Guidance Document 2

Soils and Land Quality: How to find online maps and data sets

BRITISH SOCIETY OF SOIL SCIENCE

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1. Introduction

The purpose of this paper is to advise agricultural and environmental consultants and rural practitioners (land agents and agricultural valuers) on how they can best obtain and make use of available information on soils and agricultural land quality.

Some readers may have taken modules in soils and land evaluation at college and so will have some grounding in the subject, but it is assumed here that only a minority will have had sufficient training and practice in soil and land classification to carry out their own surveys at a professional level.

For planning applications involving agricultural land in all parts of the UK there are statutory requirements to minimise the loss of the best quality agricultural land, and supporting evidence on land quality may have to be produced with an application. Likewise, The Design Manual for Roads and Bridges (DMRB)[1] is the basis of environmental impact assessments (EIAs) for infrastructure projects and the latest revision states that soil resource and/or land capability surveys should be undertaken to inform the baseline scenario.

For farmers or investors buying or renting farmland it is common sense for them or their agent to seek information on its quality.

The aim, here, is to provide an understanding of the subject areas and give directions on how to obtain published information and seek professional assistance when necessary. The first section deals with Agricultural Land Classification (ALC), as this is the short cut to understanding the agricultural quality of a piece of land and is the most commonly required data set. The next section deals with soil maps, as these are the foundation of ALC and are useful for those seeking more detail about a piece of land. A third section describes online maps and data bases that identify potentially contaminated land.

The subsequent sections describe circumstances when more detailed and specialised information might be needed on a particular piece of land, such as a farm that is for sale or rent, a planning application affecting agricultural land and the considerations for restoration of land to farming following mineral extraction. Expert assistance may have to be obtained from specialists, such as soil scientists, who carry appropriate professional indemnity for the expert advice they provide. Guidance is provided on how such advice can be obtained and examples are given of situations where information on soils and land quality has been deployed effectively.

All references were viewed and checked in September 2020. A full reference is given for documents that are also published in hard copy, but only a hyperlink is provided where the referenced material exists solely online.

[1] HM Government (2019), Design Manual for Roads and Bridges (2019), *LA09 Geology and Soils*. https://standardsforhighways.co.uk/dmrb/

2. Agricultural Land Classification – Sources of Information

2.1 Agricultural Land Classification – England

Provisional ALC maps, based on a system for grading land quality, were published by the former Ministry of Agriculture Fisheries and Food (MAFF), now the Department of Agriculture, Food and Rural Affairs (Defra) in the 1960's. The scale was 1:63,360 (one inch to one mile) and they covered the whole of England and Wales. These maps grade land according to the severity of environmental constraints on agricultural production, taking into account such factors as soil, gradient, rainfall and altitude. There are five grades, the best being Grade 1, which is land with only very minor limitations, typified by Lincolnshire silt-land. Grade 5 land, with very severe limitations, includes, for example, moorland rough grazing in the south west of England.

The maps were described by MAFF as 'provisional' because the amount of fieldwork that went into grading land varied considerably across England and Wales. The grading was based mainly on reconnaissance level ground observations of soil and topography, supplemented by information from MAFF's local agricultural and horticultural advisers. The key to understanding the accuracy and utility of these maps lies in the word 'provisional'. They were intended as a planning tool to identify and protect the best agricultural land at a time of expanding towns and cities, new airports and motorway construction and the accompanying need for mining of aggregates. MAFF stated at the time, in the accompanying booklets, that the grade of parcels of land of less than 80 hectares could not be reliably identified from these maps, which means that their use in environmental impact assessments, farm sales particulars, land valuations and rent reviews is often erroneous.

The intention was to refine, resurvey and produce a final version. However, the refinement never happened and the maps retained the 'provisional' title. They were reissued in the late 1980's at a 1:250,000 scale (quarter inch to the mile) to better reflect their originally intended strategic use and are now available online within Natural England's Access to Evidence website[2].

Natural England is the custodian of ALC maps and data (produced up to 1999) in England and provides guidance on their use in its 2012 Technical Information Note 049[3] and 2018 *Guide to assessing development proposals on agricultural land*[4]. These confirm the provisional 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 at a strategic level.

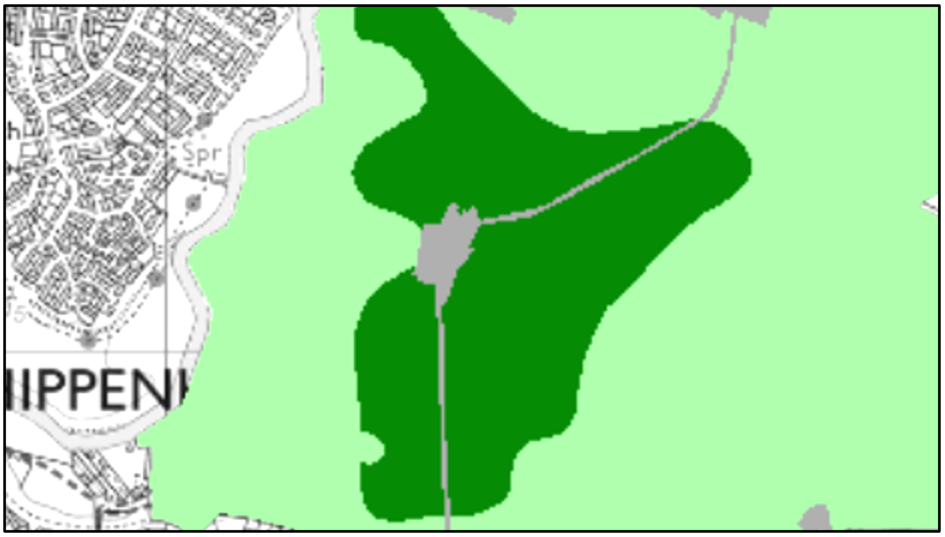
Moreover, they are only provisional because the ALC system was revised by MAFF in 1988 and these Revised Guidelines divide Grade 3 into Subgrades 3a and 3b. Land in Grades 1, 2 and Subgrade 3a later

[2] http://publications.naturalengland.org.uk/category/5954148537204736
[3] Natural England (2012) Technical Information Note 049. *Agricultural Land Classification: protecting the best and most versatile agricultural land.* http://publications.naturalengland.org.uk/publication/35012?category=23033
[4] https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development

became classed as best and most versatile (BMV). The revised ALC system and accompanying climatological data are on Natural England's Access to Evidence website[5].

The National Planning Policy Framework (NPPF)[6] requires that local government seeks to protect and preserve BMV agricultural land.

For planning applications affecting BMV land, specific consultations with Natural England are required under the Development Management Procedure Order and the Town and Country Planning Act (1990) Schedule 5 – *Conditions relating to Mineral Working*[7]. These are for non-agricultural development proposals that are not consistent with an adopted local plan and involve the loss of 20 hectares or more BMV land (or land of any area or quality in relation to mineral extraction).



Provisional Grade 3 land at Chippenham sub-divided into Subgrades 3a (dark green) and 3b[8]

Defra has digitised the 1:250,000 scale Provisional ALC maps for the whole of England and made them available on their MAGIC website within the landscape section of its interactive maps[9]. Also available on that site are some detailed surveys of land affected by planning proposals, shown at 1:10,000 scale, carried out between 1988 and 1999. These were commissioned by MAFF and Defra and use the revised classification system that identifies Subgrades 3a and 3b. This website is not easy to use and beginners may need to refer to the help section. In particular, having selected either Provisional or Post 1988 maps it is important to deselect other options and set the scale to 1:250,000 or 1:10,000 respectively. You can obtain the accompanying reports and soil profile data (where available) by clicking the 'identify' (**i**)

[5] http://publications.naturalengland.org.uk/publication/6257050620264448
[6] Ministry of Housing, Communities and Local Government (2019) *National Planning Policy Framework.* https://www.gov.uk/government/publications/national-planning-policy-framework--2
[7] Town and Country Planning Act (1990), Schedule 5, *Conditions relating to Mineral Working* http://www.legislation.gov.uk/ukpga/1990/8/schedule/5
[8] MAFF (ADAS) 1995. Agricultural Land Classification for North Wiltshire Local Plan. file:///C:/Users/Admin/Downloads/ALC%20survey%20%20report%20ALCB05195%20(5).pdf
[9] https://magic.defra.gov.uk/

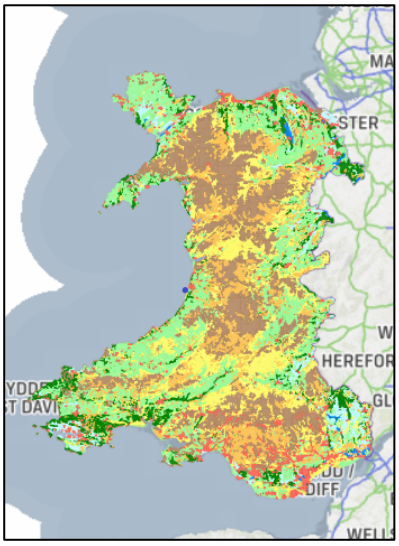
icon in the toolbar at the top of the page, and then click inside the post 1988 ALC survey you are interested in. This should open an information box, where there is a hyperlink to the ALC report and data at the bottom. Alternatively, the accompanying reports and detailed ALC maps are available in portable document format (pdf) on Natural England's Access to Evidence website[10].

Natural England has also published online *Likelihood of Best and Most Versatile Agricultural Land* strategic scale (1:250,000) maps which predict the likelihood of ALC Grades 1, 2 and 3a[11]. The maps are intended for strategic planning purposes only and are not suitable for use below 1:250,000.

2.2 Agricultural Land Classification – Wales

The Welsh ALC system is the same as England's and the management of soil and ALC maps and data in Wales is the responsibility of the Land Quality Advisory Service (LQAS) of the Welsh Government[12].

Planning Policy Wales (2018) provides strong protection for BMV land with paras 3.54 and 3.55 giving strict conditions under which such land can be developed[13].



The Welsh Government have recently developed a powerful and useful online tool called *The Predictive ALC Map for Wales*[14], using the MAFF 1988 classification[5]. It is based on published soil maps, combined with topographic and climatic data. In addition to predicting the ALC grade, the map has additional layers showing where detailed ALC surveys have been carried out and survey reports can be requested from the LQAS using the survey reference number.

For planning applications, where the Predictive ALC Map identifies land in Grades 1, 2 or 3a (i.e. BMV), a detailed survey will be required to determine what grades are actually present and in what proportion. The LQAS will provide advice on survey requirements and validate ALC surveys for Local Planning Authorities free of charge.

The Predictive ALC Map supersedes the old Provisional ALC maps, but a 1:2,000,000 scale version can be viewed on Natural England's website[2].

[10] http://publications.naturalengland.org.uk/category/5735244522061824
[11] http://publications.naturalengland.org.uk/category/5208993007403008
[12] https://gov.wales/agricultural-land-classification-enquiries
[13] Welsh Government (2018), *Planning Policy Wales* https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf
[14] http://lle.gov.wales/catalogue/item/PredictiveAgriculturalLandClassificationALCMap/?lang=en

2.3 Land Capability for Agriculture - Scotland

Scotland has a different classification system from that of England and Wales, termed the Land Capability for Agriculture (LCA)[15]. It recognises seven Classes of land, of which four are subdivided to create a total of 13 Classes and Divisions. Class 1 identifies land with the highest potential flexibility of use and Class 7 is land of very limited agricultural value. Prime Quality agricultural land is the equivalent designation to England and Wales' BMV and comprises land in Classes 1, 2 or 3.1. The Scottish Government's National Planning Policy provides continuing protection for agricultural land, as well as other important soil resources, such as peat[16].

LCA maps, in hard copy, are available from the James Hutton Institute (incorporating the former Macaulay Land Use Research Institute)[17]. Online versions are downloadable free on the Scottish Government's Scotland's environment website[18]. Much of eastern and lowland Scotland has map coverage at the scale of 1:50,000.

Another series of LCA maps is also available at the smaller scale of 1:250,000 and covers the whole of Scotland in seven map sheets. Guidance on the use of the maps states that 'Where it exists ….. the 1:50,000 scale map information is seen as the definitive mapped assessment' and should take precedent over the less detailed 1:250 000 scale maps[19].

2.4 Agricultural Land Classification – Northern Ireland

There are no published ALC maps for Northern Ireland apart from a very generalised, small scale map (Fig 9D.1) within *Soil and Environment: Northern Ireland* (Cruickshank et al 1997)[20]. The ALC system is basically the same as that of England and Wales, subdividing Grades 3 into A and B (here, capitalised), with Grades 1, 2 and 3A being classed as BMV. In the absence of ALC maps, the classification for a specific piece of land has to be applied by the user to the published soil maps (see 3.3, below), or by ordering a report from the Agri-Food and Business Sciences Institute (AFBI)[21], for which there may be a charge.

[15] Bibby, J.S, Douglas, H.A, Thomasson, A.J. and Robertson, J.S. (1982), *Land capability classification for agriculture.* Macaulay Institute for Soil Research. Summarised in: https://www.hutton.ac.uk/learning/exploringscotland/land-capability-agriculture-scotland

[16] Scottish Government (2014), *Scottish Planning Policy* https://www.gov.scot/publications/scottish-planning-policy/

[17] https://www.hutton.ac.uk/learning/exploringscotland/introduction

[18] https://soils.environment.gov.scot/maps/capability-maps/national-scale-land-capability-for-agriculture/

[19] https://www.hutton.ac.uk/learning/natural-resource-datasets/soilshutton/soils-maps-scotland/download

[20] Cruickshank J.G. (ed), (1997). *Soil and Environment: Northern Ireland*. Agricultural and Environmental Science Division, DANI and the Queens University of Belfast.

[21] https://www.afbini.gov.uk/articles/soil-maps-and-soil-survey

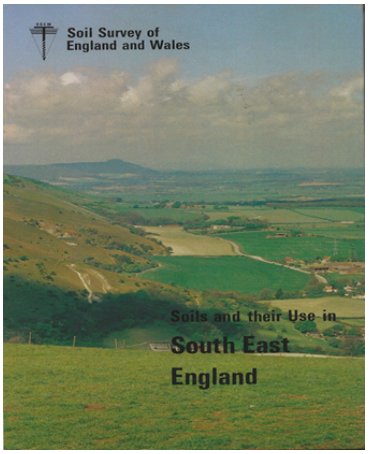
Policies for the protection of agricultural land and consultation on rural planning matters are the responsibility of the Department of Agriculture, Environment and Rural Affairs.

3. Soils - Sources of Information

Soil maps and their accompanying books are a useful resource for anyone wishing to understand more about the properties of a particular piece agricultural land than is obtainable from ALC maps. In particular, they can assist with the assessment of the suitability of land for a change of use or in gaining an understanding of problems in productivity. As such, they are often consulted by surveyors and valuers at point of sale or in rent negotiations. For EIAs concerning agricultural land, soil information is a fundamental part of the baseline data set.

3.1 Soil Maps – England and Wales

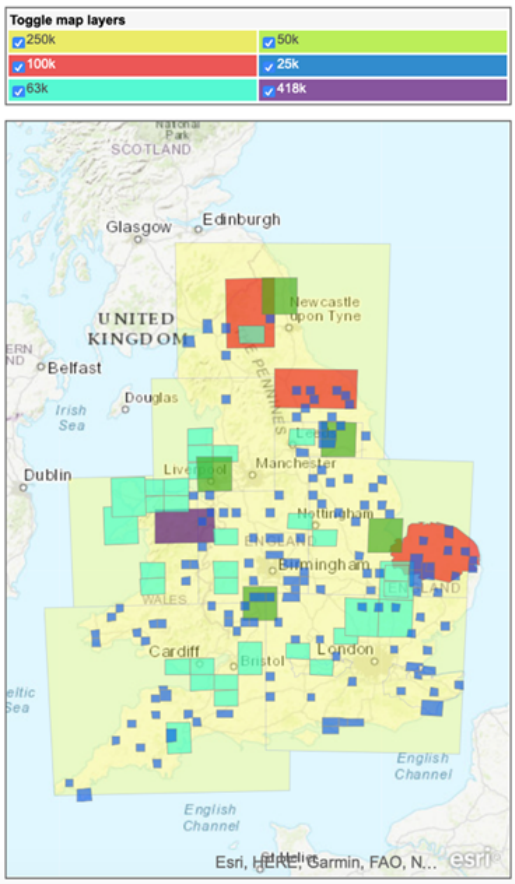
Soil mapping in England and Wales, using a national classification system, began before the Second World War, and the preparation and publication of new maps ceased in the 1990s. The Soil Survey of England and Wales (SSEW) was taken over by Cranfield University in 1987, becoming the Soil Survey and Land Research Centre (SSLRC). It is still based at Cranfield within the National Soil Resources Institute (NSRI), where its work is now focused on research into environmental issues of soil properties and management, rather than soil mapping. NSRI sells digitised and paper soil maps and associated publications and data sets through its Land Information System (LandIS) online publications site[22]. This site provides links to catalogues of published soil maps and accompanying reports. Paper versions can be purchased and digital versions of the 1:250,000 maps leased.



The whole of England and Wales is covered by the National Soil Map comprising six soil maps at a scale of 1:250,000, showing soil *associations* that contain a number of component *series* (see below), usually in a specified relationship according to geology and topography. Accompanying Regional Bulletins entitled *Soils and their Use in Wales/Northern England/Midland and Western England/South West England/ Eastern England/South East England* provide much useful information on soil properties and their suitability for a range of uses and management.

In addition, about 10% of England and Wales is covered by more detailed maps at scales of 1:63,360 and 1:50,000 and a further 15% is covered by maps at 1:25,000 (2½ inches to 1 mile). The latter show soil types field by field and were selected to be representative of a wider natural landscape. The image below, taken from the Landis publications site[22] shows the locations of these maps.

[22] http://www.landis.org.uk/publications/index.cfm

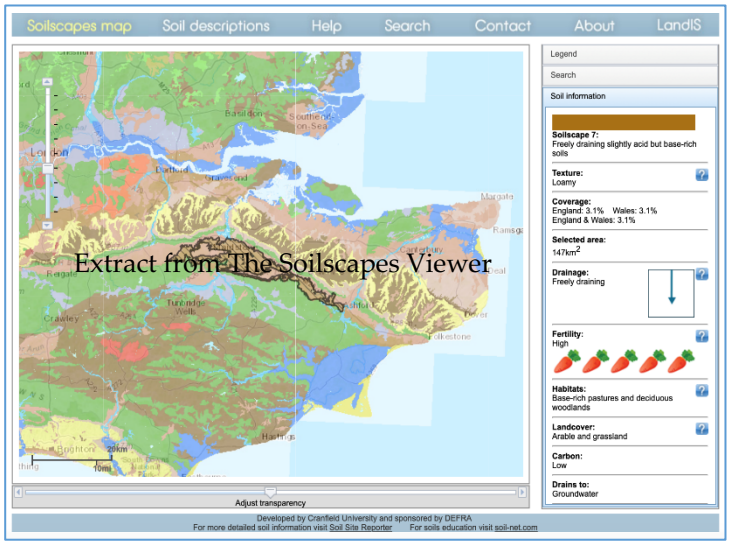


The soil maps of England and Wales are accompanied by books, variously called Memoirs, Records, Special Surveys or Bulletins, and contain a wealth of information on the soils in their landscape setting. Most can be purchased through Landis or from online bookshops and some are being digitised and downloadable, at a cost, from Landis. Another useful publication is the Soil Survey Field Handbook which provides a methodology and terminology for describing soils in the field[23].

In the late 1980s, when the Soil Survey was losing much of its government funding, detailed surveys were undertaken of individual farms, agricultural estates (e.g. Clinton Devon Estates and Rock Hall, Northumberland) and agricultural institutions (e.g. NIAB, Shuttleworth and Harper Adams) on a commercial basis. These are too numerous to list here, but anyone interested in a particular piece of land should ask the owner or manager whether they have one of these privately commissioned maps. All have been scanned and may be available on request to Landis.

The more detailed maps (scale 1:63,360 or greater) show the *soil series* as the basic map unit. A series consists of soils with similar profile characteristics (layering, texture, natural drainage, depth, organic matter content etc) and formed from similar geological parent materials and which, in a similar climate, can be expected to have the same management characteristics. Series are given the name of the place in which they were first recognised or are extensive. For example, the Fladbury series identifies a wet alluvial clay first recognised in the Vale of Evesham. A detailed description of 296 soil associations and 753 soil series described by the SSEW is available on the LandIS Soils Guide page online[24].

[23] Hodgson, J.M. (ed.) (1997). *Soil Survey Field Handbook*. Technical Monograph No. 5. Soil Survey and Land Research Centre, Silsoe.
[24] http://www.landis.org.uk/services/soilsguide/index.cfm



Extract from The Soilscapes Viewer

A *phase* may be used to subdivide a series to emphasise a local characteristic, such as topsoil stoniness, that is likely to have special management implications.

The 1:250,000, scale maps show *soil associations* that contain a number of component series, usually in a specified relationship according to geology and topography.

LandIS is constantly being updated and is an extremely useful (and award winning) online resource. In addition to the book and map stores, it has the *The Soilscapes Viewer*[25] which is a free, easy-to-use, online soil reporting tool, derived from the National Soil Map, producing summary soils information for a specific location (grid reference, postcode etc) at a scale of 1:250,000. Soilscapes is not intended as a means for supporting detailed assessments, such as land planning applications or site investigations; nor should it be used to support commercial activities.

The *Soils Site Reporter*[26] is an online soil reporting tool which produces site-specific soils information with maps and soil descriptions. Each report, downloadable in pdf format, provides detailed information on the expected soil conditions at the site and outlines interpretations of the suitability for different uses. A variety of environmental issues, such as the potential of damaging ground movement or pipe corrosion and the ease with which chemicals can leach into groundwater or run off into rivers, are also included.

In 2020 the typical charge for this service ranges from £65 (1km x 1km) to £85 (5km x 5km) for a full report, while the basic soil report ranges from £6 (1km x 1km) to £25 (5km x 5km) and is free to undergraduates.

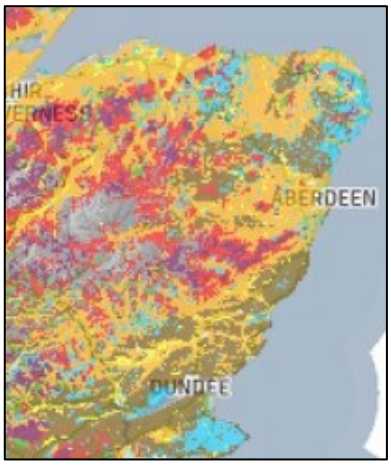
Many of the digital soil datasets are now available to lease via the Cranfield Mapshop[27]. This facility allows users to define an area of interest and then select and pay for the soil data for use in Geographical information Systems. Currently the National Soil Map, Hydrology of Soil Types map and historic auger bore data are available via this system. Other datasets can be leased via

[25] http://www.landis.org.uk/mapping/
[26] http://www.landis.org.uk/services/sitereporter.cfm
[27] https://cranfield.blueskymapshop.com/

the LandIS website[28] using an online quotation form, these datasets will all eventually be added to the Mapshop in the future.

Other Landis applications include an online Guide to the Soils of England and Wales.

3.2 Soil Maps - Scotland



As in England and Wales, the Soil Survey of Scotland began mapping in 1938 and by 1947 was charged with the systematic mapping of Scotland's soil resource. Likewise, survey work effectively came to an end in 1986. By then, approximately 95 percent of the cultivated land in Scotland was mapped in the field at 1:25,000 scale, to be published mainly at 1:63,360, but with some published at 1:50,000 and at 1:25 000 scale. All of the country is mapped at a reconnaissance scale of 1:250,000[29].

Paper versions, with accompanying books (Memoirs), can be purchased from the James Hutton Institute[17]. Digital versions of the soil maps in GIS format (digitised from both 1:250 000 and 1:25,000 scale maps) and accompanying Memoirs can be download free of charge from the Institute[30]. Digital versions are also available to view and download at the Scottish Government's Scotland's environment website[31]. Scanned copies of the original paper maps can be viewed at the National Library of Scotland's website[32].

Online information on certain soil properties are available on the James Hutton Institute's Soil Information for Scottish Soils (SIFSS) site[33]. The user is able to select a range of soil properties for a specific soil type and choose whether to display results for cultivated or semi-natural soils. SIFSS is also available as an app[34].

[28] http://www.landis.org.uk/data/pricer.cfm

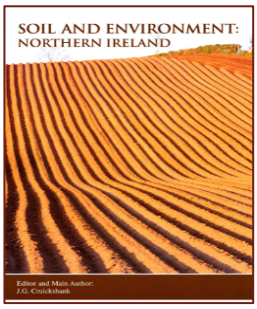
[29] https://www.hutton.ac.uk/sites/default/files/files/soils/183151002_Mapping_Scotlands_Soil_Resources.pdf
[30] https://www.hutton.ac.uk/learning/natural-resource-datasets/soilshutton/soils-maps-scotland
[31] https://soils.environment.gov.scot/maps/soil-maps/
[32] https://maps.nls.uk/series/soils/
[33] http://sifss.hutton.ac.uk/SSKIB_Stats.php
[34] https://apps.apple.com/gb/app/sifss/id581872368

The Scottish classification also employs associations and series, but maps at 1: 250,000 scale show only associations. It is worth noting that the concept of *Soil Association* differs between Scotland and the rest of the UK in that it is based on the geological origins of the parent material, thus, for example, all soils derived from Quartzite parent materials belong to the Durnhill Association. The *soil series* is very similar in concept to England and Wales being defined as *'a set of soils derived from the same or similar parent materials under the same conditions of formation and thus having a similar sequence of soil horizons'*, as are *phases*.

A screenshot of Google Earth imagery overlain by a soil map from James Hutton's SIFSS app[34]

3.3 Soil Maps – Northern Ireland

The whole of Northern Ireland has been mapped at a scale of 1:50,000 and, in addition, there is a 1:250,000 scale map of the province. The paper and digital versions of these maps can be purchased from the Agri-Food and Biosciences Institute (AFBI)[21].



4. Land Contamination – Sources of Information

Land contamination can pose risks to land users, the environment and property (collectively referred to as receptors). Regardless of how the land has come to be contaminated, it is a legal requirement to actively take steps to remove or at least reduce risks of significant harm occurring to receptors from contamination. Contamination can be present in soil, water and ground gas.

Without carrying out a ground investigation there is no certain way of confirming whether the land is contaminated beyond an unacceptable level. Even after ground investigation, it is not possible to declare a site completely free of contamination.

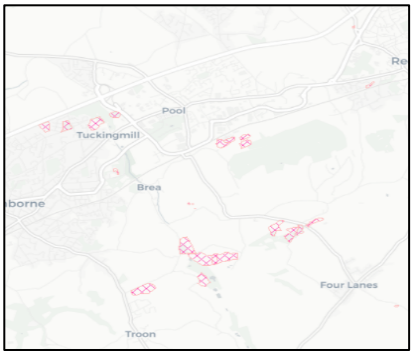
The assessment of risks requires a complex model, which establishes potential linkages between the various receptors and contaminants, and so formal decisions should only be made in consultation with a qualified person. In order to meet standards for a full contaminated land assessment there are also costs in obtaining detailed information from recognised institutions. However, there are ways to identify how likely it is for contamination to be present or absent at a site. Research is required, and many useful and freely available sources of information are described in this section. There are numerous factors which need to be considered, but a screening exercise should be able to identify potentially significant issues.

4.1 Land contamination – England and Wales

Scanned copies of historical trade directories maintained by the University of Leicester's Special Collections Online can provide information on potentially contaminative former land uses on the site or nearby (such as industrial sites, blacksmiths, garages etc) since the records began[35]. The Francis Frith collection website[36] contains historical maps and photographs which may display some of these land uses and will help put them into perspective. Historical aerial photography accessible on Google Earth Pro[37] (available to download free) can also help identify potentially contaminative former land uses. Road names will often provide clues (e.g. Old Gravel Pit Lane could suggest the presence of a former pit, perhaps infilled with waste).

Google Maps can help in the identification of present-day potentially contaminative land uses in the vicinity of the site.

Local authorities have a duty to strategically identify all known/ registered contaminated sites within their boundary and so, by the Freedom of Information Act, information can be requested directly from the local authority. Requests for information on local pollution incidents, landfills, environmental permits and some relevant licences can also be made in writing to the Environment Agency[38].



The Groundsure Envirodata viewer interactive map[39] displays locations of authorised landfills and registered historical landfills that are capable of generating harmful concentrations of ground gas and leachable contaminants.

On the right is a screenshot of a Groundsure map showing landfill sites near Redruth in Cornwall.

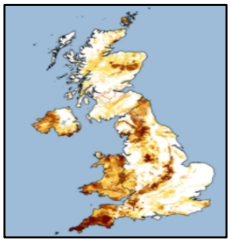
Details of some previous ground investigations are publicly available to view on the British Geological Survey website[40]. Subsurface conditions are described in detail on the historical exploratory hole logs. These logs will often include descriptions of visual or olfactory signs of contamination if they were encountered in the exploratory holes. It is useful to note, if these are detailed on the logs, any permeable geological layers, as these could provide pathways of contamination to deeper groundwater. Groundwater strikes are significant as groundwater is considered to be an environmental receptor.

Local authority online planning portals may also contain ground investigation results within documents submitted as part of previous planning applications for the site or nearby land. The portal

[35] http://specialcollections.le.ac.uk/digital/collection/p16445coll4
[36] https://www.francisfrith.com/uk/
[37] https://www.google.com/earth/versions/#download-pro
[38] https://www.gov.uk/government/organisations/environment-agency#org-contacts
[39] http://groundsure.io/#
[40] https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

can be consulted directly, as it is different from the information request to the authority described above.

If the site is close to a historical wartime strategic target (Luftwaffe target, decoy site etc), unexploded bombs could be a risk, particularly if ground disturbance is anticipated on the site. A free unexploded bomb risk map of the region can be downloaded from the Zetica website[41].



Radon is restricted to certain geological formations, such as the granites of Devon and Cornwall and Northampton Ironstone, but needs to be considered when constructing an enclosed living or working space. Public Health England provides an indicative atlas of radon levels (right)[42].

Finally, when considering sources of contamination, they are not always on record and although locations such as farmland may look 'clean and natural', accumulated years of dumping, burning or burial of wastes or the use of pesticides and insecticides may have provided a legacy of contamination. Spores of anthrax, a fatal disease of cattle, are able to survive in buried carcases and surrounding soils for up to 48 years. Such sources of contamination are very unlikely to be present on every farm, but it is important to consider the possibility.

The easily identifiable receptors are people and animals that use the site and the surrounding land, or people and animals that will use the site if there are intentions to change its use. Defra's MAGIC Map Application website[9] provides an interactive map that displays a variety of published data and is particularly relevant for identifying other receptors. Sensitive receptors on or close to the site could include groundwater Source Protection Zones, surface water bodies, sites of designated environmental interest and listed buildings.

4.2 Land contamination – Scotland

Many of the sources of information listed above also provide data for Scotland. Below are a few additional resources which provide detail for sites located in Scotland. Scanned copies of historical trade directories are maintained by the National Library of Scotland[43] and can be accessed online.

The Freedom of Information (Scotland) Act is applicable for requesting available information. Requests for information on local pollution incidents, landfills, environmental permits and some relevant licences can be made in writing to the Scottish Environment Protection Agency[44] or viewed on their Data Publication webpage[45]. Scotland's environment web map displays various features which may display possible receptors on or within the vicinity of the site[46].

[41] https://zeticauxo.com/downloads-and-resources/risk-maps/
[42] https://www.ukradon.org/information/ukmaps
[43] National Library of Scotland (2012), *Scottish Post Office Directories* https://digital.nls.uk/directories/
[44] https://www.sepa.org.uk/about-us/access-to-information/
[45] Scottish Environment Protection Agency, *SEPA Data Publication* https://www.sepa.org.uk/environment/environmental-data/
[46] https://map.environment.gov.scot/sewebmap/

4.3 Land contamination – Northern Ireland

Many of the sources of information listed earlier in this section also provide data for Northern Ireland. Below are a few additional sources which provide detail for sites located there.

Trade directories for the years 1819 to 1900 are available online[47]. Regional trade directories for years after this time can be found at the National Library of Ireland and the National Archives of Ireland. The Public Record Office of Northern Ireland Historical maps[48] website displays various illustrations which could identify historical land uses on the site or within the vicinity.

The Department of Agriculture, Environment and Rural Affairs (Daera) provide a database which holds records of previously industrial land uses on sites and has been recently updated to include information on waste management sites and locations of pollution incidents[49].

Geological data and maps are available to view on the Geological Survey Ireland website[50] and the Geological Survey of Northern Ireland website[51]. The Northern Ireland planning portal[52] provides a map search tool to browse planning applications for reports on ground investigation which may have been carried out on the site or in the vicinity. To identify potential receptors on the site or in the vicinity, information can be viewed on Daera's interactive map for Northern Ireland[53].

5. Uses of Agricultural Land Classification and Soil Maps

Readers of this section should be aware that ALC maps are intended for planning purposes and not for land and rent valuations.

By way of example, the Welsh Government guidance on using the Predictive ALC Map states, *The Predictive Agricultural Land Classification Map has not been designed for, and the Welsh Government does not approve of, the following uses: valuing agricultural land; assigning agricultural rents; and, allocating financial support*[12].

However, the use of these maps for such purposes has become so widespread that the aim here is to advise land agents and valuers of their limitations of these maps and demonstrate how corroborative information should be sought from published or commissioned soil surveys

[47] https://www.nidirect.gov.uk/services/search-street-directories
[48] Ordnance Survey Ireland and the Public Record Office of Northern Ireland (2019), *Historical Maps* https://apps.spatialni.gov.uk/PRONIApplication/
[49] https://www.daera-ni.gov.uk/publications/historical-landuse
[50] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx
[51] https://www.bgs.ac.uk/gsni/data/index.html
[52] http://epicpublic.planningni.gov.uk/publicaccess/spatialDisplay.do?action=display&searchType=Application
[53] https://www.daera-ni.gov.uk/services/natural-environment-map-viewer

5.1 Land sales

In recent years it has become common practice for farm sales' particulars to contain information on soils, taken from the 1:250,000 scale National Soil Map. Almost always, too, there is information of the grade of land taken form the Provisional ALC map. Often, however, only a minimum of information is provided; sometimes no more than, *"The farm comprises Grade 2 land with soils of the Downholland and Peacock associations."* Such information is very sparse, considering that the productive potential of the farm depends, to a large extent, on the quality of its soils. Closer reading of the information that comes with the National Soil Map enables a more complete and informative summary to be made. For example, *"The farm comprises Grade 2 land on the fen and fen-edge. The Downholland association soils on the fen have a peaty topsoil over clay, while the Peacock association on the gently sloping fen-edge comprises a humose topsoil over heavy loam and clay. All the land is under-drained and well suited to combinable crop rotations and the fen soils provide good yields of root crops and vegetables."* In terms of professional indemnity it is safe to provide this level of information, as it is taken from citable publications, and so is more than just the opinion of an individual practitioner.

Care does need to be taken, though, when quoting from these publications. For example, a recent sales' particulars said only that the soils of an irrigated sand-land farm in the Midlands were of the 541a Milford association. Anyone looking this up would have been surprised to discover Milford soils are shallow red loams over hard rock and confined to hills of Devon and Wales where they are described as best suited to pasture. The estate agent has not noticed that the suffix 'a' to 541 on the map legend was in reality 'A', and the soils were the Bearsted association of deep sands and loamy sands, well suited to horticultural and root crops.

An example of the successful use of soil information in a farm sales particulars is given in Section 7.2.

5.2 Land purchase

Land classification and soil maps listed above can assist a practitioner who is advising a purchaser on the suitability of farmland for its intended use, whether for investment or in-hand farming. In particular, in England and Wales the Landis *Soils Site Reporter*[26] will pull together a great deal of local data in a concise and readable report. For Northern Ireland such information is not yet available online and would have to commissioned from AFBI[21]. For Scotland most of the information is online but not packaged as a 'soil reporter', and the user would need to make their own interpretation from the soil and LCA maps on Scotland's environment website[18] and James Hutton Institute's *SIFSS* site[33].

If the grade of land is of concern to the purchaser, and detailed surveys of the area in question are not found on MAGIC[9], then there is little option but to engage a specialist who can examine available soil, topographic and climatic information and assess the quality according to the 1988 ALC classification in England and Wales, or the Scottish and Northern Ireland systems. The specialist will need to visit the farm to make observations with a soil auger and spade. Information on how to find a specialist with the relevant expertise is contained in Section 6.

5.3 Planning applications

The 2019 National Planning Policy Framework[6] and most local government plans state that development of BMV land should be avoided, where possible, if there is land of poorer quality or a brownfield site in the district. Therefore, many planning applications relating to farmland include a land classification survey as part of the EIA. Such as survey requires the use of a qualified specialist who is able to produce not only a map to show the grading of the land, but also a supporting report presenting the auger logs and the justification for the grading.

In recent years local planning authorities have routinely requested land classification information for proposed developments that involve the permanent loss of any agricultural land, even for those with a small footprint, such as some wind and solar farms. The impact of small-scale developments are assessed at local government level, but Natural England has to be consulted on developments that would involve the loss of 20 hectares or more of BMV land or any land affected by mineral extraction[4 and 7]. In Scotland the consultee is Scottish Government's Agriculture, Food and Rural Communities Directorate. Scottish Planning Policy (2014) states that development on prime agricultural land, or land of lesser quality that is locally important should not be permitted, except where it is essential[16]. In Northern Ireland the consultee on land quality for large scale developments is the Department of Agriculture, Environment and Rural Affairs and in Wales it is the Welsh Government's Land Quality Advisory Service. Planning Policy Wales (2018) provides strong protection for BMV land with paras 3.54 and 3.55 giving strict conditions under which such land can be developed[13].

In all parts of the UK the strength of the developer's case would depend on demonstrating that the social, economic or environmental benefit clearly outweighs the agricultural and there is no suitable alternative site for the development on land of poorer quality.

5.4 Rent reviews

In the past, the grade of land on the Provisional ALC maps was often one of the criteria by which the rental value of land was assessed, even though they were not intended for this purpose. In the 1980's tenants and their agents became increasingly aware that these maps were not accurate at farm level and many successfully employed soil specialists to reassess the grade of the land as an aid to rent negotiations. This was particularly common in eastern England where some farmers found that they were not achieving the yields on the range of crops normally associated with land in Grades 1 and 2. Very often the farmer's opinion on the quality of the land was justified as the soil survey showed that all or part of the farm was not of the quality claimed by the landlord. An example of a successful appeal by a tenant farmer is given below in Section 7.3.

This issue has been resolved on most of the affected farms, but it may become significant again if the climate changes sufficiently to affect crop production. Increasing dryness would result in yield reductions on some unirrigated crops, especially on sandy soils in the low rainfall areas of East Anglia and the East Midlands. Increasing wetness would impede cultivations on heavy land and reduce the

reliability of yields of combinable crops. Conversely, some chalk land farmers in Kent and Sussex are already investing in high value continental crops, such as champagne grape vines and olives, in anticipation of the recent warming trend continuing.

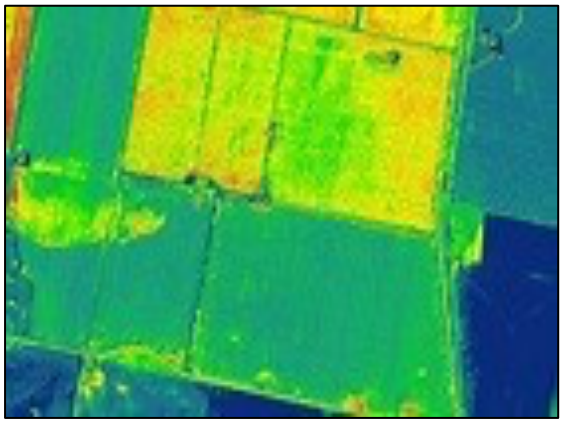
The agro climatic data sets on which the UK land classifications are based are old: 1941-1970 for rainfall and 1961-1980 for temperature[5]. It is reasonable to assume that, perhaps in the not too distant future, those who have a financial interest in the quality of land, such as landlords and tenants, may seek to challenge the basis on which the quality of a farm is assessed.

5.5. Dilapidations

Negotiations concerning dilapidations at the end of a tenancy may focus on the condition of the soil, particularly on root crop and vegetable growing land. Typical soil issues relate to structural deterioration, nutrient depletion and disease and pest build up. An example is given below in Section 7.4 of how a soil scientist was employed to resolve a dispute between the landlord and outgoing tenant.

5.6 Precision farming

The UK's farming industry is becoming increasingly interested in precision farming and published soil maps are not sufficiently detailed for this application.



In recent years, service companies have been formed who offer soil zoning services based on emergent technologies such as EMI scanning, satellite image interpretation, ground penetrating radar, near infra-red scanning and drone imaging. These services add usefully to the body of knowledge about the soils at a given site. The information is not the equivalent of a specialist soil survey, but it can reveal valuable knowledge about 'in-field variation' of soil properties for nutrient management. Many of these techniques are susceptible to recent weather conditions and soil moisture variations can contribute to the patterns reported. Examples of the companies offering such services are AgSpace[54], Rhiza[55] and Soyl[56].

These soil maps and reports are highly focused and have little application beyond precision farming and their data are not transferable to issues such as land classification and planning applications.

[54] https://ag-space.com
[55] https://www.rhizadigital.co.uk/
[56] https://www.soyl.com

5.7 Land restoration

Land agents and other consultants often manage damage claims on behalf of clients whose land has been affected by mineral extraction or construction works for infrastructure projects. Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Site (the Soil Code)[57] focuses on the sustainable use of soil, so that the mining and construction industries have a duty of care when handling and restoring soils.

Mineral planning in England is now covered in the National Planning Policy Framework[6] and accompanying online guidance[58]. This guidance describes the need to identify the quality and quantity of topsoil and subsoil resources available on mineral extractions sites for reuse in restoring the sites to agricultural land, or other use, such as nature conservation.

Further advice on the legislation, policies and advice that planning authorities need to consider to reclaim the quality and structure of soil for farming use is provided on the UK Government website, *Reclaim minerals extraction and landfill sites to agriculture*[59].

Defra's Soil Code provides a practical guide to identifying and safeguarding valuable topsoil and subsoil resources for re-use on development sites, including industrial, commercial, infrastructure (road and rail), utilities (oil, gas, water, electricity) and residential. The Code is illustrated with many case studies, such as the Channel Tunnel Rail-link (also known as HS1).

Planning and managing soil moving operations

The mineral guidance and Soil Code highlight the need to identify soil resources available for re-use on site at an early stage as part of pre-construction planning. This will commonly involve a survey on site carried out by a soil scientist (as distinct from a geotechnical or geo-environmental surveyor) using a hand auger and spade to excavate small trial pits to log soil layers to a depth of approximately 100 cm. The findings of the soil survey should include a soil map to identify the location and extent of the main soil types (also often referred to as soil units) and an accompanying description of their physical characteristics and resilience to structural damage when being handled for soil stripping, soil storage and soil spreading. It should also include laboratory analyses of representative samples (pH, nutrients, organic matter, salinity, potential contaminants etc) to adequately characterise the different soil materials.

[57] Department for Environment, Food and Rural Affairs (2009), *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*. https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites
[58] Ministry of Housing, Communities & Local Government (2014*). Minerals*. https://www.gov.uk/guidance/minerals
[59] https://www.gov.uk/government/publications/reclaim-minerals-extraction-and-landfill-sites-to-agriculture

The soil report (commonly known as a *Statement of Physical Characteristics, Soil Resource Plan* or *Soil Management Plan*) should include, in relation to the intended after-use, recommendations for soil handling, especially in terms of location and maximum heights of soil stockpiles, areas of soils to be stripped, the location of haul routes and suitable weather conditions for working. It should be stressed that inappropriate soil handling in wet weather, when the soil is too wet (plastic) and prone to compaction, is the main cause of damage to soil structure and drainage. The need for subsequent remediation, such as alleviating soil compaction, will increase the cost of the project and may not be entirely successful.

Decades of research and practical experience have gone in to producing MAFF's and Defra's good practice documents for successful soil handling and restoring agricultural land and these are available online[60] [61] (under revision in 2020). Other practical guidance is set out on pages 10 to 12 of the Soil Code[55].

Best practice guidance recommends that close liaison is maintained between the relevant parties; typically the client or agent, client's consultants (typically a soil scientist or agricultural specialist) and the contractor or contractor's consultant, in order that soil issues can be dealt with during the course of the project. For example, method statements devised prior to construction might need to be modified to meet site specific circumstances or to incorporate new ideas. This may involve supervision of the works by suitably qualified personnel.

Aftercare

On mineral and waste sites that are to be returned to agriculture there is a statutory requirement for a five-year 'aftercare' period, once the consented landform has been constructed and the restored soil profile has been replaced. This usually involves planting the restored land with a nurse crop of deep rooting grass such as Italian rye grass and clover mix in the first year to help improve soil structure and aeration, with the reintroduction of arable crops in year two or three. Annual meetings between relevant parties (mineral authority, mineral operator, soil scientist, and land-owner/farmer) are best held in the late spring/ early summer (when patchy grass growth is most visible and soil inspection pits can be easily dug) to agree grazing or crop management in the following season and to identify and agree any further remedial measures which might be necessary, such as alleviation of compaction.

[60] Ministry of Agriculture, Fisheries and Food (2000), *Good Practice for Handling Soils* http://webarchive.nationalarchives.gov.uk/20090306103114/http:/www.defra.gov.uk/farm/environment/land-use/soilguid/index.htm.
[61] Department for Environment, Food and Rural Affairs (2005), *Guidance for Successful Reclamation of Mineral and Waste Sites.* http://webarchive.nationalarchives.gov.uk/20090330220529/http://www.defra.gov.uk/farm/environment/land-use/reclamation/index.htm

While it generally is a condition of mineral planning consent, the requirement for an aftercare scheme following the restoration of agricultural land may also be given as mitigation in Environmental Impact Assessments of development projects involving agricultural land, such as HS2[62]. Soil aftercare is also described in Section 6.4 of the Soil Code[55] and in the Welsh Government Minerals Technical Advice Notes (2004 and 2009) for aggregates and coal[63 and 64].

6. Obtaining Professional Support

Soil resources and ALC surveys and advice on land restoration are best carried out by a suitably qualified and experienced soil scientist or environmental specialist who has the necessary professional indemnity insurance.

The BSSS website has a 'Find an Expert' facility[65]. Appropriately qualified and experienced specialists may be Full Members (MISoilSci) or Fellows (FISoilSci) of the British Society of Soil Science (BSSS) which now incorporates the former Institute of Professional Soil Scientists. Full members have at least five years' professional experience. Fellowship is awarded to soil scientists who have made a significant contribution to soil science. Many BSSS members also have Chartered Scientist accreditation.

BSSS has developed a professional competency scheme called *Working with Soil* in order to help those commissioning soil-related work identify appropriately qualified and experienced consultants. A set of public domain competency documents outline the skills, knowledge and experience required to carry out a range of professional activities, and can be downloaded from the Society's website[66]. Document 1 identifies the foundation field soil investigation skills required to carry out a range of investigations and there are then nine further, more focused documents relating to the conduct of projects such as ALC surveys, Soil Science in Soil Handling and Restoration and Soil Science in Land Evaluation and Planning. The documents can be incorporated into tender documents to specify the skills required of potential contractors. BSSS also offers a limited number of short training courses related to the Foundation Skill and to the ALC scheme for England and Wales.

For rural surveyors who wish to gain further training in soil science and land restoration, the National Soil Resources Institute at Cranfield University provides a range of short courses, post graduate courses and Continuing Professional Development (CPD), as do other universities and agricultural colleges, such as the Scottish Agricultural College. Some independent consultants provide bespoke, locally focused courses for individual consultancy firms and Estate Agents.

[62] Department for Transport and HS2 Limited (2013), *Phase 1 Environmental Statement*. https://www.gov.uk/government/consultations/hs2-phase-one-environmental-statement
[63] https://gov.wales/minerals-technical-advice-note-mtan-wales-1-aggregates
[64] http://lle.gov.wales/catalogue/item/MineralsTechnicalAdviceNoteMTANWales2CoalJanuary2009/?lang=en
[65] British Society of Soil Science, *Find and Expert webpage* https://www.soils.org.uk/
[66] British Society of Soil Science, *Working with Soil competency documents*. https://soils.org.uk/working-soil-0

7. Case studies

The following are a range of examples where land agents and valuers have commissioned soil and land classification experts to resolve serious issues affecting their client's interests. Names and locations have been altered.

7.1 Restoration of a landfill site

A soil scientist was commissioned by the agent of a country estate to assess the quality of restored agricultural land at a former municipal waste site in north east England. Estate land was leased to the Borough Council for use as a landfill waste site. Following the cessation of the landfill operations the land was restored using soil stripped and stored on site. The estate had specified in the lease that the restored land be returned in a condition consistent with its original and be of *no less agricultural viability than that land surrounding land.*

MAFF had commissioned a detailed ALC survey of agricultural land at an adjacent site proposed for opencast coal mining. This survey confirmed the presence grade 3a and 3b agricultural land in the vicinity and it was agreed by the estate and the council that it was representative of the landfill site prior to excavation.

The soil survey of areas of the landfill site restored to agricultural grassland found that patchy growth reflected the variable depth and quality of rootable soil on site. In some places the ground was bare and here the soil was extremely compacted and very difficult to excavate by spade and auger. Elsewhere, where soils were uncompacted, the grass cover was thick and healthy.

The restored land was assessed as ALC Grade 4 due to the uneven ground surface, soil wetness resulting from compaction and shallow rooting causing the grass to suffer from drought in summer. As it was determined to be of lower quality than the surrounding land, the estate successfully negotiated with the council that it should fulfil the terms of the lease and improve the quality of restoration.

7.2 Sale of an agricultural estate

This 500 ha estate, owned by an investment fund, was put up for sale. The Provisional ALC map showed the land to be equally divided between Grades 3 and 4, but the vendor's agents thought this was not a fair reflection of the quality of this productive arable estate. They suspected the grades reflected the fact that the land had been neglected and under grass when the original ALC assessment was made in the 1960s.

The agents commissioned a soil survey of the estate in order to accurately reassess the ALC grading. This revealed that 85% of the estate to be Grade 3a, 10% Grade 2 and only 5% Grade 4. The agents' opinion was that this significantly boosted the sale price by attracting interest from European farmers and institutional investors.

7.3 Rent review in Breckland

A tenanted farm in Breckland consisting largely of sandy soils gave lower yields of sugar beet than neighbouring farms. The landlord's agent claimed that this must be due to poor husbandry; a claim strongly disputed by the tenant who was pressing for a rent reduction. The tenant's agent commissioned a soil scientist to examine the land. A careful examination of the soils under sugar beet showed no compaction but, nevertheless, the rooting of most plants terminated abruptly at 35 cm depth.

Soil analysis revealed that the colloidal content (a combination of clay, silt and organic matter) below 35 cm was only 1.04%, indicating that the rooting medium was almost pure sand; in contrast to the more loamy sands of the surrounding farms. Research in Denmark has demonstrated that sugar beet rooting is inhibited in sandy soils with a colloidal content of less than 5%. Thus, the low yields were confirmed to be due not to poor husbandry but to the nature of the soil.

7.4 Dilapidations at a Fenland farm

The Fenland tenancy fell vacant after 12 years, during which the farmer had grown carrots, potatoes and sugar beet with only an occasional cereal break. The landlord's agent was concerned that such intensive root and potato production had damaged the productive capacity of the holding through a build-up of disease, compaction and depletion of trace elements such as copper and boron. A detailed soil survey and analysis revealed the following: moderate compaction in some fields, but within plough depth, and therefore easily removable; boron levels were adequate but copper was low in some fields, although no lower than is common in a district where regular applications are required. Nematode numbers were moderate or low in all fields. However, infection with violet root rot was severe in many fields, and it was recommended that the production of carrots, potatoes and sugar beet should cease for about five years. Dilapidations between landlord and tenant were assessed on that basis.

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