

Soil Mapping and Advisory Services
Botswana

**BOTSWANA SOIL DATABASE
MANUAL**



FOOD & AGRICULTURE
ORGANIZATION OF THE
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United Nations Development Programme
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Gaborone, 1988

The conclusions given in this report are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of this project.

The definitions employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal or constitutional status of any country, territory or sea area or concerning the delimitation of frontiers.

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ABSTRACT

This report presents guidelines for the operation of the Botswana Soil Database. Instructions to operate the computer, to input soil and laboratory data and to edit and retrieve the results are presented in Part 1. Part 2 contains technical instructions and information on the system.

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Part 1: USER MANUAL

INTRODUCTION

The Botswana soil database (BSD) is a user friendly interactive system. It includes full screen procedures to store, select and print soil profile descriptions and analytical data. BSD is developed with dBASE III+ (Ashton Tate, 1986) and runs on an IBM or any other fully compatible micro computer.

The BSD user manual gives guidelines to install and start BSD, and it serves as a reference guide to run the various procedures effectively, although the system is basically self explanatory (all necessary instructions to run BSD appear on screen).

Chapter one deals with the basic concepts of BSD. The chapters two to eight give information on the individual data handling procedures (input, edit, select, print, delete and back up).

The technical requirements and installation instructions are found in appendix A. Appendix B gives examples of printouts, and appendix C includes the BSD coding system and soil profile description form.

In this manual the keys are indicated in bold, e.g. **1** is numerical key 1 and **End** = the End key.

Text that appears on screen is printed in condensed format.

Please note that BSD is designed in such a way that user errors never seriously affect the main databases. Also it is very unlikely that power failures will cause damage to the databases, since data manipulation never occurs directly in the main databases. However harddisk failures can do seriously harm to the databases. BSD therefore forces the user to back up all datafiles after each run.

SYSTEM REQUIREMENTS

- Computer : IBM AT/XT or fully compatible with hard disc and preferably 512 kb RAM.
- Printer : Wide format matrix printer or laser printer with a "landscape" option.
- Software : dBase III +, DOS 2.1 or higher.

1 GENERAL OPERATING INSTRUCTIONS

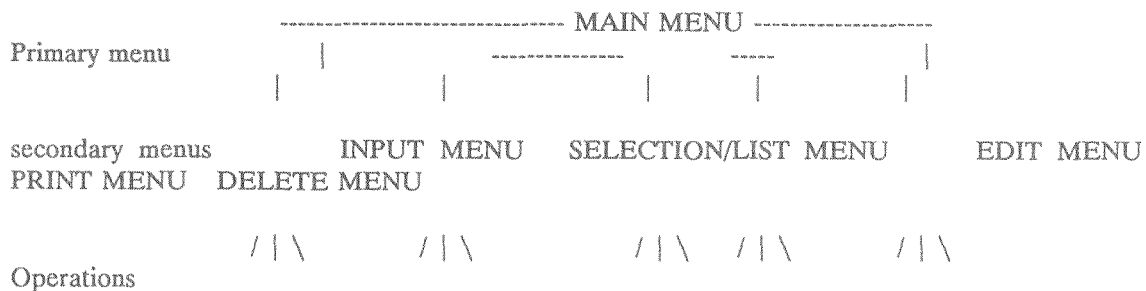
This chapter provides general information on the operation of BSD. The menu system, on-screen instructions, input/edit screens, valid profile numbers, missing values and validity control are described and explained.

1.1 Menus

A menu is a list of options displayed on screen. All operations are started from menus by simply pressing a key (both upper and lower case entries are accepted). Pressing a wrong key (any key not listed in the menu) results in the re-appearance of the menu. After an operation is finished BSD returns to the same menu and the next operation can be selected.

All menus include a help option for on-screen information on the procedures to be selected.

Starting BSD brings the program to the Main Menu. From this the secondary menus (Input Menu, Selection/list Menu, Edit Menu, Print Menu or the delete Menu) can be selected. The BSD menu structure is hierarchical (see below). Consequently a secondary menu can only be selected from the main menu and not directly from another secondary menu.



1.2 On-screen instructions to run operations

To carry out operations BSD asks for instructions from the user and displays the possible options on screen. Make a choice by simply pressing one of the keys indicated. Again both upper and lower case entries are accepted. If a wrong key is pressed, the program will wait until a right entry has been made. Pressing a wrong key will never cause damage or interrupt the program.

1.3 Input and Edit Screens

All data are entered or updated (edited) with help of so-called Input/Edit screens. On these screens the names of the variables are displayed followed by light coloured bars (fields) in which the code or the value of this variable is entered. There are different screens for site data, horizon data and analytical data. The layout of the site and horizon screens is similar to that of the soil description sheet.

The cursor can be moved over the screens by using the following keys:

<-	moves the cursor one place to the left (back)
->	moves the cursor one place to the right
	skips the cursor to the beginning of the previous field
	skips the cursor to the next field
<-'	Return or Enter key, skips the cursor to the beginning of the next field
<---	Backspace key, deletes the digit left of the cursor
Pgdn	forces the cursor to leave the screen (exit)
Esc	Escape forces the cursor to leave the screen, newly entered or modified data are lost

If a field is completely filled up the cursor will automatically jump to the next. In all other cases use -> to move within the same field or | to skip to the next.

1.4 Profile number

Soil profiles are identified in the database by the profile number. This profile number should be unique i.e. the database accepts a specific profile number only once.

The profile number consists of a location code of 2 characters (or one character and a blank) followed by a number. The number always consists of 4 digits, i.e. 1 is entered as 0001, 150 as 0150.

Valid soil profile numbers are: MA0021
PA0001
L 0135

BSD does not accept invalid soil profile numbers.

1.5 Validity Control

Site and profile information is coded according to the BSD Guidelines for Soil Profile Description (Rommelzwaal and Van Waveren, 1988). A summary of is given in Appendix C.

All coded information is checked after an input/edit screen is completed. The user is forced to replace invalid codes immediately.

Invalid codes are codes unknown to BSD (see BSD coding system). It should be realized that the character fields are always filled from left to right. Consequently a code is also considered invalid if it is placed in the wrong position(s) in a field. For instance a single character code should always occupy the first position in a field.

Please note that the computer checks only the validity of the codes and not the quality. In other words it merely checks whether a entered code exists for the variable and not if this code makes sense in this specific context.

1.6 Missing Values

For coded variables the missing value is a blank. Do not use a 0 (zero) since the 0 is used as a positive statement.

For instance leaving the entry for surface sealing blank means that no information is available. Entering a 0 means that that no sealing was observed.

For numerical variables (laboratory data, elevation, coordinates) the missing value can be either a 0 or a blank.

2 START

Before starting the database the printer should be checked and eventually reset, since it is not possible to alter the settings of the printer during the program.

2.1. Setting the Printer

(IBM Proprinter XL) :

- 1) Switch the printer off.
- 2) Check type of paper. Wide format paper is required for the printing of soil profile descriptions and analytical data.
- 3) Check amount of paper. Errors in the printing program might occur if the printer runs out of paper during a printing session.
- 4) Set top of form. The paper is properly installed if the top edge of the form is at the bottom of the numbered scale, i.e. just visible.
- 5) Switch the printer on. Both the POWER and the READY lights blink and the printer is ready to use.

Kyocera F-1000 Laser Printer

- 1) Switch the printer on
- 2) Check the amount of paper

2.2 Setting the computer

The computer is off:

- 1) Switch on the power backup
- 2) Check and eventually reset the printer (see 2.1)
- 3) Be sure both diskdrives are empty
- 4) Switch on the screen and the computer

The computer is on:

- 1) Be sure not to interrupt any other program
- 2) Check and eventually reset the printer (see 2.1)
- 3) Remove diskettes from the disk drives
- 4) Press keys **Ctrl Alt Del** simultaneously to reset the system

2.3 Start the Botswana Soil Database (BSD)

Type **BSD** followed by **<-'** **<RETURN>** to start BSD. Or start BSD directly from a DOS selection menu (if installed), in that case only a single key needs to be typed (e.g. for Gaborone-HQ press **1 <-'**). Type **BSD Laser** followed by **-'** **<RETURN>** if the computer is connected to the Laser printer.

After some time the dBASE III entry screen will appear, followed by the BSD entry screens and finally the main menu.

The following error message may appear and BSD is not started:

invalid command

The root directory (C\) is not the active directory. Type **CD ** and press **<-'**. Try again. If the same message appears again BSD is not installed properly (see Appendix A).

Main Menu		
1 Enter	4 Print/view	H Help
2 Select/List	5 Delete	Q Quit Database
3 Edit	6 Import/Write	

		Your choice?

Press **1** to enter new data, or add analytical results. See Chapter 3 for more detailed information.

Press **2** to select soil profiles from the database. The database can be searched on one or a combination of two of the following variables: profile number, location, coordinates, mapping unit, FAO soil unit, status. The selection results in a listing on screen. Subsequently a printout of this listing can be obtained as well as printed soil profile descriptions of all the selected profiles (see Chapter 4).

Press **3** to update or modify soil profile descriptions that are already stored in the database (see Chapter 5).

Press **4** to obtain printed soil profile descriptions, or to view an abridged soil profile description on screen. Printing instructions are either given for individual profile numbers, or for a range of profile numbers with the same location code e.g. **PA0001** to **PA0200** (see Chapter 6).

Press **5** to delete profile descriptions from the database. (See Chapter 7).

Press **6** to write data to a disketter or read data from a diskette (see Chapter 8)

Press **H** to obtain onscreen information on the various options.

Press **Q** to quit BSD and back up the datafiles (see Chapter 9)

3 ENTER

3.1 General remarks

This option is used to enter new profile descriptions and/or analytical and soil physical data into the database. Use **EDIT** to add information to profiles that are already stored in the database.

Site and profile information is entered according the BSD coding system See Appendix C. Since BSD checks the validity of the codes, unknown codes (= codes not included in the coding system) are not accepted.

To avoid confusion it is recommended to enter only complete descriptions, although it is possible to update or change any soil profile description later-on (see **EDIT**).

All coded information can be entered in both upper and lower case. On screen BSD automatically transfers lower case into upper. Descriptive information (site location and remarks) will be stored exactly the way it is entered.

All data are entered for individual soil profiles. The soil profile is identified by its profile number.

Invalid profile numbers are not accepted. BSD returns with an error message until a valid entry is made (See section 1.4).

The profile numbers are unique i.e. it is not possible to store two profiles with the same profile number. In case a profile number is entered that already exists in the database an error message appears and the input operation is aborted. Use **EDIT** to change or update existing profile descriptions.

3.2 Select options and enter profile number

Leave the Main Menu by pressing 1. The Input Menu appears on screen:

INPUT MENU	
1 Profile - sampled	H Help
2 Profile - not sampled	Q Quit Menu
3 Add analytical data	
4 Add soil physical data	Your selection?

Select option 1 to enter descriptions of sampled profiles, also if no analytical data are available yet. The following set of input screens will appear successively:

- Site data screen
- Horizon data screen
- Analytical data screen

Enter sample depths on the analytical input screen also if no analyses are available yet.

Select option 2 to enter descriptions of not sampled profiles (predominantly augerings). The Following set of input screens will appear successively:

- Site data screen
- Horizon data screen

Select option 3 to enter or add analytical data to soil profile descriptions which are already stored in the database. The following input screen will appear: - Analytical data

Select option 4 to enter or add soil physical data. The following input screen will appear :

- soil physical data 1
- soil physical data 2

After pressing 1 2 3 or 4 you are asked to enter the profile number. Invalid codes are not accepted. In case an invalid profile number is entered an error message appears and the user is asked to re-enter a valid number. See section 1.4 for information on validity of profile numbers. It is not possible to change a profile number after it is accepted. Use **DELETE** to remove profiles with wrong profile numbers from the database (see Chapter 7).

Subsequently the occurrence of the profile number in the database is checked. The following error messages may appear:

Profile Number already exists
in soil description Database
(or Soil Physical data already stored in database)

Input procedure aborted

Press any key to continue..

(the database already contains a soil profile description or soil physical data with the same profile number. The site, profile or soil physical input screens are skipped)

Analytical data already stored in the database

press any key to continue

(the analytical database already contains information on this profile number. The analytical input screen is skipped)

According to the Database this profile is not sampled
or the profile description is not stored yet

Continue or quit(C/Q)?

This warning might appear if option 3 is selected. It means that the analytical database does not have any information on this profile yet. This might be either due to the fact that the profile is not entered as a sampled profile (option 2 instead of 1) or that the profile information is not entered yet.

Pressing **Q** returns BSD to the Input menu, if **C** is pressed the analytical input screen will appear.

3.3 Site input screen

See section 1.3 for general information on the operation of input screens.

The site input screen consists of two pages. After completing page one the following message appears on screen:

Press 1 to modify, any other key to continue..

Pressing **1** returns the cursor to the top of page one, pressing any other key activates page 2. After completing page 2 the following message appears on screen:

SCREEN COMPLETED

PRESS 1 = Return to page 1

2 = Modify this screen

or any other key to continue...

Pressing **1** returns the cursor to page 1, pressing **2** reactivates page 2.

Press any other key to leave the site input screen. Subsequently the codes are checked. If no invalid codes are encountered BSD installs the horizon description screen, otherwise the user is prompted to replace the invalid codes first.

3.4 Horizon Description screen

The first horizon description appears automatically after the site data is checked on validity.

After the first horizon screen is filled out the following message appears on the lower part of the screen:

Screen completed any modifications (Y/N)?

Pressing **Y** causes the cursor to return to the beginning of the screen. Press **N** to continue. The following message appears on the screen:

HORIZON DESCRIPTION COMPLETED

S = Save and quit

P = go back to previous horizon

or press any other key to enter the next horizon

Press **S** only after the data of the last horizon are entered since it stops further input of horizon data. Press **P** to go back to previous horizon or press any other key to skip to the next horizon input screen. Before the next input screen appears the data is checked. If invalid codes are detected the user is prompted to replace it with a valid one.

The number of the horizon that is presently being entered is displayed on the upper right corner of the screen. Enter the horizons in the right order, since in the soil profile descriptions the horizons are printed in the sequence of entering (as indicated by the horizon number).

Use upper and lower case properly while entering the horizon designation. All other (coded) information can be entered in both upper and lower case.

Most variables allow two entries. Fill out the first (upper) entry first. Do not place any data in the second one while the first is still empty or contains a 0.

3.5 Analytical data input screen

This option is mainly used to enter sample depths since in general the analytical data are entered directly by disk. Sample depths should always be entered since they are not included in the laboratory database.

Data is entered per sample. Enter the sample data in the right order since the sample codes (A B C etc) are automatically designated following the order of input. Sample codes are displayed on screen in the upper right corner.

To operate the analytical data input screens follow the instructions given in section 3.4 (horizon input screens)

Each numerical variable has a fixed number of decimals. For pH, organic matter, CEC and particle size these numbers exceed the number of decimals in the printout with one.

Missing values are indicated with a 0 (zero). Blanks are automatically transferred into 0 (zero).

3.6 Soil physical data input screens

The first input screen includes fields to enter infiltration data, the surface stability index and remarks.

Water retention data and bulk density are entered in second screen. Data is enter per sample. Enter the data in the right order since the sample codes (A B C etc) are automatically assigned following the order of input. Sample codes are displayed on screen in the upper right corner.

To operate the soil physical data input screens follow the instructions given in section 3.4 (horizon input screens).

Missing values are indicated with a 0 (zero). Blanks are automatically transferred into 0 (zero).

4 SELECT/LIST

4.1 General information

Use this option to select soil profiles from the database, or to get an overview of contents. Printouts of the selected profiles may be obtained.

BSD offers two selection routines:

<1> A fast search routine on 1 or 2 of the following variables: profile number, FAO soil unit, mapping unit, status, coordinates. This routine covers most of the ordinary selection requests. It includes a validity check on key values and sorts the selected profiles on the first key variable. Number, soil classification, mapping unit, status and coordinates of each of the selected profiles are displayed on screen.

<2> A search routine on virtually any site, profile and analytical characteristics, or combinations of these characteristics (see table 1). The validity of the key value(s) is not checked, and the selected profiles are always sorted on profile number. The numbers of the selected profiles are displayed on screen.

A print facility to obtain descriptions (with analytical data) of the selected profiles is included in both routines.

SELECT/LIST	
1 Select on: Location Soil Unit Mapping Unit Status Agro Clim Zone Coordinates	H Help
2 Select on: any other variable(s)	Q Quit to Main Menu
3 List all	Your Selection ?

4.2 Fast search routine

This routine should be used if the database is to be searched on one, or a combination of two, of the following variables:

- Location code: for instance all Maun profiles, all Pandamatenga profiles, etc.
- Coordinates: the database can be searched on all profiles within a rectangular area defined by its coordinates.
- FAO soil unit: for instance all Luvisols, all Ferric Luvisols, or all Arenic Ferric Luvisols.
- Mapping unit: for instance all profiles within S, or S5, or S5a.
- Status
- Agro-climatic zone

Go to the Select/list menu and press 1. BSD returns with a listing of primary and secondary key variables.

Select the primary key variable by pressing 1 2 3 4 or 5. Subsequently a second key variable can be selected. Press 0 if a second key variable is not required.

Selecting twice the same variable is not possible. The entries are not accepted and a valid entry should be made.

If the variables are accepted the first key variable is displayed and the user is prompted to enter the value. Both upper and lower case entries are accepted. Subsequently the user is asked to enter the value of the second key variable (if selected).

Please note that the validity of the location and mapping unit code is not checked. Entering a non-existing code results in a no find.

A list of the selected profiles appears on screen. Key variables and values are displayed on the upper part of the screen. The number of selected profiles appears in the upper right corner (see below).

Enter FAO Soil Unit Code LF					No Profiles 213	
Profile Number	FAO unit phase	Unit	Status	Coordinates		
01003a	LF	A11	4	000000 4 4 000000	000000	000000
05504	LF	B05a	3	000000 4 4 000000	000000	000000
05510	LF	B11	4	000000 4 4 000000	000000	000000
05540	LF	B05b	3	000000 4 4 000000	000000	000000
05552	LF	B05c	3	000000 4 4 000000	000000	000000
09001	LF	010b	1	000000 4 4 000000	000000	000000
09010c	LF	010c	4	000000 4 4 000000	000000	000000
090101	LF	006a	4	000000 4 4 000000	000000	000000
090102	LF	010b	4	000000 4 4 000000	000000	000000
090103	LF	010c	4	000000 4 4 000000	000000	000000
090107	LF	010b	4	000000 4 4 000000	000000	000000
090202	LF	010	4	000000 4 4 000000	000000	000000
090010	LF	A11	4	000000 4 4 000000	000000	000000
090197	LF	005	4	000000 4 4 000000	000000	000000
090103	LF	A11	4	000000 4 4 000000	000000	000000

Press any key to continue...

After the screen is filled the listing is paused and the following message appears:

Press any key to continue...

Press any key to skip to the next page. It is not possible to return to the previous page.

After the last profile the following message appears:

End of information, Press any key to continue..

After Pressing any key BSD returns with:

- Press 1 for a printed list
- 2 for printed tabular soil descriptions
- 3 for printed soil descriptions
- 4 for printed tabular analytical data
- 0 Return to menu

Pressing 0 returns BSD to the select/list menu

Press 1 to obtain a hardcopy of the list

Press 2 or 3 to obtain printed soil profile descriptions of all selected profiles.

Press 4 to obtain a table with standard analytical data of all selected profiles

Printing of a soil profile description takes about 2 minutes. Print only a limited number of profiles at a time. The time required to print the profile descriptions should in general not exceed the back up capacity of the power supply. See Chapter 6 for more detailed information on printing. See Appendix B for examples of the various kinds of printouts.

After pressing 2 or 3 BSD returns with the following question:

Print analytical data (Y/N)?

Press Y to include a printout of the analytical and soil physical data.

4.3 Ad hoc selections

This routine is used to select on (combinations of) site variables not included in routine <1>, profile characteristics and analytical characteristics.

Go to the Select/list menu and press 2. The ad hoc selection menu appears on screen:

(see Table 1)

The key variables are grouped according to site, profile and analytical variables. Choose the appropriate group, or any combination of groups. Subsequently the list of variables of the first group appears on screen. Choose the required key variable by entering its number. A second key variable of the same group may be selected. Press <0> if a second key variable is not required.

Subsequently the selected key variables appear on screen. Enter after each variable the code or numerical value to search on.

Note that BSD does not check on the validity of the codes. If a non-existing code (for that particular variable) is entered the search procedure will result in a no find. Valid codes are given in appendix C and the BSD Guidelines for Soil Profile Description (1988).

For a numerical variable a range is defined by entering its lower and upper limits. It should be realized that values entered on the screen are not included in the range.

Repeat this exercise for the second and third group of variables (if appropriate).

The total number of selected profiles appears in the upper right corner, and the codes of the profiles that meet the selection criteria are displayed on screen. Printouts of this list, or printed descriptions of the selected profiles, with or without analytical data, can be obtained afterwards (see section 4.2 for further details).

Table 1. key variables

Site variables	Profile variables
location code	designation
sheet	depth: upper - lower
mapping unit	mottles: abundance - size - contrast - boundary - colour
status	texture
FAO soil unit - phase	structure: grade - size - type
Soil moisture regime	consistence: dry - moist - stickiness - plasticity
elevation	cutans: quantity - thickness - nature - location
author	cementation
landform	pores: abundance - size
land element	rock fragments: abundance - size - shape - weathering - nature
position of site	nodules: abundance - kind - size - shape - hardness - nature - colour
topography	carbonates
slope form	biological features: abundance - kind
micro topography	roots: abundance - size
surface sealing	boundary: width - topography
cracks	
salts	Analytical variables
bleached sand	-----
stoniness (abundance)	pH: H2O - CaCl2
rock outcrops	EC
parent material	P
rock type	organic C
drainage	CEC: soil - clay
erosion: type - intensity	exchangable cations: Ca - Mg - K - Na
land use type	base saturation
crops	sand: very coarse - coarse - medium fine - very fine
vegetation structure	silt: coarse - fine
tree species: dominant - other	clay
shrub species: dominant - other	sample depth: upper and lower limits
grass cover	
grass species: dominant - other	
human influence	
agroclimatic zone	

4.4 List database contents

Go to the Select/list menu and press **3**. The actual number of profiles stored in the database is displayed on screen and the following message appears:

Continue or quit (C/Q)?

Keep in mind that a screen displays only 16 profiles at a time. Viewing a large number of profiles may take some time. Press **Q** to cancel the listing.

5 EDIT

5.1 General information

This option is used to change or update profile descriptions and analytical and soil physical data that are already stored in the database. Use **INPUT** to enter new profiles.

The edit screens are identical to the input screens and function in the same way (see Chapter 3). The only difference is that the edit screens contain the actual information of the profile/horizon/sample to be changed, whereas the input screens are empty.

All entered codes are checked on validity. The user is prompted to replace all invalid codes immediately. See section 1.4 for further information on validity of codes.

5.2 Start EDIT

Go to the main menu and press **3**. The Edit menu appears on screen:

EDIT MENU	
C Continue H Help Q Quit to main menu	Your selection

Press **C** to continue. Enter the profile number and select the proper screens by replacing the **N** with a **Y**. Only valid profile numbers are accepted (see section 1.4). The following error messages appear in case the profile number is not found in one of the selected databases the related edit screens are cancelled:

Profile number not found in Site/Profile database

Profile number not found in analysis database

Profile number not found in soil physical database

After editing a horizon or sample the following message appears on screen:

EDITING OF THIS HORIZON/SAMPLE COMPLETED

S = Save and Quit

P = Go to previous screen

Or press other key to edit the next horizon/sample

To enter additional horizons/samples to the description any other key should be pressed after the last horizon/sample has appeared on screen. BSD returns with:

Add new horizons/samples to the description (Y/N)?

Pressing **Y** results in a empty input screen and new data can be added to the description.

6. PRINT/VIEW

6.1 General information

This option is used to obtain printouts of individual soil profiles and analytical data, or to view abridged soil profile descriptions which give a summary of characteristics, on screen.

With the range option a number of profiles with the same location code can be printed with a single print command. A valid range is for instance soil profiles MA0001 to MA0150 or PA0250 to PA0257. Check the amount of paper before a print command for a large number of profiles is given. Limit the number of soil profiles to be printed by splitting up the print command if the power supply is not reliable. For instance give separate print commands for PA0010 - PA0020, PA0021 - PA0030, PA0031 - PA0040 to obtain printouts for PA0010 to PA0040.

The printing of an extensive soil profile description using the matrix printer takes about 2 minutes.

Printing of the profile data requires a special setting of the printer (see section 2.1). Check if the printer is online. Please note that to reset the printer BSD should be restarted.

The soil profile descriptions analytical, and soil physical data are printed on an A4 format (= format of an ordinary copier). Examples are included in Appendix B. Analytical data may also be printed in a tabular format.

6.2 Run Print/View

Go to the Main menu and press 4. The Print/View menu appears:

PRINT/VIEW MENU	
1 Print soil description tabular	H Help
2 Print soil description	Q Quit to main menu
3 Print analytical data	
4 Print soil physical data	
5 View data on screen	
	Your selection?

Select option 1 to obtain a soil profile description with coded horizon information. This type of soil profile description might be useful for comparing large numbers of profiles on specific horizon characteristics.

Select option 2 to obtain a 'normal' soil profile description

Select option 3 to obtain printouts of analytical data. A tabular printout is optional

Select option 4 to obtain printout of soil physical data

Select option 5 to view a summary of site and profile characteristics on screen. This option is useful to obtain a fast general impression on the soil (an example of an abridged description is given below).

VIEW	Profile Number: PA 0001	Status: 2	Unit: L25b1	
Sheet	:1825A4	Grid: LK 360 742	Coor: 18-19-06-S 25-26-57-E Elev: 1070m	
Loc	:Kakulwane Seloko (N. Plain), traverse 6		0.9 km W Date:03/04/94	
Class	:Pellic Vertisol			
Landform	:lacustrine plain - not applicable - intermediate part			
Micro	:high gilgai			
Landuse	:no apparent management system			
Veg	:open low shrub savanna - grasscover: 90 - 70 %			
Far Mat	:lacustrine			
Drain	:poorly			
	Color	Texture	Struct (gr si ty)	Bound
A1	0 - 3 10YR 3/0.5(m)	C	st mc gr	a-w
A2	3 - 10 10YR 3/0.5(m)	C	mc fm sb	c-s
A3	10 - 25 10YR 3/0.5(m)	C	mo mc sa	g-s
B1	25 - 65 10YR 3/0.5(m)	C	mo vc pr > st cv sb	d-s
B2	65 - 175 10YR 3.5/0.5(m)	C	mo vc pr > st cv aw	d-s
Bch	175 - 220 10YR 4/0.5(m)	C		-

Press any key to continue with analytical data..

After an option is selected the program returns with:

Select range (Y/N)? N

The default is N. In this case profiles are printed one by one and the user is asked to enter the profile code. Invalid profile codes are not accepted (see section 1.4). If the soil profile does not exist BSD returns with an error message and the print procedure is aborted.

If Y is pressed a range is defined by entering successively the lowest and highest profile number of the range (the range includes both numbers). Both numbers should actually exist, otherwise an error message appears and the user is prompted to enter other (existing) profile numbers. Again only valid profile numbers are accepted.

If necessary the print procedure can be interrupted by pressing **End**. It stops the printing and returns the program to the print menu after the soil profile description presently being printed is finalized.

7 DELETE

7.1 General information

This option is used to remove soil profile descriptions from the database. After entering the profile number BSD asks for confirmation. This procedure is very time consuming. The data are removed from the site and profile databases only, the analytical and soil physical databases are not affected.

7.2 Run Delete

Go to the Main menu and press 5. The Delete menu appears on screen:

DELETE MENU			
C Continue	H Help	Q Quit to main menu	Your selection?

Press C to continue. BSD returns with:

ENTER PROFILE NUMBER

Invalid profile numbers are not accepted (see section 1.4). If the profile number is not found in the database an error message is returned and the delete procedure is aborted, otherwise the following message appears:

Are you sure (Y/N)?

Press Y to start the delete procedure. Pressing N aborts the delete procedure and returns the program to the Delete menu.

8 IMPORT/WRITE

8.1 General information

This facility is used to transfer information from one BSD database to another. Available data on a single profile or a range of profiles may be written onto a diskette and subsequently be imported into another BSD database.

In addition it offers a procedure to import standard analytical data from the Sebele Laboratory Database directly into the BSD database.

Go to the Main menu and press 6 to activate the Import/Write Menu.

8.2 Import Data from other BSD sources

Select option 1 to add site and profile descriptions to the database, option 2 to add standard analytical data and option 3 to add soil physical data.

BSD returns with:

Insert Data diskette in Drive A

Press Q to quit or any other key to continue..

The source files on the diskette should have been created with the BSD write facility (see below). If BSD cannot find the appropriate data files on the diskette a message appears on screen and the import procedure is aborted.

All site/profile, analytical or soil physical information on the diskette is appended to the database.

Existing data is not overwritten. BSD returns with the following message if a profile number already exists in the specific database(s):

Profile Number already exists and is not appended

8.3 Import analytical data from Sebele Laboratory Database

The data diskette should contain a copy of the laboratory (DATA.DBF).

Go to Import/Write Menu and press 4. Insert the Data diskette in drive A and follow the instructions that appear on screen. BSD will search the diskette for a file named DATA.DBF. If this file is not found a message appears on screen and the procedure is aborted.

Subsequently BSD asks for the highest and lowest profile number of the first location code to be transferred. BSD asks for approval to overwrite in case profile numbers are encountered that already exist in the BSD database.

Repeat the procedure for the next location code (if appropriate)

8.4 Write information to diskette

For this option a formatted high density diskette is required.

Go to the Import/Write Menu and press **5**. The write menu appears on screen. Press **C** to continue.

Subsequently BSD asks for the lowest and highest number of the first range of profile numbers to be transferred. Enter the appropriate profile numbers and specify the type of data to be written to the diskette (site/profile, analytical and/or soil physical data).

After the information is written onto the diskette BSD returns with:

Write more profiles to diskette ? (Y/N)

Press **Y** to repeat the procedure for a next range/location code.

9 QUIT AND BACK UP

Go to the main menu and press Q to quit. BSD returns with:

BACK UP PROCEDURE

Insert back up diskette in drive A

Insert the backup diskette in drive A (= upper disk drive) and follow the instructions that appear on the screen.

Subsequently the back up files are written on the diskette. Do not forget to label the diskette properly. After the back up procedure is finalized BSD returns to the operating system (DOS).

If the size of the datafiles exceeds the storage capacity of the diskette you are prompted to insert a next diskette. This should be a formatted high density diskette. One diskette can store about 800 -1000 soil profile descriptions with analytical data.

WARNING: Enter only empty diskettes since the back up procedure overwrites the diskette completely. Keep empty formatted high density diskettes available in case additional diskettes are needed to back up all files.

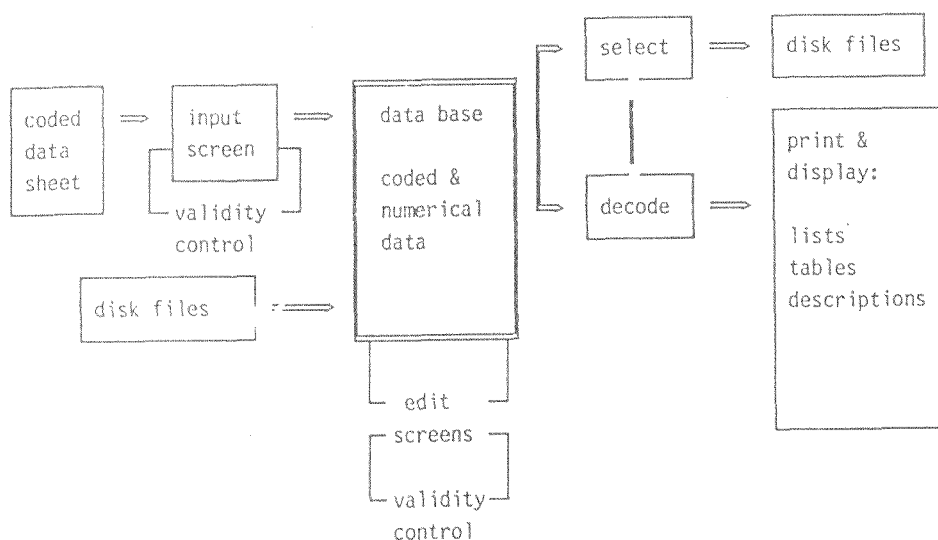
Please note that backup files cannot be used to transfer information from one BSD database to another. Follow the procedure as described in Chapter 10 to restore data from the backup diskette(s) to the harddisk.

PART 2: TECHNICAL MANUAL

1 GENERAL STRUCTURE

BSD comprises a database and an interactive shell to handle the storage, editing and retrieval of data. BSD uses dBASE III+ as supporting database management system. The interactive shell is mainly programmed in the dBASE application language. Figure 1 gives the general operating structure of BSD.

Fig 1. BSD operating structure



BSD comprises the following system files:

- * .PRG - dBASE program files: interactive input, edit, select, retrieve and print procedures.
- * .BAT - Batch files: start and install procedures.
- * .COM - Binary files: change settings on screen and printer.
- KEY*.DBF - Conversion files: decoding of soil data.

The database itself consists of dBASE data files (BSD?????.DBF) and associated index files (*.NDX).

2 INSTALLATION

The installation procedure uses the following DOS 3.1 commands:

CD = change directory
MD = make (create) directory
COPY = copy files
RESTORE = restore back up files (only for re-installation the database)

The installation requires no extensive knowledge of DOS. Although basic knowledge of DOS can be useful, especially the DOS directory and subdirectory concept. See the DOS Manual for further information on the commands and directories.

To (re-)install BSD on the harddisk of the computer:

* Go to the root directory of the harddisk

```
C>CD \
```

* BASE III plus should be installed a subdirectory named `\dbase`. See dBASE III plus manual for instructions on installation

* Create subdirectory `\bsd`:

```
C>MD \BSD
```

* Make `\bsd` the default directory:

```
C>CD \BSD
```

* Insert the BSD diskette in drive A

* Copy all files from the diskette into the BSD subdirectory:

```
C>COPY A:*.*
```

* In case the system has been used before and is being re-installed (e.g. after a harddisk crash) the database files should be restored from the BSD BACKUP DISKETTE(S):

The DOS directory should be the active directory, Enter the following command (assuming that DOS is stored in the subdirectory `\DOS`):

```
C>CD \DOS
```

Enter the first BACK UP DISKETTE in drive A. It is important that the back up diskettes are inserted in the right order!

Enter the following command:


```
C>RESTORE A: C:\BSD\*.*
```

Follow the instructions that appear on screen.

Make the \BSD directory the default:

```
C:CD \BSD
```

* Create index files:

```
C>BSDINS
```

The dBASE entry screen appears on screen and the database files are indexed.

* Copy BSD.BAT file into the root directory of the hardisk

```
C>COPY \BSD\BSD.BAT C:
```

The installation is completed. Remove the BSD program diskette from the A drive and keep it in a safe place.

After a successful installation the \BSD subdirectory should include the following files:

BSD.PRG	SITEPRNO.NDX	* BSD.BAT
BSDSITE.DBF	SITEFAO.NDX	* BSDINS.BAT
BSDHORIZ.DBF	SITEUNIT.NDX	* IND.PRG
BSDANA1.DBF	SITESTAT.NDX	* BSDLASER.BAT
BSDREMAR.DBF	SITEACZ.NDX	* = only used with installation
BSDPHYS1.DBF	HORIPRNO.NDX	
BSDPHYS2.DBF	HORIZALL.NDX	
KEYSITE.DBF	ANA1ALL.NDX	
KEYSIZES.DBF	ANA1PRNO.NDX	
KEYHORIZ.DBF	ANA1ALL.NDX	
KEYFAO88.DBF	PHY1PRNO.NDX	
KEYFAO74.DBF	PHY2PRNO.NDX	
KEYUSGRP.DBF	PHY2ALL.NDX	
KEYUSFAM.DBF	CURSONMO.COM	
KEYVEG.DBF	CURSON.COM	
KEYNAMES.DBF	CURSOFF.COM	
REMAPRNO.NDX	CONFIG.DB	

The root directory of the hardisk should include: BSD.BAT
BSDLASER.BAT

Start BSD from the root directory of the harddisk by entering the following command:

```
C>BSD (matrix printer) or C>BSDLASER (laser printer)
```

3 BSD PROGRAM STRUCTURE

The BSD program package consists of the actual BSD program file (BSD.PRG) and a number of external files. All program files are listed and briefly described in appendix A.1.

BSD.PRG

BSD.PRG consists of 39 program modules forming a hierarchical structure (see fig.2) in which each module has a clearly defined single task. The modules are linked together and encrypted with RUNTIME, the dBASE III+ pseudo compiler. Consequently BSD.PRG cannot be loaded in an editor and modifications should be made within the original modules, the so-called source files, using the dBASE application language.

It should be realized that the source files are only necessary to make changes in BSD.PRG, and not to run BSD.

The source files are listed and briefly described in appendix A.2. The modular structure is given in figure 2.

If modifications are made within the source files, or new modules are added, a new BSD.PRG should be created by using RUNTIME+. For instructions on running RUNTIME+ reference is made to the dBASE III+ program manual (1986).

Note that the dBASE III(+) editor has a limited capacity and only accepts program files upto 5Kb. Since a number of source files exceeds this limit, another editor (line editor or word processor) should be used.

Non dBASE program files

BSD uses the following external non dBASE programs:

- * BSD.BAT (DOS batch file to start BSD)
- * COMMAND.COM (DOS)
- * BACKUP.COM (DOS)
- * CURSON.COM (source file CURSON.PAS written in TURBO PASCAL)
- * CURSONMO.COM (source file CURSONMO.PAS written in TURBO PASCAL)
- * CURSOFF.COM (source file CURSOFF.PAS written in TURBO PASCAL)

The installation of BSD requires two additional program files:

- * BSDINS.BAT (DOS batch file)
- * IND.PRG (dBASE program file)

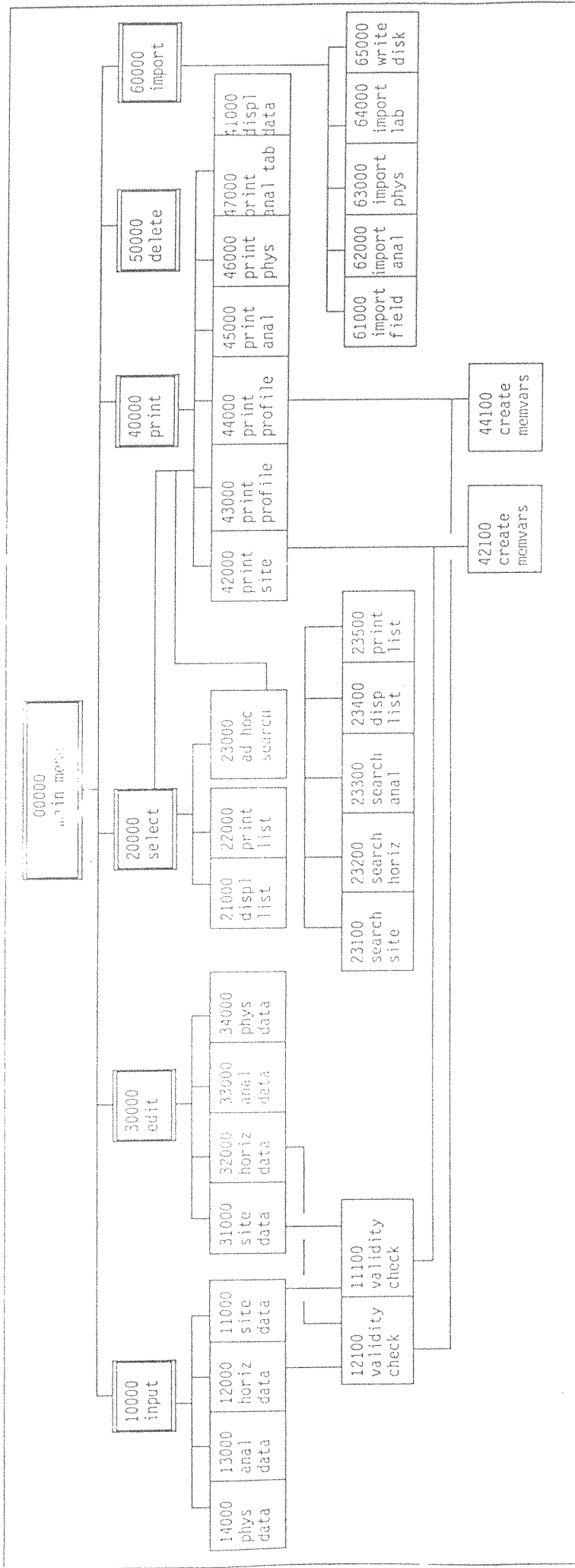


Fig. 2 BSD Modular Structure

The name of the associated source file is given by the number of the module preceded by BSD. Extension of source files is SRC.

4 CONVERSION FILES

The field description databases contain predominantly coded data. Conversion files are used in the print/display modules to decode this information.

Conversion files are database files containing one or more pairs of fields. Each pair comprises a field with codes and a second field with the associated descriptive terms. The names of the code fields always start with CO.

The conversion files are listed in appendix A.5. The structure of the files with a brief description of the contents of the fields is given in appendix A.7.

Two types of conversion files can be distinguished: fixed and updatable conversion files.

Fixed conversion files

Fixed conversion files are:

- * KEYSIZES.DBF - codes/descriptions of abundance, quantity and size classes
- * KEYHORIZ.DBF - codes/descriptions of horizon data
- * KEYSITE.DBF - codes/descriptions of site data

The contents of these files cannot be changed unless the validity check modules (BSD11100.SRC and BSD12100.SRC) are modified accordingly. Subsequently a new BSD.PRG should be created (see chapter 2).

Updatable conversion files

Updatable conversion files are:

- * KEYNAMES.DBF - codes/names of soil surveyors
- * KEYVEG.DBF - codes/names of tree/shrub and grass/forbs species
- * KEYFAO88.DBF - codes/names of FAO soil units (1988)/third level
- * KEYFAO74.DBF - codes/names of FAO soil units (1974)/phases
- * KEYUSGRP.DBF - codes/names of ST great groups and subgroups and SMR
- * KEYUSFAM.DBF - codes/names of ST mineralogy, texture, reaction and STR classes

In these files new codes can be added without changing the validity check modules. However it should be realized that:

- (1) newly added codes should be unique (the same codes may not occur twice in the same field).
- (2) In the conversion files distinction is made between codes in upper and lower case. In general codes are in upper case. Variables with lower case codes are indicated in the datadictionary by (L).
- (3) These codes should also be added in the BSD Guidelines for soil profile description (1988).

Add names of new surveyors/FAO third level terms

Use the following procedure to add new names to KEYNAMES.DBF.

* Start dBASE

* activate KEYNAMES.DBF and open a blank record

```
. USE \BSD\KEYNAMES
```

```
. APPEND
```

* Enter initials in upper case into the first field (CONA) and the name into the second (NAME).

* Close database

```
. USE
```

* Quit dBASE

```
. QUIT
```

To enter new third level codes/terms follow the procedure described above, but open KEYFAO88.DBF instead of KEYNAMES.DBF. The codes should be entered in lower case only.

5 DATABASE STRUCTURE

The database comprises 6 data files and 13 associated index files. Data file names and their contents are given below. The data file structures are described in appendix A.6.

Database files

The data is stored into 6 separate data files in order to:

- (1) limit the number of fields per database,
- (2) use the storage capacity effectively, since the amount of records needed for a single profile depends on the kind of information, i.e. a single profile
 - occupies one record in BSDSITE.DBF (site information)
 - may occupy one record in BSDREMAR.DBF (remarks)
 - occupies a number of records in BSDHORIZ.DBF (each record contains information on one horizon)
 - may occupy a number of records in BSDANA1.DBF (each record contains information on one sample)
 - may occupy one record in BSDPHYS1.DBF (Soil physical data)
 - may occupy a number of records in BSDPHYS2.DBF (each record contains information on one sample)

Connection between the databases is made on profile number (keyfield: PRNO). A second keyfield is used to identify records in BSDHORIZ.DBF, BSDANA1.DBF and BSDPHYS2.DBF, as they generally contain more than one record on a single profile number.

Datafile	Contents	key field (identifier)
BSDSITE.DBF	site data	profile number (PRNO)
BSDREMAR.DBF	remarks	profile number (PRNO)
BSDHORIZ.DBF	horizon data	profile number (PRNO) horizon number (HRNO)
BSDANA1.DBF	analytical data	profile number (PRNO) sample number (SANO)
BSDPHYS1.DBF	soil physical data	profile number (PRNO)
BSDPHYS2.DBF	soil physical data	profile number (PRNO) sample number (SANO)

Fields

The structure of the databases and a brief description of the fields is given in appendix A.6.

Related items are often stored in one field in order to keep the data structures efficient.

For instance the field CUT1 in the BSDHORIZ.DBF data file contains all information on the primary cutans. This information consists of the codes of 4 different items:

- Quantity	(1 character code)	occupies place 1	
- thickness	(2 character code)		2,3
- nature	(2 character code)		4,5
- location	(2 character code)		6,7

In the print and selection modules the information on the individual items is extracted from these fields by using the substring selection functions LEFT(), RIGHT() and SUBSTR().

Full information on the composition of these fields is given in appendix A.6. In the description column items are listed with the number of places they occupy. Items are given in the right order. For instance the contents of field CUT1 is described as Quantity (1)/ thickness (2)/nature (2)/Location (2).

Index files

The index files with associated database files and key fields are given in appendix A.4.

HORIPRNO.NDX, ANA1PRNO.NDX and PHY2PRNO.NDX are created with the UNIQUE statement (index on to unique). These index files only have a limited amount of pointers (each profile number occurs only once) and allow for fast searches.

The ordinary index files (HORIZALL.NDX, ANA1ALL.NDX, PHY2ALL.NDX) are indexed on the same keys but contain the profile numbers of all records and consequently are much larger. These index files are used in the print modules to put the horizons and samples of a soil profile in the right order.

REFERENCES

ASHTON TATE, 1986; dBASE III+

IBM Corp/MICROSOFT Inc, 1986; DOS 3.20

REMMELZWAAL, A and VAN WAVEREN, E, 1988; Botswana Soil Database. Guidelines for Soil Profile Description. FAO/UNDP/Govt. of Botswana BOT/85/011 Field document 9. Gaborone.

APPENDIX A. DATA DICTIONARY

A.1. Program files

file names	description
BSD.PRG	BSD main program
IND.PRG	create index files
BSDINS.BAT.	installation BSD
BSD.BAT	start BSD (matrix printer)
BSDLASER.BAT	start BSD (laser printer)
CURSON.COM	cursor on, colour
CURSONMO.COM	cursor on, monochrome
CURSOFF.COM	cursor off

A.2. Source files

file name	description
BSD00000.SRC	main Menu
BSD10000.SRC	input menu
BSD11000.SRC	input site data
BSD11100.SRC	quality check site data
BSD12000.SRC	input horizon data
BSD12100.SRC	quality check horizon data
BSD13000.SRC	input analytical data
BSD14000.SRC	input soil physical data
BSD20000.SRC	select/list menu
BSD21000.SRC	display table
BSD22000.SRC	print table
BSD23000.SRC	ad hoc selection
BSD23100.SRC	selection on site data
BSD23200.SRC	selection on profile data
BSD23300.SRC	selection on analytical data
BSD23400.SRC	display profile numbers
BSD23500.SRC	print profile numbers
BSD30000.SRC	edit menu
BSD31000.SRC	edit site data
BSD32000.SRC	edit horizon data
BSD33000.SRC	edit analytical data
BSD34000.SRC	edit soil physical data
BSD40000.SRC	print Menu
BSD41000.SRC	display profile on screen
BSD42000.SRC	print site data
BSD42100.SRC	create site memory variables
BSD43000.SRC	print horizon description
BSD44000.SRC	print horizon data tabular
BSD44100.SRC	create horizon memory variables
BSD45000.SRC	print analytical data
BSD46000.SRC	print soil physical results
BSD47000.SRC	print tabular analytical data
BSD50000.SRC	delete soil profiles
BSD60000.SRC	import/write menu
BSD61000.SRC	import site/profile data from disk
BSD62000.SRC	import analytical data from disk
BSD63000.SRC	import soil physical data from disk
BSD64000.SRC	import/adapt analytical data (from laboratory database)
BSD65000.SRC	write data to disk

A.3. Data files

filename	description
BSDANA1.DBF	analytical data 1
BSDHORIZ.DBF	horizon data
BSDPHYS1.DBF	soil physical data 1
BSDPHYS2.DBF	soil physical data 2
BSDREMAR.DBF	remarks data
BSDSITE.DBF	site data

A.4. Index files

file name	associated datafile	keyfield
ANA1ALL.NDX	BSDANA1.DBF	PRNO
ANA1PRNO.NDX	BSDANA1.PRNO	PRNO (unique)
HORIPRNO.NDX	BSDHORIZ.DBF	PRNO (unique)
HORIZALL.NDX	BSDHORIZ.DBF	PRNO
PHY1ALL.NDX	BSDPHYS1.DBF	PRNO
PHY2ALL.NDX	BSDPHYS2.DBF	PRNO
PHY2PRNO.NDX	BSDPHYS2.DBF	PRNO (unique)
REMAPRNO.NDX	BSDREMAR.DBF	PRNO
SITEACZ.NDX	BSDSITE.DBF	ACZ
SITEFAO.NDX	BSDSITE.DBF	FAO
SITEPRNO.NDX	BSDSITE.DBF	PRNO
SITESTAT.NDX	BSDSITE.DBF	STAT
SITEUNIT.NDX	BSDSITE.DBF	UNIT

A.5. Conversion files

file name	contents
KEYFAO74.DBF	FAO soil units (1974)/phase
KEYFAO88.DBF	FAO soil units/third level (1988)
KEYHORIZ.DBF	horizon data
KEYNAMES.DBF	surveyors
KEYSITE.DBF	site data
KEYSIZES.DBF	abundance/quantity/size classes
KEYUSFAM.DBF	ST family level
KEYUSGRP.DBF	ST great/subgroup
KEYVEG.DBF	tree/shrub/grass species

A.6. fields data files

File name	field	type	length	dec	description
BSDSITE.DBF	PRNO	C	6	0	profile number
BSDSITE.DBF	SHNO	C	6	0	sheet number
BSDSITE.DBF	GRID	C	8	0	grid number
BSDSITE.DBF	ACZ	C	5	0	agro climatic zone
BSDSITE.DBF	UNIT	C	5	0	mapping unit
BSDSITE.DBF	STAT	C	1	0	status
BSDSITE.DBF	FAO	C	5	0	FAO soil unit 74 (3) + phase(2)
BSDSITE.DBF	FAOR	C	6	0	FAO soil unit(3) + 3rd level (3) 88
BSDSITE.DBF	STSG	C	7	0	ST great group(4) + subgroup(2)
BSDSITE.DBF	STFM	C	11	0	ST mineralogy(2) + STR(2) + texture(3) + reaction(2)
BSDSITE.DBF	SMR	C	2	0	soil moisture regime
BSDSITE.DBF	LAT	N	6	0	latitude
BSDSITE.DBF	LON	N	6	0	longitude
BSDSITE.DBF	ELEV	N	4	0	elevation
BSDSITE.DBF	DATE	D	8	0	data
BSDSITE.DBF	AUTH	C	12	0	author(3) + author(3) + author(3) + author(3)
BSDSITE.DBF	LAFO	C	2	0	landform
BSDSITE.DBF	LAEL	C	2	0	land element
BSDSITE.DBF	POS	C	2	0	position of site
BSDSITE.DBF	TOP	C	1	0	topography
BSDSITE.DBF	SLGR	C	6	0	slope gradient minimum(3) + maximum(3)
BSDSITE.DBF	SLFR	C	1	0	slope form
BSDSITE.DBF	MITO	C	2	0	micro-topography
BSDSITE.DBF	SEAL	C	2	0	surface sealing
BSDSITE.DBF	CRAC	N	1	0	cracking
BSDSITE.DBF	SALT	C	2	0	surface salts
BSDSITE.DBF	SAND	C	1	0	bleached sand on surface
BSDSITE.DBF	STON	C	2	0	surface stones
BSDSITE.DBF	ROCK	C	2	0	rock outcrops
BSDSITE.DBF	PAMA	C	4	0	parent material(2) + Parent material(2)
BSDSITE.DBF	ROTY	C	2	0	rock type
BSDSITE.DBF	GEOL	C	3	0	geological unit
BSDSITE.DBF	DRAI	C	2	0	drainage
BSDSITE.DBF	MOIS	C	12	0	moisture condition(1)/depth(3) + cond(1)/depth(3) + cond(1)/depth(3)
BSDSITE.DBF	EROS	C	6	0	erosion intensity(2)/type(1) + intensity(1)/type(2)
BSDSITE.DBF	LUT	C	2	0	land use type
BSDSITE.DBF	CROP	C	4	0	crop(2) + crop(2)
BSDSITE.DBF	VEG	C	3	0	vegetation type
BSDSITE.DBF	GRCO	C	1	0	grass cover
BSDSITE.DBF	SPTR	C	18	0	dominant tree(3) + tree(3) + tree(3) + tree(3) + tree(3) + tree(3)
BSDSITE.DBF	SPSH	C	18	0	dominant shrub(3) + shrub(3) + shrub(3) + shrub(3) + shrub(3) + shrub(3)
BSDSITE.DBF	SPGR	C	18	0	dominant grass/forb (3) + grass/forb(3) + grass/forb(3) + grass/forb(3) + grass /forb(3) + grass/forb(3)
BSDSITE.DBF	HUM	C	1	0	human influence
BSDSITE.DBF	LOC	C	50	0	location, descriptive
BSDSITE.DBF	REMS	L	1	0	remarks, flag

File name	field	type	length	dec	description
BSDREMAR.DBF	PRNO	C	6	0	profile number
BSDREMAR.DBF	REMS	C	254	0	remarks, descriptive
BSDHORIZ.DBF	PRNO	C	6	0	profile number
BSDHORIZ.DBF	HRNO	N	1	0	horizon number
BSDHORIZ.DBF	DESI	C	6	0	horizon designation
BSDHORIZ.DBF	UPBO	N	3	0	depth, upper boundary
BSDHORIZ.DBF	LOBO	N	3	0	depth, lower boundary
BSDHORIZ.DBF	COL1	C	13	0	1st colour hue(5)/ value(3)/ chroma(3) + modifier(1)
BSDHORIZ.DBF	COL2	C	13	0	2nd colour hue(5)/ value(3)/ chroma(3) + modifier(1)
BSDHORIZ.DBF	MOT1	C	6	0	1st mottles abundance(1)/size(1)/ contrast(1)/ boundary(1)/ color(2)
BSDHORIZ.DBF	MOT2	C	6	0	2nd mottles abundance(1)/size(1)/ contrast(1)/ boundary(1)/ color(2)
BSDHORIZ.DBF	TEX1	C	4	0	1st texture
BSDHORIZ.DBF	TEX2	C	4	0	2nd texture
BSDHORIZ.DBF	CLAY	N	2	0	% clay, field estimate
BSDHORIZ.DBF	STR1	C	6	0	1st structure grade(2)/ size(2)/ type(2)
BSDHORIZ.DBF	STR2	C	6	0	2nd structure grade(2)/ size(2)/ type(2)
BSDHORIZ.DBF	STR3	C	1	0	relation 1st and 2nd structure
BSDHORIZ.DBF	COSP	C	4	0	consistence stickiness(2) + plasticity (2)
BSDHORIZ.DBF	COSM	C	4	0	consistence dry(2) + consistence moist(2)
BSDHORIZ.DBF	CUT1	C	7	0	1st cutans quantity(1) /thickness(2)/ nature(2)/ location(2)
BSDHORIZ.DBF	CUT2	C	7	0	2nd cutans quantity(1) /thickness(2)/ nature(2)/ location(2)
BSDHORIZ.DBF	CEME	C	1	0	cementation
BSDHORIZ.DBF	POR1	C	3	0	1st pores abundance(1)/size(2)
BSDHORIZ.DBF	POR2	C	3	0	2nd pores abundance(1)/size(2)
BSDHORIZ.DBF	ROC1	C	8	0	1st rock fragment abundance(2)/size(2) /shape(1)/weathering(1)/nature(2)
BSDHORIZ.DBF	ROC2	C	8	0	2nd rock fragment abundance(2) /size(2) /shape(1)/ weathering(1)/nature(2)
BSDHORIZ.DBF	MIN1	C	9	0	1st nodule abund(2)/kind(1)/size(1) /shape(1)/hardness(1)/nature(1)/color(2)
BSDHORIZ.DBF	MIN2	C	9	0	2nd nodule abund(2)/kind(1)/size(1) /shape(1)/hardness(1)/nature(1)/color(2)
BSDHORIZ.DBF	CARB	C	2	0	carbonates
BSDHORIZ.DBF	BIO1	C	3	0	biological features quantity(1) / kind(2)
BSDHORIZ.DBF	BIO2	C	3	0	biological features quantity(1) / kind(2)
BSDHORIZ.DBF	RTS1	C	4	0	roots quantity(2)/size(2)
BSDHORIZ.DBF	RTS2	C	4	0	roots quantity(2)/size(2)
BSDHORIZ.DBF	PH	N	3	1	field pH
BSDHORIZ.DBF	BOUN	C	2	0	boundary width(1)/topography(1)

File name	field	type	length	dec	description
BSDANA1.DBF	SAMPLE	N	5	0	lab number
BSDANA1.DBF	PRNO	C	6	0	profile number
BSDANA1.DBF	SANO	C	1	0	sample number
BSDANA1.DBF	UPBO	N	3	0	depth upper boundary
BSDANA1.DBF	LOBO	N	3	0	depth lower boundary
BSDANA1.DBF	PHW	N	5	2	pH water
BSDANA1.DBF	PHC	N	5	2	pH CaCl2
BSDANA1.DBF	EC	N	4	1	electro conductivity
BSDANA1.DBF	P	N	2	0	phosphorus
BSDANA1.DBF	OC	N	5	2	organic carbon
BSDANA1.DBF	CECS	N	6	2	CEC soil
BSDANA1.DBF	CA	N	4	1	calcium
BSDANA1.DBF	MG	N	4	1	Magnesium
BSDANA1.DBF	K	N	4	1	Potassium
BSDANA1.DBF	NA	N	4	1	Sodium
BSDANA1.DBF	PBS	N	3	0	Percentage base saturation
BSDANA1.DBF	VCS	N	4	1	very coarse sand
BSDANA1.DBF	CS	N	4	1	coarse sand
BSDANA1.DBF	MS	N	4	1	medium sand
BSDANA1.DBF	FS	N	4	1	fine sand
BSDANA1.DBF	VFS	N	4	1	very fine sand
BSDANA1.DBF	CSI	N	4	1	coarse silt
BSDANA1.DBF	FSI	N	4	1	fine silt
BSDANA1.DBF	CI	N	4	1	clay
BSDANA1.DBF	CECC	N	3	0	CEC clay
BSDANA1.DBF	METH	C	4	0	method particle size determination
BSDANA1.DBF	PRET	C	1	0	pretreatment
BSDANA1.DBF	ECM	C	1	0	method

File name	field	type	length	dec	description
BSDPHYS1.DBF	PRNO	C	6	0	profile number
BSDPHYS1.DBF	INB1	N	5	1	basic infiltration run 1
BSDPHYS1.DBF	INB2	N	5	1	basic infiltration run 2
BSDPHYS1.DBF	INB3	N	5	1	basic infiltration run 3
BSDPHYS1.DBF	INB4	N	5	1	basic infiltration run 4
BSDPHYS1.DBF	INB5	N	5	1	basic infiltration run 5
BSDPHYS1.DBF	INA1	N	4	2	'a' value run 1
BSDPHYS1.DBF	INA2	N	4	2	'a' value run 2
BSDPHYS1.DBF	INA3	N	4	2	'a' value run 3
BSDPHYS1.DBF	INA4	N	4	2	'a' value run 4
BSDPHYS1.DBF	INA5	N	4	2	'a' value run 5
BSDPHYS1.DBF	INN1	N	4	2	'n' value run 1
BSDPHYS1.DBF	INN2	N	4	2	'n' value run 2
BSDPHYS1.DBF	INN3	N	4	2	'n' value run 3
BSDPHYS1.DBF	INN4	N	4	2	'n' value run 4
BSDPHYS1.DBF	INN5	N	4	2	'n' value run 5
BSDPHYS1.DBF	STAB	N	4	2	structure stability index
BSDPHYS1.DBF	REMS	C	254		remarks

File name	field	type	length	dec	description
BSDPHYS2.DBF	PRNO	C	6	0	profile number
BSDPHYS2.DBF	SANO	C	1	0	sample code
BSDPHYS2.DBF	UPBO	N	3	0	depth upper boundary
BSDPHYS2.DBF	LOBO	N	3	0	depth lower boundary
BSDPHYS2.DBF	M003	N	5	2	water retention 0.03bar
BSDPHYS2.DBF	M005	N	5	2	water retention 0.05bar
BSDPHYS2.DBF	M01	N	5	2	water retention 0.1bar
BSDPHYS2.DBF	M03	N	5	2	water retention 0.3bar
BSDPHYS2.DBF	M1	N	5	2	water retention 1bar
BSDPHYS2.DBF	M3	N	5	2	water retention 3bar
BSDPHYS2.DBF	M5	N	5	2	water retention 5bar
BSDPHYS2.DBF	M15	N	5	2	water retention 15bar
BSDPHYS2.DBF	BULK	N	4	2	bulk density
BSDPHYS2.DBF	BULM	C	2	0	method bulk density

A.7. fields conversion files

file name	field	type	length	dec	description
KEYNAMES.DBF	CONA	C	3	0	codes surveyors
KEYNAMES.DBF	NAME	C	25	0	surveyors
KEYSIZES.DBF	COZI	C	2	0	codes sizes
KEYSIZES.DBF	SIZE	C	22	0	sizes
KEYSIZES.DBF	COQU	C	2	0	codes quantity
KEYSIZES.DBF	QMAN	C	13	0	quantity
KEYSIZES.DBF	COGV	C	2	0	codes structure grade
KEYSIZES.DBF	GRAD	C	26	0	structure grade
KEYSIZES.DBF	COOT	C	1	0	codes degree weathering / shape
KEYSIZES.DBF	OTHE	C	10	0	degree of weathering / shape
KEYSIZES.DBF	COCO	C	2	0	codes colour
KEYSIZES.DBF	COLO	C	15	0	colour
KEYSITE.DBF	COLA	C	2	0	codes landform(U) / land element(L)
KEYSITE.DBF	LAND	C	21	0	landform + landelement
KEYSITE.DBF	COTO	C	2	0	codes topography(U) / microtopography(L)
KEYSITE.DBF	TOPO	C	17	0	topography + micro-topography
KEYSITE.DBF	COLU	C	2	0	codes landuse(U) / crops(L)
KEYSITE.DBF	LUSE	C	30	0	land use + crops
KEYSITE.DBF	COVE	C	3	0	codes vegetation type / grass cover
KEYSITE.DBF	VEST	C	23	0	vegetation type + grass cover
KEYSITE.DBF	COPA	C	2	0	code parent material
KEYSITE.DBF	PAMA	C	27	0	parent material
KEYSITE.DBF	CORO	C	2	0	codes rock type
KEYSITE.DBF	ROCK	C	25	0	rock types
KEYSITE.DBF	COGE	C	3	0	codes geological unit
KEYSITE.DBF	GEOL	C	22	0	geological units
KEYSITE.DBF	CODA	C	2	0	codes drainage class
KEYSITE.DBF	DRAI	C	32	0	drainage class
KEYSITE.DBF	COOT	C	1	0	codes erosion type(U) / human influence(L)
KEYSITE.DBF	OTHE	C	23	0	erosion type + human influence

File name	field	type	length	dec	description
KEYHORIZ.DBF	COBO	C	1	0	codes boundary width(L) / topography(U)
KEYHORIZ.DBF	BOUN	C	9	0	boundary width/topography
KEYHORIZ.DBF	COTX	C	4	0	codes texture classes
KEYHORIZ.DBF	TEXT	C	20	0	texture classes
KEYHORIZ.DBF	COST	C	2	0	codes structure type
KEYHORIZ.DBF	STRU	C	30	0	structure type
KEYHORIZ.DBF	COCO	C	2	0	codes consistence dry/moist / stickiness(L) / plasticity
KEYHORIZ.DBF	CONS	C	27	0	consistence dry /moist / stickiness(L) /plasticity
KEYHORIZ.DBF	COCU	C	2	0	codes cutans nature(U)/location(L)
KEYHORIZ.DBF	CUTA	C	33	0	cutans nature/location
KEYHORIZ.DBF	CONO	C	2	0	codes nodules kind(L)/nature(U)
KEYHORIZ.DBF	NODU	C	18	0	nodules kind/nature
KEYHORIZ.DBF	COBI	C	2	0	code biological features kind
KEYHORIZ.DBF	BIOL	C	20	0	biological features kind
KEYFAO74.DBF	COFA	C	3	0	codes FAO 74 soil units(U)/phases(L)
KEYFAO74.DBF	FAO	C	27	0	FAO 74 soil unit/phase
KEYFAO88.DBF	CONF	C	3	0	codes FAO 88 soil units(U)/3rd level(L)
KEYFAO88.DBF	FAON	C	35	0	FAO 88 soil unit/3rd level
KEYUSGRP.DBF	COGG	C	3	0	codes ST great group(U)/soil moisture regime(L)
KEYUSGRP.DBF	GRAN	C	25	0	ST great group/soil moisture regime
KEYUSGRP.DBF	COSG	C	4	0	codes subgroup
KEYUSGRP.DBF	SUBG	C	28	0	subgroup
KEYUSFAM.DBF	COFA	C	3	0	codes ST mineralogy / soil temperature regime / texture / reaction
KEYUSFAM.DBF	FAMI	C	25	0	ST mineralogy/soil temperature regime/texture/reaction
KEYVEG.DBF	COSP	C	3	0	codes tree/shrub species(U)/grass-forb species(L)
KEYVEG.DBF	SPEC	C	50	0	tree-shrub species/grass-forb species

SHEET : 24Z502
 LOCATION : Sebele, Agricultural Research Center.
 AUTHOR(S) : A.B.Price M.D.Mays A.Remmelzwaal
 CLASSIFICATION FAO: Pale-Haplic Lixisol(1988) Ferric Luvisol (1974)
 ST : kandic Paleustalf ; fine loamy mixed hyperthermic

LANDFORM : plain
 TOPOGRAPHY: almost flat
 SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
 LAND USE: improved trad. dryland farming, crops: maize, beans

SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 097, slightly moist 097 - 180 cm
 SURF.STONES: none
 EROSION : moderate sheet erosion

REMARKS: USDA Pedon no.16 (Typic Haplargid). Excursion site FAO EASC meeting 1-4-87.

SAMPLES:	A:	0 - 0	B:	0 - 0	C:	0 - 0	D:	0 - 0	E:	0 - 0	F:	0 - 0	G:	0 - 0
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Ap 0 - 11 cm 10YR 3/3 (moist) and 10YR 4/4 (dry), sandy loam (15% clay), weak medium subangular blocky falling apart into weak fine granular structure, slightly hard very friable, non sticky non plastic, few very fine pores, non calcareous, common fine and medium roots, field pH: 5.5, abrupt wavy boundary.

A 11 - 33 cm 10YR 3/3 (moist) and 10YR 4/3 (dry), sandy loam (18% clay), weak medium and coarse subangular blocky structure, hard very friable, non sticky non plastic, few very fine pores, non calcareous, common fine and medium roots, field pH: 5.5, clear wavy boundary.

Bt1 33 - 51 cm 7.5YR 3/4 (moist) and 7.5YR 4/6 (dry), sandy clay loam (22% clay), weak coarse subangular blocky structure, hard friable, sticky slightly plastic, broken thin cutans on pedfaces and broken thin cutans random, few very fine pores, non calcareous, very few very fine and fine roots, field pH: 6.0, diffuse wavy boundary.

Bt2 51 - 97 cm 5YR 3/4 (moist) and 5YR 4/6 (dry), sandy clay loam (28% clay), weak coarse subangular blocky structure, hard friable, sticky slightly plastic, broken thin cutans on pedfaces and broken thin cutans random, few very fine pores, non calcareous, few fine and medium and few coarse roots, field pH: 6.0, diffuse wavy boundary.

Bt3 97 - 180 cm 5YR 4/6 (moist) and 5YR 5/6 (dry), sandy clay loam (30% clay), weak coarse subangular blocky structure, very hard friable, sticky slightly plastic, broken thin cutans on pedfaces and broken thin cutans random, few very fine and fine pores, non calcareous, few fine and medium roots, field pH: 6.0, abrupt smooth boundary.

Cmo 180 - 190 cm extremely hard, cemented,

SOIL PROFILE DESCRIPTION

Profile: G 0901 Unit: G06a Status: 1

SHEET : 242502
 LOCATION : Sebele, Agricultural Research Center.
 AUTHOR(S) : A.B.Price M.D.Mays A.Remmelzwaal
 CLASSIFICATION FAO: Pale-Haplic Lixisol(1988) Ferric Luvisol (1974)
 ST : kandic Paleustalf ; fine loamy mixed hyperthermic

LANDFORM : plain
 TOPOGRAPHY : almost flat
 SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
 LAND USE: improved trad. dryland farming, crops: maize, beans
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs -

PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 097, slightly moist 097 - 180 cm
 SURF. STONES: none
 EROSION : moderate sheet erosion

REMARKS: USDA Pedon no.16 (Typic Haplargid). Excursion site FAO EASC meeting 1-4-87.

GRID : LG-929-826
 COORD: 24-53-40-S 25-56-40-E
 DATE : 11/04/86
 ACRO CLIM.ZONE: IE3
 ELEVATION : 1015 m
 SMR: ustic
 POSITION: intermediate part
 SLOPE : - 1 % straight
 GRASSCOVER:
 LAND ELEMENT : interfluv
 MICRO TOPOGRAPHY: even
 VEGETATION: Nil
 ROCK TYPE: granite
 ROCK OUTCROP: none
 GEOL.UNIT: Gaborone granite
 DRAINAGE : well drained
 HUMAN INF: ploughing

HORIZON DEPTH	COLOR	MOTTLES	TEXTURE	STRUCTURE	CONS	CUTANS	CEM	PORES	ROCK FRAG	MODULES	CA	BIO	ROOTS	BOUND
		Ab Si Ct Bo Co	<2mm ZC	Gr Si Ty ->	ha fr b ch st sp b ch	Q Th Na lo	Ab Dia	Ab Si Sh We Na	Ab Ki Si Sh Ha Na Co	Qu Ki Qu Si				
Ap 0 - 11	10YR 3/3(m) 10YR 4/4(d)	0 0	SL 15	we w we f	ch ef 0 ns up 0			f vf 0 0	0 0	0 0	0 0	c fm	a-w	5.5
A 11 - 33	10YR 3/3(m) 10YR 4/3(g)	0 0	SL 18	we mc sb	ha vf 0 ns up 0			f vf 0 0	0 0	0 0	0 0	c fm	c-w	5.5
Bt1 33 - 51	7.5YR 3/4(m) 7.5YR 4/6(d)	0 0	SCL 22	we c sb	ha fr b ch st sp b ch			f vf 0 0	0 0	0 0	0 0	vf ff	d-w	6.0
Bt2 51 - 97	5YR 3/4(m) 5YR 4/6(g)	0 0	SCL 28	we c sb	ha fr b th st sp b th			f vf 0 0	0 0	0 0	0 0	f c	d-w	6.0
Bt3 97 - 180	5YR 4/6(m) 5YR 5/6(d)	0 0	SCL 30	we c sb	vh fr b th st sp b th			f ff 0 0	0 0	0 0	0 0	f fm	a-s	6.0
Cmo 180 - 190	/()	/()												

Soil Survey of Botswana FAO/BGT/85/011

Print date: 31/10/88

STANDARD SOIL ANALYSIS RESULTS

PROFILE: C 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	h	%S	Particle size (weight %)				CECclay	METH	PRETR				
		H2O CaCL2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0	0	5.9	4.5	0.0	3	0.2	3.9	1.9	0.6	0.4	0.0	74	7	29	20	18	8	2	2	15	21
B	0	0	5.9	4.5	0.0	3	0.2	4.7	2.2	0.6	0.4	0.0	68	7	27	19	18	9	2	2	17	23
C	0	0	5.9	4.8	0.0	3	0.2	4.7	1.8	1.1	0.4	0.0	70	7	21	21	21	11	2	3	19	21
D	0	0	5.6	4.7	0.0	2	0.2	4.5	1.5	1.8	0.4	0.0	82	9	23	21	18	8	2	2	23	16
E	0	0	5.8	4.7	0.0	2	0.2	6.4	1.4	2.2	0.4	0.0	62	6	12	17	21	13	3	2	26	22
F	0	0	5.6	4.7	0.0	1	0.2	6.9	1.4	2.6	0.4	0.0	64	8	17	15	18	11	2	2	27	23
G	0	0	4.8	4.5	0.0	0	0.1	5.1	1.2	2.1	0.4	0.0	73	10	20	17	17	10	2	2	22	21

Soil Survey of Botswana FAO/BCF/85/011

Print date: 31/10/88

METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

PART-SIZE DETERMINATION

STANDARD SOIL ANALYSIS RESULTS

NUMBER	DEPTH	PH	EC	P	C	CEC	Ca	Mg	K	Na	fBS	Particle size (weight %)						CECclay	METH	PRETR				
												H2O CaCL2	ms/cm	ppm	weight %	µ-----	meq/100gr soil				z	vcS	cS	ms
PA0001 A	0	10	6.9	6.4	0.0	3	0.6	45.1	26.7	21.5	0.5	0.6	100	0	3	17	16	4	1	4	54	79	H	A
PA0001 B	10	25	6.7	6.3	0.0	3	0.5	50.9	28.3	33.2	0.6	1.1	100	0	3	13	10	3	1	5	65	75	H	A
PA0001 C	30	50	7.5	7.1	0.5	2	0.4	55.6	31.0	33.5	0.9	2.6	100	0	3	10	8	3	2	5	69	79	H	A
PA0001 D	80	100	7.9	7.5	0.6	1	0.4	56.8	27.7	35.8	1.1	7.4	100	1	3	11	9	0	1	4	68	81	H	A
PA0001 E	140	160	8.4	7.7	0.4	2	0.2	58.2	34.5	37.0	1.1	9.0	100	1	2	6	5	2	2	3	78	73	H	A
PA0001 F	190	210	8.3	7.7	0.4	2	0.2	54.5	42.9	36.1	1.0	9.1	100	1	2	5	4	2	1	2	83	65	H	A
PA0002 A	0	20	7.3	6.7	0.0	1	0.8	51.8	26.7	23.5	1.3	1.7	100	0	3	10	6	2	2	8	69	71	H	A
PA0002 B	30	50	7.8	7.3	0.3	1	0.4	51.6	27.3	22.7	1.2	2.8	100	0	2	8	5	2	2	8	73	69	H	A
PA0002 C	80	100	8.2	7.7	0.2	1	0.6	51.1	30.4	20.6	0.7	2.7	100	0	3	8	5	2	1	7	73	67	H	A
PA0002 D	150	170	8.3	7.8	0.0	1	0.3	57.7	40.5	30.4	0.7	4.8	100	1	2	4	3	2	1	7	81	70	H	A
PA0003 A	0	20	7.1	6.4	0.3	1	0.6	46.3	33.4	13.0	0.2	0.1	100	0	5	21	12	3	3	5	51	86	H	A
PA0003 B	60	80	7.1	6.6	0.0	1	0.4	47.4	34.0	14.4	0.2	0.5	100	0	4	15	9	3	2	6	63	73	H	A
PA0003 C	120	140	8.0	7.7	0.0	1	0.4	59.7	65.0	18.9	0.5	1.3	100	5	5	8	5	2	3	5	67	86	H	A
PA0003 D	140	160	7.7	7.5	0.2	2	0.1	56.0	62.4	11.7	0.2	1.3	100	14	12	14	9	5	6	8	32	173	H	A
PA0004 A	0	20	7.4	7.3	0.1	1	0.6	55.5	50.6	11.2	0.8	0.5	100	0	4	11	6	3	4	8	64	83	H	A
PA0004 B	50	70	7.8	7.4	0.2	0	0.6	58.3	51.6	15.1	1.1	3.4	100	1	3	10	6	2	3	7	69	81	H	A
PA0004 C	110	125	7.8	7.4	0.3	0	0.6	62.6	56.0	17.9	1.3	6.3	100	2	7	3	2	1	2	8	81	75	H	A
PA0005 A	0	15	5.9	5.6	0.0	9	1.5	25.6	16.2	4.3	1.4	0.2	86	1	3	9	9	12	13	13	40	49	H	A
PA0005 B	20	40	6.2	5.5	0.0	3	0.9	23.2	18.6	5.7	1.5	0.1	100	4	4	8	8	9	8	11	48	41	H	A

TATUS
 IU irrigated farming
 IS - small scale
 IM - medium scale
 GU grazing
 GT - traditional
 GC - commercial
 MT Molapo traditional
 MI Molapo improved
 reference pit
 routine pit
 pit; incomplete
 augering
 other observations

LANDFORM
 plain
 alluvial plain
 lacustrine plain
 sandplain
 pediment
 dune/field
 plateau
 escarpment
 hill
 valley
 alluvial fan
 other see remarks

LAND ELEMENT
 A not applicable
 F interfluvial
 U dune
 D transverse dune
 D longitudinal dune
 D parabolic dune
 D barchan dune
 D interdunal depression
 A pan
 E depression
 I ridge
 E beach (ridge)
 D beach-dune complex
 P floodplain
 E terrace
 A backswamp
 T delta
 H channel
 E levee
 A valley
 F valley floor
 F alluvial fan
 S island
 other see remarks

POSITION OF SITE
 R crest
 S upper slope
 S middle slope
 S lower slope
 L slope
 I higher part plain
 N intermediate part
 O lower part plain

TOPOGRAPHY
 flat
 almost flat
 gently undulating
 undulating
 rolling
 hilly
 steeply dissected

MICRO TOPOGRAPHY
 even
 L gilgai low
 M - medium
 H - high
 I gilgai unspecified
 M termite mounds
 T animal tracks
 B animal burrows
 L hummocks low
 M - medium
 H - high
 U hummocks unspecified
 H uneven (unspecified)

LOPE FORM
 convex
 concave
 straight

WEALING
 nil
 L slight
 O moderate
 T strong

SOILS
 nil
 L slight
 T strong

LEACHED SAND
 nil
 present

LAND USE TYPE
 none
 R forest reserve
 R game reserve
 M wildlife man. area
 V disturbed vegetation
 V along fields, roads
 U dryland farming
 T - traditional
 I - improved
 M - mechanized
 C - commercial

4 many 50 - 90 %
 5 abundant > 90%

ROCK OUTCROPS
 O nil
 VF very few
 FA fairly rocky
 RO rocky
 VE very rocky
 EX extremely rocky

EROSION
intensity
 O nil
 S1 slight
 MO moderate
 ST strong

type
 S sheet erosion
 R rill erosion
 G gully erosion
 W wind erosion/
 deposition
 E wind erosion
 D wind deposition
 A accumulation by water

HUMAN INFLUENCE
 O nil
 P ploughing
 I irrigation
 C clearing
 B borrow pit
 S surface compaction

COLOR MODIFIER
 M moist
 D dry
 MM mottled moist
 MD mottled dry

MOTTLES
abundance
 O none
 F few <2%
 C common 2-20%
 M many >20%

size
 F fine <5mm
 M medium 5-15mm
 C coarse >15mm

contrast
 F faint
 D distinct
 P prominent

boundary
 S sharp
 C clear <2mm
 D diffuse >2mm

color
 W white
 R red
 RS reddish
 YR yellowish-red
 RB reddish-brown
 YB yell.-brown
 BR brown
 BS brownish
 RY red.-yellow
 Y yellow
 GR greenish
 G gray
 GS grayish
 B bluish-black
 N black

TEXTURE
basic codes:
 C clay
 SI silt
 L loam
 S sand
 VS very fine sand
 FS fine sand
 FMS fine-medium sand
 CS coarse sand

STRUCTURE
grade
 SG single grain
 WC massive weakly coherent
 MC - mod. coherent
 SC - strongly coherent
 VW very weak
 WE weak
 WH weak + moderate
 MD moderate
 MS moderate + strong
 ST strong
 VS very strong

size
 VF very fine
 FF very fine + fine
 F fine
 FM fine+medium
 M medium
 MC medium + coarse
 C coarse
 CV coarse + v.coarse
 VC very coarse
 FC fine-coarse
 MV medium-very coarse

type
 GR granular
 CR crumb
 PR prismatic
 SB subangular blocky
 AB angular blocky
 AW ang.blocky incl.
 wedge shaped
 SA sub-ang blocky
 AS ang+sub blocky
 CO columnar
 PL platy
 RS rock structure

relation I->II
 + and
 / falls apart
 / to

CONSISTENCY
dry
 LO loose
 SO soft
 SS soft-slightly hard
 SH slightly hard
 HH slightly hard-hard
 HA hard
 HV hard-very hard
 VH very hard
 EH extremely hard

moist
 LO loose
 VF very friable
 VV very fr-friable
 FR friable
 FF friable-firm
 FV firm-very firm
 VM very firm
 EM extremely firm

stickiness
 NS non sticky
 SS slightly sticky
 SL sl.sticky-sticky
 ST sticky
 SV sticky-very sticky
 VS very sticky

plasticity
 NP non plastic
 SP slightly plastic
 PP sp-plastic
 PL plastic
 PV pl-very plastic
 VP very plastic

CUTANS
quantity
 O none
 P patchy
 B broken
 C continuous

thickness
 TH thin
 MO moderately thick
 TK thick

nature
 C clay
 CS clay-sesquioxides
 CH clay-humus
 PF pressure faces
 S slickensides
 SP partly intersecting
 SI intersecting
 SL slickensides

location
 P pedfaces
 PV vertical
 pedfaces only
 PH horizontal
 pedfaces only
 PO pores
 LA lamellae
 RA random

CEMENTATION
 O non cemented
 W weakly cemented
 P partly cemented
 C cemented

PORES/ROOTS
abundance
 O nil
 VF very few (roots only)
 F few
 C common
 M many
 A abundant (roots only)

size
 VF very fine <1mm
 FF very fine+fine
 F fine 1-2mm
 FM fine+medium
 M medium 2-5mm
 MC medium+coarse
 C coarse >5mm

ROCK FRAGMENTS
abundance
 O none
 VF very few <5%
 F few 5-15%
 FQ frequent 15-40%
 VQ very fq 40-80%
 DO dominant >80%

size
 F fine <2cm
 FM fine+medium
 M medium 2-7.5cm
 MC medium+coarse
 C coarse 7.5-12cm
 CV coarse+v.coarse
 VC very coarse 12-25cm
 EC extremely coarse >25cm

shape
 R rounded
 F flat
 A angular

weathering
 F fresh-slightly weathered
 W weathered
 S strongly weath.

nature
 see rocktype

MINERAL NODULES
abundance
 see rock fragments

kind
 C concretions
 T crystals
 S soft suspension
 N nodules

size
 F fin <5mm
 M med. 5-15mm
 C coarse >15mm

shape
 S spherical
 I irregular
 A angular

hardness
 S soft
 H hard
 B both

nature
 K carbonates
 C clay
 G gypsum
 Q silica
 S iron-manganese
 F iron
 M manganese

color
 see mottles

CARBONATES
 O non calcareous
 SL slightly calc.
 MO moderately calc.
 ST strongly calc.
 EX extremely calc.

BIOL FEATURES
abundance
 see pores

kind
 B burrows
 BO burrows, open
 BI burrows, infilled
 T termite/ant act.
 I other insect act.

BOUNDARY
width
 A abrupt <2cm
 C clear 2-5cm
 G gradual 5-12cm
 D diffuse >12cm

topography
 S smooth
 W wavy
 I irregular
 B broken

TREES AND SHRUBS

ABL *Abutilon lyciodes*
 AAL *Acacia albidia*
 AAM *Acacia arenaria*
 AAT *Acacia ataxacantha*
 ABU *Acacia burkei*
 ACA *Acacia caffra*
 AER *Acacia erioloba*
 AEB *Acacia erubescens*
 AFL *Acacia fleckii*
 AGA *Acacia galpinii*
 AGE *Acacia gerrardii*
 AGR *Acacia grandicornuta*
 AHA *Acacia haematoxylon*
 AHE *Acacia hebeclada*
 AHR *Acacia hereroensis*
 AKA *Acacia karroo*
 AKI *Acacia kirkii*
 ALU *Acacia luederitzii*
 ALR *Acacia luederitzii* var. *retinens*
 ANE *Acacia mellifera*
 ANE *Acacia nebrowii*
 ANG *Acacia nigrescens*
 ANL *Acacia nilotica*
 APE *Acacia permixta*
 APO *Acacia polyacantha*
 ARH *Acacia rehmanniana*
 ARO *Acacia robusta*
 ASC *Acacia schweinfurthii*
 ASE *Acacia senegal* var. *feitorachis*
 ASR *Acacia senegal* var. *rostrata*
 ASI *Acacia sieberana*
 AC *Acacia* sp.
 AST *Acacia stuhlmannii*
 ATE *Acacia tenuispina*
 ATO *Acacia tortilis* subs. *heterocantha*
 ATS *Acacia tortilis* subs. *spirocarpa*
 AXA *Acacia xanthophloea*
 ADD *Adansonia digitata*
 AFQ *Azobila quanzensis*
 ALV *Albizia versicolor*
 ALA *Albizia anthelmintica*
 ALH *Albizia harveyi*
 AL *Albizia* sp.
 ACM *Aloe marlothii*
 BBH *Babiana hypogaea*
 BKP *Baikiaea plurijuga*
 BPM *Baphia massaiensis*
 BPO *Baphia obovata*
 BUP *Bauhinia petersiana*
 BUT *Bauhinia tonningii*
 BQM *Bequaertiodendron megalismontanum*
 BED *Berchemia discolor*
 BOS *Bolusanthus speciosus*
 BSA *Boscia albitrunca*
 BCF *Boscia foetida* subs. *rehmanniana*
 BSM *Boscia mossambicensis*
 BRB *Brachystegia boehmii*
 BRS *Brachystegia spiciformis*
 BIM *Bridelia mollis*
 BUA *Burkea africana*
 CSB *Carissa bispinosa*
 CAA *Cassia abbreviata*
 CTA *Catophractes alexandri*
 CLM *Colophospermum mopane*
 COB *Combretum albopunctatum*
 COA *Combretum apiculatum*
 COG *Combretum elaeagnoides*
 COE *Combretum erythrophyllum*
 COF *Combretum fragrans*
 COH *Combretum hereroense*
 COI *Combretum imberbe*
 COL *Combretum molle*
 COM *Combretum mossambicense*
 COZ *Combretum zeyheri*
 CMA *Commiphora africana*
 CML *Commiphora angolensis*
 CME *Commiphora edulis*
 CMO *Commiphora mollis*
 CMM *Commiphora mossambicensis*
 CMG *Commiphora pyracanthoides* subs. *glandulosa*
 CMP *Commiphora pyracanthoides* subs. *pyracanthoides*
 CMS *Commiphora schimperi*
 CM *Commiphora* sp.
 CRG *Croton gratissimus*
 CRM *Croton megalobotrys*
 CRY *Croton menyharthii*
 CR *Croton* sp.
 DAE *Dalium englerianum*
 DRC *Dichrostachys cinerea*
 DPL *Diospyros lycioides*
 DPM *Diospyros mespiliformis*
 DSC *Diplorhynchus condylocarpon*
 DMR *Dombeya rotundifolia*
 EHA *Ehretia amoena*
 EHR *Ehretia rigida*
 ELG *Elephantorrhiza goetzei*
 ELB *Elephantorrhiza burkei*
 ENC *Entandrophragma caudatum*
 EYA *Erythrophleum africanum*
 EUD *Euclia divinorum*
 EUN *Euclia natalensis*
 EUU *Euclia undulata*
 EP *Euphorbia* sp.
 FAS *Fauria saligna*
 FIC *Ficus capensis*
 FIO *Ficus soldanella*
 FIS *Ficus sycomorus*
 FIV *Ficus verruculosa*
 FRO *Friesodietsia obovato*
 GAL *Garcinia livingstonei*
 GDR *Gardenia resiniflua*
 GDV *Gardenia volkensii*
 GRB *Grewia bicolor*
 GRF *Grewia flava*
 GRV *Grewia flavescens*
 GRM *Grewia monticola*
 GRO *Grewia occidentalis*
 GRR *Grewia retinervis*

GR *Grewia* sp.
 GRS *Grewia subspathulata*
 GUC *Guibourtia coleosperna*
 HYC *Hyphaene natalensis*
 HY *Hyphaene* sp.
 HYV *Hyphaene ventricosa*
 JUG *Julbernardia globiflora*
 KGA *Kigelia africana*
 KIA *Kirkia acuminata*
 KI *Kirkia* sp.
 LAD *Lannea descolor*
 LAS *Lannea stuhlmannii*
 LOC *Lonchocarpus capassa*
 LON *Lonchocarpus nelsii*
 LYA *Lycium arenicolium*
 LY *Lycium* sp.
 MEA *Maerua angolensis*
 MRA *Markhamia acuminata*
 MAH *Maytenus heterophylla* subs. *heterophylla*
 MAS *Maytenus senegalensis*
 MAI *Maytenus tenuispina*
 MIZ *Mimusops zeyheri*
 MUS *Mundulea sericea*
 GAP *Ochna pulchra*
 OLA *Olea africana*
 OSM *Ostiospermum muricatum*
 OIS *Ostrya stuhlmannii*
 OZF *Ozoroa paniculosa*
 PAC *Pappea capensis*
 PVZ *Pavetta zeyheri*
 PEA *Peltoporum africanum*
 FXR *Phoenix* sp.
 PHR *Phyllanthus reticulatus*
 PIT *Ptilostigma tonningii*
 PPO *Popowia obovata*
 POH *Pouzaisia hypoleuca*
 PRG *Protea gagei*
 PTA *Pterocarpus angolensis*
 RGG *Rhigozum brevispinosum*
 RGT *Rhigozum trichotomum*
 RHA *Rhus lancea*
 RHL *Rhus leptodictya*
 RHU *Rhus lucens*
 RHP *Rhus pyroides*
 RH *Rhus* sp.
 RHT *Rhus tenuinervis*
 RIR *Ricinodendron rautanenii*
 SCC *Sclerocarya caffra*
 SAP *Scotia brachypetala*
 SEL *Securidaca longi-pedunculata*
 SRV *Securinea virosa*
 SSL *Sesamothamnus lugardii*
 SC *Solanum* sp.
 SPA *Spirostachys africana*
 STA *Steganotaenia araliacea*
 STC *Strychnos coccoloides*
 STP *Strychnos pungens*
 SWM *Swartzia madagascariensis*
 SYG *Syzygium guineense* var. *barotense*
 TAC *Tarchonanthus camphoratus*
 TES *Tephrosia sericea*
 TMP *Terminalia prunoides*
 TMR *Terminalia randii*
 TMS *Terminalia sericea*
 VAL *Valgueria infusta*
 VIZ *Vitex zeyheri*
 XAZ *Xanthocercis zambesiaca*
 XIA *Ximenia americana*
 XIC *Ximenia caffra*
 ZIM *Ziziphus mucronata*

FORBS

ALL *Aloe littoralis*
 AL *Aloe* spp.
 ASF *Asclepias fruticosa*
 AM *Amaranthus* spp.
 AP *Asparagus* spp.
 AGM *Argemone mexicana*
 BAE *Bauhinia esculenta*
 BO *Boophone* spp.
 BLG *Blumea gariepina*
 CAI *Casaea italica*
 CIP *Ciniclia polycephala*
 CRS *Crotolaria spathuloides*
 DPG *Dipeadi glaucum*
 DTS *Datura stramonium*
 DTF *Datura ferox*
 GE *Geigeria* sp.
 GNP *Gnidia polycephala*
 HAP *Harpagophytum procumbens*
 IN *Indigofera* spp.
 OTB *Otoplera burchelli*
 PGE *Pergularia extensa*
 SA *Sansevieria* sp.
 SRV *Sarcostemma viminale*
 SOT *Solanum incanum*
 SOK *Solanum kwebense*
 SON *Solanum nigrens*
 TAM *Tagetes minuta*
 TBT *Tribulus terrestris*
 XAS *Xanthium spinosum*

GRASSES

ANA *Andropogon amplexans*
 ANE *Andropogon eucomis*
 ATA *Antephora argentea*
 ATP *Antephora pubescens*
 ARB *Aristida brevifolia*
 ARC *Aristida congesta*
 ARM *Aristida meridionalis*
 ARN *Aristida namaquensis*
 AR *Aristida* sp.
 ARS *Aristida stipitata*
 ARU *Aristida uniplumis*
 BTR *Bothriochloa radicans*
 BRD *Brachiaria deflexa*
 BRM *Brachiaria marlothii*
 BRN *Brachiaria nigropedata*
 CEC *Cenchrus ciliaris*
 CHG *Chloris gayana*
 CHM *Chloris myrostachya*

CH *Chloris* sp.
 CHV *Chloris virgata*
 CSM *Chrysopogon montanus*
 CVE *Cymbopogon excavatus*
 CYM *Cymbopogon marginatus*
 CYP *Cymbopogon plurinodes*
 CND *Cynodon dactylon*
 DAA *Dactyloctenium aegyptium*
 DAG *Dactyloctenium giganteum*
 DNG *Danthonia glauca*
 DCA *Dichanthium annuiatum*
 DCP *Dichanthium papillosum*
 DIE *Digitaria eriantha*
 DIM *Digitaria milaniana*
 DIP *Digitaria pentzii*
 DIV *Digitaria pentzii* var. *stolonifera*
 DIS *Digitaria setivalva*
 DI *Digitaria* sp.
 ECH *Echinochloa holubii*
 ECP *Echinochloa pyramidalis*
 ELA *Eleusine africana*
 EYA *Elyonurus argenteus*
 ENC *Enneapogon cenchroides*
 ENS *Enneapogon scoparium*
 ER *Eragrostis* sp.
 ERA *Eragrostis atherstonii*
 ERB *Eragrostis biflora*
 ERC *Eragrostis ciliaris*
 ERF *Eragrostis colifera*
 ERD *Eragrostis denudata*
 ERE *Eragrostis echinochloidea*
 ERG *Eragrostis gumiflora*
 ERL *Eragrostis lehmanniana*
 ERP *Eragrostis pallens*
 ERR *Eragrostis rigidior*
 ERO *Eragrostis rotifer*
 ERS *Eragrostis superba*
 EUP *Eustachys paspaloides*
 FIA *Fingerhuthia africana*
 HEC *Heteropogon contortus*
 HPF *Hyparrhenia filipendula*
 HPH *Hyparrhenia hirta*
 HYD *Hyperthelia dissoluta*
 IMC *Imperata cylindrica*
 ISB *Ischaemum brachyatherum*
 MEA *Megaloprotachne albescens*
 ODP *Odyssea paucinervis*
 ORC *Oropetium capense*
 PAC *Panicum coloratum*
 PAK *Panicum kalaharensis*
 PAL *Panicum lanides*
 PAM *Panicum maximum*
 PAN *Panicum meyerianum*
 PAN *Panicum novemnerve*
 PAR *Panicum repens*
 PEP *Pennisetum purpureum*
 PRP *Perotis patens*
 PHC *Phragmites communis*
 POS *Pogonarthra squarrosa*
 RHR *Rhynchelytrum repens*
 RHV *Rhynchelytrum villosum*
 SCB *Schmidtia bulbosa*
 SCK *Schmidtia kalaharensis*
 SCP *Schmidtia pappephoroides*
 SEP *Setaria pallide-fusca*
 SES *Setaria spachelata*
 SEV *Setaria verticillata*
 SOV *Sorghum verticilliflorum*
 SPV *Sporobolus festivus*
 SPF *Sporobolus fimbriatus*
 SPI *Sporobolus ioclados*
 SPP *Sporobolus pyramidalis*
 SPR *Sporobolus rangei*
 SPS *Sporobolus spicatus*
 STU *Stipagrostis uniplumis*
 STA *Stipagrostis amabilis*
 STS *Stipagrostis stipitata*
 THT *Themeda triandra*
 TGB *Tragus berteronianus*
 TGR *Tragus racemosus*
 TCH *Tricholaena monachne*
 TNG *Trichoneuro grandiglumis*
 TRA *Tripsacum abyssinicum*
 TRP *Tripsacum andropogonoides*
 TRS *Tripsacum schlechteri*
 URS *Urelytrum squarrosus*
 UCD *Urochloa bobobodes*
 UCR *Urochloa brachyura*
 UCM *Urochloa mosambicensis*
 UCT *Urochloa trichopus*

Z | | | | | SHEET | | | | | GRID REF | | | | | UNIT | | | | | STATUS | |

C | | | | |

ORD | S | | | | | E | | | | | DATE | | | | | AUTHORITY | | | | |

CLASSIFICATION | | | | | (1974) | | | | | (REV) | | | | |

| | | | | GREAT GR | | | | | PART | | | | | MIN | | | | | STR | | | | | SR | | | | | SMR | | | | |

AGN HOR | | | | |

LV | | | | | LANDFORM | | | | | LAND ELEMENT | | | | | POSITION | | | | |

PO | | | | | MICROTOPO | | | | | SLOPE | | | | | MIN | | | | | MAX | | | | | FORM | | | | |

ALINE | | | | | CRACKS | | | | | SALT | | | | | BLEACHED SAND | | | | |

ND USE | | | | | CROPS | | | | | VEGETATION STRUCT. | | | | | GRASS COVER | | | | |

TEES | | | | | DOMINANT | | | | | OTHER | | | | | SHRUBS | | | | | DOMINANT | | | | | OTHER | | | | |

ASSES/FORBS | | | | | DOMINANT | | | | | OTHER | | | | |

ARENT MATERIAL | | | | | OVER | | | | | ROCK TYPE | | | | | GEOL UNIT | | | | |

MANAGE | | | | | MOIST. COND. | | | | | D | | | | | CON | | | | | TO | | | | | CON | | | | | TO | | | | | CON | | | | | TO | | | | |

INES | | | | | ROCK OUTCROPS | | | | | EROSION/DEP I | | | | | INT | | | | | TYPE | | | | | INT | | | | | TYPE | | | | | HUMAN INF. | | | | |

MARKS | | | | |

DESIGNATION	DEPTH UP/LOW	COLOUR I/II				MOTTLES I/II				TEXTURE			STRUCTURE I/II				CONSISTENCY	
		HUE	VALUE	CHROMA	MOD	AB	SI	CO	BO	COLOUR	< 2 MM	2-20 MM	> 2 MM	GRA	SIZE	TYPE	-)	DRY

1																		
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2																		
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4																		
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5																		
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6																		
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CO-LANE I/II				CEM	PORE I/II		ROCK FRAGMENTS I/II					NODULES I/II					CARB	BIO I/II		ROOTS I/II		BOUN		PH	SAMPLES
DR	TRIP	NAT	LOC		AB	DIA	AB	SIZE	SH	WE	NAT	AB	KI	SI	SH	H		NA	COLOUR	QU	KI	QU	SIZE		

1																										
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3																										
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4																										
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5																										
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6																										
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