



Preliminary Drainage Strategy

Project:

Proposed Residential Development, Hereward Way, Crowland

Client:

Sharman Architecture
Oak Barn,
Willow Drove,
Borough Fen,
Peterborough,
PE6 7QB

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Introduction

Jackson consulting engineers have been appointed by Sharman Architecture, to undertake a drainage strategy, forming part of the supporting evidence of the planning submission for 4 proposed dwellings, Hereward Road, Crowland. The following document is to assist the planners and Internal Drainage Board (IDB) in demonstrating that the development is acceptable in terms of drainage strategy and that it does not cause offsite flood risk as a result of the development.

Existing Site

The site lies to the east of Hereward Way, Crowland, PE6 0BL. An aerial location plan is shown in figure 1, please note that the red line is indicative and does not indicate the planning boundary.



Figure 1 - Site Location

Site Topography

A topographical survey is currently not available for the site, but from visual inspection and local knowledge the site would be considered flat. The site is bounded by residential property on all sides, other than onto Hereward Way.

The existing site is a mixture of brownfield with some areas being some landscaping. There are a number of storage buildings on site and the access areas are a mixture of gravel and hardstanding.

Existing services on the site have not currently been recorded.



Ground Conditions

A phase 1 or 2 ground investigation report is not available for this site currently, and the findings of this section are based on publicly available information. A relevant ground investigation will be undertaken prior to detailed design and assessed by the appointed engineer.

The bedrock geology of the site is described as 'Oxford Clay Formation'. This generally indicates that deeper infiltration into the bedrock will not be possible, and at this stage deeper infiltration devices are to be discounted.

The superficial deposits are described as 'Abbey Sand and Gravel', consisting of sand and gravel. This type of strata should offer a good response zone for shallow infiltration devices to be utilised, and subject to infiltration testing, this is the preferred method of surface water drainage disposal.

Both British Geological Survey definitions for the bedrock and superficial deposits can be found respectively in figures 2 and 3 below.

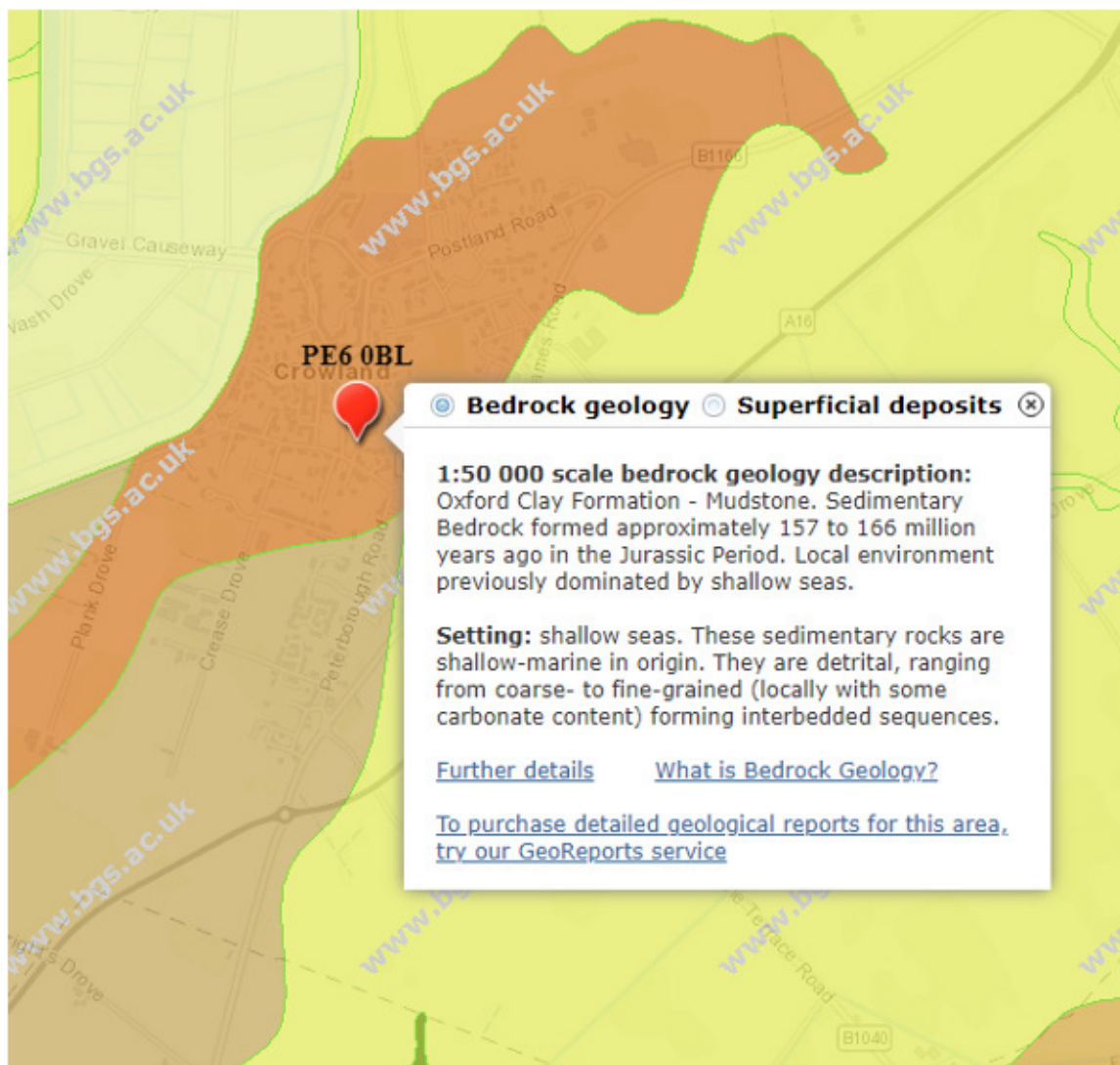


Figure 2 - BGS Bedrock Geology

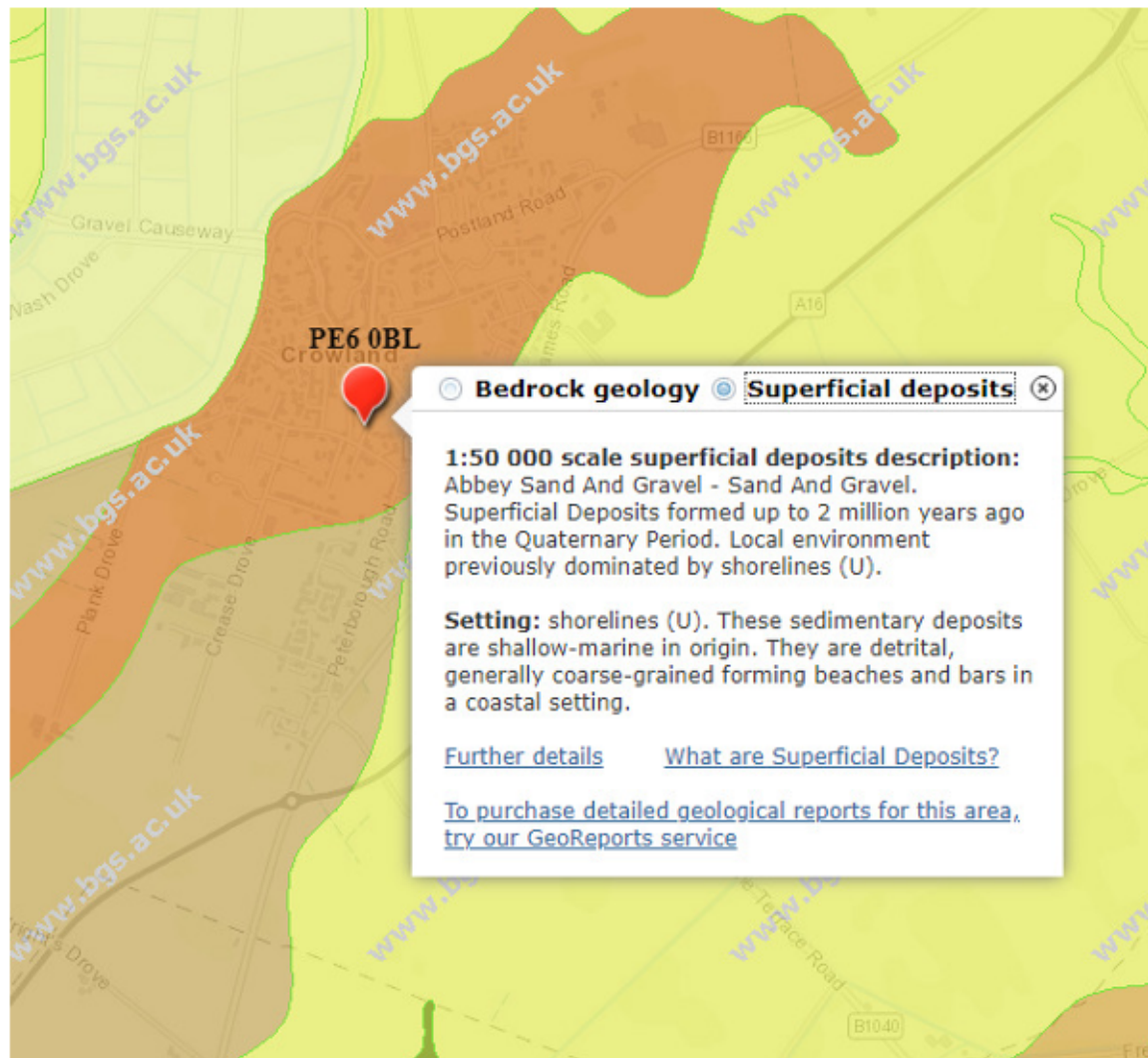


Figure 3 - BGS Superficial Deposits

Surrounding Drainage

The site falls within the catchment of North Level Internal Drainage Board. The closest watercourse is approximately 250m metres away to the north east – this is not accessible for the site.

Hereward Way itself does not appear to be served by highway drainage, with the carriageway generally falling to 'over the edge' drainage, and therefore highway drainage does not appear to be present.

Given the anticipated ground conditions and the relatively large plots the existing dwellings rest upon, it is likely that the majority of the surrounding drainage drains to soakaways.

An extract of the local AW sewers is shown below. There is a substantial foul water sewer running to Hereward Way which will be utilised for the foul water. There is an existing adopted surface water manhole roughly 30m to the south of the site, although access to this is limited by existing properties.



Figure 4 - AW Asset Map Extract

Flood Risk

The site is located in Flood Zone 1, and given the sites size a flood risk assessment is not required.

Development Proposals

The development consists of the erection of 6 dwellings with associated hardstanding, garages and gardens. The initial site layout is shown in the figure below.



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Figure 5 - Initial Site Layout

Drainage Strategy

The following section provides narrative on the principles behind the drainage strategy and has been carried out in general accordance with building regulations, DEFRA's national standards and "CIRIA's C753 – the SUDS Manual", where appropriate.

Surface Water Drainage

For new developments there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site where practicable. As required by Building Regulations and Defra's "Non-statutory Technical Standards for Sustainable Drainage Systems" (NTS), surface water must discharge to the following, listed in priority.

1. To ground – in an adequate soakaway or some other adequate infiltration system.
2. To a watercourse.
3. To a surface water sewer, highway drain or other drainage system.
4. To a combined sewer.

Infiltration

At present infiltration testing has not been undertaken, but it is expected that the designation of the soil will mean that infiltration is possible, and the sites drainage can be fully reliant on infiltration drainage, although both the infiltration rate and water table will need to be verified prior to construction.

Guidance set out in CIRIA 753 – The SUDS Manual, shows that infiltration rates of various soil types are expected to be, as described in the figure below.

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media - gravel - sand - loamy sand - sandy loam	Sandy GRAVEL Slightly silty slightly clayey SAND Silty slightly clayey SAND Silty clayey SAND	$3 \times 10^{-4} - 3 \times 10^{-2}$ $1 \times 10^{-5} - 5 \times 10^{-5}$ $1 \times 10^{-4} - 3 \times 10^{-5}$ $1 \times 10^{-7} - 1 \times 10^{-5}$
Poor infiltration media - loam - silt loam - chalk (structureless) - sandy clay loam	Very silty clayey SAND Very sandy clayey SILT N/A Very clayey silty SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$ $1 \times 10^{-7} - 1 \times 10^{-5}$ $3 \times 10^{-8} - 3 \times 10^{-6}$ $3 \times 10^{-10} - 3 \times 10^{-7}$
Very poor infiltration media - silty clay loam - clay - till	– – Can be any texture of soil described above	$1 \times 10^{-8} - 1 \times 10^{-6}$ $< 3 \times 10^{-8}$ $3 \times 10^{-9} - 3 \times 10^{-6}$
Other rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$

Figure 6 - Typical Soil Infiltration Coefficients



Sands and gravels have a range of infiltration between 3×10^{-4} and 3×10^{-2} m/s, which would represent good infiltration potential. The ground water levels are not known, but it is expected that it would be relatively high, and therefore any infiltration device will be kept as high as possible. It is expected that the roof water will discharge into soakaway crates, and the roads will be constructed out of permeable materials.

For the purpose of the application, a relatively safe infiltration rate of 1×10^{-5} m/s is being used.

The soakaways should be designed with a factor of safety, in accordance with CIRIA C753, in particular the following guidance should be used.

Size of area to be drained	Consequences of failure		
	No damage or inconvenience	Minor damage to external areas or inconvenience (eg surface water on car parking)	Damage to buildings or structures, or major inconvenience (eg flooding of roads)
$\leq 100 \text{ m}^2$	1.5	2	10
$100-1000 \text{ m}^2$	1.5	3	10
$> 1000 \text{ m}^2$	1.5	5	10

Figure 7 - Infiltration Device FoS

The houses are all below a roof area of 100 m^2 and if the devices failed it would lead to minor damage to external areas, therefore a FoS of 2 is appropriate.

The car parking areas would generally be considered as a single device, as the formation will likely be similar. The total porous paving is less than 500 m^2 , therefore a factor of safety of 3 is appropriate, again as minor damage to external areas is considered.

2 of the plots do not have the room for rear garden soakaways and therefore the soakaways need to be located in the drives – this affects plots 1 and 3. Plot 1 has an area of 112 m^2 and plot 3 has an area of 125 m^2 . Both of these will again create minor damage and therefore a FoS of 3 is required.

Watercourse

As previously described, the closest watercourse to the site is not accessible by the development and is not being considered.

Surface Water Sewer

There is an AW surface water sewer located approximately 30m to the southern boundary of the site, although access to this would be difficult. If infiltration is not deemed possible, then it is proposed that the connection will be made into the AW sewer. If the landowners do not consent to this, then it is proposed that a 'sewer requisition' will be made. A discharge rate will need to be agreed with Anglian Water through the section 106 process and an attenuated scheme developed. The levels of the drainage are not known, and a pump may be required.

It is proposed that the site will discharge through soakaways, although this is to be determined at detailed design. In the event that this is not possible, then the back up option of a connection into the AW sewer is available and therefore there is a definitive drainage solution.



Soakaway Design

Presently, the infiltration rates are unknown, but given the BGS map descriptions, it is likely that the infiltration rate of the strata will be good, conservatively estimated at 1×10^{-5} . The soakaways are split into separate design categories, with the sizes as summarised below:

3 houses – $80\text{-}90\text{m}^2 = 4.5 \times 3 \times 0.4\text{m}$ or $1.5 \times 8 \times 0.4\text{m}$

1 house – $69\text{m}^2 = 3.5 \times 3 \times 0.4\text{m}$

1 house + drive – $125\text{m}^2 = 2 \times 9.5 \times 0.4\text{m}$

1 house + drive – $110\text{m}^2 = 2 \times 8.5 \times 0.4\text{m}$

These individual calcs, with the appropriate FoS's are shown in appendix A-E respectively.

At detailed design, it is possible that the tanks could be made deeper, to reduce the overall footprint – this is dependant on the water table.

The porous paving will be constructed using permeable blocks (or other permeable surfacing) and porous sub-base. The minimum overall depth of construction is typically expected to be 450mm, which would leave a minimum of 300mm for the porous sub-base. A minimum sub-base depth of 300mm, gives a maximum water level of 137mm, and therefore it would be more than suitable. Given the nature of the porous paving, it will only receive a like for like area, and as a result it does not need to be offset 5m from the building. Furthermore, as the infiltration is like for like, the plan area size does not matter as the infiltrating area will always match. Unlike traditional soakaways, the base area cannot be discounted as it is the only place to infiltrate.

The preliminary calcs for the soakaways and porous paving can be found in appendix F respectively, with the indicative drainage sketch being provided in appendix G. All soakaways have been designed for storms up to and including 1 in 100 year + 40% climate change events.

It should be noted that only 1 case for porous paving has been included, but as it is a like for like area, if the contributing area increases, so does the infiltration surface and therefore the maximum depth will not increase.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are:

- | | |
|--|------------|
| • Residential roofs | - Very Low |
| • Non-residential parking/ low traffic roads | - Low |

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in the figures below. This simple approach is considered suitable for this type of development.



Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/Industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Figure 8 - Pollution hazard indices for different land use classifications

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates ¹	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.6 ⁴	0.5	0.6
A soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.8 ⁴	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Figure 9 - Indicative SuDS mitigation indices for discharging to groundwater

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

$$\text{Total SuDS mitigation index} \geq \text{pollution hazard index}$$



(for each contaminant type) (for each contaminant type)

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5 (\text{mitigation index}_2)$$

Where:

$$\text{Mitigation index}_n = \text{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;

Total suspended solids = Red

Metals = Blue

Hydrocarbons = Green

The figures are presented to show the actual mitigation achieved in the right-hand side column. The right-hand side's total must be higher than the left-hand side.

Roof areas

The roof water enters the below ground pipework directly, before passing into a catchpit, before entering the soakaway. Although the catchpit is not recognised as providing mitigation, it will prevent sediment from entering the soakaway. The soakaway will have a minimum of 300mm soil below the device and therefore the mitigation will be:

$$0.2 \text{ Red } 0.2 \text{ Blue } 0.05 \text{ Green} = 300\text{mm Soil } 0.4 \text{ Red } 0.3 \text{ Blue } 0.3 \text{ Green}$$

Sufficient mitigation has been provided by the soil below the soakaway.

Low traffic roads + Porous Paving

The low traffic parking will drain through a porous paving build up, and even if this is just loose stone, it will contain a geotextile to provide the water quality performance. This will then discharge directly into the sub-grade, the mitigation for the is:

$$0.5 \text{ Red } 0.4 \text{ Blue } 0.4 \text{ Green} = \text{Porous Paving } 0.7 \text{ Red } 0.6 \text{ Blue } 0.7 \text{ Green}$$

The mitigation provided by the porous paving is more than adequate.

Private Parking to Soakaway

2 plots have attenuation located underneath the parking bays. The water from the porous paving still filters through it, but rather than soaking directly to ground, it discharges into the soakaway. The mitigation from the soakaways in this instance is the same, therefore:



0.5 0.4 0.4 = Porous Paving 0.7 0.6 0.7

In summary all the methods above provide enough water quality in accordance with CIRIA's C753 requirements.

Flood Risk off-site

As the flow from site will be being discharged back into the ground, and as storms of up to the 1 in 100 year + 40% climate change events are being stored within the site, the flood risk from the site is not being increased, in accordance with DEFRA's non-statutory guidance.

Management/Maintenance

It is crucial that the elements mentioned in the drainage elements and water quality are maintained to a sufficient standard to ensure that the devices can still function as designed. Generally, the maintenance requirements are either from CIRIA 753, or manufacturer guidance. It is currently assumed that the site owners management team will maintain the SUDS devices. This can form a condition if the planning application is acceptable.

The devices outlined below are preliminary only and subject to detailed design.

Porous Paving Maintenance

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually



Soakaways

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

Catchpits

Catchpits are utilised to help prevent the ingress of heavy sediment and other debris from entering the system. Maintenance requirements are low, and it is recommended that catchpits are inspected every six months and any build-up of sediment removed.

Pipework

If sediment in the catchpits are above the incoming pipes, or if performance of the site is hampered, then the pipes are to be inspect and jetted as necessary. The condition of the pipes shall generally be checked at the catchpit inspections.



Foul Proposals

Unlike surface water drainage, the preference for foul water disposal is to connect into a sewer, and only where this is not a viable option should other means of drainage be considered.

Connection to a Sewer

Extracts of the Anglian Water asset maps, local to the site are shown in the figure 4 (extract repeated below).



There is a sewer located in Hereward Way, with the existing AW foul wastewater manhole of 0001/0903 being the closest possible connection to the site. It is proposed that the site will connect into these points either directly into the manholes mentioned, or if this is not available a new manhole will be placed on the existing sewer. The depth of the manholes are recorded as 1.4 to 1.6m deep which should provide plenty of fall to allow the site to drain, the pipe size of 225mm dia. should have good capacity.

The final connection will be determined through a section 106 application, but it is unlikely there will be an objection to this proposal. AW will need to agree the discharge rate at this later stage.



Conclusion

- The above drainage strategy demonstrates that the site can be drained through the use of a Sustainable Drainage System at an appropriate level for the development.
- Provided infiltration is sufficient, there will be no flow offsite for all storms up to and including the 1 in 100 year + 40% climate change event.
- If infiltration is not viable, then a proposed connection into the existing AW sewer to the south will be utilised, via a sewer requisition if necessary.
- The proposed scheme does not increase the risk of flooding either on or off site as a result of the development.
- The proposed foul connection is into an existing AW sewer, subject to a section 106 application.



Appendices

Appendix A – Soakaway Calculation 80-90m²

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit	0.009	5.00	10.000	500	487130.076	391618.788	0.700
Soakaway			10.000	1	487130.225	391621.628	0.728

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	1.2	0.600	0.628	0.009	0.0	31	0.605

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.700	500					
						0	1.000	9.300	100	
Soakaway	487130.225	391621.628	10.000	0.728	1		1	1.000	9.272	100

		JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway House 90.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland							
<u>Simulation Settings</u>											
Rainfall Methodology		FSR	Analysis Speed		Normal						
FSR Region		England and Wales	Skip Steady State		x						
M5-60 (mm)		20.000	Drain Down Time (mins)		240						
Ratio-R		0.400	Additional Storage (m³/ha)		0.0						
Summer CV		0.750	Check Discharge Rate(s)		x						
Winter CV		0.840	Check Discharge Volume		x						
<u>Storm Durations</u>											
15	30	60	120	180	240	360	480	600	720	960	1440
Return Period (years)		Climate Change (CC %)		Additional Area (A %)		Additional Flow (Q %)					
1		0		0		0		0			
30		0		0		0		0			
100		0		0		0		0			
100		40		0		0		0			
<u>Node Soakaway Soakaway Storage Structure</u>											
Base Inf Coefficient (m/hr)		0.03600		Invert Level (m)		9.000		Depth (m)		0.400	
Side Inf Coefficient (m/hr)		0.03600		Time to half empty (mins)		518		Inf Depth (m)			
Safety Factor		2.0		Pit Width (m)		4.500		Number Required		1	
Porosity		0.95		Pit Length (m)		3.000					
Flow+ v10.8 Copyright © 1988-2024 Causeway Technologies Ltd											

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.334	0.034	1.3	0.0066	0.0000	OK
180 minute winter	Soakaway	168	9.077	-0.195	0.3	0.9843	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	1.3	0.577	0.210	0.0063
180 minute winter	Soakaway	Infiltration		0.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.356	0.056	3.1	0.0110	0.0000	OK
360 minute winter	Soakaway	344	9.202	-0.070	0.4	2.5958	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	3.1	0.719	0.505	0.0121
360 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.366	0.066	4.0	0.0130	0.0000	OK
180 minute winter	Soakaway	180	9.264	-0.008	0.9	3.3895	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	4.0	0.763	0.654	0.0147
180 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.389	0.089	5.7	0.0175	0.0000	OK
240 minute winter	Soakaway	240	9.385	0.113	1.1	4.9423	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	5.5	0.803	0.919	0.0196
240 minute winter	Soakaway	Infiltration		0.1			



Appendix B – Soakaway Calculation 80-90m² Or

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit	0.009	5.00	10.000	500	487130.076	391618.788	0.700
Soakaway			10.000	1	487130.225	391621.628	0.728

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	1.2	0.600	0.628	0.009	0.0	31	0.605

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.700	500					
						0	1.000	9.300	100	
Soakaway	487130.225	391621.628	10.000	0.728	1		1	1.000	9.272	100

	JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway House 90 or.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland
Simulation Settings			
Rainfall Methodology FSR Region M5-60 (mm) Ratio-R Summer CV Winter CV	FSR England and Wales 20.000 0.400 0.750 0.840	Analysis Speed Skip Steady State Drain Down Time (mins) Additional Storage (m³/ha) Check Discharge Rate(s) Check Discharge Volume	Normal x 240 0.0 x x
Storm Durations			
15	30	60	120
180	240	360	480
600	720	960	1440
Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0
Node Soakaway Soakaway Storage Structure			
Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	9.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	481
Safety Factor	2.0	Pit Width (m)	8.000
Porosity	0.95	Pit Length (m)	1.500
			Depth (m) 0.400
			Inf Depth (m)
			Number Required 1
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Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.334	0.034	1.3	0.0066	0.0000	OK
180 minute winter	Soakaway	172	9.088	-0.184	0.3	1.0024	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	1.3	0.577	0.210	0.0063
180 minute winter	Soakaway	Infiltration		0.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.356	0.056	3.1	0.0110	0.0000	OK
360 minute winter	Soakaway	344	9.230	-0.042	0.4	2.6190	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	3.1	0.719	0.505	0.0121
360 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.366	0.066	4.0	0.0130	0.0000	OK
180 minute winter	Soakaway	180	9.298	0.026	0.9	3.3942	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	4.0	0.763	0.654	0.0147
180 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	Catchpit	240	9.579	0.279	1.1	0.0547	0.0000	SURCHARGED
240 minute winter	Soakaway	240	9.579	0.307	1.1	4.5657	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	5.5	0.803	0.919	0.0196
180 minute winter	Soakaway	Infiltration		0.1			



Appendix C – Soakaway Calculation 70m²

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit	0.007	5.00	10.000	500	487130.076	391618.788	0.700
Soakaway			10.000	1	487130.225	391621.628	0.728

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.9	0.600	0.628	0.007	0.0	27	0.560

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.700	500					
						0	1.000	9.300	100	
Soakaway	487130.225	391621.628	10.000	0.728	1		1	1.000	9.272	100

	JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway House 70.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland
Simulation Settings			
Rainfall Methodology FSR Region M5-60 (mm) Ratio-R Summer CV Winter CV	FSR England and Wales 20.000 0.400 0.750 0.840	Analysis Speed Skip Steady State Drain Down Time (mins) Additional Storage (m³/ha) Check Discharge Rate(s) Check Discharge Volume	Normal x 240 0.0 x x
Storm Durations			
15	30	60	120
180	240	360	480
600	720	960	1440
Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0
Node Soakaway Soakaway Storage Structure			
Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	9.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	508
Safety Factor	2.0	Pit Width (m)	3.500
Porosity	0.95	Pit Length (m)	3.000
		Depth (m)	0.400
		Inf Depth (m)	
		Number Required	1
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Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.329	0.029	1.0	0.0057	0.0000	OK
120 minute winter	Soakaway	116	9.074	-0.198	0.3	0.7426	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	1.0	0.537	0.160	0.0051
120 minute winter	Soakaway	Infiltration		0.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.348	0.048	2.4	0.0094	0.0000	OK
360 minute winter	Soakaway	336	9.205	-0.067	0.3	2.0495	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	2.4	0.678	0.393	0.0100
360 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.356	0.056	3.1	0.0110	0.0000	OK
360 minute winter	Soakaway	344	9.277	0.005	0.4	2.7587	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	3.1	0.721	0.509	0.0121
360 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
360 minute winter	Catchpit	352	9.395	0.095	0.6	0.0187	0.0000	OK
360 minute winter	Soakaway	352	9.395	0.123	0.6	3.9436	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	4.3	0.778	0.716	0.0158
360 minute winter	Soakaway	Infiltration		0.1			



Appendix D – Soakaway Calculation 125m²

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit	0.013	5.00	10.000	500	487130.076	391618.788	0.700
Soakaway			10.000	1	487130.225	391621.628	0.728

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	1.8	0.600	0.628	0.013	0.0	37	0.667

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.700	500					
						0	1.000	9.300	100	
Soakaway	487130.225	391621.628	10.000	0.728	1		1	1.000	9.272	100

	JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway House 125.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland
Simulation Settings			
Rainfall Methodology FSR Region M5-60 (mm) Ratio-R Summer CV Winter CV	FSR England and Wales 20.000 0.400 0.750 0.840	Analysis Speed Skip Steady State Drain Down Time (mins) Additional Storage (m³/ha) Check Discharge Rate(s) Check Discharge Volume	Normal x 240 0.0 x x
Storm Durations			
15	30	60	120
180	240	360	480
600	720	960	1440
Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0
Node Soakaway Soakaway Storage Structure			
Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	9.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	765
Safety Factor	3.0	Pit Width (m)	2.000
Porosity	0.95	Pit Length (m)	9.500
		Depth (m)	0.400
		Inf Depth (m)	
		Number Required	1
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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.341	0.041	1.8	0.0079	0.0000	OK
240 minute winter	Soakaway	232	9.092	-0.180	0.4	1.6625	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	1.8	0.630	0.293	0.0080
240 minute winter	Soakaway	Infiltration		0.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.372	0.072	4.5	0.0141	0.0000	OK
720 minute winter	Soakaway	690	9.229	-0.043	0.4	4.1361	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	4.4	0.781	0.733	0.0161
720 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Catchpit	10	9.392	0.092	5.8	0.0180	0.0000	OK
600 minute winter	Soakaway	585	9.304	0.032	0.5	5.4876	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	5.7	0.803	0.939	0.0199
600 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	Catchpit	472	9.898	0.598	0.9	0.1171	0.0000	FLOOD RISK
480 minute winter	Soakaway	472	9.898	0.626	0.9	7.2290	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	8.0	1.022	1.323	0.0216
180 minute winter	Soakaway	Infiltration		0.1			



Appendix E – Soakaway Calculation 110m²

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit	0.011	5.00	10.000	500	487130.076	391618.788	0.700
Soakaway			10.000	1	487130.225	391621.628	0.728

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	1.5	0.600	0.628	0.011	0.0	34	0.637

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.700	500					
						0	1.000	9.300	100	
Soakaway	487130.225	391621.628	10.000	0.728	1		1	1.000	9.272	100

	JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway House 110.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland
Simulation Settings			
Rainfall Methodology FSR Region M5-60 (mm) Ratio-R Summer CV Winter CV	FSR England and Wales 20.000 0.400 0.750 0.840	Analysis Speed Skip Steady State Drain Down Time (mins) Additional Storage (m³/ha) Check Discharge Rate(s) Check Discharge Volume	Normal x 240 0.0 x x
Storm Durations			
15	30	60	120
180	240	360	480
600	720	960	1440
Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0
Node Soakaway Soakaway Storage Structure			
Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	9.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	762
Safety Factor	3.0	Pit Width (m)	2.000
Porosity	0.95	Pit Length (m)	8.500
		Depth (m)	0.400
		Inf Depth (m)	
		Number Required	1
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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.338	0.038	1.6	0.0074	0.0000	OK
240 minute winter	Soakaway	228	9.085	-0.187	0.3	1.3671	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	1.6	0.610	0.260	0.0073
240 minute winter	Soakaway	Infiltration		0.1			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.364	0.064	3.8	0.0126	0.0000	OK
720 minute winter	Soakaway	660	9.228	-0.044	0.3	3.6832	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	3.8	0.754	0.621	0.0141
720 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	Catchpit	10	9.377	0.077	4.9	0.0151	0.0000	OK
720 minute winter	Soakaway	690	9.286	0.014	0.4	4.6245	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	4.8	0.792	0.797	0.0172
720 minute winter	Soakaway	Infiltration		0.1			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
360 minute winter	Catchpit	352	9.498	0.198	0.9	0.0388	0.0000	SURCHARGED
360 minute winter	Soakaway	352	9.498	0.226	0.9	6.4681	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute winter	Catchpit	1.000	Soakaway	6.7	0.870	1.118	0.0211
360 minute winter	Soakaway	Infiltration		0.1			



Appendix F – Porous Paving Calculation

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Catchpit		5.00	10.000	500	487130.076	391618.788	0.300
Soakaway	0.050		10.000	1	487130.225	391621.628	0.328

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Catchpit	Soakaway	2.844	0.600	9.700	9.672	0.028	100.0	100	5.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.0	0.200	0.228	0.000	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.844	100.0	100	Circular	10.000	9.700	0.200	10.000	9.672	0.228

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	487130.076	391618.788	10.000	0.300	500					
						0	1.000	9.700	100	
Soakaway	487130.225	391621.628	10.000	0.328	1		1	1.000	9.672	100

		JCE, Red Lion Street, Spalding, Lincolnshire, PE11 1SX	File: Soakaway Drives.pfd Network: Storm Network Ben Jackson 15/04/2024	Page 2 Hereward Way, Crowland							
<u>Simulation Settings</u>											
Rainfall Methodology	FSR	Analysis Speed		Normal							
FSR Region	England and Wales	Skip Steady State		x							
M5-60 (mm)	20.000	Drain Down Time (mins)		240							
Ratio-R	0.400	Additional Storage (m³/ha)		0.0							
Summer CV	0.750	Check Discharge Rate(s)		x							
Winter CV	0.840	Check Discharge Volume		x							
<u>Storm Durations</u>											
15	30	60	120	180	240	360	480	600	720	960	1440
Return Period (years)		Climate Change (CC %)		Additional Area (A %)		Additional Flow (Q %)					
1		0		0		0		0			
30		0		0		0		0			
100		0		0		0		0			
100		40		0		0		0			
<u>Node Soakaway Depth/Area Storage Structure</u>											
Base Inf Coefficient (m/hr)		0.03600		Safety Factor		3.0		Invert Level (m)		9.550	
Side Inf Coefficient (m/hr)		0.00000		Porosity		0.30		Time to half empty (mins)		112	
Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)			
0.000	500.0	500.0	0.300	500.0	500.0	0.301	0.0	500.0			
Flow+ v10.8 Copyright © 1988-2024 Causeway Technologies Ltd											

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
120 minute winter	Soakaway	86	9.576	-0.096	2.3	3.9404	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
120 minute winter	Soakaway	Infiltration		0.9			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
120 minute winter	Soakaway	90	9.614	-0.058	5.4	9.5457	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
30 minute summer	Soakaway	Infiltration		1.7			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
120 minute winter	Soakaway	94	9.640	-0.032	7.1	13.4310	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute summer	Soakaway	Infiltration		1.7			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
120 minute winter	Soakaway	112	9.687	0.015	10.0	20.5046	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute summer	Soakaway	Infiltration		1.7			



Appendix G – Preliminary Drainage Sketch



Disclaimer
This drawing remains copyright of 'Jackson Consulting Engineers', and shall not be reproduced unless written consent has been given by the company director.
Any discrepancies must be reported back to the named office below.
Any works carried out without necessary written approvals is at the risk of the developer.
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Drawing must be printed in colour. This text will be red if a coloured drawing.

- Notes:
- All drawings to be read in conjunction with Structural Engineers Drawings.
 - If in doubt - ASK!
 - Any discrepancies are to be reported back to the engineer immediately.
 - This drawing is not to be scaled.
 - All dimensions are in metres unless noted otherwise (pipe diameters are generally shown in millimetres, unless noted otherwise).
 - Drawings marked Preliminary, Information or Tender are for guidance/ approval only, i.e. NOT for Construction.
 - It is likely that existing services will be present within the existing site. Contractor to ensure all necessary precautions have been taken before any excavation takes place.
 - It is the contractors responsibility to locate existing services where they may be affected by proposed works and protect them as necessary and agreed by the utility provider.
 - Drawings to be read in conjunction with all relevant drawings.
 - Setting out to be in accordance with the Architectural plans.
 - All proprietary items to be installed in strict accordance with the manufacturers instructions and recommendations.
 - All works to be carried out in accordance wit the current British Standards, Codes for practice and Building Regulations.
 - Soakaways must be a minimum of 5m away form all buildings, including existing.
 - Porous paving can be laid close to foundations provided that they do not receive additional water.

Preliminary
For planning approval

P01	Drawing generally updated	BJ	JCE	09/04/24
Rev	Description	Dm	Ck'd	Date

Client:
Mr Parnell



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Project Title:
Proposed Residential Development,
Hereward Way,
Crowland

Drawing Title:
Drainage General Arrangement.

Drawing Status: Preliminary		
Scale: 1:200	Paper size: A1	Date:25/04/2022
Drawn: BJ	Checked: JCE	Approved: JCE
Drawing Number: 0220-JCE-00-SI-SK-C-3000		Rev P01