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## The soils of the proposed Santo industrial forest plantation, Vanuatu (ODNRI Bulletin 25)

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**OVERSEAS DEVELOPMENT  
NATURAL RESOURCES  
INSTITUTE**

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**BULLETIN No. 25**

**THE SOILS OF THE PROPOSED  
SANTO INDUSTRIAL FOREST  
PLANTATION, VANUATU**

**J. G. BENNETT**

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ii

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# Contents

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|  |            |
|--|------------|
| <b>Acknowledgements</b>                          | Page<br>iv |
| <b>Summaries</b>                                 | 1          |
| <b>Introduction</b>                              | 2          |
| <b>The soils</b>                                 | 4          |
| <b>Conclusions</b>                               | 6          |
| <b>References</b>                                | 7          |
| <b>Appendices</b>                                | 8          |
| 1 Summary of analysis methods                    | 8          |
| 2 Soil profile descriptions and analysis results | 10         |

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# Summaries

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## SUMMARIES

The soils of an area on the eastern side of the island of Espiritu Santo were assessed for suitability for the production of *Cordia alliodora*.

The soils were strongly weathered and leached volcanic clays with properties influenced by an underlying coral shelf and a rejuvenating land surface. Soil depth and terrain constraints affect the most dissected parts of the area while chemical infertility occurs in the older soils. However throughout the greater part of the area potassium deficiency is the only likely constraint to *Cordia* growth.

## RÉSUMÉ

Les sols d'une zone située à l'est de l'île d'Espiritu Santo ont été reconnus aptes à la production de *Cordia alliodora*.

Ces sols ont subi de dures épreuves météorologiques et ont perdu par lessivage des argiles volcaniques aux propriétés influencées par un plateau corallien sous-jacent et par une surface terrestre rajeunie. La profondeur du sol et les contraintes du terrain affectent les parties les plus ravinées de la superficie en question, alors que la stérilité chimique touche les sols les plus anciens. Il en ressort toutefois que dans la majeure partie de cette zone, seule une déficience en potassium risque de gêner la culture de *Cordia*.

## RESUMEN

Se llevó a cabo la evaluación de las tierras de una zona ubicada en la región oriental de la isla del Espiritu Santo, a fin de dejar establecida su adecuabilidad para la producción de *Cordia alliodora*.

Se trataba de tierras arcillosas volcánicas fuertemente erosionadas y lixiviadas, cuyas propiedades se hallaban influenciadas por la plataforma coralina subyacente y por una superficie rejuvenecedora. La profundidad del suelo y las restricciones del terreno afectaban a las partes más erosionadas de la zona, produciéndose infertilidad química en las tierras más viejas. Esto no obstante, la única probable restricción al crecimiento de *Cordia* en la mayor parte de la zona será la deficiencia de potasio.

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# The soils of the proposed Santo industrial forest plantation, Vanuatu

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## INTRODUCTION

### Background

The Vanuatu Forest Service has established a number of industrial forest plantations in support of Government policy to develop forest products for export. From the mid-1970s an area on the eastern side of the island of Espiritu Santo was recognized as being suitable, and a number of feasibility studies (IFSC, 1984 and Silviconsult, 1984 among others) reported favourably. Widespread trials conducted with *Cordia alliodora* were successful, except at one site on the island of Pentecost where failure was tentatively attributed to a nutritionally poorer soil (Neil *et al.* 1985). Because of this it was felt that more information was needed on the soils of the proposed Santo industrial forest plantation (SIFP).

On behalf of the Vanuatu Government, the Overseas Development Administration asked its Land Resources Development Centre (LRDC) (as it was then), to advise on a soil sampling programme. It was eventually agreed that a soil survey would be carried out by LRDC working with the Vanuatu Forest Service. The survey took place between 5 February and 26 March 1988.

### The environment

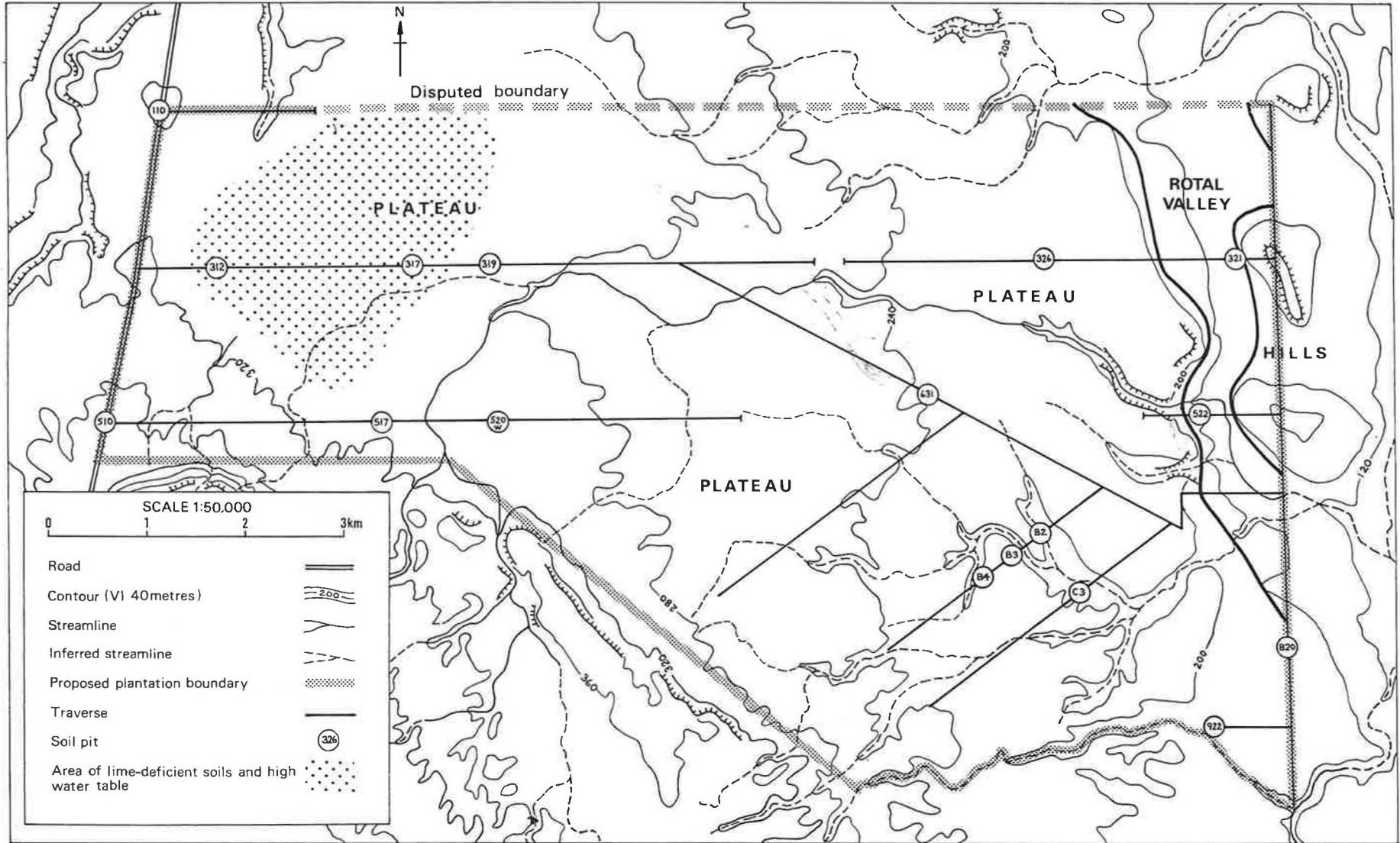
Espiritu Santo, (or Santo as it now seems to be called), is the largest island in Vanuatu and covers 4,248 km<sup>2</sup>. It lies approximately 15°S and 167°E. The project area of approximately 6,000 ha (the exact area is uncertain because of a boundary dispute) lies midway down the eastern side of the island, with the centre of the area being about 32 km NNW of Luganville town – now also known as Santo.

The 25-year mean annual rainfall at Santo town is 3,094 mm, and the mean monthly figures range from 137 mm in August to 400 mm in March. The relative humidity is constant at about 85% and it is unusual for potential evapotranspiration to exceed rainfall in any month. Rainfall in the project area, nearer to the equator and affected by high ground, is probably higher than at Santo. Cyclones occur between December and March.

The survey area is set on a raised Pleistocene coralline plateau and mantled by volcanic ash of the Quaternary period (Quantin, 1982). It consists of three landform elements (see map): a gently east-sloping plateau falling from slightly over 300 m to 200 m above sea level; a broad irregular U-shaped valley draining south at an elevation of 140 m in its middle section; and three flat-topped hills along the eastern boundary rising to just over 200 m. The valley is part of the catchment of the Rotal River. The plateau occupies by far the largest part of the area and is separated from the Rotal valley by a gentle escarpment. The valleys of streams draining the plateau become increasingly

# Map

Location of traverses and soil pits





dissected eastwards and enter the Rotal valley through deep and steep ravines bounded by massive coral outcrops. Within the Rotal valley streamlines are further incised. Few of the drainage lines carry water, even after heavy rain, and where there is perennial flow the source seems to be within the coral. The west-central part of the area is the flattest, unaffected by streamlines cutting back, with swamps in the lower-lying areas.

The 1986 Project Proposal for the development of the area describes the vegetation as tropical lowland evergreen rain forest with the most common species being: *Antiaris toxicaria* (milk tree), *Dracontomelon vitiense* (nakatambol), *Endospermum medullosum* (white wood), *Castanospermum australe* (black bean), *Dysoxylum amooroides* (stink wood) and *Pterocarpus indicus*. The effect on the primary forest of cyclones, shifting cultivation and logging has been the secondary growth of thicket, with vines of *Merremia*, *Mikania* and *Ipomea*. *Merremia* often blankets the landscape.

Shifting cultivation is traditional throughout Vanuatu. Yam, taro, sweet potato, manioc, island cabbage, sugar cane or maize may be grown for one or two years. Banana, kava and pawpaw are longer term. In some areas fallows of over 20 years are necessary for the forest to regenerate and replenish the soil nutrients depleted by successive periods of cultivation. There is no cultivation in the project area; the only forms of land use are the hunting of wild pig and bullock, and the gathering of forest products. Some logging occurs along the western boundary road.

## Survey method

There was no access into the area and lines had to be cut. It was intended that they should traverse the area east-west, 800 m apart; however the Forest Service cutting teams experienced operational difficulties and the eventual grid alignment was as shown on the map. One hundred and six auger inspections were made at 400 m intervals along the traverses; 17 pits were dug, described in more detail and sampled for chemical analysis. The pit locations are shown on the map and the data are shown in Appendix 2. The analyses were carried out by the Institute of Natural Resources of the University of the South Pacific, in Fiji.

## THE SOILS

### General morphology

The soils are developed in a mantle of volcanic ash deposited on a raised coral base. Although young in terms of geological time, volcanic ash is highly weatherable and the soils are strongly weathered with no minerals, identifiable in the field, remaining. The soils have poor horizon differentiation and remarkably uniform morphology throughout the area. Although depositional, the only suggestion of discontinuity in the solum is in the occasional irregular dark layer. Laboratory analysis showed all the soils to be clays. Textures are difficult to assess in the field however, because of strong microaggregation, and range from sandy clay loams through sandy clays, clay loams and silty clays to clays. Ease of augering was clearly related to the degree of microaggregation. There is little colour variation, (except in connection with organic matter distribution down the profile), irrespective of position within the landscape; even waterlogged soils show no change and, strangely, none of the characteristic colour changes of anaerobic activity. Subsoil colours are invariably dark brown to dark yellowish-brown with very occasional mottles. What differences do occur appear random and probably relate to minor parent material differences. The only significant variable, and that also rather arbitrary, is depth over coral. Wherever surface dissection occurs, however incipient, coral is either exposed or occurs close to the surface; however it also occurs on flatter surfaces. Where coral occurs in the profile there is no mixing with the adjacent soil. Even where infilling of voids in the coral occurs the two

materials remain discrete, and where coral sand and soil occur together (in pit 517) neither has had any physical effect on the other. Rooting can occur into broken coral and through infilled voids.

## Physical properties

The soils have favourable physical properties – good structure, rapid water infiltration and permeability, good aeration except where a water table occurs, good moisture-holding capacity and no constraint to root development above the coral. The strong microstructure, which affects the field assessment of texture, contributes largely to these properties, but the macrostructure is also well-developed. Surface organic layers show particularly strong crumb structures which, when exposed to repeated wetting and drying in cleared areas, form a coarse sand-like mulch which infills surface cracks that develop on drying; however, these structures soften on wetting. Despite the permanently moist state of the subsoil, angular-to-subangular blocky structures can always be identified. The presence of shiny, and sometimes striated, ped faces in the lower subsoils of the apparently heavier soils attests the ability of these soils to expand and contract within their moisture range. These pressure faces can appear as small slickensides, or give peds the shape of parallelepipeds, and can be observed to transmit water rapidly after rain. Roots also follow them. Although the soils have a high water-holding capacity, much of the water is held at suctions too great for the plant to extract. The amount so held is some 50% of the dry soil weight. This does not tell us how much water is available in a moist soil – only that much of it is not, and that a dry soil will absorb a lot of water before any becomes available to the crop. The soils are very sticky when worked in the wet state. Plasticity increases with the breakdown of the microaggregation.

## Chemical properties

The morphological uniformity of the soils is matched by their chemical similarity. All the soils are clays containing up to 100% clay, though they hand-texture considerably lighter. The microaggregation causing this was sufficiently strong to withstand chemical disruption in a number of cases, as evidenced by the irregular sequence of clay analysis figures down some profiles, accompanied by complementary irregularity in the silt figures. The microaggregation is associated with the advanced weathering stage of the soil and is due to the clay fraction containing so-called 'amorphous' clay minerals. Related properties are the relatively low effective cation exchange capacity with high variable charge, high free iron (citrate/dithionite/bicarbonate (CDB) Fe analyses), high phosphate retention, low bulk density and high 15-bar water retention.

Most of the soils are more fertile than was anticipated. The clay minerals are not of the expected allophane type, in which the above properties are most strongly developed, and the soils benefit from the effects of calcium released by the weathering coral. The effect of the lime, cycled through the vegetation, is to raise pH, raise the level of negative charge (effective cation exchange capacity (CEC)) and ensure high base saturation. Only three soil pits have real base saturations (at soil pH) below 90%, and most values are well above. The vegetation cycling effect is most marked in the surface organic layers where nutrient concentrations are high. Levels decrease with depth, but calcium often increases again above the weathering coral. Soil 522 provides an example of this, with the bottom sample coming from a void in the coral at the base of the pit. Clearly the coral is not providing much besides calcium. These soils therefore, influenced by the coral, have adequate nutrient retention capacity (effective CEC), satisfactory pH, high calcium saturation and adequate levels of other cations, with the possible exception of potassium. Phosphate is generally adequate but could become a problem because of the high soil retention capacity.

Soils B4, 312 and 317 lack the influence of lime. Effective CEC is reduced to 5–6 meq in the subsoil, pH (KCl) drops below 4 and base saturation, in the worst case, falls to 13%. The effects of aluminium toxicity may be felt. Of the 3 soils, 312 and 317 are the worst. The data are scanty and it may be coincidental that, in geomorphological terms, these soils occur in the oldest part of the area: relatively flat with a high water-table and least affected by streambed rejuvenation from the Rotal Valley. It is also the part of the area where fewest observations were made of the occurrence of coral exposures. This situation requires further investigation.

## Soil classification

Although the soils have a clay-size fraction containing, or even largely composed of, amorphous minerals, the soil properties do not meet the Soil Taxonomy requirements for an 'exchange complex dominated by amorphous materials'. Those requirements are based on the properties of soils whose exchange complex is strongly affected by allophane-type clays. While SIFP soils have similar properties they are less strongly expressed, therefore the soils classify neither as Andepts in the original Taxonomy, nor Andisols according to the revised proposals. They are in fact Inceptisols of the Tropept suborder and the majority appear to belong, marginally, to the Humitropept great group on the basis of organic carbon content. Those with insufficient carbon are Dystropepts because of low base saturation calculated on the basis of CEC at pH 7. It is difficult to be more precise than this. The bulk density figures used to assess carbon content are inexact, as undisturbed soil cores were not taken for analysis, and the criteria separating subgroups of Humitropepts and Dystropepts do not make adequate provision for these soils.

In the revised legend to the FAO-UNESCO *Soil map of the world*, amended fourth draft, the soils key out as Dystric Cambisols.

## Conclusions

The soils of most of the area should be suitable for plantation development. The only major nutrient likely to become deficient is potassium. Phosphate levels, thought to have been a factor in the Pentecost trial failure, are variable, but generally adequate; and the pH (KCl) is high, but not so as to limit micronutrient availability.

The significance and extent of the lime-deficient soils require further study. Their low effective CEC, pH (KCl) and effective base saturation suggest that nutritional disorders may occur. The complementary, and perhaps more significant, factor, particularly with regard to seedling establishment, is the high level of CEC saturation with potentially toxic aluminium – in the region of 75% at the bottom of pit 312. It is suggested therefore that an observation trial be set up on the site of pit 312, (conveniently close to the western boundary road), to observe *Cordia* growth on these soils. Aluminium is frequently a barrier to root development, as well as affecting vegetative growth, and this could be monitored. The effect of lime (coral) application in removing aluminium could also be studied. To determine the extent of the problem (if a problem it prove to be) samples should be taken from the surrounding area for pH testing. Soils with pH (KCl) below 4.4 seem to have a fairly high level of aluminium saturation. Care should be taken to standardize the method of analysis with that of the laboratory.

Shallow and stony soils over coral occur widely. Depth variations are unpredictable but the worst will be avoided by excluding the steeper and more rugged parts of the area on the eastern side.

A high water table, inimical to *Cordia* growth, occurs in the west-central, lime-deficient part of the area. The extent of this could be determined concurrently with a pH sampling exercise.

The fairly high content of water retained by the soil at suctions too great for plant uptake may lead to moisture stress during dry periods.

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# Appendices

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## APPENDIX 1: SUMMARY OF ANALYSIS METHODS

| <i>Analysis</i>                 | <i>Method</i>  |
|---------------------------------|--|
| pH                              | Soil:solution ratio 1:2.5, suspension stirred occasionally for 1 hour, pH recorded using precalibrated glass electrode system  |
| % carbon                        | Walkley-Black procedure using locally derived correction factor for unreacted carbon   |
| % nitrogen                      | Kjeldahl digestion followed by distillation of ammonia and titrimetric determination   |
| Acid-extractable phosphorus     | Modified Truog procedure using 0.025 mol. dm <sup>-3</sup> H <sub>2</sub> SO <sub>4</sub> , a soil:solution ratio of 1:100, shaking time 1 hour. Colorimetric (molybdenum blue) determination              |
| Phosphorus retention            | Soil shaken with standard P solution (10 g/25 cm <sup>3</sup> ) and P remaining in solution after 1 hour estimated colorimetrically  |
| Calcium carbonate               | Gas evolution of CO <sub>2</sub> using hydrochloric acid   |
| Moisture factor                 | Air-dried soil dried in oven at 105°C for 24 hours   |
| Bulk density                    | Clod method: clods removed from bag, wax coated and mass and volume measured. These values may not be accurate as no effort was made to preserve soil structural units during transportation to laboratory |
| pH (sodium fluoride)            | Soil stirred in NaF solution (1 mol. dm <sup>-3</sup> ) using a soil:solution ratio of 1:50 for 5 minutes; pH recorded with glass electrode  |
| Cation exchange capacity (pH 7) | Soil leached with ammonium acetate (1 mol dm <sup>-3</sup> , pH 7), followed by ethanol wash and sodium chloride leaching. NaCl solution distilled and ammonia released determined by titration            |
| Bases                           | Estimated in ammonium acetate leachate from above using atomic absorption spectrophotometry  |
| Exchange acidity                | Soil and BaCl <sub>2</sub> /triethanolamine buffer (pH 8.2); shaken overnight, acidity determined by titration<br><br>N.B. CEC(pH 8.2) = Bases + exchange acidity  |

|   |   |
|---|---|
| Tamms: aluminium, iron                          | After CEC NaCl leaching, soil is leached with acid oxalate using ammonium oxalate/oxalic acid solution (pH 3). Al, Fe determined by atomic absorption spectrophotometry                             |
| Citrate/dithionite/bicarbonate: aluminium, iron | Soil treated with sodium citrate/sodium bicarbonate/sodium dithionite. One g soil extracted until all the iron colour disappears. Fe and Al determined by atomic absorption spectrophotometry       |
| Potassium chloride: aluminium, hydrogen         | Soil (10 g) shaken with KCl solution (50 cm <sup>3</sup> , 1 mol. dm <sup>-3</sup> ) and allowed to stand overnight. Suspension filtered and H, Al determined by titration                          |
| Extractable sulphur                             | Soil (5 g) shaken with Ca(H <sub>2</sub> PO <sub>4</sub> ) <sub>2</sub> (0.04 mol. dm <sup>-3</sup> , 25 cm <sup>3</sup> ). Sulphate determined turbidimetrically                                   |
| Particle size                                   | <i>Moist</i> soil samples treated with H <sub>2</sub> O <sub>2</sub> and then dispersed with Calgon/sodium bicarbonate solution. Sand, silt, clay determined by sieving and hydrometer measurements |
| 15 bar water retention                          | Measured on field moist and air dried samples using a pressure plate apparatus.   |

## APPENDIX 2: SOIL PROFILE DESCRIPTIONS AND ANALYSIS RESULTS

### Soil profile description

Pit no. B2

|           |  |
|-----------|--|
| 0-9 cm    | Dark brown to dark greyish-brown (10YR-7.5YR 3/2); moist; clay; strong fine crumb, slightly coalesced; very friable; very many roots; clear smooth boundary.                                 |
| 9-24 cm   | Brown to dark yellowish-brown (10YR 4/3-3/4); moist; clay; strong fine crumb and subangular blocky; very friable; many roots; many fine tubular pores; clear smooth boundary.                |
| 24-57 cm  | Brown to dark yellowish-brown (10YR 4/3-3/4); moist; clay; weak fine subangular blocky; very friable but looser than above; many roots; very many fine tubular pores; clear smooth boundary. |
| 57-140 cm | Dark yellowish-brown (10YR 4/4); moist; clay; weak fine subangular blocky; some shiny faces slightly striated; very friable but more compact than above; no roots; many fine tubular pores.  |

### Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-9        |                                      | 6.5 | 5.8               | 9.72 | 0.75 |
| AB      | 9-24       |                                      | 6.1 | 5.3               | 2.59 | 0.21 |
| Bw1     | 24-57      |                                      | 6.2 | 5.3               | 1.30 | 0.10 |
| Bw2     | 57-94      |                                      | 6.4 | 5.0               | 0.48 | 0.04 |
|         | 94-120     |                                      | 5.7 | 4.7               | 0.37 | 0.03 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |      |
|---------|------------|-------------------------|--------|-----|--------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg   |
|         | 0-9        | 67.25                   | 35.61  |     | 27.11* | 5.93 |
|         | 9-24       | 35.77                   | 13.41  |     | 8.96   | 2.46 |
|         | 24-57      | 28.91                   | 8.99   |     | 6.47   | 1.44 |
|         | 57-94      | 29.01                   | 9.47   |     | 7.10   | 1.19 |
|         | 94-120     | 26.41                   | 8.21   |     | 5.94   | 1.11 |

| Particle size (mm, %) (fine earth fraction) |            |             |                 |             |                |       |          |
|---|------------|-------------|-----------------|-------------|----------------|-------|----------|
| Horizon                                     | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|   |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|   | 0-9        | 11          | 19              | 70          | 0              | 2     | 3        |
|   | 9-24       | 9           | 30              | 61          | 2              | 2     | 1        |
|   | 24-57      | 6           | 25              | 69          | 0              | 2     | 1        |
|   | 57-94      | 0           | 9               | 91          | 0              | 0     | 0        |
|   | 94-120     | 0           | 7               | 93          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (> 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 13  |         | 289                                   |           |         |       | 85            | 0.72                |                   | 1.296           | 0.71         | 7.1             |
| 12  |         | 70                                    |           |         |       | 93            |                     |                   | 1.195           | 0.80         | 7.2             |
| 13  |         | 108                                   |           |         |       | 97            |                     |                   | 1.207           | 0.81         | 7.2             |
| 12  |         | 187                                   |           |         |       | 88            |                     |                   | 1.183           | n.d.         | 7.2             |
| 12  |         | 188                                   |           |         |       | 86            |                     |                   | 1.203           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  | Tamm's extract (%) |      |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------------------|------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al             | Al   | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 2.13                    | 0.44 | 41.37            | 0                  | 1.03 | 1.02 |    |    |         | 2,087 | 2.26       | 6.89       | 0.06          |
| 1.59                    | 0.42 | 38.14            | 0                  | 1.02 | 0.96 |    |    |         | 574   | 2.33       | 9.15       | 0.06          |
| 0.30                    | 0.78 | 41.28            | 0                  | 0.85 | 1.00 |    |    |         | 1,098 | 2.63       | 9.72       | 0.06          |
| 0.23                    | 0.95 | 20.90            | 0                  | 0.62 | 1.05 |    |    |         | 1,526 | 2.05       | 9.29       | 0.06          |
| 0.38                    | 0.78 | 26.74            | 0                  | 0.39 | 0.76 |    |    |         | 1,227 | 1.65       | 8.71       | 0.06          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 2              | 4        | 7     | 4  | 8   | 18                                     | 70          |                   |                               | 67.2                       | 44.5    | 0.63                       |
| 2              | 2        | 7     | 6  | 7   | 26                                     | 61          |                   |                               | 46.7                       | 34.5    | 0.57                       |
| 2              | 1        | 5     | 2  | 9   | 20                                     | 69          |                   |                               | 49.6                       | 35.7    | 0.52                       |
| 0              | 0        | 0     | 0  | 3   | 6                                      | 91          |                   |                               | 54.9                       | 40.4    | 0.44                       |
| 0              | 0        | 0     | 0  | 2   | 5                                      | 93          |                   |                               | 54.1                       | 39.9    | 0.43                       |

Notes: \*Corrected for free lime  
n.d. = not determined



## Soil profile description

Pit no. B3

|                   |  |
|-------------------|--|
| 0-6 cm            | Dark to dark-brown (10YR 4/3); moist; clay; strong fine crumb, slightly coalesced; very friable; many roots; gradual smooth boundary.  |
| 6-21 cm           | Dark brown (10YR 3/3); moist; clay; moderate fine subangular blocky; very friable; common roots; very many fine tubular pores; gradual smooth boundary.                                  |
| 21-35 cm          | Dark yellowish-brown (10YR 4/4); moist; clay; moderate fine subangular blocky; very friable; few roots; many fine tubular pores; diffuse wavy boundary.                                  |
| 35-122/<br>150 cm | Strong brown (7.5YR 4/6); moist; clay; weak to moderate fine subangular blocky with striated shiny faces; very friable; few roots, common fine tubular pores; abrupt irregular boundary. |
| 122-150 cm        | Coral, slightly weathered and broken at top, with pockets of soil.   |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-6        |                                      | 6.3 | 5.6               | 11.72 | 0.91 |
| AB1     | 6-21       |                                      | 5.5 | 4.5               | 2.10  | 0.14 |
| AB2     | 21-35      |                                      | 5.4 | 4.2               | 1.35  | 0.09 |
| Bw      | 50-80      |                                      | 5.5 | 4.3               | 0.81  | 0.06 |
|         | 100-120    |                                      | 5.5 | 4.4               | 0.47  | 0.04 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-6        | 54.33                   | 32.58  |     | 28.16 | 6.00 |
|         | 6-21       | 30.22                   | 10.19  |     | 7.40  | 2.08 |
|         | 21-35      | 25.97                   | 7.86   |     | 5.62  | 1.47 |
|         | 50-80      | 24.59                   | 6.95   |     | 5.42  | 0.91 |
|         | 100-120    | 27.85                   | 12.87  |     | 11.20 | 0.77 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-6        | 0           | 11              | 89          | 0              | 0     | 0        |
|         | 6-21       | 2           | 20              | 78          | 0              | 0     | 0        |
|         | 21-35      | 0           | 11              | 89          | 0              | 0     | 0        |
|         | 50-80      | 0           | 0               | 100         | 0              | 0     | 0        |
|         | 100-120    | 0           | 0               | 100         | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 13  |         | 48                                    |           |         |       | 69            |                     |                  | 1.422           | 0.78         | 7.1             |
| 15  |         | 21                                    |           |         |       | 89            |                     |                  | 1.152           | 0.81         | 7.1             |
| 15  |         | 35                                    |           |         |       | 85            |                     |                  | 1.231           | 0.86         | 7.2             |
| 14  |         | 36                                    |           |         |       | 87            |                     |                  | 1.135           | 0.86         | 7.2             |
| 12  |         | 83                                    |           |         |       | 89            |                     |                  | 1.177           | n.d.         | 7.3             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.50                    | 0.62 | 42.14            | 0      | 0.67               | 0.81 |    |    |         | 46    | 1.99       | 8.60       | 0.28          |
| 0.11                    | 0.60 | 32.84            | 0      | 0.51               | 0.56 |    |    |         | 260   | 1.83       | 8.38       | 0.22          |
| 0.09                    | 0.68 | 28.76            | 0.20   | 0.40               | 0.57 |    |    |         | 1,330 | 1.60       | 8.84       | 0.27          |
| 0.05                    | 0.57 | 25.24            | 0.13   | 0.42               | 0.44 |    |    |         | 1,010 | 1.74       | 8.48       | 0.20          |
| 0.08                    | 0.82 | 24.16            | 0.67   | 0.35               | 0.26 |    |    |         | 1,389 | 2.66       | 12.99      | 0.16          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0              | 0        | 0     | 0  | 0   | 11                                     | 89          |                   |                               | 62.8                       | 50.4    | 0.57                       |
| 0              | 2        | 0     | 0  | 5   | 17                                     | 78          |                   |                               | 50.4                       | 36.6    | 0.47                       |
| 0              | 0        | 0     | 0  | 2   | 9                                      | 89          |                   |                               | 50.9                       | 38.7    | 0.43                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 52.6                       | 40.4    | 0.40                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 52.5                       | 40.2    | 0.40                       |

Note: n.d. = not determined

## Soil profile description

Pit no. B4

|           |   |
|-----------|---|
| 0-10 cm   | Dark brown to dark yellowish-brown (10YR 4/3-4); moist; clay; moderate fine subangular blocky; very friable; many roots; diffuse smooth boundary.                               |
| 10-31 cm  | Dark yellowish-brown (10YR 4/4); moist; clay; weak to moderate fine subangular blocky; very friable; common roots; many fine tubular pores; gradual smooth boundary.            |
| 31-57 cm  | Dark yellowish-brown to brown (10-7.5YR 4/4); moist; clay; weak fine subangular blocky; very friable; common roots; many fine tubular pores; gradual smooth boundary.           |
| 57-140 cm | Brown to strong brown (7.5YR 4/5); moist; clay; very weak subangular blocky but with some shiny faces; friable and more compact than above; few roots, many fine tubular pores. |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-10       |                                      | 4.6 | 4.0               | 7.09 | 0.43 |
| AB      | 10-31      |                                      | 4.7 | 3.7               | 2.07 | 0.12 |
| Bw1     | 31-57      |                                      | 4.7 | 3.7               | 1.14 | 0.07 |
| Bw2     | 57-85      |                                      | 4.5 | 3.7               | 0.66 | 0.04 |
|         | 100-125    |                                      | 4.5 | 3.7               | 0.44 | 0.03 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |      |      |
|---------|------------|-------------------------|--------|-----|------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca   | Mg   |
|         | 0-10       | 37.54                   | 9.12   |     | 5.55 | 2.55 |
|         | 10-31      | 26.98                   | 5.14   |     | 3.90 | 0.54 |
|         | 31-57      | 26.88                   | 5.02   |     | 4.02 | 0.43 |
|         | 57-85      | 18.35                   | 1.74   |     | 0.69 | 0.38 |
|         | 100-125    | 22.90                   | 1.52   |     | 0.57 | 0.32 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-10       | 0           | 4               | 96          | 0              | 0     | 0        |
|         | 10-31      | 0           | 29              | 71          | 0              | 0     | 0        |
|         | 31-57      | 0           | 11              | 89          | 0              | 0     | 0        |
|         | 57-85      | 0           | 2               | 98          | 0              | 0     | 0        |
|         | 100-125    | 0           | 0               | 100         | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 16  |         | 73                                    |           |         |       | 87            |                     |                  | 1.208           | 0.65         | 7.1             |
| 17  |         | 57                                    |           |         |       | 85            |                     |                  | 1.183           | 0.85         | 7.1             |
| 16  |         | 62                                    |           |         |       | 89            |                     |                  | 1.164           | 0.79         | 7.2             |
| 17  |         | 73                                    |           |         |       | 91            |                     |                  | 1.170           | 0.82         | 7.2             |
| 15  |         | 72                                    |           |         |       | 91            |                     |                  | 1.189           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  | Tamm's extract (%) |      |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------------------|------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al             | Al   | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.49                    | 0.53 | 60.60            | 0.76               | 0.62 | 0.73 |    |    |         | 92    | 1.96       | 9.10       | 1.29          |
| 0.14                    | 0.56 | 41.80            | 2.43               | 0.38 | 0.43 |    |    |         | 26    | 2.05       | 8.49       | 0.27          |
| 0.10                    | 0.47 | 35.16            | 2.39               | 0.48 | 0.64 |    |    |         | 238   | 1.91       | 8.54       | 0.26          |
| 0.08                    | 0.59 | 34.68            | 2.40               | 0.41 | 0.35 |    |    |         | 1,755 | 2.11       | 9.08       | 0.32          |
| 0.07                    | 0.56 | 34.86            | 2.46               | 0.49 | 0.37 |    |    |         | 1,859 | 1.86       | 9.30       | 0.27          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0              | 0        | 0     | 0  | 0   | 4                                      | 96          |                   |                               | 57.4                       | 44.6    | 0.46                       |
| 0              | 0        | 0     | 0  | 8   | 21                                     | 71          |                   |                               | 49.9                       | 36.5    | 0.51                       |
| 0              | 0        | 0     | 0  | 3   | 8                                      | 89          |                   |                               | 74.0                       | 37.0    | 0.42                       |
| 0              | 0        | 0     | 0  | 0   | 2                                      | 98          |                   |                               | 50.9                       | 38.3    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 51.6                       | 39.7    | 0.40                       |

Note: n.d. = not determined

## Soil profile description

### Pit no. C3

|           |  |
|-----------|--|
| 0-5 cm    | Very dark grey (10YR 3/1); moist; clay; coalesced strong fine crumb; very friable; many roots; clear smooth boundary.  |
| 5-15 cm   | Brown to dark brown (10YR 4/3); moist; clay; moderate fine to medium subangular blocky; very friable; many roots; many fine tubular pores; clear smooth boundary.  |
| 15-26 cm  | Dark yellowish-brown (10YR 4/4); moist; clay; moderate fine to medium subangular blocky; very friable; common roots; many fine tubular pores; clear smooth boundary.   |
| 26-140 cm | Dark yellowish-brown (10YR 4/4) with few distinct medium 7.5YR 5/7 mottles; moist; clay; moderate to strong fine subangular blocky with smooth shiny faces; friable; few roots; common fine tubular pores; few tubular iron nodules. |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %   |
|---------|------------|--------------------------------------|-----|-------------------|-------|-------|
|         |            | Moist                                | Dry |                   |       |       |
| A       | 0-5        |                                      | 6.2 | 5.9               | 12.05 | 0.82  |
| AB1     | 5-15       |                                      | 6.1 | 5.4               | 5.33  | 0.36  |
| AB2     | 15-26      |                                      | 5.3 | 4.2               | 2.31  | 0.18  |
|         | 30-60      |                                      | 5.3 | 4.0               | 0.37  | 0.03  |
| Bw      | 60-90      |                                      | 5.0 | 4.0               | 0.27  | 0.02  |
|         | 90-120     |                                      | 5.2 | 4.0               | 0.02  | <0.01 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |       |
|---------|------------|-------------------------|--------|-----|--------|-------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg    |
|         | 0-5        | 72.88                   | 55.45  |     | 42.65* | 11.05 |
|         | 5-15       | 43.30                   | 28.73  |     | 22.53  | 5.09  |
|         | 15-26      | 29.92                   | 10.55  |     | 7.74   | 2.05  |
|         | 30-60      | 24.57                   | 8.40   |     | 5.97   | 1.59  |
|         | 60-90      | 25.14                   | 6.62   |     | 4.60   | 1.31  |
|         | 90-120     | 24.14                   | 6.92   |     | 4.86   | 1.18  |

### Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-5        | 9           | 19              | 72          | 0              | 0     | 1        |
|         | 5-15       | 0           | 0               | 100         | 0              | 0     | 0        |
|         | 15-26      | 0           | 0               | 100         | 0              | 0     | 0        |
|         | 30-60      | 2           | 15              | 83          | 0              | 0     | 0        |
|         | 60-90      | 10          | 11              | 79          | 0              | 0     | 2        |
|         | 90-120     | 0           | 0               | 100         | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 15  |         | 76                                    |           |         |       | 71            | 0.28                |                   | 1.131           | 0.69         | 7.1             |
| 15  |         | 46                                    |           |         |       | 82            |                     |                   | 1.125           | 0.87         | 7.1             |
| 13  |         | 51                                    |           |         |       | 78            |                     |                   | 1.147           | 0.87         | 7.1             |
| 12  |         | 281                                   |           |         |       | 83            |                     |                   | 1.134           | 0.82         | 7.2             |
| 12  |         | 344                                   |           |         |       | 82            |                     |                   | 1.138           | n.d.         | 7.2             |
| -   |         | 277                                   |           |         |       | 78            |                     |                   | 1.160           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 1.34                    | 0.41 | 34.16            | 0      | 0.74               | 0.82 |    |    |         | 1,979 | 1.43       | 7.35       | 0.05          |
| 0.63                    | 0.48 | 32.70            | 0.19   | 0.79               | 0.83 |    |    |         | 376   | 1.82       | 8.73       | 0.13          |
| 0.12                    | 0.64 | 31.38            | 0.20   | 0.48               | 0.44 |    |    |         | 564   | 1.71       | 8.19       | 0.25          |
| 0.08                    | 0.76 | 26.50            | 0.65   | 0.42               | 0.22 |    |    |         | 1,837 | 1.35       | 7.88       | 0.12          |
| 0.06                    | 0.65 | 27.90            | 0.71   | 0.49               | 0.24 |    |    |         | 1,832 | 0.94       | 7.58       | 0.17          |
| 0.05                    | 0.82 | 30.42            | 0.73   | 0.41               | 0.22 |    |    |         | 4,617 | 1.29       | 7.54       | 0.17          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay < 0.002 | Fine clay < 0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|--------------|--------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |              |                    |                               | Field moist                | Air dry |                            |
| 3              | 5        | 4     | 2  | 12  | 14                                     | 72           |                    |                               | 74.1                       | 57.9    | 0.80                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100          |                    |                               | 60.2                       | 38.8    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100          |                    |                               | 52.2                       | 37.0    | 0.37                       |
| 0              | 2        | 0     | 0  | 6   | 11                                     | 83           |                    |                               | 32.6                       | 30.7    | 0.37                       |
| 4              | 4        | 6     | 2  | 11  | 10                                     | 79           |                    |                               | 54.7                       | 41.9    | 0.53                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100          |                    |                               | 55.9                       | 40.0    | 0.40                       |

Notes: \*Corrected for free lime  
n.d. = not determined

## Soil profile description

Pit no. 110

|           |   |
|-----------|---|
| 0-7 cm    | Very dark greyish-brown to dark-brown (10YR 3/2-4/3); moist; clay; strong fine crumb and moderate fine subangular blocky; very friable; many roots; clear smooth boundary.      |
| 7-31 cm   | Brown to dark brown (10YR 4/3); moist; clay; moderate fine to medium subangular blocky; friable; common roots; many fine tubular pores; gradual smooth boundary.                |
| 31-59 cm  | Dark yellowish-brown (10YR 4/4); moist; clay; weak fine subangular blocky; very friable; common roots; many fine tubular pores; gradual smooth boundary.                        |
| 59-96 cm  | Brown to dark yellowish-brown (10-7.5YR 4/4); moist; clay; weak subangular blocky with some shiny ped faces; friable; few roots, many fine tubular pores; abrupt wavy boundary. |
| 96-150 cm | Weathered and fractured coral from gravel to large stone size. Virtually no soil but fine roots follow fracture lines.  |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-7        |                                      | 5.9 | 5.4               | 10.16 | 0.79 |
| AB      | 7-31       |                                      | 6.0 | 5.4               | 2.13  | 0.17 |
| Bw1     | 31-59      |                                      | 6.1 | 5.4               | 1.49  | 0.12 |
| Bw2     | 70-90      |                                      | 6.1 | 5.4               | 0.62  | 0.07 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-7        | 58.74                   | 40.20  |     | 31.76 | 7.18 |
|         | 7-31       | 31.82                   | 13.74  |     | 10.34 | 2.52 |
|         | 31-59      | 27.58                   | 11.97  |     | 9.41  | 2.08 |
|         | 70-90      | 29.70                   | 14.17  |     | 11.86 | 1.41 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt       |             | Sand fractions |       |          |
|---------|------------|-------------|------------|-------------|----------------|-------|----------|
|         |            |             | 0.05-0.002 | Clay <0.002 | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-7        | 6           | 20         | 74          | 0              | 0     | 3        |
|         | 7-31       | 0           | 16         | 84          | 0              | 0     | 0        |
|         | 31-59      | 4           | 15         | 81          | 0              | 0     | 0        |
|         | 70-90      | 0           | 3          | 97          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 13  |         | 105                                   |           |         |       | 71            |                     |                  | 1.184           | 0.59         | 7.1             |
| 13  |         | 17                                    |           |         |       | 86            |                     |                  | 1.116           | 0.77         | 7.2             |
| 12  |         | 44                                    |           |         |       | 84            |                     |                  | 1.112           | 0.79         | 7.2             |
| 9   |         | 58                                    |           |         |       | 93            |                     |                  | 1.120           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.87                    | 0.39 | 39.14            | 0      | 0.56               | 0.46 |    |    |         | 28    | 1.08       | 7.04       | 0.34          |
| 0.50                    | 0.38 | 25.44            | 0      | 0.55               | 0.53 |    |    |         | 190   | 1.03       | 8.03       | 0.11          |
| 0.14                    | 0.34 | 25.36            | 0      | 0.58               | 0.73 |    |    |         | 323   | 0.85       | 6.89       | 0.10          |
| 0.09                    | 0.81 | 21.06            | 0      | 0.42               | 0.43 |    |    |         | 862   | 1.30       | 7.78       | 0.10          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 2              | 1        | 5     | 0  | 8   | 18                                     | 74          |                   |                               | 78.2                       | 51.1    | 0.69                       |
| 0              | 0        | 0     | 0  | 5   | 11                                     | 84          |                   |                               | 50.7                       | 37.2    | 0.44                       |
| 0              | 4        | 4     | 0  | 10  | 9                                      | 81          |                   |                               | 49.4                       | 38.0    | 0.47                       |
| 0              | 0        | 0     | 0  | 0   | 3                                      | 97          |                   |                               | 81.1                       | 40.5    | 0.42                       |

Note: n.d. = not determined



## Soil profile description

Pit no. 312

|           |  |
|-----------|--|
| 0-8 cm    | Dark brown to dark yellowish-brown (10YR 3/3-4); moist; clay; strong fine crumb and weak to moderate fine subangular blocky; very friable; many roots; gradual smooth boundary.  |
| 8-36 cm   | Dark yellowish-brown (10YR 4/3-4/4); moist; clay; weak fine subangular blocky; very friable; many roots; common fine tubular pores; gradual smooth boundary.   |
| 36-78 cm  | Strong brown (7.5YR 4/6); moist; clay; weak fine subangular blocky with few shiny ped faces; very friable; common roots; many fine tubular pores; few charcoal fragments; diffuse boundary.  |
| 78-150 cm | Strong brown (7.5YR 4/6); moist; clay; weak to moderate angular blocky with many large shiny ped faces clearly passing drainage water; friable and more compact than above; few roots; few fine tubular pores; few charcoal fragments. |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-8        |                                      | 4.4 | 3.9               | 7.85 | 0.60 |
| AB      | 8-36       |                                      | 4.4 | 4.4               | 4.57 | 0.25 |
| Bw1     | 36-78      |                                      | 4.4 | 4.1               | 1.52 | 0.10 |
| Bw2     | 90-110     |                                      | 4.4 | 4.0               | 0.31 | 0.03 |
|         | 120-140    |                                      | 4.4 | 3.7               | 0.13 | 0.01 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |      |      |
|---------|------------|-------------------------|--------|-----|------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca   | Mg   |
|         | 0-8        | 51.05                   | 4.98   |     | 2.45 | 1.38 |
|         | 8-36       | 31.36                   | 0.98   |     | 0.45 | 0.20 |
|         | 36-78      | 23.95                   | 2.20   |     | 1.43 | 0.28 |
|         | 90-110     | 21.11                   | 0.78   |     | 0.20 | 0.18 |
|         | 120-140    | 19.70                   | 0.91   |     | 0.29 | 0.14 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-8        | 10          | 19              | 71          | 0              | 0     | 0        |
|         | 8-36       | 5           | 31              | 64          | 0              | 0     | 0        |
|         | 36-78      | 2           | 17              | 81          | 0              | 0     | 0        |
|         | 90-110     | 0           | 13              | 87          | 0              | 0     | 0        |
|         | 120-140    | 0           | 7               | 93          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 13  |         | 152                                   |           |         |       | 93            |                     |                  | 1.119           | 0.74         | 7.1             |
| 18  |         | 47                                    |           |         |       | 97            |                     |                  | 1.197           | 0.72         | 7.5             |
| 15  |         | 29                                    |           |         |       | 89            |                     |                  | 1.135           | 0.78         | 7.2             |
| 10  |         | 144                                   |           |         |       | 90            |                     |                  | 1.122           | n.d.         | 7.2             |
| 13  |         | 159                                   |           |         |       | 87            |                     |                  | 1.171           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 1.04                    | 0.11 | 78.46            | 2.17   | 1.12               | 1.91 |    |    |         | 1936  | 2.45       | 8.73       | 1.58          |
| 0.13                    | 0.20 | 62.78            | 1.91   | 1.14               | 1.90 |    |    |         | 360   | 3.24       | 9.82       | 0.10          |
| 0.06                    | 0.43 | 37.54            | 3.11   | 0.53               | 0.66 |    |    |         | 1283  | 2.27       | 9.02       | 0.29          |
| 0.03                    | 0.37 | 35.82            | 4.54   | 0.58               | 0.58 |    |    |         | 3074  | 1.14       | 8.75       | 0.00          |
| 0.02                    | 0.46 | 37.38            | 5.21   | 0.52               | 0.43 |    |    |         | 4473  | 1.41       | 8.90       | 0.76          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 5              | 5        | 5     | 2  | 11  | 16                                     | 71          |                   |                               | 70.3                       | 50.6    | 0.71                       |
| 3              | 2        | 3     | 0  | 10  | 26                                     | 64          |                   |                               | 61.6                       | 34.9    | 0.55                       |
| 1              | 1        | 1     | 0  | 3   | 16                                     | 81          |                   |                               | 51.6                       | 37.1    | 0.46                       |
| 0              | 0        | 0     | 0  | 1   | 12                                     | 87          |                   |                               | 52.5                       | 38.9    | 0.45                       |
| 0              | 0        | 0     | 0  | 1   | 6                                      | 93          |                   |                               | 53.2                       | 40.5    | 0.44                       |

Note: n.d. = not determined

## Soil profile description

Pit no. 317

|            |   |
|------------|---|
| 0-5 cm     | Very dark greyish-brown to very dark-brown (10YR 3/2-2/2); moist; clay; strong fine crumb; very friable; many roots; gradual smooth boundary.   |
| 5-28 cm    | Very dark greyish-brown to dark-brown (10YR 3/2-3/3); moist; clay; strong fine crumb with some fine subangular blocky; very friable; many roots; gradual smooth boundary.   |
| 28-48 cm   | Brown to dark brown (7.5YR 4/4); moist; clay; weak fine subangular blocky; very friable; common roots; common fine tubular pores; diffuse boundary.   |
| 48-127 cm  | Brown to strong brown (7.5YR 4/5) with few fine 5YR 4/6 mottles at bottom; moist; clay; weak subangular blocky with weak shiny ped faces; very friable; common roots, many fine tubular pores; abrupt smooth boundary.      |
| 127-150 cm | Apparent discontinuity. Dark yellowish-brown (10YR 4/4); moist; clay; weak angular blocky with strong pressure faces; friable and more compact than above; few roots; many fine tubular pores; few fine charcoal fragments. |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-5        |                                      | 4.4 | 4.1               | 10.98 | 0.62 |
| AB      | 5-28       |                                      | 4.4 | 4.3               | 5.30  | 0.24 |
| Bw1     | 28-48      |                                      | 4.4 | 4.1               | 2.16  | 0.12 |
| Bw2     | { 50-70    |                                      | 4.6 | 4.0               | 1.14  | 0.09 |
|         | { 80-100   |                                      | 4.5 | 3.8               | 0.61  | 0.06 |
| Bwb     | 127-150    |                                      | 4.6 | 3.9               | 0.15  | 0.04 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |      |      |
|---------|------------|-------------------------|--------|-----|------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca   | Mg   |
|         | 0-5        | 53.66                   | 4.84   |     | 2.38 | 1.27 |
|         | 5-28       | 40.58                   | 1.69   |     | 0.62 | 0.29 |
|         | 28-48      | 27.34                   | 1.22   |     | 0.57 | 0.16 |
|         | 50-70      | 25.50                   | 1.76   |     | 0.90 | 0.18 |
|         | 80-100     | 23.44                   | 1.45   |     | 0.63 | 0.16 |
|         | 127-150    | 27.59                   | 1.23   |     | 0.43 | 0.17 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-5        | 0           | 16              | 84          | 0              | 0     | 0        |
|         | 5-28       | 0           | 29              | 71          | 0              | 0     | 0        |
|         | 28-48      | 0           | 11              | 89          | 0              | 0     | 0        |
|         | 50-70      | 0           | 15              | 85          | 0              | 0     | 0        |
|         | 80-100     | 0           | 8               | 92          | 0              | 0     | 0        |
|         | 127-150    | 0           | 20              | 80          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 18  |         | 270                                   |           |         |       | 90            |                     |                  | 1.127           | 0.63         | 7.1             |
| 22  |         | 168                                   |           |         |       | 97            |                     |                  | 1.112           | 0.72         | 7.5             |
| 18  |         | 50                                    |           |         |       | 86            |                     |                  | 1.115           | 0.79         | 7.3             |
| 13  |         | 150                                   |           |         |       | 84            |                     |                  | 1.118           | 0.87         | 7.3             |
| 10  |         | 233                                   |           |         |       | 86            |                     |                  | 1.111           | n.d.         | 7.3             |
| 4   |         | 976                                   |           |         |       | 81            |                     |                  | 1.180           | n.d.         | 7.5             |

| K    | Cation exchange (meq %) |                  | Tamm's extract (%) |      |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|------|-------------------------|------------------|--------------------|------|------|----|----|---------|-------|------------|------------|---------------|
|      | Na                      | Exchange acidity | KCl-Al             | Al   | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.70 | 0.49                    | 82.22            | 2.83               | 1.02 | 1.27 |    |    |         | 3,832 | 1.24       | 8.23       | 1.34          |
| 0.15 | 0.63                    | 65.92            | 3.04               | 1.10 | 1.00 |    |    |         | 23    | 1.66       | 8.51       | 0.34          |
| 0.05 | 0.44                    | 42.58            | 4.13               | 0.44 | 0.37 |    |    |         | 265   | 1.96       | 9.09       | 0.46          |
| 0.05 | 0.63                    | 37.60            | 4.40               | 0.50 | 0.44 |    |    |         | 593   | 1.62       | 8.16       | 0.31          |
| 0.03 | 0.63                    | 37.36            | 4.75               | 0.55 | 0.67 |    |    |         | 1,467 | 1.03       | 8.11       | 0.41          |
| 0.05 | 0.58                    | 45.06            | 4.37               | 0.71 | 0.94 |    |    |         | 2,325 | 1.33       | 7.55       | 0.21          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0              | 0        | 0     | 0  | 4   | 12                                     | 84          |                   | 70.8                          | 47.1                       | 0.56    |                            |
| 0              | 0        | 0     | 0  | 5   | 24                                     | 71          |                   | 60.2                          | 36.4                       | 0.51    |                            |
| 0              | 0        | 0     | 0  | 4   | 7                                      | 89          |                   | 53.4                          | 36.5                       | 0.41    |                            |
| 0              | 0        | 0     | 0  | 3   | 12                                     | 85          |                   | 54.6                          | 38.5                       | 0.45    |                            |
| 0              | 0        | 0     | 0  | 1   | 7                                      | 92          |                   | 55.2                          | 38.7                       | 0.42    |                            |
| 0              | 0        | 0     | 0  | 2   | 18                                     | 80          |                   | 55.2                          | 39.8                       | 0.50    |                            |

Note: n.d. = not determined

## Soil profile description

Pit no. 319

|           |  |
|-----------|--|
| 0-7 cm    | Very dark grey (10YR 3/1); moist; clay; strong fine crumb; very friable; very many roots; clear smooth boundary.   |
| 7-23 cm   | Brown to dark brown (10YR-7.5YR 4/3); moist; clay; strong fine crumb slightly coalesced; very friable; common roots; gradual smooth boundary.  |
| 23-42 cm  | Dark brown to dark yellowish-brown (10YR 4/3-3/4); moist; clay; weak to moderate fine subangular blocky; very friable; common roots; many fine tubular pores; diffuse boundary.  |
| 42-89 cm  | Dark brown (10YR 4/3-3/3); moist; clay; weak fine to medium subangular and angular blocky with few shiny ped faces; very friable but more compact than above; common roots; many fine tubular pores; diffuse boundary. |
| 89-155 cm | Dark yellowish-brown (10YR 4/4); moist; clay; weak medium angular blocky with many shiny ped faces; very friable but more compact than above; few roots; many fine tubular pores.                                      |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-7        |                                      | 6.5 | 6.8               | 15.87 | 1.17 |
| AB      | 7-23       |                                      | 6.3 | 5.9               | 3.85  | 0.29 |
| Bw1     | 23-42      |                                      | 5.9 | 5.2               | 1.60  | 0.15 |
| Bw2     | 50-80      |                                      | 5.9 | 5.6               | 0.41  | 0.06 |
| Bw3     | 110-140    |                                      | 6.0 | 5.4               | 0.29  | 0.05 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |       |
|---------|------------|-------------------------|--------|-----|--------|-------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg    |
|         | 0-7        | 69.28                   | 50.06  |     | 33.87* | 12.43 |
|         | 7-23       | 33.53                   | 19.72  |     | 12.57  | 4.26  |
|         | 23-42      | 27.26                   | 8.09   |     | 4.69   | 1.90  |
|         | 50-80      | 28.49                   | 7.39   |     | 5.13   | 1.01  |
|         | 110-140    | 28.32                   | 10.22  |     | 7.94   | 1.16  |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-7        | 13          | 27              | 60          | 0              | 0     | 2        |
|         | 7-23       | 10          | 28              | 62          | 0              | 0     | 1        |
|         | 23-42      | 8           | 23              | 69          | 0              | 0     | 0        |
|         | 50-80      | 2           | 29              | 69          | 0              | 0     | 0        |
|         | 110-140    | 0           | 9               | 91          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 14  |         | 298                                   |           |         |       | 87            | 0,50                |                  | 1.140           | 0.58         | 7.0             |
| 13  |         | 179                                   |           |         |       | 95            |                     |                  | 1.120           | 0.64         | 7.1             |
| 11  |         | 198                                   |           |         |       | 94            |                     |                  | 1.125           | 0.79         | 7.1             |
| 7   |         | 224                                   |           |         |       | 96            |                     |                  | 1.142           | 0.80         | 7.3             |
| 6   |         | 196                                   |           |         |       | 88            |                     |                  | 1.129           | n.d.         | 7.3             |

| Cation exchange (meq %) |      |                  | Tamm's extract (%) |      |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------------------|------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al             | Al   | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 3.43                    | 0.33 | 42.24            | 0                  | 1.22 | 0.75 |    |    |         | 1,972 | 0.55       | 5.93       | 0.32          |
| 2.58                    | 0.31 | 39.30            | 0                  | 1.12 | 0.77 |    |    |         | 27    | 2.53       | 8.57       | 0.31          |
| 1.02                    | 0.48 | 37.20            | 0                  | 0.84 | 1.12 |    |    |         | 1,693 | 0.75       | 9.00       | 0.16          |
| 0.14                    | 1.11 | 32.54            | 0                  | 0.73 | 1.18 |    |    |         | 1,565 | 2.29       | 8.74       | 0.16          |
| 0.10                    | 1.08 | 24.46            | 0                  | 0.36 | 0.42 |    |    |         | 971   | 1.49       | 8.46       | 0.11          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 4              | 7        | 6     | 7  | 13  | 20                                     | 60          |                   |                               | 74.3                       | 63.2    | 1.05                       |
| 3              | 6        | 4     | 1  | 21  | 16                                     | 62          |                   |                               | 49.6                       | 35.2    | 0.57                       |
| 4              | 4        | 4     | 0  | 17  | 14                                     | 69          |                   |                               | 50.9                       | 33.7    | 0.49                       |
| 1              | 1        | 1     | 0  | 4   | 27                                     | 69          |                   |                               | 56.7                       | 34.7    | 0.50                       |
| 0              | 0        | 0     | 0  | 0   | 9                                      | 91          |                   |                               | 55.3                       | 39.3    | 0.43                       |

Notes:\* Corrected for free lime  
n.d. = not determined

## Soil profile description

Pit no. 321

|                 |   |
|-----------------|---|
| 0-6 cm          | Very dark greyish-brown to dark brown (10YR-7.5YR 3/2); moist; clay; strong fine crumb slightly coalesced; very friable; many roots; abrupt smooth boundary.  |
| 6-32/45 cm      | Brown to dark brown (10YR 4/3); moist; clay; moderate fine subangular blocky; very friable; many roots; many fine tubular pores; gradual wavy boundary due to irregular distribution of organic matter. |
| 32/45-80/108 cm | Brown to strong brown (7.5YR 4/5); moist; clay; weak to moderate fine to medium subangular blocky with shiny ped faces; very friable; few roots; few pores; coral at 80 cm on one face of pit.          |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-6        |                                      | 6.7 | 6.4               | 11.22 | 0.98 |
| AB      | 6-32       |                                      | 6.2 | 5.3               | 2.08  | 0.21 |
| Bw      | 45-68      |                                      | 6.1 | 5.4               | 0.61  | 0.05 |
|         | 68-90      |                                      | 6.1 | 5.4               | 0.44  | 0.04 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |       |
|---------|------------|-------------------------|--------|-----|--------|-------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg    |
|         | 0-6        | 77.39                   | 54.77  |     | 39.34* | 13.58 |
|         | 6-32       | 37.93                   | 14.65  |     | 11.47  | 2.50  |
|         | 45-68      | 31.74                   | 14.04  |     | 11.29  | 1.79  |
|         | 68-90      | 33.19                   | 15.55  |     | 13.38  | 1.10  |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-6        | 6           | 22              | 72          | 0              | 0     | 0        |
|         | 6-32       | 3           | 10              | 87          | 0              | 0     | 0        |
|         | 45-68      | 1           | 12              | 87          | 0              | 0     | 0        |
|         | 68-90      | 0           | 6               | 94          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 11  |         | 33                                    |           |         |       | 71            | 0.52                |                   | 1.201           | 0.66         | 7.2             |
| 10  |         | 49                                    |           |         |       | 87            |                     |                   | 1.157           | 0.83         | 7.2             |
| 12  |         | 227                                   |           |         |       | 86            |                     |                   | 1.210           | 0.86         | 7.2             |
| 11  |         | 191                                   |           |         |       | 87            |                     |                   | 1.188           | n.d.         | 7.3             |

| K    | Cation exchange (meq %) |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|------|-------------------------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
|      | Na                      | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 1.50 | 0.35                    | 30.12            | 0      | 0.72               | 0.66 |    |    |         | 60    | 1.54       | 7.51       | 0.48          |
| 0.09 | 0.59                    | 32.98            | 0      | 0.65               | 0.62 |    |    |         | 336   | 2.20       | 7.87       | 0.23          |
| 0.06 | 0.90                    | 26.20            | 0      | 0.53               | 0.60 |    |    |         | 666   | 1.57       | 8.65       | 0.12          |
| 0.07 | 1.00                    | 27.08            | 0      | 0.53               | 0.42 |    |    |         | 440   | 1.59       | 8.97       | 0.12          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 2              | 4        | 2     | 6  | 8   | 14                                     | 72          |                   |                               | 79.7                       | 58.0    | 0.80                       |
| 2              | 1        | 2     | 0  | 4   | 9                                      | 87          |                   |                               | 48.2                       | 36.5    | 0.42                       |
| 0              | 1        | 0     | 0  | 1   | 12                                     | 87          |                   |                               | 56.5                       | 41.9    | 0.48                       |
| 0              | 0        | 0     | 0  | 0   | 6                                      | 94          |                   |                               | 58.8                       | 42.4    | 0.45                       |

Notes: \* Corrected for free lime  
n.d. = not determined



## Soil profile description

Pit no. 326

|              |   |
|--------------|---|
| 0-8 cm       | Brown to dark brown (10YR 4/3); moist; clay; strong fine crumb to subangular blocky; very friable; many roots; diffuse boundary.  |
| 8-32 cm      | Dark brown (10YR 4/3-3/3); moist; clay; moderate fine subangular blocky; very friable; many roots; many fine tubular pores; diffuse boundary.   |
| 32-45/70 cm  | Dark brown (10YR 4/3-3/3); moist; clay; weak fine subangular blocky; very friable; common roots; many fine tubular pores; clear irregular boundary with organic discolouration in pockets.            |
| 45/70-108 cm | Dark yellowish-brown to dark brown (10YR-7.5YR 4/4); moist; clay; weak fine subangular blocky with slightly shiny ped faces; very friable; few roots; many fine tubular pores; clear smooth boundary. |
| 108-140 cm   | Brown to strong brown (7.5YR 4/5); moist; clay; structureless and moderately coherent; firm; very few roots; many fine tubular pores.   |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-8        |                                      | 6.6 | 6.3               | 10.08 | 0.42 |
| AB1     | 8-32       |                                      | 6.1 | 5.0               | 3.30  | 0.23 |
| AB2     | 32-70      |                                      | 5.9 | 5.1               | 1.51  | 0.16 |
| Bw1     | 70-108     |                                      | 5.5 | 4.6               | 0.31  | 0.04 |
| Bw2     | 108-140    |                                      | 5.4 | 4.5               | 0.06  | 0.02 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |       |
|---------|------------|-------------------------|--------|-----|--------|-------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg    |
|         | 0-8        | 69.43                   | 45.55  |     | 28.24* | 13.90 |
|         | 8-32       | 33.84                   | 9.48   |     | 5.69   | 1.72  |
|         | 32-70      | 29.94                   | 6.75   |     | 4.82   | 1.01  |
|         | 70-108     | 26.81                   | 8.07   |     | 4.77   | 1.77  |
|         | 108-140    | 23.71                   | 7.54   |     | 4.60   | 1.97  |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-8        | 9           | 23              | 68          | 1              | 2     | 1        |
|         | 8-32       | 3           | 41              | 56          | 0              | 1     | 1        |
|         | 32-70      | 11          | 36              | 53          | 1              | 0     | 1        |
|         | 70-108     | 0           | 4               | 96          | 0              | 0     | 0        |
|         | 108-140    | 0           | 0               | 100         | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 24  |         | 355                                   |           |         |       | 84            | 0.64                |                  | 1.117           | 0.64         | 7.1             |
| 14  |         | 225                                   |           |         |       | 95            |                     |                  | 1.193           | 0.85         | 7.2             |
| 9   |         | 300                                   |           |         |       | 95            |                     |                  | 1.167           | 0.82         | 7.3             |
| 8   |         | 322                                   |           |         |       | 80            |                     |                  | 1.288           | n.d.         | 7.3             |
| 3   |         | 261                                   |           |         |       | 79            |                     |                  | 1.241           | n.d.         | 7.4             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 3.14                    | 0.27 | 39.48            | 0      | 0.95               | 0.71 |    |    |         | 112   | 2.76       | 8.88       | 0.34          |
| 1.54                    | 0.53 | 44.88            | 0      | 1.37               | 1.15 |    |    |         | 608   | 2.99       | 8.53       | 0.24          |
| 0.22                    | 0.70 | 41.24            | 0      | 1.18               | 1.52 |    |    |         | 642   | 2.98       | 9.86       | 0.29          |
| 0.40                    | 1.13 | 30.84            | 0.15   | 0.44               | 0.79 |    |    |         | 1,159 | 1.84       | 9.47       | 0.24          |
| 0.12                    | 0.85 | 29.00            | 0.21   | 0.36               | 0.39 |    |    |         | 1,644 | 1.18       | 7.14       | 0.22          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 2              | 3        | 6     | 5  | 6   | 21                                     | 28          |                   |                               | 63.8                       | 57.5    | 0.84                       |
| 1              | 0        | 3     | 2  | 15  | 27                                     | 56          |                   |                               | 47.3                       | 34.5    | 0.62                       |
| 5              | 4        | 7     | 3  | 14  | 30                                     | 53          |                   |                               | 47.0                       | 34.8    | 0.66                       |
| 0              | 0        | 0     | 0  | 0   | 4                                      | 96          |                   |                               | 53.1                       | 42.4    | 0.44                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 52.1                       | 41.7    | 0.42                       |

Notes:\* Corrected for free lime  
n.d. = not determined

## Soil profile description

Pit no. 510

|            |  |
|------------|--|
| 0-8 cm     | Dark brown (7.5YR 3/2); moist; clay; very strong fine crumb; very friable; many roots; gradual smooth boundary.  |
| 8-32 cm    | Dark brown (10YR 4/3-3/3); moist; clay; moderate fine subangular blocky with some coalesced crumb; very friable; many roots; many fine tubular pores; diffuse boundary.                                  |
| 32-66 cm   | Brown to dark brown (10YR 4/3); moist; clay; weak fine subangular blocky; very friable; common roots; many fine tubular pores; gradual smooth boundary.  |
| 66-106 cm  | Dark brown to dark yellowish-brown (10YR-7.5YR 4/4); moist; clay; weak fine-to-medium angular blocky with shiny ped faces; very friable; common roots; many fine tubular pores; gradual smooth boundary. |
| 106-150 cm | Brown to dark yellowish-brown (7.5YR-10YR 4/5); moist; clay; weak angular blocky with shiny ped faces; friable; few roots; many fine tubular pores.  |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-8        |                                      | 6.7 | 6.4               | 8.69 | 0.60 |
| AB1     | 8-32       |                                      | 6.5 | 5.7               | 2.07 | 0.23 |
| AB2     | 32-66      |                                      | 6.5 | 5.6               | 1.21 | 0.14 |
| Bw1     | 70-90      |                                      | 6.2 | 5.6               | 0.59 | 0.05 |
| Bw2     | 120-140    |                                      | 6.2 | 5.7               | 0.16 | 0.03 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |       |
|---------|------------|-------------------------|--------|-----|-------|-------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg    |
|         | 0-8        | 51.21                   | 49.81  |     | 36.36 | 11.90 |
|         | 8-32       | 27.56                   | 15.89  |     | 10.72 | 4.53  |
|         | 32-66      | 25.80                   | 12.02  |     | 8.65  | 2.55  |
|         | 70-90      | 20.90                   | 9.84   |     | 7.30  | 1.62  |
|         | 120-140    | 19.91                   | 9.89   |     | 7.41  | 1.75  |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-8        | 0           | 32              | 68          | 0              | 0     | 0        |
|         | 8-32       | 2           | 24              | 74          | 1              | 0     | 0        |
|         | 32-66      | 0           | 15              | 85          | 0              | 0     | 0        |
|         | 70-90      | 0           | 0               | 100         | 0              | 0     | 0        |
|         | 120-140    | 0           | 5               | 95          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 15  |         | 80                                    |           |         |       | 78            |                     |                  | 1.102           | 0.70         | 7.2             |
| 9   |         | 29                                    |           |         |       | 89            |                     |                  | 1.074           | 0.79         | 7.2             |
| 9   |         | 145                                   |           |         |       | 89            |                     |                  | 1.117           | 0.75         | 7.3             |
| 12  |         | 148                                   |           |         |       | 78            |                     |                  | 1.128           | n.d.         | 7.4             |
| 5   |         | 127                                   |           |         |       | 78            |                     |                  | 1.164           | n.d.         | 7.5             |

| Cation exchange (meq %) |      |                  | Tamm's extract (%) |      |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------------------|------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al             | Al   | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 1.27                    | 0.28 | 27.02            | 0                  | 0.91 | 0.84 |    |    |         | 110   | 2.18       | 9.81       | 0.13          |
| 0.18                    | 0.46 | 25.72            | 0                  | 0.55 | 0.70 |    |    |         | 204   | 2.16       | 8.80       | 0.16          |
| 0.05                    | 0.77 | 26.10            | 0                  | 0.48 | 0.68 |    |    |         | 436   | 1.81       | 6.48       | 0.11          |
| 0.04                    | 0.88 | 20.58            | 0                  | 0.27 | 0.27 |    |    |         | 1,128 | 1.25       | 7.92       | 0.06          |
| 0.03                    | 0.70 | 19.90            | 0                  | 0.28 | 0.15 |    |    |         | 908   | 1.04       | 7.94       | 0.17          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0              | 0        | 0     | 0  | 12  | 20                                     | 68          |                   |                               | 58.6                       | 49.5    | 0.73                       |
| 0              | 0        | 1     | 2  | 1   | 23                                     | 74          |                   |                               | 48.2                       | 36.3    | 0.49                       |
| 0              | 0        | 0     | 0  | 0   | 15                                     | 85          |                   |                               | 51.4                       | 40.0    | 0.47                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 48.4                       | 38.7    | 0.43                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 95          |                   |                               | 47.3                       | 40.3    | 0.42                       |

Note: n.d. = not determined

## Soil profile description

Pit no. 517

|              |   |
|--------------|---|
| 0-9 cm       | Very dark greyish-brown (10YR 3/2); moist; clay; very strong fine crumb; very friable; very many roots; clear smooth boundary.  |
| 9-24 cm      | Brown to dark brown (10YR 4/3); moist; clay; strong fine subangular blocky and crumb; very friable; many roots; gradual smooth boundary.  |
| 24-43 cm     | Dark yellowish-brown (10YR 4/4); weak to moderate fine subangular blocky; very friable; many roots; few fine tubular pores; gradual smooth boundary.  |
| 43-85/150 cm | Brown to strong brown (7.5YR 4/5); moist; clay; weak medium subangular blocky; very friable to loose; common roots but many in pocket within coral; many fine tubular pores; abrupt irregular boundary. |
| 85-150 cm    | Coral – 50% white (2.5Y 8/2) sand; no mixing with soil in pocket.   |

## Soil profile analysis results

| Horizon | Depth (cm)     | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %   |
|---------|----------------|--------------------------------------|-----|-------------------|------|-------|
|         |                | Moist                                | Dry |                   |      |       |
| A       | 0-9            |                                      | 5.9 | 5.4               | 7.14 | 0.49  |
| AB      | 9-24           |                                      | 6.0 | 5.3               | 3.35 | 0.35  |
| Bw1     | 24-43          |                                      | 5.9 | 5.3               | 1.87 | 0.14  |
| Bw2     | 50-80          |                                      | 6.1 | 5.4               | 0.66 | 0.07  |
|         | 100-120 (Soil) |                                      | 6.0 | 5.3               | 0.69 | 0.08  |
| 2C      | 100-120 (Sand) |                                      | 8.5 | 9.0               | 0.02 | <0.01 |

| Horizon | Depth (cm)     | Cation exchange (meq %) |        |           |       |      |
|---------|----------------|-------------------------|--------|-----------|-------|------|
|         |                | pH7 CEC                 | Σbases | %BS       | Ca    | Mg   |
|         | 0-9            | 48.84                   | 34.55  |           | 26.73 | 6.85 |
|         | 9-24           | 33.84                   | 18.39  |           | 13.42 | 4.16 |
|         | 24-43          | 30.68                   | 10.95  |           | 9.77  | 2.28 |
|         | 50-80          | 24.75                   | 11.19  |           | 9.04  | 1.00 |
|         | 100-120 (Soil) | 23.83                   | 12.30  |           | 10.35 | 0.64 |
|         | 100-120 (Sand) | 1.43                    |        | FREE LIME |       | 1.44 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm)     | Sand 2-0.05 | Silt       |             | Sand fractions |       |          |
|---------|----------------|-------------|------------|-------------|----------------|-------|----------|
|         |                |             | 0.05-0.002 | Clay <0.002 | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-9            | 17          | 30         | 53          | 0              | 0     | 0        |
|         | 9-24           | 0           | 13         | 87          | 0              | 0     | 0        |
|         | 24-43          | 0           | 6          | 94          | 0              | 0     | 0        |
|         | 50-80          | 0           | 0          | 100         | 0              | 0     | 0        |
|         | 100-120 (Soil) | 0           | 0          | 100         | 0              | 0     | 0        |
|         | 100-120 (Sand) | 100         | 0          | 0           |                |       |          |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 15  |         | 47                                    |           |         |       | 77            |                     |                   | 1.047           | 0.71         | 7.2             |
| 10  |         | 181                                   |           |         |       | 80            |                     |                   | 1.079           | 0.95         | 7.2             |
| 13  |         | 205                                   |           |         |       | 84            |                     |                   | 1.076           | 0.93         | 7.2             |
| 9   |         | 29                                    |           |         |       | 84            |                     |                   | 1.085           | 0.88         | 7.5             |
| 9   |         | 242                                   |           |         |       | 76            |                     |                   | 1.194           | n.d.         | 7.3             |
| -   |         | 25                                    |           |         |       | 94            | 91.4                |                   | 1.001           | n.d.         | 9.0             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.46                    | 0.51 | 36.12            | 0      | 0.60               | 0.72 |    |    |         | 43    | 2.11       | 9.19       | 0.42          |
| 0.22                    | 0.59 | 30.14            | 0      | 0.48               | 0.54 |    |    |         | 32    | 1.93       | 7.88       | 0.16          |
| 0.21                    | 0.69 | 25.76            | 0      | 0.48               | 0.69 |    |    |         | 538   | 1.83       | 8.25       | 0.11          |
| 0.04                    | 1.11 | 22.26            | 0      | 0.40               | 0.45 |    |    |         | 868   | 1.76       | 7.77       | 0.11          |
| 0.06                    | 1.25 | 22.46            | 0      | 0.30               | 0.26 |    |    |         | 716   | 1.61       | 7.61       | 0.12          |
| 0.02                    | 0.14 | 0                | 0      | 0.01               | 0    |    |    |         | 190   | 0.03       | 0.14       | 0             |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 10             | 7        | 10    | 2  | 17  | 28                                     | 53          |                   |                               | 55.2                       | 47.6    | 0.90                       |
| 0              | 0        | 0     | 0  | 0   | 13                                     | 87          |                   |                               | 47.7                       | 36.4    | 0.42                       |
| 0              | 0        | 0     | 0  | 0   | 6                                      | 94          |                   |                               | 48.8                       | 36.4    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 51.4                       | 38.3    | 0.38                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 50.5                       | 40.4    | 0.40                       |
|                |          |       |  |   |  |             |                   |                               | 1.0                        | 1.2     |                            |

Note: n.d. = not determined

## Soil profile description

Pit no. 520W

- 0-10 cm Very dark greyish-brown (10YR 3/2); moist; clay; strong fine crumb and moderate fine subangular blocky; very friable; many roots; clear smooth boundary.
- 10-26 cm Very dark greyish-brown (10YR-7.5YR 3/2); moist; clay; moderate fine to medium subangular blocky; very friable; common roots; common fine tubular pores; diffuse boundary.
- 26-55 cm Dark brown to dark yellowish-brown (10YR 3/3-3/4); moist; clay; weak fine to medium subangular blocky with few shiny ped faces; very friable; few roots; common fine tubular pores; diffuse boundary.
- 55-80 cm Dark yellowish-brown to dark brown (10YR-7.5YR 3/4); moist; clay; weak fine to medium subangular blocky with few shiny ped faces; very friable; very few roots; common fine tubular pores; gradual smooth boundary.
- 80-120 cm Brown to dark yellowish-brown (10YR-7.5YR 4/54); moist; clay; weak fine to medium angular blocky with shiny ped faces; very friable but more compact than above; very few roots; common fine tubular pores.
- 120 cm+ Water table. No change in soil morphology.

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-10       |                                      | 6.4 | 5.8               | 9.67 | 0.63 |
| AB      | 10-26      |                                      | 6.4 | 5.7               | 2.90 | 0.26 |
| Bw1     | 26-55      |                                      | 6.5 | 5.6               | 1.00 | 0.10 |
| Bw2     | 55-80      |                                      | 6.5 | 5.7               | 0.39 | 0.06 |
| Bw3     | 80-110     |                                      | 6.3 | 5.5               | 0.24 | 0.04 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-10       | 60.35                   | 46.34  |     | 36.83 | 8.22 |
|         | 10-26      | 33.78                   | 17.79  |     | 15.37 | 1.33 |
|         | 26-55      | 28.19                   | 11.22  |     | 8.94  | 1.11 |
|         | 55-80      | 28.05                   | 11.37  |     | 8.65  | 0.97 |
|         | 80-110     | 25.64                   | 9.64   |     | 7.26  | 1.18 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt       |             | Sand fractions |       |          |
|---------|------------|-------------|------------|-------------|----------------|-------|----------|
|         |            |             | 0.05-0.002 | Clay <0.002 | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-10       | 0           | 14         | 86          | 0              | 0     | 0        |
|         | 10-26      | 0           | 10         | 90          | 0              | 0     | 0        |
|         | 26-55      | 0           | 7          | 93          | 0              | 0     | 0        |
|         | 55-80      | 0           | 8          | 92          | 0              | 0     | 0        |
|         | 80-110     | 0           | 6          | 94          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 15  |         | 50                                    |           |         |       | 88            |                     |                   | 1.110           | 0.56         | 7.1             |
| 11  |         | 24                                    |           |         |       | 93            |                     |                   | 1.090           | 0.88         | 7.2             |
| 10  |         | 151                                   |           |         |       | 90            |                     |                   | 1.084           | 0.79         | 7.2             |
| 6   |         | 284                                   |           |         |       | 83            |                     |                   | 1.270           | n.d.         | 7.5             |
| 6   |         | 95                                    |           |         |       | 94            |                     |                   | 1.084           | n.d.         | 7.2             |

| K    | Cation exchange (meq %) |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|------|-------------------------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
|      | Na                      | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.56 | 0.73                    | 41.12            | 0      | 0.99               | 0.85 |    |    |         | 64    | 2.64       | 10.27      | 0.44          |
| 0.11 | 0.98                    | 31.06            | 0      | 0.79               | 0.84 |    |    |         | 194   | 2.47       | 9.41       | 0.11          |
| 0.04 | 1.13                    | 30.28            | 0      | 0.61               | 1.00 |    |    |         | 542   | 1.71       | 9.47       | 0.11          |
| 0.11 | 1.64                    | 31.86            | 0      | 0.66               | 0.94 |    |    |         | 635   | 2.56       | 10.18      | 0.12          |
| 0.07 | 1.13                    | 25.34            | 0      | 0.61               | 0.93 |    |    |         | 748   | 1.95       | 9.24       | 0.11          |

| Particle size (mm, %) (fine earth fraction) |          |       |  |   |  |             |                   |                               |                            |         |                            |
|---|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| Sand fractions                              |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
| 0.25-0.1                                    | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0   | 0        | 0     | 0  | 2   | 12                                     | 86          |                   |                               | 77.5                       | 40.6    | 0.47                       |
| 0   | 0        | 0     | 0  | 0   | 10                                     | 90          |                   |                               | 49.6                       | 32.3    | 0.36                       |
| 0   | 0        | 0     | 0  | 0   | 7                                      | 93          |                   |                               | 58.0                       | 34.1    | 0.37                       |
| 0   | 0        | 0     | 0  | 0   | 8                                      | 92          |                   |                               | 61.1                       | 39.3    | 0.43                       |
| 0   | 0        | 0     | 0  | 0   | 6                                      | 94          |                   |                               | 57.9                       | 35.9    | 0.38                       |

Note: n.d. = not determined



## Soil profile description

Pit no. 522

|          |   |
|----------|---|
| 0-5 cm   | Dark brown (7.5YR 3/2); moist; clay; very strong fine to very fine crumb and subangular blocky; very friable; very many roots; abrupt smooth boundary.  |
| 5-15 cm  | Dark brown (10YR 4/3-3/3); moist; clay; moderate to strong fine subangular blocky; very friable; common roots; few coral stones; clear smooth boundary.   |
| 15-38 cm | Dark brown to dark yellowish-brown (10YR 4/3-4/4); moist; clay; moderate fine subangular blocky; very friable but most compact horizon; common roots; many fine tubular pores; few coral stones; gradual smooth boundary. |
| 38-49 cm | Dark yellowish-brown (10YR 4/4); moist; clay; weak fine subangular blocky; very friable; common roots; many fine tubular pores; few coral stones; abrupt wavy boundary.   |
| 49+ cm   | Coral. Large boulders and smaller stones. Voids infilled with soft, floury soil, sampled from 50-70 cm.   |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %   | N %  |
|---------|------------|--------------------------------------|-----|-------------------|-------|------|
|         |            | Moist                                | Dry |                   |       |      |
| A       | 0-5        |                                      | 6.1 | 5.7               | 11.10 | 0.73 |
| AB      | 5-15       |                                      | 6.2 | 5.4               | 3.02  | 0.24 |
| Bw1     | 15-38      |                                      | 6.1 | 5.1               | 1.75  | 0.15 |
| Bw2     | 38-49      |                                      | 5.9 | 5.0               | 1.29  | 0.11 |
| Bw3     | 50-70      |                                      | 7.2 | 6.6               | 1.40  | 0.11 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-5        | 58.51                   | 48.64  |     | 39.10 | 8.53 |
|         | 5-15       | 28.09                   | 20.37  |     | 16.12 | 3.54 |
|         | 15-38      | 28.97                   | 13.91  |     | 11.13 | 2.09 |
|         | 38-49      | 27.62                   | 15.35  |     | 13.06 | 1.34 |
|         | 50-70      | 32.29                   | 26.06  |     | 24.75 | 0.45 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-5        | 5           | 20              | 85          | 0              | 0     | 1        |
|         | 5-15       | 0           | 5               | 95          | 0              | 0     | 0        |
|         | 15-38      | 0           | 1               | 99          | 0              | 0     | 0        |
|         | 38-49      | 0           | 6               | 94          | 0              | 0     | 0        |
|         | 50-70      | 0           | 3               | 97          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 15  |         | 41                                    |           |         |       | 79            |                     |                  | 1.092           | 0.72         | 7.1             |
| 13  |         | 12                                    |           |         |       | 85            |                     |                  | 1.077           | 0.89         | 7.2             |
| 12  |         | 20                                    |           |         |       | 83            |                     |                  | 1.196           | 0.90         | 7.2             |
| 12  |         | 42                                    |           |         |       | 84            |                     |                  | 1.147           | 0.75         | 7.2             |
| 13  |         | 236                                   |           |         |       | 84            |                     |                  | 1.162           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 0.57                    | 0.44 | 34.24            | 0      | 0.74               | 0.60 |    |    |         | 33    | 1.73       | 7.48       | 0.54          |
| 0.17                    | 0.54 | 27.02            | 0      | 0.70               | 0.53 |    |    |         | 54    | 2.00       | 8.30       | 0.21          |
| 0.09                    | 0.60 | 27.06            | 0      | 0.35               | 0.55 |    |    |         | 538   | 1.99       | 8.65       | 0.12          |
| 0.10                    | 0.85 | 25.50            | 0      | 0.52               | 0.44 |    |    |         | 1,021 | 1.82       | 7.78       | 0.11          |
| 0.12                    | 0.74 | 16.56            | 0      | 0.58               | 0.56 |    |    |         | 686   | 1.67       | 7.68       | 0.11          |

| Particle size (mm, %) (fine earth fraction) |          |       |  |   |  |             |                   |                               |                            |         |                            |
|---|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| Sand fractions                              |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
| 0.25-0.1                                    | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 2   | 2        | 3     | 3  | 10  | 2                                      | 85          |                   |                               | 63.3                       | 53.4    | 0.63                       |
| 0   | 0        | 0     | 0  | 0   | 5                                      | 95          |                   |                               | 50.8                       | 37.9    | 0.40                       |
| 0   | 0        | 0     | 0  | 0   | 1                                      | 99          |                   |                               | 46.9                       | 38.9    | 0.39                       |
| 0   | 0        | 0     | 0  | 0   | 6                                      | 94          |                   |                               | 52.6                       | 40.8    | 0.43                       |
| 0   | 0        | 0     | 0  | 0   | 3                                      | 97          |                   |                               | 54.4                       | 42.1    | 0.43                       |

Note: n.d. = not determined

## Soil profile description

Pit no. 631

|           |  |
|-----------|--|
| 0-8 cm    | Brown to dark brown (10YR 4/3); moist; clay; moderate to strong fine subangular blocky with some crumb; very friable; many roots; diffuse boundary.          |
| 8-34 cm   | Dark brown (10YR 4/3-3/3); moist; clay; weak to moderate fine subangular blocky; very friable; common roots; many fine tubular pores; clear smooth boundary. |
| 34-150 cm | Dark brown to very dark brown (10YR 3/3-2/2); moist; clay; weak fine subangular blocky with some shiny faces; friable; few roots; many fine tubular pores.   |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-8        |                                      | 6.2 | 5.5               | 9.35 | 0.68 |
| AB      | 8-34       |                                      | 6.2 | 4.7               | 3.08 | 0.22 |
| Bw      | 50-75      |                                      | 6.1 | 4.8               | 0.42 | 0.07 |
|         | 105-130    |                                      | 5.9 | 4.8               | 0.30 | 0.04 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-8        | 50.23                   | 43.61  |     | 31.58 | 8.89 |
|         | 8-34       | 33.54                   | 10.36  |     | 6.77  | 2.84 |
|         | 50-75      | 33.01                   | 9.08   |     | 6.35  | 1.47 |
|         | 105-130    | 34.36                   | 9.99   |     | 7.35  | 1.15 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt       |             | Sand fractions |       |          |
|---------|------------|-------------|------------|-------------|----------------|-------|----------|
|         |            |             | 0.05-0.002 | Clay <0.002 | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-8        | 9           | 21         | 70          | 2              | 2     | 1        |
|         | 8-34       | 0           | 13         | 87          | 0              | 0     | 0        |
|         | 50-75      | 0           | 10         | 90          | 0              | 0     | 0        |
|         | 105-130    | 0           | 9          | 91          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 14  |         | 64                                    |           |         |       | 85            |                     |                   | 1.108           | 0.59         | 7.1             |
| 14  |         | 32                                    |           |         |       | 92            |                     |                   | 1.177           | 0.84         | 7.1             |
| 6   |         | 136                                   |           |         |       | 94            |                     |                   | 1.170           | 0.74         | 7.1             |
| 8   |         | 168                                   |           |         |       | 93            |                     |                   | 1.269           | n.d.         | 7.2             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 2.83                    | 0.31 | 42.94            | 0      | 0.82               | 0.77 |    |    |         | 197   | 2.27       | 7.82       | 0.49          |
| 0.33                    | 0.42 | 40.92            | 0      | 0.93               | 0.81 |    |    |         | 812   | 2.55       | 9.64       | 0.29          |
| 0.20                    | 1.06 | 34.68            | 0      | 0.83               | 0.74 |    |    |         | 1,334 | 2.28       | 9.45       | 0.23          |
| 0.20                    | 1.29 | 39.06            | 0      | 0.81               | 1.31 |    |    |         | 1,066 | 1.97       | 7.47       | 0.25          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 3              | 1        | 8     | 6  | 8   | 16                                     | 70          |                   |                               | 75.9                       | 50.4    | 0.72                       |
| 0              | 0        | 0     | 0  | 0   | 13                                     | 87          |                   |                               | 52.7                       | 36.0    | 0.41                       |
| 0              | 0        | 0     | 0  | 0   | 10                                     | 90          |                   |                               | 61.0                       | 37.7    | 0.42                       |
| 0              | 0        | 0     | 0  | 0   | 9                                      | 91          |                   |                               | 63.8                       | 40.0    | 0.44                       |

Note: n.d. = not determined

## Soil profile description

Pit no. 820

|           |   |
|-----------|---|
| 0-8 cm    | Very dark greyish-brown to dark brown (10YR-7.5YR 3/2); moist; clay; strong fine subangular blocky and coalesced crumb; very friable; many roots; many fine tubular pores; clear smooth boundary. |
| 8-24 cm   | Brown to dark brown (10YR 4/3); moist; clay; moderate fine subangular blocky; very friable; many roots; many fine tubular pores; diffuse smooth boundary.   |
| 24-50 cm  | Brown to dark yellowish-brown (10YR 4/3-4/4); moist; clay; weak fine subangular blocky; very friable; few roots; many fine tubular pores; diffuse smooth boundary.                                |
| 50-130 cm | Dark yellowish-brown to dark brown (10YR-7.5YR 4/4); moist; clay; weak subangular blocky with shiny striated ped faces; very friable; few roots, many fine tubular pores.                         |

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-8        |                                      | 6.1 | 5.6               | 5.36 | 0.48 |
| AB      | 8-24       |                                      | 6.1 | 5.3               | 2.33 | 0.23 |
| Bw1     | 24-50      |                                      | 6.0 | 4.9               | 1.31 | 0.11 |
| Bw2     | 68-90      |                                      | 5.6 | 5.0               | 0.37 | 0.09 |
|         | 110-130    |                                      | 5.6 | 4.5               | 0.14 | 0.06 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |       |      |
|---------|------------|-------------------------|--------|-----|-------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca    | Mg   |
|         | 0-8        | 45.92                   | 32.52  |     | 22.15 | 7.66 |
|         | 8-24       | 30.89                   | 14.52  |     | 9.74  | 3.67 |
|         | 24-50      | 29.65                   | 9.75   |     | 6.94  | 1.89 |
|         | 68-90      | 30.87                   | 9.64   |     | 6.99  | 1.42 |
|         | 110-130    | 29.51                   | 10.19  |     | 7.11  | 1.71 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt       |             | Sand fractions |       |          |
|---------|------------|-------------|------------|-------------|----------------|-------|----------|
|         |            |             | 0.05-0.002 | Clay <0.002 | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-8        | 0           | 0          | 100         | 0              | 0     | 0        |
|         | 8-24       | 0           | 4          | 96          | 0              | 0     | 0        |
|         | 24-50      | 0           | 5          | 95          | 0              | 0     | 0        |
|         | 68-90      | 0           | 0          | 100         | 0              | 0     | 0        |
|         | 110-130    | 0           | 6          | 94          | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (<2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                  |                 |              |                 |
| 11  |         | 64                                    |           |         |       | 89            |                     |                  | 1.096           | 0.77         | 7.2             |
| 10  |         | 4                                     |           |         |       | 86            |                     |                  | 1.211           | 0.78         | 7.2             |
| 12  |         | 60                                    |           |         |       | 92            |                     |                  | 1.095           | 0.75         | 7.3             |
| 4   |         | 114                                   |           |         |       | 94            |                     |                  | 1.111           | n.d.         | 7.5             |
| 2   |         | 150                                   |           |         |       | 88            |                     |                  | 1.278           | n.d.         | 7.3             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 2.10                    | 0.61 | 33.12            | 0      | 1.07               | 0.98 |    |    |         | 55    | 2.31       | 8.64       | 0.38          |
| 0.32                    | 0.79 | 32.44            | 0      | 0.76               | 0.86 |    |    |         | 775   | 2.37       | 9.95       | 0.18          |
| 0.07                    | 0.85 | 29.96            | 0      | 0.61               | 0.80 |    |    |         | 1,358 | 2.75       | 8.74       | 0.16          |
| 0.05                    | 1.18 | 27.86            | 0      | 0.70               | 0.99 |    |    |         | 1,111 | 2.12       | 8.87       | 0.11          |
| 0.06                    | 1.31 | 32.78            | <0.1   | 0.58               | 0.60 |    |    |         | 1,713 | 2.11       | 10.37      | 0.30          |

Particle size (mm, %) (fine earth fraction)

| Sand fractions |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
|----------------|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| 0.25-0.1       | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 64.6                       | 39.6    | 0.40                       |
| 0              | 0        | 0     | 0  | 0   | 4                                      | 96          |                   |                               | 51.8                       | 37.2    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 5                                      | 95          |                   |                               | 54.2                       | 37.4    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 0                                      | 100         |                   |                               | 59.9                       | 39.1    | 0.39                       |
| 0              | 0        | 0     | 0  | 0   | 6                                      | 94          |                   |                               | 60.5                       | 43.1    | 0.46                       |

Note: n.d. = not determined

## Soil profile description

Pit no. 922

- 0-6 cm Very dark greyish-brown (10YR 3/2) with 10YR 4/3 patches; moist; clay; moderate fine subangular blocky; very friable; many roots; gradual smooth boundary.
- 6-23/30 cm Brown to dark brown (10YR 4/3); moist; clay; moderate fine subangular blocky; friable; few roots; many fine tubular pores; clear wavy boundary.
- 23/30-51/84 cm Brown to dark brown (10YR 4/3); moist; clay; moderate fine subangular blocky; friable; few roots; many fine tubular pores; clear wavy boundary.
- 51/84 cm+ Coral—massive but crumbling in patches.

## Soil profile analysis results

| Horizon | Depth (cm) | pH <sub>H<sub>2</sub>O</sub> (1:2.5) |     | pH KCl (1M) 1:2.5 | C %  | N %  |
|---------|------------|--------------------------------------|-----|-------------------|------|------|
|         |            | Moist                                | Dry |                   |      |      |
| A       | 0-6        |                                      | 6.4 | 5.9               | 9.95 | 0.74 |
| AB      | 6-23       |                                      | 5.8 | 4.4               | 6.19 | 0.32 |
| Bw      | 23-50      |                                      | 5.7 | 4.3               | 0.93 | 0.10 |

| Horizon | Depth (cm) | Cation exchange (meq %) |        |     |        |      |
|---------|------------|-------------------------|--------|-----|--------|------|
|         |            | pH7 CEC                 | Σbases | %BS | Ca     | Mg   |
|         | 0-6        | 63.51                   | 45.14  |     | 34.21* | 9.91 |
|         | 6-23       | 31.42                   | 10.81  |     | 7.68   | 2.49 |
|         | 23-50      | 32.22                   | 14.14  |     | 11.22  | 1.84 |

Particle size (mm, %) (fine earth fraction)

| Horizon | Depth (cm) | Sand 2-0.05 | Silt 0.05-0.002 | Clay <0.002 | Sand fractions |       |          |
|---------|------------|-------------|-----------------|-------------|----------------|-------|----------|
|         |            |             |                 |             | 2-1            | 1-0.5 | 0.5-0.25 |
|         | 0-6        | 0           | 8               | 92          | 0              | 0     | 0        |
|         | 6-23       | 0           | 0               | 100         | 0              | 0     | 0        |
|         | 23-50      | 0           | 0               | 100         | 0              | 0     | 0        |

| C/N | P (ppm) |                                       |           |         |       | P retention % | CaCO <sub>3</sub> % | Stones (< 2 mm) % | Moisture factor | Bulk density | pH NaF(1M) 1:50 |
|-----|---------|---------------------------------------|-----------|---------|-------|---------------|---------------------|-------------------|-----------------|--------------|-----------------|
|     | Olsen   | 0.025M H <sub>2</sub> SO <sub>4</sub> | Inorganic | Organic | Total |               |                     |                   |                 |              |                 |
| 13  |         | 48                                    |           |         |       | 84            | 0.39                |                   | 1.095           | 0.57         | 7.2             |
| 19  |         | 27                                    |           |         |       | 89            |                     |                   | 1.179           | 0.79         | 7.2             |
| 9   |         | 51                                    |           |         |       | 85            |                     |                   | 1.190           | 0.86         | 7.3             |

| Cation exchange (meq %) |      |                  |        | Tamm's extract (%) |      |    |    | S (ppm) |       | CDB Al (%) | CDB Fe (%) | KCl-H meq (%) |
|-------------------------|------|------------------|--------|--------------------|------|----|----|---------|-------|------------|------------|---------------|
| K                       | Na   | Exchange acidity | KCl-Al | Al                 | Fe   | Si | Mn | Total   | Absbd |            |            |               |
| 1.72                    | 0.36 | 34.96            | 0      | 0.84               | 1.10 |    |    |         | 184   | 2.43       | 9.89       | 0.43          |
| 0.12                    | 0.52 | 37.64            | 0.27   | 0.76               | 0.93 |    |    |         | 460   | 2.29       | 9.17       | 0.19          |
| 0.07                    | 1.01 | 29.16            | 0.27   | 0.60               | 0.57 |    |    |         | 1 238 | 1.96       | 7.98       | 0.14          |

| Particle size (mm, %) (fine earth fraction) |          |       |  |   |  |             |                   |                               |                            |         |                            |
|---|----------|-------|--|---|--|-------------|-------------------|-------------------------------|----------------------------|---------|----------------------------|
| Sand fractions                              |          |       | International fraction coarse sand 2-0.2 | International fraction fine sand 0.2-0.02 | International fraction silt 0.02-0.002 | Clay <0.002 | Fine clay <0.0002 | Ratio fine clay to total clay | 15 bar water retention (%) |         | Ratio 15 bar water to clay |
| 0.25-0.1                                    | 0.1-0.05 | 2-0.1 |  |   |  |             |                   |                               | Field moist                | Air dry |                            |
| 0   | 0        | 0     | 0  | 0   | 8                                      | 92          |                   | 79.9                          | 54.9                       | 0.60    |                            |
| 0   | 0        | 0     | 0  | 0   | 0                                      | 100         |                   | 52.2                          | 36.8                       | 0.37    |                            |
| 0   | 0        | 0     | 0  | 0   | 0                                      | 100         |                   | 57.1                          | 41.9                       | 0.42    |                            |

Note:\*Corrected for free lime