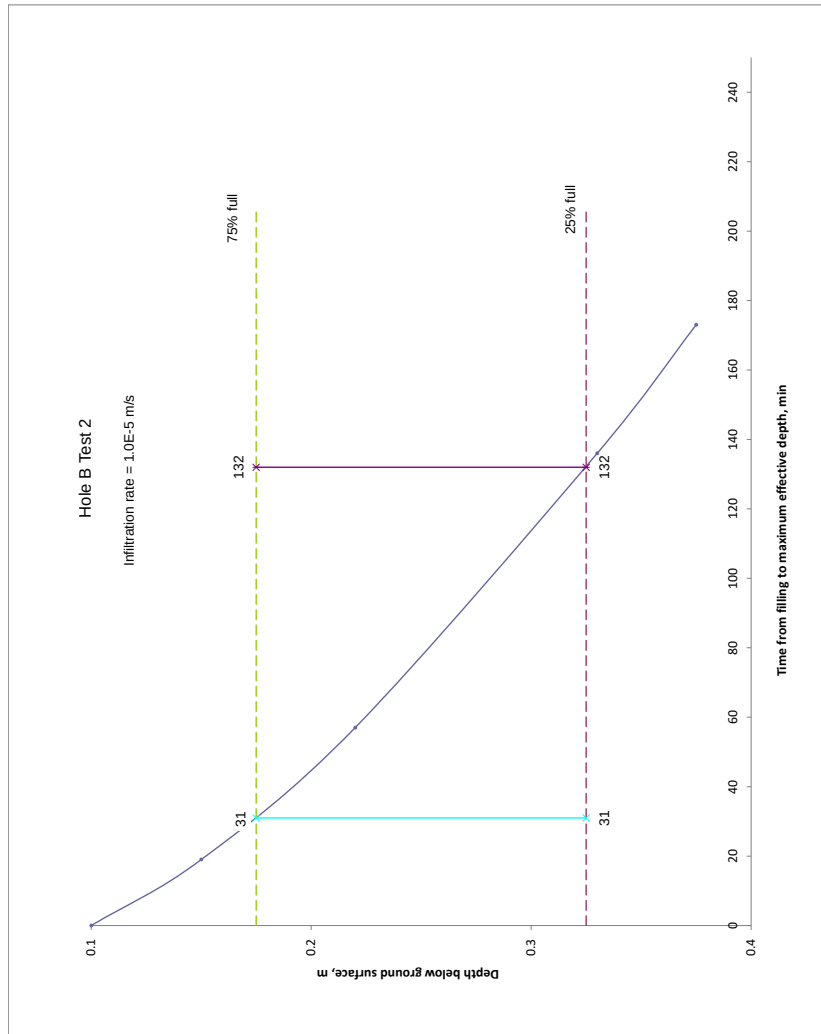
Site Notes:

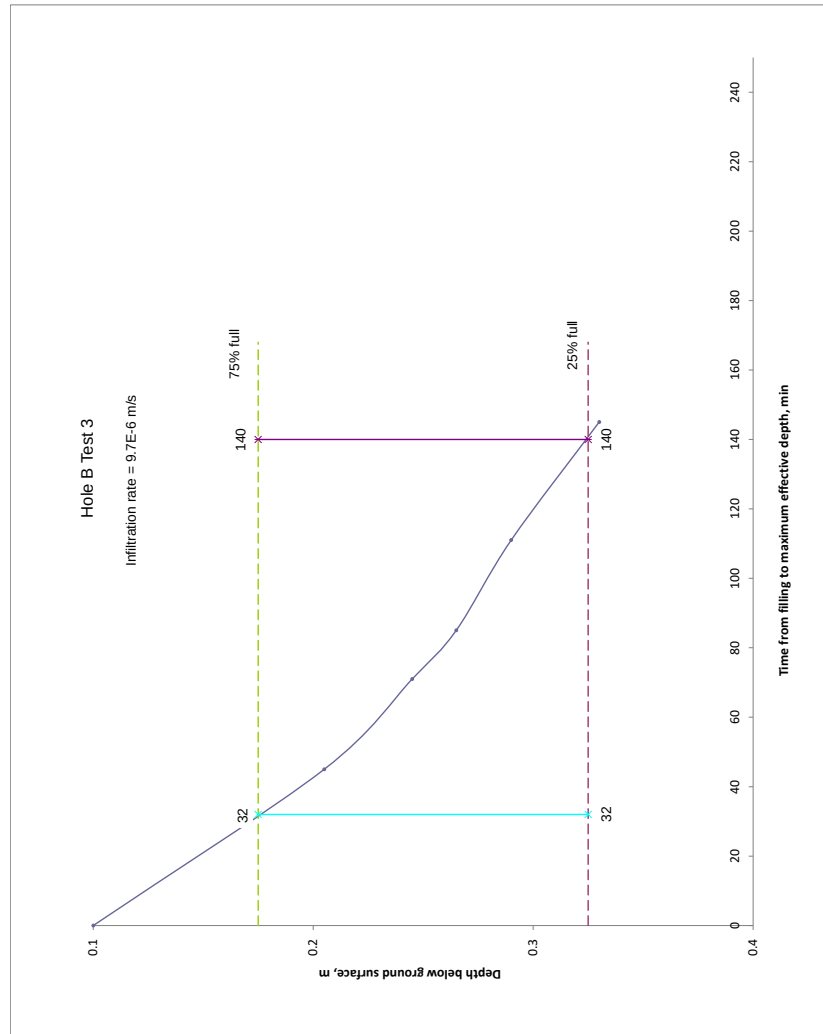












E Geo Insight report



18, PARKSIDE ROAD, READING, RG30 2DB

Order Details

Date: 23/11/2020
Your ref: 201507
Our Ref: GS-7305362
Client: Innervision Design

Site Details

Location: 469636 172762
Area: 0.14 ha
Authority: [Reading Borough Council](#)



Summary of findings

p. 2

Aerial image

p. 5

OS MasterMap site plan

p.10

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Summary of findings

Page	Section	Geology 1:10,000 scale	On site	0-50m	50-250m	250-500m	500-2000m
11	1.1	10k Availability	Identified (within 500m)				
12	1.2	Artificial and made ground (10k)	1	1	2	8	-
14	1.3	Superficial geology (10k)	1	0	0	6	-
15	1.4	Landslip (10k)	0	0	0	0	-
16	1.5	Bedrock geology (10k)	1	0	0	3	-
17	1.6	Bedrock faults and other linear features (10k)	0	0	0	0	-
Page	Section	Geology 1:50,000 scale	On site	0-50m	50-250m	250-500m	500-2000m
18	2.1	50k Availability	Identified (within 500m)				
19	2.2	Artificial and made ground (50k)	1	1	1	3	-
20	2.3	Artificial ground permeability (50k)	0	0	-	-	-
21	2.4	Superficial geology (50k)	1	0	0	4	-
22	2.5	Superficial permeability (50k)	Identified (within 50m)				
22	2.6	Landslip (50k)	0	0	0	0	-
22	2.7	Landslip permeability (50k)	None (within 50m)				
23	2.8	Bedrock geology (50k)	1	0	0	1	-
24	2.9	Bedrock permeability (50k)	Identified (within 50m)				
24	2.10	Bedrock faults and other linear features (50k)	0	0	0	0	-
Page	Section	Boreholes	On site	0-50m	50-250m	250-500m	500-2000m
25	3.1	BGS Boreholes	0	0	6	-	-
Page	Section	Natural ground subsidence					
27	4.1	Shrink swell clays	Moderate (within 50m)				
28	4.2	Running sands	Very low (within 50m)				
29	4.3	Compressible deposits	Negligible (within 50m)				
30	4.4	Collapsible deposits	Very low (within 50m)				
31	4.5	Landslides	Very low (within 50m)				
32	4.6	Ground dissolution of soluble rocks	Negligible (within 50m)				



Page	Section	Mining, ground workings and natural cavities	On site	0-50m	50-250m	250-500m	500-2000m
33	5.1	<u>Natural cavities</u>	1	0	1	5	-
34	5.2	<u>BritPits</u>	0	1	2	9	-
36	5.3	<u>Surface ground workings</u>	0	0	4	-	-
37	5.4	<u>Underground workings</u>	0	0	0	0	1
37	5.5	<u>Historical Mineral Planning Areas</u>	0	0	0	1	-
37	5.6	<u>Non-coal mining</u>	1	0	0	1	4
38	5.7	<u>Mining cavities</u>	0	0	0	2	8
39	5.8	JPB mining areas	None (within 0m)				
39	5.9	Coal mining	None (within 0m)				
40	5.10	Brine areas	None (within 0m)				
40	5.11	Gypsum areas	None (within 0m)				
40	5.12	Tin mining	None (within 0m)				
40	5.13	Clay mining	None (within 0m)				
Page	Section	Radon					
41	6.1	<u>Radon</u>	Less than 1% (within 0m)				
Page	Section	Soil chemistry	On site	0-50m	50-250m	250-500m	500-2000m
42	7.1	<u>BGS Estimated Background Soil Chemistry</u>	1	0	-	-	-
42	7.2	BGS Estimated Urban Soil Chemistry	0	0	-	-	-
42	7.3	BGS Measured Urban Soil Chemistry	0	0	-	-	-
Page	Section	Railway infrastructure and projects	On site	0-50m	50-250m	250-500m	500-2000m
43	8.1	Underground railways (London)	0	0	0	-	-
43	8.2	Underground railways (Non-London)	0	0	0	-	-
43	8.3	Railway tunnels	0	0	0	-	-
43	8.4	Historical railway and tunnel features	0	0	0	-	-
43	8.5	Royal Mail tunnels	0	0	0	-	-
44	8.6	Historical railways	0	0	0	-	-
44	8.7	Railways	0	0	0	-	-
44	8.8	Crossrail 1	0	0	0	0	-



44	8.9	Crossrail 2	0	0	0	0	-
44	8.10	HS2	0	0	0	0	-

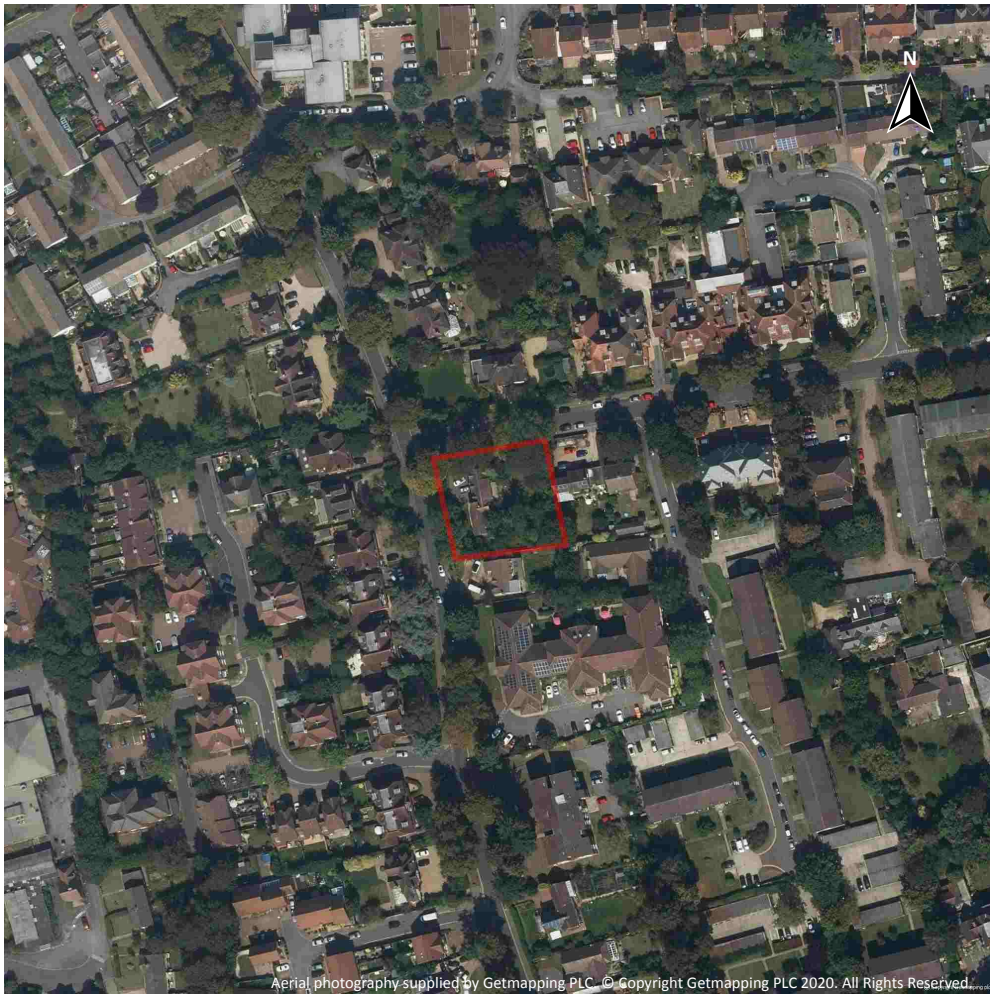


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Date: 23 November 2020



Recent aerial photograph



Aerial photography supplied by Getmapping PLC. © Copyright Getmapping PLC 2020. All Rights Reserved.

Capture Date: 25/08/2019

Site Area: 0.14ha



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Date: 23 November 2020

5

Recent site history - 2015 aerial photograph



Capture Date: 20/04/2015

Site Area: 0.14ha



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6

Recent site history - 2013 aerial photograph



Capture Date: 08/07/2013

Site Area: 0.14ha



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Recent site history - 2010 aerial photograph



Capture Date: 22/09/2010

Site Area: 0.14ha



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Recent site history - 1999 aerial photograph



Capture Date: 04/09/1999

Site Area: 0.14ha



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9

OS MasterMap site plan



Site Area: 0.14ha

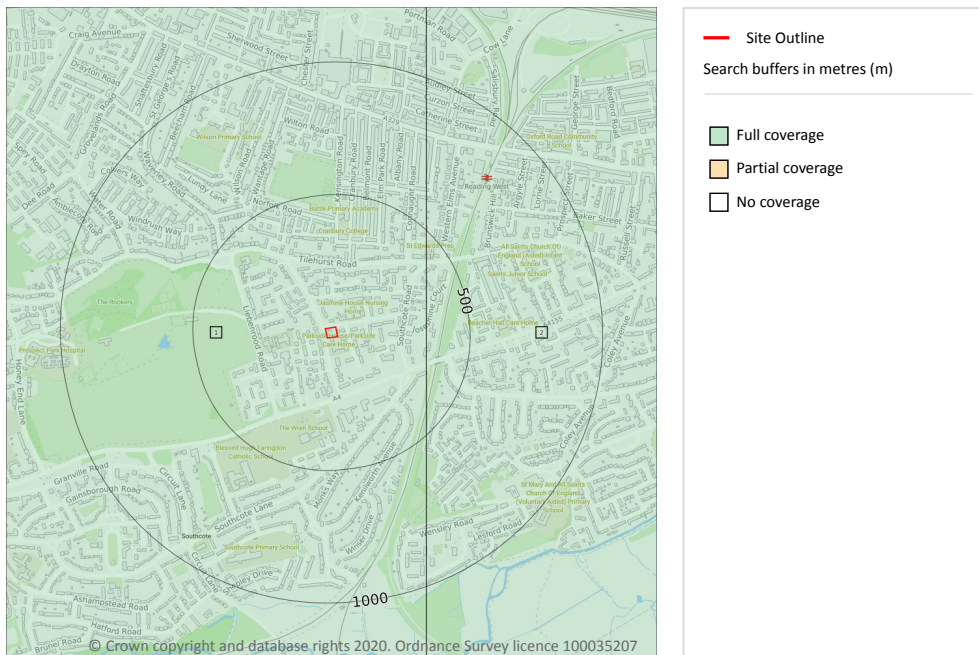


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1 Geology 1:10,000 scale - Availability



1.1 10k Availability

Records within 500m

2

An indication on the coverage of 1:10,000 scale geology data for the site, the most detailed dataset provided by the British Geological Survey. Either 'Full', 'Partial' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:10,000 scale - Availability map on [page 11](#)

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	On site	Full	Full	Full	No coverage	SU67SE
2	334m E	Full	Full	Full	No coverage	SU77SW

This data is sourced from the British Geological Survey.

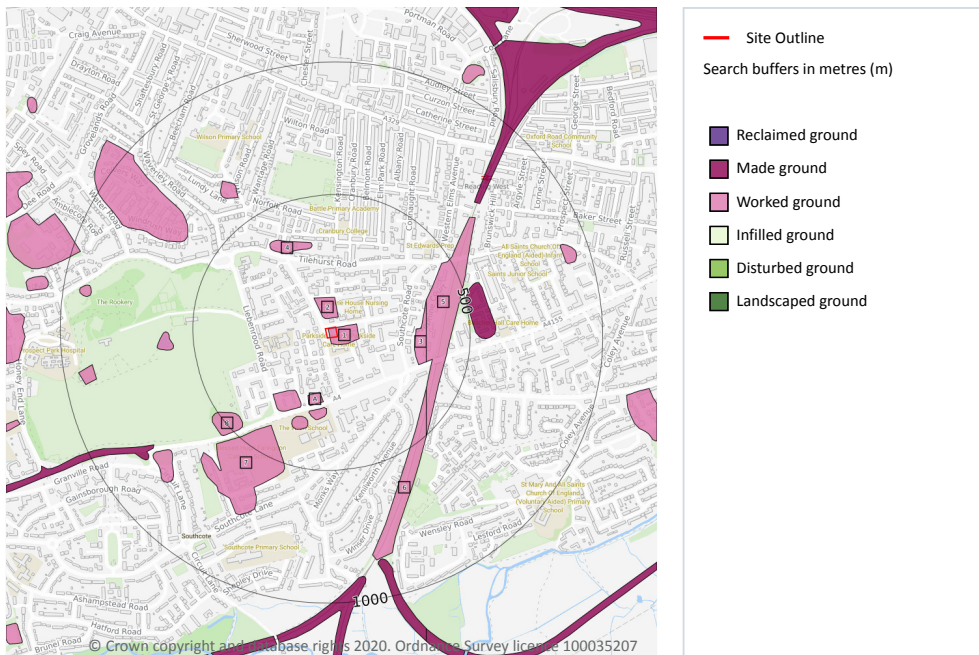


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Geology 1:10,000 scale - Artificial and made ground



1.2 Artificial and made ground (10k)

Records within 500m

12

Details of made, worked, infilled, disturbed and landscaped ground at 1:10,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:10,000 scale - Artificial and made ground map on **page 12**

ID	Location	LEX Code	Description	Rock description
1	On site	WGR-VOID	Worked Ground (Undivided)	Void
2	36m N	WGR-VOID	Worked Ground (Undivided)	Void
A	207m S	WGR-VOID	Worked Ground (Undivided)	Void
A	232m SW	WGR-VOID	Worked Ground (Undivided)	Void



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12

ID	Location	LEX Code	Description	Rock description
A	263m S	WGR-VOID	Worked Ground (Undivided)	Void
3	292m E	WGR-VOID	Worked Ground (Undivided)	Void
4	308m N	WGR-VOID	Worked Ground (Undivided)	Void
A	310m S	WGR-VOID	Worked Ground (Undivided)	Void
5	334m E	WGR-VOID	Worked Ground (Undivided)	Void
6	387m SE	WGR-VOID	Worked Ground (Undivided)	Void
7	392m SW	WGR-VOID	Worked Ground (Undivided)	Void
8	445m SW	WGR-VOID	Worked Ground (Undivided)	Void

This data is sourced from the British Geological Survey.

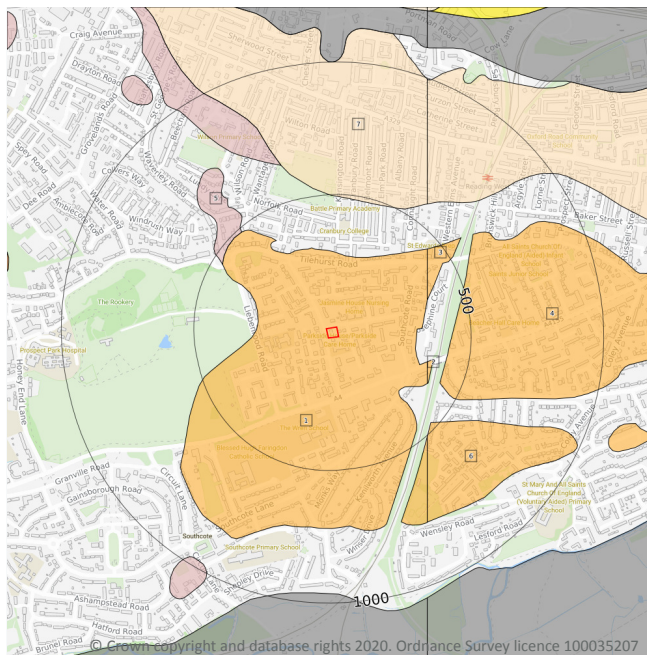


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Geology 1:10,000 scale - Superficial



— Site Outline
Search buffers in metres (m)

☒ Landslip (10k)

Superficial geology (10k)
Please see table for more details.

1.3 Superficial geology (10k)

Records within 500m

7

Superficial geological deposits at 1:10,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:10,000 scale - Superficial map on **page 14**

ID	Location	LEX Code	Description	Rock description
1	On site	LHGR-XSV	Lynch Hill Gravel Member - Sand And Gravel	Sand And Gravel
2	347m E	LHGR-XSV	Lynch Hill Gravel Member - Sand And Gravel	Sand And Gravel
3	357m E	LHGR-XSV	Lynch Hill Gravel Member - Sand And Gravel	Sand And Gravel
4	414m E	LHGR-XSV	Lynch Hill Gravel Member - Sand And Gravel	Sand And Gravel



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ID	Location	LEX Code	Description	Rock description
5	461m NW	HEAD-XVSZC	Head - Gravel, Sand, Silt And Clay	Gravel, Sand, Silt And Clay
6	475m SE	LHGR-XSV	Lynch Hill Gravel Member - Sand And Gravel	Sand And Gravel
7	484m N	TPGR-XSV	Taplow Gravel Formation - Sand And Gravel	Sand And Gravel

This data is sourced from the British Geological Survey.

1.4 Landslip (10k)

Records within 500m

0

Mass movement deposits on BGS geological maps at 1:10,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

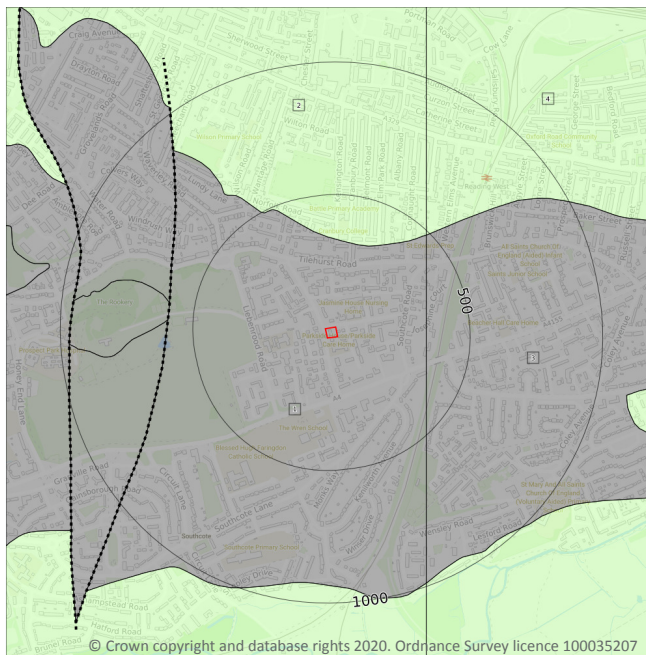


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Geology 1:10,000 scale - Bedrock



— Site Outline
Search buffers in metres (m)
.... Bedrock faults and other linear features (10k)
Bedrock geology (10k)
Please see table for more details.

1.5 Bedrock geology (10k)

Records within 500m

4

Bedrock geology at 1:10,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:10,000 scale - Bedrock map on **page 16**

ID	Location	LEX Code	Description	Rock age
1	On site	LMBE-CLSISA	Lambeth Group - Clay, Silt And Sand	Paleocene Epoch
2	322m N	LSNCK-CHLK	Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk	Campanian Age - Turonian Age



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ID	Location	LEX Code	Description	Rock age
3	334m E	LMBE- CLSISA	Lambeth Group - Clay, Silt And Sand	Paleocene Epoch
4	487m NE	LSNCK-CHLK	Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk	Campanian Age - Turonian Age

This data is sourced from the British Geological Survey.

1.6 Bedrock faults and other linear features (10k)

Records within 500m

0

Linear features at the ground or bedrock surface at 1:10,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

This data is sourced from the British Geological Survey.

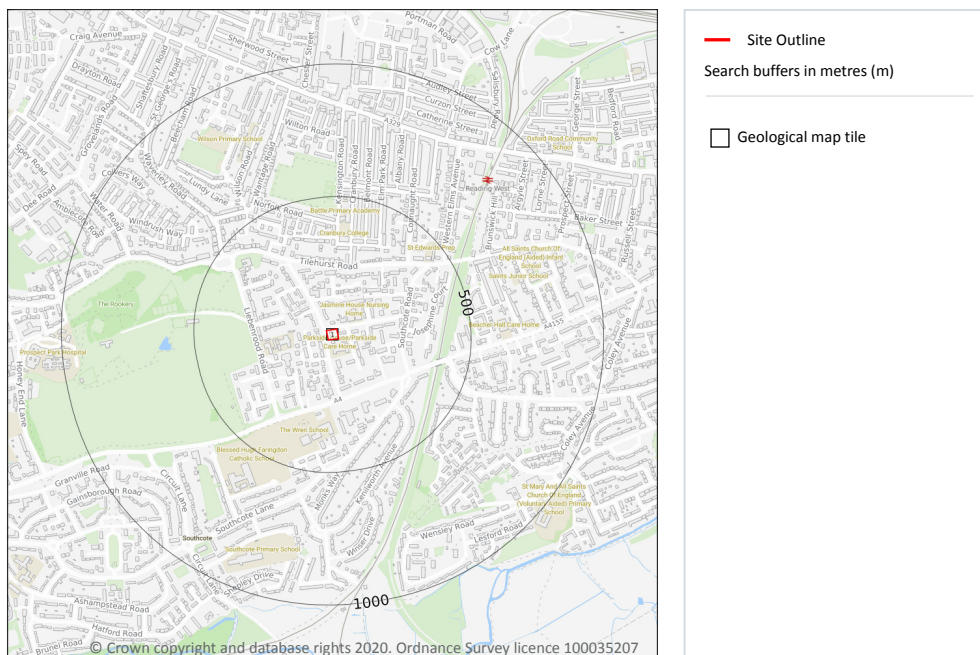


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2 Geology 1:50,000 scale - Availability



2.1 50k Availability

Records within 500m

1

An indication on the coverage of 1:50,000 scale geology data for the site. Either 'Full' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:50,000 scale - Availability map on **page 18**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	On site	Full	Full	Full	No coverage	EW268_reading_v4

This data is sourced from the British Geological Survey.

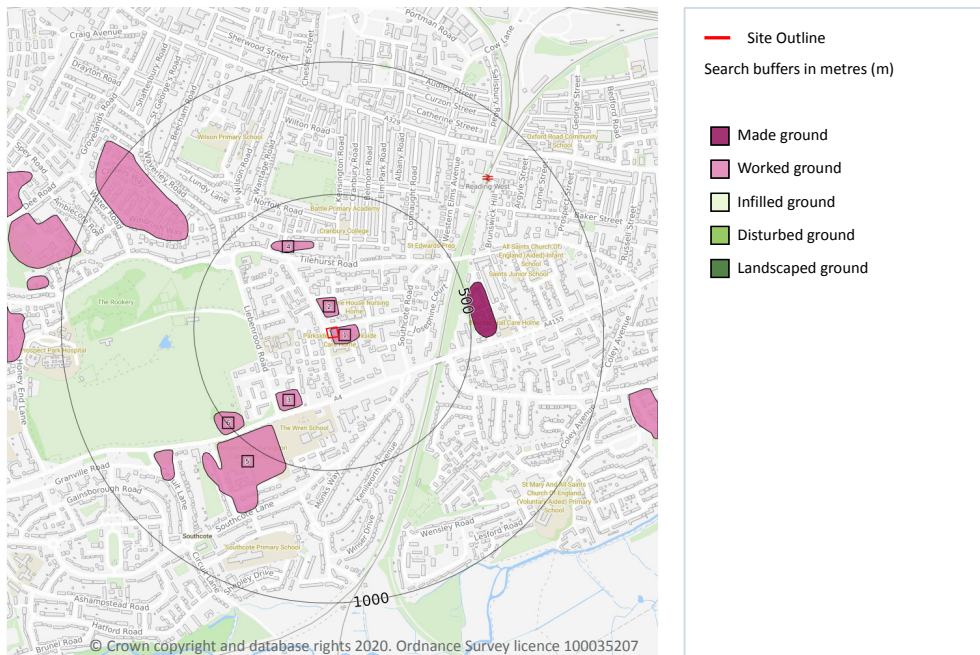


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18

Geology 1:50,000 scale - Artificial and made ground



2.2 Artificial and made ground (50k)

Records within 500m

6

Details of made, worked, infilled, disturbed and landscaped ground at 1:50,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:50,000 scale - Artificial and made ground map on **page 19**

ID	Location	LEX Code	Description	Rock description
1	On site	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID
2	42m N	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID
3	228m SW	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID
4	309m N	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID



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19

ID	Location	LEX Code	Description	Rock description
5	393m SW	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID
6	440m SW	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID

This data is sourced from the British Geological Survey.

2.3 Artificial ground permeability (50k)

Records within 50m

0

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any artificial deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.

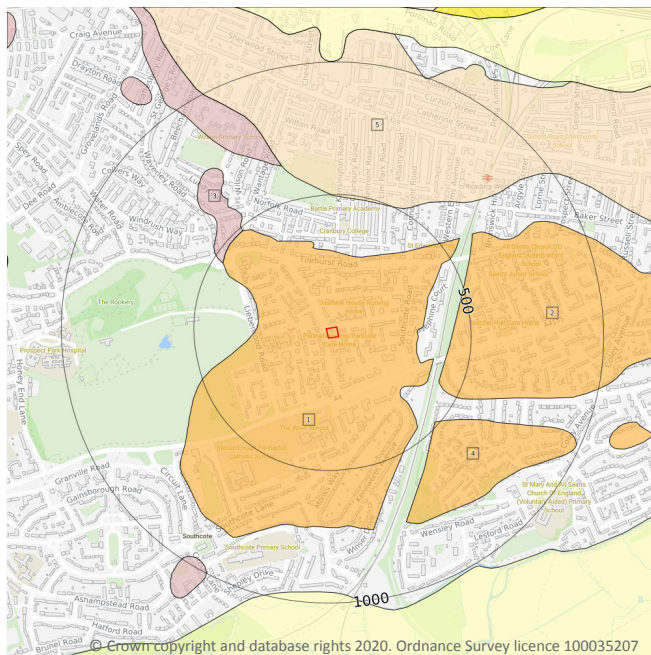


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Geology 1:50,000 scale - Superficial



— Site Outline
Search buffers in metres (m)

☒ Landslip (50k)

Superficial geology (50k)
Please see table for more details.

2.4 Superficial geology (50k)

Records within 500m

5

Superficial geological deposits at 1:50,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:50,000 scale - Superficial map on **page 21**

ID	Location	LEX Code	Description	Rock description
1	On site	LHGR-XSV	LYNCH HILL GRAVEL MEMBER	SAND AND GRAVEL
2	410m E	LHGR-XSV	LYNCH HILL GRAVEL MEMBER	SAND AND GRAVEL
3	462m NW	HEAD-XVSZC	HEAD	GRAVEL, SAND, SILT AND CLAY



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Date: 23 November 2020



ID	Location	LEX Code	Description	Rock description
4	485m SE	LHGR-XSV	LYNCH HILL GRAVEL MEMBER	SAND AND GRAVEL
5	488m N	TPGR-XSV	TAPLOW GRAVEL MEMBER	SAND AND GRAVEL

This data is sourced from the British Geological Survey.

2.5 Superficial permeability (50k)

Records within 50m **1**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any superficial deposits (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	Intergranular	Very High	High

This data is sourced from the British Geological Survey.

2.6 Landslip (50k)

Records within 500m **0**

Mass movement deposits on BGS geological maps at 1:50,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

This data is sourced from the British Geological Survey.

2.7 Landslip permeability (50k)

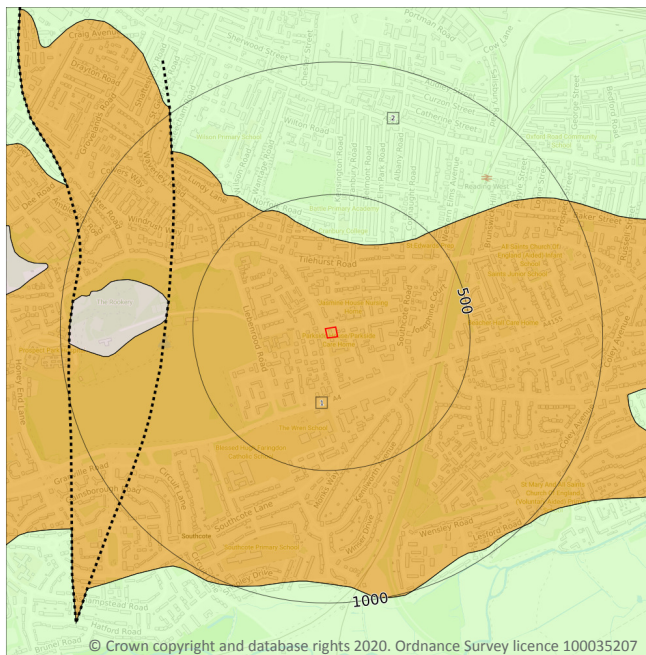
Records within 50m **0**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any landslip deposits (the zone between the land surface and the water table).

This data is sourced from the British Geological Survey.



Geology 1:50,000 scale - Bedrock



— Site Outline
Search buffers in metres (m)
.... Bedrock faults and other linear features (50k)
Bedrock geology (50k)
Please see table for more details.

2.8 Bedrock geology (50k)

Records within 500m

2

Bedrock geology at 1:50,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:50,000 scale - Bedrock map on **page 23**

ID	Location	LEX Code	Description	Rock age
1	On site	LMBE-XCZS	LAMBETH GROUP - CLAY, SILT AND SAND	THANETIAN
2	324m N	SNCK-CHLK	SEAFORD CHALK FORMATION AND NEWHAVEN CHALK FORMATION (UNDIFFERENTIATED) - CHALK	CONIACIAN

This data is sourced from the British Geological Survey.



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2.9 Bedrock permeability (50k)

Records within 50m

1

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of bedrock (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	Mixed	Moderate	Very Low

This data is sourced from the British Geological Survey.

2.10 Bedrock faults and other linear features (50k)

Records within 500m

0

Linear features at the ground or bedrock surface at 1:50,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

This data is sourced from the British Geological Survey.

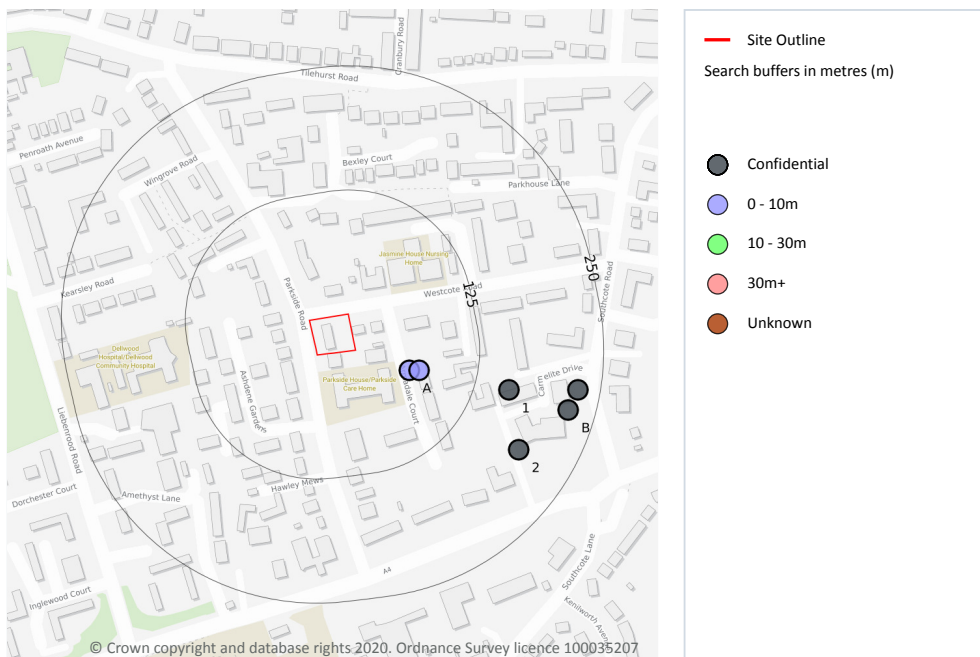


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3 Boreholes



3.1 BGS Boreholes

Records within 250m

6

The Single Onshore Boreholes Index (SOBI); an index of over one million records of boreholes, shafts and wells from all forms of drilling and site investigation work held by the British Geological Survey. Covering onshore and nearshore boreholes dating back to at least 1790 and ranging from one to several thousand metres deep.

Features are displayed on the Boreholes map on **page 25**

ID	Location	Grid reference	Name	Length	Confidential	Web link
A	58m E	469720 172730	ARMDALE COURT WESTCOTE ROAD READING 1	5.25	N	15949997
A	67m E	469730 172730	ARMDALE COURT WESTCOTE ROAD READING 2	5.0	N	15949998



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ID	Location	Grid reference	Name	Length	Confidential	Web link
1	159m E	469820 172710	CARMELITE MONASTERY READING SOAKAGE TESTING TP4	-	Y	N/A
2	192m SE	469830 172650	CARMELITE MONASTERY READING SOAKAGE TESTING TP3	-	Y	N/A
B	223m E	469880 172690	CARMELITE MONASTERY READING SOAKAGE TESTING TP2	-	Y	N/A
B	228m E	469890 172710	CARMELITE MONASTERY READING SOAKAGE TESTING TP1	-	Y	N/A

This data is sourced from the British Geological Survey.

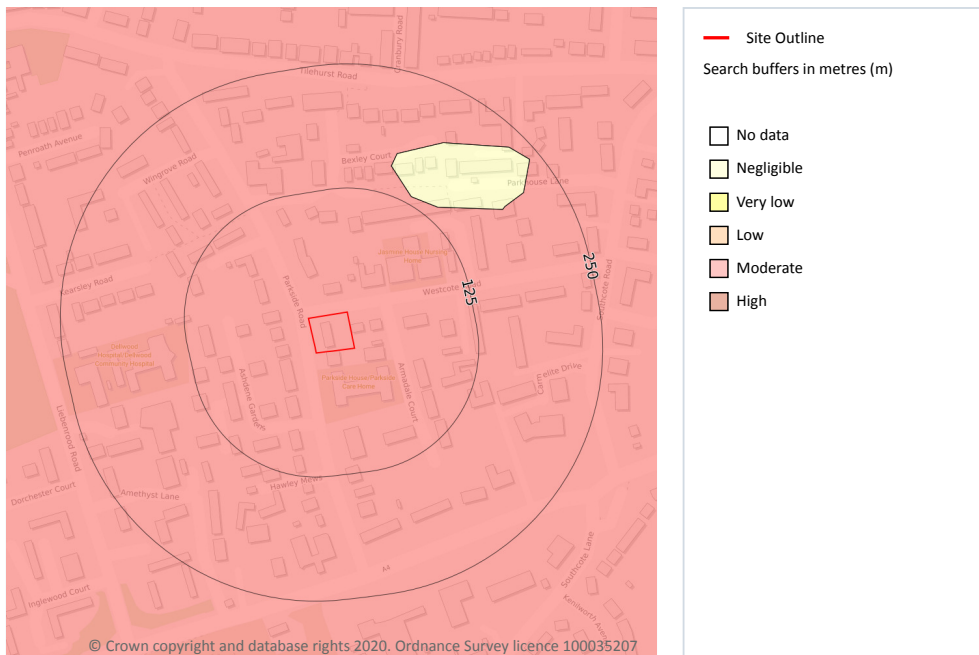


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4 Natural ground subsidence - Shrink swell clays



4.1 Shrink swell clays

Records within 50m

1

The potential hazard presented by soils that absorb water when wet (making them swell), and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and local drainage).

Features are displayed on the Natural ground subsidence - Shrink swell clays map on **page 27**

Location	Hazard rating	Details
On site	Moderate	Ground conditions predominantly high plasticity.

This data is sourced from the British Geological Survey.

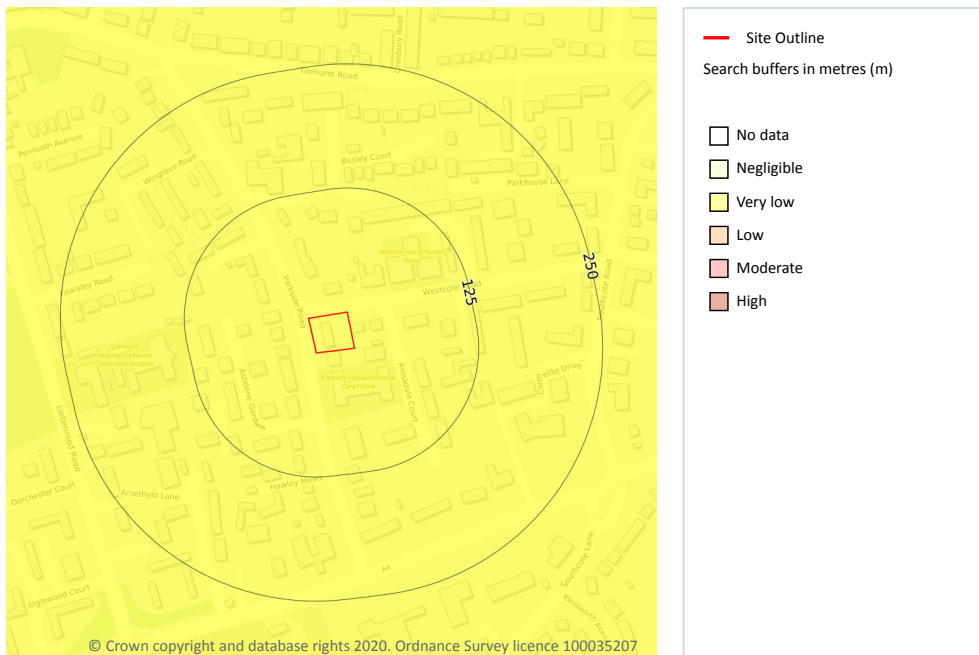


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Natural ground subsidence - Running sands



4.2 Running sands

Records within 50m

1

The potential hazard presented by rocks that can contain loosely-packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.

Features are displayed on the Natural ground subsidence - Running sands map on **page 28**

Location	Hazard rating	Details
On site	Very low	Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.

This data is sourced from the British Geological Survey.

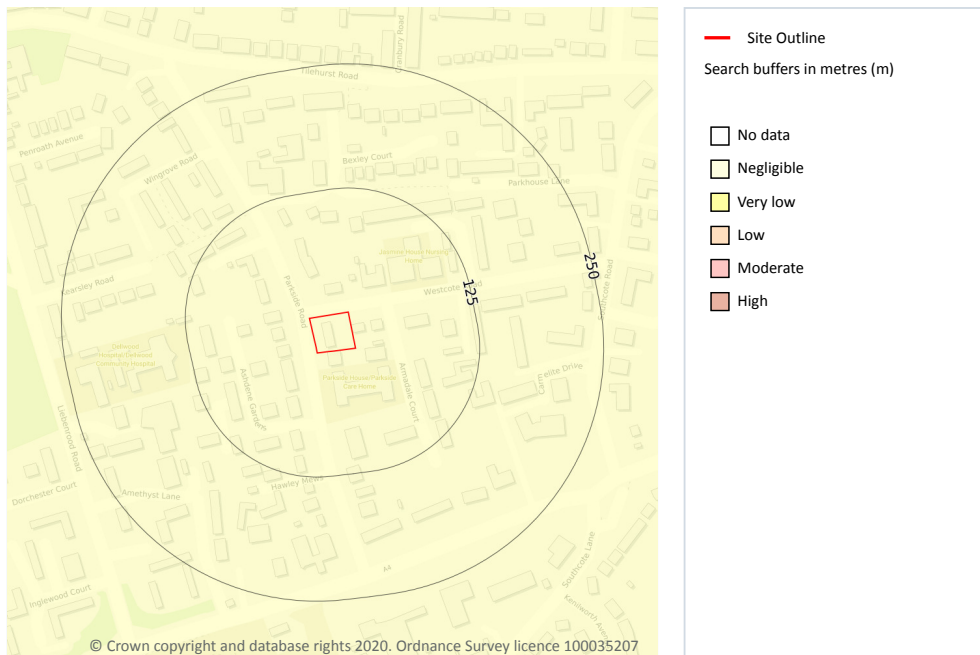


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Natural ground subsidence - Compressible deposits



4.3 Compressible deposits

Records within 50m

1

The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.

Features are displayed on the Natural ground subsidence - Compressible deposits map on **page 29**

Location	Hazard rating	Details
On site	Negligible	Compressible strata are not thought to occur.

This data is sourced from the British Geological Survey.

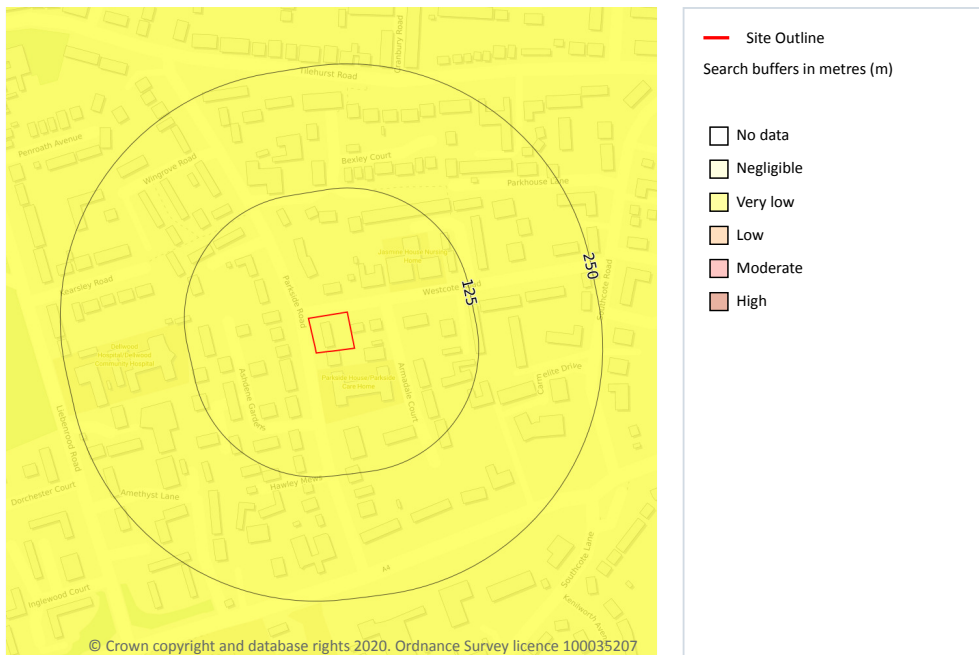


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Natural ground subsidence - Collapsible deposits



4.4 Collapsible deposits

Records within 50m

1

The potential hazard presented by natural deposits that could collapse when a load (such as a building) is placed on them or they become saturated with water.

Features are displayed on the Natural ground subsidence - Collapsible deposits map on **page 30**

Location	Hazard rating	Details
On site	Very low	Deposits with potential to collapse when loaded and saturated are unlikely to be present.

This data is sourced from the British Geological Survey.

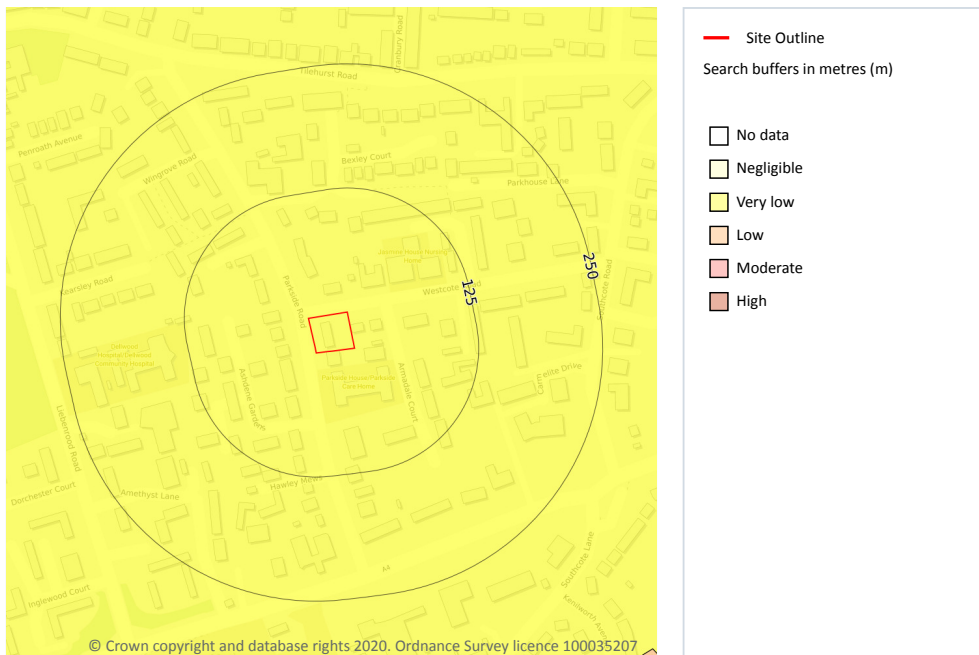


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Natural ground subsidence - Landslides



4.5 Landslides

Records within 50m

1

The potential for landsliding (slope instability) to be a hazard assessed using 1:50,000 scale digital maps of superficial and bedrock deposits, combined with information from the BGS National Landslide Database and scientific and engineering reports.

Features are displayed on the Natural ground subsidence - Landslides map on **page 31**

Location	Hazard rating	Details
On site	Very low	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.

This data is sourced from the British Geological Survey.

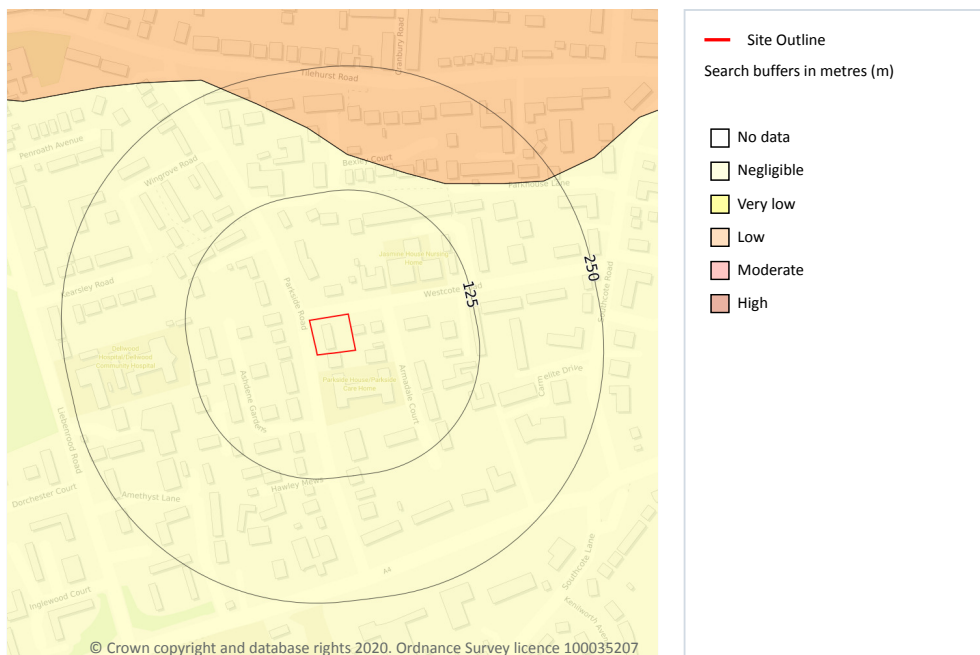


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Natural ground subsidence - Ground dissolution of soluble rocks



4.6 Ground dissolution of soluble rocks

Records within 50m

1

The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.

Features are displayed on the Natural ground subsidence - Ground dissolution of soluble rocks map on **page 32**

Location	Hazard rating	Details
On site	Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

This data is sourced from the British Geological Survey.



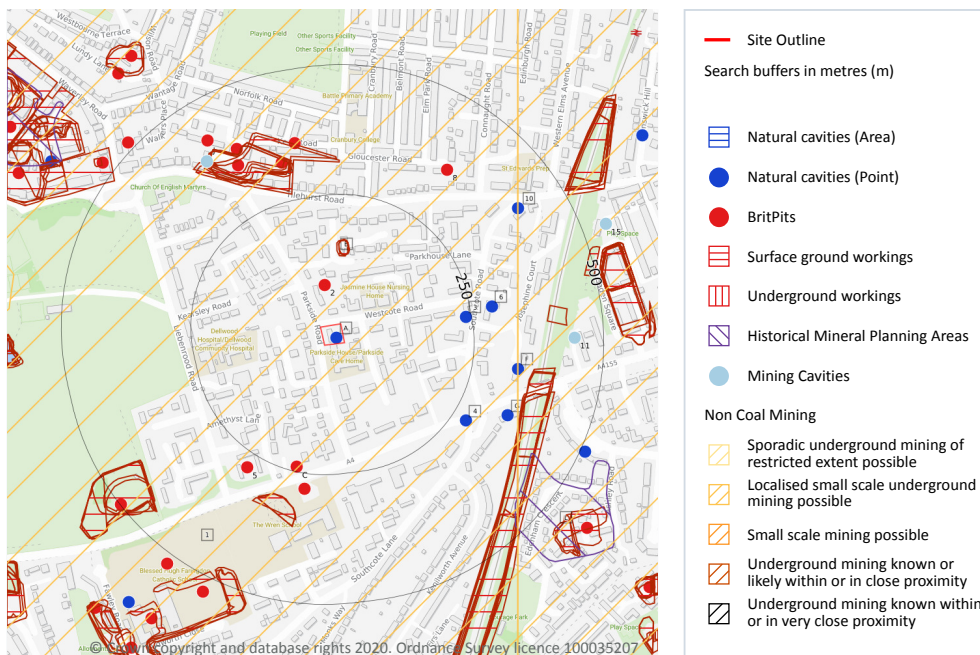
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5 Mining, ground workings and natural cavities



5.1 Natural cavities

Records within 500m

7

Industry recognised national database of natural cavities. Sinkholes and caves are formed by the dissolution of soluble rock, such as chalk and limestone, gulls and fissures by cambering. Ground instability can result from movement of loose material contained within these cavities, often triggered by water.

Features are displayed on the Mining, ground workings and natural cavities map on [page 33](#)

ID	Location	Details	Source
A	On site	Type: Solution Pipe x 1 Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Richard Hermann Associates Ltd Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely



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ID	Location	Details	Source
3	239m E	Type: Solution Pipe Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Peter Brett Associates Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely
4	278m SE	Type: Unknown x 3 Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Peter Brett Associates Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely
6	292m E	Type: Sinkhole x 1, Solution Pipe x 1 Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Peter Brett Associates LLP Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely
F	338m E	Type: Solution Pipe x 1 Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: - Full Bibliography: BLAKE, J.H., The geology of the country around Reading., HMSO, London., 1903; British Geological Survey Memoir (Sheet 268);; HULL, E. AND WHITAKER, W., The geology of parts of Oxfordshire and Berkshire., HMSO, London., 1861; British Geological Survey Mem Confidentiality: Data source can be revealed, data can be used freely
G	344m SE	Type: Sinkhole x 1, Solution Pipe x 1 Superficial Geology: Lynch Hill Gravel Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Peter Brett Associates LLP Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely
10	408m NE	Type: Solution Widened Joint or Fissure x 1 Superficial Geology: - Bedrock Geology: Chalk Group, Lambeth Group	Simple Bibliography: Peter Brett Associates LLP Full Bibliography: - Confidentiality: Data source can be revealed, data can be used freely

This data is sourced from Peter Brett Associates (PBA).

5.2 BritPits

Records within 500m

12

BritPits (an abbreviation of British Pits) is a database maintained by the British Geological Survey of currently active and closed surface and underground mineral workings. Details of major mineral handling sites, such as wharfs and rail depots are also held in the database.

Features are displayed on the Mining, ground workings and natural cavities map on **page 33**



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ID	Location	Details	Description
A	25m E	Name: Wilton House Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
2	79m N	Name: Parkside Road Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
C	240m S	Name: Westfield Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
5	278m SW	Name: Lodge Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
C	279m S	Name: Oaklands Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
D	325m N	Name: Prospect Park Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
D	349m NW	Name: Prospect Park Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority


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ID	Location	Details	Description
D	358m N	Name: Prospect Park Brick Works Address: READING, Berkshire Commodity: Clay & Shale Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
8	361m NE	Name: Tilehurst Road Sand Pit Address: READING, Berkshire Commodity: Sand Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
D	379m NW	Name: Prospect Park Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
J	420m NW	Name: Prospect Park Gravel Pit Address: READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority
K	498m SW	Name: Prospect Park Gravel Pit Address: Southcote, READING, Berkshire Commodity: Sand & Gravel Status: A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Type: Ceased Status description: Site which, at date of entry, has ceased to extract minerals. May be considered as Closed by operator. May be considered to have Active, Dormant or Expired planning permissions by Mineral Planning Authority

This data is sourced from the British Geological Survey.

5.3 Surface ground workings

Records within 250m

4

Historical land uses identified from Ordnance Survey mapping that involved ground excavation at the surface. These features may or may not have been subsequently backfilled.

Features are displayed on the Mining, ground workings and natural cavities map on **page 33**

ID	Location	Land Use	Year of mapping	Mapping scale
B	131m N	Unspecified Pit	1938	1:10560
B	132m N	Unspecified Pit	1960	1:10560



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ID	Location	Land Use	Year of mapping	Mapping scale
B	134m N	Unspecified Pit	1932	1:10560
B	134m N	Unspecified Pit	1932	1:10560

This data is sourced from Ordnance Survey/Groundsure.

5.4 Underground workings

Records within 1000m

1

Historical land uses identified from Ordnance Survey mapping that indicate the presence of underground workings e.g. mine shafts.

Features are displayed on the Mining, ground workings and natural cavities map on **page 33**

ID	Location	Land Use	Year of mapping	Mapping scale
-	949m W	Unspecified Workings	1991	1:10000

This data is sourced from Ordnance Survey/Groundsure.

5.5 Historical Mineral Planning Areas

Records within 500m

1

Boundaries of mineral planning permissions for England and Wales. This data was collated between the 1940s (and retrospectively to the 1930s) and the mid 1980s. The data includes permitted, withdrawn and refused permissions.

Features are displayed on the Mining, ground workings and natural cavities map on **page 33**

ID	Location	Site Name	Mineral	Type	Planning Status	Planning Status Date
L	419m SE	Berkeley Ave	Sand	Surface mineral working	Valid	05/10/57

This data is sourced from the British Geological Survey.

5.6 Non-coal mining

Records within 1000m

6

The potential for historical non-coal mining to have affected an area. The assessment is drawn from expert knowledge and literature in addition to the digital geological map of Britain. Mineral commodities may be divided into seven general categories - vein minerals, chalk, oil shale, building stone, bedded ores, evaporites and 'other' commodities (including ball clay, jet, black marble, graphite and chert).



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Features are displayed on the Mining, ground workings and natural cavities map on **page 33**

ID	Location	Name	Commodity	Class	Likelihood
1	On site	Not available	Chalk	B	Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered
7	334m E	Not available	Chalk	B	Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered
-	824m N	Not available	Chalk	A	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
-	891m N	Not available	Chalk	A	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
-	937m N	Not available	Chalk	A	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
-	953m N	Not available	Chalk	A	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered

This data is sourced from the British Geological Survey.

5.7 Mining cavities

Records within 1000m

10

Industry recognised national database of mining cavities. Degraded mines may result in hazardous subsidence (crown holes). Climatic conditions and water escape can also trigger subsidence over mine entrances and workings.

Features are displayed on the Mining, ground workings and natural cavities map on **page 33**

ID	Location	Mine Address	Mineral	Data source	Publisher
J	388m NW	'Elm Lodge/Jesse's Brick Field', Tilehurst, Berkshire	Chalk	The Brick-making Industry in Reading: A Temporal & Spatial Analysis	Undergraduate Dissertation, University of Reading
11	444m E	Reading, Berkshire	Chalk	-	-



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ID	Location	Mine Address	Mineral	Data source	Publisher
15	547m E	Reading, Berkshire	Chalk	-	-
-	697m NW	'Reading/berks Brick Co', Tilehurst, Berkshire	Chalk	The Brick-making Industry in Reading: A Temporal & Spatial Analysis	Undergraduate Dissertation, University of Reading
-	730m E	Reading (West), Berkshire	Chalk	-	-
-	763m NE	'Cooper's Brick & Lime Manufactory', Reading (West), Berkshire	Chalk	-	-
-	848m W	'Grovelands'-Excavations (1), Tilehurst, Berkshire	Chalk	The Brick-making Industry in Reading: A Temporal & Spatial Analysis	Undergraduate Dissertation, University of Reading
-	868m E	Reading (West), Berkshire	Chalk	-	-
-	888m NW	'Grovelands'-Works Complex, Tilehurst, Berkshire	Chalk	The Brick-making Industry in Reading: A Temporal & Spatial Analysis	Undergraduate Dissertation, University of Reading
-	920m E	Reading, Berkshire	Chalk	-	-

This data is sourced from Peter Brett Associates (PBA).

5.8 JPB mining areas

Records on site

0

Areas which could be affected by former coal mining. This data includes some mine plans unavailable to the Coal Authority.

This data is sourced from Johnson Poole and Bloomer.

5.9 Coal mining

Records on site

0

Areas which could be affected by past, current or future coal mining.

This data is sourced from the Coal Authority.



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5.10 Brine areas

Records on site**0**

The Cheshire Brine Compensation District indicates areas that may be affected by salt and brine extraction in Cheshire and where compensation would be available where damage from this mining has occurred. Damage from salt and brine mining can still occur outside this district, but no compensation will be available.

This data is sourced from the Cheshire Brine Subsidence Compensation Board.

5.11 Gypsum areas

Records on site**0**

Generalised areas that may be affected by gypsum extraction.

This data is sourced from British Gypsum.

5.12 Tin mining

Records on site**0**

Generalised areas that may be affected by historical tin mining.

This data is sourced from Mining Searches UK.

5.13 Clay mining

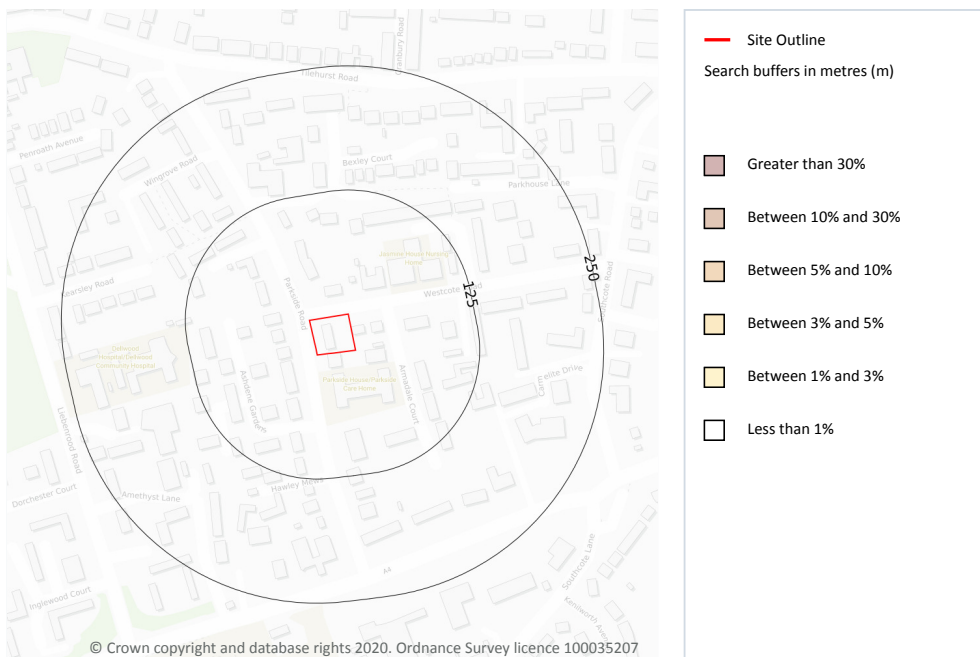
Records on site**0**

Generalised areas that may be affected by kaolin and ball clay extraction.

This data is sourced from the Kaolin and Ball Clay Association (UK).



6 Radon



6.1 Radon

Records on site

1

Estimated percentage of dwellings exceeding the Radon Action Level. This data is the highest resolution radon dataset available for the UK and is produced to a 75m level of accuracy to allow for geological data accuracy and a 'residential property' buffer. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain. The data was derived from both geological assessments and long term measurements of radon in more than 479,000 households.

Features are displayed on the Radon map on **page 41**

Location	Estimated properties affected	Radon Protection Measures required
On site	Less than 1%	None**

This data is sourced from the British Geological Survey and Public Health England.



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7 Soil chemistry

7.1 BGS Estimated Background Soil Chemistry

Records within 50m

1

The estimated values provide the likely background concentration of the potentially harmful elements Arsenic, Cadmium, Chromium, Lead and Nickel in topsoil. The values are estimated primarily from rural topsoil data collected at a sample density of approximately 1 per 2 km². In areas where rural soil samples are not available, estimation is based on stream sediment data collected from small streams at a sampling density of 1 per 2.5 km²; this is the case for most of Scotland, Wales and southern England. The stream sediment data are converted to soil-equivalent concentrations prior to the estimation.

Location	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
On site	15 - 25 mg/kg	No data	100 mg/kg	60 mg/kg	1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg

This data is sourced from the British Geological Survey.

7.2 BGS Estimated Urban Soil Chemistry

Records within 50m

0

Estimated topsoil chemistry of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc and bioaccessible Arsenic and Lead in 23 urban centres across Great Britain. These estimates are derived from interpolation of the measured urban topsoil data referred to above and provide information across each city between the measured sample locations (4 per km²).

This data is sourced from the British Geological Survey.

7.3 BGS Measured Urban Soil Chemistry

Records within 50m

0

The locations and measured total concentrations (mg/kg) of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc in urban topsoil samples from 23 urban centres across Great Britain. These are collected at a sample density of 4 per km².

This data is sourced from the British Geological Survey.



8 Railway infrastructure and projects

8.1 Underground railways (London)

Records within 250m	0
---------------------	---

Details of all active London Underground lines, including approximate tunnel roof depth and operational hours.

This data is sourced from publicly available information by Groundsure.

8.2 Underground railways (Non-London)

Records within 250m	0
---------------------	---

Details of the Merseyrail system, the Tyne and Wear Metro and the Glasgow Subway. Not all parts of all systems are located underground. The data contains location information only and does not include a depth assessment.

This data is sourced from publicly available information by Groundsure.

8.3 Railway tunnels

Records within 250m	0
---------------------	---

Railway tunnels taken from contemporary Ordnance Survey mapping.

This data is sourced from the Ordnance Survey.

8.4 Historical railway and tunnel features

Records within 250m	0
---------------------	---

Railways and tunnels digitised from historical Ordnance Survey mapping as scales of 1:1,250, 1:2,500, 1:10,000 and 1:10,560.

This data is sourced from Ordnance Survey/Groundsure.

8.5 Royal Mail tunnels

Records within 250m	0
---------------------	---

The Post Office Railway, otherwise known as the Mail Rail, is an underground railway running through Central London from Paddington Head District Sorting Office to Whitechapel Eastern Head Sorting Office. The line is 10.5km long. The data includes details of the full extent of the tunnels, the depth of the tunnel, and the depth to track level.



This data is sourced from Groundsure/the Postal Museum.

8.6 Historical railways

Records within 250m	0
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Former railway lines, including dismantled lines, abandoned lines, disused lines, historic railways and razed lines.

This data is sourced from OpenStreetMap.

8.7 Railways

Records within 250m	0
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Currently existing railway lines, including standard railways, narrow gauge, funicular, trams and light railways.

This data is sourced from Ordnance Survey and OpenStreetMap.

8.8 Crossrail 1

Records within 500m	0
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The Crossrail railway project links 41 stations over 100 kilometres from Reading and Heathrow in the west, through underground sections in central London, to Shenfield and Abbey Wood in the east.

This data is sourced from publicly available information by Groundsure.

8.9 Crossrail 2

Records within 500m	0
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Crossrail 2 is a proposed railway linking the national rail networks in Surrey and Hertfordshire via an underground tunnel through London.

This data is sourced from publicly available information by Groundsure.

8.10 HS2

Records within 500m	0
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HS2 is a proposed high speed rail network running from London to Manchester and Leeds via Birmingham. Main civils construction on Phase 1 (London to Birmingham) of the project began in 2019, and it is currently anticipated that this phase will be fully operational by 2026. Construction on Phase 2a (Birmingham to Crewe) is anticipated to commence in 2021, with the service fully operational by 2027. Construction on Phase 2b (Crewe to Manchester and Birmingham to Leeds) is scheduled to begin in 2023 and be operational by 2033.

This data is sourced from HS2 Ltd.



Contact us with any questions at:
info@groundsure.com
 08444 159 000

Date: 23 November 2020



Data providers

Groundsure works with respected data providers to bring you the most relevant and accurate information. To find out who they are and their areas of expertise see <https://www.groundsure.com/sources-reference>.

Terms and conditions

Groundsure's Terms and Conditions can be accessed at this link: <https://www.groundsure.com/terms-and-conditions-jan-2020/>.

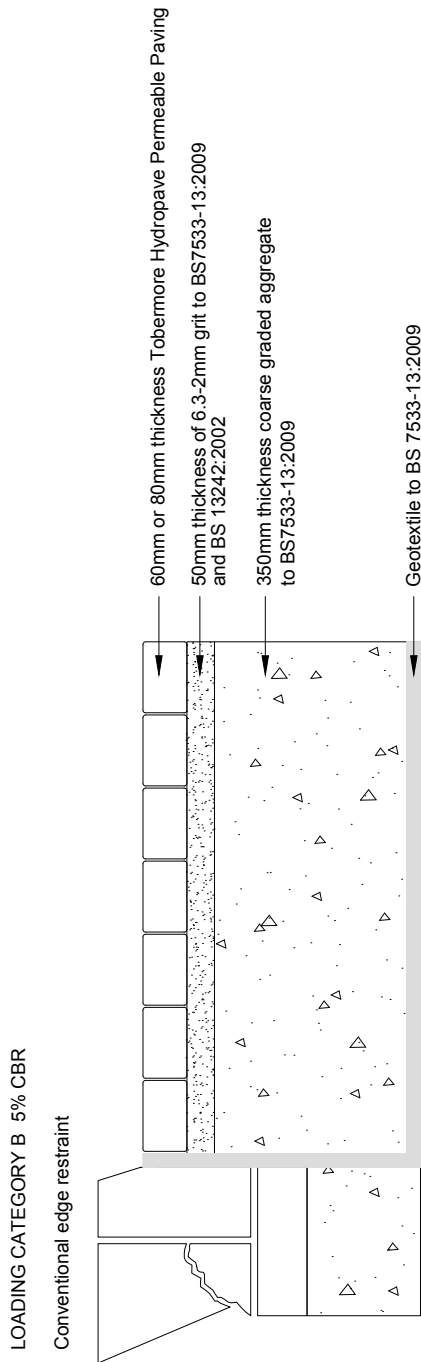


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F Pervious surface option



Disclaimer:

- These design cross-sections and suggested build-ups are provided for illustration only and are intended to depict an idealised situation.
- In all instances, local design solutions are preferred and should be checked to ensure suitability with ground conditions and planned traffic usage.
- Refer to BS 7533 Part 13 for depths of capping layers.
- All references are to latest edition of BS 7533. Tobermore can provide a project specific solution if required.

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