PLANNING FOR SOIL CONSERVATION

Introduction

This is the second of two articles originally published on LinkedIn and adapted for the RTPI Blog.

The author carrying out a soil and ALC survey in one of his open plan offices (Essex)

I hope that my introduction to soils "*Why are Soils Neglected?*" has made soils more "knowable" for some. This article adds to my description of some important soil properties relevant to land use planning, and it is illustrated with photos taken during my field survey work. I venture further to make connections between soil properties, soil functions, soil health and good practice in soil handling for land restoration. I also indicate the most appropriate use of different soil types for biodiversity gains.

Soil performs 'functions' that are components of the following terrestrial ecosystem services:

- Biomass (food, fibre, timber and fuel) production;
- Ecological habitats and a platform for soft (i.e. green) infrastructure;
- Interactions with the atmosphere: as a component of the carbon and nitrogen cycles;
- Interactions with the atmosphere: as a component of the hydrological cycle;
- The preservation of archaeology, cultural heritage, community benefits and geodiversity; and
- As a source of materials.

Soils also act as a platform for hard development.

Land loss and soil displacement

Land-take and the consequent displacement of soils by development are the primary impacts of most types of development, particularly in the change from agriculture to urban land uses. Although in some cases other types of land use change occur, perhaps in association with urban development, where soils are not necessarily displaced, such as tree planting for landscaping, and the creation of wildlife habitats on agricultural land. Hard development (built structures and manufactured impermeable surfaces) displaces, seals off and largely isolates any remaining soil from the rest of the terrestrial ecosystem.

In addition to this loss of the land resource, the effects of development on displaced soil resources should also be assessed within the development control process. This should be with reference to changes in soil properties that affect soil functions and soil health within soils that are conserved for use both on and off-site. This article is primarily about these soil properties.

Some important soil properties

In my first article I showed how soils (and subsoils in particular) are influenced by the parent materials (weathered rocks) in which they have developed. I also made the point that subsoils are important because they have structures that provide drainage channels which also supply the oxygen necessary for root respiration and the uptake of nutrients. Plant roots extend their roots down the drainage channels and penetrate the porous structures.

Organic matter and carbon are stored mainly in dark brown and generally loamy topsoils. On agricultural land in the UK topsoils tend to have uniform depths of between 20 and 25cm because of repeated ploughing and other cultivations to these depths. The lighter coloured subsoils are more variable. They can have several horizons (layers), each with combinations of textures and structures which often change with increasing depth, as described below.

Soil textures are variations in the proportions of sand, silt and clay contents in the mineral part of the soil, and they have a big influence on soil structures. Larger and less porous structures are associated with heavier (clayey and silty) soil textures. Smaller and more porous structures are associated with loamy textures, which are a mix of sands, silts and clays. Photo 1 shows a deep loam over a red marl that occurs at depth, and Photos 2 to 4 show the transition from upper subsoil to lower subsoil structures within this profile. The heavier textures with increasing depth lead to gradually larger structures. Photo 5 shows the larger upper subsoil structures present in other profiles where the red marl occurs closer to the ground surface. Compare the more favourable structures in the deep loam with those in a soil profile where the topsoil occurs directly over Red Marl (Photo 6) and the fragments of large soil structures taken from the marl at a shallow depth (Photo 7).

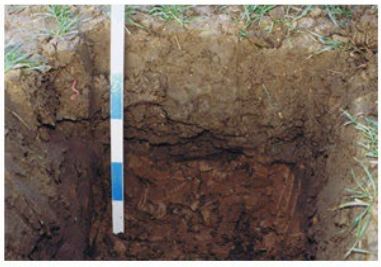
1) Deep Loam Over Red Marl

2) Shallow Upper Subsoil Structures

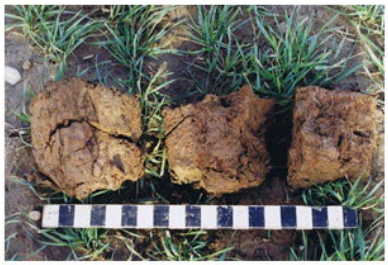
3) Deeper Upper subsoil Structures

4) Lower Subsoil Structures

5) Larger Upper Subsoil Structures where Red Marl is Closer to the Ground Surface

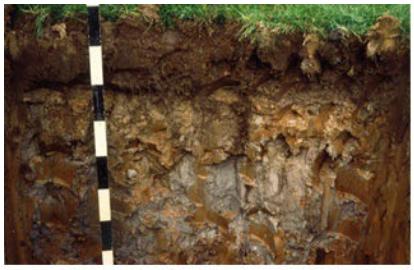


6) Shallow Soil Over Red Marl



7) Fragments of Large Subsoil Structures (no Upper Subsoil Structures)

Soils developed in parent materials like silts and clays have heavy textures at shallow depths, with larger less porous structures and fewer drainage channels. They are prone to wetness, and a relatively high water-table, particularly in topographic receiving sites, and they require more careful soil handling under drier conditions than loamy soils. These soils and structures are shown in Photos 8 to 10.

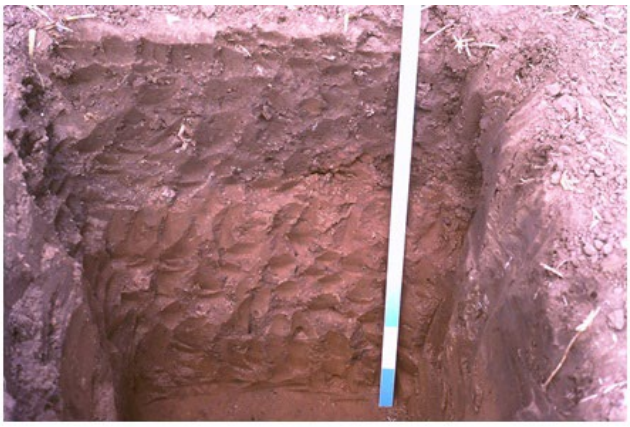


8) Clay Soil Profile

9) Large Subsoil Structures (no Upper Subsoil Structures) in Clay Soil

10) Clay Soil with High Water Table

Soils on sandy parent materials have textures that generally get sandier with depth. They have weakly developed and friable structures that break down easily, and in driers areas they are prone to drought. These soils and structures are shown in Photos 11 and 12.



11) Sandy Soil Profile

12) Weakly Developed and Friable Subsoil Structures in Sandy Soil

The first article shows how to match soil types available at a development site with proposed soft (i.e. green) land uses to make the most sustainable use of soils and secure lasting biodiversity gains.

Agricultural land quality

For some time, the focus of development control has been on the loss of agricultural land and the quality of such land, particularly best and most versatile and prime agricultural land, according to the Agricultural Land Classification (ALC) for England, Wales and Northern Ireland, and the Land Classification for Agriculture (LCA) for Scotland, and this relates mainly to the biomass function. In response to evolving environmental considerations, however, greater consideration is now being given to the other soil functions.

Briefly in respect of agricultural land quality, the weathering and erosion of rocks, and the mixing of sands, silts and clays deposited as surface materials explains why most UK topsoils are loamy. Soils developed on deeper loamy surface deposits also have the loamy upper subsoils of varying thickness (as described above) with smaller and more porous structures to depth, and a greater density of drainage channels. They are less prone to wetness or drought and are associated with higher

grades/classes of agricultural land. Generally speaking, the thicker the loamy upper subsoils the higher the grade or class of agricultural land.

The deep loamy soil and associated structures shown above in Photos 1 to 4 are likely to be classified as ALC Grades 1 and 2 and LCA Classes 1 and 2, unless downgraded by climatic or topographic limitations.

Development impacts on soils

In the development control process the significance of impacts on soils should be determined with reference to changes in soil properties which are well understood by soil practitioners. Some of the more important properties have been described above, but others include depth to impermeable layers, hydraulic conductivity, depth to groundwater, levels of soil organic matter and stored carbon, nutrient and pH levels and soil biota populations. The soil properties that determine soil functions are understood, but we have yet to arrive at the formal recognition of soil properties defining the relatively new concept of soil health. As soil health influences soil functions, the soil properties that determine both are likely to be broadly similar, however. Soil health is a work in progress, and this explains why the recently published IEMA guidance on land and soils in EIA is based on soil functions.

https://www.iema.net/resources/blog/2022/02/17/launch-of-new-eia-guidance-on-land-and-soils

Conserving soils displaced by development

Where soils disturbed by development are conserved for reuse (both on and off-site) as a form of mitigation, the protection and retention of the soil properties described above (and soil structure in particular) is important. The Defra (2009) "*Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*" (CoP) is concerned with the conservation and protection of soil resources displaced by development on construction sites, and it is being revised. In general terms, the current CoP is technically sound, particularly in respect of advice on soil handling, however, experienced practitioners are concerned at the widespread failure to implement this guidance. Therefore, the emphasis of the revised CoP should be on the effective implementation of good practice in soil handling.

Good practice in soil handling methods and the use of suitable machinery in dry conditions, as set out in the CoP, is necessary to achieve successful land restoration and habitat creation/translocation. This will avoid the loss of soil, and the destruction of soil structures through compaction by heavy machinery.

In Photo 13, note the well-developed subsoil structures in this undisturbed soil profile, and the largely vertical drainage channels between them. Compare this with the platy non-porous structures with horizontal cleavages and an absence of vertical drainage channels in the damaged soil material shown in Photo 14 that has become compacted by inappropriate soil handling in wet conditions.

13) Soil Profile Showing Well Developed Structures and Drainage Channels

14) Impermeable Platy Soil Structures Caused by Compaction

The detailed site-specific soil information required for the validation of development control decisions, together with the effective subsequent application of planning conditions for soil conservation, monitoring, and enforcement of restoration standards on construction sites is set out in the first article.

All photos in this and my first article are my own, and they are free for you to use. Please attribute them to “Chris Stapleton”.