Kingswood Inspiring Learning, Green Park, Stablebridge, Aston Clinton, HP22 5NE

Flood Risk Assessment and Drainage Strategy

For Axis

KRS.0310.061.R.001.C

February 2024

www.krsenviro.com

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2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The Site is located at Kingswood Inspiring Learning, Green Park, Stablebridge, Aston Clinton, HP22 5NE (see Figure 1). The National Grid Reference (NGR) of the Site is 488503, 211452.

Figure 1 - Site Location

2.2 Existing Development

The existing Site is a residential and outdoor activity centre.

2.3 Proposed Development

The Proposed Development is for the erection of additional accommodation and classroom cabins, temporary and permanent toilets, activity equipment, the change of use of the dining room/nursery to provide accommodation and ancillary works including access tracks and landscaping (see Appendix 1). Further details with regard to the Proposed Development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

The Site slopes from north to south with ground levels of approximately 100 metres Above Ordnance Datum (mAOD) to the north west and 115mAOD to the south west.

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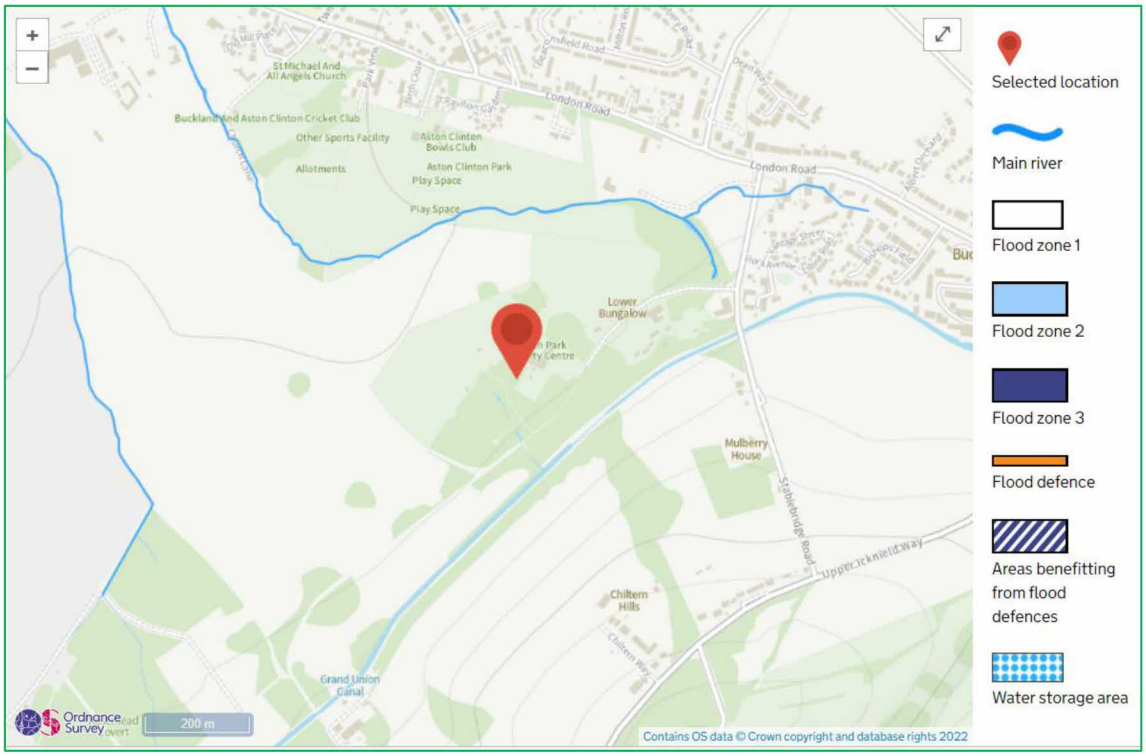

Figure 2 - Environment Agency Flood Zones

Table 1 - Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

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Key: : Development is appropriate, ×: Development should not be permitted.

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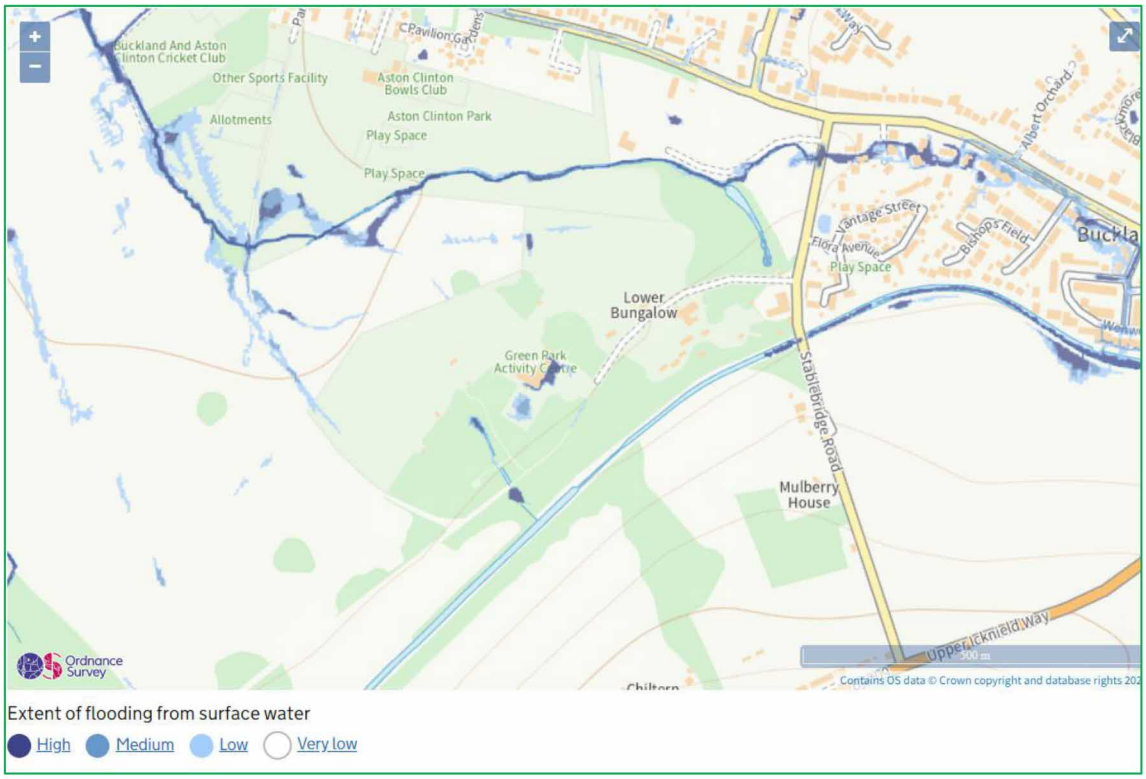

Figure 3 - Environment Agency Surface Water Flood Map

3.11 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment. There are no public sewers located within the vicinity of the Site therefore, the risk of flooding from sewer flooding is considered to be not significant.

3.12 Flooding from Artificial Drainage Systems/Infrastructure Failure

The Grand Union Canal is located along the southern boundary of the Site. The level of the water in canals is normally determined predominantly by the level and size of weirs. Most canal water levels are managed around a normal operating zone (NOZ) which is typically +/- 200mm, but water levels outside of the NOZ may be experienced at times. The existence of a number of lock gates along the length of the canal provides a mechanism for control. These locks moderate flows through the canal and provide some protection against upstream flood flows through the delay and timely release of flows downstream.

The main incidents of uncontrolled loss of water from canals are overtopping and breaching as a result of inundation from adjacent watercourses, vandalism or structural failure. The water levels in canals are maintained by the Canal & River Trust using reservoirs, feeders and boreholes, and thereafter manages the water by transferring it within the canal system.

When surface water enters canals, the level of the water rises. Eventually the water level will reach a point where it discharges from our waterways through control structures. Where the capacity of these control structures is exceeded, overtopping may result.

Breaches which may lead to flooding can occur on canals. There can be a number of causes for these including: culvert collapse, animal burrowing and overtopping. The Canal & River Trust operates a comprehensive asset management system which enables us to manage the risks of such events occurring. Breaches occur on average at a rate of three per year over the whole of the Canal & River Trust owned canal network (that's over 2,000 miles of canal).

Given the above, it is evident that canal flows are sufficiently controlled, and the likelihood of canal overtopping is extremely rare. This point is reinforced by the lack of recorded canal flooding events within the vicinity of the Site. The risk of flooding from canal flooding is considered to be not significant.

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the Site. The Environment Agency Reservoir flood map shows that the Site is not at risk of flooding from reservoir failure (see Figure 4). This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be not significant.

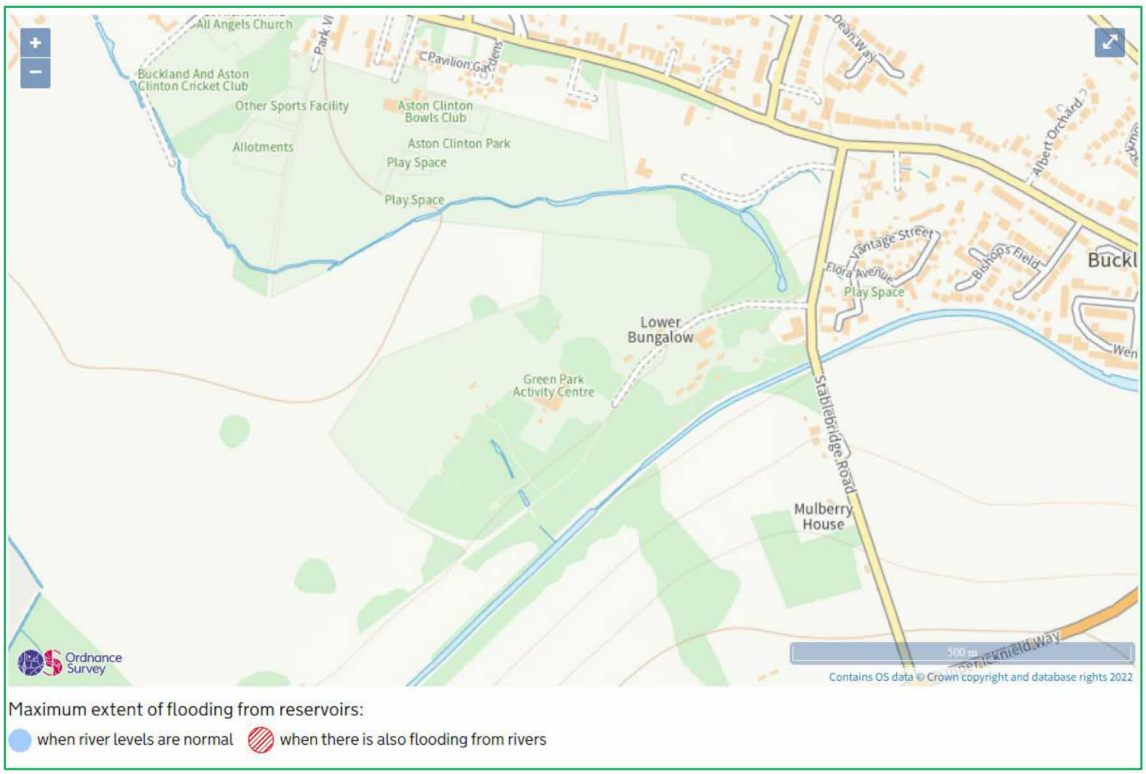

Figure 4 - Environment Agency Reservoir Flood Map

3.13 The Effect of the Development on Flood Risk

The Site is located within Flood Zone 1 therefore, the Proposed Development will have no impact on flood risk and the overall direction of the movement of water will be maintained within the developed Site and surrounding area. There will no net loss in flood storage capacity. The

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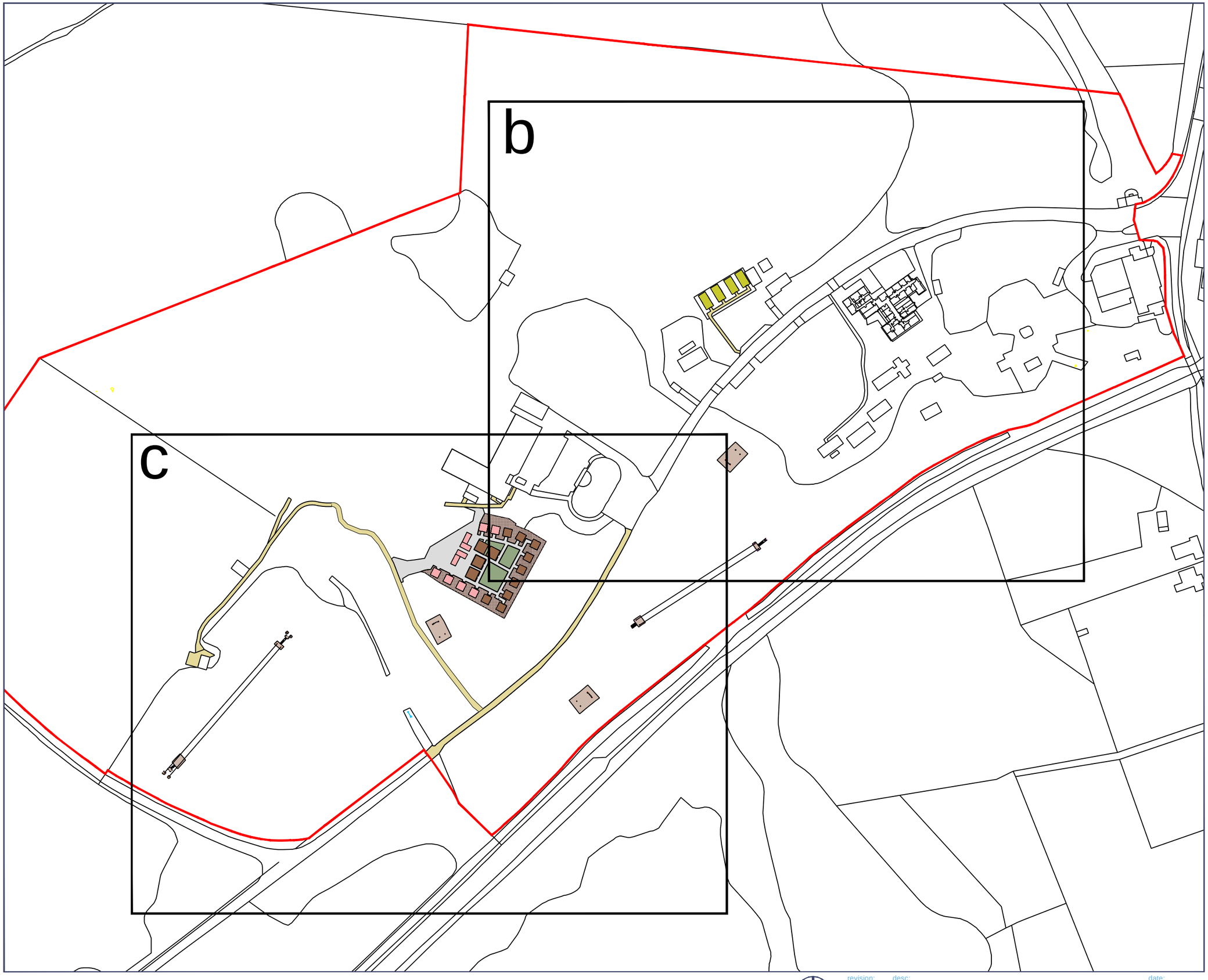

- Application Site
- Existing 8 Bed Cabin
- Existing Staff Cabin
- Proposed 8 Bed Cabin
- Proposed Toilet Block
- Proposed Classroom Cabin
- Access Track
- Bark Chippings
- Existing Grass
- Hardstanding
- Activity Areas
- Zip Wire

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Client
Inspiring Learning

Project
Green Park Inspiring Learning

Drawing Title
General Arrangement - Overall Plan

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Date	Drawn	Checked
November 2023	SK	SH

Dwg no	Rev
2885-02-02a	

Environmental
Geotechnical
Specialists

SOAKAWAY
LETTER
REPORT

job number	C3630/23/E/5503
date	04/12/2023
site address	Kingswood Inspiring Learning, Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE
written by	S. Hale
checked by	R. Palmer
issued by	S. Hale

Contents

Appendices

Report on Soakaway Testing

Location:	Kingswood Inspiring Learning Green Park, Stablebridge Road, Aylesbury, Buckinghamshre, HP22 5NE		
For:	KRS Enviro		
Report No.	C3630/23/E/5503	Report Date:	December 2023

For and on behalf of **Rogers Geotechnical Services Ltd**

Steven Hale BSc FGS Geo-environmental Technician	**Rob Palmer** MSc FGS ACIEH Senior Geo-environmental Engineer

Report Summary[1]

Item	Comments	Section
Geology	West Melbury Marl Chalk Formation and Zig Zag Chalk Formation (Undifferentiated).	4.
Strata Conditions	Capping of topsoil with granular made ground apparent to the cabin area. Chalk encountered beneath the capping to all areas.	5.
Groundwater Monitoring	Six groundwater monitoring visits are to be carried out to inspect three monitoring wells. Results are presented in Table 4.	6.2
Suitability of Soakaways	Not recommended.	7.

[1] This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

1. Introduction

We thank you for your request to undertake percolation testing at the above-mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 16th November 2023 in accordance with your instruction to proceed. This report describes the work undertaken, presents the data obtained and discusses the results of the tests

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between trial pit positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Fieldworks

3.1 Soakaways

Four trial pits were excavated in order to undertake soakaway testing, the positions of which are shown in Appendix 1. However, only two of these pits were utilised for the soakaway tests, as shallow water strikes were met in TP03 and TP03a. The water strike in TP03 caused side collapses which rendered the trial pit unusable for testing. On the other hand, TP03a was monitored as the water strike filled the trial pit. The soakaway tests were undertaken at the base of the pit at depths rational to the construction of soakaways. The soils exposed in the trial pits were logged on site in general accordance with BS5930: 2015 +A1: 2020, and full descriptions are given on the trial pit records which are presented in Appendix 2. Photographs of the trial pits are included within Appendix 3.

Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the back-actin g arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground. As such, foundations placed in this disturbed material may not perform as anticipated.

3.2 Boreholes & Water Monitoring Installs

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 87mm for the first 1m through 77mm, 67mm and 57mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 4. Also included on these records are the core diameters and percentages of core recovered.

Once the boreholes were completed, water monitoring standpipes were installed between 3.0m and 4.0m depth in all of the boreholes and the installation details are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal above, and the installation was capped with a stop box cover in a concrete surround.

4. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	-	-	None indicated beneath the site.
Solid Geology (Undifferentiated)	West Melbury Marly Chalk Formation	West Melbury Chalk Member	Buff, grey and off-white, soft, marly chalk and hard grey limestone arranged in couplets.
	Zig Zag Chalk Formation	Zig Zag Chalk Member	Mostly firm, pale grey to off-white blocky chalk with a lower part characterised by rhythmic alternations of marls and marly chalks with firm white chalk. Thin gritty, silty chalk beds act as markers in the sequence.

5. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	**Strata Type**	**Positions Layer Revealed**	**Groundwater Strikes** m below ground level
0.20 – 0.45	TOPSOIL (Greyish brown, very organic, silty, gravelly SAND)	TP01, TP02, WS01 & WS02	None

[2] Sources: British Geological Survey (NERC) Map Sheets 238; Aylesbury; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

0.30 – 0.45	TOPSOIL (Dark brown, very organic, slightly sandy, clayey SILT)	TP03, TP03a & WS03	None
0.45 – 0.80	MADE GROUND (Granular)	TP01, TP02, WS01 & WS02	None
0.50	MADE GROUND (Black, bituminous material)	TP01	None
0.75	MADE GROUND (Granular)	TP01	None
2.00 – 3.40	WEST MELBURY MARLY CHALK FORMATION and ZIG ZAG CHALK FORMATION (Extremely weak, medium to high density, light grey CHALK)	TP01, TP02, WS01 & WS02	(TP02 – 2.00m)
+1.10 – 2.20	WEST MELBURY MARLY CHALK FORMATION and ZIG ZAG CHALK FORMATION (Structureless CHALK composed of soft, light grey, sandy, gravelly CLAY).	TP03, TP03a & WS03	(TP03 – 1.50m & 1.60m) (TP03a -1.10m)
+4.00	WEST MELBURY MARLY CHALK FORMATION and ZIG ZAG CHALK FORMATION (Very weak, medium to high density, light grey CHALK)	WS01	None
+4.00	WEST MELBURY MARLY CHALK FORMATION and ZIG ZAG CHALK FORMATION (Extremely weak, medium to high density, light grey thinly laminated, marly CHALK)	WS02	None
+3.00	WEST MELBURY MARLY CHALK FORMATION and ZIG ZAG CHALK FORMATION (Extremely weak, medium to high density, light grey)	WS03	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

6. Insitu Testing

6.1 Soakaway Test

On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 5 and are summarised below:

Table 3: Soakaway Test Results

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/sec)	Drainage Characteristics
TP01	0.30 x 1.80	1.33 to 1.57	Side – Extremely weak, medium to high density, chalk Base – As above	*1.5 x 10^{-6}	Poor
TP02	0.30 x 1.80	1.25 to 1.04	Side – Extremely weak, medium to high density, chalk Base – As above	-	Poor

*Estimated from linear extrapolation

During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in both trial pits. In TP01, the test was ran for 3 hours during which it did not fall below 25% of the effective volume. As such, linear extrapolation was used in order to estimate the infiltration rate for the test. During the test in TP02, the trial pit was noted to be filling

with water as a result of the water strike recorded at 2.00m. The trial pit was monitored for 2 hours during which it did not cease to fill. On this basis, the test in TP02 could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils and the infilling as a result of the water strike. Due to the negative water movement it was not possbile to extrapolate the results obtained in order to obtain a soil infiltration rate.

While it was not possible to carrry out soakaway tests in TP03 or TP03a due to the rate at which they filled from water strikes, it was possible to monitor TP03a. It was recorded that the trial pit was excavated to a depth of 1.10m whereupon a waterstrike began to rapidly fill the pit. The water level was monitored and noted to rise from 1.10m to 0.90m over the course of 1 hour. Afterwards, the trial pit was observed to settle for an additional half an hour with no further movement.

6.2 Standpipe Monitoring

Subsequent to the site investigation, a period of water monitoring has been organised. Monitoring is ongoing, but the results to date are presented below:

Table 4: Summary of Standpipe Monitoring

Position	Date	Atmospheric Conditions	Water Level	Standpipe Depth
WS01	30/11/2023	Sunny	3.20	4.10
WS02	30/11/2023	Sunny	1.37	3.70
WS03	30/11/2023	Sunny	1.23	2.86

7. Discussion

The soils encountered beneath the topsoil and made ground were found to be typical of the undifferentiated fraction of the underlying West Melbury Marl Chalk Formation and Zig Zag Chalk Formation. The strata conditions and subsequent drainage characteristics appear to be comparable across the site. In this instance, the infiltration testing has revealed that the soils have poor drainage characteristics. This is likely due to the soils encountered being the most weathered fraction of the underlying geology. Given the cohesive nature of the weathered fracture, fewer fractures are present of which would usually be the conduit for any movement of groundwater. Whilst the made ground included gravel, these soils cannot be recommended as a soakage stratum due to the potential for collapse compression. Therefore, soakaways cannot be recommended at this site and an alternative form of drainage should be considered.

8. References

Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.

British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.

Barnes, G. (2000). *Soil Mechanics Principle and Practice.* 2nd ed. London: Macmillan Press Ltd, p.47.

Appendix 1

Site Plan

Notes:

RGS
Environmental
Geotechnical
Specialists

Rogers Geotechnical Services Ltd

Offices 1 & 2, Barncliffe
Business Park,
Near Bank,
Shelley,
Huddersfield,
HD8 8LU

Telephone: 0843 50 66 87
www.rogersgeotech.co.uk

Client:

KRS Enviro

Job Number:

C3630/23/E/5503

Project Details:
Kingswood Inspiring Learning,
Green Park, Stablebridge Road,
Aylesbury, HP22 5NE

Scale:	Not to scale - reference only

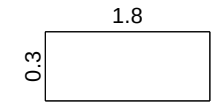
Appendix 2

Trial Pit Records

Trial Pit Log

Trialpit No **TP01** Sheet 1 of 1

Project Name:	Kingswood Inspiring Learning	Project No. C3630/23/E/5503	Co-ords: - Level:	Date 16/11/2023
Location:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE		Dimensions (m): Depth 2.00	Scale 1:50
Client:	KRS Enviro			Logged SH



Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.45		
				0.50		
				0.75		
				2.00		

Remarks:

Stability: Stable

Trial Pit Log

			Trialpit No **TP02** Sheet 1 of 1	
Project Name:	Kingswood Inspiring Learning	Project No. C3630/23/E/5503	Co-ords: - Level:	Date 16/11/2023
Location:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE		Dimensions (m): Depth 2.00	Scale 1:50
Client:	KRS Enviro			Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.80		
				2.00		

Remarks:

Stability: Stable

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name:	Kingswood Inspiring Learning	Project No. C3630/23/E/5503	Co-ords: - Level:	Date 16/11/2023
Location:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE	Dimensions (m): Depth 2.00	2 / 0.3	Scale 1:50
Client:	KRS Enviro			Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.30		
				2.00		

Remarks: Trial pit collapsed before tests could be carried out due to the groundwater strikes.

Stability: Unstable

Trial Pit Log

			Trialpit No	**TP03a**
				Sheet 1 of 1
Project Name:	Kingswood Inspiring Learning	Project No. C3630/23/E/5503	Co-ords: - Level:	Date 16/11/2023
Location:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE	Dimensions (m): Depth 1.10	1.5 / 0.3	Scale 1:50
Client:	KRS Enviro			Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.30		
▼				1.10		

Remarks:

Stability: Stable

Appendix 3

Trial Pit Photographs

Photo 1: TP01

Photo 2: TP02

Photo 3: TP03

Photo 4: TP03a

Appendix 4

Borehole Records


Well


Well


Well

Appendix 5

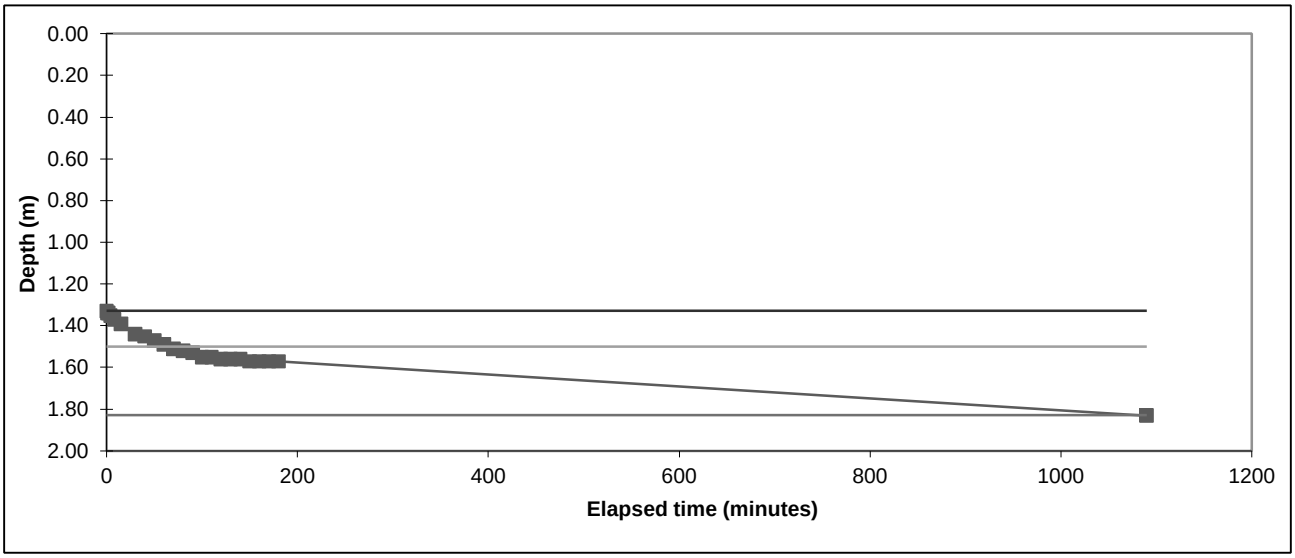
Soakaway Results

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP01	Test No:	1	Date:	16/11/2023
Length (m):	1.800		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	2.00		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.330	110	1.550
1	1.340	120	1.560
2	1.340	130	1.560
4	1.350	140	1.560
8	1.370	150	1.570
15	1.390	160	1.570
30	1.440	170	1.570
40	1.450	180	1.570
50	1.470	1090	1.831
60	1.490		
70	1.510		
80	1.520		
90	1.530		
100	1.550		



Start water depth for analysis (mbgl):	1.33		
75% effective depth (mbgl):	1.50	Elapsed time (mins):	65.0
50% effective depth (mbgl):	1.67		
25% effective depth (mbgl):	1.83	Elapsed time (mins):	1086.5
Base of soakage zone (mbgl):	2.00		

Volume outflow between 75% and 25% effective depth (m^3):	0.178
Mean surface area of outflow (m^2):	1.93
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	1021.5

Soil infiltration rate (m/s):	**1.5E-6**

Remarks Results processed following BRE 365 (2007).
Result obtained via linear extrapolation.

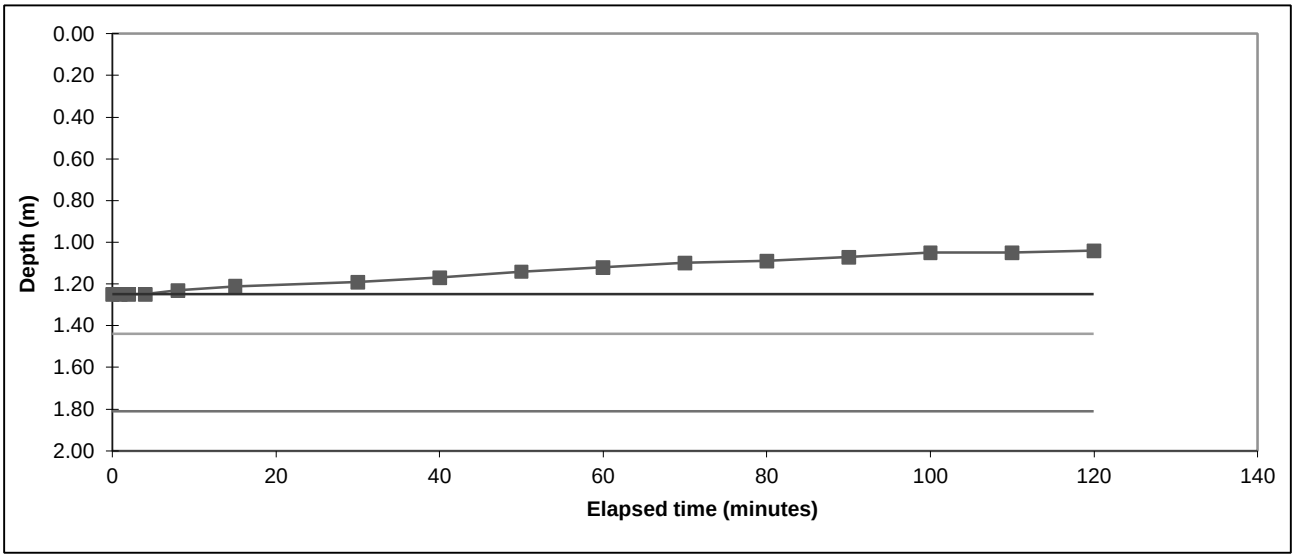
Client:	KRS Enviro	**Job No:**
Site:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE	C3630/23/E/5503

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP02	Test No:	1	Date:	16/11/2023
Length (m):	1.800		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	2.00		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.250	110	1.050
1	1.250	120	1.040
2	1.250		
4	1.250		
8	1.230		
15	1.210		
30	1.190		
40	1.170		
50	1.140		
60	1.120		
70	1.100		
80	1.090		
90	1.070		
100	1.050		



Start water depth for analysis (mbgl):	1.25		
75% effective depth (mbgl):	1.44	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.63		
25% effective depth (mbgl):	1.81	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.00		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			2.09
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks	Results processed following BRE 365 (2007). Soil practically impermeable as water strike countered infiltration.

Client:	KRS Enviro	**Job No:**
Site:	Green Park, Stablebridge Road, Aylesbury, Buckinghamshire, HP22 5NE	C3630/23/E/5503

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.040	Urban	0.000
SAAR (mm)	694	Region Number	Region 6

Results	l/s
QBAR Rural	0.2
QBAR Urban	0.2
Q100 years	0.6
Q1 year	0.1
Q30 years	0.4
Q100 years	0.6

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.642	0.642	1.9	9.0	O K
30 min Summer	99.779	0.779	1.9	10.9	O K
60 min Summer	99.833	0.833	1.9	11.7	O K
120 min Summer	99.802	0.802	1.9	11.2	O K
180 min Summer	99.744	0.744	1.9	10.4	O K
240 min Summer	99.678	0.678	1.9	9.5	O K
360 min Summer	99.527	0.527	1.9	7.4	O K
480 min Summer	99.403	0.403	1.9	5.6	O K
600 min Summer	99.309	0.309	1.9	4.3	O K
720 min Summer	99.240	0.240	1.9	3.4	O K
960 min Summer	99.154	0.154	1.8	2.2	O K
1440 min Summer	99.088	0.088	1.5	1.2	O K
2160 min Summer	99.063	0.063	1.1	0.9	O K
2880 min Summer	99.052	0.052	0.9	0.7	O K
4320 min Summer	99.042	0.042	0.6	0.6	O K
5760 min Summer	99.037	0.037	0.5	0.5	O K
7200 min Summer	99.033	0.033	0.4	0.5	O K
8640 min Summer	99.030	0.030	0.4	0.4	O K
10080 min Summer	99.028	0.028	0.3	0.4	O K
15 min Winter	99.729	0.729	1.9	10.2	O K
30 min Winter	99.891	0.891	1.9	12.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.514	0.0	10.4	17
30 min Summer	90.826	0.0	13.6	31
60 min Summer	56.713	0.0	17.0	54
120 min Summer	34.204	0.0	20.5	86
180 min Summer	25.103	0.0	22.6	122
240 min Summer	20.035	0.0	24.0	156
360 min Summer	14.542	0.0	26.2	220
480 min Summer	11.583	0.0	27.8	280
600 min Summer	9.702	0.0	29.1	338
720 min Summer	8.391	0.0	30.2	392
960 min Summer	6.667	0.0	32.0	508
1440 min Summer	4.815	0.0	34.7	736
2160 min Summer	3.471	0.0	37.5	1100
2880 min Summer	2.749	0.0	39.6	1468
4320 min Summer	1.977	0.0	42.7	2180
5760 min Summer	1.563	0.0	45.0	2872
7200 min Summer	1.301	0.0	46.8	3664
8640 min Summer	1.120	0.0	48.4	4392
10080 min Summer	0.987	0.0	49.7	4976
15 min Winter	138.514	0.0	11.6	17
30 min Winter	90.826	0.0	15.3	31

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.965	0.965	2.0	13.5	O K
120 min Winter	99.920	0.920	1.9	12.9	O K
180 min Winter	99.834	0.834	1.9	11.7	O K
240 min Winter	99.736	0.736	1.9	10.3	O K
360 min Winter	99.505	0.505	1.9	7.1	O K
480 min Winter	99.327	0.327	1.9	4.6	O K
600 min Winter	99.215	0.215	1.9	3.0	O K
720 min Winter	99.148	0.148	1.8	2.1	O K
960 min Winter	99.089	0.089	1.6	1.2	O K
1440 min Winter	99.063	0.063	1.1	0.9	O K
2160 min Winter	99.049	0.049	0.8	0.7	O K
2880 min Winter	99.042	0.042	0.6	0.6	O K
4320 min Winter	99.035	0.035	0.5	0.5	O K
5760 min Winter	99.031	0.031	0.4	0.4	O K
7200 min Winter	99.028	0.028	0.3	0.4	O K
8640 min Winter	99.025	0.025	0.3	0.4	O K
10080 min Winter	99.024	0.024	0.2	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	56.713	0.0	19.0	58
120 min Winter	34.204	0.0	23.0	92
180 min Winter	25.103	0.0	25.3	132
240 min Winter	20.035	0.0	26.9	170
360 min Winter	14.542	0.0	29.3	236
480 min Winter	11.583	0.0	31.1	292
600 min Winter	9.702	0.0	32.6	344
720 min Winter	8.391	0.0	33.8	396
960 min Winter	6.667	0.0	35.8	498
1440 min Winter	4.815	0.0	38.8	734
2160 min Winter	3.471	0.0	42.0	1100
2880 min Winter	2.749	0.0	44.3	1460
4320 min Winter	1.977	0.0	47.8	2188
5760 min Winter	1.563	0.0	50.4	2944
7200 min Winter	1.301	0.0	52.5	3584
8640 min Winter	1.120	0.0	54.2	4240
10080 min Winter	0.987	0.0	55.7	5032

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.403	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.040

Time (mins) From:	To:	Area (ha)
0	4	0.040

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	14.0	1.000	14.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

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