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LAND TYPES

AND

DOMINANT SOIL UNITS

OF

MAREMANI NATURE RESERVE

1. INTRODUCTION

Soil is the growth medium for plants that serve as food and provide habitat for a variety of living organisms. Soil in it self also provide habitat for living organisms. It is with justification that one can say that soil, as well as the geological substrate, are the backbone on which other facets of nature are build.

Different soil bodies have different characteristics. These soil characteristics, noticeable and non-noticeable but measurable, are used for classification purposes. Soil characteristics, individual and collectively, determine the intrinsic behaviour and suitability of soils for different vegetation types.

The soils present in a particular area are, among other things, directly correlated to the geological substrate, position in the landscape and climatic conditions under which it developed. One normally finds that a particular soil type will almost always occur at a particular place in the landscape. Broad soil patterns can therefore be identified according to particular circumstances in particular landscapes. These soil patterns consist of different soil forms that have different characteristics, but the sequences of soil forms are more or less the same throughout the landscape. These broad patterns are, amongst other things, important for understanding the functioning of natural systems. This reasoning is basically the land type principle.

A second grouping can also be done. Soil forms with reconcilable characteristics can be grouped together because their intrinsic behaviour, potential and suitability will be more or less the same. Reconcilable soils are normally found within a specific terrain unit or a specific position in the landscape (terrain form). The same groupings can thus be identified in different soil patterns.

Soils are correlated with the geological substrate, and vegetation communities (structural and floristic) are associated with certain soil groups. Game species are also associated with certain vegetation communities (habitats). These homogeneous areas are called management areas and it is these units that are important for management of natural systems, wildlife sanctuaries or game farms. A management area will

therefore be subjected to the same impacts (burning programmes etc.) and will respond in the same manner to management actions such as grazing, burning, erosion control etc.

2. BACKGROUND TO LAND TYPE SURVEYS

Identification of soil forms to produce a detailed soil map or soil inventory of a particular area can be a time consuming and very expensive exercise. The size, diversity and management objectives of an area determine the time and finances to be spent. The bigger and more diverse the area the more time and money would normally be spend to compile inventory data or a soil map.

For the purpose of wildlife management, including physical management of an area and determining of utilization potential, it is necessary to produce identifiable manageable homogeneous soil units. This is done by means of re-evaluating inventory data or soil maps by grouping certain soil characteristics (erodability of soils, clay content, soil depth etc.) and reconcilable soils.

To provide a sound perspective of South Africa's agricultural potential, the Department of Agriculture initiated land type surveys in the early 1970's. To attain this objective, it was essential that a systematic compiled inventory of the natural factors that determine agricultural potential namely, climate, terrain form and soil type were done. A land type denotes an area that can be shown at 1:250 000 scale and that displays a marked degree of uniformity with respect to terrain form, soil patterns and climate.

The inventory data from the land type surveys is in essence a description of the characteristics of the abiotic components of fairly large uniform natural environments and has therefore a much wider application than only for agricultural purposes. Soil forms with reconcilable characteristics that occur in the same terrain unit can be identified and grouped together for management purposes. Time and money are also saved identifying above-mentioned groups because a lot of data has already been collected as part of the land type surveys, although at a very large scale. On site confirmation are however needed. This data is especially useful for larger conservation areas where management is aimed at larger homogeneous units or systems rather than small isolated individual units.

3. METHODS

A desktop study was done to evaluate published land type data (Sobczyk, M.E., Kirsten, W.F.A & Hammond, T. 1988).

Maremani Nature Reserve was visited from 18 June 2001 until 21 June 2001. The occurrence of described land types for the study area (soil forms & series present, position in the landscape etc.) was confirmed on site. As large an area as possible was covered with a vehicle to provide an overall perspective of the landscapes, topography, geology, soil forms, vegetation types etc. in the study area. Land type data is presented in appendix A and a land type map is attached as appendix B, figure 1.

Since soil forms were classified during the land type surveys according to the Binomial System (MacVicar et.al. 1977), were the same system used for confirmation of occurrence of soil forms. The Taxonomic System (MacVicar et.al. 1991) was only used as a reference system. Soil forms were identified with the aid of an auger and any other natural occurring or man made soil profiles, for instance excavations made by warthogs or elephants, old mines, eroded areas along rivers or roads and road excavations. Definitions of horizons and materials diagnostic for identification of soil forms are not provided in this report because of the lengthy extend of the definitions. These definitions can be obtained from the Binomial System.

A second classification was also done. Land type data was re-evaluated and soil forms with reconcilable characteristics grouped together to obtain homogeneous dominant soil units in terms of intrinsic behaviour, potential and suitability (Appendix C). A detailed soil map was not produced because the exact location and extend of soil profiles done for identifying a land type are unknown. No soil profiles were actually excavated in the study area during the land type surveys. To perform this exercise now would have been too costly and unpractical. To provide a visual tool for distinguishing between soil forms are photos of the dominant soil forms attached as appendix D.

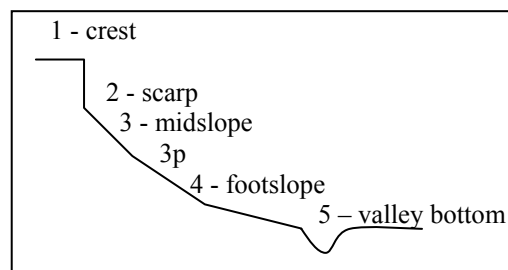
4. DESCRIPTIONS OF LAND TYPES

As previously mentioned, displays a land type a marked degree of uniformity with respect to terrain form, soil patterns and climate. These aspects are discussed in more detail.

4.1. TERRAIN FORM

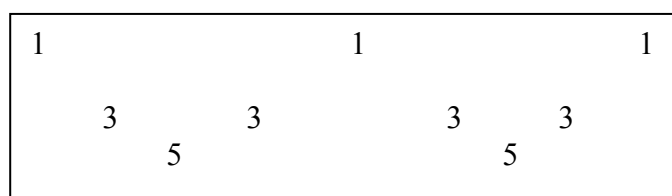
A terrain unit is any part of the land surface with homogeneous form and slope. A terrain can be thought of as being made up of all or some of the following kinds of terrain units: crest (1), scarp (2), midslope (3), footslope (4) and valley bottom (5). Whether a terrain unit is a footslope or a midslope depends on its position and, to an extent, upon the steepness of the slope. For instance, a midslope lies immediately below a crest or scarp. In contrast with a midslope, a scarp is steeper than 100% and usually steeper than 70°.

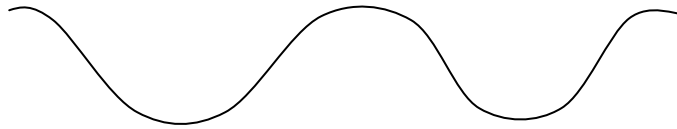
A normal terrain form are as follows:



A terrain type can consist of one of the following phases:

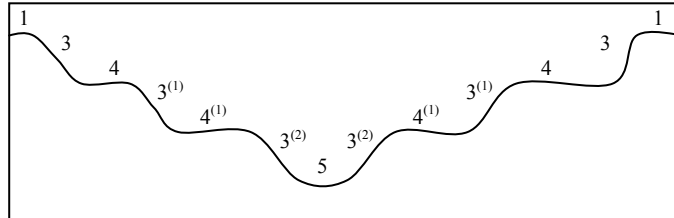
❖ A single phase terrain type:





❖ A multi-phase terrain type:

A 3⁽¹⁾ indicates a second phase midslope and 3⁽²⁾ a third phase midslope.



4.2. PEDOSYSTEMS (soil patterns)

A pedosystem denotes land over which terrain form and soils pattern each displays a marked degree of uniformity. Soils do not occur randomly in a landscape, but follow a pattern determined by factors such as geology and topographic position, many of which in turn have either played a part in shaping the landscape or are inherent features of the landscape (e.g. a valley bottom). The soil composition of terrain types was described by detailing which soil series of the Binomial System (MacVicar et.al. 1977) occur on each terrain unit.

4.3. CLIMATE ZONES

Climate zones are zones of which all the agricultural important climatic parameters would display either a narrow range of variation or a marked regularity in pattern of variation. The parameters were obtained through climate measurements (from meteorological stations) and natural vegetation, soils, crop performance, altitude and topography as indicators of climate boundaries.

5. LAND TYPES IN THE STUDY AREA

Land type data are presented in appendix A. A map of the five land types that are represented in the study area is provided in appendix B, figure 1. Each land type and the dominant soil forms that occur in the land type are discussed.

5.1. LAND TYPE Ae266

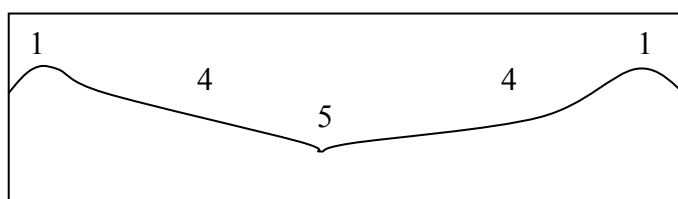
5.1.1. General

This land type is representative of the western areas of the farms Singelele and Berkenrode. This land type is part of map units Aa - Ai which refer to yellow and red soils without water tables and belonging in one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The map units refer to land that does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40% of the area. Ae

refers to red, high base status soils that are more than 300 mm deep with no dunes.

This land type is a single-phase terrain type that consists of 10% crests, 70% footslopes and 20% valley bottoms on Bulai Gneiss and metaquartzite, gneiss and amphibolite of the Beit Bridge Complex.

The terrain form of the land type is as follows:



The slope range of crests is 15 - 50%, footslopes 2 – 10% and valley bottoms 4 – 10%. The range of slope length of crests is 50 – 100 m, footslopes 250 – 5000 m and valley bottoms 20 – 150 m. The slope shape of crests is convex, that of footslopes convex - straight and valley bottoms straight - concave. Unit 1 has 100%, unit 4, 33% and unit 5, 15% mechanical limitations in terms of stoniness and shallowness of soils.

This land type consists therefore of a more or less flat topography with scattered steep rocky outcrops and smaller drainage lines. It occupies 705 hectares (4.6%) in the study area.

Soils or land classes found in this land type are rocks, soil series of the Mispah form (Ms10, Ms20, Ms22), Hutton form (Hu36, Hu37, Hu34, Hu35), Oakleaf form (Oa16, Oa35, Oa36, Oa45, Oa31), Clovelly form (Cv34, Cv36, Cv46) and streambeds.

5.1.2. Rocks

Crests consist of 70% rocks and footslopes of 10% rocks. The lack of soil is the main characteristic of these areas that occupy 14% of the land type. These areas are visible in the form of rocky outcrops with steep slopes. The potential of these areas are very low.

5.1.3. Mispah form (Ms) (Appendix D, photo 1)

Soils of the Mispah form are distributed in unit 1 (30% - Ms10) and unit 4 (15% - Ms10, 6% - Ms20, 2% - Ms22). These soils are very shallow (100 – 300 mm) on rock and occupy nearly 20% of the land type. Ranges of clay percentage in the A-horizon are 8 – 15%, except for the Kalkbank series (Ms22) that have clay content of 10 – 20%. The texture of these soils is loam medium sand to sandy loam. The A horizon are almost always non-calcareous. The depth-limiting material is rock.

5.1.4. Hutton (Hu) (Appendix D, photo 2) and Clovelly (Cv) form

Hutton soils occupy 44% of the land type and is the most dominant soil form in the land type. It occurs in 60% (50% - Hu36, 10% - Hu34 & Hu35) of the areas of footslopes and in 10% (Hu37) of the valley bottoms. These soils are non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status.

The Shorrocks (Hu36) and Makatini (Hu37) series occupy 37% of the land type, is fairly deep (500 – 1200 mm) and have no mechanical limitations. Ranges of clay percentage in the A-horizon are 10 – 20% and 15 – 35% in the B21 horizon. Medium sandy loam to sandy clay loam is the most common texture class of the B-horizon. Depth-limiting material are rocks.

The Clovelly form (5% - Cv34 & Cv36, 2% - Cv46) also occurs in footslopes, have a low clay content and occupies small areas in the land type.

5.1.5. Oakleaf form (Oa) (Appendix D, photo 3)

The Oakleaf form is dominant in the valley bottoms (45% - Oa16 & 25% - Oa35, Oa36 & Oa45) and occupies 15% of the total area of the land type. The soil depth range from 800 – 1200 mm and no mechanical limitations occurs. The clay content is fairly low for drainage lines and ranges, for the Leeufontein (Oa16) series, in the A-horizon between 15 – 20% and between 15 – 25% in the B21 horizon. Medium / coarse sandy loam to sandy clay loam is the most common texture class of the B-horizon. The B-horizon is almost always non-calcareous and the depth-limiting material is also rocks.

5.1.6. Streambeds

Streambeds occupy 15% of the valley bottoms and 3% of the land type. These areas are characterised by a total lack of soil.

5.2. LAND TYPE Fc483

5.2.1. General

This land type is representative of the eastern areas of the farms Singelele and Berkenrode, the southwestern areas of Vryheid, western and southern areas of Magdala, the central areas of Randjesfontein and most of the farm Dover.

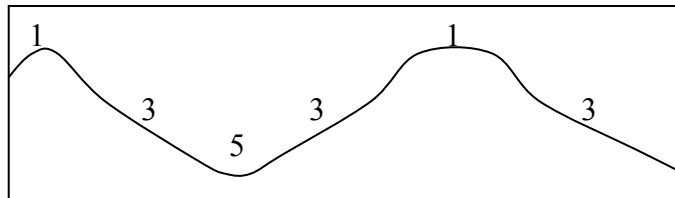
Accommodated in this group of units are pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. Fc in the land type name refers to land where lime occurs regularly in upland and valley bottom soils. There need not be much of it and it need not occur in every soil present. Lime has been used as an indicator of the extend to which these youthful landscapes have been leached.

The geological substrate in the land type is metaquartzite, magnetite quartzite, amphibolite and metapelite of the Mount Dowe Group, Beit Bridge Complex; migmatite grey and leucocratic pyroxene-bearing gneiss of the Sand River Gneiss.

This land type is also a single-phase terrain type that consists of 10% crests, 75% midslopes and 15% valley bottoms. The slope percentages of crests range between 4 – 10%, midslopes between 5 – 45% and valley bottoms between 2 – 8%. The length of the slopes of the three terrain types range between 50 – 200 m, 100 – 1000 m and 50 – 100 m respectively. The slope shape is convex – straight, straight – concave and concave in unit 1, 3 and 5 respectively.

Stones, boulders, shallow soils on rocks or the lack of soils occur in 95% of crests, 89% of midslopes and 30% of valley bottoms.

The terrain form is as follows:



This land type have a more uniform undulating topography where crests are not as steep as in the previous land type and drainage lines are well defined. It occupies 3850 hectares or 25% of the study area. The landscape is also very rocky.

Soils or land classes found in this land type are rocks, soil series of the Mispah form (Ms10, Ms20), Hutton form (Hu36, Hu34, Hu35, Hu44, Hu45), Clovelly form (Cv36, Cv44), Oakleaf form (Oa35, Oa45, Oa16, Oa26, Oa36, Oa46), Glenrosa form (Gs22, Gs25) and stream beds.

5.2.2. Rocks

Rocks are very prominent in this land type because 20% of the surfaces of crests and midslopes consist of rocks and 5% of the surface of valley bottoms consists of rocks. Nearly 18% of the total area of the land type consists of rocks. These areas are characterised by the lack of soil.

5.2.3. Mispah form (Ms)

This soil form is dominant in the land type because 55% of the surface of the land type is occupied by soils of the Mispah form. This soil form is distributed throughout 65% of the surface of crests and midslopes but do not occur in valley bottoms. Calcium carbonate (a calcareous horizon) is present in midslopes but not on crests. These soils are very shallow (100 – 200 mm) on hard rock. The clay percentage in the A-horizon is low (4 – 12%) with a

medium - coarse sand to loamy sand texture. The depth-limiting material is rock.

5.2.4. Hutton (Hu) and Clovelly (Cv) form

Soils of the Hutton and Clovelly form do occur on crests and midslopes but are not common. The soil depth is fairly shallow on crests (250 – 500 mm) and deeper on midslopes. Stones and boulders are always present. The clay percentage in the A-horizon is low (6 – 15%) and slightly higher in the B21 horizon (8 – 25%). Loam medium to coarse sand to sandy loam is the most common texture class of the B-horizon. The most common soils are non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status. The depth-limiting material is rock.

The Clovelly form occupies small areas in the land type.

5.2.5. Oakleaf form (Oa)

The Oakleaf form is dominant in the valley bottoms (40% - Oa35 & Oa45, 15% Oa16 & Oa26 and 5% Oa36 & Oa46) but occupies only 9% of the land type. These soils are fairly deep (900 – 1200 mm) with no mechanical limitations. The clay percentages range between 6 – 10% (Oa35 & Oa45) and 15 – 25% in the A-horizon and 8 – 15% (Oa35 & Oa45) and 20 – 30% in the B21 horizon. Texture classes of the B-horizons are loam coarse sand to sandy loam (Oa35 & Oa45) and medium sandy clay loam. Depth-limiting material are rocks.

5.2.6. Glenrosa form (Gs)

Soils of the Glenrosa form only occur on midslopes, are not very common in the land type (1.5%), and are fairly shallow (250 – 400 mm). The clay percentage in the A-horizon is low (3 – 12%) and the soil texture is coarse sand to loamy sand. The B2 horizon or directly underneath it are calcareous.

5.2.7. Streambeds

Streambeds occupy 25% of the valley bottoms and nearly 4% of the land type.

5.3. LAND TYPE Fc484

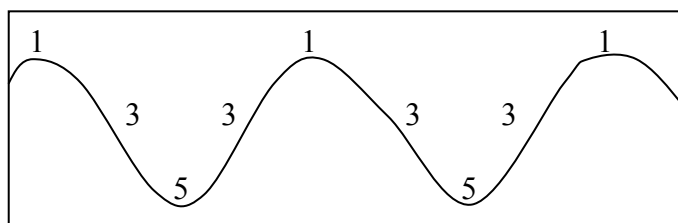
5.3.1. General

Land type Fc484 is typical of the northern, eastern and south-eastern areas of the farm Vryheid, the entire farm Bokveld, the northern, eastern and south-western areas of Malala Hoek, the northern, eastern and south-eastern areas of Twilight, the eastern areas of Chirundu, the north-western areas of Palm Grove, the northern and western areas of Steenbokrandjies, the western areas of Boschrand, the north-eastern areas of Magdala and the north-western areas of Randjesfontein.

The pedology and meaning of the name of this land type is the same as for the previous land type.

This land type is also a single-phase terrain type that consists of 10% crests, 80% midslopes and 10% valley bottoms. The geological substrates are marble, gneiss, quartzite, amphibolite and calc-silicate rocks of the Beit Bridge Complex.

The terrain form is as follows:



The slope range of crests is 6 - 20%, midslopes 8 – 60% and valley bottoms 2 – 10%. The range of slope length of crests is 50 – 150 m, midslopes 100 – 800m and valley bottoms 20 – 600 m. The slope shape of crests is convex, that of midslopes straight - concave and valley bottoms concave. A 100% and 82% of units 1 and 3 respectively have severe mechanical limitations in terms of stoniness and shallowness of soils.

This land type consists therefore of steeper and shorter slopes on crests and midslopes and larger drainage lines than the previous land type. It occupies 6200 hectares or 40.5% of the study area.

Soils or land classes found in this land type are rocks, soil series of the Mispah form (Ms10, Ms20, Ms22), Hutton form (Hu 34, Hu36, Hu33, Hu46), Oakleaf form (Oa33, Oa36, Oa43, Oa46, Oa13, Oa14, Oa16, Oa26), Clovelly form (Cv33, Cv36), Fernwood form (Fw21, Fw22) and streambeds.

5.3.2. Rocks

Rocks cover 50%, 30% and 5% of the surface's of crests, midslopes and valley bottoms respectively. The lack of soil is the main characteristic of these areas that occupy nearly 30% of the land type.

5.3.3. Mispah form (Ms)

Soils of the Mispah form are the most dominant land class in this land type and occupy 42% of the total surface of the land type. It is represented in 40% (Ms10) of the areas of crests and 47% (30% - Ms20, 15% - Ms10 & Ms20, 2% - Ms22) of the areas of midslopes. These soils are shallow on hard rock (100 – 300 mm). Ranges of clay percentage in the A-horizon are 8 – 15%, and the texture of these soils is loam fine to coarse/medium sand to sandy loam. The A horizon are calcareous in the Mudén (Ms20) and Kalkbank (Ms22) series and non-calcareous in the Mispah (Ms10) series. The depth-limiting material is rock.

5.3.4. Hutton (Hu) and Clovelly (Cv) form

The Hutton soil form occupies 18% of the total surface of the land type. It occurs in 10% of crests (Hu34), 20% (5% - Hu36, 10 % - Hu33 & Hu34, 5% - Hu36) of the areas of midslopes and in 10% of the valley bottoms (Hu46). These soils are, except for Hu46, non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status.

These soils are very shallow (150 – 350 mm), even in valley bottoms (500 – 600 mm). The clay percentage in the A-horizons' is low (6 – 12%), and fairly higher (10 – 20%, 8 – 15% & 15 – 25%) in the B21 horizons'. Loam medium or fine to medium sand to sandy loam is the most common texture class of the B-horizon. The depth-limiting material is rock.

The Clovelly form (Cv33, Cv36) occurs on midslopes and represents only 2% of the area of midslopes. These soils are low in clay content but fairly deep (600 – 1200 mm). The texture class of these soils is loam fine - medium sand to sandy loam.

5.3.5. Oakleaf form (Oa)

Soils of the Oakleaf form are found in 75% of valley bottoms (40% - Oa33 & Oa36, 20% - Oa43 & Oa46, 15% - Oa13, Oa14, Oa16 & Oa26). The soil depth range from 600 – 1200 mm and no mechanical limitations occurs. The clay content is fairly low for drainage lines and ranges in the A-horizon between 6 – 12% or 8 – 15%, and between 8 – 20% in the B21 horizon. Loam fine - medium sand to sandy loam is the most common texture class of the B-horizon. The depth-limiting material is rock.

5.3.6. Fernwood form (Fw)

Soils of the Fernwood form are only present in this land type and have a small distribution of 1% in midslopes near streambeds (Fw21 & Fw22). These soils are fairly deep (900 – 1200 mm) but occupy only 0.8% of the land type. The clay content is low and range in the A-horizon and B21 horizon between 6 – 10%. The texture of these soils is fine-medium sand to loamy sand. These soils are neutral to alkaline in the A-horizon. There are no mechanical limitations associated with these soils but the depth-limiting material is also rocks.

5.3.7. Streambeds

Streambeds occupy 10% of the valley bottoms and only 1% of the land type. Streambeds in this land type are also characterised by a total lack of soil.

5.4. LAND TYPE Ah89

5.4.1. General

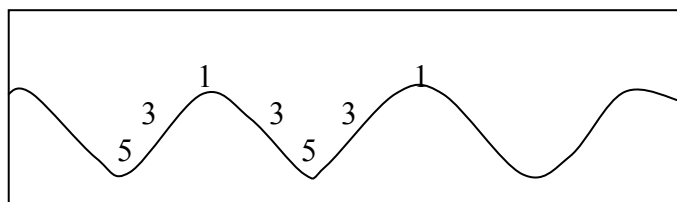
Land type Ah89 is represented in the following farms: the southern and eastern areas of the farm Steenbokrandjies, the western and central south-eastern areas of Palm Grove, the southern, central and central northern areas of Chirundu, the northern, central and eastern areas of Bochrand, the southern areas of Randjesfontein and the eastern areas of Dover.

Ah in the land type name refers, as with land type Ae266, to yellow and red soils without water tables and belonging in one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The map unit refers to land that does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40% of the area. However, Ah (red and yellow, high base status) indicates land with red and yellow soils each of which covers more than 10% of the area while high base status red-yellow apedal soils occupy a larger area than dystrophic and/or mesotrophic soils.

The geological substrate is of the Beit Bridge Complex, Malaladrift Formation; leucogneiss, metaquartzite, and amphibolite. Gumbu Gneiss, marble, gneiss; metaquartzite, and amphibolite.

This land type is a single-phase terrain type that consists of 10% crests, 75% midslopes and 15% valley bottoms.

The terrain form is as follows:



The slope range of crests is 4 - 15%, midslopes 2 – 10% and valley bottoms 2 – 5%. The range of slope length of crests is 50 – 150 m, midslopes 400 – 500m and valley bottoms 50 – 250 m. The slope shape of crests is convex - straight, that of midslopes convex - concave and valley bottoms straight - concave. A 100%, 15% and 15% of units 1, 3 and 5 respectively have mechanical limitations in terms of stoniness and shallowness of soils.

This land type consists therefore of a slightly undulating topography and occupies 2681 hectares (17.5%) of the study area.

Soils or land classes found in this land type are rocks, soil series of the Mispah form (Ms10, Ms20, Ms22), Hutton form (Hu36, Hu 44, Hu46, Hu45, Hu34,

Hu35), Oakleaf form (Oa16, Oa26, Oa35, Oa36), Clovelly form (Cv36, Cv46, Cv34, Cv35), Glenrosa form (Gs26), Bainsvlei form (Bv36) and streambeds.

5.4.2. Rocks

Rocks are not as dominant in this land type as in the other land types and cover only 20% and 5% of the surfaces of crests and midslopes respectively. The lack of soil is again the main characteristic of these areas that occupy 6% of the land type.

5.4.3. Mispah form (Ms)

Soils of the Mispah form are also not as dominant in this land type as in the other land types and occupy only 15% of the total surface of the land type. It is the only soil form on crests (60% Ms10 & 20% Ms20) and represents 10% (5% Ms10 & 5% Ms22) of the areas of midslopes. These soils are shallow (100 – 300 mm) on hard rock. Ranges of clay percentage in the A-horizon are 6 – 12%, and the soil texture is medium-coarse sand to loamy sand. The A horizon are calcareous in the Muden (Ms20) and Kalkbank (Ms22) series and non-calcareous in the Mispah (Ms10) series. The depth-limiting material is rock.

5.4.4. Hutton form (Hu)

Hutton soils occupies 48% of the land type and is the most dominant soil form in the land type and on midslopes. It occurs in 63% (33% Hu36; 15% Hu44, Hu46 & Hu45; 15% Hu34 & Hu35) of the areas of midslopes and in 5% of the valley bottoms (Hu36). Hu36, Hu34 and Hu35 are non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status. Hu44, Hu46 & Hu45 are calcareous in the B21 horizon.

These soils are fairly shallow (400 – 1000 mm) but have no mechanical limitations. Ranges of clay percentage in the A-horizon are 10 – 15% (Hu36) and 8 – 12% (Hu34, Hu35, Hu44, Hu45 & Hu46). Ranges of clay percentage in the B21 horizon are 15 – 20% (Hu36), 10 – 20% (Hu44, Hu45 & Hu46) and 10 – 15% (Hu34, Hu35). Soil textures in the B-horizon range between medium sandy loam (Hu36), loam medium sand to sandy loam (Hu44, Hu45 & Hu46) and loam medium-course sand to sandy loam (Hu34, Hu35). The depth-limiting material is rock.

5.4.5. Clovelly form (Cv)

Clovelly soils occupies a relatively small area (16%) in the land type. It occurs in 20% of the areas of midslopes (10% - Cv36; 5% - Cv46 & 5% - Cv34 & Cv35) and in 5% of the valley bottoms (Cv36). Cv36, Cv34 and Cv35 are non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status. Cv46 are calcareous in the B21 horizon. These soils are fairly shallow (Cv36: 400 – 750 mm, Cv46: 600 – 900 mm & Cv34 & Cv35: 300 – 600 mm) but have no mechanical limitations.

Ranges of clay percentage in the A-horizon are 12 – 18% (Cv36, Cv46), and 8 – 12% (Cv34, Cv35). Ranges of clay percentage in the B21 horizon are 15 – 20% for Cv36 and Cv46, and 10 – 15% for Cv34 and Cv35. Soil textures in the B-horizon range between medium sandy loam (Cv36 & Cv46) and loam medium-course sand to sandy loam (Cv34, Cv35). The depth-limiting material is rock.

5.4.6. Oakleaf form (Oa)

The Oakleaf form is dominant in the valley bottoms (40% - Oa16 & Oa26, 30% - Oa35 & Oa36) and occupies 11% of the total area of the land type. The soils are fairly deep, 800 – 1200 mm, and no mechanical limitations occurs. The clay content in the A-horizon is fairly low for drainage lines and ranges between 10 – 20%. The clay content in the B21 horizon ranges between 15 – 25% for Oa16 & Oa26 and 10 – 25% for Oa35 & Oa36. Soil texture classes of the B-horizon are medium-coarse sandy loam to sandy clay loam for Oa16 & Oa26 and loam medium-coarse sand to sandy clay loam for Oa35 & Oa36. The B-horizon of Oa16, Oa35 and Oa36 is non-calcareous and the B-horizon of Oa26 is calcareous. The depth-limiting material is also rocks.

5.4.7. Glenrosa form (Gs)

Soils of the Glenrosa form occur only on midslopes (2%) and are not very common in the land type. These soils are fairly shallow (300 – 600 mm). The clay percentage in the A-horizon is fairly high in comparison with other soil forms (18 – 25%) and the soil texture is loam. The B2 horizon or directly underneath it are calcareous.

5.4.8. Bainsvlei form (Bv)

Soils of the Bainsvley form (Bv36) occur only in valley bottoms (5%) and are not common in the land type. These soils are fairly shallow (500 – 700 mm). The clay percentage is 15 – 20% in the A-horizon and 20 – 25% in the B21 horizon. The soil texture is medium sandy clay loam. The B21 horizon have undergone not much leaching and have a high base status.

5.4.9. Streambeds

Streambeds occupy 15% of the valley bottoms and 2.2% of the land type. These areas are characterised by a total lack of soil.

5.5. LAND TYPE Ib314

5.5.1. General

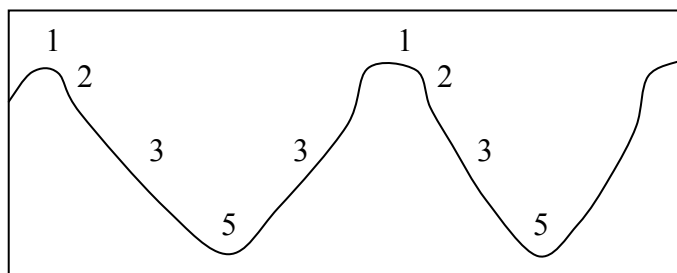
Land type Ib314 is represented on the central southern areas of the farm Malala Hoek, the north-eastern, eastern and central southern areas of Palm Grove, the western areas of Twilight, two areas stretching from north to south on Chirundu and a small area on the eastern side of Boschrand.

Ib in the land type name indicates land types with exposed rock (exposed country rock, stones or boulders) covering 60 – 80% of the area. The rocky portions may be underlain by soil which would have qualified the unit for inclusion in another broad soil pattern were it not for the surface rockiness.

The geological substrate in the land type is metaquartzite, magnetite quartzite, leucocratic quartz-feldspathic gneiss of the Mount Dowe Group, Beit Bridge Complex.

This land type is a single-phase terrain type that consists of 10% crests, 5% scarps, 80% midslopes and 5% valley bottoms.

The terrain form is as follows:



The slope range of crests is 5 - 25%, scarps 75 – 150%, midslopes 8 – 40% and valley bottoms 4 – 15%. The range of slope length of crests is 50 – 200 m, scarps 50 – 100 m, midslopes 100 – 800 m and valley bottoms 10 – 50 m. The slope shape of crests is convex, scarps is straight - concave, midslopes is concave and that of valley bottoms concave. A 100%, 100%, 95% and 45% of units 1, 2, 3 and 5 respectively have mechanical limitations in terms of stoniness and shallowness of soils.

This land type consists therefore of a very steep mountainous topography. It occupies 1874 hectares or 12% of the study area.

There are only a few soil forms or land classes present in this land type. They are rocks, soil series of the Mispah form (Ms10), Hutton form (Hu34 & Hu35), Oakleaf form (Oa16 & Oa36) and streambeds.

5.5.2. Rocks

Rocks are dominant in this land type (63%) and cover 60%, 85%, 65% and 25% of the surfaces of crests, scarps, midslopes and valley bottoms respectively. These areas have a total lack of soil.

5.5.3. Mispah form (Ms)

Soils of the Mispah form are the second most dominant unit and occupy 29% of the total surface of the land type. It is the only soil form on crests (40% - Ms10) and scarps (15% - Ms10) and represents 30% (Ms10) of the areas of midslopes. These soils are very shallow (50 – 250 mm) on hard rock with a

clay percentage in the A-horizon of 8 – 20%. The soil texture is loam medium-coarse sand to sandy loam. The A horizon are non-calcareous and the depth-limiting material is rock.

5.5.4. Hutton form (Hu)

Hutton soils occupies 4.5% of the land type. Hu34 occurs in 5% of the areas of midslopes and Hu35 in 10% of the valley bottoms. Hu34 and Hu35 are non-calcareous in the B21 horizon, have undergone not much leaching and have a high base status. These soils are shallow (300 – 600 mm) and many stones are present in the profile. Ranges of clay percentage are 8 – 15% in the A-horizon and B21 horizons. Soil textures in the B-horizon are loam medium-course sand to sandy loam. The depth-limiting material is rock.

5.5.5. Oakleaf form (Oa)

The Oakleaf form (Oa16 & Oa36) is dominant in the valley bottoms (45%) but occupies only 2.2% of the total area of the land type. These soils are deeper, 600 – 900 mm, and have no mechanical limitations. The clay content in the A-horizon is between 10 – 18%. The clay content in the B21 horizon is between 15 – 25%. The soil texture class of the B-horizon are medium-coarse sandy loam to sandy clay loam. The B-horizon and directly below is non-calcareous. The depth-limiting material is also rocks.

5.5.6. Streambeds

Streambeds occupy 20% of the valley bottoms, only 1% of the land type and are characterised by a total lack of soil.

6. DOMINANT SOIL UNITS

Homogeneous soil units were obtained by grouping soil forms with reconcilable characteristics in specific terrain units (Appendix C). Only the dominant soil forms are used because the others occupy small isolated areas that are not separately manageable. Three soil forms, namely Mispah, Hutton and Oakleaf and rocks dominate the landscapes of the study area. These units cover 93% of the study area.

6.1. ROCKS AND MISPAH SOILS ON CRESTS, SCARPS AND MIDSLOPES

Rocks and Mispah soils are dominant on crests of all five land types, the scarp of land type Ib314 and midslopes of land type Fc483, Fc484 and Ib314. Hutton soils also occur on crests of land types Fc483 and Fc484, but occupy small areas. Mispah soils cover approximately 32% of the study area and are the single most dominant soil form. Rocks are the second most dominant and cover 26% of the study area.

Soils of the Mispah form are very shallow with a medium to coarse loamy sand to sandy loam texture, fairly low clay content and are mostly non-calcareous (Appendix C, Table 1). Some of these soils are however calcareous. This can have an influence on the plant species composition of that area. Bottlebrush Grass

Enneapogon scoparius and Trumpet Thorn *Catophractes alexandri* are typical species in these areas. Last mentioned areas are normally more palatable and game will prefer these areas. Mispah soils have a low moisture content, hygroscopicity, and plant basal cover and are very sandy. They have therefore a very low regeneration potential and carrying capacity.

Degeneration of these soils through overgrazing and erosion results normally in a total loss of topsoil and exposure of the underlying rocks. This process is irreversible. The areas where these soils occur have normally steep slopes and water erosion can be a major problem. The placement and maintenance of especially roads in these areas are very important.

6.2. HUTTON SOILS ON FOOTSLOPES AND SOME MIDSLOPES

Hutton soils are dominant on footslopes of land type Ae266 and midslopes of land type Ah89. Hutton soils do occur on other terrain units and land types but in very small areas. This soil type covers 25% of the study area and is the third most dominant soil form.

These soils are relatively shallow, in comparison with normal Hutton soils, have a medium to coarse loamy sand to sandy loam texture and are mostly non-calcareous with a high base status (Appendix C, Table 2). The shallowness and low clay content of these soils result also in a relatively low potential. The moisture content and hygroscopicity are fairly low and therefore are the regeneration potential and carrying capacity also low. The potential is however higher than that of the Mispah soils.

These soils are, with their straight slopes and long slope lengths, more susceptible to wind erosion than water erosion. Overgrazing of these areas results in a removal of the plant basal cover that leads to a total exposure of the A-horizon. Topsoil has already been lost in many parts of these areas due to wind erosion.

The Hutton soil series on the footslopes of land type Ae266 have a higher clay contents in the A and B21-horizon with a sandy loam to sandy clay loam texture. They are also deeper than the previously mentioned Hutton soil series. They have therefore a higher water-retaining capacity and a higher potential. These areas will be preferred by game and will therefore be more exposed to overgrazing than the other areas. This specific area can be managed separately from the other Hutton soil areas.

6.3. OAKLEAF SOILS IN VALLEY BOTTOMS

Valley bottoms also occur in all the land types and represent 13% of the study area. The Oakleaf soil form is dominant in the valley bottoms and occupy on average 65% of these areas. Clovelly, Hutton and Bainsvley soil forms also occur in the valley bottoms but occupy small isolated areas. This soil type covers 9% of the study area and is the fourth most dominant soil form. These soils are fairly deep because of their position in the landscape. They also have a large range in clay contents and texture classes because of their pedogenesis, and can be subdivided into four groups accordingly (Appendix C, Table 3).

The first group occupy a very small area of land type Ae266. These soils have very low clay content in the A (2 – 6%) and B21-horizons (4 – 8%) and have a medium sand texture.

The second grouping is dominant in valley bottoms of land types Fc483 and Fc484. These soils's clay content is higher than the first groups' and range from 6 – 15% in the A-horizon and 8 – 20% in the B21-horizon. The texture is fine to medium loamy sand to sandy loam.

The third group occurs in land types Ae266, Ah89 and Ib314. These soils's clay content is higher than the second groups' and range from 10 – 20% in the A-horizon and 15 – 25% in the B21-horizon. The texture is medium to coarse sandy loam to sandy clay loam.

The fourth group is only represented in small areas of land type Fc483. The clay content is even higher than the third groups' and range from 15 – 25% in the A-horizon and 20 – 30% in the B21-horizon. The texture is medium sandy clay loam.

These four areas do not have to be managed as separate units. The occurrence of these different areas are however important for the placement of roads, water points and other infrastructure and for understanding of the functioning of the system. A difference in utilisation of these areas by game might also occur because of a difference in vegetation. All the drainage lines in the study area do not have exactly the same vegetation, especially in terms of structure. The difference in clay content might be one of the explanations. Valley bottoms are palatable areas for game and they tend to overgraze these areas, especially with the occurrence of water.

6.4. STREAM BEDS

Stream beds occur in every land type and represents, on average, 17% of the valley bottoms and 2.2% of all land types. These areas are characterised by a total lack of soil. Stream beds are the second single most dominant part of valley bottoms but are mentioned separately because of the total lack of soil and therefore a lack in vegetation (Appendix C, Table 4).

7. **CONCLUSIONS**

- 7.1. Land types do provide an important broad soil pattern classification of the study area.
- 7.2. Two land types, Fc484 and Fc483, occupy 65% (10 050 hectares) of the study area.
- 7.3. The soils present in the study area are directly correlated to the position in the landscape and climatic conditions under which it has developed.

- 7.4. Particular soil types do occur at particular places in the landscapes of Maremani Nature Reserve.
- 7.5. Broad soil patterns are identified in particular landscapes and they show a similarity in the sequences of occurrence of soil forms throughout a landscape.
- 7.6. Soil patterns in the study area are reconcilable with the published descriptions of the land types that occur in the area.
- 7.7. Soil forms and soil series' within a specific terrain unit in a landscape or different landscapes show reconcilable characteristics and are grouped together because their intrinsic behaviour, potential and suitability are more or less the same.
- 7.8. All the soils that occur in the study area have rocks as a depth-limiting material. This is one of the critical limiting factors that influence the occurrence and distribution of vegetation (structural and floristic) in the study area.
- 7.9. Rocks, Mispah, Hutton and Oakleaf soil forms represents 93% of all the soil forms that occur in the study area.
- 7.10. Rocks and Mispah soils dominate the landscapes and occupy 58% of the study area.
- 7.11. These soils occur in all the land types but are mainly limited to crests, scarps and some midslopes with relatively short steep slopes.
- 7.12. The occurrence of lime in Mispah soils can have an influence on the vegetation composition of that area.
- 7.13. Areas where rocks and Mispah soils occur are characterised by a total lack of soil or very shallow sandy soils with a low moisture content, hygroscopicity, plant basal cover and very low regeneration potential and carrying capacity.
- 7.14. Mismanagement of these soils through actions such as overgrazing, grading of roads, misplacement or no maintenance of roads result almost always in a total loss of the topsoil. This process is irreversible.
- 7.15. Hutton soils occupy 25% of the study area but occur mainly on footslopes and midslopes of two land types, namely Ae266 and Ah89.
- 7.16. These soils are relatively shallow, have a medium to coarse loamy sand to sandy loam texture and are mostly non-calcareous. They also have not undergone much leaching and have a high base status.

- 7.17. Hutton soil on the footslopes of land type Ae266 can be separated from other Hutton soils because they are deep and have significantly higher clay contents. They have a medium sandy loam to sandy clay loam texture.
- 7.18. Vegetation on areas where Hutton soils occur will have, because of the medium to coarse sandy nature of these soils, a more typical “sandveld” species composition.
- 7.19. Hutton soils are more susceptible to wind erosion than water erosion. Overgrazing of these areas results in a removal of the plant basal cover that leads to an exposure of the A-horizon. Topsoil has already been lost in many parts of these areas due to wind erosion.
- 7.20. Oakleaf soils dominate valley bottoms (65%) but represent only 9% of the soils that occur in the study area.
- 7.21. These soils are deep because of their position in the landscape. They have a large range in clay contents and texture classes because of their pedogenesis and are subdivided into four groups accordingly.
- 7.22. It is in these valley bottom areas that the all-important riverine vegetation types occur. These areas are very palatable and are preferred by game. Game also utilise these areas, because of the accumulation of minerals and salts, as natural licks.
- 7.23. These areas are susceptible to erosion because of their medium - coarse texture, position in the landscape and accumulation of water during normal thundershowers.
- 7.24. Soil conservation, and a proper management plan, is one of the most important aspects in management because it is the growth medium for vegetation on which animals dependent for fodder and habitat. It also prevents siltation of rivers or dams and can prevent great financial expenses of constructing rehabilitation and erosion control structures.

8. RECOMMENDATIONS

- 8.1. A soil conservation plan can be compiled that address the prevention, management and rehabilitation of degraded areas and co-ordinate soil conservation actions.
- 8.2. Such a plan can include the following aspects.
- 8.2.1. Legal aspects.
- ✓ Determine which Acts are applicable.

- ✓ Determine requirements and compliance.
- ✓ Implement corrective actions.
- ✓ Apply for participation in soil conservation schemes if applicable.

8.2.2. Erosion control.

- ✓ Inventory phase: compile an inventory of eroded areas, classify areas.
- ✓ Planning phase: prioritise areas, compile rehabilitation plans, design erosion control structures, compile monitoring actions.
- ✓ Implementation phase: implement plans, construct control structures.
- ✓ Monitoring phase: monitor structures and other actions.
- ✓ Re-evaluation phase: re-evaluate effectiveness and implement mitigation action.

8.2.3. Roads.

- ✓ Construction of new roads.
- ✓ Maintenance.
- ✓ Identification of problem areas.
- ✓ Rehabilitation of problem areas.
- ✓ Relocation or realignment of roads that cause serious erosion.

8.2.4. Pollution control.

- ✓ Determine possible soil pollution sources.
- ✓ Implement mitigation actions.
- ✓ Monitor pollution for compliance with legal and other requirements.

8.2.5. Integration with other management aspect such as veld condition, stocking rate of game, fire control, bush control etc.

- ✓ Minimize unnatural water and wind erosion through improvement of grass basal cover and species composition by maintaining conservative game stocking rates according to current veld condition and climatic conditions.
- ✓ Minimize erosion through improvement of grass production (basal cover and species composition), and carrying capacity, by combating bush encroachment.
- ✓ Enhance establishment of vegetation in donga erosion areas through removal of the influence of game by fencing off these areas.
- ✓ Combat erosion on areas where old infrastructure was removed through active rehabilitation programmes.

9. REFERENCES

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APPENDIX A – LAND TYPES OF MAREMANI NATURE RESERVE

Slope shape: X – concave, Y – convex, Z – straight.

Land type	Terrain unit	% of land type	Slope %	Slope Length	Slope shape	Dominant soils	% Occurrence
Fc483	1	10	4-10	50-200	Y-Z	Rocks, Mispah, Hutton	20, 65, 15
	3	75	5-45	100-1000	Z-X	Rocks, Mispah, Hutton, Glenrosa	20, 65, 13, 2
	5	15	2-8	50-100	X	Rocks, Clovelly, Oakleaf, Stream beds	5, 10, 60, 25
Fc484	1	10	6-20	50-150	Y	Rocks, Mispah, Hutton	50, 40, 10
	3	80	8-60	100-800	Z-X	Rocks, Mispah, Hutton, Oakleaf, Fernwood	30, 47, 20, 2, 1
	5	10	2-10	20-600	X	Rocks, Oakleaf, Hutton, Stream beds	5, 75, 10, 10
Ae266	1	10	15-50	50-100	Y	Rocks, Mispah	70, 30
	4	70	2-10	250-5000	Y-Z	Rocks, Hutton, Mispah, Clovelly	10, 60, 23, 7
	5	20	4-10	20-150	Z-X	Hutton, Oakleaf, Stream beds	10, 75, 15
Ah89	1	10	4-15	50-150	Y-Z	Rocks, Mispah	20, 80
	3	75	2-10	400-500	Y-X	Rocks, Hutton, Mispah, Clovelly, Glenrosa	5, 63, 10, 20, 2
	5	15	2-5	50-250	Z-X	Hutton, Clovelly, Oakleaf, Bainsvley, Stream beds	5, 5, 70, 5, 15
Ib314	1	10	5-25	50-200	Y	Rocks, Mispah	60, 40
	2	5	75-150	50-100	Z-X	Rocks, Mispah	85, 15
	3	80	8-40	100-800	X	Rocks, Mispah, Hutton	65, 30, 5
	5	5	4-15	10-50	X	Rocks, Hutton, Oakleaf, Stream beds	25, 10, 45, 20

APPENDIX B – LAND TYPE MAP

APPENDIX C - DOMINANT SOIL UNITS

Table 1: Mispah - dominant soil form of crests, scarps and some midslopes.

Land Type	Fc483	Fc484	Ae266	Ae266	Ah89	Ib314
Terrain unit	1	1	1	4	1	1
% Rocks	20	50	70	10	20	60
Dominant soil form	Ms10	Ms10	Ms10	Ms10	Ms10	Ms10
% Occur.	65	40	30	15	60	40
Depth (mm)	100-200	50-200	100-300	100-300	100-300	50-250
Clay % (A)	4-12	8-15	8-15	8-15	6-12	8-20
Texture	me/coSa-LmSa	Lmfi/coSa-SaLm	LmmeSa-SaLm	LmmeSa-SaLm	me/coSa-LmSa	Lmme/coSa-SaLm
A-horizon	Non- calc.	Non- calc.	Non- calc.	Non- calc.	Non- calc.	Non- calc.

Land Type	Ib314	Ib314	Fc484	Fc483	Fc484	Ah89
Terrain unit	2	3	3	3	3	1
% Rocks	85	65	30	20	30	20
Dominant soil form	Ms10	Ms10	Ms10, Ms20	Ms20	Ms20	Ms20
% Occur.	15	30	15	65	30	20
Depth (mm)	50-250	50-250	100-300	100-200	50-200	100-300
Clay % (A)	8-20	8-20	8-15	4-12	8-15	6-12
Texture	Lmme/coSa-SaLm	Lmme/coSa-SaLm	Lmfi/coSa-SaLm	me/coSa-LmSa	Lmfi/coSa-SaLm	me/coSa-LmSa
A-horizon	Non- calc.	Non- calc.	Non- calc. & calc.	Calc.	Calc.	Calc.

Table 2: Hutton - dominant soil form of footslopes and some midslopes.

Land Type	Ae266	Ae266	Ah89	Ah89	Ah89
Terrain unit	4	4	3	3	3
% Rocks	10	10	5	5	30
Dominant soil form	Hu36	Hu34, Hu35	Hu36	Hu44, Hu46, Hu45	Hu34, Hu35
% Occur.	50	10	33	15	15
Depth (mm)	500-1200	400-900	400-1000	500-900	400-1000
Clay % (A)	10-20	8-12	10-15	8-12	8-12
Clay % B21	15-35	10-15	15-20	10-20	10-15
Texture	meSaLm-SaClLm	Lmme/coSa-SaLm	meSaLm	LmmeSa-SaLm	Lmme/coSa-SaLm
B-horizon	Non- calc.	Non- calc.	Non- calc.	Calcareous	Non- calc.
B21-horizon	Eutrophic	Eutrophic	Eutrophic	-	Eutrophic

Sa – sand Lm – loam Cl – clay
 fi – fine me – medium co - coarse

Table 3: Oakleaf - dominant soil form of valley bottoms.

Land Type	Ae266		Fc483	Fc484	Fc484	Fc484
Dominant soil form	Oa31		Oa35, Oa45	Oa33, Oa36	Oa43, Oa46	Oa13, Oa14, Oa16, Oa26
% Occur.	5		40	40	20	15
Depth (mm)	800–1200		900–1200	600–1200	600–1200	600–1200
Clay % A	2 – 6		6–10	6–12	8 – 15	8 – 15
Clay % B21	4 – 8		8–15	8-20	10 – 20	9 – 18
Texture	meSa		LmcoSa-SaLm	Lmfi/meSa-SaLm	LmfiSa-SaLm	LmfimeSa-SaLm
Colour of B-horizon	Not red		Not red	Not red	Not red	Red

Land Type	Ae266	Ae266	Ah89	Ah89	Ib314
Dominant soil form	Oa16	Oa35, Oa36, Oa45	Oa16, Oa26	Oa35, Oa36	Oa16, Oa36
% Occur.	45	25	40	30	45
Depth (mm)	800–1200	800–1200	800–1200	800–1200	600 – 900
Clay % A	15–20	10 – 20	10–20	10 – 20	10–18
Clay % B21	15–25	10 – 25	15–25	10 – 25	15–25
Texture	me/coSaLm-SaCILm	Lmme/coSa-SaCILm	me/coSaLm-SaCILm	Lmme/coSa-SaCILm	me/coSaLm-SaCILm
Colour of B-horizon	Red	Not red	Red	Not red	Red & not red

Land Type	Fc483	Fc483
Dominant soil form	Oa16, Oa26	Oa36, Oa46
% Occurrence	15	5
Depth (mm)	900–1200	900–1200
Clay % A	15 – 25	15 – 25
Clay % B21	20 – 30	20 – 30
Texture	meSaCILm	meSaCILm
Colour of B-horizon	Red	Not red

Table 4: Stream beds

Land Type	Fc483	Fc484	Ae266	Ah89	Ib314
Terrain unit	5	5	5	5	5
% Occurrence in unit	25	10	15	15	20
% Occurrence in land type	3.8	1	3	2.2	1

APPENDIX D – PHOTOS OF DOMINANT SOIL FORMS