

Hampshire Water Transfer and Water Recycling Project

Environmental Statement – Appendix 12.1 Agricultural land quality

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The Southern Water logo consists of three stylized, wavy blue lines of varying lengths, positioned to the right of the text 'Southern Water'.

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1 Introduction

- 1.1.1 This report presents an investigation of the Agricultural land classification (ALC) and soil resources of land required for the delivery of the Hampshire Water Transfer and Water Recycling Project (hereafter referred to as the 'Proposed Development').
- 1.1.2 This report is a technical appendix of Environmental Statement (ES) Chapter 12 Land use and agriculture, Volume I (Document reference 6.1, DCO Volume 6).
- 1.1.3 A full description of the Proposed Development and its key components can be found in ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6).
- 1.1.4 Guidance for assessing the quality of agricultural land in England and Wales is set out in the Department for Environment, Food and Rural Affairs (Defra)/Welsh Government guidelines for grading the quality of agricultural land [1], and summarised in Natural England's Technical Information Note (TIN) 049 [2].
- 1.1.5 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors affecting grading are climate, site conditions and soil which, together with interactions between them, form the basis for classifying land into one of the five grades.
- 1.1.6 Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use. Grade 2 is very good quality agricultural land, with minor limitations which affect crop yield, cultivations or harvesting. Grade 3 land has moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield, and is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land). Grade 4 land is poor quality agricultural land with severe limitations which significantly restrict the range of crops and/or level of yields. Grade 5 is very poor quality land, with very severe limitations which restrict use to permanent pasture or rough grazing.
- 1.1.7 Land, which is classified as Grades 1, 2 and 3a in the ALC system, is defined as best and most versatile (BMV) agricultural land.
- 1.1.8 As explained in Natural England's TIN049 [2], the whole of England and Wales was mapped from reconnaissance field surveys in the late 1960s and early 1970s, to provide general strategic guidance on agricultural land quality for planners. This Provisional series of maps was published on an Ordnance Survey base at a scale of One Inch to One Mile (1:63,360).
- 1.1.9 Most of the agricultural land affected by the Proposed Development is on the route of the Pipeline between the Water Recycling Plant (WRP) site and Otterbourne Water Supply Works (WSW). Much of the land is shown as Provisional Grade 3 or 4, although there are smaller areas of higher quality land (Provisional Grades 1 and 2), particularly around Waltham Chase and Shirrell Heath, and along the M27 motorway north of Fareham.

1.1.10 However, TIN049 explains that:

"These maps are not sufficiently accurate for use in assessment of individual fields or development sites, and should not be used other than as general guidance. They show only five grades: their preparation preceded the subdivision of Grade 3 and the refinement of criteria, which occurred after 1976. They have not been updated and are out of print. A 1:250 000 scale map series based on the same information is available. These are more appropriate for the strategic use originally intended ..."

1.1.11 TIN049 explains that a definitive ALC grading should be obtained by undertaking a survey according to the published guidelines.

1.1.12 Due to the installation of pipelines requiring mostly temporary and short-term use of agricultural land, most of the baseline data has been determined from soil samples obtained from the Ground Investigation (GI) team which have been analysed in the context of the ALC guidelines. Areas proposed for built aspects of development that requires longer-term use have been subject to detailed survey in accordance with the ALC guidelines.

2 Site and climatic conditions

2.1 General features, land form and drainage

- 2.1.1 The topography of land within the Order Limits is variable. From west of Havant to north of Portchester, the Proposed Development broadly traverses the middle of a north-facing slope, at altitudes of around 50m to 60m above Ordnance Datum (AOD). Portsdown Hill is a prominent south-facing chalk escarpment rising to approximately 100m AOD, with the north-facing dip slope falling to elevations of between 25m and 65m AOD. From north of Portchester to Otterbourne, the Proposed Development crosses a series of hills and valleys, repeatedly ranging between altitudes of 50m to 60m AOD and 10m to 20m AOD respectively.
- 2.1.2 The valleys crossed are those of the Wallington River, River Meon, River Hamble and River Itchen.
- 2.1.3 Land drainage within the Order Limits is facilitated by the slopes and water directed into each of the valleys. Land within each of the valleys and immediately adjacent to each river channel is mapped as Flood Zone 3 [3].

2.2 Agro-climatic conditions

- 2.2.1 Agro-climatic data for multiple locations within the Order Limits have been interpolated from the Meteorological Office’s standard 5km grid point data set at representative altitudes and are given in Table 2-1.
- 2.2.2 The climate within the Order Limits is warm and wet. Moisture deficits are mostly moderately large. The numbers of Field Capacity Days (FCD) (when the soil is full or over-full with water) are relatively large compared with average for lowland England (150) and are unfavourable for agricultural field work but there is no overriding climatic limitation to agricultural land quality within the Order Limits.

Table 2-1 Agro-climatic parameters

Parameter	Value				
Easting	463100	458400	456100	453000	451100
Northing	107500	108700	114000	118500	120100
Approximate location	Southwick	Crockerhill	Shirrell Heath	Winters Hill	Lower Upham
Altitude (m AOD)	60	10	50	55	44
Average Annual Rainfall (mm)	823	804	848	848	824
Accumulated Temperatures >0°C (day °C)	1486	1543	1495	1489	1501
Field Capacity Days	168	166	176	180	177
Average Moisture Deficit, wheat (mm)	106	114	106	104	105
Average Moisture Deficit, potatoes (mm)	99	109	99	97	98
Grade according to climate	1	1	1	1	1

2.2.3 In addition, agro-climatic data has also been obtained for the detailed surveys of the Above Ground Plant (AGP) sites, comprising Break Pressure Tanks (BPT) and Intermediate Pumping Stations (IPS), as shown in Table 2-2. The climate across the AGP sites is warm and mostly wet (moist at Albany Farm). The numbers of FCD are relatively large compared with average for lowland England (150) and are unfavourable for agricultural field work, but there is no overriding climatic limitation to agricultural land quality.

Table 2-2 Agro-climatic parameters for the Above Ground Plant sites

Parameter	Value			
AGP	BPT/IPS-E	IPS-F	IPS-G	BPT-K
Location	Portsmouth Hill	Albany Farm	Titchfield Lane	Winters Hill
Easting	466400	458200	456400	452800
Northing	106500	109200	111700	118500
Altitude (m AOD)	84	20	49	65
Average Annual Rainfall (mm)	823	796	836	854
Accumulated Temperatures >0°C (day °C)	1458	1533	1498	1477
Field Capacity Days	166	162	172	180
Average Moisture Deficit, wheat (mm)	103	114	107	103
Average Moisture Deficit, potatoes (mm)	95	109	100	95
Grade according to climate	1	1	1	1

2.3 Soil parent material and soil type

- 2.3.1 The bedrock geology mapped by the British Geological Survey [4] between Havant and Crockerhill belongs to the White Chalk Subgroup of the Chalk Group, comprising chalk with flints. From Crockerhill to Otterbourne, the underlying geology is primarily London Clay Formation, with interbedded clay, silts and sands of the Bracklesham Group west of Wickham and west of Waltham Chase.
- 2.3.2 Superficial deposits are mapped within the valleys and sequentially comprise alluvium, river terrace deposits and head, from valley bottom to footslopes and mid-slopes.
- 2.3.3 The mapped soil information [5] shows the Upton 1 association in conjunction with the underlying chalk in the east of the Order Limits. These soils comprise shallow, well-drained (Wetness Class (WC) I) silty soils over chalk.
- 2.3.4 Three main soil associations predominate across the remainder of the Order Limits and all have similar characteristics. The Windsor association has clay loam topsoils over slowly permeable clay subsoils; and the Wickham 3 and Wickham 4 associations are characterised by clay loam or silty clay topsoils over slowly

permeable clay subsoils. These three associations are all typically poorly drained, in WC IV.

2.3.5 The Proposed Development passes through small pockets of other associations, notably:

1. Carstens association, characterised by well-drained (WC I) clay soils over chalk, on the valley sides of the Wallington River.
2. Coombe 1 association on the valley footslopes of the Wallington River, which includes well-drained (WC I) fine silty soils over chalk.
3. Holidays Hill association at Shirrell Heath, which includes very acid, sandy over slowly permeable clayey subsoils in WC IV.
4. Fladbury 3 association in the channels of the River Meon and the River Hamble comprising clayey and fine silty textures in WC IV.
5. Sonning 2 association at the north-western extent of the Order Limits, comprising well-drained (WC I), flinty, coarse loamy and gravelly soils.
6. Adventurers' 3 association in the valley of the River Itchen, which includes deep peat and extremely calcareous mineral soils in WC V.

3 Assessment of agricultural land quality

3.1 Methodology

- 3.1.1 The GI surveys in 2023 and 2024 involved a programme of collecting data from boreholes, trial pits and window samples at locations distributed throughout the Order Limits. Subsamples from each soil horizon (topsoil, upper subsoil and lower subsoil) were taken at locations within the Order Limits as shown on ES Figure 12.6 Agricultural land classification, Volume III (Document reference 6.3, DCO Volume 6), and despatched to the Agricultural Land and Soils team for analysis.
- 3.1.2 The detailed surveys of the AGP sites were undertaken at an intensive sampling density of more than one observation per hectare.
- 3.1.3 The analysis of the soil samples from the GI surveys and the AGP surveys followed the same methodology, examining soil characteristics in terms of the ALC criteria and guidelines [1]. Each sample was analysed for the following characteristics:
1. Texture
 2. Colour
 3. Stone content
 4. Consistency
 5. Structure
 6. Permeability
 7. Mottling
 8. Calcium carbonate content
 9. Visible roots
- 3.1.4 In addition, representative subsamples were submitted for laboratory determination of particle size distribution (to confirm hand texturing), pH, organic matter content and nutrient contents (Phosphorus, Potassium and Magnesium). Twenty soil samples were submitted for laboratory analysis (15 from the Pipeline between the WRP site and Otterbourne WSW, and five from the AGP sites), with the results given in Annex A.
- 3.1.5 These relevant soil characteristics were assembled to establish the full soil profile, enabling a WC to be assigned, and a droughtiness limitation calculated.
- 3.1.6 Soil WC was determined from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling, and slowly permeable subsoil layers at least 15cm thick, in relation to the number of FCD at the location.
- 3.1.7 Soil droughtiness was investigated by the calculation of moisture balance equations. The calculations for each profile observed are included in Annex A. Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated Moisture Deficit (MD) for the standard crops wheat and potatoes. The MD is a function of potential evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs.

- 3.1.8 Each profile was then graded according to the established guidelines and criteria for classifying agricultural land, under the ALC system of England and Wales.

3.2 Agricultural land classification

- 3.2.1 Assessment of agricultural land quality has been carried out according to the ALC guidelines [1]. Soil profiles have been described according to Hodgson [6] which is the recognised source for describing soil profiles and characteristics according to the revised ALC guidelines. Soil matrix colours are described as per their notation in the Munsell soil colour charts [7].

Pipelines between the Water Recycling Plant site and Bedhampton Springs

- 3.2.2 An area of grassland at Mill Lane, Bedhampton to the north of the A27 and the WRP site was surveyed by the former Ministry of Agriculture, Fisheries and Food (MAFF) and classified as Subgrade 3a. The survey report [8] indicates that the profiles are in WC II with gleying and slowly permeable layers at depth but with a heavy clay loam topsoil texture, there is a moderate wetness and workability limitation to Subgrade 3a.

Pipeline between the Water Recycling Plant site and Otterbourne Water Supply Works

- 3.2.3 Analysis of the GI soil samples identified seven main soil types along the Pipeline between the WRP site and the Otterbourne WSW. They are described in paragraphs 3.2.4 to 3.2.10, as they occur from east to west within the Order Limits. The soil types identified match well with the mapped information, with typical soil profiles shown in the photographs in Annex A.4.
- 3.2.4 In the east where the bedrock is chalk, and aligning with the Upton 1 soil association, the topsoil comprises dark greyish brown (10YR4/2) medium clay loam which is slightly stony and calcareous. This overlies light grey (10YR7/1) heavy clay loam which is very stony with chalk stones. The subsoil is friable with a crumb structure and is extremely calcareous. The subsoil sample was from a depth of 50cm, indicating at least moderate depth to chalk bedrock. The profile is well-drained, WC I, and is limited by droughtiness to Grade 2. This soil type is illustrated by profile 3E3113HP in Annex A.4.
- 3.2.5 Near the Wallington River, largely aligning with the mapped Carstens association, the profile includes brown (7.5YR4/2) medium clay loam topsoil which is non-calcareous and moderately flinty. The topsoil is friable with fine angular blocky structure. The subsoil is similar but heavy clay loam in texture and includes mottling which is indicative of soil wetness. The structure remains permeable and the profile is in WC II. There is a soil wetness limitation to Grade 2. This soil type is illustrated by profile 3F2521HP in Annex A.4.
- 3.2.6 On the east-facing valley side at Crockerhill, there is a dark greyish brown (10YR5/2) medium clay loam topsoil, which is firm and has a fine to medium angular blocky structure. This passes to brown (7.5YR5/3) clay subsoil which is firm to very firm with a medium angular blocky structure and is slowly permeable. The profile is in WC IV and limited by wetness to Subgrade 3b. This soil type is illustrated by profile 3F3602HP in Annex A.4.

- 3.2.7 To the south of Wickham and broadly coinciding with geology of the Bracklesham Group, the topsoil is sandy silt loam which is dark brown (10YR3/3). The topsoil is friable with a fine subangular blocky structure. There is an upper subsoil of brown (10YR4/3) sandy clay loam which is mottled and very slightly stony, with a fine subangular blocky structure and weak consistency. A lower subsoil is distinguishable and comprises dark yellowish brown (10YR4/4) sandy clay, with a firm, medium angular blocky structure. The profile is moderately well-drained, WC II, but limited most by droughtiness, to Grade 2. This soil type is illustrated by profile 3W8535SA in Annex A.4.
- 3.2.8 North of Wickham, the soil profile aligns with the mapped Wickham association and includes dark greyish brown (10YR4/2) medium clay loam topsoil which is non-calcareous and very slightly stony. It has a coarse subangular blocky structure. The subsoil is grey (10YR5/1) clay which is extremely firm and has a massive structure. There is common mottling. The subsoil is gleyed and slowly permeable and the profile in WC IV. There is a wetness limitation to Subgrade 3b. This soil type is illustrated by profile 3H4511HP in Annex A.4.
- 3.2.9 Between Shirrell Heath and Waltham Chase, the topsoil is very dark greyish brown (10YR3/2) medium sandy loam which is very slightly stony and has a loose crumb structure. The upper subsoil is greyish brown to brown (10YR5/2 to 10YR5/3) clayey sand, which is friable and permeable, but gleyed. The profile is assessed as WC II, with a likely droughtiness limitation to Grade 2, but may be limited by the effect of groundwater. This soil type is illustrated by profile 3J5003HP in Annex A.4.
- 3.2.10 To the north of Crowdhill, the soil correlates well with the mapped Windsor association and comprises very dark grey (10YR3/1) clay to silty clay topsoil overlying mottled dark greyish brown (10YR4/2) clay subsoil, which is very firm, coarse angular blocky and slowly permeable. The profile is in WC IV and is limited by wetness to Grade 4. This soil type is illustrated by profile 3L6027HP in Annex A.4.
- 3.2.11 Analysis of the soil samples made available indicates that slightly less than half of the agricultural land within the Order Limits (114ha or 48%) is within the category of BMV (Grades 1, 2 and 3a) and slightly over half (126ha or 52%) is non-BMV (Subgrade 3b and Grade 4), with the distribution shown in ES Figure 12.6 Agricultural land classification, Volume III (Document reference 6.3, DCO Volume 6), and in Table 3-1.

Table 3-1 Agricultural land classification (ha)

Component/Section	Grade 1	Grade 2	Subgrade 3a	Subgrade 3b	Grade 4	Non-agricultural
Budds Farm Wastewater Treatment Works (WTW)	-	-	-	-	-	13.2
Havant Thicket Reservoir	-	-	-	-	-	295.2
Pipelines between Budds Farm WTW and the WRP site	-	-	-	-	-	12.2

Component/Section	Grade 1	Grade 2	Subgrade 3a	Subgrade 3b	Grade 4	Non-agricultural
WRP site	-	-	-	-	-	9.9
Pipelines between the WRP site and Bedhampton Springs	-	-	0.7	-	-	3.6
Pipeline between the WRP site and Otterbourne WSW						
<i>Section D: WRP site to Portsdown Hill</i>	-	6.4	1.0	-	-	35.8
<i>Section E: Portsdown Hill to Boarhunt</i>	5.8	23.8	17.2	6.3	-	2.3
<i>Section F: Boarhunt to Crockerhill</i>	-	9.0	-	18.2	0.1	0.7
<i>Section G: Crockerhill to Wickham</i>	1.4	1.5	7.7	4.1	1.3	29.4
<i>Section H: Wickham to Shedfield</i>	-	4.6	3.2	7.3	-	1.2
<i>Section J: Shedfield to the River Hamble</i>	6.1	-	16.0	12.2	-	0.9
<i>Section K: The River Hamble to Lower Upham</i>	-	-	-	24.9	11.3	2.1
<i>Section L: Lower Upham to Brambridge</i>	-	-	1.9	-	37.9	2.5
<i>Section M: Brambridge to Otterbourne Water Supply Works</i>	-	-	8.0	2.6	-	9.8
Totals	13.2	45.2	55.8	75.6	50.6	421.9

Above Ground Plant sites

3.2.12 BPT/IPS-E at Portsdown Hill has heavy clay loam or heavy silty clay loam topsoil which is dark greyish brown (10YR4/2) and slightly stony (up to 15%). Topsoil depth is between 25cm and 30cm and mostly lies directly over fractured chalk, although one observation includes a light grey (10YR7/2) medium clay loam upper subsoil to a depth of 47cm. The topsoil is friable, with a granular structure, and is calcareous. The chalk was observed in the pits to a full soil profile depth of 120cm and is rootable throughout. These soils are in WC I and limited by soil droughtiness to Subgrade 3a where the chalk is found at shallow depths in the horizon or to Grade 2 where the chalk is deeper in the profile.

- 3.2.13 IPS-F at Albany Farm has heavy clay loam or heavy silty clay loam topsoil which is brown (10YR4/3) and slightly stony. A small amount of upper subsoil in one profile was observed as dark yellowish brown (10YR3/4) heavy clay loam, but the auger was stopped on stone at shallow depth. The profile is in WC II and limited by wetness to Subgrade 3a. The upper subsoil in a second profile is identified as strong brown (7.5YR4/6) silty clay which is slightly stony, including flint and chalk, very firm and with a coarse, subangular blocky structure. The upper subsoil is slowly permeable. There is a lower subsoil of extremely chalky heavy silty clay loam which passes to chalk at around 65 cm depth. The profile is in WC III and is limited by wetness to Subgrade 3b.
- 3.2.14 IPS-G at Titchfield Lane has sandy silt loam topsoil which is very dark greyish brown or dark yellowish brown (10YR3/2 or 10YR4/4). The topsoil is moderately stony and non-calcareous. The upper subsoil observed is also sandy silt loam and becomes increasingly stony with depth. The soil was observed to 40-50cm before becoming too stony to auger. The lower subsoil is assumed to be a very stony sandy loam. The soil profiles are limited by droughtiness to Subgrade 3a.
- 3.2.15 BPT-K at Winters Hill has dark greyish brown (10YR4/2) heavy silty clay loam topsoil which is friable to firm and has a medium subangular blocky structure. Mottling is evident from the topsoil. The subsoil horizons comprise grey or greyish brown (10YR5/1 or 10YR5/2) clay which is firm to very firm and coarsely structured. There are many prominent mottles. The profiles are slowly permeable immediately beneath the topsoil and are WC IV. There is a wetness limitation to Grade 4.

Annex A Laboratory and Soil Profile Data

A.1 Laboratory data - Pipeline between the Water Recycling Plant site and Otterbourne Water Supply Works

Borehole	3E3111H P	3E3119H P	3H4507H P	3H4511H P	3J5003HP	3K5508H P	3K5515H P	3K5529H P	3K5607H P	3L6027H P	3L6103H P	3W8535S A	HTDP1	HTDP2	HTDP4
% Sand	19	22	49	37	75	26	16	17	14	17	12	47	21	19	21
% Silt	53	53	35	39	18	47	51	49	43	45	48	39	45	50	41
% Clay	28	25	16	24	7	27	33	34	43	38	40	14	34	31	38
Texture	HZCL	MCL	SZL	MCL	SL	HCL	HZCL	HZCL	C	C/ZC	ZC	SZL	HCL	HZCL	C
pH	7.8	8	6.9	7.1	6.9	6.3	6.6	6.9	6.6	6.5	7.2	5.6	7.8	7.9	8
% Organic Matter	4.7	3.3	2.1	2.2	1.8	2.6	4	4.1	2.5	6.6	2.4	2.9	6.8	6.3	5.3
P mg/l (Index)	18.4(2)	12.6(1)	26.2(3)	17.8(2)	72.2(5)	<2.5(0)	<2.5(0)	<2.5(0)	3.2(0)	4.6(0)	<2.5(0)	20.0(2)	55.8(4)	21.2(2)	21.0(2)
K mg/l (Index)	121(2-)	171(2-)	118(1)	123(2-)	89.8(1)	51.6(0)	126(2-)	115(1)	110(1)	80.2(1)	95.5(1)	52.0(0)	172(2-)	191(2+)	98.3(1)
Mg mg/l (Index)	56.7(2)	50.8(2)	46.3(1)	69.0(2)	23.5(0)	86.6(2)	124(3)	136(3)	355(6)	585(6)	331(5)	56.9(2)	41.3(1)	55.8(2)	33.4(1)

A.2 Laboratory data – Above Ground Plant sites

AGP site	BPT/IPS-E (1)	BPT/IPS-E (2)	IPS-F	IPS-G	BPT-K
% Sand	21	19	24	47	19
% Silt	45	50	46	36	48
% Clay	34	31	30	17	33
Texture	HCL	HZCL	HCL	SZL	HZCL
pH	7.8	7.9	7.9	6.5	5.9
% Organic Matter	6.8	6.3	3.6	3.7	4.3
P mg/l (Index)	55.8(4)	21.2(2)	6.8(0)	61.6(4)	2.6(0)
K mg/l (Index)	172(2-)	191(2+)	173(2-)	342(3)	115(1)
Mg mg/l (Index)	41.3(1)	55.8(2)	54.9(2)	49.3(1)	171(3)

Key:
C – Clay
HCL – Heavy clay loam
HZCL – Heavy silty clay loam
MCL – Medium clay loam
SL – Sandy loam
SZL – Sandy silt loam
ZC – Silty clay
P - Phosphorus
K - Potassium
Mg - Magnesium

A.3 Soil profile data summary - Pipeline between the Water Recycling Plant site and Otterbourne Water Supply Works

Borehole Number	Easting	Northing	Depth cm	Texture	Colour	Mottling	Slowly permeable	Stones%	Structure	Consistency	Probable WC	Probable Grade
3G4024DS	456585	111997	25	hCL	7.5YR3/2	none	n	5 flint	fsab	fri	4	4
			25	C	5YR5/3	Fe com	y	5 flint	cab	firm	N/A	N/A
			60	C	5YR5/3	Fe com	y	10 flint	cab	plastic	N/A	N/A
3G4102SA	456666	112101	10	SCL	10YR4/2	Fe few, faint	n	5 flint	mab	fri,	3	3a
			80	C	7.5YR5/3	Fe many	y	5 flint	mab	v firm, weak	N/A	N/A
3G4105SA	456361	111686	10	mCL	10YR3/1	None	n	10 gravel	msab	fri, moist	3	3a
			40	hCL	10YR4/2+5/2	Fe few	n	25 flint gravel	msab	weak, moist	N/A	N/A
3H4507HP	457147	112356	20	SZL	10YR4/2	none	n	10 gravel	msab	soft, weak	4	3b
			50	C	10YR5/1	Fe com	y	0	cab	v firm	N/A	N/A
3H4511HP	457140	112468	20	mCL	10YR4/2	Fe few	n	1 pebble	csab	v firm	4	3b
			50	C	10YR5/1	Fe com	y	0	massive	ext firm	N/A	N/A
3H4603HP	457114	112665	30	LS/SL	10YR4/1	none	n	15%	crumb	fri	1	3a
			40	mS	10YR4/2	none	n	15%	crumb	fri	N/A	N/A
3K5508HP	453820	116989	20	hCL	10YR4/3	Fe com	n	2 pebble	msab	weak	N/A	3b/4
3K5513HP	453046	117766	5	mZCL	10YR4/2	root stains	n	0	fsab	fri	4	3b
			50	C	10YR5/2	Fe com	N/A	N/A	cab/massive	firm	N/A	N/A
3K5515HP	452943	118254	20	hZCL	10YR4/2	Fe few	n	2 pebble	msab	weak	4	3b/4
3K5529HP	452639	118730	20	hZCL	10YR4/3	Fe few	n	5 pebble + flint	msab	weak	4	3b/4
3K5604HP	453275	117637	10	hZCL	10YR4/2	Fe com	n	0	fab	firm	4	4
			40	C	10YR5/1	Fe com	y	0	cab	v firm	N/A	N/A
3K5607HP	452945	118490	20	C	2.5Y5/1	Fe com	y	2 pebble	mab	firm	4	4
			50	C	10YR5/4	Fe com	y	0	mab	firm	N/A	N/A
			100	C	2.5Y5/1	Fe v many	y	0	cab	ext firm	N/A	N/A
3L6015HP	451686	119819	20	hZCL	10YR4/1	Fe com	n, but waterlogged	0	mab	sticky, wet	4	4
			85	C	10YR5/1	Fe many	N/A	5 small gravel	mab	firm, sticky, wet	N/A	N/A
3L6024HP	450204	120254	30	C	10YR5/1	Fe many	n	0	mab	firm	4	4
3L6027HP	449517	120487	15	C/ZC	10YR3/1	none	n	1 gravel	mab	firm/fri	4	4
			75	C	10YR4/2	Fe com	y	0	cab	v firm	N/A	N/A
3L6101DS	451624	119889	20	C	10YR4/1	Fe com	n	1 gravel	csab	firm	4	4
			50	C	10YR5/1	Fe com med	y	5 gravel	cab/ massive	v firm	N/A	N/A
3L6103HP	451145	120062	20	ZC	10YR4/3	Fe few	n	2 flint, pebble	msab	N/A	4	4
			50	ZC	2.5Y5/2	Fe com	y	0	csab	firm	N/A	N/A
			100	C	2.5Y5/1	FeMn v many	y	0	cab	v firm	N/A	N/A
3W8526HP	458016	110456	5	mSL	7.5YR4/1	none	n	1%	fsab	fri	1	1
			50	SCL	10YR4/3	Fe, com, faint	n	0	fab	moist, fri	N/A	N/A
3W8527HP	458067	110540	20	fSL	10YR4/2	none	n	1%	fab	fri	4	3a
			40	C+	10YR5/3	Cfd	y	0%	cab	v firm	N/A	N/A
3W8528HP	457714	110765	20	mSL	10YR4/2	none	n	0%	fab	fri	3	2
			40	SCL	7.5YR5/2	Mff	mod	10%	mab	firm/fri	N/A	N/A
3W8531HP	457280	110668	30	mCL	10YR4/2	none	n	1%	fab	fri	4	3b
			80	C+	10YR5/1	Cmd	y	0	cab	v firm	N/A	N/A
3W8532HP	456998	110576	10	fSL	10YR4/2	none	n	0	msab	fri	1	1

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Borehole Number	Easting	Northing	Depth cm	Texture	Colour	Mottling	Slowly permeable	Stones%	Structure	Consistency	Probable WC	Probable Grade	
3W8532HP	456998	110576	40	fSL	10YR6/1	Fe com	n	0	msab	fri	N/A	N/A	
3W8535SA	456844	110705	20	SZL	10YR3/3	Fe few v.faint	n	0	fsab	fri	2	2	
			40	SCL	10YR4/3	Fe com, v.faint	n	1 flint	fsab	weak	N/A	DR	
			100	SC	10YR4/4	Fe few	y	50% flint	mab	firm	N/A	N/A	
3W8560HP	458001	110136	5	mCL	7.5YR4/1	none	n	2% flint	fab	firm/fri	4	3b	
			50	SC	7.5YR5/2	Cmd	y	1%	mab	firm	N/A	N/A	
3E3106TP	465296	106977	10	mZCL	10YR4/3	none	n	1%	f+msab	fri	3	3a	
			50	hZCL	10YR5/3	com faint	mod	1%	mab	firm/fri	N/A	N/A	
3E3020DS	434355	107186	10	mZCL	10YR5/2	none	n	8% hard chalk	fsab	fri	1	2	
			50	hCL?	Chalk gravel + soft chalk	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			180	Chalk	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3E3022HP	434032	107254	10	mCL	10YR4/2	none	n	1%	fsab	fri	1	1	
			60	hCL	10YR6/4	none	n	35% flint and chalk	fsab	fri	N/A	N/A	
			90	hCL	10YR7/2	none	n	60% flint and chalk	crumb	fri	N/A	N/A	
3E3028HP	462897	107493	50	hCL	10YR8/1	none	n	60% hard chalk	crumb	fri	1	2	
3E3023HP	463916	107256	5	mCL	10YR3/3	none	n	25% flint	fab	fri	1	2	
3E3034HP	461782	107751	5	mCL	10YR3/1	none	n	10% flint	fsab	firm/fri	1	1	
			50	mZCL	10YR3/1	few	n	12% flint	fab	fri	N/A	N/A	
3E3038HP	460853	107821	20	hZCL	10YR4/2	none	n	5% flint	fab	firm/fri	1	2	
			40	hCL	10YR6/2	none	n	50% chalk	crumb	fri	N/A	N/A	
3E3103HP	466080	106971	10	C	10YR5/2	Fe com	n	15% flint	cab	firm	3	3b	
			40	hCL	10YR4/2	Fe com faint	mod	5% small	mab	firm	N/A	N/A	
3E3104HP	465799	107056	20	SC	7.5YR5/3	Fe com	n	10% flint and hard chalk	cab/massive	extr firm	4	3b	
			40	C	10YR5/2	Fe com	y	1%	cab	v firm	N/A	N/A	
3E3109HP	463625	107323	5	hCL	10YR4/2	none	n	10% flint	fab	fri	N/A	N/A	
3E3111HP	463137	107418	5	hZCL	10YR4/2	none	n	5% flint	fab	fri	2	3a	
			50	hZCL	10YR4/3	none	n	12% flint	fab	fri	N/A	N/A	
3E3112TP	462514	107661	10	mCL	10YR4/2	none	n	15% flint	crumb	fri	N/A	N/A	
3E3113HP	462261	107687	5	mCL	10YR4/2	none	n	10% flint	fab	moist, fri	1	2	
			50	hCL	10YR7/1	none	n	60% chalk and flint	crumb	fri	N/A	N/A	
3E3119HP	462710	107568	5	mCL	10YR3/3	none	n	2% flint	fab	fri	2	2	
			50	hCL	10YR6/3	Fff	n	20% chalk and flnt	crumb	fri	N/A	N/A	
3F3521HP	458501	108717	5	mCL	7.5YR4/2	none	n	20% flint	fab	fri	2	2	
			50	hCL	7.5YR4/2	Fe com	n	15% flint	msab	fri	N/A	N/A	
3F3523DR	458257	109015	20	mCL	10YR4/2	none	n	1% flint	fab	fri	1	1	
			50	mZCL	7.5YR4/2	none	n	15% flint	fab	fri	N/A	N/A	
3E3602HP	458307	108896	5	mCL	10YR4/2	none	n	2%	f/mab	firm	4	3b	
			50	C	7.5YR5/3	Mff	y	8%	mab	firm to v firm	N/A	N/A	
3J5003HP	456128	113965	10	SL	10YR3/2	none	n	1%	crumb	loose	2	1	
			50	clayey sand	10YR5/2-5/3	Cfd	n	0	fab	fri	N/A	N/A	
3J5013HP	455701	114753	20	LmS	7.5YR3/2	none	n	8% flint	fab	fri	2-3	2/3a	
			40	mSL	10YR5/2	Fe com	n	0	cab	moist, fri	N/A	N/A	
3J5017HP	455371	114971	10	mSL	10YR5/1	none	n	10%	fab	fri	4	3a	
3J5017HP	455371	114971	50	SC	10YR5/2	Fe com	y	1%	cab	firm	N/A	N/A	

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Borehole Number	Easting	Northing	Depth cm	Texture	Colour	Mottling	Slowly permeable	Stones%	Structure	Consistency	Probable WC	Probable Grade	
3J5101HP	455771	114594	10	SZL	10YR4/2	Cfd	n	0	fab	fri	4	3a	
			30	C	10YR5/2	mfd	y	0	cab/massive	extr firm	N/A	N/A	
3J5102HP	455712	114662	10	SCL	10YR4/2	none	n	0	fab	fri	4	3b	
			50	C	10YR5/3	Fe com	y	0	cab	firm	N/A	N/A	
HTDP1	466384	106473	28	hCL	10YR4/2	none	n	15	N/A	N/A	1	2	
			120	Chalk	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A
HTDP2	466458	106512	30	hZCL	10YR4/2	none	n	14	N/A	N/A	1	2	
			47	mCL	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A
			120	Chalk	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A
HTDP3	466194	106556	25	hCL	10YR4/2	none	n	15	N/A	N/A	1	3a	
			120	Chalk	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A
HTDP4	466274	106509	28	C	10YR4/2	none	n	15	N/A	N/A	1	3a	
			49	Chalk	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A
			120	Chalk	10YR7/2	none	n	N/A	N/A	N/A	N/A	N/A	N/A

Key:

Textures

C Clay
 SC Sandy clay
 ZC Silty clay
 hCL Heavy clay loam
 mCL Medium clay loam
 SCL Sandy clay loam
 mZCL Medium silty clay loam
 hZCL Heavy silty clay loam
 SZL Sandy silt loam
 fSL Fine sandy loam
 mSL Medium sandy loam
 LS Loamy sand
 LmS Loamy medium sand
 mS Medium sand

Structure

f, m, c sab Fine, medium or coarse subangular blocky
 f, m, c ab Fine, medium or coarse angular blocky

Colour

Codes refers to the Munsell Soil Colour Book
 For example 10YR4/2
 10YR is the hue
 4/ is the value
 /2 is the chroma

Mottling

Fe Iron (ochreous)
 Mn Manganese
 Com Common
 cfd Common, fine, distinct
 cmd Common, medium, distinct
 fff Few, fine, faint
 mfd Many, fine, distinct
 mff Many, fine, faint

A.4 Soil profile photographs from Ground Investigation samples

Graphic A-1 3E3113HP Typical Upton 1 soil. Medium clay loam over heavy clay loam and chalk, WC I and Grade 2



Graphic A-2 3F2521HP Typical Carstens soil. Medium clay loam over heavy clay loam, WC II and Grade 2



Graphic A-3 3F3602HP Medium clay loam over slowly permeable clay. WC IV and Subgrade 3b



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Graphic A-4 3W8535SA Sandy silt loam over sandy clay loam and sandy clay. WC II and Grade 2



Graphic A-5 3H4511HP Typical Wickham soil, medium clay loam over clay, WC IV and Subgrade 3b



Graphic A-6 3J5003HP Medium sandy loam over clayey sand. WC II and Grade 2



Graphic A-7 3L6027HP Typical Windsor soil. Clay/silty clay over clay. WC IV and Grade 4



A.5 Soil profile data – Above Ground Plant sites

Break Pressure Tank and Intermediate Pumping Station E

Stone types		
%	TA _v	EA _v
hard	1	0.5
chalk	10	7

Climate Data	
MDwheat	103
MDpotato	95
FCD	166

Wetness Class Guidelines		II	III	IV	V
SPL within 80cm, gleying within 40cm					
SPL within 80cm, gleying at 40-70cm					
No SPL but gleying within 40cm	coarse subsoil	/		other cases	//

Maximum depth of auger penetration is underlined

Site No.	Depth cm	Texture	CaCO ₃	Colour	Mottle colour	abundance	stone % hard	stone% chalk	Struct-ure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
PIT 1	0	28	HCL	very	10YR4/2		15			43	43			/	2	2	WE DR
	28	120	Chalk	very	10YR7/2					71	42						
											Total	114	85	Chalk was fri granular medium (5-30mm)			
											MD	11	-10				
										Droughtiness grade (DR)		2	2				
PIT 2	0	30	hZCL	very	10YR4/2		14			49	49			/	2	2	WE DR
	30	<u>47</u>	mCL	very	10YR7/2			60		21	21						
	47	120	Chalk	very	10YR7/2					52	23						
											Total	123	94	30cm+ mZCL, fractured chalk, small peds.			
										MD	20	-1	From 80cm+ chalk fragments <100mm				
										Droughtiness grade(DR)		2	2				
Auger 3	0	<u>25</u>	HCL	very	10YR4/2		15			39	39			/	2	3a	DR
	25	120	Chalk	very	10YR7/2					74	45						
											Total	113	84	Western field. OSR stubbles with flints <250mm			
											MD	10	-11	Assume fractured chalk from 25cm+			
										Droughtiness grade(DR)		2	3a				
Auger 4	0	28	C	very	10YR4/2		15			41	41			/	3a	3a	DR
	28	<u>49</u>	Chalk	very	10YR7/2					21	21						
	49	120	Chalk	very	10YR7/2					50	21						
											Total	112	83	Topsoil fri granular medium			
										MD	9	-12	28+ friable granular chalk				
										Droughtiness grade(DR)		2	3a				

Intermediate Pumping Station F

Stone types		
%	TAv	EAv
hard	1	0.5
chalk	10	7

hard flint & pebble

Climate Data	
MDwheat	114
MDpotato	109
FCD	162

Wetness Class Guidelines	II	III	IV	V
SPL within 80cm, gleying within 40cm	>71cm	44-71cm	<44cm	
SPL within 80cm, gleying at 40-70cm	>57cm	<57cm		
No SPL but gleying within 40cm	coarse subsoil	I	other cases	II

Maximum depth of auger penetration is underlined

Site No.	Depth cm	Texture	CaCO ₃	Colour	Mottle colour	abundance	stone% hard	stone% chalk	Structure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
SE1	0	24	hCL	y	10YR 4/3		3	5		41.016	41	n	n	II	3a	3a	WE
	24	<u>30</u>	hCL	y	10YR 3/4		2	5		9.24	9	n	n				
	30	65	ZC	y			0	50		36.25	44	(n)	(y)				
	65	120	Chk	very			0	90		<u>39</u>	<u>5</u>	n	n				
									Total	125	99						
									MD	11	-10						
									Droughtiness grade (DR)	2	2						
SE2	0	25	hZCL	y	10YR 4/3		2	5		45	45	n	n	III	3b	3b	WE
	25	55	ZC	y	7.5YR 4/6	Mn cfd	2	10	poor	32	35	n	y				
	55	65	hZCL	very	10YR 6/3	Mn cfd	0	70		8	12	y	n				
	65	120	Chk	very			0	0		<u>39</u>	<u>5</u>	n	n				
									Total	124	97						
									MD	10	-12						
									Droughtiness grade(DR)	2	3a						

Graphic A 8 SE1



Graphic A 9 SE2



Intermediate Pumping Station G

Stone types		
%	TAv	EAv
hard	1	0.5

hard flint & pebble

Climate Data	
MDwheat	107
MDpotato	100
FCD	172

Wetness Class Guidelines	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
SPL within 80cm, gleying within 40cm	>75cm	47-75cm	<47cm	
SPL within 80cm, gleying at 40-70cm	>61cm	<61cm		
No SPL but gleying within 40cm	coarse subsoil		<i>I</i> other cases	<i>II</i>

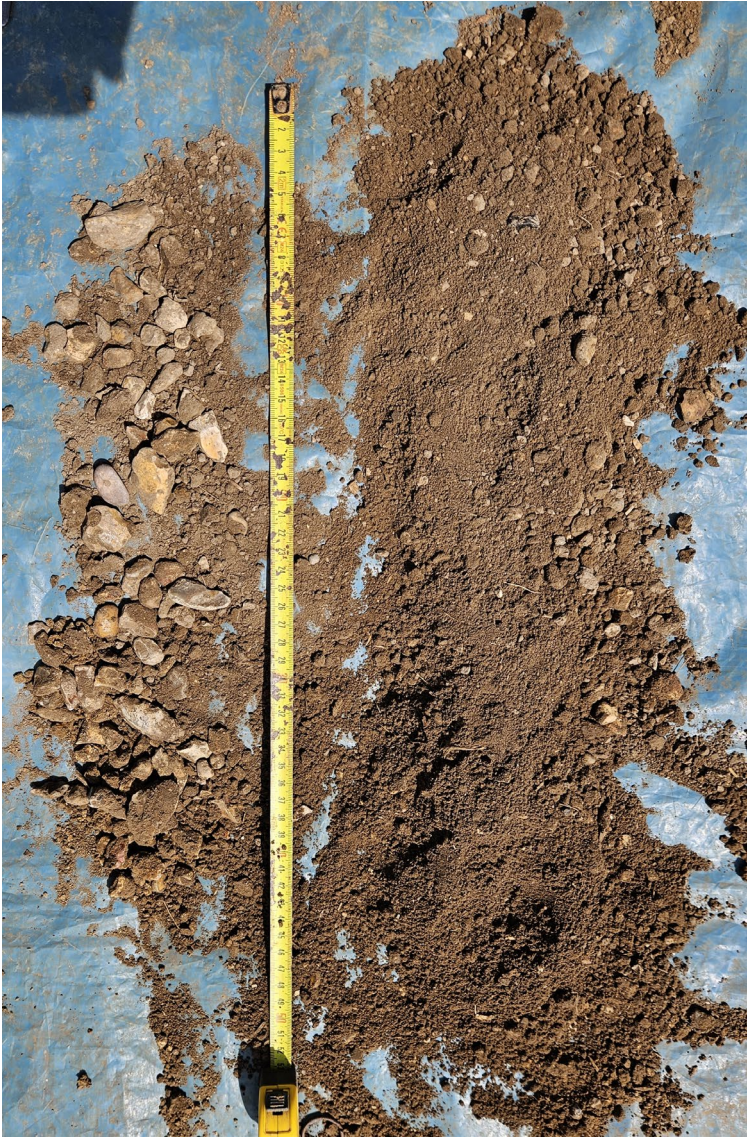
Maximum depth of auger penetration is underlined

Site No.	Depth cm	Texture	CaCO ₃	Colour	Mottle colour	abund- ance	stone% hard	stone% hard	Struct- ure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
TL1	0	20	SZL	n	10YR 4/4		20			30.8	31	n	n	<i>II</i>	1	3a	DR
	20	<u>40</u>	SZL	n	10YR 3/3		50			18	18	n	n				
	40	120	SL				50			<u>48</u>	<u>24</u>						
										Total	97	73					
									MD	-10	-27						
									Droughtiness grade (DR)		3a	3a					
TL2	0	25	SZL	n	10YR 3/2		22			38	38	n	n	<i>I</i>	1	3a	DR
	25	<u>40</u>	SZL	n	10YR 3/3		25			20	20	n	n				
	40	120	SL				50			<u>48</u>	<u>24</u>						
										Total	105	81					
									MD	-2	-19						
									Droughtiness grade(DR)		3a	3a					

Graphic A-10 TL1



Graphic A-11 TL1



Break Pressure Tank K

Stone types		
%	TA _v	EA _v
hard	1	0.5

hard
flint & pebble

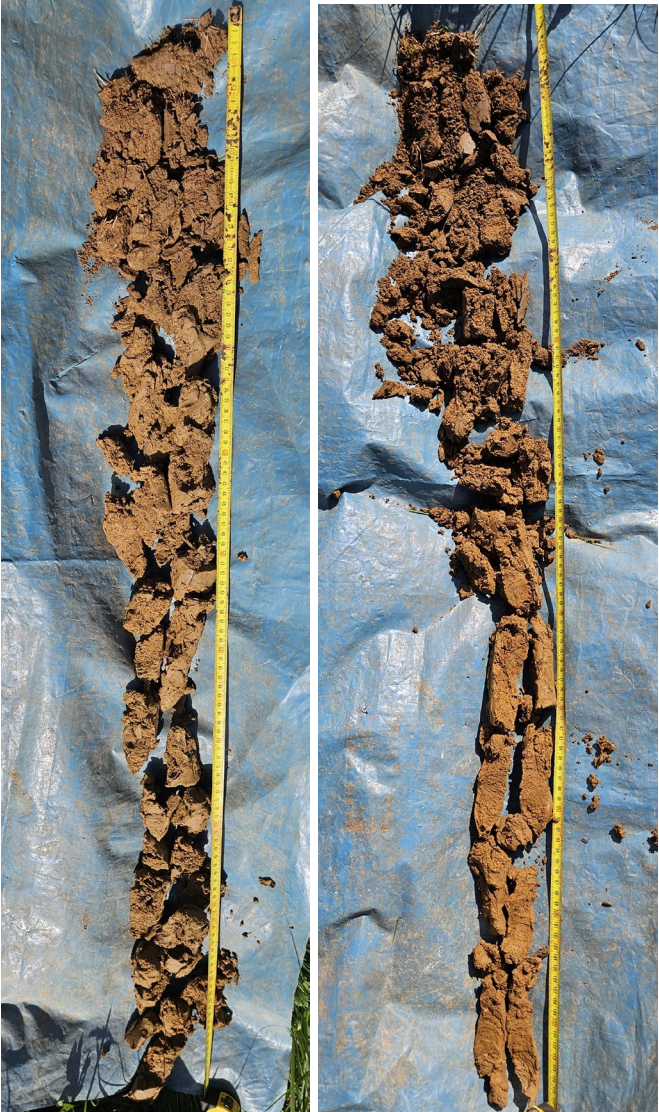
Climate Data	
MDwheat	103
MDpotato	95
FCD	180

Wetness Class Guidelines	II	III	IV	V
SPL within 80cm, gleying within 40cm	>76cm	49-76cm	<49cm	
SPL within 80cm, gleying at 40-70cm	>64cm	<64cm		
No SPL but gleying within 40cm	coarse subsoil		I other cases	II

Maximum depth of auger penetration is underlined

Site No.	Depth cm	Text ure	CaCO ₃	Colour	Mottle colour	abund- ance	stone% hard	stone%	Struct- ure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)
WH1	0	25	hZCL	n	10YR 4/2	och	cmd	0		47.5	48	y	n	IV	4	4	WE
	25	120	C	n	10YR 5/2	och Mn	mmp	0	poor	82	59	y	y				
										Total	129	106					
										MD	26	11					
										Droughtiness grade (DR)				2	1		
WH2	0	25	hZCL	n	10YR 4/2	och	cmd	2		47	47	y	n	IV	4	4	WE
	25	70	C	n	10YR 5/2	och Mn	mmp	0	poor	47	59	y	y				
	70	120	C	n	10YR 5/1	och Mn	vmmp	0	poor	35	0	y	y				
										Total	128	105					
									MD	25	10						
										Droughtiness grade(DR)				2	1		

Graphic A-12 WH1 Graphic A-13 WH2



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from
Southern
Water. 

The Southern Water logo graphic consists of three stylized, white, wavy lines that resemble water or a breeze, positioned to the right of the word 'Water'.