33 Castle Hill Street, Holland Park
Brisbane, Queensland 4121
ACN 010 856 158
ISON
Telephone: (07) 849 4466
Fax: (07) 349 0334
ENVIRONMENTAL PLANNERS

BIOLOGICAL & PHYSICAL ASSESSMENT

SOILS, LAND CAPABILITY, FLORA, FAUNA & FARM MANAGEMENT

KOGAN CREEK COAL PROJECT AREA.

Prepared for: Allied Queensland Coalfields Ltd

Prepared by: Ison Environmental Planners

July, 1993.

BIOLOGICAL & PHYSICAL ASSESSMENT

SOILS, LAND CAPABILITY, FLORA, FAUNA & FARM MANAGEMENT

KOGAN CREEK PROJECT AREA, BRIGALOW

TABLE OF CONTENTS

1. INTRODUCTION

The Kogan Creek coal deposit is held by Aberdare Collieries Pty Ltd a wholly owned subsidiary of Allied Queensland Coalfields Ltd (AQC) under Coal Exploration Permit (EPC) 464 and 517. The company is applying for a mining lease covering an area of approximately 2779 ha. The land proposed for the mining lease application is between Brigalow and Kogan. The company is interested in coal extraction, with initial concentration around the existing trial pit and supported by mining infrastructure.

Ison Environmental Planners was commissioned to assist in environmental planning for the project by collecting information on the soils, flora and fauna of the site to allow rehabilitation and farm management planning to proceed. The aim was to undertake a soil survey, sampling and analysis program, to prepare a report and map on the results and provide recommendations for soil handling and treatment. Information on the quality and quantity of the existing soil resource and its treatment is required to allow adequate rehabilitation planning and, prior to site earthworks, the economic recovery of suitable plant growth material for use in the revegetation program.

Soil information was also used to establish the land capability. For areas owned by the company, management options were reviewed for agricultural activities for areas prior to disturbance or buffer areas not required for mining. In addition the principal vegetation types and component species and potential for fauna habitat were surveyed to provide a record of existing vegetation and aid in the selection of species for long term rehabilitation.

Detailed field surveys were conducted in June-July 1992 and June 1993.

To assist the field survey work to determine the sampling pattern and to map the distribution of the soils and vegetation across the different landforms, stereo-pairs of colour air photographs at 1: 25,000 scale, a 1:10,000 topographical plan, geological maps and ground observations were used.

This report details the results of the surveys incorporating data on the analysis of the chemical characteristics of the sampled soil with appropriate comments on their suitability and land capability with recommendations on soil recovery and farm management planning.

2. SOIL SURVEY METHOD

The basic purpose of the soil survey was to obtain information sufficient to characterise the soils, identify the properties of the various soils horizons, their influence on the establishment of plants and to identify approximate recoverable quantities of topsoil.

Standard soil survey procedures were adopted using field observations of vegetation communities, topography, field assessment of soil properties supplemented by laboratory determination of key chemical properties. Sites were inspected and sampled using a Jarret handauger to a maximum depth of 900 mm or to auger refusal by hard rock or gravel.

Soils were described horizon by horizon in terms of depth, colour, presence of mottling, texture, rock/stone and the presence of accumulations. Field surveys were conducted in June-July 1992 and June 1993. Soils were classified in terms of Principal Profile Forms (Northcote, 1979) and Great Soil Group (Stace *et al*, 1968) where applicable.

Field pH tests were undertaken to provide a guide to the acidity levels in the profile. Samples were collected for laboratory analysis to represent the main soil types, their variation across the site and the various layers.

3. CRITERIA FOR TOPSOIL

The suitability for retaining topsoil to be used in rehabilitation is influenced by a range of soil factors. The criteria which have been used to assess whether a particular horizon in a soil profile is suitable for topsoil are presented in Table 1.

Table 1. Criteria for topsoil suitability.

Criteria	**Undesirable Characteristics**
Depth	< 100 mm - minimum grader/bulldozer selection
Particle Size Analysis	High fine sand content; high silt content
Structure	Coarse blocky or columnar subsoil structure; tough, massive subsoil clay
Moisture retention	Very low moisture holding capacity
Salinity	EC (1:5) > 1.0 mS/cm; presence of salt tolerant plants
Sodicity	ESP > 6
Acidity	pH < 4.5 or > 8.0
Soil Variability	High, short distance variability
Stone, rock	High stone or rock content (> 30 % for sands and loams; > 50 % for clays)

4. CRITERIA FOR LAND CAPABILITY

Land capability assessment is a general system of land evaluation based on limiting factors to crop growth such as slope, wetness, fertility, effective soil depth and a number of other factors described in Rosser *et al* (1974).

Table 2. Land capability classification (Rosser *et al* 1974).

CLASS I	Land suitable for all agricultural and pastoral uses
CLASS II	Land suitable for all agricultural uses but with slight restrictions to use for cultivation
CLASS III	Land suitable for all agricultural uses but with moderate restrictions to use for cultivation
CLASS IV	Land primarily suited to pastoral use but which may be safely used for occasional cultivation with careful management
CLASS V	Land which in all other characteristics would be arable but has limitations which, unless removed, make cultivation impractical and/or uneconomic
CLASS VI	Land which is not suitable for cultivation but is well suited to pastoral use and on which pasture improvement involving the use of machinery is practicable
CLASS VII	Land which is not suitable for cultivation but on which pastoral use is possible only with careful management. Pasture improvement involving the use of machinery is not practicable
CLASS VIII	Land which has such severe limitations that it is unsuited for either cultivation or grazing

5. DESCRIPTION OF PRINCIPAL SOIL LANDSCAPES

Detailed descriptions of field soil surveys are presented in Appendix I. Sites 1 to 6 were described in June-July 1992 and sites 11 to 28 were described June 1993.

Each soil landscape was assessed for its potential for topsoil recovery and land capability. The soil landscapes usually comprise one dominant soil but other soils may be present in minor amounts. The approximate boundaries between the various soil landscapes are presented in figure 1 with the land capability presented in figure 2.

5.1 Lithosol soil landscape (sites 3, 17, 19, 26, 27)

These soils are shallow and stony with rock outcrop common. A number of other soils are present including sands and shallow solodic soils.

These soils are unsuitable for topsoil recovery but could be suited for road making materials, particularly those sited in the south-east corner of the area assessed. This area is more extensively covered with ironstone gravel and rocky outcrop.

Land capability for this soil landscape is class VII - limited pastoral, non arable. Major limitations to plant growth are shallow effective soil depth, stoniness, rockiness, low fertility and high erodibility.

5.2 Dark solodic soil landscape (sites 2, 12, 15, 16, 21, 25)

These soils have seasonally hardsetting surfaces and a texture contrast profile. Surface soils have 30 - 250 mm of fine sandy loam, silty loam or clay loam texture overlying black neutral to alkaline sodic clay subsoils. Carbonate accumulations are common at depth. Bleached horizons (A2) are common where surface soils are deeper.

These soils are highly variable in their suitability for topsoil recovery. Topsoils in the vicinity of sites 12 and 15 are too shallow and are unsuitable for recovery. Topsoils around site 25 are silty and not desirable as topsoil, whereas topsoils near sites 16 and 21 have 100 to 200 mm of suitable topsoil.

Land capability for this soil landscape is mainly classes IV - primarily pastoral, occasional cultivation and V - pastoral, non arable. Major limitations to plant growth are poor drainage, low fertility, low effective soil depth, hardsetting surfaces and sodic subsoils highly susceptible to erosion.

5.3 Yellow and brown solodic soils landscape (sites 4, 6, 14, 23)

These soils have seasonally hardsetting surfaces and a texture contrast profile. Surface soils have 150 to 200 mm of sandy loam to fine sandy clay loam texture overlying brown or grey brown columnar or blocky clay subsoil. The surface 150 to 200 mm are suitable as topsoil.

Land capability for this soil landscape is class V - pastoral, non arable. Major limitations to plant growth are hardsetting surfaces, poor drainage, low fertility, low effective soil depth and sodic subsoils highly susceptible to erosion.

5.4 Grey - dark cracking clay soil landscape (sites 1, 11, 13, 18, 20, 24, 28)

These soils are deep cracking clay soils with dark or dark grey subsoils. These soils have crusting surfaces which form a coarse self-mulch under cultivation.

Topsoils 80 to 120 mm deep are suitable for stockpiling during dry conditions.

Land capability for this soil landscape is class IV - primarily pastoral, occasional cultivation. Major limitations to plant growth are crusting surfaces and sodic subsoils highly susceptible to erosion.

6. SOIL CHEMICAL ANALYSIS

Field pH (hydrogen ion concentration) was evaluated during the soil survey. For each soil type, selected surface (A horizon) and subsoil (B horizon) samples were collected of representative profiles during the field work in July, 1992 and submitted for chemical analysis in accordance with NATA registered laboratory procedures.

A summary of the key parameters is presented as Table 3.

Table 3. Summary of results of the laboratory analysis of selected soil samples of the principal representative profiles at the Kogan Creek coal project, Brigalow.

Soil Type	Site Fig.1	Sample No.	Depth (mm)	Texture	pH $CaCl_2$	Salinity (ppm)	ESP (%)	Ca/Mg Ratio
Cracking clays	1	TP10A	200-1600	Heavy Clay	7.4	2440	20.4	1.1
		TP10B	160-4000	Sandy Clay	7.7	1210	29.6	1.0
Dark Solodics	2	D511	0-230	Sandy Clay Loam	6.3	680	13.0	1.4
		D512	230-450	Clay Loam	7.8	5980	32.1	1.0
		D513	450-900	Medium Heavy Clay	8.1	2360	9.9	3.3
Lithosols	3	3077	0-300	Clayey Fine Sand	4.2	1030	40.0	1.5
		3078	300-650	Sandy Light Clay	4.6	2160	41.2	0.3
Yellow/brown Solodics	4	TP6A	0-350	Loamy Sand	4.6	90	4.4	0.2
		TP6B	350-2400	Sandy Clay Loam	7.2	1040	26.4	2.4
Yellow/brown Solodics	6	TP2A	0-350	Clayey Sand	5.0	840	29.0	1.1
		TP2B	350-2300	Medium Clay	8.0	1330	33.2	1.2
		TP2C	2300-3900	Sandy Clay	6.5	940	56.0	0.2

The pH of the surface soils vary from extremely acid (4.2) to neutral (7.4); generally increasing with depth. The pH is considered extremely low in the lithosols and A horizon of the lighter solodic soils and is sufficiently acidic to have potential direct detrimental effects on plant growth as well as the more likely indirect effects by modifying the availability of some soil elements and creating an induced deficiency or toxicity for plant growth. Lime or dolomite is needed to increase soil pH to an acceptable level.

Salinity is generally satisfactory. Except for site 1, the surface salinity is low to moderate and is unlikely to affect the growth of the plant species to be used on the site.

Soil structure is adversely affected when sodicity or the proportion of sodium, as measured by the ESP (exchangeable sodium percentage) is high or the Ca/Mg (calcium/magnesium) ratio is low. It is important to note that salinity refers to the concentration of all soluble salts in the soil while sodicity refers to the amounts of sodium relative to the other cations.

Only the A horizon of the yellow/ brown solodic soils are non-sodic. All other samples are moderate to strongly sodic. ESP levels are likely to be the controlling factor in the suitability of the soils for use in rehabilitation, particularly given the high sodicity of much of the overburden. Use of sodic soils or overburden will result in a tendency for soils to lose aggregation and to develop impermeability, surface crusting and poor aeration through its influence on soil structure. However, the cracking characteristics of the clay soils allows water penetration despite their sodicity.

In addition the soils have a low to moderate exchangeable Ca/Mg ratio with only the deeper samples from the solodic soils at sites 2 and 4 having an adequate Ca/Mg ratio. The calcium to magnesium ratio is unsatisfactory and potentially will adversely affect soil structure and hence plant growth.

The results confirm the field observations that the clay subsoils are dispersive, unstable and unsuitable as rehabilitation soil materials.

The essential plant nutrient status of these soils varies with the parent material but are low to very low with deficiencies of most macro and trace elements. At the end of mining, further detailed chemical analysis of plant nutrients will be required and fertilizer requirements can then be made taking into account current soil fertility levels, plant species to be used, time of the year and seasonal conditions.

7. TOPSOIL RECOVERY AND STORAGE

The recommended stripping depth and the distinguishing soil features of suitable topsoil materials (A horizon) and unsuitable underlying horizons are described in Table 4. The soil type refers to the subsection in Section 5 in which the soils were described.

Table 4. Recommended stripping depth of topsoil for recovery and use in the rehabilitation program and distinguishing soil features of the principal soil types, Kogan Creek coal project, Brigalow.

Soil Type	Stripping depth (mm) (Average)	Distinguishing features of suitable soil	Distinguishing features of unsuitable soil
Lithosols	-	-	shallow stony soils, rock outcrops
Dark solodics	150 (30-250)	black or grey brown loamy	tough dark clay
Yellow/ brown solodics	180 (150-200)	grey brown, loamy	tough yellow or brown clay
Grey-dark clays	100 (80-120)	black or grey brown organic rich clay	black or grey brown clay deeper than 100 mm

The topsoils available on site are generally satisfactory for use as a plant growth medium although they will lack essential plant nutrients. While the existing topsoil is of low nutrient value it will have better biological properties compared to overburden material as it will contain soil microorganisms and plant propagules as well as being easier to work and form a reasonable seedbed.

The B horizon material has poor chemical properties that will affect its physical properties and should not be used. The heavier textured subsoils or B horizons of the solodic soils are generally high in sodium, often have high levels of salts and are physically unstable. When exposed at the surface they readily erode and are an unsuitable medium for plant growth.

Vegetation should be slashed and recovered with the soil as a source of organic matter unless the existing plant species are a potential weed problem. To improve the cation balance, the following soil amendment at the rate nominated below should be incorporated into the topsoil during pre-stripping operations by broadcasting the required amendment over the soil surface following slashing of the vegetation but prior to soil recovery so that the material can become incorporated during soil handling.

Lime ($CaCO_3$) 6 t/ha (400 g/m^2)
Gypsum ($CaSO_4$) 5 t/ha (300 g/m^2)
* The actual rate used will need to be adjusted depending on the depth of topsoil at that location.

Detailed chemical analysis of essential plant nutrients was undertaken on surface samples. While natural fertility is low in all soil types, correct fertilizer additions will enable a reasonable level of soil fertility to be achieved.

It is important to note that the soil resource at this site is limited and even the material identified as topsoil has limitations.

8. FLORA/ FAUNA SURVEY METHODS

Following an initial inspection of the extent of the proposed area by vehicle in which broad vegetation types were identified, a more detailed survey of transects was made by foot allowing time to describe the vegetation communities and identify individual plant species present in the communities. Broad vegetation types were defined on the colour aerial photographs for the purpose of designing field sampling. Species of vegetation were recorded and described in terms of growth form or habit (i.e. tree, shrub, grass etc.), relative abundance and location.

At selected sites where there was a significant change in the vegetation communities, closer sampling was carried out to identify all plant species, particularly in the herbaceous layer. The broad vegetation communities were mapped at a scale of 1:25 000.

Any plant species not readily identified in the field or which required more detailed investigation were collected, recorded in terms of location, pressed and checked with locality lists by the Chinchilla Field Naturalists, or verified through the Queensland Herbarium, botanical keys and checklists from reports in surrounding regions for positive confirmation of genus and species.

A literature search has shown records of 24 rare or endangered species within the 1° grid cell (approx 11,000 km^2) that includes the proposed mine. Records are from Bean (1989), Thomas and McDonald (1989), Stanley and Ross (1983), Queensland Herbarium (1992) and records on Queensland Herbarium specimen vouchers. The survey undertaken sought to confirm the presence or absence of these plants within the MLA.

Rare and threatened plant species for the 1° grid cell covering the study area.

	Endangered	Vulnerable	Rare	Poorly Known
Observed	0	0	0	0
Possible	2	12	7	3

During these field examinations, a thorough search was made around the bases of trees and adjacent areas to assess diversity and likely fauna utilisation, including any evidence such as diggings and scratches on the trunks of trees.

In order to collate a list of fauna species that utilise the various plant communities within the proposed mining lease, observations were supplemented by the results of previous surveys, the accounts of local residents and information from field naturalists familiar with the area, especially Mr Roy Hando.

This report includes an assessment of the diversity of plant communities for areas of significance and potential for wildlife habitat, including the presence of weed species.

9. FLORA SURVEY RESULTS

A total of 175 species from 128 genera representing 56 families were identified. Of these, 27 species were introduced species. The vegetation of the proposed mining area is predominantly open eucalypt forest and woodland. Seven communities were recognised, all being variable in structure and composition. The communities grade into each other, with many species common to each. A complex history of clearing and regrowth extends over much of the area, including areas of marginal or no agricultural potential. The approximate extent of the communities and their condition is shown in Figure 3.

In all cases, the vegetation communities were fairly simplistic in their composition with little understorey and herbaceous diversity partially due to previous clearing and grazing management compounded by the lack of rain to break the dormancy of herbaceous plants.

There was some evidence of remaining stands of vegetation dominated by *Acacia harpophylla* (brigalow), *Eucalyptus pilligaensis* (gum-topped box/pilliga grey box), and *Allocasuarina luehmannii* (bull oak) with some regrowth areas dominated by wattles. However it is difficult to determine the extent of their range prior to clearing. Other species that have local dominance include *Eucalyptus umbellata* (Queensland peppermint), cypress, bull oak, ironbark, narrow-leaved box and poplar box.

10. DESCRIPTION OF VEGETATION COMMUNITIES

There were sufficient variations in soils and vegetation for a number of distinct vegetation classes or groups to be identified; sometimes in narrow or small populations and in other places as remnants along roadways and other cleared areas.

There were similarities in several of the plant communities as evidenced by the frequent occurrence of *Eucalyptus crebra* (narrow-leaved ironbark), *Eucalyptus populnea* (poplar box), *Eucalyptus tereticornis* (Queensland blue gum), *Callitris columellaris* (white cypress pine), *Acacia leiocalyx* (early flowering black wattle), *Acacia deanei* (green wattle), and *Pittosporum philliraeoides* (weeping pittosporum). There were several broad areas of forests within the proposed mining lease dominated by narrow-leaved ironbark and cypress pine in the north-western portion, poplar box woodland in the western portion, and mixed eucalypt forests comprising ironbark, bloodwood, rusty gum, peppermint, narrow-leaved grey box, cypress, some bull oak and wattle regrowth in the south-eastern portion.

The vegetation classifications presented in figure 3 are described below:-

E1 *Eucalyptus tereticornis* dominant forest along drainage lines

The Queensland blue gum riverine forests are generally indicators of alluvium soils and the availability of underground water, and were commonly seen along the Condamine River, Kogan Creek and also Eastern Branch Creek, as well as occurring in shallow depressions.

Other frequently occurring species within this community are *Angophora floribunda* (rough-barked apple), *Eucalyptus coolabah* (coolibah), *Acacia deanei* (green wattle) with *Lomandra longifolia* (spiny-headed mat rush) and rushes occurring as common ground covers along stream banks.

Some variations to this community occurred along sections of both Kogan Creek and Eastern Branch Creek with some areas dominated by brigalow and other areas by cypress. Another interesting plant was *Callostemma luteum* (native daffodil).

E2 *Eucalyptus populnea* (poplar box) woodland

Poplar box is another widespread species that occurs adjacent to E1 and also overlaps to some extent with all drainage lines, creeks and shallow depressions. In the majority of cases poplar box woodland areas have been cleared for pastures because of the slightly deeper loams.

The extent and degree of disturbance to the poplar box community makes it difficult to determine the diversity; however remaining vegetation provides some evidence such as *Acacia melvillei* (yarran), brigalow, *Acacia excelsa* (ironwood), *Pittosporum philliraeoides* (weeping pittosporum), *Geijera parviflora* (wilga), *Santalum lanceolatum* (sandalwood) and *Eremocitrus glauca* (limebush).

E3 Eucalyptus pilligaensis (narrow-leaved box/gum-topped box)

This species reached heights of 20 metres and was usually the dominant tree in the area growing on a loamy topsoil. Often there was an overlapping with E2 except for less diversity in the shrub and herbaceous layers.

Principal species include cypress, black wattle, *Acacia spectabilis* (glory wattle), ironwood, ironbark, *Dianella brevipedunculata* (blue flax lily), *Gahnia aspera* (rough saw-sedge) and *Eragrostis*, *Aristida* and *Chloris* species of grasses.

E4 *Eucalyptus crebra* (narrow-leaved ironbark) and *Callitris columellaris* (white cypress pine)

There was considerable variation in these vertically layered forests with commonly occurring species including *Angophora leiocarpa* (smooth-barked apple/rusty gum), black wattle, *Acacia julifera*, *Acacia burrowii* (currawong), *Alphitonia excelsa* (red ash/soap tree), *Petalostigma pubescens* (quinine berry), and *Hakea fraseri* (corkwood oak). Occasionally, there were *Eucalyptus fibrosa* (broad-leaved ironbark), weeping pittosporum and an understorey of bull oak.

E5 Mixed Eucalyptus open forest

The initial vegetation survey had placed this community as narrow-leaved ironbark layered open forest. However, there were several other eucalypts worthy of inclusion such as *Eucalyptus dolichocarpa* (long-fruited bloodwood), *Eucalyptus umbellata* (Queensland peppermint), poplar box, gum-topped box and occasionally *Eucalyptus tessellaris* (carbeen/moreton bay ash).

This community also features similar shrub and herbaceous layers to E4, with some areas being dominated by cypress pine regrowth, and others by wattles, corkwood oak and with sparse grass cover. Occasionally there were quinine berry and wombat berry.

Both E4 and E5 communities occurred on shallow soils often of sandstone origin and frequently on gravelly and stony ridges, with dominant species being narrow-leaved ironbark and cypress. Some areas of disturbance were being colonised by bull oak and wattle.

B *Acacia harpophylla* (Brigalow) community with softwood association

Once a widespread species on the Darling Downs, brigalow does not often occur as a community but rather as remnant stands along roadways and sometimes adjacent to drainage lines on the proposed mining lease as a regrowth species (refer to photos of Kogan Creek)

Because of the low fertility and dominance of lighter, sandy soils it is postulated that brigalow was not an extensive community on the proposed mining lease. Many former brigalow areas are now dominated by poplar box and ironbark, with acacia regrowth.

Consequently, there are few remaining pure stands of brigalow; with other commonly occurring species being *Casuarina cristata* (belah), *Capparis mitchellii* (native pomegranate), *Capparis lasiantha* (nipan's wait-a-while), *Eremophila deserti* (ellangowan poison bush), scrub wilga and sandalwood.

C *Allocasuarina lluehmannii* (bull oak) regrowth areas

There were some very dominant and extensive bull oak areas, particularly in the north-western portion and east of the trial pit in a band along the eastern and south-eastern tracks along the ridge. One of the features of these communities is poorly drained, shallow soils and the lack of other shrubbery and eucalypts.

11. WEED SPECIES

Of the 175 species observed, 27 were introduced plants. Although there were not many areas of weed invasion, most occurred in areas that have been cleared. Species include bathurst burr, noogoora burr, cobbler's pegs, common sida, rattlepods, fleabanes, prickly roly-poly, and prickly pear, although the latter was mostly associated with roads and tracks.

Within larger areas of open forest and woodland, there was little evidence of weed species invasion because of the regrowth of native species such as wattles, cypress, bull oak, grass and eucalypts. Ironically, this initial clearing for fencing, building, fodder and broadscale grazing has made it more difficult to muster stock because of the dense regrowth.

12. FAUNA

The occurrence of restricted habitats likely to support rare or endangered species is considered unlikely. On this basis no formalised fauna survey or trapping program has been undertaken. However, observations have been recorded during the course of normal exploration and survey works as well as during the vegetation surveys.

Fauna: Observed & Possible

	Observed	Possible
Frogs	2	8
Reptiles	3	13
Snakes	0	8
Birds	76	145
Mammals	10	34

Some of the most prominent fauna included emus, grey kangaroos, swamp wallaby, hares and mixed flocks of birds such as double-barred finch, cockatoo, apostle bird, cockatiel and crested pigeon. Those animals and birds able to take advantage of the human-modified landscape are most common. Large numbers of eastern grey kangaroo and swamp wallaby occur, particularly near the pasture-forest interface. Emus are common on open grazing land, as is Gould's monitor lizard.

Despite the dry seasons and extent of the drought, there is a diversity of fauna utilising the lease area. This was particularly noticeable along Kogan Creek and Eastern Branch Creek, partially due to the availability of water and shelter. Waterholes and the fringing vegetation support a range of animals and birds, although numbers and species diversity are considerably lower than on the nearby Condamine River where water dragons and long-necked tortoise were widely observed.

Another feature of these drainage lines was the potential for nesting and breeding in tree hollows in blue gums by possum, galah, cockatiel, cockatoo, rosella, kookaburra, and possibly glider and fruit or insect bat. These hollows may also provide shelter for feral cats which predate upon the native fauna. Along these drainage lines, there was also widespread bird utilisation including sulphur crested cockatoo, galah, cockatiel, noisy miner, honeyeater, kingfisher, black-faced cuckoo-shrike, grey shrike-thrush, kookaburra, lorikeet and rosella.

The abundance of blue gums also yielded the highest number of scats or faecal pellets, especially from the common brushtail possums, and any alteration to this plant community needs to be kept to a minimum. Other scats collected for identification included wallaby, and possibly glider and bandicoot; with some scratches on trunks due to goanna as well as those fauna listed. Local landowners report rare sightings of koala or their scats (3 sightings in 24 years). All were associated with *Eucalyptus populnea* (Poplar Box) trees. This vegetation type is widespread in the region but covers only a small proportion of the proposed mining area.

It was also evident from observations, that some mixed species flocks of small birds may be due to the time of year when winter migration and breeding increases their occurrence. Apart from the vegetation along drainage lines, other forms of permanent water storage areas increased the occurrence of pelican, greater egret, ibis, cormorant and duck.

A notable feature of the area is the large number of feral animals. Over a 2 day period in July, 1992, over 30 feral pigs were sighted in the south of the area. Hares, foxes, goats, feral cats, house mice and one dingo were also recorded. While a mapping program would be required to determine the range and numbers of small mammals and nocturnal animals in the area, the number of feral animals and loss of habitat due to clearing suggest that occurrences would be restricted.

13. CONSERVATION STATUS AND BIOLOGICAL SIGNIFICANCE

This proposed mining lease area has been modified by factors such as clearing of forests of cypress, ironbark and bloodwood for building and fencing material, as well as for grazing, pasture crops, and rural infrastructure.

Even with these alterations, there were sightings of hare, wallaby, grey kangaroo, grass eaters such as finch, rosella, galah, emu, cockatoo; with flocks of pigeons and apostle bird also common. This was complemented by larger forest areas that provide shelter and food for a variety of fauna.

Although the forest areas were of poor quality and lacked the diversity which would increase fauna utilisation, they offered adequate protection, shelter and breeding sites for a range of arboreal animals. As stated in the fauna assessment, these breeding hollows also can provide shelter for feral cats which devastate the native fauna.

Only a more detailed study over several seasons would reveal the diversity and range of fauna utilisation both within the proposed mining lease and adjacent areas. However, there is broad fauna utilisation of plant species based upon seasonal flowering and fruiting.

During the field surveys, no evidence was found to indicate the presence of rare or endangered flora or fauna, and the proposed mining operations should not have an adverse impact upon flora or fauna on a regional level.

14. CONCLUSIONS/ RECOMMENDATIONS FROM FLORA & FAUNA STUDY

The vegetation of the proposed mining area is predominantly open eucalypt forest and woodland. All are widespread in the region, with no rare or threatened flora having been identified within the MLA or its immediate surrounds.

The wide regional destruction of vegetation and the landform types encountered on the Kogan site, coupled with extensive clearing of the more fertile areas of the site has undoubtedly long since adversely impacted upon the diversity and abundance of fauna in the district. The proposed mining operations are not therefore expected to have any further major impact.

In order to maintain habitat areas for fauna, forest areas should be left undisturbed by mining operations where feasible. Only limited wildlife corridors remain on the site. Kogan Creek connects the Condamine River with the Braemar State Forest to the south of the MLA.

Clearing of the river flats for cultivation and the sporadic retention of narrow bands of vegetation on the creek line preclude its use by all but those animals least dependent on such movement corridors for survival.

It is important to retain vegetation linkage between a range of plant communities for the continued utilisation by fauna. This linkage could include providing a rehabilitation plan to revegetate areas following mining using hardy and useful species such as wattle, eucalypt, cypress, bull oak, soap tree, quinine berry, weeping pittosporum, salt bush, vines and grasses.

The major area of disturbance will be the area disturbed during the coal extraction, construction of infrastructure, especially the washplant, coal stockpiles and tailings evaporation ponds. Unless the area is to be actively mined, creek banks should be left untouched and trees protected along the drainage lines.

Taking into account the results of the field studies undertaken together with the above recommendations the mine plan as proposed should ensure that mining operations will not have an adverse impact upon the flora or fauna of the region. Revegetation as proposed in the mine plan will be required to minimise any impact by the selected re-establishment of vegetation native to the site.

15. FARM MANAGEMENT

Most of the land contained in the Kogan Creek coal project area is unproductive land which is not economical to improve within the present profitability constraints of farming. An analysis of the options follows:

15.1 Beef breeding and grain crops

Only the small area of the better soil types is suitable for crop production in today's economic climate where margins from grain growing are very slim. Beef production is therefore the main enterprise suitable for the property. The carrying capacity of much of the land is extremely low and productivity of livestock would be poor. Most of the useful feed for cattle would be on the soils along Kogan Creek and the heavier soils adjacent to the Condamine River.

The main reason for such a low profit is the small amount of production related to labour and overhead costs. This is a common problem on small farms throughout Australia and farmers with small farms have to supplement their income with off-farm work. Many of the viable farmers in the area now crop more than 600ha with one labour unit and only a little more in administration and machinery and administration costs.

15.2 Beef breeding and cultivation of forage crops

Cultivating and growing forage crops on the useful cultivation land would improve beef production. The initial assessment indicates that the extra cost of producing the forage crops does not provide enough return to make it worthwhile.

15.3 Beef breeding and fattening on improved pasture

Planting improved pasture on the cultivation land produces a lower income than that of growing forage crops on this land, but because costs are lower and less machinery is required, the final return is greater.

This is the simplest option with less outlay and less risk than the grain production and more surplus time of a resident manager available for general maintenance of the properties and other duties associated with the coal project.

15.4 Sharefarming and agistment of grazing lands

Sharefarming is normally conducted on a 75:25 share basis, whereby the landowner receives 25% of gross crop proceeds and the sharefarmer 75%, after providing all inputs of labour and machinery for crop production. The yield estimates are lower because sharefarmers usually put less into the crop and achieve crop yields lower than resident owners. Agistment or grazing rights for cattle on the property will add to the sharefarming potential.

However, there would still be some expenses associated with property maintenance (fences, yards, roads, buildings etc) and overheads involved with rates, insurance and administration.

15.5 Agistment with pasture

The cultivation land could be converted into pasture and the whole property let for grazing. This would improve the attractiveness of the property for grazing immensely.

15.6 Conclusion

The most profitable option for the use of the land is to sharefarm the useful cultivation land and lease grazing rights to the remaining unused portions of the land aggregation. Of the other options available, converting the existing cultivation to improved pasture and conducting a beef breeding enterprise on all available land appears to be the most viable option.

16. REFERENCES

Bean, A.R. (1989). 'The Distribution of Queensland Eucalypts'. (Bean: Nambour).

Hando, Roy (editor) (1988). 'Going Bush with Chinchilla Nats'. (Chinchilla Field Naturalists' Club Inc.)

Northcote, K.H. (1979). 'A Factual Key to the Recognition of Australian Soils'. Rellim Technical Publications, Glenside, S.A.

Queensland Herbarium (1992). 'Census of Queensland Plants' (Queensland DPI: Brisbane).

Rosser, J., Swartz, G.L., Dawson, N.M. and Briggs, H.S. (1974). 'A Land Capability Classification for Agricultural Purposes'. Queensland Department of Primary Industries, Division of Land Utilisation Technical Bulletin No. 14.

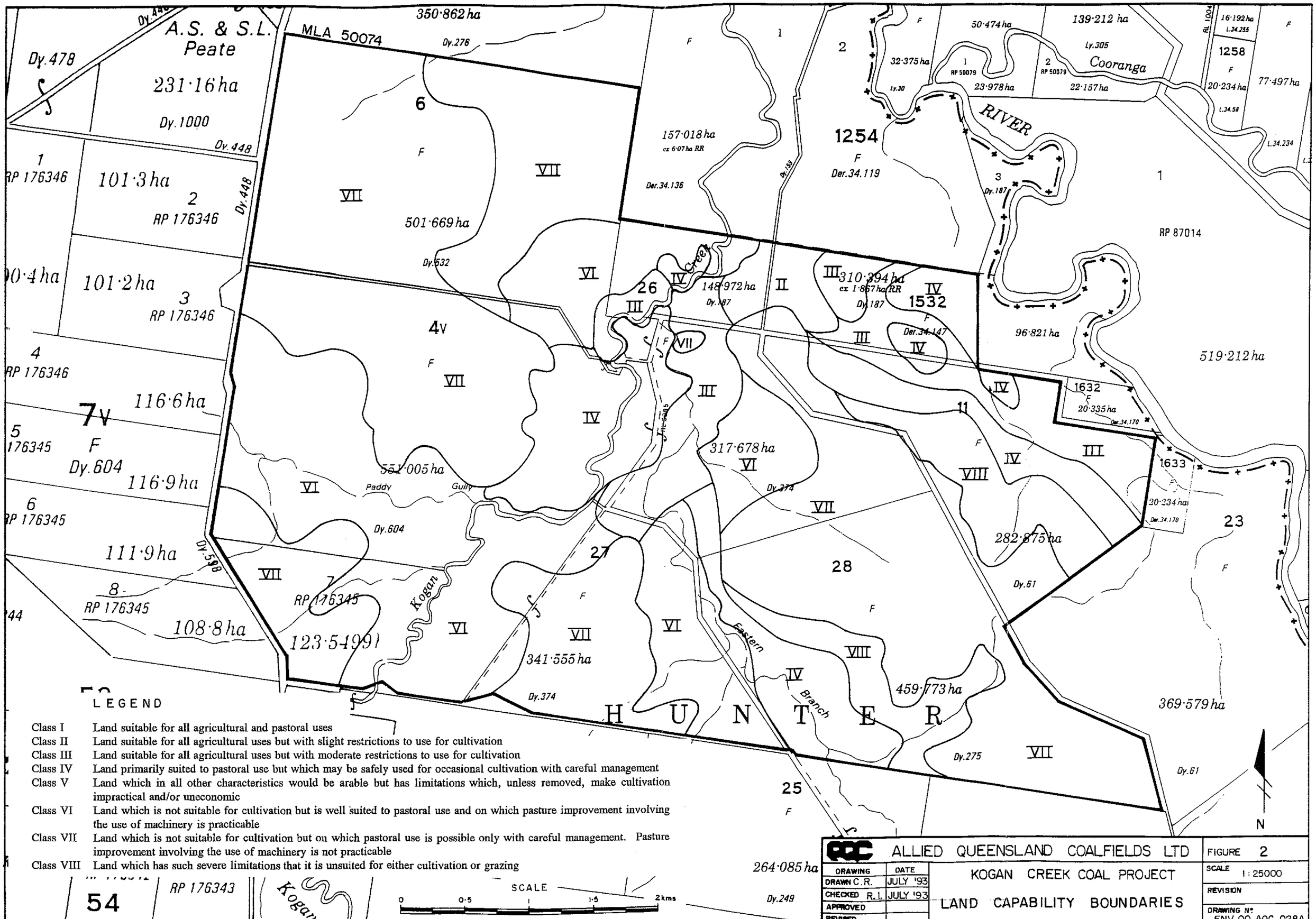
Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. and Hallsworth, E.G. (1968). 'A Handbook of Australian Soils', Rellim Technical Publications, Glenside, S.A.

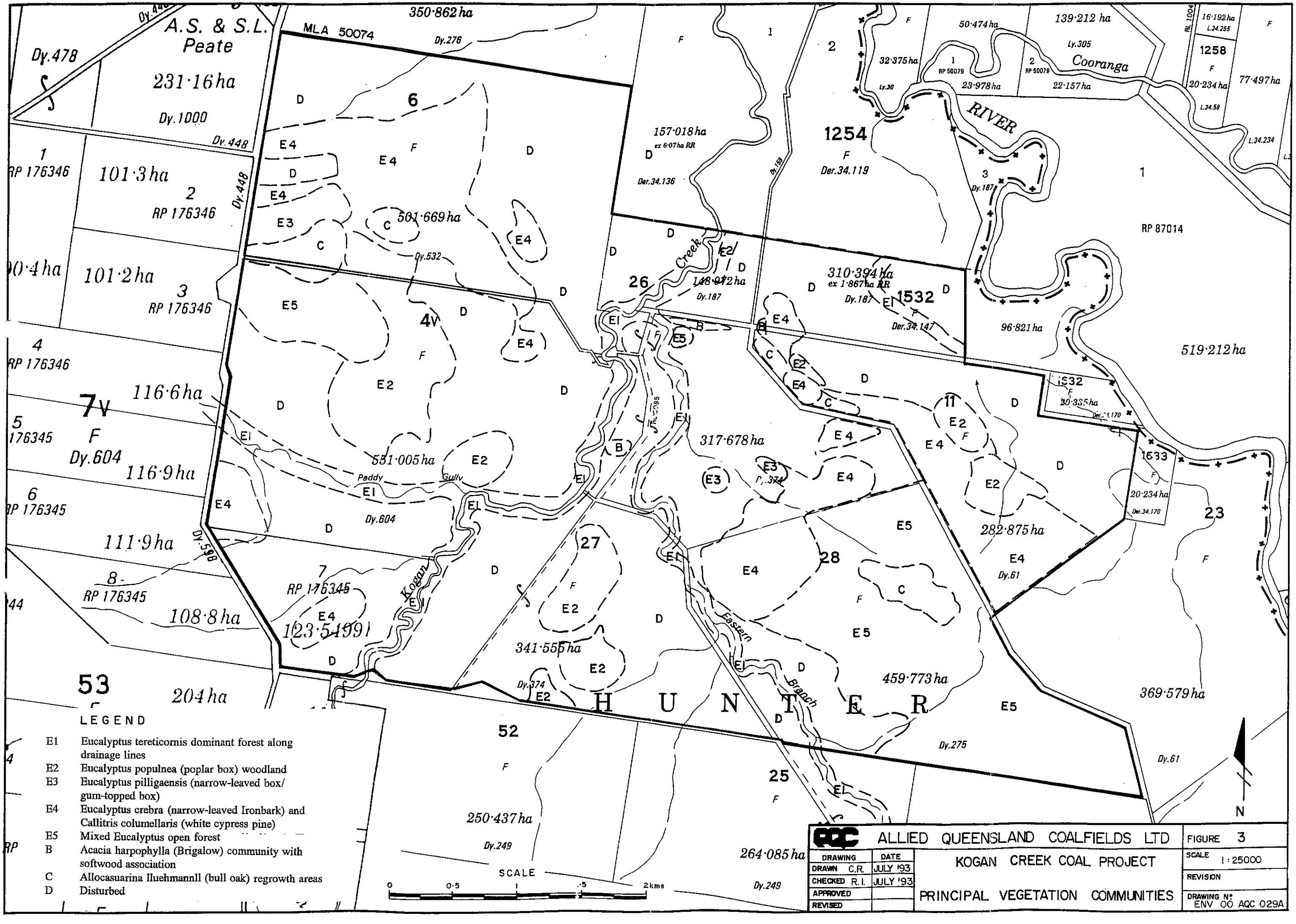
Stanley, T.D. and Ross, E.M. (1983). Flora of South-eastern Queensland, vols. 1, 2 and 3. (Qld DPI: Brisbane).

Thomas, M.B. and McDonald, W.J.F. (1989). 'Rare and Threatened Plants of Queensland'. (Queensland D.P.I.: Brisbane).

A.S. & S.L. Peate
231·16ha
Dy.1000
Dy.478
Dy.448
1 RP 176346
101·3ha
2 RP 176346
Dy.448
101·2ha
3 RP 176346
4 RP 176346
116·6ha
7v
5 176345 F
Dy.604
116·9ha
6 RP 176345
111·9ha
8 RP 176345
108·8ha
Dy.598
53 F Dy.71
204ha
202ha
13 RP 176342
14 RP 176342
15 RP 176343
54
MLA 50074
350·862ha
Dy.276
6 F
501·669ha
LITHOSOL
Dy.532
YELLOW / BROWN SOLODIC
4v F
551·005ha
YELLOW / BROWN SOLODIC
Paddy
Gully
Dy.604
LITHOSOL
RP 176345
123·54091
Kogan
DARK SOLODIC
27 F
LITHOSOL
341·555ha
Dy.374
11 RP 176344
Dy.48
100·1ha
16 RP 76343
Kogan
52 F
250·437ha
Dy.249
F 1 2
157·018ha
ex 6·07ha RR
Der.34.136
Dy.159
CRACKING CLAY
Creek
26
148·972ha
Dy.187
F
1254 F
Der.34.119
DARK SOLODIC
310·394ha
ex 1·867ha RR
Dy.187
1532 F
Der.34.147
YELLOW / BROWN SOLODIC
96·821ha
F
LITHOSOL
317·678ha
Dy.374
DARK
11
F
28 LITHOSOL F
459·773ha
Dy.275
25 F
264·085ha
Dy.249
F 50·474ha
32·375ha
1 RP 50079
23·978ha
2 RP 50079
22·157ha
139·212ha
Ly.305
Cooranga
Ly.30
RIVER
3 Dy.187
1
RP 87014
519·212ha
RL 1004
16·192ha
L.34.255
1258 F
20·234ha
L.34.58
77·497ha
L.34.234
1632 F
20·335ha
Der.34.170
CRACKING CLAY SOLODIC
1633 F
20·234ha
Der.34.170
23 F
282·875ha
Dy.61
369·579ha
Dy.61
Eastern Branch
H U N T E R
SCALE
0 0·5 1·5 2kms
N

ACQC	ALLIED QUEENSLAND COALFIELDS LTD		FIGURE 1
DRAWING	DATE	KOGAN CREEK COAL PROJECT	SCALE 1:25000
DRAWN C.R.	JULY '93		REVISION
CHECKED R.I.	JULY '93	SOIL LANDSCAPE BOUNDARIES	
APPROVED			DRAWING N° ENV 00 AQC 027A
REVISED			


A.S. & S.L. Peate
231·16ha
Dy.478
Dy.1000
Dy.448
1 RP 176346
101·3ha
2 RP 176346
101·2ha
3 RP 176346
4 RP 176346
116·6ha
7V
5 176345 F
Dy.604
116·9ha
6 RP 176345
111·9ha
8 RP 176345
108·8ha
MLA 50074
350·862ha
Dy.276
6
501·669ha
Dy.532
4V
551·005ha
Paddy
Gully
Dy.604
Dy.598
7 RP 176345
123·549ha
Kogan
27
341·555ha
Dy.374
157·018ha
ex 6·07ha RR
Der.34.136
Dy.189
1
2
F
50·474ha
32·375ha
1 RP 50079
2 RP 50079
23·978ha
22·157ha
139·212ha
Ly.305
Cooranga
Ly.30
1254
Der.34.119
RIVER
3
Dy.187
1
RP 87014
519·212ha
16·192ha
L.34.235
1258
20·234ha
77·497ha
L.34.58
L.34.234
26
148·972ha
Dy.187
Creek
310·394ha
ex 1·867ha RR
1532
Der.34.147
96·821ha
1632
20·335ha
Der.34.170
11
317·678ha
Dy.374
1633
20·234ha
Der.34.170
282·875ha
Dy.61
23
28
Eastern
Branch
459·773ha
Dy.275
369·579ha
Dy.61
25
264·085ha
Dy.249
54
RP 176343
Kogan
SCALE
0 0·5 1·5 2kms
N
LEGEND
Class I Land suitable for all agricultural and pastoral uses
Class II Land suitable for all agricultural uses but with slight restrictions to use for cultivation
Class III Land suitable for all agricultural uses but with moderate restrictions to use for cultivation
Class IV Land primarily suited to pastoral use but which may be safely used for occasional cultivation with careful management
Class V Land which in all other characteristics would be arable but has limitations which, unless removed, make cultivation impractical and/or uneconomic
Class VI Land which is not suitable for cultivation but is well suited to pastoral use and on which pasture improvement involving the use of machinery is practicable
Class VII Land which is not suitable for cultivation but on which pastoral use is possible only with careful management. Pasture improvement involving the use of machinery is not practicable
Class VIII Land which has such severe limitations that it is unsuited for either cultivation or grazing
ALLIED QUEENSLAND COALFIELDS LTD
FIGURE 2
DRAWING
DATE
DRAWN C.R. JULY '93
CHECKED R.I. JULY '93
APPROVED
REVISED
KOGAN CREEK COAL PROJECT
LAND CAPABILITY BOUNDARIES
SCALE 1:25000
REVISION
DRAWING Nº ENV 00 AQC 028A



LEGEND

E1	Eucalyptus tereticornis dominant forest along drainage lines
E2	Eucalyptus populnea (poplar box) woodland
E3	Eucalyptus pilligaensis (narrow-leaved box/ gum-topped box)
E4	Eucalyptus crebra (narrow-leaved Ironbark) and Callitris columellaris (white cypress pine)
E5	Mixed Eucalyptus open forest
B	Acacia harpophylla (Brigalow) community with softwood association
C	Allocasuarina lluehmannll (bull oak) regrowth areas
D	Disturbed

ALLIED QUEENSLAND COALFIELDS LTD

KOGAN CREEK COAL PROJECT

PRINCIPAL VEGETATION COMMUNITIES

DRAWING	DATE
DRAWN C.R.	JULY '93
CHECKED R.I.	JULY '93
APPROVED	
REVISED	

FIGURE 3

SCALE 1:25000

REVISION

DRAWING No: ENV 00 AQC 029A

APPENDIX I

REPRESENTATIVE SOIL PROFILE DESCRIPTIONS

BIOLOGICAL & PHYSICAL ASSESSMENT

SOILS, LAND CAPABILITY, FLORA, FAUNA & FARM MANAGEMENT

KOGAN CREEK PROJECT AREA, BRIGALOW

Representative Soil Profile Descriptions: PRELIMINARY SOIL SURVEY, July 1992.

SITE 1	***CRACKING CLAY***
Great Soil Group :	Black Earth/ Grey Clay affinity
Principal Profile Form :	Ug 5.15
Topography :	Floodplain ; Slope <1%
Drainage :	Slow
Land Use :	Grazing

Depth (m)	Description
0 - 0.20	Dark brown (7.5 yr 3/2) self mulching, cracking, heavy clay, very firm, pH 6.5, very fine roots common. Clear, irregular boundary to -
0.20 - 1.60	Dark brown (7.5 yr 3/3) medium - heavy, massive clay, strong to very strong, rare gravel traces, pH 7.5. Abrupt to -
1.60 - 4.00	Brown (7.5 yr 5/2) fine sandy clay, massive, very strong, pH 7.5.

SITE 2	***DARK SOLODIC***
Great Soil Group :	Solodized Solenetz
Principal Profile Form :	Dd 2.33
Topography :	Footslope of Rise ; Slope 2%
Drainage :	Moderately rapid
Vegetation :	*Cassinia laevis* regrowth, remnant pasture grasses
Land Use :	Abandoned pasture

Depth (m)	Description
0 - 0.23	Very dark grey (10 R 3/1) sandy clay loam; very firm; medium sub-angular blocky; common fine roots; pH 6.0. Clear, discontinuous boundary to -
0.23 - 0.45	Pink grey (7.5 yr 6/2) clay loam with sporadic white coating to particles; very firm; medium sub-angular blocky; pH 8.5; swells strongly on wetting. Abrupt to -
0.45 - 0.85	Dark brown (7.5 yr 3/2) with common; distinct, coarse yellow brown (10 yr 5/4) mottle, medium - heavy clay; columnar, rough faced peds; weak; pH 8.5.

SITE 3	***LITHOSOL***
Great Soil Group :	Lithosol (Yellow earth)
Principal Profile Form :	Gn 2.41
Topography :	Plateau, Slope 2%
Drainage :	Well drained
Land Use :	Virgin : *Eucalyptus crebra* open forest

Depth (m)	Description
0 - 0.30	Greyish brown (10 yr 5/2) hardsetting clayey fine sand; weak; few very fine roots; pH 5.5. Grading to -
0.30 - 0.65	Pale brown (10 yr 6/3) sandy light clay; firm; pH 5.5. Grading into weathered Springbok Sandstone.

SITE 4	***PALE SOLODIC***
Great Soil Group :	Yellow/ brown solodic
Principal Profile Form :	Dd 2.43
Topography :	Alluvial Plain, Slope 1%
Drainage :	Well drained
Vegetation :	*Eucalyptus populnea* (poplar box) woodland
Land Use :	Grazing

Depth (m)	Description
0 - 0.30	Light brown grey (10 yr 6/2) loamy sand, hardsetting; weak; common, fine roots; pH 5.0. Clear, broken to -
0.30 - 0.35	Very pale brown (10 yr 7/3) loamy sand; weak; few fine roots. Abrupt to -
0.35 - 2.40	Very dark grey (7.5 yr 3/0) sand clay loam; moderate, smooth, columnar peds, 50-100mm; very firm, pH 7.0. Abrupt to weathered sandstone.

SITE 5	***ALLUVIAL***
Great Soil Group :	Alluvial soil
Principal Profile Form :	Uc 1.2
Topography :	Creek terrace, Slope 1%
Drainage :	Excessive
Land Use :	Creek fringing vegetation, grazing

Depth (m)	Description
0 - 2.0	Light brown sand, loose, siliceous, very fine grain.
2.0 - 5.5	Light brown sand, loose, siliceous, medium grain.
5.5 - 6.0 - buried layers	Light brown sandy gravel, loose.
6.0 - 6.6	Brown sand, siliceous, loose, medium-coarse grain, sharp to weathered sandstone Poor auger sample recovery in loose sands, pH not determined due to use of drilling additives.

SITE 6	***PALE SOLODIC***
Great Soil Group :	Yellow/ brown solodic
Principal Profile Form :	Dd 1.12
Topography :	Alluvial plain, Slope <1%
Drainage :	Well drained
Land Use :	Grazing, cropping in past

Depth (m)	Description
0 - 0.35	Brown (7.5 yr 5/2) clayey fine sand; massive; weak; very fine roots common; moist; occasional clayey aggregations; pH 5.0. Abrupt to -
0.35 - 2.30	Very dark grey (7.5 yr 3/0) sandy medium clay; massive; very strong; pH 8.0; granular quartz throughout; minor coarse Carbonate segregations. Clear to -
2.30 - 3.90	Grey brown (10 yr 5/2) sandy clay; fine to medium sand; gravelly, cobbles towards base; massive; very strong; pH 6.5.

Representative Soil Profile Descriptions: DETAIL SOIL SURVEY, June 1993.

SITE	HORIZON	DESCRIPTION
11	**Grey clay affinity**	Ug 5.1, 0.3% slope
	A1 0-30	very dark grey (10yr 3/1) heavy clay, pH 7.5
	B2 1 30-150	very dark grey (10yr 3/1) heavy clay, pH 8
	B2 2 150-400	very dark grey (10yr 3/1) heavy clay, pH 9.
12	**Dark solodic**	Dd 1.13, 3.0% slope
	A1 0-30	very dark grey (10yr 3/1) clay loam, pH 6.3
	B2 1 30-250	very dark grey (10yr 3/1) medium heavy clay, pH 9.5
	B2 2 250-500	dark grey (10yr 4/1) medium heavy clay, pH 9.5
13	**Grey clay affinity**	Ug 5.1, 0.5% slope
	A1 1 0-30	very dark grey (10yr 3/1) medium heavy clay, pH 7.0
	A1 2 30-80	very dark grey (10yr 3/1) heavy clay, pH 6.0
	B 2 1 80-200	very dark grey (10yr 3/1) heavy clay, pH 7.0
14	**Yellow/ brown Solodic**	Dy 4.12, 1.0% slope
	A1 0-150	very dark greyish brown (10yr 3/2) fine sandy clay loam, pH 6.0
	B2 1 150-400	(10yr 4/2) fine sandy medium clay, pH 6.5
15	**Dark solodic**	Dd 3.12, 1.0% slope
	A1 0-50	dark greyish brown (10yr 4/2) fine sandy loam, pH 6.5
	B 2 1 50-230	very dark greyish brown (10yr 3/2) fine sandy medium clay, pH 7.0
	B2 2 230-500	very dark greyish brown (10yr 3/2) medium heavy clay, pH 7.2
16	**Dark solodic**	Dd 3.13, 1.0% slope
	A1 0-120	very dark grey (10yr 3/1) clay loam, pH 7.0
	B2 1 120-250	very dark grey (10yr 3/1) heavy clay, pH 8.0
	B2 2 350-500	very dark grey (10yr 3/1) heavy clay, pH 7.5
17	**Lithosol**	
	A1 0-200	dark greyish brown (10yr 4/2) sandy loam, pH 5.6
18	**Grey clay affinity**	Ug 5.1
	A1 0-80	dark greyish brown (10yr 4/2) medium heavy clay, pH 5.6
	B2 1 80-250	very dark greyish brown (10yr 3/2) heavy clay, pH 5.8
	B 2 2 250-600	very dark greyish brown (10yr 3/2) heavy clay, pH 5.4
19	**Lithosol**	Uc 1.21
	A1 0-20	greyish brown (10yr 5/2) fine sandy loam, pH 4.9
	C	parent material
20	**Cracking clay**	
	A1 0-80	medium heavy clay, pH 6.0
	B2 1 80-200	heavy clay, pH 8.5

SITE	HORIZON	DESCRIPTION
21	**Dark solodic**	Dd 1.12
	A1 0-180	dark greyish brown (10yr 4/2) fine sandy loam, pH 5.8
	B2 1 180-350	very dark greyish brown (10yr 3/2) heavy clay, pH 8.0
22	**Solodized solonetz**	
	A1 1 0-150	loamy sand, pH 5.5
	A1 2 150-350	clayey sand, pH 6.1
23	**Yellow/ brown solodic**	Db 1.41
	A1 0-180	black (10yr 2/1) sandy loam, pH 7.5
	B2 1 180-250	dark brown (10yr 3/3) sandy clay loam, pH 6.3
24	**Alluvial**	Ug
	A1 0-50	medium heavy clay, pH 6.0
	A1 2 50-120	medium heavy clay, pH 6.5
	B2 1 120-250	heavy clay, pH 8.5
25	**Dark solodic**	Dd 1.41
	A1 0-100	dark greyish brown (10yr 4/2) ?m pH 5.3
	A2 e 100-250	light grey (10yr 7/2) ?, pH 5.2
	B2 1 250-400	very dark greyish brown (10yr 3/2) heavy clay, pH 5.5
26	**Lithosol**	soils range from lithosols to poor solodics (sandy) to sands, dominantly sands; 300-400 mm deep.
27	**Lithosol**	Shallow
	A1 0-100	sandy loam, pH 5.9
		pH 5.4
28	**Cracking clay**	0.5% slope, cultivated
	A1 0-100	Dark grey (10yr 4/1), medium heavy clay, pH 6.0, gradual,
	B2 1 100-300	Very dark grey (10yr 3/1), heavy clay, pH 6.2