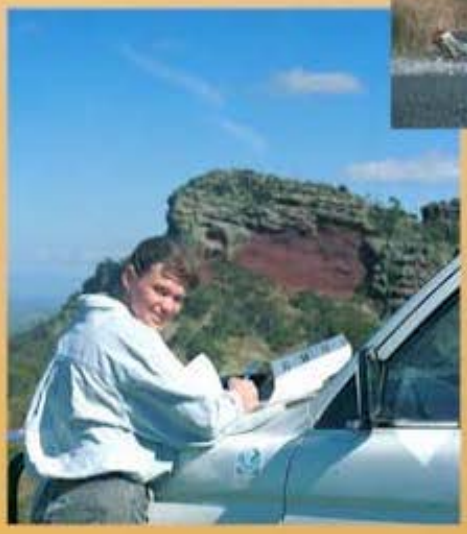
Soil Data Entry Handbook

3rd Edition

for the
NSW Soil And Land
Information System
(SALIS)



Compiled and edited by
H.B. Milford, A.J.E. McGaw
and K.J. Nixon

NSW Department of Land and Water Conservation

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NSW Department of Land and Water Conservation
Resource Information Systems Group, Parramatta

2001

Acknowledgements

A number of people made significant contributions to the seminal 1st edition of this handbook (Morse *et al.* 1982), as well as to the 2nd edition (Abraham & Abraham 1996). The contributions of Rick Morse, the late Barry Craze, Glenn Atkinson, John Crichton, Peter Ryan, Tony Koppi, Neil Abraham, Brian Murphy, Ken Ryan, Susan Abraham, Andrew Rawson and Andrea Francis are acknowledged with thanks. We also acknowledge the contributions of members of the Soil Data System User Group in selecting and defining values and attributes.

This revised and updated 3rd edition has been developed to accompany the changeover from the NSW Soil Data System to the NSW Soil and Land Information System (SALIS), which took place during 1998-99. The authors wish to thank Warwick Mills, Roger Harrop, Casey Murphy and Greg Chapman for their input and review at various stages through the project.

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Copies of this report may be obtained from:

The Information Centre,
Department of Land and Water Conservation
23-33 Bridge Street, Sydney, NSW 2000
Tel: 02 9228 6415; email: infocentre@dlwc.nsw.gov.au

Further information on DLWC's soils program may be obtained from the website: www.dlwc.nsw.gov.au/care/soil

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Contents

1 INTRODUCTION

1.1 Preamble

This handbook describes the characteristics of the site and soil profile information collected in the field for entry into the NSW Soil and Land Information System (SALIS). This is most commonly carried out through use of the Soil Data Card, although direct entry is possible by the SALIS Administrator or a SALIS user. The ranges and definitions of the values contained herein are specific to the Soil Data Card and SALIS. They have, however, been developed after consultation with many users and are also consistent, wherever possible, with Macdonald *et al.* (1990) *Australian Soil and Land Survey Field Handbook*.

This handbook has been designed for use in conjunction with any of the Soil Data Cards current at time of writing, as well as a reference for data editing in SALIS by the data owner. Site and General Area information make up the first part of this handbook. The second part contains the attributes and values for layer information. The third part is a list of references used, whilst the fourth part is an index of terms.

1.2 Standards

In order to uphold the notion of Australian Standards for scientific terminology in Soil Science, this handbook closely follows the terminology and definitions found in:

R.C. McDonald, R.F. Isbell, J.G. Speight, J. Walker and M.S. Hopkins 1990, *Australian Soil and Land Survey Field Handbook* (2nd Edition), published by Inkata Press Proprietary Limited, Melbourne, Victoria.

We gratefully acknowledge the permission of the copyright owners to use these definitions.

For ease in using this handbook, the definitions of values are generally not sourced within the text. Other than Macdonald *et al*. (1990) mentioned above, additional sources include:

Bates, R.L. and Jackson, J.A. (eds) 1984, *Dictionary of Geological Terms* (3rd Edition). Doubleday, New York, NY, USA.

Gary, M., MacAfee, R. and Wolf, C.L. (eds) 1972, *Glossary of Geology*. American Geological Institute, Washington DC, USA.

Moore, W.G. 1988, *The Penguin Dictionary of Geography* (7th Edition), Penguin, London, UK.

Morse, R.J., Atkinson, G. and Craze, B. 1982, *Soil Data Card Handbook*. Soil Conservation Service of NSW Technical Handbook No. 4, Soil Conservation Service of NSW, Sydney, NSW.

Abraham S.M. and Abraham N.A. 1996, *Soil Data System Site and Profile Information Handbook.* NSW Department of Land and Water Conservation, Sydney, NSW.

A complete list of referenced work is found in **3 References** at the rear of this book.

1.3 Explanation of Text Format

The text of this document is formatted into five different styles:

- Base font is used for general descriptions and explanations.
- Database terms such as ATTRIBUTE appear in SMALL CAPITALS, as do characteristics of attributes, e.g., size, type.
- Feature names are set in **BOLD CAPITALS**.
- The attributes of each feature are printed in **boldface**.
- The values of an attribute are printed in *italics* with a definition in smaller type following where necessary.

1.4 About SALIS

The Soil and Land Information System (SALIS) is a digital information system that has been developed to allow direct access to the substantial natural resource dataset held in custodianship by the NSW Department of Land and Water Conservation (DLWC), in particular land and soil information. SALIS is a much enhanced replacement for the NSW Soil Data System (NSW SDS), which it replaced in 1998-99. SALIS provides a storage, management and distribution solution for both point-based data such as soil profiles, and for spatial (map) information, including DLWC's Soil Landscape maps and Acid Sulfate Soils maps.

1.5 Soil Data in SALIS

1.5.1 Surveys and Soil Profiles

The fundamental soil record in the SALIS database is the **Soil Profile.** This is a point on the Earth's surface around which the **site** is described. The **profile** consists of a column of soil extending downwards from the soil surface through all its horizons to parent material, other substrate material or to a specified depth (McDonald *et al.* 1990). Each profile is uniquely identified by its number and geographic location. **Soil profiles** are grouped into larger parent entities called **Soil Surveys,** each with its own unique name and number.

SALIS allows collection and storage of soil morphological and chemical information along with a wide range of physiographic information relating to the site and general area of the Soil Profile. The exact data recorded for each Soil Profile may vary significantly depending on the purpose for which the data was collected. However, all Soil Profiles must be accurately geolocated and must include a set of fundamental data attributes, including the identity of the person who collected them.

The soil data is scanned into the SALIS database, and is assigned to its parent Survey, before being verified and edited to eliminate errors. Once certified error-free, the soil data may be viewed and used depending on the status it has been assigned. Samples of the soil materials and photographic images of the **site**, general area and/or the **soil profile** may also be recorded. These are processed separately and are later consolidated with the field observations in the complete **Profile Description**.

1.5.2 SALIS Data Status

Data in the SALIS database has one of several security ratings attached to it depending on its status. These ratings may be summarised into two basic groups: Confidential and Public.

1.5.2.1 Confidential data

Once entered into SALIS, all data is considered to be Confidential. This means that only the owner of that data may access or edit it. No other persons (other than the Administrator-level SALIS users) can access the information. To make their data accessible to other users the owner needs to declare their profiles or surveys Public. This may be done by contacting the SALIS Administrator, or may be specified on the newer types of Soil Data Card.

Importantly, data should only be made Public once it has been checked by its owner and certified to be complete, accurate and error-free. This is the ultimate responsibility of the data owner, in consultation with the SALIS Administrator. Data containing errors cannot be made Public. All SALIS data is encouraged to be made Public once considered to be error-free, unless real issues of confidentiality exist—e.g., data collected by an external consultancy firm for a specific purpose and held in commercial confidence.

1.5.2.2 Public data

Once data is declared Public it is accessible to all SALIS users and members of the public. However, nobody is able to change Public information except the SALIS Administrator.

1.5.2.3 Essential and Key Attributes

In this handbook, a number of the ATTRIBUTES are described as being either Essential or Key ATTRIBUTES.

Essential attributes are those that *must* be described for all soil profiles. Examples of Essential ATTRIBUTES include **AMG Easting** and **AMG Northing**.

Key ATTRIBUTES must be described if any other information about the land or soil characteristic they describe is to be recorded. An example of a Key ATTRIBUTE is **Coarse Fragment Type**, which must be recorded if any other information about coarse fragments in the soil layer is to be described.

1.6 The Soil Data Card

The Soil Data Card is a scannable media which provides a structured way of recording information whilst avoiding issues such as data double-handling and transcription errors. There are a number of different types of Soil Data Cards available, each produced for somewhat different user requirements. The Soil Data Cards are designed using Scanform© technology by NCS Australasia Pty. Ltd., in which data is entered by filling in particular sequences of circles on the card with a 2B pencil. This allows the data to be extracted from the card by using an optical scanner, which greatly accelerates the rate of data capture.

1.6.1 Versions of the Soil Data Card

The various types of Soil Data Card are listed below in approximate chronological order, from the formation of the NSW SDS in 1990 to the time of writing. New versions of the Soil Data Card will be added to the existing set as time goes on and requirements change, and new cards may also be developed for large-scale applications with specialised requirements. Please contact the SALIS Administrator for more information, or to provide suggestions on changes or additions to the Soil Data Card(s).

1.6.1.1 2-page Soil Data Card

Yellow, 1 double-sided page. This card used tick-boxes and text fields for recording data, which was then entered into the NSW SDS manually. This card should not be used under any circumstances. If you have any unused cards of this type, please destroy them, and contact the SALIS Administrator for free replacement cards.

1.6.1.2 8-page Soil Data Card (Version 1)

Brown text on white, 4 double-sided pages. This was the first Soil Data Card designed using Scanform technology. These cards may be distinguished from the later Version 2 cards by the lack of integral support for the Australian Soil Classification (ASC) on the front page—any card without a series of ASC fields, or with those fields inserted via a coloured stamp, is an original 8-page card. The original 8-page card is no longer sanctioned for use as it cannot be scanned into SALIS. If you have any unused cards of this type, please destroy them, and contact the SALIS Administrator for replacement cards.

1.6.1.3 4-page Soil Data Card (Version 1)

Orange text on white, 2 double-sided pages. This is a compressed 8-page Scanform card supporting only 5 soil layers instead of 6 and with a more limited set of attributes. The first version of the 4-page card, like the original 8-page card, is no longer sanctioned for use as it cannot be scanned into SALIS. If you have any unused cards of this type, please destroy them, and contact the SALIS Administrator for replacement cards.

1.6.1.4 4-page Soil Data Card (Version 2)

Green text on white, 2 double-sided pages. This is a refined version of the original 4-page card, and is fully supported for SALIS use. It supports the recording of up to 5 soil layers and is thus suitable for moderately detailed soil descriptions.

1.6.1.5 8-page Soil Data Card (Version 2)

Brown text on white, 4 double-sided pages. This can be distinguished from its preceding version by the ASC fields integrated into its front page, along with a number of less noticeable refinements. This card is also fully supported for SALIS use. This card is recommended for detailed soil descriptions, as it contains more data attributes than the 4-page Soil Data Card and also allows up to 18 separate soil layers to be described.

1.6.1.6 2-page CRA Soil Data Card (Versions 1 and 2)

Teal (Version 1) and blue (Version 2) text on white, 1 double-sided page. These cards were designed specifically for the Comprehensive Regional Assessment (CRA) soil surveys in 1998-99, but are also sanctioned for use in general soil work as observation-level cards for rapid soil description. Since this card was designed for observation-level usage in high-rainfall forest areas, it does not include attributes such as soil pH. The two versions of this card differ only in minor details, and both are fully supported for SALIS use.

1.6.1.7 4-page Soil Data Card (Version 3)

Green text on white, 2 double-sided pages. This is an enhanced version of the Version 2 4-page card, with some additional fields for location and data quality assurance, and also allowing up to 18 separate soil layers to be recorded. Released in 2000, it is fully supported for SALIS use.

1.6.1.8 2-page Observation Soil Data Card

Maroon text on white, 1 double-sided page. This card is an enhanced version of the CRA Soil Data Card intended for rapid, observation-level soil descriptions, and is the first Soil Data Card to support the new Geodetic Datum of Australia (GDA) grid referencing system. Released in 2000, it is fully supported for SALIS use.

1.6.1.9 2-page Western Regional Assessment Soil Data Card

Rust text on white, 1 double-sided page. This card is a combination of attributes from the 2-page CRA and 2-page Observation Soil Data Cards along with several new fields plus GDA support. Released in 2001, the WRA Soil Data Card is fully supported for SALIS use.

1.6.2 Where and how can I get Soil Data Cards?

Please contact the SALIS Administrator to obtain blank Soil Data Cards. These are available free of charge.

1.6.3 General Procedures for Use of Soil Data Cards

The following is a list of guidelines to be followed when using Soil Data Cards:

- Your Soil Surveyor Number (used in the *'Described By'* section of the card) is for use only on data that you have collected, others are *at no stage* allowed to use your number. Your surveyor number makes you personally responsible for the quality of data entered.
- Treat your Soil Data Cards with reasonable care. If a card is creased, crumpled, torn, damp, dusty or dirty then it is very difficult to scan. As it is time-consuming for SALIS staff to enter Soil Data Cards by hand, please keep your Soil Data Cards in good condition.

- Enter data onto the Soil Data Card only in the places provided. Information that is written in blank spaces on the card will not be recorded in SALIS.
- Enter data onto the Soil Data Card using a 2B pencil, taking note of the advice on the card regarding its use. The optical card scanner is only capable of detecting marks made by 2B pencil, and those made using any other writing instrument may not be scanned.
- The Soil Data Card contains a series of key fields that are essential. A Soil Data Card cannot be scanned without these fields being filled in. Consult the relevant sections of this Manual for information about which fields are essential. Examples include AMG Eastings and Northings, Surveyor number, Date, etc..
- Send the completed Soil Data Card to the SALIS Information Officer for scanning. The cards will be returned to you once scanning is completed, along with a SALIS report which will allow you to check the data for errors. Some errors may already have been identified by the SALIS Administrator or staff. A variety of different reports in numerous formats are available for this and other purposes.
- Data is accessible to its owner-user (the person or organisation who recorded the data), once it has been entered into SALIS.

1.7 SALIS Outputs

Both standard and customised outputs are available in various forms, including tables, charts and graphs, detailed reports, spreadsheets and maps. Outputs can be supplied in hard copy or in a variety of digital formats either on disk or by email. In the future, outputs of various types will be available on the Internet including, from March 2001, public soil profile data via the Soil Profile Attribute Data Environment (SPADE) spatial viewer on the Internet at http://spade.dlwc.nsw.gov.au.

The most basic form of output in the past has been the **Plain English Report (PER).** A Plain English Report (PER) describes all the attributes of a particular soil profile and is easily understood by those with only general soils knowledge. A PER may include soil chemical information where soil testing has been carried out.

The NSW SDS produced a single type of PER, but SALIS can produce a variety of reports in various formats to suit end users, which may include graphs, tables and (progressively) photographs. Please contact the SALIS Administrator for more information. Photographs may be included in SALIS with your soil information by sending the negatives, slides or digital images to the SALIS Administrator.

1.8 Lab Data File Requirements

Soil sample test data may be provided to SALIS providing that the following basic rules are followed.

Data files require a header record in line one, and sample results record in each subsequent line. Each sample requires a standard header, followed by the test results for that sample. Fields within each line must be delimited by commas ‘,’—i.e., Comma Separated Values or CSV. The end of each line is determined by a Carriage Return character followed by a Line Feed character. Text strings must be quoted (‘ or “) if they contain commas.

For further information, please contact the SALIS Administrator.

1.9 Do You Need More Information?

The Handbook that you are now reading contains information about all fields on all supported versions of the Soil Data Card(s) at the time of writing, as well as information about SALIS operations.

The latest version of the Handbook is the 3rd Edition, current as of March 2001, which is the companion handbook to Release 3.02 of SALIS. This Handbook is available in Acrobat PDF format on the Internet by downloading it from the SALIS Website at http://dlwc.nsw.gov.au/care/soil/salis.htm.

The DLWC Soils Internet pages at http://dlwc.nsw.gov.au/care/soil/index.htm provide useful information about the Department’s soil programs, including SALIS, and links to other sources of soil and land information.

Inquiries and requests for assistance can be sent to the **SALIS Administrator** at:

Telephone :	(02) 9895 6204 or (02) 9895 6163
Fax:	(02) 9895 7985
Mail:	Soil And Land Information System (SALIS) Resource Information Systems Group Natural Resource Products Division Department of Land and Water Conservation PO Box 3720 PARRAMATTA NSW 2124
E-Mail:	soils@dlwc.nsw.gov.au
Web page address:	http://dlwc.nsw.gov.au/care/soil/salis.htm

2 EXPLANATION OF TERMS AND ATTRIBUTES

2.1 SURVEY TITLE

A **survey** is defined by a unique number and name. The survey number is automatically allocated by SALIS. The survey title can be up to 40 printable characters and is assigned by the user.

2.2 SITE LOCATION DESCRIPTION

A **Site Location** is a short description of the location of the **profile**—e.g., "cutting west of bridge". Up to 38 characters may be used, including spaces.

If details require more than 38 characters, you may use abbreviations; some commonly used examples are given below:

HWY	highway	XRD	crossroad, intersection
RD	road	RES	Reserve
R	river	MT	Mountain
N	north	NP	National Park
S	south	SF	State Forest
E	east	CK	creek
W	west	ST	street
ADJ	adjacent	STR	stream
FR	from	NR	near
CNR	corner	T/O	turnoff
BR	bridge	TR	track

2.3 PROFILE MAP DETAILS

2.3.1 Profile Number

ESSENTIAL ATTRIBUTE, NUMBER, 1 VALUE ONLY, RIGHT-JUSTIFIED

Each **profile** in a **survey** must have a unique **profile number**. It is recommended that a Survey commence with profile number 1 and that subsequent profiles be numbered in sequential order so as to avoid confusion.

2.3.2 1:100 000 Map Sheet Number

ESSENTIAL ATTRIBUTE, 4-DIGIT NUMBER, 1 VALUE ONLY

The identification number of the 1:100 000 map sheet on which the **profile** occurs, e.g., the Sydney 1:100 000 map sheet number is 9130.

2.3.3 Eastings

ESSENTIAL ATTRIBUTE, 6-DIGIT NUMBER, 1 VALUE ONLY

For all Soil Data Cards except the 4-page (Version 3) and 2-page Observation and WRA cards, use only the AMG coordinate system (for Global Positioning System (GPS) users, the AGD66 datum). These latter cards cater for GDA grid references via the Map Type field (see **2.3.6 Map Type** below). Measure the location to the nearest 1 mm on the map used and record the coordinate to this accuracy only, i.e., to the nearest 100 m for a 1:100 000 map and 25 m for a 1:25 000 map.

2.3.4 Northings

ESSENTIAL ATTRIBUTE, 7-DIGIT NUMBER, 1 VALUE ONLY

For all Soil Data Cards except the 4-page (Version 3) and 2-page Observation and WRA cards, use only the AMG coordinate system (for Global Positioning System (GPS) users, the AGD66 datum). These latter cards cater for GDA grid references via the Map Type field (see **2.3.6 Map Type** below). Measure the location to the nearest 1 mm on the map used and record the coordinate to this accuracy only, i.e., to the nearest 100 m for a 1:100 000 map and 25 m for a 1:25 000 map.

2.3.5 How to Record Grid References

To record the grid reference of the junction of Cloughs Road and The Rock Road on the example 1:25 000 map sheet shown in ***Figure 1***, follow the steps below. The progressive assembly of the AMG grid reference is given in brackets in each step, with the result underlined and bolded.

1. Locate the nearest vertical (north-south) grid line to the left (west) of the junction with a small number before the large two-digit number, and note this number (**5**).

2. Locate the first vertical (north-south) grid line to the left (west) of the junction and note its large two-digit number (5**21**).

3. Place a straight-edge at the junction point oriented parallel to the north-south grid lines, and measure the distance in mm from the nearest north-south grid line to the west of the intersection between the straight-edge and the nearest horizontal map border (9 mm). Now use the map scale to give a figure in metres (in this instance 25 x 9 = 225 m) and append this to the numbers recorded in Steps 1 and 2 (521**225**). This is the **AMG Easting**.

4. Locate the nearest horizontal (east-west) grid line below (south of) of the junction with a small number before the large two-digit number, and note this number (**61**).

5. Locate the first horizontal (east-west) grid line below (south of) of the junction and note its large two-digit number (61**12**).

6. Place a straight-edge at the junction point oriented parallel to the east-west grid lines, and measure the distance in mm from the nearest east-west grid line to the south of the intersection between the straight-edge and the nearest vertical map border (9 mm). Now use the map scale to give a figure in metres (in this instance 25 x 9 = 225 m) and append this to the numbers recorded in Steps 4 and 5 (6112**225**). This is the **AMG Northing**.

7. The AMG grid reference for the junction of Cloughs Road and The Rock Road, to the nearest 25 m, is 521225E, 6112225N.

⚠ Note: you can also estimate the distances if you don't have a ruler with you. A graduated ruler is built into several types of Soil Data Card and may be used for this purpose.

Figure 1: Example 1:25 000 map (Uranquinty (8327-4-S) 1:25 000 sheet © CMA 1989)

2.3.6 Map Type

CHOICE, 1 VALUE ONLY

2-page Observation, 2-page WRA and 4-page (Version 3) Soil Data Cards only.

Record the type of map grid location system used to determine the **Eastings** and **Northings** coordinates.

Reference List of VALUES

1	*GDA*	Coordinates determined using the Geodetic Datum of Australia (GDA) (equivalent to the GPS WGS84 or GDA94 datums).
2	*AMG*	Coordinates determined using the Australian Map Grid (AMG) (equivalent to the GPS AGD66 datum).

2.3.7 Locational Accuracy

ESSENTIAL ATTRIBUTE, CHOICE, 1 VALUE ONLY

This field describes the level of accuracy used to determine the coordinates that locate the soil profile site. Record the scale of the map sheet used to determine the **Eastings** and **Northings** coordinates. Not all values may be available on all types of Soil Data Card.

2.3.8 Card Number

CHOICE, 1 VALUE ONLY

4-page (Version 3) and 8-page Soil Data Cards only.

Allows the description of more than 6 layers if required by the use of up to 3 sequentially numbered cards. Card 1 is used for **layers** 1 – 6, card 2 is used for **layers** 7 - 12, and card 3 for **layers** 13 - 18. **Card number** is inferred to be 1 for all cards unless more than 6 **layers** occur at a **site**.

2.3.9 Location on 1:100 000 Map

CHOICE, 1 VALUE ONLY

2-page Observation, 4-page and 8-page Soil Data Cards only.

This information is not stored in the database. The Surveyor may use the grid provided which represents the outline of the eight 1:25 000 sheets within a 1:100 000 map sheet to mark the relative location of the profile being described.

2.3.10 Data To Become Public

CHOICE, 1 VALUE ONLY

2-page Observation and 4-page (Version 3) Soil Data Cards only.

Record your preference for when the soil data recorded on the card is made publicly accessible via SALIS. It is recommended that data becomes Public after 1 year. This is the default value for this attribute unless the data owner specifies otherwise.

2.3.11 Type of Profile Assessment

CHOICE, 1 VALUE ONLY

2-page WRA Soil Data Card only.

Record a value that best describes the purpose for which the **profile** was described and recorded. This may relate both to the purpose for which the soil was described and the purpose of the **survey** that the **profile** is part of.

Reference List of VALUES

1	***Random***	The location of the **profile** was determined completely randomly—e.g., through generation of grid references within the **survey** area using a random number generator.
2	*Bulked*	The **profile** describes a number of sub-samples taken at several sites within a defined area—e.g., a paddock. In this case, the **GRID REFERENCES** recorded for the profile should indicate the centre of the defined area, and the area across which the samples were taken should be recorded in the **SITE FIELD NOTES**.
3	*Map Checking*	The **profile** location was determined to assist in the definition of a soil or land mapping unit or classification, such as a Soil Landscape. In this case, the identity or basic characteristics of the mapping unit or classification should be recorded in the **SITE FIELD NOTES**, and if available the abbreviation for that mapping unit should be recorded in the **SOIL MAP CODE**.
4	***Opportunistic***	The **profile** location was determined based on the opportunity of gaining a good description of the soil, due to prevailing circumstances at the time of description including ease of access to the site, availability of a good soil exposure in a batter or road cutting, etc..

5	*Curiosity/Unusual Profile*	The **profile** was described at this location because the soil was intrinsically interesting or unusual (a striking colour, unusual soil type, etc.) and therefore may not necessarily represent the dominant soils of the area around it. In this case, an indication of why the **profile** was described should be recorded in the **SITE FIELD NOTES**.
6	*Boundary Checking*	The **profile** location was chosen to assist in locating the boundary of a defined soil or land mapping unit, such as a Soil Landscape.
7	***Pre-Planned***	The **profile** location was determined based on hypotheses or modelling of the most appropriate locations likely to present a typical example of the land, soil and other features found in the local landscape or land mapping unit, such as a Soil Landscape. In this case, the identity or basic characteristics of the mapping unit or classification should be recorded in the **SITE FIELD NOTES**, and if available the abbreviation for that mapping unit should be recorded in the **SOIL MAP CODE**.
8	*Transect/Catena*	The **profile** was described at its location as part of a set of observations taken along a transect, a Catena (a cross-section of the local landscape from highest to lowest point), or other linear feature such as a road or pipeline. In this case, the type of transect, Catena or other feature used should be recorded in the **SITE FIELD NOTES**.
9	*Grid*	The **profile** location was chosen as part of a set of observations taken on a grid pattern. An indication of the grid used (e.g., its size) should be recorded in the **SITE FIELD NOTES**.

2.3.12 Type Profile

CHOICE, 1 VALUE ONLY

2-page WRA Soil Data Card only.

Use this ATTRIBUTE to indicate if the **profile** is considered to be a 'Type Profile'—i.e., a soil description that characterises the dominant soils in the Soil Landscape in which the **profile** occurs.

2.4 SITE DETAILS

2.4.1 Described by

ESSENTIAL ATTRIBUTE, 4-DIGIT NUMBER, 1 VALUE ONLY

A unique 4-digit number must be recorded to identify the person describing the **profile**. These codes are allocated by the SALIS Administrator. It is important that the person actually describing the profile be identified so that the data can be reliably attributed to that person, rather than (for example), the person supervising the project for which the data was collected.

2.4.2 Profile Date

ESSENTIAL ATTRIBUTE, 1 VALUE ONLY

The date on which the **profile** was described.

2.4.3 Same as Site

3-DIGIT NUMBER, 1 VALUE ONLY, RIGHT JUSTIFIED

Where all or the majority of the **site** information to be recorded is considered to be identical with that entered for a previous **profile**, the **profile number** of the previous **profile** may be recorded here. The essential ATTRIBUTES must be completed on each card, but any **site** information from the previous **profile** will be duplicated unless it is filled in, on the current card.

Example: A **profile** is completed when information is recorded in LANDFORM, TOPOGRAPHY, VEGETATION, HYDROLOGY, and EROSION. A second **profile** is described which has the same features except that it has a lower elevation and there are more types of erosion. The second field card can be completed by filling the essential ATTRIBUTES and then the VALUE for elevation, the whole EROSION table and the previous **profile** number in **Same as Site.**

Simply stated, the rule for completing the boxes on the second card is "fill it all or nothing at all". Where no VALUE for a site ATTRIBUTE is entered, the respective VALUE from the previous **profile** will be duplicated; but where a VALUE is entered on the second card, this will replace any VALUE from the previous **profile**. Note that the **Same as Site** number must be **smaller** than the **Profile Number** of the card it is entered on. One VALUE may be recorded and is filled in right justified on the field card. No **layer** information will be recorded unless it is entered separately.

2.4.4 Photo Taken

CHOICE, 1 VALUE ONLY

This attribute allows the surveyor to record whether at least one photograph of the profile, site or both were taken. Any notes about the photographs taken may be recorded in the **SITE FIELD NOTES** section.

2.4.5 Nature(s) of Exposure

CHOICE, MAXIMUM 2 VALUES

Indicate the method by which the soil was exposed to enable description.

2.4.6 Number of Layers Described

1 OR 2 DIGIT NUMBER, RIGHT JUSTIFIED

Record the number of mineral soil layers being described. Do not count **organic layers** or the **substrate.**

Where more than one card (4-page Version 3 and 8-page cards only) is used to describe the **profile**, the total number of **layers** in the **profile** is entered on each of the cards for that **profile.**

The VALUE ranges from 0 to a maximum of 5 for the 4-page Soil Data Card (Versions 1 and 2) or 18 (for the 8-page Soil Data Card).

2.5 SOIL AND MAP CODES

2.5.1 GSG (Great Soil Group)

ALPHABETIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

Record the appropriate GSG code for the **profile**. The GSG codes are adapted from Stace *et al.* (1968). Record only one code for each **profile** and fill it in left justified on the field card.

Reference List of VALUES

SK	*Solonchak*	NKB	*Non-calcic Brown Soil*
A	*Alluvial Soil*	E	*Euchrozem*
L	*Lithosol*	X	*Xanthozem*
KS	*Calcareous Sand*	K	*Krasnozem*
SS	*Siliceous Sand*	GBP	*Grey-brown Podzolic Soil*
ES	*Earthy Sand*	RP	*Red Podzolic Soil*
C	*Chocolate Soil*	YP	*Yellow Podzolic Soil*
BRE	*Brown Earth*	BP	*Brown Podzolic Soil*
KRE	*Calcareous Red Earth*	LP	*Lateritic Podzolic Soil*
RE	*Red Earth*	GP	*Gleyed Podzolic Soil*
YE	*Yellow Earth*	P	*Podzol*
TR	*Terra Rossa Soil*	HP	*Humus Podzol*
GBK	*Grey-brown Calcareous Soil*	PP	*Peaty Podzol*
RK	*Red Calcareous Soil*	AH	*Alpine Humus Soil*
DL	*Desert Loam*	HG	*Humic Gley*
RBH	*Red and Brown Hardpan Soil*	NP	*Neutral Peat Soil*
GC	*Grey Clay*	ALP	*Alkaline Peat Soil*
BC	*Brown Clay*	ACP	*Acid Peat Soil*
RC	*Red Clay*	NSG	*No suitable Group*
BE	*Black Earth*	SZ	*Solonetz*
R	*Rendzina*	SDS	*Solodized Solonetz*
CM	*Chernozem*	SC	*Solodic Soil*
PS	*Prairie Soil*	SH	*Soloth* or *Solod*
W	*Wiesenboden*	SB	*Solonized Brown Soil*
RBE	*Red-brown Earth*		

2.5.2 Affinity with GSG

CHOICE, 1 VALUE ONLY

When the soil profile does not accurately match any of the Great Soil Groups as described in Stace *et al*., (1968) but, in the opinion of the soil surveyor, has an affinity with one of them, then this VALUE should be filled in along with the Great Soil Group for which the **profile** has an affinity.

2.5.3 Factual Key

ALPHANUMERIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

8-page and 4-page Soil Data Cards only.

Record the Principal Profile Form (Northcote 1979). The extended Principal Profile Form may be recorded in the **SITE FIELD NOTES** if required.

⚠ Any Principal Profile Form defined in Northcote (1979) will be accepted, along with other Principle Profile Forms which do not exist according to Northcote (1979).

2.5.4 Geology Map Code

ALPHANUMERIC CODE, UP TO 6 CHARACTERS, 1 VALUE ONLY, LEFT JUSTIFIED

Record the **Geology Map Code** as published by the Australian Geological Society Organisation (AGSO) (http://www.agso.gov.au). Please clearly use the appropriate case for the specified code. Otherwise, record the reference to the geology in the **SITE FIELD NOTES** section of the first card described in the survey.

2.5.5 Soil Map Code

ALPHANUMERIC CODE, UP TO 4 CHARACTERS, 1 VALUE ONLY, LEFT JUSTIFIED

A code may be recorded by the soil surveyor for possible use on a Soils Map.

2.5.6 Australian Soil Classification (Aust Class)

ALPHANUMERIC CODES, 1 VALUE ONLY

A 2-letter code is recorded at the Order level; and further codes are added for Sub-order, Great Group, Subgroup and Family levels where appropriate classes are available, as described in the Australian Soil Classification (Isbell 1996).

⚠ Under the ARMCANZ agreement the Australian Soil Classification (ASC) must be used as the primary soil classification for all work relating to the NSW or Federal Governments.

2.5.7 Soil Taxonomy

ALPHABETIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

🗎 *8-page Soil Data Card only.*

Record the **Soil Taxonomy** (Soil Survey Staff 1975) classification code. Contact the SALIS Administrator for a list of the values if required.

2.5.8 Atlas (Northcote) Code

5-CHARACTER ALPHANUMERIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

🗎 *8-page Soil Data Card only.*

Record the map unit code assigned in the *Atlas of Australian Soils* (Northcote 1966).

Any code defined in Northcote (1966) will be accepted. These are usually in the form of one or more letters followed by up to three numerals. Codes should be copied exactly, retaining correct case as appropriate.

2.5.9 Atlas (A & M) Code

2-CHARACTER ALPHABETIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

🗎 *8-page Soil Data Card only.*

Record the "Soil Resources" map unit code assigned in the *Atlas of NSW* (Atkinson and Melville 1987). Contact the SALIS Administrator for a list of the values if required

2.5.10 Land System Code

2-CHARACTER ALPHABETIC CODE, 1 VALUE ONLY, LEFT JUSTIFIED

🗎 *8-page Soil Data Card only.*

Where appropriate, record the **Land System Code** (Soil Conservation Service of NSW 1:250 000 Land System Series, used in Western NSW). Record the 2-letter code found on the appropriate Land System Map, using upper case letters only.

2.6 LAND USE

2.6.1 Site

CHOICE, 1 VALUE ONLY

The present **LAND USE** at the **site** is recorded so that the degree of disturbance of the soils morphological properties can be determined (see also **Site Disturbance**). Describe the **LAND USE** within a radius of 10 m of the **profile** or to the edge of the **Landform Element** or until there is a change in **LAND USE**, whichever is the lesser distance.

For historical land use, see **Prior Land Use** which is described in **PROFILE ADDENDUM CODE**

Reference List of VALUES

1	*National/State parks*	Land in public ownership which is in a relatively undisturbed condition.
2	*timber/scrub/unused*	Unlogged State and private forests and partially cleared land which is not grazed or is being allowed to regenerate. Does not include land which is currently being used for agricultural, pastoral or forestry production.
3	*logged native forest*	Stands of native forest that show evidence of having been or being logged.
4	*hardwood plantation*	Land where the vegetation has been cleared and replaced with a plantation of native hardwood species— e.g., *Eucalyptus* spp.
5	*softwood plantation*	Land where the vegetation has been cleared and replaced with a plantation of softwood species—e.g., *Pinus radiata*.
6	*voluntary/native pasture*	Cleared land to woodland with a ground cover of grasses and/or legumes which are either native species or naturalised (self-sown) exotic species; generally lower productivity and nutrient status than improved pastures.
7	*improved pasture*	Cleared to lightly wooded land with a ground cover of grasses and/or legumes which are generally exotic species; the grazing productivity has been raised by the use of fertilisers and/or cultivation.
8	*cropping*	Land normally cultivated for agricultural production—e.g., for grain and fodder production, rice, cotton, etc., but not for improved pasture or for vegetables, flowers or trees. Note: irrigation may be recorded under **Site Disturbance**.
9	*orchard/vineyard*	Land used for the production of fruit trees and/or vines.
10	*vegetables/flowers*	Land used for the production of vegetables and/or flowers.
11	*urban*	Land associated with cities or towns; includes residential, commercial and recreational areas and their associated infrastructure; allotment sizes are generally less than one hectare.
12	*industrial*	Land used for the manufacture of goods; includes factories, warehouses, sawmills, refineries, etc., and their grounds.
13	*quarrying/mining*	Land used for an extractive industry including spoil dumps, infrastructure and rehabilitated areas.
14	*other*	For any land use not adequately covered by the VALUE listed above, use this VALUE and record the appropriate description in **SITE FIELD NOTES**.

2.6.2 General Area

CHOICE, UP TO 3 VALUES

Describe the main forms of **LAND USE** within a distance of 300 m from the **profile** or to the edge of the **landform element**, whichever is the lesser distance. The Reference List of VALUES is the same as those used for **2.6.1 Site**.

2.7 TOPOGRAPHY

TOPOGRAPHY has ATTRIBUTES that describe the **site**, generally extending from the **profile** to a radius of 10 m, or the edge of the **landform element** whichever is the lesser.

2.7.1 Slope, Estimated or Measured

CHOICE, 1 VALUE ONLY

Indicate whether the slope gradient was measured, for example, with a clinometer or Abney level, or estimated.

2.7.2 Slope Percentage

PERCENTAGE, 1 VALUE ONLY, RIGHT JUSTIFIED

The **slope** of the land at each **site** is the tangent of the ground surface, from the horizontal angle, an incline upwards or downwards expressed as a percentage (Morse *et al.* 1982). If the **site** is an excavation, record the probable natural **slope** prior to disturbance.

2.7.3 Elevation

UP TO 4-DIGIT NUMBER, 1 VALUE ONLY, RIGHT JUSTIFIED

The **elevation** of the **site** is usually determined from a topographic map. Although a measure of elevation can also be obtained from a GPS, this is not recommended due to the poor accuracy of non-differential GPSs. Record the **elevation** in whole metres, above mean sea level. **Negative elevation**, that is the depth of a land surface below sea level, is acceptable on the 8-page Soil Data Card only, and is indicated by filling in the minus ('-') circle.

2.7.4 Aspect

CHOICE, 1 VALUE ONLY

The **aspect** refers to the direction that the slope faces and should be recorded in the field using one of the 8 cardinal points. Note that level **sites** will have no **aspect,** but the blank central position on the Soil Data Card may be filled in to record that the site is without aspect.

2.7.5 Plan Curvature

CHOICE, 1 VALUE ONLY

🗎 *2-page CRA Soil Data Card only.*

The **plan curvature** refers to the degree of concavity or convexity across (perpendicular) to the slope—in other words, whether the surface shape is convergent, divergent or broadly parallel. This is in contrast to **slope morphology** (see **2.8.1.3 Slope Morphology** below), which refers to the landform shape upslope and downslope.

1	*Divergent*	The cross-section of the slope is convex—i.e., the cross-section curves downwards towards its extremities, so that any runoff diverges from the centre towards the extremities.
2	*Parallel*	The cross-section of the slope is straight—i.e., the slope is planar, so that any runoff flows downslope in the same direction.
3	*Convergent*	The cross-section of the slope is concave—i.e., the cross-section curves downwards towards its centre, so that any runoff converges from the extremities towards the centre.

2.7.6 Position in Landform Element

CHOICE, 1 VALUE ONLY

🗎 *2-page CRA Soil Data Card only.*

Position in landform element refers to the position of the soil profile site within the **landform element** in which it occurs—i.e., whether it is in the upper part, middle or lower part of the landform element.

2.8 LANDFORM

The ATTRIBUTES of **LANDFORM** are divided into two groups. In the first group are **site** features that describe landform factors directly affecting the **site**. This group can be observed within a 10 m radius from the soil **profile** and describes the unit of land referred to as a **landform element**.

In the second group are landscape features which place the **landform element** into its geomorphic context by describing the nature of the surrounding landscape within a 300 m radius—i.e., the **landform pattern** and **local relief.**

2.8.1 Site Features

Site features apply to the area within a radius of 10 m of the **profile.**

2.8.1.1 Site Process

CHOICE, 1 VALUE ONLY

4-page and 8-page Soil Data Cards only.

Describe the principal form of geomorphological activity using one of the VALUES defined below.

Additional or more detailed information can be recorded by using the **PROFILE ADDENDUM CODES** for **Soil Landscape Geomorphic Class**—see **2.14 Profile Addendum Codes**.

Reference List of VALUES

Denudational Process

1	*residual*	*In situ* processes of weathering, leaching and new mineral formation are dominant. Lateral surface movement is minimal. A residual site may occur either on low gradient topography, such as a plateau surface, or where soil material is of such a nature as to resist lateral movement despite a considerable slope gradient (Paton 1978).
2	*transportational*	Both subsurface *in situ* processes and surface processes of lateral movement occur. These processes are normal on hillslopes, but, depending on the type of materials involved, the slope gradient necessary for lateral movement of surface material can be very low (Paton 1978).

Depositional Process

3	*depositional*	The processes of lateral surface movement are dominant (Paton 1978). It typically occurs in colluvial areas—e.g., footslopes.
4	*alluvial*	Unconsolidated surface material deposited mainly by running water—e.g., streams or rivers.
5	*littoral*	Surface material is comprised of unconsolidated sediments deposited by tidal water.
6	*lacustrine*	Unconsolidated surface material deposited mainly in standing water—e.g., lakes.
7	*aeolian*	Dominant surface materials have been transported and deposited by the wind.

Disturbed Terrain

8	*disturbed*	Landform components have been permanently altered from their original state by human activity.

2.8.1.2 Site Morphology

CHOICE, 1 VALUE ONLY

Site morphology is the morphological type that best describes the **landform element**. The morphological types are illustrated in ***Figure 2*** and defined below.

Reference List of VALUES

1	*flat*	Is neither a crest nor a depression and is level or very gently inclined (less than 3% slope gradient).
2	*crest*	Stands above all or almost all points in the adjacent terrain. It is characteristically smoothly convex upwards.
3	*hillock*	Comprised of a narrow crest and adjoining slopes, the crest length being less than the width of the landform element, cf. *ridge*.
4	*ridge*	Comprised of a narrow crest and adjoining slopes, the crest length being greater than the width, cf. *hillock*.
5	*upper slope*	Adjacent to and below a crest or flat but not adjacent to or above a depression.
6	*midslope*	Below but not adjacent to a crest or a flat, and above but not adjacent to a flat or a depression.
7	*simple slope*	Adjacent to either a crest and a flat, a crest and a depression, two flats, or a flat and a depression.
8	*lower slope*	Adjacent to and above a flat or a depression but not adjacent to and below a crest or flat.
9	*open depression*	Is situated below most points in the adjacent terrain. It extends at the same elevation as, or lower than, the locality where it is observed.
10	*closed depression*	Stands below all points in the adjacent terrain.

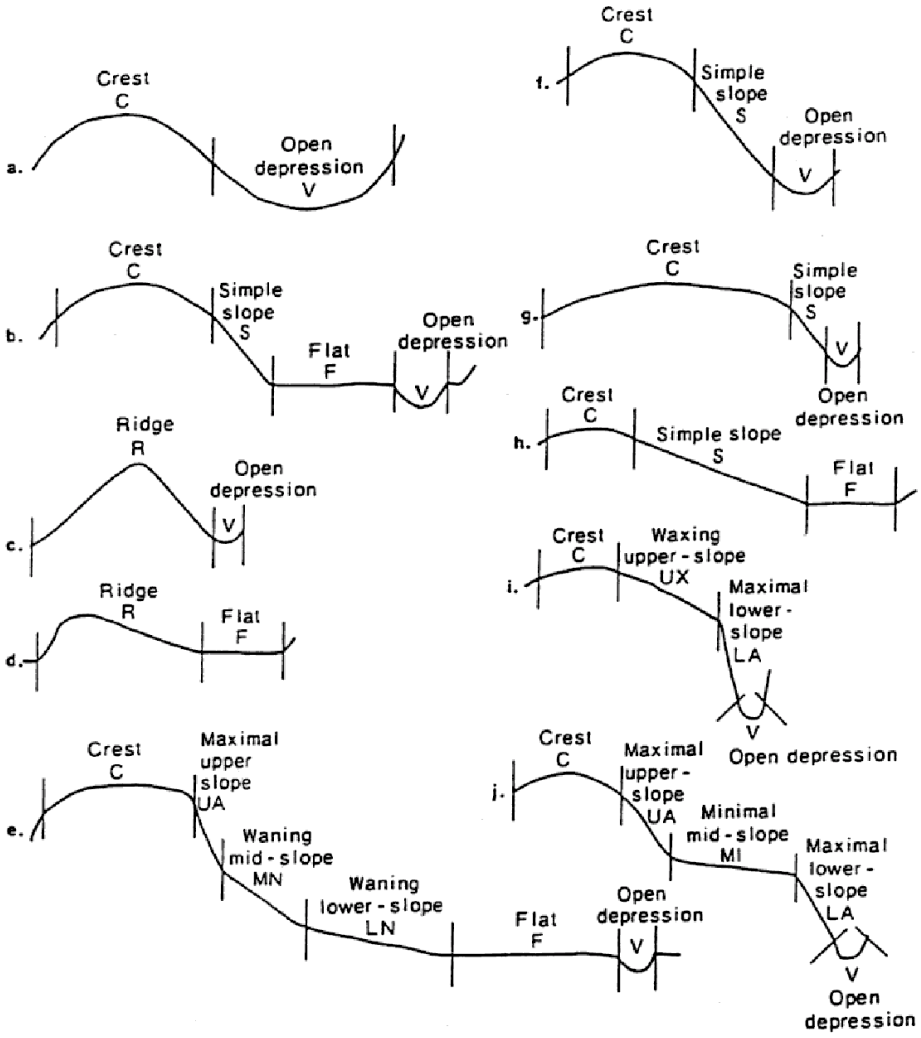

Figure 2: Morphological types of Landform Element

2.8.1.3 Slope Morphology

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

Slope morphology is the slope inclination relative to adjacent **landform elements** (see ***Figure 2***). In general, crests are similar to waxing slopes, and depressions to waning slopes, whereas flats do not relate to such a scheme.

Reference List of VALUES

1	*waxing*	Element upslope is gentler, element downslope is steeper.
2	*waning*	Element upslope is steeper, element downslope is gentler.
3	*maximal*	Element upslope is gentler, element downslope is gentler.
4	*minimal*	Element upslope is steeper, element downslope is steeper.

2.8.2 General Area Features

Landscape features apply to the area within 300 m of the **profile.**

2.8.2.1 Local Relief

CHOICE, 1 VALUE ONLY

4-page and 8-page Soil Data Cards only.

Local relief is the difference in elevation between the high and low points of the landscape. ***Table 1*** illustrates the relationship between **local relief**, **slope percentage**, and **landform pattern** and can be used to assist when assigning a VALUE.

Table 1 Landform Pattern characterised by **Local Relief** and **Slope**

Local Relief	**Slope Percentage**						
	Level <1%	*Very Gently Inclined* 1 - 3%	*Gently Inclined* 3 - 10%	*Mod. Inclined* 10 - 32%	*Steep* 32 - 56%	*Very Steep* 56 - 100%	*Precipitous* >100%
Very High >300 m				Rolling mountains	Steep mountains	Very steep mountains	Precipitous mountains
High 90 – 300 m			Undulating hills	Rolling hills	Steep hills	Very steep hills	Precipitous hills
Low 30 – 90 m			undulating low hills	rolling low hills	steep low hills	Very steep low hills	Badlands
Very Low 9 – 30 m		Gently undulating rises	undulating rises	Rolling rises	steep rises	badlands	Badlands
Extremely Low <9 m	Level plain	Gently undulating plain	undulating plain	Rolling plain	badlands	badlands	Badlands

From McDonald *et al.* (1990)

2.8.2.2 Landform Pattern

CHOICE, 1 VALUE ONLY

2-page WRA, Observation, 4-page and 8-page Soil Data Cards only.

Record a value which best describes the general landform within a radius of 300m of the site. **Landform Patterns** descriptions are based on those from McDonald *et al.* (1990).

Reference List of VALUES

1	*alluvial fan*	Level to very gently inclined complex pattern of extremely low relief. The rapidly migrating alluvial stream channels are shallow to moderately deep, locally numerous, but elsewhere widely spaced. The channels form a centrifugal to divergent, integrated, reticulated to distributary pattern. Includes areas that are bar plains being aggraded or eroded by frequently active channelled stream flow, and other areas comprising terraces or stagnant alluvial plains with slopes that are greater than usual formed by channelled stream flow but now relict; incision in the up-slope area may give rise to an erosional stream bed between scarps. Typical elements are stream bed, bar and plain. Also includes scarp (cf. *sheet-flood fan* and *pediment*).
2	*alluvial plain*	Level with extremely low relief. The shallow to deep alluvial stream channels are sparsely to widely spaced, forming a unidirectional integrated network. There may be frequently active erosion and aggradation by channelled and overbank stream flow, or relicts from these processes. Typical elements are stream channel plain, bar, scroll, levee, backplain, swamp, ox-bow, flood-out lake. Includes other active patterns such as floodplain, bar plain, meander plain, covered plain, anastomotic plain, delta. Also includes the relict patterns stagnant alluvial plain, terrace.
3	*anastomotic plain*	A floodplain with slowly migrating deep stream channels, usually moderately spaced, forming a divergent to unidirectional integrated reticulated network. There is frequently active aggradation by overbank and channelled stream flow. Typical elements are stream channel, levee, backplain (dominant) (cf. *alluvial plain* and *floodplain*).
4	*badlands*	Steep to precipitous slopes, with low to extremely low relief typically with numerous fixed erosional stream channels which form a non-directional integrated tributary network. There is continuously active erosion by collapse, landslide, sheet flow, creep and channelled stream flow. Typical elements are ridge (dominant), stream bed, gully. Also includes summit surface, hillcrest, hillslope, talus (cf. *mountains, hills, low hills, rises* and *plain*).
5	*bar plain*	A floodplain with numerous rapidly migrating, shallow, alluvial channels forming a unidirectional integrated reticulated network. Active aggradation and erosion by channelled stream flow are frequent. Typical elements are stream bed, bar (dominant) (cf. *alluvial plain* and *floodplain*).

6	*beach ridge plain*	Level to gently undulating with extremely low relief on which stream channels are absent or very rare. Consists of relict parallel beach ridges. Typical elements are beach ridge (co-dominant), swale (co-dominant). Also includes beach, foredune, tidal creek (cf. *chenier plain*).
7	*caldera*	A large basin-shaped volcanic depression of very high relief and steep to precipitous slope. Either without stream channels or has fixed erosional channels forming a centripetal integrated tributary pattern. Typical elements are scarp, hillslope, lake cone. Also includes cone, hillcrest, stream channel.
8	*chenier plain*	Level to gently undulating with extremely low relief on which stream channels are very rare. Consists of relict, parallel linear ridges built up by waves, separated by and built over flats (mudflats) aggraded by tides or overbank stream flow. Typical elements are beach ridge (co-dominant), flat (co-dominant). Also includes tidal flat, swamp, beach, foredune, tidal creek (cf. *beach ridge plain*).
9	*coral reef*	May be active or relict, built up to sea-level of the present day or of a former time by corals and other organisms. Mainly level, with moderately inclined to precipitous slopes below sea-level. Stream channels are generally absent, but there may occasionally be fixed deep erosional tidal stream channels forming a disintegrated non-tributary pattern. Typical elements are reef flat, lagoon, cliff (submarine). Also includes beach and beach ridge.
10	*covered plain*	Floodplain with slowly migrating deep alluvial channels, usually widely spaced and forming a unidirectional integrated non-tributary network. There is frequently active aggradation by overbank stream flow. Typical elements are stream channel, levee, backplain (dominant). Also includes swamp (cf. *alluvial plain* and *floodplain*).
11	*delta*	Floodplain projecting into a sea or lake, with slowly migrating, deep alluvial channels, usually moderately spaced, typically forming a divergent integrated distributary network. Aggraded by frequently active overbank and channelled stream flow that is modified by tides. Typical elements are stream channel, levee, backplain (co-dominant), swamp (co-dominant), lagoon (co-dominant). Also includes beach ridge, swale, tidal creek. (cf. *alluvial plain, floodplain* and *chenier plain*).
12	*dunefield*	Level to rolling with very low or extremely low relief without stream channels, built up or locally excavated, eroded or aggraded by wind. Typical elements are dune, swale, blow-out.
13	*escarpment*	Steep to precipitous, forming a linearly extensive, straight or sinuous, inclined surface which separates terrain at different altitudes. Above the escarpment commonly is a plateau. Relief may be high (hilly) or low (planar). The upper margin is often marked by an included cliff or scarp. Typical elements are hillcrest, hillslope. Also includes cliff, scarp, talus, footslope and alcove.
14	*floodplain*	An alluvial plain characterised by frequently active erosion and aggradation by channelled or overbank stream flow. Includes other patterns: bar plain, meander plain, covered plain, anastomotic plain and delta (cf. *alluvial plain*).
15	*hills*	Gently inclined to precipitous slopes of high relief. Fixed, shallow erosional stream channels, closely to very widely spaced, form a non-directional or convergent, integrated tributary network. There is continuously active erosion by wash and creep and occasionally active erosion by landslides. Typical elements are hillcrest, hillslope (dominant), drainage depression, stream bed. Also includes footslope, alcove, valley flat, gully, tor, summit surface, scarp, landslide talus, bench, doline (cf. *mountains, low hills, rises* and *plain*).
16	*karst*	A pattern of unspecified relief and slope, typically with fixed deep erosional stream channels forming a non-directional disintegrated tributary pattern and many closed depressions without stream channels. Eroded by continuously active solution and rarely active collapse, the products being removed through underground channels. Typical elements are hillcrest, hillslope (dominant), doline. Also includes summit surface, valley flat, plain, alcove, drainage depression, stream channel, scarp, footslope and landslide, talus.
17	*lava plain*	Level to undulating with very low to extremely low relief typically with widely spaced fixed erosional stream channels which form a non-directional, integrated or interrupted tributary pattern. Aggraded by volcanism (lava flow) that is generally relict, it is subject to erosion by continuously active sheet flow, creep, and channelled stream flow. Typical elements are plain, hillslope, stream bed.
18	*low hills*	Gentle to very steep slopes of low relief typically with fixed erosional stream channels, closely to very widely spaced, which form a non-directional or convergent integrated tributary pattern. There are continuously active sheet flow, creep, and channelled stream flow. Typical elements are hillcrest, hillslope (dominant), drainage depression, stream bed. Also includes footslope, alcove, valley flat, gully, tor, summit surface, landslide, doline.
19	*made land*	Where human activity has brought about severe disturbance to the natural landscape features. It includes irrigation areas, reclaimed land, restored mining areas, etc. Typical elements are fill-top (dominant), cut-over surface, cut face, embankment, berm, trench. Also includes mound, pit, dam.
20	*meander plain*	A floodplain with widely spaced, rapidly migrating, moderately deep alluvial stream channels which form a unidirectional integrated non-tributary network. There are frequently active aggradation and erosion by channelled stream flow with subordinate aggradation by overbank stream flow. Typical elements are stream channel, scroll, plain (dominant). Also includes ox-bow (cf. *alluvial plain* and *floodplain*).
21	*meteor crater*	Extremely rare; comprising a circular closed depression (cf. *crater*) with a raised margin; typically of low to high relief and having a large range of slope values, without stream channels, or with a peripheral integrated pattern of centrifugal tributary streams. The pattern is excavated, heaved up and built up by meteor impact. Typical elements are crater, scarp, talus, footslope, plain, hillcrest, hillslope.
22	*mountains*	Moderate to precipitous slopes of very high relief with fixed erosional stream channels which are closely to very widely spaced and form a non-directional or diverging integrated tributary network. There is continuously active erosion by collapse, landslide, sheet flow, creep, and channelled stream flow. Typical elements are hillcrest, hillslope (dominant), stream bed. Also includes talus, landslide, alcove, valley flat, scarp, cirque, footslope (cf. *hills, low hills, rises* and *plain*).

23	*pediment*	Gently inclined to level feature of extremely low relief; typically with numerous, rapidly migrating, very shallow, incipient stream channels which form a centrifugal to diverging integrated reticulated pattern. Underlain by bedrock, eroded and locally aggraded by frequently active channelled stream flow or sheet flow with subordinate wind erosion. Characteristically lies downslope from adjacent hills with markedly steeper slopes. Typical elements are pediment, plain stream bed (cf. *sheet-flood fan* and *alluvial fan*).
24	*pediplain*	Level to very gently inclined with extremely low relief and no stream channels, eroded by barely active sheet flow and wind. Largely relict from more effective erosion by stream flow in incipient stream channels as on a pediment. Typical element is plain.
25	*peneplain*	Level to gently undulating with extremely low relief and sparse, slowly migrating stream channels which form a non-directional integrated tributary pattern. It is eroded by barely active sheet flow, creep, and channelled and overbank stream flow. Typical elements are plain (dominant), stream channel.
26	*plain*	Level to undulating or, rarely, rolling with extremely low relief.
27	*plateau*	Level to rolling with plains, rises or low hills standing above a cliff, scarp or escarpment that extends around a large part of its perimeter. A bounding scarp or cliff may be included or excluded; a bounding escarpment would be an adjacent pattern. Typical elements are plain, summit surfaces, cliff. Also includes hillcrest, hillslope, drainage depression, rock flat, scarp, stream channel.
28	*playa plain*	Level with extremely low relief, typically without stream channels; aggraded by rarely active sheet flow and modified by wind, waves, and soil phenomena. Typical elements are playa, lunette, plain.
29	*rise*	Very gentle to steep slopes. Very low relief. The fixed erosional stream channels are closely to very widely spaced and form a non-directional to convergent, integrated or interrupted tributary pattern. The pattern is eroded by continuously active to barely active creep and sheet flow. Typical elements are hillcrest, hillslope (dominant), footslope, drainage depression. Also includes valley flat, stream channel, gully, tor, fan (cf. *mountains, hills, low hills* and *plain*).
30	*sand plain*	Level to gently undulating with extremely low relief and without channels; formed possibly by sheet flow or stream flow but now relict and modified by wind action. Typical element is plain. Also includes dune, playa, lunette.
31	*sheet-flood fan*	Level to very gently inclined with extremely low relief and numerous, rapidly migrating, very shallow incipient stream channels forming a divergent to unidirectional, integrated or interrupted reticulated pattern. Aggraded by frequently active sheet flow and channelled stream flow with subordinate wind erosion. Typical elements are plain, stream bed (cf. *alluvial fan* and *pediment*).
32	*stagnant alluvial plain*	An alluvial plain on which erosion and aggradation by channelled and overbank stream flow are barely active or inactive because of reduced water supply, without apparent incision or channel enlargement that would lower the level of stream action. Typical elements are stream channel, plain (dominant). Also includes bar, scroll, levee, backplain, swamp, ox-bow, flood-out, lake (cf. *floodplain* and *terrace*).
33	*terrace*	A former floodplain on which erosion and aggradation by channelled]and overbank stream flow are either barely active or inactive because deepening or enlargement of the stream channel has lowered the level of flooding. Typical elements are plain (dominant), scarp, channel bench. Also includes stream channel, scroll, levee.
34	*tidal flat*	Level with extremely low relief and slowly migrating deep alluvial stream channels which form non-directional integrated tributary patterns. Aggraded by frequently active tides. Typical elements are plain (dominant), stream channel. Also includes lagoon, dune, beach ridge, beach.
35	*volcano*	Very rare; typically very high and very steep, without stream channels, or with erosional stream channels forming a centrifugal interrupted tributary pattern. Built up by volcanism, and modified by erosional agents. Typical elements are cone, crater. Also includes scarp, hillcrest, hillslope, stream bed, lake, maar.

2.8.2.3 Landform Element

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

The specific **landform element** for a **site** may be defined in terms of its shape (**site morphology**), slope and primary geomorphic activity (**site process**) responsible for its development.

Reference List of VALUES

1	*hillcrest*	Very gently inclined to steep smoothly convex crest, standing above a hillslope, eroded mainly by creep and sheetwash (overland flow).
2	*summit surface*	Very wide, level to gently inclined crest with abrupt margins, commonly eroded by water-aided mass movement or sheetwash.
3	*cone*	A hillock with a circular symmetry built up by volcanism; the crest may form a ring around a crater.
4	*tor*	Steep to precipitous hillock, typically convex, with a surface mainly of bare rock, either coherent or comprising sub-angular to rounded boulders, eroded by sheetwash or mass movement.
5	*cliff*	High, laterally extensive, maximal slope (greater than 72^{o} slope gradient), usually eroded by gravitational fall as a result of erosion of the base by various agencies; sometimes built up by marine organisms (cf. *scarp*).
6	*bar*	Elongated, gently to moderately inclined low ridge built up by channelled stream flow; part of a stream bed.

7	*beach ridge*	Elongated, nearly straight, low ridge built up by waves and usually modified by wind; often a relict feature remote from the beach.
8	*levee*	Very long, very low, nearly level sinuous ridge, immediately adjacent to a stream channel, built up by overbank flow. Levees often occur in pairs bounding the two sides of a stream channel at the level reached by frequent floods; part of a covered plain (cf. *embankment*).
9	*prior stream*	Long, generally sinuous low ridge built up from materials originally deposited by channelled stream flow along the line of a former stream channel; may include a depression marking the old stream bed and relict levees.
10	*scroll*	Long curved very low ridge, built up by channelled stream flow and left relict by channel migration; part of a meander plain.
11	*dune*	Moderately inclined to very steep ridge or hillock built up by wind.
12	*foredune*	Elongated, nearly straight, moderately inclined to very steep ridge, built up by the wind from material from an adjacent beach.
13	*lunette*	Elongated, gently curved, low ridge, built up by wind on the margin of a playa, or intermittent lake, typically with a moderately inclined wave-modified slope towards the playa, and a gentle outer slope gradient.
14	*embankment*	Slope or ridge built up by human activity.
15	*mound*	A hillock built up by human activity.
16	*dam*	A ridge built up by human activity so as to close a depression.
17	*hillslope*	Gently inclined to precipitous slope, commonly simple and maximal and eroded by sheetwash, creep or water-aided mass movement; part of mountains, hills, low hills and rises.
18	*cliff/scarp*	Very wide steep to precipitous maximal slope, possibly formed as a direct result of a fault, eroded by gravity, water-aided mass movement or sheet flow (cf. *cliff*).
19	*bench*	Short, gently or very gently inclined minimal midslope or flat, eroded or aggraded by any agent.
20	*landslide*	Moderately inclined to very steep slope, eroded in the upper part and aggraded in the lower part by water-aided mass movement, characterised by irregular hummocks.
21	*footslope*	Moderately to very gently inclined waning lower slope resulting from aggradation or erosion by sheet flow, earth flow or creep (cf. *pediment*).
22	*pediment*	Large gently inclined to level waning lower slope, with slope lines inclined in a single direction, or somewhat convergent or divergent, eroded or sometimes slightly aggraded by sheet flow; underlain by bedrock (cf. *footslope*).
23	*talus*	Moderately inclined to steeply waning lower slope, aggraded by gravity, usually formed from an accumulation of rock fragments and other soil material at the foot of a cliff or steep slope.
24	*scree*	Sheet of any loose, fragmental material, lying on or mantling a slope. (Note: Some authorities regard *scree* as the material that makes up the sloping land feature known as *talus*.)
25	*bank*	Very short but laterally extensive slope, moderately inclined to precipitous, forming the margin of a stream channel and resulting from erosion or aggradation by channelled stream flow; part of a stream channel.
26	*beach*	Short, low, laterally extensive slope, gently or moderately inclined, built up or eroded by waves, forming the shore of a lake or sea.
27	*fan*	Large, gently inclined to level element with a radial slope inclined away from a point, resulting from aggradation or occasionally from erosion by channelled, often braided stream flow, or possibly by sheet flow.
28	*cut face*	Slope eroded by human activity.
29	*berm*	Short, very gently inclined to level minimal midslope in an embankment or cut face, eroded or aggraded by human activity; or a flat built up by waves above a beach.
30	*plain*	Large, very gently inclined or level element of unspecified geomorphological origin.
31	*backplain*	Large flat resulting from aggradation by overbank stream flow at some distance from the stream channel and, in some cases, having biological (peat) accumulations; often characterised by a high watertable and the presence of swamps or lakes; part of a covered plain.
32	*flood-out*	A flat, inclined radially away from a point on the margin or at the end of a stream channel, aggraded by overbank stream flow or by channelled stream flow associated with channels developed within the overbank flow; part of a covered plain.
33	*channel bench*	A flat at the margin of a stream channel aggraded and, in part, eroded by overbank and channelled stream flow; an incipient floodplain; is sometimes referred to as “low terrace”, but the term “terrace” should be restricted to **Landform Patterns** above the influence of active stream flow.
34	*rock flat*	A flat of bare consolidated rock usually eroded by sheetwash.
35	*rock platform*	A flat of consolidated rock eroded by waves.
36	*scald*	A flat, bare of vegetation, from which soil has been eroded or excavated by surface wash or wind; or a bare surface caused by salting.

37	*tidal flat*	Large flat subject to inundation by water that is usually salty or brackish, eroded and aggraded by tidal processes.
38	*valley flat*	Small, gently inclined to level flat, aggraded or sometimes eroded by channelled or overbank stream flow, enclosed by hillslopes; a minature alluvial plain located on a narrow valley floor.
39	*cut-over surface*	A flat eroded by human activity.
40	*fill top*	A flat aggraded by human activity.
41	*drainage depression*	A level to gently inclined, long, narrow, shallow, open depression with smoothly concave cross-section, rising to moderately inclined sideslopes, eroded or aggraded by sheetwash.
42	*gully*	An open depression with short, precipitous walls and moderately inclined to very gently inclined floor or small stream channel, eroded by channelled stream flow and consequent gravitational fall and water-aided movement.
43	*alcove*	Moderately inclined to very steep, short open depression with concave cross-section, eroded by collapse, landslides, creep or surface wash.
44	*estuary*	A stream channel close to its junction with a sea or lake, where the action of channelled stream flow is modified by tides and waves; width typically increases downstream.
45	*stream bed*	Linear, generally sinuous, open depression forming the bottom of a stream channel eroded and locally excavated, aggraded or built up by channelled stream flow; parts that are built up include bars; part of a stream channel.
46	*stream channel*	Linear, generally sinuous, open depression, in parts eroded, excavated and aggraded by channelled stream flow; may include stream bed, banks and bars.
47	*swale*	Linear, level-floored depression excavated by wind, or a relict feature between ridges built up by wind or waves, or built up to a lesser height than them; or a long curved relict open or closed depression between scrolls built up by channelled stream flow.
48	*tidal creek*	Intermittently water-filled open depression, in parts eroded, excavated and aggraded by channelled tide-water flow; type of stream channel characterised by a rapid increase in width downstream.
49	*trench*	An open depression excavated by human activity.
50	*cirque*	Precipitous to gently inclined and typically closed depression of concave cross-section and profile excavated by ice; the closed part of the depression may be shallow, the larger part being an open depression like an alcove.
51	*crater*	Steep to precipitous closed depression excavated by explosions due to volcanism, human action, or impact of an extra-terrestrial object.
52	*sinkhole/doline*	Steep-sided closed depression, eroded by solution, directed towards an underground drainage way, or by collapse consequent on such solution; typical of karst terrain.
53	*maar*	A level-floored, commonly water-filled closed depression with a nearly circular steep rim, excavated by volcanism.
54	*lagoon*	A closed depression filled with water that is typically salty or brackish, bounded at least in part by forms aggraded or built up by waves or reef- building organisms.
55	*lake*	Water-filled closed depression.
56	*pan/playa*	Large, shallow, level-floored closed depression, intermittently water filled, but mainly dry due to evaporation, generally bounded by flats, aggraded by sheet flow and channelled stream flow.
57	*ox-bow*	Long, curved, commonly water-filled closed depression, eroded by channelled stream flow, but closed as a result of aggradation by channelled or overbank stream flow during the formation of a meander plain; the floor may be more or less aggraded by overbank stream flow, wind, and biological (peat) accumulation.
58	*swamp*	Almost level, closed or almost closed depression with a seasonal or permanent watertable at or above the surface, commonly aggraded by overbank stream flow and sometimes biological accumulation.
59	*blow-out*	A usually small, open or closed depression excavated by wind.
60	*pit*	A closed depression excavated by human activity.

2.8.2.4 Microrelief

CHOICE, 1 VALUE ONLY

8-page Soil Data Card only.

Microrelief refers to small-scale variations in relief up to a few metres above and below the general land surface, within a radius of 10 m of the **profile.**

Reference List of VALUES

1	*none*	
2	*normal gilgai*	Irregularly distributed small mounds and subcircular depressions varying in size and spacing. The vertical interval is usually less than 0.3 m, and the horizontal interval is usually 3 - 10 m. The surface is almost level.

3	*crabhole gilgai*	Irregularly distributed small depressions and mounds separated by a more-or-less continuous shelf. The vertical interval is usually less than 0.3 m and the horizontal interval is usually 3 - 20 m. The surface is almost level.
4	*linear gilgai*	Long, narrow, parallel, elongate mounds and broader elongate depressions more-or-less at right angles to the contour. They usually occur on sloping land. The vertical interval is usually less than 0.3 m, and the horizontal interval is usually 5 - 8 m.
5	*lattice gilgai*	Discontinuous elongate mounds and/or elongate depressions more-or-less at right angles to the contour. They usually occur on sloping land, and commonly between linear gilgai on lower slopes and plains.
6	*melonhole gilgai*	Irregularly distributed large depressions, usually greater than 3 m in diameter, or greatest dimension, sub-circular or irregular and varying from closely spaced in a network of elongate mounds to isolated depressions set in an undulating shelf with occasional small mounds. Some depressions may also contain sinkholes. The vertical interval is usually greater than 0.3 m, and the horizontal interval is usually 6 - 50 m. The surface is almost level.
7	*biotic*	Examples of biotic microrelief include termite mounds, rabbit warrens, wombat burrows, pig wallows, man-made terraces, stump holes and coppice mounds such as dillon bush mounds.
8	*terracettes*	Small terraces on sideslopes resulting from soil creep and/or trampling by hoofed animals.
9	*other*	When none of the other values describe the **microrelief**, select this option and enter a description in **SITE FIELD NOTES**; includes debil-debil, swamp hummock, contour gilgai, mound/depression, karst, sinkhole, mass movement, contour trench, spring mound and spring hollow.

2.9 SITE CONDITION

SITE CONDITION describes the surface condition characteristics which extend from the soil **profile** to a radius of 10 m or the edge of the **landform element**, whichever is the lesser.

2.9.1 Ground Cover Percentage

PERCENTAGE, 1 VALUE ONLY, RIGHT JUSTIFIED

Indicate the percentage of the ground surface that is covered by material that may act to reduce the erosion hazard. Exclude any canopy which does not affect rate of overland flow and/or does not provide protection against raindrop impact. Materials may include surface rock, mulch, gravel, living vegetation, etc. ***Figure 3*****,** or the approximate abundance chart on the 4-page (Versions 2 and 3) and 8-page Soil Data Cards, may be used to assist in the visual estimation of **ground cover percentage**.

2.9.2 Expected Dry Condition

CHOICE, 1 VALUE ONLY

4-page and 8-page Soil Data Cards only.

The surface condition of a soil may have a characteristic appearance when dry: this **expected dry condition** may affect the use of the soil and is diagnostic of particular soil characteristics.

Reference List of VALUES

1	*hardsetting*	Compact, hard and apparently apedal structure forms when the surface soil dries out (Northcote 1979). In cultivated soils, clods usually retain this condition until completely broken down by repeated cultivation. Soils which do not set hard are either pedal in both the dry and moist state or are apedal, single-grained.
2	*surface crusting*	Thin surface layer or flake, usually less than 10 mm thick, can be separated from and lifted off the soil below when the surface soil dries out.
3	*self-mulching*	Strongly pedal loose surface mulch forms as the soil dries out. The peds naturally separate from one another and are usually less than 5 mm in least dimension. Although very heavy consistent rainfall or ploughing of these, generally clay, soils when wet may appear to destroy the surface mulch, it will reform upon drying (Northcote 1979).
4	*seasonal cracking*	Refers to those shrinking clay soils which, during a dry period, develop cracks as wide as or wider than 5 mm and which penetrate at least 0.3 m into the soil material (Northcote 1979). However, if the surface soil is massive, all such cracks may not be evident at the surface. As a minimum, the frequency of cracking should be of the order of one crack per square metre.
5	*loose*	Incoherent mass of individual particles or aggregates forms the soil surface. The surface is easily disturbed by pressure of forefinger.

2.9.3 Current Condition

CHOICE, MAXIMUM 2 VALUES

Describe the **Current Condition** of the surface soil.

Reference List of VALUES

1	*gravelly*	The amount of surface gravel (particles from 2 mm to 60 mm in diameter) is in excess of 60% of ground cover percentage.
2	*cracked*	Cracks equal to or wider than 6 mm penetrate to 0.3 m or more and at least 1 crack per square metre. Cracks may lie below a thin massive surface layer.
3	*self-mulched*	Soil surface **layer** is highly pedal and loose, forming a mulch.
4	*loose*	Incoherent mass of individual particles or aggregates forms the soil surface. The surface is easily disturbed by pressure of forefinger.
5	*soft*	Coherent mass of individual particles or aggregates forms the soil surface. The surface may be easily disturbed by pressure of forefinger.
6	*firm*	Coherent mass of individual particles or aggregates forms the soil surface. The surface may be disturbed or indented by moderate pressure of forefinger.
7	*hard set*	Soil surface layer is compact, hard and apparently apedal. A surface seal may or may not occur.
8	*surface crust*	Thin surface layer or flake, usually less than 10 mm thick, can be separated from and lifted off the soil below, and often seals the surface from penetration by moisture.
9	*trampled*	Soil surface has been extensively disturbed under dry conditions by hoofed animals.
10	*poached*	Soil surface has been extensively disturbed under wet conditions by hoofed animals.
11	*recently cultivated*	Series of furrows or other cultural marks are visible on the surface, indicating that the surface soil has been recently cultivated or otherwise disturbed.
12	*water repellent*	Water is not readily absorbed into the surface layer. The degree of water repellence can be recorded in **SITE FIELD NOTES**.
13	*other*	Record the type of condition, e.g., cryptogam, in **SITE FIELD NOTES**.

2.9.4 Current Condition (Wet)

CHOICE, MAXIMUM 2 VALUES

2-page WRA Soil Data Card only.

Describe the **current condition** of the surface soil when the surface is wet—i.e., moist or wet in terms of **SOIL WATER STATUS**.

2.9.5 Current Condition (Dry)

CHOICE, MAXIMUM 2 VALUES

2-page WRA Soil Data Card only.

Describe the **current condition** of the surface soil when the surface is dry—i.e., dry or moderately moist in terms of **SOIL WATER STATUS**.

2.9.6 Site Disturbance

CHOICE, MAXIMUM 2 VALUES

Describe any land use activities that may have affected soil properties. More detail is provided under the entity **LAND USE**.

Reference List of VALUES

1	*natural disturbance*	No disturbance other than from native fauna; no hoofed animal grazing.
2	*no effective disturbance*	No disturbance is evident other than grazing by hoofed animals.
3	*limited clearing*	Clearing has been limited or the land has been selectively logged.
4	*extensive clearing*	Clearing has been extensive although not complete; the land may or may not be pasture improved but not cultivated.
5	*cleared, no cultivation*	Clearing has been complete; the land may or may not be pasture improved but not cultivated.
6	*occasional cultivation*	Clearing has been extensive to complete; the land has been cultivated at some stage.
7	*rainfed cultivation*	The land has been cultivated at some stage; but no irrigation has occurred.
8	*irrigated cultivation*	Irrigation has occurred, either past or present.
9	*highly disturbed*	For example, quarrying, road works, mining, landfill, urban development, etc.

2.10 LITHOLOGY

ATTRIBUTES of **LITHOLOGY** describe the parent rock type and/or soil parent material of the **site**. **Substrate** refers to bedrock and strata underlying the soil.

2.10.1 Rock Outcrop

CHOICE, 1 VALUE ONLY

Rock in this context refers specifically to outcrop of the *in situ* rock material, i.e., **substrate,** within a radius of 10 m from the **profile,** and not to loose rocks (or 'floaters') which may be of a colluvial origin. Partially buried boulders and other stones are identified in **COARSE FRAGMENTS**.

2.10.2 Outcrop Same As

CHOICE, 1 VALUE ONLY

🗎 *8-page Soil Data Card only.*

Describe the **LITHOLOGY** of the **rock outcrop** by indicating the relationship of the **rock outcrop** to the **solum parent material** and/or the **substrate**.

2.10.3 Identification Method

CHOICE, 1 VALUE ONLY

🗎 *2-page CRA, 4-page and 8-page Soil Data Cards only.*

Indicate the method used to identify the **LITHOLOGY**.

2.10.4 Substrate Strength

CHOICE, 1 VALUE ONLY

🗎 *2-page CRA, 4-page and 8-page Soil Data Cards only.*

Indicate the average **substrate strength** assessed using a knife, pick or hammer.

Reference List of VALUES

1	*weak*	(<50 MPa). Knife easily cuts or scratches; pick blow crumbles or indents deeply; hammer blow shatters rock to many small fragments or powder.
2	*moderate*	(50 - 100 MPa). Knife makes slight or no mark; pick blow indents shallowly; hammer blow breaks rock readily into a few large and some small fragments.
3	*strong*	(>100 MPa). Knife makes no mark; pick blow makes no mark; hammer blow breaks rock into 1 or 2 large fragments or does not break it at all.

2.10.5 Weathering and/or Alteration

CHOICE, MAXIMUM 2 VALUES

🗎 *2-page CRA, 4-page and 8-page Soil Data Cards only.*

Substrate materials may be so extensively weathered and/or altered that it may be difficult or impossible to determine their original nature. Describe the **weathering** and/or **alteration** that has occurred.

Reference List of VALUES

1	*ferruginised*	Iron enriched.
2	*kaolinised*	Clay enriched, usually pale coloured.
3	*silicified*	Silica enriched.
4	*calcified*	Calcium carbonate enriched.
5	*fresh rock*	No earth material, original rock structure preserved, no decay of feldspars.
6	*faintly weathered rock*	Rusty stain on cracks, trace of earth material, original rock structure preserved, 75 - 99% of original **substrate strength**, no decay of feldspars.

7	*slightly weathered rock*	Slight rusty stain, trace of earth material, interlocked rectangular corestones (if present), original rock structure preserved, 75 - 100% of original **substrate strength**, feldspars partly decayed, few microfractures.
8	*moderately weathered rock*	Strong rusty stain, <50% earth material, interlocked rectangular corestones (if present), original rock structure preserved, 40 - 75% of original **substrate strength**, most of feldspars decayed, microfractures present throughout.
9	*highly weathered rock*	Strong rusty stain, >50% earth material, corestones free and rounded (if present), original rock structure preserved, 15 - 40% of original **substrate strength**, nearly all feldspars decayed, numerous microfractures.
10	*structured saprolite*	Strong rusty stain, may be pallid, 100% earth material, corestones rare and rounded if present, original rock structure preserved, <15% of original **substrate strength**, all feldspars decayed, numerous microfractures.
11	*massive saprolite*	Strong rusty stain, may be mottled, 100% earth material, no corestones, original rock structure lost, <15% of original **substrate strength**, all feldspars decayed.
12	*other*	Deeply weathered but no specific weathering nature apparent. Further information should be entered in **SITE FIELD NOTES**.

2.10.6 Lithology

Indicate the **lithology** of the **solum parent material** and **substrate** separately. The major lithological divisions of unconsolidated sediments, sedimentary rocks, metamorphic rocks and igneous rocks have been included for use if the specific **lithology** cannot be identified. If a **lithology** is required and is not listed, record the major division—e.g., sedimentary division—and record *other*, then record the **lithology** in the **SITE FIELD NOTES**.

2.10.6.1 Solum Parent Material

CHOICE, MAXIMUM 3 VALUES

This refers to the material from which the solum (A and B horizons) of the soil have developed. The **solum parent material** may be identified by loose stones present on, or in, the soil. The **solum parent material** may be the same as or different to the **substrate**. Solum layer may have different parent materials in a number of situations including:

- a lithological boundary occurring at or immediately below the upper solum;
- solum LAYERS may have formed from colluvium and be derived from contrasting upslope material; or,
- the solum LAYERS may have formed from depositional material such as alluvium or windblown sand.

Reference List of VALUES

1	*not identified*	**Solum Parent Material** has not been identified.
2	*unconsolidated*	A range of materials, usually forming surface layers or deposits and not compacted or cemented into rock.
3	*gravel*	Loose detrital material composed mainly of small pebbles or rock fragments, >2 mm and <60 mm; may be mixed with other unconsolidated material.
4	*sand*	Material with the particle size range of 2 mm to 0.02 mm; commonly quartz grains.
5	*silt*	Material within the particle size range of 0.02 mm to 0.002 mm. Non-plastic when moist and not deposited by floods (see *Alluvium*).
6	*clay*	Fine-grained material, <0.002 mm; composed normally of hydrated aluminium silicate minerals and plastic when moist.
7	*organic material*	A deposit composed of plant remains at various stages of decomposition.
8	*alluvium*	Unconsolidated detrital material transported by water.
9	*colluvium*	Heterogeneous rock and soil detritus transported by downslope processes.
10	*lacustrine*	Deposits in or pertaining to lakes; typically fine-grained laminated sediments predominate; may contain evaporates such as salts; coarser sediments may be found on lake margins.
11	*aeolian*	Material that has been transported and deposited by wind; composed of well-sorted medium to fine sand, silt or clay; often found as dunes or sand sheets.
12	*marine*	Sediment that has been transported and deposited by marine processes; includes beach sands and the fine sand, silt and mud of tidal flats.

13	*calcareous sand*	Material with the particle size range of 2 mm to 0.02 mm containing up to 50% calcium carbonate.
14	*fill*	Man-made deposits of rock, soil, tailings, etc.
15	*mud*	Mixture of water with silt or clay-sized particles.
16	*till*	Unstratified drift, deposited directly by a glacier without reworking by meltwater and consisting of a mixture of clay, silt, sand, gravel and boulders ranging widely in size and shape.
17	*sedimentary*	Rocks resulting from the consolidation of sediment, including organic accumulations and chemical precipitates; distinguished from loose sediments by the degree of lithification.
18	*shale*	Fine-grained detrital sedimentary rock which is laminated and easily split into layers.
19	*siltstone/mudstone*	Fine-grained detrital sedimentary rock composed mainly of silt or clay respectively and is not easily split into layers.
20	*sandstone-quartz*	Detrital sedimentary rock with predominantly sand-sized quartz particles cemented by silica or carbonates with little fine-grained matrix material.
21	*sandstone-lithic*	Detrital sedimentary rock with predominantly sand-sized particles including rock fragments, quartz and feldspar set in a fine-grained matrix.
22	*conglomerate*	Detrital sedimentary rock substantially composed of rounded particles which are larger than 2 mm in diameter.
23	*limestone*	Non-clastic sedimentary rock consisting essentially of the carbonate minerals calcite and dolomite; may be organic, detrital or chemically precipitated.
24	*tuff*	Consolidated volcanic ash; water-laid tuffs generally show excellent bedding and may appear similar to shales or sandstones; pyroclastic fragments are less than 20 mm in diameter.
25	*breccia*	Coarse-grained clastic rock of angular, broken rock fragments in a fine-grained matrix or held together with mineral cement.
26	*greywacke*	Dark grey firmly indurated sandstone with poorly sorted quartz and feldspar with dark rock and mineral fragments in a clayey matrix.
27	*arkose*	Coarse-grained sandstone, typically pink or red, of quartz and at least 25% feldspar in clay and iron oxide matrix.
28	*dolomite*	Sedimentary rock containing >90% dolomite and <10% calcite; often associated and interbedded with limestone.
29	*calcrete*	Calcareous duricrust; a conglomerate of sand and gravel cemented by calcium carbonate into a hard mass.
30	*aeolianite*	(*Eolianite*); a consolidated sedimentary rock consisting of clastic material deposited by the wind.
31	*chert*	A hard dense sedimentary rock of interlocking quartz crystals, often white or coloured; also called flint.
32	*jasper*	Red chert, usually associated with iron ores.
33	*metamorphic*	Rocks that have been changed in their mineralogical, textural or small scale structural compositions by the action of heat and/or pressure.
34	*gneiss*	Coarse-grained banded crystalline rock formed during high grade regional metamorphism; most have a granitic composition with minerals separating into schistose bands of micas and amphiboles and granulose bands of quartz and feldspar.
35	*schist/phyllite*	Schists are largely or completely recrystallised during moderately intense regional metamorphism; characterised by a parallel arrangement and fine scale foliation of lamellar minerals, particularly micas. Phyllites are low temperature regionally metamorphosed, fine-grained rocks which have a distinctive shiny surface caused by the reorientation of mica minerals along cleavage planes.
36	*slate*	Fine-grained regionally metamorphosed argillaceous rock which has a well-developed cleavage and splits readily into thin plates.
37	*hornfels*	Tough, fine-grained granulose rock produced by the thermal metamorphism of argillaceous or calcareo-argillaceous rock; no cleavage, schistosity or parallel alignment of materials.
38	*quartzite*	Regionally or thermally metamorphosed rock in which quartz is the primary constituent; grains have recrystallised into an interlocking mosaic texture with little or no trace of cementation.
39	*greenstone*	Any compact dark green metamorphosed basic igneous rock.
40	*amphibolite*	Crystalloblastic rock consisting mainly of amphibole and plagioclase with little or no quartz.
41	*marble*	Limestone which has been recrystallised by heat and pressure during metamorphic processes.

42	*igneous*	Rocks which have solidified from molten magma at or below the earth's surface; grains are characteristically crystalline and interlocking; crystal size decreases with increasing rate of cooling of the molten rock material.
43	*coarse-acidic*	Igneous rock type with more than 20% free quartz and containing the feldspars orthoclase and/or plagioclase; grain size is normally greater than 5 mm, but may include medium-grained rocks with grain sizes greater than 3 mm; includes granite and adamellite.
44	*coarse-intermediate*	Feldspathic igneous rock type with less than 10% free quartz and up to 50% ferromagnesian minerals; grain size is greater than 3 mm; includes granodiorite, diorite, monzonite and syenite.
45	*coarse-basic*	Quartz-free igneous rock type containing more than 50% ferromagnesian minerals; calcic-plagioclase is the dominant feldspar; common ferromagnesian minerals are olivine and pyroxene; grain size is greater than 3 mm; includes gabbro.
46	*fine-acidic*	Igneous rock type with an excess of 20% free quartz, less than 20% ferromagnesian minerals and containing the feldspars orthoclase and plagioclase; grain size is normally less than 1 mm but may include medium-grained rocks with grain sizes up to 3 mm and the acid porphyries; includes rhyolite, quartz porphyry and quartz-orthoclase porphyry.
47	*fine-intermediate*	Feldspathic igneous rock with less than 10% free quartz and up to 50% ferromagnesian minerals; grain size is less than 3 mm; includes trachyte, trachyandesite and andesite.
48	*fine-basic*	Quartz-free igneous rock type containing more than 50% ferromagnesian minerals; calcic-plagioclase is the dominant feldspar; grain size is less than 3 mm; includes basalt, latite and dolerite.
49	*serpentinite*	Rock consisting almost wholly of serpentine-group minerals; includes antigorite, chrysotile.
50	*gabbro*	A group of dark coloured basic intrusive igneous rocks; it is the approximate intrusive equivalent of basalt.
51	*dolerite*	Intrusive igneous rock with lath-shaped plagioclase crystals included in pyroxene crystals; also called diabase.
52	*diorite*	Group of intrusive intermediate igneous rocks; intrusive equivalent of andesite.
53	*syenite*	Coarse-intermediate plutonic igneous rock; the intrusive equivalent of trachyte; usually contains orthoclase, microdine or perthite, a small amount of plagioclase, hornblende and other mafic minerals but little or no quartz.
54	*granodiorite*	Coarse-intermediate intrusive igneous rock; the intrusive equivalent of rhyodacite; contains quartz, oligoclase or andesine, potassium feldspar and mafic minerals.
55	*adamellite*	Coarse-acidic igneous rock.
56	*granite*	Coarse-acidic plutonic igneous rock.
57	*aplite*	Light coloured, intrusive, acidic igneous rock characterised by fine-grained texture.
58	*quartz porphyry*	Extrusive or intrusive rock containing larger crystals of quartz and alkali feldspar set in a finer groundmass.
59	*basalt*	Dark to medium dark coloured fine-grained extrusive mafic basic igneous rock.
60	*andesite*	Dark coloured fine-grained intermediate extrusive rock.
61	*trachyte*	Fine-grained porphrytic intermediate extrusive rock; main components are alkali feldspar and minor mafic minerals.
62	*rhyolite*	Fine-grained porphrytic acidic extrusive igneous rock; exhibits flow texture; consists of quartz and feldspar in a glassy to cryptocrystalline groundmass.
63	*obsidian*	Black or dark coloured volcanic glass.
64	*scoria*	Vesicular cindery crust on the surface of andesitic or basaltic lava; usually heavier, darker and more crystalline than pumice.
65	*ash*	Fine (usually <4.0 mm) pyroclastic material; usually unconsolidated.
66	*agglomerate*	Chaotic assemblage of coarse angular pyroclastic material.
67	*other*	When VALUES listed are inadequate to describe **Lithology**, this may be used in conjunction with either *unconsolidated, sedimentary*, *metamorphic* or *igneous* and **SITE FIELD NOTES**.

2.10.6.2 Substrate

CHOICE, MAXIMUM 3 VALUES

May be identified from an exposure or outcrop.

Select VALUES from the Reference List of VALUES found in **2.10.6.1 Solum Parent Material** above.

2.10.7 Spacing of Discontinuities

CHOICE, 1 VALUE ONLY

2-page CRA Soil Data Card only.

Spacing of discontinuities describes the integrity and continuousness of the substrate immediately underlying the soil **profile**. This is described both in terms of the size of individual continuous rock fragments and in the amount of jointing or fracturing of the rock mass as a whole.

2.10.8 Fragment Amount

CHOICE, 1 VALUE ONLY

2-page CRA Soil Data Card only.

Fragment Amount is a general measure of the amount of coarse fragments within the soil **profile**, measured in a similar way to coarse fragment amount in layers (see **2.37.2 Fragment Amount**) but averaging the fragment content of the soil **profile** as a whole.

2.11 VEGETATION

VEGETATION describes the vegetative characteristics generally extending from the soil **profile** to a radius of 10 m or the edge of the **landform element**, whichever is less. Structural formation classes used are equivalent to Specht *et al.* 1974.

2.11.1 Crown Separation Ratio

CHOICE, 1 VALUE ONLY

8-page Soil Data Card only.

The **crown separation ratio** is the average distance between crowns, divided by the average diameter of crowns.

Describe the Crown Separation Ratio for the upper stratum and, if relevant, record in **SITE FIELD NOTES** the Crown Separation Ratio for the mid stratum within the complete vegetation unit.

2.11.2 Upper Stratum Height

CHOICE, 1 VALUE ONLY

CRA 2-page and 8-page Soil Data Cards only.

Describe the mean **upper stratum height**.

2.11.3 Vegetation Community

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

Describe the original, or native, vegetation if any remains.

Reference List of VALUES

1	*unknown*	Impossible to ascertain native vegetation.
2	*rainforest*	Canopy cover >70%, maximum height >10 m; structurally complex (more than one stratum) and floristically diverse with dense crowns; emergents, vines, ferns and epiphytes present.
3	*wet sclerophyll*	Canopy cover 30 - 70%, maximum height >10 m; sclerophyllous trees; at least one moist stratum of mesophytic shrubs; ferns are frequently present.
4	*dry sclerophyll*	Canopy cover 30 - 70%, maximum height >10 m; sclerophyllous trees; a single lower stratum of xerophytic shrubs and herbs.
5	*woodland-grass understorey*	Canopy cover <30%, maximum height >5 m; lower stratum of sod or tussock grass; grades into dry sclerophyll or grassland.
6	*woodland-shrub understorey*	Canopy cover <30%, maximum height >5 m; lower stratum characterised by shrubs; grades into dry sclerophyll or shrubland.
7	*tall shrubland*	Canopy cover <70%, maximum height >2 m.

8	*low shrubland*	Canopy cover <30%, maximum height <2 m; sparse upper stratum with a lower stratum of grasses and forbs.
9	*heath*	Canopy cover <30%, maximum height <2 m; dense upper stratum with a sporadic lower stratum of forbs.
10	*grassland/herbland*	Grasses, single stratum of grasses and forbs.
11	*swamp complex*	Mixed growth forms; low shrubs, heath, swamp grasses, sedges, rushes and forbs.
12	*littoral complex*	Mixed growth forms; mosaic of mangroves, low shrubs, forbs, sedges and swamp grasses adjacent to estuarine or tidal areas.
13	*no vegetation*	Bare, mainly due to extreme moisture stress, high salinity or lack of suitable rooting material.

2.11.4 Growth Forms

CHOICE, MAXIMUM 4 VALUES

2-page CRA, 4-page and 8-page Soil Data Cards only.

Record up to 4 **growth forms** which dominate the **site**. Consider **growth forms** in each stratum: the upper stratum, the mid stratum and the lower stratum.

Reference List of VALUES

1	*tree*	Woody plant more than 2 m tall with a single stem or branches well above the base.
2	*mallee tree*	Woody perennial plant usually of the genus *Eucalyptus;* multi-stemmed with fewer than five trunks of which at least three exceed 100 mm in diameter at breast height; usually 8 m or more tall.
3	*shrub*	Woody plant, multi-stemmed at the base (or within 200 mm from ground level) or, if single-stemmed, less than 2 m tall.
4	*mallee shrub*	Commonly less than 8 m tall, usually with five or more trunks, of which at least three of the largest trunks do not exceed 100 mm in diameter at breast height.
5	*heath shrub*	Shrub, usually less than 2 m tall, commonly with ericoid leaves.
6	*chenopod shrub*	Xeromorphic single or multi-stemmed halophyte exhibiting drought and salt tolerance.
7	*hummock grass*	Coarse xeromorphic grass with a mound-like form often dead in the middle; genera are *Triodia* and *Plectrachne*. These differ from sedges in that the leaf sheath is always split, ligules are present, the leaf is usually flat, the stem cross-section is circular, and evenly spaced internodes.
8	*tussock grass*	Forms discrete but open tussocks usually with distinct individual shoots or, if not, then not forming a hummock. These are the common agricultural grasses. These differ from sedges in that the leaf sheath is always split, ligules are present, the leaf is usually flat, the stem cross-section is circular, and evenly spaced internodes.
9	*sod grass*	Grass of short to medium height forming compact tussocks in close contact at their base and uniting as a densely interfacing leaf canopy. These differ from sedges in that the leaf sheath is always split, ligules are present, the leaf is usually flat, the stem cross-section is circular, and evenly spaced internodes.
10	*sedge*	Herbaceous, usually perennial, erect plant; generally with a tufted habit and of the families *Cyperaceae* and *Restionaceae*. These differ from grasses in that the leaf sheath is never split (except *Restionaceae*), there is usually no ligule, the leaf is not always flat, the stem cross-section is circular, triangular or polygonal, and there is an extended internode below the inflorescence.
11	*rush*	Herbaceous, usually perennial, erect plant. Rushes are grouped in the families *Juncaceae*, *Typhaceae*, *Restionaceae* and the genus *Lomandra*.
12	*forb*	Herbaceous or slightly woody annual or sometimes perennial plant; not a grass.
13	*fern/cycad*	Characterised by large and usually branched leaves (fronds), herbaceous to arborescent and terrestrial to aquatic; spores in sporangia on the leaves or separate sporophylls.
14	*moss*	Small plant usually with a slender leaf-bearing stem with no true vascular tissue.
15	*lichen*	Composite plant consisting of a fungus living symbiotically with algae; without true roots, stems or leaves.
16	*liverwort*	Often moss-like in appearance or consisting of a flat, ribbon-like green thallus.
17	*vine*	Climbing, twining, winding or sprawling plant usually with a woody stem.

2.11.5 Species Stratum

CHOICE, 1 VALUE ONLY FOR EACH SPECIES

8-page Soil Data Card only.

For each species code entered, a stratum should be recorded.

Reference List of VALUES

1	*Upper Stratum*	Tallest stratum, canopy
2	*Mid Stratum*	Second tallest stratum
3	*Lower Stratum*	Third tallest stratum

2.11.6 Species Dominance

CHOICE, 1 VALUE ONLY FOR EACH SPECIES

8-page Soil Data Card only.

For each species code entered, a code may be entered which identifies whether the species is dominant, co-dominant or subdominant within the association.

Reference List of VALUES

1	*Dominant*	Most abundant or physically predominant species in the stratum.
2	*Co-dominant*	Two or more species are said to be co-dominant where their combined abundance is significantly greater than the combined abundance of all other species in the association. It is also important for the relative abundance of the co-dominant species to be relatively similar. If one species is significantly more abundant than another, this species is said to be dominant and the other sub-dominant.
3	*Subdominant*	Less abundant than either co-dominant or dominant species.

2.11.7 Species

NUMERIC CODE, MAXIMUM 6 VALUES ON SOIL DATA CARD, UP TO 20 VALUES IN SALIS DATABASE

8-page Soil Data Card only.

A list of 4-character numerical codes has been compiled from SCS, CaLM and DLWC staff, Leigh and Mulham (1965), Beadle, Evans and Carolin (1982) and other reliable sources for plant **species** in New South Wales. This list is not exhaustive and codes will be added as required. New codes will be provided by the SALIS Administrator on request. Up to six species codes may be recorded on the soil data card, although more than this may be recorded in the database.

A Reference List of VALUES is available, on request, from the SALIS Administrator. Partial lists can also be made available to individuals as required.

2.11.8 Effective Rooting Depth

CHOICE, 1 VALUE ONLY

CRA 2-page Soil Data Card only.

Effective rooting depth indicates the depth to which the roots of plants have penetrated the soil **profile,** recorded in metres to the nearest centimetre.

2.12 HYDROLOGY

HYDROLOGY describes the surface and subsurface water regime at the **profile**.

2.12.1 Presence of Free Water

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

Indicate the **presence of free water** or watertable as observed and its relationship to the ground surface.

2.12.2 Free Water Depth

DEPTH (M) TO 2 SIGNIFICANT FIGURES, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

Record **free water depth** in metres to the nearest centimetre, either above or below the soil surface, if it is exposed at the time of description.

2.12.3 Run-on

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

This is a subjective assessment of the amount and rate at which water is likely to enter the **site** by overland flow.

Reference List of VALUES

1	*none*	Water does not enter the site by overland flow—e.g., crests.
2	*low*	Small volumes of overland flow occur—e.g., upper slopes and spurs.
3	*moderate*	Significant overland flow occurs—e.g., some midslopes and some lower slopes.
4	*high*	Areas where concentrated overland flow occurs—e.g., some lower slopes and drainage depressions.
5	*very high*	Large volumes of water enter the site by channelised flow—e.g., gullies and major drainage lines.

2.12.4 Runoff

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

This is a subjective assessment of the amount and rate of water that is likely to leave the **site** by overland flow. The source of water may be **run-on**, **runoff** from another **site**, and/or precipitation excess at the **site** during rainfall. **Runoff** is modified by **landform element**, soil type and **ground cover**, especially **vegetation**.

Reference List of VALUES

1	*none*	Water does not leave site as surface flow. Free water lies on the surface for long periods or enters the soil immediately. The site is usually level and/or the soil is loose and porous.
2	*low*	Water remains ponded on the surface for significant periods or enters the soil fairly quickly. The site is usually either nearly level or gently sloping or the soil is relatively porous.
3	*moderate*	Water lies on the surface for short periods only. A moderate amount of water may enter the soil.
4	*high*	Most of the water rapidly leaves the site as surface flow, with little entering the soil. The site usually has moderate to steep slope and/or the soil has a low infiltration rate or capacity.
5	*very high*	Water very rapidly leaves the site as surface flow. The site usually has a steep to very steep slope and the soil has a low infiltration rate or capacity.

2.12.5 Permeability

CHOICE, 1 VALUE ONLY

4-page and 8-page Soil Data Cards only.

Permeability is an intrinsic property of the soil **profile**, independent of climate and drainage. It is the measure of a **profile's** potential to transmit water (saturated hydraulic conductivity, Ks) and is controlled by the least permeable **layer** in the **profile**. It is inferred from ATTRIBUTES of the soil such as structure, texture, porosity, cracks and macropores, and shrink-swell properties.

Reference List of VALUES

1	*very slowly permeable*	Vertical transmission of water in the least permeable layer is very slow in that the **profile** would take periods of a month or more after thorough wetting to reach field capacity if there were no obstructions to movement from the **profile**. Structure may vary, but cracks and macropores between peds close on wetting. Texture is usually clay or silty clay, and there is an absence of visible (hand lens) pores that could conduct water when wet.
2	*slowly permeable*	Vertical transmission of water in the least permeable layer is slow in that the **profile** would take a week or more after thorough wetting to reach field capacity if there were no obstructions to movement from the **profile**. Structure may vary, usually from massive to moderate. Texture is usually clay or silty clay, and there will be few visible (hand lens) pores that conduct water when wet. If texture is coarser, the inter-particle voids are filled with fine minerals.
3	*moderately permeable*	Vertical transmission of water in the least permeable layer is such that such that the **profile** would take no more than a few days (1 - 5) after a thorough wetting to reach field capacity if there were no obstructions to water movement from the **profile**. The soil may vary in structure, but grade is usually at least moderate and blocky, or polyhedral peds are common. If massive, the soil material is always porous. The pores and channels which remain open when wet are clearly visible with a hand lens.
4	*highly permeable*	Vertical transmission of water in the least permeable layer is such that the **profile** would take no more than 1 - 12 hours after a thorough wetting to reach field capacity if there were no obstructions to water movement from the **profile**. Layers have large, continuous and clearly visible connecting pores and cracks that do not close with wetting. Texture is usually sandy, and nodules or gravels are commonly present. Soil layers are usually apedal, but some medium to fine-textured soils with strong granular structure or cementation of aggregates can be highly permeable.

2.12.6 Profile Drainage

CHOICE, 1 VALUE ONLY

Profile drainage controls local soil moisture conditions. It provides a statement about soil and **site** drainage that is likely to occur in most years. It is affected by a number of ATTRIBUTES, both internal and external, that may act separately or together. Internal ATTRIBUTES include soil structure, texture, cracks and macropores, hydraulic conductivity, and water-holding capacity, while external ATTRIBUTES are source and quality of water, evapotranspiration, slope length and gradient and position in the landscape.

Reference List of VALUES

1	*very poorly drained*	Water is removed from the soil so slowly that the watertable remains at or near the surface for most of the year. Surface flow, ground water and subsurface flow are major sources of water, although precipitation may be important where there is a perched watertable and precipitation exceeds evapotranspiration. Very poorly drained soils vary widely in texture and depth and often occur in depressed sites. Strong gleying and accumulation of surface organic matter are usually features.
2	*poorly drained*	Water is removed very slowly in relation to supply. Subsurface and/or ground water flow, as well as precipitation, may be a significant water source. Seasonal ponding resulting from **run-on** and insufficient outflow also occurs. A perched watertable may be present. Poorly drained soils vary widely in texture and depth; many have **layers** that are gleyed, mottled, or possess orange or rusty linings of root channels. All **layers** remain wet for periods of several months.
3	*imperfectly drained*	Water is removed only slowly in relation to supply. Precipitation is the main source if available water storage capacity is high, but subsurface flow and/or ground water contribute as available water storage capacity decreases. Imperfectly drained soils range widely in texture and depth. Some **layers** may be mottled and/or have orange or rusty linings of root channels, and are wet for periods of several weeks.
4	*moderately well drained*	Water is removed from the soil somewhat slowly in relation to supply due to low permeability, shallow watertable, lack of gradient, or some combination of these. Moderately well-drained soils are usually medium to fine in texture. Significant additions of water by subsurface flow are necessary in coarse-textured soils. Some **layers** may remain wet for as long as a week after addition of water.

5	*well drained*	Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying moderately permeable material or laterally as subsurface flow. Well-drained soils are often medium in texture. Some **layers** may remain wet for several days after addition of water.
6	*rapidly drained*	Water is removed from the soil rapidly in relation to supply. Excess water flows downward rapidly if underlying, material is highly permeable. There may be rapid subsurface lateral flow during heavy rainfall provided there is a steep gradient. Rapidly drained soils are usually coarse textured or shallow or both. No **layer** is normally wet for more than several hours after addition of water.

2.12.7 pH (Soil Water)

DECIMAL TO 1 SIGNIFICANT FIGURE, 1 VALUE ONLY

8-page Soil Data Card only.

The acidity of free water in the soil body is measured in the field using a properly calibrated pH meter and recorded to one decimal place.

2.12.8 EC (Soil Water)

DECIMAL TO 1 SIGNIFICANT FIGURE, 1 VALUE ONLY

8-page Soil Data Card only.

The salinity of free water in the soil body is measured in the field using an properly calibrated EC meter and recorded in decisiemens (dS) correct to one decimal place.

2.13 EROSION

EROSION is the detachment and transport of soil from a site. Assisting processes may include physical and chemical weathering. Record details of **EROSION** observable within a 20 m radius from the **profile**. This is an assessment of the degradation status of the **site**, which is its condition compared with essentially undisturbed land.

Type is a key ATTRIBUTE and must be completed before VALUES for the other related ATTRIBUTES can be entered. The **type** selected also restricts the valid VALUES possible for the other related ATTRIBUTES of **EROSION**. These possible VALUES are presented for each **erosion** type.

2.13.1 Erosion Type

ESSENTIAL ATTRIBUTE IF FURTHER EROSION INFORMATION TO BE ENTERED, CHOICE, MAXIMUM 4 VALUES

4-page and 8-page Soil Data Cards only.

On the soil data card, record the **type** by filling in the **erosion severity** box under the desired **type** column.

Reference List of VALUES

1	*None*	No appreciable erosion of any type is evident at the site.
2	*Wind*	Detachment and transport of soil from the land surface by the action of the wind. The soils most susceptible to wind erosion tend to either be single grained or have poor aggregate stability and have a predominance of fine sand particles.
3	*Sheet*	Removal of a relatively uniform **layer** of soil from the land surface by raindrop splash and/or runoff. No perceptible channels are formed. Indicators include soil deposits in downslope sediment traps such as fence lines, logs or farm dams, pedestalling and exposure of subsoils or roots. In many situations local knowledge of an area must be used to provide the correct interpretation.
4	*Rill*	Removal of soil from the land surface by the formation of numerous small channels up to 0.3 m deep. It typically occurs on recently cultivated or disturbed soil. Sheet erosion grades into rill erosion or, where very severe, into gully erosion. It is very difficult to assess rill erosion unless the site is observed immediately after the erosion event as the rills are eventually lost due to revegetation or cultivation and the evidence indicates a sheet process. Indicators include rill frequency and depth, lack of topsoil layer, exposure of subsoils or roots, etc. Local knowledge of an area is necessary for correct interpretation.
5	*Gully*	A complex process whereby the removal of soil is characterised by large (deeper than 0.3 m) channels cut into slopes or in drainage lines.
6	*Scald*	Where surface soil is removed by wind and/or water, often exposing a more clayey subsoil which is bare and relatively impermeable to water. Scalds are a typical erosion **type** on duplex soils in arid or semi-arid regions and are generally associated with alluvial plains or prior streams.

7	*Tunnel*	Removal of subsurface soil by the action of water while the surface soil remains relatively intact. It is an erosion process resulting from soil dispersion and/or slaking after water seepage. The tunnels so formed normally have outlets in a gully side, batter or earth wall, or at the ground surface further downslope. They normally collapse initiating gully erosion (Crouch 1976).
8	*Stream Bank*	Removal of soil from a stream bank by the direct action of stream flow. It typically occurs during periods of high stream flow.
9	*Wave*	Progressive removal of soil or sand from the margins of beaches, beach ridges, dunes, dams or lakes by the action of waves.
10	*Mass Movement*	Downslope displacement of unstable soil material on slopes. Its occurrence depends on profile drainage, soil mineralogy and slope morphology. It may occur as a catastrophic event—e.g., mud slides, landslides- or as a slow incipient process—e.g., creep.

2.13.2 Erosion Severity

CHOICE, 1 VALUE ONLY PER TYPE

4-page and 8-page Soil Data Cards only.

Record only one VALUE for each **type**. For each **erosion type ATTRIBUTE**, the valid combinations of VALUES are as follows:

Reference List of VALUES

Type: *None*

1	*none*	No appreciable form of erosion.

Type: *Wind*

1	*none*	No appreciable form of wind erosion.
2	*not evident*	No appreciable form of wind erosion is observed, but the site may be susceptible.
4	*minor*	Finer soil particles have been removed resulting in a marked increase in the coarse fraction of the soil surface to a depth of about 10 mm.
5	*moderate*	Gross movement of the coarser particles has occurred; hummocks and drift banks are evident in the lee of nearby vegetation and other obstacles.
6	*severe*	Significant deflation of the soil surface has occurred leaving hard material.
7	*very severe*	Soil surface is completely removed exposing deeper **layers** and leaving a hard compact surface—e.g., subsoil, weathered country rock or pans.

Type: *Sheet*

1	*none*	No appreciable form of sheet erosion.
2	*not evident*	No appreciable form of sheet erosion is observed, but the site may be susceptible.
4	*minor*	Often very difficult to assess because evidence may be lost as a result of revegetation or cultivation; indicators include such factors as shallow soil deposits in downslope sediment traps.
5	*moderate*	Indicators include partial exposure of roots, substantial quantities of sediment in downslope traps (farm dams, fence lines, etc.) and shallow A_1 horizons.
6	*severe*	Indicators include lack of surface soil **layers**, exposure of subsoil **layers**, pedestalling, root exposure, and substantial soil deposits in downslope sediment traps.

Type: *Rill*

1	*none*	No appreciable form of rill erosion.
4	*minor*	Occasional rills.
5	*moderate*	Rills common
6	*severe*	Numerous rills forming corrugated ground surface.

Type: *Gully*

1	*none*	No appreciable form of gully erosion.

4	*minor*	Gullies are isolated, linear and discontinuous, and are restricted to the primary or minor drainage lines.
5	*moderate*	Gullies are continuous and linear and are restricted to the primary or minor drainage lines.
6	*severe*	Gullies are either continuous or discontinuous and either tend to branch away from the primary drainage lines into minor drainage lines and onto footslopes or have multiple branches within primary drainage lines.

Type: *Scald*

1	*none*	No appreciable form of scald erosion.
4	*minor*	Less than 5% of the site is scalded.
5	*moderate*	5 - 50% of the site is scalded.
6	*severe*	More than 50% of the site is scalded.

Type: *Tunnel*

1	*none*	No appreciable form of tunnel erosion.
2	*not evident*	No appreciable form of tunnel erosion is observed, but the site may be susceptible.
3	*evident*	Tunnel erosion is observed.

Type: *Stream Bank*

1	*none*	No appreciable form of stream bank erosion.
2	*not evident*	No appreciable form of stream bank erosion is observed, but the site may be susceptible.
3	*evident*	Stream bank erosion is observed.

Type: *Wave*

1	*none*	No appreciable form of wave erosion.
2	*not evident*	No appreciable form of wave erosion is observed, but the site may be susceptible.
3	*evident*	Wave erosion is observed.

Type: *Mass Movement*

1	*none*	No appreciable form of mass movement erosion.
3	*evident*	Mass movement erosion is observed.

2.13.3 Present Condition

CHOICE, 1 VALUE ONLY PER TYPE

4-page and 8-page Soil Data Cards only.

Describe the present status of each **EROSION TYPE** observed at the **site**. In some cases it will be difficult to assess accurately the **present condition** or activity status of an eroded **site**. For example, the self-mulching character of black soils may give the false impression of a stabilised **site**; the hummocky topography often produced by landslides (and particularly evident on aerial photography) may give the false impression of an actively eroding **site**.

2.13.4 Gully Depth

CHOICE, 1 VALUE ONLY FOR GULLY EROSION TYPE

4-page and 8-page Soil Data Cards only.

Gully depth is used only with the **type** *gully*, and indicates the range of the maximum depth of gullies occurring at a **site**.

2.14 PROFILE ADDENDUM

4-page and 8-page Soil Data Cards only.

A **PROFILE ADDENDUM** is provided for regularly recording characteristics not catered for in the standard Soil Data Card. Please contact the SALIS Administrator if you require the addition of a special Addendum code.

The total number of **PROFILE ADDENDA** that can be entered on the data card for any one **profile** is 4. Where necessary, **SITE FIELD NOTES** can be used to record other ATTRIBUTES or VALUES and more detailed descriptions.

ATTRIBUTES and VALUES

2.14.1 Addendum Code

KEY ATTRIBUTE, 4-CHARACTER ALPHABETIC CODE, 1 VALUE ONLY

These will be assigned by the SALIS Administrator after consultation with the user.

2.14.2 Ref.

2-CHARACTER NUMERICAL CODE, 1 VALUE ONLY, LEFT JUSTIFIED

This ATTRIBUTE qualifies the **Addendum Code.** The number will be assigned by the SALIS Administrator after consultation with the user.

Reference list of VALUES

AAAA - ***Fungal Mat Occurrence***

AAAA 1 *none*

AAAA 2 *sporadic, <20% by area*

AAAA 3 *patchy, 20 - 70% by area*

AAAA 4 *thick, >70% by area*

BBBB - ***Soil Observation Level***

Four levels of detail of soil description can be defined based on attributes adapted from Hackett (1983) and Bouma (1989) by McKenzie (1992).

Table 2 Soil Observation Level

	Level	No. of Variables	Time taken	Type of data	Nature of description	Interpretation
BBBB 1	A	1	1 - 30 mins	Soil name or brief profile description	Broad, qualitative, static and empirical	General statements of suitability for major types of land use; 2-page Soil Data Card
BBBB 2	B	50 – 200	20 - 60 mins	Profile description	Can be detailed but qualitative, static and semi-empirical	Specific statements on some limitations; 4-page Soil Data Card
BBBB 3	C	80 – 400	2 - 20 days	Profile description and laboratory data	Detailed, quantitative and static but mechanistic	Specific statements of most forms of limitations; 8-page Soil Data Card
BBBB 4	D	100 - 500	10 - 30 days	Direct measures of parameters controlling soil processes	Detailed, quantitative, dynamic and mechanistic	Dynamic and probabilistic prediction of processes controlling land use. Input for computer models; 8-page Soil Data Card plus Addenda

CCCC - ***Soil Landscape Geomorphic Class***

CCCC 1 *Residual Landscapes*

Residual soil landscapes are dominated by sites where deep soils have formed from *in situ* weathering of parent materials (This has presumably taken place over long periods where the rate of soil formation has been greater than rate of erosion.) Residual soil landscapes typically have level to undulating elevated topography. Landform elements include some summit surfaces, plateaux, terrace plains, peneplains and old ground surfaces. Stream channels are usually poorly defined.

CCCC 2 *Vestigial Landscapes*

Vestigial soil landscapes are dominated by sites where shallow soils have formed from *in situ* weathering of typically resistant parent materials. Vestigial soil landscapes typically have level to undulating elevated topography. Landform elements include summit surfaces, plateaux and old ground surfaces. Rock outcrop may be common.

CCCC 3 *Karst Landscapes*

Karst soil landscapes are dominated by solutional processes, particularly on limestone and related rock types. Soil parent materials include accumulations of less soluble minerals. Drainage patterns are deranged and solution hollows are common. Landform patterns may include tors, hillslopes and dolines.

CCCC 4 *Colluvial Landscapes*

Colluvial soil landscapes are affected by mass movement. Soil parent material mostly consists of colluvial mass movement debris including scree and talus along with other landslide, mudflow and creep deposits. Colluvial soil landscapes usually include alcoves, cliffs, cliff-foot slopes, scarps, landslides, talus, some moderately inclined to precipitous hillslopes and areas of commonplace evidence of mass movement.

CCCC 5 *Erosional Landscapes*

Erosional soil landscapes have been primarily sculpted by erosive action of running water. Streams are well defined and competent to transport their sediment load. Soil depth is usually shallow (with occasional deep patches) and mode of origin is variable and complex. Soils may be either absent, derived from water washed parent materials or derived from insitu weathered bedrock. Erosional soil landscapes usually consist of steep to undulating hillslopes and may include tors, benches, and areas of rock outcrop. Evidence of mass movement is rare.

CCCC 6 *Transferral Landscapes*

Transferral soil landscapes are deep deposits of mostly eroded parent materials washed from areas directly upslope. Stream channels are often discontinuous and slopes are generally concave. Transferral landscapes include footslopes, valley flats, fans, bajadas and piedmonts.

CCCC 7 *Alluvial Landscapes*

Alluvial soil landscapes are formed by deposition along rivers and streams. Soil parent material is alluvium. Alluvial soil landscapes include floodplains and alluvial deposits. Typical landform elements include those found on meander plains; including bars, backplains, scrolls, scroll plains, flood-outs, ox-bows, levees, terraces, prior and current stream channels.

CCCC 8 *Estuarine Landscapes*

Estuarine Soil Landscapes occur where rivers and streams enter large bodies of water such as the sea or inland lakes. Channel flow is dissipated and is also modified by wave and/or tidal action. Soil materials may be influenced by saline conditions. Estuarine soil landscapes include estuaries, deltas, tidal creeks and tidal flats.

CCCC 9 *Lacustrine Landscapes*

Lacustrine soil landscapes result from infilling of lakes with sediments deposited in still water. Soil parent materials are usually fine grained, well sorted and often varved. Ground surfaces are level to gently inclined and slightly concave. Landform elements include lakes, playas, some ox-bows and some lagoons.

CCCC10 *Beach Landscapes*

Beach soil landscapes have ground surfaces and soil parent materials which have been deposited by wave action. Beach soil landscapes typically occur near sandy coast lines and near lake edges. Typical landform elements include beaches, berms, beach ridges, and some plains. Due to map scale limitations, associated foredunes and windblown soils are included.

CCCC11 *Aeolian Landscapes*

Aeolian soil landscapes have accumulated by deposition of sand-sized particles by wind action. Aeolian soil landscapes include dunefields, dunes, blow-outs, sand sheets and lunettes.

CCCC12 *Swamp Landscapes*

Swamp soil landscapes are dominated by ground surfaces and soils which are at least seasonally wet. Soil parent material includes large amounts of accumulated decayed organic matter. Watertables are frequently close to the surface. Landform elements may include swamps and some relic ox-bows, abandoned channels, lagoons and swales.

CCCC99 *Disturbed Landscapes*

Disturbed soil landscapes are dominated by ground surfaces arising from human activity. Soil parent materials have been moved, accumulated, removed or replaced (with soil or other items). Landform elements include fill-tops, embankments, cut faces, cut-over surfaces, dams, mounds and pits.

DDDD - ***Prior land use***

DDDD 1 *Dense Timber*

DDDD 2 *Wooded*

DDDD 3 *Cleared Land*

DDDD 4 *Shrub/heathland*

DDDD 5 *Rehabilitated*

DDDD11 *Unlogged/uncleared*

DDDD12 *Dense Timber-regenerating*

DDDD20 *Scattered Timber*

DDDD21 *Natural woodland*

DDDD61 *Unimproved pasture*

DDDD62 *Irrigated non-legume pasture*

DDDD63 *Rain-fed non-legume pasture*

DDDD64 *Irrigated legume pasture*

DDDD65 *Rain-fed legume pasture*

DDDD66 *Irrigated continuous cropping*

DDDD67 *Rain-fed continuous cropping*

DDDD68 *Irrigated non-continuous cropping*

DDDD69 *Rain-fed non-continuous cropping*

DDDD90 *Unknown*

DDDD99 *Other*

An updated list of the available VALUES for **PROFILE ADDENDUM CODE** is available on request from the SALIS Administrator.

2.15 SALINITY

CHOICE, 1 VALUE ONLY

Saline soils often have **ground cover percentage** equal to or nearly zero. Where vegetation is present, it is usually stunted with deep blue-green foliage and has considerable variability in size. These features, however, are not invariable indicators of salinity as they may be caused by inadequate nutrition or uneven irrigation. Further, some plant species are more tolerant of saline conditions than others and may be used to reclaim affected areas. Such species (ordered from highly tolerant to moderately tolerant) are *Puccinellia* spp., tall wheat-grass, couch, wimmera ryegrass, rhodes grass, phalaris, strawberry clover and lucerne. The presence of **SALINITY** is often reflected in the **VEGETATION** and **SITE CONDITION**.

The ATTRIBUTE **$AgNO_3$** under CHEMICAL TESTS (see **4.24.3**) may be used to record the results of a diagnostic test of the **SALINITY** status of **layers** in the **profile**.

Reference List of VALUES

1 *no salting evident* Effect of salting is not apparent in the vegetation or on the soil surface.

2 *salting evident* Growth of salt sensitive plants is inhibited but that of salt-tolerant plants is not affected; patches of bare ground may occur.

3 *strongly evident* Only a few species of salt-tolerant plants survive and much of the ground is bare with a surface crust; free salts are often visible on the ground surface.

2.16 EROSION HAZARD

CHOICE, 1 VALUE ONLY

The **EROSION HAZARD** of a parcel of land refers to its susceptibility to the prevailing agents of erosion. It is dependent upon a number of factors including climate, landform and geomorphic activity, soil erodibility and land use. However, this definition is modified to allow for possible changes to the level of land management. Where necessary, **EROSION HAZARD** may be described in terms of special conditions applying at the time of the soil survey—e.g., at varying stocking rates, or disturbance during highway construction. These terms of reference should be defined in the **SITE FIELD NOTES** for the first **profile** of a **survey**.

Reference List of VALUES

1	*slight*	The combination of slope, runoff/run-on and soil erodibility is such that no appreciable erosion damage is likely to take place.
2	*moderate*	Significant short-term soil erosion may occur as a result of the combination of steep slope gradient, high soil erodibility and adverse runoff/run-on factors. Control can be obtained with such management techniques as topsoiling, vegetative techniques, phasing development and the implementation of structural works.
3	*high*	Major soil erosion, in some cases long-term, can be expected to occur. Control of this risk will require the adoption of appropriate management techniques or intensive soil conservation works.
4	*very high*	Major short-term and long-term erosion damage can be expected on this land. The combination of slope, soil erodibility and runoff/run-on ratings makes intensive soil conservation works necessary.
5	*extreme*	Even with intensive short-term and long-term soil conservation works, significant soil erosion is likely to occur on this class of land.

2.17 SITE FIELD NOTES

ALPHANUMERIC FIELD, UP TO 200 CHARACTERS

For each **profile** an entity called **SITE FIELD NOTES** is available to enter additional information about that **profile**. Additional information would include ATTRIBUTES and VALUES not listed in the remainder of the system and more detailed descriptions. Any text recorded for this ATTRIBUTE is manually typed into the database.

While use of this entity is not compulsory, it does have a number of specific functions:

- to qualify, amend or add to other records so that the unique nature of a soil may be described;
- to enable the lateral distribution of soils and their boundaries to be described;
- to define the purpose of the survey;
- to define the terms of reference, e.g., for erosion hazard descriptions;
- to define the VALUE "*other*" when used; and,
- to record the extended Principal Profile Form, if required.

2.18 LAYER STATUS

Soils can be viewed as being comprised of **layers**, each of which may have morphological characteristics different from those which occur below and/or above it. Each **layer** is generally parallel to the land surface, although this may not be true for the **layer boundary**.

Layers may be identified as horizons (see **2.18.4 Horizon Code**), but they are not necessarily equivalent. **Layers** may also be described based on arbitrarily defined levels.

ATTRIBUTES and VALUES

2.18.1 Layer Number

DERIVED FROM OTHER ATTRIBUTES

For each **profile** recorded on an 8-page soil data card, SALIS can store information on up to 2 organic **layers**, 1 mineral surface **layer**, 21 subsurface **layers** and 1 substrate **layer**.

SALIS automatically sets up the required **layer** records using the VALUES recorded for those **layers**, with reference to **number of layers** and **Card Number.** A maximum of 6 subsurface soil **layers** can be recorded on each 8-page and 2-page Soil Data Card, with a maximum

of 5 layers able to be recorded on each 4-page Soil Data Card. If you are using the 8-page or 4-page Version 3 Soil Data Cards, you may use extra cards when a **profile** has more than 6 **layers** of mineral soil to be described by filling in additional cards and using the **CARD NUMBER** field to designate those subsequent cards.

Reference List of VALUES

-2, -1	Organic or peat layers above the mineral surface. (*8-page Soil Data Cards only*)
0	Surface of mineral soil.
1 - 18	Subsurface layers.

2.18.2 Upper Depth

DEPTH (M) TO 2 SIGNIFICANT FIGURES, 1 VALUE ONLY, ESSENTIAL ATTRIBUTE FOR LAYERS -2, -1, 99

8-page Soil Data Card only.

For each **layer**, record the average depth of **upper depth** from the mineral surface, excluding living vegetation and organic and peat **layers**. For organic **layers**, the **depths** are measured above the mineral soil surface and the **upper depth** will be greater than the **lower depth**—e.g., **upper organic:** 0.12 - 0.10 m and **lower organic:** 0.10 - 0.0 m. In Reports the **upper depths** are reported as negative numbers for Organic Layers.

Upper depth is assumed to be the lower depth of the previous **layer** unless it is entered. The **upper depth** of the **substrate**, if this is reached, is recorded in the box marked **Top of Substrate** on the Soil Data Card

2.18.3 Lower Depth

DEPTH (M) TO 2 SIGNIFICANT FIGURES, 1 VALUE ONLY, ESSENTIAL ATTRIBUTE FOR LAYERS 1 - 18

Record the **lower depth** of each **layer**, in metres, from the mineral surface excluding living vegetation and organic and peat layers. For organic **layers**, the **depths** are measured above the mineral soil surface and the **lower depth** will be less than the **upper depth—**e.g., **upper organic:** 0.12 - 0.10 m and **lower organic:** 0.10 - 0.0 m. In a Plain English Report the **lower depths** are reported as negative numbers for organic **layers**.

Lower Depth is not recorded for the **substrate**. **Lower depth** VALUES are assumed for organic layers if not completed.

2.18.4 Horizon Code

ALPHANUMERIC CODE, 1 TO 3 CHARACTERS, 1 VALUE ONLY PER LAYER

Each **layer** can be allocated a particular **Horizon Code**. **Horizon Codes** are deduced from the **profile** description data (McDonald *et al*. 1990) and should be allocated only after completing the other ATTRIBUTES for the **profile**. A **layer** may be given a general designation—e.g., *A*—or a more detailed classification—e.g., A_1 or A_2—depending upon the characteristics evident. Where a broad horizon—e.g., B_2—has been subdivided into narrower **layers—**e.g., B_{21}, B_{22}, and B_{23}—these are numbered downwards from the surface.

Reference List of VALUES

O	Horizon dominated by organic materials, forming layer(s) above the mineral soil surface; may be subdivided into 0_1 or 0_2.
O_1	Undecomposed organic debris, e.g., leaves or twigs, whose original form can be recognised with the naked eye.
O_2	Organic debris in various stages of decomposition. The original form of most of the debris cannot be recognised with the naked eye.
P	Layer(s) of organic debris in various stages of decomposition that have accumulated under water or in excessive wetness.
P_1	Relatively undecomposed material whose original form can be recognised with the naked eye.
P_2	Moderately to completely decomposed organic material whose original form of material can generally not be detected with naked eye. Can be further divided into P_{21}, P_{22}.
A	Surface mineral horizon(s) with some organic accumulation; either darker in colour than underlying horizons, or lighter in colour but with a lower silicate clay/sesquioxide content.
A_1	Mineral horizon at or near surface and containing some humified organic matter; usually darker than underlying horizons, and with maximum biologic activity for any given soil profile. Can be further divided

	into A_{11}, A_{12} or A_{13}.
A_{11}	Darker, uppermost section of A_1.
A_{12}	Usually lighter than A_{11}, but not pale enough to qualify as an A_2. Can be divided into A_{13}.
A_2	Mineral horizon(s) characterised by one or more of the following: less organic matter, sesquioxides and/or organic material than adjacent horizons; different structure and/or consistence to adjacent horizons; and/or paler colours than adjacent horizons. Further division is possible into A_{21}, A_{22}, and A_{23}.
A_3	Transitional horizon(s) from A to B but with properties more like A. Further division is possible into A_{31}, A_{32}, A_{33}.
B	Subsoil horizon(s) characterised by one or more of the following: concentration of silicate clay, iron, aluminium, and/or organic material; different structure and/or consistence to adjacent horizons; and/or stronger colours than adjacent horizons.
B_1	Transition from A to B but with properties more like the underlying B_2. Further division is possible into B_{11}, B_{12} and B_{13}.
B_2	Horizon(s) dominated by one or more of the following: an illuvial, residual or other concentration of silicate clay, iron, aluminium and/or humus; maximum pedological organisation as indicated by a different structure and/or consistence, and/or a stronger colour. Further division is possible into B_{21}, B_{22} and B_{23}.
B_3	Transition from B to C with properties more like B_2 but intergrading to the properties of the C horizon below. Further division is possible into B_{31}, B_{32} and B_{33}.
C	Layer(s) of consolidated or unconsolidated, generally partially weathered material showing lack of pedological development and/or presence of remnant geological structure or organisation, e.g., sedimentary laminae, 'ghost' rock structures such as saprolite.
C_1	Can be further subdivided into C_{11}, C_{12} and C_{13}.
C_2	Can be further subdivided into C_{21}, C_{22} and C_{23}.
C_3	Can be further subdivided into C_{31}, C_{32} and C_{33}.
AB	Transition from A to B but not dominated by properties characteristic of either horizon.
AB_1	Can be further subdivided into AB_{11}, AB_{12} and AB_{13}.
AB_2	Can be further subdivided into AB_{21}, AB_{22} and AB_{23}.
AB_3	Can be further subdivided into AB_{31}, AB_{32} and AB_{33}.
AC	Transition from A to C but not dominated by properties characteristic of either horizon; B horizon not present.
AC_1	Can be further subdivided into AC_{11}, AC_{12} and AC_{13}.
AC_2	Can be further subdivided into AC_{21}, AC_{22} and AC_{23}.
AC_3	Can be further subdivided into AC_{31}, AC_{32} and AC_{33}.
BC	Transition from B to C but not dominated by properties characteristic of either horizon.
BC_1	Can be further subdivided into BC_{11}, BC_{12} and BC_{13}.
BC_2	Can be further subdivided into BC_{21}, BC_{22} and BC_{23}.
BC_3	Can be further subdivided into BC_{31}, BC_{32} and BC_{33}.
D	Layer(s) showing contrast in pedological organisation to overlying A and/or B horizons, but is not C or buried soil.
D_1	Can be further subdivided into D_{11}, D_{12} and D_{13}.
D_2	Can be further subdivided into D_{21}, D_{22} and D_{23}.
D_3	Can be further subdivided into D_{31}, D_{32} and D_{33}.
F	Fill layers; mineral layers of materials imported by human activity, recent sedimentation, etc., and numbered from the surface downwards.
F_1	Can be further subdivided into F_{11}, F_{12} and F_{13}.

F_2	Can be further subdivided into F_{21}, F_{22} and F_{23}.
F_3	Can be further subdivided into F_{31}, F_{32} and F_{33}.
R	Continuous masses of moderately strong to strong, non-displaced bedrock; underlies the solum or other unconsolidated surficial material; very few cracks or joints allowing penetration of roots.

A prefix numeral (e.g., $2B_2$) indicates buried soils or soils below lithological discontinuities or **layers** with obvious difference(s) in **lithology**. These **layers** are numbered from the surface downwards, but the upper, or modern soil, is not numbered 1, this being assumed. **NB:** buried soil **layers** should also be given the suffix "*b*". Prefix numerals from 2 to 4 may be used with any **horizon code**.

2.18.5 Horizon Suffix

CHOICE, UP TO 2 VALUES PER LAYER

Horizon suffixes allow additional summary information about a **layer** to be recorded. They should be allocated only after completing the other ATTRIBUTES for the **profile**.

Reference List of VALUES

b	Buried soil horizon; used in mineral soils only. See references to buried soil layers above.
c	Accumulation of concretions or nodules of iron and/or aluminium and/or manganese.
d	Densipan; very fine sandy earthy pan.
e	Conspicuously bleached; 80% or more of the horizon is white, near white or much paler than adjacent horizons; Munsell Notations for dry soil for all hues, value 7 or greater, with chroma 4 or less, and where adjacent horizons have hues 5YR or redder, value 6 or greater, with chroma 4 or less (Northcote 1979); most common in A_2 horizons.
f	Faunal accumulation such as worm casts dominating certain A_1 horizons.
g	Strong gleying; indicative of permanent or periodic intense reduction due to wetness and characterised by greyish, bluish or greenish colours, generally of low chroma; mottles may be prominent and may have reddish hues and higher chromas if oxidising conditions occur periodically; roots may have rusty or yellowish outlines.
h	Accumulation of amorphous organic matter-aluminium complexes in which iron contents are very low; the dominantly organic-aluminium complexes occur as discrete pellets between clean sand grains or completely fill the voids, occasionally they may coat sand grains; *h* is often combined with *s* where both organic and iron components are significant; *h* and *hs* horizons may be soft or cemented and form the characteristic B horizons of poorly drained Podzols or Spodosols.
j	Sporadically bleached horizon; bleached material is white, near white or much paler than adjacent horizons; Munsell Notations for dry soil for all hues, value 7 or greater, with chroma 4 or less, and where adjacent horizons have hues 5YR or redder, value 6 or greater, with chroma 4 or less; bleach occurs irregularly as blotches at the interface of horizons, or as nests of bleached grains at the interface of A and B horizons where no other evidence of an A_2 occurs (Northcote 1979); most common in A_2 horizons.
k	Accumulation of carbonates, commonly calcium carbonate.
m	Strong cementation or induration; confined to irreversibly cemented horizons which are essentially continuous (more than 90%) though they may be broken.
n	Accumulation of manganiferous or ferromanganiferous concretions, strong nodules or mangans.
p	Ploughing, tillage practices or other human disturbance—e.g., deep ripping; used only with A horizons; where the plough layer clearly includes what was once B horizon and it is no longer possible to infer with any reliability what the texture and depth of the A horizon where the plough layer is designated Ap; may be subdivided into subhorizons—e.g., Ap_1, Ap_2. Note: an Ap_2 horizon is not the same as an A_2 horizon but a subdivision equivalent to A_{12}.
q	Accumulation of secondary silica; if cementation is continuous or nearly continuous, this information should be recorded in **LAYER FIELD NOTES** and the suffix *qm* used.
r	Layers of weathered rock (including saprolite) that, although consolidated, can be dug with hand tools.
s	Accumulation of sesquioxide-organic matter complexes in which iron is dominant relative to aluminium; may form coating on sand grains, occur as discrete pellets or, with moderate amounts of iron, may fill voids forming cemented patches; organic matter content is variable and distribution often irregular; *s* is

	often combined with *h* where both organic and iron components are significant; *s* and *sh* horizons may be soft or hard and form the characteristic B horizons of free-draining Podzols or Spodosols.
t	Accumulation of silicate clay; different mechanisms (such as illuviation, formation *in situ*) may be responsible for the clay accumulation, but these may be difficult to confirm; used only with B horizons.
w	Development of colour and/or structure in B horizon with little or no accumulation of clay.
x	Fragipan or earthy pan; A horizon with high bulk density relative to the horizon above, seemingly cemented when dry but when moist showing a moderate to weak cementation.
y	Accumulation of calcium sulphate (gypsum).
z	Accumulation of salts more soluble than calcium sulphate and calcium carbonate.
?	Query; used where doubt is associated with the nomenclature of the horizon; details should be recorded in **LAYER FIELD NOTES**.

2.18.6 Soil Material

ALPHANUMERIC CODE, UP TO 4 CHARACTERS, 1 VALUE ONLY PER LAYER

🗎 *4-page and 8-page Soil Data Cards only.*

A code may be recorded by the soil surveyor—e.g., for use in soil survey reports and for analysis of soil attributes. Up to four printable characters may be used, in any combination of letters, both upper and lower case, and numerals.

⚠ For the CRA 2-page Soil Data Card, users may enter a soil material code in the **LAYER FIELD NOTES**.

2.18.7 Base of Observation

CHOICE, 1 VALUE ONLY PER LAYER

A code may be used to record the status of the profile at the lowest point of the observations. Where bedrock is not reached the surveyor may make a subjective decision to record that either the soil, or, more specifically, the layer continues.

Reference List of VALUES

1	*layer continues*	Bedrock is not reached. The soil surveyor is strongly certain that the underlying material is identical to that of the lowest layer recorded.
2	*soil continues*	Bedrock is not reached. The soil surveyor is uncertain of the nature of the underlying soil material.
3	*equipment refusal*	The soil is too hard, tough, stony, unconsolidated or deep for further exploration, e.g., a rock "floater" has been encountered or the soil incorporates saturated sands which are too fluid to be withdrawn from the observation hole.
4	*bedrock reached*	Bedrock has been reached. This will be confirmed by the completion of the "top of substrate" value.

2.19 LAYER BOUNDARY

LAYER BOUNDARIES define the nature of changes between soil **layers** (McDonald *et al.* 1990). They are specified by two terms: one is **Distinctiveness**, the measure of the thickness or width of the transition zone between **layers**; while the other is a measure of its **Shape** (or departure from planar form) as expressed in the vertical section (**profile**).

Note that for this entity, **Layer Number** refers to the boundary between the current **layer** and the **layer** immediately below—e.g., **layer** 1 describes the boundary between **layer** 1 and **layer** 2.

ATTRIBUTES and VALUES

2.19.1 Distinctiveness

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

For each **layer**, record one VALUE to describe the **distinctiveness** of the boundary with the **layer** below.

2.19.2 Shape

CHOICE, 1 VALUE ONLY

2-page CRA, 4-page and 8-page Soil Data Cards only.

For each **layer**, record one VALUE to describe the **shape** of the boundary with respect to the **layer** below.

Reference List of VALUES

1	*smooth*	Almost a planar surface.
2	*wavy*	Undulating with troughs relatively wider than they are deep.
3	*irregular*	Undulating with troughs relatively deeper than they are wide.
4	*tongued*	Tongues, considerably deeper than they are wide, into an adjacent layer.
5	*broken*	Discontinuous.

2.20 SAMPLE TAKEN

CHOICE, UP TO 3 VALUES PER LAYER

2-page CRA, 4-page and 8-page Soil Data Cards only.

The entity **SAMPLE TAKEN** refers to soil samples taken from a **layer** for further testing and investigation. The purpose of this field is to assist in the tracking of samples for laboratory testing and the correct assignment of the results.

Record the VALUE that best describes the type of **SAMPLES TAKEN**. If required, VALUES not listed and more detailed descriptions can be recorded in **LAYER FIELD NOTES**.

Reference List of VALUES

1	*none*	No sample taken for this **layer**.
2	*unspecified*	Type of sample not identified.
3	*disturbed*	Sample taken from single profile; structure of the soil not retained in the sample; larger roots and coarse fragments may be removed.
4	*undisturbed*	Sample taken from single profile using wide bore corer or similar equipment; structure is still evident and all roots and coarse fragments are retained.
5	*micro-morphological*	Sample taken from single profile and prepared at the **site** using resin or similar material so that all micromorphological structures are retained for examination and the sample can be cut for microscopic analysis.
6	*bulked*	Sample taken from the equivalent layer within the radius of the site; any number of smaller samples are brought together to provide a large sample for laboratory analysis. It is recommended that at least 12 sub-samples be used to build up a bulked sample.
7	*bulk density*	samples of the equivalent layer taken in as intact a state as possible—e.g., using bulk density rings.

2.21 COLOUR

Soil **COLOUR** is measured using the *Munsell Soil Color Charts* (Munsell 1975) or the *Revised Standard Soil Color Charts* (Oyama and Takehara 1970). In this system, colour is defined with respect to three independent coordinates, recorded in the following order:

Hue—the name of the colour family—e.g., red, yellow, green

Value—the amount of darkness or lightness—e.g., dark red or light red

Chroma—the degree of saturation of the colour—e.g., pale red or bright red.

Standard viewing conditions are overcast sky or open shade, side lit at 45^0. When using the Munsell Color Charts the soil aggregate should be viewed through the holes in the page using the appropriate achromatic mask (Melville and Atkinson 1985).

Soil colour measurements should be made on the surface of a freshly broken aggregate of moist soil. The only exceptions are for A_2 horizons, which require both moist and dry readings for their diagnostic characteristics to be determined.

ATTRIBUTES of COLOUR

2.21.1 Moist Munsell Notation

MUNSELL CODE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Dry samples should be moistened and the colour recorded when the visible moisture film disappears from the aggregate surface. With most soils, dry samples will change colour with the addition of water, usually a decrease of 1.5 to 2 units of **value** and an increase in **chroma** of 1.5 to 2 units.

A reference list of VALUES will be found in the introduction of Oyama and Takehara (1970).

2.21.2 Dry Munsell Notation

MUNSELL CODE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Dry soil colour is recorded using the same methodology as for **Moist Munsell Notation**, above. Dry soil colour measurements should be made on the surface of a freshly broken aggregate of dry soil.

A reference list of VALUES will be found in the introduction of Oyama and Takehara (1970).

2.21.3 Value/Chroma (V/C) Rating

DERIVED FROM OTHER ATTRIBUTES

2-page CRA, 4-page and 8-page Soil Data Cards only.

Value/Chroma Rating, as described by Northcote (1979), is automatically generated within the database for each **layer** that has a **Moist Munsell Notation** VALUE. It distinguishes the classes of **value** and **chroma** that are applicable to every hue in the soil colour charts. They are used to distinguish the Principal Profile Form using the **Factual Key** (Northcote 1979).

2.21.4 Colour

CHOICE, 1 VALUE ONLY PER LAYER

2-page CRA and 2-page Observation Soil Data Cards only.

Record a general indication of the colour of a soil layer at its current moisture condition, as a less accurate alternative to Munsell notation.

Reference List of VALUES

1	*dark*	V/C 1 for all hues.
2	*red*	V/C 2b, 3b or 4 for hues as red as or redder than 2.5YR.
3	*orange*	V/C 4 for hues 5YR, 7.5YR or 10YR.
4	*yellow*	V/C 3b or 4 for hues as yellow as or yellower than 2.5Y.
5	*brown*	V/C 5 for all hues; or V/C 2b for hues as yellow as or yellower than 5YR; or V/C 3b for hues 5YR, 7.5YR, 10YR.
6	*pale*	V/C 3a for all hues.
7	*grey*	V/C 2a for all hues.
8	*gley*	Any colour on the Munsell “gley” charts.

2.21.5 Isbell Colour

CHOICE, 1 VALUE ONLY PER LAYER

2-page Observation Soil Data Card only.

Record a general indication of the visible colour of a soil layer, using the set of VALUES defined for the Australian Soil Classification (Isbell 1996).

Reference List of VALUES

1	*black*	The dominant colour (moist) for all hues has a value of 3 or less and a chroma of 2 or less.
2	*red*	The dominant colour (moist) has a hue of 5YR or redder and a chroma of 3 or more.
3	*brown*	The dominant colour (moist) has a hue yellower than 5YR and a value of 5 or less and a chroma of 3 or more.
4	*yellow*	The dominant colour (moist) has a hue yellower than 5YR and a value of 6 or more and a chroma of 4 or more.
5	*grey*	The dominant colour (moist) for all hues has a value of 4 or more and chroma 2 or less; for hues yellower than 5YR values of 6 or more and chromas of 3 are allowed.

2.21.6 Shade

CHOICE, 1 VALUE ONLY FOR A LAYER WITH RECORDED COLOUR OR ISBELL COLOUR

2-page Observation Soil Data Card only.

Qualifies the specified value for **Colour** or **Isbell Colour**. Use this attribute, where necessary, to specify if the colour recorded in these attributes is *dark* or *light*.

2.22 MOTTLES

MOTTLES are masses, blotches or streaks of subdominant colours within the soil. They do not include the glaze or colour skin which may occur on the outside of some **peds** (see PED COATINGS—Coating Type). Northcote (1979) defines **mottles** as colours which differ from the dominant colour by 5 units in hue and/or 2 units in **value** or 4 units in chroma and affect at least 10% of the soil mass. Only the extreme colours of the mottle need to be described. Provision is made for recording descriptions under the headings of **dominant mottle** and **subdominant mottle**.

Mottle dominance and **type** are key ATTRIBUTES and require VALUES before VALUES for the related ATTRIBUTES can be entered in the database. On the field card, dominance is indicated by completing the appropriate column(s). The **mottle type** must be filled in if related ATTRIBUTES are to be described.

ATTRIBUTES and VALUES

2.22.1 Mottle Dominance

4-page and 8-page Soil Data Cards only.

ATTRIBUTES for two **mottle dominances** for each **layer** can be recorded. If a **layer** has more than one dominant and one subdominant mottle, use the **FIELD LAYER NOTES** to record information on the other mottles.

2.22.2 Mottle Type

CHOICE, 1 VALUE ONLY PER MOTTLE DOMINANCE

8-page Soil Data Card only.

Describes the general nature or likely cause of the colour patterns for each **mottle dominance** in each **layer**.

Reference List of VALUES

1	*not evident*	No mottles observed in layer.
2	*unspecified*	Mottles observed but type not identified.
3	*biological*	Colour patterns due to biological mixing of soil material from other horizons—e.g., earthworm casts.

4	*mechanical*	Colour patterns due to mechanical mixing of soil material from other horizons—e.g., inclusions of B horizon material in Ap horizons.
5	*weathered*	Colour patterns due to inclusions of weathered substrate material and includes patterns due to chemical reactions—e.g., fluctuating watertable.

2.22.3 Mottle Colour

CHOICE, 1 VALUE ONLY PER MOTTLE DOMINANCE

Alternate to or in conjunction with Munsell Notation, VALUES from **colour** can be recorded to describe the colour of the mottle. Record only one VALUE under each dominance heading. ***Table 3*** may be used to assign a **colour** VALUE.

Reference List of VALUES

1	*dark*	V/C 1 for all hues.
2	*red*	V/C 2b, 3b or 4 for hues as red as or redder than 2.5YR.
3	*orange*	V/C 4 for hues 5YR, 7.5YR or 10YR.
4	*yellow*	V/C 3b or 4 for hues as yellow as or yellower than 2.5Y.
5	*brown*	V/C 5 for all hues; or V/C 2b for hues as yellow as or yellower than 5YR; or V/C 3b for hues 5YR, 7.5YR, 10YR.
6	*pale*	V/C 3a for all hues.
7	*grey*	V/C 2a for all hues.
8	*gley*	Any colour on the Munsell "gley" charts.

Table 3 Table for attributing simple colour names to mottles

Hue	Redder than 5YR	5YR	7.5YR	10YR	yellower than 10YR
V/C					
1	Dark	dark	Dark	dark	Dark
2a	Grey	grey	Grey	grey	Grey
2b	Red	red	brown	brown	Brown
3a	Pale	pale	pale	pale	Pale
3b	Red	red	brown	brown	Red
4	Red	orange	orange	orange	Yellow
5a	Brown	brown	brown	brown	Brown
5b	Brown	brown	brown	brown	Brown

2.22.4 Mottle Contrast

CHOICE, 1 VALUE ONLY PER MOTTLE DOMINANCE

4-page and 8-page Soil Data Cards only.

Describe the **contrast** of the boundary between the mottle and the remainder of the soil. Record only one VALUE under each dominance heading for each **layer**.

Reference List of VALUES

1	*faint*	Indistinct; evident only on close examination.

2	*distinct*	Readily evident although not striking.
3	*prominent*	Striking and conspicuous.

2.22.5 Mottle Abundance

CHOICE, 1 VALUE ONLY PER MOTTLE DOMINANCE

Describe the proportion of the soil mass that can be described as mottled.

2.22.6 Munsell Notation

MUNSELL CODE, 1 VALUE ONLY PER MOTTLE DOMINANCE

8-page Soil Data Card only.

Mottle colour may be measured using the *Munsell Soil Color Charts* (Munsell 1975) or the *Revised Standard Soil Color Charts* (Oyama and Takehara 1970). In this system, **colour** is defined with respect to three independent coordinates as defined in **Moist Munsell Notation.**

Soil colour measurements should be made on the surface of a freshly broken aggregate of moist soil. Dry samples should be moistened and the colour recorded when the visible moisture film disappears from the aggregate surface. With most soils, dry samples will change colour with the addition of water, usually a decrease of 1.5 to 2 units of value.

2.23 MECHANICAL TESTS

ATTRIBUTES and VALUES

2.23.1 Shear Strength

VALUE (KPA), 1 VALUE ONLY PER LAYER, RIGHT JUSTIFIED

8-page Soil Data Card only.

Record the peak **shear strength (kPa)** measured with the aid of a shear vane.

2.23.2 Compressive Strength

VALUE (KPA), 1 VALUE ONLY PER LAYER, RIGHT JUSTIFIED

8-page Soil Data Card only.

Record the **compressive strength (kPa)** of the soil measured with the aid of a penetrometer, ASAE S313.2-1985.

2.24 CHEMICAL TESTS

ATTRIBUTES and VALUES

2.24.1 pH Testing Method

CHOICE, 1 VALUE ONLY PER LAYER

2-page Observation, 4-page and 8-page Soil Data Cards only.

A number of methods are used to record the acidity or alkalinity of the soil **layers** in the field. This is a key attribute since interpretation of the pH value recorded is dependent upon knowing which method was used to determine it.

Reference List of VALUES

1	*Raupach*	The soil **pH** is determined using the method developed by Raupach and Tucker (1959). In this test, a small sample of soil is mixed with a few drops of Raupach Indicator on a spot plate to form a paste. The sample is then sprinkled with neutral barium sulphate powder and, after two minutes, its colour is compared with a standard colour chart to determine the **pH** to the nearest half unit. **NB:** this test is known to be inaccurate, especially if poorly maintained or out-of-date testing kits and/or reagents are used. Results should only be used for comparative purposes on the same soil profile.
2	*pH meter*	The soil pH is determined on a 1:5 soil:water mixture using a correctly calibrated field pH meter. Please note that inaccuracies will occur when de-ionised water is not used to make the sample.
3	*test strip*	The soil pH is determined on a moist bolus using a test strip. Ideally, de-ionised water should be used but

this is generally unimportant since the buffering capacity of soil is much greater than water.

2.24.2 pH

DECIMAL TO 1 SIGNIFICANT FIGURE, 1 VALUE ONLY PER LAYER

2-page Observation, 4-page and 8-page Soil Data Cards only.

The **pH** of any layer is determined using one of the methods described above in **pH Testing Method.**

2.24.3 $AgNO_3$ (Silver Nitrate)

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

The presence of chloride ions can be tested by mixing a small sample of soil with distilled water in a test tube and adding a few drops of a 5% solution of silver nitrate ($AgNO_3$). A white precipitate of silver chloride will form in the presence of chloride ions. The soil-water mixture should be filtered (if it is cloudy) prior to adding the silver nitrate.

Reference List of VALUES

1	*no precipitate*	The test is negative (no white precipitate).
2	*light precipitate*	A light precipitate forms.
3	*conspic.white precip.*	A conspicuous white precipitate forms.

2.24.4 HCl (Hydrochloric Acid)

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

The presence of **carbonate** in soils can be tested by adding several drops of 1 M hydrochloric acid to a small soil sample. Effervescence will occur if **carbonate** is present.

Reference List of VALUES

1	*no effervescence*	No effervescence occurs.
2	*audible/slight efferv.*	An audible and/or a slightly visible effervescence occurs.
3	*strong effervescence*	A strong audible and visible effervescence occurs.

2.24.5 H_2O_2 (Hydrogen Peroxide)

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

The presence of **manganese dioxide** can be tested by adding two or three drops of a 10% hydrogen peroxide solution to a small soil sample on a spot plate. Effervescence will occur if **manganese dioxide** is present. Note: The presence of organic matter or iron pyrite may also give a positive reaction.

Reference List of VALUES

1 *no effervescence*

2 *effervescence*

2.25 STRUCTURE

Soil **STRUCTURE** refers to the distinctness, size, shape and condition of natural, or artificially produced soil aggregates (peds). It can be reliably described only in a relatively fresh vertical exposure or a relatively undisturbed soil core and cannot be described fully from an auger boring. Sections which have been exposed for a long time (road cuttings, gullies) are unsuitable for the determination of **STRUCTURE** unless the section is cut back 0.3 - 0.5 m to expose fresh soil; surface exposures may alter significantly due to daily or seasonal moisture and temperature changes.

ATTRIBUTES and VALUES

2.25.1 Grade of Pedality

CHOICE, 1 VALUE ONLY PER LAYER

Grade of Pedality describes the relative proportion of peds in the soil. It may vary with the soil water status.

1	*single grained*	Soil occurs as a loose incoherent mass of individual particles (as in sands).
2	*massive*	Soil occurs as a coherent mass showing no evidence of any distinct arrangement of soil particles.
3	*weak pedality*	In an undisturbed soil, peds are indistinct and barely observable. When displaced, up to 30% of the soil material consists of peds (Northcote 1979).
4	*moderate pedality*	Although not distinct in an undisturbed soil, peds are well formed and evident. When displaced, 30 - 70% of the soil material consists of peds (Northcote 1979).
5	*strong pedality*	Peds are quite distinct in an undisturbed soil. When displaced, more than 70% of the soil material consists of peds (McDonald *et al.* 1990).

2.25.2 Dominance

Provision is made to describe both dominant and subdominant peds in terms of **ped size** and **ped shape**.

2.25.2.1 Dominant Peds

Dominant peds are the most obvious peds observed in an undisturbed soil sample. The relative difference between the strength of cohesion within peds and the strength of adhesion between peds is greater for **dominant peds** than for **subdominant peds.** Ped dominance is assessed in a different way to the primary and compound ped concepts used in McDonald *et al.* (1990).

2.25.2.2 Subdominant Peds

4-page and 8-page Soil Data Cards only.

These peds may form when **dominant peds** either pack together to form larger compound entities or break into simpler units. **Subdominant peds** are less conspicuous than **dominant peds.** In many cases, **subdominant peds** can be identified only by gently probing an *in situ* soil section in an attempt to identify zones or planes of weakness (planar voids). Other ped types, which are weaker than the **subdominant peds**, may occur and provision is made to describe them in the **FIELD LAYER NOTES.**

Recording of compound pedality is possible by recording the primary ped details as the **dominant ped**, the next most conspicuous ped as the first **subdominant ped**, the third most conspicuous as the second **subdominant ped**, and any remaining peds in the **FIELD LAYER NOTES.**

2.25.3 Dominant Ped Size

CHOICE, 1 VALUE ONLY PER LAYER

Peds are placed in size classes depending upon their average least dimension (in millimetres). This is the minimum horizontal dimension of the ped for all **ped shapes** except *platy* and *lenticular*. With *platy* and *lenticular* **ped shape** the minimum dimension is a vertical measurement of the ped.

2.25.4 Subdominant Ped Size

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Peds are placed in size classes depending upon their average least dimension (in millimetres). This is the minimum horizontal dimension of the ped for all **ped shapes** except *platy* and *lenticular*. With *platy* and *lenticular* **ped shape** the minimum dimension is a vertical measurement of the ped.

2.25.5 Dominant Ped Shape

CHOICE, 1 VALUE ONLY PER LAYER

Figure 3 can be used to assist in selecting the most appropriate VALUE.

Reference List of VALUES

1	*platy*	Soil particles are arranged around a horizontal plane and bounded by relatively flat horizontal faces with accommodation to the faces of surrounding peds.
2	*lenticular*	Soil particles are arranged around an elliptical or circular plane and are bounded by curved faces with considerable accommodation to the faces of surrounding peds; most vertices between adjoining faces are angular and acute.
3	*prismatic*	Soil particles are arranged around a vertical axis and are bounded by well-defined, relatively flat faces with considerable accommodation to the faces of surrounding peds; vertices between adjoining faces are usually angular.
4	*columnar*	Similar to *prismatic*, but the peds are usually larger and have domed tops.
5	*angular blocky*	Soil particles are arranged around a point and bounded by six relatively flat, roughly equal faces with re-entrant angles between adjoining faces few or absent. There is usually considerable accommodation of ped faces to the faces of surrounding peds. Most vertices between adjoining faces are angular.
6	*sub-angular blocky*	Similar to *angular blocky* except peds are bounded by flat and rounded faces with limited accommodation to the faces of surrounding peds. Many vertices are rounded.
7	*polyhedral*	Soil particles are arranged around a point and bounded by more than six relatively flat, unequal, dissimilar faces. Re-entrant angles between adjoining faces are a feature. There is usually considerable accommodation of ped faces to the faces of surrounding peds. Most vertices are angular.
8	*granular*	Peds are spheroidal or polyhedrons having planar or curved surfaces which have slight or no accommodation to faces of surrounding peds. Peds are relatively non-porous.
9	*crumb*	Similar to *granular* but are more porous and usually less than 5 mm in diameter.
10	*round*	Soil particles are arranged in a spheroidal shape. There are no planar faces. There is slight or no accommodation to faces of surrounding peds.

2.25.6 Subdominant Ped Shape

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Possible VALUES for **Subdominant Ped Shape** are the same as those for **2.25.5 Dominant Ped Shape** above.

2.25.7 Artificial Aggregates

CHOICE, 1 VALUE ONLY PER LAYER

8-page Soil Data Card only.

Some soil **layers** consist of artificial aggregates formed by cultivation or work being done on the soil. The distinction between artificial aggregates and peds can be difficult. In cultivated layers, where the surveyor is not confident the aggregates are natural peds, they should be recorded as *clods* or *fragments.*

Reference List of VALUES

1	*clods*	Artificial aggregates with a diameter of 100 mm or more comprise a greater proportion of the structure of the layer.
2	*fragments*	Artificial aggregates with a diameter of less than 100 mm comprise the greater proportion of the structure of the layer.

2.26 FABRIC

CHOICE, 1 VALUE ONLY PER LAYER

2-page Observation, 4-page and 8-page Soil Data Cards only.

FABRIC describes the appearance of the soil material as expressed by the spatial arrangement and nature of the solid particles and associated voids when observed with a X10 hand lens. Differences in **FABRIC** are associated with the presence or absence of peds; the lustre or lack thereof on the ped surfaces; and the presence, size and arrangement of pores (voids) in the soil mass. **FABRIC** VALUES are defined by Northcote (1979).

Reference List of VALUES

1	*sandy*	Soil material is commonly single grained. The closely packed sand grains provide the characteristic appearance of the soil mass.
2	*earthy*	Soil material is porous, coherent, massive to weakly pedal, characterised by the presence of pores (voids) and generally a massive appearance. Ultimate soil particles (such as sand grains) are coated with oxides and/or clays and are arranged (clumped) around the pores.
3	*rough-faced ped*	Peds have relatively porous surfaces with a generally aggregated appearance, and are non-lustrous and non-shiny. More than 50% of the peds are rough-faced. They usually have less clearly defined faces than smooth-faced peds and the pedality of the soil may be questioned. However, after gentle pressure is applied to the soil mass, the characteristic size and shape of the soil aggregates confirm its pedality. Granular peds with common or many macropores are always rough-faced, but this condition varies in other ped forms.
4	*smooth-faced ped*	Peds have clearly defined faces. Characteristically, more than 50% of the ped surfaces are smooth matt. They have a generally lacquered surface appearance although the degree of lustre, or shininess, may be variable.

2.27 CONSISTENCE

CONSISTENCE is a statement of the strength and nature of cohesion of a hand sample of soil material as it occurs in the field (Butler 1955; Butler and Hubble 1977). Like **FIELD TEXTURE** it is determined by manipulation. It varies considerably according to the moisture content of the sample, so it is important to also record a VALUE for **SOIL WATER STATUS** at the time of testing.

ATTRIBUTES and VALUES

2.27.1 Degree of Plasticity

CHOICE, 1 VALUE ONLY PER LAYER

8-page Soil Data Card only.

A plastic soil is one in which an applied stress may produce continuous, permanent deformation without rupture. It becomes evident within a particular water content range. It should be distinguished from the **plasticity index**, which is defined numerically as the **liquid limit** minus the **plastic limit** which are measured as laboratory tests.

The **degree of plasticity** is determined at the soil moisture content used for **FIELD TEXTURE**; that is, just below sticky point. The soil is rolled between the palms of the hand and, if possible, 40 mm long rolls are formed. The rolls are dangled from the thumb and forefinger.

Reference List of VALUES

1	*non-plastic*	Rolls 40 mm long and 6 mm in diameter will not form.
2	*slightly plastic*	Rolls 40 mm long and 6 mm in diameter will form and support their own weight; rolls 40 mm long and 4 mm in diameter will form but will not support their own weight.
3	*moderately plastic*	Rolls 40 mm long and 4 mm in diameter will form and will support their own weight; rolls 40 mm long and 2 mm in diameter will form but will not support their own weight.
4	*very plastic*	Rolls 40 mm long and 2 mm in diameter will form and will support their own weight.

2.27.2 Stickiness

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Stickiness is determined on a wet (beyond 'sticky point', which equates to field capacity) bolus. Press the wet sample into the upward facing palm and invert the hand. Observe the adherence of the soil to the palm.

Reference List of VALUES

1	*non-sticky*	Soil does not feel sticky and falls.
2	*slightly sticky*	Soil feels sticky but comes cleanly off the skin and falls.
3	*moderately sticky*	Soil adheres to the palm, falling only after gentle shaking of the hand in a vertical motion.
4	*very sticky*	Soil adheres strongly to the palm, requiring vigorous shaking in a vertical motion to remove it from the hand.

2.27.3 Texture Modifier

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Many soils contain **texture modifiers**. These **modifiers** affect the degree to which the **CONSISTENCE** and/or **FIELD TEXTURE** properties of soils suggests the amount of clay-sized particles they contain (Butler 1955). The presence of **texture modifiers** may be identified by determining 2 **FIELD TEXTURES**: one after an initial 1 - 2 minute working of the soil sample, and another after a prolonged 10 minute kneading. For example, a soil sample which might initially appear to be a clay loam is eventually classed as a medium clay. Other soils appear to decrease in **texture grade** as they are worked (Northcote 1979). MacDonald *et al*. (1990) refer to this as Plasticity Type.

Reference List of VALUES

1	*decrease > = 1 grade*	Bolus decreases one or more **texture grades** (becomes lighter) as it is worked. This occurs, for example, in the presence of large amounts of fine-grained calcium and/or magnesium carbonates with clays and clay loams. These soils have previously been termed superplastic. Record the original **texture grade**.
2	*no change*	Bolus does not change in **texture grade** as it is worked.
3	*increase <2 grades*	Bolus increases one **texture grade** (becomes heavier) as it is worked. These soils have been frequently termed subplastic and are usually red in colour; peds have been generally stabilised by iron and the fine peds take time to break down. Record the final **Texture Grade**.
4	*increase > = 2 grades*	Bolus increases two or more **texture grades** (becomes heavier) as it is worked. These soils have previously been termed strongly subplastic. Record the final **texture grade**.

2.28 Disruptive Test

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

The compressive strength of the soil in its field condition is judged from the force required to cause a 20 mm cube (aggregate or sample) of the soil to just break or deform when a compressive force is applied between the thumb and forefinger.

Reference List of VALUES

1	*loose*	No force required. Separate particles such as loose sands.
2	*very weak force*	Very small or almost nil force is required.
3	*moderately weak force*	Small but significant force is required.
4	*moderately firm force*	Moderate to firm force is required.
5	*very firm force*	Strong force but within power of thumb and forefinger.
6	*moderately strong force*	The force required is beyond the capability of the thumb and forefinger.

2.28.1 Shearing Test

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

With a 20 mm cube (aggregate or sample) of the soil and maintaining the same force, subject the sample to 2 seconds of rotational shearing between the thumb and forefinger and observe the effect upon the material.

Reference List of VALUES

1	*no change*	No more than a slight rounding of the cube occurs.
2	*brittle*	There is a sudden disintegration into fractured fragments.
3	*crumbly*	Some disintegration occurs where the cube readily breaks into discreet natural aggregates which do not deform.
4	*labile*	The cube fractures and fragments are easily deformed.
5	*plastic*	The cube does not fracture but is readily remoulded.

2.28.2 Toughness

CHOICE, 1 VALUE ONLY PER LAYER

8-page Soil Data Card only.

Toughness is a measure of the consistency of the soil near its plastic limit. A small sample of soil without coarse fragments is moulded to the consistency of putty. This specimen is then rolled out into a thread about 3 mm diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally looses its plasticity and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin type clays and organic clays.

Reference List of VALUES

1	*high*	The lump is stiff and tough with disruption ranging from moderately to very firm force or strong force.
2	*medium*	The lump is somewhat stiff and tough with disruption ranging from moderately weak to moderately strong.
3	*weak*	The lump is weak and crumbly with disruption being very weak. Non-plastic soils have a loose crumbly reaction.

2.29 FIELD TEXTURE

FIELD TEXTURE is determined on soil material that is finer than 2 mm diameter—i.e., only material that after crushing will pass through a 2 mm sieve. Take a sample of soil sufficient to fit comfortably into the palm of the hand. Moisten the soil with water, a little at a time, and knead until the ball of soil just fails to stick to the fingers. More soil or water may be added to maintain this condition, which is known as sticky point. This approximates field moisture capacity for the soil. Continue kneading and moistening until there is no apparent change in the soil ball. This usually takes 1 - 3 minutes, but note the need to continue past this point for possible **texture modifiers**. The soil ball, or bolus, is now ready for shearing manipulation. The behaviour of the bolus and of the ribbon produced by shearing (pressing out) between thumb and forefinger and the feel of the material between the fingers characterises the **texture**.

Texture grade is a key ATTRIBUTE and must be completed before VALUES of related ATTRIBUTES can be entered.

ATTRIBUTES and VALUES

2.29.1 Texture Grade

KEY ATTRIBUTE, CHOICE, 1 VALUE ONLY PER LAYER

Twenty **texture grades** are recognised. Definitions of **grades** are from Northcote (1979) and MacDonald *et al.* (1990).

Reference List of VALUES

1	*sand*	Coherence nil to very slight; cannot be moulded; single sand grains adhere to fingers; approx. clay content commonly <5%.
2	*loamy sand*	Slight coherence; will form minimal ribbon of about 5 mm; approx. clay content about 5%, some organic matter; discolours fingers with dark stain.
3	*clayey sand*	Slight coherence; sticky when wet; many sand grains stick to fingers; will form minimal ribbon 5 - 15 mm; little or no organic matter; approx. clay content 5 - 10%; discolours fingers with clay stain.
4	*sandy loam*	Bolus coherent but very sandy to touch; will form ribbon of 15 - 25 mm; sand grains readily visible; approx. clay content 10 - 20%.
5	*loam*	Bolus coherent and rather spongy; smooth feel when manipulated but with no obvious sandiness or silkiness; may be somewhat greasy to the touch if much organic matter present; will form ribbon of about 25 mm; approx. clay content 25%.
6	*silty loam*	Coherent bolus, very smooth to silky when manipulated; will form ribbon of about 25 mm; approx. clay content 25% and with 25% or more.
7	*sandy clay loam*	Strongly coherent bolus, sandy to touch; sand grains visible in finer matrix; will form ribbon of 25 - 40 mm; approx. clay content 20 - 30%.
8	*clay loam*	Coherent plastic bolus; smooth to manipulate; will form ribbon of 40 - 50 mm; approx. clay content 30 - 35%.
9	*clay loam sandy*	Coherent plastic bolus; sand grains visible in finer matrix; will form ribbon of 40 - 50 mm; approx. clay content 30 - 35%.
10	*silty clay loam*	Coherent smooth bolus; plastic and often silky to the touch; will form ribbon of 40 - 50 mm; approx. clay content 30 - 35% and with silt 25% or more.
11	*sandy clay*	Plastic bolus; sand grains can be seen, felt or heard in clayey matrix; will form ribbon of 50 - 75 mm; approx. clay content 35 - 40%.
12	*silty clay*	Plastic bolus; smooth and silky to manipulate; will form ribbon of 50 - 75 mm; approx. clay content 35 - 40%, with silt 25% or more.
13	*clay*	Smooth plastic bolus; slight to firm resistance to shearing between thumb and forefinger; handles like plasticine; will form ribbon of 50 - 75 mm or more; approx. clay content 35 - 50% or more.
14	*fibric peat (fibrous peat)*	Undecomposed or weakly decomposed organic material. Plant fibres (other than living roots) are distinct, readily identifiable and make up more than $^{2}/_{3}$ of the material.
15	*hemic peat (semi-fibrous peat)*	Moderately to well decomposed organic material. Plant remains vary from most being difficult to identify to being unidentifiable. It is intermediate in degree of decomposition between the less decomposed fibric peat and the more decomposed sapric peat.
16	*sapric peat (humified peat)*	Strongly to completely decomposed organic material. Fibres make up less than $^{1}/_{3}$ of the material; plant remains vary from few being identifiable to being completely amorphous.
17	*sandy peat*	Undecomposed to strongly decomposed organic material in which the bolus is sandy to touch.
18	*loamy peat*	Undecomposed to strongly decomposed organic material in which the bolus has obvious mineral particle content but no obvious sandiness to touch, is smooth, non-sticky when wet and weakly coherent.
19	*clayey peat*	Undecomposed to strongly decomposed organic material in which the bolus has obvious fine mineral particle content, is sticky when wet and is coherent.
20	*granular peat*	Dominantly decomposed organic material that has dried irreversibly to fine granules through exposure and drying and/or cultivation. Granules are approximately 1 - 2 mm in diameter and have granular or sub-angular blocky STRUCTURE.

2.29.2 Sand Fraction

CHOICE, 1 VALUE ONLY PER TEXTURE GRADE

In soils where the **texture grade** is sandy, the diameters of those particles is defined as medium. If the average diameter of the sand particles is subjectively assessed as not being medium, then one VALUE from **sand fraction** can recorded for each **texture grade**.

Reference List of VALUES

1	*coarse*	Predominantly 0.2 - 2.0 mm; they are easily observed with the naked eye.

2	*fine*	Predominantly 0.02 - 0.20 mm; they are difficult to see with the naked eye but are clearly visible with a hand lens. The grains can be felt and heard when rubbed between the fingers.

2.29.3 Clay Fraction

CHOICE, 1 VALUE ONLY PER TEXTURE GRADE

The non-clay **texture grades** (clay loams and coarser) may be qualified according to whether they are at or near the light (lower clay content) or heavy (higher clay content) end of the range for that particular **texture grade**. Note that light medium, medium and medium heavy qualifiers can be applied only to **texture grades** as fine as or finer than sandy clay. It is strongly recommended that this ATTRIBUTE be used only where considered essential. If used too freely, it can lead to excessive, unnecessary detail of doubtful usefulness.

Reference List of VALUES

1	*light*	Nearer the lower end of the clay content range; when used with **texture grade** *clay*, bolus will form a ribbon of 50 - 75 mm and has a clay content of 35 - 40%.
2	*light medium*	Between the lower end and the middle of the clay content range; when used with **texture grade** *clay*, bolus will form a ribbon of 75 mm and has a clay content of 40 - 45%.
3	*medium*	Near the middle of the clay content range; when used with **texture grade** *clay*, bolus will form a ribbon of 75 mm or more and has a clay content of 45 - 55%.
4	*medium heavy*	Between the middle and the higher end of the clay content range.
5	*heavy*	Nearer the higher end of the clay content range; when used with **texture grade** *clay*, bolus will form a ribbon of 75 mm or more and has a clay content of 50% or more. Generally difficult to work at sticky point.

2.29.4 Organic Fraction

CHOICE, 1 VALUE ONLY PER TEXTURE GRADE

Soils that contain an appreciable amount of organic matter can have their **texture grade** qualified by **organic fraction**.

Reference List of VALUES

1	*sapric*	Organic and non-fibrous; dark organic stain discolours fingers; greasy feel in clayey textures and coherence in sandy textures. Fibres (excluding living roots) or plant tissue remains are not visible to naked eye, and little or none are visible with X10 hand lens.
2	*fibric*	Organic and fibrous; dark organic stain discolours fingers; greasy feel in clayey textures and coherence in sandy textures. Fibres (excluding living roots) or plant tissue remains are visible to naked eye or easily visible with X10 hand lens.
3	*hemic*	Organic and semi-fibrous; dark organic stain discolours fingers; greasy feel in clayey textures and coherence in sandy textures; it is intermediate in decomposition between *sapric* and *fibric*; fibres excluding living roots vary from most being difficult to identify to being unidentifiable.

2.30 ERODIBILITY TESTS

ATTRIBUTES and VALUES

2.30.1 Crumb Test

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

This test is a modification of the Emerson Aggregate Test (Emerson 1967). It provides a simple field assessment of aggregate stability or dispersibility from similar EAT 2-hour classes, which are based on a 2-hour testing period. Describe the behaviour of a natural aggregate or worked bolus when placed in distilled water. Failure to respond within 3 minutes does not necessarily mean that no response will be measurable within 2 hours.

The Emerson Aggregate Test is defined as “a classification of soil aggregates based on their coherence in water. Small aggregates are placed in dishes of distilled water and their behaviour observed. The conditions under which they slake, swell and disperse allow the different aggregates to be separated into eight different classes” (Charman and Murphy, 1991).

2.30.2 Bolus Formation Test

CHOICE, 1 VALUE ONLY PER LAYER

🗎 *8-page Soil Data Card only.*

Dry or moderately moist samples of some dispersible soils are very difficult to wet. When water is added to such materials in the process of bolus formation, the surface deflocculates preventing further infiltration of water. This produces a very slimy surface on an essentially unwetted soil ball and is rather like trying to grip a handful of ballbearings or gravel. A knife or fingernail will cut through each of these "ballbearings" to expose the dry interior. In extreme circumstances the soil material will not form into a smooth bolus unless it is ground to a powder prior to adding water.

This test provides a field assessment of aggregate dispersibility. Describe the behaviour of the bolus during bolus formation.

Reference List of VALUES

1	*no deflocculation*	Deflocculation does not occur. Particles remain flocculated and structure persists at the surface allowing infiltration.
2	*deflocculation*	Deflocculation occurs. Pores are clogged at the surface making a relatively impenetrable barrier to further water entry.

2.30.3 Field Dilatency Test

CHOICE, 1 VALUE ONLY PER LAYER

🗎 *2-page WRA and 8-page Soil Data Cards only.*

This test assists in identifying the character of the fine fraction of the soil material. A small sample of soil, without coarse fragments, is prepared with additional water if necessary to approximately sticky point (the sample is soft but not sticky).

The resulting soil pat is placed in the palm of one hand and is shaken rapidly horizontally, which can be done by striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and the gloss disappear from the surface.

Reference List of VALUES

1	*none*	No noticeable sheen appears on the surface after 30 seconds.
2	*very slow*	A barely noticeable reaction occurs after more than 10 seconds.
3	*slow*	A noticeable reaction occurs within 5 - 10 seconds.
4	*rapid*	A very noticeable reaction occurs within a few seconds.

2.31 SOIL ERODIBILITY

CHOICE, 1 VALUE ONLY PER LAYER

🗎 *4-page and 8-page Soil Data Cards only.*

The **ERODIBILITY** rating of a soil is a function of its susceptibility to detachment and transport of its constituent particles by erosive agents. It is a function of mechanical, chemical and physical characteristics and is independent of factors such as topography, rainfall intensity, plant cover, etc. (see **Erosion Hazard**). The upper **layers** are termed "topsoil", and the lower **layers** are termed "subsoil".

The assignment of a VALUE of **ERODIBILITY** to a **layer** is subjective, but the following rules apply. See also ***Table 4.***

Texture	Very fine sands (0.02 - 0.20 mm) and silts (0.002 - 0.020 mm) are more erodible than other **texture grades**.
Aggregate stability	Topsoils low in organic matter or subsoils low in sesquioxides tend to be structurally unstable. Structurally unstable soils generally slake or disperse in water—i.e., the aggregates break up into smaller aggregates or individual particles. Where these are less than about 2 mm, they can be readily transported by water. Soils with unstable aggregates tend to be more erodible than soils with stable aggregates.
Infiltration	Soils with slow infiltration rates tend to be more erodible than soils with rapid internal drainage rates.
Existing erosion	The level of existing erosion is likely to be worse in areas with a high soil erosion hazard and high soil erodibility.

Record the VALUE which best describes the degree of **erodibility** for each **layer**.

Table 4 Soil Erodibility Classes (source: Murphy 1984)

Erodibility	Topsoil	Subsoil
Low	High organic matter (>3%) (soils have a dark colour and feel greasy when textured). Cemented layers including iron, manganese and silicon pans—e.g., silcrete, ortstein and laterite.	Cemented layers including iron, manganese and silicon pans—e.g., silcrete, ortstein and laterite.
	High coarse sand	High coarse sand
	Well-structured, non-dispersible clay loams and clays having aggregates which do not slake in water to particles less than 2 mm (Emerson Aggregate Classes 4, 6, 7 and 8), e.g., red, smooth and rough ped earths (Gn3, Gn4 soils), some cracking clays (Ug5.1, Ug5.2, Ug5.3 soils), some structured loams (Um6.1 soils), and friable duplex soils (Dr4, Db3 soils).	
Moderate	Moderate organic matter (2 - 3%). Moderate fine sand and silt, e.g., hard, pedal red duplex soils (Dr2 soils). Well-structured clay loams and clays which slake in water to particles less than 2 mm (Emerson Aggregate Classes 3 to 6), e.g., black cracking clays (Ug5.1, Ug5.2 and Ug5.3 soils).	Stable non-dispersible loams and clay loams, e.g., red and yellow massive earths (Gn2.1 and Gn2.2 soils). Non-dispersible or slightly dispersible clays with particles that slake to finer than 2 mm (Emerson Aggregate Classes 3 to 6), e.g., non-sodic, red, brown and yellow duplex soils (Dr, Db and Dy soils).
High	Low (1 - 2%) to very low (<1%) organic matter, e.g. soils with bleached A_2 horizons. High to very high silt and fine sand (>65%).	Dispersible clays (Emerson Aggregate Classes 1 and 2), e.g., sodic, yellow and red soils, (Dy3.4, Dr3.4, Dr2.3 soils). Unstable, dispersible clayey sands and sandy clays, e.g., yellow and grey massive earths formed on sandstone and some granites (Gn2.3, Gn2.8, Gn2.9, Dy5.8 soils). Unstable materials high in silt and fine sand, e.g., unconsolidated sediments and alluvial materials.

If required, any VALUES not listed and more detailed descriptions can be recorded in **LAYER FIELD NOTES**.

2.32 SOIL WATER STATUS

CHOICE, 1 VALUE ONLY PER LAYER

2-page CRA, 4-page and 8-page Soil Data Cards only.

Describe the **SOIL WATER STATUS** of the **layer** at the time of description.

Note the following general guidelines: *dry* is below permanent wilting point; material becomes darker when moistened; *moderately moist* is the drier half of the available moisture range; *moist* is the wetter half of the available moisture range; and *wet* is at, or exceeding, **field capacity**.

However, these guidelines may not apply to sodic 2:1 clays, which may appear moderately moist even when their soil moisture status is below wilting point.

Reference List of VALUES

Sands/Sandy Loams

1	*dry*	Will flow through the fingers or fragments will powder.
2	*moderately moist*	Appears dry; bolus will not hold together.
3	*moist*	Forms a weak ball but breaks easily; broadly equivalent to sticky point or field capacity.
4	*wet*	Leaves a wet outline on the hand when squeezed, or is wetter; bolus is sticky.

Loams

1	*dry*	Will not form a ball when squeezed in the hand; fragments will powder.
2	*moderately moist*	Forms a crumbly ball on squeezing in the hand.
3	*moist*	Will ball; will not ribbon.
4	*wet*	Leaves a wet outline on the hand when squeezed, or is wetter; bolus is sticky.

Clay Loams/Clays

1	*dry*	Will not ball when squeezed in the hand; fragments will break to smaller fragments or peds.
2	*moderately moist*	Will ball but will not ribbon.
3	*moist*	Will ball and ribbon easily.
4	*wet*	Leaves a wet outline on the hand when squeezed, or is wetter; bolus is sticky.

2.33 PED COATING

PED COATING refers to coatings (cutans) resulting from the concentration of particular soil constituents or the *in situ* modification of the soil material. Coatings include clay, sesquioxide, manganese, ferromanganese, organic matter or carbonate coatings. If required, ATTRIBUTES or VALUES not listed or more detailed descriptions can be recorded in **LAYER FIELD NOTES**.

ATTRIBUTES and VALUES

2.33.1 Coating Amount

CHOICE, 1 VALUE ONLY PER LAYER

4-page and 8-page Soil Data Cards only.

Record the VALUE which best describes the **amount** of **PED COATING**.

Reference List of VALUES

1	*none*	No ped coatings are observed in layer.
2	*few (<10%)*	Up to 10% of the ped faces or pore linings are coated.
3	*common (10 - 50%)*	Between 10 and 50% of the ped faces or pore linings are coated.
4	*many (>50%)*	More than 50% of the ped faces or pore linings are coated.

2.33.2 Coating Type

CHOICE, 1 VALUE ONLY PER LAYER

8-page Soil Data Card only.

Observe possible coatings with a X10 hand lens. Record the VALUE which best describes the **type** of **PED COATING**. For each **layer**, record only one VALUE.

Reference List of VALUES

1	*clay*	Coatings of clay often differ in colour from the matrix of the ped. They are frequently difficult to distinguish from stress cutans which are not true coatings.
2	*mangan*	Coating contains manganese oxides or hydroxides. May have glazed appearance. Very dark brown to

		black.
3	*stress cutans*	*In situ* modifications of natural surfaces in soil materials due to differential forces such as shearing. They are not true coatings.
4	*slickensides*	Stress cutans with smooth striations or grooves.
5	*topsoil*	Coating formed from soil material from upper layers.
6	*organic*	Coating composed of organic material.
7	*other*	Coating composed of iron oxide, calcium carbonate, sodium carbonate or gypsum, that is not described by any VALUE. A description should be entered in **LAYER FIELD NOTES** if this VALUE is used.
8	*unspecified*	Nature of coatings cannot be determined.

2.33.3 Coating Distinctiveness

CHOICE, 1 VALUE ONLY PER LAYER

8-page Soil Data Card only.

Record the VALUE which best describes the ease and certainty with which a coating is identified. This ATTRIBUTE relates to the thickness and to the colour contrast with the adjacent material and may change markedly with moisture content. For each **layer**, record only one VALUE.

Reference List of VALUES

1	*faint*	Coating is evident only on close examination with X10 magnification. Little contrast occurs with adjacent material.
2	*distinct*	Coating can be detected without magnification. Contrast with adjacent material is evident in colour, texture or other properties.
3	*prominent*	Coating is conspicuous without magnification when compared with a surface broken through the soil. Colour, texture or some other property contrasts sharply with properties of the adjacent material, or the feature is thick enough to be conspicuous.

2.34 CRACKS & MACROPORES

4-page and 8-page Soil Data Cards only.

The space occupied by air or water within the soil matrix, and visible with the naked eye, may be described. This is an important factor for consideration of a soil's hydraulic properties, e.g., rates of infiltration and permeability. Two aspects of this space are considered: **CRACKS** are generally planar voids and **MACROPORES**, including those formed by biological activity, are approximately circular in cross-section.

The occurrence of **CRACKS** may be recorded within specific width classes. The number of **MACROPORES** observable within a specified sample area may be recorded for specific diameter classes.

If required, other information or more detailed descriptions can be recorded in **LAYER FIELD NOTES**, or using **Layer Addendum Codes.**

ATTRIBUTES and VALUES

2.34.1 Crack Width

CHOICE, 1 VALUE ONLY PER WIDTH RANGE PER LAYER

Cracks, or interped spaces, form an integrated pattern so that the peds can be defined and detached. The size of these cracks may vary with changes in **SOIL WATER STATUS**. Indicate for each width range whether or not **CRACKS** of that width are observed in each **layer**.

2.34.2 Macropore Diameter

CHOICE, 1 VALUE ONLY PER DIAMETER CLASS PER LAYER

Record, for each diameter range, the estimated number of **MACROPORES** of that diameter observed within the specified sample area. For diameters less than or equal to 2 mm, the sample area is equal to 10 mm X 10 mm. When the diameter exceeds 2 mm, the sample area used equals 100 mm X 100 mm.

2.35 ROOTS

CHOICE, 1 VALUE ONLY PER ROOT DIAMETER CLASS PER LAYER

🗎 *4-page and 8-page Soil Data Cards only.*

ROOTS may be described within specific root diameter classes. For each class the **Amount** or number of roots in an area of 10 cm × 10 cm may be recorded. Carefully pick back about 5 mm over an area of 10 cm × 10 cm of the **profile** face with a trowel or knife. Estimate the number of **ROOTS** visible in each root diameter class. It is difficult to accurately estimate the number of **ROOTS**, but the broad groups of ATTRIBUTES should suffice for most soil survey purposes. Where necessary, **LAYER FIELD NOTES** can be used to record more detailed descriptions using other ATTRIBUTES or more VALUES.

LAYER FIELD NOTES may also be used to record a general indication of roots within the **layer**, which can be recorded in the database under the root diameter class of **Unspecified**.

2.36 SOIL FAUNAL ACTIVITY

🗎 *8-page Soil Data Card only.*

SOIL FAUNAL ACTIVITY refers to the modification of soil morphology, in particular **STRUCTURE** and **MACROPORES**, by soil fauna including ants, earthworms, termites, larvae, etc. It may result in a lowering of the bulk density and consequent increasing of permeability. The degree of modification in a **layer** is dependent upon the dominant types of organisms and the intensity or degree of activity.

If required, other information or more detailed descriptions can be recorded in **LAYER FIELD NOTES.**

ATTRIBUTES and VALUES

2.36.1 Faunal Activity Degree

KEY ATTRIBUTE, CHOICE, 1 VALUE ONLY PER LAYER

The **degree** of **SOIL FAUNAL ACTIVITY** in the **layer** is the volume of soil affected by faunal activity as a proportion of the total volume of the **layer**.

2.36.2 Faunal Activity Type

CHOICE, UP TO 3 VALUES PER LAYER

Describe the **type** of **SOIL FAUNAL ACTIVITY** in each **layer**.

2.37 COARSE FRAGMENTS

🗎 *4-page and 8-page Soil Data Cards only.*

COARSE FRAGMENTS refer to all particles larger than 2 mm in size. Included are rock fragments inferred to be not continuous with underlying bedrock and other fragments such as charcoal and shells, but not segregations of pedogenic origin (see **SEGREGATIONS**).

⚠ On the CRA 2-page Soil Data Card this layer-based attribute is replaced by a general estimation of coarse fragment content throughout the soil profile—see **2.10.8 Fragment Amount.**

ATTRIBUTES and VALUES

2.37.1 Fragment Type

KEY ATTRIBUTE, CHOICE, UP TO 3 VALUES PER LAYER

Describe the sources or types of **COARSE FRAGMENTS**. On the field card, provision is made to separately record the information related to each of the types via 3 sub-columns within each **layer** column. Record the most important coarse fragment type first, i.e., to the left.

2.37.2 Fragment Amount

CHOICE, 1 VALUE ONLY PER COARSE FRAGMENT TYPE

The amount expressed as a percentage is visually estimated using ***Figure 3*** as a guide.

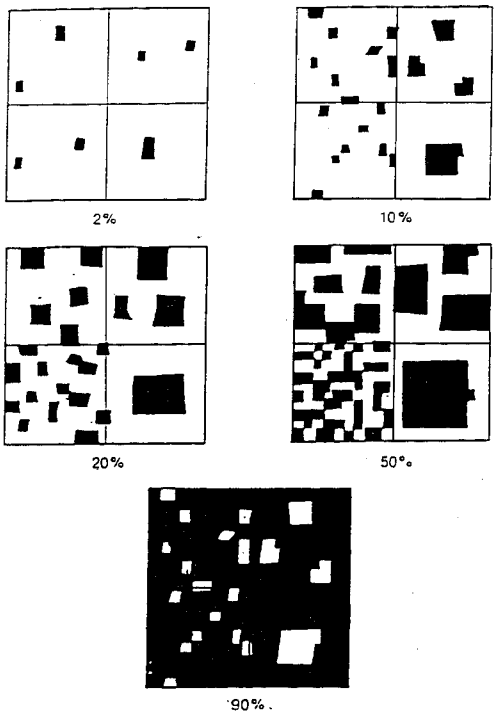

Figure 3 Chart for visually estimating percentage of abundance of an attribute

2.37.3 Fragment Distribution

CHOICE, 1 VALUE ONLY PER COARSE FRAGMENT TYPE

Describe the **distribution** of **COARSE FRAGMENTS** within the **layer**.

Reference List of VALUES

1	*stratified*	Occur in recognisable bands, usually parallel with the soil surface.
2	*dispersed*	Tend to be randomly scattered throughout the layer.

2.37.4 Fragment Orientation

CHOICE, 1 VALUE ONLY PER COARSE FRAGMENT TYPE

Describe the **orientation** of **COARSE FRAGMENTS** within the **layer**.

Reference List of VALUES

1	*undisturbed*	All fragments are remnants of the underlying **substrate**; general orientation closely parallels that of the joint/bedding planes within the **substrate**.
2	*reoriented*	Orientation is not related to the joint/bedding plane patterns of the underlying **substrate**.

2.37.5 Fragment Weathering

CHOICE, 1 VALUE ONLY PER COARSE FRAGMENT TYPE

Assess the degree of **weathering** of **COARSE FRAGMENTS** by comparing the appearance of the exposed face with a freshly broken surface.

Reference List of VALUES

1	*non-weathered*	Little difference between the exposed surface of the rock and a freshly broken surface.
2	*weakly weathered*	The rock has a weathered surface layer so that it is necessary to break it open to identify its **Lithology** accurately.
3	*strongly weathered*	Sufficiently weathered so as not to contain any surfaces similar in colour or texture to an unweathered surface; often easily broken.

2.37.6 Fragment Shape

CHOICE, UP TO 3 VALUES PER COARSE FRAGMENT TYPE

Describe the **shape** of each **type**, using ***Figure 4*** as a visual guide.

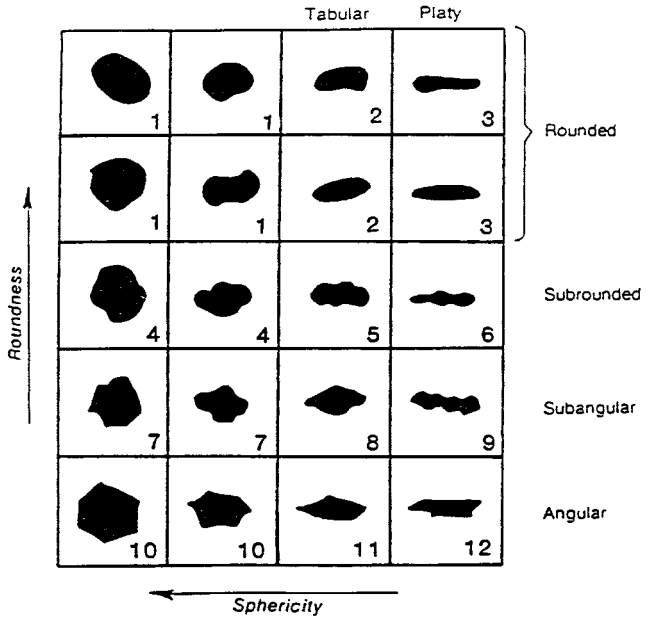

Figure 4 Fragment shapes

2.37.7 Fragment Size

CHOICE, UP TO 3 VALUES PER COARSE FRAGMENT TYPE

Describe the average size range of each **type** of **COARSE FRAGMENT**, considering the maximum dimension of the fragments.

2.38 PANS

4-page and 8-page Soil Data Cards only.

A **PAN** is an indurated and/or cemented soil **layer** that is denser and less permeable than the **layers** above and below it and more or less impenetrable to plant roots.

ATTRIBUTES and VALUES

2.38.1 Pan Type

KEY ATTRIBUTE, CHOICE, UP TO 3 VALUES PER LAYER

On the Soil Data Card, provision is made to separately record the information related to each **pan type** via 3 sub-columns within each **layer** column.

Reference List of VALUES

1	*not evident*	No pans observed in the layer.
2	*calcrete*	Hardened layer of calcium or magnesium carbonates; may be referred to by various names including calcareous pan, caliche, carbonate, kunkar, travertine, and secondary limestone; all show some effervescence when treated with dilute hydrochloric acid.
3	*silcrete*	Hard to very hard siliceous material composed almost entirely of secondary silica.
4	*earthy*	This value should be used only if the **pan** cannot be assigned to either *duripan*, *fragipan*, *densipan* or *red-brown hardpan*.
5	*duripan*	An earthy **pan** so cemented by silica that dry fragments do not slake in water and are always brittle, even after prolonged wetting (described by Soil Survey Staff 1975).
6	*fragipan*	An earthy **pan** which is usually loamy; dry fragments slake in water; wet fragments do not slake in water

		but have moderate or weak brittleness. Fragipans are more stable on exposure than overlying or underlying horizons (described by Soil Survey Staff 1975), e.g., protrude from adjacent layers when exposed in road batters.
7	*densipan*	A very fine sandy (0.02 - 0.05 mm) *earthy* **pan**. Fragments, both wet and dry, slake in water. Densipans are less stable on exposure than overlying or underlying horizons (described by Smith, Ayra and Stark 1975).
8	*red-brown hardpan*	An **earthy pan** which is normally red with a dense yet porous appearance; very hard (cannot be penetrated by a soil auger), with an irregular laminar cleavage and some vertical fissures; thickness may vary from >0.3 m to <3 m; other variable features include bedded and unsorted sand and gravel lenses, wavy black veinings, probably manganiferous, and off-white veins of calcium carbonate (calcium carbonate is not common and the red-brown hardpan in which it occurs may be relatively brittle and finely laminar); usually present below the soil profile and is not a feature of any particular soil group.
9	*thin ironpan*	Commonly thin (2 - 10 mm) black to dark reddish **pan** cemented by iron, iron and manganese or iron-organic matter complexes; has wavy or convoluted form and usually occurs as a single pan; described as a placic horizon by the Soil Survey Staff (1975).
10	*ferricrete*	Indurated material rich in hydrated oxides of iron (usually goethite and hematite) occurring as cemented nodules and/or concentrations, or as massive sheets; may be referred to as laterite, duricrust or ironstone.
11	*alcrete*	Indurated material rich in aluminium hydroxides; commonly consists of cemented pisoliths and usually known as bauxite.
12	*manganiferous*	Indurated material dominated by oxides of manganese.
13	*ortstein*	Layer strongly cemented by iron and organic matter marked by local colour variability, both laterally and vertically; may occur in the B horizons of Podzols.
14	*organic*	A layer relatively high in organic matter but low in iron; relatively thick and weakly to strongly cemented by aluminium, usually becoming progressively more cemented with depth; usually relatively uniform laterally; commonly forms the B horizon of Humus Podzols and referred to as coffee rock or sandrock.
15	*cultivated*	Subsurface soil layer having higher bulk density, lower total porosity and lower permeability to both air and water than the soil directly above or below as a result of cultivation practices.
16	*other*	Used when none of the above descriptions suits the observation; further comments should be entered into **LAYER FIELD NOTES**.

2.38.2 Pan Cementation

CHOICE, 1 VALUE ONLY PER PAN TYPE

The degree of **cementation** of a **pan** is assessed by the reaction of a piece of the pan, 30 mm diameter, placed in water for 1 hour. Record only one VALUE for each **type**.

Reference List of VALUES

1	*uncemented*	The pan sample slakes.
2	*weakly cemented*	A soaked piece of the pan can be crushed between the thumb and forefinger.
3	*moderately cemented*	Crushing is beyond the power of thumb and forefinger, but the sample crushes underfoot on a hard flat surface when the weight of an average man (80 kg) is applied slowly.
4	*strongly cemented*	A soaked piece of the pan cannot be crushed underfoot, but it can be broken with a hammer.
5	*very strongly cemented*	A soaked piece of the pan cannot be broken with a hammer or can be broken only with extreme difficulty.

2.38.3 Pan Continuity

CHOICE, 1 VALUE ONLY PER PAN TYPE

Describe the lateral **pan continuity** across an exposure of 1 m or more.

Reference List of VALUES

1	*continuous*	Extends as a layer with little or no break across the exposure.
2	*discontinuous*	Broken by cracks, but the original orientation of fragments is preserved.
3	*broken*	Broken by cracks, and the fragments are disoriented.

2.38.4 Pan Structure

CHOICE, 1 VALUE ONLY PER PAN TYPE

Describe the **pan structure** or appearance within an exposure.

Reference List of VALUES

1	*massive*	No recognisable structure occurs.
2	*vesicular*	Sponge-like structure with large pores which may or may not be filled with softer material.
3	*pisolitic*	Spheroidal concretions cemented together.
4	*nodular*	Nodules of irregular shape cemented together.
5	*platy*	Plate-like units cemented together.
6	*vermicular*	Worm-like structure and/or cavities.

2.39 SEGREGATIONS

4-page and 8-page Soil Data Cards only.

SEGREGATIONS are discrete accumulations of material in the soil resulting from the concentration of some constituent, usually by chemical or biological action. **SEGREGATIONS** may be formed *in situ* by current or relic pedogenic processes, or derived from older soils or material. They are distinguished from **PED COATINGS** at the macroscale because they occur within the body of the aggregate rather than at a surface. More than one **type** of **SEGREGATIONS** (not **PANS**) may occur in a soil **layer**.

ATTRIBUTES and VALUES

2.39.1 Segregation Type

KEY ATTRIBUTE, CHOICE, UP TO 3 VALUES PER LAYER

Describe the **types** of **SEGREGATIONS** observed. On the field card provision is made to separately record the information related to each **Segregation Type** via 3 sub-columns within each **layer** column.

Reference List of VALUES

1	*not evident*	No segregation observed in the layer.
2	*calcareous*	Calcium and/or magnesium carbonates, detectable, when not visible, by the application of 2 or 3 drops of 1 M hydrochloric acid to a sample of the soil.
3	*gypseous*	Gypsum (calcium sulfate) usually occurring as transparent or near-white crystals which may be so fine as to seem powdery; alternatively, may appear in a fine, thread-like form, or as beards or pendants; nests of larger gypsum crystals up to 5 mm in size may also occur; crystals are soft, may be broken between the thumb and fingernail and do not effervesce when treated with HCl; more extensive deposits, from finely crystalline powdery forms (kopi) to large arrowhead and oyster crystals, up to 150 mm and larger, are associated with geological formations and may occur below some modern soils; dunes of kopi occur in arid areas marginal to salt lake systems (Northcote 1979).
4	*manganiferous*	Manganese oxides.
5	*ferruginous*	Ironstone gravels; may be localised within or scattered throughout the soil profile.
6	*ferromanganiferous*	Ironstone gravels containing oxides of manganese; may be localised within or scattered throughout the soil profile.
7	*organic*	nclusions from an organic source. This is not intended to include living organic matter.
8	*not identified*	Segregations observed but not identified.
9	*other*	Used when none of the above descriptions suit the observation; further comments should be entered into **LAYER FIELD NOTES**.

2.39.2 Segregation Amount

CHOICE, 1 VALUE ONLY PER SEGREGATION TYPE

The volume of soil occupied by **concretions** may be visually estimated using ***Figure 4*** as a guide.

2.39.3 Segregation Strength

CHOICE, 1 VALUE ONLY PER SEGREGATION TYPE

Strength is used to qualify the **form**—e.g., when hard nodules are observed, the **strength** is recorded as *2* (**strong**) and the **form** as *2* (**nodules**). Similarly if soft nodules are observed, the **strength** is recorded as *1* (**weak**) and the **form** as *2* (**nodules**).

Reference List of VALUES

1	*weak*	Can be broken between thumb and forefinger.
2	*strong*	Cannot be broken between thumb and forefinger.

2.39.4 Segregation Form

CHOICE, UP TO 3 VALUES PER SEGREGATION TYPE

Describe the dominant **form** in which the **SEGREGATIONS** occur.

Reference List of VALUES

1	*soft segregations*	Finely divided material which contrast with the soil matrix in both colour and composition but not easily separated as discrete bodies; outline or boundary may be clearly defined or diffuse.
2	*nodules*	Irregular rounded mineral aggregate; no concentric or symmetric interior fabric but may have hollow interior; usually easily separated from the soil matrix; if nodules are soft, then **strength** *1* (**weak**) should also be entered; if nodules are hard, then **strength** *2* **(strong)** should also be entered.
3	*fragments*	Broken pieces of segregations.
4	*crystals*	Crusts or coatings on the soil surface, within the soil and along fissures, or as crystal chambers and crystal tubes filling or partly filling voids; frequently composed of carbonates, bicarbonates, sulfates and chlorides of calcium, magnesium and sodium.
5	*veins*	Fine (<2 mm wide) linear segregations.
6	*concretions*	Spheroidal mineral aggregates; crudely concentric internal fabric can be seen with naked eye; includes pisoliths and oliths.
7	*root linings*	Linings of former or current root channels.
8	*tubules*	Medium to coarse (>2 mm wide) tube-like segregations which may or may not be hollow.

2.39.5 Segregation Size

CHOICE, UP TO 3 VALUES PER SEGREGATION TYPE

Describe the average size range of each **type** of **SEGREGATION**, considering the maximum dimension of the segregations.

2.40 LAYER FIELD NOTES

ALPHANUMERIC FIELD, UP TO 200 CHARACTERS

The entity **LAYER FIELD NOTES** is available to enter additional information about each **layer**. Additional information includes ATTRIBUTES and VALUES not listed on the soil data card and more detailed descriptions. Where the ATTRIBUTE *other* is used, a fuller explanation is entered in the appropriate **LAYER FIELD NOTE.**

There are no ATTRIBUTES or VALUES for this entity. Any text written onto the field card is manually typed into the database.

2.41 LAYER ADDENDUM

8-page Soil Data Card only.

A **LAYER ADDENDUM** code is provided for regular recording of characteristics not catered elsewhere on the soil data card. A particular user of the System may request this from time to time for a specific purpose or for such characteristics as are not seen to be required for use by the general community.

The total number of layers that can be entered for a **profile** is 21. This allows for any combination from all 21 used in only 1 **layer** of the **profile,** or for the 21 rows used evenly over all the **layers** of the **profile**. Where necessary, **LAYER FIELD NOTES** can be used to record other ATTRIBUTES or VALUES and more detailed descriptions.

ATTRIBUTES and VALUES

2.41.1 Layer

VALUES for this ATTRIBUTE are the Layer Numbers which correspond to the numbers assigned to the **layers** in **LAYER STATUS**. On the field card, the **layers** are indicated by 6 broad columns.

2.41.2 Layer Addendum Codes

KEY ATTRIBUTE, 4-CHARACTER ALPHABETIC CODE, 1 VALUE ONLY PER LAYER, LEFT JUSTIFIED

This field is intended to be used to record details about soil layers that are not catered for in other parts of the Soil Data Card. These will be assigned by SALIS staff after consultation with the user.

2.41.3 Ref.

2-CHARACTER NUMERIC CODE, 1 VALUE ONLY, RIGHT JUSTIFIED

This ATTRIBUTE qualifies the **Addendum Code.**

Reference List of VALUES

Watertable

QQQQ 1	*none*	A watertable is not present.
QQQQ 2	*seasonal*	A watertable is present only seasonally.
QQQQ 3	*permanent*	A watertable is present at all times.
QQQQ 4	*perched*	A watertable is held above the main body of ground water by an impermeable layer or stratum, usually clay, and is separated from the main body of ground water by an unsaturated zone. It may be seasonal or permanent.

Ped Porosity

RRRR 1	*porous*	
RRRR 2	*dense*	

Root Distribution

SSSS 1	*in-ped*	Most roots pass through the peds.
SSSS 2	*ex-ped*	Most roots follow ped interfaces.
SSSS 3	*in-ped & ex-ped*	

Maximum size of macropores

TTTT 3	*0.3 mm*
TTTT 5	*0.5 mm*
TTTT 10	*1.0 mm*
TTTT 20	*2.0 mm*
TTTT 30	*3.0 mm*
TTTT 40	*4.0 mm*
TTTT 50	*5.0 mm*
TTTT 60	*6.0 mm*
TTTT 70	*7.0 mm*
TTTT 80	*8.0 mm*
TTTT 90	*9.0 mm*
TTTT 99	*9.9 mm*

Macropore Abundance

UUUU 1	*0.1%*
UUUU 2	*0.2%*
UUUU 3	*0.3%*
UUUU 5	*0.5%*
UUUU 10	*1.0%*
UUUU 15	*1.5%*
UUUU 20	*2.0%*
UUUU 25	*2.5%*
UUUU 30	*3.0%*
UUUU 35	*3.5%*
UUUU 40	*4.0%*
UUUU 45	*4.5%*
UUUU 50	*5.0%*
UUUU 55	*5.5%*
UUUU 60	*6.0%*
UUUU 65	*6.5%*
UUUU 70	*7.0%*
UUUU 75	*7.5%*
UUUU 80	*8.0%*
UUUU 85	*8.5%*
UUUU 90	*9.0%*
UUUU 95	*9.5%*

Macropore Distribution *(Hodgson 1976)*

VVVV 1	*TYPE A*
VVVV 2	*TYPE B*
VVVV 3	*TYPE C*
VVVV 4	*TYPE D*

Layer Permeability

WWWW 1	*Rapid*	Water penetration occurs at a rate of >130 mm/h.
WWWW 2	*Mod. to rapid*	Water penetration occurs at a rate of 60 - 130 mm/h.
WWWW 3	*Moderate*	Water penetration occurs at a rate of 20 - 60 mm/h.
WWWW 4	*Slow to mod*	Water penetration occurs at a rate of 5 - 20 mm/h.
WWWW 5	*slow*	Water penetration occurs at a rate of 1 - 5 mm/h.
WWWW 6	*very slow*	Water penetration occurs at a rate of <1 mm/h.

Vesicles

XXXX 1	*not vesicular*
XXXX 2	*very slightly vesicular*
XXXX 3	*slightly vesicular*
XXXX 4	*moderately vesicular*

XXXX 5	*very vesicular*	

Dents Classification *for Acid Sulphate Soils (Dent 1986)*

Horizons of unripe saline clay soils

YYYY 1	*Gr*	Practically unripe or half ripe; permanently reduced and accumulating pyrite.
YYYY 2	*Gro*	Half ripe; partly oxidised; iron pipes and ped coatings.
YYYY 3	*Go*	Nearly ripe; oxidised; mottles; nodules, pipes and coatings of iron or iron oxide, not potentially acid.
YYYY 4	*Gj*	Severely acid; black, dark grey or pinkish brown, usually with pale yellow jarosite mottles; practically unripe or half ripe; reserve of pyrite present.
YYYY 5	*G*	Undifferentiated, unripe surface layer.

Horizons developing after drainage

YYYY 6	*GBj*	Severely acid; grey with pale yellow jarosite mottles; half ripe or nearly ripe; reserve of pyrite present.
YYYY 7	*Bj*	Severely acid; strongly mottles grey with reddish iron oxide and yellow jarosite mottles; ripe.
YYYY 8	*Bg*	Not severely acid; strongly mottled grey with reddish iron oxide mottles and nodules; ripe.
YYYY 9	*Hj*	Severely acid peat.
YYYY 10	*A*	Surface mineral horizon distinguished by a concentration of organic matter, not severely acid.

Horizons developing under prior conditions

YYYY x0	*xA*	As for *A* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x1	*xGr*	As for *Gr* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x2	*xGro*	As for *Gro* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x3	*xGo*	As for *Go* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x4	*xGj*	As for *Gj* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x5	*xG*	As for *G* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x6	*xGBj*	As for *GBj* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x7	*xBj*	As for *Bj* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x8	*xBg*	As for *Bg* above but "x" represents prior stage(s) of acid sulphate horizon development.
YYYY x9	*xHj*	As for *Hj* above but "x" represents prior stage(s) of acid sulphate horizon development.

Dry Strength *(Crushing Characteristics)*

ZZZZ 1	*loose*	No force required. Separate particles such as loose sands.
ZZZZ 2	*very weak force*	Very small or almost nil force is required.
ZZZZ 3	*moderately weak force*	Small but significant force is required.
ZZZZ 4	*moderately firm force*	Moderate to firm force is required.
ZZZZ 5	*very firm force*	Strong force but within the power of thumb and forefinger.
ZZZZ 6	*moderately strong force*	The force required is beyond the capability of the thumb and forefinger.

Please note that this list is regularly updated by the SALIS Administrator to ensure that it represents a complete list of the currently available codes and can be supplied on request to any registered SALIS user.

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4 INDEX