W121 – Land North of Tuttles Lane East, Wymondham,
Norfolk Flooding and Surface Water Management Note
Welbeck Strategic Land III Limited
March 2018

Introduction

This note has been prepared to support the allocation of Land North of Tuttles Lane East, Wymondham.

This review takes account of the National Planning Policy Framework (NPPF) and its associated planning practice guidance and the definitions of sources of flooding within the Flood and Water Management Act (FWMA) 2010.

Information to inform this note has been obtained from the following sources:

- Various sources of mapping;
- Anglian Water (AW) sewer plans and liaison with AW;
- The Norfolk County Council Preliminary Flood Risk Assessment (PFRA); and
- A site visit.

The site is approximately centred on OS grid reference 611696, 303159 and extends to approximately 55.0 ha. The majority of the site is currently undeveloped agricultural land.

An unnamed tributary of the River Tiffey flows through the eastern area of the site. The watercourse flows in a predominantly north-westerly direction from the south-east corner of the site.

Ordnance Survey contours show ground levels falling from the east and west toward the aforementioned watercourse.

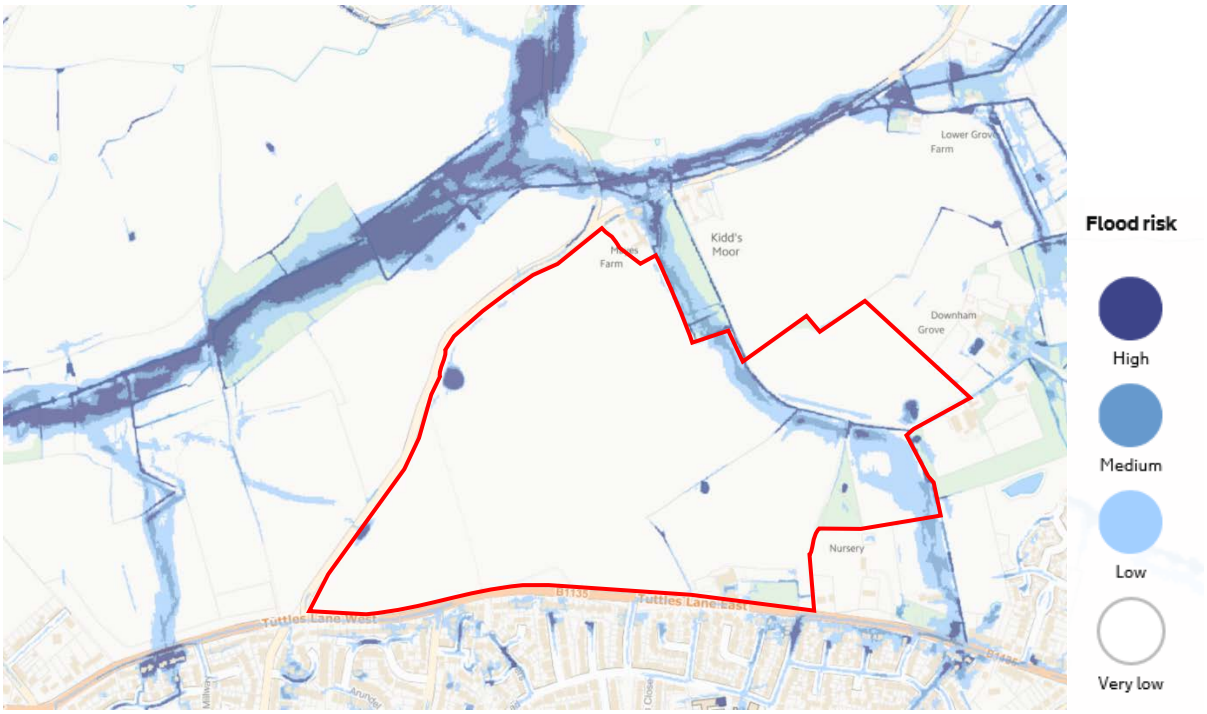
Sources of Flooding

GOV.UK flood mapping shows the entire site as Flood Zone 1 (the low probability flood area). The site is not therefore considered to be exposed to flooding as the result of overtopping of a Main River or other significantly sized watercourse.

Surface water flood mapping indicates areas where surface water runoff may pool and flow during and following various rainfall events. There are four bands of surface water flooding:

- High (indicates an area with greater than a 1 in 30 chance of flooding);
- Medium (indicates between a 1 in 30 and 1 in 100 chance of flooding);
- Low (indicates between a 1 in 100 and 1 in 1,000 chance of flooding); and
- Very Low (covers all other land i.e. less than a 1 in 1,000 chance of flooding).

The mapping (refer to extract provided below) shows that the majority of the site is located in the Very Low flood risk area. There are localised areas of surface water flooding associated with the watercourse in the east of the site and also a number of isolated areas of flooding within the site.



Extract of the surface water flooding map, source GOV.UK website (Feb 2018)
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The impact of surface water flooding on the proposed residential units should be readily manageable through appropriate masterplanning that makes space in the layout for water (allowing for low impact flood routes along landscaped corridors for example).

British Geological Survey (BGS) borehole records and mapping shows that the site is underlain by Boulder Clay with Chalk at depth. Groundwater flooding (flooding resulting from the emergence of a groundwater body at the surface of the site) is therefore not considered a realistic threat.

AW sewer plans (appended) show a network of surface water sewers which serve the development to the south of the site, and outfall to the watercourse which runs through the site. The land to the south of the site slopes down towards the site. Floodwater arising from any overloading of the network could potentially be directed towards Tuttles Lane. Any such flows would tend to be directed east and west along/within Tuttles Lane rather than directly onto the site. Any flows which were able to enter onto the site (via the creation of new access roads) would tend to be managed within the on-site road network (rather than affecting the proposed housing etc). Sewer flooding is not therefore considered a significant or unmanageable threat for the proposed development.

The site does not lie in a reservoir inundation zone and there are no lakes or canals in the vicinity of the site.

In light of the findings there are not considered to be any flood risk related reasons why the site could not be developed in line with current guidance on flood risk and development.

Surface Water Management

BGS mapping shows that the site is underlain by superficial deposits of the Lowestoft Formation (Diamicton) and bedrock geology of the Lewes Nodular Chalk Formation. The BGS report shows that the ground conditions across the site have a low to moderate permeability potential. Later stage intrusive ground investigations and site-specific infiltration testing may identify areas of the site where infiltration drainage techniques can be used.

However, for the purposes of securing sufficient space for surface water in the emerging layout an attenuated discharge from the site to the local watercourse has been assumed. Surface water runoff from the proposed development would be managed via on-site attenuation (sized for the 1 in 100 annual probability storm plus an appropriate climate change allowance). Currently it is proposed that flows would be discharged at the mean annual greenfield runoff rate (Q_{BAR}) of 3.2 l/s/ha.

Drawing number W121 – 300 (appended) shows an outline attenuation strategy assuming 1 m deep grassed basins with 1 in 4 side slopes. The attenuation has been sized assuming that approximately 50 % of the site area becomes impermeable (i.e. provision roads, roofs, hard landscaping etc).

Appended Information

Anglian Water Sewer plans
BGS Infiltration SuDS GeoReport
CCE drawing number W121 - 300

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Date: 17/01/18

Scale: 1:1250

Map Centre: 611667,303054

Data updated: 01/10/17

Our Ref: 249464 - 1

Wastewater Plan A0

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2018 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

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Wymondham

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0502	611065	302581	F	-	-	-
0503	611077	302574	F	-	-	-
0504	612072	302587	F	44.69	42.87	1.82
0505	612035	302581	F	45.37	43.98	1.39
0506	612003	302578	F	45.8	44.31	1.49
0601	611020	302607	F	45.81	43.85	1.96
0601	612027	302697	F	43.98	41.97	2.01
0602	610998	302689	F	46.26	42.87	3.39
0602	612079	302693	F	43.83	41.87	1.96
0603	611025	302684	F	45.58	43.14	2.44
0603	612099	302690	F	43.48	41.57	1.91
0604	611048	302673	F	45.27	43.38	1.89
0604	612021	302654	F	-	-	-
0605	611072	302684	F	45.41	43.55	1.86
0701	611006	302738	F	45.15	42.42	2.73
0701	612015	302700	F	44.41	42.45	1.96
0702	611024	302778	F	44.47	42.09	2.38
0702	612064	302787	F	44.25	42.04	2.21
0703	611022	302788	F	44.84	42.33	2.51
0703	612031	302779	F	-	-	-
0704	611064	302793	F	44.67	42.44	2.23
0705	611081	302707	F	45.59	43.79	1.8
0706	611076	302725	F	45.8	44.14	1.66
0707	611018	302796	F	-	-	-
0800	611075	302805	F	-	-	-
1502	612185	302571	F	43.93	41.66	2.27
1503	612195	302590	F	43.88	41.55	2.33
1504	612112	302594	F	44.53	43.35	1.18
1504	611129	302590	F	-	-	-
1601	611188	302638	F	46.72	45.2	1.52
1601	612156	302684	F	43.59	41.38	2.21
1602	611135	302658	F	46.49	44.85	1.64
1602	612188	302680	F	43.68	41.27	2.41
1603	612201	302699	F	43.59	41.85	1.74
1701	612134	302780	F	43.57	41.51	2.06
1701	611145	302719	F	46.58	44.45	2.13
1702	611133	302748	F	46.57	44.76	1.81
1703	611169	302747	F	46.43	44.23	2.2
1704	611157	302795	F	45.84	42.83	3.01
1800	611191	302801	F	-	-	-
2504	611283	302591	F	48.36	46.25	2.11
2505	611206	302583	F	-	-	-
2601	612232	302635	F	43.88	41.43	2.45
2601	611206	302616	F	46.94	45.74	1.2
2602	611227	302693	F	47.33	44.28	3.05
2602	612248	302651	F	43.46	41.1	2.36
2603	611298	302677	F	47.95	44.9	3.05
2603	612271	302680	F	43.33	40.97	2.36
2604	611292	302629	F	48.13	45.69	2.44
2604	612281	302691	F	42.93	-	-
2605	612285	302699	F	42.93	40.72	2.21
2606	612206	302678	F	43.6	41.19	2.41
2607	612224	302670	F	43.5	-	2.41
2608	612288	302645	F	43.37	41.74	1.63
2701	612232	302756	F	42.92	-	-
2701	611220	302746	F	46.46	43.85	2.61
2702	612216	302763	F	43.1	40.94	2.16
2702	611258	302754	F	46.5	43.53	2.97
2703	611255	302797	F	47.25	43.22	4.03
2703	612289	302735	F	-	-	-
2800	611244	302805	F	-	-	-
3601	611389	302643	F	48.1	45.64	2.46
3601	612304	302604	F	43.64	42.38	1.26
3602	611376	302691	F	47.29	45.71	1.58
3701	611322	302730	F	47.12	45.65	1.47
3701	612381	302724	F	43.13	40.64	2.49
3702	611354	302727	F	47.09	45.23	1.86
3702	612336	302738	F	42.81	40.3	2.51
3703	611368	302725	F	47.21	45.06	2.15
3704	611366	302703	F	47.36	45.36	2
3706	611361	302786	F	-	-	-
3707	611386	302727	F	47.2	44.9	2.3
3708	611390	302756	F	47.24	44.7	2.54
3801	611327	302806	F	47.07	43.46	3.61
4503	611439	302585	F	48.71	46.9	1.81
4504	611495	302582	F	48.46	47.06	1.4
4505	611487	302598	F	48.3	46.76	1.54
4601	611463	302623	F	48.19	46.17	2.02
4602	611498	302647	F	47.95	45.46	2.49
4603	611409	302670	F	47.35	45.36	1.99
4604	611440	302677	F	47.61	45.14	2.47
4605	611479	302694	F	47.57	45.11	2.46
4701	611462	302705	F	47.39	44.83	2.56
4702	611444	302726	F	47.35	44.75	2.6
4703	611442	302729	F	47.3	44.78	2.52
4704	611422	302754	F	47.41	44.6	2.81
4705	611403	302772	F	47.12	44.4	2.72
4706	611416	302786	F	47.23	44.16	3.07
4707	611461	302743	F	47.63	45.18	2.45
4708	611476	302752	F	47.67	45.32	2.35
4709	611479	302774	F	47.72	45.61	2.11
4801	611411	302832	F	47.38	43.87	3.51
4802	611416	302854	F	-	-	-
5601	611567	302597	F	48.63	47.22	1.41
5602	611526	302655	F	48.08	47.02	1.06
5603	611540	302661	F	48.14	46.58	1.56
5604	611548	302686	F	48.06	46.8	1.26
5701	611544	302700	F	48	46.64	1.36
5702	611532	302794	F	47.23	45.67	1.56
5801	611508	302838	F	47.59	44.13	3.46
5802	611599	302829	F	47.69	44.48	3.21
5803	611538	302853	F	-	-	-
6501	611644	302578	F	48.52	46.08	2.44
6601	611638	302605	F	48.67	-	-
6602	611629	302684	F	48.3	45.59	2.71
6603	611678	302693	F	48.08	45.32	2.76
6701	611613	302701	F	48.22	46.51	1.71
6702	611608	302787	F	47.53	45.27	2.26
6703	611649	302785	F	47.36	44.95	2.41
6704	611678	302720	F	47.84	45.18	2.66
6801	611652	302816	F	47.17	44.71	2.46
6802	611686	302809	F	47.09	44.83	2.26
7502	611717	302592	F	48.3	46.79	1.51
7601	611724	302683	F	47.91	45.65	2.26
7602	611793	302678	F	47.31	45.2	2.11
7800	611704	302819	F	-	45.7	-
7801	611776	302834	F	-	-	-
8601	611860	302662	F	46.53	44.42	2.11
8801	611807	302815	F	46.41	44.75	1.66
8802	611894	302808	F	45.69	43.98	1.71
9601	610981	302604	F	47.18	45.84	1.34
9601	611948	302607	F	45.92	44.34	1.58
9602	610988	302610	F	46.74	43.46	3.28
9602	611953	302620	F	45.93	44.24	1.69
9603	610996	302674	F	45.43	42.99	2.44
9603	611953	302632	F	45.89	-	-
9604	610977	302645	F	46.86	44.52	2.34
9604	611903	302652	F	46.13	44.62	1.51
9605	610952	302652	F	45.63	43.85	1.78
9605	611971	302669	F	45.42	44.06	1.36
9606	610938	302693	F	44.6	42.67	1.93
9701	611984	302708	F	43.83	42.88	0.95
9703	610969	302780	F	43.71	40.95	2.76
9801	611957	302800	F	44.86	42.75	2.11
0557	612071	302592	S	44.65	43.44	1.21
0651	611022	302609	S	45.83	44.52	1.31
0651	612018	302653	S	44.51	43.35	1.16
0652	610998	302674	S	45.38	43.7	1.68
0652	612025	302696	S	44.36	42.75	1.61
0653	610999	302688	S	46.26	43.62	2.64
0653	612051	302694	S	44.08	42.37	1.71
0654	611023	302683	S	45.58	43.76	1.82
0654	612083	302690	S	43.98	42.32	1.66
0655	611047	302672	S	45.38	44.06	1.32
0656	611073	302682	S	45.4	44.24	1.16
0751	611008	302739	S	45.1	43.25	1.85
0751	612062	302741	S	43.84	42.83	1.01
0752	611027	302775	S	44.45	42.77	1.68
0752	612004	302797	S	44.74	42.88	1.86
0753	611031	302787	S	-	-	-
0754	611087	302790	S	-	-	-
0755	611029	302780	S	-	-	-
0756	611084	302707	S	45.45	44.44	1.01
0757	611078	302727	S	45.85	44.59	1.26
0851	611053	302812	S	-	-	-
1552	612185	302573	S	43.95	41.84	2.11
1553	612193	302590	S	43.9	41.84	2.06
1651	611188	302641	S	-	-	-
1651	612101	302687	S	43.83	42.12	1.71
1652	611140	302662	S	-	-	-
1652	612129	302686	S	43.71	42	1.71
1751	611148	302710	S	-	-	-
1751	612135	302730	S	43.35	42.49	0.86
1752	611155	302744	S	-	-	-
1752	612162	302778	S	43.39	42.13	1.26
1753	611119	302745	S	-	-	-
1754	611116	302789	S	-	-	-
1755	611154	302789	S	-	-	-
1756	611188	302745	S	-	-	-
2651	611295	302679	S	-	-	-
2651	612227	302634	S	43.47	41.41	2.06
2652	611250	302681	S	-	-	-
2652	612244	302652	S	43.3	41.29	2.01
2653	612234	302660	S	43.54	41.38	2.16
2653	611203	302625	S	-	-	-
2654	612221	302670	S	43.6	41.51	2.09
2655	612204	302676	S	43.69	41.68	2.01
2656	612293	302646	S	43.42	42.05	1.37
2657	612266	302674	S	43.21	41.21	2
2658	612279	302691	S	43.01	41.15	1.86
2659	612204	302693	S	43.57	42.36	1.21
2660	612266	302670	S	43.225	41.265	1.96
2661	612290	302646	S	43.405	41.325	2.08
2751	612283	302702	S	42.95	41.09	1.86
2752	611265	302799	S	-	-	-
2753	611272	302789	S	-	-	-
2753	612239	302763	S	-	-	-
2754	611231	302707	S	-	-	-
2754	612211	302710	S	43.43	41.67	1.76
2755	611211	302740	S	-	-	-
2755	612285	302719	S	42.81	-	1.66
2851	611286	302806	S	-	-	-
3051	612391	303022	S	-	-	-
3551	612305	302603	S	43.685	41.445	2.24
3552	612311	302586	S	43.795	41.575	2.22
3651	611386	302624	S	48	47.11	0.89
3651	612309	302673	S	-	-	-
3652	611372	302619	S	48.03	47.24	0.79
3751	612349	302723	S	-	-	-
3752	611328	302794	S	47.26	45.4	1.86
3752	612323	302733	S	-	-	-
3753	611366	302790	S	46.9	45.65	1.25
3753	612304	302740	S	-	-	-
3754	611375	302793	S	47.01	45.72	1.29
3755	611319	302727	S	47.14	46.18	0.96
3756	611358	302724	S	47.1	45.78	1.32
3757	611376	302723	S	47.31	45.92	1.39
3758	611391	302699	S	47.28	46.04	1.24
3851	611342	302804	S	47.33	45.52	1.81
4552	611438	302587	S	48.64	47.36	1.28
4553	611483	302597	S	48.3	47.29	1.01
4651	611459	302622	S	48.18	46.92	1.26
4652	611494	302648	S	47.91	46.73	1.18
4653	611477	302691	S	47.5	46.49	1.01
4654	611402	302691	S	47.2	46.1	1.1
4655	611404	302670	S	47.31	46.35	0.96
4657	611409	302662	S	47.62	46.41	1.21
4658	611437	302674	S	-	-	-
4751	611442	302734	S	47.5	46.09	1.41
4752	611461	302745	S	47.6	46.39	1.21
4753	611473	302753	S	47.68	46.67	1.01
4754	611477	302773	S	47.8	46.63	1.17
4755	611403	302777	S	47.5	45.87	1.63
4851	611408	302807	S	47.24	46.07	1.17
5557	611569	302596	S	48.62	47.51	1.11
5651	611524	302655	S	48.06	47.15	0.91
5652	611540	302662	S	48.16	46.95	1.21
5653	611550	302688	S	48.06	-	-
5751	611545	302702	S	47.98	46.87	1.11
5752	611534	302791	S	47.26	46.05	1.21
5753	611581	302712	S	48.2	46.89	1.31
5754	611579	302749	S	48.05	46.34	1.71
5755	611587	302787	S	47.66	45.85	1.81
5851	611570	302835	S	-	-	-
6552	611680	302588	S	47.78	46.32	1.46
6553	611678	302599	S	47.71	46.1	1.61
6554	611686	302585	S	48.84	47.48	1.36
6555	611687	302599	S	48.75	47.19	1.56
6651	611614	302699	S	48.2	46.74	1.46
6652	611631	302686	S	48.3	46.29	2.01
6653	611661	302691	S	48.13	46.02	2.11
6654	611680	302695	S	48.03	45.82	2.21
6655	611695	302691	S	48.04	-	-
6751	611645	302704	S	48.52	46.91	1.61
6752	611645	302749	S	48.01	46.35	1.66
6753	611650	302780	S	47.36	45.7	1.66
6754	611611	302784	S	47.52	45.76	1.76
6755	611680	302725	S	47.79	45.73	2.06
6851	611613	302841	S	-	-	-
6852	611655	302820	S	-	-	-
6853	611685	302815	S	-	-	-
7551	611717	302579	S	48.37	47.26	1.11
7552	611718	302593	S	48.28	47.07	1.21
7553	611751	302577	S	48.15	47.14	1.01
7651	611752	302603	S	48.03	46.87	1.16
7652	611755	302678	S	47.8	46.24	1.56
7653	611726	302685	S	47.91	46	1.91
7654	611794	302679	S	47.3	45.39	1.91
7751	611799	302738	S	46.89	45.78	1.11
7752	611766	302742	S	47.14	46.23	0.91
7753	611743	302752	S	46.97	45.96	1.01
7754	611742	302778	S	46.71	45.9	0.81
7755	611748	302778	S	46.65	45.69	0.96
7851	611799	302800	S	-	-	-
7852	611755	302808	S	-	-	-
8651	611802	302677	S	47.21	45.35	1.86
8652	611858	302664	S	46.6	45.04	1.56
8751	611804	302705	S	47.08	45.77	1.31
8752	611871	302725	S	45.96	44.59	1.37
8753	611876	302779	S	45.81	44.2	1.61
8754	611810	302783	S	46.54	45.33	1.21
8851	611890	302800	S	-	-	-
8852	611804	302819	S	-	-	-
8853	611800	302828	S	-	-	-
9651	610976	302646	S	46.77	44.76	2.01
9651	611944	302606	S	46.04	43.97	2.07
9652	610950	302653	S	45.63	44.03	1.6
9652	611948	302620	S	45.92	43.91	2.01
9653	611953	302635	S	45.61	43.75	1.86
9654	610990	302611	S	46.61	44.38	2.23
9654	611905	302652	S	46.08	44.77	1.31
9655	611970	302672	S	45.26	43.5	1.76
9656	611920	302692	S	45.8	44.49	1.31
9751	611989	302731	S	-	-	-
9752	611933	302732	S	45.44	44.23	1.21
9753	611906	302712	S	45.75	44.92	0.83
9754	611942	302773	S	45.08	43.72	1.36
9755	611970	302791	S	44.66	43.55	1.11

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James Howard
34
CB7 5NQ

Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: *GR_217855/1*

Client reference:

British Geological Survey
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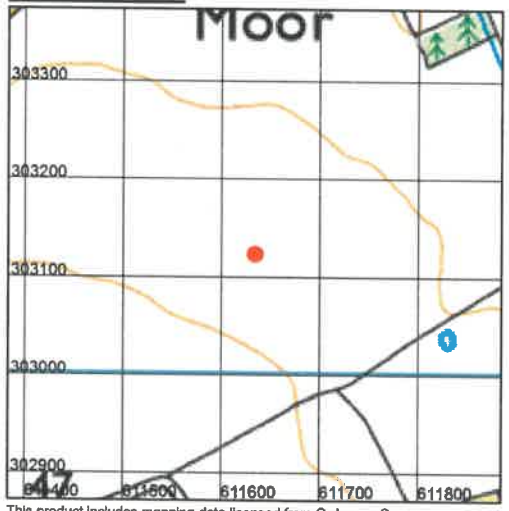
Search location



Point centred at:
611634,303123

Search location indicated in red

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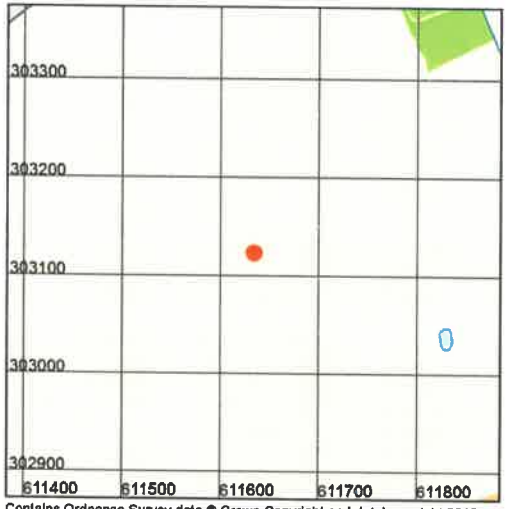
Scale: 1:5 000 (1cm = 50 m)



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Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data.**

  Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data.**

  Comprises a further 24 maps in four thematic sections:

  - **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
  - **Drainage potential.** Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
  - **Ground stability.** Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
  - **Groundwater protection.** Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

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This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed*' national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed*', available from http://nora.nerc.ac.uk/16618/.

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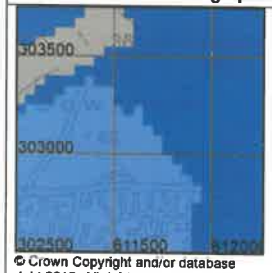
PART 1: SUMMARY DATA

This section provides a summary of the data on the following pages.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



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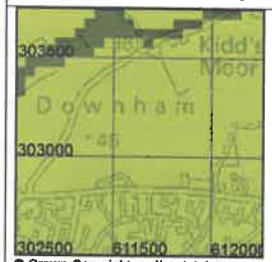
- Highly compatible for infiltration SuDS.
  The subsurface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS.
  The subsurface is probably suitable although the design may be influenced by the ground conditions.
- Opportunities for bespoke infiltration SuDS.
  The subsurface is potentially suitable although the design will be influenced by the ground conditions.
- Very significant constraints are indicated.
  There is a very significant potential for one or more hazards associated with infiltration.

Is ground instability likely to be a problem?



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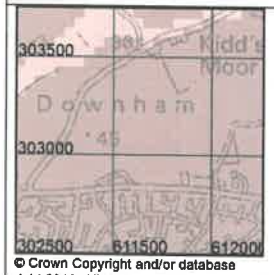
- Increased infiltration is very unlikely to result in ground instability.
- Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability
- Ground instability problems are probably present. Increased infiltration may result in ground instability.
- There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



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- The groundwater is not expected to be especially vulnerable to contamination.
- The groundwater may be vulnerable to contamination.
- The groundwater is likely to be vulnerable to contaminants.
- Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

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PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

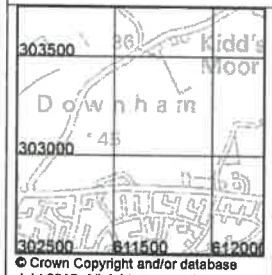
Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard



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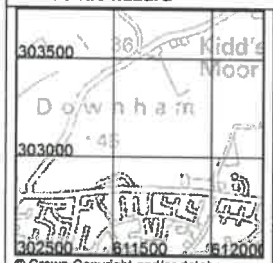
- Very significant soluble rock hazard.
  Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.
- Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard



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- Very significant landslide hazard.
  Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.
- Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

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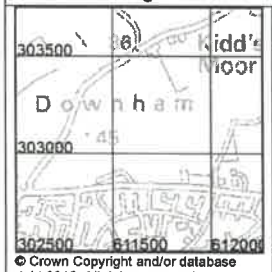
Shallow mining hazard



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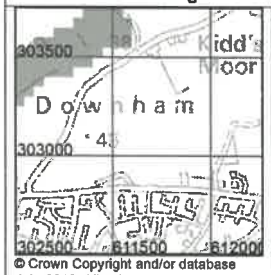
☐ Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater



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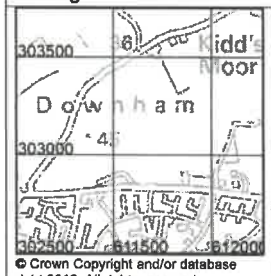
☐ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground



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☐ Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

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Section 2. Drainage potential

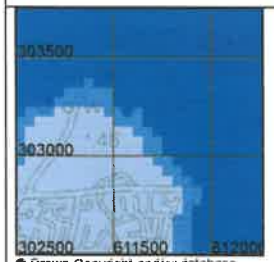
The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table



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Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.

Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.

Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

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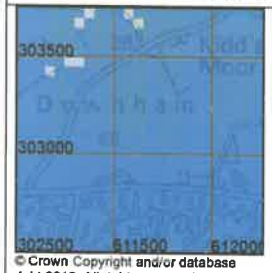
Superficial deposit permeability



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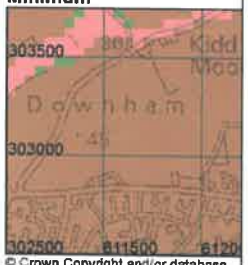
- Superficial deposits are likely to be **free-draining**.
- The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.
- Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

- Very Low
- Low
- Moderate
- High
- Very High

Minimum



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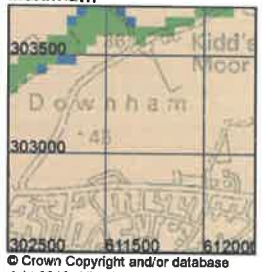
Maximum



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Superficial deposit thickness

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- The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).
- The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

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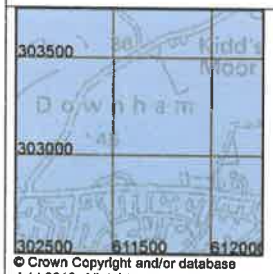
Bedrock permeability



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- Bedrock deposits are likely to be **free-draining**.
- The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.
- Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

Key

- Very Low
- Low
- Moderate
- High
- Very High

Minimum

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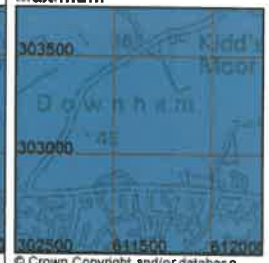
Maximum



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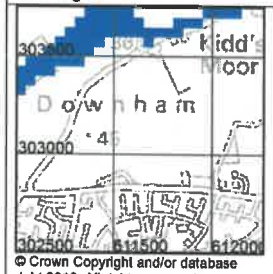
Geological indicators of flooding



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- Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

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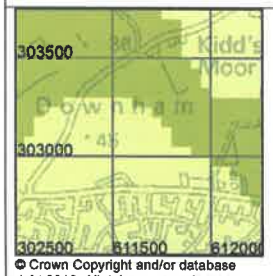
Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks



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- Increased infiltration is unlikely to result in subsidence.
- Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
- Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
- Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

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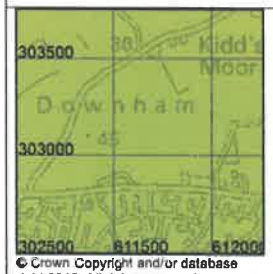
Landslides



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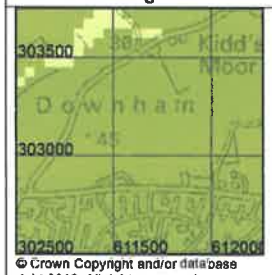
- Increased infiltration is unlikely to lead to slope instability.
- Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
- Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
- Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining



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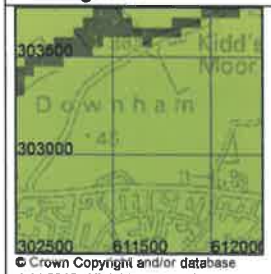
- Increased infiltration is unlikely to lead to subsidence.
- Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
- Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



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- Increased infiltration is unlikely to cause ground collapse associated with running sands.
- Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

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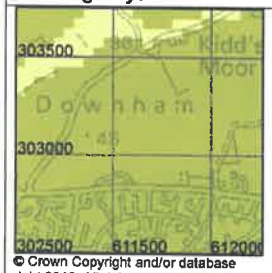
Swelling clays



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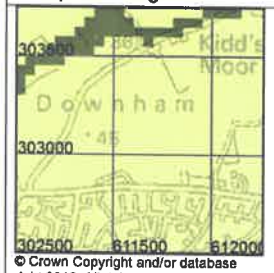
- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



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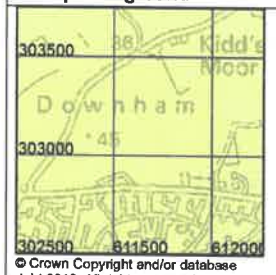
- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



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- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

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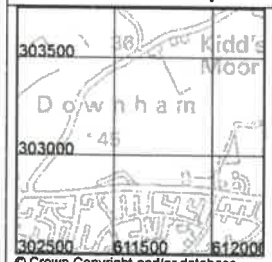
Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

For more information read 'Explanation of terms' at the end of this report.

Groundwater source protection zones



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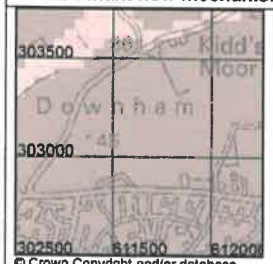
Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2018.

- Groundwater is not within a source protection zone.
- Source protection zone IV
- Source protection zone III
- Source protection zone II
- Source protection zone I.

Predominant flow mechanism



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- Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
- Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

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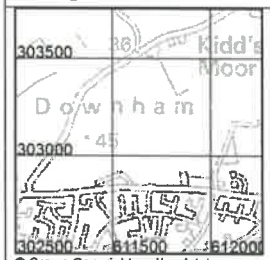
Made ground	
 © Crown Copyright and/or database right 2018. All rights reserved. Licence number 100021290 EUL	Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

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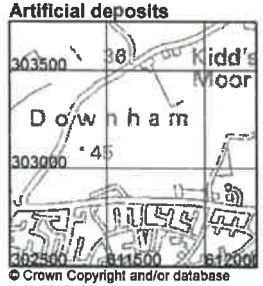
Section 5. Geological Maps

The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



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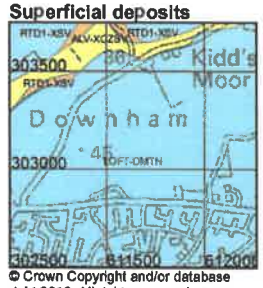
Superficial deposits



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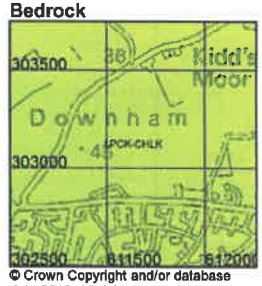
Bedrock



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Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:
No deposits recorded by BGS in the search area

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
	LOFT-DMTN	LOWESTOFT FORMATION	DIAMICTON
	RTD1-XSV	RIVER TERRACE DEPOSITS, 1	SAND AND GRAVEL

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Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	LPCK-CHLK	LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION (UNDIFFERENTIATED)	CHALK

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Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
    - previous land use,
    - potential for, or presence of contaminated land
    - presence of perched water tables
    - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
    - made ground, where not recorded
    - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
    - zones around private water supply boreholes that are susceptible to groundwater contamination.
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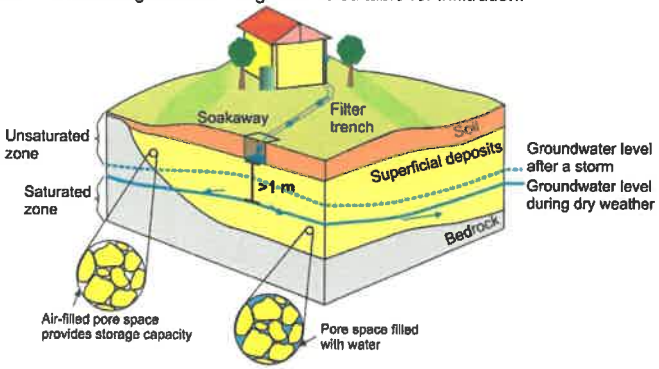
Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

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Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

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Natural ground instability
Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell
A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)
A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)
Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

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Compressible ground
Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits
Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand
Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)
Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

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For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk. For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

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- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

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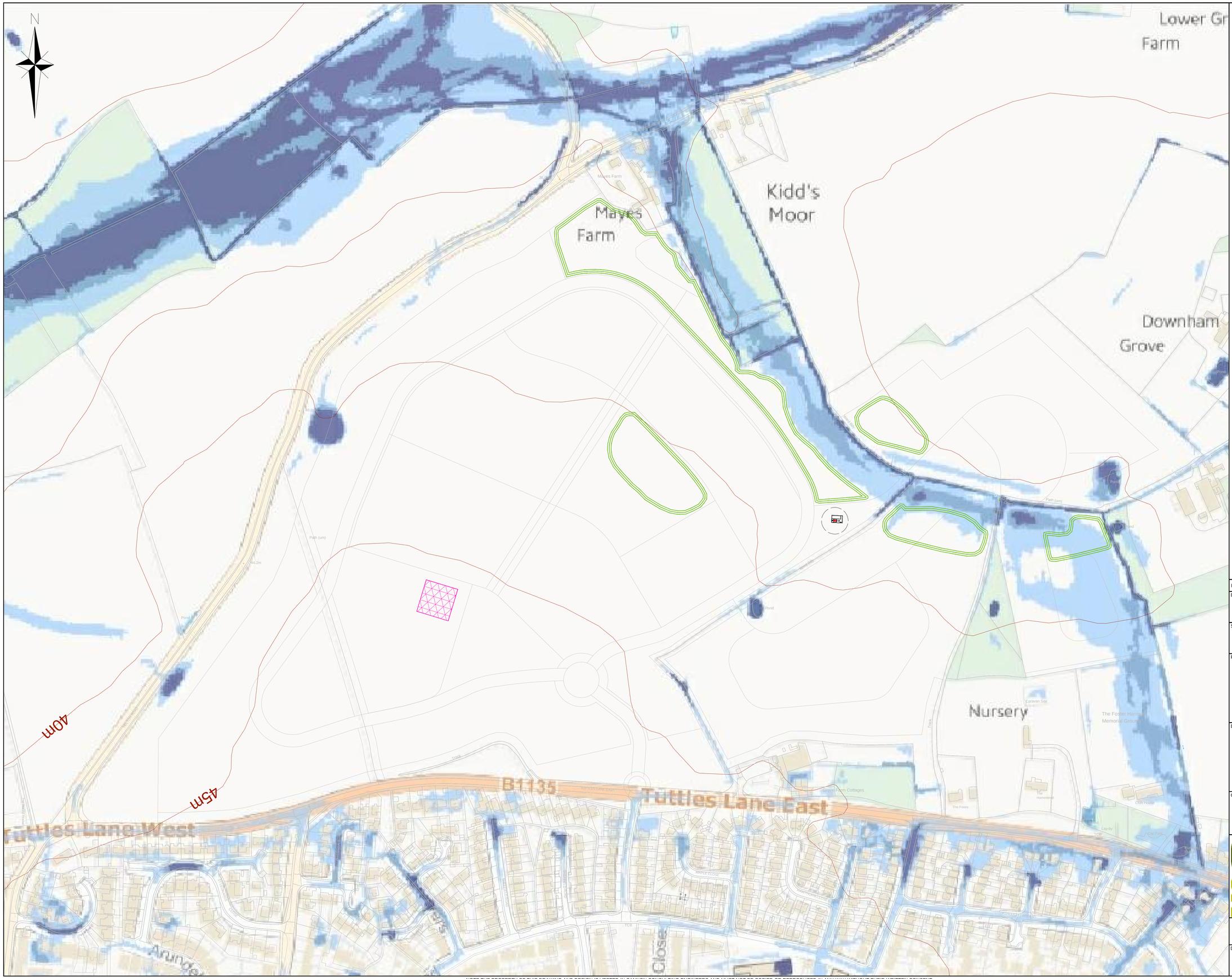

KEY:

- INDICATIVE WASTWATER PUMPING STATION
- INDICATIVE SW ATTENUATION BASIN
- INDICATIVE CELLULAR STORAGE CRATES

EXTENT OF SW FLOODING

- HIGH PROBABILITY
- MEDIUM PROBABILITY
- LOW PROBABILITY

REV	DESCRIPTION	DE	DR	CH	PA	DATE

DESIGNED BY	DRAWN BY	CHECKED BY	PASSED BY
-	DP	-	-

SCALES @ A1 SIZE	DATE	ISSUE STATUS
D.N.S.	21/02/2018	PLANNING

PROJECT TITLE

LAND OFF TUTTLES LANE, WYMONDHAM

DRAWING TITLE

CONSTRAINTS AND OPPORTUNITIES PLAN

CLIENT

WELBECK STRATEGIC LAND III LTD

CANNON CONSULTING ENGINEERS
Highways, Transport & Infrastructure Planning

Cannon Consulting Engineers
Cambridge House, Kentford, Newmarket, Cambs, CB8 7PN
Tel: +44 (0)1638 555 107
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