The High Speed Rail (London – West Midlands) (Greatmoor Railway Sidings Etc.) Order

Environmental Statement – technical appendices
Volume 4.2:
Agriculture, forestry and soils impact assessment

August 2016
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Department for Transport

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1 Introduction

1.1.1 The agriculture, forestry and soils appendix for the Greatmoor Railway Sidings provide background details on the Agricultural Land Classification.

1.1.2 The map referred to throughout the agriculture, forestry and soils appendix is shown on Map ES-09, in Volume 3 of this ES.

2 Soils and Agricultural Land Classification Surveys

2.1 Background

2.1.1 The soil and agricultural land classification baseline data has been derived from desk study and relates primarily to the identification of soil resources in the study area, the associated physical characteristics of geology, topography and climate which underpin the assessment of agricultural land quality. The main sources of information have included:

- National Soil Map[1];
- Soils and Their Use in South East England[2];
- solid and superficial deposits from the Geology of Britain viewer[3];
- gridpoint meteorological data for Agricultural Land Classification of England and Wales[4]; and
- Provisional Agricultural Land Classification of England and Wales (1:250,000)[5].

2.2 Soils and land resources

2.2.1 The location and extent of soil types displaying different characteristics and of agricultural land in the different Agricultural Land Classification (ALC) grades are influenced by topography; drainage; geology; and soil parent material.

2.2.2 The main soil and land use interactions are then evaluated and include agricultural land quality and other key soil interactions within the study area.

Topography and drainage

2.2.3 The wider area is influenced in the south by the Midvale limestone ridge and in the north by the clay lowlands; the study area is gently undulating.

[1] Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale.*
[2] Soil Survey of England and Wales (1984), *Soils and Their Use in South East England*.
[3] British Geological Survey. http://bgs.ac.uk/geologyofbritain/home/html: Accessed on 18 March 2013
[4] Meteorological Office (1989), Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations.
[5] Ministry of Agriculture, Fisheries and Food (MAFF) (1983), *Agricultural Land Classification of England and Wales* (1:250,000).

2.2.4 There are two main watercourses in the general area, the River Ray and Muxwell Brook, both of which run east to west, together with several minor watercourses. The River Ray crosses between Woodlands Farm and Woodlands Farm Cottages whilst Muxwell Brook follows the boundary of Sheephouse Wood Site of Special Scientific Interest (SSSI) and the Calvert landfill site.

Geology and soil parent materials

2.2.5 The bedrock geology consists of the Ancholme Group comprised of a succession of different mudstones. The majority of the study area is underlain by the Stewartby Member; the south-eastern section is underlain by the Weymouth Member. Both are predominantly of silty clay material, but localised sands and gravels may also occur.

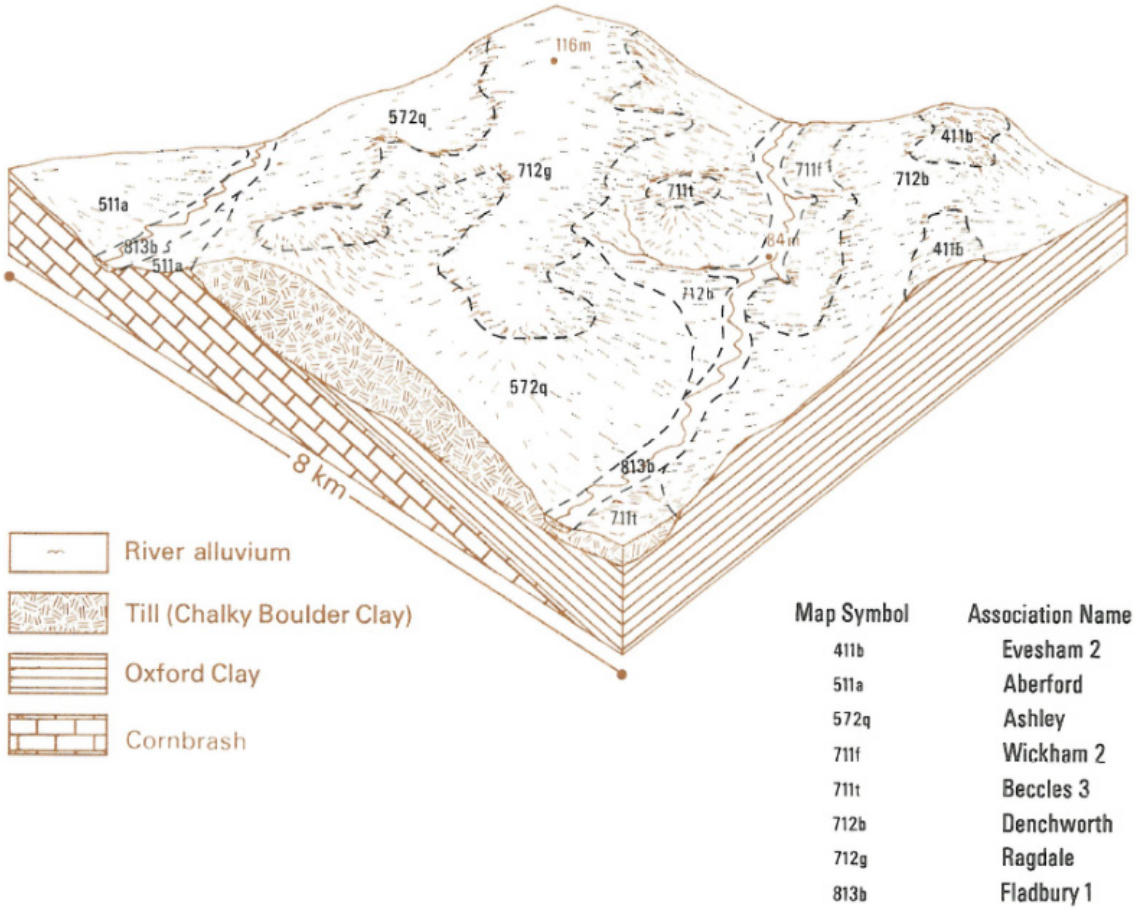
Description and distribution of soil types

2.2.6 The National Soil Map[1] shows the study area to be dominated by slowly permeable, seasonally wet, basic loams and clays. The soils mapped by the Soil Survey of England and Wales[2] are of the Denchworth association which is characterised by stoneless, clayey, wet and poorly drained soils of Wetness Class (WC) IV[6]. It is shown in Figure 1 to have developed over heavy Oxford Clay, although the depiction is not specific to the study area.

2.2.7 Typical profiles of the main soil series within the association are depicted in Figure 2 alongside a basic description of each horizon. In addition, detailed profile descriptions of the Denchworth series and Wickham series (Table 1) which constitute about 40% and 20% respectively of the soils found in the Denchworth association. References to soil colours have been derived from a standard Munsell Soil Colour Chart[7]. Other technical references may be found in the Soil Survey of England and Wales[2].

[6] The Wetness Class of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six categories from well drained WCI to very poorly drained WCVI.
[7] Munsell Color Charts (2000), Munsell Color, Grand Rapids, MI, USA

Figure 1: Development of the Evesham 2, Aberford, Denchworth and Ragdale soil associations in a landscape context



National Soil Resources Institute (NSRI) 2013. The Soils Guide. Available: http://www.landis.org.uk/. Cranfield University, UK

Figure 2: Predominant soil series profile descriptions

National Soil Resources Institute (NSRI) 2013. The Soils Guide. Available: http://www.landis.org.uk/. Cranfield University, UK

Table 1: Dominant soil series

Denchworth series
0cm–14cm, very dark brown (10YR 2/2) humose clay; common distinct very fine and fine sharply defined yellowish brown (10YR 5/6), medium and fine clearly defined light olive brown (2.5YR 5/4) mottles; moist; moderately developed medium and fine subangular blocky peds with a tendency to angular in places; low packing density; moderately porous; very firm soil strength; moderately firm ped strength; very sticky, very plastic; many very fine fibrous and common fine and very fine fleshy roots; earthworms active; abrupt smooth boundary.
14cm–39cm, light olive brown (2.5YR 5/4) clay; very many medium to extremely fine prominent sharply defined yellowish brown (10YR 5/4) and distinct clearly defined light olive brown (2.5Y 5/6) and greyish brown (2.5Y 5/2) mottles as well as common prominent grey (5Y 5/1) mottles with sharp boundaries; moist; strongly developed coarse angular blocky peds with occasional inclined shiny slickensided faces coated greyish brown (2.5Y 5/2), vertical faces particularly in the upper part of the horizon coated with black (5YR 2/1) and dark yellowish brown (10YR 3/4) organic material; low packing density; moderately porous; very firm soil and ped strength; moderately sticky, very plastic; common very fine fibrous roots mainly concentrated along ped faces; earthworms active, coarse vertical channels coated with very dark greyish brown (10YR 3/2); few rounded ferri-manganiferous concretions; clear smooth boundary.
39cm–61cm, olive grey (5Y 5/2) clay; many prominent light olive brown (2.5Y 5/6), yellowish brown (10YR 5/6) and olive (5Y 5/4 and 5/6) medium to very fine sharply defined mottles; moist; weakly developed coarse and medium angular blocky peds with a tendency to prismatic; many olive grey (5Y 5/2) and grey (5Y 5/1) ped faces and inclined slickensides; medium packing density; slightly porous; very firm soil strength, moderately firm ped strength; very sticky, very plastic; common very fine fibrous roots mainly concentrated along ped faces; earthworms active; common rounded ferri-manganiferous nodules; abrupt smooth boundary.
61cm–110cm, grey (5Y 5/1) clay; very many medium to extremely fine yellowish brown (10YR5/6) sharply defined mottles; very moist; strongly developed fine angular blocky rock structure with tendency to platy, faces uniform grey (5Y 5/1) or yellowish brown (10YR 5/6); medium packing density; slightly porous; moderately firm soil strength; semi-deformable; moderately sticky, very plastic; few very fine fibrous roots mainly along shale partings; common rounded ferri-manganiferous concretions.
Wickham series
0cm–22cm, dark greyish brown (10YR4/2)[8] very slightly stony silty clay loam with few fine greyish brown (10YR5/2) mottles; medium subangular and tabular chert; moist; moderately developed medium subangular blocky; medium packing density; moderately firm soil strength; many very fine fibrous roots; non-calcareous; clear wavy boundary
22cm–45cm, brown (10YR5/3) slightly stony silty clay loam with many fine strong brown (7.5YR5/6) mottles; medium subrounded and tabular chert; very moist; weakly developed; adherent coarse subangular blocky with light brownish grey (2.5Y6/2) faces; medium packing density; moderately firm soil and ped strength; common very fine fibrous roots; non-calcareous; few rounded ferruginous concretions; gradual wavy boundary
45cm–65cm, light grey (5Y7/1) slightly stony silty clay with many fine strong brown (7.5YR5/8) mottles; medium subangular and tabular chert; very moist; weakly developed; adherent medium prismatic; high packing density; moderately firm soil and ped strength; few fine fibrous roots; very slightly calcareous; gradual wavy boundary
65cm–110cm, light grey to grey (5Y6/1) stoneless silty clay with many fine strong brown (7.5YR5/8) mottles; moist; weakly developed, adherent coarse prismatic; high packing density; very firm soil and ped strength; very slightly calcareous

Palmer (1982). Soils in Hereford and Worcester I, Soil Survey Record No. 76; Jarvis et al (1984). Soils and their Use in South East England, Soil Survey of England and Wales Bulletin No. 15

[8] Munsell colour notation describes colour by three attributes: hue (with five principal colours - red (R), yellow (Y), green (G), blue (B), and purple (P) with a preceding intermediate value 2.5-10; value or brightness where zero is black (most dark) and ten is white (most light); and chroma that distinguishes the difference from a pure hue to a grey shade.

2.3 Soil and land use interactions

Agricultural land quality

2.3.1 A review of background ALC information has been undertaken to determine the land quality context in the study area. There is no detailed post-1988 ALC data available.

Desk assessment of Agricultural Land Classification

2.3.2 The study area has been subject to desk-based assessment which has relied on the interpretation of soil mapping, topography and agro-climatic data, and the interactions between each factor. This resulted in an assessment of the likely soil textures, soil drainage status, landform, gradient, presence of or depth to poorly permeable soil layers and the extent to which crop growth may be limited by soil droughtiness.

2.3.3 A professional judgement has then been made of the predominant ALC grade which is likely for a soil with the given characteristics found in the climatic zone of the location within the area. The judgement is influenced by the surveyor's experience of previous surveys in the locality and on similar soil types. The resulting grade is that which is considered to be the most likely grade that would be found should a detailed site investigation be conducted although this does not mean in all cases that that grade will be found in practice.

2.3.4 Context land quality was ascertained using information derived from the provisional ALC maps of England and Wales produced by MAFF in the 1960s and 1970s[5]. These maps show the section to be provisionally mapped as approximately equal proportions of Grade 3, good to moderate quality land, and Grade 4, poor quality land. These maps were originally published at a scale of 1:63,360 and are available at a scale of 1:250,000 in paper and digital formats. The main limitations of these provisional maps are that they are published on strategic scales only and according to a methodology which has since been revised twice. Therefore they cannot be used to definitively classify individual sites and hence further data analysis was conducted.

Agro-climatic data

2.3.5 The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point data, set out in Table 2. The data show the area to be moderately warm and dry, with an average accumulated temperature of 1,416 day° and average rainfall of approximately 640mm per year. The average number of field capacity days (FCD[9]) is 136 which is lower than the average for lowland England (150 days) and is considered to be generally favourable for providing opportunities for agricultural land working.

2.3.6 Fundamentally, climate does not in itself place any limitation upon land quality in this area but the interactions of climate with soil characteristics are important in determining the wetness limitations of the land.

[9] Field Capacity Day is a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate and opportunities for mechanised fieldwork are then possible.

Table 2: Interpolated agro-climatic data

Agro-climatic parameter	Greatmoor
Altitude (mAOD)	75m
Average Annual Rainfall	642mm
Accumulated Temperature above 0°C	1,416 day°
Field Capacity Days	136 days
Average Moisture Deficit, wheat	108mm
Average Moisture Deficit, potatoes	100mm

Site limitations

2.3.7 The assessment of site factors is primarily concerned with the way in which topography influences the use of agricultural machinery and hence the cropping potential of land. Gradient and microrelief, with complex changes of slope angle or direction over short distances, is not considered to present any limitation to the grading of study area.

2.3.8 Given the extensive network of river channels, brooks and ditches flood risk is likely to be relatively high within the study area however there is insufficient data available to downgrade agricultural land classification according to actual flooding.

Soil limitations

2.3.9 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. Together they influence the functions of soil and affect the water availability for crops, drainage, workability and trafficability. In this study area though, the soil type is likely to be the generally seasonally wet soils overlying the heavy clay geology. This is likely to result in respective limitations to the grading due mainly to soil wetness and workability.

Interactive limitations

2.3.10 The physical limitations which result from interactions between climate, site and soil are soil wetness, droughtiness and susceptibility to erosion. Each soil can be allocated a WC based on soil structure, evidence of waterlogging and the number of FCD. The topsoil texture then determines its ALC Grade in accordance with the MAFF ALC guidelines (Figure 3)

Figure 3: Agricultural land classification grade according to soil wetness

Wetness Class	Texture[1] of the top 25 cm	Field Capacity Days <126	126-150	151-175	176-225	>225
	S[2] LS[3] SL SZL	1	1	1	1	2
	ZL MZCL MCL SCL	1	1	1	2	3a
I	HZCL HCL	2	2	2	3a	3b
	SC ZC C	3a(2)	3a(2)	3a	3b	3b
	S[2] LS[3] SL SZL	1	1	1	2	3a
	ZL MZCL MCL SCL	2	2	2	3a	3b
II	HZCL HCL	3a(2)	3a(2)	3a	3a	3b
	SC ZC C	3a(2)	3b(3a)	3b	3b	3b
	S[2] LS SL SZL	2	2	2	3a	3b
	ZL MZCL MCL SCL	3a(2)	3a(2)	3a	3a	3b
III	HZCL HCL	3b(3a)	3b(3a)	3b	3b	4
	SC ZC C	3b(3a)	3b(3a)	3b	4	4
	S[2] LS SL SZL	3a	3a	3a	3b	3b
	ZL MZCL MCL SCL	3b	3b	3b	3b	3b
IV	HZCL HCL	3b	3b	3b	4	4
	SC ZC C	3b	3b	3b	4	5
	S LS SL SZL	4	4	4	4	4
	ZL MZCL MCL SCL	4	4	4	4	4
V	HZCL HCL	4	4	4	4	4
	SC ZC C	4	4	4	5	5
Soils in Wetness Class VI - Grade 5						

[1]For naturally calcareous soils with more than 1% $CaCO_3$ and between 18% and 50% clay in the top 25 cm. the grade, where different from that of other soils, is shown *in brackets*

[2] Sand is not eligible for Grades 1, 2 or 3a

[3] Loamy sand is not eligible for Grade 1

Where: S = sand, Z = silt, C = clay, L = loamy and P= peat.

For sand the coarseness of the grain is sub-divided into coarse (c), medium (m) and fine (f). The subdivisions of clay loam and silty clay loam classes are indicated as medium (M) (less than 27% clay); heavy (H) (27-35% clay).

2.3.11 The average number of Field Capacity Days in the study area is 136, and shown in the highlighted column.

2.3.12 Thus, soils of the Denchworth association, developed over clay bedrock and comprising seasonally waterlogged profiles of WC IV, with clay and clay loam topsoils are classified as Subgrade 3b.

3 References

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