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**Report to Defra for Project SP1304: Evaluation of the
Occurrence of Soils with pH Higher than 8.3 Observed
Within the Countryside Survey**

Final Report

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Contents

Executive Summary:	3
Abstract	4
1) Identification of soils in Countryside Survey (CS) with pH higher than 8.3	5
1.1 <i>Theoretical background</i>	5
1.2 <i>Review of CS soil pH data</i>	5
2) Assessment of CS soil pH values	7
2.1 <i>Summary of methodologies used in CS</i>	7
2.2 <i>Re-analysis of CS2007 samples with pH > 8.3</i>	7
2.3 <i>Re-appraisal of soil pH analyses used in methodological comparison</i>	9
3) Evaluation of the possible causes for elevated pH values	11
3.1 <i>Natural occurrence</i>	11
3.2 <i>Management</i>	12
3.3 <i>Atmospheric pollution</i>	12
4) Evaluation of the possible implications for elevated pH values	15
References	19
Note 1: Principal measurements made on soils from CS2007 with pH>8.3	20

Executive Summary

Countryside Survey (CS) data published in 2007 (CS2007) suggested that there has been a progressive increase, since the first CS in 1978, in soils with pH higher than 8.3 and above. The objectives of this project were to

1. Identify soils in the CS survey with pH>8.4 and analyze for possible trends in time of increasing pH values for the same locations across CS surveys.
2. If the trend was confirmed, to evaluate the causes of this elevated soil pH. The possible causes for high pH values in soils fall into three categories: natural occurrence, management, and contamination.

We found in this study:

1. Using CS data collected in 1978, 1998, and 2007, that the mean soil pH for locations with pH>8.3 and sampled in all three surveys had experienced an increase of ~1 pH unit from 1978 to 2007.
2. The majority of samples were from calcareous soil types or over calcareous parent material, and predominantly in the Arable Broad Habitat type. Visual observation of samples revealed the presence of abundant calcite crystals in most of the soils indicating that farming practices may be bringing calcareous minerals to the surface via deeper ploughing. In addition, the region where soil pH is increasing is coincident with the greatest decrease in acid atmospheric deposition over the last 20 years.

We also found, using a stability diagram, that more than half of the soils in this study were located in the area where a decrease in permeability is expected. A stability diagram considers the variables affecting soil colloid stability, like electrical conductivity, Na/Ca ratio, and pH, and delineates the threshold which separates the stable from unstable soils. Stability issues in soils have broad implications for erosion and runoff. Since the preservation of aggregate stability is crucial for soil function it is imperative that soils susceptible to degradation are identified and specific studies made to mitigate soil structural damage.

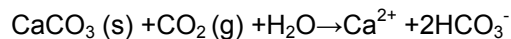
Abstract

Soil pH values in the UK have generally increased during the last three decades but this increase has been particularly pronounced in the South-East of England. There has also been a progressive increase, since the first Countryside Survey in 1978, in soils with pH values of 8.3 and above, indicating that pH may not be controlled by the presence of calcite alone. The maximum pH value in solution when calcite reaches saturation at atmospheric conditions is 8.3, but higher values can be reached when, in the presence of calcite, monovalent cations, most commonly sodium, are accumulated. The combination of high pH and the presence of sodium has detrimental effects on soil properties with implications for ecosystem function and services. This combination is associated with colloid dispersion, loss of organic carbon, decrease in soil permeability, and increase in run-off and erosion. Using Countryside Survey (CS) data collected in 1978, 1998, and 2007 we found that the mean soil pH for locations with $\text{pH} > 8.3$ and sampled in all three surveys had experienced an increase of ~ 1 pH unit from 1978 to 2007. The majority of samples were from calcareous soil types or over calcareous parent material, and predominantly in the Arable Broad Habitat type. Visual observation of samples revealed the presence of abundant calcite crystals in most of the soils indicating that farming practices may be bringing calcareous minerals to the surface via deeper ploughing. In addition, the region where soil pH is increasing is coincident with the greatest decrease in acid atmospheric deposition over the last 20 years. Relatively low Na/Ca ratios indicated a system still controlled mostly by calcite rather than sodic salts. However, when the soils were plotted on a stability diagram that considered the variables affecting soil colloid stability, more than half of the soils were located in the area where a decrease in permeability is expected. This has broad implications for erosion and runoff. Since the preservation of aggregate stability is crucial for soil function it is imperative that soils susceptible to degradation are identified and specific studies are made to mitigate soil structural damage.

1) Identification of soils in Countryside Survey (CS) with pH higher than 8.3

1.1 Theoretical background

The theoretical pH of a solution exposed to the atmosphere ($p_{\text{CO}_2}=10^{-3.5}$ atm) in the presence of calcite crystals is pH=8.3 (Stumm and Morgan, 1996) according to the following chemical equation and equilibrium thermodynamics:



The partial pressure of CO_2 in soils can be more than 100 times higher the atmosphere so that pH values from 7.5 to 8.5 may indicate calcite saturation. When pH is controlled by the calcite system only, soils do not in general exhibit structural problems since the abundance of Ca provides good aggregate stability. When monovalent cations, like sodium, accumulate in the soil, the pH can rise above 8.3 causing dispersion of soil colloids. For this study we have chosen a value of 8.3 as the threshold above which soil pH may no longer be controlled by calcite.

1.2 Review of CS soil pH data

The results from Countryside Survey 2007 (CS2007) have shown a general increase in soil pH across most Broad Habitats in Great Britain since the first survey in 1978 (Carey et al., 2008; Emmett et al., 2010). In some localized areas of the South East of England data from CS squares sampled in all three surveys (Fig 1A) show a distinct increase in the median soil pH from ~7.5 in 1978 to ~8.5 in 2007 (Fig. 1B). This full pH unit increase is considerable taking into account that pH is a logarithmic scale. Of this increase, 0.74 units change occurred between 1978 and 1998. Figure 2 shows the number of samples determined to be pH>8.3 in 1978, 1998 and 2007, with the yellow background of points representing the CS squares where samples were taken in CS2007. Fewer samples were taken in 1978 and 1998 compared to 2007 and there are relatively few points that represent plots re-sampled in all three surveys. From Fig. 2 we observe an increasing number of points with pH>8.3.

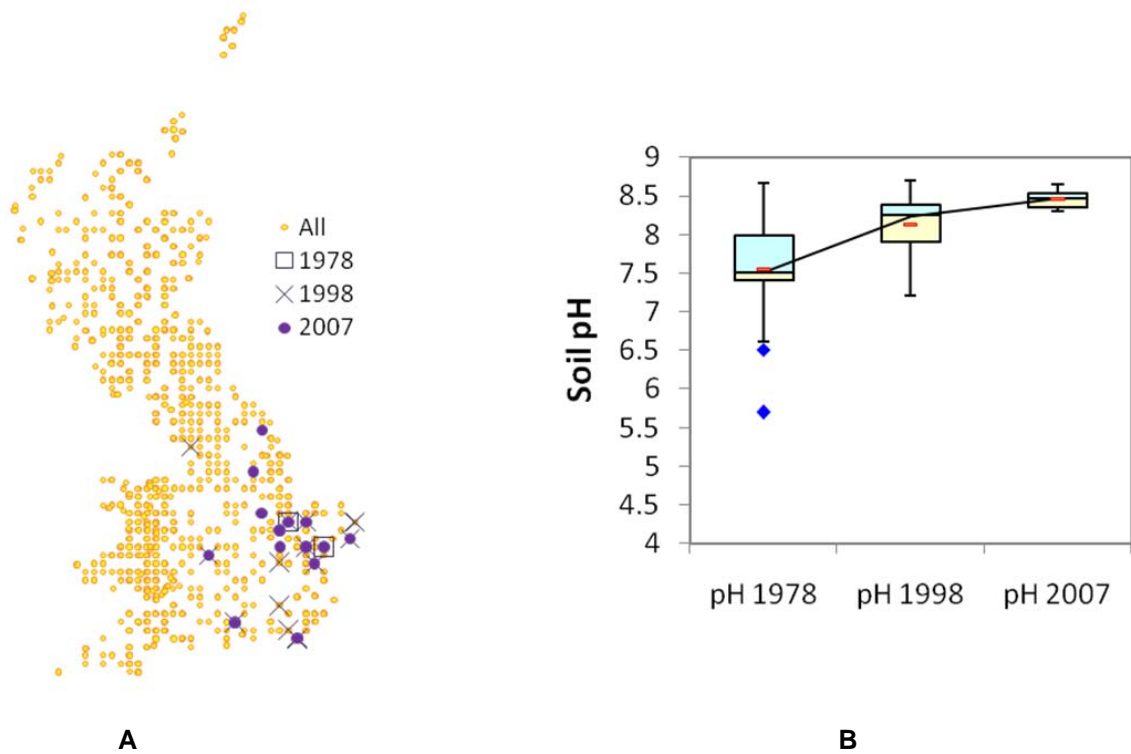


Figure 1. A) Map of points sampled in CS2007, with locations where repeat plots had pH ≥ 8.3 in any of the 3 surveys. The number of repeat plots with higher pH values has increased over time. B) Boxplot of pH change with time, using 2007 repeat plots that had a pH ≥ 8.3 . The line on the graph joins the median values.

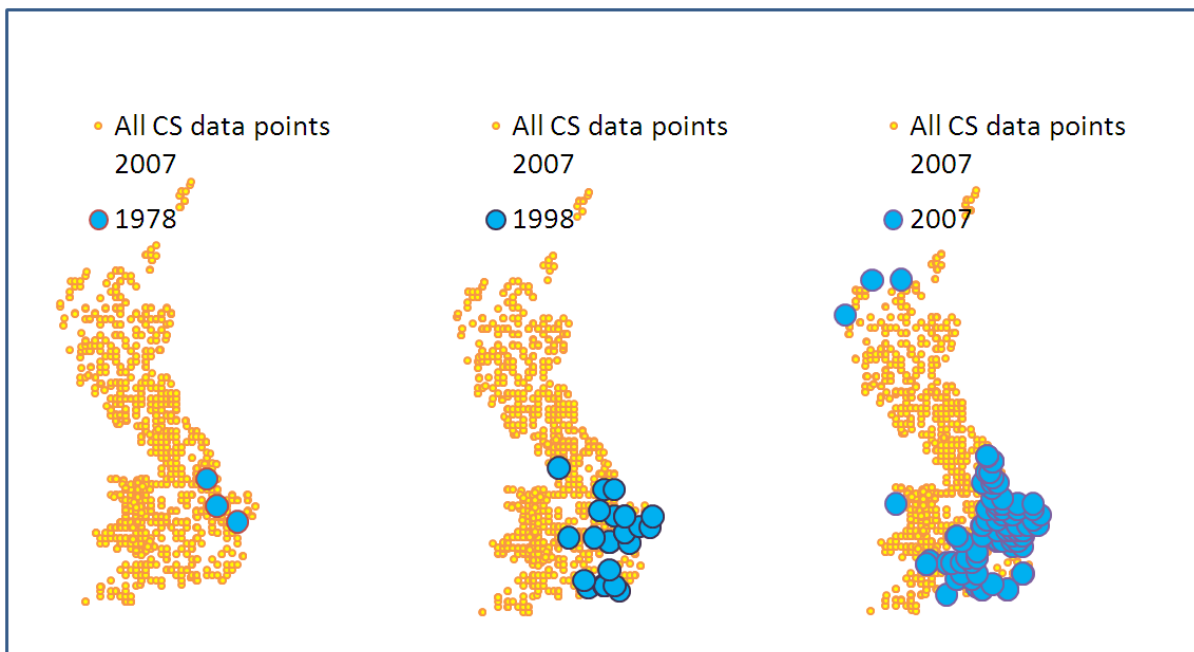


Figure 2. Locations of soils with pH > 8.3 for the Countryside Surveys of 1978, 1998, and 2007.

2) Assessment of CS soil pH values

2.1 Summary of methodologies used in CS

In 1978 and 2007, the pH of fresh soil was measured using a modified version of the method employed by the Soil Survey of England and Wales (Avery & Bascomb, 1974) in which 25 ml of deionised water (DIW) was added to 10 g of field-moist soil in a 50 ml plastic beaker to give a ratio of soil to deionised water of 1:2.5 by weight. The suspension was stirred thoroughly and left to stand for 30 minutes after which time the pH electrode was inserted into the suspension and a reading taken after a further 30 seconds.

The fresh soil pH measurements were made as soon as possible after the sample was opened in the laboratory. Care was taken to ensure that the temperature of the buffer solutions used to calibrate the pH meter differed by no more than 1°C from the temperature of the soil suspensions. The pH electrode was carefully rinsed and dried between each measurement; particular care was taken to clean the electrode following calibration with buffer solutions. The calibration of the pH meter was checked after a batch of 25 samples using pH 4 and pH 7 buffer solutions. If either of the buffer solution calibration values differed by more than 0.02 pH units from the expected value, the meter was re-calibrated. A standard soil, a certified reference soil and a duplicate analysis was performed on every batch of 25 samples

In 1978 and 2007 the soil samples were analyzed for pH in CEH-Bangor using a soil:DIW ratio of 1:2.5, however samples from the CS1989 were analyzed in Lancaster where soil pH was measured using the protocol described by Allen (1989) that gave a suspension with a soil :water ratio of approximately 1:2 by weight. Evidence from the literature (summarised in Emmett *et al.*, 2008) indicated that this small difference in ratio would not lead to a significant difference in pH results. Notwithstanding, the comparability of the two methods was checked by measuring soil pH in deionised water on a subset of approximately 200 air-dried samples taken from the 1998 soil sample archive. The comparison of the repeated measurements gave no cause for concern in relation to the comparability of the two methods (Emmett *et al.*, 2008), although the data are discussed below in relation to the effects of sample aging on soil pH measurement. It should be noted that in 1978, soil pH was reported to 0.05 pH units whereas data were reported to 0.01 pH units in 1998 and 2007

2.2 Re-analysis of CS2007 samples with pH > 8.3

In order to confirm the results from CS2007, soil pH was measured on 106 archived, air-dried samples from CS2007 out of the original 153 soils with pH equal to or greater than 8.3. The selection of the samples was made to have a maximum geographical and habitat coverage within the stock remaining in the archives. The same method was used as in 2007 (1:2.5 soil:DIW ratio).

When reanalyzed we found that the measured pH of the archived samples was consistently lower than the published data for field moist samples from CS2007 (Fig. 3) This discrepancy can be explained by the soils having been air-dried and stored for ~4 years in dry conditions. Under field conditions, soils host a large microbial and invertebrate population which stimulates biological activity affecting dissolution and precipitation of minerals in the soil profile. The elimination of water for long periods of time, as in the case of stored soils, alters natural biogeochemical cycles causing solutes dissolved in soil pore water to precipitate. Dissolved organic carbon, normally present in the soil, may coat the precipitates as water is driven off and this will affect the subsequent solubility of the minerals when the soils are re-wetted. Residues of the living organisms that were in the soil at the time of sampling may also contribute to the coatings formed on mineral surfaces. Over time, the precipitated salts undergo an ageing process changing to more stable mineral phases; when the soils are rewetted the chemical equilibrium attained is not necessarily the same as before, especially when the salts are not highly soluble, as in the case of calcite. Other processes may occur during soil drying that affect intrinsic structural components such as cementing of colloidal particles by mineral precipitates consolidating very small pores. Where those areas become hydrophobic due to coating by the omnipresent organic matter, water will not have immediate access (Abdul-Kareem and McRae, 1984).

When we reanalysed the soils from CS2007 with $\text{pH} > 8.3$, we found only 6 samples from the 106 analyzed to have a $\text{pH} > 8.3$ (Fig.3; Table 1 in Note 1), although visually we observed that almost all of them contained white crystals identified as calcite (Fig. 4). Identification was performed by the addition of hydrochloric acid into some of the handpicked white crystals and observing effervescence caused by the production of CO_2 . The calcite crystals observed in the soils in this study are unlikely to have a pedogenic origin since pedogenic calcite crystals rarely reach a size visible to the naked eye (Lebron and Suarez, 1995). It is most likely that the calcite crystals come directly from the parent material.

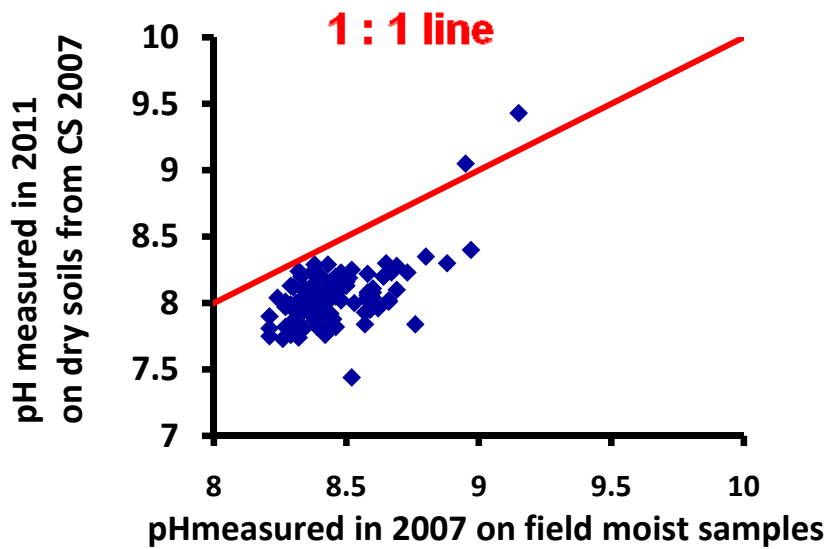


Figure 3. Relationship between the pH values from the CS2007 report (Emmett et al., 2010) and the pH values measured in this work.



Figure 4. Image showing a variety of soils with pH 8.3 or greater in the CS2007 report, reanalysed in this study. Calcite particles (white specks) are an integral part of the composition of the soil material for all of the samples.

2.3 Re-appraisal of soil pH analyses used in methodological comparison

The exercise to compare the pH method used in 1978 and 2007 and with that from 1998 provide a useful data resource of 200 samples with which to examine the effects of drying and ageing on soil pH measurement. In 1998 soil pH was measured both on field moist soils and within a few

days on a subsample of soil after air drying. Plotting data for air dried versus field moist soils (Fig. 5) shows that the majority of air-dried samples have lower pH values with relatively few (23%) with higher pH values. There is a more pronounced deviation from the 1:1 line as the pH increases above 8.0. For these high pH samples, we attribute the discrepancies between the pH measured in fresh versus dry soil to a reduction in calcite dissolution kinetics.

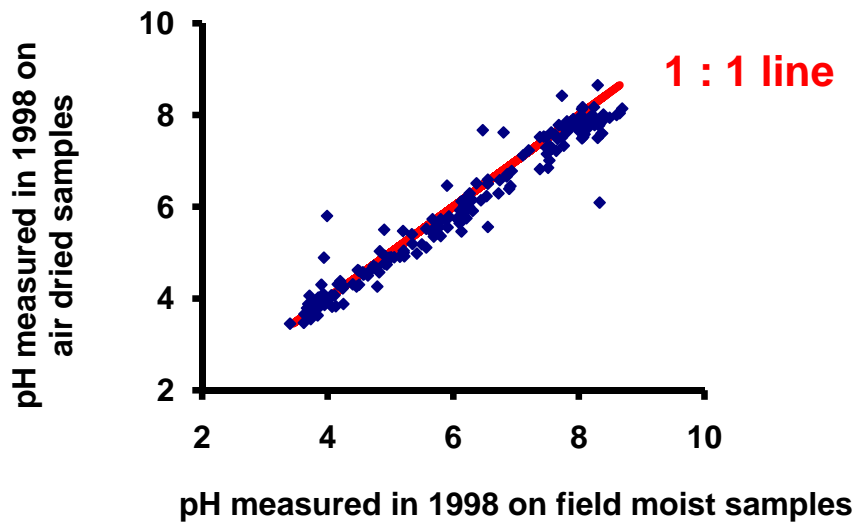


Figure 5. Soil pH values measured in 1998 on samples of field moist soil and on samples from the same soil after air drying. Both measurements were performed in a soil: deionised water ratio of 1:2.0.

The same samples shown in Fig. 5 were re-measured in 2007 after 9 years of storage in dry conditions to investigate the effect on soil pH measurement of changing the soil:water ratio from 1:2.0 to 1:2.5. The scatter of points about the 1:1 line in Fig. 6 is more random compared to Fig. 5, we observe that about 2/3 of the data are, again, below the 1:1 line and that at high pH there is deviation from linearity. Whilst the effects of different methodologies cannot be unequivocally ruled out, the data more likely indicate that other processes are occurring such as ageing of the mineral phases precipitated after drying the soil and transformation towards more stable minerals.

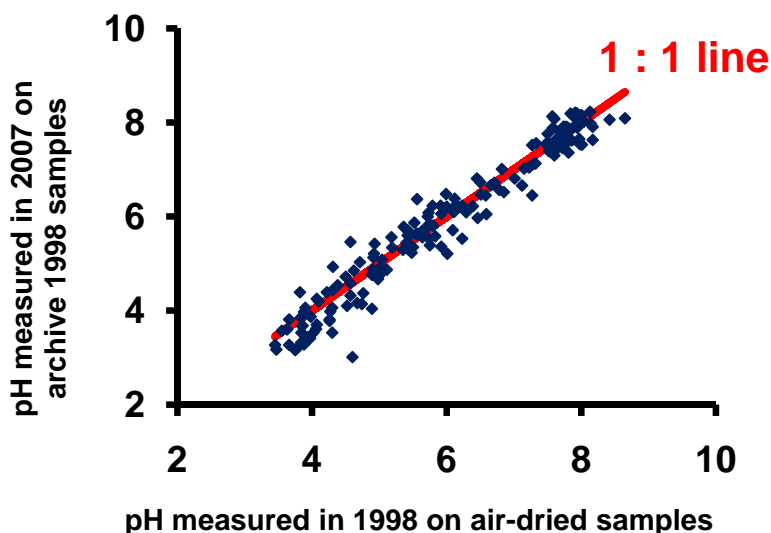


Figure 6. Soil pH values measured on air-dried soils in 1998 and then again in 2007. In 1998 the ratio of soil to de-ionised water was 1:2.0; in 2007 the ratio was 1:2.5.

3) Evaluation of the possible causes for elevated pH values

3.1 Natural occurrence

The majority of the samples investigated in this study were found on calcareous soil types and over calcareous parent materials; these would be important factors leading to pH values close to 8.3 (Table 1). Observation of 2-4 mm sized calcite crystals in many of the samples indicates that they come from the parent material rather than being of pedogenic origin, suggesting that changing arable practices may be an important factor influencing soil pH change between the surveys (see below). With the exception of several coastal locations, the pH values measured in this study, as compared with the ones published in the CS2007 report (Emmett et al., 2010) indicate that the high pH values in Emmett et al. (2010) were due exclusively to the presence of calcium carbonates rather than sodium carbonates. If the latter were present, the pH values measured in this study would have been as high as the previous measurements because sodium carbonates are much more soluble than their calcium counterparts and are not subject to as many kinetic or inhibitory effects. The sample points with the highest pH values are very close to the coast and are mapped as Littoral Sediment or Supra-littoral Sediment Broad Habitats where sodium will be abundant. The two samples above the 1:1 line in Fig. 3 (samples 64x2 and 1084x3) were identified from coastal locations (Table 2 in Note 1) with relatively high sodium/calcium ratios (Table 1 in Note 1) it is then likely that the presence of the highly soluble sodium bicarbonate accounts for both the high pH values (~ 9) and the proximity to the 1:1 line in Fig. 3. Detailed information on the location, Broad Habitat, soil type and parent material associated with each sample can be found in Table 2 in Note 1.

3.2 Management

We found that most of the soils investigated were in the Arable Broad Habitat (Table 1). The significant increase in mean soil pH from 1978 to 2007, observed for managed agricultural land, will be influenced by farming practices like liming, use of fertilizers, irrigation. In particular, deeper ploughing is likely to bring relatively un-weathered chalk or chalky till parent material to the soil surface. The presence of 2-4 mm calcite particles in the soil samples supports this explanation.

3.3 Atmospheric pollution

In England, many areas of arable and arable ley or short term grassland are located in areas close to emission sources and will have experienced relatively large reductions in acid deposition loading, especially from dry deposition of SO₂ (NEG-TAP, 2001) compared to areas further west where wet deposition dominates inputs (Emmett et al., 2010).

The area of land under Group 1 in Fig. 7A is where the decrease in SO₂ deposition has been the most rapid in the past 20 years (Fig.7B). Lower acid inputs over the last 20 years would allow the soils to recover from acidification and re-establish their natural condition. In this case since the parent materials are calcareous it is not surprising that pH values have been increasing as the soils will be well buffered and will recover quickly. Figure 8 shows in red the areas where pH values are above 8.5 in 2007. By comparing with Fig 7A we observe that high pH values are within the same regional boundaries as those depicted for Group 1. Group 2 also has some geographical similarities with the more neutral zone, depicted in yellow, in Fig. 8.

Table 1. Summary breakdown of factors influencing soil samples with pH 8.3 or greater from CS2007 and potential relevance for soil management. Numbers of samples in parentheses.

Proximate factors		Ultimate factors	Relevance
Location	Soil	Parent material & Land use	
Coastal (21)	-	<ul style="list-style-type: none"> - Parent material typically sedimentary carbonate (Chalk/Limestone) or unconsolidated sandy deposits (Aeolian). - Broad habitats include littoral, neutral grassland or calcareous grassland. 	<ul style="list-style-type: none"> - Samples from England, Wales & Scotland. - High pH is primarily influenced by sodium due to their proximity to the sea.
Inland (132)	Calcareous (87)	<ul style="list-style-type: none"> - Roughly equal numbers on sedimentary carbonate (Chalk/Limestone) and unconsolidated deposits (Glacigenic, Fluvial & Marine derived). - Predominantly Arable broad habitat with some Improved grassland, Neutral grassland and Broadleaf woodland 	<ul style="list-style-type: none"> - Samples from England only. - High pH can be accounted for by natural occurrence of calcareous soils. - Modern arable practices (e.g. deeper ploughing) may bring calcium-rich material to surface.
	Non-Calcareous (42)	<ul style="list-style-type: none"> - Parent material is mostly unconsolidated deposits (Glacigenic, Fluvial & Marine derived) with a few sedimentary carbonate (Chalk/Limestone). - Predominantly Arable broad habitat with a few Neutral grassland and Broadleaf woodland. 	<ul style="list-style-type: none"> - Samples from England only. - High pH generally not accounted for by natural occurrence of calcareous soil. - Modern arable practices (e.g. deeper ploughing) may bring calcium-rich material to surface.
	Data NA (3)	-	-

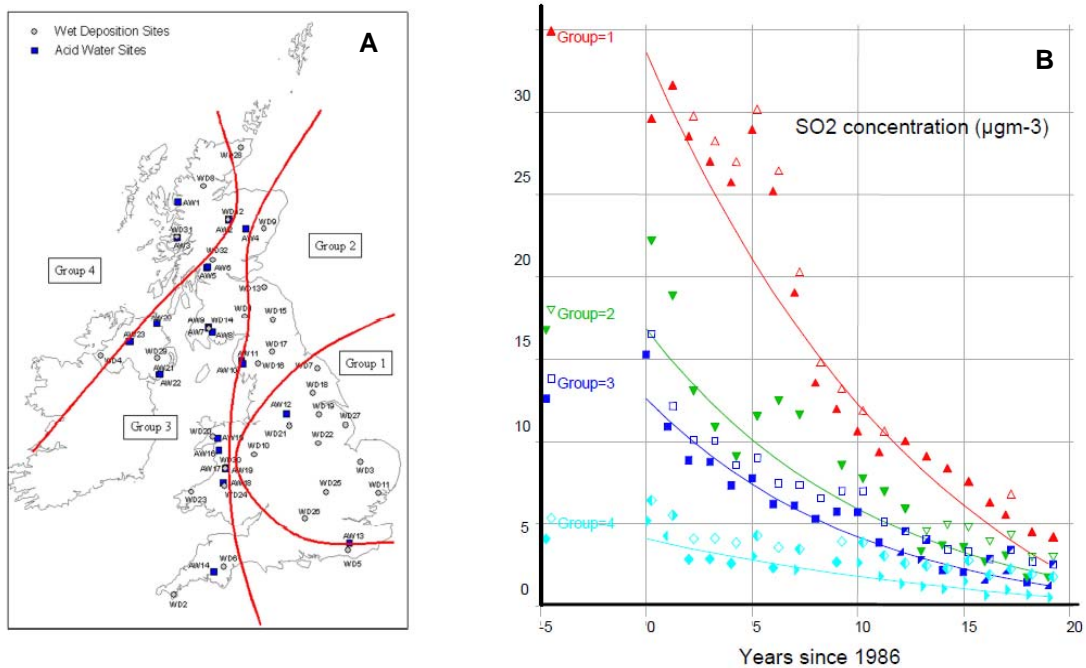


Figure 7. A) map for UK and The regional grouping of sites in the UK precipitation chemistry network used in the statistical analysis of trends. B) Trends in SO₂ over the last 20 years in the four groups of monitoring stations (Emmett et al., 2010).

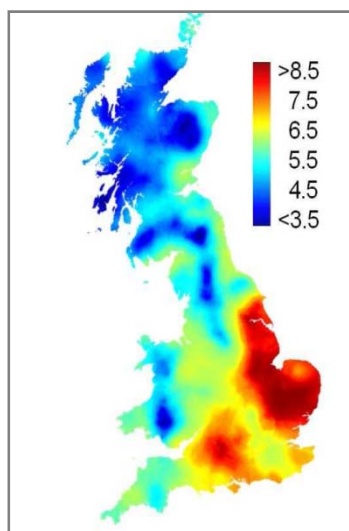


Figure 8. Map of soil pH (0-15 cm) using ordinary kriging (Emmett et al., 2010)

4) Evaluation of the possible implications for elevated pH values

The presence of monovalent cations, for example sodium, in soils can cause the pH to increase to higher values than those expected if calcite were the only mineral controlling the pH in the system. High pH values and high Na/Ca ratios in soils have multiple negative effects on the functionality of soils, but the emergent properties most clearly affected are soil structure and hydraulic conductivity. Soil structure is defined as the arrangement of soil particles (Baver, 1940) and when these coalesce they form aggregates and the compliment pore space. Poor management or changes in the ecosystem may cause the pH to increase with the consequent degradation of soil aggregates which break apart releasing fine particles. Water movement helps to transport these colloids clogging pores deeper in the soil profile and causing a decrease in hydraulic conductivity. To describe the relationship between hydraulic conductivity and solution composition, Quirk and Schofield (1955) developed the concept of 'threshold concentration'. Threshold concentration is defined as the concentration in the percolating solution that would give a 10-15% decrease in the relative permeability at a given exchangeable sodium percentage (ESP; Fig. 9). ESP is difficult to measure and the sodium adsorption ratio (SAR) can be used as a surrogate which is linearly correlated with ESP for values below 30 (U.S. Salinity Laboratory Staff, 1954). SAR is defined as:

$$SAR = \frac{(Na)}{\sqrt{\frac{(Ca) + (Mg)}{2}}}$$

Where the cationic concentrations are measured in the extract from a saturated paste and expressed in $\text{mmol}_c \text{L}^{-1}$.

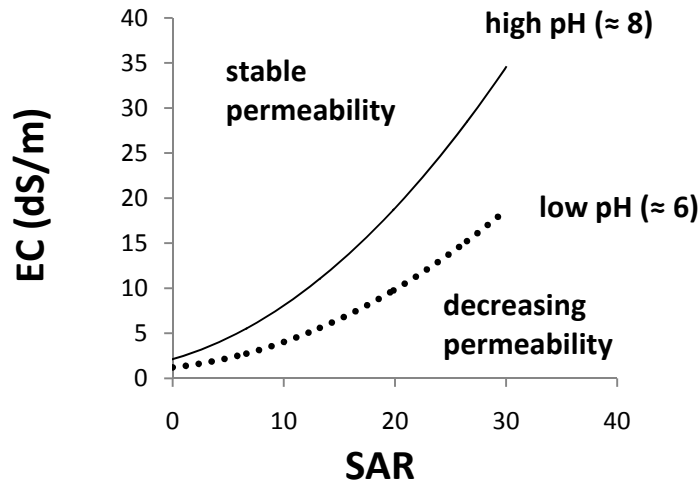


Fig. 9. Stability diagram for Rothamsted soil (dashed line), after Quirk and Schofield (1955). Continuous line represents the theoretical displacement of the threshold line when pH increases, for example from 6 to 8 (Mays, 2007).

Figure 9 shows the threshold line (dashed line) that delineates the conditions at which a soil can become unstable as a result of changing chemical conditions, for example a soil with a pH = 6, a SAR of 10 and EC = 5 dS/m can become unstable if irrigated with water that increases the SAR to 15. The same effect would be achieved by keeping the EC and SAR constant but increasing the pH above 8. Unfortunately, the threshold line to separate stable from unstable soil, is not universal; different mineralogies, climatic conditions, and organic matter content affect the stability of a soil and different stability lines are published for different soils in the literature.

Conventionally EC, and SAR in the diagram in Fig. 9 are measured in the liquid extracted from a saturated paste, the ratio between soil:DIW for a saturated paste for a typical soil is approximately 1:0.5. However for this study, the amount of soil available for analysis was smaller than the required for the preparation of the paste, consequently we prepared 1:2.5 soil:DIW water suspensions and after measuring the pH, we filtered the supernatant and use that extract to analyze for EC, and cations. We do not anticipate any impact on the results as a consequence of the different soil:DIW ratio but we will have to account for it when representing our data in the stability diagram. Cations were analyzed by atomic absorption in a Perkin Elmer 400. The results in Fig. 10 shows the analyzed data in the 1:2.5 expressed in $\text{mmol}_c \text{L}^{-1}$ after multiplying by 5, which is the correction factor to express the results in the 1:0.5 ratio of a typical saturation extract.

We plotted the soils in this study on to the Quirk and Schofield diagram (Fig. 10) as this was developed using soil from Rothamsted in England which will be similar to many of the soils encountered in this study. We observed that more than half of the soils in this study are located in the

area where stability is possibly compromised. More specific studies need to be done to clarify and confirm the stability status of the particular soils in this study. Five soils from this study have been excluded from Figure 10 because the EC and SAR for those soils were one order of magnitude higher than for the rest and, outside of the range of determination for the Quirk and Schofield threshold line. All the data are presented in Table1 in Note 1.

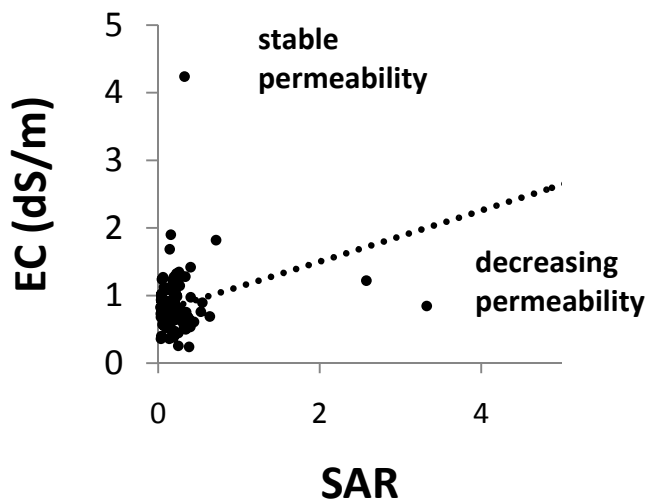


Figure 10. Threshold line from Quirk and Schofield (1955) with Rothamstead soil and soils from CS-2007 with pH>8.3.

Conclusions

Re-analysis of archived, air-dried samples of soils found to have a pH > 8.3 in 2007 showed pH values that were systematically 0.3 to 1.0 units lower than those reported for field moist soils in Emmett et al. (2010). This result is consistent with data from measurements in 1998 which showed lower pH values measured on air-dried compared to field moist soils. Furthermore, re-analysis in 2007 of samples stored since 1998 suggests that soil pH may be affected by ageing of the sample. The differences in soil pH are attributed to physico-chemical and biological transformations that affect soils during the drying process, including precipitation of salts and coating of mineral particles by organic matter. Changes in mineral phases with time may irreversibly alter the equilibrium dynamics of mineral phases which will directly affect the chemistry of re-wetted soils. Such changes during the drying and storage of soils should be considered when planning studies using archived soils from repositories.

The most likely reason for the increase in pH with time in the soils investigated in this study is the decrease in the last 20 years of acid deposition, particularly SO₂ dry deposition, which has allowed the soils to recover towards their natural soil pH. This natural pH is probably controlled by calcite for the majority of the soils analyzed. Soil erosion and agricultural management practices, such as deep ploughing may contribute to bringing more calcite minerals to the surface from the parent material.

Even with the lower pH values measured in this study we estimate that almost half of the soils investigated may possibly have structural problems with degradation of soil aggregate stability and function. More studies are needed to identify vulnerable soils and to completely understand the consequences that continuously increasing pH may have on soil quality and function in the UK.

Acknowledgements

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Note 1: Principal measurements made on soils from CS2007 with pH>8.3

Table 1. Series number and plot number for soils with pH close to or higher than 8.3 in the Countryside Survey in 2007 values shown in pH 2007 column, this pH was measured in a fresh sample at field moisture in a 1:2.5 soil: deionised water ratio. Measurements taken for this study were made from the dry soils stored for 4 years: pH, electrical conductivity (EC), sodium (Na), calcium (Ca), and magnesium (Mg) in a soil: water ratio of 1:2.5. Sodium adsorption ratio (SAR) was calculated by transforming the data to saturated paste (multiplying by a factor of 5).

Series Number	Plot Number	pH 2007	pH 2011	EC ($\mu\text{S}/\text{cm}$)	Na (mg/L)	Ca (mg/l)	Mg (mg/l)	SAR
40	X5	8.38	7.95	256	8.7	47.6	1.8	0.34
64	X2	8.95	9.05	244	27.4	5.6	1.8	2.58
64	X3	8.37	8.23	135	5.7	16.3	0.8	0.37
109	X2	8.48	8.11	179	1.9	32.1	0.7	0.20
109	X3	8.40	8.03	229	2.7	36.7	1.2	0.27
135	X2	8.29	7.80	284	5.1	58.2	1.9	0.40
135	X3	8.21	7.90	380	1.9	53.9	1.0	0.16
135	X4	8.24	8.04	202	2.2	35.0	0.7	0.23
135	X6	8.34	7.94	270	3.0	49.9	0.8	0.26
138	X4	8.34	8.10	246	2.7	44.4	0.7	0.25
138	X5	8.32	8.24	217	1.3	34.6	0.3	0.14
147	X4	8.43	8.29	151	2.9	25.4	0.7	0.35
147	X3	8.38	8.29	110	2.2	16.6	0.7	0.32
180	X2	8.34	8.10	158	1.8	28.1	0.5	0.21
180	X4	8.44	7.83	364	9.0	54.5	3.2	0.72
182	X2	8.31	7.86	337	1.8	59.0	0.9	0.14
182	X4	8.40	8.02	208	2.1	36.6	0.7	0.21
184	X2	8.46	8.10	115	1.1	20.1	0.4	0.15
212	X3	8.46	8.05	194	1.9	30.6	1.0	0.21
214	X1	8.48	8.02	222	0.8	31.7	1.3	0.08
214	X2	8.34	8.11	154	2.3	24.6	0.5	0.28
214	X3	8.66	8.02	236	2.0	25.7	1.4	0.23
214	X5	8.33	8.22	150	1.3	20.2	0.8	0.17
242	X1	8.58	8.22	155	1.0	24.2	0.3	0.12
242	X4	8.97	8.40	169	15.2	6.6	0.8	3.33
242	X5	8.51	8.19	48	2.6	16.2	0.8	0.38
279	X3	8.32	7.74	195	4.0	35.9	0.9	0.40
300	X2	8.42	7.76	265	2.7	51.1	1.4	0.23
308	X1	8.46	8.18	168	1.5	27.5	0.7	0.17
308	X4	8.50	8.13	180	1.6	33.6	0.8	0.17
310	X3	8.46	8.20	155	1.6	27.0	0.9	0.18
339	X2	8.48	8.23	152	1.6	27.0	0.5	0.19
339	X4	8.57	7.84	132	2.3	24.2	0.5	0.28

Series Number	Plot Number	pH 2007	pH 2011	EC ($\mu\text{S}/\text{cm}$)	Na (mg/L)	Ca (mg/l)	Mg (mg/l)	SAR
341	X2	8.60	8.08	130	1.5	21.7	0.3	0.20
341	X3	8.38	8.14	107	2.8	18.8	0.0	0.40
366	X1	8.44	8.16	136	1.3	22.7	0.2	0.17
366	X2	8.45	7.88	197	2.3	34.1	1.8	0.23
366	X4	8.43	8.11	138	5.1	23.4	0.4	0.64
367	X1	8.73	8.23	117	0.9	20.7	0.3	0.12
367	X3	8.64	8.20	115	0.9	21.0	0.2	0.12
367	X5	8.40	7.84	193	2.0	36.3	0.9	0.20
368	X1	8.65	8.30	243	1.9	39.1	2.0	0.18
368	X3	8.58	8.06	151	1.3	25.2	0.5	0.16
391	X3	8.33	8.03	255	2.1	42.9	0.6	0.20
391	X5	8.60	8.11	175	1.9	31.5	0.5	0.21
395	X2	8.29	7.76	95	1.4	17.7	0.3	0.20
396	X1	8.66	8.01	149	1.7	26.9	0.6	0.20
396	X3	8.69	8.10	133	2.5	21.9	0.3	0.33
396	X4	8.39	7.89	89	1.6	15.0	0.4	0.25
396	X5	8.60	8.04	130	1.9	21.1	0.8	0.25
398	X2	8.52	8.25	135	0.4	18.9	0.8	0.05
398	X3	8.36	8.02	149	0.5	21.2	0.8	0.06
398	X4	8.64	8.20	109	0.5	13.4	0.7	0.08
398	X5	8.48	8.11	103	0.7	9.5	0.7	0.13
419	X1	8.21	7.81	848	4.9	77.9	4.6	0.33
419	X3	8.48	8.13	184	1.8	27.3	1.4	0.20
477	X4	8.36	8.08	127	2.8	17.3	1.5	0.39
477	X5	8.35	8.10	152	4.0	19.5	1.4	0.53
477	X1	8.33	8.20	135	1.8	22.6	0.9	0.23
478	X1	8.29	7.99	185	1.3	25.4	1.3	0.15
478	X3	8.37	8.00	146	0.3	31.5	1.5	0.03
478	X4	8.38	7.98	140	0.9	18.3	1.1	0.12
478	X5	8.41	7.96	104	0.7	14.8	0.8	0.11
481	X3	8.40	8.02	100	2.2	15.1	0.4	0.34
481	X4	8.36	7.93	77	1.1	12.0	0.3	0.19
481	X5	8.26	7.73	134	1.2	18.5	0.8	0.17
484	X3	8.52	7.44	117	2.2	16.9	1.2	0.31
508	X1	8.69	8.28	4630	726.8	24.0	39.1	47.60
508	X2	8.30	8.12	6700	1073	50.4	76.1	49.84
508	X3	8.27	7.97	7380	1193	60.9	82.2	52.43
508	X4	8.32	8.00	6300	817.9	53.6	73.0	38.19
508	X5	8.39	8.10	5750	913.4	49.5	74.4	11.29
510	X5	8.40	8.21	122	10.6	10.4	0.4	0.44
510	X2	8.46	7.82	72	0.8	9.4	0.5	0.03

Series Number	Plot Number	pH 2007	pH 2011	EC ($\mu\text{S/cm}$)	Na (mg/L)	Ca (mg/l)	Mg (mg/l)	SAR
513	X2	8.40	8.06	80	1.0	12.6	0.4	0.04
533	X1	8.30	7.87	204	1.6	31.4	1.1	0.04
533	X3	8.58	8.02	133	2.3	23.7	0.3	0.06
533	X4	8.57	7.93	134	2.2	15.1	1.2	0.07
535	X1	8.21	7.75	187	1.5	28.4	2.4	0.04
535	X2	8.27	7.82	136	1.1	16.3	2.1	0.04
535	X3	8.32	7.83	143	1.7	18.5	2.8	0.05
535	X5	8.50	8.16	187	1.5	26.6	2.5	0.04
594	X4	8.35	8.02	197	1.7	34.4	0.7	0.04
595	X1	8.27	8.01	225	3.2	37.0	0.3	0.07
595	X2	8.36	8.09	196	2.1	34.1	0.5	0.05
595	X3	8.58	8.08	200	1.6	32.5	0.4	0.04
595	X4	8.29	8.13	200	1.7	34.3	0.3	0.04
609	X2	8.31	8.00	254	2.7	37.0	0.8	0.06
609	X4	8.80	8.35	114	1.8	20.1	0.2	0.05
624	X1	8.43	8.01	168	2.4	25.1	3.2	0.06
624	X2	8.44	7.92	206	2.1	32.2	3.4	0.05
624	X4	8.31	7.93	186	1.7	27.1	3.8	0.04
624	X5	8.35	7.95	142	1.6	19.2	3.5	0.05
624	X6	8.36	8.11	248	2.1	34.9	3.2	0.05
653	X1	8.38	7.87	177	2.0	30.4	1.3	0.05
653	X3	8.59	7.95	181	2.2	28.7	1.2	0.06
653	X5	8.53	8.00	156	2.1	28.6	0.5	0.05
653	X6	8.39	7.82	165	1.1	27.3	1.1	0.03
1084	X3	9.15	9.43	72	2.9	7.1	1.2	0.14
1084	X4	8.88	8.30	128	6.3	16.7	1.7	0.20
1084	X5	8.62	7.96	164	8.7	22.5	1.9	0.24
1174	X3	8.58	8.04	179	16.4	14.3	2.7	0.55
1174	X4	8.34	7.81	157	7.3	18.0	1.5	0.23
1249	X5	8.76	7.84	180	2.9	25.6	2.9	0.07

Table 2. Location, habitat, soil type and parent material characteristics of CS2007 soil samples with pH equal or greater than 8.3. EZ = Environmental Zone; BH = Broad Habitat; AVC = Aggregate Vegetation Class. Parent material data derived from Soil Parent Material Model (SPMM, British Geological Society).

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
40X5	8.38	Coastal	2	ENG	6	4	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Limestone	High
63X1	8.45	Inland	2	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Surficial	Unc_Residual	Clay-Silt-Sand-Gravel	None
64X2	8.95	Coastal	2	ENG	19	1	NA	NA	NA	NA	NA	NA
64X3	8.37	Coastal	2	ENG	4	1	8.41	Typical Argillic gley soils	Superficial	Unc_Marine	Clay-Silt-Sand-Gravel	None
68X1	8.48	Coastal	2	ENG	7	4	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
68X3	8.55	Coastal	2	ENG	6	4	5.81	Typical Paleo-argillic brown earths	Bedrock	Sed_Carbonate	Chalk	High
68X4	8.56	Coastal	2	ENG	6	4	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
89X1	8.31	Inland	1	ENG	1	5	3.44/5.11	Colluvial rendzina/Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
109X2	8.48	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
109X3	8.4	Inland	1	ENG	4	3	5.71	Typical Argillic brown earths	Bedrock	Sed_Carbonate	Chalk	High
109X4	8.53	Inland	1	ENG	6	4	3.42	Grey rendzina	Bedrock	Sed_Carbonate	Chalk	High
112X2	8.52	Inland	1	ENG	5	3	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
112X4	8.34	Inland	1	ENG	5	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
135X6	8.34	Inland	1	ENG	6	3	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
138X4	8.34	Inland	1	ENG	5	3	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
138X5	8.32	Inland	1	ENG	3	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
147X3	8.38	Inland	1	ENG	4	1	7.12	Pelo-Stagnogley soils	Bedrock	Sed_Clastic	Mudstone	Low
147X4	8.43	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Clastic	Mudstone	Low
176X4	8.43	Coastal	8	WAL	21	NA	2.2	Unripened gley soil	Superficial	Unc_Marine	Clay-Silt-Sand	None
179X6	8.45	Inland	2	ENG	5	3	3.43	Brown rendzina	Bedrock	Sed_Clastic	Mudstone	Variable(Low)
180X2	8.34	Inland	1	ENG	4	NA	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Limestone	High
180X4	8.44	Inland	1	ENG	1	5	4.11	Typical Calcareous pelosol	Bedrock	Sed_Carbonate	Limestone	High
182X2	8.31	Inland	1	ENG	4	2	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
182X3	8.45	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
182X4	8.4	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
184X2	8.46	Inland	1	ENG	1	4	7.11	Typical Stagnogley soils	Bedrock	Unc_Marine	Clay-Silt-Sand	None
212X3	8.46	Inland	2	ENG	4	1	5.71	Typical Argillic brown earths	Bedrock	Sed_Clastic	Sandstone-Mudstone	Variable
214X1	8.48	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
214X2	8.34	Inland	1	ENG	4	2	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
214X3	8.66	Inland	1	ENG	5	3	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
214X5	8.33	Inland	1	ENG	4	2	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
242X1	8.58	Inland	2	ENG	4	1	5.21/5.11	Typical Brown Calcareous Sand/Typical Brown Calcareous earth	Bedrock	Sed_Carbonate_Clastic	Limestone-Sandstone	High
242X4	8.97	Inland	2	ENG	4	3	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate_Clastic	Limestone-Sandstone	High
242X5	8.51	Inland	2	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate_Clastic	Limestone-Sandstone	High
279X3	8.32	Inland	1	ENG	6	2	5.63	Pelogleyic brown alluvial soils	Surficial	Unc_Residual	Clay-Silt-Sand-Gravel	None
281X5	8.39	Inland	1	ENG	4	NA	4.11	Typical Calcareous pelosol	Bedrock	Unc_Marine	Clay-Silt-Sand	None
300X2	8.42	Inland	1	ENG	6	3	5.72	Stagnogleyic Argillic brown earths	Bedrock	Sed_Carbonate	Limestone	High
307X2	8.41	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
307X4	8.4	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
307X5	8.41	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable
308X1	8.46	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
308X4	8.5	Inland	1	ENG	4	2	5.71	Typical Argillic brown	Superficial	Unc_Glacigenic	Diamicton	Variable

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
310X3	8.46	Inland	1	ENG	4	1	4.11	earths Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
311X3	8.48	Inland	1	ENG	4	1	7.14	Pelo-Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton	Variable
311X4	8.35	Inland	1	ENG	1	2	5.43	Gleyic Brown Earth	Superficial	Unc_Glacigenic	Diamicton	Variable
328X1	8.61	Inland	2	ENG	5	3	4.11	Typical Calcareous pelosol	Bedrock	Sed_Carbonate_Clastic	Mudstone	Variable
328X2	8.75	Inland	2	ENG	6	2	4.11	Typical Calcareous pelosol	Bedrock	Sed_Carbonate_Clastic	Mudstone	Variable
333X4	8.32	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay- Sand-Gravel	Variable
339X1	8.43	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
339X2	8.48	Inland	1	ENG	4	1	4.21	Typical Non-calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
339X4	8.57	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
341X2	8.6	Inland	1	ENG	4	1	5.71	Typical Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
341X3	8.38	Inland	1	ENG	4	1	5.71	Typical Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
364X2	8.3	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay- Sand-Gravel	Variable
366X1	8.44	Inland	1	ENG	4	2	9.2	Disturbed soils	Bedrock	Sed_Carbonate	Chalk	High
366X2	8.45	Inland	1	ENG	1	5	9.2	Disturbed soils	Bedrock	Sed_Carbonate	Chalk	High
366X4	8.43	Inland	1	ENG	4	1	10.24	Earthy eutro-amorphous Peat soils	Bedrock	Sed_Carbonate	Chalk	High
367X1	8.73	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
367X3	8.64	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
367X5	8.4	Inland	1	ENG	5	4	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
368X1	8.65	Inland	1	ENG	4	2	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
368X3	8.58	Inland	1	ENG	4	1	5.13	Stagnogleyic Brown Calcareous Earth	Superficial	Unc_Glacigenic	Diamicton	Variable
369X1	8.44	Inland	1	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
369X2	8.32	Inland	1	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
369X4	8.44	Inland	1	ENG	4	2	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
369X5	8.56	Inland	1	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
391X3	8.33	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
391X5	8.6	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
396X1	8.66	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
396X3	8.69	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
396X4	8.39	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
396X5	8.6	Inland	1	ENG	4	1	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
398X2	8.52	Inland	1	ENG	6	1	5.21/3.43	Typical Brown Calcareous Sand/Brown rendzina	Superficial	Unc_Glacigenic	Diamicton	Variable
398X3	8.36	Inland	1	ENG	4	NA	5.54/5.21	Argillic brown sands/Typical Brown Calcareous Sand	Superficial	Unc_Glacigenic	Diamicton	Variable
398X4	8.64	Inland	1	ENG	4	1	5.54/5.21	Argillic brown sands/Typical Brown Calcareous Sand	Superficial	Unc_Glacigenic	Diamicton	Variable
398X5	8.48	Inland	1	ENG	4	2	5.54/5.21	Argillic brown sands/Typical Brown Calcareous Sand	Superficial	Unc_Glacigenic	Diamicton	Variable

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
400X1	8.5	Inland	1	ENG	6	2	5.81	Typical Paleo-argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
400X3	8.6	Inland	1	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
400X5	8.54	Inland	1	ENG	4	1	7.11	Typical Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton	Variable
402X2	8.33	Inland	1	ENG	4	1	7.11	Typical Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton	Variable
402X3	8.49	Inland	1	ENG	4	1	7.11	Typical Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton	Variable
402X4	8.74	Inland	1	ENG	4	1	5.71	Typical Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
419X3	8.48	Inland	1	ENG	4	1	NA	NA	NA	NA	NA	NA
421X3	8.35	Inland	1	ENG	4	1	8.73	Argillic humic gley soils	Surficial	Unc_Organic	Peat	None
421X4	8.48	Inland	1	ENG	4	2	8.73	Argillic humic gley soils	Surficial	Unc_Organic	Peat	None
428X1	8.34	Inland	1	ENG	4	1	5.71	Typical Argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
428X2	8.71	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable
449X1	8.36	Inland	1	ENG	4	2	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
449X2	8.48	Inland	1	ENG	4	3	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
451X1	8.42	Inland	1	ENG	6	2	4.11	Typical Calcareous pelosol	Superficial	Unc_Glacigenic	Diamicton	Variable
451X2	8.34	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable
451X3	8.56	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable
451X4	8.62	Inland	1	ENG	4	1	5.12	Gleyic Brown Calcareous Earth	Superficial	Unc_Glacigenic	Diamicton	Variable
451X5	8.53	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Superficial	Unc_Glacigenic	Diamicton	Variable
457X1	8.48	Inland	1	ENG	6	2	NA	NA	NA	NA	NA	NA
475X1	8.47	Inland	1	ENG	4	1	5.72	Stagnogleyic Argillic brown earths	Bedrock	Sed_Carbonate	Limestone	High
475X2	8.36	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Limestone	High

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
475X3	8.37	Inland	1	ENG	4	1	5.13	Stagnogleyic Brown Calcareous Earth	Bedrock	Sed_Carbonate	Limestone	High
475X4	8.57	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Limestone	High
475X5	8.35	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Limestone	High
477X1	8.33	Inland	1	ENG	17	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
477X4	8.36	Inland	1	ENG	4	1	8.11	Typical Alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
477X5	8.35	Inland	1	ENG	4	1	8.11	Typical Alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
478X3	8.37	Inland	1	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
478X4	8.38	Inland	1	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
478X5	8.41	Inland	1	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
481X3	8.4	Inland	1	ENG	4	1	5.71/5.81	Typical Argillic brown earths/Typical Paleo-argillic brown earths	Superficial	Unc_Glacigenic	Diamicton	Variable
481X4	8.36	Inland	1	ENG	4	1	5.41	Typical Brown Earths	Superficial	Unc_Glacigenic	Diamicton	Variable
484X3	8.52	Inland	1	ENG	4	1	0	NA	Surficial	Unc_Aeolian	Clay-Silt-Sand	None
487X5	8.54	Coastal	8	WAL	22	4	5.42	Stagnogleyic Brown Earth	Superficial	Unc_Glacigenic	Diamicton	Variable
507X3	8.43	Inland	1	ENG	4	1	5.32	Gleyic Brown Calcareous Alluvial Soils	Superficial	Unc_Marine	Clay-Silt	None
507X4	8.33	Inland	1	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
508X1	8.69	Coastal	2	ENG	21	NA	2.2	Unripened gley soil	Superficial	Unc_Marine	Clay-Silt	None
508X2	8.3	Coastal	2	ENG	21	3	2.2	Unripened gley soil	Superficial	Unc_Marine	Clay-Silt	None
508X4	8.32	Coastal	2	ENG	21	NA	2.2	Unripened gley soil	Superficial	Unc_Marine	Clay-Silt	None
508X5	8.39	Coastal	2	ENG	21	NA	2.2	Unripened gley soil	Superficial	Unc_Marine	Clay-Silt	None
510X2	8.46	Inland	1	ENG	4	1	5.51/5.54	Typical Brown Sands/Argillic brown sands	Superficial	Unc_GlacioFluvial	Clay-Silt-Sand-Gravel	None
510X3	8.67	Inland	1	ENG	4	1	5.81	Typical Paleo-argillic brown earths	Superficial	Unc_GlacioFluvial	Clay-Silt-Sand-Gravel	None
510X5	8.4	Inland	1	ENG	4	1	5.81	Typical Paleo-argillic brown earths	Superficial	Unc_GlacioFluvial	Clay-Silt-Sand-Gravel	None

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
513X2	8.4	Coastal	1	ENG	4	1	5.41	Typical Brown Earths	Surficial	Unc_Fluvial	Sand-Gravel	None
533X1	8.3	Inland	1	ENG	4	1	3.43	Brown rendzina	Surficial	Unc_Fluvial	Sand-Gravel	None
533X3	8.58	Inland	1	ENG	4	1	5.12	Gleyic Brown Calcareous Earth	Surficial	Unc_Fluvial	Sand-Gravel	None
533X4	8.57	Inland	1	ENG	5	2	5.12	Gleyic Brown Calcareous Earth	Surficial	Unc_Fluvial	Sand-Gravel	None
535X3	8.32	Inland	1	ENG	4	1	8.13	Pelo-alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
535X5	8.5	Inland	1	ENG	4	1	8.13	Pelo-alluvial gley soils	Superficial	Unc_Marine	Clay-Silt	None
577X1	8.63	Inland	1	ENG	4	1	7.12	Pelo-Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
592X5	8.47	Inland	1	ENG	4	1	5.32	Gleyic Brown Calcareous Alluvial Soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
594X4	8.35	Inland	1	ENG	4	1	7.11	Typical Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton-Clay-Sand-Gravel	Variable
595X2	8.36	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
595X3	8.58	Inland	1	ENG	4	1	3.43	Brown rendzina	Bedrock	Sed_Carbonate	Chalk	High
609X2	8.31	Inland	1	ENG	4	1	5.71	Typical Argillic brown earths	Bedrock	Sed_Carbonate	Chalk	High
609X4	8.8	Inland	1	ENG	4	1	5.11	Typical Brown Calcareous earth	Bedrock	Sed_Carbonate	Chalk	High
624X1	8.43	Inland	1	ENG	4	1	8.14	Pelo-calcareous alluvial gley soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
624X2	8.44	Inland	1	ENG	6	2	8.14	Pelo-calcareous alluvial gley soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
624X4	8.31	Inland	1	ENG	4	1	8.14	Pelo-calcareous alluvial gley soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
624X5	8.35	Inland	1	ENG	4	1	8.14	Pelo-calcareous alluvial gley soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
624X6	8.36	Inland	1	ENG	4	NA	8.14	Pelo-calcareous alluvial gley soils	Surficial	Unc_Fluvial	Clay-Silt-Sand-Gravel	None
625X4	8.32	Inland	2	ENG	4	2	5.72	Stagnogleyic Argillic brown earths	Superficial	Unc_Marine	Clay-Silt	None

SAMPLE	pH	LOCATION	COUNTRYSIDE SURVEY DATA					PARENT MATERIAL DATA				
			EZ	COUNTRY	BH	AVC	Soil Classification	Substrate	Root Parent Material	General Lithology	CaCO ₃ rank	
653X1	8.38	Inland	2	ENG	4	1	7.11	Typical Stagnogley soils	Superficial	Unc_Glacigenic	Diamicton	Variable(Low)
653X3	8.59	Inland	2	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Glacigenic	Diamicton	Variable(Low)
653X5	8.53	Inland	2	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Glacigenic	Diamicton	Variable(Low)
653X6	8.39	Inland	2	ENG	4	2	8.12	Calcareous alluvial gley soils	Superficial	Unc_Glacigenic	Diamicton	Variable(Low)
653X7	8.69	Inland	2	ENG	4	1	8.12	Calcareous alluvial gley soils	Superficial	Unc_Glacigenic	Diamicton	Variable(Low)
666X4	8.55	Inland	1	ENG	4	2	3.42	Grey rendzina	Bedrock	Sed_Carbonate	Chalk	High
666X5	8.46	Inland	1	ENG	4	NA	3.42	Grey rendzina	Bedrock	Sed_Carbonate	Chalk	High
1084X3	9.15	Coastal	5	SCO	19	3	3.61	Typical Sand-pararendzina	Surficial	Unc_Aeolian	Sand	None
1084X4	8.88	Coastal	5	SCO	4	4	5.21	Typical Brown Calcareous Sand	Surficial	Unc_Aeolian	Sand	None
1084X5	8.62	Coastal	5	SCO	7	4	5.21	Typical Brown Calcareous Sand	Surficial	Unc_Aeolian	Sand	None
1172X4	8.46	Coastal	5	SCO	6	4	3.21	Typical sand-ranker	Surficial	Unc_Aeolian	Sand	None
1174X3	8.58	Coastal	5	SCO	2	4	3.21	Typical sand-ranker	Surficial	Unc_Aeolian	Sand	None
1174X4	8.34	Coastal	5	SCO	7	4	3.21	Typical sand-ranker	Surficial	Unc_Aeolian	Sand	None
1249X1	8.62	Coastal	8	WAL	NA	4	0	NA	Superficial	Unc_Marine	Clay-Silt-Sand	None
1249X5	8.76	Coastal	8	WAL	6	3	0	NA	Superficial	Unc_Marine	Clay-Silt-Sand	None