Norwich Western Link

Environmental Statement

Chapter 13: Geology and Soils

Appendix 13.5: River Wensum Floodplain Soil Resource Survey

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Contents

1 Introduction

1.1.1 Reading Agricultural Consultants Ltd (RAC) was instructed by WSP to carry out a soil resource survey where the proposed Norwich Western Link scheme would cross the floodplain of the River Wensum, by means of a detailed survey of soil characteristics. The purpose of the survey was to investigate and identify any peat reserves within the survey area.

1.1.2 We have included a summary of key information shown in this document in an accessible format in section 1.1.1. However, some users may not be able to access all technical details that are included in the rest of this document. If you require this document in a more accessible format, please contact norwichwesternlink@norfolk.gov.uk

READING AGRICULTURAL CONSULTANTS

January 2023

WSP

Norwich Western Link:
River Wensum Floodplain Soil Resource Survey

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Contents

1. Introduction

1.1. Reading Agricultural Consultants Ltd (RAC) is instructed by WSP to carry out a soil resource survey where the proposed Norwich Western Link scheme would cross the floodplain of the River Wensum, by means of a detailed survey of soil characteristics. The purpose of the survey is to investigate and identify any peat reserves within the survey area.

1.2. The survey of in-situ soils has been carried out across undisturbed land and has followed the following specification:

- use a hand-held soil auger and insulated spade to excavate soils to 1.2m below ground level;
- record the relevant characteristics of all soil horizons in accordance with the Soil Survey Field Handbook[1];
- take selected samples for topsoil and subsoil laboratory analysis of organic matter;
- take selected topsoil samples for laboratory analysis of pH, major nutrients and particle size analysis; and
- reinstate auger holes and pits.

2. Site and climatic conditions

General features, land form and drainage

2.1. The survey area extends to 6.18ha of land within the floodplain of the River Wensum. The main channel of the River Wensum runs through the survey area to the north-east and is orientated east to west. A subsidiary channel runs through the survey area close to the south-western extent with the same orientation. Land within the survey area is in permanent pasture.

2.2. Topography within the survey area is generally flat at 8m-9m above Ordnance Datum (AOD).

[1] **Hodgson, J. M. (Ed.) (1997).** *Soil survey field handbook.* Soil Survey Technical Monograph No. 5, Silsoe.

2.3. The survey area drains into the River Wensum and is located within the Environment Agency (EA) Flood Zone 3.

Agro-climatic conditions

2.4. Agro-climatic data for the survey area have been interpolated from the Meteorological Office's standard 5km grid point dataset at representative altitude of 9m AOD. The data are given in Table 1. Climate at the site is moderately warm and dry, and has large to very large moisture deficits. The number of Field Capacity Days (FCD) is smaller than is average for lowland England (150) and is favourable for providing opportunities for agricultural field work.

Table 1: Local agro-climatic conditions

Parameter	Value
Average Annual Rainfall	620mm
Accumulated Temperatures >0°C	1417 day°
Field Capacity Days	121 days
Average Moisture Deficit, wheat	121mm
Average Moisture Deficit, potatoes	117mm

Soil parent material and soil type

2.5. The underlying bedrock geology mapped by the British Geological Survey[2] is undifferentiated chalk. Formations include the Lewes Nodular Chalk Formation, the Seaford Chalk Formation, the Newhaven Chalk Formation, the Culver Chalk Formation and the Portsdown Chalk Formation. These formations generally comprise chalk of varying hardness with varied seams of flint and marl.

2.6. Superficial alluvium deposits are mapped across the survey area. These deposits typically comprise clay, silt, sand and gravel.

2.7. The Soil Survey of England and Wales soil association mapping[3] (1:250,000 scale) shows the Adventurers 2 association within the survey area. This association is characterised by deep peat soils over variable subsoils, usually sandy and sometimes gravelly. Profiles are typically well drained, and assessed as Wetness Class (WC) I[4].

[2] **British Geological Survey (2022).** *Geology of Britain viewer*, http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[3] **Soil Survey of England and Wales (1984).** *Soils of Eastern England* (1:250,000), Sheet 4.
[4] **Hodge et al (1984).** *Soils and Their Use in Eastern England*. Soil Survey of England and Wales Bulletin 13, Harpenden.

3. Soil Survey Methods

3.1. In total, 25 soil profiles were examined using an Edelman (Dutch) auger at an observation density of approximately four per hectare. The locations of observations are shown on Figure RAC/9430/1. Two observation pits were also excavated to examine the subsoil. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm or any impenetrable layer:

- soil texture;
- significant stoniness;
- colour (including localised mottling);
- consistency;
- structural condition;
- free carbonate; and
- depth.

3.2. Three topsoil samples were submitted for laboratory determination of soil pH, organic matter content and major nutrients (Phosphorus (P), Potassium (K) and Magnesium (Mg)). An additional 11 samples have been analysed for organic matter content only. All laboratory results are included in Appendix 1.

4. Soil characteristics

4.1. Soil profiles have been described according to Hodgson (1997)[1]. There are two soil types present within the survey area, depending on the presence or absence of peat within the soil profile, as shown on Figure RAC/9430/2. Soil profile summaries are recorded in Appendix 2, with photographs of typical soil profiles included in Appendix 3.

Soil Type 1

4.2. The first soil type comprises those that include a peat loam or loamy peat subsoil at variable depths, as shown on Figure RAC/9430/2.

4.3. Topsoil comprises very dark greyish brown to dark brown (10YR3/2 to 10YR3/3 in the Munsell soil colour charts[5]), heavy clay loam or sandy clay loam, with one recording of clay. The topsoil is organic, with laboratory analysis confirming 9.2% - 22.7% organic matter. The topsoil is considered an organic loam. The topsoil is predominantly stoneless to very slightly stony at 0% - 5% by volume, with a few recordings of up to 10%. The topsoil structure is medium subangular blocky and the consistency is friable.

4.4. The upper subsoil comprises black (10YR2/1), very dark brown (10YR2/2) or very dark greyish brown (10YR3/1), stoneless, loamy peat, with one recording of peaty loam. The laboratory analyses record organic matter contents of 12.0% - 36.7%. Samples at P1, P2 and Observation 13 have an organic matter content of 29.3% - 36.7% (and are classified as loamy peat or peaty loam). These locations best represent the majority of the subsoil peat observed between the river channels. Observations 8 and 23 recorded lower levels of organic matter at 12.0% - 21.1%, which are classified as organic loam. The peaty subsoils within the site are semi-fibrous, and the plant matter observed readily breaks down. Photographs of this horizon are shown in Appendix 3.

4.5. The lower subsoil (where peat is not observed to the full depth of the soil profile) comprises predominantly grey (10YR5/1), dark greyish brown (10YR5/2) or dark grey (10YR4/1), medium sandy loam or loamy sand. This horizon is slightly to moderately stony, up to 25%, and commonly prevents the auger from reaching the full observation depth of 120cm.

Soil Type 2

4.6. The second soil type is found in three locations within the survey area where no peat was recorded within the soil profile, as shown on Figure RAC/9430/2.

4.7. The topsoil comprises very dark grey (10YR3/1), very dark greyish brown (10YR3/2), dark brown (10YR3/3) or dark greyish brown (10YR4/2), sandy clay loam or loamy sand, which is variably organic. The topsoil is friable and has a coarse granular to medium subangular blocky structure.

4.8. The subsoil comprises grey (10YR5/1), brown (10YR5/3), yellowish brown (10YR5/4) or light yellowish brown (10YR6/4), loamy sand or sandy clay loam. This horizon is slightly to moderately stony, estimated at up to 25%, and restricts observation by auger within the upper horizon.

[5] **Munsell Color (2009).** *Munsell Soil Color Book*. Grand Rapids, MI, USA

Appendix 1: Laboratory Data

Determinand	2 TS	P1 TS	P2 TS	Units
Sand 2.00-0.063mm	38	26	62	% w/w
Silt 0.063-0.002mm	28	21	9	% w/w
Clay <0.002mm	34	53	29	% w/w
Organic matter	9.2	18.7	16.9	%
Soil organic matter class	Organic mineral	Organic mineral	Organic mineral	
Texture	Organic heavy clay loam	Organic clay	Organic sandy clay loam	

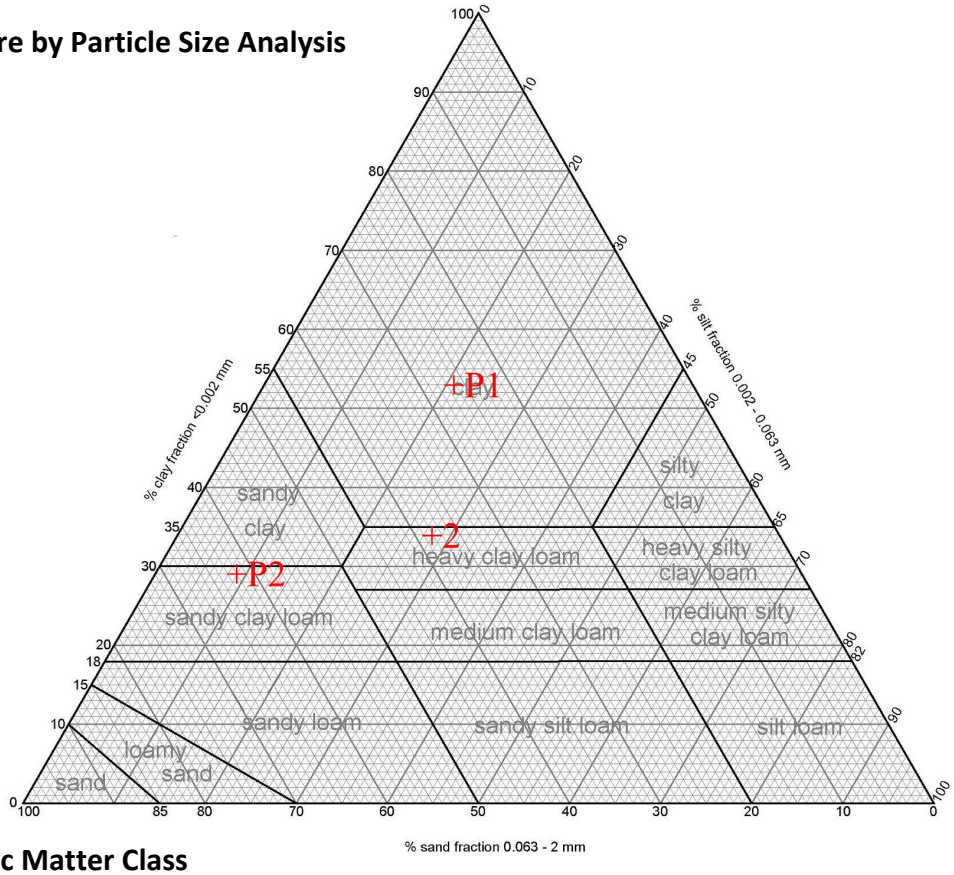
Determinand	2 TS	P1 TS	P2 TS	Units
Soil pH	7.6	7.6	6.2	
Phosphorus (P)	33.6	10.0	6.0	Mg/l (av)
Potassium (K)	40.3	26.6	<15	Mg/l (av)
Magnesium (Mg)	41.4	20.5	10.0	Mg/l (av)

Determinand	2 TS	P1 TS	P2 TS	Units
Phosphorus (P)	3	1	0	ADAS Index
Potassium (K)	0	0	0	ADAS Index
Magnesium (Mg)	1	0	0	ADAS Index

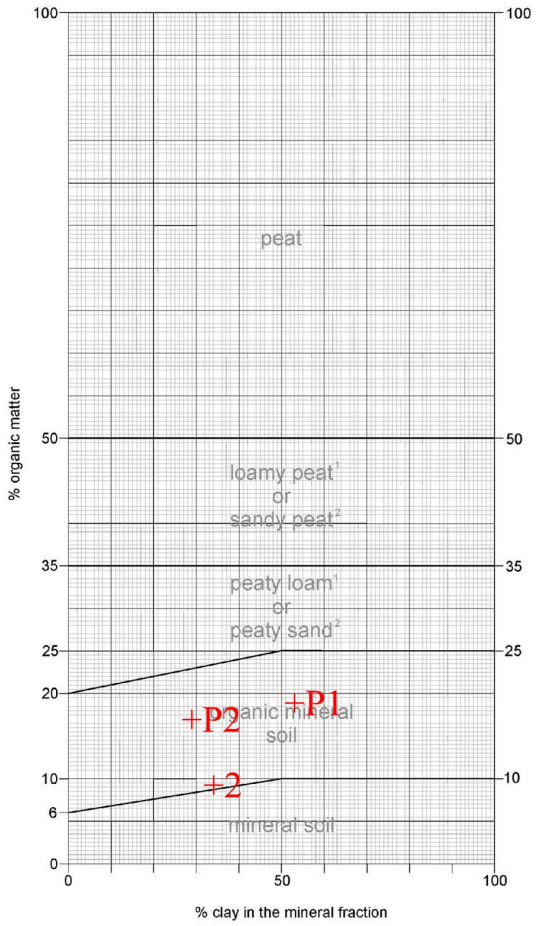
Determinand	8 TS	13 TS	19 TS	23 TS	25 TS	Units
Organic matter	16.0	22.7	15.9	15.3	15.0	%
Soil organic matter class	Organic mineral	Organic mineral	Organic mineral	Organic mineral	Organic mineral	

Determinand	P1 USS	8 USS	P2 USS	13 USS	13 LSS	23 USS	Units
Organic matter	36.7	12.0	31.9	30.4	29.3	21.1	%
Soil organic matter class	Loamy peat	Organic mineral	Peaty loam	Peaty loam	Peaty loam	Organic mineral	

Topsoil Texture by Particle Size Analysis



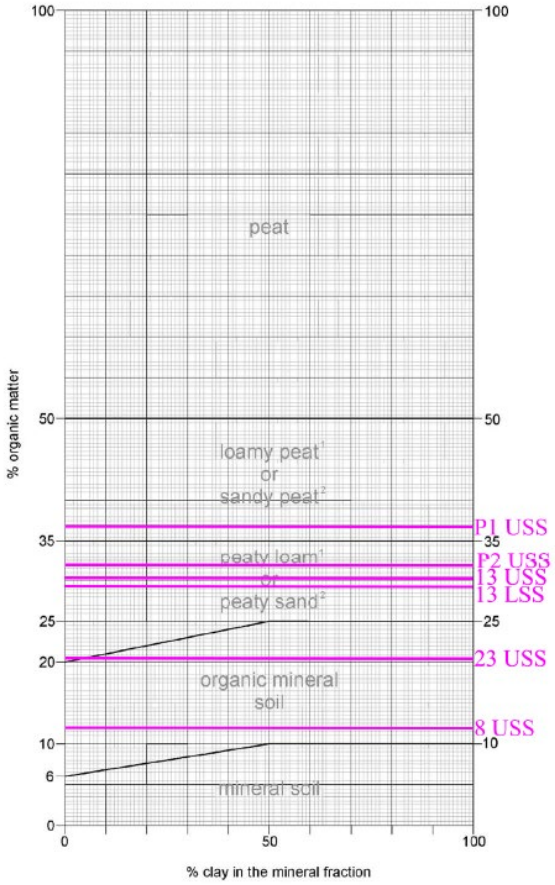
Topsoil Organic Matter Class



[1] Less than 50% sand in the mineral fraction

[2] 50% sand or more in the mineral fraction

Subsoil Organic Matter Class



[1] Less than 50% sand in the mineral fraction

[2] 50% sand or more in the mineral fraction

Appendix 2: Soil Profile Summaries

Norwich Western Link- Soil data

Climate Data	
MDwheat	121
MDpotato	117
FCD	121
AAR	620

Climate
1417 D°

Maximum depth of auger penetration is underlined

Site No	Depth (cm)		Texture	$CaCO_3$	Colour	Mottle colour	abundance	stone%	Gley	SPL
1	0	30	ohCL		10YR3/2			10	n	n
	30	45	hCL		10YR3/2			10	n	n
	45	55	LmS		10YR5/1			20	n	n
	55	120	LmS		10YR5/1			25	n	n
2	0	33	ohCL	calc	10YR3/2			5	n	n
	33	70	PL		10YR2/1			0	n	n
	70	105	PL		10YR2/1			0	n	n
	105	120	LmS		10YR4/1			10	n	n
3	0	35	ohCL	calc	10YR3/2			10	n	n
	35	62	PL		10YR2/1			0	n	n
	62	70	mSL		10YR5/1			15	n	n
	70	120	LmS		10YR5/1			20	n	n
4	0	25	ohCL	sli	10YR3/2			3	n	n
	25	100	PL		10YR2/1			0	n	n
	100	120	PL		10YR2/1			0	n	n
5	0	7	oLmS		10YR3/1			10	n	n
	7	15	LmS		10YR5/3, 10YR6/3			25	n	n
	15	120	LmS		10YR5/1			25	n	n

6	0	30	LmS		10YR3/3			20	n	n
	30	120	LmS		10YR5/1			25	n	n
7	0	20	oSCL	mod	10YR3/3	Fe	many	20	n	n
	20	40	SCL	mod	10YR4/1	Fe	com	25	n	n
	40	120	LmS		10YR5/1			25	n	n
8	0	25	ohCL		10YR3/3	Fe	com	0	n	n
	25	70	ohCL		10YR2/1			0	n	n
	70	100	LP		10YR2/1			0	n	n
	100	120	mSL		10YR5/1			25	n	n
9	0	30	oSCL		10YR3/2	Fe	com	3	n	n
	30	35	SCL		10YR4/2			20	n	n
	35	120	LmS		10YR5/1			25	n	n
10	0	23	oSCL		10YR3/2	Fe	com	10	n	n
	23	80	PL		10YR2/1			0	n	n
	80	120	LmS		10YR5/1			25	n	n
P2	0	20	oSCL		10YR3/2	Fe	com	2	n	n
	20	52	PL		10YR2/1	Fe	few	0	n	n
	52	60	mSL		10YR4/1			10	n	n
	60	120	LmS		10YR5/1			25	n	n
11	0	24	oSCL		10YR3/2			5	n	n
	24	50	PL		10YR2/1			0	n	n
	50	60	omSL		10YR3/1			10	n	n
	60	120	LmS		10YR5/1			25	n	n
12	0	25	oLmS		10YR3/2			15	n	n
	25	30	LmS		10YR6/2			25	n	n
	30	120	LmS		10YR3/1			25	n	n

13	0	22	ohCL	10YR3/2			0	n	n
	22	80	LP	10YR2/1			0	n	n
	80	120	LP	10YR3/1			0	n	n
14	0	25	ohCL	10YR3/2			0	n	n
	25	50	LP	10YR2/1			0	n	n
	50	63	LP	10YR3/1			0	n	n
	63	120	LmS	10YR3/1			25	n	n
15	0	24	ohCL	10YR3/2			0	n	n
	24	80	LP	10YR2/2			0	n	n
	80	120	LmS	10YR5/2			10	n	n
16	0	22	ohCL	10YR3/2			0	n	n
	22	45	LP	10YR2/1			0	n	n
	45	60	mSL	10YR5/2			20	n	n
	60	120	LmS	10YR5/1			25	n	n
17	0	23	ohCL	10YR3/2			10	n	n
	23	50	LP	10YR2/1			0	n	n
	50	120	LmS	10YR5/2			25	n	n
18	0	25	SCL	10YR4/2			5	n	n
	25	65	SCL	10YR5/4			5	n	n
	65	85	SC	10YR5/4, 10YR6/4	Fe	com	10	n	n
	85	120	SC	10YR6/4	Fe	com	20	n	n
19	0	40	oSCL	10YR3/2			0	n	n
	40	120	SCL	10YR5/4			20	n	n
20	0	30	oLmS	10YR3/2			10	n	n
	30	50	LmS	10YR4/2			15	n	n
	50	120	LmS	10YR5/2			25	n	n

21	0	22	ohCL	10YR3/2	Fe	com	0	n	n
/P1	22	60	LP	10YR2/1			0	n	n
	60	120	PL	10YR2/1			0	n	n
22	0	20	ohCL	10YR3/2	Fe	com	2	n	n
	20	110	PL	10YR2/1			0	n	n
	110	120	LmS	10YR2/1			20	n	n
23	0	25	ohCL	10YR3/2	Fe	com	2	n	n
	25	80	ohCL	10YR2/1			0	n	n
	80	120	PL	10YR2/1			0	n	n
24	0	23	ohCL	10YR3/2	Fe	com	2	n	n
	23	120	PL	10YR2/1			0	n	n
25	0	25	ohCL	10YR3/2	Fe	com	2	n	n
	25	80	PL	10YR2/1			0	n	n
	80	90	LmS	10YR4/1			10	n	n
	90	120	LmS	10YR5/1			25	n	n

Appendix 3: Site Photographs

Pit 1: Pit wall

Pit 1: Pit wall

Pit 1: Topsoil turf

Pit 1: Topsoil

Pit 1: Loamy peat subsoil

Pit 1: Loamy Peat subsoil

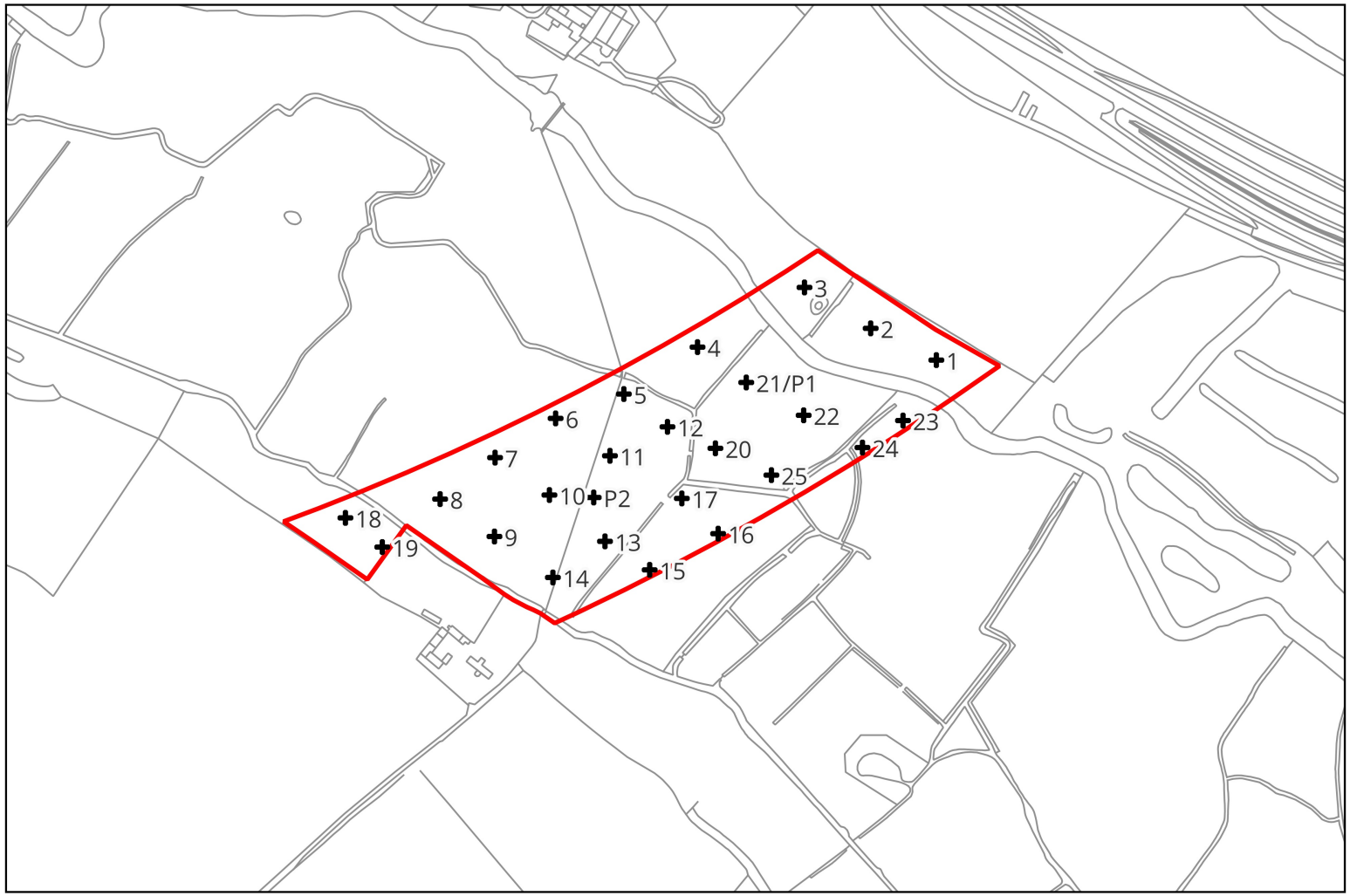
Pit 2: Overview

Pit 2: Topsoil turf

Pit 2: Loamy peat subsoil photos

Observation 5: Stony loamy sand topsoil

Observation 6 Stony loamy sand topsoil



KEY

- Survey boundary
- 1 Observation
- P Pit

0 100 200 300 m

Title
OBSERVATION MAPPING

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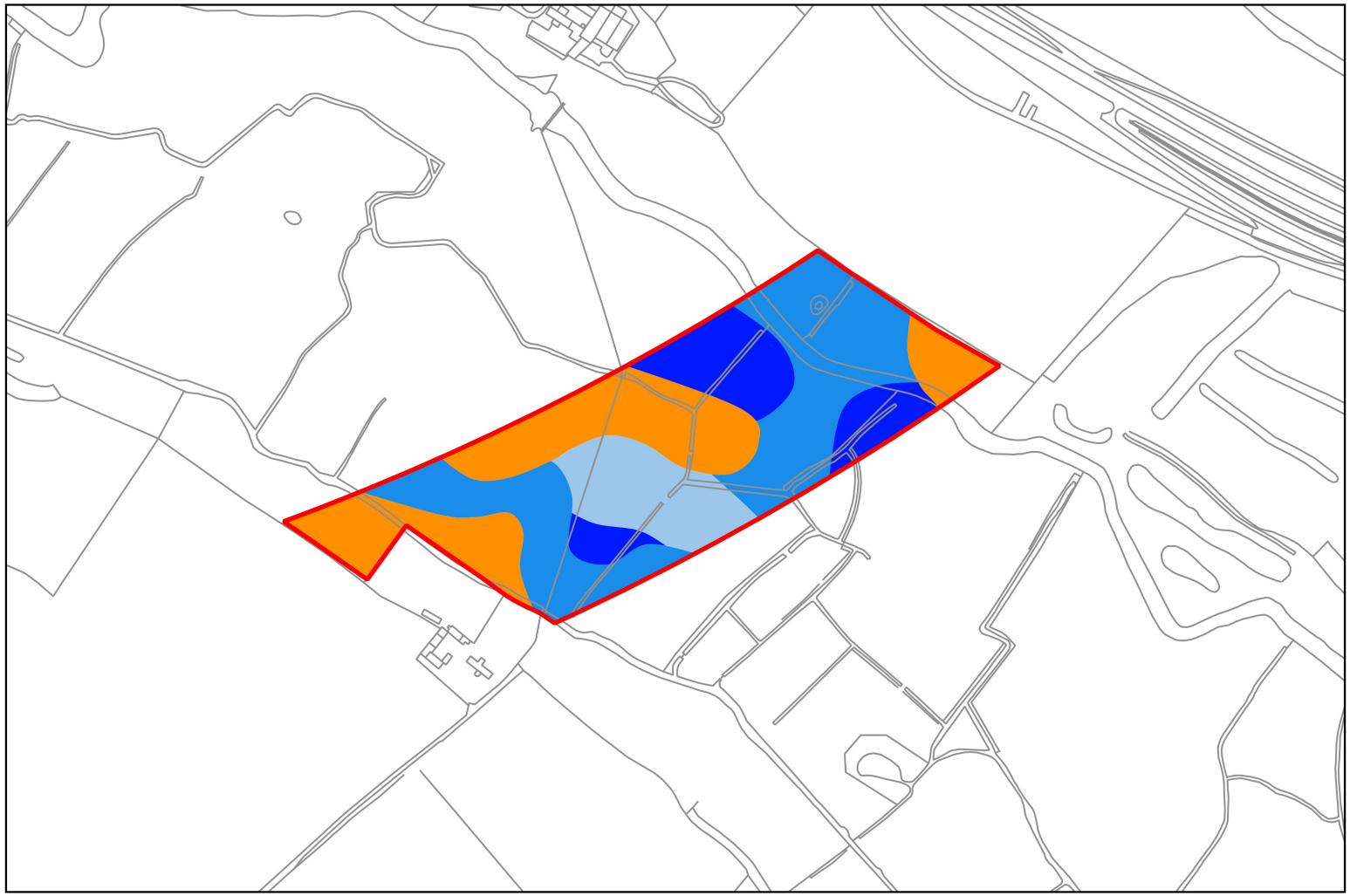
Scales 1:5,000@A4	Date 12/2022



KEY- maximum depth peat is observed

- No peat in profile
- 0-60cm
- 60-120cm
- 120cm+ (maximum depth not observed)

0 100 200 300 m

N

Title
PEAT MAPPING

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