APPENDIX B : ADAS Soil Resources Report 2005 and 2009

M1 JUNCTION 19 IMPROVEMENT
PRE-WORKING SURVEY OF SOIL RESOURCES 2005 and 2009

1. INTRODUCTION

The M1 Junction 19 Improvement will would involve disturbance of agricultural land and movement of significant quantities of soils and geological materials. Some of the areas used during the construction phase will ultimately be restored to agriculture.

ADAS was instructed to carry out a pre-working soil investigation of the areas that will would be be temporarily disturbed and devise strategies for sustainable soil management and restoration of these areas to agricultural use. The areas included temporary haul routes, the contractor's compound site and areas required during construction.

In order to achieve a good agricultural restoration it is important to strip, store and replace soils with care. The rooting depth of many crops is at least 1 m and the aim should be to return the land, where possible, with a total depth of 1.2 m of soil that is relatively free from compaction. This is necessary to allow rainfall to percolate through the profile and to permit crop root penetration for the extraction of moisture and nutrients.

Soil resources were first investigated in 2005 for the footprint of the proposal current at that time, together with areas required temporarily for that scheme. Following the announcement for the Preferred Route in February 2009 and amendments to the layout for the junction since 2005, a similar survey was carried out in 2009 on further areas required for temporary use. This survey also included an investigation to identify possible low nutrient subsoils for use in habitat creation areas.

This report confirms methodologies and findings for both the 2005 and 2009 surveys.

2. METHODOLOGY

Soils were investigated to a maximum depth of 1 metre by means of a hand auger and/or spade. Auger borings were carried out at a minimum density of one boring per hectare in areas where access had been agreed. Supplementary examinations were made, in addition to the main borings, in order to confirm fair representation of detail in the main investigation record.

The main survey was carried out in November 2009 and this was supplemented with information collected during a previous survey in September 2005. The areas investigated are listed in Tables 1 (2009) and 2 (2005) and are shown on Figure 5.2 (amended by ADAS).

Representative samples of topsoil (0-150 mm depth) were collected from most fields investigated and submitted for laboratory analysis of available nutrients and organic matter content. Selected samples of subsoil (300-600 mm depth) were also submitted for analysis.

Table 1: Fields investigated in 2009**

Field*	Profile Nos.	Proposed use
3a	1	Temporary haul road within HA ownership
3b	2-4	Temporary haul road within HA ownership
3c	5-7	Temporary haul road within HA ownership
3d	8-10	Temporary haul road within HA ownership
3e	11	Temporary use for construction
5a	12	Temporary use for construction
5b	13	Temporary haul road to be returned to landowner
5c	14	Temporary haul road to be returned to landowner
5d	21-22	Temporary haul road within HA ownership
5e	23-24	Temporary haul road within HA ownership
5f	25-26	Temporary haul road within HA ownership
5g	27	Temporary use for construction
7a	15	Temporary haul road within HA ownership
7b	16-18	Temporary haul road within HA ownership
7c	19-20	Temporary haul road within HA ownership
9a	28	Temporary use for construction

* Numbers relate to ownership plot nos. followed by individual field/area refs. (a-g) for that ownership

**Access could not be arranged for additional sites at Manor Farm, Catthorpe (Plot 4).

Table 2: Fields investigated in 2005

Field	Profile Nos.	Proposed use
5 (05)	1-6 (05)	Site compound
4 (05)	7-8 (05)	Temporary use for construction
10 (05)	9-10 (05)	Flood plain compensation area; level lowered and returned to agriculture.

SOILS PRESENT

3.1 General

Details of individual auger borings are listed at Annex A and summarised below.

At the time of 2009 survey, land to the north of the M6 and Rugby Road was in winter wheat, oilseed rape or grass leys. Land bordering the north side of the A14 was permanent grassland.

The soils in the areas examined have been classified, by the Soil Survey of England and Wales (1:250,000 scale -Soils of Midland and Western England), as being of the Beccles, Ragdale, Wickham and Denchworth soil associations. The Beccles and Ragdale associations have developed over chalky till and are generally located to the north of the M6 and Rugby Road. The Ragdale association comprises clay or clay loam textures over clay. The Beccles association is characterised by a surface layer of loamy drift and has sandy clay loam or clay loam upper horizons overlying clay. The Wickham and Denchworth associations are formed over Lias clays and occur to the south and east of the junction. The Denchworth soils have clay textures in both topsoils and subsoils. Wickham association soils are formed where drift overlies the clay and typically have clay loam to silty clay loam topsoils and heavier subsoils. All these soils have naturally impeded drainage and are subject to seasonal waterlogging.

3.1.1 Land to NW of Junction - Fields 3a-3e

Soils of the Beccles association predominated in this area. There was generally 250-300 mm of sandy clay loam or clay loam topsoil overlying sandy clay loam, clay loam or sandy loam in the upper subsoil and clay in the lower subsoil. Most profiles had rusty mottled colorations indicative of naturally impeded drainage. Soils were slightly stony or stony, and the depth of loamy material over the clay was variable. There was up to 800 mm of loamy textured soil in some areas whereas at the western end of field 3b, clay loam topsoil directly overlay calcareous clay subsoil. In field 3c and the east end of 3b soil profiles were very compact, dry and stony and may have been subject to previous disturbance.

3.1.2 Land between M1 and Rugby Road - Fields 5a-5c and Field 5(2005)

Soils were quite variable in this area although generally characterised by loamy drift over clay (as in 3.1.1). Topsoil textures included sandy loam, sandy clay loam and clay loam and topsoil depths were 250-290mm. Upper subsoils were commonly of clay loam or sandy clay loam and lower subsoils of clay but in some locations, clay occurred immediately below the topsoil. Rusty mottling was evident within 400 mm depth in most of the subsoils.

3.1.3 Land bordering N side of A14 (Fields 7a-7c, Fields 5d-5g and Field 9a)

Soils in this section commonly had clay loam topsoils overlying mottled clay subsoils. Slightly lighter soils occurred in field 5d where sandy clay loam textures occurred in both topsoils and subsoils. Topsoil depths ranged from 150-300 mm and were particularly variable in fields 7a, 7b and to a lesser extent 5e were former ridge and furrow systems were evident.

3.1.4 Land between A14 and M1- Field 4(2005)

Soils in this field had clay textures in both topsoils and subsoils (Denchworth association). Topsoil depths were around 250 mm and rusty mottling was present in the subsoils within 400 mm.

3.1.5 Flood compensation area to W of M1- Field 10(2005)

Soils in this area had a good depth (250 mm) of clay loam or silty clay loam topsoil but subsoils were variable and showed signs of previous disturbance. These included buried topsoil layers within the subsoil horizon, and subsoils that were very compact, poorly structured and with gravely clay below 450-600 mm depth. Previous disturbance had probably occurred during construction of the adjacent A14 Trunk Road.

3.2 Topsoil Analyses

Results are listed in full at Annex B and summarised in Tables 3 and 4 below.

Most areas sampled had topsoil pHs in the range 6.1-7.4. The exceptions to this were three fields in the land to the north of the A14 (fields 5d, 5e and 7b) with more acidic pHs of 5.8.

Concentrations of available nutrients are quoted in milligrams per litre of soil followed by the equivalent nutrient index. Indices are an aid to interpretation and for agricultural soils can generally be considered as follows:

index 0 - very low
1 - low to moderate
2/3 - recommended level for most crops
4 and above - high

The lowest levels of available soil nutrients occurred in the permanent pasture fields to the north of the A14 Trunk Road where phosphorus and potassium indices were generally 0 or 1.

Topsoil organic matter levels were variable but most were above average falling within the range 4.2% to 13.6%.

Table 3: Topsoil available nutrients, pH and organic matter (Fields sampled in 2009)

Field	pH	Phosphorus	Potassium	Magnesium	Organic matter
		Soil nutrient index			%
3a	6.4	2	2+	3	6.7
3b	6.4	2	1	2	6.0
3c	6.2	2	2-	2	5.5
3d	6.9	2	2+	2	5.3
3e	6.8	2	2-	2	6.5
5a	7.4	2	3	3	4.8
5b/c	6.7	3	3	2	4.2
5d	5.8	3	1	3	4.4
5d-ss[1]	6.4	0	0	2	1.7
5e	5.8	1	1	4	8.4
5f	6.1	1	1	4	11.0

Field	pH	Phosphorus	Potassium	Magnesium	Organic matter
7a	6.3	0	1	4	9.5
7b	5.8	0	1	5	10.0
7b-ss[1]	6.3	0	2-	4	4.5
7c	6.3	1	1	3	8.8

[1] Subsoil sample 300-600 mm depth

Table 4: Topsoil available nutrients, pH and organic matter (Fields sampled in 2005)

Field	pH	Phosphorus	Potassium	Magnesium	Organic matter
		Soil nutrient index			%
5 (05)	6.4	2	2+	2	7.4
4 (05)	7.2	2	2+	3	8.3
10 (05)	7.1	2	3	4	13.6

3.3 Subsoil analyses

From the survey, it can generally be assumed that subsoils from any of the areas investigated are likely to have low nutrients.

Samples 5D-SS and 7B-SS reported in full in Annex B (and summarised in Table 3 above) are subsoil samples. Both are low in phosphorus (P) and 5D-SS is also low in potassium (K).

4. SOIL STRIPPING

4.1 General

In order to achieve a good restoration it is important to pay special attention to soil stripping. Any areas to be excavated below soil level e.g. flood compensation areas should be planned to allow reinstatement to agricultural land of similar quality to the original, taking into account gradients acceptable for cultivation machinery and providing suitable falls and outlets for drainage systems. Soil handling should always be planned to minimise risks of soil structural damage, contamination and erosion.

Damage to soil structure is primarily a result of compaction by machinery, smearing from the passage of a scraper blade or by the slippage of wheels trafficking over the land. Such damage will be minimised if the movement of equipment on site is controlled, with soil stripping carried out under dry conditions. It is therefore particularly important that site operations are carried out under as dry conditions as practicable. Operations carried out under wet conditions could cause damage which may be impossible to rectify in the short term.

Throughout the soil stripping process the movement of machinery should be restricted so that no unnecessary trafficking takes place over topsoil or subsoil. Careful supervision should be provided to ensure that the agreed movements of traffic are fully understood and maintained throughout the whole operation.

Good working practices will need to be adopted by the contractor to minimise risks of soil erosion. A construction site is particularly vulnerable to run-off of muddy water

and soil erosion as it is normally stripped of vegetative growth/topsoil and the subsoil can be subject to heavy levels of trafficking.

The likelihood of erosion will depend on land gradient, soil texture, magnitude of trafficking and precipitation levels during the construction period. Soil erosion can represent a significant pollution risk to the environment if silt-laden water is not prevented from entering a body of water. This report gives guidelines for soil handling and it is recommended that the contractor should develop a plan that sets down procedures for recognising when and where there is a risk of pollution from soil erosion. Equipment and materials should be readily available to contain and handle any silt-laden water within the working areas. In addition, the contractor should have an Emergency Plan detailing procedures to be followed should a pollution incident occur.

4.2 Topsoil Stripping

Topsoils should be carefully stripped and stored from all areas that will be returned to agriculture. These include the contractor's compound site, construction laydown areas, haul routes and flood plain compensation areas. It is not necessary to strip topsoil from the areas where topsoil will be stored.

Any vegetative growth higher than 150 mm should be cut and removed from the land surface prior to topsoil stripping. This will reduce the risk of anaerobic zones developing in the topsoil heaps.

Animal diseases and soil borne plant pests can easily be transferred from one field (or farm) to another. This can happen when stripped soil is moved and placed in a different area or when transported by machinery working on the project. Advice on avoiding such problems is given in 'Preventing the spread of plant and animal diseases' MAFF (1991 PB 0486).

Recommended topsoil stripping depths for the areas examined are listed in Table 5.

Table 5: Recommended Topsoil Stripping Depths

Field	Profile Nos.	Stripping Depth (mm
3a	1	300
3b	2-4	250
3c	5-7	300
3d	8-10	300
3e	11	250
5a	12	300
5b/c	13-14	300
5d	21-22	300
5e	23-24	250[12]
5f	25-26	200
5g	27	250[2]
7a	15	200[12]
7b	16-18	200[12]
7c	19-20	200[2]
9a	28	300[2]
5 (05)	1-6 (05)	300
4 (05)	7-8 (05)	250

Field	Profile Nos.	Stripping Depth (mm
10 (05)	9-10 (05)	250

[1] Ridge and furrow – topsoil depth variable
[2] Indistict boundary between topsoil and subsoil

Specific information of topsoil depth is not available for other areas (Plot 4), but depths are likely to be around 250-300 mm for arable and ley grassland fields and 150-200 mm for permanent grassland fields. In most areas the topsoil can be readily identified by its darker colour compared to the underlying subsoil. However, colour differences are not always apparent, particularly in long term grassland. Some of the fields to the north of the A14 Trunk Road have previous ridge and furrow systems. Where these occur, an average stripping depth has been quoted but depths recoverable may differ between ridges and furrows.

4.3 Subsoil protection -

Site office compound, construction laydown areas & haul roads

On areas where subsoils will remain *in situ* during site working i.e. the site office compound, construction laydown areas and haul roads, the subsoil surface should be covered with protective membranes prior to laying down hardcore. This will reduce risks of contamination and loss of material.

4.4 Subsoil Stripping –

Flood plain compensation areas

Where subsoil excavations are to be carried out for flood plain compensation areas or any other purposes, on land that is to be restored to agriculture, it is imperative that subsoils are carefully stripped and stored.

Natural subsoils have undergone development through weathering over many thousands of years and are usually superior to the underlying parent material down to a depth of approximately 1m. Additionally, it is likely that in some areas, the upper subsoils (250-500 mm) will be of significantly better quality material than the lower subsoils (500-1000 mm). Where this the case, the upper and lower subsoil layers should be stripped and stored separately so they can be reinstated at the correct levels in the restored profile.

The recommended subsoil stripping depth for the flood plain compensation area surveyed in 2005 is listed in Table 6.

Table 6: Recommended Subsoil Stripping

Field No.	Type	Layer - Depth below original ground surface (mm)
10a	Subsoil	250 - 1000

5. SOIL STORAGE

Topsoil and subsoil should be stored separately and 'like on like' to minimise contamination and loss. This means that topsoil heaps should overlie topsoil. Topsoils should be stripped and removed from any areas where subsoil is to be stored.

Topsoils and subsoils from the different areas should be stored separately for replacement on their area of origin. Where upper subsoil is of better quality than the lower subsoil and should be stored separately.

All soil storage mounds should be as shallow as practicable and carefully constructed using the minimum amount of compaction necessary to ensure stability. The mounds should be graded, and unless storage is short term (ie no more than a few months) mounds should be seeded with a suitable grass/clover mix. The sward should be maintained as appropriate to discourage weeds and maintain vigour

6. SOIL REINSTATEMENT

6.1 General

It is essential to minimise compaction of soils during reinstatement. Working during periods of very wet weather should be avoided, as any soil structural damage caused could be impossible to resolve in the short term.

The requirements for remedial drainage systems should be assessed and land grading carried out with regard to suitable falls and outlets for drainage requirements.

6.2 Site Compound, lay down areas and haul roads

When all structures, machinery and materials (including protective membranes) have been removed to expose the subsoil surface, this should be graded if necessary. The subsoil should be thoroughly loosened, but only in dry conditions. A winged tine subsoiler should be used, working to a depth of 250 mm below the surface of the subsoil and with a tine spacing not more than 500 mm. Subsoil loosening should be carried out before topsoil replacement and special care should be taken to avoid damage to any services and shallow drains.

Topsoil should be replaced to the original pre-working depth taking particular care to minimise compaction of the loosened subsoil by careful control of traffic movement and working only in dry conditions. A further soil loosening operation should be carried out following topsoil replacement (unless topsoil can be loose tipped and levelled without re-compacting the subsoil). A winged tine subsoiler should be used, working to a depth of 400 mm below the surface and with a tine spacing not more than 800 mm.

Any stone with a dimension greater than 100 mm, brought to the surface during subsoiling operations, should be collected and removed.

6.3 Flood plain compensation areas

Any areas where excavations have taken place should be graded to suitable contours for agricultural use prior to replacement of the full 1 metre depth of subsoils and topsoils.

Where subsoils of different quality occurred at different depths, the lower subsoil material should be replaced first so that lower and upper subsoils are restored at the correct depths in the reinstated profile.

Following completion of replacement of the subsoils they should be thoroughly loosened to a depth of 400 mm using a tine spacing of not more than 800 mm. Topsoils should then be replaced and similarly loosened (unless topsoil can be loose tipped and levelled without re-compacting the subsoil). Any stone with a dimension greater than 100 mm, brought to the surface during subsoiling operations, should be collected and removed.

7. CROP ESTABLISHMENT

A crop with a good fibrous root system (i.e. grass or autumn sown cereals) should be established as soon as practicable after reinstatement of all agricultural areas. Plant roots will help the formation of soil structure and maintenance of the fissures formed during loosening. The crop will also assist de-watering of the soil by evapotranspiration. These factors are essential for the development of the restored soil profile. Soil slumping and the risk of erosion following heavy rainfall will be reduced once the crop has established.

The crop should be given adequate fertiliser for establishment and any deficiency in lime corrected before planting. Normal agricultural practice for crop establishment should be followed and particular care should be taken to avoid recompaction of the soil. Trafficking or working of the soil under wet conditions must be avoided.

ANNEX A

SOIL PROFILE DESCRIPTIONS
2009 and 2005 Surveys

Soil Profile Descriptions 2009 Survey

Area	No.		Depth (mm)	Description
3a	1	Winter wheat	0-300 300-420 420-800 800-1000	Dark brown slightly stony sandy clay loam Brown with slight rusty mottles, slightly stony clay loam Brown with rusty mottles, slightly stony clay loam Grey with rusty mottles slightly calcareous clay
3b	2	Grass ley	0-280 280-1000	Dark brown clay loam Brown calcareous clay
3b	3	Grass ley	0-270 270-580 580+	Dark brown clay loam Brown slightly stony calcareous clay Impenetrable due to stone
3b	4	Grass ley	0-250 250-450 450+	Dark brown stony sandy clay loam Brown stony sandy clay loam Impenetrable due to stone *4a. 0-250 sandy clay loam, 250-450 sandy clay loam, 450+ impenetrable; very compact and stony, probably disturbed*.
3c	5	Grass ley	0-280 280-550 550+	Dark brown stony clay loam Brown stony sandy clay loam Impenetrable due to stone *Dry & compact- probably disturbed*
3c	6	Grass ley	0-280 280-540 540+	Dark brown stony sandy clay loam Brown stony sandy clay loam Impenetrable due to stone *Dry & compact- probably disturbed*
3c	7	Grass ley	0-290 290-400 400-550 550-700 700-1000	Dark brown stony sandy clay loam Brown stony sandy clay loam Brown clay Brown sandy clay loam Grey clay with rusty mottles and inclusions of brown sandy clay and sand *Dry & compact upper subsoil- probably disturbed*
3d	8	Oilseed rape	0-280 280-450	Dark brown slightly stony clay loam Brown slightly calcareous clay with slight rusty mottling

Area	No.		Depth (mm)	Description
			450-800	Brown sandy clay with rusty mottles and manganese concretions
			800-1000	Brown clay with rusty mottles and manganese concretions
3d	9	Oilseed rape	0-300	Dark brown slightly stony clay loam
			300-520	Brown slightly stony clay loam with slight rusty mottling and manganese concretions
			520-730	Brown slightly stony sandy clay loam with rusty mottles and manganese concretions
			730+	Impenetrable – pipe?
3d	10	Oilseed rape	0-300	Dark brown clay loam
			300-420	Grey brown clay loam with slight rusty mottling
			420-1000	Brown sandy clay with rusty mottles
3e	11	Grass ley	0-230	Dark brown slightly stony clay loam
			230-400	Brown clay
			400-550	Brown sandy clay with rusty mottles
			550-1000	Grey calcareous clay with rusty mottles
5a	12	Winter wheat	0-280	Dark brown slightly stony clay loam
			280-320	Brown slightly stony clay loam
			320-400	Brown slightly stony clay
			400-750	Dark grey slightly calcareous clay with rusty mottles
			750+	Impenetrable due to stone
5b	13	Winter wheat	0-290	Dark brown slightly stony sandy clay loam
			290-420	Brown slightly stony clay loam with rusty mottles
			420-1000	Grey brown slightly stony clay with rusty mottles
5c	14	Winter wheat	0-320	Dark brown slightly stony sandy clay loam
			320-850	Brown stony sandy loam
			850+	Impenetrable due to stone
7a	15	Permanent grass (ridge and furrow)	0-250	Dark brown with rusty mottles slightly stony clay loam; indistinct boundary to subsoil
			250-480	Brown slightly stony clay
			480-550	Brown slightly stony clay with slight rusty mottling

Area	No.		Depth (mm)	Description
			550-1000	Grey clay with slight rusty mottling *Boring on side of ridge* *14a. Topsoil depth 200*
7b	16	Permanent grass (ridge and furrow)	0-170 170-680 680-750 750-1000	Dark brown slightly stony clay loam Brown slightly stony clay Brown slightly stony clay with slight rusty mottling Grey clay with slight rusty mottling *Boring on side of ridge*
7b	17	Permanent grass (ridge and furrow)	0-250 250-650 650-760 760-1000	Dark brown slightly stony clay loam; indistinct boundary to subsoil Brown slightly stony clay with rusty mottles and manganese concretions Brown slightly stony sandy clay loam with rusty mottles Grey clay *Boring on top of ridge; dry compact surface, possibly disturbed*
7b	18	Permanent grass (ridge and furrow)	0-220 220-300 300-480 480-1000	Dark brown slightly stony clay loam; indistinct boundary to subsoil Brown slightly stony clay Brown slightly stony sandy clay with rusty mottles Grey clay *Boring in furrow*
7c	19	Permanent grass	0-160 160-750 750-1000	Dark brown slightly stony clay loam; indistinct boundary to subsoil Brown clay with rusty mottles and manganese concretions Grey clay with rusty mottles
7c	20	Permanent grass	0-220 220-700 700-1000	Dark brown clay loam; indistinct boundary to subsoil Brown slightly stony sandy clay loam Brown sandy clay with rusty mottles
5d	21	Permanent grass	0-300	Dark brown sandy clay loam

Area	No.		Depth (mm)	Description
			300-820	Orange brown slightly stony sandy clay loam with slight rusty mottling and manganese concretions
			820+	Impenetrable due to stone
5d	22	Permanent grass	0-280	Dark brown slightly stony clay loam
			280-500	Orange brown slightly stony sandy clay with rusty mottles and manganese concretions
			500-850	Orange brown stony sandy clay loam with rusty mottles
			850+	Impenetrable due to stone
5e	23	Permanent grass (slight/mod ridge and furrow)	0-280	Dark brown slightly stony clay loam; indistinct boundary with subsoil
			280-600	Brown slightly stony clay
			600-1000	Grey clay with rusty mottles
5e	24	Permanent grass (slight/mod ridge and furrow)	0-200	Dark brown slightly stony clay loam; indistinct boundary with subsoil
			200-420	Brown slightly stony clay
			420-850	Brown clay with rusty mottles
			850-950	Brown stony sandy clay with rusty mottles
			950+	Impenetrable due to stone
5f	25	Permanent grass	0-220	Dark brown slightly stony clay loam
			220-580	Brown clay with slight rusty mottling and manganese concretions
			580-850	Brown stony sandy clay loam
			850+	Impenetrable due to stone
5f	26	Permanent grass	0-220	Dark brown slightly stony clay loam
			220-450	Grey brown clay with rusty mottles
			450-720	Grey clay
			720-1000	Brown stony sandy clay loam
5g	27	Permanent grass	0-250	Dark brown slightly stony clay loam
			250-550	Brown slightly stony clay
			550-680	Brown slightly stony clay with slight rusty mottling

Area	No.		Depth (mm)	Description
			680-730	Brown slightly stony sandy clay
			730-900 900+	Brown sandy clay loam Impenetrable due to stone
9a	28	Permanent grass	0-300 300-1000	Dark brown slightly stony clay loam; indistinct boundary to subsoil Brown clay

Soil Profile Descriptions 2005 Survey

Field	No.		Depth (mm)	Description
5(05)	1	Recently cultivated	0-280 280-450 450-1000	Dark brown slightly stony sandy clay loam Brown with rusty mottles, slightly stony clay Greyish brown with rusty mottles, slightly stony clay
5(05)	2	Recently cultivated	0-290 290-650 650+	Dark brown slightly stony sandy loam Brown stony sandy clay loam Impenetrable due to stones
5(05)	3	Recently cultivated	0-290 290-350 350-1000	Dark brown slightly stony sandy clay loam Brown with rusty mottles, slightly stony sandy clay loam Greyish brown with rusty mottles, slightly stony clay
5(05)	4	Recently cultivated	0-250 250-650 650-850 850-1000	Dark brown slightly stony clay loam Greyish brown with rusty mottles, slightly stony clay Brown slightly stony sandy clay loam Brown slightly stony loamy sand
5(05)	5	Recently cultivated	0-250 250-350 350-500 500-800 800-1000	Dark brown slightly stony sandy clay loam Brown slightly stony clay loam with slight rusty mottling Brown with slight rusty mottling, slightly stony sandy clay Brown slightly stony sandy clay loam Greyish brown slightly stony clay
5(05)	6	Recently cultivated	0-310 310-530 530-1000	Dark brown slightly stony clay loam Brown with rusty mottles and manganese concretions, slightly stony clay Greyish brown with rusty mottles, slightly calcareous clay
4(05)	7	W. Cereal (just Emerging)	0-260 260-500 500-1000	Dark brown slightly stony clay Brown slightly stony clay with rusty mottles Grey slightly calcareous clay with rusty mottles
4(05)	8	W. Cereal (just emerging)	0-240 240-650 650-1000	Dark brown slightly stony clay Brown slightly stony clay with rusty mottles Grey slightly stony, slightly calcareous clay with rusty mottles

Field	No.		Depth (mm)	Description
10(05)	9	Rape Stubble (cultivated)	0-250 250-450 450-600 600+	Dark brown silty clay loam Brown slightly stony clay loam with rusty mottles Dark brown gravely clay loam (buried topsoil?) Impenetrable due to stones *Disturbed profile* *19a Topsoil depth 250mm, impenetrable below 450mm*
10(05)	10	Rape Stubble (cultivated)	0-250 250-350 350-600 600-750 750-1000	Dark brown slightly stony clay loam Dark brown clay loam with rusty mottles (buried topsoil) Grey clay with prominent rusty mottles, very compact Brown gravely clay Brown gravely clay with sandy loam inclusions *Disturbed profile*

ANNEX B

SOIL CHEMICAL ANALYSES

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Client : ACORUS M1JNCT19

Sample Matrix : Agricultural Soil

Laboratory Reference
Card Number 24406/09

Date Received 13-Nov-09
Date Reported 07-Dec-09

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
105162/09	1	**3A** *No cropping details given*	**6.4**	**2**	**2+**	**3**	**24.6**	**188**	**108**
105163/09	2	**3B** *No cropping details given*	**6.4**	**2**	**1**	**2**	**16.6**	**116**	**78**
105164/09	3	**3C** *No cropping details given*	**6.2**	**2**	**2-**	**2**	**17.8**	**154**	**93**
105165/09	4	**3D** *No cropping details given*	**6.9**	**2**	**2+**	**2**	**21.2**	**214**	**77**
105166/09	5	**3E** *No cropping details given*	**6.8**	**2**	**2-**	**2**	**17.2**	**147**	**77**
105167/09	6	**5A** *No cropping details given*	**7.4**	**2**	**3**	**3**	**22.8**	**263**	**118**

If general fertiliser and lime recommendations have been requested, these are given on the following sheets.
The analytical methods used are as described in DEFRA Reference Book 427
The index values are determined from the DEFRA Fertiliser Recommendations RB209 7th Edition (Appendix 4).

Released by Dr R C Wilkinson On behalf of NRM Ltd Date 07/12/09

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Client : ACORUS M1JNCT19

Sample Matrix : Agricultural Soil

Laboratory Reference
Card Number 24406/09

Date Received 13-Nov-09
Date Reported 07-Dec-09

Samples will be stored until 13-DEC-2009

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
105168/09	7	**5B/C** *No cropping details given*	**6.7**	**3**	**3**	**2**	**31.4**	**363**	**59**
105169/09	8	**7A** *No cropping details given*	**6.3**	**0**	**1**	**4**	**7.2**	**107**	**196**

If general fertiliser and lime recommendations have been requested, these are given on the following sheets.
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Released by *Dr R C Wilkinson* On behalf of NRM Ltd Date *07/12/09*

MICRO NUTRIENT REPORT

DATE **7th December 2009**

SAMPLES FROM **ACORUS M1JNCT19**

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Reference: **24406/105162/09-1** Field Name: **3A**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	6.7	1					

Reference: **24406/105163/09-1** Field Name: **3B**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	6.0	1					

Reference: **24406/105164/09-1** Field Name: **3C**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	5.5	1					

Reference: **24406/105165/09-1** Field Name: **3D**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	5.3	1					

Reference: **24406/105166/09-1** Field Name: **3E**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	6.5	1					

Reference: **24406/105167/09-1** Field Name: **5A**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	4.8	1					

Reference: **24406/105168/09-1** Field Name: **5B/C**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	4.2	1					

Reference: **24406/105169/09-1** Field Name: **7A**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	9.5	2					

Notes (*)

(1) The levels of organic matter in this soil are adequate. This should help to retain moisture and plant nutrients.

(2) The levels of organic matter in this soil are good. This should help to retain moisture and plant nutrients.

DATE **7th December 2009**
SAMPLES FROM **ACORUS M1JNCT19**

SAMPLED BY

Report reference **24406/09-1**

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Field Name / Field Size / Lab No. / Soil Type	Last Crop	Next Crop	Recommendations Units/acre P_2O_5	Recommendations Units/acre K_2O	Recommendations Units/acre MgO	Additional Notes
3A 105162						Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.
3B 105163						Potassium status low - additional nutrient required. Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.
3C 105164						Arable rotation assumed for lime recommendation. Needs Lime at 1.5 T/Ac.
3D 105165						
3E 105166						
5A 105167						
5B/C 105168						
7A 105169						Phosphate deficiency may limit crop performance. Potassium status low - additional nutrient required. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.

Fertiliser recommendations are based on **DEFRA RB209 (Seventh Edition - 2000).** If a nutrient is deficient and no recommendation is given, either no recommendation is given in RB209 or we have insufficient data to give a recommendation.

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Client : ACORUS M1JNCT19

Sample Matrix : Agricultural Soil

Laboratory Reference
Card Number 24407/09

Date Received 13-Nov-09
Date Reported 07-Dec-09

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
105170/09	1	**7B** *No cropping details given*	**5.8**	**0**	**1**	**5**	**9.2**	**114**	**313**
105171/09	2	**7B-SS** *No cropping details given*	**6.3**	**0**	**2-**	**4**	**8.2**	**151**	**248**
105172/09	3	**7C** *No cropping details given*	**6.3**	**1**	**1**	**3**	**9.6**	**108**	**121**
105173/09	4	**5D** *No cropping details given*	**5.8**	**3**	**1**	**3**	**26.8**	**69**	**127**
105174/09	5	**5D-SS** *No cropping details given*	**6.4**	**0**	**0**	**2**	**6.8**	**49**	**86**
105175/09	6	**5E** *No cropping details given*	**5.8**	**1**	**1**	**4**	**12.4**	**98**	**182**

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Released by *Dr R C Wilkinson* On behalf of NRM Ltd Date *07/12/09*

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Client : ACORUS M1JNCT19

Sample Matrix : Agricultural Soil

Laboratory Reference

Card Number 24407/09

Date Received 13-Nov-09
Date Reported 07-Dec-09

Samples will be stored until 13-DEC-2009

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
105176/09	7	**5F** *No cropping details given*	**6.1**	**1**	**1**	**4**	**13.4**	**117**	**201**

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Released by *Dr R C Wilkinson* On behalf of NRM Ltd Date *07/12/09*

MICRO NUTRIENT REPORT

DATE **7th December 2009**

SAMPLES FROM **ACORUS M1JNCT19**

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Reference: **24407/105170/09-1** Field Name: **7B**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	10.0	1					

Reference: **24407/105171/09-1** Field Name: **7B-SS**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	4.5	2					

Reference: **24407/105172/09-1** Field Name: **7C**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	8.8	1					

Reference: **24407/105173/09-1** Field Name: **5D**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	4.4	2					

Reference: **24407/105174/09-1** Field Name: **5D-SS**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	1.7	3					

Reference: **24407/105175/09-1** Field Name: **5E**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	8.4	1					

Reference: **24407/105176/09-1** Field Name: **5F**	**Result**	**(*)**	**V Low**	**Low**	**Risk**	**Normal**	**High**
Organic Matter (Wet Oxidation) %	11.0	1					

Notes (*)

(1) The levels of organic matter in this soil are good. This should help to retain moisture and plant nutrients.

(2) The levels of organic matter in this soil are adequate. This should help to retain moisture and plant nutrients.

(3) The low levels of organic matter in this soil can be improved through the use of green manure crops, farm yard manures or composts.

DATE **7th December 2009**
SAMPLES FROM **ACORUS M1JNCT19**

SAMPLED BY

Report reference **24407/09-1**

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Field Name / Field Size / Lab No. / Soil Type	Last Crop	Next Crop	Recommendations Units/acre P_2O_5	Recommendations Units/acre K_2O	Recommendations Units/acre MgO	Additional Notes
7B 105170						Phosphate deficiency may limit crop performance. Potassium status low - additional nutrient required. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 2.5 T/Ac.
7B-SS 105171						Phosphate deficiency may limit crop performance. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.
7C 105172						Overall nutrient status low - additional nutrient required. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.
5D 105173						Potassium status low - additional nutrient required. Arable rotation assumed for lime recommendation. Needs Lime at 2.5 T/Ac.
5D-SS 105174						Phosphate and Potash deficiencies may limit crop performance. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 1 T/Ac.
5E 105175						Overall nutrient status low - additional nutrient required. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 2.5 T/Ac.
5F 105176						Overall nutrient status low - additional nutrient required. Apply fertiliser to seedbed to help establishment. Arable rotation assumed for lime recommendation. Needs Lime at 1.5 T/Ac.

Fertiliser recommendations are based on **DEFRA RB209 (Seventh Edition - 2000).** If a nutrient is deficient and no recommendation is given, either no recommendation is given in RB209 or we have insufficient data to give a recommendation.