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SOILS OF THE C.S.I.R.O. PASTURE RESEARCH STATION, SAMFORD EAST, QUEENSLAND

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C O N T E N T S

THE SOILS OF THE C.S.I.R.O. PASTURE RESEARCH STATION, SAMFORD EAST

by

C. H. Thompson and G. G. Murtha

I. INTRODUCTION

The C.S.I.R.O. Pasture Research Station is situated in the South Pine River Valley one mile north of Samford village and sixteen miles by road from Brisbane. It has recently been enlarged by the acquisition of 430 acres of land adjoining the original property along Cedar Creek road.

Beckmann (1957) has mapped and described the soil types of the original property (Samford West). A survey of the new area (Samford East) has now been made to map the distribution of great soil groups and parent materials. This will be used in planning the development of the area, in the selection of experimental sites, and in the interpretation of results.

Differences in soil parent materials, topographic position, and drainage are the main factors determining the characteristics, distribution and fertility of these soils.

II. ENVIRONMENT

(a) Landscape and Geology.

Samford East is part of a landscape of low hills separated by narrow flats and drainage lines with gentle gradients to the South Pine River and its terraces. The highest elevation on the station is approximately 250 feet m.s.l. and the maximum local relief is about 150 feet.

The low hills are characterized by rounded crests, by long slopes of 5-8 degrees to the north and west, and by sharp slopes of 15-24 degrees to the south and east. The hills in the south-eastern half of the area are of Lower Paleozoic metasediments while those along the western boundary and in the central north are of granodiorite. The metasediments are mainly mica-schists intruded by veins of quartz, but include some metamorphosed sandstone and shale bands. Hornfels occurs in the contact zone between the granodiorite and metasediments.

The local drainage lines are concave in cross-section and are less than 600 feet wide. They consist of alluvium derived from the nearby hills of metasediments, hornfels and granodiorite.

Two terraces are readily recognized along the South Pine River; old high terrace with gentle slopes away from the river and short steep scarps to a low terrace flanking the stream. Generally flat but uneven surfaces cut by old meander channels of the stream are characteristic of the young terrace. The river alluvium consists of silt, sand and gravel beds derived from volcanic, granitic and metamorphic rocks.

(b) Climate.

The area has a sub-humid and sub-tropical climate with generally wet, hot summers and relatively dry warm winters. The average annual rainfall* is 41 inches with a strong summer incidence but useful falls may occur during the winter period.

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* Data from Comm. Met. Bur. "Results of rainfall observations in Queensland", District 40.

Details of the climate have previously been presented by Beckmann (1957) together with an appraisal of the length of growing season.

(c) Vegetation.

More than half of the property has been developed for pastures and cultivation. The remaining area is indigenous forest modified by fire, timber cutting, and by the invasion of some introduced species e.g. Lantana camara. An estimate of the original forest cover has been made from the least disturbed areas and three formations - grassy forest; open grassy woodland and fringing forest - are recognized. Their component species and relationships to the soils of the area are listed in Table 1.

III. THE SOILS

The soils were examined along traverse lines 500 feet apart and mapped on an air-photo base enlarged to the scale of 500 feet to the inch. Eleven units approximating great soil groups are recognized. These are classified according to the Australian and American schemes in Table 2. The main morphological features are briefly given below and detailed descriptions of the most common profiles developed in different parent materials are presented in Appendix 1.

(a) Lithosols (area 48 acres including podzolic intergrades)

These are shallow, stony soils less than 8 inches to parent rock. The surface horizons are grey-brown sandy loams or loams grading with depth into brown sandy clay loams with large amounts of weathered rock fragments.

These soils occupy hill crests on steep 15-24 degree hill slopes. The parent materials are metamorphosed sandstone layers in the metasediments.

TABLE 1. COMMON SPECIES OCCURRING IN THE SAMFORD EAST AREA.

Formation	Common tree and shrub species	Ground cover	Soils
Grassy forest	Eucalypt dominance: Eucalyptus major, E. umbra, E. intermedia, E. crebra, E. dermophylla, Tristania conferta, Acacia cunninghamii, Lantana camara.	Xanthorrea sp., Macrozamia lucida, Themeda australis, Imperata cylindrica, Digitaria didactyla, Aristida sp., Pteridium aquilinium.	Lithosols, Lithosolic podzolics, Red podzolics.
	Eucalypt-Tristania co-dominance: Eucalyptus intermedia, E. tesselaris, Tristania suaveolens, T. conferta, Angophora subvelutina, Casuarina littorialis, Melalauca quinquinervia, Banksia integrifolia, Lantana camara.	Pteridium aquilinium, Themeda australis, Imperata cylindrica, Digitaria didactyla, Axonopus sp.	Yellow podzolics, Meadow podzolics.
	Tristania-Melalaeuca dominance: Tristania suaveolens, Melaleuca quinquinervia, M. linariifolia, Eucalyptus tereticornis.	Axonpus sp., Cyperaceous sp., Digitaria sp.	Low humic gleys. Gleyed soils with texture contrast.
Open grassy woodland	Eucalyptus melanophloia, E. tesselaris, E. major, E. intermedia, Flindersia australis, Acacia cunninghamii, Hakea florulentia.	Themada australis, Imperata cylindrica, Digitaria didactyla.	Prairie-like.
	Euclayptus tereticornis, E. tesselaris.	Digitaria sp., Paspalum sp.	Alluvial-prairie-like, parts of gleyed soil on high terrace.
Fringing forest	Castanospermum australe, Eugenii ventenatii, Casuarina cunninghamii, Callistemon viminalis, Lantana camara.	Digitaria sp., Paspalum sp., Chloris sp.	Banks of South Pine River, may have extended over low terrace alluvial soils.

TABLE 2. CLASSIFICATION OF SOIL UNITS

Report designation	Great Soil Group	
	Australian Classification*	American classification+
Lithosols	Skeletal	Lithosol
Lithosolic-Podzolic intergrade	-	-
Red podzolic	Red podzolic	Red-yellow podzolic
Yellow podzolic	Yellow podzolic	Red-yellow podzolic
Meadow podzolic	Meadow podzolic	? Red-yellow podzolic
Gleyed soils with texture contrast	? Meadow podzolic	? Low humic gley or planosol
Low humic gley	Acid swamp soils	Low humic gley
Solodic soils	? Soloth	? Planosol
Prairie-like	? Prairie soil	? Reddish prairie
Prairie-like – alluvial intergrade	-	-
Alluvial	Alluvial soil	Regosol

* C. G. Stephens 1956

\+ Based on the U.S.D.A. Year Book "Soils and Man", 1938, and Soil Science, Vol. 67, 1949.

(b) Lithosolic-podzolic intergrades.

Gravelly soils with weak horizonation and sola less than 18 inches thick form this group. The surface horizons are dark grey-brown sandy loams or loams; there is a thin yellowish brown subsurface horizon and below 8-12 inches a weakly differentiated reddish clay subsoil.

These soils have formed in weathered metasediments on the crests and upper hill slopes. They occur intermingled with the lithosols and are mapped with those.

(c) Red podzolics (97 acres)

The red Podzolics are mildly acid soils with texture contrast and clear or diffuse boundaries between A and B horizons. They are characterized by about 10 inches of dark grey-brown sandy loam or loam surface soil, a reddish or yellowish brown sandy clay loam subsurface horizon with varying amounts of gravel, and clear boundaries to red clay subsoils below depths of 12-23 inches. The sola are about 3 feet thick, grading into weathered metasediment parent material. Important features are the moderately-developed fine structure of the surface and clay horizons, and the number of fine pores and channels through the soil.

The red podzolics occupy sloping sites (5-8 degrees) immediately below the lithosols. Some areas are associated with layers of metamorphosed sandstone parent material and these profiles have a lower clay content than those formed in mica-schist.

(d) Yellow podzolics (39 acres).

Dominantly yellow-brown subsoil colours and association with lower, moist sites distinguish these soils from the red podzolics. The surface horizons are dark sandy loams or loams. Light yellow-brown sandy clay loams are characteristic of the subsurface soils and there is a clear boundary to the dominantly yellow-grey heavy clay B2 horizon at depths ranging from 17 to 27 inches. Yellow-brown and red mottles are prominent in the deeper subsoil.

The yellow-podzolics occupy basal hill slopes of 3-5 degrees and have developed in parent materials derived from the metasediments.

(e) Meadow podzolics (10 acres)

Moderately thick, dark surface horizons, bleached subsurface layers, and mottled clay subsoils with ferruginous nodules are the important features of those soils. The surface horizons are dark grey-brown sandy loams or loams with some rusty flecks. The subsurface soils are pale yellowish grey clayey sands with rusty markings. Below 19-23 inches there is a gradual boundary to light grey, mottled with red and yellow sandy clay grading into coarsely mottled heavy clays with depth.

These soils have developed in mixed colluvial-alluvial materials derived mainly from metasediments but in places with additions from hornfels and granodiorite. They occupy basal hill slopes marginal to the drainage flats and extend onto higher slopes around seepage areas.

(f) Gleyed soils with texture contrast (59 acres).

Soils in this group have fairly sharp texture contrast and moderately-developed gley features in both surface and clay horizons.

Typical features include dark surface and bleached subsurface horizons with prominent ochreous flacking and fine black spheroidal nodules. Abrupt boundaries to mottled clay subsoils with prismatic structure and bluish prism faces are characteristic of the subsoil.

These soils are closely related to the poorly drained members of the Australian group of meadow podzolic soils, but show more pronounced gley features than are normal for this group. In many features they are similar to the American group of low humic gley soils. (Thorp and Smith, 1949) but have stronger texture contrast.

Typical occurrences are found along the minor drainage lines, marginal to the main swampy area, and on the lower slopes of the high terraces. Three parent materials are recognized i.e. alluvium of local origin, South Pine River alluvium, and colluvium from granodiorite. Each material has weathered to produce soils distinguishable at the series level.

(i) Gleyed soils developed in local alluvium:- The distinguishing features are - dark brownish grey sandy loam surface soil, brownish grey subsurface horizons with rusty flecks, mottled grey clay B horizons at 15 inches and prominently mottled grey, red etc. clay subsoils below 2 feet. These soils are found along minor drainage lines and marginal to the main swampy area.

(ii) Gleyed soils formed in South Pine River alluvium:- The main profile features are: dark brownish grey silt loam surface soil patchy bleached subsurface horizon with many fine black nodules, brownish grey clays at 11 inches with prismatic structure, and dominantly brown clayey sand deep subsoils below about 3 feet. The soils occur along the back slopes and in depressions across the old river terrace.

(iii) Gleyed soils developed in granodiorite colluvium:- Soils of this group are characterized by very dark brown clay loam surface horizon with a strong grade of structure, dark subsurface soils with many fine nodules; yellow-grey heavy clay subsoils below 16 inches, and bluish grey clay deep subsoils. Their occurrence is restricted to a minor drainage lines and seepage areas on the lower slopes of the central-northern granodiorite hill.

(g) Low humic gleys (46 acres).

The low humic gley soils are formed in wet environments on alluvial parent materials derived from metasediments, hornfels and granodiorite. Characteristic features include thin, light clay surface horizons with organic enrichment, grey heavy clay subsoils with prismatic structure and bluish prism faces, and coarsely mottled red and yellow deep subsoils. Ochreous flecks are prominent in the upper part of the profile and numerous ferro-manganiferous nodules a feature of the deep subsoil.

Many profiles were found to be moderately to strongly acid in reaction throughout, while other were neutral or slightly alkaline below 2 feet. These could not be mapped separately in the field but an association between alkaline reaction and dominantly yellow mottling was observed.

(h) Solodic soils (2 acres).

These are soils with strong texture contrast and abrupt boundaries between the surface and clay horizons. The main morphological features are:

(1) Thin dark brownish grey sandy loam surface soils.

(2) Weakly to clearly-defined bleached subsurface soils.

(3) Abrupt boundaries between 10 and 18 inches to brownish grey heavy clays with prismatic structure.

(4) Mottled clay subsoils with weathered granodiorite fragments.

(5) Clayey weathered granodiorite below depths of 2-3 feet.

(6) Slightly acid soils and neutral to slightly alkaline C horizon.

The solodic soils occupy gentle hill slopes below the podzolic soils. It seems likely that they have developed in mixed parent materials, the surface horizons being derived largely from the metasediments and the clay layers from weathered granodiorite.

The unit mapped in equivalent at the series level to the G2 type (solodized solonetz) recognized by Beckmann (1957). It is classified with the "solodic soils" rather than with the solodized solonetz because of the absence of columnar structure and because the structural units are more porous and of softer consistence than normal for the solodized solonetz group. In the Australian Classification (Stephens, 1956) it can be placed as a borderline soloth.

(i) Prairie-like soils (35 acres).

Typical features of soils grouped as prairie-like include:

(1) Dark surface horizons with strong fine structure and moderate organic content.

(2) Gradual boundaries between surface and subsoil.

(3) Slightly acid to neutral reaction throughout the profile.

In the Samford area these soils are characterized by 3-9 inches of very dark grey-brown clay loam or light clay surface soil, red-brown heavy clay subsoils with strong prismatic breaking to blocky structure,

and diffuse boundaries to clayey weathered granodiorite at depths of 24-30 inches. A yellow-brown variant is recognized along the western boundary. It has surface horizons less than 5 inches thick, dominantly yellow-brown clay horizons and sola depth of less than 2 feet.

The prairie-like unit is equivalent at the series level to the G1 type (reddish prairie) mapped by Beckmann (1957). It differs from the American prairie group (Smith, Allway and Riecken, 1950) in having stronger texture differentiation and sharper break between A and B horizons (clear rather than diffuse boundaries), coarser structural units, and harder consistence.

(j) Alluvial prairie-like intergrade.

These soils have dark grey-brown sandy loam or loam surface horizons grading into patchy reddish-brown and grey-brown sandy clays at depths of 4-8 inches. There is a gradual boundary at 9 inches to reddish brown sandy medium clay and at greater depth a gradual change to sandy clay loams and clayey sand. The parent materials are sandy alluvia of the South Pine River and the soils have formed on the higher parts of the old terrace well above present stream level.

On morphology these soils are placed as intermediate between the alluvial and prairie-like soils. The main features influencing this classification are: weak horizonation, neutral to slightly acid reaction, and moderate crumb structure and organic accumulation in the surface horizons of virgin areas. Under cultivation the surface structure collapses and becomes virtually massive.

(k) Alluvial soils.

Typical alluvial soils (Stephens, 1956) are associated with the fine sandy alluvium of the low terrace along the South Pine River. These are deep soils with little or no profile differentiation apart from slight organic accumulation at the surface.

Dark grey-brown fine sandy loams or fine sandy clay loams with moderate crumb structure are characteristic of the surface horizons. There is little change in the next 3 feet except that the structure is massive or weak blocky and faint brownish and yellowish patches are evident. Yellowish brown colours are more common below 3 feet and the texture decreases to clay fine sand.

IV. FACTORS AFFECTING USE OF THE SOILS FOR EXPERIMENTAL PASTURES

The principal factors affecting use of these soils for experimental purposes are differences in drainage and moisture regime, variations in physical properties and low nutrient status. Susceptibility to erosion and frequency of flooding are generally minor considerations,

but may be significant at specific sites. Particular attention should be given to the size and uniformity of individual soil areas when locating experimental plots.

Table 3 summarizes the main features influencing the use of the soils for experimental purposes.

(a) Drainage and moisture status.

Drainage conditions in the area vary from excessive to very poor depending on site, thickness and texture of the developed soil and on the porosity of the underlying rocks. There is also a considerable range in the available moisture capacity and general moisture status of the soils.

The lithosols and lithosolic-podzolic intergrades have very free to excessive drainage. Texture and structure favour a high range of available water, but shallow depth, porous nature and sloping site restrict water storage to so that the soils dry quickly following rain and will be droughty for much of the year. Pastures on these will respond to light falls of rain, but owing to the limited soil moisture storage capacity will give optimum production only in seasons of very well-distributed rainfall.

The red-podzolic, alluvial, and alluvial-prairie-like soils are freely drained. However, textural differences in the red podzolic and alluvial-prairie-like soils result in different permeability rates between the surface and subsoil causing short-term (24-48 hours) saturation above the clay following heavy rains. These soils have moderate to high available water capacity, but total water storage is limited by the high macroporosity of the soil mass. Even following good rains pastures are expected to show moisture stress in dry periods of more than 3 weeks duration, although those on the alluvial soil should maintain growth for a longer period.

The yellow-podzolic s and prairie-like groups have slower internal drainage than the abovementioned soils, but their moisture characteristics generally should be well-suited to pasture growth. It is expected that growth will continue into dry periods.

The solodic, meadow podzolic and gleyed soils with texture contrast show evidence of impeded drainage above the clay horizons. During rainy periods perched water-tables will occur above the clay subsoils. In the solodic soils this is of fairly short duration, but in the other soils it is prolonged by run-off and seepage from higher areas. Pastures on the solodic soils will show moisture stress early in dry periods, while those on the meadow-podzolic and gleyed soils should maintain growth well into dry seasons.

The low humic gleys are clayey soils occupying depressional sites and consequently have very slow internal and external drainage. Water lies on the surface for several weeks following rain and pastures will be retarded by wet conditions. Good growth should be obtained as the soils dry out, extending well into dry periods. Optimum production is dependent on the provision of some surface drains to remove surplus water.

TABLE 3. FACTORS AFFECTING USE OF THE SOILS FOR EXPERIMENTAL PASTURES

Soil Unit	Area and Uniformity	Topography	Internal Drainage	Soil Moisture Status*	General Comments
Lithosols and lithosolic-podzolic	48 acres Mixed, very shallow and shallow soils	Crests and upper hill slopes of 3°	Very free to excessive	Low (limited by thin sola)	Very shallow soils which will be droughty in most years – may produce good pasture in favourable seasons with well distributed rainfall
Red podzolic	97 acres Fairly uniform	Middle and upper hill slopes of 5-8°	Free	Fair-moderate (limited by macroporosity of soil mass)	Fairly deep, porous soils. Pastures on these are expected to show moisture stress in dry periods of more than three weeks' duration.
Yellow podzolic	39 acres includes small areas of meadow podzolics	Basal hill slopes of 3-5°	Fair	Moderate (extended by some subsurface seepage from higher areas)	Long periods of saturation above clay following rain. Pasture growth may be retarded during wet periods but will give optimum yields in drier seasons.
Meadow podzolic	10 acres includes small areas of yellow podzolic and gleyed soils	Basal hill slopes of 1-3°	Impeded on clay subsoil	Moderate to high (extended by subsurface seepage from higher areas)	Long periods of saturation above clay following rain. Pasture growth may be retarded during wet periods but soil moisture will be maintained into dry periods permitting extended pasture growth.
Gleyed soils with texture contrast	59 acres includes three types on different parent material	Marginal to swampy drainage depressions – slopes of 1-2°	Impeded on clay subsoils	Moderate to high (extended by subsurface seepage from higher areas)	Long periods of saturation above clay following rain. Pasture growth retarded during wet periods but soil moisture will be maintained into dry periods permitting extended pasture growth.
Low humic gleys	46 acres Somewhat variable probably two types included	Swampy depressions with slow drainage to the river	Very slow	Moderate to high (soil wet for long periods due to seepage from higher areas)	Water on surface for periods following rain. Wet conditions will retard pasture growth, but those soils can maintain growth well into dry periods.

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Soil Unit	Area and Uniformity	Topography	Internal Drainage	Soil Moisture Status*	General Comments
Solodic soils	2 acres fairly uniform	Crests and ridge slopes of 2-4°	Impeded on clay subsoil	Fair - ? Moderate	Short periods of saturation above clay following rain. Pastures expected to show moisture stress in dry periods of more than 3 weeks' duration.
Prairie-like soils	35 acres fairly uniform	Sloping crests of 2-4° and hill slopes of 5-12°	Fair	Moderate to high	Good pasture growth expected on these soils in wet periods with growth continuing well into the dry season.
Prairie-like alluvial	35 acres Variable including areas of gleyed soils	Terrace slopes of 1° and less	Free	Moderate	Pasture expected to show moisture stress in dry periods of more than 3 week duration. Surface structure of low stability may "crust" with cultivation.
Alluvial	63 acres fairly uniform	Generally flat to gently sloping	Free	Moderate to high	Deep permeable soils which should carry pasture growth into the early part of dry seasons. Surface structure of low stability, deteriorates with cultivation and may "crust".

* Soil moisture status includes moisture storage from rainfall plus additions from seepage. It is intended by this to give an approximate estimate of soil wetness and period during which soil moisture is above wilting point.

(b) Physical properties.

Important physical properties affecting the use of these soils and an approximate assessment of their available moisture range are summarized in Table 4. The considerable range in surface and subsoil textures and the form and degree of structural development are indicated.

Many of the soils with sandy loams surface horizons have strongly-developed crumb to fine blocky structure in the virgin state. These structural units have low stability and will deteriorate with cultivation. It is anticipated that over-cultivation of the alluvial, alluvial-prairie-like, and gleyed soils of the high terrace will rapidly lead to structural collapse with the formation of surface crusts. On the other hand the prairie-like soils with strongly-structured clay loam surface horizons and moderate organic content are very stable. The structure of these soils should stand intensive cultivation for some time without serious deterioration.

(c) Nutrient status

Representative profiles of the red podzolic, alluvial, alluvial prairie-like, low humic gley and gleyed soils of the high terrace have been sampled for laboratory examination. These data will be presented in a later report but can serve only as a general guide to the inherent fertility of the soils.

The soils are closely related to those in the Samford West area and are expected to have similar nutrient status. Experience on the western property has shown the soils to be of generally low nutrient content and that heavy fertilization is necessary for optimum yields. Andrew (1957) in a series of pot trials with alluvial-podzolic and gleyed soils has shown clover responses to additional of phosphorous, boron and zinc on the prairie-like soils formed on granodiorite.

Analysis of surface samples taken during the survey indicate that all of the soils, with the exception of the alluvial soils, are deficient in available phosphorus (values range from 4 to 14 p.p.m.).

It is obvious that heavy basal dressings of phosphatic fertilizers will be necessary and that responses to applications of a number of the minor elements may be expected.

The only exception is the alluvial soil which has a much higher phosphorus content (230 p.p.m. available P.). Since it is formed in alluvium derived from a range of rock types including basalt, it is expected to have higher general nutrient status.

TABLE 4. PHYSICAL PROPERTIES OF THE SOILS

Soil Unit	Texture		Structure		Moist Consistence		Range of "available" moisture	
	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil
Lithosols and lithosolic-podzolics	Sandy loams and loams	Weathered rock and gravelly clay	Weak crumb grading to fine blocky	-	Extremely friable	Firm	Moderate to high	Low to fair
Red podzolics	Sandy loams and loams	Medium clays	Moderate crumb grading to fine blocky	Strong fine blocky	Extremely friable	Friable to firm	Moderate to high	Moderate
Yellow podzolics	Sandy loams and loams	Heavy clays	Strong crumb grading to fine blocky	Moderate fine to medium blocky	Extremely friable	Firm to plastic	Moderate to high	Moderate
Meadow podzolics	Sandy loams and loams	Heavy clays	Strong crumb grading to fine blocky	Weak prismatic to blocky	Very friable	Firm to plastic	Moderate to high	Low to moderate
Gleyed soils with texture contrast	Sandy loams silty loams and clay loams	Heavy clays	Crumb to fine blocky	Prismatic breaking to blocky units	Friable to firm	Firm to plastic	Moderate to high	Low to Moderate
Low humic gleys	Very thin light clays	Heavy clays	Crumb to fine blocky	Strong prismatic breaking to blocky units	Friable to plastic	Firm to plastic	Moderate to high	Fair
Solodic soils	Sandy Loams	Heavy clays	Weak crumb to fine blocky	Moderate prismatic arranged in crude columns	Friable	Very firm	Moderate to high	Low to Fair
Prairie-like soils	Clay loams and light clays	Heavy clays	Moderate to strong fine blocky	Moderate prismatic breaking to strong blocky	Friable to firm	Firm	High	Moderate

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TABLE 4. PHYSICAL PROPERTIES OF THE SOILS (continued)

Soil Unit	Texture		Structure		Moist Consistence		Range of "available" moisture	
	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil	Surface	Subsoil
Prairie-like alluvial	Sandy loams or loams	Medium clays	Fine blocky (virgin) Massive (cultivated)	Massive to weak prismatic	Friable	Firm	Moderate to high	High
Alluvial	Fine sandy loam	Fine sandy loam to fine sandy clay loam	Moderate crumb to fine blocky	Massive	Very friable	Very friable	High	High

(d) Erosion.

There is little evidence of soil erosion under natural vegetation or under couch grass pasture. However, soil loss by erosion must be expected with the cultivation of soils on moderately to steeply sloping sites including most of the podzolic areas. Since these are highly permeable erosion should not be of a serious nature unless rains of high intensity fall on the fine cultivated surface.

(e) Flooding.

It is anticipated that parts of the low terrace will be inundated during periods of high flood in the South Pine River. Local flooding of depressions (low humic gley soils) can be expected but could be minimized, improving drainage outlets to the South Pine River.

(f) Variation within the mapping units.

The area has been mapped into units dominated by particular great soil groups. Attention is drawn to the fact that that none of these units has uniform soil characteristics; most embrace more than one soil type, and many include smaller areas of other great soil groups. Some units are more variable than others and this should be kept in mind when planning field experiments.

Each of the alluvial, red podzolic and prairie-like units is reasonably uniform and of sufficient area for experimental use. The yellow podzolic, alluvial-prairie-like intergrade, and gleyed soils of the high terrace are more variable, each including small areas of other soils. A number of soil types are included in the low humic gleys and gleyed soils with texture contrast. Lithosols and lithosolic-podzolic intergrades have been mapped as one unit. The areas of meadow podzolic and solodic soils are too small for experimental use.

V. ACKNOWLEDGEMENTS

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APPENDIX I

DETAILED PROFILE DESCRIPTION DEFINING THE CHARACTERISTICS IN EACH OF THE GREAT SOIL GROUPS MAPPED

Munsell colour references are for moist soil unless otherwise specified.

LITHOSOLS

	Depth in Inches		Description
A_{11}	0		Dark grey-brown (10YR 4/2) sandy loam or loam: weak crumb grading to blocky ¼-½" structure; extremely friable; varying amounts of quartz and metasediment gravels. Grading into:
A-C	3	(2 ((4	Brown (10YR 4/3) and dark grey-brown sandy clay loam; large amount of metasediment fragments and quartz gravel. Grading to:
C		(4 ((8	Yellowish brown, grey, etc. weathered metasediments with varying amounts of quartz gravel.

LITHOSOLIC – PODZOLIC INTERGRADES

	Depth in Inches		Description
A_1	0		Dark grey-brown (10YR 4/2) sandy loam or loam: weak crumb grading to blocky ¼-½" structure; extremely friable; low amounts of quartz and metasediment gravel. Diffuse boundary to:
?A_2	4	(3 ((6	Patchy yellowish brown (7.5YR 6/3) and grey-brown (10YR 4.5/2) sandy loam or sandy clay loam; weak blocky ½" structure; extremely friable, moderate amounts of quartz and metasediment gravel. Grading to:
B_2-B_3		(8 ((12	Reddish brown (5YR 4/4) light clay with fine yellowish brown mottle; weak blocky structure; moderate to large amounts of weathered metasediments and quartz gravel. Grading to:
C		(12 ((20	Yellowish brown, grey, etc. weathered metasediments with varying amounts of quartz gravel.

RED PODZOLICS

	Depth in Inches		Description
A_{11}	0		Dark grey-brown (10YR 3/2) sandy loam or loam: moderate crumb grading to blocky 1/8-1/4" structure, extremely friable; many 1/16- ¼" pores; few pieces ½" quartz gravel. Diffuse boundary to:
A_{12}	6	(3 ((8	Patchy dark grey-brown (10YR 4/2 or 3/2) and reddish-brown (5YR 4/4) sandy loam or loam; moderate blocky ¼" structure, extremely friable; many 1/16- ¼" pores; low amounts ½-1" quartz gravel. Diffuse boundary to:
A_2	10	(8 ((12	Yellowish brown (7.5YR 5/3) and reddish brown (5YR 4/4) sandy clay loam; massive to weak blocky structure; extremely friable, grey-brown worm casts; many 1/16-1/8" pores; moderate to large amounts ½-2" quartz gravel. Clear boundary over 1" to:
B_2	17	(12 ((23	Brownish red (2.5YR 3/6) medium clay with faint reddish and yellowish brown mottles; strong blocky ¼- ½" structure, firm to friable when moist; few pieces ½" quartz gravel. Diffuse boundary to:
B_3	32	(24 ((39	Mottled red-brown (2.5YR 5/3), yellowish-brown (10YR 5/4) and reddish brown (5YR 4/4) light to medium clay; weak to moderate blocky structure; low amounts of quartz gravel and weathered mice-schist fragments increasing with depth. Diffuse boundary to:
C	42	(27 ((?	Reddish brown, white, grey, yellow-brown, etc. clayey weathered mica-schist, with varying amounts of ½ -3" quartz gravel in veins.

Range in characteristics: Small areas are included with thinner surface horizons than the general range indicated above and a few have sola more than 5 feet thick to parent rock. Where metamorphosed sandstone bands occur, profiles with similar colour and horizonation have formed, but the B horizons have lower clay content than those developed in schist.

YELLOW PODZOLICS

	Depth in Inches		Description
A_{11}	0		Dark grey-brown (10YR 3/2) sandy loam or loam: strong crumb grading to blocky 1/8-1/4" structure; extremely friable; many 1/16- 1/8" pores; few pieces of quartz gravel. Diffuse boundary to:
A_{12}	7	(6 ((9	Patchy grey-brown (10YR 4/2) light brown (10YR 6/3) and yellowish brown (10YR 5/4) loam or sandy loam; moderate fine blocky structure; many 1/16- 1/8" pores; low to moderate amounts of ½" quartz gravel. Diffuse boundary to:
A_2	5	(13 ((18	Yellow brown (10YR 6/4) and yellow-grey (2.5Y 7/5) sandy clay loam; moderate blocky ½-1" structure; many fine pores; low to moderate amounts ½-1" quartz gravel. Clear boundary over 1" to:
B_2	1	(17 ((27	Yellow-grey (2.5Y 7/4) medium to heavy clay with distinct reddish and brownish mottles; moderate blocky ¼-1" structure; low amounts of quartz gravel. Diffuse boundary to:
B_3	0	(36 ((?	Mottled yellow-grey, yellow-brown and red light to medium clay; weak blocky structure, varying amounts of quartz gravel and weathered metasediment fragments.
		48	Maximum.

MEADOW PODZOLICS

	Depth in Inches		Description
A_{11}	0		Dark grey-brown (10YR 3/2) sandy loam or loam: strong crumb grading to fine blocky structure; some rusty flecking along root-lines. Diffuse boundary to:
A_{12cg}	7	(5 ((9	Light yellow-grey-brown (2.5YR 5/4) or light grey-brown (10YR 6/2) sandy loam with grey-brown patches; massive to weak blocky structure; rusty flecking along root-lines, some ochreous specks. Diffuse boundary to:
A_{2g}	12	(10 ((16	Pale yellow-grey-brown (2.5Y 5/4), or light grey (10YR 7/2) clayey sand to sandy clay loam; massive structure; saturated at time of survey; ochreous and reddish mottle and rusty root-lines evident; few pieces of quartz gravel. Gradual or clear boundary to:
B_{1g}	21	(19 ((23	Light grey (2.5Y 7/1), or yellowish grey (2.5Y 6/3) sandy clay with distinct yellowish and reddish mottles; massive to weak coarse blocky structure; low amounts ¼-½" soft reddish nodules.
B_{2cg}	27	(23 ((40	Light grey (2.5Y 7/1) heavy clay with prominent coarse yellow and red mottles; low amounts ½-1" soft red nodules.
		48	Maximum.

GLEYED SOILS WITH TEXTURE CONTRAST

Three gleyed soils formed in different parent materials are included in this group.

Profile 1:

The parent materials of this soil are South Pine River alluvia derived from volcanic, granitic and metamorphic rocks.

	Depth in Inches		Description
A_1	0		Dark brownish grey (10YR 3/1) silty loam, or silty clay loam: moderate blocky 1" structure breaking to ¼" units; friable; faint rusty root flecking. Diffuse boundary to:
A_{2g}	5	(4 ((8	Brownish-grey (10YR 4/1) with light grey (10YR 6/1) patches, silty loam; massive to weak blocky structure; friable; many fine pores; low to moderate amounts 1/16-1/8" spheroidal black nodules. Clear boundary over 1" to:
B_{2g}	11	(8 ((16	Brownish-grey (2.5Y 5/1) heavy clay with faint yellowish and dark grey mottles; strong prismatic 4x5x3" structure breaking to 2" blocky units; few rusty and reddish flecks; dark grey clay loam fill in fissures between prisms and dark grey aggregate (surface) staining. Diffuse boundary to:
D_1	33	(27 ((36	Mottled brown, yellow-brown and grey sandy clay decreasing to clayey sand; few black segregations; few pieces of water-worn gravel.
	72		Maximum.

GLEYED SOILS WITH TEXTURE CONTRAST (continued)

Profile 2:

The parent materials of profile 2 are local alluvium derived mainly from metasediments with some additions from granodiorite and hornfels.

	Depth in Inches		Description
A_1	0		Dark brownish grey (10YR 3/1) sandy loam: moderate crumb 1/3-1/4"; very friable; few pieces ¼-1/2" quartz gravel. Gradual boundary to:
A_{2g}		(2 ((5	Brownish-grey (10YR 4/1, 5/1) sandy loam or sandy clay loam; massive to weak blocky structure; friable moist; many 1/16-1/8" pores; prominent yellowish flecks and rusty root-lines; few pieces of quartz gravel. Clear boundary to:
B_{1g}	15	(12 ((18	Grey (2.5Y 7/1), with yellow-brown (10YR 6/6) and red-brown (2.5YR 5/8) mottles, sandy clay increasing to medium clay; weak prismatic structure few pieces of quartz gravel. Diffuse boundary to:
B_{2g}	23	(21 ((27	Mottled red (10R 5/8), grey (2.5Y 7/1) and yellowish brown (10YR 5/4) heavy clay; few fine black segregations, fine black nodules and quartz gravel.
		45	Maximum.

GLEYED SOILS WITH TEXTURE CONTRAST (continued)

Profile 3:

The parent materials of profile 2 are colluvium from granodiorite overlying weathered granodiorite in situ.

Depth in Inches		Description
A_1	0	Very dark brown (10YR 2/2) clay loam; strong fine blocky ¼" structure; friable moist; few rusty flecks along root-lines. Diffuse boundary to:
A_{1cg}	(4	Patchy very dark brown (10YR 2/2) and brown clay loam; moderate blocky ½-1" structure; friable moist; few rusty flecks and root-lines; low amounts 1/8" black spheroidal nodules. Clear boundary to:
B_{2cg}	(16	Yellow-grey (2.5Y 54) heavy clay, with yellowish mottles and rusty flecks; weak prismatic structure; stiff plastic wet; low amounts 1/16-1/8" yellowish and reddish spheroid nodules. Diffuse boundary to:
B_{3g}	(27	Mottled bluish grey and yellow-brown heavy clay; stiff plastic when wet; many fine 1/64" pores; moderate amounts 1/8-1/2" black spheroidal nodules.
	45	Maximum.

LOW HUMIC GLEYS

	Depth in Inches		Description
A_1	0		Very dark brown (10YR 2/2) clay loam; moderate crumb structure; friable moist; many pores and channels. Gradual boundary to:
A_{1g}		(1 ((2	Dark grey-brown (10YR 3/2) light clay; moderate blocky ¼-1/2" structure; friable moist; prominent rusty flecks and root-lines; many fine pores. Clear boundary to:
BG	7	(3 ((9	Dark brownish grey (10YR 3/1, 4/1) medium to heavy clay; strong prismatic 1x1x3" structure breaking to 1" blocky units; plastic wet; prominent rusty flecks, fine patches and root-lines; bluish-grey coatings on aggregate faces. Diffuse boundary to:
G_1		(15 ((24	Mottled grey (2.5Y 3/1, 10YR 4/1), red (10R 5/6) and yellow (9YR 6/3) heavy clay; low to moderate ½-1" black ferro-manganiferrous nodules with brown follicles. Diffuse boundary to:
G_2		(24 ((32	Bluish grey (2.5Y 7/6 or 5Y 5/2) mottled with red (10R 5/6), or yellow (5Y 7/8), heavy clay; low to large amounts of ¼-1" black nodules as in G1 horizon; quartz and hornfels gravels in some areas.
		48	Maximum.

Range in characteristics: Many profiles are slightly acid throughout while others are slightly alkaline below 24 inches. Generally the latter had few red mottles in the lower subsoil but this is probably fortuitous.

SOLODIC SOILS

	Depth in Inches		Description
A_2	0		Dark grey-brown (10YR 3/2) sandy loam, or loam; moderate crumb grading to fine blocky structure; friable moist; few pieces of quartz gravel. Gradual boundary to:
A_2	3	(2 ((5	Brownish grey (10YR 4/1) with dark grey-brown patches sandy loam; massive to weak blocky structure; many fine pores; few rusty flecks along root-lines; moderate amount of quartz gravel. Abrupt boundary to:
B_2	12	(10 ((18	Light brownish grey with fine reddish and yellowish mottles, medium to heavy clay; moderate prismatic 2x2x4" structure (arranged in crude macro-columnar form) breaking to strong grade 1" blocky units; some light grey A2 dusting on prism faces. Diffuse boundary to:
B_3		(18 ((26	Grey mottled with yellow-brown and red medium clay; massive to weak blocky structure, moderate amounts of weathering granodiorite. Diffuse boundary to:
C		(26 ((36	Mottled grey, white, yellow, black, etc. clayey weathered granodiorite.

Range in characteristics: The A2 horizon is distinct in places and weakly developed or absent in others. Field examinations indicate that thin soil is equivalent at the series level with the G2 unit recognized by Beckmann in Samford West.

PRAIRIE-LIKE SOILS

Depth in Inches			Description
A_1	0		Very dark brown (7.5YR 2/2) clay loam or light clay; moderate 2" blocky structure breaking to ¼" units; firm when moist. Clear boundary to:
B_2	6	(3 ((9	Red-brown (2.5YR 3/6) heavy clay; moderate prismatic structure 4x4x6" breaking to blocky 1-2" units; dark brown light clay fill in fissures between prisms. Diffuse boundary to:
B_3	18	(13 ((24	Red-brown (2.5YR 5/3) mottled with yellow-brown (10YR 6/6) medium clay; weak coarse blocky structure; pockets of weathered granodiorite increasing with depth. Diffuse boundary to:
C	26	(24 ((30	Yellow-brown, white, green, black, etc. clayey weathered granodiorite.

Range in characteristics: A yellow-brown variant has been examined along the western boundary. Main points of difference are:

a) Surface horizons less than 5 inches thick.
b) Clay horizons dominantly yellow-brown.
c) Sola less than 2 feet thick to weathered rock.

ALLUVIAL PRIAIRIE-LIKE INTERGRADES

	Depth in Inches		Description
A_1	0		Dark grey-brown (10YR 3/2, d. 10YR 6/2) sandy loam or loam; massive (cultivated), moderate crumb structure (Grassland); many fine pores and channels; few pieces ½" water-worn gravel. Diffuse boundary to:
?B_1		(4 ((8	Patchy reddish brown (5YR 4/8) and grey-brown (7.5YR 4/2) sandy clay; massive to weak blocky structure; many fine pores. Gradual boundary to:
?B_2	9	(8 ((12	Reddish-brown (5YR 4/3) with faint brown (7.5YR 4/4) mottled sandy medium clay; massive to weak prismatic structure; faint grey-brown markings along fracture lines; many fine pores; few pieces of ½" water-worn gravel. Diffuse boundary to:
?C	17	(15 ((27	Brown (7.5YR 4/4) with reddish and yellowish patches, sandy clay; massive; very porous; white flecks of weathering minerals; low amounts of water-worn gravel. Diffuse boundary to:
		(27 ((33	Brown (7.5YR 4/4), with yellowish patches, clayey sand; large to low amounts of ¼-3" water-worn gravels including basalt, granodiorite, and metasediments.
		70	Maximum

Range in characteristics: A fine sandy variant with a fine sandy loam surface, medium to heavy clay subsoils below 11-15 inches and fine sandy clay below 3 feet occurs in the north-eastern section.

ALLUVIAL SOILS

	Depth in Inches		Description
A_1	0		Dark grey-brown (10YR 3/2) fine sandy loam, or fine sandy clay loam; moderate crumb grading to ¼" blocky structure; very friable; many 1/16-1/8" pores. Diffuse boundary to:
	7	(5 ((10	Dark grey-brown (10YR 3/2) fine sandy clay loam, or fine sandy clay loam; massive; very friable; many fine pores. Diffuse boundary to:
	24	(21 ((33	Dark brown (7.5YR 3/2) fine sandy clay loam; with brown and yellowish patches; massive; very friable; many fine pores. Diffuse boundary to:
	39	(33 ((	Dark brown and yellowish brown clayey fine sand to fine sandy clay; massive; very friable, many pores.
		60	Maximum

SOIL MAP

D.R. 11/1960

C.S.I.R.O. PASTURE RESEARCH STATION

SAMFORD EAST

PARISH OF BUNYA — COUNTY OF STANLEY

SAMFORD, QUEENSLAND

SOIL PARENT MATERIALS

- META-SEDIMENTS & QUARTZ VEINS
- GRANODIORITE
- ALLUVIUM of LOCAL ORIGIN
- PINE RIVER ALLUVIUM

KEY TO SOILS

L	LITHOSOLS
RPz	RED PODZOLIC SOILS
YPz	YELLOW PODZOLIC SOILS
MPz	MEADOW PODZOLIC SOILS
GS	GLEY SOILS & TEXTURE CONTRAST
LHG	LOW HUMIC GLEY SOILS
So	SOLODIC SOILS
PL	PRAIRIE-LIKE SOILS
A-PL	ALLUVIAL-PRAIRIE-LIKE INTERGRADE
A	ALLUVIAL SOILS

Sample sites..... ⊙ B423

Tracing from aerial photograph
scale approximate

— SCALE —

FEET 500 0 500 1000 FEET

CHAINS 10 0 10 20 CHAINS