SOILS AND AGRICULTURAL QUALITY OF LAND AFFECTED BY OXFORD FLOOD ATTENUATION SCHEME

Report 1345/1

1st March, 2018

Land Research ASSOCIATES

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OF LAND AFFECTED BY OXFORD FLOOD ATTENUATION SCHEME

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Report 1345/1
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SUMMARY

This report provides information on the soils and agricultural quality of land affected by the Oxford Flood Attenuation Scheme.

The land is mainly located on a floodplain and has heavy soils with poor drainage, which give subgrade 3b agricultural quality land, limited by wetness and flood risk. An area of higher ground west of the A34 has shallow soils over limestone, which give subgrade 3b land due to droughtiness limitations.

Care is required to avoid compaction damage to topsoils and subsoils during soil stripping and construction, particularly under wet conditions.

1.0 Introduction

1.1 This report provides information on the soils and agricultural quality of land west of Oxford which will form the site of the Oxford Flood Attenuation Scheme (OFAS).

SITE ENVIRONMENT

1.2 The land investigated comprises a corridor of land adjacent to Hinksey Stream (the route of the attenuation scheme), plus fields in the vicinity proposed for habitat creation. The land is mainly level, at an approximate elevation of 55 m AOD. A parcel of land to the west of the A34 is on higher sloping ground, at an average elevation of approximately 85 m AOD.

AGRICULTURAL USE

1.3 The agricultural land is all under long term pasture and silage meadow.

1.4 The land is registered under an Entry Level Plus Higher Level Stewardship Agreement as part of a wider holding.

PUBLISHED INFORMATION

1.5 1:50,000 scale BGS information records the main area of the site to be underlain by river alluvium with occasional patches of Northmoor Member sands and gravels. The small western part of the site (west of the A34) is shown to be underlain by Oxford Clay in the east and Kingston Formation sandstone in the west.

1.6 The National Soil Map (published at 1:250,000 scale) shows the main body of the site as belonging to the Thames Soil Association, comprising stoneless clayey soils formed in river alluvium. The western part of the site (west of the A34) is shown as belonging to the Denchworth and Elmton 1 Soil Associations, comprising slowly permeable clayey soils and shallow calcareous soils over limestone, respectively[1].

1.7 Provisional Agricultural Land Classification mapping shows the main body of the site as grade 4, with grade 3 west of the A34. No more detailed survey of the site has been published.

[1] Jarvis, M. G., *et al*., (1984). *Soils and their use in South East England,* Soil Survey of England and Wales. Bulletin No. 15, Harpenden.

2.0 Soils

2.1 The National Planning Practice Guidance states that the planning system should protect and enhance valued soils and prevent the adverse effects of unacceptable levels of pollution. This is because soil is an essential finite resource that provides important ecosystem services, for example as a growing medium for food, timber and other crops, as a store for carbon and water, as a reservoir of biodiversity and as a buffer against pollution.

2.2 A detailed soil resource and agricultural quality survey was carried out in October and November 2017. It was based on observations at intersects of a 100 m grid, giving a sampling density of one observation per hectare. During the survey, soils were examined by a combination of pits and augerings to a maximum depth of 1.0 m. A log of the sampling points and a map (Map 1) showing their location is in an appendix to this report.

Heavy alluvial soils

2.3 The main site is located on clayey floodplain alluvium over sands and gravels. The soils associated with this land have variably calcareous heavy silty clay loam or silty clay topsoil, sometimes peaty where in wetter locations. The upper subsoils are clay-textured, poorly structured (dense) and slowly permeable. The depth to the underlying gravel varies, but it is mainly at depths of over 80 cm below the land surface.

2.4 An example deeper clay profile is described below from a soil description pit at observation 52 (Map 1).

0-30 cm	Very dark greyish brown (10YR 3/2) heavy silty clay loam; weakly developed coarse subangular blocky structure; firm; very slightly stony with a few small and medium hard angular mixed stones; very calcareous; clear smooth boundary to:
30-100+ cm	Grey (N5) silty clay with many medium strong brown (7.5YR 4/6) and common fine light grey (N7) mottles; weakly developed coarse angular blocky structure becoming massive with depth; firm becoming plastic with depth; stoneless; very calcareous.

2.5 These soils are mainly poorly-draining (Wetness Class IV) and have a low capacity to absorb excess winter rainfall.

3.0 Agricultural land quality

3.1 To assist in assessing land quality, the Ministry of Agriculture, Fisheries and Food (MAFF) developed a method for classifying agricultural land by grade according to the extent to which physical or chemical characteristics impose long-term limitations on agricultural use for food production. The MAFF Agricultural Land Classification (ALC) system classifies land into five grades numbered 1 to 5, with grade 3 divided into two subgrades (3a and 3b). The system was devised and introduced in the 1960s and revised in 1988.

3.2 The agricultural climate is an important factor in assessing the agricultural quality of land and has been calculated using the Climatological Data for Agricultural Land Classification[2]. The relevant site data for an average elevation of 55 m is given below.

• Average annual rainfall:	642 mm
• January-June accumulated temperature >0°C	1451 day°
• Field capacity period (when the soils are fully replete with water)	136 days late Nov–early Apr
• Summer moisture deficits for:	wheat: 111 mm potatoes: 105 mm

3.3 The survey described in the previous section was used in conjunction with the agro-climatic data above to classify the site using the revised guidelines for Agricultural Land Classification issued in 1988 by the Ministry of Agriculture, Fisheries and Food[3]. There are no climatic limitations at this locality.

SURVEY RESULTS

3.4 The agricultural quality of the land is limited by wetness, flooding and droughtiness. Land of grade 3 has been identified.

Subgrade 3b

3.5 This grade accounts for all of the agricultural land at the site. The land dominantly has heavy poorly-draining soils, which will stand wet for long periods in winter and spring. Arable use is mainly limited by wetness to autumn-sown cereal based rotation.

[2]Meteorological Office, (1989).*Climatological Data for Agricultural Land Classification*.
[3]MAFF, (1988).*Agricultural Land Classification for England and Wales: Guidelines and Criteria for Grading the Quality of Agricultural Land*.

3.6 The land is mainly on a flood plain and within a zone of high flooding likelihood. Given the heavy soils and low-lying position of the land, it is likely that occasional winter floods of long duration will affect this land. Flooding is therefore an equal limiting factor for most of the site.

Non Agricultural

3.7 This comprises farm tracks, water courses, and areas of woodland and scrub.

Grade areas

3.8 The boundaries between the different grades of land are shown on Map 3 and the areas occupied by each are shown below.

Table 1: Areas occupied by the different land grades

Grade/subgrade	*Area (ha)*	*% of the agricultural land*	*% of the total land*
Sub-grade 3b	59.5	100	79
Non Agricultural	15.4	-	21
Unsurveyed	43.6	-	-
Total	118.5	100	100

4.0 Soil resources and their use

4.1. As part of the Government's 'Safeguarding our Soils' Strategy, Defra published a code of practice on the sustainable use of soils on construction sites, which can be helpful in design of developments and setting planning conditions. An Environment Agency strategy Soil a Precious Resource: Our strategy for protecting, managing and restoring soil (Environment Agency, 2007) has complementary aims.

Topsoil

4.2. Due to the high clay content of the topsoils they can be difficult to handle with machinery and are highly susceptible to compaction damage when wet. Soil handling would be best performed between late May and early September when the soils are likely to be drier.

Subsoil

4.3. The heavy subsoils are susceptible to compaction during construction activities which could result in restricted rooting depth, increased droughtiness and risk of localised flooding. If compacted during construction subsoils should be loosened before any topsoil is spread on them.

Soil Handling

4.4. Areas not being built over (e.g. environmental buffers and landscape areas) should not be trafficked by construction vehicles as thiswill render the soils impermeable, preventing percolation of rainfall beyond the base of the topsoil, which will quickly become saturated.

4.5. Stripped topsoil should be stored in separate resource bunds no more than 3 m high and kept grassed and free from construction traffic until required for re-use. The Construction Code of Practice for Sustainable Use of Soils on Construction Sites (Defra, 2009) provides guidance on good practice in soil handling.

APPENDIX

MAPS AND DETAILS OF OBSERVATIONS

Land at OFAS: ALC and soil resources survey – Details of observations at each sampling point

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	Depth (cm)	Texture	Stones >20 mm (%)	Depth (cm)	Texture	Mottling	Depth (cm)	Texture	Mottling	(°)	Class	Grade	Main limitation
1	12	HZCL sl ca	<5	12-80+	ZC sl ca	xxx				<1	IV	3b	W
2	60	C ca	<5	60-100+	C (made land)	xxx				<1	IV	3b	W
3	23	C sl ca	<5	23-35	C sl ca	x	35-70	C sl ca	xxx	<1	IV	3b	W
4	Non-agricultural – shrubs and vegetation												
5	Non-agricultural – shrubs and vegetation												
6	22	HZCL	5-10	22-80+	C (disturbed)	xxx				<1	IV	3b	W
7	25	HZCL ca	<5	25-80+	ZC ca	xxx				<1	Non-agricultural		
8	36	HCL	<5	36-85	C sl ca	xxx	85-95+	S & G					
9	Non-agricultural – shrubs and vegetation												
10	Non-agricultural – shrubs and vegetation												
11	16	ZC	<5	16-80+	ZC ca	xxx				<1	IV	3b	W
12	18	HZCL	<5	18-90+	ZC ca	xxx->xxxx				<1	IV	3b	W
13	16	HZCL/ZC	<5	16-80+	ZC	xxx				<1	IV	3b	W
14	25	HZCL ca	<5	25-80+	ZC ca	xxx				<1	IV	3b	W
15	20	HZCL	<5	20-80+	ZC ca	xxx				<1	IV	3b	W
16	18	HZCL	<5	18-80+	ZC ca	xxx				<1	IV	3b	W
17	10	HZCL ca	<5	10-30	HZCL ca	xx	30-80+	ZC ca	xxx	<1	IV	3b	W
18	12	HZCL	<5	12-25	HZCL	x	25-80+	ZC ca	xxx->xxxx	<1	IV	3b	W
19	15	C	<5	15-80+	C	xxx				<1	IV	3b	W
20	12	ZC ca	<5	12-75	ZC ca	xxx	75+	Chalky gravel		<1	IV	3b	W
21	14	HZCL sl ca	<5	14-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
22	12	HZCL ca	<5	12-42	HZCL ca	x	42-80+	HZCL/ZC ca	xxx	<1	III	3a	W
23	10	HZCL ca	<5	10-28	HZCL/ZC ca	xx	28-80+	ZC ca	xxx->xxxx	<1	IV	3b	W
24	20	HZCL/ZC ca	<5	20-72	ZC ca	xxx	72+	Chalky gravel		<1	IV	3b	W
25	27	HCL	5	27-50	S/HCL ca	Disturbed?				<1	-	-	-
26	21	HCL ca	5	21-46	C ca	xxx	46-61 61+	SCL Chalky gravel	xxx	<1	IV	3b	W
27	20	ZC ca	<5	20-80+	ZC ca	xxx				<1	IV	3b	W
28	18	ZC sl ca	<5	18-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
29	14	HZCL	<5	14-110+	ZC	xxx->xxxx				<1	IV	3b	W
30	16	HZCL ca	<5	16-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
31	14	ZC ca	<5	14-58	ZC ca	xxx	58+	Chalky gravel		<1	IV	3b	W
32	14	HZCL	<5	14-80+	ZC	xxx->xxxx				<1	IV	3b	W
33	20	HZCL ca	<5	20-55	ZC ca	xxx	55-70+	Chalky gravel		<1	IV	3b	W
34	21	ZC sl ca	<5	21-80+	ZC ca	xxxx				<1	IV	3b	W
35	18	HZCL ca	<5	18-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
36	20	ZC sl ca	<5	20-80+	ZC sl ca	xxx				<1	IV	3b	W
37	12	HZCL	<5	12-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
38	18	ZC ca	<5	18-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
39	15	ZC	<5	15-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
40													
41	21	HZCL	<5	21-80+	ZC	xxx				<1	IV	3b	W

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	Depth (cm)	Texture	Stones >20 mm (%)	Depth (cm)	Texture	Mottling	Depth (cm)	Texture	Mottling	(°)	Class	Grade	Main limitation
42	20	HZCL	<5	20-80+	ZC ca	xxx				<1	IV	3b	W
43	14	HZCL	<5	14-80+	ZC	xxx				<1	IV	3b	W
44	16	ZC/HZCL ca	<5	16-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
45	12	ZC ca	<5	12-22	ZC ca	xx	22-80+	ZC ca	xxx->xxxx	<1	IV	3b	W
46	18	ZC	<5	18-80+	ZC ca	xxx->xxxx				<1	IV	3b	W
47	16	HZCL	<5	16-100+	ZC ca	xxx				<1	IV	3b	W
48	17	HZCL ex ca	<5	17-100+	ZC ex ca	xxx				<1	IV	3b	W
49	18	MZCL ca	<5	18-45+	SCL/chalk gravel	xxx				<1	-	3b	F
50	30	HZCL	<5	30-80+	ZC ca	xxx				<1	IV	3b	W
51	20	HZCL	<5	20-100+	ZC ca	xxx				<1	IV	3b	W
52	21	(Z)C sl ca	<5	21-44	C	xxx	44-80+	Chalky gravel	xx	<1	IV	3b	W
53	27	HCL v ca	10	27-50	(Z)C v ca	xxx	50-110+	ZC v ca	xxxx	<1	III/IV	3a/b	W
54	20	ZC v ca	<5	20-80	ZC sl ca	xxxx	80-110+	Calc gravel		<1	IV	3b	W
55	18	ZC sl ca	<5	18-70	ZC sl ca	xxxx	70-80+	Calc gravel		<1	IV	3b	W
56	20	ZC sl ca	<5	20-110+	ZC sl ca	xxxx				<1	IV	3b	W
57	26	ZC v sl ca	<5	26-55	C sl st, ca	xxx	55-60+	Calc gravel		<1	IV	3b	W
58	17	HZCL/ZC	<5	17-35	C sl st, ca	xxx	35-110+	ZC	xxxx	<1	IV	3b	W
59	12	HZCL	<5	12-22	ZC sl ca	xxx	22-110+	ZC	xxxx	<1	IV	3b	W
60	8	HZCL sl ca	<5	8-22	ZC ca	xxx	22-75 75-85+	ZC sl ca Calc gravel	xxxx	1	IV	3b	W
61	21	ZC sl ca	<5	21-45	ZC sl ca	xxxx	45-72 72+	ZC sl st Stopped, gravel	xxx	<1	IV	3b	W
62	30	ZC ca	<5	30-50	ZC ca	xxxx	50-110+	ZC	xxxx	<1	IV	3b	W
63	25	ZC v sl ca	<5	25-110+	ZC v sl ca	xxxx				<1	IV	3b	W
64	20	HZCL sl ca	<5	20-50	ZC sl ca	xxxx	50-110+	(Z)C	xxx	<1	IV	3b	W
65	14	HZCL ca	<5	14-45	ZC ca	xxxx	45-110+	ZC	xxxx	<1	IV	3b	W
66	16	HZCL ca	<5	16-110+	ZC ca	xxxx				<1	IV	3b	W
67	22	MZCL	<5	22-80+	C	xxx				<1	IV	3b	W
68	23	HZCL	<5	23-100+	ZC ca	xxx				<1	IV	3b	W
69	22	HZCL	<5	22-100+	ZC	xxx				<1	IV	3b	W
70	16	HZCL	<5	16-80+	C ca	xxx				1	IV	3b	W
71	18	HZCL	<5	18-80+	C ca	xxx				<1	IV	3b	W
72	30	C	<5	30-80+	C	xxx				4	IV	3b	W
73	26	C	<5	26-35	C	xx	35-80+	C	xxx	3	IV	3b	W
74	16	HZCL sl ca	<5	16-80+	ZC ca	xxx				<1	IV	3b	W
75	27	C	<5	27-80+	C ca	xxxx				5	IV	3b	W
76	28	C	<5	28-40	C	x	40-110+	C	xxx	5	III/IV	3b	W
77	17	HZCL	<5	17-67	ZC	xxx	67-100+	Chalky gravek		<1	IV	3b	W
78	17	C	<5	17-80+	ZC	xxx				<1	IV	3b	W
79	22	ZC	<5	22-50+	ZC	xxx				<1	IV	3b	W
80	27	HCL ex ca	10	27-42+	Soft limestone					3	I	3b	D
81	30	SCL	5	30-100+	MSL	x				1	I	3b	T
82	16	C ca	<5	16-100+	C ca	xxx				<1	IV	3b	W
83	23	HZCL	<5	23-90+	ZC	xxx				<1	IV	3b	W
84	30	HCL ex ca	10	30-40+	Soft limestone					3	I	3b	D

Obs	Topsoil			Upper subsoil			Lower subsoil			Slope	Wetness	Agricultural quality	
No	**Depth (cm)**	**Texture**	**Stones >20 mm (%)**	**Depth (cm)**	**Texture**	**Mottling**	**Depth (cm)**	**Texture**	**Mottling**	**(°)**	**Class**	**Grade**	**Main limitation**
85	Non-agricultural – made ground												
86	Non-agricultural – made ground												
87	Non-agricultural – made ground												
88	Non-agricultural – made ground												
89	Non-agricultural – made ground												
90	Non-agricultural – made ground												

Key to table

Mottle intensity:
o unmottled
x few to common rusty root mottles (topsoils)
or a few ochreous mottles (subsoils)
xx common to many ochreous mottles and/or dull structure faces
xxx common to many greyish or pale mottles (gleyed horizon)
xxxx dominantly grey, often with some ochreous mottles (gleyed horizon)

a depth underlined (e.g. 50) indicates the top of a slowly permeable layer
(a wavy underline indicates the top of a layer borderline to slowly permeable)

Texture:
C - clay
ZC - silty clay
SC - sandy clay
CL - clay loam (H-heavy, M-medium)
ZCL - silty clay loam (H-heavy, M-medium)
SCL - sandy clay loam
SZL - sandy silt loam (F-fine, M-medium,C-coarse)
SL - sandy loam (F-fine, M-medium, C-coarse)
LS - loamy sand (F-fine, M-medium, C-coarse)
S - sand (F-fine, M-medium, C-coarse)
P - peat (H-humified, SF-semi-fibrous, F-fibrous)
LP - loamy peat; PL - peaty loam
R - bedrock

Limitations:
W - wetness/workability
D - droughtiness
De - depth
St – stoniness
Sl – slope
F - flooding
T – topography/microrelief

Texture suffixes & prefixes:
ca – calcareous: x-extremely, v-very, sl-slightly
(ca) marginally calcareous
mn - ferrimanganiferous concentrations
gn – greenish, yb – yellowish brown, rb – reddish brown
r – reddish; (v)st – (very) stony; sdst– sandstone;lst - limestone
dist - disturbed soil layer; mdst - mudstone

Client:

ch2m

Project:

Oxford Flood Alleviation Scheme

Title:

Map 1 - Survey observations

Key

- Revised site boundary (Feb 2018)
- Unsurveyed land (no access)
- Auger observation
- Soil observation pit
- Unsurveyed land (added to site since date of survey)

Scale - 1 : 12,500 at A3

Date - 01/13/2018

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Client:

ch2m SM

Project:

Oxford Flood Alleviation Scheme

Title:

Map 2 - Agricultural Land Classification

Key

- Project areas
- Unsurveyed land (no access)
- Subgrade 3b land
- Non-agricultural land
- Unsurveyed land (added to site since date of survey)

Scale - 1 : 12,500 at A3

Date - 01/03/2018

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