Acid Sulfate Soils of the Proserpine River Floodplain, North Queensland

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Natural Resources and Water

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Queensland 2007

MWQ_2
ISBN 978 1 7417 2793 7

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Acknowledgments

The author gratefully acknowledges the assistance of the many people and organizations who made significant contributions during the course of the study, especially:

- The Natural Heritage Trust, Fitzroy Basin Association and Mackay Whitsunday Natural Resource Management Group for providing the funds that made this project possible.
- All landowners who supported the study by providing access to their properties.
- Scott Hardy of the Whitsunday Shire Council for organising landowner details and advice on acid sulfate soils in the shire.
- Ian Hall for operating the geoprobe® for the deep sediment sampling and installing piezometers.
- Agnes McAvoy, Nev Christianos and Craig Thompson for assistance with the field work.
- Scott Hardy, Bernie Powell, Don Malcolm and Shane Pointon for refereeing this report.
- Dave Lyons and Sonya Mork for organising soil analyses and data reports.
- Luke Nouwens and Cyndi Thomson for cartographic work on the acid sulfate soil maps.

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Summary

Acid sulfate soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulfides which, when exposed to atmospheric oxygen in the presence of water, form sulfuric acid with the subsequent release of toxic levels of iron, aluminium and other heavy metals. These products are hazardous to both natural and man-made environments. There are an estimated 2.3 million hectares of these sediments located along the 6500 km of Queensland coastline.

This study, funded by the Natural Heritage Trust, involves an area of some 6307 ha of the Proserpine River floodplain, North Queensland, and is part of the statewide program to identify ASS hazard areas. The Proserpine area was investigated to build upon the work of Hardy (2001), and to define the area and depth to ASS in sugar cane lands, which is one of the areas at risk of disturbance.

The survey area extends from Conway Beach on the east side of the Proserpine River, around to the tributary known as Lethe Brook on the west side. ASS were mapped at two scales, 1:25 000 on the sugar cane lands, and at a broader scale of 1:100 000 on the grazing lands. Overall 158 boreholes were examined to depths of up to 6 m. Profiles were described in the field according to McDonald *et al.* (1990), with field peroxide oxidation tests carried out at regular 0.25 m intervals down the profile, or from within horizons thinner than 0.25 m.

Soil samples for analysis were collected at depth intervals of 0.5 m from each borehole. Actual acid sulfate soils (AASS) were analysed by either the suspension peroxide oxidation combined acidity and sulfate method (SPOCAS), or by the chromium suite of analyses. Potential acid sulfate soils (PASS) were analysed only by the chromium reducible sulfur method (S_{CR}). Some 1052 samples were analysed to determine the actual and potential acid sulfate soil layers.

Map units were allocated an AASS code (**A**) and/or PASS code (**S**), and a depth code number indicating the depth to these soil layers based on the laboratory data (e.g. A1S2). Polygon colours on the acid sulfate soil map also highlight the depth to an actual or potential acid sulfate soil layer and associated level of risk. Sediments with an acid neutralising capacity (ANC), containing either shells or strong alkalinity, are indicated on the map units by the N subscript (e.g. $S3_N$).

The study identified 1511 hectares (ha) of PASS and 227 ha of AASS at 1:25 000, and 1710ha of ASS at the 1:100 000 scale. ASS are shallowest in the tidal zone and occur mainly in the upper two metres of the profile. On other landforms such as floodplains and dune fields, ASS generally occur at depths between 2 and 5 m.

Analysis of AASS layers (pH <4) indicate that they tend to have very little potential for further acid generation, with oxidisable sulfur contents (%S) commonly less than 0.02%S. Existing acidity concentrations (actual and retained, expressed in moles H^+/tonne soil) are also often less than the soil texture threshold levels. The sulfur content varies significantly between the sandy and clayey PASS sediments. Throughout the survey area, the mean value in the pyritic sands is 0.3%S, while pyritic clays averaged 1.2%S, indicating that the mangrove muds (clays) pose the highest potential environmental risk. Fine shells in the sandy sediments, and the natural buffering capacity in a few of the alkaline clay sediments provided limited to full acid neutralising capacities (ANC) in some of the PASS layers.

The groundwater at three sites around the Proserpine River is being monitored on a regular basis to assess the shallow groundwater quality in these areas of the catchment. No disturbances of ASS were found.

1. Introduction

A mapping project to identify the extent of acid sulfate soils (ASS) at six coastal locations in Central Queensland was initiated in 2004 by the Fitzroy Basin Association, Mackay Whitsunday Natural Resource Management Group and the Department of Natural Resources and Water (NRW) with funding support from the Natural Heritage Trust. Priority areas of mapping are centered round the Mackay and Rockhampton districts. As well as providing substantial in-kind support, NRW was contracted to identify areas for mapping, undertake field surveys, install water monitoring bores (piezometers) and provide laboratory analyses of soil and water.

Acid sulfate soils are soils or sediments containing sulfides (primarily pyrite) or an acid-producing layer as a result of the oxidation of sulfides. They commonly occur in low-lying, very poorly drained, coastal land at elevations less than 5 m AHD (Australian Height Datum). Excavating soil or sediment, extracting groundwater and lowering the groundwater level or filling land may cause disturbance of ASS. When exposed to air, sulfides oxidise to produce sulfuric acid. Disturbed land can release acid, aluminium, iron and heavy metals into drainage waters, thus affecting aquatic plants and animals. Concrete and steel infrastructure including pipes, foundations and bridges are susceptible to acidic corrosion leading to accelerated structural failure (Ahern *et al.* 1998, Powell and Martens 2005). Other potential impacts include deoxygenation of waterways (Bush *et al.* 2004) and the excess iron may stimulate blooms of cyanobacteria such as *Lyngbya majuscula*. More detailed information on ASS, its formation and effects can be found in Malcolm *et al.* (2002).

The Proserpine River area was selected to provided detailed ASS mapping for the sugar industry. The aims of the study were to map the extent of ASS at a scale of 1:25 000 on the sugar cane lands and at a broader scale of 1:100 000 on the grazing and tidal lands, and to monitor groundwater through a network of piezometers to gain an understanding of the quality of the shallow groundwater. The monitoring of the groundwater would indicate if ASS had been disturbed and if off-site effects were occurring. The information from this project will be used by state and local government authorities and the sugar cane industry to help manage ASS around Proserpine.

1.1 Survey area

The survey area includes the low-lying land from Conway Beach, on the eastern side of the mouth of the Proserpine River, up around the river and down to the major tributary known as the Lethe Brook on the west side (Figure 1). This is only the upper part of the Proserpine and O'Connell River deltas, but is the main area where sugar cane is known to be grown on ASS. Part of the survey area includes the Goorganga Plain wetlands (Photograph 1).

During the last ice age, which ended 10 000 years before the present (BP), the Proserpine and O'Connell Rivers carved out a large basin between the hills of the Conway range in the east and low hills to the west when the sea level was about 130 m lower than it is today (Chappell 1987). As the sea level rose, the basin was infilled with mainly estuarine clay sediments, in which the ASS formed. Later floods buried these sediments as the delta continued to grow seawards. After the sea level stabilised at its current height some 6000 years BP (Chappell 1987), sand dune deposits were laid down at beach fronts with mangrove forests colonising the wetter intertidal areas behind these sand barriers. Continued alluvial and estuarine deposition has extended the Proserpine River delta seawards by several kilometres, leaving relict former beach ridges stranded on the floodplain (Hardy 2003).

Stephens (1993) studied the Proserpine and O'Connell River deltas to determine the coastal processes that have operated in the past and are operating today. Deep drilling on the Goorganga Plain to the south of the Lethe Brook found predominantly clayey ASS buried beneath the recent floodplain deposits with frequent channel cross-cutting and infilling with sandy sediments.

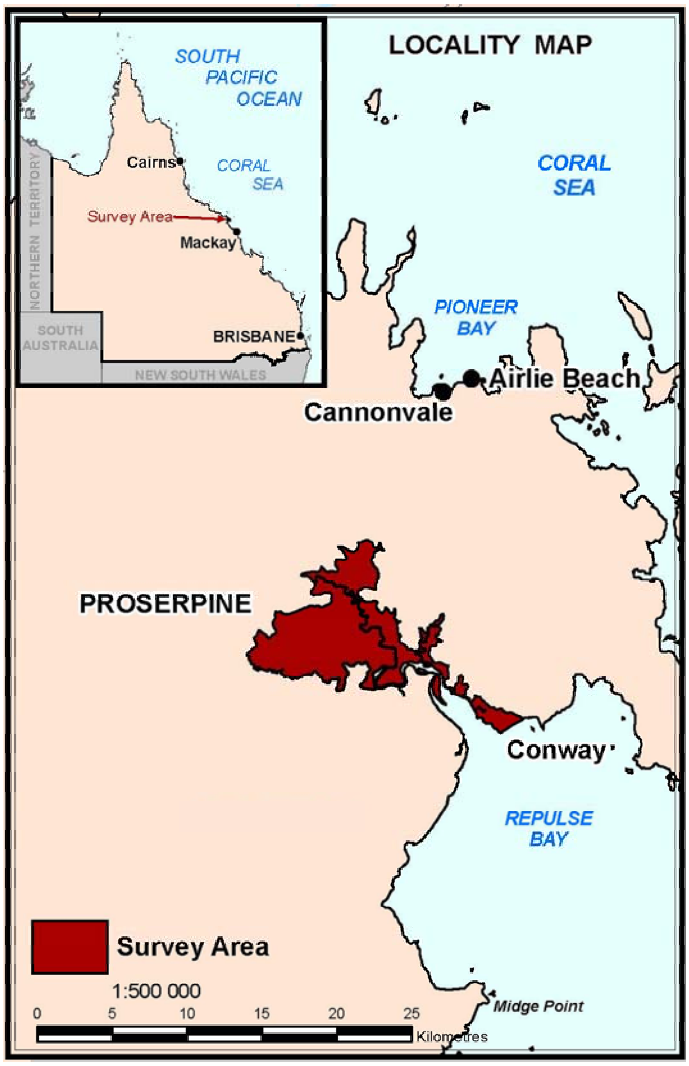

Figure 1. Location of the Proserpine survey area

Photograph 1. Goorganga Plain wetlands

2. Methods

Field sampling

The Proserpine 1:250 000 geological maps, 1:100 000 topographic maps and the ASS and soil map of Hardy (2001, 2003) covering the study area were reviewed before field work began. Black and white aerial photographs from 1988, at a scale of approximately 1:25 000, were used for aerial photo interpretation of the landscape, identifying locations for borehole sites, and carrying out mapping of soil boundaries.

The intensity of the mapping was determined by the land use. The sugar cane lands were mapped at the semi-detailed scale of 1:25 000 as these lands posed the highest risk for disturbance of ASS through excavation and/or deep drainage. The other grazing and tidal lands were mapped at a broad scale of 1:100 000. Free soil survey techniques were employed for both scales, with boreholes located at various spacings depending on the scale (Reid 1988). Boreholes were spaced at intervals between 250 to 400 m on the sugar cane lands and at one kilometre or greater on the other areas. Wider intervals were used in the tidal zone because the consistency of depth to ASS meant that intensive field sampling was not warranted.

Starting on the lowest-lying land of the tidal flats, boreholes were located progressively up the catchment until ASS were no longer encountered, or a landform boundary identified the inland limit of the Holocene estuarine deposition. The soil profiles were sampled using various methods depending on the landform being sampled. A tapered gouge auger, 1.8 m long with an 83 mm diameter, was used to sample in mangrove areas and, occasionally, on supratidal flats (saltpans) that were wet and inaccessible to a four-wheel-drive-vehicle (Photograph 2).

A trailer-mounted, vacuum-vibro soil-coring rig was used to obtain intact 50 mm cores of saturated sediments to a maximum depth of 6.0 m (Photograph 3) on the floodplain areas. Depending on the type of sediments present, the drier overlying soil materials were first removed with hand augers. This soil was laid out in half-metre sections on a vinyl tarpaulin. When the soil materials were moist and soft enough, the vibro-corer was inserted into the augered hole to sample the deeper, saturated Holocene sediments. The cores were extruded into 2 m x 100 mm PVC trays in order to record soil properties and for sampling. A Geoprobe® coring machine was also used for difficult gravelly sites, for deeper sampling beyond 6.0 m and to install piezometers (Photograph 4). A total of 158 boreholes were described and sampled as part of this project.

The properties of the soil materials such as texture, colour, mottles, structure, soil moisture status, coarse fragments and segregations were described according to McDonald *et al.* (1990) and recorded in code format for each horizon on NRW field sheets. The soil was classified by the Australian Soil Classification (Isbell 1996), and other features of the land such as landform, slope and microrelief were also recorded. Mangrove and other tree species were identified using Lovelock (1993) and/or Alcock and Champion (1989).

Field pH (pH_F) and peroxide oxidised pH (pH_{FOX}) were measured with a portable pH meter (TPS Ionode WP84) at 0.25 m intervals down the profile, or within other soil horizons if these were less than 0.25 m thick. Soil samples were collected at 0–0.1 m, 0.2–0.3 m, 0.5–0.6 m and 0.8–1.0 m intervals in the upper metre, and then at 0.5 m intervals throughout the remainder of the soil profile, with approximately 500 grams of soil placed in sealed plastic bags. However if the upper part of the profile was not an ASS, then sampling started at 0.9–1.0 m, with samples at 1 m intervals until ASS material was encountered, which was then sampled at standard 0.5 m intervals. Profiles that did not contain any ASS were sampled at 1 m intervals starting at either 0.9–1.0 or 1.9–2.0 m.

Soil samples were refrigerated in the field and transferred to a freezer for longer-term storage. They were then sent frozen to the NRW soil laboratory at Indooroopilly for analysis. One thousand and fifty-two soil samples were analysed by the methods described below.

Photograph 2. Gouge auger, 1.8 m long, used for hand sampling in mangrove forests

Photograph 3. Trailer mounted vibro-coring soil rig used for sampling wet sediments

Photograph 4. Geoprobe® used for deep sediment sampling

Laboratory soil analysis

The method of analysis selected depended on whether the ASS layers were assessed as being an actual acid sulfate soil (AASS) or potential acid sulfate soil (PASS). AASS samples containing *jarosite*, or with a pH of 4 or less, were analysed by the suspension peroxide oxidation combined acidity and sulfate method (SPOCAS) (Ahern *et al*. 2004) or the chromium suite of analyses (Ahern *et al*. 2004). The chromium suite of analyses was used from profile 812 onwards as it tends to be a more accurate measure of the oxidisable sulfur than the SPOCAS method.

Analytes from the SPOCAS methods include:

- total actual acidity (TAA)
- total potential acidity (TPA)
- 1M potassium chloride (KCl) extractable sulfur (S_{KCl}).
- peroxide sulfur (S_P)
- 4M HCl extractable sulfur (S_{HCl})
- 1M KCl and peroxide oxidised extracted calcium and magnesium (e.g. Ca_{KCl} and Ca_P).

Total sulfidic acidity (TSA) is calculated from the acid trail (TSA = TPA–TAA), while the peroxide oxidisable sulfur (S_{POS}) is determined by the sulfur trail ($S_{POS} = S_p – S_{KCl}$). An additional analyte of the SPOCAS method is the 4M HCl extractable sulfur (S_{HCl}), which enables net acid soluble sulfur (S_{NAS}), otherwise known as retained acidity ($S_{NAS} = [S_{HCl} – S_{KCl}]$x 0.75), to be calculated (Ahern *et al*. 2004). The chromium suite is essentially similar except that the oxidisable sulfur is determined by the chromium reducible sulfur method, and the other analyses include TAA, S_{KCl}, S_{HCl} and 1M KCl and peroxide extracted calcium and magnesium as outlined above.

The potential acid sulfate soil (PASS) samples were analysed by the chromium reducible sulfate (S_{CR}) method only (Sullivan *et al*. 2000). The acid neutralising capacity (ANC) of the PASS samples was determined by the back titration method (Ahern *et al*. 2004).

All field and laboratory data were entered into the NRW Soil and Land Information (SALI) database and are available from NRW upon request.

Interpretation of field and laboratory data

The determination of which horizons constitute an AASS or PASS is based on an assessment of field morphological properties (e.g. soil colour, mottles and coarse fragments such as shell), field pH test results, and laboratory results. The texture-based action criteria (Ahern *et al.* 1998) are used to identify ASS based on laboratory results. The action criteria are based on the sum of existing acidity plus potential acidity (i.e. net acidity), soil texture and the amount of soil being disturbed. For disturbances of 1 to 1000 tonnes of soil, the action criteria are 0.03 %S for sands, 0.06 %S for loams to light clays, and 0.1 %S for medium to heavy clays. If more than 1000 tonnes of soil are being disturbed, the action criterion is 0.03% S regardless of texture. If these values are met or exceeded, the soil is classified as an acid sulfate soil and will require treatment. For the purposes of this report, the identification of ASS is based on the action criteria where the volume of disturbance is ≤1000 tonnes.

Potential sulfidic acidity was assessed using the S_{CR} method for PASS samples, or S_{POS} and TPA results for the AASS. If these values meet or exceed the texture-based ASS action criteria, the soil was identified as PASS. Existing acidity (i.e. AASS) was assessed using TAA laboratory results above the action criteria, the presence of jarosite and a field pH (pH_F) and/or laboratory value (pH_{KCl}) of 4 or less. Neutralising capacity was assessed using either the sum of reacted calcium (Ca_A) and magnesium (Mg_A) cations for the AASS, or the acid neutralising capacity back titration method (ANC_{BT}) for the PASS samples.

The results of selected laboratory analyses and field pH test results are reported in the Appendix.

Mapping unit categories

The presence and depth to ASS layers are the basis of the mapping units. The upper depth of the first horizon in which the action criteria have been exceeded is assigned a 'depth code' as follows:

- **S0** indicates ASS between 0 and 0.5 m,
- **S1** indicates ASS between 0.5 to 1 m,
- **S2** indicates ASS between 1 to 2 m,
- **S3** indicates ASS between 2 to 3 m,
- **S4** indicates ASS between 3 to 4 m,
- **S5** indicates ASS between 4 to 5 m,
- **S5**+ indicates ASS occurs at depths greater than 5 m.

If AASS layers were present, the horizon was assigned an A code, as well as the depth code as shown above. For example, **'A0'** denotes a horizon with a pH of 4 or less, occurring between depths of 0 and 0.5 m. As AASS usually overlie PASS, the 'A' code and the 'S' code are combined. For example **'A0S2'** denotes a soil layer with a pH of 4 or less, between depths of 0.0 and 0.5 m, overlying PASS at 1 to 2 m.

Some of the PASS layers were found to have either significant quantities of fine shell, or were strongly alkaline, thus providing effective acid neutralizing capacity. The 'N' subscript at the end of a map unit code indicates the presence of neutralising agents in the ASS sediments, e.g. $\mathbf{S2_N}$.

Other map units used in the study are:

$\mathbf{S_{LA}}$—(limited assessment) indicates land that was inaccessible to field survey because of its topography or thick vegetation, but was in a landscape position that indicated it had a high probability of being underlain by ASS.

LP—(low probability) indicates land above the inland extent of Holocene deposition, below, at or above an elevation of 5 m AHD (Australian Height Datum), which field survey showed had little if any probability of being underlain by ASS.

NA—(not assessed) indicates land not assessed by field survey, and therefore excluded from the defined ASS map units.

Soil mapping

The distribution of ASS was mapped onto 1988 black and white aerial photographs, based on interpretation of the field data and landforms identified on the photographs. Quite often, a distinct landform change was used to identify the probable limit of ASS. When this was not available, such as on the western side of the Proserpine River, the boundary was determined by continuing field investigations further inland until the ASS no longer occurred. Once analytical data were available, ASS areas were subdivided into units showing the AASS and/or PASS codings. PASS depth categories were coloured in shades of red, pink, orange and brown, with red denoting the shallowest depth. Where AASS were present, a yellow dot pattern was used to indicate this. Those map units which were found to have significant neutralising capacity, at least 1.5 times the level of oxidisable sulfur, are indicated on the map with a green dot pattern.

The location of each site is also shown on the map. As a reliable 5 m contour line was not available for this study area, no contours are included on the map. All lands found not to be underlain by ASS are mapped as LP, regardless of elevation. Cartographers at NRW Rockhampton transferred the linework from the aerial photographs to a base map to produce the ASS map.

3. Results: Description of ASS map units and analytical data

The Proserpine survey area consists almost entirely of the floodplain and estuarine lands of the Proserpine River from Conway Beach to the Lethe Brook, plus small areas of coastal sand deposits at Conway and Wilson Beach. The ASS mapping identified 277.1 ha of AASS, and 3220.5 ha of PASS (Table 1). However AASS may be underestimated, as the Goorganga Plain wetlands were mapped as the "S" map unit (1:100 000 scale mapping code). This scale of mapping does not indicate whether AASS is present. The rest of the survey area was mapped at 1:25 000 where the map units show the depth to AASS and/or PASS.

Table 1. Areas and proportions of the Proserpine ASS survey map units

Map unit	Map unit area (ha)	Percentage of area assessed (%)
Actual acid sulfate soils		
A0S2	30.8	0.5
A1	3.1	<0.1
A1S2	24.0	0.4
A1S3	18.4	0.3
A2S2	79.8	1.3
A2S3	70.3	1.1
A3S3	46.6	0.7
A4S4	4.1	<0.1
Total	**277.1**	**4.4**
Potential acid sulfate soils		
S0	126.6	2.0
S2	470.6	7.5
$S2_N$	9.8	0.1
S2/S3	6.5	0.1
S3	221.1	3.5
S3/S4	8.2	0.1
S4	243.9	3.9
S5	74.6	1.2
S5+	64.1	1.0
S (1: 100 000 scale mapping)	1709.7	27.1
S_W	11.4	0.2
Total	**2946.5**	**46.7**
Acid sulfate soil on undisturbed land		
S_{LA}	1152.8	18.3
Low probability land		
LP	1930.4	30.6
Total area	**6306.8**	**100.0**

On the western floodplain of the Proserpine River, AASS occur only on the Goorganga Plain wetlands. Outside the wetlands, only PASS were found. No relationship similar to this was found on the narrow eastern floodplain.

All of the AASS are underlain by PASS with the exception of one small area where the AASS directly overlies the basement clay. Laboratory data show that the AASS contain sulfide levels less than 0.03 %S in most soils. Retained acidity levels are also generally below this level as well, and there are only a few profiles that have %S contents for potential and retained acidity >0.1 %S. Actual acidity levels are dominantly between 10 to 70 mol H^+/t, with only a few greater than this, up to the maximum of 140 mol H^+/t.

PASS sampled as part of this survey consistently have between 1 and 2 %S. The Proserpine delta PASS are predominantly clay sediments and were found to have, on average, twice the sulfide levels of the Mackay and Bowen areas. Very few sandy PASS lenses were identified in the soils of the Proserpine delta.

On the west side of the Proserpine River, the PASS becomes progressively deeper the further inland it is from the Proserpine River or Lethe Brook. In the lower reaches on these rivers, the PASS in the red mangrove forests fringing the river is very shallow and occurs in the upper half metre of the profile (S0 map units). However due to access difficulties, the only S0 areas that could be mapped are on the Proserpine River to the south of the Salt Water Creek. Above the junction of Lethe Brook and the Proserpine River it appears from aerial photo interpretation that these fringing red mangrove forests no longer occur, with the PASS occurring between depths of one to two metres (S2 map units) in the more inland tidal areas.

There is a complete absence of the PASS that occurs between depths of 0.5 to 1 m, which is the S1 map unit. The S2 map units occur inland from the tidal lands. After this, the PASS gradually becomes deeper with distance inland with the S3, S4, S5 and S5+ occurring in succession. Whereas on the eastern floodplain, there is in places less correlation, with shallower PASS sometimes occurring further inland than the deeper areas of PASS.

The 'S' map unit (1:100 000 scale mapping) covers the largest area and comprises the dense mangrove forests of the tidal zone and the grazing lands of the Goorganga Plain.

The limited assessment lands (S_{LA}) include the extensive tidal lands where access was limited, while the LP map units consist of low-lying lands formed on either older alluvium or the footslopes of the surrounding rises and hills underlain by bedrock.

All of these areas are described in more detail in the following sections.

3.1 Actual acid sulfate soils on relatively undisturbed land

A0S2 (AASS layer 0 to 0.5 m depth and PASS layer 1 to 2 m depth)

Two A0S2 map units occur on the floodplain on the east side of the Proserpine River and have an area of 30.8 ha. Another A0S2 profile was found in a *Melaleuca* wetland at the end of Glen Isla road in the 1:100 000 S map unit on the western side of the river. These A0S2 soils mainly occur in wet swampy environments that have either blue gum, swamp or broad-leaved paperbark vegetation, or occasionally on saltpans.

These map units are characterised by thick, strongly acidic subsurface soils with a pH between 3.8 and 4.0 at 0.3 m, which often decreases to 3.1 in the lower subsoil. Soils typical have red, brown and jarosite mottled light or light medium clay AASS, overlying PASS. The AASS layers have TAAs of between 31 and 85 mol H^+/t (54 mol H^+/t average), oxidisable sulfur levels of <0.03 %S, and only two sites have a small amount of retained acidity in the jarosite equivalent to 0.06 to 0.11 %S.

The PASS occur at depths of 1.2 to 1.8 m and consist of very dark grey, light clays. These clays commonly have very high levels of sulfides that vary from 1.1 to 3.7 %S (1.8% average), except for one profile that has a thin PASS layer only 0.4 m thick with 0.11 %S.

A1 (AASS layer 1 to 2 m depth)

The A1 map unit (3.1 ha) occurs on the floodplain on east side of the Proserpine River in a small area between two mangrove-lined drainage depressions. The profile at this site has characteristic red mottles in the upper 0.85 m of the subsoil. The pH ranged from 3.9 to 4.3 from 0.8 to 2.25 m, and the TAA over this depth range varies from 14 to 47 mol H^+/t. Below 2.25m the pH increases to 5.5 and a sandy lens underlies the clay subsoil at 3.85 m. No jarosite mottles were observed. Sulfides were not recorded at any of the depths sampled (all <0.02 %S), and the retained acidity is also negligible (<0.01 %S). It is unclear as to whether the acidity in this soil is the result ASS oxidation.

A1S2 (AASS layer 0.5 to 1 m depth and PASS layer 1 to 2 m depth)

The A1S2 map units are found only on the eastern floodplain of the Proserpine River with another four profiles of this category occurring in the wetlands around Glen Isla Road (Photograph 5) and to the north of the Lethe Brook in the S map unit (1:100 000 scale mapping). The A1S2 map units occur in broad, vegetated drainage depressions or valley flats of small tributaries of the Proserpine River. The A1S2 map units cover a total area of 24 ha.

The vegetation of these landforms varies from forests of broad-leaved paperbark and swamp paperbark to blue-leaved paperbark on the Goorganga Plain wetlands. One site had also a poplar gum upper stratum with an understorey of broad-leaved paperbark. These soils have between 0.3 to 0.8m of black, light medium to medium heavy clay that overlies the mottled, AASS layer. The AASS layer is always a grey light clay with 20–50% red and brown mottles. Beginning at depths between 0.55 to 0.85 m, the AASS has TAA measurements of between 22 and 107 mol H^+/t (50 mol H^+/t average). The lower part of the AASS layer, which is usually 0.4 to 0.7 m thick, contains 2–20% of jarosite mottles that has between 0.02 to 0.15 %S of retained acidity (0.08 %S average).

The AASS commonly overlies PASS between depths of 1.2 to 1.9 m. The PASS is a dark or very dark grey light clay and apart from the very upper 0.2 m, has very high sulfide levels that vary from 1.2 to 2.5 %S, with an average of 1.3 %S. In two profiles, the upper 0.2 m of the PASS has lower sulfide levels of 0.2 and 0.5%. Also in some locations, a gley, heavy clay basement occurred below the grey clay PASS at depths of 2.3 and 2.9 m. The upper layer of this basement material is also sulfidic with sulfide levels in the order of 0.1 to 0.8 %S.

A1S3 (AASS layer 0.5 to 1 m depth and PASS layer 2 to 3 m depth)

All of the A1S3 profiles occur on the Goorganga Plain wetland on the western floodplain of the Proserpine River. Only one A1S3 map unit was identified with the other two profiles occurring in the broad scale S map unit. As a result this map unit category has an area of only 18.4 ha. The areas where the A1S3 soils occur have been cleared for sugar cane or grazing and have only remnant trees of broad-leaved paperbark remaining.

These soils have between 0.7 to 0.85 m of dark or grey mottled clay loam or light medium to medium heavy clay, (recent alluvial sediments) overlying the AASS. Extremely acid pH values (<4.0), begin at 1.0 m and often continue to depths of 2.5 to 3.5 m. The AASS is a dark grey to grey, light medium to medium clay with 20–50%, red, brown and yellow mottles. A jarosite horizon, with 2–20% jarosite mottles, occurs in the lower part of the AASS layer and is 0.5 to 1.0 m thick. It has a pH of 3.3 to 3.8 and TAA measurements of 35 to 121 mol H^+/t (74 mol H^+/t average). These horizons have very little sulfides remaining (<0.02 to 0.02 %S). However some residual acidity exists in the jarosite with S_{NAS} levels equivalent to up to 0.23 %S.

The AASS overlies the predominantly dark grey, light clay PASS which has sulfide contents of 0.4 to 2 %S (0.91 %S average). These A1S3 profiles also had one or more sandy lenses in the PASS layer that are 0.2 to 0.5 m thick. These lenses are often gravelly with 10–20%, rounded gravels of andesite and quartz, 2–60 mm in size. They also usually have lower levels of pyrite than the clay PASS sediments, with sulfide levels of between 0.34 to 0.88 %S. These sites were only sampled to 3.1–4.9 m and the basement heavy clays were not reached in any of these profiles.

A2S2 (AASS layer and PASS layer 1 to 2 m depth)

Six A2S2 map units occur on the alluvial plain on both sides of the Proserpine River, and an intertidal flat on the east side. This map unit is one of the larger ASS areas with a total area of 79.8 ha and only one profile occurs in the broad scale S map unit. Two of these floodplain map units are still vegetated and comprised forests of blue gum and poplar gum with a broad-leaved paperbark understorey on the alluvial plain. The intertidal flats have a dense forest of looking-glass mangrove with an understorey of large-leaved orange mangrove.

These soils typically have 0.5 to 1.5 m of mottled, dark or grey, medium to medium heavy clay (recent alluvium) overlying AASS sediments. The AASS layers begin at 1.15 to 1.6 m, are dark grey or grey, light or light medium clays with 20–50% red, brown and yellow mottles, and are 0.2 to 0.6 m thick. In about half of these profiles, the AASS is only strongly to very strongly acidic with pHs of 4.4 to5.5. The TAA measurements of these layers are low with levels from <10 to 26 mol H^+/t, whereas the extremely acid AASS layers with pHs of 3.5 to 4.0 have higher TAA values of 25 to 40 mol H^+/t. Jarosite occurs in nearly all of these AASS layers. These soils are generally low in sulfide content (<0.02 %S) with only one soil having 0.04 %S. The retained acidity in the jarosite is more significant at three sites with S_{NAS} levels of 0.05 to 0.11 %S, with the remainder being <0.03 %S.

At two sites the AASS directly overlies gley, heavy clay basement sediment at depths of 1.8 and 2.05 m. At other sites, the AASS is underlain by dark grey, light clay PASS that occurs at depths between 1.6 and 1.9m. Again these PASS sediments have very high sulfide levels that from 0.8 to 2.1 %S (1.2 %S average). Two sites also have some limited ANC, that is equivalent to 0.16 %S and 0.22 %S. However these levels do not exceed the sulfide content of the PASS, so these sediments are only partially self-neutralising.

A2S3 (AASS layer 1 to 2 m depth and PASS layer 2 to 3 m depth)

Despite having the most number of sites (9) of any map unit, only three areas were mapped, as most of the sites occur in the broad-scale S map unit, thus giving a total area of only 70.3 ha. Two of the map units are found to the south of the Glen Isla Road on the Goorganga Plain wetlands, with the remaining one adjacent to Palm Creek on the east floodplain of the Proserpine River. All of these areas are fully cleared for sugar cane or cattle grazing, while the Goorganga Plain has remnant trees of Moreton Bay ash, blue gum and blue-leaved paperbark.

These soils have 0.5 to 1.65 m of recent alluvium that overlies the AASS. This recent sediment is a dark, grey or dark grey-brown to yellow brown, mottled, light medium to medium heavy clay, occasionally with a clay loam topsoil. It has pH values that are dominantly between 4.4 and 6.0. The AASS begin at depths between 1.1 to 1.9m and are 0.5 to 1.3m thick. They are dark grey-brown, dark grey or grey, light or light medium clays with 20–50%, red and brown mottles. However despite being mainly extremely acidic with pHs of 2.8 to 4.0, jarosite is only present in half of the profiles. These soils have <2–10% of fine, jarosite mottles, but only low levels of retained acidity that are between <0.01 and 0.08 %S. The other profiles without jarosite do not have any retained acidity with S_{NAS} levels of <0.01 %S and 0.02 %S. All of the AASS have sulfide contents of between <0.02%S to 0.03 %S. The actual acidity levels varied from <10 mol H^+/t to 92 mol H^+/t, with an average of 44 mol H^+/t average.

The PASS occurs between depths of 2.2 to 2.8 m, except in one soil where the AASS directly overlies gley, heavy clay basement at 2.4 m. The majority of the PASS sediments are dark grey, light clays that have sulfide contents of between 0.74 %S and 1.9 %S (1.3 %S average). Three sites have sandy PASS layers that are between 0.4 to 1.2 m thick. These sandy sediments have significantly lower sulfide levels of between 0.03 %S to 0.25 %S (0.12 %S average), compared to the overlying clays. One of the clayey PASS layers also has some self neutralising capacity. The neutralizing capacity equivalent ranges from 0.19% to 1.1 %S, compared to the sulfide content of the PASS which ranges from 1.1% to 1.5 %S, which means the soil is only partially self-neutralising.

A3S3 (AASS layer and PASS layer 2 to 3 m depth)

Three A3S3 map units occur on the Goorganga Plain wetlands on the western floodplain of the Proserpine River, and have a total area of 46.6 ha. Two sites occur also in the broad-scale S map unit. Most of these areas have been cleared for sugar cane or cattle grazing, however one site still has remnant vegetation of poplar gum and Moreton Bay ash.

These soils have between 1.1 to 1.7m of dark, mottled, light medium to medium heavy clay (recent alluvium) that becomes dark grey or grey with 20 – 50%, brown or dark mottles below 0.5 to 1.2 m. This alluvium has pH values ranging from 4.2 to 6.2 and overlies AASS estuarine sediments. The AASS occur between depths of 2.1 and 2.6 m deep and as they become deeper, the layers are only 0.2 to 0.5 m thick. They are very dark grey, dark grey or grey-brown, light or light medium clays with 2–20% brown mottles and <2–10% jarosite mottles. One site has a clayey fine sand AASS, that although extremely acid (pH 3.7), does not contain any jarosite. All other soils have pH values of between 3.7 and 4.6 with TAA levels of between 11 and 80 mol H^+/t (35 mol H^+/t average). Two AASS sites have significant sulfide levels of 0.29 %S and 0.66 %S, while the remaining sites have less than 0.04 %S. Retained acidity levels are generally less than 0.02%S with only one site with an S_{NAS} of 0.1 %S.

PASS material occurs between 2.3 to 3.0 m and is predominantly a very dark or dark grey, light or silty light clay, except for two profiles which have sandy PASS lenses. This sandy PASS has only low sulfide levels of 0.07 %S and 0.29 %S (0.16 %S average), compared to the clay PASS which has much higher sulfide contents of between 0.8 %S and 2.1 %S (1.3 %S average). Site 774 has an alkaline clay PASS that has significant neutralizing capacity in the lower PASS layer. The upper metre of the PASS has sulfide contents of 0.9 %S and 1.6 %S with equivalent neutralizing capacity of 0.24 %S and 1.2 %S, and is therefore only partially self-neutralising. The lower metre of the PASS however has up to two times the neutralising capacity of the PASS with equivalent neutralising capacity of 1.3 %S and 1.8 %S, compared to the sulfide levels in the PASS of 0.6 %S and 1.3 %S. This is one of the few profiles where the neutralizing capacity exceeded the sulfide content of the PASS.

A4S4 (AASS layer and PASS layer 3 to 4m depth)

Only one A4S4 map unit was identified in the study area. It is located adjacent to the upper reaches of Lethe Brook. This unit has an area of only 4 ha, and has been cleared of all trees and sown to introduced grasses for cattle grazing. This soil has 3.5 m of recent alluvium over the ASS. This upper alluvial layer is a very dark grey, light medium clay to 0.85 m, overlying dark grey, medium clay with 10–20% brown mottles.

This alluvium overlies a thin AASS only 0.3 m thick, which is a dark grey, light clay with 2–20% jarosite mottles. This thin AASS has a sulfide content of 0.39 %S, retained acidity of 0.18 %S and a TAA of 131 mol H^+/t. A very dark grey, light clay PASS underlies the AASS at 3.85 m and has sulfide levels of 1.3 %S and 1.5 %S to the depth of sampling (4.8 m).

Photograph 5. Wetlands of the Goorganga Plain with AASS at 0.5 to 1 m, underlain by PASS at 2 m, A1S2 map units

Photograph 6. Red and grey mangrove forest fringing the tidal creeks and rivers with PASS in the surface 0.5 m, S0 map unit

Photograph 7. Mangrove forests of the S2 map units with looking-glass and milky mangrove

3.2 Potential acid sulfate soils on relatively undisturbed land

S0 (PASS layer 0 to 0.5 m depth)

There is only one S0 map unit in the study area, located in the narrow tidal zone on the east bank of the Proserpine River to the south of Salt Water Creek. The map unit has an area of 1709.7 ha. The mangrove forests in this map unit consist of dense stands of red mangrove with the interwoven aerial roots (Photograph 6) adjacent to the river and creeks, with low forests of grey mangrove that have an understorey of large-leaved orange mangrove in areas further away from the drainage lines.

The soils consist of very dark grey, dark grey or very dark grey brown, mangrove muds that display no profile development apart from a darkening from organic matter in the surface soil. The topsoil is sulfidic with low to moderate sulfide levels of 0.05 %S to 0.37 %S. The deeper mud layers below this vary in sulfide content from 0.2 %S to 2.3 %S. Overall these mangrove muds have a high average sulfide concentration of 1.1 %S. Deep sampling below 1.8 m was not possible as these sites were sampled with a hand gouge auger. No neutralising capacity was recorded.

S2 and $S2_N$ (PASS layer 1 to 2 m depth)

The S2 map units are one of the most extensive and occur on all of the landforms in the Proserpine survey area. They are found mainly on the slightly elevated, drier tidal areas adjacent to the Proserpine River and Lethe Brook (Photograph 7). This map unit also occurs in a large area on the fringe of the Goorganga Plain wetlands, on two low-lying areas on the east side floodplain, as well as on a small frontal dune area at Wilson Beach. The S2 maps units are therefore the most extensive with a total area of 480.4 ha. If more field sampling had been possible, then large areas of the S and S_{LA} map units most likely would have been mapped as S2.

The floodplain areas have been cleared for sugar cane or grazing with only remnant paperbarks, blue gums and Moreton Bay ash trees remaining. The drier tidal areas have a closed forest of looking-glass mangrove and milky mangrove, with a few cotton trees in the upper stratum, while wrinkle pod mangrove is most common in the mid-stratum. The ground layer is often bare or occasionally has thickets of the mangrove fern. On Lethe Brook, this vegetation association changes to a very tall closed forest of swampy paperbark with a tall mid-stratum of wrinkle pod mangrove (Photograph 8).

The soils on the floodplain and tidal areas consist of up to 0.3 m of dark surface light to medium clays that overlie mottled, dark grey, grey or grey-brown subsoils of light to medium clays that extend to depths of 1.1 to 1.85 m. These subsoils overlie the predominantly very dark grey to grey clay PASS. A few of the soils have dark grey, sandy PASS lenses within the clay sediments. Gley, heavy clay basement material underlies the PASS at depths of 2.6 to 4.7 m at three sites, but due to time constraints many of these profiles were only cored to depths of 3.0 m, so the basement may not have been reached.

The site at Wilson Beach however is sandy and consists of former beach deposits. The surface soil is a shelly, dark brown, fine sand that changes sharply to a shelly, clay loamy, non-pyritic sediment at 1.15 m. This overlies the interbedded shelly, fine sand and clay PASS at 1.9 m, which continues to the basement heavy clay at 4.7 m. This is the only profile that was fully self-neutralising throughout the PASS, which is indicated on the map as the $S2_N$ map unit. In this soil the sulfide content varies from 0.21 %S to 0.88 %S, while the equivalent neutralizing capacity in these sediments is between 1.9 %S to 11 %S, which exceeds the sulfide levels of the PASS.

Of all of the S2 sites analysed, those containing clay PASS have significantly higher sulfide levels than the sands. The clay PASS varies from 0.1 %S to 2.8 %S with an average of 1.1 %S, while the sandy sediments have sulfide contents ranging from 0.03 %S to 0.87 %S with an average of 0.23 %S. Only one loamy sediment was found, and it has a sulfide level of 0.21 %S.

S2/S3 (PASS layer 1 to 3 m depth)

The S2/S3 map unit occurs on a narrow channel bench on the east side floodplain between the river and the more elevated, older Pleistocene alluvial sediments. The two depths have been used in this map unit to indicate the highly variable surface elevation (up to one metre) of the channel benches, levees and overflow channels. This occurs in only one small map unit, with an area of 6.5 ha, near at the furthest inland occurrence of ASS on the Proserpine River.

The soil consists of 1.4 to 2.4 m of interbedded dark or dark brown, fine sandy, loamy and light medium clay (recent alluvial sediments), that overlie very dark grey, light clay PASS. Only the upper metre of the PASS was sampled and it contains sulfide levels of 0.05 %S in the upper 0.1 m, increasing to 1.0 %S and 1.2 %S at 0.5 m intervals below this. The clay PASS also has some partial ANC equivalent to 0.16 %S and 0.38 %S.

S3 (PASS layer 2 to 3 m depth)

The S3 map units are also extensive with six map units on both the eastern and western floodplains of the Proserpine River, and also in a small area at Wilson Beach. These maps units have a total area of 221.1 ha. Five S3 profiles also occur in the broad scale S map unit to the north of the Lethe Brook on the western side of the river. These areas are cleared and used for sugar cane or cattle grazing and have only remnant paperbarks, blue gums and Moreton Bay ash trees.

The soils of this map unit consist of a dark, light medium or medium clay topsoil overlying mottled, dark grey to brown, medium clay subsoil to 2.1 m (recent alluvium). Occasionally this upper alluvial sediment is underlain by up to one metre of a non-sulfidic, mottled, grey, light clay estuarine sediment. The predominant dark grey, light clay PASS occurs between depths of 2.1 to 2.9 m and apart from one profile, the upper part of the PASS is always clay. Many of these clay layers have lenses of sandy PASS that are 0.2 to 0.5 m thick. The soil of the S3 map unit at Wilson Beach however has 1.8 m of former sand dune deposit that overlies very gravelly, light clay PASS horizons. In the shallower parts of the basin, the gley, heavy clay Pleistocene basement layer occurred between depths of 4.35 m and 4.7 m.

The clay PASS has sulfide levels of 4.2 %S and 5.1 %S (the two highest levels recorded in this study). Overall the sulfide levels of the clay PASS varies from 0.12 %S to 5.1 %S with an average of 1.3 %S. Whereas the sand lenses have levels between 0.02 %S and 0.64 %S with an average of 0.26 %S. The two loamy PASS sediments sampled have low to moderate sulfide contents of 0.12 %S and 0.56 %S. The PASS at Wilson Beach did not contain any fine shell, but the PASS in several other profiles contained some limited neutralizing capacity. On two occasions the neutralizing capacity exceeded the sulfide content of the PASS, but is still below the 1.5 times threshold considered to be effectively self-neutralising. For the remainder, the neutralizing capacity is only equivalent to 13 to 82% of the sulfide content of the PASS. Therefore no self-neutralising S3 map units were mapped.

S3/S4 (PASS layer 2 to 4 m depth)

The only S3/S4 map unit occurs inland of the S2/S3 map unit on the channel bench of the Proserpine River, and is the most inland ASS unit on the Proserpine River. It covers an area of 8.2 ha. This map unit has an uneven topography (similar to that of levees and overflow channels), and varies in elevation by at least one metre. The soil on this channel bench consists of one to two metres of dark or dark brown, interbedded sands and sandy clays that overlie up to one and a half metres of non-sulfidic, very dark grey or grey, mottled light clay estuarine sediments overlying PASS at 2.6 to 3.6 m. This PASS material is a very dark grey, light clay with sulfide contents of between 0.9%S and 1.4 %S. In its upper 0.5 m, the PASS has a neutralizing capacity equivalent to 0.29 %S. The channel bench is currently growing sugar cane.

S4 (PASS layer 3 to 4 m depth)

There are five S4 map units mapped on the outer fringe of the ASS lands where they join the older Pleistocene alluvium of the LP map units, or the S5 and S5+ map units. The S4 units occur in large areas on the western floodplain around the edge of the Goorganga Plain wetlands, with a smaller map unit on the northern end of the ASS area on the eastern floodplain. The S4 map units have a total area of 243.9 ha. As all of these areas are used for growing sugar cane, except for one of the S4 map units on Lethe Brook which is in a fully cleared grazing block.

The overlying alluvial sediments identified in this unit contain interbedded sand and loamy sediments. The surface metre of soil is a dark, dark grey or dark brown, clay loam to medium clay overlying clay subsoil that either continues to the light clay estuarine sediments, or the sediments become interbedded lenses of sand, loam and clays that are 0.1 to 0.6 m thick. The dark grey PASS, which occurs between 3.1 to 3.8 m, are mainly clay sediments, with only a few profiles having sand lenses 0.2 to 0.5 m thick. Several profiles had also non-sulfidic sand lenses separating layers of clayey PASS sediments. The gley, heavy clay basement was only reached in shallower areas of the basin at depths of 3.6 to 4.4 m.

The clay PASS has significantly higher sulfide levels than the sandy sediments. The clays vary from 0.05 %S to 2.8 %S with an average of 1.1 %S. The sands have sulfide levels of between 0.04 %S and 0.4 %S, with an average of 0.17 %S. A few of the clay sediments displayed neutralising capacity in the field pH oxidation test. The neutralising capacity accounted for less than half of the sulfide content in the PASS, except for one layer of PASS which was very low in pyrite (0.05 %S) and this had a neutralising capacity equivalent to four times this amount of pyrite.

S5 (PASS layer 4 to 5 m depth)

Three S5 map units occur on the western floodplain of the Proserpine River and occupy an area of 74.6 ha. In all cases they occur between a S4 and either the S5+ or LP map units on the outer fringe of the lands underlain by ASS. These areas are all used for growing sugar cane and are fully cleared. One S5 site occurs in the frontal dunes at Conway Beach in the broad scale S map unit.

The overlying alluvial sediments consist of alternating lenses of sand, silts and clay in layers 0.1 to 1.2 m thick. These layers overlie clay or sandy PASS at depths of 4.1 to 4.9 m. The PASS sediments are also comprised of alternating layers of sands and clays, mainly 0.2 to 0.6 m thick. The clay PASS has sulfide levels between 0.4 %S and 2.5 %S with an average of 0.93 %S. In contrast, the sandy PASS has much lower sulfide levels between 0.04 %S and 0.54 %S, with an average of 0.19 %S. The PASS of these maps units were found to have only very limited neutralising capacity. One PASS layer recorded a neutralizing capacity of one-tenth of the sulfide content of the PASS, while another PASS layer with a sulfide level of 0.09 %S is fully self-neutralising with an equivalent sulfide content of 0.16 %S.

The sand dune at Conway Beach has pale brown, fine sandy, shelly aeolian sediments to a depth of 4.1 m. This overlies a shelly, sandy PASS with a sulfide level of 0.31 %S and a neutralising capacity equivalent to 2.5 %S and 2.9 %S. This upper sandy PASS layer also overlies a shelly light clay PASS layer that is also fully self-neutralising with an neutralising capacity equivalent to 3.2 %S and 4.4 %S, and a sulfide content of 0.55 %S. This profile is within the S map unit and so is not indicated as self-neutralising with the green dots on the map.

S5+ (PASS layer >5 m depth)

One S5+ map unit occurs on the western floodplain just to the east if the intersection of Tobin Road and the Pacific highway. It has an area of 64.1 ha. However another S5+ sites was described in the broad-scale S map unit at Conway Beach. The S5+ map unit is all under sugar cane, and the upper two metres of recent alluvial sediments consist mainly of a dark, medium clay, up to 1.2 m thick, that overlies mottled grey or brown, sandy, loamy or clayey interbedded sediments. These sediments

Photograph 8. Swamp paperbark forest on the Lethe Brook, S2 map units

Photograph 9. S2 map unit on a coastal dune at Wilson Beach

Photograph 10. Proserpine floodplain used for sugar cane with PASS at 3 to 6 m, S3 to S5map units

continue to depths of two to four metres after which sandy alluvial sediments occur. These sediments overlie the loamy or clayey PASS sediments at depths of 5.2 to 5.6 m. The PASS layers are only 0.2 m to 0.4 m thick and are underlain by more non-sulfidic, alluvial sand or clay sediments. Only five PASS samples were obtained from these profiles as the maximum depth of sampling is six metres. The one loamy sediment collected recorded a sulfide content of 0.06 %S, while the clays were slightly higher at 0.21 %S and 0.57 %S.

The site located in the S map unit is situated in a swale between the sand dunes at Conway Beach. This soil has 1.6 m of pale, fine aeolian sands that overlie 3.6 m of pale brown, fine sands that have 10–20% of fine, broken shells that are 2 – 20 mm in size. Fine sandy PASS occurs at 5.2 m and it also has 2–10% of fine shells that provide a neutralising capacity equivalent to 0.87 %S. However the sulfide content of this sandy PASS ranges between 0.05 %S and 0.06 %S and is therefore fully self-neutralising.

S (1:100 000 map unit)

The S map unit was used wherever the site density did not satisfy the requirements of 1:25 000 scale mapping. Time did not permit mapping the grazing lands at a more intensive scale due to delays to field work caused by the extended wet season in 2006. Also many of the tidal lands were only sampled at very wide intervals as access to these lands is severely limited by dense mangrove forests, and therefore it was not possible to map these lands in greater detail. The frontal dunes at Conway Beach were also only mapped as an S map unit as again access was restricted.

The sampling that was possible in these lands has been reported along with the data from the 1:25 000 map units in the preceding sections, and all of the analytical data for these sites is also in the appendix. Complete profile and pH data can be obtained from the NRW database upon request.

The S map units covered the floodplains, the frontal dunes at Conway Beach and the dense mangrove forests in the broad tidal flats of the Proserpine River. These map units cover a total area of 1709.7 ha.

S_W (PASS in permanently wet swamps)

Four small, permanently wet swampy areas were mapped as S_W units. The PASS in these closed depressions tended to be at shallower depths than on the surrounding lands and are up to two metres deep. All occur on the west side floodplain and are found in the broad scale 1:100 000 S map unit. They were all full of water during the period of field sampling.

3.3 Acid sulfate soils on undisturbed limited assessment land

S_{LA} (Limited field assessment on lands underlain by ASS)

The S_{LA} map unit includes the tidal areas along the Proserpine River that were inaccessible to even hand sampling due to dense vegetation or impassible drainage lines. It is reasonable to assume that these map units would have been similar to those where sampling was possible and would consist of shallow PASS (<0.5 m deep) in narrow strips immediately next to the river, with the PASS becoming progressively deeper (1 to 2 m deep) further inland. The vegetation is similar to those S0 and S2 map units with dense forests of red mangroves adjacent to the river and looking-glass mangrove, milky mangrove and cotton tree on the drier inland areas. The S_{LA} map units are quite extensive as these tidal areas are in the order of two kilometers wide. As a result they occupy a total area of 1152.8 ha.

3.4 Land with a low probability of acid sulfate soil occurrence

LP (Land with a low probability of being underlain by acid sulfate soils on elevations less than 20 m AHD)

In order to define the extent of the ASS, the soil sampling was either continued further inland, or higher in the landscape until two consecutive boreholes occurred that did not contain any ASS to a depth of six metres, or a landform boundary was identified that defined the extent of the Holocene ASS deposition. Therefore many boreholes were cored around the perimeter of the ASS area in order to fully define its boundary with the LP lands.

On the eastern side of the Proserpine River, the LP map unit consists of alluvial and colluvial lands to the footslopes of the nearby surrounding hills. On the western side of the Proserpine River, the floodplain extends many kilometres inland, so the LP map unit was restricted to just inland of the last boreholes. As an accurate 5 m contour line could not be obtained for this survey area, the LP map units consists of land both above and below an elevation of 5 m AHD, and are therefore not mapped separately in this study as they are in others. The LP map units have a total area of 1930.4 ha.

3.5 Potential acid sulfate soil analytical data summary

The PASS sediments in the study area comprised all three ASS texture groups of sands, loams and clays. The PASS however are mainly clays (80%), with just under one-fifth being sandy sediments (19%) and only four of the soils sampled were loamy sediments (1%). The clayey PASS have, on average, significantly higher sulfide levels than the sandy sediments, with an average of 1.2 %S compared to 0.31 %S for the sands (Figure 2). This is significantly different to the levels found in both the Mackay and Bowen ASS studies (Muller and Coutts 2005, Muller 2006), where the clay sediments averaged about 0.8 %S with the sands at around 0.25 %S.

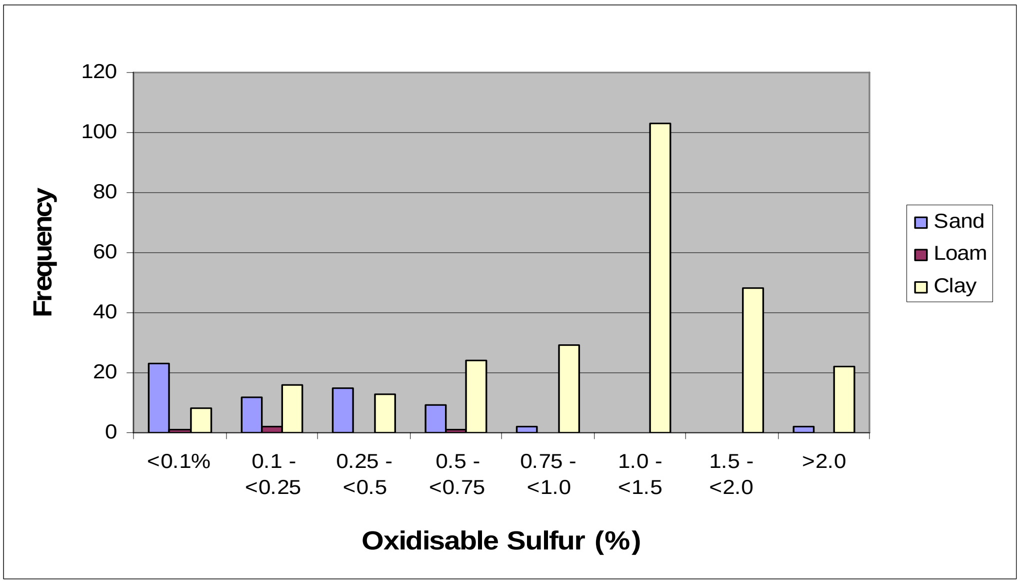

Figure 2. Frequency of PASS samples within oxidisable sulfur ranges for the three ASS texture groups

The %S levels of the sands are mainly less than 0.5%, with only four samples that were greater than 0.75%S, including the highest level of 2.3%. In comparison, the %S levels of the clay sediments are mainly higher than 0.75%S, with more than half being 1% or more. The clay PASS also has a very high maximum of 5%. A large number of the PASS horizons are greater than 1%S, while all the samples that are less than 0.25%S are always from the upper layer of a PASS. There are insufficient loamy PASS samples to make a comparison with the sand and clay sediments, with the four layers found being between 0.06%S to 0.52%S with an average of 0.23%S.

Photograph 11. Grazing lands mapped in the S map unit

Photograph 12. Swampy closed depression on the Goorganga Plain, S_W map unit

Photograph 13. Soil of the Proserpine River floodplain with PASS (dark grey sediment at end of third row of soil) beginning at 2.8 m, S3 map unit

4. Discussion

This study mapped only part of the Proserpine River delta to the north of Lethe Brook. There is at least twice as much of this type of floodplain between Lethe Brook and the O'Connell River. All of this area was mapped at a scale of 1:50 000 by Hardy (2003). Before this an interpretative ASS map for the Whitsunday shire was developed (Hardy 2001). The current project complements the mapping of Hardy (2003), which was based on soil cores to 1.8 m deep. Deeper boring to six metres has more precisely defined the inland extent of ASS.

The ASS at Proserpine consists of PASS, less than 2 m deep, throughout the mangrove and swamp paperbark forests that fringe the main watercourses of the Proserpine River and Lethe Brook. Surrounding these forests in the wetlands to the west of the Proserpine River are shallow AASS, again mainly less than two metres deep. These AASS are also underlain by PASS between two and three metres deep. The wetlands stop just to the north of Glen Isla road and these lands contain older Pleistocene alluvium which are not underlain by ASS. To the south of the Glen Isla road, a band of deep ASS continues almost to the Bruce Highway, and it only crosses across the highway in a kilometre wide strip that follows Lethe Brook. This deeper ASS consists mainly of PASS between three to six metres deep. The deposition of ASS to the east of the Proserpine River is restricted in width as the river runs close to the surrounding hills of the Conway Range. Most of the ASS are in the mangrove-forested tidal zone, with only small areas underlying the floodplain to the north of the Saltwater Creek, apart from the coastal deposits of ASS at Conway and Wilson Beaches.

The study identified 277.1 ha of AASS and 3220.5 ha of PASS. The AASS mainly occurred at depths of 0.5 to 1 m (A1 map units) and 1 to 2 m (A2 map units), while most of the PASS occurs between 1 to 2 m depth (S2 map units). There are only small areas of AASS greater than 2 m depth (A3 and A4 map units), while the PASS continues to depths of 6 m. This decreasing level of risk is reflected by the colour scheme on the ASS maps. The darker the red colour, the shallower the ASS and hence the greater risk of disturbance by excavation or lowering the watertable through deep drainage or dewatering.

The AASS contain less than 0.1% of oxidisable sulfur, which is similar to other areas where ASS have been mapped around Mackay and Bowen. Only a few of these layers had greater than this level present in the sediment either as unoxidised sulfides or as retained acidity in the jarosite. Levels of actual acidity are less than 70 mol H^+/t.

The PASS however recorded much higher levels of oxidisable sulfur than at Mackay or Bowen. This is most likely as the Proserpine River delta would have been a sheltered, still water environment that favoured the deposition of clay sediments. When sandy PASS were found, they were present mainly in thin layers between the clay sediments. The Proserpine River delta environment also favours the formation of pyrite with an average sulfide content in the clay PASS is 1.2%, which is 50% higher than values recorded in the Mackay and Bowen districts.

Some of the clay sediments were slightly alkaline but had limited neutralising capacity, which was mainly equivalent to 50% or less of the sulfide levels in the PASS. Only the sandy, shelly PASS at Wilson and Conway Beaches were found to have significant levels of neutralising capacity from the finely crushed shells. The neutralising capacity of this shelly material is equivalent to more than twice the sulfide levels in the PASS.

5. References

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6. Glossary

Acid sulfate soils (ASS): Soils or soil horizons which contain sulfides, or acid soil horizons affected by oxidation of sulfides. Acid sulfate soils is the common name given to naturally occurring sediments and soils containing iron sulfides (principally iron disulfide or their precursors). The exposure of the sulfide in these soils to oxygen by drainage or excavation leads to the generation of sulfuric acid. The term 'acid sulfate soils' includes both actual and potential acid sulfate soils. (See below).

Action criteria: The oxidisable sulfur (%S) values of soil samples which exceed the Queensland acid sulfate soils guidelines (Ahern *et al.* 1998). Soils that exceed these criteria are classed as ASS, and may require remedial treatment such as application of neutralising agents if disturbed or drained. The action criteria used as the determinant of PASS are:

- 0.03 %S or 18 mol H^+/t for sands
- 0.06 %S or 36 mol H^+/t for loams to light clays
- 0.1 %S or 62 mol H^+/t for light medium to heavy clays.

Note that when excavations exceed 1000 tonnes (or m^3), the action criterion of 0.03 %S or 18 mol H^+/t applies regardless of texture.

Actual acid sulfate soils (AASS): Soils containing highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulfides, primarily pyrite. This oxidation produces hydrogen ions in excess of the capacity of the sediment to neutralise the acidity, resulting in soils of pH of 4 or less, and often the formation of the iron mineral jarosite. These soils can usually be identified by the presence of yellow mottles and coatings of jarosite.

Anaerobic: Conditions where oxygen is excluded, usually by waterlogging.

Australian Height Datum (AHD): The datum used for determining elevations in Australia. Using a national network of benchmarks and tide gauges, a mean sea level has been set as zero elevation.

Borehole: The hole created when an auger or push tube is inserted into the soil body. The portion removed (the core) demonstrates the soil profile and is used for profile description and soil sampling.

Holocene: The period of time about 10 000 years before present. It is an epoch of the Quaternary period (the last 1.8 million years).

Jarosite: An acidic, pale yellow iron sulfate mineral, $KFe_3(OH)_6(SO_4)_2$. The most conclusive indicator of AASS, jarosite is a byproduct of the acid sulfate soil oxidation process, and forms at a pH less than 3.7. It is commonly found along root channels and other soil surfaces exposed to air.

Pleistocene: An epoch of the Quaternary period—the period of time from 1.8 million years ago to about 10 000 years ago (the start of the Holocene epoch).

Potential acid sulfate soils (PASS): Soils containing iron sulfides of sulfidic material, which have not been exposed to air or to have oxidised. The field pH of these soils in the undisturbed state can be 4.1 or more, and may be neutral or slightly alkaline. However, they pose a considerable environmental risk when disturbed, as they will become very acidic from oxidation of the iron sulfides to sulfuric acid when exposed to air.

Pyrite: Pale bronze or brass yellow, isometric mineral (FeS_2). It is the most widespread and abundant of the sulfide minerals.

Quaternary: A geological period of time extending from 1.8 million years ago to the present. It incorporates both the Pleistocene and Holocene epochs.

Watertable: The portion of the ground saturated with water; often used specifically to refer to the upper limit of the saturated ground.

Chemical acronyms used for acid sulfate soil analytical procedures

POCAS: Peroxide oxidation, combined acidity and sulfate method

SPOCAS: Suspension peroxide oxidation, combined acidity and sulfate method

pH_F: Field pH

pH_{FOX}: Field oxidised pH of the soil sample by 30% hydrogen peroxide

pH_{KCl}: pH of a 1:5 solution of soil and 1 molar (M) potassium chloride (KCl)

S_{CR}: Chromium reducible sulfur method

S_{POS}: Oxidisable sulfur measured by the SPOCAS method

TAA: Titratable actual acidity

TPA: Titratable peroxide acidity

TSA: Titratable sulfidic acidity

ANC_{BT}: Acid neutralising capacity estimated by the back titration method

Notes for the appendix

Texture codes: The texture codes, such as 'FS' for fine sand, used in the Appendix are from McDonald *et al.* (1990)

s-ANC_{BT}: The ANC converted to %S units, i.e. % $CaCO_3$ x 3.121 = equivalent %S

s-ANC: Acid neutralising capacity estimated by the sum of the reacted calcium and magnesium cations from the SPOCAS method, expressed in equivalent %S units

To convert mol H^+/t to the equivalent %S, divide by 623.7

The dotted line between some samples indicates a change in soil horizon, due mainly to texture, but also because of changes in colour, mottles, gravels and shells, calcareous and/or manganese concretions and sediment type.

Not all the SPOCAS and field pH data is presented in the Appendix. Full data sets are available from NRMW upon request. The data shown is only for those horizons that were sampled and analysed.

Appendix

Selected profile pH and analytical data

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
683	1.4-1.5	KS	6.5	4.5	<0.02							
	1.9-2.0	KS	6.4	4.8	<0.02							
	2.4-2.5	KS	6.2	4.2	<0.02							
	2.9-3.0	KS	6.1	3.9	<0.02							
	3.4-3.5	KS	6.4	3.9	<0.02							
	3.9-4.0	MC	6.3	6.1	<0.02							
	4.4-4.5	MHC	6.4	6.6	<0.02							
684	0-0.1	ZLMC	4.3	2.7	<0.02							
	0.2-0.3	ZLMC	4.8	3.7	<0.02							
	0.55-0.65	ZLC	4.3	6.5	<0.02							
	0.9-1.0	ZLC	3.8	3.1			22	10	<10	0.02		<0.02
	1.4-1.5	ZLC	5.2	3.2			<10	<10	<10	<0.01		<0.02
	1.9-2.0	ZLC	5.8	1.8	0.20							
	2.4-2.5	ZLC	6.2	1.2	1.4							
	2.9-3.0	ZLC	6.4	1.7	1.3							
	3.4-3.5	ZLC	6.6	1.6	1.3							
770	2.4-2.5	FSLMC	6.9	6.9	<0.02							
	2.9-3.0	FS	6.7	7.1	<0.02							
	3.9-4.0	FS	6.9	7.3	<0.02							
	4.4-4.5	KS	7.4	7.4	<0.02							
	4.9-5.0	KS	7.2	7.4	<0.02							
	5.7-5.8	KS	7.7	7.6	<0.02							
771	0-0.1	LMC	4.5	3.8	<0.02		88					
	0.2-0.3	LMC	4.6	3.4	<0.02		76					
	0.5-0.6	MC	4.2	4.3	<0.02		61					
	0.9-1.0	MC	3.8	4.3			39	21	<10	0.02		<0.02
	1.4-1.5	LMC	3.5	3.6			43	33	<0	0.03		<0.02
	1.8-1.9	LC	3.3	2.8			79	150	71	0.13		<0.02
	1.9-2.0	ZLC	3.4	1.0			87	393	306	0.51		<0.02
	2.4-2.5	ZLC	3.6	0.9			84	904	820	1.3		<0.02
	2.9-3.0	MHC	4.6	1.7	0.74		33					
	3.2-3.3	MHC	4.7	2.0	0.80		22					
772	0.2-0.3	MHC	4.4	3.9	<0.02		135					
	0.5-0.6	LMC	3.8	3.9			89	88	<10	0.04		<0.02
	0.9-1.0	LMC	3.5	3.6			71	75	<10	0.02		<0.02
	1.4-1.5	LC	3.4	3.7			54	63	<10	0.01		<0.02
	1.9-2.0	MC	3.3	3.7			51	46	<10	<0.01		<0.02
	2.4-2.5	MHC	3.5	4.0			53	54	<10	<0.01		<0.02
773	0.9-1.0	MHC	5.6	6.4	<0.02							
	1.9-2.0	MC	5.5	6.3	<0.02							
	2.9-3.0	MC	5.9	6.8	<0.02							
	3.9-4.0	MC	6.7	7.4	<0.02							
	4.9-5.0	MHC	6.7	7.2	<0.02							
774	0.9-1.0	MHC	6.6	6.9	<0.02							
	1.9-2.0	LC	5.2	4.5	<0.02							
	2.2-2.3	LC	4.0	3.5			24	24	<10	<0.01		<0.02
	2.4-2.5	LC	6.2	3.9	0.88	0.24						
	2.9-3.0	LC	7.0	5.3	1.6	1.2						
	3.4-3.5	LC	7.1	6.1	1.4	1.0						
	3.9-4.0	LC	7.5	6.5	1.3	1.3						
	4.4-4.5	ZLC	6.9	6.4	0.63	1.8						
	4.9-5.0	ZLC	6.9	6.3	0.63	1.3						
	5.4-5.5	ZLC	6.9	6.5	1.1	0.87						

Site	Depth	Texture	pH_F	pH_{FOX}	S_{CR}	s-ANC_{BT}	TAA	TPA	TSA	S_{POS}	S_{NAS}	s-ANC
	(m)				%S	%S	mol H^+/t			%S	%S	%S
775	1.4-1.5	LC	5.5	5.9	<0.02							
	1.9-2.0	LC	5.7	2.9	0.08							
	2.4-2.5	LC	6.6	2.2	1.2	0.93						
	2.9-3.0	LC	6.5	5.3	1.2	0.93						
	3.4-3.5	LC	6.9	5.4	1.1	1.3						
	3.9-4.0	LC	7.0	5.7	1.2	0.99						
	4.2-4.3	S	7.5	5.4	0.53	0.16						
	4.4-4.5	MHC	6.8	7.9	0.16	0.38						
776	0-0.1	LMC	4.3	3.8	<0.02							
	0.5-0.6	LMC	3.7	3.6			71	75	<10	0.01		<0.02
	0.9-1.0	LMC	3.6	3.5			58	55	<10	0.02		<0.02
	1.4-1.5	LC	3.3	3.3			44	39	<10	<0.01	0.01	<0.02
	1.9-2.0	LC	3.4	2.4	0.05		52	160	108	0.13		<0.02
	2.4-2.5	LC	3.9	1.6	1.4		80	1067	987	1.6		<0.02
	2.9-3.0	LC	5.4	1.8	1.1							
	3.4-3.5	LC	5.8	1.9	1.4							
	3.65-3.75	MHC	7.0	7.3	0.58	0.29						
777	0.9-1.0	MC	7.0	5.9	<0.02							
	1.9-2.0	MC	7.1	6.2	<0.02							
	2.9-3.0	FSLMC	6.2	5.3	<0.02							
	3.9-4.0	FSLC	7.7	6.8	<0.02							
	4.9-5.0	CFS	7.6	5.9	<0.02							
778	0-0.1	LMC	7.2	6.2	<0.02							
	0.5-0.6	LMC	6.2	5.4	<0.02							
	0.9-1.0	LC	5.9	5.1	<0.02		<10	<10	<10	0.08	0.02	<0.02
	1.4-1.5	LC	5.8	2.4	0.36							
	1.7-1.75	LC	6.1	0.3	1.2							
779	1.9-2.0	LMC	6.9	6.5	<0.02							
	2.4-2.5	FSLC	6.8	5.6	<0.02							
	2.9-3.0	LC	6.4	1.7	0.12							
	3.4-3.5	LC	6.1	1.4	1.2							
	3.9-4.0	LC	6.5	1.2	1.1							
	4.4-4.5	KS	5.6	1.4	0.06							
	4.9-5.0	KS	5.5	1.6	<0.02							
780	1.4-1.5	MC	6.5	5.3	<0.02							
	1.9-2.0	LMC	6.0	4.8	<0.02							
	2.4-2.5	LC	4.7	4.1			<10	<10	<10	0.01		<0.02
	2.9-3.0	LC	3.4	0.8			80	464	384	0.66	0.10	<0.02
	3.4-3.5	LC	6.4	1.1	1.3							
	3.9-4.0	LC	6.6	1.1	1.4							
	4.4-4.5	LC	6.8	1.2	1.3							
	4.9-5.0	LC	6.9	1.1	0.96							
	5.4-5.5	LC	6.8	1.0	1.1							
781	0.9-1.0	LMC	6.0	5.1	<0.02							
	1.4-1.5	LC	4.5	3.8	<0.02		24					
	1.9-2.0	LC	4.5	1.6	0.53		41					
	2.4-2.5	LC	6.4	1.1	1.5							
	2.9-3.0	LC	6.5	1.1	1.5							
	3.4-3.5	FSMHC	7.0	6.8	0.32	0.29						
782	0.9-1.0	LMC	6.1	5.6	<0.02							
	1.4-1.5	LC	5.6	4.8	<0.02							
	1.9-2.0	LC	6.0	1.7	2.0							
	2.4-2.5	S	6.6	2.2	0.15							
	2.7-2.8	KS	6.5	2.3	0.05							
	2.9-3.0	KS	6.5	6.4	<0.02							
	3.9-4.0	KS	6.7	6.3	<0.02							
	4.9-5.0	KS	7.3	5.8	<0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
783	0.9-1.0	LMC	6.8	6.1	<0.02							
	1.4-1.5	LMC	6.4	5.9	<0.02							
	1.9-2.0	LC	6.1	1.4	0.65							
	2.4-2.5	LC	6.2	0.7	1.9							
	2.9-3.0	LC	6.2	1.0	0.87							
	3.4-3.5	LC	6.3	0.9	1.2							
	3.9-4.0	S	6.8	1.4	0.07							
	4.1-4.1	LC	6.4	1.2	1.4							
784	1.9-2.0	LMC	5.7	5.1	<0.02							
	2.2-2.3	FS	6.4	5.4	<0.02							
	2.4-2.5	LC	5.9	1.7	0.65							
	2.9-3.0	LC	5.9	1.6	1.1							
	3.4-3.5	KS	6.2	1.4	0.61							
	3.9-4.0	KS	7.5	1.0	0.32							
	4.2-4.3	KS	7.1	1.9	0.02							
	4.4-4.5	MC	7.4	5.7	<0.02							
785	1.9-2.0	KS	6.3	4.9	<0.02							
	2.4-2.5	KS	7.0	5.2	<0.02							
	2.9-3.0	KS	7.2	4.8	<0.02							
	3.4-3.5	S	7.1	1.4	0.40							
	3.9-4.0	LC	6.6	1.4	2.1							
	4.4-4.5	LC	6.7	1.7	1.8							
786	1.9-2.0	LMC	6.6	5.3	<0.02							
	2.4-2.5	MC	6.5	5.0	<0.02							
	3.4-3.5	MC	7.0	6.4	<0.02							
	3.9-4.0	FS	7.1	4.8	0.02							
	4.4-4.5	FS	7.4	4.2	<0.02							
	4.6-4.7	KS	6.8	1.5	0.06							
	4.9-5.0	FS	6.7	1.2	2.1							
	5.4-5.5	FS	7.3	1.3	0.54							
	5.9-6.0	LC	6.6	1.9	0.27							
787	0.9-1.0	FSLC	6.2	6.8	<0.02							
	1.9-2.0	FSLC	7.0	7.8	<0.02							
	2.9-3.0	LMC	7.1	6.2	<0.02							
	3.9-4.0	LMC	7.1	5.0	<0.02							
	4.05-4.1	MC	7.4	7.2	<0.02							
788	0.9-1.0	FSLC	7.4	6.3	<0.02							
	1.9-2.0	LMC	6.9	6.0	<0.02							
	2.9-3.0	SCL	7.0	6.5	<0.02							
	3.9-4.0	LC	7.3	7.2	<0.02							
	4.9-5.0	FS	7.2	6.6	<0.02							
	5.4-5.5	FSL	6.6	3.4	0.06							
	5.9-6.0	ZLC	6.1	3.4	0.02							
789	1.9-2.0	S	5.7	5.3	<0.02							
	2.4-2.5	LC	6.3	5.0	<0.02							
	2.9-3.0	MHC	6.6	6.1	<0.02							
790	1.9-2.0	MC	6.3	6.9	<0.02							
	2.9-3.0	LMC	6.2	6.1	<0.02							
	3.4-3.5	LC	6.1	4.5	0.05							
	3.9-4.0	LC	6.2	2.4	1.6							
	4.4-4.5	LC	6.4	1.1	0.78							
	4.9-5.0	LC	6.1	1.1	0.89							
	5.4-5.5	LC	6.2	1.1	0.98							
791	1.9-2.0	MC	6.7	6.6	<0.02							
	2.4-2.5	LC	5.9	5.7	0.17	0.19						
	2.9-3.0	LC	6.3	1.3	1.5							
	3.4-3.5	LC	6.3	1.4	1.2							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
791 cont	3.9-4.0	LC	6.3	1.8	1.0							
	4.4-4.5	LC	6.3	1.9	0.92							
	4.9-5.0	LC	6.2	1.8	0.74							
	5.4-5.5	KS	6.3	1.2	0.12							
796	0.9-1.0	LMC	7.7	5.5	<0.02							
	1.9-2.0	SLC	6.6	4.9	<0.02							
	2.9-3.0	KS	6.3	5.3	<0.02							
	3.9-4.0	LMC	6.6	5.3	<0.02							
	4.9-5.0	LMC	7.3	6.0	<0.02							
	5.7-5.8	MHC	7.3	6.2	<0.02							
797	1.9-2.0	FS	7.3	6.6	<0.02							
	2.9-3.0	FS	7.6	7.5	<0.02							
	3.4-3.5	FS	7.6	4.7	<0.02	2.9						
	3.9-4.0	FS	7.4	5.0	<0.02	1.6						
	4.4-4.5	FS	7.4	5.0	<0.02	1.3						
	4.9-5.0	FS	7.5	5.1	<0.02	2.4						
	5.4-5.5	FS	7.6	4.9	<0.02	0.77						
798	1.9-2.0	LC	6.0	5.7	<0.02							
	2.9-3.0	S	6.6	5.4	<0.02							
	3.2-3.3	S	7.1	4.8	0.02							
	3.4-3.5	S	6.8	1.7	0.13							
	3.9-4.0	S	6.6	5.3	<0.02							
	4.4-4.5	KS	6.2	5.3	<0.02							
	4.9-5.0	KS	6.7	5.0	<0.02							
	5.4-5.5	FS	6.3	1.7	0.24							
802	0.9-1.0	FS	7.5	8.2	<0.02							
	1.4-1.5	CLFS	6.9	6.6	<0.02	1.6						
	1.9-2.0	FSCL	7.0	6.2	0.21	1.9						
	2.4-2.5	FS	7.2	6.6	0.87	2.6						
	2.9-3.0	LC	7.4	6.9	0.88	3.6						
	3.4-3.5	LC	7.4	6.3	0.66	4.7						
	3.9-4.0	LC	7.5	7.0	0.67	10.8						
	4.4-4.5	LC	7.4	6.1	0.88	7.1						
	4.7-4.8	MC	8.1	1.8	0.32	1.1						
803	0.9-1.0	FS	7.1	6.2	<0.02							
	1.4-1.5	FS	7.5	6.2	<0.02							
	2.4-2.5	LC	7.2	4.8	0.16	0.22						
	3.4-3.5	LC	7.2	6.2	<0.02							
	3.9-4.0	LC	7.0	6.7	<0.02							
	4.4-4.5	LC	6.9	1.0	4.2							
	4.7-4.8	LMC	7.0	1.7	3.0							
804	1.9-2.0	KS	6.8	6.5	<0.02							
	2.9-3.0	KS	7.1	5.5	<0.02							
	3.3-3.4	KS	6.4	6.2	<0.02							
	3.5-3.6	LC	6.3	1.9	0.24							
	3.9-4.0	KS	6.7	5.3	<0.02							
	4.4-4.5	KS	6.3	3.7	<0.02							
805	1.9-2.0	MC	6.1	6.5	<0.02							
	2.9-3.0	MC	6.0	5.6	<0.02							
	3.9-4.0	LMC	6.5	6.1	<0.02							
	4.9-5.0	LMC	7.0	7.5	<0.02							
	5.6-5.7	S	6.9	6.7	<0.02							
806	1.9-2.0	MC	6.3	7.5	<0.02							
	2.9-3.0	MC	6.9	5.9	<0.02							
	3.9-4.0	MC	6.7	5.7	<0.02							
	4.9-5.0	LC	7.7	7.8	<0.02							
	5.9-6.0	LC	7.0	7.2	<0.02							

Site	Depth	Texture	pH_F	pH_{FOX}	S_{CR}	s-ANC_{BT}	TAA	TPA	TSA	S_{POS}	S_{NAS}	s-ANC
	(m)				%S	%S	mol H^+/t			%S	%S	%S
807	1.9-2.0	LMC	6.4	5.7	<0.02							
	2.9-3.0	FS	6.9	6.5	<0.02							
	3.9-4.0	FS	6.6	5.9	<0.02							
	4.6-4.7	FS	6.6	5.2	<0.02							
	4.9-5.0	KS	6.6	6.0	<0.02							
	5.4-5.5	KS	6.1	1.9	<0.02							
	5.6-5.7	LC	6.4	2.1	0.21							
	5.9-6.0	KS	6.3	5.4	<0.02							
808	0.9-1.0	MC	7.4	5.9	<0.02							
	1.9-2.0	S	6.6	5.9	<0.02							
	2.9-3.0	FSLC	6.0	5.3	<0.02							
	3.9-4.0	MC	6.6	6.4	<0.02							
	4.4-4.5	MC	6.9	6.8	0.02							
809	1.7-1.8	LC	6.2	3.4	<0.02							
	2.4-2.5	FSLC	6.1	3.7	0.02							
	2.9-3.0	S	6.2	4.9	<0.02	<0.15						
	3.17-3.2	LC	6.2	4.2	<0.02	0.16						
	3.7-3.8	S	6.9	2.4	<0.02	<0.15						
	4.2-4.3	S	7.0	2.0	0.03	<0.15						
	4.9-5.0	S	6.9	5.7	<0.02							
	5.4-5.5	S	6.2	1.6	0.04							
	5.7-5.8	LC	6.3	1.8	0.63							
810	0-0.1	LMC	5.6	3.7	<0.02							
	0.9-1.0	FSLMC	6.6	5.2	<0.02							
	1.9-2.0	LMC	7.0	6.1	<0.02							
	2.4-2.5	LMC	7.3	5.9	<0.02							
	2.9-3.0	LC	6.3	5.3	<0.02							
	3.4-3.5	LC	6.4	1.5	0.53	0.16						
	3.9-4.0	LMC	7.3	7.3	<0.02							
	4.4-4.5	LMC	7.5	7.3	<0.02							
	4.9-5.0	LMC	6.5	7.2	<0.02							
811	0.9-1.0	MC	6.5	5.7	<0.02							
	1.6-1.7	LC	3.9	3.1			31	23	<10	0.04		<0.02
	1.9-2.0	LC	5.1	3.6	1.1	0.16						
	2.4-2.5	LC	5.7	4.5	0.83	0.16						
	2.9-3.0	LC	6.2	2.6	0.88	<0.1						
	3.4-3.5	KS	5.8	3.2	<0.02							
	4.4-4.5	KS	6.3	6.1	<0.02							
	4.6-4.7	KSLMC	6.2	6.0	<0.02							
	4.9-5.0	MHC	6.4	6.0	<0.02							
812	0.5-0.6	MHC	6.1	5.4	<0.02							
	0.9-1.0	LMC	5.8	5.1	<0.02		<10				<0.01	
	1.4-1.5	LC	6.2	5.9	<0.02		<10				0.07	
	1.9-2.0	LC	6.4	6.2	<0.02		<10				<0.01	
	2.4-2.5	LC	6.6	3.1	1.3	0.19						
	2.9-3.0	LC	7.4	4.5	1.5	0.67						
	3.4-3.5	LC	7.1	4.7	1.1	0.48						
	3.9-4.0	LC	7.2	5.2	1.2	0.51						
	4.4-4.5	LC	7.6	6.8	1.2	1.1						
	4.9-5.0	FSMC	7.8	8.4	0.06	0.26						
813	0.9-1.0	LMC	6.6	7.1	<0.02							
	1.9-2.0	MHC	7.8	7.0	<0.02							
	2.9-3.0	MHC	7.3	6.4	<0.02							
	3.9-4.0	MHC	7.5	6.6	<0.02							
	4.9-5.0	MHC	7.3	7.2	<0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	$s\text{-}ANC_{BT}$ %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
814	0.5-0.6	MC	4.6	3.4	<0.02		29					
	0.9-1.0	LMC	4.7	3.9	<0.02		16					
	1.4-1.5	LMC	5.2	4.3	<0.02		<10					
	1.6-1.7	LC	5.5	4.8	<0.02		11				0.10	
	1.9-2.0	LC	6.3	6.9	<0.02		<10-				0.06	
	2.1-2.2	LC	6.3	7.1	<0.02							
	2.8-2.9	MHC	6.7	7.2	<0.02							
815	0.9-1.0	MC	7.7	6.4	<0.02							
	1.9-2.0	MC	7.3	6.6	<0.02							
	2.9-3.0	FSMC	6.9	6.3	<0.02							
	3.2-3.3	FS	7.3	6.3	<0.02							
	3.9-4.0	MC	7.1	6.7	<0.02							
	4.9-5.0	MC	6.9	6.3	<0.02							
	5.9-6.0	MHC	6.9	6.5	<0.02							
816	1.4-1.5	MC	5.5	4.2	<0.02							
	1.9-2.0	LC	3.7	2.9	<0.02		44				<0.01	
	2.4-2.5	LC	3.7	1.2	0.05		69				<0.01	
	2.7-2.8	FS	3.8	3.2	<0.02		16				<0.01	
	2.9-3.0	KS	4.3	3.1	<0.02		<10				<0.01	
	3.9-4.0	KS	6.4	5.5	<0.02							
	4.9-5.0	LC	6.2	3.1	0.32	0.16						
	5.4-5.5	KS	6.1	2.1	<0.02							
817	0.5-0.6	LC	4.7	4.1	<0.02		40				0.01	
	0.9-1.0	LC	4.4	3.8	<0.02		35				<0.01	
	1.4-1.5	LMC	3.8	3.4	<0.02		61				<0.01	
	1.9-2.0	MC	3.2	3.7	<0.02		30				<0.01	
	2.4-2.5	ZLMC	5.6	3.5	0.35							
	2.9-3.0	ZLMC	6.9	6.8	<0.02							
818	1.4-1.5	MC	6.1	5.6	<0.02							
	1.9-2.0	LC	5.3	5.5	<0.02							
	2.4-2.5	LC	5.5	2.1	0.06							
	2.9-3.0	LC	5.8	1.5	1.6							
	3.4-3.5	LC	6.6	2.3	1.4	0.32						
	3.9-4.0	LC	6.8	1.9	1.5	0.35						
	4.4-4.5	LC	7.3	2.4	1.2	0.45						
	4.9-5.0	LC	7.2	2.2	1.1	0.42						
	5.4-5.5	LC	7.0	2.0	0.95	0.48						
819	1.4-1.5	LMC	7.3	6.8	<0.02							
	1.9-2.0	LMC	7.1	6.5	<0.02							
	2.4-2.5	LC	5.3	3.5	<0.02	0.16						
	2.9-3.0	LC	6.8	2.5	0.24	0.16						
	3.1-3.2	KSL	6.8	6.3	0.12	<0.15						
	3.4-3.5	S	6.8	1.8	0.06	<0.15						
	3.9-4.0	KS	7.1	3.4	<0.02	<0.15						
	4.4-4.5	KS	6.9	2.3	0.02	<0.15						
	4.9-5.0	KS	6.8	2.4	<0.02	<0.15						
	5.4-5.5	KS	6.7	3.8	<0.02	<0.15						
820	0.9-1.0	MC	6.8	7.2	<0.02							
	1.4-1.5	LMC	6.3	5.7	<0.02							
	1.9-2.0	LC	5.7	4.8	<0.02							
	2.2-2.3	LC	3.7	1.2	0.29		46				0.02	
	2.4-2.5	LC	5.8	1.8	1.6							
	2.9-3.0	LC	7.0	1.7	1.8							
	3.4-3.5	LC	7.3	2.0	1.9							
	3.9-4.0	LC	7.2	1.3	1.7							
	4.4-4.5	KS	7.5	1.8	0.10							
	4.9-5.0	KS	7.5	2.0	0.09							
	5.4-5.5	KS	7.3	1.9	0.14							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA mol H^+/t	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
821	1.4-1.5	LMC	6.9	6.2	<0.02							
	1.9-2.0	LC	5.9	5.3	<0.02							
	2.4-2.5	LC	5.9	1.2	1.6							
	2.9-3.0	LC	6.7	1.8	1.6							
	3.4-3.5	LC	6.6	1.5	1.6							
	3.9-4.0	LC	6.1	1.8	1.4							
	4.4-4.5	LC	6.0	1.3	1.1							
	4.9-5.0	LC	5.4	1.7	1.0							
	5.4-5.5	KS	6.5	1.5	0.38							
822	0.9-1.0	FSL	6.7	6.8	<0.02							
	1.3-1.4	FS	6.5	5.2	<0.02							
	1.4-1.5	LC	6.6	4.8	<0.02	0.19						
	1.9-2.0	ZLMC	6.6	3.7	0.02	0.19						
	2.4-2.5	LC	7.0	4.2	0.02	<0.15						
	2.9-3.0	LC	6.5	4.3	0.05	0.16						
	3.4-3.5	LC	7.1	1.7	2.7							
	3.9-4.0	MC	8.4	9.1	0.42	0.29						
823	0-0.1	LMC	5.4	5.2	<0.02							
	0.9-1.0	MC	8.2	7.6	<0.02							
	1.9-2.0	FSLC	7.3	7.0	<0.02							
	2.9-3.0	FSLC	7.0	6.1	<0.02							
	3.4-3.5	FS	7.0	6.4	<0.02							
	3.8-3.9	MHC	7.2	6.4	<0.02							
824	0.9-1.0	MC	7.0	7.4	<0.02							
	1.2-1.3	LC	7.3	6.8	<0.02							
	1.4-1.5	LC	7.1	7.0	0.02	0.22						
	1.9-2.0	LC	6.3	1.3	1.0							
	2.4-2.5	LC	6.0	1.7	1.4							
	2.9-3.0	LC	7.1	1.4	1.1							
	3.4-3.5	LC	6.5	4.7	1.2	0.29						
	3.9-4.0	LC	7.0	1.1	1.6							
	4.4-4.5	KS	7.4	1.5	0.37	<0.15						
	4.9-5.0	CLFS	7.4	7.1	<0.02							
	5.4-5.5	CLFS	6.7	6.9	<0.02							
825	0.5-0.6	MHC	5.1	4.3	<0.02		29					
	0.8-0.9	LMC	4.6	3.6	<0.02		53				0.01	
	0.9-1.0	LMC	3.8	3.5	<0.02		77				<0.01	
	1.4-1.5	LC	3.6	3.0	<0.02		121				<0.01	
	1.9-2.0	LC	3.4	2.3	<0.02		153					
	2.4-2.5	KS	3.9	1.2	0.88		55					
	2.7-2.8	LC	4.4	1.1	0.41		108					
	2.9-3.0	KS	5.3	1.0	0.34							
826	1.9-2.0	MC	7.2	6.4	<0.02							
	2.4-2.5	LMC	6.9	6.3	<0.02							
	2.9-3.0	LC	7.1	6.1	0.07	0.19						
	3.4-3.5	LC	6.9	2.2	2.8	0.22						
	3.9-4.0	LC	6.1	1.2	0.73							
	4.4-4.5	KS	7.0	1.3	0.24							
	4.9-5.0	LC	7.1	1.7	1.0							
	5.4-5.5	KS	6.8	1.8	0.06							
827	0.9-1.0	FSLC	5.8	5.2	<0.02							
	1.4-1.5	LMC	5.9	5.3	<0.02							
	1.7-1.8	LC	6.0	6.0	<0.02							
	1.9-2.0	LC	6.3	1.8	0.17							
	2.4-2.5	LC	6.2	1.4	2.1	<0.15						
	2.9-3.0	S	7.5	2.1	0.1	<0.15						
	3.4-3.5	S	7.6	3.3	0.03	<0.15						
	3.9-4.0	S	7.8	4.2	0.02	<0.15						

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
828	0.9-1.0	MC	7.6	7.9	<0.02							
	1.4-1.5	MC	6.6	6.1	<0.02							
	1.9-2.0	LC	6.1	5.7	<0.02							
	2.4-2.5	LC	6.2	1.6	1.1							
	2.9-3.0	LC	6.4	1.8	1.3							
	3.4-3.5	KS	7.7	1.6	0.1							
	3.9-4.0	KS	8.0	6.2	<0.02	<0.15						
	4.1-4.2	MHC	8.0	7.2	<0.02	0.16						
829	0.9-1.0	FS	6.5	6.1	<0.02							
	1.9-2.0	S	6.6	6.2	<0.02							
	2.85-2.95	LC	5.5	4.8	<0.02							
	2.95-3.0	KS	6.5	6.3	<0.02							
	3.9-4.0	KS	6.9	6.4	<0.02							
	4.4-4.5	LC	5.6	4.3	0.09	0.16						
	4.6-4.7	KS	6.6	5.3	<0.02	<0.15						
	4.9-5.0	KS	6.4	1.8	0.15							
	5.4-5.5	KS	6.3	5.9	<0.02	<0.15						
830	1.4-1.5	FS	7.5	8.6	<0.02							
	1.9-2.0	FS	7.9	8.0	<0.02	1.2						
	2.4-2.5	FS	8.2	9.0	<0.02	1.4						
	2.9-3.0	FS	8.1	9.3	<0.02	2.1						
	3.4-3.5	FS	8.1	9.2	<0.02	3.5						
	3.9-4.0	FS	8.1	9.1	<0.02	2.6						
	4.4-4.5	FS	8.4	9.5	<0.02	2.2						
	4.9-5.0	FS	8.4	9.3	<0.02	2.2						
	5.1-5.2	FS	8.4	7.0	<0.02	1.5						
	5.4-5.5	FS	9.2	6.9	0.06	0.93						
	5.9-6.0	FS	8.9	6.5	0.05	0.8						
832	0.9-1.0	KS	5.6	5.6	<0.02							
	1.4-1.5	LC	5.9	5.7	<0.02							
	1.9-2.0	LC	6.1	5.9	<0.02	0.29						
	2.4-2.5	MC	6.6	6.3	<0.02	0.29						
833	0.9-1.0	LMC	6.9	6.3	<0.02							
	1.9-2.0	MC	6.8	5.8	<0.02							
	2.9-3.0	FS	6.3	5.7	<0.02							
	3.9-4.0	KS	6.4	6.0	<0.02							
	4.9-5.0	KS	6.3	6.2	<0.02							
834	0.9-1.0	LMC	6.7	5.6	<0.02							
	1.9-2.0	CFS	6.2	5.7	<0.02							
	2.9-3.0	FS	6.3	5.9	<0.02							
	3.9-4.0	FS	7.1	6.2	<0.02							
	4.4-4.5	FS	6.1	5.8	<0.02							
	4.65-4.75	FS	6.3	5.2	<0.02	<0.15						
	4.8-4.9	FS	6.2	5.1	<0.02	<0.15						
	4.9-5.0	LC	6.2	5.7	<0.02	0.19						
	5.35-5.45	LC	6.3	1.6	0.57							
	5.5-5.6	KS	7.1	6.5	<0.02							
835	0.9-1.0	MHC	7.9	7.2	<0.02							
	1.9-2.0	MHC	8.0	7.3	<0.02							
	2.9-3.0	FSMC	7.9	7.4	<0.02							
	3.9-4.0	LMC	7.6	7.2	<0.02							
	4.9-5.0	LMC	7.5	7.0	<0.02							
836	1.9-2.0	LMC	6.5	5.5	<0.02							
	2.9-3.0	MC	6.6	5.6	<0.02							
	3.9-4.0	SLC	7.0	6.0	<0.02							
	4.9-5.0	KS	7.0	6.2	<0.02							
	5.4-5.5	ZLC	6.4	3.8	0.03	0.38						
	5.9-6.0	ZLC	7.0	7.5	<0.02	0.42						

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA mol H^+/t	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
837	0.9-1.0	MC	6.6	5.4	<0.02							
	1.4-1.5	LMC	6.1	5.2	<0.02							
	1.9-2.0	LMC	5.0	4.3	<0.02		22					
	2.2-2.3	LC	5.5	1.3	0.78		49					
	2.4-2.5	LC	5.9	1.2	2.0							
	2.9-3.0	LC	6.5	1.9	0.62							
	3.4-3.5	LC	5.8	2.1	1.3	<0.15						
	3.9-4.0	LC	6.5	3.6	1.2	0.16						
	4.4-4.5	LC	6.5	1.5	0.8							
	4.9-5.0	KS	6.4	1.8	0.3							
838	0.95-1.0	LC	6.9	6.4	<0.02							
	1.4-1.5	ZL	7.0	5.6	<0.02							
	1.55-1.65	ZLC	6.8	4.3	<0.02							
	1.9-2.0	ZLC	6.7	3.9	0.02							
	2.4-2.5	MC	6.8	7.0	<0.02							
839	0.9-1.0	MC	7.4	7.6	<0.02							
	1.9-2.0	FSLMC	6.9	7.7	<0.02							
	2.9-3.0	LMC	7.3	6.9	<0.02							
	3.9-4.0	LMC	7.2	6.5	<0.02							
	4.9-5.0	MHC	7.1	6.4	<0.02							
840	1.9-2.0	MC	6.7	7.9	<0.02							
	2.4-2.5	MC	6.9	6.0	<0.02							
	2.9-3.0	LC	7.4	7.8	<0.02							
	3.4-3.5	LC	6.5	1.7	2.6							
	3.9-4.0	LC	6.7	1.5	1.1							
	4.4-4.5	KS	6.8	1.8	0.08							
	4.9-5.0	KS	7.1	2.1	0.04							
841	1.9-2.0	FSLMC	7.4	7.8	<0.02							
	2.9-3.0	FS	6.5	6.3	<0.02							
	3.9-4.0	FS	6.6	6.5	<0.02							
	4.4-4.5	FS	6.0	2.4	0.04	<0.15						
	4.9-5.0	LC	5.9	2.3	1.2	0.19						
	5.4-5.5	LC	6.8	2.0	2.5	0.26						
842	0.9-1.0	MC	7.4	7.6	<0.02							
	1.9-2.0	MC	7.1	6.1	<0.02							
	2.9-3.0	MHC	6.5	6.3	<0.02							
	3.9-4.0	MHC	6.5	6.2	<0.02							
	4.9-5.0	MHC	7.2	6.3	<0.02							
	5.9-6.0	MHC	6.6	6.0	<0.02							
843	0.9-1.0	MC	6.0	5.4	<0.02							
	1.9-2.0	MC	5.3	5.2	<0.02							
	2.9-3.0	MHC	5.8	5.4	<0.02							
	3.9-4.0	MHC	5.9	5.6	<0.02							
	4.9-5.0	MHC	6.5	6.0	<0.02							
	5.0-6.0	MHC	7.1	6.0	<0.02							
844	0.9-1.0	MC	7.0	6.4	<0.02							
	1.9-2.0	LC	6.5	6.3	<0.02							
	2.9-3.0	SLC	7.1	6.6	<0.02							
	3.9-4.0	KSLC	6.7	5.7	<0.02							
	4.9-5.0	MHC	6.2	5.9	<0.02							
845	0.9-1.0	LMC	7.1	6.7	<0.02							
	1.9-2.0	LC	7.2	7.1	<0.02							
	2.4-2.5	LC	7.0	6.3	<0.02							
	2.9-3.0	LC	6.0	5.5	1.1							
	3.4-3.5	LC	7.0	1.8	1.0	0.48						
	3.9-4.0	LC	6.9	1.6	0.87							
	4.4-4.5	LC	7.2	1.7	0.94	0.45						
	4.7-4.8	FS	6.9	1.6	0.09							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
845 cont	4.9-5.0	KS	7.1	2.8	<0.02							
	5.4-5.5	KS	7.0	1.8	0.03							
	5.51-5.6	LC	6.8	1.0	5.1							
846	1.4-1.5	MC	6.4	7.0	<0.02							
	1.9-2.0	LC	5.7	5.1	0.02							
	2.3-2.4	LC	6.4	5.8	<0.02		<10				0.01	
	2.55-2.65	LC	6.7	4.3	0.04							
	2.9-3.0	S	6.8	6.3	<0.02							
	3.4-3.5	S	7.3	4.3	0.02							
	3.9-4.0	S	7.2	4.4	0.03							
	4.4-4.5	S	7.5	6.3	<0.02							
	4.9-5.0	S	7.6	6.1	<0.02							
	5.4-5.5	S	7.3	1.9	0.04							
	5.7-5.8	LC	6.6	1.5	0.57							
847	0.9-1.0	LMC	4.3	3.9	<0.02		30					
	1.4-1.5	LC	3.5	2.6	<0.02		50					
	1.9-2.0	LC	3.3	2.2	<0.02		58					
	2.4-2.5	LC	4.4	1.6	1.9		63					
	2.9-3.0	LC	6.0	1.6	1.8							
	3.4-3.5	LC	6.6	1.4	1.2							
	3.9-4.0	LC	7.0	1.5	1.7							
	4.4-4.5	KS	7.2	1.5	0.24							
	4.9-5.0	LC	6.5	1.4	1.1							
848	1.4-1.5	MC	6.8	5.8	<0.02							
	1.9-2.0	LC	5.3	2.6	<0.02							
	2.4-2.5	LC	6.4	1.3	1.7							
	2.9-3.0	LC	6.8	1.4	1.4							
	3.4-3.5	S	6.7	1.3	0.57							
	3.9-4.0	S	6.6	1.5	0.54							
	4.1-4.2	LC	6.7	1.1	1.2							
	4.4-4.5	KS	7.0	5.0	<0.02							
	4.7-4.8	MHC	7.1	7.2	<0.02							
849	0.9-1.0	MC	3.8	3.4	<0.02		35					
	1.4-1.5	LMC	3.4	2.9	<0.02		101					
	1.9-2.0	LC	3.3	3.0			76	75	<10	0.02	0.05	<0.01
	2.2-2.3	LC	3.1	2.3			100	111	11	0.02	0.23	<0.01
	2.4-2.5	LC	2.8	1.6	0.07		140					
	2.9-3.0	LC	3.3	1.8	0.83		103					
	3.2-3.3	KS	3.7	1.5	0.37		17					
	3.4-3.5	LC	3.6	1.7	1.0		86					
	3.9-4.0	LC	5.3	1.4	1.3							
850	0.9-1.0	MC	5.9	5.0	<0.02							
	1.9-2.0	LC	3.1	2.4			36	23	<10	<0.01	<0.01	0.01
	2.4-2.5	LC	2.8	2.0			32	22	<10	0.02	0.01	<0.01
	2.9-3.0	LC	5.3	0.7	1.4		30					
	3.4-3.5	LC	6.1	1.2	1.2							
851	0-0.1	LMC	6.2	4.7	<0.02							
	0.4-0.5	LMC	6.7	6.3	<0.02							
	0.9-1.0	LC	6.2	5.6	<0.02							
	1.4-1.5	LC	6.1	5.6	<0.02							
	1.9-2.0	LC	6.3	0.7	1.0							
852	0.5-0.6	LMC	3.9	3.3	<0.02		34					
	0.9-1.0	LMC	3.3	3.0	<0.02		42					
	1.4-1.5	LC	3.2	0.7			103	398	295	0.42	0.07	<0.01
	1.9-2.0	LC	4.0	0.8	1.8		85					
	2.4-2.5	LC	5.5	0.2	1.8							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
853	0.9-1.0	MHC	6.4	5.4	<0.02							
	1.4-1.5	LMC	4.2	3.3	<0.02		39					
	1.9-2.0	LC	3.6	3.0			75	80	<10	<0.01	0.01	<0.01
	2.4-2.5	LC	3.5	2.8			92	115	23	0.02	0.01	<0.01
	2.85-2.95	LC	3.7	1.2	1.1		76					
	3.4-3.5	KS	6.7	2.0	0.05							
	3.9-4.0	KS	7.1	2.0	0.03							
	4.4-4.5	KS	6.7	0.9	0.42							
854	1.9-2.0	FSLC	6.4	5.7	<0.02							
	2.4-2.5	KS	5.6	4.1	<0.02							
	2.6-2.65	LC	5.8	0.9	1.6							
	2.75-2.8	LC	5.4	1.2	2.2							
	2.9-3.0	FS	5.7	2.3	0.08							
	3.4-3.5	FS	5.7	2.0	0.64							
	3.9-4.0	KS	6.2	2.1	0.02							
	4.4-4.5	LC	6.1	1.5	0.89							
855	0-0.1	LC	6.7	4.7	<0.02							
	0.5-0.6	LC	6.5	5.5	<0.02							
	0.9-1.0	LC	6.1	5.2	<0.02							
	1.4-1.5	LC	6.5	1.8	0.11							
	1.9-2.0	LC	6.2	1.6	0.34							
856	1.4-1.5	LMC	3.9	3.4	<0.02		62					
	1.9-2.0	LC	3.8	3.2			76	78	<10	<0.1	<0.01	<0.01
	2.4-2.5	LC	4.3	3.1			37	22	<10	<0.01	0.01	<0.01
	2.6-2.7	FS	4.2	3.1			28	16	<10	0.01	0.02	<0.01
	2.9-3.0	FS	4.3	2.9	<0.02		23					
	3.4-3.5	FS	6.1	1.5	0.2							
	3.9-4.0	FS	6.3	1.5	0.36							
	4.4-4.5	FS	6.9	0.9	0.5							
	4.9-5.0	FS	7.4	2.0	0.27							
857	0.5-0.6	MHC	4.3	3.2	<0.02		42					
	0.9-1.0	LMC	3.6	3.2			33	18	<10	0.01	0.04	0.04
	1.4-1.5	LC	3.4	2.9			38	21	<10	0.02	0.02	0.04
	1.9-2.0	LC	5.3	1.1	2.5							
	2.4-2.5	LC	6.0	1.1	1.7							
	2.9-3.0	LC	6.2	1.4	1.6							
	3.4-3.5	LC	6.2	1.5	1.6							
858	0.9-1.0	LC	6.2	5.7	<0.02							
	1.4-1.5	LC	6.3	5.8	<0.02							
	1.9-2.0	LC	6.6	1.3	1.3							
	2.4-2.5	LC	7.0	1.6	1.4							
	2.9-3.0	LC	7.1	1.5	1.3							
	3.4-3.5	LC	7.2	1.6	2.5	0.74						
859	0.9-1.0	MC	7.0	6.4	<0.02							
	1.9-2.0	FS	5.4	4.9	<0.02		<10					
	2.4-2.5	FSL	5.9	4.9	<0.02							
	2.9-3.0	CFS	6.5	1.8	0.59							
	3.4-3.5	CFS	7.1	1.6	0.71							
	3.9-4.0	CFS	6.6	1.3	0.27							
860	0.9-1.0	LC	4.4	2.9	<0.02		40					
	1.4-1.5	LC	4.0	2.9			35	21	<10	0.01	0.03	<0.01
	1.9-2.0	LC	5.6	1.3	0.56							
	2.4-2.5	LC	6.1	1.7	1.5							
	2.9-3.0	LC	7.1	1.3	1.4							
861	0.9-1.0	LC	6.9	7.3	<0.02							
	1.4-1.5	LC	7.1	6.6	<0.02							
	1.9-2.0	LC	7.2	1.1	2.2							
	2.3-2.4	FS	7.6	5.2	0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
862	0.9-1.0	LMC	7.0	7.5	<0.02							
	1.4-1.5	KS	6.1	4.9	<0.02							
	1.9-2.0	LC	6.9	1.7	0.81							
	2.3-2.4	FS	6.7	5.6	<0.02							
863	0.9-1.0	LMC	6.8	7.4	<0.02							
	1.9-2.0	MC	7.0	6.0	<0.02							
	2.9-3.0	MC	7.3	6.2	<0.02							
	3.9-4.0	MC	7.5	6.2	<0.02							
	4.9-5.0	MC	7.0	5.7	<0.02							
	5.9-6.0	MC	7.0	6.1	<0.02							
864	0.9-1.0	MHC	7.1	7.9	<0.02							
	1.9-2.0	SC	8.0	6.4	<0.02							
	2.9-3.0	SC	7.9	6.4	<0.02							
	3.9-4.0	SC	8.1	6.1	<0.02							
	4.9-5.0	MHC	7.9	5.9	<0.02							
865	0.9-1.0	LMC	5.3	4.6	<0.02							
	1.4-1.5	LMC	5.7	4.3	<0.02							
	1.9-2.0	LMC	6.2	5.4	<0.02							
	2.4-2.5	LMC	5.9	3.8			11	10	<10	0.04	<0.01	<0.01
	2.9-3.0	LC	4.3	1.6	0.82		59					
	3.4-3.5	LC	6.6	2.3	1.1							
	3.9-4.0	LC	7.0	2.0	0.89							
	4.4-4.5	LC	7.3	2.4	2.1							
	4.7-4.8	S	7.3	2.2	2.3							
866	0.9-1.0	LMC	5.8	5.1	<0.02							
	1.9-2.0	LMC	6.1	5.7	<0.02							
	2.9-3.0	LMC	6.4	5.0	<0.02							
	3.4-3.5	LC	5.7	2.4	0.99							
	3.9-4.0	LC	6.6	1.8	0.91							
	4.4-4.5	LC	6.6	1.9	1.2							
867	0.9-1.0	MC	7.7	7.3	<0.02							
	1.9-2.0	MC	7.8	6.8	<0.02							
	2.9-3.0	MC	7.6	8.0	<0.02							
	3.9-4.0	MHC	7.7	8.2	<0.02							
	4.9-5.0	MHC	7.7	8.5	<0.02							
868	0.9-1.0	S	6.7	6.6	<0.02							
	1.4-1.5	S	6.8	6.2	<0.02							
	1.9-2.0	LC	6.6	4.0	<0.02	0.22						
	2.3-2.4	LC	6.2	3.3	0.02	0.16						
	2.4-2.5	MHC	6.4	4.1	<0.02							
	2.9-3.0	MHC	7.0	6.0	<0.02							
869	0.9-1.0	MHC	6.2	5.6	<0.02							
	1.9-2.0	MC	6.7	8.3	<0.02							
	2.9-3.0	MC	7.0	5.1	<0.02							
	3.2-3.3	LC	6.7	5.0	<0.02							
	3.7-3.8	LC	6.7	1.7	1.1							
	4.2-4.3	LC	7.3	1.6	1.3							
	4.6-4.7	LC	6.9	1.8	1.2							
870	0.9-1.0	S	5.6	4.2	<0.02							
	1.9-2.0	MC	6.6	2.7	<0.02							
	2.4-2.5	MC	6.0	3.1	<0.02							
	2.9-3.0	MC	5.9	4.9	<0.02							
	3.4-3.5	MC	6.3	6.2	<0.02							
	3.9-4.0	MC	7.0	7.0	<0.02							
871	0.9-1.0	LMC	6.7	6.0	<0.02							
	1.9-2.0	LMC	5.9	5.5	<0.02							
	2.9-3.0	LMC	6.6	5.8	<0.02							
	3.9-4.0	LMC	6.8	5.6	<0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
872	0.9-1.0	MC	6.5	5.4	<0.02							
	1.9-2.0	MC	6.2	5.2	<0.02							
	2.9-3.0	MC	6.4	7.5	<0.02							
	3.6-3.7	LC	3.2	1.6			131	33	212	0.39	0.18	0.02
	4.1-4.2	LC	5.3	1.8	1.3							
	4.7-4.8	LC	6.9	2.1	1.5							
873	1.9-2.0	LMC	7.2	7.1	<0.02							
	2.9-3.0	FS	6.6	6.3	<0.02							
	3.9-4.0	LC	6.3	5.8	<0.02							
	4.4-4.5	LC	6.6	6.3	<0.02							
	4.9-4.95	LC			0.4							
	5.4-5.5	LC	6.9	1.2	0.99							
874	1.4-1.5	S	6.9	5.8	<0.02							
	1.9-2.0	FSLC	6.3	5.4	<0.02							
	2.55-2.6	FS	6.2	4.6	<0.02							
	2.9-3.0	KS	6.7	2.1	<0.02							
	3.4-3.5	LC	6.3	2.3	0.02							
	3.9-4.0	LC	6.2	2.4	0.03							
875	1.9-2.0	FSMC	8.0	6.5	<0.02							
	2.9-3.0	FSMC	7.9	7.5	<0.02							
	3.9-4.0	SMC	7.8	7.5	<0.02							
	4.9-5.0	MC	7.9	7.7	<0.02							
	5.9-6.0	MC	7.2	7.0	<0.02							
876	1.9-2.0	FSLC	6.0	5.1	<0.02							
	2.9-3.0	MC	6.2	5.5	<0.02							
	3.9-4.0	MC	6.1	5.7	<0.02							
	4.9-5.0	MC	6.1	5.9	<0.02							
	5.9-6.0	SLMC	6.4	5.9	<0.02							
877	0.9-1.0	S	5.5	5.3	<0.02							
	1.9-2.0	KS	6.5	5.7	<0.02							
	3.2-3.3	KS	6.6	2.4	<0.02							
	3.9-4.0	LC	6.7	2.1	0.05							
	4.2-4.3	LC	6.8	2.8	0.05							
	4.6-4.7	MHC	6.8	5.1	<0.02							
878	1.9-2.0	LMC	7.2	8.3	<0.02							
	2.9-3.0	MC	6.9	8.5	<0.02							
	3.9-4.0	MHC	6.8	5.8	<0.02							
	4.9-5.0	MHC	6.9	5.9	<0.02							
	5.9-6.0	MHC	7.3	5.8	<0.02							
879	0.9-1.0	LMC	3.6	4.6			35	23	<10	<0.01	<0.01	<0.01
	1.4-1.5	LMC	3.5	4.3			39	28	<10	<0.01	<0.01	0.01
	1.8-1.9	LMC	3.3	3.9			40	38	<10	0.02	0.02	0.01
	2.4-2.5	LC	4.2	1.5	2.0		44					
	2.9-3.0	LC	5.2	1.6	1.1							
	3.4-3.5	LC	5.6	2.1	0.91							
	3.9-4.0	LC	5.7	2.0	0.98							
	4.8-4.9	FS	6.5	2.1	0.74							
880	0.9-1.0	LMC	5.4	5.0	<0.02							
	1.4-1.5	LMC	4.1	4.3	<0.02		10					
	1.9-2.0	LC	4.3	4.1			17	<10	<10	0.03	0.04	<0.01
	2.2-2.3	LC	6.0	1.4	1.6							
	2.7-2.8	LC	6.5	1.8	0.9							
	3.2-3.3	LC	7.0	2.0	1.3							
	3.7-3.8	LC	6.9	2.1	1.3							
	4.2-4.3	LC	6.9	2.0	1.3							
	4.7-4.8	LC	7.8	1.7	0.74							

Site	Depth	Texture	pH_F	pH_{FOX}	S_{CR}	s-ANC_{BT}	TAA	TPA	TSA	S_{POS}	S_{NAS}	s-ANC
	(m)				%S	%S	mol H^+/t			%S	%S	%S
881	0.9-1.0	LMC	7.2	5.5	<0.02							
	1.9-2.0	MC	6.2	4.9	<0.02							
	2.9-3.0	MC	6.3	5.3	<0.02							
	3.9-4.0	MC	6.1	4.1	<0.02							
	4.7-4.8	MC	6.0	5.1	<0.02							
882	1.4-1.5	LC	4.4	3.9	<0.02		15					
	1.9-2.0	LC	3.9	3.1			27	19	<10	<0.01	<0.01	0.01
	2.3-2.4	LC	3.4	2.3			34	26	<10	0.02	0.09	0.01
	2.9-3.0	LC	3.9	1.2	1.5		54					
	3.4-3.45	LC	-	-	1.2							
	3.9-4.0	S	6.5	1.2	0.25							
883	0.9-1.0	MC	6.4	5.8	<0.02							
	1.2-1.3	LMC	4.4	4.3	<0.02		23					
	1.5-1.6	LC	4.5	3.8	<0.02		28					
	1.9-2.0	CFS	4.2	4.1			12	<10	<10	<0.01	<0.01	<0.01
	2.4-2.5	CFS	3.8	3.4			12	79	67	0.07	<0.01	<0.01
	2.9-3.0	FS	5.8	1.3	0.29							
	3.4-3.5	FS	5.9	0.8	0.26							
884	0-0.1	LMC	5.1	1.8	0.02		52					
	0.5-0.6	LMC	5.2	3.6	<0.02							
	0.9-1.0	LC	6.0	5.0	<0.02							
	1.4-1.5	LC	6.5	7.1	<0.02							
	1.9-2.0	LC	6.6	1.9	0.17							
	2.4-2.5	LC	6.9	1.8	1.1							
	2.9-3.0	LC	7.1	1.8	1.1							
	3.4-3.5	LC	7.4	1.9	1.2							
885	0.9-1.0	FSMC	6.9	6.8	<0.02							
	1.9-2.0	LMC	7.3	6.7	<0.02							
	2.9-3.0	MC	7.1	6.7	<0.02							
	3.9-4.0	MHC	7.1	6.1	<0.02							
	4.7-4.8	MHC	6.9	6.0	<0.02							
886	0-0.1	LMC	6.6	4.6	<0.02							
	0.5-0.6	LMC	6.7	6.5	<0.02							
	0.9-1.0	LC	6.5	5.8	<0.02							
	1.4-1.5	LC	6.5	2.0	1.4							
	1.9-2.0	LC	7.3	2.3	1.2							
	2.4-2.5	LC	7.0	1.7	0.78							
887	0.9-1.0	LMC	6.7	5.9	<0.02							
	1.4-1.5	LMC	4.9	4.5	<0.02		20					
	1.9-2.0	LMC	3.8	3.5			53	34	<10	0.01	0.02	0.01
	2.4-2.5	LC	3.4	2.8			82	69	<10	0.02	0.08	0.01
	2.9-3.0	LC	3.6	2.8			75	85	10	0.03	0.02	0.01
	3.4-3.5	LC	5.9	1.3	1.4							
	3.9-4.0	LC	5.7	1.4	1.2							
	4.4-4.5	LC	6.0	2.1	1.4							
888	0.9-1.0	MC	6.2	5.6	<0.02							
	1.9-2.0	MC	7.1	8.5	<0.02							
	2.9-3.0	MHC	7.2	6.0	<0.02							
	3.9-4.0	MHC	7.5	8.8	<0.02							
	4.7-4.8	MHC	7.5	8.7	<0.02							
889	1.9-2.0	KSLC	6.7	5.5	<0.02							
	2.9-3.0	KSLC	7.3	6.0	<0.02							
	3.9-4.0	KSLC	7.2	5.8	<0.02							
	4.9-5.0	KSLC	7.0	5.9	<0.02							
	5.9-6.0	KSLC	7.3	6.4	<0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA mol H^+/t	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
890	0.9-1.0	LMC	7.0	6.0	<0.02							
	1.9-2.0	LMC	7.1	5.9	<0.02							
	2.9-3.0	FSLC	7.3	6.2	<0.02							
	3.9-4.0	FSLC	7.2	5.8	<0.02							
891	0.9-1.0	LMC	6.7	5.9	<0.02							
	1.9-2.0	MC	6.4	5.6	<0.02							
	2.9-3.0	MHC	7.1	5.9	<0.02							
	3.9-4.0	MHC	7.1	6.3	<0.02							
	4.7-4.8	MC	7.0	5.8	<0.02							
892	0.9-1.0	MC	6.9	8.4	<0.02							
	1.9-2.0	MC	5.9	5.0	<0.02							
	2.9-3.0	MC	5.1	5.8	<0.02							
	3.9-4.0	MC	5.8	5.8	<0.02							
	4.7-4.8	MC	6.5	5.9	<0.02							
893	0.9-1.0	FS	6.6	5.9	<0.02							
	1.9-2.0	FS	8.4	8.7	<0.02							
	2.4-2.5	FS	8.1	5.8	<0.02							
	2.9-3.0	FS	7.7	5.9	<0.02	3.7						
	3.4-3.5	FS	7.4	6.0	<0.02	4.4						
	3.9-4.0	FS	7.4	5.9	<0.02	2.1						
	4.4-4.5	FS	7.3	6.3	0.31	2.5						
	4.9-5.0	FS	7.4	6.2	0.31	2.9						
	5.4-5.5	LC	7.4	6.0	0.55	3.2						
	5.9-6.0	LC	7.5	6.4	0.55	4.4						
894	0-0.1	MC	4.4	3.5	<0.02		64					
	0.4-0.5	LC	-	-	<0.02		31				0.02	
	0.9-1.0	LC	3.2	2.7	<0.02		49				0.02	
	1.2-1.3	LC	5.3	2.5	0.03		11					
	1.9-2.0	FSLC	5.4	4.2	<0.02							
	2.3-2.4	FSLC	-	-	0.11	0.42						
895	0.9-1.0	FSLC	5.3	5.5	<0.02		35					
	1.9-2.0	FSLMC	5.1	5.1	<0.02		18					
	2.9-3.0	FSLMC	5.1	5.1	<0.02		22					
	3.9-4.0	FSL	5.3	4.5	<0.02		11					
	4.7-4.8	KSLC	5.1	4.9	<0.02							
896	0-0.05	LC	7.0	6.1	0.05	0.48						
	0.2-0.3	LC	7.0	5.8	0.19	0.38						
	0.5-0.6	LC	7.0	3.2	0.63	0.26						
	0.9-1.0	LC	6.7	1.7	1.1							
	1.4-1.5	LC	7.5	2.0	2.3							
897	0.9-1.0	LMC	5.4	5.4	<0.02							
	1.9-2.0	LMC	6.0	5.7	<0.02							
	2.9-3.0	SLC	6.3	5.6	<0.02							
	3.9-4.0	-	6.8	7.9	<0.02							
898	1.4-1.5	MC	5.1	4.6	<0.02		42					
	1.9-2.0	LC	5.0	3.2	0.2	<0.1						
	2.2-2.3	LC	5.0	2.2	0.73	<0.1						
	2.4-2.5	LC	5.4	2.2	2.8	<0.1						
	2.9-3.0	MC	6.7	5.9	<0.02							
	3.4-3.5	MC	7.6	6.1	<0.02							
899	0-0.05	LC	6.7	5.6	0.23	1.2						
	0.2-0.3	LC	6.6	5.3	0.45	0.93						
	0.5-0.6	LC	6.8	1.4	1.1							
	0.9-1.0	LC	6.9	1.1	1.5							
900	0.9-1.0	LMC	5.1	4.3	<0.02		16					
	1.9-2.0	LMC	6.0	5.8	<0.02							
	2.9-3.0	LMC	6.5	5.6	<0.02							
	3.4-3.5	LMC	6.3	5.6	<0.02							

Site	Depth	Texture	pH_F	pH_{FOX}	S_{CR}	s-ANC_{BT}	TAA	TPA	TSA	S_{POS}	S_{NAS}	s-ANC
	(m)				%S	%S	mol H^+/t			%S	%S	%S
901	0.9-1.0	LMC	6.3	5.4	<0.02							
	1.9-2.0	LMC	6.6	5.5	<0.02							
	2.9-3.0	FSC	7.0	5.6	<0.02							
	3.9-4.0	LMC	6.8	5.6	<0.02							
	4.3-4.4	LMC	7.0	5.4	<0.02							
902	0-0.1	LC	6.2	1.7	0.37							
	0.2-0.3	LC	6.3	1.1	1.8							
	0.5-0.6	LC	6.3	1.4	1.7							
	0.9-1.0	LC	6.2	1.5	2.2							
903	0.9-1.0	SCL	5.8	5.2	<0.02							
	1.4-1.5	SCL	5.5	7.0	<0.02							
	1.6-1.7	KSLC	-	-	<0.02							
904	1.9-2.0	LMC	5.6	4.6	<0.02		17					
	2.4-2.5	LMC	5.9	2.4	1.1	0.22						
	2.9-3.0	LMC	6.4	2.3	1.7	0.35						
	3.4-3.5	LMC	6.8	2.3	1.3	0.42						
	3.9-4.0	LMC	6.8	1.6	1.6							
	4.35-4.45	KSL	-	-	0.52							
	4.7-4.8	LMC	7.8	5.7	<0.02							
905	0.9-1.0	MC	6.1	5.8	<0.02							
	1.2-1.3	LC	5.9	5.3	<0.02							
	1.4-1.5	LC	5.8	5.2	<0.02							
	1.9-2.0	LC	6.1	4.6	<0.02	0.19						
	2.2-2.3	SLC	6.4	4.7	0.09	0.32						
906	0.9-1.0	MC	5.9	5.0	<0.02							
	1.4-1.5	LC	6.4	6.6	<0.02							
	1.7-1.8	LC	7.2	6.5	<0.02		<10				0.05	
	1.9-2.0	LC	6.9	6.4	<0.02							
	2.2-2.3	SLC	7.1	6.8	<0.02							
	2.4-2.5	SLC	7.2	6.2	<0.02							
907	0.9-1.0	SLC	6.6	5.2	<0.02							
	1.9-2.0	MC	7.5	5.9	<0.02							
	2.9-3.0	MC	7.5	5.5	<0.02							
	3.9-4.0	MC	8.0	5.9	<0.02							
	4.9-5.0	MC	7.7	6.3	<0.02							
	5.5-5.6	MC	8.2	6.4	<0.02							
908	0.9-1.0	MC	6.0	5.4	<0.02							
	1.9-2.0	LMC	6.6	5.7	<0.02							
	2.9-3.0	LMC	7.2	5.6	<0.02							
	3.0-4.0	SLC	6.9	8.6	<0.02							
	4.9-5.0	LMC	7.0	5.9	<0.02							
	5.3-5.4	LMC	7.2	5.9	<0.02							
909	0.9-1.0	SLC	6.9	6.4	<0.02							
	1.9-2.0	SMC	7.7	7.1	<0.02							
	2.9-3.0	MHC	7.5	7.1	<0.02							
	3.9-4.0	MHC	7.1	6.4	<0.02							
910	0.9-1.0	FSLC	7.9	6.3	<0.02							
	1.9-2.0	KSLC	7.9	6.1	<0.02							
	2.9-3.0	KSLC	8.2	6.5	<0.02							
	3.9-4.0	LMC	7.8	5.9	<0.02							
	4.9-5.0	SLC	7.8	6.2	<0.02							
911	0.9-1.0	LMC	5.6	5.4	<0.02							
	1.9-2.0	LC	6.7	6.6	<0.02							
	2.4-2.5	LC	6.3	5.2	<0.02							
	2.9-3.0	LC	6.8	3.7	1.4	0.29						
	3.4-3.5	LC	7.5	2.0	0.88							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
912	1.9-2.0	LMC	5.4	5.2	<0.02							
	2.4-2.5	LC	6.1	2.0	1.8							
	2.9-3.0	LC	6.2	2.2	1.7	0.22						
	3.4-3.5	LC	6.5	2.3	1.4	0.48						
913	0.9-1.0	LMC	6.5	5.7	<0.02							
	1.9-2.0	LC	6.9	7.1	<0.02							
	2.4-2.5	LC	7.1	4.9	0.06	0.16						
	2.9-3.0	LC	7.4	5.1	1.2	0.38						
	3.4-3.5	LC	7.7	2.1	1.0	0.38						
914	2.4-2.5	LMC	6.9	5.6	<0.02							
	2.9-3.0	LMC	7.1	5.4	<0.02							
	3.4-3.5	LC	7.6	2.6	0.24	0.22						
	3.9-4.0	LC	6.9	2.2	1.2	0.42						
	4.4-4.5	LC	7.5	5.0	1.0	0.58						
	4.7-4.8	LC	7.4	5.3	1.3	0.61						
915	0.5-0.6	MC	6.2	6.1	<0.02							
	0.9-1.0	LMC	6.0	6.9	<0.02							
	1.4-1.5	LC	5.4	4.5	<0.02							
	1.9-2.0	LC	5.9	4.5	0.03							
	2.4-2.5	LC	6.7	2.1	1.3							
	2.9-3.0	LC	7.0	1.5	1.6							
	3.4-3.5	LC	7.3	1.9	1.4							
916	0.9-1.0	LMC	6.0	4.9	<0.02							
	1.9-2.0	MC	7.4	5.8	<0.02							
	2.9-3.0	LMC	7.9	5.8	<0.02							
	3.9-4.0	LMC	7.8	6.1	<0.02							
	4.7-4.8	LMC	7.3	5.6	<0.02							
917	0.9-1.0	MC	6.8	7.0	<0.02							
	1.4-1.5	LMC	4.4	3.4	<0.02		30					
	1.9-2.0	LC	4.0	3.1	<0.02		51				0.02	
	2.4-2.5	LC	4.4	3.0	<0.02		35					
	2.9-3.0	LC	5.6	1.3	1.2							
	3.4-3.5	LC	6.3	1.1	1.9							
918	0.9-1.0	MHC	5.5	6.4	<0.02							
	1.9-2.0	MC	7.2	6.5	<0.02							
	2.9-3.0	MC	7.2	7.0	<0.02							
	3.9-4.0	FS	6.9	7.4	<0.02							
	4.4-4.5	S	7.8	6.0	<0.02							
919	0.9-1.0	LMC	4.1	3.4	<0.02		67					
	1.4-1.5	LC	3.8	2.7	<0.02		51				0.02	
	1.9-2.0	LC	3.8	2.9	<0.02		54				0.1	
	2.1-2.2	LC	4.1	3.4	<0.02		41				<0.01	
	2.3-2.4	LMC	4.0	3.3	<0.02		27				0.05	
920	0.5-0.6	MHC	6.9	6.1	<0.02							
	0.9-1.0	LMC	7.0	6.1	<0.02							
	1.4-1.5	LC	6.9	6.1	<0.02							
	1.9-2.0	LC	7.0	1.2	1.2							
	2.4-2.5	LC	7.0	1.5	1.7							
921	0.5-0.6	LC	4.4	3.3	<0.02		47					
	0.9-1.0	LC	3.9	3.6	<0.02		31				0.01	
	1.4-1.5	LC	4.3	4.0	<0.02		16					
	1.9-2.0	FSLC	4.2	3.8	<0.02		14					
	2.9-3.0	FSLC	5.2	4.4	<0.02							
	3.9-4.0	S	5.8	5.3	<0.02							

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	$s\text{-}ANC_{BT}$ %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
922	0.5-0.6	LMC	4.5	4.3	<0.02		11					
	0.9-1.0	LC	3.8	3.6	<0.02		22				0.15	
	1.4-1.5	LC	5.2	3.6	<0.02	<0.15						
	1.9-2.0	LC	6.4	1.0	1.2							
	2.4-2.5	LC	6.8	1.4	1.3							
923	0.5-0.6	LC	6.7	4.1	<0.02							
	0.9-1.0	LMC	6.9	6.7	<0.02							
	1.9-2.0	LMC	7.3	6.6	<0.02							
	2.4-2.5	LC	6.9	6.4	<0.02							
924	0.5-0.6	LC	6.0	4.3	<0.02							
	0.9-1.0	LC	6.4	4.9	<0.02							
	1.4-1.5	LMC	6.6	5.9	<0.02							
925	0.2-0.3	MC	5.3	3.8	<0.02							
	0.5-0.6	MC	5.8	4.7	<0.02							
926	0.4-0.5	ZLMC	5.0	4.4	<0.02							
	0.7-0.8	LMC	5.6	6.8	<0.02							
	0.9-1.0	LMC	3.8	3.6	<0.02		30					
	1.4-1.5	LC	3.0	2.4	<0.02		78				0.13	
	1.9-2.0	LC	3.5	1.1	1.6		70					
	2.4-2.5	LC	6.2	1.3	1.5							
927	0-0.1	LMC	5.5	4.1	<0.02							
	0.5-0.6	LMC	5.5	4.5	<0.02							
	0.9-1.0	LC	5.2	4.5	<0.02		<10					
	1.2-1.3	LC	5.0	4.3	<0.02		<10				0.01	
	1.4-1.5	LC	4.9	2.5	<0.02		<10					
	1.9-2.0	LC	5.3	1.2	1.7							
	2.4-2.5	LC	5.9	1.2	1.6							
928	0.5-0.6	MHC	5.9	4.7	<0.02							
	0.9-1.0	LC	4.7	4.2	<0.02		26					
	1.4-1.5	LC	5.1	4.6	<0.02		11				0.06	
	1.6-1.7	LC	5.4	4.7	<0.02		<10					
	1.9-2.0	LC	6.0	3.6	0.29	0.22						
	2.4-2.5	LC	6.3	1.4	1.5							
	2.9-3.0	LC	6.4	1.3	2.1							
	3.1-3.12	MC	7.2	8.1	0.06							
929	0.5-0.6	LC	3.3	3.0	<0.02		52					
	0.9-1.0	LC	3.2	2.5	<0.02		55					
	1.3-1.4	LC	3.1	2.1	0.02		85				0.09	
	1.6-1.7	LC	3.4	1.1	1.1		124				0.01	
	1.9-2.0	LC	5.5	1.0	3.7							
	2.4-2.5	LC	6.2	0.9	3.6							
930	0.9-1.0	MC	5.3	4.3	<0.02							
	1.4-1.5	LC	3.6	2.7	<0.02		25				<0.01	
	1.9-2.0	LC	4.9	1.2	1.2		29					
	2.4-2.5	LC	5.7	1.5	0.85							
931	0.9-1.0	LMC	6.8	5.4	<0.02							
	1.4-1.5	FSLC	6.3	5.1	<0.02							
	1.9-2.0	FSLC	6.0	1.4	0.59							
	2.4-2.5	LC	6.1	1.3	1.8							
932	0-0.1	LMC	6.5	5.3	<0.02							
	0.5-0.6	LC	6.6	5.3	<0.02							
	0.9-1.0	LC	6.2	2.7	0.09							
	1.4-1.5	LC	6.2	1.2	1.1							
	1.9-2.0	LC	6.4	2.1	1.3	0.9						

Site	Depth (m)	Texture	pH_F	pH_{FOX}	S_{CR} %S	s-ANC_{BT} %S	TAA	TPA	TSA	S_{POS} %S	S_{NAS} %S	s-ANC %S
							mol H^+/t					
933	0-0.1	LC	3.9	1.6	0.04		65					
	0.2-0.3	LC	4.3	3.4	<0.02		42					
	0.5-0.6	LC	3.9	3.0	<0.02		45				0.15	
	0.9-1.0	LC	4.5	2.5	<0.02		21					
	1.4-1.5	LC	4.8	1.1	1.6							
	1.9-2.0	LC	5.5	1.3	1.4							
	2.4-2.5	LC	5.9	1.3	1.3							

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