

MR MARTIN OSBORNE-SHAW



**LAND TO THE REAR OF THE SPIRES, CROSS ROAD, EAST PRESTON
WEST SUSSEX, BN16 2ST**

Flood Risk and Drainage Assessment

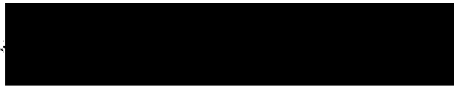
April 2020



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Environmental Assessment Services Ltd

REPORT DATA SHEET

Requirement	Data
Report Reference	Osborne-Shaw/LandrearofSpires/FRA&DA
Date	April 2020
Client	Mr Martin Osborne-Shaw
Report type	Flood Risk and Drainage Assessment
Purpose	Planning
Revisions	
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Flood Risk and Drainage Assessment

April 2020

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Flood Risk and Drainage Assessment

April 2020

1. BACKGROUND

- 1.1 Environmental Assessment Services (EAS) Limited was instructed to prepare a Flood Risk and Drainage Assessment for the proposed development on Land at the rear of The Spires, East Preston in West Sussex.

2. EXISTING SITE & PROPOSED REDEVELOPMENT

- 2.1 The site comprises a plot of land accessible via Cross Road, East Preston, approximately 3 km east of the town of Littlehampton in West Sussex. The site was formerly part of the gardens of 'The Spires', a large property on Springfield Road in East Preston. The site area is approximately 0.33 ha. The Ordnance Survey (OS) map reference for the site is TQ 0630 0212. The site elevation is approximately + 7.5 m OD. Figure 1 for Site Location Plan and Figure 2 for the Existing Site Layout.
- 2.2 It is proposed to develop the site with a five-bedroom family home, double garage and utility storage. The site will feature a large basement and thus will require extensive groundworks. There will be an access road via Cross Road. See Figure 3 for the Proposed Site Layout.
- 2.3 According to the British Geological Survey, the site lies on Late Pleistocene Brickearth over Upper Cretaceous White Chalk Sub-group. The Brickearth is described as buff loam or silt, and typically resembles a clayey silt with occasional small chalk or flint pieces.
- 2.4 The Department for Environment, Food and Rural Affairs (Defra) online mapping (MAGIC) shows the site to lie on a superficial Secondary A Aquifer, overlying a bedrock Principle aquifer. The site does not lie within a groundwater Source Protection Zone (SPZ). The site is deemed to be of medium groundwater vulnerability.
- 2.5 There are no significant watercourses within the immediate vicinity of the site.

3. FLOOD RISK ASSESSMENT

3.1 *Sources of Flooding*

3.1.1 According to the Environment Agency (EA) online Flood Map for Planning, the site lies within Flood Zone 1, at low risk of flooding from rivers and the sea. See Appendix B.

3.1.2 The EA's online Risk of Flooding from Surface Water map shows the site to be at very low risk of surface water flooding. The nearest areas of greater risk are part of a garden to the north of the site and parts of some highways within the vicinity. See Appendix B.

3.1.3 The site is shown as moderately vulnerable to groundwater flooding, although this type of flooding is usually associated with more permeable strata than the Brickearth underlying the site.

3.2 *Risks to Property*

3.2.1 According to the EA flood mapping, the proposed building will not be at a significant risk of damage from flooding. However, the proposed basement will have to be protected against the possible ingress of groundwater. The basement should be tanked to make it waterproof and should incorporate a sump and automatic pump as a precautionary measure.

3.2.2 Following the Government's 'Flood Risk Assessment: Standing Advice' for vulnerable developments, ground floor levels should be raised to either 300 mm over the existing ground level or 600 mm over the estimated flood level, whichever is the highest. In this case, the proposed ground floor levels at the site should not be less than 300 mm above ground level.

3.3 *Risks to Occupiers*

3.3.1 There should be no significant flood related risk to those present in the proposed building at ground floor level and above or in gardens and dry access may be made via Cross Road and Angmering Lane.

3.3.2 It is recommended that the basement should not include bedrooms.

3.4 *Likely Risks to Flood Risk Elsewhere*

3.4.1 The present development plan will result in an increase in impermeable area at the site.

3.4.2 A change in impermeable area can increase peak flows following a rainfall event. However, as flows will be managed on site by sustainable drainage (SuDS) measures, there should be no increase in flood risk downstream.

4. EXISTING DRAINAGE

- 4.1 The site was visited on 18 March 2020 in order to examine any existing drainage and carry out percolation testing. See Appendix C: Site Photographs.
- 4.2 There is no formal surface water drainage on the site as the site presently comprises garden, mainly laid to grass. Surface water presently soaks into the surface soil. There is very little gradient to assist run-off leaving the site.
- 4.3 The flow permitted to leave the redeveloped site should not exceed the Greenfield flow rate. The Greenfield runoff rate for the site has therefore been estimated using the UK Sustainable Drainage (UKSUDS) Greenfield Runoff Estimation Tool. The runoff rates are given for scenarios up to (and including) the 1 in 100 year storm event, as summarised in Table 4.1 below and provided in Appendix D: Greenfield Runoff Rate.

TABLE 4.1
GREENFIELD RUNOFF RATES

Return period	Flow rates (l/s)
Qbar	0.96
1 in 1 year	0.82
1 in 30 year	2.21
1 in 100 year	3.06
1 in 200 year	3.59

- 4.4 The maximum discharge permitted to leave the site post development should not exceed Qbar (0.96 l/s), including any foul sewage discharge. The peak foul sewage discharge from the site has been calculated at 0.05 l/s, based on the flow calculations given in Sewers for Adoption. The maximum permitted discharge for the whole site will therefore be 0.91 l/s.
- 4.5 Only the roofs, paved areas and other impermeable features will be positively drained to a fixed outlet, the remainder of the site will drain as existing greenfield.

5. PROPOSED DRAINAGE

It is generally required that the drainage design of a developed site should limit the discharge from the site to greenfield flow rates. The ways in which this can be achieved are discussed in 5.1 and 5.2 below:

5.1 Drainage to Soakaway

- 5.1.1 Drainage to soakaway (infiltration) is the preferred Sustainable Urban Drainage System (SUDS) solution. It was uncertain whether the underlying Brickearth would be a suitable medium for soakaways, as this will depend on the distribution of the clay and silt.

- 5.1.2 Percolation testing was undertaken at the site on 18 March 2020 (after a period of considerable rainfall), in order to investigate the practicality of soakaway as a method of disposal of surface water
- 5.1.3 Percolation testing comprised the excavation of three trial holes to 1.2 m below ground level in order to examine the geology at different locations across the site outside the footprint of the proposed house. A deeper trial pit was excavated in the centre of the site to assess the late Winter/early Spring groundwater level
- 5.1.4 Trial hole locations are shown in Figure 2. No groundwater was encountered during the sinking of the trial holes. The geology appeared to be similar in all trial holes; dark grey organic topsoil with roots over light brown and buff clayey sandy silt. The clay content varied between the trial holes.
- 5.1.5 Percolation testing was undertaken in the trial holes. The hole was filled with water and the water level drop relative to the time was recorded. The infiltration rates (f) were calculated. The infiltration rates recorded in trial holes 1 and 3 were too low for a practicable soakaway. However, the infiltration rate recorded at Trial Hole 2 was $f = 2.16 \times 10^{-6}$ m/s. This is just within the practicable range for soakaway drainage.
- 5.1.6 A soakaway must be located some margin (typically 1 m) above groundwater level to work successfully. Groundwater was encountered in the deep trial pit excavated in the centre of the site. Groundwater eventually stabilized in the trial pit at 1.95 m below ground level (+5.65 m OD).
- 5.1.7 An outline drainage scheme based on a soakaway located at the position of Trial Hole 2 is shown in Figure 3. This outline scheme is based on a soakaway designed for the 1 in 30 year return period event whilst discharging 50% of the volume within 24 hours, but capable of accepting the 1 in 100 year return period storm event plus 40% allowance for climate change. Suggested size is 7 m x 8 m x 0.4 m deep, suggested invert level + 6.7 m OD. The soakaway may be constructed from AquaCell Lite units (or similar) wrapped in permeable geotextile. See Appendix E.

5.2 Attenuation Storage

- 5.2.1 The alternative to soakaway drainage would be attenuation storage onsite, with discharge limited to the Greenfield flow for the area. This would require a discharge point, which does not appear to be available within the immediate vicinity of the site.
- 5.2.2 In this case, drainage to soakaway is the preferred option and attenuation storage does not need to be considered further.

5.3 Other Sustainable Urban Drainage System (SUDS) Options

- 5.3.1 Additional SUDS options could include the use of permeable paving in any areas of external hard standing. Permeable paving will permit surface water to infiltrate into the underlying structure, delay discharge and reduce peak flows.
- 5.3.2 It is recommended that the permeable paving be underlain by a shallow (200 mm deep) drainage blanket of no fines 20 – 70 mm stone (or recycled crushed concrete) wrapped in permeable geotextile.
- 5.3.3 Rainwater harvesting could also be adopted. Rainwater could be used for irrigation purposes within the garden, via water butts connected to roof downpipes.

5.4 Extreme Event

- 5.4.1 If an extreme storm event overwhelmed the surface water drainage system at the site and/or if the drainage system were to fail, ground levels would indicate that surface water would follow a very slight fall, flow slowly towards the northeast and off site, as per the present situation. Ground levels suggest that there would be some shallow puddles forming on site.

5.6 Foul Sewerage

- 5.6.1 The preferred option is always to discharge to a public foul sewer, where this is practicable. In this case, there appears to be a deep foul sewer running west to east beneath the south side of Cross Road. It should be practicable to connect into this sewer via the site entrance/access corridor.
- 5.6.2 Southern Water has confirmed that there is a foul sewer in Cross Road. The nearest chamber is No. 3101 outside No. 3 Cross Road. This sewer would appear to discharge to a sewer in Angmering Lane at chamber No. 4101. It may be necessary to commission a capacity check from Southern Water for this sewer. In any event, consent from Southern Water will be required to connect to a public sewer. The design flow will be 0.45 l/s.
- 5.6.3 Southern Water has not yet supplied details of the invert and cover levels for their sewer chambers, or pipe sizes for the connecting sewers. If suitable details of the sewer in Cross Road and Angmering Lane are not available from Southern Water, it will be necessary to commission a survey of the sewer in Cross Road.

6. CONCLUSIONS

- 6.1 The site comprises a former part of the gardens of 'The Spires', a large property on Springfield Road in East Preston. It is proposed to develop the site with a five-bedroom family home, double garage, utility storage and a large basement. The site access will be via a driveway to Cross Road. See Figure 3 for the Proposed Site Layout.
- 6.2 The site lies within Flood Zone 1, at low risk of flooding from rivers and the sea, and within an area at low risk of surface water flooding. The site is indicated to be within an area moderately vulnerable to groundwater flooding, however, this is usually associated with more permeable subsoils than the Brickearth underlying the site. Otherwise, there are no significant flood risks to property, proposed occupants, nor is there likely to be increased risk of flooding downstream. Safe access and egress will be possible via the surrounding highways.
- 6.3 Groundwater was encountered less than 2 m below ground level. This represents a high groundwater level measured after a wet winter and early Spring. This, and the possible moderate vulnerability to groundwater flooding, will require that the proposed basement should be tanked to a waterproof standard and should incorporate a sump with automatic pump as a precautionary measure. It is recommended that the basement should not include bedrooms.
- 6.4 There is no formal surface water drainage on the site as existing. The proposed redevelopment will result in an increase in the impermeable area of the site compared to the existing. A sustainable drainage solution (SuDS) will be required.
- 6.5 The underlying geology comprises Brickearth deposits over Cretaceous Chalk. Percolation testing carried out across the site revealed unsuitable infiltration rates for drainage to soakaway, except in the southeast part of the site where a marginal infiltration rate was recorded. Due to the lack of alternative outlets for surface water, the chosen drainage strategy is drainage to soakaway, with the soakaway located in the southeast corner of the site, a suitable distance from the proposed house. See Figure 3.
- 6.6 Additional SUDS options which could be incorporated into the redevelopment include permeable paving over drainage blankets and rainwater harvesting from downpipes for garden irrigation purposes.
- 6.7 The preferred option for the disposal of foul sewerage will be discharge to the public foul sewer. In this case there is a public foul sewer in Cross Road and this may be accessed from the site. The public foul sewer is reputed to be at an elevation which would permit a gravity connection from the site, although this is subject to confirmation.

7. MAINTENANCE

- 7.1 New chambers and gullies will require occasional maintenance to remove any silt build-up and preserve the efficient function of the drainage system for the life of the development.
- 7.2 Silt, mainly in the form of grit and dust, will wash into the system during rainfall. This may be exacerbated when there are areas of disturbed/unvegetated soil in the catchment during development works.
- 7.3 It is recommended that accumulated litter and debris is removed regularly, especially after most autumn/winter leaf fall has occurred.
- 7.4 The soakaway should require minimal maintenance, as long as the silt trap on the inlet chamber is regularly cleared of silt. In the longer term, the soakway may be excavated and reconstructed.
- 7.5 Maintenance will be the responsibility of the freeholder of the new house.
- 7.6 A maintenance management plan should accompany the detailed design.

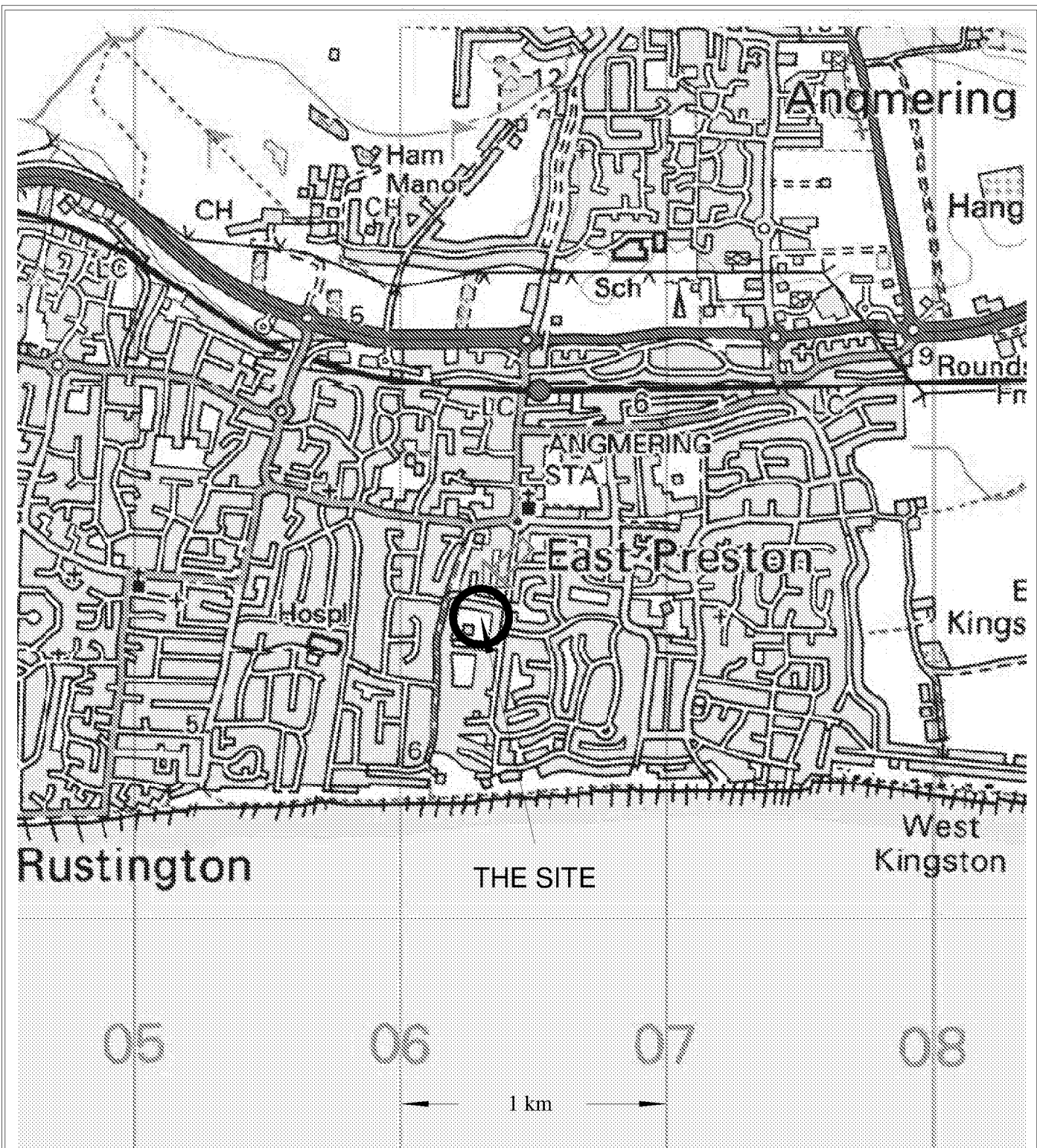
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APPENDIX A: FIGURES

Figure 1: Site Location Plan

Figure 2: Existing Site & Percolation Testing Locations

Figure 3: Proposed Drainage Arrangement



Reproduced from the 1:25000 scale Ordnance Survey map with permission. Licence No. 100005508

Scale as shown

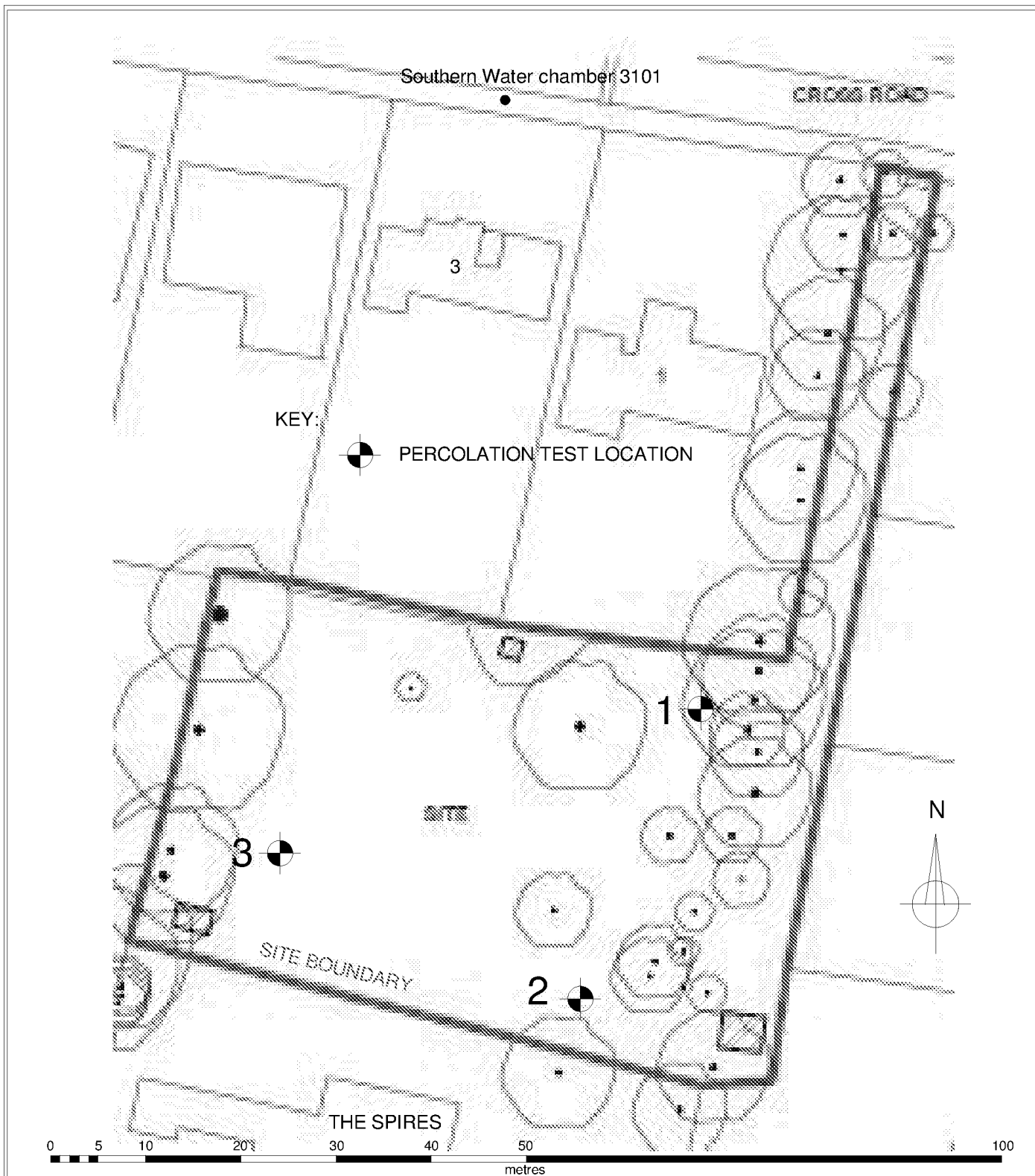


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Figure 1: Site Location

April 2020



Scale as shown

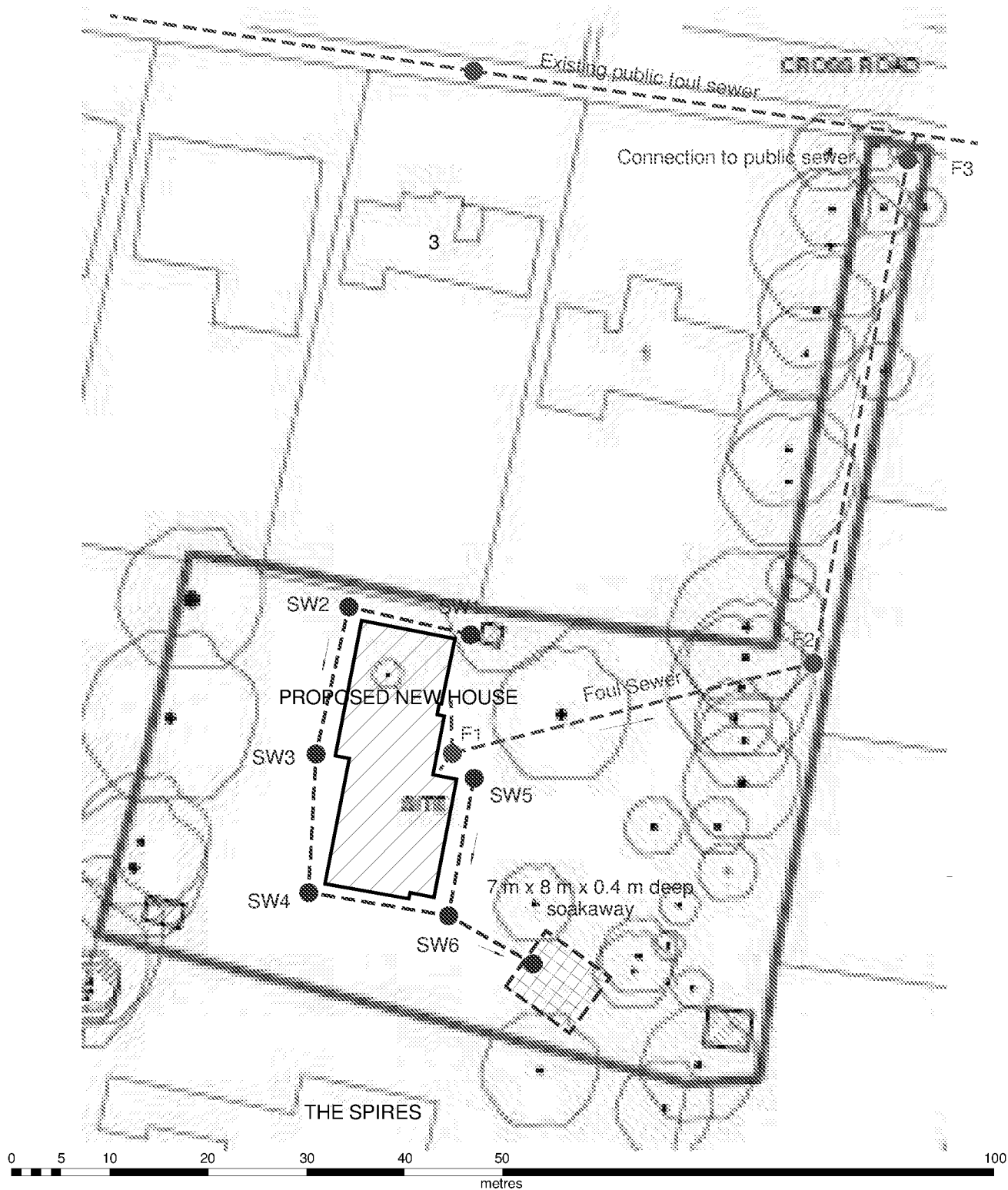


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Figure 2: The Existing Site & Percolation Test Locations

April 2020



Scale as shown



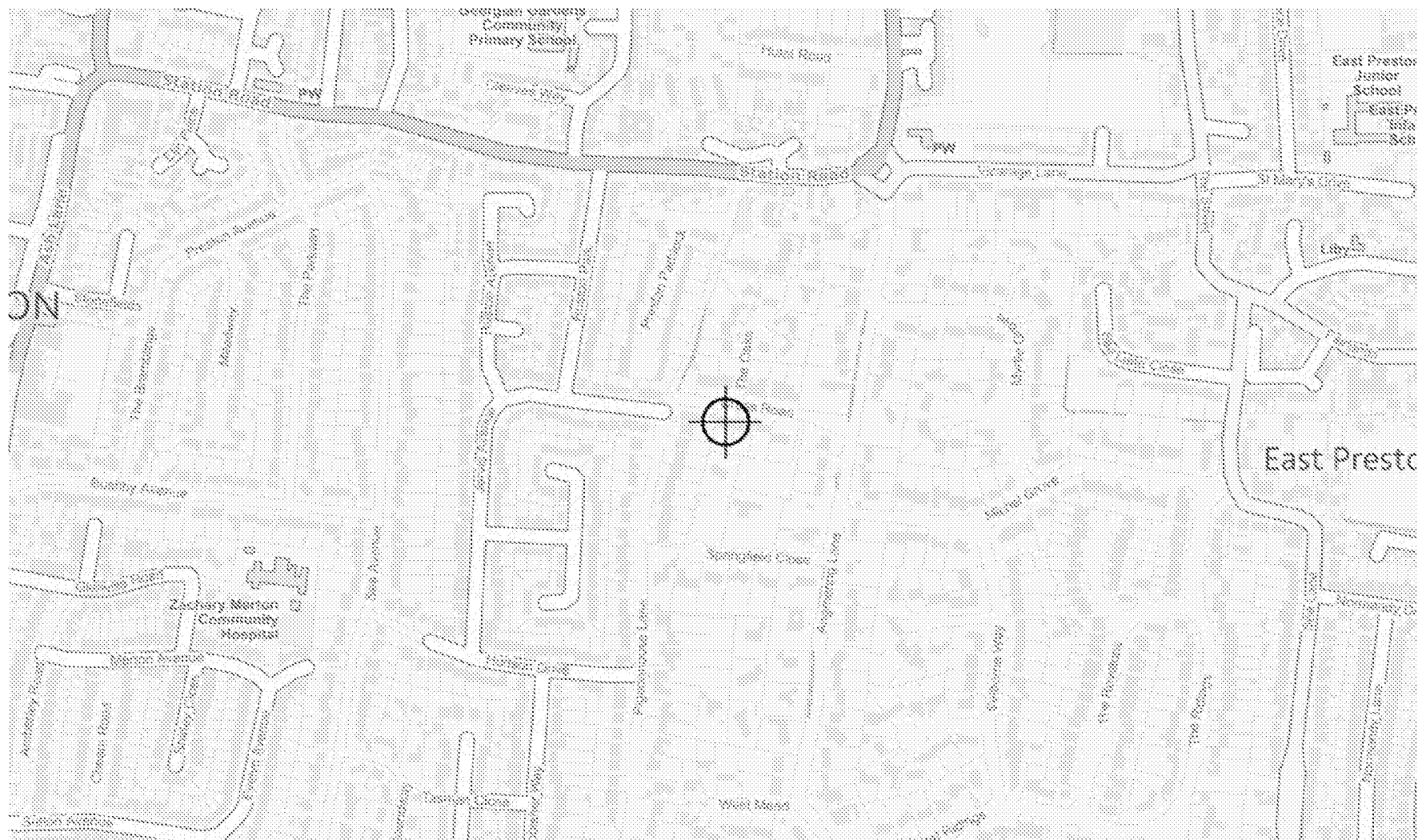
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Figure 3: Proposed Drainage Arrangement

April 2020

APPENDIX B

EA Surface Water Flood Map Extracts



ENVIRONMENT AGENCY FLOOD MAP FOR PLANNING



ENVIRONMENT AGENCY SURFACE WATER FLOOD RISK MAP

APPENDIX C **Site Photographs**



Photo 1: The site looking west.



Photo 2: The site looking east towards the site access.



Photo 3: The site access to Cross Road.



Photo 4: Site entrance on Cross Road



Photo 5: Central trial pit.



Photo 6: Soil excavated from trial pit (Brickearth).



Photo 7: Eventual groundwater level in trial pit.



Photo 8: Southern Water foul sewer chamber No. 3101 in verge outside No. 3 Cross Road.

APPENDIX D
UK Sustainable Drainage (UKSUDS) Calculations (Greenfield Runoff Rate)

Calculated by:

Site name:

Site location:

Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	708	708
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.37$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

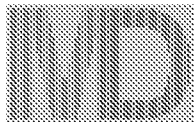
Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.96	0.96
1 in 1 year (l/s):	0.82	0.82
1 in 30 years (l/s):	2.21	2.21
1 in 100 year (l/s):	3.06	3.06
1 in 200 years (l/s):	3.59	3.59

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuDS.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuDS.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX E

MasterDrain Soakaway Design



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Job No.
MO-S/FRA&DA

Sheet no.
1

Date
06/04/20

MasterDrain
SW 16.52

Project
Land behind The Spires 30 yr

Title
Filled pit soakaway calculations for East Preston

By
MDM

Checked

Reviewed

Data:-

Location hydrological data (FSR):-

Location	= East Preston	Grid reference	= TQ0602
M5-60 (mm)	= 20.0	r	= 0.36
Soil index	= 0.40	SAAR (mm/yr)	= 720
WRAP	= 3	Area	= England and Wales

Soil classification for WRAP type 3

- i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
- ii) Permeable soils with shallow ground water in low-lying areas;
- iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Design data:-

Safety factor = 1.5 - No damage or inconvenience (SF=1.5)
Fill porosity = 0.95 - Plastic cells (porosity = 0.95)

Equivalent porosity (n1) = 0.95

Pit dimensions= 7.0 x 8.0 metres

Area drained = 300 m²

Infiltration coefficient = 0.007776 m/hr
Effective inf.coeff (q) = 0.005184

Return period = 30 yrs

Climate change factor = 0%

Calculations :-

Filled Excavation:-

Perimeter of pit = (2 x Excavation Width)+(2 x Excavation Length)
Area of base = Excavation Width x Excavation Length
Infiltration area = (Area of base)+(Perimeter of pit x Hmax)
Temporary constant 'a'
= (Area of base / perimeter)-((AreaDrained x Rainfall depth /1000)/(Perimeter/Inf. coeff))
Temporary constant 'b' = (Perimeter/Inf. coeff) / (Area of base x porosity)
Hmax = a*((EXP(-1 x b x Duration of storm))-1)

Note: The Hmax calculation is iterated to a maximum value of Hmax.

Note: Duration of storm in hours, Rainfall depth in mm/hr x Climate Change factor.

Results :-

Emptying time to 50% volume = 22:10 (hr:min)

hMax (Depth) = 0.27 metres

Time to maximum = 14:01 hr:min

Rainfall at maximum = 4.31mm/hr

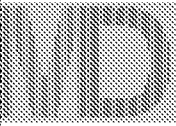
Width (m) = 7.0

Length (m) = 8.0

Total Infiltration area = 64.0m² (base area + sidewall area).

Total available volume = 14.25m³

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.
Formulae and methods from CIRIA 156.



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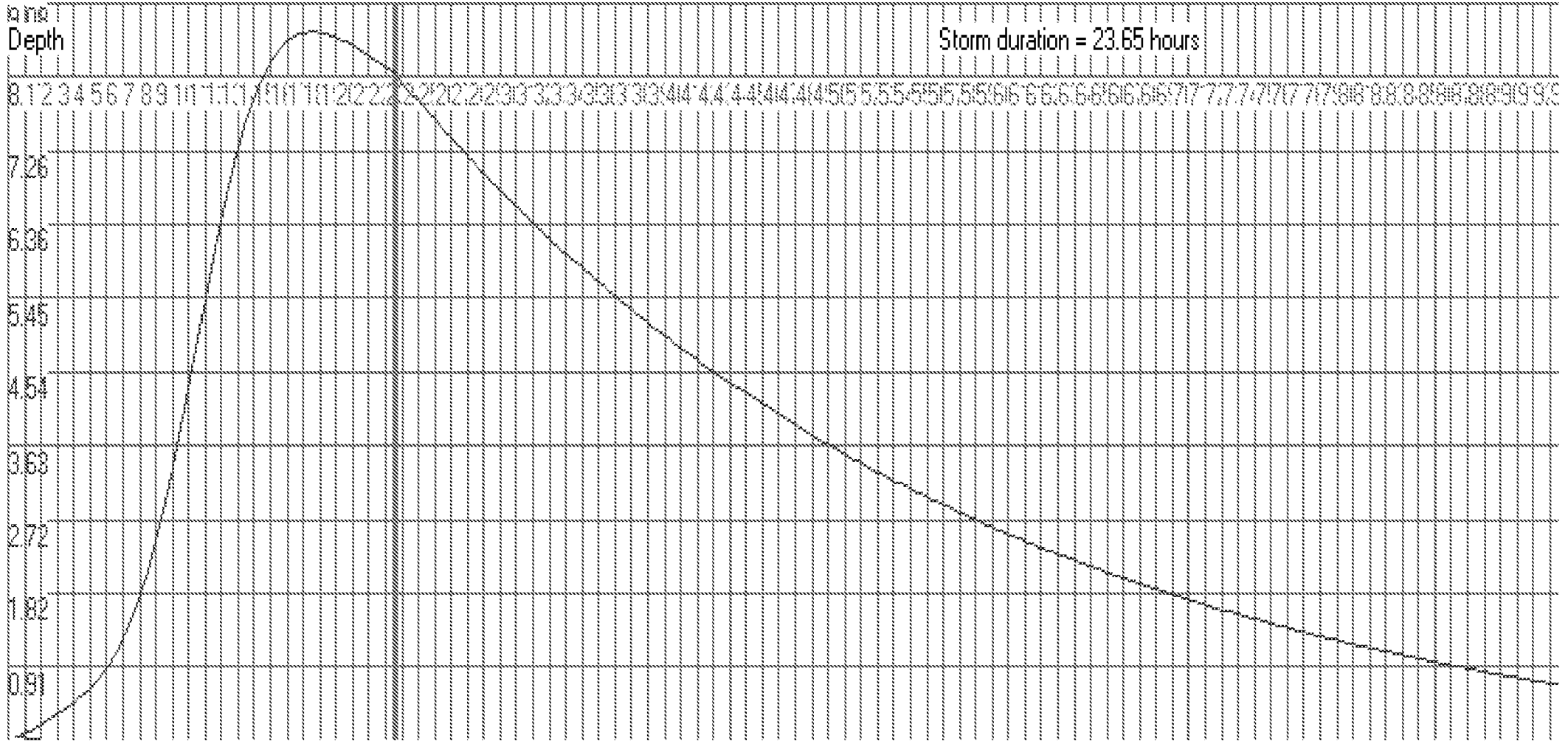
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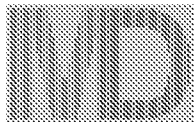
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Date 06/04/20		
By MDM	Checked	Reviewed

Project Land behind The Spires 30 yr
Title Worst case soakaway times to empty.





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Sheet no.
1

Date
06/04/20

MasterDrain
SW 16.52

Project **Land behind The Spires 100 yr + 40%**

Title **Filled pit soakaway calculations for East Preston**

By

MDM

Checked

Reviewed

Data:-

Location hydrological data (FSR):-

Location	= East Preston	Grid reference	= TQ0602
M5-60 (mm)	= 20.0	r	= 0.36
Soil index	= 0.40	SAAR (mm/yr)	= 720
WRAP	= 3	Area	= England and Wales

Soil classification for WRAP type 3

- i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
- ii) Permeable soils with shallow ground water in low-lying areas;
- iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Design data:-

Safety factor = 1.5 - No damage or inconvenience (SF=1.5)
Fill porosity = 0.95 - Plastic cells (porosity = 0.95)

Equivalent porosity (n1) = 0.95

Pit dimensions= 7.0 x 8.0 metres

Area drained = 300 m²

Infiltration coefficient = 0.007776 m/hr
Effective inf.coeff (q) = 0.005184

Return period = 100 yrs

Climate change factor = 40%

Calculations :-

Filled Excavation:-

Perimeter of pit = (2 x Excavation Width)+(2 x Excavation Length)
Area of base = Excavation Width x Excavation Length
Infiltration area = (Area of base)+(Perimeter of pit x Hmax)
Temporary constant 'a'
= (Area of base / perimeter)-((AreaDrained x Rainfall depth /1000)/(Perimeter/Inf. coeff))
Temporary constant 'b' = (Perimeter/Inf. coeff) / (Area of base x porosity)
Hmax = a*((EXP(-1 x b x Duration of storm))-1)

Note: The Hmax calculation is iterated to a maximum value of Hmax.

Note: Duration of storm in hours, Rainfall depth in mm/hr x Climate Change factor.

Results :-

Emptying time to 50% volume = 41:25 (hr:min)

hMax (Depth) = 0.55 metres

Time to maximum = 24:00 hr:min

Rainfall at maximum = 5.17mm/hr

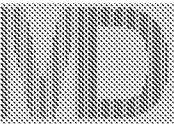
Width (m) = 7.0

Length (m) = 8.0

Total Infiltration area = 72.5m² (base area + sidewall area).

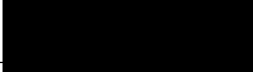
Total available volume = 29.34m³

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.
Formulae and methods from CIRIA 156.



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**MasterDrain
SW 16.52**

Project **Land behind The Spires 100 yr + 40%**

Title **Worst case soakaway times to empty.**

Job No.
MO-S/FRA&DA

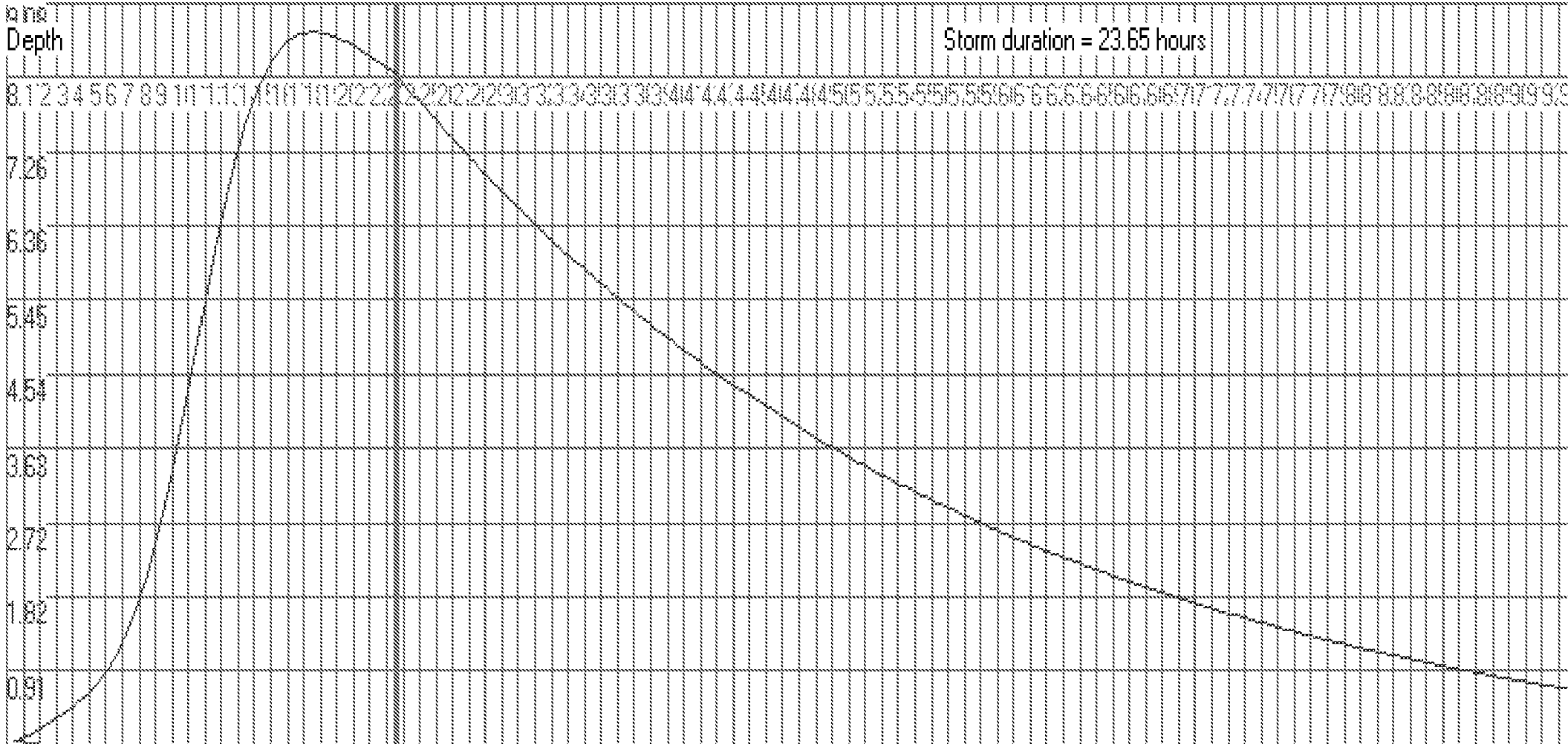
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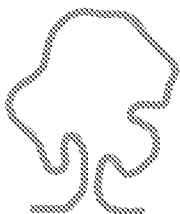
Date **06/04/20**

By
MDM

Checked

Reviewed





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