Soil Survey and Assessment of Trafficability in the South-West Forests of Western Australia – Adaptive Management and Operational Trials Harvested in Winter 2004

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Cover photograph: Uncorded primary extraction track north of Whisker Road in Murtin forest block,south-west WA. Severe rutting occurred on this site during winter harvesting in 2003 (photograph by Kim Whitford).

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1 Summary

Ten forest sites (timber harvesting sites) within the South-west Forest Region in the Shires of Collie, Bridgetown, Manjimup and Frankland were soil surveyed at a scale of 1:5,000 using free survey techniques.

The soil surveys were conducted to aid in assessing the main soil attributes that influence the development of soil rutting and compaction during timber harvesting operations.

Gravel content, soil texture, slope and depth to rock, clay or texture contrast layers are recognised soil/landform attributes that influence trafficability. The relative importance of these soil/landform attributes in influencing trafficability within the forest sites was assessed.

A value was assigned to each soil landscape attribute that reflects the degree that it influences trafficability. Numerical ratings (referred to as a Trafficability rating) were derived for each soil type by summation of each attribute value. Low values indicate low rutting impact (a high Trafficability rating) while soils prone to rutting have a low trafficability rating.

Soil types containing abundant ironstone gravel and shallow ferricrete within the soil profile exhibited negligible rutting while the occurrence of clayey horizons within 50 cm was commonly associated with moderate to very high rutting.

Trafficability rating tables resulting from this study could provide a guide to predicting soil trafficability risk prior to timber harvesting. However, the authors would like to note that this study was based on assessing soil disturbance from a dry year and the frequency of traffic along snig tracks was not known. Although we recognised that timber harvesting operations usually aim to minimise soil disturbance and thus avoid harvesting when the soil is saturated, the trafficability rating tables should be tested over a range of moisture conditions.

2 Introduction

The purpose of this consultancy is to provide a detailed soil assessment of 10 forest cells within the Southwest Forest Region.

The scope of the work includes:

- soil mapping;
- soil characterisation;
- soil sampling;
- soil analyses and interpretation;
- identify soil factors that influence soil susceptibility to compaction and wheel rutting as a prerequisite in the development of soil trafficability rating tables.

Soil trafficability in respect to timber harvesting activities relates to the impact of tyred and tracked harvesting vehicles on the forest floor. The movement of heavy harvesting machinery can result in soil disturbance and compaction, particularly during wet conditions when soil deformation and disturbance from wheel slippage becomes a major hazard.

Undisturbed forest soils generally have low soil bulk densities and well structured or friable topsoil horizons with high organic matter content.

Wheel slippage of harvesting machinery under moist or wet conditions often results in soil layer mixing, reduction of topsoil organic matter and a decline in soil porosity that reduces soil permeability and aeration. All of these impacts inhibit site regeneration and may lead to a reduction in stand growth and forest productivity (Rab Whitford *et al*. 2003).

The degree to which forest soils are susceptible to soil rutting and compaction depends on their inherent attributes, particularly soil moisture. The main attributes that were considered relevant to the assessment of trafficability by DEC and WADA (see van Gool and Moore, 1999) were:

- soil gravel content;
- soil texture within the top 50 cm of the soil profile;
- depth to texture contrast layer (commonly sandy clay loam or clay);
- occurrence of surface laterite or depth to ferricrete (rock);
- slope.

Ironstone gravel is a common attribute of the soils within the forest region and is considered by DEC (Whitford, 2005) as the most significant variable whereby the risk of rutting is reduced in soil containing > 50% gravel by weight (Wronski, 1984).

Soil mapping and the collection of soil attribute data in areas that have been logged under a range of moisture conditions would provide a basis for understanding which soil attributes or combination of attributes are critical to the assessment of soil trafficability within the south-west forests. The ability to predict soil trafficability would help to manage and reduce the risk of soil degradation during timber harvesting operations.

3 Methodology and approach

3.1 Soil survey

Ten forest sites selected by DEC were soil surveyed and sampled during the months of April, May and June 2005, prior to major rainfall.

The ten sites are listed below:

Barlee, compartment 5, cell 1 (16 ha)

Challar, compartment 9, cell 1 (22 ha)

Channybearup, compartment 2, cells 1-3 (20 ha)

Diamond Two, compartment 12, cell 1 (16 ha)

Dingup, compartment 1, cell 4 (37 ha)

Fleays, compartment 3, cell 32 (33 ha)

Jolly, compartment 1, cell 2 (25 ha)

Lindsay, compartment 25, cell 1-3 (27 ha)

Muirillup, compartment 5, cells 2 and 3c (19 ha)

Preston, compartment 5, cells 1 (26 ha)

The forest sites occur within the Western Darling Range and Warren-Denmark Southland Zones (Schoknecht *et al.* 2004), which contain a variety of soil landforms and vegetation communities including karri, jarrah and marri forest (see Figure 1). The climate is Mediterranean with dry, mild to warm summers and annual rainfall is in the range of 900-1200 mm.

The soils encountered are representative of the dominant soils within the southwest forests that occur over granite-gneiss basement rocks. Soil parent materials are predominantly laterite and laterite colluvium derived from the above-mentioned igneous rocks or soils have developed insitu from underlying clays and weathered rocks in dissected areas stripped of laterite.

Appendix B lists the extent of each WA soil group encountered within each zone. As a comparison, soils of the Donnybrook Sunklands Zone (soils formed on sedimentary rocks) were also included.

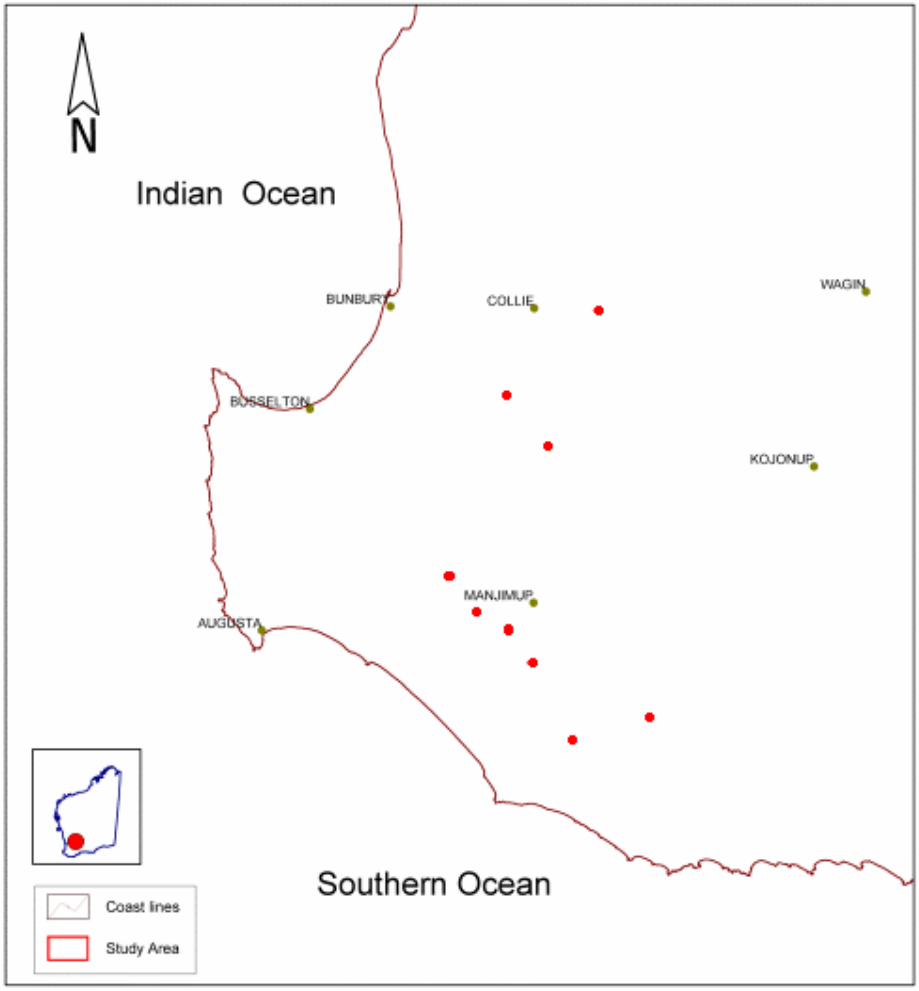

Figure 1. Location of sites within the study area.

The sites were harvested during July to December 2004. Table 1 indicates the period of harvest and the Soil Dryness Index (SDI) during timber harvesting operations. SDI provides a guide to soil moisture conditions and it is derived from rainfall and evaporation (Mount, 1972; Burrows, 1987).

Table 1. Soil Dryness Index (SDI) across the 2004 winter harvesting season.

Note the period of harvest is based on the dates of the initial and final soil disturbance surveys conducted by the Forest Products Commission

Forest block	Compartment	Cell	Area (ha)	SDI		Period of harvest	
				Initial	Final	Initial survey	Final Survey
Barlee	5	1	16.6	0	0	26 July	26 July
Challar	9	1	22.0	115	270	15 September	1 October
Channybearup	2	1	9.6	314	314	8 October	8 October
Channybearup	2	2	9.0	175	175	15 October	15 October
Channybearup	2	3	3.7	332	332	22 October	22 October
Diamond Two	12	1	16.0	82	33	15 July	28 July
Dingup	1	4	37.0	270	274	1 October	13 October
Fleays	3	32	32.7	555	555	21 October	21 October
Jolly	1	2	25.0	144	63	23 September	18 October
Muirillup	5	2	11.0	234	404	18 October	4 November
Muirillup	5	3c	8.0	307	404	1 October	4 November
Preston	5	1	17.6	99	221	20 September	11 November
Lindsay	25 & 26	1	18.0	314	314	8 October	21 October

Daily rainfall records for 2004 from Manjimup WADA Research Station automated weather station are listed in Table 2. A comparison of 2004 rainfall records with historical data indicates that rainfall during 2004 was well below average and lowest recorded in the past 10 years, particularly during the months of September and October.

Table 2. Daily rainfall records for WADA Manjimup automated weather station

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0.2	1.6	0	0	0	1.2	6	0	6.2	0	0
2	0.2	0	2	0	0	0	5.8	10.4	0	0	13.6	0
3	0	0	0	0	0	0	10.6	3	0	0	5.2	0
4	0	0	0.4	0	0	6	2	2	0	0	1.4	0
5	0.2	0.2	0.6	1	0	2.2	0.2	7.8	5.4	0	0	5
6	0	0	0	0	0	15.2	0	5.2	9	6.8	0	1
7	0.2	0	0.2	0	9.4	5.2	14.4	1.8	2.6	4	0	0
8	0	0	4.8	0	3.2	13.8	15.4	0.6	1.8	0	0	0
9	0	2.4	0	0	0.2	4.2	5.2	0.2	5.6	0.8	2.8	0
10	0	2.4	0	0	16.8	5	0.4	0	1.4	0.2	16.8	0
11	0	0	0	0	5	30.8	0.4	0	0	0	2.4	0
12	0	0	0	0	1.2	11.2	2	21.2	0	8	4.6	0
13	0.2	0	0	4.8	0	5.2	0	2.4	0	3.2	0	0
14	0	0	0	0.2	0	1	0	8.8	0	0.4	0	0
15	0	0	0	4.6	0	0	0	0.8	0	0	0	0
16	0	0	0	0.2	8.4	0.2	1.6	0.6	0	3.4	0	0
17	0	0.2	0	0	2.8	18.6	0	2	0	0	5.2	0.2
18	0	0	0	1.6	14	0.6	0	5.8	0	0	3.6	0.6
19	0.4	0	0	2.2	1.6	1.6	0	0	9.6	0	0	0
20	0.2	0.8	0	0	0	0	0	0.2	0	0	0	0
21	0.2	0	0	6.2	7.2	0	6.2	7.2	2.4	0	0	0
22	0	0	0	5.4	19.4	13.4	12.8	1	1.8	0	0	0
23	0	0	0	0.2	1	1.4	2	9.2	0	0	0	0
24	0	0	0.2	0	0	4.6	0.2	12.2	0	0	0	0
25	0	0	0	0.4	0	0.2	9.6	14.8	0	0	0.2	0
26	0	0	0	0	0	0	0	3.8	6.6	0	2	0
27	0	0	0.4	0	0	24	0	16.2	0.2	0	4	0
28	0	0	0	0	0	4	0	6.2	0.6	0	0	0
29	0	0	0	0	0.2	0	0	0.2	0.8	0.6	0	0
30	0.8	-0.1	1	0	0	4.2	8.4	0.4	1.4	0.2	0.2	0
31	1	-0.1	0	-0.1	14.8	-0.1	5.2	1.8	-0.1	0	-0.1	0

Soil mapping utilised coloured, stereo-aerial photography at a scale of 1:5,000 together with location maps for each forest site. The soil survey involved ground traverses using free survey techniques. Soil observation sites were chosen by selecting representative landform elements and vegetation communities. Generally, a soil observation density of 1/ha was set as the minimum standard unless the block was uniform.

Soil observation sites were located with a Garmin GPS 76 and reported as UTM coordinates using GDA 94 datum. Soil observations were carried out with a spade and 75 mm auger to a minimum depth of 50 cm provided rock or stone was not prohibitive. A kilogram soil sample was taken, at each soil observation site, from the upper 30 cm of the topsoil for ironstone gravel determination.

Soil description methods followed Australian standard methods (McDonald and Isbell, 1990) also a standard field sheet, equivalent to McDonald *et al*. (1990) was used to record data. Subsequently soil data was transferred to an Access database.

Soil mapping units (SMU) were identified for each forest site and delineated onto 1:5,000 coloured aerial photography overlain with 5 m contours. The SMU represents the most common soil type or soil association that could be delineated at the scale of 1:5,000. Soil types occurring within SMU generally have similar chemical and physical properties and management potential in relation to trafficability. Other secondary factors that were used to define SMU were slope and landform as these factors influenced water movement and vehicle traction.

Once all forest sites were surveyed the most common soil types were identified. Representative soil profiles of the most commonly encountered soil types were described and sampled from eleven 1.5 m soil pits. Each representative soil profile was photographed using a Canon 7 Mega pixel digital camera.

Soil samples (> 1 kg) were collected from each soil horizon and generally 4 samples were collected from each soil profile. The < 2 mm fractions of the soil samples were analysed. Chemical analysis followed methods listed in Rayment and Higgenson (1992) while soil particle size analysis conformed to Klute, (1986). Analytical methods are listed below:

Organic carbon – method 6B2 (LECO method). Total organic carbon-high frequency induction furnace, volumetric.

Soil pH (1:5 H_20) – method 4A1.

EC (1:5 H_20) – method 3A1.

Exchangeable cations – method 15A1, Exchangeable bases (Ca, Mg, Na, K) 1M ammonium chloride at pH 7.0, no pre-treatment for soluble salts.

Soil particle size (pipette method) – method 15-4.

3.2 Assessment of soil trafficability

Soil trafficability in this assessment relates to the impact resulting from the movement of timber harvesting machinery.

The movement of large rubber tyred or metal tracked machinery disturbs the soil profile through compression, vibration and displacement of topsoil. The impact of vehicle movement depends on the physical properties of the soil, in particular soil bulk density, soil structure and soil strength or consistence which is highly dependent on soil moisture. In general, the impact of vehicle movement is greatest when the soil is saturated (wet) when water content is above field capacity or the upper storage limit (Moore, 1998).

Saturated soil conditions are associated with soil stickiness or evidence of free water when a handful of soil (bolus) is squeezed. Once free water cannot be squeezed from a soil bolus the soil is in the moist state or at its upper storage limit. The terms moist, moderately moist or dry are qualitative terms for soil water content between the upper and lower storage limits (refer to Moore, 1998, Soil water section 3.3).

Moist or saturated soil conditions typically occur during the rainfall season (late autumn to late spring) and saturated soil conditions usually developed in texture contrast soils where soil infiltration is reduced by an abrupt change of soil pore size.

Soil compaction and soil rutting are the main visible impacts of vehicle movement that can be quantified.

Soil compaction

Soil compaction is the increase of soil bulk density resulting from compression by heavy machinery. Soil compaction reduces the soil air filled porosity and hydraulic conductivity as soil pores and root channels are diminished.

Soil compaction can be measured by comparing penetrometer resistance in undisturbed and disturbed areas. This method is simple and quick although it is difficult to replicate measurements in gravelly soils containing > 20% gravel by volume. Soil bulk density is a more precise laboratory method of measuring soil compaction, however obtaining undisturbed soil samples is difficult, particularly from dry, coarse textured gravelly soils that lack coherence.

Soil compaction can also be indicated by the formation of clay and organic laminae within coarse textured profiles that have undergone frequent and heavy traffic. The laminae are usually < 10 mm thick and form bands at the compaction zone through the settling of redistributed fines within a saturated soil profile. Machinery vibration is probably the main mechanism in redistributing soil fines.

Simple field assessments of soil compaction can also determined by probing with a steel rod or narrow bladed spade (tiling spade). In undisturbed forest sites a tiling spade can usually penetrate the topsoil to 40 cm while in compacted areas penetration below 10 cm is often not possible.

Soil rutting

Soil rutting is the deformation of the soil surface, by tyre or track machinery and it is most severe under saturated soil conditions. In general, rutting is associated with compaction and reduction of soil shear strength as soil moisture increases. Once the soil becomes saturated it is easily deformed as the majority of soil pores are filled with water, and since water cannot be deformed, on compression the soil solids are displaced and the soil takes on a liquid state. In the liquid state soil structure and soil pores are destroyed through soil displacement. Also, bonds developed from inorganic and organic cementing agents such as silicates and colloids dissolve or weaken resulting in the formation of mud or slurry.

The development of ruts usually results in the mixing of soil layers, destruction of the topsoil organic mulch and development of water channels and gullies.

Soil rutting was assessed measuring the depth of deformation and extent of topsoil disturbance. A classification of the extent of rutting is shown in Table 3.

Table 3. Rutting classification

Rutting rating	Description
Nil	Negligible topsoil compression evidence of crushed vegetation.
Very low	Topsoil compressed by 5 cm and organic layer intact.
Low	Topsoil compressed by 5-10 cm organic layer mostly intact.
Moderate	Topsoil compressed by 10-20 cm, organic layer disturbed to reveal lower topsoil.
High	Topsoil compressed by 20-30 cm, organic layer incorporated into soil mass. Evidence of soil puddling or mud.
Very high	Topsoil compressed by > 30 cm, organic layer incorporated into soil mass. Evidence of soil puddling or incorporation of subsoil clay.

3.3 Assessment of trafficability factors

The main soil/landform factors that influence forestry related soil disturbance in Australia are reviewed in Ryan, Murphy and McKenzie (2003), while numerous international reviews cover specific regions, e.g. (Arnup, 1999).

However, the local land resources and climate would determine which factors are most relevant. The trafficability assessment was also influenced by the surveyors experience and observation of soil trafficability and water erosion risk in relation to soil conservation practices on agricultural land (see Wells and King, 1989; Moore, 1998).

In this study, the main factors considered specific to the South-west forests include:

- soil texture;
- soil gravel content;
- topsoil depth or depth to texture contrast horizon (sandy clay loam to clay);
- occurrence of laterite rock as outcrop or within the soil profile;
- slope.

These factors are static and can be quantified by field observations and simple tests.

Each soil-land characteristic was assigned a numerical value to the degree that each characteristic would impact on rutting when the soil is moist. These values were determined after completing the soil survey through a process of interpolation and reiteration.

Note: Areas of disturbance in each forest site generally accounted for < 10% of the total area. Therefore values assigned to each soil-land characteristic were interpolated from rutting occurring in only part of the site and rutting was not evident on all soil types. Also, timber harvesting operations were generally carried out after dry periods when topsoil horizons are not saturated so that the risk of rutting is minimal.

Soil drainage is also a major determining factor although its assessment is generally inferred from the above mentioned factors. A more precise assessment of soil drainage also includes consideration of rainfall intensity, position in the landscape and soil structure and colour. However, as the soil observation depth was generally confined to the upper 50 cm of the soil profile it was not possible to assess drainage for all soil profiles particularly the deep duplex soils.

A description of how the soil/ landform factors were assessed is given below.

Soil texture

Soil texture or texture grade was determined by forming a moist soil bolus and pressing it out between thumb and forefinger to produce a ribbon. The length of ribbon is correlated to the clay percentage as per tables in Northcote *et al.* (1979) and thus a texture grade can be determined. (Note: The bolus is formed from the fine earth < 2 mm soil fraction derived by sieving.)

Soil texture provides an estimation of soil water holding capacity (WHC) and drainage (refer to Moore 1998). Coarse textured soils (sands) are rapidly drained and have very low WHC. Sands generally do not achieve field capacity as soil pores are predominantly large and drain under the influence of gravity.

Loamy soils and clays have high WHC as they contain a large proportion of fine pores that retain soil water at high tensions. Soils containing a high proportion of silt are known to have very low bearing capacity and shear strength particular if the soil particle size is poorly sorted. Soils with clay loam to clay texture have a plastic consistence when moulded in the moist state and have very low shear strengths once the soil liquid limit is reached. These soils are less permeable than sands and loams particularly if the soil structure is destroyed through shearing.

Gravel content

Soils containing moderate to abundant gravel are less prone to compaction and have high shear strength as the inert gravel can form a rigid matrix against compaction and shearing -thus maintaining pore space. Furthermore, sub-rounded to angular gravel imparts greater shear strength as these coarse fragments can interlock to resist displacement.

In the field, soil gravel content is determined by sieving with a 2 mm sieve or by visual estimation from a soil cutting using percentage charts (see McDonald *et al.* 1990). Sieving is the preferred method however it is impractical to sieve clayey soils or when the soil is saturated, as fine earth will adhere to the sieve and block sieve apertures.

A visual assessment of gravel retained on a sieve in relation to the < 2 mm fine earth fraction provides a volumetric estimate of gravel content. Weighing representative sieved samples provides a comparison with gravel percentage determined by weight. This allows surveyors to standardise field volumetric estimates with subsequent percentage gravel by weight values determined from laboratory analysis. Figure 2 provides an example of a relationship established with samples derived from a gravelly clayey sand. A regression coefficient of 0.85 was determined for gravel volume estimates within the range of 5-80%.

Note:

- Soil surveyors usually ignore recording values outside the above-mentioned range as estimates outside this range are difficult to reproduce.
- Gravel size influences estimation, as fine gravels are more comparable to fine earth volumes than large gravels.
- Gravel size most commonly encountered within the study area was in the range of 2-30 mm in diameter with most gravels < 15 mm in diameter.
- Soil sieving under field conditions is not practical when the soil is moist or saturated as fine earth will adhere to the sieve and block sieve apertures.

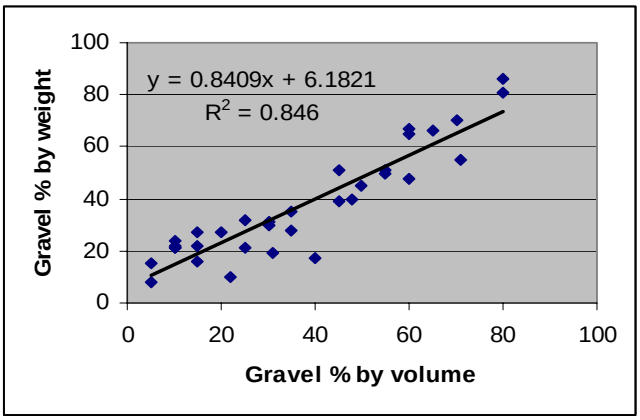

Figure 2. **The relationship between gravel weight percentage and gravel volume percentage.**

Depth to clay or texture contrast layer

This soil factor generally indicates the depth of permeable soil over a less permeable layer. A sudden change in soil texture within a soil profile indicates a change in pore size and thus a reduction in permeability. This results in soil saturation or waterlogging at the texture contrast layer.

In areas of low relief, texture contrast soils can be subject to prolonged subsoil waterlogging and inundation as there is negligible lateral flow. Shallow texture contrast soils (< 30 cm in depth) are more prone to saturation than deeper soils as the shallow topsoils have low water storage, i.e. topsoil saturation can occur following a 8-10 mm rainfall event. Subsequent rainfall can result in surface runoff and subsoil lateral flow. In this condition the less permeable subsoils are more vulnerable to exposure through topsoil displacement. Exposure of the clay subsoil increases surface runoff and subsequent soil erosion.

Deep texture contrast soils (> 50 cm in depth) are also subject to waterlogging, although the upper topsoil horizons are generally better drained than the underlying soil layers.

Laterite outcrop or rock within the soil profile

Soils that are associated with laterite outcrop or soils that contain rock and stone within the soil profile are usually highly stable and resistant to rutting. Laterite outcrop generally indicates that laterite rock is commonly encountered within a depth of 30 cm, together with abundant laterite gravel and stone. In addition clay is rarely encountered within the upper 50 cm of the soil profile. The laterite may occur as separate boulders, or weakly to strongly cemented layers or sheets (see Glossary: Reticulite and ferricrete). Weakly cemented gravel layers such as reticulite generally have high bulk density and shear strength, which is maintained even under moist or wet soil conditions.

Slope

The landform grade or slope has a major influence on trafficability as rutting is more likely to develop on slopes. Slope was recorded as a per cent value and determined in the field using a Suunto inclinometer. .Slopes< 5% have minimal impact on traction as most of machinery weight is evenly distributed over both axles. On progressively steeper slopes more vehicular weight is transferred to one axle thus resulting in increased compaction or soil displacement.

Note: Partial loss of wheel traction in agricultural machinery and light trucks is usually evident on cleared wet slopes > 10% while significant wheel slippage is more prevalent on slopes > 15%.

The development of wheel ruts on moderate to steep slopes increases the risk of soil erosion with gullying often being initiated. Together, the abovementioned soil and land characteristics influence soil water holding capacity, soil drainage and thus the potential of soil deformation under vehicle traffic.

Other factors that were considered in the assessment but not rated as dominant characteristics include:

- Soil colour
- Geology
- Landform

Soil colour

Soil colour of the lower topsoil and subsoil horizons provides an indication of soil drainage, i.e. the colour sequence from black to light grey, yellow, brown and red often indicates improving drainage, with red soil colours usually associated with the best soil drainage and aeration.

In addition, evidence of soil mottles indicates oxidation and reduction reactions brought on by periodic waterlogging.

Note: Soil colours are not always a reliable indicator of soil drainage and cannot be used as the only determinant factor as soil mottling and colour could also be relict from past climatic conditions, e.g. red–brown colours can be associated with seepage areas and swamps where soluble iron has precipitated on drying and oxidation.

Geology

The regional geology or soil parent material determines the mineralogy of the soil clay which influences structure development, clay plasticity and dispersability.

The distribution of karri loams (red-brown loamy earths) is commonly linked to dissected landforms where relatively young soils have developed from granite, gneiss and other metamorphic rocks. The mineralogy of the red-brown earths is dominated by kaolinite although there is also significant vermiculite and illite (McArthur, 2004), which contributes to the development of fine granular structure. The gravelly laterite soils that dominate the plateaux and gently undulating landforms are derived from deeply weathered granites, gneiss and quartzite that form residual gravels, deep yellow or pale sands and mottled pallid clays. The gravelly soils generally have weak to moderately structured subsoils that are partly ferruginised with sesquioxide segregations.

Apart from the broad generalizations mentioned above, geology could not be used as a major determinant of trafficability as most of the blocks studied were mantled by laterite colluvium, soil observation depth was too shallow to identify substrate, and the existing 1:250,000 regional geological information is too broad for the scale of the current mapping exercise.

Landform

The development of soils within the south–west forest is strongly linked to landform and therefore boundaries between landform elements were used to define soil mapping units.

Typically, wet soils are located in depressions and drainage lines. Areas of low relief such as saddles and midslope benches are prone to waterlogging while any break of slope, e.g. concave slopes, footslopes and breakaways are often associated with seepage.

As mentioned above, karri is associated with dissected landforms stripped of laterite caprock. The dominant soils are loamy duplexes, loams and loamy earths that have high WHC. These moist soils occurring within seepage prone landscapes provide an ideal niche for karri. In general, sites that contain karri are optimum moist sites that retain soil moisture or are water gaining areas that can be subject to seepage well into the dry season.

4 Results

4.1 Soil assessment

Nine broad soil units have been identified within the survey area. The soil units represent a variety of soil types that have similar morphological characteristics that can be represented by a soil group (Schoknecht, 2002) or a derivation of a soil group where further distinction is required.

The soil units identified in this study are listed below together with a brief description of a typical soil profile. More detailed descriptions are provided in the supplementary reports for each forest site (see Attachments 1-10) and soil profile descriptions for each observation site appear in the appendices of the supplementary reports.

Soil profiles that were representative of the most common forest soils were described from soil pits, and samples were collected from these soil pits for soil chemical and particle size analysis (refer to Appendix A).

LGr – Loamy gravels

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Kandosol

Description: Very dark brown gravelly loam or sandy loam over yellow-brown to red gravelly sandy loam to sandy clay loam. Topsoil horizons contain > 20% ironstone gravel by volume.

Location: Fleays, Preston, Barlee, Muirullup, Diamond

Landform: Gently inclined upper to mid slopes.

Parent material: Laterite colluvium

Main characteristics:

Well drained to moderately well drained.

Low to moderate water holding capacity.

Moderate to abundant gravel content.

Subsoil clay loam or clay may be encountered within 100 cm.

LGr/c – Loamy gravels over clay

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

Description: Very dark brown gravelly loam or sandy loam containing common to abundant ironstone gravel over yellow-red gravelly sandy loam to light sandy clay loam. Yellow to red mottled sandy clay loam or clay occurs at 30-50 cm.

Location: Lindsay, Preston, Challar, Diamond, Muirillup

Landform: Very gently inclined to steep upper to mid slopes.

Parent material: Laterite colluvium, Gneissic rock

Main characteristics:

Moderately well drained to imperfectly drained.

Common to abundant gravel content.

Moderate to high water holding capacity.

LD – Loamy duplexes

WA soil group: Loamy duplex

Soil classification: Ferric Eutrophic Brown Chromosol

Description: Very dark brown loam or sandy loam containing few to abundant ironstone gravel over yellow-brown sandy clay loam or clay, occurring within 30 cm. Pale yellow or light grey mottling may be evident in the clay horizon. Mottling is indicative of periodic waterlogging.

Location: Diamond

Landform: Very gently inclined to gently inclined upper slopes.

Parent material: Gneissic rock

Main characteristics:

Moderately well drained less commonly imperfectly drained.

Few to abundant gravel content.

BLD – Brown loamy duplexes

WA soil group: Loamy duplex

Soil classification: Ferric Eutrophic Brown Chromosol

Description: Very dark brown loam or sandy loam containing few to abundant ironstone gravel over yellow-brown sandy clay loam or clay, occurring within 30 cm.

Location: Channybearup

Landform: Very gently inclined to gently inclined mid to lower slopes.

Parent material: Gneissic rock

Main characteristics:

Subsoil clay within 30 cm.

Moderately well drained less commonly imperfectly drained.

Few to abundant ironstone gravel and segregations.

LE – Loamy earths

WA soil group: LE – Loamy earth

WA soil group: Friable red-brown loamy earth

Soil classification: Mellanic Eutrophic Brown Kandosol

Description: Very dark brown loam or sandy loam containing few to common ironstone gravel over brown to yellowish red loam to clay loam.

Location: Diamond

Landform: Very gently inclined to gently inclined mid to lower slopes within broad drainage depressions.

Parent material: Gneissic rock

Main characteristics:

Well drained to moderately well drained.

Negligible to common gravel content.

Very high water holding capacity.

High silt content.

RLE – Red loamy earths

WA soil group: Friable red/brown loamy earth

Soil classification: Haplic Eutrophic Red Kandosol

Description: Very dark red-brown loam or sandy loam containing few to common ironstone gravel over brown to yellowish red loam to clay loam.

Location: Channybearup

Landform: Very gently inclined crests to steep sideslopes.

Parent material: Gneissic rock

Main characteristics:

Well drained to moderately well drained.

Negligible to common gravel content.

Very high water holding capacity.

High silt content.

ShGr – Shallow gravels

WA soil group: Shallow gravel

Soil classification: Petroferric Orthic Tenosol

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are very dark grey-brown, gravelly sand to sandy loam overlying yellow to red gravelly sand to sandy loam.

Location: Lindsay, Barlee, Fleays, Dingup, Challar

Landform: Commonly level crests to gently inclined slopes. Rarely moderately steep slopes.

Parent material: Laterite

Main characteristics:

Rapidly drained to moderately well drained.

Abundant gravel content.

Few to common surface rock.

Very low water holding capacity.

SGr – Sandy gravels

WA soil group: Sandy gravel

Soil classification: Basic Ferric Orthic Tenosol

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone.

Topsoils are very dark brown, gravelly loamy sand or clayey sand overlying yellow to red gravelly loamy sand or clayey sand.

Location: Jolly, Lindsay, Barlee, Preston, Fleays, Dingup

Landform: Level to gently inclined slopes.

Parent material: Laterite colluvium and deeply weathered granitic rocks.

Main characteristics:

Rapidly drained to well drained.

Abundant gravel content.

Very low water holding capacity

DSGr – Duplex sandy gravels

WA soil group: Duplex sandy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

Topsoils are very dark brown, gravelly loamy sand or clayey sand overlying yellow to red gravelly loamy sand or clayey sand. Yellow to red mottled gravelly sandy clay loam or clay is encountered by 50 cm.

Location: Lindsay, Barlee, Muirillup

Landform: Very gently inclined crests to steep sideslopes.

Parent material: Laterite colluvium consisting of abundant ironstone gravel and stone overlying ferruginous clay.

Main characteristics:

Well drained to moderately well drained.

Common to abundant gravel content.

Low to moderate water holding capacity

SD – Sandy duplexes

WA soil group: Deep sandy duplex

Soil classification: Ferric Eutrophic Brown Chromosol

Topsoils are very dark brown, loamy sand or clayey sand overlying yellow brown loamy sand or clayey sand, containing few to common ironstone gravel. Yellow to red mottled gravelly sandy clay loam or clay is encountered by 30-70 cm.

Location: Channybearup, Jolly

Landform: Very gently inclined to gently inclined slopes associated with broad flow lines.

Parent material: Colluvium associated with flow lines. Ironstone gravel layers may occur above the clay layer.

Main characteristics:

Well drained to moderately well drained.

Potential subsoil waterlogging.

BDS – Brown deep sands

WA soil group: Brown deep sand

Soil classification: Basic Arenic Orthic Tenosol

This unit is usually associated with open depressions and contains sandy valley infill.

Topsoils are dark brown, humic, loamy or clayey sand overlying strong brown to yellowish red clayey sand that may contain rare ironstone gravel.

Location: Challar

Landform: Gently inclined open depressions and valley side slopes.

Parent material: Colluvium

Main characteristics:

Rapidly drained to well drained.

Negligible or few gravel content.

Low water holding capacity.

4.2 Soil analysis

The analytical data for each of the eleven soil pits is listed together with a soil profile description in Appendix A. The main patterns that can be drawn from the analyses are as follows:

%Stone

Ironstone gravels are generally more abundant within the topsoil horizons and are less common within the subsoil B2 horizons. Discrepancies are evident between laboratory data and field estimations and this is partly because estimates carried out in the field were based on *in situ* visual assessments as soil horizons were commonly saturated and could not be completely sieved, particularly the subsoil clays. Also, soft segregations within the clay samples harden when oven dried and are likely to be included in the gravel component extracted during analysis.

EC(1:5)

Soil electro-conductivity values were typically very low although a slight concentration of salts was evident at the soil surface.

pH (H_20)

The soil reaction trend for most soil profiles was acid. Soil pH values within the topsoil horizons were commonly slightly acid to neutral while subsoil horizons were acid to slightly acid.

Soil particle size

Soil particle size analysis generally conformed to field texturing.

The Channybearup and Diamond soils (karri soils) contained significant proportions of silt relative to clay, which imparted a fine sandy and more clayey, feel to the field texture.

Subsoil clays of laterite soils commonly contained > 45% clay, which should correspond to a field texture of light medium to heavy clay. However, as the clays are predominantly kaolinitic and contain soft ferruginous segregations these two factors will impart a less clayey texture, i.e. light to light medium clay.

Organic carbon

Results from most soils follow the general trend whereby 5-10% organic carbon is encountered within the upper 0-10 cm and < 1% occurs within the lower topsoil horizon.

The red–brown loamy duplex soils within the Channybearup and Diamond blocks contained slightly higher levels of organic carbon throughout the soil profile.

Exchangeable cations

Chemical analyses indicate that most nutrients are concentrated within the organic topsoil horizon. Exchangeable calcium is the dominant cation at the soil surface while more magnesium occurs within the lower soil horizons. This is a common trend although calcium was the dominant cation, throughout the soil profile, in several 'karri loam' soils. The karri loams are generally considered to be the most fertile soils within the south-west (McArthur, 1991).

4.3 Trafficability assessment

As indicated in the methodology section, the soil assessment was carried out in areas logged during an exceptionally dry year and timber harvesting operations were carried out to minimise soil disturbance, e.g. areas prone to rutting were corded. Nevertheless, moderate to very high rutting was evident in karri sites.

Moderate to very high rutting occurred in Diamond within soil units LD, LGr and LE with very high rutting evident on the break of slope within these units. This rutting at Diamond only occurred off the cording when operations off the cording occurred after timber harvesting had finished.

Moderate to high rutting was evident in Lindsay, Challar, Muirillup and Channybearup on soil units LGr/c, RLE and LGr particularly within moderately steep areas.

Rutting was low to negligible on soil units ShGr, SGr and DSGr, which occurred within Dingup, Barlee, Jolly, Lindsay and Fleays.

Table 1 lists the range of each soil/landform characteristic and the assigned numerical score. These values were determined by interpolation and reiteration.

Table 1. Individual scores assigned to soil characteristics to compute the forest trafficability score

Characteristic	Individual score							
	-2	-1	0	1	2	3	4	5
Gravel content 0-50 cm				> 60%	> 40-60%	20-40%	< 20%	
Topsoil texture				Sand	Loamy sand	Clayey sand to sandy loam	Loam to sandy clay loam	Silt loam, clay loam, medium clay
Topsoil depth over sandy clay loam to clay				> 50 cm		30-50 cm		< 30 cm
Presence of laterite or depth to laterite stone or boulder	Outcrop in vicinity or 0-30 cm	> 30-50 cm						
Slope			0-5%	> 5-10%	10-15%	> 15-20%		

Note: Scores for depth to clay or clay loam are not included if laterite is encountered.

Table 2 shows theTrafficability Ratings determined by adding the individual scores for each of the soil characteristics. The sum of these individual scores is the forest trafficability score which corresponds to one of five Trafficability Ratings. Examples of this process, as determined for two soil types are provided in Table 3a.

Table 2. Trafficability rating score

Trafficability rating score	< 5	5-6	7-8	9-10	> 10
Trafficability Rating	Very high (VH)	High (H)	Moderate (M)	Low (L)	Very low (VL)

Example determinations of Trafficability Ratings

Table 3. Calculating trafficability rating for loamy gravel over clay and sandy gravel

Soil type: LGr/c – Loamy gravel over clay

Slope: 6%

Profile morphology

Horizon	Depth (cm)	Description
Ap	0-10	Very dark brown (10YR2/2); **sandy loam**; massive, earthy fabric; pH 5.5. Gradual boundary to
A12	10-40	Pale brown (7.5YR6/4) with dark greyish brown organic staining **gravelly sandy clay loam, 40% ironstone gravel**; massive, earthy fabric; pH 6.0. Clear boundary to
B2	40-60	Strong brown (7.5YR5/8) with common yellow mottles **light clay**; weak, medium angular blocky structure; pH 6.5. Diffuse boundary to

Individual scores: Gravel content = 2; Soil texture = 5; Slope = 1; Depth to clay = 5.

Trafficability rating score: 2 + 5 + 1 + 5 = 13.

Trafficability Rating = very low.

Soil type: SGr – Sandy gravel

Slope: 6%

Profile morphology

Horizon	Depth (cm)	Description
Ap	0-10	Black (10YR2/1); **humic gravelly sand, 50% ironstone gravel**; massive, sandy fabric; pH 6.0. Clear boundary to
A12	10-40	Yellowish brown (10YR5/8) **gravelly loamy sand, 60% ironstone gravel**; structureless, sandy fabric; pH 7.0. Clear boundary to
R	40+	Laterite.

Individual scores: Gravel content = 2; Soil texture = 2; Slope = 1; Depth to clay = 1; Presence of Laterite = -1

Trafficability rating score: 2 + 2 + 1 + 1 – 1 = 5.

Trafficability Rating = High

Summary table

Table 4 provides a summary listing of the soil map units, component soil groups, areas and common soil characteristics and the overall trafficability ratings for wet and dry conditions.

Table 4. Summary of the soils surveyed and Trafficability Ratings

Forest block (total area surveyed)	**Area (ha)**	**Soil map unit**	**WA soil group**	**Topsoil texture fine earth**	**Gravel %**	**Depth to texture contrast (cm)**	**Laterite Occurrence**	**Slope %**	**Trafficability**	
									Moist	**Dry**
Channybearup	16.5	RLE	Friable red/brown loamy earth	sl-scl	< 20	40 +	Not evident	< 6	l-vl	h
(21.6 ha)	2.4	SD	Duplex sandy gravel	lfs-l	< 30	40 +	Not evident	< 5	m	h
	2.7	BLD	Brown deep loamy duplex	lfs-l	< 20	40 +	Not evident	3-20	l-vl	h-m
Fleays	25.6	ShGr	Shallow gravel	ls-cs	60	> 50	30 cm	5-10	h-vh	vh
(37.2 ha)	11.6	SGr + LGr	Sandy gravel + loamy gravel	sl-scl	60	5-> 50	Not evident	7-10	m-vl	vh
Dingup	22.4	ShGr + SGr	Shallow gravel + Sandy gravel	ls-cs	50-70	> 50	< 50	3-5	v-h	vh
(27.2 ha)	4.8	ShGr	Shallow gravel	ls-cs	50-70	> 50	< 50	< 3	v-h	vh
Diamond	7.6	LE	Friable red/brown loamy earth	fsl-l	< 10	> 50	Not evident	5-6	v-l	h-m
(25.6 ha)	6.9	LD	Yellow/brown shallow	sl-lscl	5-60	15-40	Not evident	2-4	m-vl	h
			Loamy duplex							
	11.1	LGr	Loamy gravel	sl-lscl	10-50	35-50	Not evident	4-6	m-l	h-m
Lindsay	14.3	ShGr, vg-gs	Sandy gravel	cs-sl	50-70	> 50	< 50 cm	2-6	vh-h	vh
(29 ha)	2.6	ShGr, mms	Sandy gravel	cs-sl	50-70	> 50	< 50 cm	2-6	h	vh
	4.9	DSGr, mms	Duplex sandy gravel	cs-sl	50-70	45 +	≥ 50 cm+	10-20	l-m	m-h
	7.2	LGr/c	Loamy gravel	sl	25-70	35-55	Not evident	5-20	l-vl	m-h
Muirillup	13.4	DSGr	Duplex sandy gravel	cs	10-50	40-50	Not evident	6-8	l-m	m-h
(33 ha)	19.6	LGr	Loamy gravel	sl-l	20-60	30-60	Not evident	6-20	l-vl	m-h
Preston	10.6	LGr	Loamy gravel	sl-lscl	20-60	5	Not evident	3-8	l-vl	vh
(20.1 ha)	6	LGr/c	Loamy gravel, clay subsoil	sl	30-60	< 50	Not evident	6	l-vl	vh
	3.5	SGr	Sandy gravel	ls-cs	60	> 50	Not evident	7-13	m-h	h-vh
Jolly	11.2	DSGr + SGr	Duplex sandy gravel + Sandy gravel	s-cs	0-70	> 40	Rarely encountered	< 2	l-h	h-vh
(24.8 ha)	13.6	SGr	Sandy gravel	cs	50-70	> 50	Sporadic occurrence	< 2	m-vh	vh
Barlee	10.4	ShGr + SGr	Shallow gravel + Sandy gravel	cs	50-70	> 50	Common outcrops	< 5	h-vh	vh
(16.6 ha)	3.5	DSGr	Duplex sandy gravel	cs-sl	50-70	≥ 30	Not evident	3-8	m-h	Vh
	2.7	DSGr + LGr	Sandy gravel + Loamy gravel	cs-sl	60-70	≥ 25	Rarely encountered	5-12	vl-h	h
Challar	18.3	LGr/c	Loamy gravel	sl	20-70	30-40	Not evident	3-13	m-l	h-vh
(26.2 ha)	3.7	BDS	Brown deep sand	ls-cs	< 10	> 50	Not evident	5-10	m	h
	4.2	ShGr	Shallow gravel	cs-sl	20-70	> 50	< 50 cm	6-10	vh	vh

Topsoil texture codes: s – sand; ls - loamy sand; cs - clayey sand; sl - sandy loam; l – loam; lscl - light sandy clay loam; scl - sandy clay loam.

Trafficability codes: vl - very low; l – low; m – moderate; h – high; vh - very high.

4.4 Soil/Vegetation associations

General soil-geology-vegetation associations were noted during the site surveys. These associations are listed below:

- Jarrah dominant communities were associated with Shallow gravels, Sandy gravels and Duplex sandy gravels, less commonly loamy gravels. Gravel content was commonly in the range of 50-80% by volume and laterite stone or rock outcrop was usually evident.
- Jarrah-marri communities were associated with sandy gravels, loamy gravels and duplex sandy gravels where subsoil clay layers are likely to be encountered within 100 cm. Laterite outcrop was less common within this community.
- Marri dominant communities were commonly associated with loamy gravels, loamy gravels overlying clay and duplex soils. Gravel content was common to abundant but generally less abundant relative to soils supporting jarrah.
- Karri dominant communities often occurred on red or brown loamy earths or loamy gravels with common or moderate gravel (< 60% by volume). Basic or intermediate igneous rocks are the main parent materials.
- Karri-marri communities are associated with gravelly loams and brown loamy duplex soils and deep brown sands occurring within flow lines.

5 Discussion

The soils identified within this study represent over 60% of the soils encountered within the south-west Forests. The main omissions evident from Appendix B are Rocky soils, Semi-wet, Wet soils, Grey loams and Grey duplex soils. Most of these soil types are omitted from timber harvesting as they are subject to prolonged waterlogging and occur within drainage buffers.

All soil texture groups are represented apart from cracking clays or massive clays, which are rare and account for < 1% of forest soils.

The trafficability rating table is generally applicable to the assessment of most soil types within the study area although it was not possible to assess all soil attribute permutations and moisture regimes. In particular, the shallow loamy gravels (gravelly sandy clay loams) containing > 50% ironstone gravel with textures finer than sandy loam are not common within the study area. These soil types occurred in Preston and Fleays with minor areas at Lindsay and Muirillup. The gravelly sandy clay loams were scored as having a very low trafficability rating although negligible or low rutting was evident on these soils.

At Preston and Fleays, LGr soils occurred on gently inclined upperslopes, topsoils depth was commonly < 10 cm and the gravelly sandy clay loam horizons contained 50-70% gravel by volume. Site elevation and shallow topsoil would indicate that this site is prone to runoff thus topsoils are unlikely to remain saturated for long periods. Further site investigations would be warranted in assessing these soils with a range of topsoil depths and gravel content at various moisture regimes.

The friable loamy earths occurring at Diamond (see DIAP03 in Appendix A) appear to be more prone to rutting than similar soils at Channybearup (see CPPO2 in Appendix A). This could be attributed to a combination of landscape position, soil profile depth and site drainage, i.e. loams at Diamond occurred on mid to lower slopes where seepage and subsoil waterlogging were active. Also, the occurrence of weathered rock within soil pits indicated shallow profile depth.

The soil profiles at Channybearup were associated with broad upper slopes while soil pits indicated that soil profiles were deep and well drained with no evidence subsoil waterlogging. Furthermore, the soil pits exhibited well developed structure throughout the soil profile. These characteristic are difficult to assess from auger holes and cannot be determined from topsoil or upper subsoil horizons.

Such examples highlight the many factors that influence soil trafficability and the limitations of assessing soil characteristics from only the upper 50 cm of the soil profile.

In general, the soil gravel content appears to be the main factor influencing rutting within the forest sites as most soils are derived from laterite colluvium containing few to many ironstone gravel. Soils containing > 60% gravel by volume exhibited negligible rutting irrespective of soil profile morphology although further assessment is required of gravelly clay loams.

Soils containing < 40% gravel by volume are commonly associated with Loamy duplex, Sandy duplex soils, Loamy earths and Brown deep sands that are often associated with dissected landscapes and valley deposits.

This soil–landscape association is characterised by high WHC and moisture gaining sites that support karri or marri Forest in contrast to jarrah. These soil types typically have a moderate to very low trafficability ratings.

An exception to this trend are Duplex sandy gravels (DSGr) occurring at Barlee (see site codes BR03 and BR04 in Attachment 1). These soil types are shallow to moderately deep duplex soils occurring within a broad flow line that supports jarrah as the dominant tree with an understorey of tea-tree.

At the above-mentioned sites, topsoil horizons contain coarse angular sand and abundant dark sub rounded to sub angular gravel. This soil unit was assigned a moderate to high trafficability rating as soil rutting was negligible. The occurrence of laterite outcrop or stone and boulders within the soil profile significantly reduces the risk of soil rutting.

Laterite outcrop is almost always associated with abundant ironstone gravel colluvium and soils usually contain > 50% gravel by volume throughout the soil profile. Areas of laterite outcrop are generally confined to plateaux and areas dominated by jarrah. Ferricrete and or reticulite are usually encountered within a depth of 50 cm and clay layers were not encountered above the ferricrete substrate. All soil units containing common laterite outcrop were assessed as having a high to very high trafficability. Minor pockets of low to moderate rutting were evident within ShGr units at Lindsay and Barlee. However, rutting at these sites was associated with depressions containing non-gravelly sands and loams.

The affects of slope could not be assessed for all soil types and all slope categories as most forest blocks had slopes < 10% apart from parts of Channybearup, Muirillup, Diamond and Lindsay where slopes up to 22% were encountered. Moderate rutting was evident on slopes > 15% in the above mentioned cells apart from areas of Shallow gravels within Lindsay.

Severe rutting was evident within Diamond near soil pit DIAP02. The site is situated on a concave slope with a grade of about 10-15% and seepage was evident in the vicinity. Such sites could not be identified from 1:5,000 aerial photography or 5 metre contours. At least 2 metre contours would be required to delineate similar hazardous areas.

It should also be noted that the assessment of soil compaction and rutting within clear felled and selectively logged sites is not directly comparable as soil disturbance within selectively logged sites is mainly confined to snig tracks. The clear felling process causes widespread soil disturbance i.e. (topsoil removal, topsoil burial and exposure of subsoil) which is separate from the development of snig track rutting.

6 Conclusions

The trafficability rating system has general applicability to most soil landscapes within the study area. Most of the five attributes within the rating table can be visually assessed although basic training would be required in soil texturing and gravel estimation.

Soils that have a very high to high trafficability rating are generally shallow gravels, and sandy gravels supporting jarrah forest. These areas are less prone to degradation and capable of being logged over a wide soil moisture range, i.e. during winter and spring.

Karri soils were usually assigned a moderate to very low trafficability rating even though they are generally well structured and contain relatively higher amounts of organic matter, i.e. soil attributes that reduce compaction. Nevertheless, loamy soil texture and high silt fraction promote high WHC. These soil types are associated with dissected landscapes, typically gently inclined to moderately steep slopes that often contain seepage areas.

Timber harvesting within most karri areas should be restricted to summer and autumn prior to major rainfall. Timber harvesting may also be possible in late spring on crest and upper slopes provided that soil profiles are deep and well drained.

Similarly, vegetation communities dominated by marri are often associated with duplex and gradational soils that have a moderate to low trafficability.

The various mixed vegetation communities are not affiliated with specific soil types and generally reflect soil complexity. These communities would warrant selective logging by soil unit.

The soil observation depth of 50 cm is generally sufficient to characterise soil trafficability although a minimum depth of 80 cm is required for soil classification, e.g. a depth of 80 cm distinguishes deep sands from shallow sands or deep duplex soils. Also, the occurrence of subsoil clay between depths of 50-80 cm would be significant in the assessment of drainage and subsoil waterlogging (see Figure 3, Diamond Pit 3), particularly on karri soils.

Further assessment of gravelly loams and clay loam soils, situated on various landscape positions, and is recommended as these soil types were poorly represented.

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9 Glossary

Bearing Capacity: In forest operations soil bearing capacity is usually considered as the maximum allowable wheel contact pressure. Another term used to describe the bearing capacity of soil is vehicle mobility, in particular in the US military.

Bolus The bolus is formed from the fine earth <2mm soil fraction derived by sieving.

Bulk density Bulk density is defined as the mass of oven dry soil per unit volume of soil.

Cementation Refers to brittle, hard consistence due to some cementing substance. The classes of cementation are weakly cemented, strongly cemented, and indurated.

Colour Soil colour is defined in terms of hue, value and chroma using Munsell soil colour charts. Colours are classified by an alphabetical/numerical code of the hue, value and chroma.
e.g. 10YR6/8:
10YR is the hue (brownish yellow)
6: medium high value
8: high chroma
The classification makes it possible to distinguish slight differences in colour. Soil colour is an observable measure of the organic content, and may also be an indicator of drainage and aeration.

Compaction**:** Compaction is the densification of soils as a result of the application of stresses, usually resulting from passes of vehicle traffic. Soil compaction occurs when a soil is subjected to an external pressure that exceeds its strength. The result is compression of the soil leading to a rearrangement of the soil particles and a decrease in pore volume. In forestry, compaction can occur as a result of the movement of the harvesting and snigging machinery and logs over the soil. Compaction can also occur naturally in soils over longer periods as a result of settlement and slumping.

Displacement: Soil displacement is the mechanical movement of soil by equipment and logs. It involves excavation, scalping, exposure of underlying material and burial of topsoils.

Disturbance: Soil disturbance is usually defined in terms of mixing and/or removal of litter and soil, which may change the physical, chemical or biological properties of a soil. Soil disturbance can be used as an index of environment impacts due to logging. Soil disturbance is one of the important factors, which determines the extent and degree of erosion.

Field capacity (Water-holding capacity) The amount of water held in a soil after any excess has drained away following saturation. Generally, soils are considered to be at field capacity after draining for 48 hours.

Ferruginization (Ferruginous adj.) Dissolution of iron from its parent material and its precipitation and formation into clay minerals, yellow-red mottles and segregations.

Footslopes Moderate to very gently inclined waning lower slope.

Hydraulic conductivity: Water can move through soil as saturated flow, unsaturated flow, or vapor flow. Saturated flow takes place when the soil pores are completely filled (or saturated) with water. Unsaturated flow occurs when

the larger pores in the soil are filled with air, leaving only the smaller pores to hold and transmit water. Vapor flow occurs as vapor pressure differences develop in relatively dry soils. Vapor migrates from an area of high vapor pressure to an area of low vapor pressure. Hydraulic conductivity is a soil property that describes the ease with which the soil pores permit water (not vapor) movement. It depends on the type of soil, porosity, and the configuration of the soil pores.

Massive — A soil layer that appears as a coherent or solid mass that has no structure.

Mottles — Mottles are spots, blotches or streaks of colour which can be distinguished from the main background soil colour. Mottles usually indicate periodic waterlogging in the zone of its occurrence.

Pan — An indurated and/or cemented soil horizon. The nature of the dominant cementing agent is used to identify different types of pans. The most common types are:

Silica pan	Cementing agent is amorphous silica analogous to fragipan, silcrete, red brown hardpan and duripan.
Sesquioxide pan	Cemented by iron and aluminium oxides analogous to laterite, bauxite, bog iron ore.
Iron pan	Cemented by iron oxides, analogous to ferricrete, caprock.
Carbonate pan	Cemented by calcium and magnesium carbonates analogous to travertine, calcrete.
Clay pan	Concentrations of dense clays.

Porosity — Soil is approximately 50% pore space or has 50% porosity. Pore spaces vary in size however and the size of the pore space may be as important as the porosity.

Although clay soils have more porosity, more pore space than surface soils water moves more slowly through them because the pore spaces of clay are so small. Macropores, such as tha pore spaces in sand are large enough that they cannot contain water against gravity. Pores that can hold water fter wetting are caled micropores or capillary pores.

Soils with macropores are well aerated while soils with micropores may be wet and airless

Puddling — Soil puddles when it is wet. Puddling is most serious when soil moisture potentials are higher than field capacity because moist soils aggregates have low strength. During puddling, soil aggregates are sheared and the structure that they contribute to soil is destroyed. Volume change is assumed to be small because the soils are nearly saturated, with no air space to displace.

Reticulite — Cemented to weakly cemented loamy sand to sandy clay loam exhibiting a network of voids and channels. Sesquioxides are the main cementing agents.

Saturation — Saturation is defined as the condition in which all the soil pores are filled with water.

Segregations — A soft to hard accumulation of minerals that have formed within the soil by the precipitation of cementing compounds. Some forms of segregation are: concretions, nodules and crystals.

Shear strength — The strength of soil is the maximum shear stress it can sustain, or the shear stress acting on a shear slip surface along which it is failing.

Soil Consistence	The resistance of a soil to deformation or rupture and its degree of cohesion and adhesion. Consistence describes the resistance of a soil to mechanical stress and manipulations at various moisture contents – wet, moist and dry. It is a function of the cohesive and adhesive properties of the soil.
Soil Dryness Index	Numerical indicator of vegetation and topsoil moisture conditions that is derived from rainfall and its frequency.
Soil horizon	A layer of soil that is distinguished by the degree of alteration brought about by soil formation factors. Letters, e.g. A, B, C and D designates soil horizon.
Soil Mineralogy	The dominant minerals that exist in rocks are feldspars, amphiboles, pyroxenes, quartz, mica, apatite, clay, iron oxides (goethite) and carbonate minerals. As these minerals are weathered rocks, new minerals are synthesized in the weathering processes. Those minerals least resistant to weathering disappear first. Quartz is the most resistant so that there is more quartz remaining in soils than other primary minerals. Weathering processes are constant and observable all the time…weathering is stimulated by the naturally occurring acids in nature. As primary minerals are weathered nutrients are released in the form of ions available for plant life. The primary minerals disappear and secondary minerals are formed. Clay minerals begin to accumulate.
Soil moisture content	Soil moisture content is the proportion of water in the soil. It is usually expressed as per unit mass or volume of soil.
Soil reaction trend	Soil reaction trend indicates the general direction of pH changes down the soil profile, that is the change in pH with depth.
Soil structure	Soil structure is the spatial arrangement of individual soil particles. In general, there are three broad categories of soil structure – single grained, massive, and aggregated. When particles are entirely unattached to each other, the structure is completely loose, as it is in the case of coarse sandy soils or unconsolidated deposits of desert dust. Such soils were labelled structureless or single grained structure. On the other hand, when the soil is tightly packed in large cohesive blocks, as is sometimes the case with dried clay, the structure can be called massive. When soil particles are associated in quasi-stable small clods known as aggregates or peds, this structure is called aggregated, is generally the most desirable for plant growth. Soil characteristics such as water movement, aeration, bulk density, and porosity are influenced by the overall aggregation soil particles Soil structure is classified in terms of grade or distinctness (weak, moderate, strong), class or size (fine, medium, coarse, very coarse), and type (granular, platy, prismatic, blocky).
Soil texture	Soil texture is the relative proportions of sand, silt and clay in a soil. Sand is the 2.0 to .05 millimeter fraction and can be divided into very fine, fine, medium, coarse and very coarse sand separates. Silt is the .05 to .002 millimeter (2 microns) particle size separation. It is difficult to feel the difference between fine or very fine sand and silt. Generally, silt feels smooth like powder while sand is gritty. Clay particles

are separates with a diameter of less than .002 millimeters or 2 microns. Clays tend to be plate shaped not spherical and are very small but have a very large surface area per gram.

Soil units

Groupings of soils occurring in the landscape. They should:

* contain soils with similar chemical and physical properties;
* be sufficiently different to justify their separation at the published map scale;
* meet the specified objectives of the soil survey.

Stickiness

Stickiness may seriously hamper a vehicle operating in wet, fine-grained soil. Under extreme conditions, sticky soil can accumulate in vehicle running gears, making travel and steering difficult. Normally, stickiness is troublesome only when it occurs in soils of low-bearing capacity (normally, fine-grained soils).

Structure

The term relates to the arrangement of soil particles. Structured soils have soil particles orderly arranged in a recognisable shape. The forms are: crumb, granular, polyhedral, blocky, platy, columnar and prismatic.

Texture

Soil texture is determined by the proportion of sand, silt and clay content. The descriptive terms fine, medium and coarse refer to the sand particle size, that is:

coarse sand – 2 mm - 0.6 mm
medium sand – 0.6 mm - 0.2 mm; and
fine sand – 0.2 mm - 0.02 mm.

Trafficability (Soil trafficability)

Soil is tractable if a tractor or a forest machine can move on that soil to satisfactorily perform the function of the machine without causing significant damage to the soil. Trafficability can be defined as: the period during the year when soil traffic is possible without causing unfavourable compaction. The trafficability can be split into two components. The first component is the threshold value for trafficability, expressed in moisture content or matric potential, stating whether trafficking is possible. The second component is the period during which the soil is trafficable, which is a function of the soil moisture regime and the threshold values.

Appendix A. Representative soil type descriptions

Project and site code: SWF DIAP01 (see Figure 1)

Date: 18/05/2005

Location: MGA Zone: 50 420251 mE 6190583 mN

Location notes: More gravel below 20-45 cm

Slope: 3%

Site notes: Moderate trafficability rating

Vegetation notes: Tall jarrah, marri, tea tree understorey

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-7	brown (10YR4/3 moist) humic clayey sand; moist soil; massive structure; earthy fabric; 10% rounded ironstone medium gravels; pH 7; clear boundary.
A12	7-45	brownish yellow (10YR6/6 moist) clayey sand; wet soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5; abrupt boundary.
B2	45-90	yellow (10YR8/6 moist) light clay; common reddish yellow (7.5YR6/6 moist) mottles and few reddish yellow (5YR6/6 moist) mottles; wet soil; moderate, angular blocky structure; smooth-ped fabric; pH 6.5; diffuse boundary.
C	90-150+	white (10YR8/1 moist) light clay; common brownish yellow (10YR6/8 moist) mottles and few dark red (2.5YR3/6 moist) mottles; moist soil; moderate, 10-20 mm, angular blocky structure; smooth-ped fabric; ferruginous; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_029	DI1 7-45	43	3	6.8	88	6.5	5.5	0.8	1.24a	0.89a	0.08a	0.03a
802_030	45-90	18	4	6.2	39	16	45	0.28	0.45a	1.04a	0.13a	0.02a
802_031	90-150	26	3	6.1	35	8	57	0.15	0.38a	1.63a	0.16a	< 0.02

Figure 1. Diamond Pit 1 (DIAP01).

Project and site code: SWF DIAP02 (see Figure 2)

Date: 18/05/2005

Location: MGA Zone: 50 420130 mE 6190582

Location notes: Seepage 30 m west.

Site notes: High trafficability rating

Slope: 4-5%

Vegetation notes: Marri

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A0	0-10	black (7.5YR2.5/1 moist) humic loam; moist soil; massive structure; earthy fabric; pH 6.5; clear boundary.
A12	10-40	red (2.5YR4/6 moist) clayey sand; moist soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6; diffuse boundary.
A2	40-70	strong brown (7.5YR5/8 moist) clayey coarse sand; common red (2.5YR5/8 moist) mottles; wet soil; massive structure; earthy fabric; 75% rounded ironstone medium gravels; pH 6; abrupt boundary.
B2	70-120+	strong brown (7.5YR5/8 moist) light medium clay; many brownish yellow (10YR6/8 moist) mottles and common red (2.5YR4/8 moist) mottles; moist soil; moderate, angular blocky structure; smooth-ped fabric; ferruginous concretions; pH 6.

Lab No. 4A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_032	10-40	49	3	6.6	87	8	5	1.22	0.44a	0.69a	0.06a	0.12a
802_033	40-70	45	2	6.3	80	11	9	0.65	0.15a	0.58a	0.06a	0.08a
802_034	70-120	32	3	6.1	40.5	10.5	49	0.59	0.12a	1.67a	0.23a	0.10a

Figure 2. Diamond Pit 2 (DIAP02).

Project and site code: SWF DIAP03 (see Figure 3)

Date: 18/05/2005

Location: MGA Zone: 50 420024 mE 6190621 mN

Site notes: Low trafficability rating

Slope: 6%

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Melanic Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	black (7.5YR2.5/1 moist) humic loam; moist soil; massive structure; earthy fabric; pH 7; clear boundary.
A12	20-65	strong brown (7.5YR4/6 moist) fine sandy loam; moist soil; massive structure; earthy fabric; pH 6.5; gradual boundary.
A2s	65-100	brownish yellow (10YR6/6 moist) clayey sand; wet soil; massive structure; earthy fabric; 70% rounded ironstone coarse gravels; pH 6.5; abrupt boundary.
B2g	100-150+	pale red (2.5YR7/2 moist) gritty sandy clay loam; few medium distinct brownish yellow (10YR6/8 moist) mottles and very few dark yellowish brown (10YR4/8 moist) mottles; wet soil; massive structure; earthy fabric; 10% quartz; pH 6.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_035	0-20	39	9	6.9	94	5.5	0.5	9.79	16.25a	6.76a	0.34a	0.66a
802_036	20-65	17	4	6.5	85	10.5	4.5	0.14	1.19a	1.47a	0.21a	0.26a
802_037	65-100	65	2	6.3	88.5	7	4.5	0.15	0.16a	0.38a	0.09a	0.04a
802_038	100-150	24	6	5.5	41	6.5	52.5	0.25	0.10a	3.07a	0.56a	0.04a

Figure 3. Diamond Pit 3 (DIAP03).

Project and site code: SWF CPP01 (see Figure 4)

Date: 18/05/2005

Location: MGA Zone: 50 413032 mE 6201529 mN

Location notes: Layer 54-130 brittle segregation. 35-40 thin gravel layer 50% Fe

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; massive structure; earthy fabric; pH 6.5; gradual boundary.
A12	10-35	reddish yellow (7.5YR6/6 moist) sandy loam; moist soil; massive structure; earthy fabric; pH 6.5; bleach between A12 - B1; clear boundary.
B1s	35-40	reddish yellow (7.5YR6/6 moist) sandy loam; moist soil; massive structure; earthy fabric; 50% rounded ironstone medium gravels; pH 6.5; clear boundary.
B12	40-54	yellow (10YR7/8 moist) sandy clay loam; moist soil; massive structure; earthy fabric; 10% rounded ironstone medium gravels; pH 6.5; clear boundary.
B2	54-130+	yellow (10YR7/8 moist) light medium clay; common fine distinct red (2.5YR5/8 moist) mottles; wet soil; strong, subangular blocky structure; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_001	CP1 10-40	10	1	6.5	83	9	8	0.84	0.62a	0.51a	0.05a	0.06a
802_002	40-54	19	2	6.6	75	10.5	14.5	0.3	0.44a	0.59a	0.04a	0.06a
802_003	54-130	23	3	6.1	31.5	14	54.5	0.34	0.12a	1.25a	0.07a	0.13a

Figure 4. Channybearup Pit 1 (CPP01).

Project and site code: SWF CPP02 (see Figure 5)

Date: 18/05/2005

Location: MGA Zone: 50 413040 mE 6201704 mN

Slope: 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red deep loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/3 moist) humic fine sandy loam; moist soil; weak, crumb structure; 10% rounded ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-30	yellowish red (5YR5/6 moist) fine sandy loam; moist soil; weak, crumb structure; 15% rounded ironstone fine gravels; pH 6.5; gradual boundary.
B1	30-70	yellowish red (5YR5/6 moist) sandy clay loam; moist soil; weak, crumb structure; 60% rounded ironstone medium gravels; pH 6.5; clear boundary.
B2	70-110	red (2.5YR4/8 moist) light clay; moist soil; moderate, angular blocky structure; 1% rounded ironstone fine gravels; pH 6.5; diffuse boundary.
BC	110-150+	red (2.5YR4/8 moist) clay loam, fine sandy; common brownish yellow (10YR6/8 moist) mottles; moist soil; massive structure; earthy fabric; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_004	CP2 0-10	66	10	7	91	7.5	1.5	5.73	8.02a	3.39a	0.17a	0.34a
802_005	10-30	22	2	6.8	84	9	7	1.8	1.24a	1.12a	0.04a	0.14a
802_006	30-70	44	2	6.6	75	11	14	0.71	0.46a	0.56a	0.04a	0.12a
802_007	70-110	23	3	6.2	34.5	16	49.5	0.36	0.32a	0.55a	0.08a	0.12a

Figure 5. Channybearup Pit 2 (CPP02).

Project and site code: SWF CPP03 (see Figure 6)

Date: 18/05/2005

Location: MGA Zone: 50 413093 mE 6202297 mN

Slope: 5-6%

Site notes: Very low trafficability rating

Vegetation notes: Karri, marri

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Mottled Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (7.5YR2.5/1 moist) humic loam; moist soil; granular structure; pH 6.5; clear boundary.
A12	10-40	strong brown (7.5YR4/6 moist) loam, fine sandy; moist soil; granular structure; pH 6.5; gradual boundary.
B21	40-70	strong brown (7.5YR5/6 moist) light clay; common red (2.5YR5/6 moist) mottles moist soil; granular structure; pH 6.5; clear boundary.
B22	70-130+	reddish yellow (7.5YR7/8 moist) light clay; common red (2.5YR5/6 moist) mottles and common white (10YR8/1 moist) mottles moist soil; moderate, angular blocky and prismatic structure; fine ferruginous 2.5YR5/6; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_008	CP3 0-10	55	5	6.3	82.5	12.5	5	6.99	5.11a	2.28a	0.14a	0.28a
802_009	10-40	43	2	6.5	75	11	14	1.47	0.58a	0.84a	0.05a	0.12a
802_010	40-70	24	2	6.2	34	12.5	53.5	0.84	0.30a	1.78a	0.05a	0.14a
802_011	70-130	29	2	5.9	43	12.5	44.5	0.26	0.07a	1.69a	0.08a	0.06a

Figure 6. Channybearup Pit 3 (CPP03).

Project and site code: SWF CPP04 (see Figure 7)

Date: 18/05/2005

Location: MGA Zone: 50 413372 mE 6201813 mN

Slope: 16%

Site notes: Very low trafficability rating

Vegetation notes: Karri

Current classification

WA soil group: Red deep loamy duplex, 1999

Australian soil classification: Haplic Eutrophic Red Chromosol or Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	dark reddish brown (5YR3/3 moist) humic loam; moist soil; weak, crumb structure; 4% rounded ironstone fine gravels; pH 7; clear boundary.
A12	15-30	red (2.5YR4/6 moist) fine sandy loam; moist soil; weak, crumb structure; 4% rounded ironstone fine gravels; pH 7; gradual boundary.
B1	30-70	red (2.5YR4/6 moist) sandy clay loam; moist soil; granular structure; pH 7; clear boundary.
B2	70-110	red (2.5YR4/6 moist) light clay; moist soil; moderate, granular structure; pH 7; gradual boundary.
BC	110-150+	reddish yellow (7.5YR6/8 moist) light clay; moist soil; moderate, granular structure; pH 7.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_012	CP4 0-15	42	7	7.4	90.5	9.5	< 0.5	4.27	9.40a	1.89a	0.16a	0.57a
802_013	15-30	14	5	7.1	84	11.5	4.5	1.66	3.58a	1.01a	0.07a	0.40a
802_014	30-70	24	3	6.7	63	14.5	22.5	0.46	1.29a	0.55a	0.08a	0.22a
802_015	70-110	22	3	6.4	37	18	45	0.58	1.52a	0.54a	0.14a	0.07a
802_016	110-150	25	3	6.3	47.5	24	29.5	0.34	1.30a	0.46a	0.13a	0.07a

Figure 7. Channybearup Pit 4 (CPP04).

Project and site code: SWF CPP05 (see Figure 8)

Date: 18/05/2005

Location: MGA Zone: 50 412924 mE 6201614 mN

Location notes: Edge of swale

Slope: < 5%

Site notes: Moderate trafficability rating

Vegetation notes*:* Karri, marri, jarrah

Current classification

WA soil group: Yellow/Brown Deep Sandy Duplex

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-30	dark brown (7.5YR3/2 moist) humic clayey sand; moist soil; massive structure; earthy fabric; pH 6.5; gradual boundary.
A12	30-70	strong brown (7.5YR5/6 moist) loamy sand; wet soil; massive structure; sandy fabric; ferruginous; 30% rounded ironstone medium gravels and rounded quartz fine gravels; pH 6.5; abrupt boundary.
B2	70-140+	white (10YR8/1 moist) light clay; many yellow (10YR7/6 moist) mottles and few dark red (2.5YR3/6 moist) mottles; moist soil; weak, granular structure; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_017	CP5 0-30	22	4	7.4	93	5.5	1.5	2.2	3.36a	1.29a	0.08a	0.21a
802_018	30-70	22	2	7.1	86.5	7	6.5	0.29	0.26a	0.37a	0.02a	0.11a
802_019	70-110	24	4	5.8	32.5	12	55.5	0.34	0.17a	1.67a	0.13a	0.19a

Figure 8. Channybearup Pit 5 (CPP05).

Project and site code: SWF JP01 (see Figure 9)

Date: 20/05/2005

Location: MGA Zone: 50 426391 mE 6262008

Slope: < 5%

Site notes: High trafficability rating

Vegetation notes: Jarrah

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark brown (10YR2/2 moist) humic clayey fine sand; moist soil; massive structure; earthy fabric; many medium ferruginous concretions; 50% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	15-55	yellowish brown (10YR5/8 moist) loamy medium sand; moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5; diffuse boundary.
A2	55-100	brownish yellow (10YR6/8 moist) loamy medium sand; moist soil; single grain structure; sandy fabric; 70% rounded ironstone medium gravels; pH 6.5; abrupt, irregular boundary.
B2	100-140+	brownish yellow (10YR6/6 moist) light clay; abundant distinct yellowish red (5YR5/6 moist) mottles; moist soil; moderate, 5-10 mm, angular blocky structure; smooth-ped fabric; 20% subrounded ironstone medium gravels; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_020	JP1 0-15	67	4	6.4	93	7	< 0.5	5.44	5.23a	2.06a	0.18a	0.33a
802_021	15-55	50	3	6.6	92.5	6.5	1	0.56	0.34a	0.40a	0.05a	0.08a
802_022	55-100	49	1	6.8	88.5	8	3.5	0.34	0.27a	0.44a	0.04a	0.08a
802_023	100-140	32	2	6.4	55.5	9.5	35	0.36	0.30a	0.84a	0.06a	0.10a

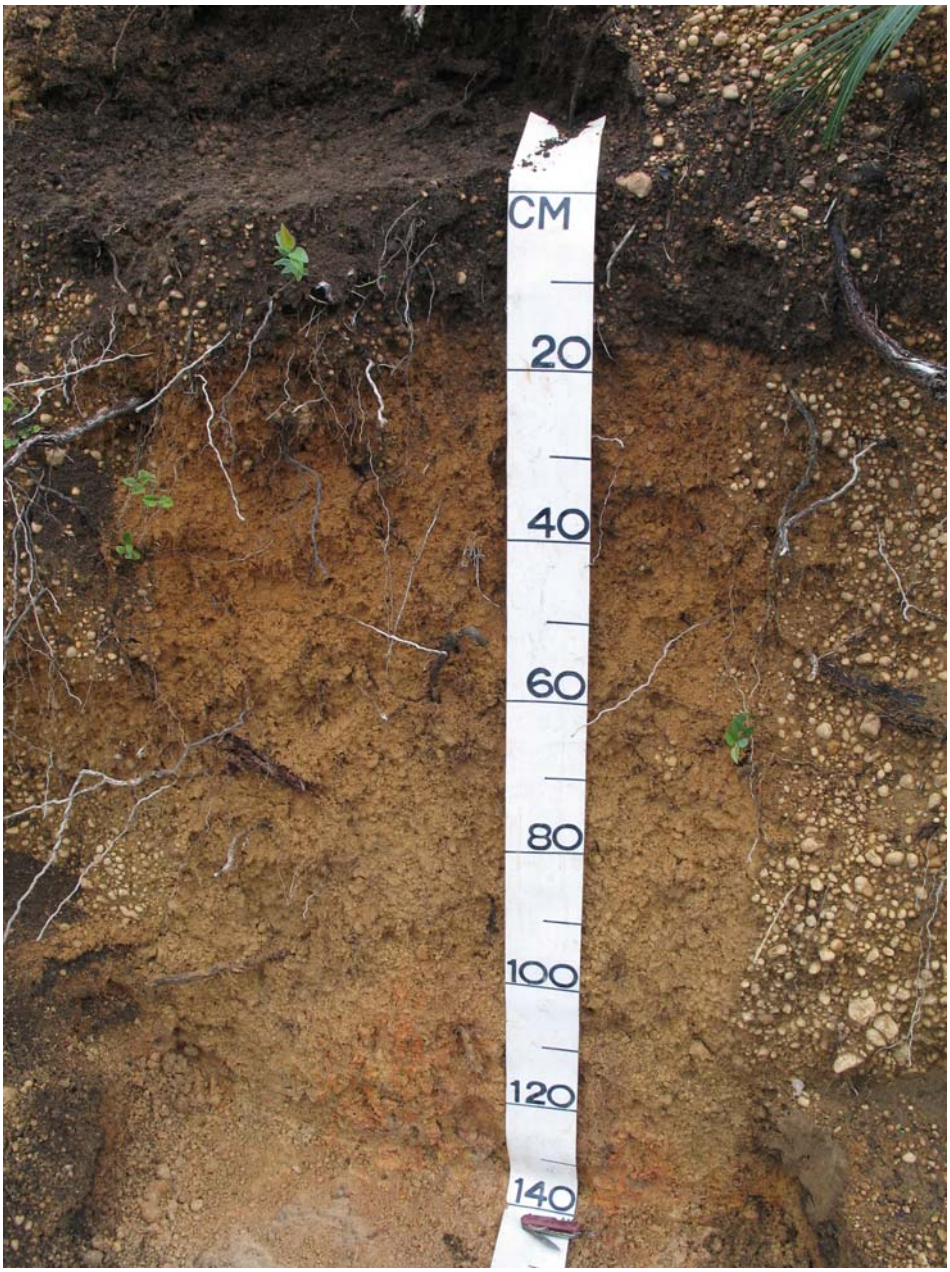


Figure 9. Jolly Pit 1 (JPP01).

Project and site code: SWF LYP01 (see Figure 10)

Date: 19/05/2005

Location: MGA Zone: 50 402150 mE 6207945 mN

Location notes: Head of valley. B2 30% soft segregation 2.5YR4/8. A12 grading to B2 40-50 cm ferruginous SCL-CL.

Slope: 6%

Site notes: Very low trafficability rating

Vegetation notes: Marri few karri

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic sandy loam; moist soil; massive structure; earthy fabric; pH 7; clear boundary.
A12	5-50	brown (7.5YR5/4 moist) sandy clay loam; wet soil; massive structure; earthy fabric; 60% rounded ironstone coarse gravels; pH 6.5; gradual boundary.
B2	50-120+	yellow (10YR7/6 moist) light clay; common red (2.5YR4/8 moist) mottles and few white (10YR8/1 moist) mottles; wet soil; strong, angular blocky structure; 30% rounded ironstone medium gravels; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_024	LY1 5-50	41	4	7.2	68.5	11.5	20	2.31	5.01a	1.78a	0.19a	0.08a
802_025	50-120	30	3	6.5	41.5	16	42.5	0.67	0.96a	0.82a	0.10a	0.04a

Figure 10. Lindsay Pit 1 (LYP01).

Project and site code: SWF LYP02 (see Figure 11)

Date: 19/05/2005

Location: MGA Zone: 50 402239 mE 6207975 mN

Slope: 5%

Site notes: Very high trafficability rating

Vegetation notes: Jarrah, marri

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Ferric Petroferric Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 70% rounded ironstone fine gravels; pH 6; clear boundary.
A12	10-40	brown (7.5YR4/4 moist) loamy sand; moist soil; single grain structure; smooth-ped fabric; 70% rounded ironstone medium gravels; pH 6; abrupt boundary.
R	40-60	strong brown (7.5YR5/6 moist); moist soil; laterite; abrupt boundary.
A13	60-80	brownish yellow (10YR6/6 moist) clayey sand; wet soil; massive structure; earthy fabric; 70% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	80-120+	light yellowish brown (10YR6/4 moist) light clay; many reddish yellow (7.5YR6/8 moist) mottles and few red (2.5YR4/8 moist) mottles; wet soil; sandy fabric; pH 6.5.

Lab No. 04A	Sample	Stones %	EC (1:5) mS/m	pH (H_2O)	Sand %	Silt %	Clay %	C (comb) %	Ca (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%
802_026	LY2 0-10	84	3	5.9	96	4	< 0.5	7.87	8.42a	3.79a	0.18a	0.33a
802_027	10-40	81	2	5.8	92	5	3	1.08	0.53a	0.39a	0.05a	0.03a
802_028	80-120	26	2	6.2	46	15.5	38.5	0.56	0.39a	0.54a	0.09a	< 0.02

Figure 11. Lindsay Pit 2 (LYP02).

Appendix B. Common soils of the South-west forests

WA soil groups (Schoknecht, 2002) found in the Donnybrook Sunklands (zone 214), the Warren-Denmark Southland (zone 254), and the Western Darling Range (zone 255)(Schoknecht *et al.* 2004).

WA soil group	WA soil groups	Area% in soil-landscape zones		
Code	Description	Zone 214	Zone 254	Zone 255
101	Saline wet soil	0	1	2
103	Semi-wet soil	11	9	4
105	Wet soil	8	8	3
201	Bare rock	0	1	2
203	Stony soil	1	1	2
301	Deep sandy gravel*	5	5	6
302	Duplex sandy gravel*	35	15	19
303	Loamy gravel*	3	15	19
304	Shallow gravel*	5	5	5
403	Grey deep sandy duplex	3	7	1
404	Grey shallow sandy duplex	0	2	0
407	Yellow/brown deep sandy duplex*	1	3	2
408	Yellow/brown shallow sandy duplex	0	1	4
422	Pale shallow sand	2	1	0
424	Yellow/brown shallow sand	0	0	1
441	Brown deep sand*	1	0	0
443	Gravelly pale deep sand	4	1	2
444	Pale deep sand*	8	8	3
446	Yellow deep sand*	6	2	2
462	Brown sandy earth	0	0	1
464	Yellow sandy earth	2	1	2
465	Pale sandy earth	3	0	0
505	Brown deep loamy duplex*	0	3	4
506	Red deep loamy duplex	0	1	0
508	Yellow/brown shallow loamy duplex	0	1	4
541	Brown loamy earth*	1	3	5
543	Friable red/brown loamy earth*	1	3	4
544	Red loamy earth*	0	0	1
545	Yellow loamy earth	1	0	1
* Soil group identified in this study.				
214 Donnybrook Sunkland Zone				
254 Warren-Denmark Southland Zone				
255 Western Darling Range Zone				
Note: Soils comprising < 1% were omitted from the table				

Attachment 1 - Soil Assessment of Barlee

Compartment 5, Cell 1,
Barlee Road, Manjimup

Summary

Barlee Compartment 5, Cell 1 contains 3 soil/landform units.

ShGr+SGr: Shallow gravels and Sandy gravels on very gently inclined slopes.

DSGr: Duplex sandy gravels within a broad swale.

SGr+LGr: Sandy gravels and Loamy gravels on gentle slopes.

Soil unit ShGr+SGr has a high to very high trafficability rating. DSGr has a moderate to high trafficability rating while minor areas of loamy gravel within soil unit SGr+LGr have a very low trafficability rating.

Site description

This site has an area of approximately 16 hectares and consists of jarrah and marri forest with jarrah being the dominant trees.

The site is very gentle to gently undulating with slopes generally < 5%.

A broad laterite spur extends from the southern boundary to the centre of the block. Very gentle to gentle slopes grade to the north and west and a broad open depression (swale) covers the upper third of the block.

Geology

Regional geological mapping indicates that Archean quartz-feldspar biotite gneiss (Wilde and Walker, 1984) is the dominant basement rock.

Boulder laterite and ironstone cap rock occurs on the broad spur while most of the block is mantled by ironstone gravel colluvium.

Soils

Three soil units were identified that represent associations of ironstone gravel soil types occurring on a very gentle to gently undulating plateau.

The soil units are described below and soil profile descriptions are provided in Appendix A.

ShGr+SGr: Shallow gravels and Sandy gravels on very gently inclined slopes.

WA soil group: Shallow gravel, Sandy gravel.

Soil classification: Petroferric Orthic Tenosol.

This unit is associated with a broad laterite spur and very gently inclined slopes having a grade commonly < 5%.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock. Topsoils are dark brown, humic gravelly clayey sand overlying yellowish brown to strong brown gravelly clayey sand or less commonly sandy loam. The sandy gravel horizon extends below 50 cm or may overlie laterite boulders or ferricrete.

Gravel content was commonly in the range of 50-70% by volume and gravel size was generally < 10 mm diameter. Laterite boulder outcrop was common on the ridge of the laterite spur and it occurred sporadically through out the unit.

The soil reaction trend is neutral.

Trafficability rating

These soils typically have a high to very high trafficability rating due to the abundant gravel content, occurrence of shallow boulder laterite and absence of clay within the soil profile.

Soil rutting was not evident within the soil unit apart from Site 9 where upper topsoil horizons contained few gravel.

DSGr: Duplex sandy gravels within a swale

WA soil group: Duplex sandy gravel.

Soil classification: Ferric Eutrophic Brown Chromosol.

This soil unit is associated with lower slopes associated with a broad swale having a grade of 3-8%.

Soil types include Duplex sandy gravels, sandy gravels and minor areas of loamy gravel. Topsoils are dark brown gravelly clayey sand to sandy loam overlying brown or strong brown gravelly sand to sandy loam. Abundant gravel is evident throughout the soil profile including the subsoil clay. Ironstone gravel content is usually 50-70% by volume and gravel size < 10 mm diameter. Clay was not always encountered within 50 cm although slightly paler subsoil colours within the sandy gravels indicate subsoil saturation as a result of confining subsoil clay.

A scree of fine, black, subangular ironstone gravel was commonly evident within this unit particularly in the area between sites 1 and 2.

The soil reaction trend is acid to neutral.

Trafficability rating

This soil unit has a moderate to high trafficability rating as indicated by the very high gravel content. Tyre rutting was not evident.

SGr+LGr: Sandy gravels and Loamy gravels on gentle slopes

WA soil group: Loamy gravel, Sandy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

This soil unit represents gentle slopes bordering the western edge of the laterite spur having a grade of 5-12%.

Soil parent material is laterite colluvium.

Soil types are similar to soil unit DSGr although slopes have more grade and the duplex soils have clay horizons occurring at 25-40 cm. Topsoils are dark brown gravelly clayey sand to sandy loam containing abundant ironstone gravel overlying yellowish brown to strong brown gravelly clayey sand to sandy loam. Subsoil clays are strong brown light to medium clay containing negligible gravel.

The soil profile usually has a neutral soil reaction trend.

Trafficability rating

This soil unit has moderate to low trafficability rating as a result of the gentle slopes and areas of clay subsoil.

Minor areas of slight to moderate rutting were evident.

Management considerations

Most of Barlee block contains gravelly soils that have a high to very high trafficability rating.

Areas prone to rutting occur at the break of slope along the western edge of the laterite spur.

Soil profile descriptions – Barlee, Compartment 5, Cell 1

Project and site code: SWF BR01

Date: 13/04/2005

Location: MGA Zone: 50 393286 mE 6219353 mN

Slope: 7%

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moderately moist soil; massive structure; earthy fabric; 50% rounded ferruginous ironstone fine gravels; pH 6; clear boundary.
A12	10-30	brown (7.5YR4/4 moist) gritty sandy loam; moderately moist soil, slightly sticky; massive, crumb structure; earthy fabric; 70% rounded ferruginous ironstone medium gravels; pH 6.5; gradual boundary.
A13	30-50	Strong brown (7.5YR4/6 moist) gritty clayey sand; moist soil; massive, crumb structure; 70% ferruginous ironstone; pH 6.5.

Project and site code: SWF BR02

Date: 13/04/2005

Location: MGA Zone: 50 393378 mE 6219403 mN

Location notes: No rutting. Dark surface gravel.

Slope: < 7%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Bleached-Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic clayey sand; slightly sticky; massive structure; earthy fabric; 70% rounded ferruginous ironstone medium gravels; pH 5.
A2	10-20	brown (7.5YR5/4 moist) gritty clayey sand; slightly sticky; single grain structure; sandy fabric; 70% subangular ferruginous fine gravels and subrounded; pH 6.
B2	20-50	strong brown (7.5YR4/5 moist) gritty clayey sand; non-sticky; single grain structure; sandy fabric; 70% subangular ferruginous medium gravels and subrounded; pH 5.5.

Project and site code: SWF BR03

Date: 13/04/2005

Location: MGA Zone: 50 393402 mE 6219486 mN

Slope: < 8%

Site notes: High trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	strong brown (7.5YR4/6 moist) humic clayey fine sand; moderately moist soil, non-sticky; single grain structure; 30% subrounded ferruginous; pH 6.5; clear boundary.
A2	10-40	brown (7.5YR5/4 moist) coarse sand; moist soil, non-sticky; single grain structure; 80% subrounded ferruginous fine gravels; pH 6.5; clear boundary.
B2	40-60+	strong brown (7.5YR5/8 moist) sandy light clay; moist soil; weak, crumb structure; 70% subrounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF BR04

Date: 13/04/2005

Location: MGA Zone: 50 393252 mE 6219447 mN

Slope: 5-6%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; moderately moist soil; single grain structure; 70% subrounded ferruginous medium gravels; pH 6; clear boundary.
A12	10-35	strong brown (7.5YR4/6 moist) clayey sand; moderately moist soil; single grain structure; 70% subrounded ferruginous; pH 6; gradual boundary.
B2	35-50	strong brown (7.5YR5/6 moist) sandy clay loam; moist soil; weak, crumb structure; 70% subrounded ferruginous; pH 6.

Project and site code: SWF BR05

Date: 13/04/2005

Location: MGA Zone: 50 393287 mE 6219285 mN

Slope: 11%

Site notes: Very low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic clayey sand; single grain structure; 60% subrounded ferruginous fine gravels; pH 6; clear boundary.
A12	10-25	yellowish brown (10YR5/4 moist) sandy loam; single grain structure; 70% subrounded ferruginous fine gravels; pH 6; abrupt boundary.
B2	25-50+	strong brown (7.5YR5/8 moist) light medium clay; weak, granular structure; 50% subrounded ferruginous medium gravels; pH 6.5.

Project and site code: SWF BR06

Date: 13/04/2005

Location: MGA Zone: 50 393378 mE 6219317 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Other classifications

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ferruginous medium gravels; pH 6; clear boundary.
A12	5-25	yellowish brown (10YR5/4 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 70% rounded ferruginous medium gravels; pH 6; sharp boundary.
R	25+	ferricrete; Laterite cap rock.

Project and site code: SWF BR07

Date: 13/04/2005

Location: MGA Zone: 50 393485 mE 6219271 Mn

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	black (7.5YR2.5/1 moist) humic sandy loam; slightly sticky; massive structure; earthy fabric; 70% rounded ferruginous fine gravels; pH 6.5; clear boundary.
	10-50+	strong brown (7.5YR4/6 moist) sandy loam; slightly sticky; massive structure; earthy fabric; 70% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF BR08

Date: 13/04/2005

Location: MGA Zone: 50 393546 mE 6219166

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	black (7.5YR2.5/1 moist) humic clayey sand; massive structure; earthy fabric; 5% rounded ferruginous fine gravels; pH 6.
A12	3-20	strong brown (7.5YR4/6 moist) sand; single grain structure; sandy fabric; 75% rounded ferruginous fine gravels; pH 6.
R	20	Laterite.

Project and site code: SWF BR09

Date: 13/04/2005

Location: MGA Zone: 50 393451 mE 6219130 mN

Location notes: Some rutting (low rating)

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/3 moist) humic clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 5% rounded ferruginous fine gravels; pH 6.5.
A12	5-15	strong brown (7.5YR5/6 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 5% rounded ferruginous fine gravels; pH 6.5.
A13	15-50	strong brown (7.5YR5/6 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 70% rounded ferruginous fine gravels; pH 6.

Project and site code: SWF BR10

Date: 13/04/2005

Location: MGA Zone: 50 393361 mE 6219178 mN

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark greyish brown (10YR4/2 moist) humic clayey sand; moderately moist soil, slightly sticky; single grain structure; sandy fabric; 60% rounded ferruginous fine gravels; pH 6; clear boundary.
A12	5-50+	yellowish brown (10YR5/4 moist) clayey fine sand; moist soil, slightly sticky; single grain structure; sandy fabric; 70% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF BR11

Date: 13/04/2005

Location: MGA Zone: 50 393279 mE 6219205 mN

Slope: 5-7%

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	brown (7.5YR4/3 moist) humic sandy loam; moderately moist soil; weak, < 2 mm, crumb structure; 50% subrounded ferruginous fine gravels; pH 6; clear boundary.
	10-50+	strong brown (7.5YR5/5 moist) sandy loam; moderately moist soil; weak, < 2 mm, crumb structure; 70% subrounded ferruginous fine gravels; pH 6.

Project and site code: SWF BR12

Date: 13/04/2005

Location: MGA Zone: 50 393241 mE 6219039 mN

Slope: 10%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (10YR4/3 moist) humic clayey sand; slightly sticky; weak, < 2 mm, crumb structure; 60% rounded ferruginous fine gravels; pH 6.5; clear boundary.
A12	10-50+	yellowish brown (10YR5/4 moist) clayey sand; slightly sticky; weak, < 2 mm, crumb structure; 70% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF BR13

Date: 13/04/2005

Location: MGA Zone: 50 393191 mE 6218917

Location notes: Gravel size 3-20 mm (1-2)

Slope: 6%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (7.5YR4/4 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ferruginous fine gravels; pH 6.5; clear boundary.
A12	10-50+	strong brown (7.5YR5/6 moist) clayey medium sand; moist soil; single grain structure; sandy fabric; 70% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF BR14

Date: 13/04/2005

Location: MGA Zone: 50 393288 mE 6219009 mN

Slope: 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-2	black (10YR2/1 moist) humic clayey sand; moderately moist soil; sandy fabric; 10% subrounded ferruginous medium gravels; pH 5; abrupt boundary.
A2	2-30	yellowish brown (10YR5/4 moist) clayey sand; moderately moist soil; sandy fabric; 70% subrounded ferruginous medium gravels and subangular; pH 6.5; gradual boundary.
B1	30-40	strong brown (7.5YR5/6 moist) sandy loam; moist soil; weak, crumb structure; smooth-ped fabric; 70% subangular ferruginous medium gravels; pH 6.5; clear boundary.
B2	40-60	strong brown (7.5YR5/8 moist) light clay; moderately moist soil; weak, 2-5 mm, angular blocky structure; smooth-ped fabric; 1% angular ferruginous medium gravels; pH 7.

Project and site code: SWF BR15

Date: 13/04/2005

Location: MGA Zone: 50 393352 mE 6219100 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark greyish brown (10YR4/2 moist) humic loamy sand; moderately moist soil, non-sticky; single grain structure; sandy fabric; 70% rounded ferruginous medium gravels; pH 6; clear boundary.
A12	10-50+	yellowish brown (10YR5/4 moist) clayey sand; moderately moist soil, slightly sticky; single grain structure; sandy fabric; 70% rounded ferruginous medium gravels; pH 6.5.

Project and site code: SWF BR16

Date: 13/04/2005

Location: MGA Zone: 50 393391 mE 6219025 mN

Location notes: Sharp (angular) sand. Gravel size 3-30 mm

Slope: < 5%

Site notes: Very high trafficability rating

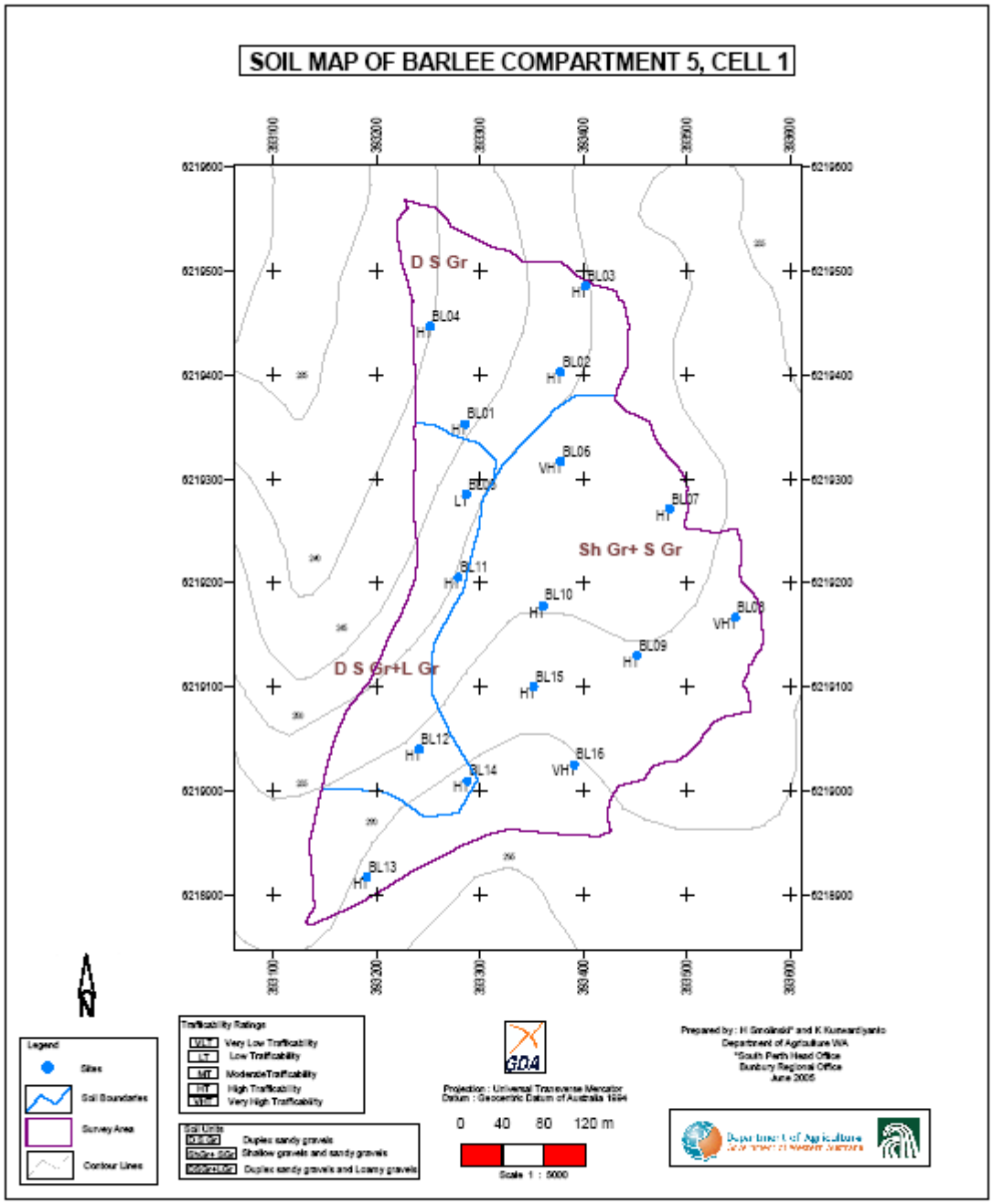
Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic clayey medium sand; non-sticky; single grain structure; sandy fabric; 50% subrounded ferruginous fine gravels; pH 5; clear boundary.
A12	5-30	brown (7.5YR5/4 moist) clayey medium sand; non-sticky; single grain structure; sandy fabric; 70% subrounded ferruginous fine gravels; pH 6.
R	30	Laterite.


SOIL MAP OF BARLEE COMPARTMENT 5, CELL 1
D S Gr
Sh Gr+ S Gr
D S Gr+L Gr
BL01
BL02
BL03
BL04
BL05
BL06
BL07
BL08
BL09
BL10
BL11
BL12
BL13
BL14
BL15
BL16
Legend
Sites
Soil Boundaries
Survey Area
Contour Lines
Trafficability Ratings
Very Low Trafficability
Low Trafficability
Moderate Trafficability
High Trafficability
Very High Trafficability
Soil Units
Duplex sandy gravels
Shallow gravels and sandy gravels
Duplex sandy gravels and Loamy gravels
GDA
Projection : Universal Transverse Mercator
Datum : Geocentric Datum of Australia 1994
0 40 80 120 m
Scale 1 : 5000
Prepared by : H Smolinski* and K Kunwardjanto
Department of Agriculture WA
*South Perth Head Office
Bunbury Regional Office
June 2005

Attachment 2 – Soil Assessment of Challar

Compartment 9, Cell 1
Bevan Road, Manjimup

Summary

Challar Compartment 9, Cell 1 contains 3 soil units.

ShGr: Shallow gravels.

BDS: Brown deep sands.

LGr/c: Loamy gravels over clay.

Most of the site has a low trafficability rating apart from the laterite plateau which is associated with shallow gravelly soils that have a very high trafficability rating.

Site description

This site has an area of approximately 23 hectares and consists predominantly of karri forest with marri and jarrah being secondary forest trees. The cell is centred on a very gentle inclined laterite plateau with gentle to moderately steep (3-13%) side slopes. It also contains two broad flow lines consisting of deep sandy soils.

Geology

Regional geological mapping indicates that Proterozoic Porphyritic Granite (Wilde and Walker, 1984) is the dominant basement rock. Rock outcrop was not evident apart from minor scattered granite stone and gravel.

Boulder laterite and cap rock was evident on the plateau and along broad spurs.

Soils

The 3 soil units represent an association of soil type and landform.

The soil units are described below and soil profile descriptions are provided in Appendix A.

ShGr: Shallow gravels

WA soil group: Shallow gravel

Soil classification: Petroferric Orthic Tenosol

This soil unit is associated with the laterite plateau and upperslopes and contains shallow gravelly soils.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are dark brown, humic, gravelly clayey sand to loam overlying strong brown gravelly clayey sand to sandy loam that is massive or displays a weak crumb structure. Laterite gravel and stone is common to abundant within the soil profile and laterite boulder or ferricrete is usually encountered within 50 cm.

The soil reaction trend is neutral.

Trafficability rating

These soils typically have a very high trafficability rating, which is due to the abundant gravel content, occurrence of shallow boulder laterite and absence of clay above the ferricrete.

Soil profiles are well drained.

BDS: Brown deep sands

WA soil group: Brown deep sand

Soil classification: Basic Arenic Orthic Tenosol

This unit is associated with open depressions and contain sandy valley infill.

The soils are deep sands that display minimal development apart from slight texture increase with depth and colour contrast between the lower topsoil and subsoil horizons. Topsoils are dark brown, humic, loamy or clayey sand overlying strong brown to yellowish red clayey sand that may contain rare ironstone gravel. The soil profile has a loose consistence and it is structureless with a sandy fabric.

The soil reaction trend is neutral.

Trafficability rating

These soils have a moderate trafficability rating. Although the soil profile is deep and generally rapidly drained the side slopes within the depression are prone to subsoil waterlogging and are subject to run-on. Slight rutting was evident and tracks were very compact.

LGr/c: Loamy gravels over clay

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

This soil unit is associated with mid to upperslopes having a grade of 3-13%.

Soil parent material is laterite colluvium overlying clay formed *in situ* from granite. The soils are commonly loamy gravels that usually have a clay subsoil occurring at 30-40 cm.

Duplex sandy gravels and sandy gravels are minor associated soils. These soils generally have a clayey sand matrix while the sandy gravels did not contain clay within a depth of 50 cm. Loamy gravels have dark brown sandy loam surface horizons overlying strong brown gravelly sandy loam, containing abundant ironstone gravel. Yellowish red or less commonly yellow-brown clay was encountered at 30-40 cm. Strong to moderately developed, fine angular blocky structure was evident in the upper subsoil horizon. Few ironstone gravel were usually evident within the subsoil clay.

The soil profile usually has a neutral soil reaction trend.

Trafficability rating

This soil unit has a moderate to low trafficability rating. Low to moderate rutting was evident, particularly in minor depressions.

Management considerations

Most of Challar has a low trafficability rating as subsoil clay was usually encountered by 40 cm.

Soil profile descriptions – Challar, Compartment 9, Cell 1

Project and site code: SWF CH01

Date: 20/4/2005

Location: MGA Zone: 50 459436 mE 6172268 mN

Slope: 10%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/3 moist) humic sandy loam; moderately moist soil; 15% rounded ferruginous ironstone medium gravels; pH 7; gradual boundary.
A12	10-30	strong brown (7.5YR4/6 moist) sandy loam; moderately moist soil, slightly sticky; 40% rounded ferruginous ironstone coarse gravels; pH 7; gradual boundary.
B2	30-60	yellowish red (5YR5/6 moist) light clay; moderately moist soil; 1% rounded ferruginous ironstone fine gravels; pH 6.5.

Project and site code: SWF CH02

Date: 12/04/2005

Location: MGA Zone: 50 459397 mE 6172312 mN

Slope: 10%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/3 moist) humic clayey sand; moderately moist soil; massive structure; earthy fabric; 10% rounded ferruginous ironstone medium gravels; pH 7; gradual boundary.
A12	10-30	strong brown (7.5YR5/8 moist) clayey sand; moderately moist soil, slightly sticky; granular structure; 60% rounded ferruginous ironstone medium gravels; pH 7; clear boundary.
B2	30-60	yellowish red (5YR5/8 moist) light clay; moderately moist soil; 70% rounded ferruginous ironstone medium gravels; pH 7.

Project and site code: SWF CH03

Date: 12/04/2005

Location: MGA Zone: 50 459399 mE 6172377 mN

Slope: 6-7%

Site notes: Low trafficability rating

Current classification

WA soil group: Brown deep sand, 1999

Australian soil classification: Basic Arenic Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/4 moist) humic loamy sand; moist soil; 1% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-20	strong brown (7.5YR4/6 moist) clayey sand; moist soil; 1% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A13	10-60	yellowish red (5YR5/8 moist) clayey sand; moist soil; 1% rounded ferruginous ironstone fine gravels; pH 6.5.

Project and site code: SWF CH04

Date: 12/04/2005

Location: MGA Zone: 50 459391 mE 6172441 mN

Slope: 6%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark brown (7.5YR2.5/3 moist) humic clayey sand; moist soil; 10% rounded ferruginous ironstone fine gravels; pH 7.
A12	15-30	strong brown (7.5YR4/6 moist) sandy loam; moist soil; 50% rounded ferruginous ironstone medium gravels; pH 6.5.
B2	30-60	yellowish red (5YR5/5 moist) light clay; moist soil; 60% rounded ferruginous ironstone medium gravels; pH 6.5.

Project and site code: SWF CH05

Date: 12/04/2005

Location: MGA Zone: 50 459476 mE 6172444 mN

Slope: 11%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; moist soil; moderate structure; earthy fabric; 40% rounded ferruginous ironstone medium gravels; pH 7; gradual boundary.
A12	10-50	strong brown (7.5YR5/8 moist) clayey sand; moist soil; moderate structure; earthy fabric; 70% rounded ferruginous ironstone medium gravels; pH 7.

Project and site code: SWF CH06

Date: 12/04/2005

Location: MGA Zone: 50 459518 mE 6172418 mN

Slope: 10%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic heavy clayey sand; moist soil; 20% rounded ferruginous ironstone fine gravels; pH 7.
A12	10-50	strong brown (7.5YR5/8 moist) clayey sand; moist soil; 50% rounded ferruginous ironstone coarse gravels; pH 7.

Project and site code: SWF CH07

Date: 12/04/2005

Location: MGA Zone: 50 459523 mE 6172342 mN

Slope: 11%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; 30% rounded ferruginous ironstone fine gravels; pH 6.5.
A12	10-30	strong brown (7.5YR5/6 moist) clayey sand; 60% rounded ferruginous ironstone medium gravels; pH 6.5.
B2	30-50	yellowish red (5YR5/8 moist) light medium clay; 1% rounded ferruginous igneous rock (unidentified) fine gravels; pH 7.

Project and site code: SWF CH08

Date: 12/04/2005

Location: MGA Zone: 50 459597 mE 6172333 mN

Location notes: Laterite boulders on the surface

Slope: 7%

Site notes: High trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	brown (7.5YR4/4 moist) humic heavy clayey sand; moist soil; 10% rounded ferruginous ironstone fine gravels.
A12	5-15	strong brown (7.5YR5/8 moist) clayey sand; moist soil; 20% rounded ferruginous ironstone medium gravels.
R	15+	laterite

Project and site code: SWF CH09

Date: 12/04/2005

Location: MGA Zone: 50 mE mN

Location notes: Laterite boulders on the surface

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	brown (7.5YR4/4 moist) humic clayey sand; moist soil; 50% rounded ferruginous ironstone medium gravels; pH 7; gradual boundary.
A12	5-50	strong brown (7.5YR5/8 moist) clayey sand; moist soil; 70% rounded ferruginous ironstone medium gravels; pH 7.

Project and site code: SWF CH10

Date: 12/04/2005

Location: MGA Zone: 50 459645 mE 6172453 mN

Slope: 7%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic clayey sand; moist soil; 40% rounded ferruginous ironstone fine gravels; pH 7.
A12	10-35	strong brown (7.5YR5/6 moist) clayey sand; moist soil; 60% rounded ferruginous ironstone medium gravels; pH 7.
B2	35-60	red (2.5YR5/8 moist) light clay; moist soil; 50% rounded ferruginous ironstone medium gravels; pH 7.

Project and site code: SWF CH11

Date: 12/04/2005

Location: MGA Zone: 50 459730 mE 6172461 mN

Slope: 7%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic loamy sand; moderately moist soil; 10% rounded ferruginous ironstone fine gravels; pH 6.5.
A12	10-40	strong brown (7.5YR5/6 moist) clayey sand; moderately moist soil; massive structure; earthy fabric; 50% rounded ferruginous ironstone medium gravels; pH 6.5.
A13	40-60	strong brown (7.5YR5/8 moist) clay loam, sandy; few medium faint yellow (10YR7/8 moist) mottles; moderately moist soil; pH 6.

Project and site code: SWF CH12

Date: 12/04/2005

Location: MGA Zone: 50 459761 mE 6172554 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic sandy loam; moist soil; pH 7; gradual boundary.
A12	10-35	yellowish brown (10YR5/6 moist) sandy loam; moist soil; 20% rounded ferruginous ironstone medium gravels; pH 7; clear boundary.
B2	35-60	brownish yellow (10YR6/8 moist) light clay; few medium faint strong brown (7.5YR5/8 moist) mottles; moist soil; granular structure; pH 7.

Project and site code: SWF CH13

Date: 12/04/2005

Location: MGA Zone: 50 459868 mE 6172567 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Mottled Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic sandy loam; common medium faint strong brown (7.5YR5/8 moist) mottles; moist soil; crumb structure; pH 6.5; gradual boundary.
A12	10-40	brownish yellow (10YR6/6 moist) sandy loam; many medium faint strong brown (7.5YR5/8 moist) mottles; moist soil; crumb structure; pH 6.5; clear boundary.
B2	40-60	reddish yellow (5YR6/8 moist) light medium clay; common medium faint strong brown (7.5YR5/8 moist) mottles; weak moist consistence, slightly plastic; weak, angular blocky structure; pH 7.

Project and site code: SWF CH14

Date: 12/04/2005

Location: MGA Zone: 50 459945 mE 6172664 mN

Slope: 6-8%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (7.5YR4/4 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 50% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-40	strong brown (7.5YR4/6 moist) sandy loam; moist soil, slightly plastic; massive structure; earthy fabric; 60% rounded ferruginous ironstone medium gravels; pH 6.5; clear boundary.
B2	40-60	strong brown (7.5YR5/8 moist) light clay; moist soil; weak, angular blocky structure; pH 6.5.

Project and site code: SWF CH15

Date: 12/04/2005

Location: MGA Zone: 50 459767 mE 6172294 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic loam; 20% rounded ferruginous ironstone medium gravels; pH 6.5.
A12	5-20	strong brown (7.5YR5/8 moist) clayey sand; 70% rounded ferruginous ironstone medium gravels; pH 6.5.
R	20+	Laterite rock.

Project and site code: SWF CH16

Date: 12/04/2005

Location: MGA Zone: 50 459780 mE 6172362 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	brown (7.5YR4/4 moist) humic sandy loam; weak moist consistence, slightly plastic; massive structure; 40% rounded ferruginous ironstone medium gravels; pH 7.5.
R	15+	

Project and site code: SWF CH17

Date: 12/04/2005

Location: MGA Zone: 50 459844 mE 6172429 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/3 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 15% rounded ferruginous ironstone fine gravels; pH 6; gradual boundary.
A12	10-40	strong brown (7.5YR4/6 moist) sandy loam; moist soil; massive structure; earthy fabric; 70% rounded ferruginous ironstone medium gravels; pH 6.5; clear boundary.
B2	40-60	yellowish red (5YR5/6 moist) light clay; few medium faint reddish yellow (7.5YR6/8 moist) mottles; moist soil; weak, granular structure; 5% rounded ferruginous ironstone medium gravels; pH 6.5.

Project and site code: SWF CH18

Date: 12/04/2005

Location: MGA Zone: 50 459940 mE 6172461 mN

Location notes: Very fine iron gravels on top layer

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/3 moist) humic sandy loam; moist soil; 25% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-40	strong brown (7.5YR4/6 moist) sandy loam; moist soil, slightly sticky; weak, crumb structure; 60% rounded ferruginous ironstone medium gravels; pH 6.5; clear boundary.
B2	40-60	yellowish red (5YR5/8 moist) light clay; few medium faint red (2.5YR4/6 moist) mottles; moist soil; pH 6.5.

Project and site code: SWF CH19

Date: 12/04/2005

Location: MGA Zone: 50 459979 mE 6172571 mN

Slope: 7%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 10% rounded ferruginous ironstone fine gravels; pH 6; gradual boundary.
A12	10-35	dark yellowish brown (10YR4/4 moist) sandy loam; moist soil; crumb structure; 70% rounded ferruginous ironstone medium gravels; pH 6; clear boundary.
B2	35-50	yellowish red (5YR5/8 moist) light clay; moist soil; angular blocky structure; pH 6.

Project and site code: SWF CH20

Date: 12/04/2005

Location: MGA Zone: 50 460058 mE 6172559 mN

Slope: 13%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic sandy loam; moderately moist soil; 5% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-40	brownish yellow (10YR6/6 moist) clayey sand; moist soil, slightly sticky; 70% rounded ferruginous ironstone medium gravels; pH 6.5; clear boundary.
B2	40-60	yellowish red (5YR5/8 moist) light medium clay; moist soil, slightly sticky; moderate, angular blocky structure; smooth-ped fabric; pH 6.5.

Project and site code: SWF CH21

Date: 12/04/2005

Location: MGA Zone: 50 460110 mE 6172495 mN

Slope: 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sands supergroup, 1999

Australian soil classification: Basic Arenic Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic clayey sand; moist soil; pH 6.5; gradual boundary.
A12	10-60	strong brown (7.5YR5/8 moist) clayey fine sand; moist soil; pH 6.5.

Project and site code: SWF CH22

Date: 12/04/2005

Location: MGA Zone: 50 460038 mE 6172435 mN

Slope: 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Brown deep sand, 1999

Australian soil classification: Basic Arenic Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/4 moist) humic clayey sand; moist soil; weak, granular structure; 1% rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-60	strong brown (7.5YR5/8 moist) clayey sand; moist soil; weak, granular structure; 1% rounded ferruginous ironstone fine gravels; pH 7.

Project and site code: SWF CH23

Date: 12/04/2005

Location: MGA Zone: 50 459962 mE 6172405 mN

Slope: 6%

Site notes: Moderate trafficability rating

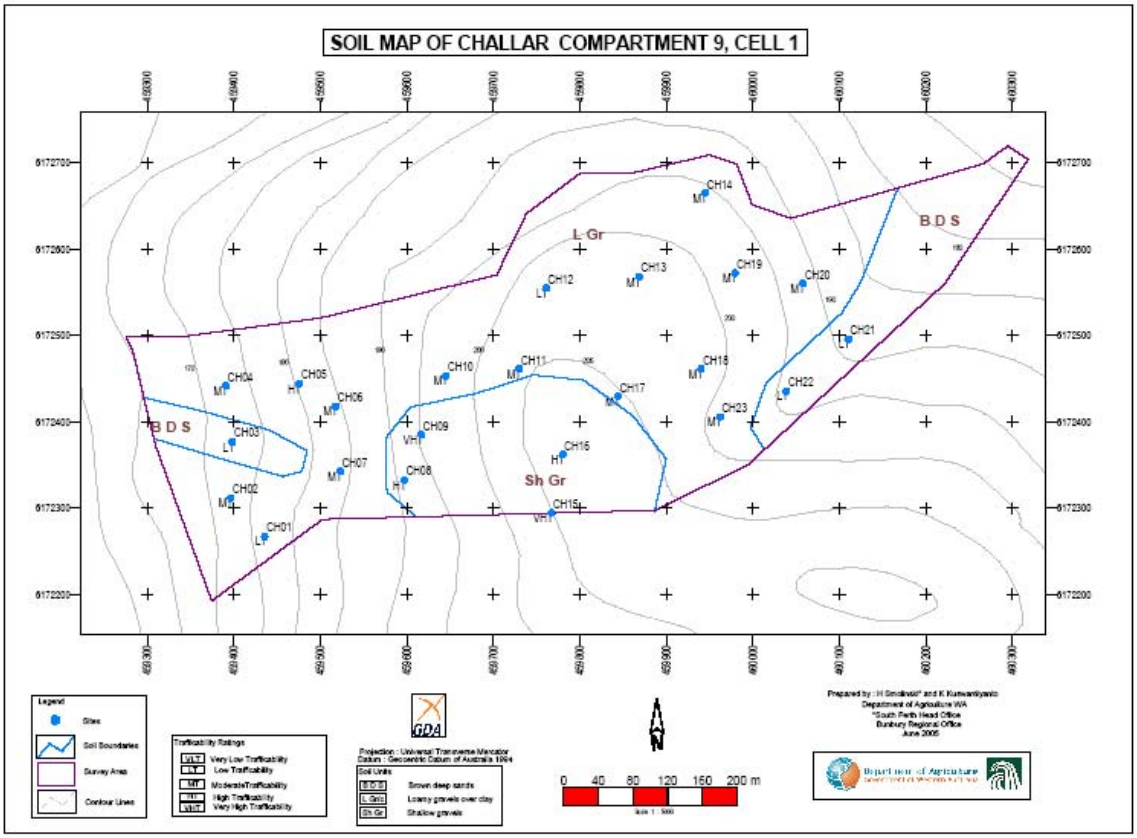
Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	humic loam; moderately moist soil; pH 6.5; gradual boundary.
A12	10-35	sandy loam; moderately moist soil; 70% rounded ferruginous ironstone fine gravels; pH 6; clear boundary.
B2	35-50	light clay; few medium faint yellowish red (5YR5/8 moist) mottles; moderately moist soil; angular blocky structure; 10% rounded ferruginous ironstone medium gravels; pH 6.


SOIL MAP OF CHALLAR COMPARTMENT 9, CELL 1
L Gr
B D S
B D S
Sh Gr
CH01
CH02
CH03
CH04
CH05
CH06
CH07
CH08
CH09
CH10
CH11
CH12
CH13
CH14
CH15
CH16
CH17
CH18
CH19
CH20
CH21
CH22
CH23
Legend
Sites
Soil Boundaries
Survey Area
Contour Lines
Trafficability Ratings
Very Low Trafficability
Low Trafficability
Moderate Trafficability
High Trafficability
Very High Trafficability
Projection : Universal Transverse Mercator
Datum : Geocentric Datum of Australia 1994
Soil Units
Brown deep sands
Loamy gravels over clay
Shallow gravels
0 40 80 120 160 200 m
Department of Agriculture

Attachment 3 – Soil Assessment of Channybearup

Compartment 2, Cells 1-3
Palings Road, Shire of Manjimup

Summary

Channybearup Compartment 2 Cells 1-3 contains three main soil units.

RLE: Red Loamy Earths

SD: Sandy duplexes

BLD: Brown loamy duplexes

Friable, red-brown loamy earth is the dominant soil type. These soils have sandy loam to clay loam textures and usually contain < 30% ironstone gravel within topsoil horizons.

The site has a very low to moderate trafficability rating.

Site description

This site has a total area of 20 hectares.

Prior to timber harvesting, the cells were covered by karri and marri forest with karri being dominant. A broad crest, carrying remnant karri forest, is situated at the south-east corner of the site and surrounding slopes are generally very gently to gently inclined. Minor parts along the east boundary are moderately steep.

A flow line defines the western boundary.

Geology

Regional geological mapping indicates that Archean quartz-feldspar-biotite gneiss is the dominant basement rocks (Wilde and Walker, 1984).

The block is mantled by colluvium derived from laterite gravels and red sand, silt and clays that have probably formed from weathered gneiss.

Soils

The main soil types are locally referred to as karri loams which usually include red-brown loamy earths and moderately deep red/brown loamy duplex soils containing few to abundant ironstone gravel. Secondary soils are brown loamy duplex and sandy duplex that border the flow line.

The soil units are described below and soil profile descriptions are provided in Appendix A.

RLE: Red loamy earths

WA soil group: Friable red-brown loamy earth

Soil classification: Ferric Eutrophic Red Kandosol, Haplic Eutrophic Red Kandosol

This soil unit is associated with gentle to moderate steep slopes and contains a complex of yellow to red gravelly duplex soils having loamy topsoil horizons. Subsoil clay was encountered between 30-60 cm.

Topsoils are very dark brown gravelly loam to sandy loam containing negligible to many ironstone gravel overlying brownish yellow to strong brown gravelly sandy loam containing many to abundant ironstone gravel. Yellowish red clay loam or clay was commonly encountered by 50 cm also yellow and brown mottles were also evident.

The soil reaction trend is acid to neutral.

The yellowish red and brown loamy earths generally exhibit a gradual texture increase with depth, which indicates the soil profile is moderately well drained to well drained. A weak crumb or granular structure is evident when the soils are moderately moist and in undisturbed sites soil bulk density is typically low.

These soils are similar to the loamy earths at Diamond (see Attachment 4) however soil profiles are deeper and better drained as there was no evidence of subsoil waterlogging or soil saturation during sampling.

Trafficability rating

This soil unit was assigned a very low to low trafficability rating, based on the occurrence of loamy topsoils and sandy clay loam or clay by 50 cm. Moderate rutting was evident in this unit, particularly in areas of moderately steep slope (east boundary). However this could not always be distinguished from soil disturbance associated with clear felling.

Soil compaction tests, using a tiling spade, indicate that compaction layers had developed between a depth of 10-20 cm. In comparison, undisturbed sites showed little resistance to a depth of 40 cm.

SD: Sandy duplexes

WA soil group: Duplex sandy gravel

Soil classification: Ferric Eutrophic Yellow Chromosol

This soil unit is associated with a broad flow line occurring along the west boundary.

The soils are commonly moderately deep to deep Duplex sandy gravels and Loamy gravels having clay subsoils occurring at 40-70 cm.

Topsoils are very dark brown humic clayey sand to loams overlying strong brown loamy fine sand to sandy loam containing few to abundant ironstone gravel. Brown to white mottled clay loam or clay was encountered at 40-70 cm. Ironstone and igneous gravel may be encountered within the clay layer.

The soil reaction trend is neutral.

Trafficability rating

This unit has a moderate trafficability rating.

The moderately deep sandy topsoils are less prone to rutting relative to the loamy earths. However, the soils within the flow line are more prone to subsoil waterlogging as indicated by lower topsoil saturation, above the clay layer, during sampling.

BLD: Brown loamy duplexes

WA soil group: Brown deep loamy duplex

Soil classification: Mottled Eutrophic Brown Chromosol

This soil unit is associated with very gentle to gently inclined slopes bordering the flow line.

The soils are loamy duplex soils containing < 20% ironstone gravel within topsoil horizons. Topsoils are dark brown humic loam overlying strong brown loam containing 10-20% ironstone gravel. Strong brown sandy clay loam or light clay is encountered at about 40 cm and it may contain few to common ironstone gravel (< 20%).

The soil reaction trend is neutral.

Trafficability rating

This unit has a low to very low trafficability rating.

Lower topsoils are prone to waterlogging and < 20% gravel occurs within the topsoil horizons.

Management considerations

Channybearup block generally has a low to very low trafficability rating when the soils are moist.

The friable red-brown loamy earths at this site are situated higher in the landscape, deep and better drained than loams at Diamond which suggests they are less prone to rutting.

Soil unit BLD and moderately steep areas of RLE have the highest risk of soil rutting.

Soil profile descriptions – Channybearup, Compartment 2, Cells 1-3

Project and site code: SWF CP01

Date: 23/04/2005

Location: MGA Zone: 50 413118 mE 6201459 mN

Slope: 10%

Site notes: Very low trafficability rating

Current classification

WA soil group: Brown loamy earth, 1999

Australian soil classification: Haplic Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/2 moist) humic sandy loam; moderately moist soil; weak, crumb structure; 10% ferruginous igneous rock (unidentified); pH 7; clear boundary.
A12	10-50	yellowish red (5YR4/6 moist) sandy loam; moderately moist soil; weak, crumb structure; 15% angular ferruginous igneous rock (unidentified); pH 6.5; clear boundary.
B2	50-60+	yellowish red (5YR5/6 moist) sandy clay loam; moist soil; 30% angular ferruginous igneous rock (unidentified); pH 6.5.

Project and site code: SWF CP02

Date: 27/04/2005

Location: MGA Zone: 50 413078 mE 6201515 mN

Slope: 9%

Location notes: Crest. Fine Fe gravel < 3 mm rounded

Site notes: Very low trafficability rating

Current classification

WA soil group: Brown loamy earth, 1999

Australian soil classification: Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR2/2 moist) humic loam; moderately moist soil; 5% rounded ferruginous fine gravels; pH 7.
A12	10-30	black (5YR2.5/0 moist) fine sandy loam; moderately moist soil; 10% rounded ferruginous fine gravels; pH 7.
B1	30-50	yellowish red (5YR5/8 moist) sandy clay loam; moist soil; 10% rounded ferruginous fine gravels; pH 6.5.
B2	50-60+	yellowish red (5YR5/8 moist) fine sandy clay loam; moist soil; 30% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF CP03

Date: 27/04/2005

Location: MGA Zone: 50 413069 mE 6201631 mN

Location notes: Crest, upper slope

Slope: < 2%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red deep loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/2 moist) humic loam; moist soil; weak, crumb structure; 5% ferruginous fine gravels; pH 7; clear boundary.
A12	10-30	yellowish red (5YR4/6 moist) sandy clay loam; moist soil; weak, crumb structure; 5% ferruginous fine gravels; pH 6.5; clear boundary.
A13	30-40	yellowish red (5YR5/8 moist) sandy clay loam; moist soil; weak, crumb structure; 50% ferruginous medium gravels; pH 6.5; abrupt boundary.
B2	40-50+	yellowish red (5YR5/8 moist) light clay; moist soil; moderate, 2-5 mm, angular blocky structure; pH 7.

Project and site code: SWF CP04

Date: 27/04/2005

Location: MGA Zone: 50 412916 mE 6201639 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Brown deep sand, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
	0-15	dark brown (7.5YR3/2 moist) humic loam; moist soil; single grain structure; earthy fabric; 1% rounded ferruginous fine gravels; pH 6.
	15-60	strong brown (7.5YR5/6 moist) loamy fine sand; moist soil; massive structure; earthy fabric; 5% rounded ferruginous fine gravels; pH 6.5.
	60-70+	strong brown (7.5YR5/6 moist) clayey fine sand; moist soil; massive structure; earthy fabric; 60% rounded ferruginous medium gravels; pH 6.5.

Project and site code: SWF CP05

Date: 27/04/2005

Location: MGA Zone: 50 412917 mE 6201716 mN

Location notes: SWL

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	very dark brown (7.5YR2/2 moist) humic loam; moderately moist soil; single grain structure; earthy fabric; 5% rounded ferruginous; pH 6.5.
A12	20-40	strong brown (7.5YR5/6 moist) sandy loam; moist soil; weak, crumb structure; 30% rounded ferruginous; pH 7.
B2	40-50+	brown (7.5YR5/4 moist) clay loam; moist soil; 60% angular ferruginous coarse gravels; pH 6.5.

Project and site code: SWF CP06

Date: 27/04/2005

Location: MGA Zone: 50 413012 mE 6201771 mN

Location notes: Slight SWL

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Red deep sandy duplex, 1999

Australian soil classification: Haplic Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	dark reddish brown (5YR3/3 moist) humic sandy loam; moist soil; massive, crumb structure; 5%; pH 7.
A12	15-50	yellowish red (5YR5/6 moist) clayey sand; moist soil; weak, crumb structure; 5% ferruginous fine gravels; pH 6.5.
B2	50-60+	yellowish red (5YR5/8 moist) sandy clay loam; moist soil; 10% ferruginous fine gravels; pH 6.

Project and site code: SWF CP07

Date: 27/04/2005

Location: MGA Zone: 50 413110 mE 6201774 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Red loamy earth, 1999

Australian soil classification: Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark reddish brown (5YR3/3 moist) humic fine sandy loam; moderately moist soil; weak, crumb structure; 1% ferruginous; pH 7.
A12	5-50	yellowish red (5YR4/6 moist) fine sandy loam; moderately moist soil; weak, crumb structure; 1% ferruginous; pH 7.
B2	50-60+	yellowish red (5YR5/6 moist) sandy clay loam; moist soil; weak, crumb structure; 1% ferruginous; pH 7.

Project and site code: SWF CP08

Date: 27/04/2005

Location: MGA Zone: 50 412969 mE 6201850 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red loamy earth, 1999

Australian soil classification: Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR2/2 moist) humic loam; massive, crumb structure; sandy fabric; 1% rounded ferruginous fine gravels; pH 6.5.
A12	10-40	yellowish red (5YR4/6 moist) fine sandy loam; crumb structure; sandy fabric; 5% rounded ferruginous fine gravels; pH 6.5.
B1	40-50	yellowish red (5YR5/8 moist) sandy clay loam; crumb structure; sandy fabric; 5% rounded ferruginous fine gravels; pH 6.
B2	50-60+	yellowish red (5YR5/8 moist) clay loam, fine sandy; 5% rounded ferruginous fine gravels; pH 6.

Project and site code: SWF CP09

Date: 27/04/2005

Location: MGA Zone: 50 413060 mE 6201853 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	dark reddish brown (5YR2.5/2 moist) humic loam; moderately moist soil; weak, crumb structure; 5% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	15-40	yellowish red (5YR4/6 moist) sandy loam; moderately moist soil; weak, crumb structure; 25% rounded ironstone fine gravels; pH 6.5; gradual boundary.
B1	40-60	yellowish red (5YR5/8 moist) sandy clay loam; moist soil; weak, crumb structure; 25% rounded ironstone fine gravels; pH 7; clear boundary.
B2	60-70+	yellowish red (5YR5/8 moist) clay loam, sandy; few red (2.5YR4/8 moist) mottles; moist soil; 50% subrounded ironstone fine gravels; pH 7.

Project and site code: SWF CP10

Date: 27/04/2005

Location: MGA Zone: 50 412964 mE 6201966 mN

Location notes: LS

Slope: 10%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red deep loamy duplex

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
	0-5	dark reddish brown (5YR3/3 moist) humic loam; moderately moist soil; weak, crumb structure; 5% ironstone fine gravels; pH 7; gradual boundary.
	5-40	yellowish red (5YR4/6 moist) sandy loam; moderately moist soil; weak, crumb structure; 10% ironstone fine gravels; pH 6.5; clear boundary.
	40-50+	yellowish red (5YR5/6 moist) clay loam, fine sandy; moist soil; 60% ironstone coarse gravels; pH 6.5.

Project and site code: SWF CP11

Date: 27/04/2005

Location: MGA Zone: 50 413033 mE 6201933 mN

Slope: 10%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/3 moist) humic loam; weak, crumb structure; 10% ironstone; pH 7.
A12	10-40	yellowish red (5YR4/6 moist) sandy clay loam; weak, crumb structure; 30% ironstone medium gravels; pH 7.
B2	40-50+	red (2.5YR5/8 moist) clay loam; 70% ironstone medium gravels; pH 7.

Project and site code: SWF CP12

Date: 27/04/2005

Location: MGA Zone: 50 413358 mE 6201822 mN

Slope: 20%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red loamy earth, 1999

Australian soil classification: Haplic Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark reddish brown (2.5YR3/3 moist) humic sandy loam; moderately moist soil; crumb structure; 5% rounded ironstone fine gravels; pH 7.
A12	5-30	dark red (2.5YR3/6 moist) sandy loam; moderately moist soil; crumb structure; 5% rounded ironstone fine gravels; pH 7.
B1	30-50	dark red (2.5YR3/6 moist) sandy clay loam; moist soil; crumb structure; 5% rounded ironstone fine gravels.
B2	50-60+	red (2.5YR4/6 moist) clay loam; moist soil; 1% rounded ironstone fine gravels; pH 6.

Project and site code: SWF CP13

Date: 28/04/2005

Location: MGA Zone: 50 413346 mE 6201957 mN

Slope: 7%

Site notes: Very low trafficability rating

Current classification

WA soil group: Red loamy earth, 1999

Australian soil classification: Ferric Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/3 moist) humic loam; moderately moist soil; weak, crumb structure; 10% ironstone fine gravels; pH 7.5; clear boundary.
A12	10-40	yellowish red (5YR4/6 moist) fine sandy loam; moderately moist soil; weak, crumb structure; 10% ironstone; pH 7.5; gradual boundary.
B2	40-60+	red (2.5YR4/6 moist) clay loam, sandy; moist soil; 60% ironstone medium gravels; pH 6.5.

Project and site code: SWF CP15

Date: 28/04/2005

Location: MGA Zone: 50 mE mN

Location notes: Few stone at 30 cm

Slope: 6-7%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR2.5/2 moist) humic loam; moderately moist soil; massive, crumb structure; 20% rounded ironstone fine gravels.
A12	10-40	yellowish red (5YR4/6 moist) sandy loam; moist soil; weak, crumb structure; 40% rounded ironstone fine gravels.
B2	40-50+	red (2.5YR5/8 moist) clay loam, sandy; moist soil; weak, crumb structure; 70% subrounded ironstone fine gravels.

Project and site code: SWF CP16

Date: 28/04/2005

Location: MGA Zone: 50 413159 mE 6201844 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	dark brown (7.5YR3/3 moist) humic loam; moderately moist soil; weak, crumb structure; 20% rounded ironstone fine gravels; pH 7.5.
A12	20-40	strong brown (7.5YR4/6 moist) loamy fine sand; moderately moist soil; weak, crumb structure; 30% rounded ironstone fine gravels; pH 7.5.
B2	40-50+	yellowish red (5YR5/8 moist) fine sandy clay loam; moist soil; 60% rounded ironstone fine gravels; pH 7.

Project and site code: SWF CP17

Date: 28/04/2005

Location: MGA Zone: 50 413159 mE 6201869 mN

Location notes: Similar to CP16

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic loam; weak, crumb structure; 20% rounded ironstone fine gravels; pH 7.5; gradual boundary.
A12	5-40	strong brown (7.5YR4/6 moist) loamy fine sand; weak, crumb structure; 30% rounded ironstone fine gravels; pH 7.5; clear boundary.
B2	40-50+	yellowish red (5YR5/6 moist) sandy clay loam; 60% rounded ironstone medium gravels; pH 7.

Project and site code: SWF CP18

Date: 28/04/2005

Observation type/category:

Location: MGA Zone: 50 413024 mE 6202057 mN

Slope: 12%

Site notes: Very low trafficability rating

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loam; moist soil; 10% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	10-30	strong brown (7.5YR4/6 moist) loam; moist soil; 20% rounded ironstone medium gravels; pH 6.5; clear boundary.
B2	30-50+	yellowish red (5YR5/6 moist) clay loam, sandy; moist soil; 70% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF CP19

Date: 28/04/2005

Location: MGA Zone: 50 413020 mE 6202176 mN

Slope: 6-7%

Site notes: Very low trafficability rating

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loam; moderately moist soil; weak, crumb structure; 10% rounded ironstone medium gravels; pH 6.5.
A12	10-40	strong brown (7.5YR5/8 moist) loam; moist soil; weak, crumb structure; 20% rounded ironstone medium gravels; pH 6.5.
B2	40-50+	strong brown (7.5YR5/8 moist) light clay; moist soil; 20% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF CP20

Date: 28/04/2005

Location: MGA Zone: 50 413069 mE 6202266 mN

Slope: < 5%

Site notes: Low trafficability rating

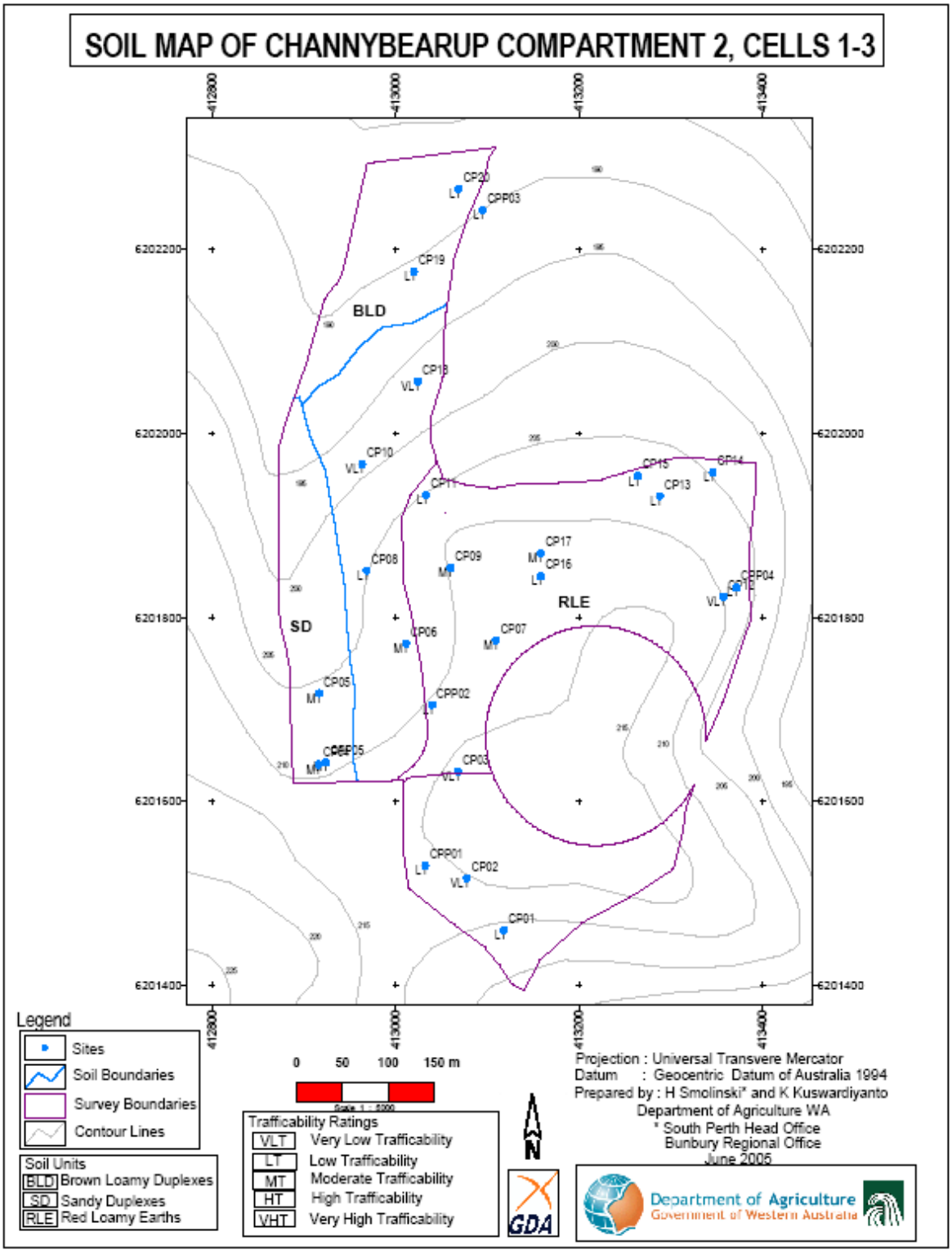
Current classification

WA soil group: Brown deep sandy duplex, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	dark brown (7.5YR3/4 moist) humic loam; moderately moist soil; weak, granular structure; 10% rounded ironstone medium gravels; pH 7.5.
A12	20-50	strong brown (7.5YR5/6 moist) loamy fine sand; moist soil; weak, crumb structure; 10% rounded ironstone medium gravels; pH 7.
B2	50-60+	strong brown (7.5YR5/6 moist) sandy clay loam; moist soil; 30% rounded ironstone medium gravels; pH 6.5.


SOIL MAP OF CHANNYBEARUP COMPARTMENT 2, CELLS 1-3
412800
413000
413200
413400
6202200
6202000
6201800
6201600
6201400
CP20
CPP03
CP19
BLD
CP18
CP10
CP11
CP15
CP14
CP13
CP17
CP16
CP08
CP09
CP04
CP12
RLE
SD
CP06
CP07
CP05
CPP02
CP03
CPP01
CP02
CP01
Legend
Sites
Soil Boundaries
Survey Boundaries
Contour Lines
Soil Units
BLD Brown Loamy Duplexes
SD Sandy Duplexes
RLE Red Loamy Earths
0 50 100 150 m
Trafficability Ratings
VLT Very Low Trafficability
LT Low Trafficability
MT Moderate Trafficability
HT High Trafficability
VHT Very High Trafficability
GDA
Projection : Universal Transvere Mercator
Datum : Geocentric Datum of Australia 1994
Prepared by : H Smolinski* and K Kuswardiyanto
Department of Agriculture WA
* South Perth Head Office
Bunbury Regional Office
June 2006
Department of Agriculture
Government of Western Australia

Attachment 4 – Soil Assessment of Diamond Two

Compartment 12, Cell 1, Gray Road, Manjimup

Summary

Diamond Two Compartment 12 Cell 1 contains 3 soil units.

LE: Loamy earths

LD: Loamy duplexes

LGr: Loamy gravels

Soil units LD and LGr have a moderate to very low trafficability rating while the loamy earths within LE have a very low trafficability rating.

Loamy topsoil horizons containing significant silt and fine sand are a common soil characteristics within this site.

Site description

This site has an area of approximately 16 hectares and consists of jarrah, marri and karri forest with marri and karri being the dominant trees.

The site is very gentle to gently inclined (2-6%) with a northwest aspect.

A broad crest occurs along the eastern boundary and a broad swale covers the western third of the block.

Geology

Regional geological mapping indicates that Archean quartz-feldspar biotite gneiss (Wilde and Walker, 1984) is the dominant basement rocks although rock outcrop was not encountered on site.

Colluvial gravels derived mainly from laterite and minor residual quartz were encountered on crest and upper slopes. Bog-iron ore was encountered within subsoils on midslopes that are subject to lateral flow and seepage.

Soils

Three soil units representing an association of soil type and distinct landform were identified:

- Loamy earths associated with lower slopes within a broad swale.
- Loamy gravels and Loamy gravels over clay, occurring at 30-50 cm in association with gently inclined mid to upper slopes.
- Loamy duplex soils associated with very gently inclined crest and upper slopes.

The soil units are described below and soil profile descriptions are provided in Appendix A.

LE: Loamy earths

WA soil group: Friable red/brown loamy earth

Soil classification: Eutrophic Brown Kandosol

This unit is associated with lower slopes within a broad swale having a grade of 5-6%.

Soil parent material is silty colluvium derived from granite- gneiss.

The soils are locally referred to as karri Loams and can be classified as Eutrophic Brown Kandosols. Topsoils are dark brown, humic fine sandy loam or loam that displays a crumb or fine granular structure. Subsoils are strong brown silty loams that also display a fine granular structure.

Few (< 10%) fine ferruginous gravel may be evident throughout the soil profile.

The soil reaction trend is acid to neutral.

A soil pit within this unit indicates that clay subsoils are likely to be encountered within 100 cm.

Trafficability rating

These soils typically have a texture of sandy loam to silty loam and contain a significant silt fraction.

Loamy soils have a very high water holding capacity and once saturated have very low shear strength. As this soil unit is associated with lower slopes it is subject to run-on and subsoil lateral flow. Furthermore, during soil sampling, seepage was evident at the break of slope and subsoils were saturated particularly above the clay layer. Soils within this unit are likely to remain saturated for a prolonged period after major rainfall events.

This soil unit has a very low trafficability rating (prone to compaction and rutting) once the soils are saturated.

LD: Loamy duplexes

WA soil group: Yellow/brown shallow loamy duplex

Soil classification: Eutrophic brown chromosol

This soil unit is associated with upperslopes having a grade 2-4%.

Soil types include Yellow/brown shallow loamy duplex and Loamy gravels.

Topsoils are very dark brown sandy loam overlying very pale brown to yellow- brown sandy loam to light sandy clay loam. Few to abundant (5-60%) ironstone gravel and quartz fragments were encountered within the lower topsoil horizon.

Yellow-brown light to medium clay was encountered between 15-40 cm, commonly at 30 cm.

Topsoils are massive or displayed a crumb structure while the clay layer exhibited an angular blocky structure.

The soil reaction trend is acid to neutral

Trafficability rating

This soil unit has a moderate to very low trafficability rating with gravel content and depth to clay being the main variables.

Loamy topsoils that contain negligible gravel would have low shear strength once saturated. Soil saturation is likely to be a common event in winter, as the shallow clay layer would impede drainage.

LGr: Loamy gravels

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

This soil unit is associated with mid to upperslopes having a grade of 4-6%.

The soils are commonly loamy gravels and are similar in morphology to soils within LD although the clay layer occurs at > 35 cm. Deeper gravelly loams were also encountered within this unit.

Topsoils are dark brown sandy loam containing negligible to few ironstone gravel. Lower topsoil horizons (A12 horizon) are commonly strong brown sandy loam to light sandy clay loam containing common to abundant ironstone gravel. The clay layer, if encountered, is a strong brown light to medium clay.

The soil profile has an acid to neutral soil reaction trend.

Trafficability rating

This soil unit generally has a moderate to low trafficability rating and is less prone to degradation than soil units LE and LD although shallower duplex soils were also encountered.

Strong brown soil colours and moderately deep to deep gravelly soil profiles suggest the unit is well drained to moderately well drained.

Management considerations

This site has a moderate to very low trafficability rating.

Most soil types have fine sandy loam to silty loam textures with negligible to abundant ironstone gravel. Soils containing < 60% by volume ironstone gravel are likely to have very low shear and bearing strength once saturated.

LE and LD are most at risk of rutting as both soil units are prone to saturation while the loamy earths are subject to lateral flow and thus prone to prolonged periods of subsoil waterlogging.

Soil profile descriptions – Diamond Two,Compartment 12, Cell 1

Project and site code: SWF DIA01

Date: 11/04/2005

Location: MGA Zone: 50 419977 mE 6190645 mN

Location notes: Flat to gently sloping floors. Few channels. 3 to 10 deg. smooth slopes.

Slope: 6%

Site notes: Very low trafficability rating. No gravels on the surface, poor trafficability due to silt.

Vegetation notes: Marri and karri forest

Current classification

WA soil group: Loamy earths supergroup, 1999

Australian soil classification: Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/4 moist) fine sandy loam; massive, < 2 mm, crumb structure; earthy fabric; very few (< 1%) rounded ferruginous ironstone fine gravels; pH 6; gradual boundary.
A12	10-60	brown (7.5YR4/4 moist) silty loam; < 2 mm, crumb structure; earthy fabric; very few (< 1%) ferruginous ironstone fine gravels; pH 6.

Project and site code: SWF DIA02

Date: 11/04/2005

Location: MGA Zone: 50 420040 mE 6190615

Slope: 5-6%

Site notes: Very low trafficability rating

Vegetation notes: Marri and karri forest

Current classification

WA soil group: Loamy earths supergroup, 1999

Australian soil classification: Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) mixed with strong brown (7.5YR4/6 moist) humic silty loam; moist soil; crumb and crumb structure; earthy fabric; pH 6.5; gradual boundary.
A12	10-50	Strong brown (7.5YR4/6) silty loam; fine crumb structure; moist soil; pH 6.5.

Project and site code: SWF DIA03

Date: 11/04/2005

Location: MGA Zone: 50 420077 mE 6190605 mN

Slope: 5-6%

Site notes: Very low trafficability

Vegetation notes: Marri and karri forest.

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loam; moist soil; few (10%) rounded ferruginous ironstone medium gravels; pH 6; gradual boundary.
A12	10-40	strong brown (7.5YR4/6 moist) silty loam; moist soil; 60% rounded ferruginous ironstone medium gravels; pH 6.
B2	40-60	reddish yellow (7.5YR6/8 moist) fine sandy light medium clay; moist soil; few (< 10%) rounded ferruginous ironstone medium gravels; pH 6.

Project and site code: SWF DIA04

Date: 11/04/2005

Location: MGA Zone: 50 420169 mE 6190596 mN

Slope: < 5%

Site notes: Low trafficability

Vegetation notes: Marri and karri forest

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) mixed with strong brown (7.5YR5/6 moist) mixed with strong brown (7.5YR5/6 moist) humic sandy loam; moderately moist soil; massive structure; earthy fabric; few (< 10%) rounded ferruginous ironstone medium gravels; pH 6; gradual boundary.
A12	10-20	fine sandy loam; moderately moist soil; massive structure; earthy fabric; few (< 10%) rounded ferruginous ironstone; pH 6.5; gradual boundary.
A13	20-50	fine sandy loam; moderately moist soil; massive structure; earthy fabric; many (40%) rounded ferruginous ironstone coarse gravels; pH 6.5.

Project and site code: SWF DIA05

Date: 11/04/2005

Location: MGA Zone: 50 420211 mE 6190577 mN

Slope: < 5%

Site notes: Moderate trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moist soil; crumb structure; earthy fabric; common (20%) rounded ferruginous ironstone medium gravels; pH 6.5.
	10-30	reddish yellow (7.5YR6/6 moist) sandy loam; moist soil; crumb structure; earthy fabric; abundant (70%) rounded ferruginous ironstone coarse gravels; pH 6.5.
	30-50	reddish yellow (7.5YR7/6 moist) light medium clay; moist soil; pH 6.5.

Project and site code: SWF DIA06

Location: MGA Zone: 50 420283 mE 6190580 mN

Slope: 6%

Site notes: Moderate trafficability rating

Vegetation notes: Jarrah

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic sandy loam; moist soil; crumb structure; common (20%) rounded ferruginous ironstone medium gravels; pH 6; gradual boundary.
A12	10-30	light yellowish brown (10YR6/4 moist) clayey sand; moist soil; crumb structure; abundant (70%) rounded ferruginous ironstone medium gravels; pH 6; clear boundary.
B2	30-60	reddish yellow (7.5YR7/6 moist) light medium clay; moist soil; weak, 5-10 mm, angular blocky structure; pH 6.

Project and site code: SWF DIA07

Date: 11/04/2005

Location: MGA Zone: 50 420110 mE 6190754

Slope: 6%

Site notes: Moderate trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	very dark brown (7.5YR2.5/2 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; few (< 10%) rounded ferruginous ironstone medium gravels; pH 6; gradual boundary.
A12	20-40	strong brown (7.5YR5/6 moist) fine sandy loam; moist soil; massive structure; earthy fabric; many (50%) rounded ferruginous ironstone coarse gravels; pH 6; gradual boundary.
A13	40-60	strong brown (7.5YR4/6 moist) fine sandy loam; wet soil; massive structure; abundant (70%) rounded ferruginous ironstone coarse gravels; pH 6.5.

Project and site code: SWF DIA08

Date: 11/04/2005

Location: MGA Zone: 50 40080 mE 6190785 mN

Slope: 6%

Site notes: Low trafficability

Vegetation notes: Karri and Marri

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	very dark brown (7.5YR2.5/2 moist) humic loam; moist soil; massive structure; earthy fabric; few (10%) rounded ferruginous ironstone fine gravels; pH 6.5; gradual boundary.
	10-50	brown (7.5YR4/4 moist) fine sandy loam; moist soil; massive structure; earthy fabric; abundant (60%) rounded ferruginous ironstone medium gravels; pH 6.5; gradual boundary.
	50-60	strong brown (7.5YR5/6 moist) fine sandy clay loam; moist soil; massive structure; earthy fabric; abundant (60%) rounded ferruginous ironstone medium gravels; pH 6.5.

Project and site code: SWF DIA09

Date: 11/04/2005

Location: MGA Zone: 50 420132 mE 6190742 mN

Slope: 6%

Site notes: Low trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; moist soil; massive structure; earthy fabric; very few (< 10%) rounded ferruginous ironstone medium gravels; pH 6.
	10-30	brown (7.5YR4/4 moist) fine sandy loam; wet soil; massive structure; earthy fabric; few (10%) rounded ferruginous ironstone medium gravels; pH 6.
	30-60	light brown (7.5YR6/4 moist) sandy loam; wet soil; abundant (60%) rounded ferruginous ironstone medium gravels; pH 6.

Project and site code: SWF DIA10

Date: 11/04/2005

Location: MGA Zone: 50 420194 mE 6190728 mN

Slope: 6%

Site notes: Low trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	dark brown (7.5YR3/3 moist) humic fine sandy loam; moist soil; many (40%) rounded ferruginous ironstone medium gravels; pH 6.
	10-35	strong brown (7.5YR5/6 moist) fine sandy loam; moist soil; many (30-40%) rounded ferruginous ironstone medium gravels; pH 6.
	35-60	light brown (7.5YR6/4 moist) fine sandy light medium clay; moist soil; many (25%) rounded ferruginous ironstone medium gravels; pH 6.

Project and site code: SWF DIA11

Date: 11/04/2005

Location: MGA Zone: 50 420288 mE 6190694 mN

Slope: < 5%

Site notes: Very low trafficability

Site notes: Between A1 and A2 there is a thin layer of 10YR6/4.

Vegetation notes: Marri-jarrah-karri forest.

Current classification

WA soil group: Brown deep loamy duplex, 1999.

Australian soil classification: Haplic Eutrophic Yellow Chromosol.

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic heavy sandy loam; moist soil; very few (< 5%) rounded ferruginous ironstone fine gravels; pH 6.
A12	10-40	yellowish brown (10YR5/8 moist) sandy clay loam; moist soil; very few (< 5%) rounded ferruginous ironstone fine gravels; pH 6.5.
B2	40-60	yellow (10YR7/6 moist) light medium clay; moist soil; very few (< 5%) rounded ferruginous ironstone fine gravels; pH 6.5.

Project and site code: SWF DIA12

Described by: Henry Smolinski

Date: 11/04/2005

Location: MGA Zone: 50 420300 mE 6190700 mN

Slope: < 5%

Site notes: Low trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Loamy duplex, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; 5% rounded ferruginous fine gravels; pH 6.5.
A12	5-15	very pale brown (10YR7/4 moist) sandy loam; moist soil; 60% rounded ferruginous ironstone medium gravels; pH 6.5.
B2	15-50	reddish yellow (7.5YR6/6 moist) light medium clay; moist soil; 10% rounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF DIA13

Date: 11/04/2005

Location: MGA Zone: 50 420298 mE 6190669 mN

Slope: < 5%

Site notes: Low trafficability

Vegetation notes: Marri-jarrah-karri forest

Current classification

WA soil group: Brown deep loamy duplex, 1999

Australian soil classification: Mottled Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
	0-10	Very dark brown (10YR2/2) gritty sandy loam, < 5% ironstone gravel; massive, earthy fabric; moist soil; pH 6.
	10-30	Dark yellowish brown (10YR4/4) gritty fine sandy loam with 10% ironstone gravel; weak crumb structure, moist soil; pH 6.5.
	30-60	Yellow (10YR7/8) with yellowish red mottles light clay; strong angular blocky structure; moist soil; pH 6.

Project and site code: SWF DIA14

Date: 12/04/2005

Location: MGA Zone: 50 420220 mE 6190517 mN

Slope: < 5%

Site notes: Moderate trafficability

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Haplic Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark grey (7.5YR3/1 moist) humic loam; moist soil; massive, granular structure; 10% rounded ferruginous ironstone medium gravels; pH 6.
A12	10-30	strong brown (7.5YR5/6 moist) loamy fine sand; moist soil; granular structure; 50% rounded ferruginous ironstone medium gravels; pH 6.5.
B2	30-50	brownish yellow (10YR6/6 moist) light clay; moist soil; moderate, granular structure; 5% rounded ferruginous ironstone fine gravels; pH 6.

Project and site code: SWF DIA15

Date: 12/04/2005

Location: MGA Zone: 50 420147 mE 6190565 mN

Location notes: High rutting evident, at loading bay quartz stone on surface

Slope: < 5%

Site notes: Moderate trafficability

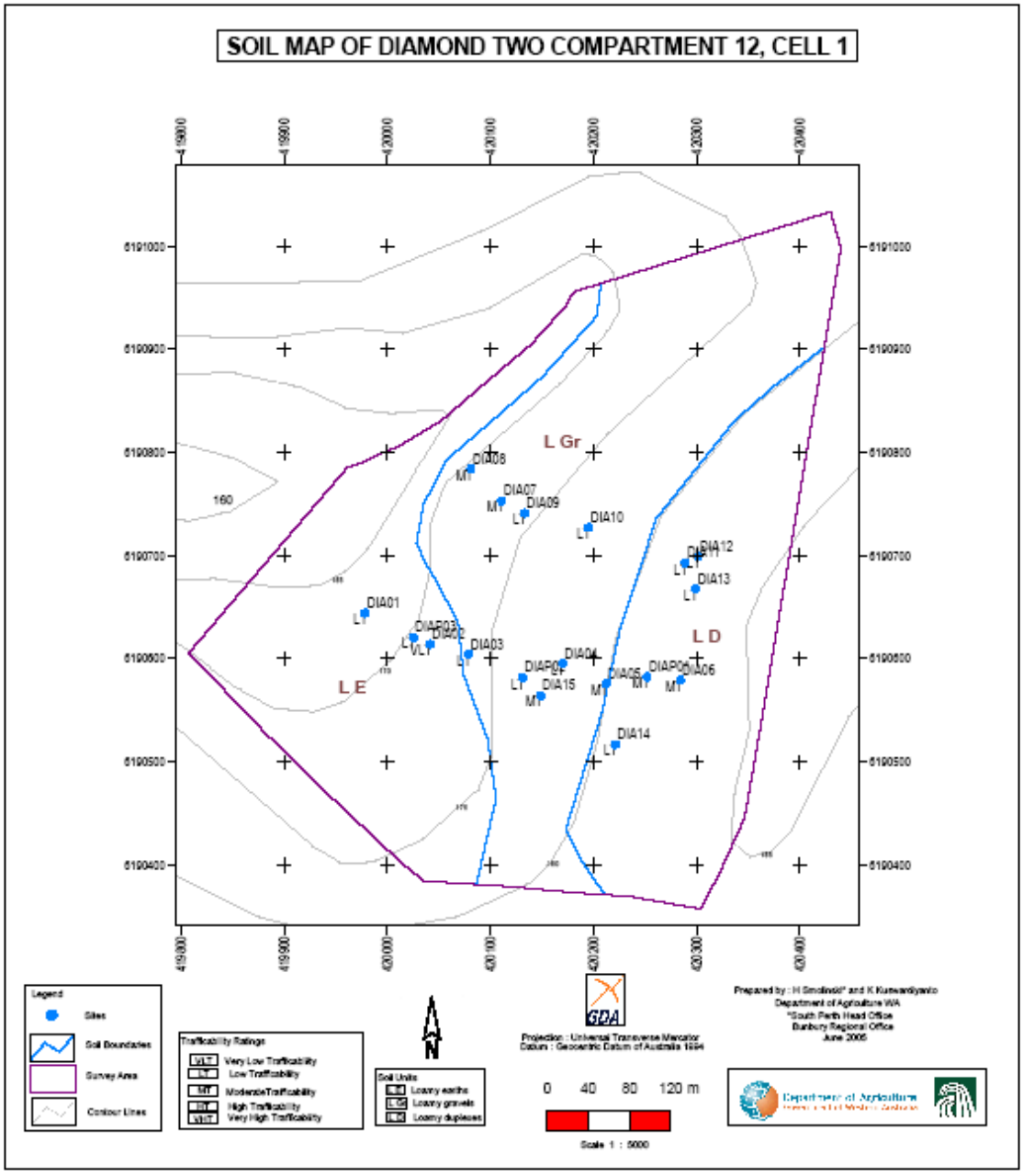
Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moist soil; weak, crumb structure; 10% rounded ferruginous ironstone fine gravels; pH 6.
A12	10-50	strong brown (7.5YR5/6 moist) sandy loam; moist soil; weak, crumb structure; 50% rounded ferruginous ironstone medium gravels; pH 6.5.
B2	50-60+	brownish yellow (10YR6/8 moist) light clay; few coarse faint red (2.5YR4/8 moist) mottles; moist soil; weak, granular structure; 10% rounded ferruginous ironstone fine gravels; pH 6.5.


SOIL MAP OF DIAMOND TWO COMPARTMENT 12, CELL 1
L Gr
L D
L E
DIA01
DIA02
DIA03
DIA04
DIA05
DIA06
DIA07
DIA08
DIA09
DIA10
DIA11
DIA12
DIA13
DIA14
DIA15
DIAP01
DIAP02
DIAP03
DIAP04
DIAP05
DIAP06
160
Legend
Sites
Soil Boundaries
Survey Area
Contour Lines
Trafficability Ratings
Very Low Trafficability
Low Trafficability
Moderate Trafficability
High Trafficability
Very High Trafficability
Soil Units
Loamy earths
Loamy gravels
Loamy duplexes
N
GDA
Projection : Universal Transverse Mercator
Datum : Geocentric Datum of Australia 1994
0 40 80 120 m
Scale 1 : 5000
Prepared by : H Smolinski* and K Kuswardiyanto
Department of Agriculture WA
*South Perth Head Office
Bunbury Regional Office
June 2005
Department of Agriculture

Attachment 5 – Soil Assessment of Dingup

Compartment 1
Cell 4 Road Manjimup

Summary

Dingup, Compartment 1, Cell 4 contains 2 soil units.

ShGr+SGr: Shallow gravels and Sandy gravels associated with gently inclined slopes.

ShGr: Shallow gravels associated with lower slopes.

Both soil units have a very high to high trafficability rating as most soils are gravelly clayey sands overlying boulder laterite or ferricrete.

Site description

The site has an area of approximately 28 hectares and consists of jarrah, marri forest with jarrah being the dominant tree.

The site is very gentle to gently inclined with a grade commonly between 5-8%.

A broad laterite plateau defines the northern boundary and most of the block grades to the south and south-east.

Geology

Regional geological mapping (Wilde and Walker, 1984) indicates that Archean granites are the dominant basement rocks. The basement rocks are strongly lateritised and mantled by residual boulder laterite and ferricrete. Laterite outcrop is evident throughout the block.

Soils

The soils have developed from laterite colluvium, which is predominantly gravelly clayey sand.

Two soil units were identified on the basis of landform and soil development.

The soil units are described below and soil profile descriptions are provided in Appendix A.

ShGr+SGr Shallow Gravels and Sandy gravels on very gently to gently inclined slopes

WA soil group: Shallow gravel, Sandy gravel

Soil classification: Petroferric Orthic Tenosol, Ferric Orthic Tenosol

This unit is associated with the lateritic plateau and sideslopes having a common grade of 3-5%.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are dark brown, gravelly clayey sand overlying brown to strong brown clayey sand that is massive or displays a weak crumb structure. A reddish brown variant was also encountered on upperslopes.

Laterite boulder outcrop was usually evident within the unit or it occurred within a depth of 50 cm.

Abundant ironstone gravel (50-70% by volume) occurred throughout the soil profile. Gravel shape is variable although round to subround gravel was more common. Gravel size ranged between 3-30 mm diameter with most < 10 mm diameter. Clay loam or clay horizons were not encountered within the soil profile (< 50 cm).

The soil reaction trend is acid to neutral.

Trafficability rating

This soil unit has a very high trafficability rating due to the abundant gravel content, occurrence of shallow boulder laterite and absence of clay within the soil profile.

ShGr Shallow gravels, lower slopes

WA soil group: Shallow gravel

Soil classification: Petroferric Bleached-Orthic Tenosol

This unit is associated with a broad open depression and lower slopes having a grade commonly < 3%.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are dark red-brown, gravelly loamy sand to clayey sand, less commonly sandy loam overlying red-brown gravelly loamy or clayey sand. Laterite boulder, stone or ferricrete is usually encountered within 50 cm and also evident on the soil surface. A scree of fine black pisolitic and angular gravel was a common feature of the upper topsoil and it is usually associated with paler coloured loamy sands that contain bleached sand grains.

The soil reaction trend is neutral.

Trafficability rating

These soils typically have a very high trafficability rating due to the abundant gravel content, occurrence of shallow boulder laterite and coarse soil texture.

Seepage was evident in vicinity of Site 20 and soils within the centre of the open depression are subject to periodic waterlogging. Nevertheless, abundant gravel and common laterite within the soil profile would minimise soil rutting.

Management considerations

The soils within Dingup are highly resistant to rutting and negligible rutting was evident during site assessment.

Soil profile descriptions – Dingup, Compartment 1, Cell 4

Project and site code: SWF DP01

Date: 29/04/2005

Location: MGA Zone: 50 426369 mE 6208250 mN

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (5YR2.5/1 moist) humic clayey fine sand; moderately moist soil; massive structure; earthy fabric; 60% subrounded ferruginous ironstone medium gravels; pH 6.
A12	5-50	yellowish red (5YR4/6 moist) clayey fine sand; moderately moist soil; crumb structure; 70% subrounded ferruginous ironstone fine gravels; pH 6.5.
R	50	Lateritic stone.

Project and site code: SWF DP02

Date: 29/04/2005

Location: MGA Zone: 50 426309 mE 6208276 mN

Location notes: Lateritic rock on the surface

Slope: 9%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	dark reddish brown (5YR3/3 moist) humic clayey fine sand; massive structure; earthy fabric; 70% subrounded ferruginous ironstone medium gravels; pH 6.
A12	3-25	yellowish red (5YR4/6 moist) clayey fine sand; single grain structure; earthy fabric; 70% subrounded ferruginous ironstone coarse gravels; pH 6.5.
R	25	

Project and site code: SWF DP03

Date: 29/04/2005

Location: MGA Zone: 50 426259 mE 6208378 mN

Location notes: Lateritic rock on the surface. Stone in profile

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11		dark brown (7.5YR3/3 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 20% subrounded ferruginous ironstone fine gravels; pH 6.5.
A12		strong brown (7.5YR5/8 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 50% subrounded ferruginous ironstone fine gravels; pH 6.5.
R		

Project and site code: SWF DP04

Date: 29/04/2005

Location: MGA Zone: 50 426164 mE 6208369 mN

Location notes: Few laterite rock outcrop

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/2 moist) humic fine sandy loam; moderately moist soil; massive structure; earthy fabric; pH 6.
A12	5-25	strong brown (7.5YR5/6 moist) clayey fine sand; moderately moist soil; massive structure; earthy fabric; 60% rounded ferruginous ironstone fine gravels; pH 6.5.
R	25	laterite

Project and site code: SWF DP05

Date: 29/04/2005

Location: MGA Zone: 50 426172mE 6208266mN

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	brown (7.5YR4/4 moist) humic clayey fine sand; single grain structure; sandy fabric; 20% rounded ferruginous fine gravels; pH 6.
A12	3-30	strong brown (7.5YR5/6 moist) clayey fine sand; single grain structure; sandy fabric; 60% rounded ferruginous fine gravels; pH 6.5.
R	30	laterite

Project and site code: SWF DP06

Date: 29/04/2005

Location: MGA Zone: 50 426219 mE 6208140 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric-Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	dark reddish brown (5YR2.5/2 moist) humic loam; moderately moist soil; massive structure; earthy fabric; 10% rounded ferruginous fine gravels; pH 5.
A12	3-40	yellowish red (5YR4/6 moist) clayey fine sand; moderately moist soil; massive structure; earthy fabric; 70% rounded ferruginous medium gravels; pH 6.5.
A13	40-50	yellowish red (5YR5/6 moist) clayey fine sand; moist soil; 70% rounded ferruginous medium gravels; pH 6.5.

Project and site code: SWF DP07

Date: 29/04/2005

Location: MGA Zone: 50 426245 mE 6208121 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	brown (7.5YR4/2 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 50% subrounded ferruginous medium gravels; pH 6.
A12	5-20	brown (7.5YR5/4 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 70% subrounded ferruginous medium gravels; pH 6.
R	20	

Project and site code: SWF DP08

Date: 29/04/2005

Location: MGA Zone: 50 426299 mE 6208145 mN

Location notes: Black gravel

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	very dark grey (7.5YR3/1 moist) humic clayey fine sand; single grain structure; sandy fabric; 60% rounded ferruginous fine gravels; pH 5.
A12	8-30	brown (7.5YR5/4 moist), pink (7.5YR7/4 dry) loamy fine sand; single grain structure; sandy fabric; 70% rounded ferruginous medium gravels; pH 5.5.
R	30	laterite.

Project and site code: SWF DP09

Date: 29/04/2005

Location: MGA Zone: 50 426108 mE 6208098 mN

Slope: 8%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	black (5YR2.5/1 moist) humic loam; moderately moist soil; massive structure; earthy fabric; 20% rounded ferruginous fine gravels; pH 5.
A12	3-20	yellowish red (5YR4/6 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 70% subrounded ferruginous fine gravels; pH 6.
R	20	laterite

Project and site code: SWF DP10

Date: 29/11/2005

Location: MGA Zone: 50 426038 mE 6208128 mN

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic fine sandy loam; moderately moist soil; massive structure; earthy fabric; 60% rounded ferruginous ironstone medium gravels and subangular; pH 6.
A12	5-40	strong brown (7.5YR4/6 moist) clayey fine sand; moderately moist soil; massive structure; earthy fabric; 70% rounded ferruginous and subangular; pH 6.5; cfs-fsl.
R	40	laterite

Project and site code: SWF DP11

Date: 29/04/2005

Location: MGA Zone: 50 425925 mE 6208154 mN

Location notes: Laterite outcrop

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic fine sandy loam; massive structure; earthy fabric; 50% subrounded ferruginous medium gravels and subangular; pH 6.
A12	5-50+	strong brown (7.5YR5/8 moist) clayey fine sand; massive structure; earthy fabric; 60% subrounded ferruginous medium gravels and subangular; pH 6.5.

Project and site code: SWF DP12

Date: 29/04/2005

Location: MGA Zone: 50 425921 mE 6208028 mN

Location notes: Shallow laterite

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (5YR2.5/1 moist) humic fine sandy loam; moderately moist soil; massive structure; 30% subrounded ferruginous fine gravels; pH 6.
A12	5-25	yellowish red (5YR4/6 moist) clayey fine sand; moderately moist soil; massive structure; 50% subrounded ferruginous fine gravels; pH 6.5.
R	25	laterite rock.

Project and site code: SWF DP13

Date: 29/04/2005

Location: MGA Zone: 50 425930 mE 6207967 mN

Location notes: Laterite outcrop

Slope: 6%

Site notes: Very high trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/3 moist) humic fine sandy loam; massive structure; earthy fabric; 50% subrounded ferruginous fine gravels; pH 6.5.
A12	5-40	strong brown (7.5YR4/6 moist) clayey fine sand; massive structure; earthy fabric; 70% subrounded ferruginous coarse gravels; pH 6.
A13	40-60+	strong brown (7.5YR5/6 moist) clayey fine sand; massive structure; earthy fabric; 70% subrounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF DP14

Date: 29/04/2005

Location: MGA Zone: 50 425932 mE 6207832 mN

Location notes: Common surface laterite. Common rock

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
	0-5	black (7.5YR2.5/1 moist) humic fine sandy loam; massive structure; earthy fabric; 30% rounded ferruginous medium gravels; pH 5.
	5-30	brown (7.5YR4/4 moist) fine sandy loam; weak, crumb structure; rough-ped fabric; 60% subrounded ferruginous fine gravels; pH 6.5.
	30+	laterite.

Project and site code: SWF DP15

Date: 29/04/2005

Location: MGA Zone: 50 426084 mE 6207958 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark grey (7.5YR3/1 moist) humic clayey fine sand; moist soil; massive structure; earthy fabric; 50% subangular ferruginous fine gravels; pH 6.
A12	5-15	brown (7.5YR4/2 moist) clayey fine sand; moist soil; single grain structure; sandy fabric; 60% subangular ferruginous fine gravels; pH 6.
A13	15-25	brown (7.5YR5/4 moist) loamy fine sand; moist soil; single grain structure; sandy fabric; 70% subangular ferruginous fine gravels; pH 6.
R	25+	laterite

Project and site code: SWF DP16

Date: 17/05/2005

Location: MGA Zone: 50 425701 mE 6207815 mN

Location notes: Common laterite outcrop, dark gravel 3-30 m commonly < 5 mm

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	black (5YR2.5/1 moist) humic loamy sand; single grain structure; sandy fabric; 60% subrounded ferruginous fine gravels; pH 5.5; clear boundary.
A12	8-20	reddish brown (5YR5/4 moist) loamy sand; single grain structure; sandy fabric; 70% subrounded ferruginous fine gravels; pH 5.5.
R	20+	laterite

Project and site code: SWF DP17

Date: 17/05/2005

Location: MGA Zone: 50 425757 mE 6207896 mN

Location notes: Similar to site 16, few cobbler in profile. Grad 3-30 m, dominant < 5 mm.

Slope: 6-7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic loamy sand; single grain structure; sandy fabric; 70% subangular ferruginous fine gravels; pH 5.5; clear boundary.
A12	5-20	strong brown (7.5YR4/6 moist) loamy sand; single grain structure; sandy fabric; 70% subangular ferruginous fine gravels; pH 6.
R	20+	laterite.

Project and site code: SWF DP18

Date: 17/05/2005

Location: MGA Zone: 50 425749 mE 6207988 mN

Location notes: Laterite on surface, common laterite

Slope: 8%

Site notes: Very high trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loamy sand; massive structure; earthy fabric; 70% subrounded ferruginous fine gravels; pH 6.5.
A12	10-50+	strong brown (7.5YR4/6 moist) clayey sand; massive structure; earthy fabric; 70% subrounded ferruginous fine gravels; pH 6.5.

Project and site code: SWF DP19

Date: 17/05/2005

Location: MGA Zone: 50 425706 mE 6208097 mN

Location notes: Round to subrounded granite, dominant < 5 mm round

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic loamy sand; moderately moist soil; massive structure; earthy fabric; 10% subrounded ferruginous fine gravels; pH 6; clear boundary.
A12	5-50	strong brown (7.5YR4/6 moist) fine sandy loam; moderately moist soil; massive structure; earthy fabric; 60% subrounded ferruginous fine gravels; pH 7.
R	50+	laterite.

Project and site code: SWF DP20

Date: 17/05/2005

Location: MGA Zone: 50 425798 mE 6207800 mN

Location notes: Seepage area. Rock in profile. SWT. Gravel 3-20 m < 5 mm round to subrounded

Slope: < 5%

Site notes: Very high trafficability rating

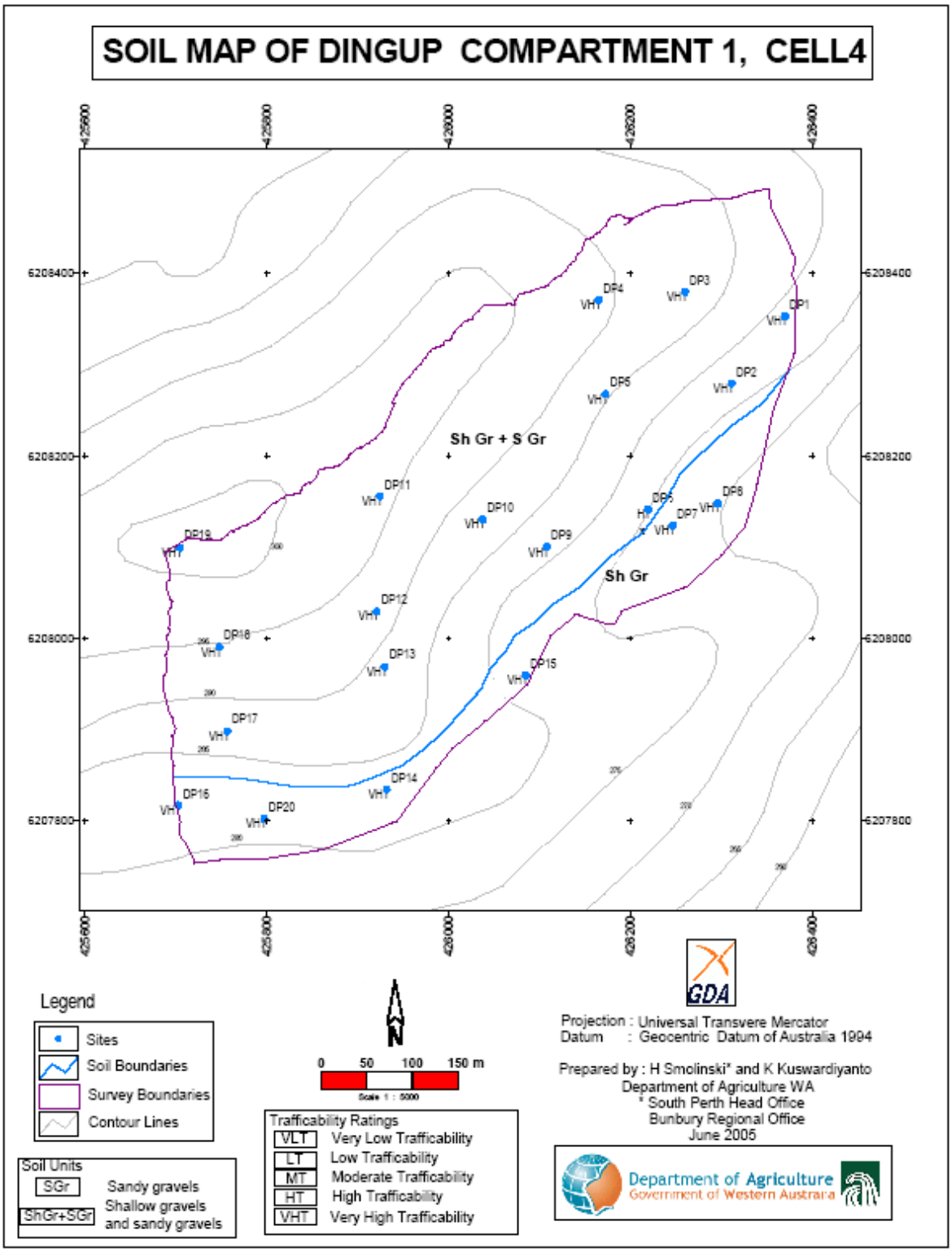
Current classification

WA soil group: Shallow gravel

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (5YR2.5/1 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 10% subrounded ferruginous fine gravels and rounded; pH 5.5; clear boundary.
A12	5-50	yellowish red (5YR4/5 moist) clayey fine sand; wet soil; massive structure; earthy fabric; 70% subrounded ferruginous fine gravels and rounded; pH 6.5.
R	50+	laterite.


SOIL MAP OF DINGUP COMPARTMENT 1, CELL4
425600
425800
426000
426200
426400
6208400
6208200
6208000
6207800
Sh Gr + S Gr
Sh Gr
DP1
DP2
DP3
DP4
DP5
DP6
DP7
DP8
DP9
DP10
DP11
DP12
DP13
DP14
DP15
DP16
DP17
DP18
DP19
DP20
VHT
GDA
Legend
Sites
Soil Boundaries
Survey Boundaries
Contour Lines
Soil Units
SGr
Sandy gravels
ShGr+SGr
Shallow gravels and sandy gravels
0 50 100 150 m
Scale 1 : 5000
Trafficability Ratings
VLT Very Low Trafficability
LT Low Trafficability
MT Moderate Trafficability
HT High Trafficability
VHT Very High Trafficability
Projection : Universal Transvere Mercator
Datum : Geocentric Datum of Australia 1994
Prepared by : H Smolinski* and K Kuswardiyanto
Department of Agriculture WA
* South Perth Head Office
Bunbury Regional Office
June 2005
Department of Agriculture
Government of Western Australia

Attachment 6 – Soil Assessment of Fleays

Compartment 3, Cell 32
Don Road, Shire of Collie

Summary

Fleays: Compartment 3 Cell 32 contains 2 soil units.

ShGr: Shallow gravels.

SGr+LGr: Sandy gravels and Loamy gravels.

Soil unit ShGr represents areas of shallow gravelly soils in association with laterite outcrop. These soils generally have a very high trafficability rating.

Soil unit SGr+LGr represents an association of deep sandy gravels and loamy gravels occurring within a broad swale. These soil types have a very low to moderate trafficability rating.

Site description

Fleays, Compartment 3, Cell 32 covers an area of about 33 hectares and consists of open jarrah and marri forest with jarrah being the dominant tree. *Banksia menziesii* is a common understorey species.

The block contains gently inclined gravelly slopes separated by a broad saddle.

A broad swale gently grades to the east boundary (see plan).

Geology

Regional geological mapping indicates that Archean adamellite (Wilde and Walker, 1982) is the dominant basement rock and it has been strongly lateritised.

Boulder laterite outcrop is common along the ridgeline while laterite colluvium is associated with the swale and side slopes.

Soils

Fleays, Compartment 3, Cell 32 contains two main soil units that represent ironstone gravelly soils.

The soil units are described below and soil profile descriptions are provided in Appendix A.

ShGr: Shallow gravel

WA soil group: Shallow gravel

Soil classification: Petro-Ferric Orthic Tenosol

This soil unit is associated with the very gently inclined saddle and gently inclined slopes that contain common laterite rock outcrop and stone.

Soils are commonly sandy gravels that overlie laterite rock and stone, occurring within 50 cm.

Topsoil horizons are dark brown gravelly loamy sand to clayey sand containing 10-40% ironstone gravel by volume overlying strong brown or dark yellowish brown gravelly clayey sand to sandy loam. Gravel content within the lower topsoil is usually 60% by volume.

The soil reaction trend is neutral.

Minor associated soils are loamy gravels having a sandy clay loam matrix.

Trafficability rating

This soil unit has a high to very high trafficability rating as the soil textures are commonly gravelly clayey sand and ironstone rock and stone is encountered within 50 cm.

Tyre rutting was not evident.

SGr+LGr: Sandy gravels + Loamy gravels

WA soil group: Sandy gravel, Loamy gravel

Soil classification: Ferric Orthic Tenosol, Ferric Eutrophic Brown Kandosol

This soil unit represents a broad swale containing an association of moderately deep sandy gravels and loamy gravels. The occurrence of laterite outcrop was less common relative to ShGr.

Topsoils are very dark grey-brown gravelly clayey sands to sandy loams containing about 10-40% ironstone gravel overlying yellowish brown or strong brown gravelly sandy loam to sandy clay loam containing 60% ironstone gravel.

The soil reaction trend is neutral.

Trafficability rating

This soil unit has a moderate to very low trafficability rating.

Areas containing loamy gravels with a sandy clay loam matrix would be more prone to rutting as these soils should remain moist for a longer period in comparison to the sandy gravels.

Note: Aerial photography indicates that the tree canopy appears to be more dense in the area containing sites 25 and 27. This area consists of loamy gravels.

Tyre rutting was not evident.

Management considerations

Fleays block is generally highly resistant to soil degradation due to the abundant gravel content and common occurrence of laterite outcrop.

The area of gravelly sandy clay loams containing Sites 25-27 was rated as having a very low trafficability however soil rutting was not evident.

Soil profile descriptions – Fleays, Compartment 3, Cell 32

Project and site code: SWF FL01

Date: 28/04/2005

Location: MGA Zone: 50 441959 mE 6307647 mN

Slope: 4%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/3 moist) humic sandy loam; moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50+	strong brown (7.5YR5/6 moist) clayey fine sand; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF FL02

Date: 28/04/2005

Location: MGA Zone: 50 441902 mE 6307658 mN

Location notes: Iron boulders and Granitic rocks on the surface

Slope: 4%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	humic sandy loam; moist soil; pH 6.5; clear boundary.
R	5+	dark brown (10YR3/3 moist); 40% rounded ironstone fine gravels; Ironstone.

Project and site code: SWF FL03

Date: 28/04/2005

Location: MGA Zone: 50 442033 mE 6307774 mN

Location notes: Iron boulders on the surface, hit rock at 25 cm

Slope: 11%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (10YR3/3 moist) humic sandy loam; moist soil; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-25	dark yellowish brown (10YR4/6 moist) clayey sand; moist soil; earthy fabric; 70% rounded ironstone medium gravels; pH 6.5; clear boundary.
R	25+	Laterite.

Project and site code: SWF FL04

Date: 28/04/2005

Location: MGA Zone: 50 442097 mE 6307728 mN

Location notes: Rock outcrop on the surface

Slope: 11%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	very dark brown (7.5YR2.5/2 moist) humic loamy sand; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	3-30	strong brown (7.5YR4/6 moist) clayey sand; 60% rounded ironstone medium gravels; pH 6.5; clear boundary.
R	30+	laterite

Project and site code: SWF FL05

Date: 28/04/2005

Location: MGA Zone: 50 442188 mE 6307662 mN

Location notes: Rock out crop on the surface

Slope: 8%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	very dark brown (7.5YR2.5/2 moist) humic loamy sand; moist soil; 20% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	3-30	strong brown (7.5YR4/6 moist) clayey sand; moist soil; 60% rounded ironstone medium gravels; pH 6.5; clear boundary.
R	30+	Laterite.

Project and site code: SWF FL06

Date: 28/04/2005

Location: MGA Zone: 50 442351 mE 6307703 mN

Slope: 8%

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moist soil; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50+	strong brown (7.5YR5/6 moist) sandy loam; moist soil; earthy fabric; 80% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL07

Date: 29/04/2005

Location: MGA Zone: 50 442429 mE 6307760 mN

Location notes:

Slope: 8%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; 40% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50+	dark yellowish brown (10YR4/6 moist) clayey sand; moist soil; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF FL08

Date: 29/04/2005

Location: MGA Zone: 50 442425 mE 6307874 mN

Location notes: Rock outcrop on the surface

Slope: 10%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	dark brown (7.5YR3/2 moist) humic sandy loam; 20% rounded ironstone fine gravels; pH 6.5.
B2	5-45	brown (7.5YR4/4 moist) sandy clay loam; 40% rounded ironstone fine gravels; pH 6.5.
R	45+	laterite

Project and site code: SWF FL09

Date: 29/04/2005

Location: MGA Zone: 50 442277 mE 6307844 mN

Location notes: Rock outcrop on the surface. Hit rock at 30 cm.

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	dark brown (10YR3/3 moist) humic sandy loam; moist soil; 20% rounded ironstone; pH 6.5; clear boundary.
B2	5-30	dark yellowish brown (10YR4/6 moist) clayey sand; moist soil; 60% rounded ironstone fine gravels; pH 6.5; clear boundary.
R	30+	laterite

Project and site code: SWF FL10

Date: 28/04/2005

Location: MGA Zone: 50 442130 mE 6307816 mN

Location notes: Rockout crops on the surface, hit rock at 25 cm

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic loamy sand; moist soil; earthy fabric; pH 6.5; clear boundary.
A12	5-25	strong brown (7.5YR5/6 moist) sandy loam; moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5; clear boundary.
R	25+	laterite

Project and site code: SWF FL11

Date: 28/04/2005

Location: MGA Zone: 50 442245 mE 6308019 mN

Location notes: Rock outcrop on the surface

Slope: 8-9%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic loamy sand; earthy fabric; 20% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	5-35	light yellowish brown (10YR6/4 moist) clayey sand; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.
R	35+	Laterite.

Project and site code: SWF FL12

Date: 29/04/2005

Location: MGA Zone: 50 442328 mE 6308096 mN

Location notes: Rock outcrop on the surface

Slope: 8%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic loamy sand; moist soil; earthy fabric; 20% rounded ironstone coarse gravels; pH 6; clear boundary.
A12	5-30	dark yellowish brown (10YR4/6 moist) clayey sand; moist soil; earthy fabric; 60% rounded ironstone; pH 6.
R	30+	laterite

Project and site code: SWF FL13

Date: 29/04/2005

Location: MGA Zone: 50 442408 mE 6307970 mN

Location notes: Rock outcrop on the surface, hit rock at 20 cm

Slope: 12-13%

Site notes: High trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (10YR3/3 moist) humic sandy loam; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-20	dark yellowish brown (10YR4/6 moist) clayey sand; moist soil; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5.
R	20+	laterite

Project and site code: SWF FL14

Date: 28/04/2005

Location: MGA Zone: 50 442367 mE 6307730 mN

Slope: 7%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark yellowish brown (10YR4/4 moist) humic loamy sand; moderately moist soil; earthy fabric; 70% rounded ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-50+	yellowish brown (10YR5/6 moist) clayey sand; moderately moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF FL15

Date: 29/04/2005

Location: MGA Zone: 50 442461 mE 6308050 mN

Location notes: Rock outcrop on the surface

Slope: 9%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/2 moist) humic loamy sand; earthy fabric; 20% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-20	strong brown (7.5YR4/6 moist) clayey sand; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5.
R	20+	Laterite.

Project and site code: SWF FL16

Date: 29/04/2005

Location: MGA Zone: 50 442363 mE 6307919 mN

Location notes: Rock outcrop on the surface

Slope: 10%

Site notes: Very high trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	humic loamy sand; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	clayey sand; moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL21

Date: 29/04/2005

Location: MGA Zone: 50 442573 mE 6307836 mN

Slope: 11%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/2 moist) humic loamy sand; moderately moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	strong brown (7.5YR4/6 moist) clayey sand; moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL22

Date: 29/04/2005

Location: MGA Zone: 50 442375 mE 6308054 mN

Slope: 9%

Location notes: Rock outcrop on the surface

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (7.5YR2/3 moist) humic sandy loam; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6; clear boundary.
B2	5-45	strong brown (7.5YR4/6 moist) sandy clay loam; moist soil; earthy fabric; 40% rounded ironstone fine gravels; pH 6.
R	45+	laterite

Project and site code: SWF FL23

Date: 28/04/2005

Location: MGA Zone: 50 442271 mE 6307922 Mn

Location notes: Iron boulders on the surface

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic loamy sand; moderately moist soil; 20% rounded ironstone medium gravels; pH 6; clear boundary.
A12	5-15	yellowish brown (10YR5/4 moist) clayey sand; moderately moist soil; 70% rounded ironstone coarse gravels; pH 6.
R	15+	Laterite.

Project and site code: SWF FL24

Date: 29/04/2005

Location: MGA Zone: 50 442541 mE 6308071 mN

Slope: 9%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic loamy sand; moist soil; 40% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-45+	yellowish brown (10YR5/6 moist) clayey sand; moist soil; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL25

Date: 29/04/2005

Location: MGA Zone: 50 442550 mE 6307990 mN

Slope: 9%

Site notes: Very low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic loamy sand; moderately moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moderately moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL26

Date: 29/04/2005

Location: MGA Zone: 50 442567 mE 6308039 mN

Slope: 9%

Site notes: Very low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic loamy sand; moderately moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moderately moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL27

Date: 29/04/2005

Location: MGA Zone: 50 442696 mE 6308001 mN

Location notes:

Slope: 9%

Site notes: Very low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	black (10YR2/1 moist) humic sandy loam; moderately moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6; clear boundary.
B2	5-50+	dark yellowish brown (10YR4/6 moist) sandy clay loam; moderately moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL28

Date: 28/04/2005

Location: MGA Zone: 50 442084 mE 6307632 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic loamy sand; 20% rounded ironstone fine gravels; pH 6.5.
A12	5-50+	strong brown (7.5YR4/6 moist) clayey sand; 70% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL29

Date: 28/04/2005

Location: MGA Zone: 50 440222 mE 6307664 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-10	very dark brown (7.5YR2.5/2 moist) humic loamy sand; earthy fabric; 40% rounded ironstone fine gravels; pH 6.
B2	10-60+	strong brown (7.5YR5/6 moist) sandy clay loam; earthy fabric; 70% rounded ironstone medium gravels; pH 6.

Project and site code: SWF FL30

Date: 28/04/2005

Location: MGA Zone: 50 442050 mE 6307728 mN

Location notes: Rock out crop on the surface, hit rock at 10 cm

Slope: 7%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Ferric Petro-ferric Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	very dark greyish brown (10YR3/2 moist) humic loamy sand; moderately moist soil; 40% rounded ironstone medium gravels; pH 6.
A12	3-10	dark yellowish brown (10YR4/4 moist) clay loam, sandy; moderately moist soil; 60% rounded ironstone medium gravels; pH 6.
R	10+	laterite

Project and site code: SWF FL31

Date: 29/04/2005

Location: MGA Zone: 50 442312 mE 6307949 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (10YR3/3 moist) humic loamy sand; 40% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	yellowish brown (10YR5/6 moist) clayey sand; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF FL32

Date: 29/04/2005

Location: MGA Zone: 50 442322 mE 6307761 mN

Location notes: Rock outcrop on the surface

Slope: 8%

Site notes: Very high trafficability rating

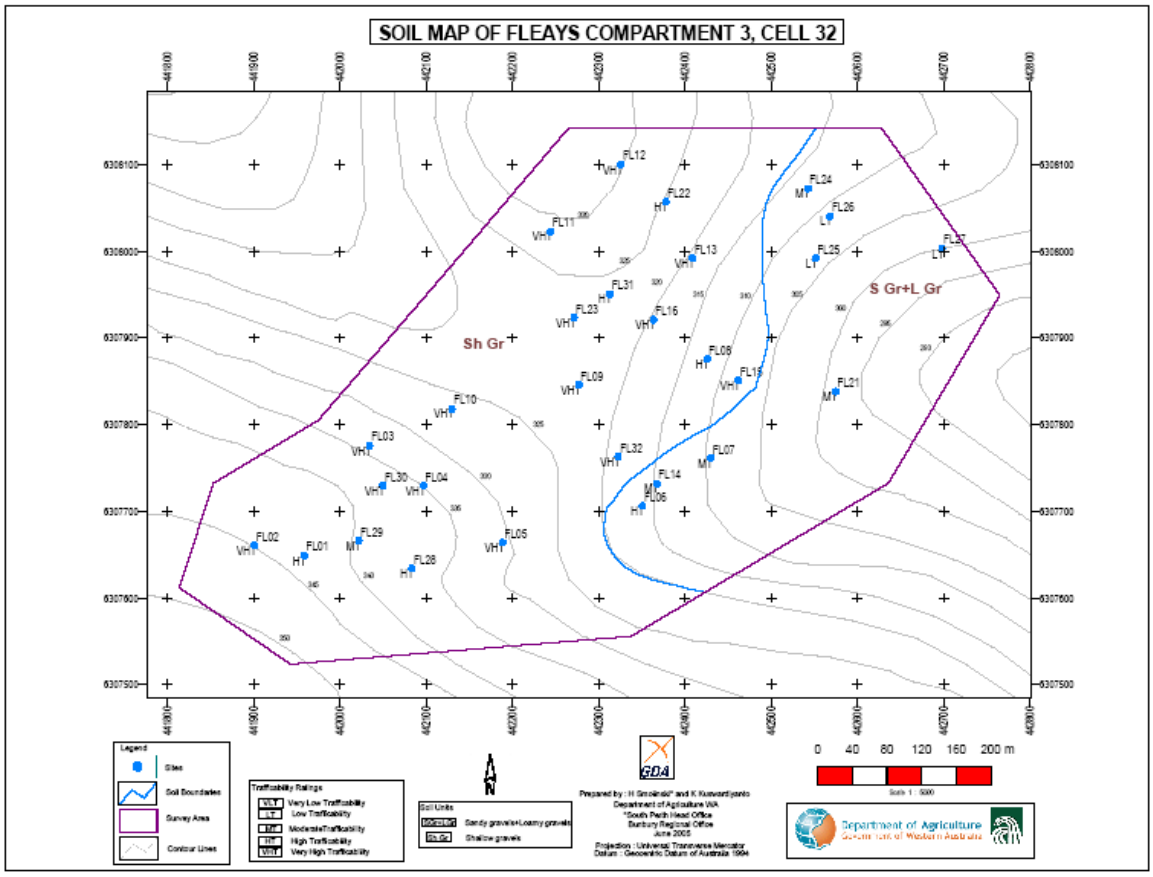
Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic loamy sand; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50+	strong brown (7.5YR5/6 moist) clayey sand; 70% rounded ironstone fine gravels; pH 6.5.


SOIL MAP OF FLEAYS COMPARTMENT 3, CELL 32
Sh Gr
S Gr+L Gr
FL01
FL02
FL03
FL04
FL05
FL06
FL07
FL08
FL09
FL10
FL11
FL12
FL13
FL14
FL15
FL16
FL21
FL22
FL23
FL24
FL25
FL26
FL27
FL28
FL29
FL30
FL31
FL32
0 40 80 120 160 200 m
GDA
Department of Agriculture

Attachment 7 – Soil Assessment of Jolly

Compartment 1, Cell 2 Wilga Road
Shire of Bridgetown-Green bushes

Summary

Jolly, Compartment 1, Cell 2 contains 2 soil units.

DSGr+SGr: Duplex sandy gravels and Sandy gravels.

SGr: Sandy gravels

Soil units DSGr+SGr has a low to high trafficability rating while soil unit SGr has a high to very high trafficability rating.

Site description

Jolly, Compartment 1, Cell 2 covers an area of approximately 25 hectares and consists of open jarrah and marri forest with jarrah being dominant.

The site is very gentle inclined with slopes generally < 2%.

Flow lines are not evident within the block although a very broad open depression, identified from contours, occurs along the south-west boundary.

Geology

Regional geological mapping indicates that Archean quartz-feldspar biotite gneiss (Wilde and Walker, 1984) is the dominant basement rock.

Boulder laterite and ironstone cap rock occurs on the broad spur while most of the site is mantled by ironstone gravel colluvium.

Soils

The soil units consist predominantly of deep sandy gravels that may overlie a gravelly sandy clay loam or clay below 60-100 cm.

The soil units are described below and soil profile descriptions are provided in Appendix A.

DSGr+SGr: Duplex sandy gravels and sandy gravels

WA Soil Group: Duplex sandy gravel, Sandy gravel

Soil classification: Ferric Eutrophic Brown Chromosol; Ferric Orthic Tenosol

This soil unit is associated with the broad open depression. Soils include:

- moderately deep sandy duplex soils having pale brown to brownish yellow topsoils, ironstone gravel occurs above the clay layer;
- pale sands and Pale sandy gravels containing < 50% ironstone gravel;
- yellow brown sandy gravels containing abundant ironstone gravel.

Coloured aerial photography indicates that the duplex sandy gravels, deep sands and pale sandy gravels are indicated by pale patches while the darker areas represent the yellow-brown sandy gravels.

Duplex soils have greyish brown to very dark greyish brown sand to clayey sands containing few to common ironstone gravel overlying pale brown to brownish yellow loamy sand or clayey sand that may contain ironstone gravel.

Pale brown to brownish yellow sandy clay loam or sandy clay containing few to common ironstone gravel was encountered at 40-50 cm.

Pale sandy soils have grey-brown loamy sand topsoils overlying light grey to light yellowish brown loamy sands that may overlie brownish yellow gravelly loamy sands.

Yellow brown sandy gravels have very dark brown gravelly clayey sand topsoils overlying brownish yellow or yellowish brown gravelly clayey sands.

Ironstone gravel content is commonly in the range of 50-70% by volume.

The soil reaction trend is acid to neutral.

Trafficability rating

The duplex and sandy soils that contain < 50% gravel have a low to moderate trafficability rating. These soil types are prone to rutting and compaction when wet.

Duplex soils are subject to periodic waterlogging as indicated by the occurrence of termite mounds.

SGr: Sandy gravels

WA Soil Group: Deep sandy gravel

Soil classification: Ferric Orthic Tenosol

The main soils within this soil unit are yellow-brown deep sandy gravels that contain abundant ironstone gravel.

Topsoils are very dark brown gravelly clayey sand overlying yellow-brown gravelly clayey sand. Gravel content is usually 50-70% by volume.

A soil cutting at the gravel pit indicates that yellow-brown and reddish mottled clay is encountered at about 100 cm. Clay was also encountered at 40 cm at sites 18 and 20.

The soil reaction trend is neutral.

Areas of laterite rock outcrop were also encountered within this unit.

Trafficability rating

This soil unit commonly has a high trafficability rating as indicated by the very high gravel content and very low to low rutting was encountered.

Management considerations

Jolly block generally has a high trafficability rating with a low risk of soil rutting.

Areas of Duplex sandy gravel and pale sands have a low to moderate trafficability rating during the winter months.

Soil profile descriptions – Jolly, Compartment 1, Cell 2

Project and site code: SWF JL01

Date: 14/04/2005

Location: MGA Zone: 50 426353 mE 6261684 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark grey (10YR4/1 moist) humic fine sand; moderately moist soil, moderately sticky; single grain structure; sandy fabric; pH 5; f-mS.
A12	10-30	pale brown (10YR6/3 moist) medium sand; moderately moist soil, non-sticky; single grain structure; sandy fabric; 30% rounded ironstone medium gravels; pH 6; m-kS.
B2	30-40+	yellowish brown (10YR5/5 moist) loamy coarse sand; moderately moist soil, moderately sticky; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL02

Date: 14/04/2005

Location: MGA Zone: 50 426260 mE 6261804 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Bleached-Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark grey (2.5Y 3/1 moist) humic clayey sand; dry soil, moderately sticky; massive structure; earthy fabric; 2% rounded ironstone medium gravels; pH 6; clear boundary.
A12	10-30	light yellowish brown (2.5Y 6/4 moist) clayey medium sand; moderately moist soil, moderately sticky; massive structure; earthy fabric; 30% rounded ironstone coarse gravels; pH 6.5; Cm-kS; gradual boundary.
A3	30-40	light brownish grey (2.5Y 6/3 moist) clayey medium sand; moderately moist soil, moderately sticky; massive structure; earthy fabric; 50% rounded ironstone; pH 6.5; Cm-kS; gradual boundary.
B2	40-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moderately moist soil, moderately sticky; massive structure; earthy fabric; 70% rounded ironstone; pH 6.5.

Project and site code: SWF JL03

Date: 14/04/2005

Location: MGA Zone: 50 426126 mE 6261863 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA Soil Group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist); humic loamy sand moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	5-40	yellowish brown (10YR5/8 moist);clayey sand moderately moist soil; single grain structure; sandy fabric; 70% rounded ironstone medium gravels; pH 6.5; gradual boundary.
A13	40-60+	brownish yellow (10YR6/6 moist); loamy sand moderately moist soil; single grain structure; sandy fabric; 70% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL04

Date: 14/04/2005

Location: MGA Zone: 50 426049 mE 6261910 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark yellowish brown (10YR4/4 moist) humic sandy loam; moderately moist soil; < 2 mm, granular structure; rough-ped fabric; 50% rounded ironstone coarse gravels; pH 6.5.
A12	10-40	brownish yellow (10YR6/8 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone cobbles; pH 6.5.
A12	40-60+	brownish yellow (10YR6/8 moist) sandy clay loam; dry soil; massive structure; 50% rounded ironstone medium gravels and angular quartz fine gravels; pH 7.

Project and site code: SWF JL05

Date: 14/04/2005

Location: MGA Zone: 50 426098 mE 6261786 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Yellow/deep sand, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; pH 6; clear boundary.
A12	5-30	light yellowish brown (10YR6/4 moist) loamy fine sand; moderately moist soil; single grain structure; sandy fabric; pH 6.5; Lf-mS; gradual boundary.
A13	30-60+	very pale brown (10YR7/4 moist) loamy fine sand; moderately moist soil; massive structure; earthy fabric; 1% rounded ironstone fine gravels; pH 6.5; Lf-mS.

Project and site code: SWF JL06

Date: 14/04/2005

Location: MGA Zone: 50 426188 mE 6261739 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Pale deep sand, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic loamy sand; moderately moist soil; single grain structure; sandy fabric; pH 6; clear boundary.
A12	5-20	light yellowish brown (10YR6/4 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; pH 6; gradual boundary.
A2	20-40	pale red (2.5YR7/2 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; pH 6.5; clear boundary.
B2	40-60+	white (2.5Y 8/2 moist) loamy sand; mottles; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL07

Date: 14/04/2005

Location: MGA Zone: 50 426335 mE 6261609 mN

Location notes: Termite mounds. MTR

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Grey Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	very dark greyish brown (10YR3/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 1% rounded ironstone medium gravels; pH 6.5; clear boundary.
A2	8-50	light yellowish brown (10YR6/4 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 35% rounded ironstone medium gravels; pH 6.5; gradual boundary.
B2	50-60+	pale brown (10YR6/3 moist) sandy clay; few very pale brown (10YR7/4 moist) mottles; moderately moist soil; massive structure; earthy fabric; 50% rounded ironstone medium gravels; pH 6.

Project and site code: SWF JL08

Date: 14/04/2005

Location: MGA Zone: 50 426422 mE 6261783 mN

Location notes: L-MTR

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Pale deep sand, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic loamy sand; single grain structure; sandy fabric; pH 5; clear boundary.
A21	10-30	light yellowish brown (10YR6/4 moist) loamy sand; single grain structure; sandy fabric; pH 6.5; gradual boundary.
A22	30-45	light grey (2.5Y 7/2 moist) loamy sand; single grain structure; sandy fabric; 2% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2s	45-60+	white (2.5Y 8/2 moist) loamy sand; massive structure; earthy fabric; 70% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF JL09

Date: 14/04/2005

Location: MGA Zone: 50 426361 mE 6261835 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic clayey sand; moderately moist soil; massive structure; earthy fabric; 40% rounded ironstone medium gravels; pH 5; clear boundary.
A12	10-40	yellowish brown (10YR5/6 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6; gradual boundary.
A13	40-60+	brownish yellow (10YR6/8 moist) clayey sand; moderately moist soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.

Project and site code: SWF JL10

Date: 14/04/2005

Location: MGA Zone: 50 426326 mE 6261923 mN

Location notes: Very low to low rutting

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	black (10YR2/1 moist) humic clayey sand; moderately moist soil; single grain structure; 40% rounded ironstone medium gravels; pH 5.5; clear boundary.
A12	8-25	brownish yellow (10YR6/8 moist) loamy sand; moderately moist soil; single grain structure; 60% rounded ironstone medium gravels; pH 6; clear boundary.
R	25+	laterite.

Project and site code: SWF JL11

Date: 14/04/2005

Location: MGA Zone: 50 426390 mE 6261945 mN

Location notes: Low rutting

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 5.5; gradual boundary.
A12	10-40	yellowish brown (10YR5/6 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5; gradual boundary.
A13	40-60+	brownish yellow (10YR6/8 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.

Project and site code: SWF JL12

Date: 14/04/2005

Location: MGA Zone: 50 mE mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6; clear boundary.
A12	10-30	brownish yellow (10YR6/6 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6; diffuse boundary.
A13	30-50+	brownish yellow (10YR6/8 moist) clayey sand; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL13

Date: 14/04/2005

Location: MGA Zone: 50 426527 mE 6261817 mN

Location notes: Very low to low rutting

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic sandy loam; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6.
A12	10-40	yellowish brown (10YR5/6 moist) clayey sand; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.
A13	40-60+	brownish yellow (10YR6/8 moist) clayey sand; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL14

Date: 14/04/2005

Location: MGA Zone: 50 426466 mE 6261717 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Bleached-Ferric Eutrophic Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	black (10YR2/1 moist) humic loamy sand; moderately moist soil; sandy fabric; 50% rounded ironstone coarse gravels; pH 5.5.
A2	8-50	light yellowish brown (10YR6/4 moist) loamy sand; moderately moist soil; sandy fabric; 60% rounded ironstone coarse gravels; pH 6.5.
B2	50-60+	yellow (10YR7/8 moist) sandy clay loam; moderately moist soil; < 2 mm, granular structure; rough-ped fabric; 40% rounded ironstone coarse gravels; pH 6.5.

Project and site code: SWF JL15

Date: 14/04/2005

Location: MGA Zone: 50 426223 mE 6262108 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic sandy loam; moderately moist soil; single grain structure; sandy fabric; 30% rounded ironstone fine gravels; pH 6; clear boundary.
A12	10-50	yellowish brown (10YR5/6 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone fine gravels; pH 6.5; gradual boundary.
A13	50-60+	brownish yellow (10YR6/8 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF JL16

Date: 14/04/2005

Location: MGA Zone: 50 426195 mE 6262107 mN

Location notes: Laterite outcrop adjacent

Slope: < 5%

Site notes: Very High Trafficability Rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist); single grain structure; sandy fabric; 60% rounded ironstone fine gravels; pH 5.5; clear boundary.
A12	10-40	yellowish brown (10YR5/8 moist); single grain structure; sandy fabric; 70% rounded ironstone fine gravels; pH 6.5; diffuse boundary.
A13	40-60+	brownish yellow (10YR6/8 moist); single grain structure; sandy fabric; 70% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF JL17

Date: 14/04/2005

Location: MGA Zone: 50 426114 mE 6262185 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone; pH 6; clear boundary.
A12	10-50	brownish yellow (10YR6/6 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 70% rounded ironstone; pH 6.5; clear boundary.
B2	50-65+	brownish yellow (10YR6/8 moist) sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; 70% rounded ironstone; pH 6.5.

Project and site code: SWF JL18

Date: 14/04/2005

Location: MGA Zone: 50 426048 mE 6262169 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (10YR4/3 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6; clear boundary.
A12	10-40	brownish yellow (10YR6/5 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6; abrupt boundary.
B2	40-60+	brownish yellow (10YR6/8 moist) light clay; moderately moist soil; < 2 mm, granular structure; rough-ped fabric; 5% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL19

Date: 14/04/2005

Location: MGA Zone: 50 426053 mE 6262085 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-8	black (10YR2/1 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 40% rounded ironstone medium gravels; pH 6; clear boundary.
A12	8-60+	yellowish brown (10YR5/5 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL20

Date: 14/04/2005

Location: MGA Zone: 50 426115 mE 6262046 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 30% rounded ironstone medium gravels; gradual boundary.
A12	10-30	strong brown (7.5YR5/8 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 40% rounded ironstone medium gravels; gradual boundary.
A2	30-40	brownish yellow (10YR6/6 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; abrupt boundary.
B2	40-60+	reddish yellow (7.5YR6/8 moist) sandy clay loam; few red (2.5YR4/8 moist) mottles and few brownish yellow (10YR6/8 moist) mottles; moderately moist soil; < 2 mm, granular structure; rough-ped fabric; few fragments.

Project and site code: SWF JL21

Date: 14/04/2005

Location: MGA Zone: 50 426205 mE 6261987 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic loamy sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	10-50+	yellowish brown (10YR5/6 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF JL22

Date: 14/04/2005

Location: MGA Zone: 50 426275 mE 6261980 mN

Slope: < 5%

Site notes: High trafficability rating

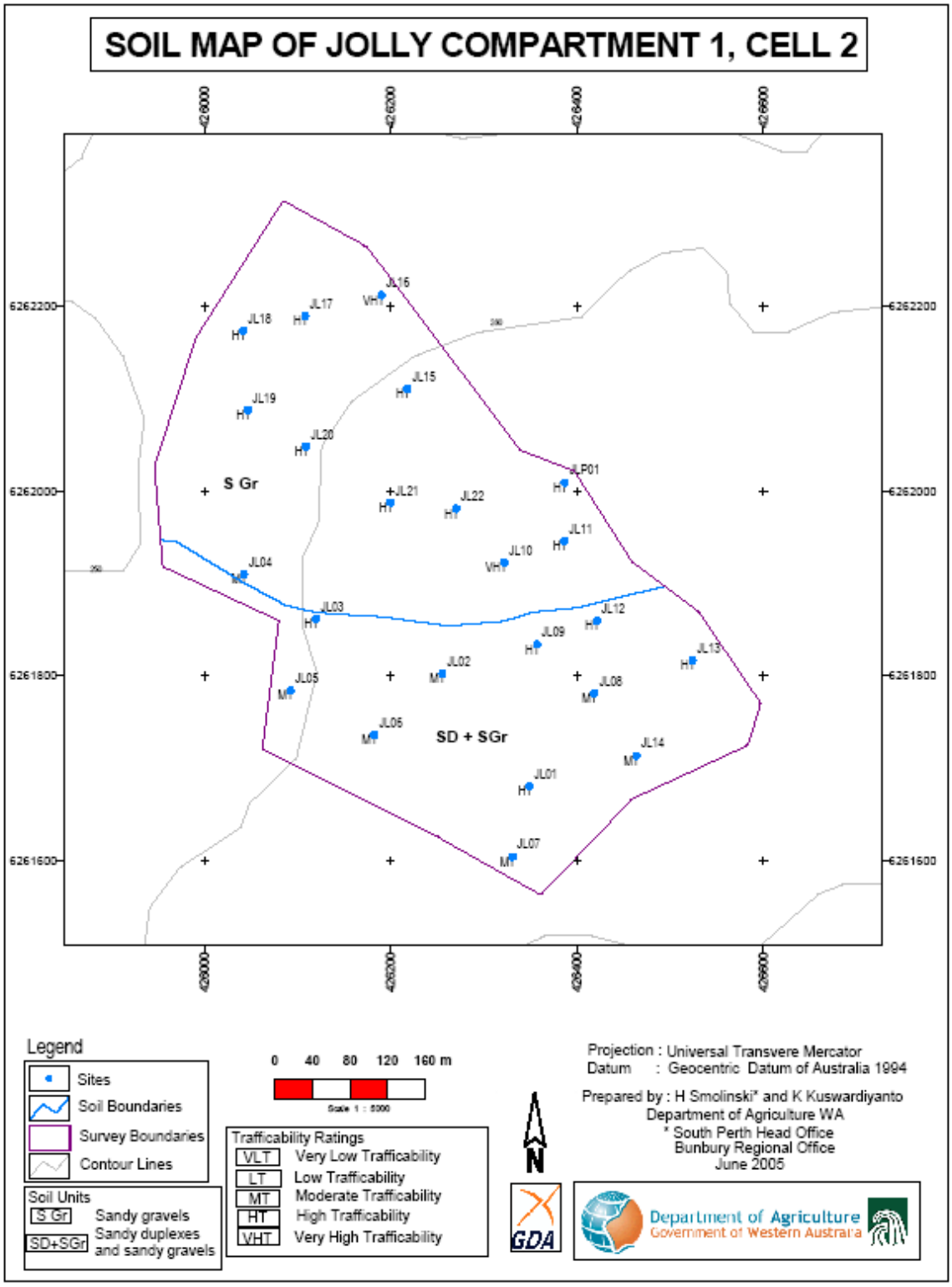
Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic clayey sand; moderately moist soil; single grain structure; sandy fabric; 50% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	10-50+	brownish yellow (10YR6/8 moist) clayey sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels; pH 6.


SOIL MAP OF JOLLY COMPARTMENT 1, CELL 2
426000
426200
426400
426600
6262200
6262000
6261800
6261600
JL16
VHT
JL17
HT
JL18
HT
JL15
HT
JL19
HT
JL20
HT
JLP01
HT
JL21
HT
JL22
HT
JL11
HT
JL10
VHT
JL04
MT
JL03
HT
JL12
HT
JL09
HT
JL13
HT
JL02
MT
JL05
MT
JL08
MT
JL06
MT
JL14
MT
JL01
HT
JL07
MT
S Gr
SD + SGr
Legend
Sites
Soil Boundaries
Survey Boundaries
Contour Lines
Soil Units
S Gr
Sandy gravels
SD+SGr
Sandy duplexes and sandy gravels
0 40 80 120 160 m
Scale 1 : 5000
Trafficability Ratings
VLT Very Low Trafficability
LT Low Trafficability
MT Moderate Trafficability
HT High Trafficability
VHT Very High Trafficability
N
GDA
Projection : Universal Transvere Mercator
Datum : Geocentric Datum of Australia 1994
Prepared by : H Smolinski* and K Kuswardiyanto
Department of Agriculture WA
* South Perth Head Office
Bunbury Regional Office
June 2005
Department of Agriculture
Government of Western Australia

Attachment 8 – Soil Assessment of Lindsay

Compartment 25 & 26, Cells 1-3
Manjimup

Summary

Lindsay Compartment 25&26, Cell 1-3 contains 5 soil/landform units.

ShGr, vg-gs: Shallow gravels, very gently to gently inclined slopes.

ShGr, mms: Shallow gravels, moderately steep slopes.

DSGr, mms: Duplex sandy gravels, moderately steep slopes.

LGr/c: Loamy gravels over clay.

Soil units ShGr, vg-gs and ShGr, mms have a very high to high trafficability ratings while soil units DSGr, mms and LGr/c have a moderate to low ratings.

Site description

Lindsay Compartment 25&26, Cell 1-3 has an area of approximately 28 hectares and consists of jarrah, marri and karri forest with jarrah and marri being the dominant trees. Karri was encountered within flow lines and areas of moderately steep slope.

A broad laterite plateau occurs at the centre of the block and gravelly spurs grade to the west and south-east. Moderately steep slopes flank the gravelly spurs.

Geology

Regional geological mapping indicates that Archean quartz-feldspar biotite gneiss (Wilde and Walker, 1984) is the dominant basement rocks. Outcrops of gneiss were evident at Sites 1, 4, 14 and 15.

Boulder laterite and cap rock was evident on the plateau and along the spurs.

Soils

Three main soil types were identified although five soil units were mapped as an association of soil type and slope class.

The soil units are described below and soil profile descriptions are provided in Appendix A.

ShGr, vg-gs: Shallow Gravels, very gently to gently inclined slopes

WA soil groups: Shallow gravel, Deep sandy gravel

Soil classification: Petroferric Bleached-Orthic Tenosol

This unit is associated with lateritic crest and spurs having a grade commonly in the range of 2-6%.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are dark brown, humic clayey sand to sandy loam overlying brown to strong brown clayey sand to sandy loam that is massive or displays a weak crumb structure.

Laterite boulder outcrop was usually evident within the unit or it occurred within the soil profile. On the central laterite plateau the soils commonly have leached loamy sand topsoils. The soil colour within the lower topsoil was usually brown to light brown and bleached sand grains were also evident. Massive caprock was often encountered within 50 cm.

Abundant ironstone gravel (50-70% by volume) occurred throughout the soil profile. Fine black pisolitic gravel was a feature of the leached loamy sands occurring on the plateau.

The soil reaction trend is neutral.

Trafficability rating

This soil unit has a high to very high trafficability rating due to the abundant gravel content, occurrence of shallow boulder laterite and absence of clay within the upper 50 cm of the soil profile.

ShGr, mss: Shallow Gravels, moderately steep slopes

WA soil group: Shallow gravel

Soil classification: Petroferric Orthic Tenosol

This unit is associated with moderately steep slopes having a grade commonly > 10%.

Soil parent material is laterite colluvium consisting of abundant ironstone gravel and stone in association with laterite boulder and shallow cap rock.

Topsoils are dark reddish brown, humic clayey sand to sandy loam overlying reddish brown clayey sand to sandy loam that is massive or displays a weak crumb structure. Laterite stone and boulder outcrop was usually evident within the unit or it occurred within the soil profile by 50 cm. Abundant ironstone gravel (50-70% by volume) occurred throughout the soil profile. Fine black pisolitic gravel was a feature of the leached loamy sands occurring on the plateau.

The soil reaction trend is neutral.

Trafficability rating

These soils typically have a high to very high trafficability rating due to the abundant gravel content, occurrence of shallow boulder laterite and absence of clay within the soil profile.

Note: Low to moderate rutting and topsoil disturbance was evident at turning points.

DSGr, mss: Duplex sandy gravels, moderately steep slope

WA soil group: Duplex sandy gravel

Soil classification: Ferric Eutrophic Brown Chromosol, Bleached-Ferric Eutrophic Brown Chromosol

This soil unit is associated with upper to mid slopes having a grade > 10%.

Soil types include Yellow/brown deep sandy duplex and Sandy gravels and Loamy gravels.

Topsoils are dark brown clayey sand to sandy loam overlying brown, light yellowish brown or less commonly yellowish red clayey sand to sandy loam. Abundant gravel is evident within the topsoil horizons.

Clay was not always encountered within 50 cm although pale subsoil colours and subsoil saturation indicated that clay is likely to occur within 100 cm.

Topsoils are massive or displayed a crumb structure while the clay layer exhibited an angular blocky structure.

The soil reaction trend is usually neutral.

Trafficability rating

This soil unit has a low to moderate trafficability rating with the steeper slopes being more prone to rutting and soil erosion.

LGr/c: Loamy gravels over clay

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Chromosol

This soil unit is associated with mid to upperslopes having a grade of 5-20%.

Soil parent material is laterite and gneiss colluvium.

The soils are commonly Loamy gravels that usually have a clay subsoil occurring by 50 cm.

Topsoils are dark red-brown sandy loam overlying brown to reddish brown sandy loam containing few to abundant ironstone and gneiss gravel.

Structured, strong brown to yellowish red clay loam or clay was encountered at 35-55 cm and it contained few to abundant gravel.

The soil profile usually has a neutral soil reaction trend.

Trafficability rating

This soil unit has moderate to low trafficability rating with steeper slopes being prone to water erosion. Slight to moderate rutting was evident particularly in flow lines where gravel content was < 50%.

Management considerations

Most of Lindsay block contains gravelly soils that have a high to very high trafficability rating.

Areas of LGr/c soils are prone to degradation and should only be entered in late spring to autumn prior to substantial rainfall. Topsoil horizons are likely to reach field capacity after a 40-60 mm rainfall event.

Flow lines and areas having a grade > 10% are more prone to soil disturbance.

Soil profile descriptions – Lindsay, Compartment 25 & 25, Cell 1

Project and site code: SWF LY01

Date: 28/04/2005

Location: MGA Zone: 50 402238 mE 6207618 mN

Slope: 17%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR2.5/2 moist) humic sandy loam; moist soil; weak, crumb structure; 60% subangular ironstone fine gravels and igneous rock (unidentified); pH 7; clear boundary.
A12	10-40	reddish brown (5YR4/4 moist) loamy fine sand; moist soil; weak, crumb structure; 70% subangular ironstone medium gravels and igneous rock (unidentified); pH 6; gradual boundary.
A13	40-50+	yellowish red (5YR4/6 moist) sandy clay loam; moist soil; 70% subangular ironstone medium gravels and igneous rock (unidentified); pH 6.5.

Project and site code: SWF LY02

Date: 28/04/2005

Location: MGA Zone: 50 402186 mE 6207564 mN

Slope: 18%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark reddish brown (5YR2.5/2 moist) humic loam; moist soil; weak, crumb structure; 10% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	5-50	yellowish red (5YR4/6 moist) fine sandy loam; moist soil; weak, crumb structure; 60% rounded ironstone medium gravels; pH 6.5; clear boundary.
B2	50-60+	yellowish red (5YR5/6 moist) light clay; few red (2.5YR4/8 moist) mottles; moist soil; moderate, granular structure; pH 6.

Project and site code: SWF LY03

Date: 28/04/2005

Location: MGA Zone: 50 402137 mE 6207609 mN

Location notes: Saturated over clay. In swale 40-50%. Moderate to high rutting

Slope: 12-13%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moderately moist soil; 60% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	5-50	strong brown (7.5YR4/6 moist) clayey sand; moist soil; 70% rounded ironstone fine gravels and subangular; pH 6.5; abrupt boundary.
B2	50-70+	strong brown (7.5YR5/8 moist) light clay; few brownish yellow (10YR6/8 moist) mottles; moist soil; 10% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY04

Date: 28/04/2005

Location notes: SA-SR-R dark gravel

Slope: 14%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) loamy sandy loam; moist soil; 60% subangular ironstone; pH 7; clear boundary.
A12	10-55	brown (7.5YR4/4 moist) sandy loam; moist soil; 70% subangular ironstone; pH 7; gradual boundary.
B2	55-60+	strong brown (7.5YR5/6 moist) light clay; few red (2.5YR4/8 moist) mottles; moist soil; 50% subangular ironstone; pH 6.5.

Project and site code: SWF LY05

Date: 28/04/2005

Location: MGA Zone: 50 402111 mE 6207462 mN

Slope: 21%

Site notes: Very low trafficability rating

Current classification

WA soil group: Duplex sandy grave, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark reddish brown (5YR2.5/2 moist) humic loam; weak, crumb structure; 10% rounded ironstone fine gravels; pH 6.5.
A12	5-35	yellowish red (5YR4/6 moist) loamy fine sand; weak, crumb structure; 25% subrounded ironstone fine gravels and subangular tabular; pH 6.5.
B2	35-50+	yellowish red (5YR5/8 moist) clay loam, fine sandy; moderate, angular blocky and granular structure; rough-ped fabric; 50% subrounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY06

Date: 28/04/2005

Location: MGA Zone: 50 401996 mE 6207484 mN

Slope: < 21%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moderately moist soil; weak, crumb structure; 60% rounded ironstone medium gravels and subrounded; pH 6.5; clear boundary.
A12	10-50	strong brown (7.5YR4/6 moist) fine sandy loam; moist soil; weak, crumb structure; 70% rounded ironstone medium gravels and subrounded; pH 6.5; diffuse boundary.
A13	50-60+	strong brown (7.5YR5/6 moist) sandy loam; moist soil; 70% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF LY07

Date: 28/04/2005

Location: MGA Zone: 50 401952 mE 6207563 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels and subangular; pH 6.5; clear boundary.
A12	10-50+	strong brown (7.5YR4/6 moist) clayey fine sand; moist soil; massive structure; earthy fabric; 70% rounded ironstone medium gravels and subangular; pH 6.5.

Project and site code: SWF LY08

Date: 28/04/2005

Location: MGA Zone: 50 401998 mE 6207625 mN

Location notes: Area of shallow laterite

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-3	dark reddish brown (5YR2.5/2 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 10% rounded ironstone fine gravels; pH 5.5; clear boundary.
A12	3-30	yellowish red (5YR4/6 moist) fine sandy loam; moist soil; weak, crumb structure; 70% rounded ironstone fine gravels; pH 6.5.
R	30+	laterite stone + boulders.

Project and site code: SWF LY09

Date: 28/04/2005

Location: MGA Zone: 50 402068 mE 6207707 mN

Location notes: Laterite on surface. Similar to 8 but loamy

Slope: 9%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR2.5/2 moist) humic loam; moderately moist soil; massive structure; earthy fabric; 30% rounded ironstone fine gravels; pH 7; clear boundary.
A12	10-30	yellowish red (5YR4/6 moist) loam; moderately moist soil; weak, crumb structure; 60% rounded ironstone medium gravels; pH 6.5.
R	30+	ironstone.

Project and site code: SWF LY10

Date: 28/04/2005

Location: MGA Zone: 50 402172 mE 6207717 mN

Location notes: SWL

Slope: 9-10%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic sandy loam; weak moist consistence; weak, crumb structure; 60% rounded ironstone medium gravels; pH 7.5; clear boundary.
A12	10-50+	strong brown (7.5YR5/6 moist) fine sandy loam; weak moist consistence; weak, crumb structure; 60% rounded ironstone medium gravels; pH 7.5.

Project and site code: SWF LY11

Date: 28/04/2005

Location: MGA Zone: 50 402439 mE 6207868 mN

Location notes: Laterite on surface

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loamy sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels and subrounded; pH 6.5; clear boundary.
A12	10-30	brown (7.5YR4/4 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 70% rounded ironstone medium gravels and subrounded; pH 6.5; clear boundary.
A13	30-70+	strong brown (7.5YR5/6 moist) loamy sand; moist soil; 70% rounded ironstone medium gravels and subrounded; pH 6.5.

Project and site code: SWF LY12

Date: 28/04/2005

Location: MGA Zone: 50 402439 mE 6207868 mN

Slope: 9%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loamy sand; moderately moist soil; single grain structure; sandy fabric; 60% rounded ironstone medium gravels and subrounded; pH 6.5; clear boundary.
A12	10-30	brown (7.5YR4/4 moist) loamy sand; moderately moist soil; single grain structure; sandy fabric; 70% rounded ironstone medium gravels and subrounded; pH 6.5; clear boundary.
A13	30-50+	strong brown (7.5YR5/6 moist) loamy sand; moist soil; 70% rounded ironstone medium gravels and subrounded; pH 6.5.

Project and site code: SWF LY13

Date: 28/04/2005

Location: MGA Zone: 50 402510 mE 6207887 mN

Location notes: Few dark gravel

Slope: 9%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic loamy fine sand; dry soil; single grain structure; sandy fabric; 50% subrounded ironstone fine gravels; pH 5.5.
A12	10-30	brown (7.5YR4/4 moist) loamy fine sand; dry soil; single grain structure; sandy fabric; 70% subrounded ironstone fine gravels; pH 6.
A13	30-50+	strong brown (7.5YR5/6 moist) loamy fine sand; dry soil; 70% subrounded ironstone fine gravels; pH 6.

Project and site code: SWF LY14

Date: 28/04/2005

Location: MGA Zone: 50 402594 mE 6207941 mN

Slope: 11%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (7.5YR2.5/1 moist) humic clayey fine sand; moist soil; massive structure; earthy fabric; 20% subrounded ironstone medium gravels.
A12	10-50	strong brown (7.5YR5/6 moist) loamy fine sand; moist soil; single grain structure; sandy fabric; 60% subrounded ironstone medium gravels and subangular.
A13	50-60+	light yellowish brown (10YR6/4 moist) clayey fine sand; wet soil; 60% subrounded ironstone fine gravels and angular.

Project and site code: SWF LY15

Date: 28/04/2005

Location: MGA Zone: 50 402644 mE 6207826 mN

Slope: 15%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (7.5YR2.5/1 moist) humic sandy loam; moist soil; massive structure; sandy fabric; 10% rounded ironstone fine gravels; pH 7.
A12	10-45	brown (7.5YR4/4 moist) clayey fine sand; moist soil; single grain structure; earthy fabric; 60% rounded ironstone fine gravels; pH 6.5.
B2	45-60+	strong brown (7.5YR5/6 moist) light clay; moist soil; 10% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY16

Date: 28/04/2005

Location: MGA Zone: 50 402611 mE 6207774 mN

Slope: 16%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/4 moist) humic fine sandy loam; moist soil; single grain structure; earthy fabric; 50% rounded ironstone fine gravels and subangular; pH 6.5.
A12	10-50	yellowish red (5YR4/6 moist) fine sandy loam; moist soil; single grain structure; earthy fabric; 60% rounded ironstone fine gravels and subangular; pH 6.5.
A13	50-60+	reddish yellow (5YR6/6 moist) fine sandy loam; moist soil; single grain structure; earthy fabric; 70% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY17

Date: 28/04/2005

Location: MGA Zone: 50 402592 mE 6207701 mN

Location notes: 7-10 cm stone in profile

Slope: < 22%

Site notes: High trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (5YR2.5/1 moist) humic fine sandy loam; massive structure; earthy fabric; 40% rounded ironstone fine gravels; pH 7.5.
A12	10-30	reddish brown (5YR4/4 moist) clayey fine sand; massive structure; earthy fabric; 70% rounded ironstone medium gravels; pH 7.
R	30+	laterite

Project and site code: SWF LY18

Date: 28/04/2005

Location: MGA Zone: 50 402519 mE 6207726 mN

Location notes: Shallow laterite soils similar to LY17. 30-40 cm cap rock

Slope: 15%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (5YR2.5/1 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 40% rounded ironstone fine gravels; pH 7.
A12	5-30	reddish brown (5YR4/4 moist) clayey fine sand; moist soil; single grain structure; earthy fabric; 70% rounded ironstone medium gravels and subrounded; pH 6.5.
R	30+	laterite

Project and site code: SWF LY19

Date: 28/04/2005

Location: MGA Zone: 50 402440 mE 6207767 mN

Slope: < 5%

Site notes: Very high trafficability rating, laterite in vicinity

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (7.5YR2.5/1 moist) humic clayey fine sand; moist soil; 70% rounded ironstone fine gravels and subrounded; pH 6.5.
A12	5-15	brown (7.5YR4/4 moist) clayey fine sand; moist soil; sandy fabric; 70% rounded ironstone fine gravels; pH 6.
A13	15-60+	strong brown (7.5YR4/6 moist) clayey fine sand; moist soil; sandy fabric; 70% rounded ironstone fine gravels and subrounded; pH 6.

Project and site code: SWF LY20

Date: 29/04/2005

Location: MGA Zone: 50 402148 mE 6207960 mN

Location notes: Edge of swale

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic loam; moist soil; massive structure; earthy fabric; 10% rounded ironstone fine gravels; pH 7; clear boundary.
A12	5-40	strong brown (7.5YR5/6 moist) fine sandy clay loam; moist soil; moderate, granular structure; 40% rounded ironstone fine gravels; pH 6.5; abrupt boundary.
B2	40-50+	strong brown (7.5YR5/8 moist) light clay; few faint brownish yellow (10YR6/8 moist) mottles and few red (2.5YR4/6 moist) mottles; moist soil; moderate, angular blocky structure; 5% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY21

Date: 29/04/2005

Slope: < 5%

Location: MGA Zone: 50 402219 mE 6207961 mN

Site notes: High trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 50% subrounded ironstone fine gravels; pH 6.5; diffuse boundary.
A12	10-40	dark yellowish brown (10YR3/4 moist) fine sandy loam; moist soil; single grain structure; sandy fabric; 60% subrounded ironstone fine gravels; pH 6.5; clear boundary.
AA13	40-60+	brownish yellow (10YR6/8 moist) fine sandy loam; moist soil; massive structure; earthy fabric; 70% subrounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY22

Date: 29/04/2005

Location: MGA Zone: 50 402292 mE 6207905 mN

Location notes: Dark grey gravel on surface

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (10YR2/1 moist) humic clayey fine sand; moist soil; massive structure; earthy fabric; 60% subrounded ironstone fine gravels; pH 6; clear boundary.
A12	10-45	brown (7.5YR4/3 moist) clayey fine sand; moist soil; single grain structure; sandy fabric; 70% rounded ironstone fine gravels and subrounded; pH 6; sharp boundary.
R	45+	laterite stone.

Project and site code: SWF LY23

Date: 29/04/2005

Location: MGA Zone: 50 402252 mE 6207842 mN

Slope: < 5%

Location notes: Stone in profile

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (7.5YR2.5/1 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 60% rounded ironstone fine gravels; pH 7; clear boundary.
A12	10-40	strong brown (7.5YR4/6 moist) gravelly clayey fine sand; moist soil; massive structure; earthy fabric; 70% rounded ironstone fine gravels; pH 6.5; sharp boundary.
R	40+	moist soil.

Project and site code: SWF LY24

Date: 29/04/2005

Location: MGA Zone: 50 402194 mE 6207790 mN

Location notes: FSL grading to loam

Slope: 6%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic fine sandy loam; massive structure; earthy fabric; 40% rounded ironstone medium gravels and subrounded; pH 7.
A12	10-30	strong brown (7.5YR4/6 moist) fine sandy loam; massive structure; earthy fabric; 50% rounded ironstone medium gravels; pH 6.5.
R	30+	laterite stone.

Project and site code: SWF LY25

Date: 29/04/2005

Location: MGA Zone: 50 402323 mE 6207810 mN

Slope: 8%

Site notes: High trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (7.5YR2.5/1 moist) humic fine sandy loam; massive structure; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5; gradual boundary.
A12	10-20	brown (7.5YR4/4 moist) fine sandy loam; massive structure; earthy fabric; 50% rounded ironstone fine gravels; pH 6; gradual boundary.
A13	20-45	strong brown (7.5YR5/6 moist) fine sandy loam; massive structure; earthy fabric; 60% rounded ironstone fine gravels; pH 6.
R	45+	laterite.

Project and site code: SWF LY26

Date: 29/04/2005

Location: MGA Zone: 50 402341 mE 6207915 mN

Slope: < 5%

Site notes: Very high trafficability rating

Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	black (5YR2.5/1 moist) humic clayey fine sand; massive structure; earthy fabric; 60% subrounded ironstone fine gravels and subangular; pH 6; clear boundary.
A12	10-25	reddish brown (5YR4/4 moist) clayey fine sand; single grain structure; sandy fabric; 70% subrounded ironstone fine gravels and subangular; pH 6.5.
R	25+	laterite.

Project and site code: SWF LY27

Date: 29/04/2005

Location: MGA Zone: 50 402658 mE 6207648 mN

Slope: 18%

Site notes: Low trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (7.5YR2.5/2 moist) humic clayey fine sand; moist soil; massive structure; earthy fabric; 60% subrounded ironstone fine gravels; pH 7.5; clear boundary.
A12	5-40	brown (7.5YR4/4 moist) clayey fine sand; moist soil; massive structure; earthy fabric; 60% subrounded ironstone fine gravels; pH 7; diffuse boundary.
A13	40-60+	strong brown (7.5YR5/6 moist) clayey fine sand; moist soil; massive structure; earthy fabric; 60% subrounded ironstone fine gravels; pH 6.5.

Project and site code: SWF LY28

Date: 29/04/2005

Location: MGA Zone: 50 mE mN

Location notes: Laterite in profile

Slope: 22%

Site notes: Moderate trafficability rating

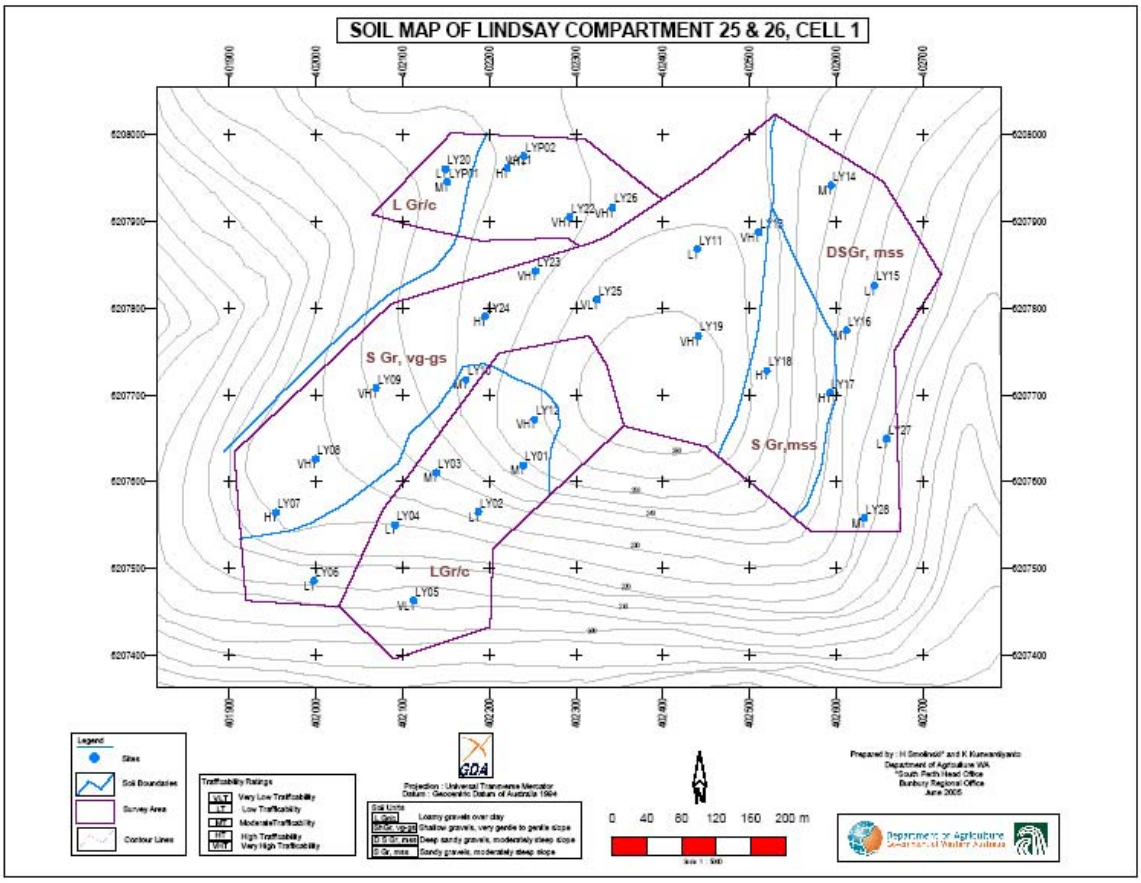
Current classification

WA soil group: Shallow gravel, 1999

Australian soil classification: Basic Ferric-Petroferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	black (5YR2.5/1 moist) humic loam; weak, crumb structure; 30% rounded ironstone fine gravels and subangular; pH 7.
A12	5-50	reddish brown (5YR4/4 moist) fine sandy loam; weak, crumb structure; 60% rounded ironstone fine gravels and subrounded; pH 7.
R	50+	red (2.5YR4/8 moist) mottles and yellow (10YR7/8 moist) mottles; laterite.


SOIL MAP OF LINDSAY COMPARTMENT 25 & 26, CELL 1
L Gr/c
S Gr, vg-gs
LGr/c
DSGr, mss
S Gr,mss
Legend
Sites
Soil Boundaries
Survey Area
Contour Lines
Trafficability Ratings
Very Low Trafficability
Low Trafficability
Moderate Trafficability
High Trafficability
Very High Trafficability
Soil Units
Loamy gravels over clay
Shallow gravels, very gentle to gentle slope
Deep sandy gravels, moderately steep slope
Sandy gravels, moderately steep slope
Projection : Universal Transverse Mercator
Datum : Geocentric Datum of Australia 1994
GDA
0 40 80 120 160 200 m
Prepared by : H Smolinski* and K Kuswandiyanto
Department of Agriculture WA
*South Perth Head Office
Bunbury Regional Office
June 2005
Department of Agriculture

Attachment 9 – Soil Assessment of Muirillup

Compartment 5, Cells 2+3c
Preston Road, Muirillup

Shire of Manjimup

Summary

Muirillup, Compartment 5, Cells 2+3c contains 2 soil units

DSGr: Duplex sandy gravels

LGr/c: Loamy gravels over clay

The block has a very low to moderate trafficability rating with the gentle to moderately steep slopes of soil unit LGr/c being more prone to rutting.

Both soil units consist of duplex soils that have gravelly topsoil horizons containing 30-50% ironstone gravel and a clay layer occurring at 35-50 cm.

Site description

Muirillup, Compartment 5, Cells 2+3c has an area of approximately 19 hectares and contains karri and marri forest with jarrah being mainly confined to soil unit DSGr.

A broad laterite crest is situated at the centre of the block and gently inclined spurs extend to the south and east. Gentle to moderately steep slopes border the crest along the west and north boundaries.

Two large rock outcrops occur on midslopes adjacent to the north-east boundary.

Geology

Regional geological mapping indicates that Proterozoic granite rocks including porphoritic granite are the dominant basement rocks (Wilde and Walker, 1984).

Two large rock outcrops occur along the north-east boundary.

The block is mantled by colluvium derived from weathered granites and laterite.

Soils

The soil units consist predominantly of moderately deep duplex sandy gravels and loamy gravels that contain a clay horizon occurring at 35-60 cm.

The soil units are described below and soil profile descriptions are provided in Appendix A.

DSGr: Duplex sandy gravels

WA soil group: Duplex sandy gravel

Soil classification: Ferric Eutrophic Yellow Chromosol

This soil unit is associated with the crest and very gentle to gently inclined spurs and sideslopes.

The soils are commonly are Duplex sandy gravels with gravelly clayey sand topsoil horizons although few loamy gravels were also encountered. Topsoils are dark brown clayey sands overlying yellow to yellowish brown clayey sand containing < 30% ironstone gravel. Lower topsoils contain 10-50% ironstone gravel by volume. Brownish yellow sandy clay is usually encountered at 40-50 cm and it contains common red-brown mottles and few to common iron segregations

The soil reaction trend is acid to neutral.

Trafficability rating

This unit has a moderate to low trafficability rating.

Soils occurring on the crest generally contain abundant gravel while the mid to lower slopes contained less gravel and were prone to subsoil waterlogging as indicated by lower topsoil saturation above the clay layer.

LGr/c: Loamy gravels over clay

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Red Chromosol

This soil unit is associated with gentle to moderate steep slopes and contains a complex of yellow to red gravelly duplex soils having a sandy loam topsoil. Subsoil clay was encountered between 30-60 cm. Note: Several sandy clay loam topsoils were also encountered.

Topsoils are very dark brown gravelly loam to sandy loam containing negligible to many ironstone gravel overlying brownish yellow to strong brown gravelly sandy loam containing many to abundant ironstone gravel. Yellowish red clay loam or clay was commonly encountered by 50 cm although yellow and brown subsoils were also evident.

The soil reaction trend is acid to neutral.

Trafficability rating

This soil unit has a low to very low trafficability rating as indicated by the loamy topsoils and common occurrence of clay within 50 cm. Rutting was evident in this unit particularly in areas of moderately steep slope.

Management considerations

Muirillup block generally has a low to moderate trafficability rating with a high risk of rutting particularly on moderately steep slopes.

The area of very gently inclined slopes between sites 9 and 13 is less prone to degradation although a moderate risk of rutting would occur when the soils are saturated.

The occurrence of rock outcrop within this site indicates the soils on sideslopes are prone to seepage as the shallow basement rock would restrict draunage.

Soil profile descriptions – Muirillup, Compartment 5, Cell 2 & 3C

Project and site code: SWF MU01

Date: 26/04/2005

Location: MGA Zone: 50 434353 mE 6164563 mN

Slope: 13%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	dark brown (7.5YR3/2 moist) humic sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; 30% rounded ironstone; pH 6.5; gradual boundary.
A12	15-40	strong brown (7.5YR5/8 moist) sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; 50% rounded ironstone; pH 6.5; clear boundary.
B2	40-60+	yellowish red (5YR5/8 moist) sandy light clay; moist soil, moderately sticky; 10% rounded ironstone; pH 6.5.

Project and site code: SWF MU02

Date: 26/04/2005

Location: MGA Zone: 50 434313 mE 6164490 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Brown loamy earth, 1999

Australian soil classification: Haplic Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark greyish brown (10YR3/2 moist) humic fine sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; pH 6.
A12	15-50	brownish yellow (10YR6/6 moist) sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; 5% igneous rock (unidentified); pH 6.
B2s	50-60+	brownish yellow (10YR6/6 moist) sandy loam; moist soil, slightly sticky; massive structure; earthy fabric; 60% igneous rock (unidentified); pH 6.

Project and site code: SWF MU03

Date: 26/04/2005

Location: MGA Zone: 50 434264 mE 6164551 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark brown (10YR2/2 moist) humic loam; moist soil; weak, crumb structure; rough-ped fabric; 20% rounded ironstone medium gravels; pH 6.
A12	15-30	yellowish brown (10YR5/4 moist) sandy clay loam; moist soil; massive structure; earthy fabric; 30% rounded ironstone medium gravels; pH 6.
B2	30-50+	light yellowish brown (10YR6/4 moist) fine sandy clay; few strong brown (7.5YR5/8 moist) mottles and few strong brown (7.5YR4/8 moist) mottles; moist soil; 10% rounded ironstone medium gravels; pH 6.

Project and site code: SWF MU04

Date: 26/04/2005

Location: MGA Zone: 50 434162 mE 6164543 mN

Location notes: Lower slope. M-HTR

Slope: 8%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark brown (10YR2/2 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 30% rounded ironstone medium gravels; pH 6.
A12	15-30	yellowish brown (10YR5/4 moist) fine sandy loam; moist soil; massive structure; earthy fabric; 30% rounded ironstone medium gravels; pH 6.
A13	30-60	yellowish brown (10YR5/4 moist) fine sandy loam; moist soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.
B2	60-70+	brownish yellow (10YR6/6 moist) clay loam; few red (2.5YR4/8 moist) mottles and few light yellowish brown (10YR6/4 moist) mottles; moist soil; 10% rounded ironstone medium gravels; pH 6.

Project and site code: SWF MU05

Date: 26/04/2005

Location: MGA Zone: 50 434118 mE 6164621 mN

Slope: 8%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2/2 moist) humic loam; moist soil; massive structure; earthy fabric; 50% rounded ironstone medium gravels; pH 6; clear boundary.
A12	10-50	strong brown (7.5YR4/6 moist) fine sandy loam; moist soil; massive structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6; gradual boundary.
A13	50-60	strong brown (7.5YR5/8 moist) sandy clay loam; moist soil; massive structure; earthy fabric; 70% rounded ironstone medium gravels; pH 6.

Project and site code: SWF MU06

Date: 26/04/2005

Location: MGA Zone: 50 434147 mE 6164728 mN

Slope: 8%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-15	very dark brown (7.5YR2.5/2 moist) humic loam; moist soil; weak, crumb structure; 40% rounded igneous rock (unidentified) medium gravels; pH 6; gradual boundary.
A12	15-35	strong brown (7.5YR4/6 moist) sandy clay loam; moist soil; weak, crumb structure; 60% rounded igneous rock (unidentified) medium gravels; pH 6; lscl - lfs; gradual boundary.
B2	35-50+	yellowish red (5YR5/6 moist) sandy clay loam; moist soil; massive structure; earthy fabric; 50% rounded igneous rock (unidentified); pH 6.

Project and site code: SWF MU07

Date: 26/04/2005

Location: MGA Zone: 50 434184 mE 6164813 mN

Slope: 13%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/4 moist) humic fine sandy loam; moist soil; massive structure; earthy fabric; 30% rounded igneous rock (unidentified) medium gravels; pH 6.5; clear boundary.
A12	10-35	strong brown (7.5YR5/6 moist) clayey fine sand; moist soil; massive structure; earthy fabric; 50% rounded igneous rock (unidentified); pH 6.5; abrupt boundary.
B2	35-50+	yellowish red (5YR5/6 moist) fine sandy clay; moist soil; 5% rounded igneous rock (unidentified); pH 6.5.

Project and site code: SWF MU08

Date: 26/04/2005

Location: MGA Zone: 50 434225 mE 6164830 mN

Slope: 8%

Site notes: Low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark reddish brown (5YR3/3 moist);humic fine sandy loam massive structure; earthy fabric; 30% rounded igneous rock (unidentified) medium gravels; pH 7; clear boundary.
A12	10-40	yellowish red (5YR5/6 moist); fine sandy loam, massive structure; earthy fabric; 50% rounded igneous rock (unidentified) medium gravels; pH 6.5; abrupt boundary.
B2	40-60+	red (2.5YR4/8 moist); fine sandy clay loam 20% rounded igneous rock (unidentified) medium gravels; pH 6.5.

Project and site code: SWF MU09

Date: 26/04/2005

Location: MGA Zone: 50 434304 mE 6164776 mN

Slope: < 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (7.5YR4/3 moist) humic sandy loam; moderately moist soil; massive structure; earthy fabric; 50% rounded igneous rock (unidentified); pH 6.
A12	10-40	strong brown (7.5YR5/6 moist) clayey fine sand; moderately moist soil; massive structure; earthy fabric; 50% rounded igneous rock (unidentified) medium gravels; pH 6.5.
B2	40-50+	red (2.5YR4/8 moist) light clay; strong brown (7.5YR5/6 moist) mottles; moist soil; 30% rounded igneous rock (unidentified) medium gravels; pH 6.5.

Project and site code: SWF MU10

Date: 26/04/2005

Location: MGA Zone: 50 434267 mE 6164670 mN

Location notes: Rutting evident. A2 saturated above clay

Slope: 20%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (10YR3/3 moist) humic sandy loam; massive structure; earthy fabric; 50% rounded igneous rock (unidentified) medium gravels; pH 6.5.
A12	10-50	yellowish brown (10YR5/4 moist) fine sandy loam; massive structure; earthy fabric; 60% rounded igneous rock (unidentified) medium gravels; pH 7.
B2	50-60+	brownish yellow (10YR6/8 moist) sandy clay; many red (2.5YR4/8 moist) mottles; 30% rounded igneous rock (unidentified) medium gravels; pH 6.5.

Project and site code: SWF MU11

Date: 27/04/2005

Location: MGA Zone: 50 434455 mE 6164723 mN

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (10YR2/2 moist) humic sandy loam; moderately moist soil; massive structure; earthy fabric; 20% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	10-40	yellowish brown (10YR5/8 moist) fine sandy loam; moderately moist soil; massive structure; earthy fabric; 50% rounded ironstone medium gravels; pH 6; abrupt boundary.
B2	40-50+	light yellowish brown (10YR6/4 moist) light clay; common strong brown (7.5YR5/8 moist) mottles and few red (2.5YR4/8 moist) mottles; moderately moist soil; pH 6.

Project and site code: SWF MU12

Date: 27/04/2005

Location: MGA Zone: 50 434552 mE 6164666 mN

Location notes: Saturated above clay

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic fine sandy loam; moderately moist soil; earthy fabric; 30% rounded ironstone medium gravels; pH 5; gradual boundary.
A12	10-50	yellowish brown (10YR5/6 moist) clayey fine sand; moderately moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5; saturated above clay; abrupt boundary.
B2	50-60+	brownish yellow (10YR6/5 moist) fine sandy clay; red (2.5YR4/6 moist) mottles and brownish yellow (10YR6/8 moist) mottles; wet soil; 10% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF MU13

Date: 27/04/2005

Location: MGA Zone: 50 434569 mE 6164567 mN

Location notes: Similar to site 12

Slope: 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 20% rounded ironstone medium gravels; pH 6.5.
A12	10-50	yellowish brown (10YR5/4 moist) clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.
B2	50-60+	brownish yellow (10YR6/6 moist) sandy clay loam; few strong brown (7.5YR5/8 moist) mottles and red (2.5YR4/8 moist) mottles; moist soil; 10% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF MU14

Date: 27/04/2005

Location: MGA Zone: 50 434535 mE 6164455 mN

Location notes: Saturated above clay

Slope: 9%

Site notes: Low trafficability rating

Current classification

WA soil group: Yellow/brown deep sandy duplex, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark grey (10YR4/1 moist) humic loamy fine sand; moderately moist soil; single grain structure; earthy fabric; pH 6.5.
A12	10-50	yellow (10YR7/6 moist) loamy fine sand; moderately moist soil; single grain structure; sandy fabric; 20% rounded ironstone medium gravels; pH 6.5.
B2	50-60+	yellow (10YR7/6 moist) sandy light clay; many strong brown (7.5YR5/8 moist) mottles; moist soil; pH 6.

Project and site code: SWF MU15

Date: 27/04/2005

Location: MGA Zone: 50 434466 mE 6164466 mN

Location notes: Gravel 20 m. Upper slope from 14. Saturated at clay

Slope: 5%

Site notes: Low trafficability rating

Current classification

WA soil group: Yellow/brown deep sandy duplex, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-20	dark greyish brown (10YR4/2 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; pH 6.5; clear boundary.
A12	20-40	brownish yellow (10YR6/6 moist) clayey fine sand; moderately moist soil; single grain structure; sandy fabric; 20% rounded ironstone medium gravels; pH 6.5; abrupt boundary.
B2	40-60+	brownish yellow (10YR6/6 moist) fine sandy clay; common strong brown (7.5YR5/8 moist) mottles; wet soil; pH 6.

Project and site code: SWF MU16

Date: 27/04/2005

Location: MGA Zone: 50 434448 mE 6164572 mN

Slope: 6%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Red Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/2 moist) humic clayey fine sand; weak, crumb structure; 10% rounded igneous rock (unidentified) medium gravels; pH 6.5.
A12	10-50	strong brown (7.5YR5/8 moist) clayey fine sand; weak, crumb structure; 35% rounded igneous rock (unidentified) medium gravels; pH 6.5; cfs-sl.
B2	50-60+	reddish yellow (5YR6/8 moist) fine sandy clay loam; 10% rounded igneous rock (unidentified) medium gravels; pH 6.5.

Project and site code: SWF MU17

Date: 27/04/2005

Location: MGA Zone: 50 434302 mE 6164895 mN

Location notes: Granite gneiss

Slope: 20-25%

Site notes: Low trafficability rating

Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark greyish brown (10YR3/2 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 20% rounded igneous rock (unidentified) medium gravels; pH 6.5.
A12	10-55	yellowish brown (10YR5/8 moist) clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 60% rounded igneous rock (unidentified) medium gravels; pH 6.5.
B2	55-60+	reddish yellow (7.5YR6/8 moist) fine sandy clay loam; few red (2.5YR4/8 moist) mottles; moist soil; massive structure; earthy fabric; 50% rounded igneous rock (unidentified) medium gravels; pH 6.5.

Project and site code: SWF MU18

Date: 27/04/2005

Location: MGA Zone: 50 434200 mE 6164919 mN

Slope: 20-25%

Site notes: Very low trafficability rating

Current classification

WA soil group:

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/3 moist) humic clayey fine sand; single grain structure, 30% ironstone and igneous gravel; earthy fabric; pH 6; clear boundary.
A12	10-30	strong brown (7.5YR5/6 moist) clayey fine sand; single grain structure; 40% ironstone gravel; earthy fabric; pH 6; gradual boundary.
B1	30-40	reddish yellow (7.5YR6/8 moist) sandy clay loam; massive structure; 50% ironstone gravel; earthy fabric; pH 6; abrupt boundary.
B2	40-50+	yellowish red (5YR5/8 moist) light clay; common yellow (10YR7/8 moist) mottles; moderate, angular blocky structure; 10% ironstone gravel; rough-ped fabric; pH 6.5.

Project and site code: SWF MU19

Date: 27/04/2005

Location: MGA Zone: 50 434130 mE 6164877 mN

Slope: 11%

Site notes: Very low trafficability rating

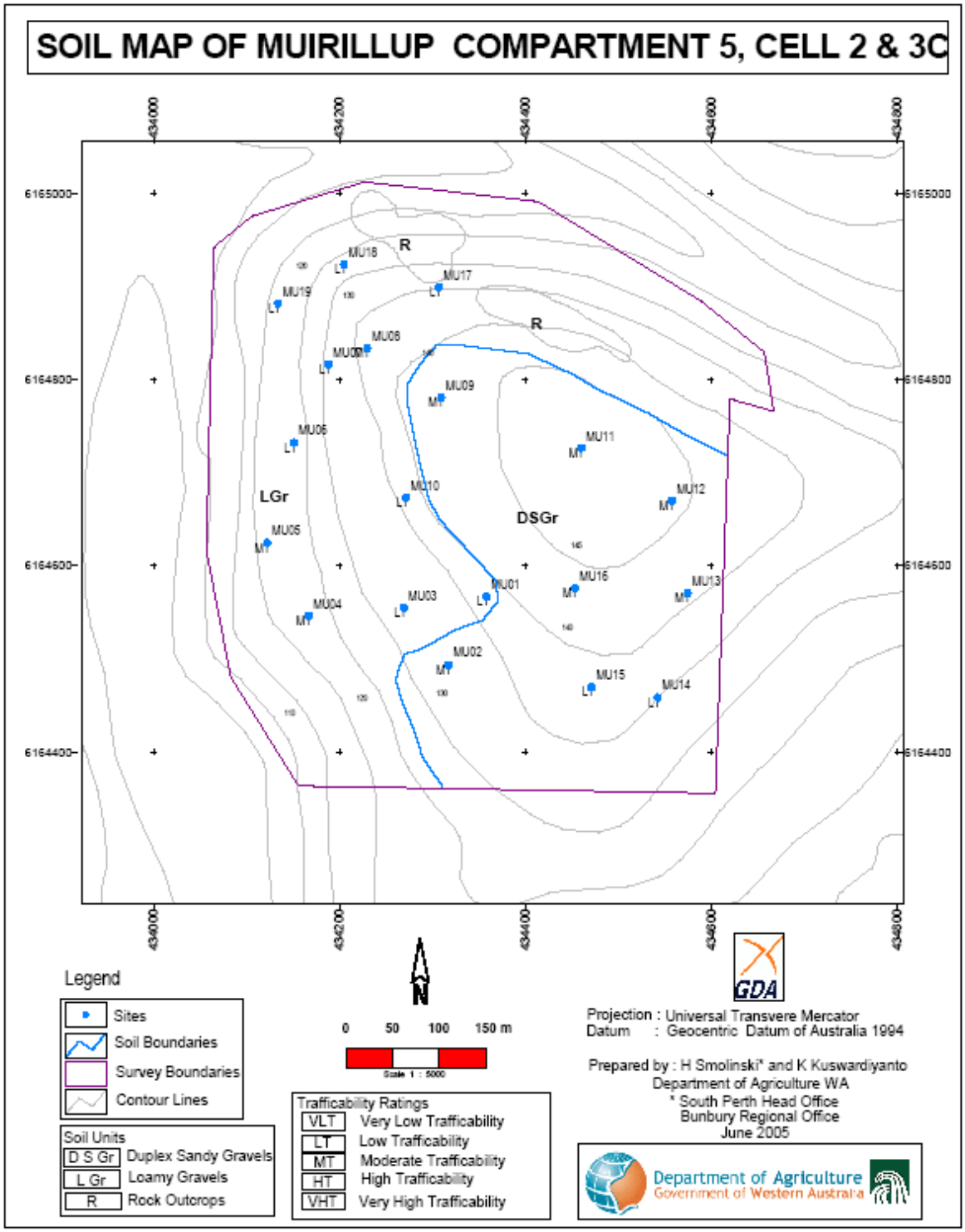
Current classification

WA soil group: Duplex sandy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	brown (7.5YR4/3 moist) humic clayey fine sand; moderately moist soil; single grain structure; earthy fabric; 30% rounded igneous rock (unidentified) medium gravels; pH 6; gradual boundary.
A12	10-40	reddish yellow (7.5YR6/8 moist) clayey fine sand; moderately moist soil; massive structure; earthy fabric; 30% rounded igneous rock (unidentified) medium gravels; pH 6; cfs-sl; abrupt boundary.
B2	40-50+	reddish yellow (7.5YR6/8 moist) light clay; many red (2.5YR4/8 moist) mottles and few yellow (10YR7/8 moist) mottles; moderately moist soil; moderate, granular structure; rough-ped fabric; 1% rounded igneous rock (unidentified) medium gravels; pH 6.


SOIL MAP OF MUIRILLUP COMPARTMENT 5, CELL 2 & 3C
434000
434200
434400
434600
434800
6165000
6164800
6164600
6164400
MU18
MU17
MU19
MU08
MU09
MU06
MU11
MU10
MU12
MU05
MU01
MU16
MU13
MU04
MU03
MU02
MU15
MU14
R
R
LGr
DSGr
N
0 50 100 150 m
Scale 1 : 5000
GDA
Legend
Sites
Soil Boundaries
Survey Boundaries
Contour Lines
Soil Units
D S Gr Duplex Sandy Gravels
L Gr Loamy Gravels
R Rock Outcrops
Trafficability Ratings
VLT Very Low Trafficability
LT Low Trafficability
MT Moderate Trafficability
HT High Trafficability
VHT Very High Trafficability
Projection : Universal Transvere Mercator
Datum : Geocentric Datum of Australia 1994
Prepared by : H Smolinski* and K Kuswardiyanto
Department of Agriculture WA
* South Perth Head Office
Bunbury Regional Office
June 2005
Department of Agriculture
Government of Western Australia

Attachment 10 – Soil Assessment of Preston

Compartment 5, Cells 1+2, Grimwade Road
Shire of Donnybrook-Balingup

Summary

Preston Cells 1 and 2 contain 3 soil units.

LGr: Loamy gravels.

LGr/c: Loamy gravels over clay.

SGr: Sandy gravels.

Soil units LGr and LGr/c have similar profile morphology and generally have very low trafficability ratings as shallow gravelly sandy clay loams were commonly encountered.

Soil units SGr represented deep gravelly clayey sands that have a moderate trafficability rating.

Site description

Preston Cells 1 and 2 have a combined area of 26 hectares and consists of open jarrah and marri forest with jarrah being the dominant tree.

The Cells are very gentle to gently inclined with slopes in the range of 2-10% with common slopes at about 5-6%.

Both Cells contain crest and upperslope landform elements and also contain the upper catchments of broad flow lines.

Geology

Regional geological mapping indicates that Archean migmatite and quartz-feldspar biotite gneiss (Wilde and Walker, 1982) are the dominant basement rocks.

Sporadic laterite outcrop was encountered within all soil units and most of the landscape is mantled by laterite colluvium.

Soils

The soil units are predominantly gravelly with gravel content in the topsoil horizons in the range of 20-60% by volume.

Preston block appears to be atypical of most gravelly soils within the region as many soils have shallow medium textured (sandy clay loam) subsoils.

The soil units are described below and Soil profile descriptions are provided in Appendix A.

LGr: Loamy gravels

WA soil group: Loamy gravel

Soil classification: Ferric Eutrophic Brown Kandosol

This soil unit is associated with the crest and upperslope landform elements.

Soils are commonly loamy gravels having gravelly sandy clay loam profiles.

Topsoils are very dark brown gravelly sandy loams containing about 20% ironstone gravel overlying yellowish brown or strong brown gravelly light sandy clay loam to sandy clay loam. Gravel content is in the range of 40-60% and gravel size is commonly 5-20 mm diameter.

The soil reaction trend is neutral.

Trafficability rating

The loamy gravels have a very low trafficability rating when the soils are moist to wet. Very low to low rutting was evident in both cells which suggests this soil unit could be more stable than predicted.

LGr/c: Loamy gravels over clay

WA soil group: Loamy gravel, Loamy duplex

Soil classification: Ferric Eutrophic Brown Kandosol, Ferric Eutrophic Brown Chromosol

This soil unit is associated with midslopes and spurs and soils are equivalent to LGr soil types although light medium clay was also encountered within 50 cm.

These duplex soils have dark brown sandy loam topsoils overlying gravelly yellowish brown sandy clay loam or light to medium clay. Clay horizons may display a weak angular blocky structure. Gravel content within the lower topsoil is in the range of 30-60% by volume.

The soil reaction trend is neutral.

Trafficability rating

This soil unit has been assigned a very low trafficability rating as the subsoils are likely to become periodically waterlogged during winter.

SGr: Sandy gravels

WA soil group: Sandy gravel

Soil classification: Ferric Orthic Tenosol

This soil unit is associated with gently inclined upper to mid slopes and very gently inclined mid slope benches.

Sandy gravel is the dominant soil type while minor areas of deep brown sand containing few ironstone gravel occur on benches and open depressions.

Topsoils are commonly very dark greyish brown loamy sands containing about 10-20 ironstone gravel. Lower topsoils are strong brown to yellowish brown gravelly clayey sands extending below 50 cm. Gravel content is commonly 60% by volume.

Minor areas of Brown deep sand were also encountered.

Trafficability rating

This soil unit commonly has a moderate to high trafficability rating as indicated by the very high gravel content, coarse texture and absence of clay within 50 cm.

Rutting was not evident.

Management considerations

Preston block contains both sandy gravels and loamy gravels and generally has a very low to moderate trafficability rating when the soils are moist to saturated.

Waterlogging is unlikely to persist within the loamy gravels as the cells occur on gently inclined upperslopes. Once the soils are dry the LGr and LGr/c soil types would have a very high trafficability.

Soil profile descriptions – Preston, Compartment 5, Cell 1 & 2

Project and site code: SWF PR01

Date: 05/05/2005

Location: MGA Zone: 50 412876 mE 6279934 mN

Slope: 8%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	dark brown (7.5YR3/2 moist) humic loamy sand; moist soil; earthy fabric; 15% rounded ironstone fine gravels and; pH 6.5; clear boundary.
A12	10-50+	strong brown (7.5YR5/6 moist) clayey sand; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR02

Date: 05/05/2005

Location: MGA Zone: 50 412822 mE 6279986 mN

Slope: 7%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/2 moist) humic loamy sand; moist soil; earthy fabric; 10% rounded ironstone medium gravels; pH 6.5; clear boundary.
A12	5-50+	strong brown (7.5YR5/6 moist) clayey sand; moist soil; earthy fabric; 50% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR03

Date: 05/05/2005

Location: MGA Zone: 50 412755 mE 6279943 mN

Slope: 7%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	dark brown (7.5YR3/2 moist) humic loamy sand; moist soil; 10% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-60+	strong brown (7.5YR5/6 moist) clayey sand; moist soil; 50% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR04

Date: 05/05/2005

Location: MGA Zone: 50 412689 mE 6279824 mN

Slope: 8%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic loamy sand; moist soil; 10% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	yellowish brown (10YR5/6 moist) clayey sand; moist soil; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR05

Date: 05/05/2005

Location: MGA Zone: 50 412762 mE 6279744 mN

Slope: 12%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-10	very dark brown (7.5YR2.5/2 moist) humic loamy sand; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
A12	10-50+	strong brown (7.5YR5/6 moist) clayey sand; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR06

Date: 05/05/2005

Location: MGA Zone: 50 412832 mE 6279800 mN

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR07

Date: 05/05/2005

Location: MGA Zone: 50 412856 mE 6279733 mN

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR08

Date: 05/05/2005

Location: MGA Zone: 50 412477 mE 6279678 mN

Slope: 9%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-10	dark brown (7.5YR3/2 moist) humic sandy loam; moist soil; earthy fabric; 5% rounded ironstone fine gravels; pH 6; gradual boundary.
B2	10-50	brown (7.5YR4/4 moist) sandy clay loam; moist soil; earthy fabric; 70% rounded ironstone medium gravels; pH 6.

Project and site code: SWF PR09

Date: 05/05/2005

Location: MGA Zone: 50 412522 mE 6279585 mN

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic sandy loam; moderately moist soil; earthy fabric; 5% rounded ironstone fine gravels; pH 6; clear boundary.
B21	5-25	yellowish brown (10YR5/4 moist) sandy clay loam; moderately moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6; gradual boundary.
B22	25-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moderately moist soil; earthy fabric; 70% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR10

Date: 05/05/2005

Location: MGA Zone: 50 412608 mE 6279620 mN

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 10% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; few medium faint strong brown (7.5YR5/8 moist) mottles; moist soil; weak, subangular blocky structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR11

Date: 05/05/2005

Location: MGA Zone: 50 412327 mE 6279663 mN

Slope: < 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-10	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moist soil; massive structure; earthy fabric; 10% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	10-50+	strong brown (7.5YR5/6 moist) sandy clay loam; moist soil; weak, subangular blocky structure; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR12

Date: 05/05/2005

Location: MGA Zone: 50 412274 mE 6279545 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Chromosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (7.5YR2/2 moist) humic sandy loam; massive structure; earthy fabric; 5% rounded ironstone fine gravels; pH 6.5; gradual boundary.
B21	5-25	dark brown (7.5YR3/4 moist) light clay; weak, subangular blocky structure; earthy fabric; 40% rounded ironstone fine gravels; pH 6.5; clear boundary.
B22	25-50+	strong brown (7.5YR4/6 moist) light medium clay; weak, subangular blocky structure; earthy fabric; 5% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF PR13

Date: 05/05/2005

Location: MGA Zone: 50 412197 mE 6279464 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	dark brown (10YR3/3 moist) humic sandy loam; moist soil; earthy fabric; 20% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	dark yellowish brown (10YR4/6 moist) sandy clay loam; moist soil; earthy fabric; 40% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR14

Date: 05/05/2005

Location: MGA Zone: 50 412059 mE 6279507 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic sandy loam; moist soil; 5% rounded ironstone fine gravels; pH 6.5; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moist soil; 30% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR15

Date: 06/05/2005

Location: MGA Zone: 50 412129 mE 6279247 mN

Location notes: A2 water repellent (bleach layer)

Slope: < 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	dark brown (10YR3/3 moist) humic sandy loam; moderately moist soil; 20% rounded ironstone fine gravels; pH 6; gradual boundary.
A2	5-10	brown (10YR5/3 moist) clayey sand; moderately moist soil; 20% rounded ironstone fine gravels; pH 6; gradual boundary.
A3	10-50+	yellowish brown (10YR5/6 moist) clayey sand; moderately moist soil; 60% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF PR16

Date: 06/05/2005

Location: MGA Zone: 50 412231 mE 6279493 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Yellow Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (10YR2/2 moist) loam; moist soil; massive structure; earthy fabric; pH 6; clear boundary.
B21	5-30	yellowish brown (10YR5/6 moist) sandy clay loam; moist soil; massive structure; earthy fabric; 60% rounded ironstone fine gravels; pH 6; clear boundary.
B22	30-50+	brownish yellow (10YR6/8 moist) light medium clay; few medium faint strong brown (7.5YR5/8 moist) mottles; moist soil; weak, angular blocky structure; 5% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF PR17

Date: 06/05/2005

Location: MGA Zone: 50 412272 mE 6279381 mN

Slope: < 5%

Site notes: High trafficability rating

Current classification

WA soil group: Deep sandy gravel, 1999

Australian soil classification: Basic Ferric Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark brown (10YR2/2 moist) humic sandy loam; moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	yellowish brown (10YR5/6 moist) clayey sand; moist soil; earthy fabric; 60% rounded ironstone fine gravels; pH 6.

Project and site code: SWF PR18

Date: 06/05/2005

Location: MGA Zone: 50 412325 mE 6279495 mN

Slope: 5%

Site notes: Moderate trafficability rating

Current classification

WA soil group: Brown deep sand, 1999

Australian soil classification: Basic Arenic Orthic Tenosol

Soil profile description

Horizon	Depth (cm)	Description
A11	0-5	very dark greyish brown (10YR3/2 moist) humic clayey sand; moist soil; sandy fabric; 5% rounded ironstone fine gravels; pH 6; clear boundary.
A12	5-50+	strong brown (7.5YR5/8 moist) clayey fine sand; moist soil; sandy fabric; 5% rounded ironstone fine gravels; pH 6.5.

Project and site code: SWF PR19

Date: 06/05/2005

Location: MGA Zone: 50 412390 mE 6279418 mN

Slope: 5%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification:

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic sandy loam; moderately moist soil; earthy fabric; 10% rounded ironstone fine gravels; pH 6; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; wet soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.

Project and site code: SWF PR20

Date: 06/05/2005

Location: MGA Zone: 50 412360 mE 6279556 mN

Slope: 6%

Site notes: Very low trafficability rating

Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark greyish brown (10YR3/2 moist) humic sandy loam; moist soil; earthy fabric; 5% rounded ironstone fine gravels; pH 6; clear boundary.
B2	5-50+	yellowish brown (10YR5/6 moist) sandy clay loam; moist soil; earthy fabric; 40% rounded ironstone fine gravels; pH 6.

Project and site code: SWF PR21

Date: 06/05/2005

Location: MGA Zone: 50 412423 mE 6279537 mN

Slope: 6%

Site notes: Very low trafficability rating

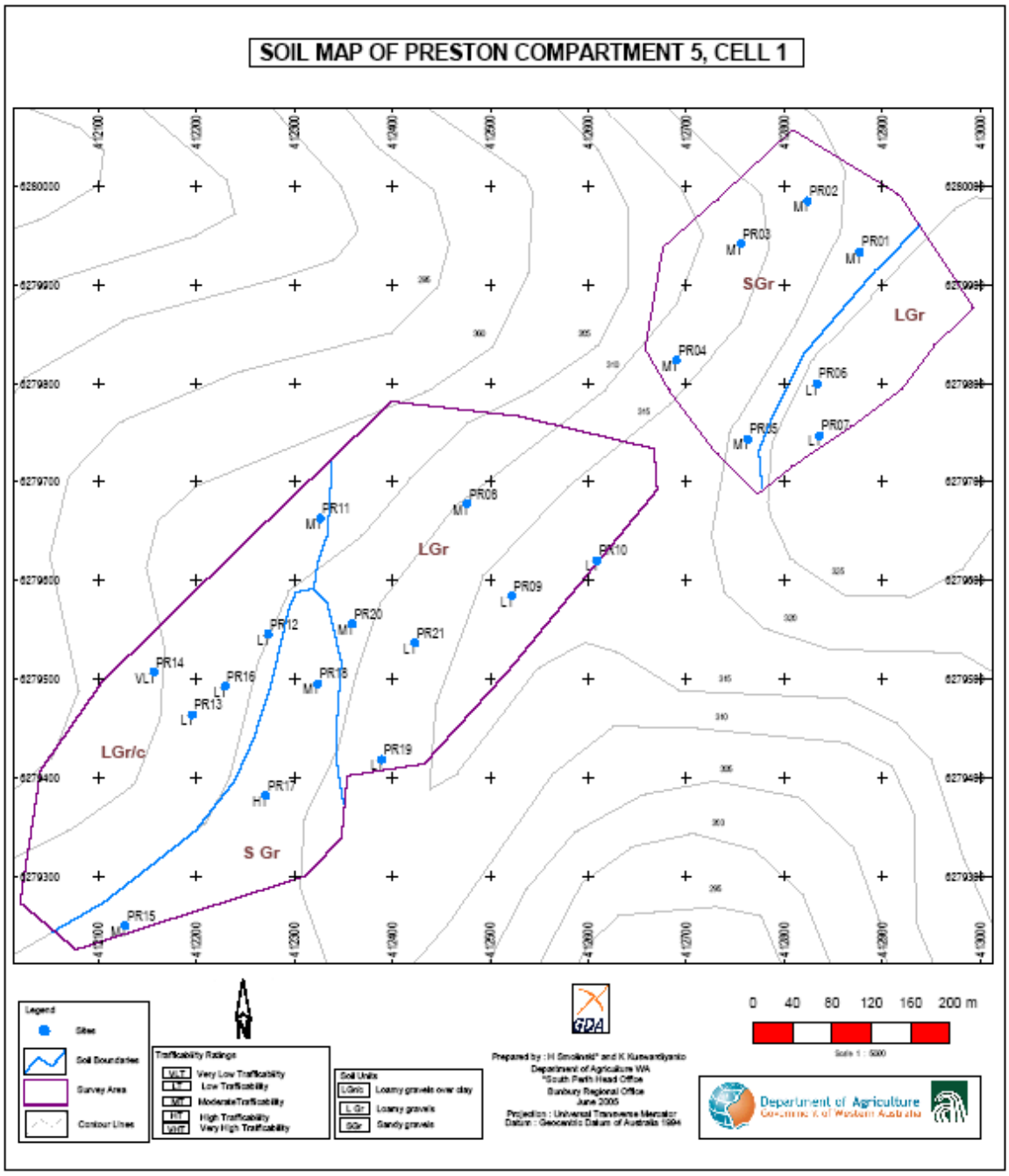
Current classification

WA soil group: Loamy gravel, 1999

Australian soil classification: Ferric Eutrophic Brown Kandosol

Soil profile description

Horizon	Depth (cm)	Description
A1	0-5	very dark brown (7.5YR2.5/2 moist) humic sandy loam; moist soil; earthy fabric; 5% rounded ironstone fine gravels; pH 6; clear boundary.
B2	5-50+	strong brown (7.5YR5/8 moist) sandy clay loam; moist soil; earthy fabric; 60% rounded ironstone medium gravels; pH 6.5.


SOIL MAP OF PRESTON COMPARTMENT 5, CELL 1
SGr
LGr
LGr
LGr/c
S Gr
PR01
PR02
PR03
PR04
PR05
PR06
PR07
PR08
PR09
PR10
PR11
PR12
PR13
PR14
PR15
PR16
PR17
PR18
PR19
PR20
PR21
Legend
Sites
Soil Boundaries
Survey Area
Contour Lines
Trafficability Ratings
VLT Very Low Trafficability
LT Low Trafficability
MT Moderate Trafficability
HT High Trafficability
VHT Very High Trafficability
Soil Units
LGrlc Loamy gravels over clay
L Gr Loamy gravels
SGr Sandy gravels
GDA
0 40 80 120 160 200 m
Department of Agriculture