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Report F 6

**Report on a detailed examination
of the soils of
SILVICULTURAL RESEARCH PLOT 53
NIAH F.R.
4th DIVISION**

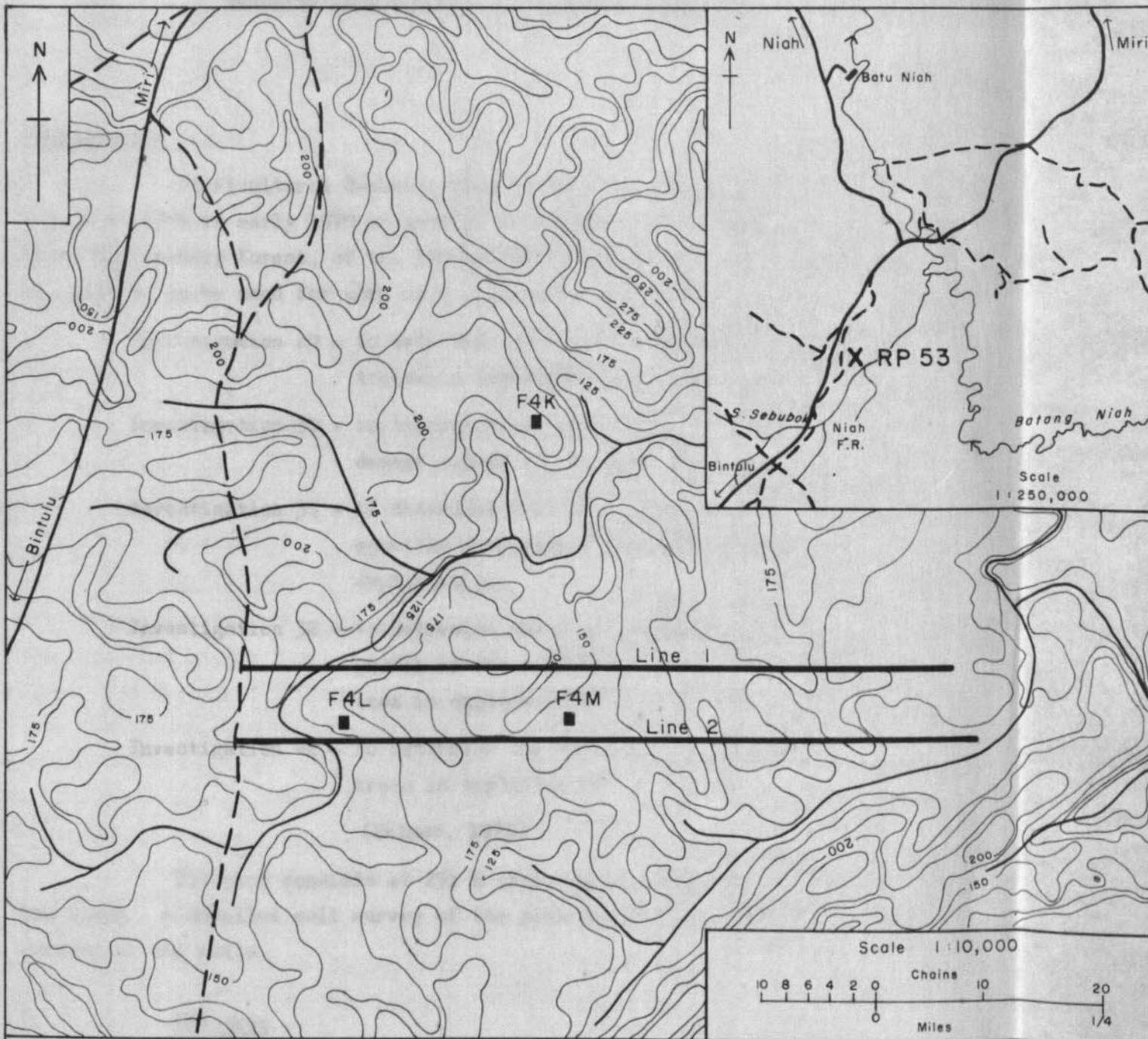
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**Soil Survey
Research Section**

**Forest Department
Sarawak**

Silvicultural Research Plot 53



KEY

- | | |
|--|---|
| <p>— 100 — Contour (feet).</p> <p>— PWD main road.</p> <p>— Lines of RP53.</p> | <p>— Main drainage line.</p> <p>- - - Logging Road</p> <p>■ Soil profile pit.</p> |
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Report on a detailed examination of the soils of Silvicultural
Research Plot 53, Niah F.R., 4th Division.

Introduction

Silvicultural Research Plot No.53 was established in the Niah Forest Reserve in early 1970 as part of Project S8, the Silviculture of Mixed Dipterocarp Forest, of the 1966-70 Forest Research Development Plan. The plot is to be used for work on 5 investigations, i.e.

Investigation 29 - to determine the need for silvicultural treatment immediately after exploitation.

Investigation 30 - to determine the amount and severity of damage caused by exploitation.

Investigation 31 - to determine the stand table structure and specific composition immediately after exploitation.

Investigation 32 - to determine the recruitment survival and growth of the seedling and sapling population in exploited MDF.

Investigation 42 - to determine the survival and growth of trees in exploited MDF.

(Palmer, 1971)

The plot consists of 251 ½ chain-square quadrats laid out in two lines. A detailed soil survey of the plot was done to check on the uniformity of the soils.

1. The area

1.1 Location

The plot is situated in Block 4 of the 1969/70 coupe in the Niah Forest Reserve. The plot fronts on to a logging road, so initially access was good, but this road is now (February 1972) no longer used and is breaking up. However the main Miri-Bintulu road is less than ½ mile away, so access will never become too difficult.

1.2 Climate

The nearest rainfall station to the plot is at Niah (Station 4-16). This is a recent installation, readings having commenced in January 1963. Since then there have been two long breaks in the record, so that

annual totals are available for only 3 complete years. From these, it appears that the rainfall pattern is similar to that of Miri, with a mean annual rainfall of about 120 inches, which is relatively well distributed throughout the year (D.I.D., 1963, 1967, 1969, 1970).

1.3 Geology

The area is underlain by the rocks of the Neogene Setap Shale Formation (Haile, 1962). The dominant rock types are moderately soft grey mudstones and shales. These may have calcareous lenses and there is a suggestion of slightly calcareous parent material in the moderate subsoil Reserve calcium levels in Profile F4 M (see Appendix). There are subordinate beds of grey fine-medium grained sandstone, and fragments of this are found as weak stone lines in many of the soils of the plot, but the parent material of all but a few is predominantly or wholly shale. In the vicinity of the plot, the strata are moderately folded, with dips generally less than 40°.

1.4 Landform

The area is topographically typical of the outcrop of the Setap Shale Formation, consisting of low, moderately steep hills and short ridges. Relief-forming harder beds of sandstone are rare so that there are few long ridges, and the dense drainage pattern is dendritic. Summit altitudes are low (less than 250 feet a.m.s.l.), but Quaternary dissection appears to have been intermittently vigorous as relief is moderate (about 100-150 feet). The short slopes are moderately steep and generally straight, although a tendency for toe-slope steepening was sometimes noted, giving a slightly convex profile, and suggesting a recent renewal of down-cutting.

The minor streams are cut into rock or very rocky gully-wash deposits, and fine earth alluvial deposits are rare. Piping is moderately common and small areas of 'psuedokarst' topography were found.

1.5 Previous soil survey coverage

The plot lies in the area covered by the Bekenu-Niah-Suai reconnaissance soil survey (Wall, 1965). The vicinity of the plot was mapped as deep, heavy textured Red Yellow Podsollic soils of the Merit family.

2. Methods

Eight days of fieldwork were done by the writer and Assistant Forest Officer J.D. Mamit in April 1970.

2.1 Layout of plot

The plot consists of 251 quadrats laid out in two lines. Each quadrat is 1/40 acre in area, measuring 1/2 chain square. The lines run at a true bearing of 90° from endpoints on the logging road at the front of Block 4, which are 7 1/2 (Line 1) and 12 1/2 (Line 2) chains from the northern boundary of the block. Each quadrat is marked with one permanent belian post, and the corners are marked by temporary posts with brightly coloured plastic flagging.

2.2. Location of soil inspections

The soils were examined with a 48 inch Edelmann auger. The augerings were located at the centre points of alternate quadrats. Intervening plots were augered if:

- (a) a soil boundary was found in the one chain separating the initial augerings.
- or (b) the initial augerings fell on a disturbed area (i.e. tractor path or spoil heap).

When the augering survey was complete, three profiles were described and sampled, to give more details about the main soils found. The descriptions and analyses from these profiles are in the Appendix.

2.3 Maps and aerial photographs

The accompanying map is based on a 1:10,000 sheet produced by the Land and Survey Department. This sheet has not yet been issued, but L. & S. made the machine plot available to the Forest Department.

The most recent aerial photographs of the area were flown in 1971 (L. & S. sortie 15/71, prints 161-2). These were used for modifying the logging roads lines on the accompanying map. They are at too small a scale (ca 1:25,000) to be useful for detailed soil survey.

2.4 Other studies

The area has been used for other soil investigations, i.e. a study of the variability of soils over short distances, and preliminary observations on the soil damage caused by tractor logging. The methods used and the findings of these investigations will be reported separately.

3. Soils

3.1 Classification

The main soils of the area are Red Yellow Podsolics of the Merit family (Sarawak Soil Survey Staff 1966). These are of clay loam - silty clay loam texture at the surface, but go to clay in the subsoil. As well as an

increase in clay content, there is generally a reddening in the matrix colour with depth, going from brownish yellow or yellow in the A horizons to reddish yellow in the B horizon. There are also some soils of Kapit family which are genetically similar, but have a shallower profile, with weathering rock or abundant stones within 10 inches of the surface.

The soils of Merit family in the plot have been subdivided into three depth phases, using the criteria adopted for the Upper Rajang (Baillie, 1971). By these criteria, the shallow phase includes those soils with abundant stones or weathering rock starting between 10 and 20 inches. In the intermediate phase the stone-free soil is 20-40 inches deep. The deep phase includes all soils with more than 40 inches of stone-free soil.

The soils quadrats 80 and 81 of Line 1 are similar to the dominant Merits except that their sand contents are higher, so that they qualify for the medium-textured Bekenu family.

In Line 2, the soils of quadrats 37-43 are qualify for normal Merit family except for the matrix colours in the subsoil. These are pale yellow, light grey and very pale brown in contrast to the yellows or reddish yellows found elsewhere. These pale coloured soils appear to be the Setap Shale Formation analogues of Semongok series (a member of the Merit family), which is found on the Bau Formation shales in West Sarawak (Scott, 1964).

There are considerable areas of disturbed land in the plot due to tractor working. It has been estimated that about 9% of the whole block has suffered soil damage during logging operations (J.R. Palmer, pers. comm., 1970).

There are some very small areas of gleyed alluvial soils, but these are not important enough for inclusion in Tables 1 and 2.

The criteria for the classification of the undisturbed hill soils found on the plot are summarised in Table 1.

Table 1
Classification of Soils of Silvicultural R.P. 53

S.G.	Family	Series	Phase	Depth (ins.)	Subsoil matrix colour	Subsoil texture	Profile (see Appdx)
letal	Kapit	-	-	0-10	Yellow, Reddish yellow	Stony clay or clay loam	-
Yellow solic	Bekenu	-	-	10-40+	"	Sandy clay	-
	Merit	?Semongok	-	10-40+	Pale yellow, Light grey, Very pale brown	Clay	-
		-	Shallow	10-20	Yellow, Reddish yellow	"	F4M
		-	Inter-mediate	20-40	"	"	F4L
	-	-	Deep	40+	"	"	F4K

3.2 Distribution

The distribution of the soils in the two lines is summarised in Table 2. No account is taken of disturbed ground or streams.

Table 2
Distribution of Soils in Silvicultural R.P.53

Line	Quadrat	Soil
1	1-10	Merit - deep phase
	11-13	" - intermediate
	14-19	" - shallow
	20-43	" - deep
	44-59	Kapit + shallow Merit
	60-79	Merit - intermediate + deep
	80-81	Bekenu
	82-87	Kapit + shallow Merit
	88-94	Merit - intermediate + deep
	95-100	" - shallow
	101-104	" - deep
	105-109	" - intermediate
	110-114	Kapit
	115-121	Merit - intermediate
2	1-22	Merit - intermediate + deep
	23-30	" - shallow
	30-36	" - intermediate
	37-44	Semongok
	45-44	Merit - intermediate
	46-68	" - deep
	69-75	Kapit + shallow Merit
	76-96	Merit - intermediate
	97-105	" - intermediate + shallow
	106-121	" - intermediate + deep

Table 2 shows that Line 1 can be regarded as a Kapit - Merit complex, and Line 2 as almost entirely Merit. By Sarawak standards the soils of the plot are fairly homogeneous, and it is unlikely that a more uniform area of the same size could be easily found. There is no obvious pedological reason why the experimental results from this plot should not be valid for other low-lying shale areas in Sarawak.

Appendix

Soil Profile Descriptions and Analyses

The soils are described along the lines laid down in the Soil Survey Manual (Soil Survey Staff, 1951). The Munsell system is used for colour notation and the colours refer to the soil moisture condition at the time of description.

The chemical and mechanical analyses were carried out by the Department of Agriculture at the laboratory of the Semongok Agricultural Research Centre, using the methods described in Sim (1965).

- 10-27 Reddish yellow (7.5R 7/6) with few fine faint yellow (2.5Y 7/6) particles. Clay, moderately compact plastic, with strong continuous (horizontal) crack faces (10R 7/5 yellow) / moist, firm, plastic, slightly sticky, slightly porous, few roots. Diffuse boundary
- 10-28 Medium yellow (7.5R 6/6) with some fine faint pale yellow (2.5Y 7/6) and fine fine light grey (10B 7/5) particles. Clay, moderate to weak degree of plasticity, moderate to hard, continuous (horizontal) crack faces (10R 7/5 yellow) / moist, sticky, non porous, few roots. Diffuse boundary
- 10-29 As above but with some fragments of dark red, light yellow, brown and light grey nodules. Hard nodules very tight and strong. Gradual regular boundary
- 10-30 Slightly hard light grey, pale yellow and dark reddish brown weathering shale, with few patches of reddish yellow and yellow clay.

Depth (m)	pH	C		N		P		K		S		Clay (%)	Texture
		org	tot	org	tot	org	tot	org	tot				
0-5	5.5	1.2	2.2	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay loam
5-10	5.5	1.0	2.0	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay loam
10-15	5.5	0.8	1.8	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay loam
15-20	5.5	0.7	1.7	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay
20-25	5.5	0.6	1.6	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay
25-30	5.5	0.5	1.5	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay loam
30-35	5.5	0.4	1.4	0.15	0.3	15	25	1.5	3.5	15	25	25	Clay

Profile F4 K

Classification: G.S.G. Family Merit Phase Deep
 Red Yellow Podsollic
 Location: Block 1 of 1969/70 coupe, Niah F.R. (about 1/2 mile north of RP 53).
 Topography: Midslope of low hill (gradient 24°).
 Parent material: Setap Formation Shale.
 Vegetation: Recently exploited Mixed Dipterocarp Forest.

- 1/2-0 inches Dark brown litter.
- 0-3 Yellowish brown (10YR 5/6), silty clay-clay, weak fine subangular blocky with weak discontinuous clayskins, moist-dry, friable, porous, many roots.
 Gradual regular boundary
- 3-9 Brownish yellow (10YR 6/6), silty clay-clay, moderate medium subangular blocky with weak continuous clayskins [10YR 5/6 (yellowish brown)], moist, slightly friable, slightly plastic, porous, common roots.
 Gradual regular boundary
- 9-19 Yellow (10YR 7/8), clay, moderate medium subangular block with weak continuous clayskins [10YR 5/6 (yellowish brown)], moist, slightly firm, plastic, slightly sticky, porous, few roots.
 Diffuse boundary
- 19-27 Reddish yellow (7.5YR 7/8) with few fine faint yellow (2.5Y 7/8) mottles, clay, massive-weak coarse prismatic, with strong continuous clayskins on vertical crack faces [10YR 7/8 (yellow)] moist, firm, plastic, slightly sticky, slightly porous, few roots.
 Diffuse boundary
- 27-45 Reddish yellow (7.5YR 6/8) with common fine faint pale yellow (2.5Y 7/4) and few fine faint light grey (10YR 7/1) mottles, clay, massive - weak coarse prismatic strong continuous clayskins on cracks [10YR 7/8 (yellow)], moist, slightly plastic, slightly sticky, non porous, few roots.
 Diffuse boundary
- 45-59 As above but with common fragments of dark red, light yellowish brown and light grey moderately hard medium grained sandstone.
 Gradual regular boundary
- 59-68+ Slightly hard light grey, pale yellow and dark reddish brown weathering shale, with few patches of reddish yellow and yellow clay.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					% of fine earth					Texture
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	0 - 3	3.8	2.8	0.20	140	280	1420	2950	6.6	0.2	0.3	43.2	27.3	29.2	Clay loam
2	4 - 8	4.3	0.6	0.09	110	270	1650	3370	7.6	0.2	0.2	41.2	29.3	32.3	Clay loam
3	12-16	4.5	0.4	0.04	100	310	2020	4360	10.8	0.2	0.2	34.3	37.5	38.8	Clay loam
4	21-25	4.8	0.3	0.06	100	330	2120	4710	12.7	0.8	0.5	31.2	26.6	41.6	Clay
5	34-38	4.9	0.3	0.07	110	430	2580	4910	15.5	0.5	0.4	27.0	25.1	50.6	Clay - Clay loam
6	50-54	4.9	0.2	0.06	110	510	2840	5860	17.4	4.0	1.5	24.5	25.7	47.3	Clay

Profile F4L

Classification: G.S.G. Family Phase
 Red Yellow Podsollic Merit Intermediate
 Location: Block 4 of 1969/70 coupe Niah F.R. Close to quadrat 11 in line
 2 of RP 53.
 Topography: Midslope of low hill (gradient 21°).
 Parent material: Setap Formation Shale.
 Vegetation: Recently exploited Mixed Dipterocarp Forest.

- 1-0 inches Dark brown litter.
- 0-3 Yellowish brown (10YR 5/8), silty clay, weak medium crumb, moist-dry, friable, porous, many roots.
 Gradual regular boundary
- 3-9 Brownish yellow (10YR 6/6) with very few fine faint pale yellow (2.5Y 7/4) and brown (10YR 5/3) mottles, silty clay-clay, weak fine subangular blocky, moist-dry, friable, porous, many roots.
 Gradual regular boundary
- 9-18 Yellow (10YR 7/8) with very few fine faint pale yellow (2.5Y 7/4) mottles, clay, moderate medium subangular blocky with very weak discontinuous clayskins, moist, slightly firm, slightly plastic, slightly porous, many roots.
 Gradual regular boundary
- 18-34 Reddish yellow (7.5YR 6/8) with few fine very faint pale yellow (2.5Y 7/4) mottles, clay, moderate medium subangular blocky with weak continuous clayskins [10YR 6/6 (brownish yellow)], moist, firm, slightly plastic, slightly porous, common roots.
 Gradual regular boundary
- 34-45 As above horizon but with many pieces of mixed hard and soft dark red, dark reddish brown, pale yellow and light grey medium grained sandstone. Few roots.
 Clear wavy boundary
- 45-48+ Slightly hard light grey, pale brown and dark reddish brown weathering shale with patches of reddish yellow and pale yellow clay. No roots.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					% of fine earth					Texture
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	0 - 3	3.8	1.6	0.20	140	310	1960	3380	8.3	0.3	0.2	17.5	33.9	28.8	Clay
2	5 - 8	4.1	0.8	0.11	110	330	2120	4210	10.2	0.3	0.3	32.0	30.2	41.2	Clay loam
3	11-15	4.4	0.5	0.06	100	360	2440	4990	12.8	0.4	0.3	28.0	27.5	48.8	Clay
4	22-28	4.4	0.5	0.07	120	460	2980	5490	13.7	0.8	0.3	25.7	26.3	55.7	Clay
5	37-41	4.6	0.6	0.10	130	560	3110	5630	16.3	4.0	1.4	21.7	23.0	54.5	Clay

Profile F4M

Classification: G.S.G. Family Merit Phase Shallow
 Red Yellow Podsollic
 Location: Block 4 of 1969/70 coupe Niah F.R. Close to quadrat 35 in line
 2 of RP 53.
 Topography: Lower slope of minor ridge (gradient ca 12°).
 Parent material: Setap Formation Shale.
 Vegetation: Recently exploited Mixed Dipterocarp Forest.

1½-0 inches Leaf and litter layer.

0-2 Brownish yellow (10YR 6/8) with common medium faint yellowish brown (10YR 5/6) mottles, silty clay loam-silty clay, moderate medium crumb, moist, friable, porous, many roots.
 Clear regular boundary

2-5 Yellow (10YR 7/8), silty clay, moderate fine subangular blocky with weak discontinuous clayskins [10YR 6/8 (yellow)], moist, slightly firm, slightly porous, common roots.
 Gradual slightly wavy boundary

5-16 Reddish yellow (7.5YR 7/8) with fine very faint reddish yellow (5YR 7/8) and yellow (2.5Y 8/6) mottles, clay, moderate medium subangular blocky with moderate continuous mixed coloured clayskins, moist, firm, non-porous, few roots, few fragments of slightly hard red, yellow and dark red shale.
 Gradual slightly wavy boundary

16-19 As above but stones increase to many, and structure dominated by stones.
 Clear irregular boundary

19-27 Soft light grey, pale yellow and reddish yellow shale with common patches of reddish yellow, yellowish red and light grey clay. Roots rare.

27-36+ Hard grey shale. No roots.

Sample No.	Depth (ins.)	pH	% H ₂ O	% Org. C	% Total N	Conc. HCl Extract					% of fine earth					Texture
						P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	0 - 2	3.9	3.1	0.32	250	680	2890	5900	12.7	5.8	1.8	19.0	26.5	43.7	Clay	
2	2 - 5	4.3	1.2	0.17	190	690	3540	5430	14.0	4.7	1.7	14.8	27.0	57.1	Clay	
3	8 - 11	4.5	0.5	0.17	190	760	4140	6400	18.6	4.7	2.3	9.7	27.7	61.0	Clay	
4	21-23	4.8	0.2	0.09	180	430	4330	6770	15.1	0.9	2.0	8.8	34.8	57.2	Clay	

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