Spinifex Ridge
Molybdenum Project

Baseline Soil Survey

November 2006
Baseline Soil Survey
Spinifex Ridge Molybdenum Project
Moly Mines Limited

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EXECUTIVE SUMMARY

The baseline soil survey for the Spinifex Ridge Molybdenum Project Area areas has indicated that the majority of the soil profiles show little pedological organization or structure, with only slight textural differences present through the majority of soil profiles examined. Most profiles consisted of a shallow loamy, or clayey sand to sandy loam A-horizon, overlying a B-horizon dominated by a high coarse fraction (>2mm), generally increasing in size and abundance with increasing depth.

The soil materials sampled exhibited a wide range of pH values, with little consistency between soil pH and position within the landscape, or vegetation community. Similarly, landscape position offered little explanation for the electrical conductivity (EC) of materials sampled, the majority of which were considered to be non-saline.

Soil nutrient analyses indicated low nutrient levels (total N, available P, K and S) that were typical for the region, again with little consistent trend in nutrient level in relation to position within the landscape or to vegetation community. As expected, the level of all measured nutrients generally decreased slightly with depth in the soil profile.

Analysis of water-soluble metal concentrations in surface soils indicated very low baseline levels. Most materials sampled were below the detectable limit for the bulk of the elements measured, with only Al regularly occurring at a detectable level. For the metals detected, there was no apparent correlation with landform or vegetation unit.

There was little apparent difference in the physical or chemical soil properties of surface soils between the sample sites to the north, and those to the south of Talga Range.

Issues requiring consideration during project development, include topsoil management, the potential erodibility of the materials, and possible heavy metal content of deeper regolith materials. Direct return of topsoils is preferred where possible, alternatively, ‘paddock-dumped’ soil stockpiles are recommended. Stockpiles and landforms should be designed and constructed to minimize the potential for erosion. Finally, further definition of heavy metal content of deeper regolith materials is recommended as the project develops, to ensure appropriate management of these materials.
# TABLE OF CONTENTS

1.0 **INTRODUCTION** .................................................................................................................. 5

1.1 **PROJECT BACKGROUND** ................................................................................................. 5
1.2 **SCOPE AND OBJECTIVES OF THE STUDY** ................................................................. 5

2.0 **MATERIALS AND METHODS** ......................................................................................... 5

2.1 **SAMPLING REGIME** ....................................................................................................... 5
2.2 **TEST WORK AND PROCEDURES** ................................................................................... 6

3.0 **RESULTS & DISCUSSION** ............................................................................................... 8

3.1 **SOUTHERN SITE DESCRIPTIONS** ................................................................................... 8
  3.1.1 Site S1 .......................................................................................................................... 9
  3.1.2 Site S2 .......................................................................................................................... 10
  3.1.3 Site S3 .......................................................................................................................... 11
  3.1.4 Site S4 .......................................................................................................................... 12
  3.1.5 Site S5 .......................................................................................................................... 13
  3.1.6 Site S6 .......................................................................................................................... 14
  3.1.7 Site S7 .......................................................................................................................... 16
  3.1.8 Site S8 .......................................................................................................................... 18
  3.1.9 Site S9 .......................................................................................................................... 20
  3.1.10 Site S10 ..................................................................................................................... 21
  3.1.11 Site S11 ..................................................................................................................... 23
  3.1.12 Site S12 ..................................................................................................................... 25
  3.1.13 Site S13 ..................................................................................................................... 26
  3.1.14 Site S14 ..................................................................................................................... 28
  3.1.15 Site S15 ..................................................................................................................... 29
  3.1.16 Site S16 ..................................................................................................................... 30
  3.1.17 Site S17 ..................................................................................................................... 31
  3.1.18 Site S18 ..................................................................................................................... 33
  3.1.19 Site S19 ..................................................................................................................... 34
  3.1.20 Site S20 ..................................................................................................................... 36
  3.1.21 Site S21 ..................................................................................................................... 37
  3.1.22 Site S22 ..................................................................................................................... 38
  3.1.23 Site S23 ..................................................................................................................... 39
  3.1.24 Site S24 ..................................................................................................................... 40

3.2 **NORTHERN SITE DESCRIPTIONS** .................................................................................. 41
  3.2.1 Site N1 .......................................................................................................................... 42
  3.2.2 Site N2 .......................................................................................................................... 43
  3.2.3 Site N3 .......................................................................................................................... 44
  3.2.4 Site N4 .......................................................................................................................... 45
  3.2.5 Site N5 .......................................................................................................................... 46
  3.2.6 Site N6 .......................................................................................................................... 47
  3.2.7 Site N7 .......................................................................................................................... 48
  3.2.8 Site N8 .......................................................................................................................... 49
  3.2.9 Site N9 .......................................................................................................................... 50
  3.2.10 Site N10 ..................................................................................................................... 51
  3.2.11 Site N11 ..................................................................................................................... 52
  3.2.12 Site N12 ..................................................................................................................... 53
  3.2.13 Site N13 ..................................................................................................................... 54
  3.2.14 Site N14 ..................................................................................................................... 55
  3.2.15 Site N15 ..................................................................................................................... 56
  3.2.16 Site N16 ..................................................................................................................... 57
  3.2.17 Site N17 ..................................................................................................................... 58

3.3 **SOIL PROFILE MORPHOLOGY** ...................................................................................... 59
3.4 **SOIL STRUCTURE** .......................................................................................................... 59
3.5 **SOIL TEXTURE** .............................................................................................................. 60
3.6 **SOIL pH** ......................................................................................................................... 60
List of Figures

Figure 1  Soil sample sites ........................................................................................................7
Figure 2  Individual and average soil pH (H₂O) of samples with corresponding sample depth,
grouped into landscape units. .................................................................................................61
Figure 3  Electrical Conductivity (EC) values with corresponding sample depth, grouped into
landform: a) Complete range of EC values measured, b) greater detail of values within
0 – 0.3 dS/m range, and c) Average values for each landscape unit. .....................................62
Figure 4  Individual and average nitrate N (mg/kg) levels with corresponding sample depth,
grouped into landscape unit. ..................................................................................................63
Figure 5  Individual and average ammonium N (mg/kg) levels with corresponding sample depth,
grouped into landscape unit. ..................................................................................................64
Figure 6  Available phosphorus (mg/kg) of individual samples and average values with
corresponding sample depth, grouped into landscape unit................................................64
Figure 7  Available potassium (mg/kg) of individual samples and average values with
corresponding sample depth, grouped into landscape unit................................................65
Figure 8  Available sulphur (mg/kg) of individual samples and average values with
corresponding sample depth, grouped into landscape unit. (Two samples registered
higher than indicated on figure: Site S24, 0-5cm = 145 mg/kg, Site S7, 80-90cm = 512
mg/kg) ..................................................................................................................................65

List of Tables

Table 1  Soil sample characteristics - Site S1 ..........................................................................9
Table 2  Soil sample characteristics - Site S2 ..........................................................................10
Table 3  Soil sample characteristics - Site S3 ..........................................................................11
Table 4  Soil sample characteristics - Site S4 ..........................................................................12
Table 5  Soil sample characteristics - Site S5 ..........................................................................13
Table 6  Soil sample characteristics - Site S6 ..........................................................................15
Table 7  Soil sample characteristics - Site S7 ..........................................................................17
Table 8  Soil sample characteristics - Site S8 ..........................................................................19
Table 9  Soil sample characteristics - Site S9 ..........................................................................20
Table 10 Soil sample characteristics - Site S10 .................................................................22
Table 11  Soil sample characteristics - Site S11 ................................................................. 24
Table 12  Soil sample characteristics - Site S12 ................................................................. 25
Table 13  Soil sample characteristics - Site S13 ................................................................. 27
Table 14  Soil sample characteristics - Site S14 ................................................................. 28
Table 15  Soil sample characteristics - Site S15 ................................................................. 29
Table 16  Soil sample characteristics - Site S16 ................................................................. 30
Table 17  Soil sample characteristics - Site S17 ................................................................. 32
Table 18  Soil sample characteristics - Site S18 ................................................................. 33
Table 19  Soil sample characteristics - Site S19 ................................................................. 35
Table 20  Soil sample characteristics - Site S20 ................................................................. 36
Table 21  Soil sample characteristics - Site S21 ................................................................. 37
Table 22  Soil sample characteristics - Site S22 ................................................................. 38
Table 23  Soil sample characteristics - Site S23 ................................................................. 39
Table 24  Soil sample characteristics - Site S24 ................................................................. 40
Table 25  Soil sample characteristics - Site N1 ................................................................. 42
Table 26  Soil sample characteristics - Site N2 ................................................................. 43
Table 27  Soil sample characteristics - Site N3 ................................................................. 44
Table 28  Soil sample characteristics - Site N4 ................................................................. 45
Table 29  Soil sample characteristics - Site N5 ................................................................. 46
Table 30  Soil sample characteristics - Site N6 ................................................................. 47
Table 31  Soil sample characteristics - Site N7 ................................................................. 48
Table 32  Soil sample characteristics - Site N8 ................................................................. 49
Table 33  Soil sample characteristics - Site N9 ................................................................. 50
Table 34  Soil sample characteristics - Site N10 ............................................................... 51
Table 35  Soil sample characteristics - Site N11 ............................................................... 52
Table 36  Soil sample characteristics - Site N12 ............................................................... 53
Table 37  Soil sample characteristics - Site N13 ............................................................... 54
Table 38  Soil sample characteristics - Site N14 ............................................................... 55
Table 39  Soil sample characteristics - Site N15 ............................................................... 56
Table 40  Soil sample characteristics - Site N16 ............................................................... 57
Table 41  Soil sample characteristics - Site N17 ............................................................... 58
Table 42  Water soluble metal concentrations of soil materials from southern sites (yellow highlight indicates reportable level detected) .................................................. 67
Table 43  Water soluble metal concentrations of soil materials from northern sites (yellow highlight indicates reportable level detected) .................................................. 68

List of Plates (not included in download version)

Plate 1  Soil sample Site 1 .................................................................................................. 9
Plate 2  Soil sample Site 2 ................................................................................................ 10
Plate 3  Soil sample Site 3 ................................................................................................ 11
Plate 4  Soil sample Site 4 ................................................................................................ 12
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Plate 5 Soil sample Site 5 ................................................................. 13
Plate 6 Soil profile at Site 6 ................................................................ 14
Plate 7 Soil sample Site 6 .................................................................. 14
Plate 8 Soil profile at Site 7 ..................................................................16
Plate 9 Soil sample Site 7 ................................................................... 16
Plate 10 Soil profile at Site 8 .............................................................. 18
Plate 11 Soil sample Site 8 ................................................................. 18
Plate 12 Soil sample Site 9 ................................................................. 20
Plate 13 Soil profile at Site 10 ..............................................................21
Plate 14 Soil sample Site 10 ............................................................... 21
Plate 15 Soil profile at Site 11 ..............................................................23
Plate 16 Soil sample Site 11 ............................................................... 23
Plate 17 Soil sample Site 12 ............................................................... 25
Plate 18 Soil profile at Site 13 ..............................................................26
Plate 19 Soil sample Site 13 ............................................................... 26
Plate 20 Soil sample Site 14 ............................................................... 28
Plate 21 Soil sample Site 15 ............................................................... 29
Plate 22 Soil sample Site 16 ............................................................... 30
Plate 23 Soil profile at Site 17 ..............................................................31
Plate 24 Soil sample Site 17 ............................................................... 31
Plate 25 Soil sample Site 18 ............................................................... 33
Plate 26 Soil profile at Site 19 ..............................................................34
Plate 27 Soil sample Site 19 ............................................................... 34
Plate 28 Soil sample Site 20 ............................................................... 36
Plate 29 Soil sample Site 21 ............................................................... 37
Plate 30 Soil sample Site 22 ............................................................... 38
Plate 31 Soil sample Site 23 ............................................................... 39
Plate 32 Soil sample Site 24 ............................................................... 40

Appendices
Appendix A Glossary of Terms .......................................................... 72
Appendix B Root Scoring Categories .................................................. 75
Appendix C Soil Electrical Conductivity Classes .............................. 77
1.0 INTRODUCTION

1.1 Project Background

Outback Ecology Services (OES) was commissioned by Moly Mines Limited (Moly Mines) to conduct a baseline soil survey of Exploration Licence E45/2226 and the proposed project footprint area to the north (a component of Licence EA45/2825) at Spinifex Ridge, located approximately 50km north-east of Marble Bar, Western Australia. The survey was one component of a broader assessment undertaken concurrently by Outback Ecology that also considered vegetation and flora, vertebrate fauna, aquatic ecology and stygofauna. This report combines an initial survey of the area immediately south of the Talga Range (completed in 2005), with a survey of surface soils from north of the Talga Range completed in 2006.

1.2 Scope and Objectives of the Study

The proposed mining operation is to include a single open-cut mine and associated infrastructure, including waste and tailings storage facilities. At the time of survey, no exact locations for infrastructure had been identified. Soil sample sites were chosen to encompass the range of landform and vegetation communities present within the project area, comprising E45/2226 as well as the proposed footprint area to the north of the Talga Range. Soil sampling and profile descriptions were restricted to surface soils, apart from areas where costeasing from historic exploration activities facilitated deeper examination. This report documents the results of this survey and includes:

- Description of soil profile morphology, to the maximum depth possible, based on Australian Soil Classification Standards,
- Evaluation of soil physical parameters (soil structure and texture),
- Measurement of soil chemical parameters (soil pH, electrical conductivity, total N, ammonium and nitrate N, extractable P, K and S, and organic C),
- Examination of possible correlations between measured soil properties, landform and vegetation communities.

2.0 MATERIALS AND METHODS

2.1 Sampling Regime

The investigation into soil properties consisted of assessment and sampling at 24 sites to the south of the Talga Range, and 17 sites to the north (Figure 1). The sites selected encompassed a range of landform and vegetation units within the area of the ore body, proposed waste dumps / infrastructure footprints and surrounding areas. Sampling was generally restricted to surface soils (0-5cm and 10-
20cm sampling intervals), however deeper samples were collected from some sites within the ore body area (southern sites) where costeanning had exposed the soil profile.

Where possible, the soil profile was described (soil profile morphology, soil structure, root distribution) based on the Australian Soil and Land Survey Handbook (McDonald et al. 1998). Samples were collected from consistent depth intervals at each site for analyses of chemical and physical parameters.

2.2 Test Work and Procedures

CSBP Soil and Plant Laboratory conducted analyses on the soils from the 41 sites for ammonium and nitrate N (Scarle, 1984), extractable phosphorus and potassium (Colwell, 1965; Rayment and Higginson, 1992), extractable sulphur (Blair et al., 1991) and organic carbon (Walkley and Black, 1934). Analysis of total nitrogen was conducted by combustion at 950°C in oxygen using a Leco FP-428 Nitrogen Analyser. Measurements of electrical conductivity (1:5 H$_2$O) and pH (1:5 H$_2$O), were conducted using the methods described in Rayment and Higginson (1992).

Analysis of the water soluble metal concentrations of surface soils from each site was conducted by ALS Environmental on a 1:5 soil / water leachate using ICPAES.

All chemical characteristics reported have been measured on the <2mm fraction of soil material collected.

Soil texture was assessed by OES staff using the procedure described in McDonald et al. (1998). The approximate percentage of coarse material (>2mm) was estimated visually for each sample.
Figure 1  Soil sample sites
3.0 RESULTS & DISCUSSION

A description of the soil profile morphology to the maximum depth possible at each site has been documented, with a summary of measured parameters tabulated for each of the southern sites (Sections 3.1.1 – 3.1.24), and the northern sites (3.2.1 – 3.2.17). Individual soil characteristics are then discussed in further detail (Sections 3.3 – 3.10). For comparative purposes, sites have been grouped based on their location, with landform units of valley floor, drainage lines, lower / mid slope and upper slope / crest.

3.1 Southern Site Descriptions

Terminology for the descriptions of soil parameters are based on those described in McDonald et al., (1998). The vegetation classifications given for each site are based on those described in the concurrent Outback Ecology Vegetation and Flora Baseline Report for the Project Area (OES 2006a).
3.1.1 Site S1

Site Details: Valley Floor

GPS Coordinates: 20°54.551S 120°05.284E

**Texture:** Loamy sand throughout top 20cm of profile dominated by coarse fragments. Sub angular and angular coarse fragments 5-50mm in size.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and very weak consistence throughout top 20cm of profile.

**Root growth:** Penetration throughout soil matrix, decreasing slightly with depth.

**Vegetation Classification:**
P1 *Acacia inaequilatera* high shrubland to open shrubland over *Corchorus parviflorus* low scattered shrubs to open shrubland over *Triodia epactia* hummock grassland.

### Plate 1 Soil sample Site S1

![Plate 1 Soil sample Site S1](image)

### Table 1 Soil sample characteristics - Site S1

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>40</td>
<td>6.6</td>
<td>0.017</td>
<td>2</td>
<td>0.24</td>
<td>0.02</td>
<td>3</td>
<td>1</td>
<td>10</td>
<td>200</td>
<td>1.6</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>40</td>
<td>7.0</td>
<td>0.032</td>
<td>1</td>
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<td>0.02</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>104</td>
<td>1.7</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.2 Site S2

**Site Details:** Valley floor

**GPS Coordinates:** 20°54.390
120°05.519

*Texture:* Loamy sand throughout top 20cm of profile dominated by coarse fragments. Sub angular and angular coarse fragments 5-75mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and very weak consistence throughout top 20cm of profile.

*Root growth:* Penetration throughout soil matrix, decreasing slightly with depth.

*Vegetation Classification:* P1 Acacia inaequilateral high shrubland to open shrubland over Corchorus parviflorus low scattered shrubs to open shrubland over Triodia epactia hummock grassland.

**Plate 2** Soil sample Site S2

---

**Table 2** Soil sample characteristics - Site S2

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil Texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>10</td>
<td>6.9</td>
<td>0.018</td>
<td>2</td>
<td>0.25</td>
<td>0.02</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>132</td>
<td>1.4</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>40</td>
<td>6.8</td>
<td>0.015</td>
<td>1</td>
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<td>0.02</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>89</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.3 Site S3

Site Details: Lower slope

GPS Coordinates: 20°54.083 120°05.748

Texture: Clayey sand throughout top 20cm of profile dominated by coarse fragments. Sub angular and angular coarse fragments 5-100mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
H1 Acacia inaequilateralensis scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Plate 3 Soil sample Site S3

Table 3 Soil sample characteristics - Site S3

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H2O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>6.7</td>
<td>0.013</td>
<td>2</td>
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<tr>
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<td>Clayey sand</td>
<td>25</td>
<td>6.7</td>
<td>0.018</td>
<td>1</td>
<td>0.25</td>
<td>0.03</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>125</td>
<td>1.9</td>
</tr>
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</table>

* See Appendix B for Root Abundance Scoring details
3.1.4 Site S4

**Site Details:** Drainage line – Creek bed

**GPS Coordinates:**
- 20°54.215
- 120°06.019

*Plate 4 Soil sample Site S4*

**Texture:** Sand to loamy sand throughout top 20cm of profile. Sub rounded, rounded and sub angular coarse fragments 5-20mm in size.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and very weak consistence throughout top 20cm of profile.

**Root growth:** Patchy penetration throughout soil matrix, some areas with zero root growth corresponding to bare patches.

**Vegetation Classification:**
- **D3** Eucalyptus camaldulensis var. obtusa / E. vitrix open woodland to woodland over *Melaleuca glomerata* / *Acacia ampliceps* / *Acacia coriacea* ssp. pendens and *Acacia tumida* var. *pilbarenensis* low open woodland to woodland over *Cyperus vaginatus* very open sedges over *Triodia longiceps* hummock grassland.

**Table 4 Soil sample characteristics - Site S4**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sand</td>
<td>5</td>
<td>7.4</td>
<td>0.080</td>
<td>0</td>
<td>0.62</td>
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<td>2</td>
<td>8</td>
<td>121</td>
<td>7.8</td>
</tr>
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<td>Loamy sand</td>
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<td>7</td>
<td>170</td>
<td>5.4</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.5 Site S5

Site Details: Lower mid slope

GPS Coordinates: 20° 53' 49.3
120° 05' 52.1

Texture: Clayey sand throughout top 20cm of profile dominated by coarse fragments. Sub angular and angular coarse fragments 5-150mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
H1 Acacia inaequilatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Table 5 Soil sample characteristics - Site S5

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>50</td>
<td>7.8</td>
<td>0.074</td>
<td>2</td>
<td>0.63</td>
<td>0.06</td>
<td>5</td>
<td>1</td>
<td>12</td>
<td>182</td>
<td>3.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.9</td>
<td>0.110</td>
<td>1</td>
<td>0.38</td>
<td>0.04</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>84</td>
<td>21.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.6 Site S6

**Site Details:** Lower slope  

**GPS Coordinates:** 20°53' 27.6  
120°06’ 02.4

**Texture:** Clayey sand throughout top 20cm of profile, increasing in clay content to sandy clay loam at around 40cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-150mm in size, increasing in volume with depth to approximately 90% at around 40cm.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

**Root growth:** Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 40cm.

**Vegetation Classification:**

**H1**  
*Acacia inaequilateral*- scattered tall shrubs to high open shrubland over mixed *Corchorus parviflorus* / *Indigofera monophylla* / *Tephrosia spp.* / *Ptilotus calostachyus* low scattered shrubs to low open shrubland over *Triodia epactia* hummock grassland.
Table 6  Soil sample characteristics - Site S6

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>50</td>
<td>6.9</td>
<td>0.019</td>
<td>2</td>
<td>0.19</td>
<td>0.02</td>
<td>2</td>
<td>1</td>
<td>12</td>
<td>219</td>
<td>2.8</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>75</td>
<td>7.5</td>
<td>0.028</td>
<td>1</td>
<td>0.21</td>
<td>0.03</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>129</td>
<td>1.8</td>
</tr>
<tr>
<td>40-50</td>
<td>Sandy clay loam</td>
<td>90</td>
<td>8.3</td>
<td>0.080</td>
<td>1</td>
<td>0.34</td>
<td>0.04</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>69</td>
<td>3.1</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.7 Site S7

Site Details: Lower mid slope

GPS Coordinates: 20°53' 23.6
120°06' 00.4

Plate 8 Soil profile at Site S7

Texture: Clayey sand throughout top of profile, increasing in clay content to sandy clay loam at around 40cm, and clay loam at 70cm. Profile dominated by coarse fragments beyond 50cm, sub angular and angular coarse fragments 5-100mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments increasing from around 30cm.

Root growth: Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 70cm.

Vegetation Classification:

H1 Acacia inaequilatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Plate 9 Soil sample Site S7
Table 7  Soil sample characteristics - Site S7

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>25</td>
<td>8.3</td>
<td>0.085</td>
<td>2</td>
<td>0.28</td>
<td>0.03</td>
<td>4</td>
<td>1</td>
<td>8</td>
<td>213</td>
<td>2.8</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>25</td>
<td>8.3</td>
<td>0.092</td>
<td>1</td>
<td>0.28</td>
<td>0.03</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>124</td>
<td>2.9</td>
</tr>
<tr>
<td>40-50</td>
<td>Sandy clay loam</td>
<td>50</td>
<td>8.1</td>
<td>0.127</td>
<td>1</td>
<td>0.21</td>
<td>0.02</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>100</td>
<td>11.6</td>
</tr>
<tr>
<td>80-90</td>
<td>Clay loam</td>
<td>50</td>
<td>9.3</td>
<td>0.974</td>
<td>1</td>
<td>0.24</td>
<td>0.02</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>79</td>
<td>512</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.8 Site S8

Site Details: Upper slope

GPS Coordinates: 20° 53’ 11.9
120° 06’ 06.5

Texture: Clayey sand throughout top of profile, increasing in clay content to clay loam at around 40cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-100mm in size, increasing in volume with depth to approximately 90% at around 30cm.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

Root growth: Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 30cm.

Vegetation Classification:
H1  Acacia inaequilateral  scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.
Table 8  Soil sample characteristics - Site S8

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>20</td>
<td>8.4</td>
<td>0.087</td>
<td>3</td>
<td>0.67</td>
<td>0.06</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>165</td>
<td>2.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>75</td>
<td>8.4</td>
<td>0.094</td>
<td>1</td>
<td>0.52</td>
<td>0.05</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>248</td>
<td>5.1</td>
</tr>
<tr>
<td>40-50</td>
<td>Clay loam</td>
<td>90</td>
<td>8.4</td>
<td>0.110</td>
<td>1</td>
<td>0.42</td>
<td>0.04</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>378</td>
<td>3.2</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.9 Site S9

Site Details: Drainage line

GPS Coordinates: 20°53’14.5
120°06’02.8

Texture: Clayey sand throughout top 20cm of profile dominated by coarse fragments. Sub angular coarse fragments 5-100mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
D5 Corymbia hamersleyana low open woodland over Acacia tumida var. pilbarenis / A. pyrifolia open scrub to high open shrubland over Triodia epactia hummock grassland.

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.6</td>
<td>0.078</td>
<td>2</td>
<td>1.48</td>
<td>0.15</td>
<td>15</td>
<td>21</td>
<td>10</td>
<td>458</td>
<td>3.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.7</td>
<td>0.068</td>
<td>2</td>
<td>0.69</td>
<td>0.08</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>317</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.10 Site S10

**Site Details:** Lower slope

**GPS Coordinates:** 20°53’ 30.4
120°06’ 11.7

**Texture:** Clayey sand throughout top of profile, increasing in clay content to clay loam at around 30cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-100mm in size, increasing in volume with depth to approximately 75% at around 40cm.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

**Root growth:** Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 40cm.

**Vegetation Classification:**
(prior to being burnt)

P1 Acacia inaequilatera high shrubland to scattered shrubs over Triodia epactia hummock grassland.

---

**Plate 13** Soil profile at Site S10

**Plate 14** Soil sample Site S10
Table 10  Soil sample characteristics - Site S10

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H_2O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>25</td>
<td>8.2</td>
<td>0.097</td>
<td>2</td>
<td>0.47</td>
<td>0.04</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>182</td>
<td>8.3</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>8.5</td>
<td>0.095</td>
<td>1</td>
<td>0.53</td>
<td>0.05</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>138</td>
<td>29.5</td>
</tr>
<tr>
<td>40-50</td>
<td>Clay loam</td>
<td>75</td>
<td>8.5</td>
<td>0.106</td>
<td>1</td>
<td>0.27</td>
<td>0.03</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>128</td>
<td>28.3</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.11 Site S11

**Site Details:** Mid slope

**GPS Coordinates:**
20°53' 33.2
120°06' 21.8

Texture: Clayey sand throughout top of profile, increasing in clay content to clay loam at around 40cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-75mm in size, increasing in volume with depth to approximately 75% at around 40cm.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

Root growth: Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 50cm.

Vegetation Classification:
(prior to being burnt)

**H1** Acacia inaequiliatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Plate 15 Soil profile at Site S11

Plate 16 Soil sample Site S11
Table 11  Soil sample characteristics - Site S11

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>50</td>
<td>8.3</td>
<td>0.151</td>
<td>2</td>
<td>1.10</td>
<td>0.09</td>
<td>8</td>
<td>4</td>
<td>10</td>
<td>174</td>
<td>25.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>25</td>
<td>8.3</td>
<td>0.133</td>
<td>2</td>
<td>0.92</td>
<td>0.09</td>
<td>8</td>
<td>3</td>
<td>7</td>
<td>158</td>
<td>18.2</td>
</tr>
<tr>
<td>40-50</td>
<td>Clay loam</td>
<td>75</td>
<td>8.5</td>
<td>0.129</td>
<td>1</td>
<td>0.56</td>
<td>0.06</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>236</td>
<td>16.9</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.12 Site S12

**Site Details:** Drainage line – creek bed

**GPS Coordinates:** 20°53' 31.9 120°06' 19.0

- **Texture:** Clay loam to clayey sand throughout top 20cm of profile. Less than 5% coarse material in profile surface.

- **Structure:** Apedal, single grained throughout profile surface. Sandy fabric and very weak consistence throughout top 20cm of profile.

- **Root growth:** Patchy penetration throughout soil matrix, some areas with zero root growth corresponding to bare patches.

- **Vegetation Classification:** (prior to being burnt)
  
  **D3** *Eucalyptus camaldulensis* var. *obtusa* / *E. vitrix* open woodland to woodland over *Melaleuca glomerata* / *Acacia ampliceps* / *Acacia coriacea* ssp. *pendens* and *Acacia tumida* var. *pilbarensis* low open woodland to woodland over *Cyperus vaginatus* very open sedges over *Triodia longiceps* hummock grassland.

---

**Table 12  Soil sample characteristics - Site S12**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clay loam</td>
<td>5</td>
<td>9.6</td>
<td>1.664</td>
<td>1</td>
<td>1.1</td>
<td>0.08</td>
<td>14</td>
<td>2</td>
<td>14</td>
<td>242</td>
<td>28.3</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>10</td>
<td>9.3</td>
<td>0.593</td>
<td>1</td>
<td>0.52</td>
<td>0.04</td>
<td>9</td>
<td>2</td>
<td>5</td>
<td>112</td>
<td>13.3</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.13 Site S13

**Site Details:** Lower slope

**GPS Coordinates:**
- 20°53’ 23.6
- 120°06’ 10.0

---

**Text:**

**Vegetation Classification:**

**H1**  
*Acacia inaequilateral* scattered tall shrubs to high open shrubland over mixed *Corchorus parvillorus* / *Indigofera monophylla* / *Tephrosia* spp. / *Ptilotus calostachyus* low scattered shrubs to low open shrubland over *Triodia epactia* hummock grassland.

**Texture:** Clayey sand throughout top 10cm of profile, increasing in clay content to sandy clay loam and clay loam, sandy, at around 40cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-100mm in size, increasing in volume with depth to approximately 90% at around 40cm.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

**Root growth:** Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 40cm.
### Table 13  Soil sample characteristics - Site S13

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>25</td>
<td>7.6</td>
<td>0.037</td>
<td>2</td>
<td>0.47</td>
<td>0.04</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>206</td>
<td>10.8</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy clay loam</td>
<td>40</td>
<td>8.1</td>
<td>0.050</td>
<td>1</td>
<td>0.41</td>
<td>0.04</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>160</td>
<td>7.5</td>
</tr>
<tr>
<td>40-50</td>
<td>Clay loam, sandy</td>
<td>90</td>
<td>8.1</td>
<td>0.060</td>
<td>1</td>
<td>0.37</td>
<td>0.04</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>77</td>
<td>6.3</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.14 Site S14

**Site Details:** Drainage line

**GPS Coordinates:** 20° 53' 25.5
120° 05' 08.6

---

**Table 14 Soil sample characteristics - Site S14**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>10</td>
<td>8.0</td>
<td>0.045</td>
<td>2</td>
<td>0.83</td>
<td>0.07</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>354</td>
<td>2.0</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>20</td>
<td>7.9</td>
<td>0.044</td>
<td>2</td>
<td>0.57</td>
<td>0.05</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>254</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

---

*Texture:* Loamy sand increasing to clayey sand throughout top 20cm of profile. Sub angular and angular coarse fragments 5-50mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Penetration throughout soil matrix, decreasing slightly with depth.

*Vegetation Classification:* D5 *Corymbia hamersleyana* low open woodland over *Acacia tumida* var. *pilbarensis/* *A. pyrifolia* open scrub to high open shrubland over *Triodia epactia* hummock grassland.
3.1.15 Site S15

**Site Details:** Lower slope

**GPS Coordinates:** 20°53’ 25.2
120°05’ 16.8

---

**Texture:** Clayey sand throughout top 20cm of profile. Sub angular and angular coarse fragments 5-150mm in size.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

**Root growth:** Penetration throughout soil matrix, decreasing slightly with depth.

**Vegetation Classification:**
H1 Acacia inaequilateral substituted tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

---

**Table 15 Soil sample characteristics - Site S15**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>8.4</td>
<td>0.107</td>
<td>2</td>
<td>0.47</td>
<td>0.04</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>107</td>
<td>23.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>25</td>
<td>8.4</td>
<td>0.142</td>
<td>1</td>
<td>0.41</td>
<td>0.03</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>94</td>
<td>34.9</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.16 Site S16

Site Details:  Lower slope

GPS Coordinates:  20°53’ 28.7
120°05’ 23.7

Texture: Clayey sand increasing to sandy clay loam in top 20cm of profile. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-75mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
H1  *Acacia inaequilateral* scattered tall shrubs to high open shrubland over mixed *Corchorus pavillorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus* low scattered shrubs to low open shrubland over *Triodia epactia* hummock grassland.

Plate 22  Soil sample Site S16

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.0</td>
<td>0.016</td>
<td>2</td>
<td>0.22</td>
<td>0.02</td>
<td>1</td>
<td>2</td>
<td>19</td>
<td>329</td>
<td>3.4</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy clay loam</td>
<td>50</td>
<td>8.0</td>
<td>0.025</td>
<td>1</td>
<td>0.32</td>
<td>0.03</td>
<td>2</td>
<td>2</td>
<td>11</td>
<td>307</td>
<td>2.2</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

Table 16  Soil sample characteristics - Site S16
3.1.17 Site S17

GPX Coordinates: 20°53'24.7
120°05'28.8

Site Details: Lower slope

Texture: Clayey sand throughout top 10cm of profile, increasing in clay content to sandy clay loam at around 10cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-75mm in size, increasing in volume with depth to approximately 90% at around 30cm.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

Root growth: Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 60cm.

Vegetation Classification:
H1 Acacia inaequilatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.
Table 17  Soil sample characteristics - Site S17

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>8.2</td>
<td>0.093</td>
<td>2</td>
<td>0.83</td>
<td>0.07</td>
<td>3</td>
<td>2</td>
<td>9</td>
<td>221</td>
<td>3.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy clay loam</td>
<td>75</td>
<td>8.5</td>
<td>0.083</td>
<td>2</td>
<td>0.46</td>
<td>0.05</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>174</td>
<td>2.4</td>
</tr>
<tr>
<td>40-50</td>
<td>Sandy clay loam</td>
<td>90</td>
<td>8.4</td>
<td>0.095</td>
<td>1</td>
<td>0.28</td>
<td>0.03</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>103</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.18 Site S18

Site Details: Valley floor

GPS Coordinates: 20°53’ 25.9
120°05’ 32.6

Texture: Clayey sand through top 20cm of profile. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-75mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification: H1 Acacia inaequilatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Table 18 Soil sample characteristics - Site S18

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.4</td>
<td>0.075</td>
<td>2</td>
<td>0.78</td>
<td>0.07</td>
<td>2</td>
<td>9</td>
<td>259</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>50</td>
<td>7.4</td>
<td>0.052</td>
<td>1</td>
<td>0.89</td>
<td>0.06</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>272</td>
<td>3.4</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.19 Site S19

Site Details: Lower slope

GPS Coordinates: 20° 53' 26.3
120° 05' 39.5

Texture: Clayey sand throughout top 20cm of profile, increasing in clay content to sandy clay loam at around 30cm. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-75mm in size, increasing in volume with depth to approximately 75% at around 40cm.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile. Some weak aggregates between coarse fragments at depth.

Root growth: Penetration throughout soil matrix, decreasing with depth to few roots penetrating beyond 60cm.

Vegetation Classification:
H1 Acacia inaequilatera scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.
### Table 19  Soil sample characteristics - Site S19

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil Texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>25</td>
<td>7.3</td>
<td>0.040</td>
<td>2</td>
<td>1.02</td>
<td>0.08</td>
<td>6</td>
<td>4</td>
<td>12</td>
<td>339</td>
<td>3.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.8</td>
<td>0.095</td>
<td>2</td>
<td>0.50</td>
<td>0.04</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>190</td>
<td>4.7</td>
</tr>
<tr>
<td>40-50</td>
<td>Sandy clay loam</td>
<td>75</td>
<td>8.0</td>
<td>0.102</td>
<td>1</td>
<td>0.42</td>
<td>0.04</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>107</td>
<td>5.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.20 Site S20

Site Details: Hill crest  
GPS Coordinates: 20°53’ 41.8 120°06’ 08.5

Texture: Loamy sand increasing to clayey sand in top 20cm of profile. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-150mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification: (prior to being burnt)  
H1 Acacia inaequilateral scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Table 20  Soil sample characteristics - Site S20

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>75</td>
<td>8.0</td>
<td>0.070</td>
<td>1</td>
<td>1.01</td>
<td>0.09</td>
<td>7</td>
<td>8</td>
<td>11</td>
<td>232</td>
<td>13.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>90</td>
<td>8.0</td>
<td>0.130</td>
<td>1</td>
<td>0.56</td>
<td>0.05</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>127</td>
<td>4.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.21 Site S21

**Site Details:** Lower slope

**GPS Coordinates:**
- 20°53' 50.3
- 120°06' 18.9

*Texture:* Clayey sand in top 20cm of profile. Profile dominated by coarse fragments, sub angular and angular coarse fragments 5-100mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Penetration throughout soil matrix, decreasing slightly with depth.

*Vegetation Classification:* (prior to being burnt)
- **H1** *Acacia inaequilatera* scattered tall shrubs to high open shrubland over mixed *Corchorus parviflorus* / *Indigofera monophylla* / *Tephrosia* spp. / *Ptilotus calostachyus* low scattered shrubs to low open shrubland over *Triodia epactia* hummock grassland.

---

Table 21  Soil sample characteristics - Site S21

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrates N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>75</td>
<td>7.4</td>
<td>0.021</td>
<td>1</td>
<td>0.31</td>
<td>0.03</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>161</td>
<td>3.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>75</td>
<td>8.0</td>
<td>0.034</td>
<td>1</td>
<td>0.37</td>
<td>0.04</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>85</td>
<td>25.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.22 Site S22

Site Details: Drainage line

GPS Coordinates: 20°54'07.8
120°06'16.9

Texture: Sand to loamy sand in top 20cm of profile. Less than 5% sub angular and sub rounded coarse fragments 5-25mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Few roots, although penetration throughout soil matrix, abundance decreasing slightly with depth.

Vegetation Classification: (prior to being burnt)
P1 Acacia inaequilatera high shrubland to scattered shrubs over Triodia epactia hummock grassland.

Plate 30 Soil sample Site S22

Table 22 Soil sample characteristics - Site S22

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sand</td>
<td>5</td>
<td>7.9</td>
<td>0.087</td>
<td>1</td>
<td>0.2</td>
<td>0.02</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>183</td>
<td>12.8</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>5</td>
<td>8.7</td>
<td>0.199</td>
<td>1</td>
<td>0.19</td>
<td>0.02</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>34</td>
<td>27.1</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.23 Site S23

Site Details: Lower slope

GPS Coordinates: 20°54'17.0
120°06'17.0

Texture: Clayey sand through top 20cm of profile. Profile dominated by sub angular coarse fragments 5-75mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
H1 Acacia inaequilateral scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Plate 31 Soil sample Site S23

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.7</td>
<td>0.017</td>
<td>2</td>
<td>0.43</td>
<td>0.02</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>171</td>
<td>2.5</td>
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<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.5</td>
<td>0.021</td>
<td>1</td>
<td>0.50</td>
<td>0.03</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>166</td>
<td>3.7</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.1.24 Site S24

Site Details: Lower slope

GPS Coordinates: 20°53’ 35.1’
120°05’ 56.1’

Texture: Clayey sand through top 20cm of profile. Profile dominated by sub-angular coarse fragments 5-100mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Penetration throughout soil matrix, decreasing slightly with depth.

Vegetation Classification:
H1 Acacia inaequilateral scattered tall shrubs to high open shrubland over mixed Corchorus parviflorus / Indigofera monophylla / Tephrosia spp. / Ptilotus calostachyus low scattered shrubs to low open shrubland over Triodia epactia hummock grassland.

Table 24 Soil sample characteristics - Site S24

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H2O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Total N (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>6.3</td>
<td>0.233</td>
<td>2</td>
<td>0.22</td>
<td>0.02</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>244</td>
<td>145.0</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>50</td>
<td>6.9</td>
<td>0.018</td>
<td>1</td>
<td>0.21</td>
<td>0.02</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>187</td>
<td>4.2</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2 Northern Site Descriptions

The soil profile morphology, soil physical and chemical characteristics of each sample site north of the Talga Range are summarised for each site (Sections 3.2.1 to 3.2.16). The vegetation classifications given for each site are based on those described in the concurrent OES Vegetation and Flora Survey Report for the Project Area (OES 2006a).
3.2.1 Site N1

**Site Details:** Valley floor / flat, adjacent to major drainage line

**GPS Coordinates:**
- 0199681 mN
- 7689199 mE

**Texture:** Clayey sand through top 20cm of profile. Profile dominated by sub-angular and sub-rounded coarse fragments 5-200mm in size.

**Structure:** Apered, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

**Root growth:** Few roots, penetration throughout soil matrix.

**Vegetation Classification:** P9 Mixed *Grevillea* and *Acacia* scattered tall shrubs over *Triodia epactia* hummock grassland.

### Table 25 Soil sample characteristics - Site N1

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.6</td>
<td>0.039</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>280</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>40</td>
<td>7.4</td>
<td>0.094</td>
<td>1</td>
<td>0.16</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>219</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.2 Site N2

**Site Details:** Minor drainage line

**GPS Coordinates:**
- 0199291 mN
- 7692400 mE

*Texture:* Clayey sand through top 20cm of profile. Profile dominated by sub-angular and sub-rounded coarse fragments 5-100mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:* P9 Mixed Grevillea and Acacia scattered tall shrubs over Triodia epactia hummock grassland.

### Table 26 Soil sample characteristics - Site N2

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>50</td>
<td>7.0</td>
<td>0.014</td>
<td>1</td>
<td>0.27</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>185</td>
<td>1.9</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>50</td>
<td>6.9</td>
<td>0.014</td>
<td>1</td>
<td>0.24</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>205</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.3 Site N3

**Site Details:** Minor drainage line

**GPS Coordinates:**

- 0199092 mN
- 7689230 mE

- *Texture:* Sandy loam through top 20cm of profile. Approximately 5-20% sub-angular and sub-rounded coarse fragments 5-50mm in size.

- *Structure:* Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.


- *Vegetation Classification:* D7  *Acacia tumida var. pilbarensis* open scrub to high shrubland over *Triodia epactia* open hummock grassland along drainage lines.

**Plate 35 Soil sample Site N3**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H$_2$O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy loam</td>
<td>5</td>
<td>6.9</td>
<td>0.014</td>
<td>2</td>
<td>0.11</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>151</td>
<td>1.6</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy loam</td>
<td>20</td>
<td>6.9</td>
<td>0.015</td>
<td>1</td>
<td>0.17</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>164</td>
<td>1.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

**Table 27 Soil sample characteristics - Site N3**
3.2.4 Site N4

Site Details: Minor drainage line

GPS Coordinates: 0197866 mN
7689803 mE

Texture: Sandy loam through top 20cm of profile. Approximately 10-25% sub-angular coarse fragments 5-50mm in size.

Structure: Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Few roots, penetration throughout soil matrix.

Vegetation Classification:
P2 Acacia inaequilatera high open shrubland to scattered shrubs over Triodia wiseana hummock grassland with some Triodia epactia.

Plate 36 Soil sample Site N4

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H2O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy loam</td>
<td>10</td>
<td>6.9</td>
<td>0.018</td>
<td>1</td>
<td>0.55</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>130</td>
<td>3.4</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy loam</td>
<td>25</td>
<td>6.8</td>
<td>0.021</td>
<td>1</td>
<td>0.62</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>118</td>
<td>3.6</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

Table 28 Soil sample characteristics - Site N4
3.2.5 Site N5

**Site Details:** Valley floor / flat

**GPS Coordinates:**
- 0197403 mN
- 7690820 mE

*Texture:* Loamy sand through top 20cm of profile. Profile dominated by sub-angular coarse fragments 5-100mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:* P9 Mixed *Grevillea* and *Acacia* scattered tall shrubs over *Triodia epactia* hummock grassland.

**Plate 37** Soil sample Site N5

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>40</td>
<td>6.9</td>
<td>0.015</td>
<td>1</td>
<td>0.30</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>122</td>
<td>2.4</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>75</td>
<td>6.9</td>
<td>0.015</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>106</td>
<td>2.4</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.6 Site N6

**Site Details:** Valley floor / flat  
**GPS Coordinates:** 0196465 mN  
7689197 mE

*Texture:* Loamy sand through top 20cm of profile. Profile dominated by sub-angular coarse fragments 5-75mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:*  
**P1** *Acacia inaequilatera* high shrubland to scattered shrubs over *Triodia epactia* hummock grassland.

---

**Plate 38  Soil sample Site N6**

---

**Table 30  Soil sample characteristics - Site N6**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>25</td>
<td>6.7</td>
<td>0.016</td>
<td>1</td>
<td>0.31</td>
<td>1</td>
<td>1</td>
<td>23</td>
<td>263</td>
<td>2.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>50</td>
<td>6.6</td>
<td>0.024</td>
<td>1</td>
<td>0.28</td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>237</td>
<td>1.7</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.7 Site N7

**Site Details:** Valley floor / flat

**GPS Coordinates:**

- 0196057 mN
- 7689898 mE

*Texture:* Clayey sand through top 20cm of profile. Approximately 5-20% sub-angular coarse fragments 5-50mm in size.

*Structure:* Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:* P1 *Acacia inaequilatera* high shrubland to scattered shrubs over *Triodia epactia* hummock grassland.

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil Texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>5</td>
<td>6.5</td>
<td>0.026</td>
<td>1</td>
<td>0.27</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>174</td>
<td>2.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
<td>20</td>
<td>6.8</td>
<td>0.014</td>
<td>1</td>
<td>0.29</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>161</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.8 Site N8

Site Details: Valley floor / flat, adjacent to minor drainage line

GPS Coordinates: 0196802 mN
7691100 mE

Texture: Loamy sand through top 20cm of profile. Profile dominated by sub-angular coarse fragments 5-100mm in size.

Structure: Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Few roots, penetration throughout soil matrix.

Vegetation Classification:
P9 Mixed Grevillea and Acacia scattered tall shrubs over Triodia epactia hummock grassland.

Plate 40 Soil sample Site N8

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil Texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>50</td>
<td>6.6</td>
<td>0.016</td>
<td>1</td>
<td>0.31</td>
<td>1</td>
<td>1</td>
<td>137</td>
<td>137</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>75</td>
<td>6.6</td>
<td>0.025</td>
<td>1</td>
<td>0.38</td>
<td>1</td>
<td>1</td>
<td>119</td>
<td>119</td>
<td>2.5</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

Table 32 Soil sample characteristics - Site N8
3.2.9 Site N9

Site Details: Minor drainage line

GPS Coordinates: 0196123 mN
7692250 mE

Plate 41 Soil sample Site N9

Texture: Clayey sand to sandy loam through top 20cm of profile. Approximately 25-40% sub-angular and sub-rounded coarse fragments 5-75mm in size.

Structure: Predominantly apedal, with some weak aggregates from 5-20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Common roots, penetration throughout soil matrix.

Vegetation Classification: D7 Acacia tumida var. pilbarensis open scrub to high shrubland over Triodia epactia open hummock grassland along drainage lines.

Table 33 Soil sample characteristics - Site N9

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Ammon. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>25</td>
<td>6.5</td>
<td>0.017</td>
<td>2</td>
<td>0.57</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>167</td>
<td>2.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy loam</td>
<td>40</td>
<td>6.4</td>
<td>0.014</td>
<td>2</td>
<td>0.43</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>153</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.10 Site N10

**Site Details:** Valley floor / flat

**GPS Coordinates:** 0197252 mN 7691790 mE

**Plate 42** Soil sample Site N10

*Texture:* Loamy sand through top 20cm of profile. Profile dominated by sub-angular coarse fragments 5-75mm in size.

*Structure:* Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:* Mixed *Grevillea* and *Acacia* scattered tall shrubs over *Triodia epactia* hummock grassland.

**Table 34** Soil sample characteristics - Site N10

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>30</td>
<td>6.6</td>
<td>0.014</td>
<td>1</td>
<td>0.23</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>107</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>50</td>
<td>6.8</td>
<td>0.015</td>
<td>1</td>
<td>0.21</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>97</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.11 Site N11

**Site Details:** Bank of drainage line

**GPS Coordinates:** 0197510 mN 7689014 mE

Texture: Sandy loam to sandy clay loam through top 20cm of profile. Approximately 25-40% sub-angular and sub-rounded coarse fragments 5-75mm in size.

Structure: Predominantly apedal, with some weak aggregates from 5-20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Common roots, penetration throughout soil matrix.

Vegetation Classification: D7 Acacia tumida var. pilbarensis open scrub to high shrubland over Triodia epactia open hummock grassland.

Table 35 Soil sample characteristics - Site N11

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy loam</td>
<td>25</td>
<td>6.9</td>
<td>0.019</td>
<td>2</td>
<td>0.19</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>142</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy clay</td>
<td>25</td>
<td>7.0</td>
<td>0.02</td>
<td>2</td>
<td>0.33</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>150</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.12 Site N12

Site Details: Valley floor / flat

GPS Coordinates: 0199276 mN
7690860 mE

Texture: Sandy loam through top 20cm of profile. Approximately 10% sub-angular coarse fragments 5-50mm in size.

Structure: Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Few roots, penetration throughout soil matrix.

Vegetation Classification:
P9 Mixed Grevillea and Acacia scattered tall shrubs over Triodia epactia hummock grassland.

Plate 44 Soil sample Site N12

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy loam</td>
<td>10</td>
<td>6.7</td>
<td>0.014</td>
<td>1</td>
<td>0.22</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>152</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy loam</td>
<td>10</td>
<td>6.7</td>
<td>0.015</td>
<td>1</td>
<td>0.24</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>163</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

Table 36 Soil sample characteristics - Site N12
3.2.13 Site N13

**Site Details:** Valley floor / flat

**GPS Coordinates:** 0197994 mN 7693005 mE

**Texture:** Sandy loam through top 20cm of profile. Approximately 10% sub-angular coarse fragments 5-50mm in size.

**Structure:** Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

**Root growth:** Few roots, penetration throughout soil matrix.

**Vegetation Classification:**

P2 *Acacia inaequiliata* high open shrubland to scattered shrubs over *Triodia wislana* hummock grassland with some *Triodia epactia*.

---

**Table 37  Soil sample characteristics - Site N13**

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H2O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy loam</td>
<td>10</td>
<td>6.8</td>
<td>0.016</td>
<td>1</td>
<td>0.33</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>164</td>
<td>2.0</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy loam</td>
<td>10</td>
<td>6.8</td>
<td>0.016</td>
<td>1</td>
<td>0.30</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>148</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.14 Site N14

**Site Details:** Minor drainage line

**GPS Coordinates:** 0197932 mN
7692160 mE

*Texture:* Sandy clay loam through top 20cm of profile. Approximately 10-20% sub-angular and sub-rounded coarse fragments 5-50mm in size.

*Structure:* Thin surface crust present, overlying predominantly apedal, single grained soil, with some weak aggregates to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

*Root growth:* Few roots, penetration throughout soil matrix.

*Vegetation Classification:* P9 Mixed Grevillea and Acacia scattered tall shrubs over Triodia epactia hummock grassland.

### Table 38 Soil sample characteristics - Site N14

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Sandy clay loam</td>
<td>10</td>
<td>6.8</td>
<td>0.017</td>
<td>2</td>
<td>0.36</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>235</td>
<td>3.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Sandy clay loam</td>
<td>20</td>
<td>6.9</td>
<td>0.015</td>
<td>1</td>
<td>0.27</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>231</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.15 Site N15

**Site Details:** Valley floor / flat

**GPS Coordinates:** 0198910 mN 7689791 mE

- **Texture:** Loamy sand through top 20cm of profile. Approximately 20-40% sub-angular coarse fragments 5-50mm insize.

- **Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

- **Root growth:** Few roots, penetration throughout soil matrix.

- **Vegetation Classification:**
  
  P1 Acacia inaequilateral high open shrubland to scattered shrubs Triodia epactia hummock grassland.

### Plate 47 Soil sample Site N15

### Table 39 Soil sample characteristics - Site N15

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Loamy sand</td>
<td>20</td>
<td>6.6</td>
<td>0.125</td>
<td>1</td>
<td>0.17</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>140</td>
<td>4.0</td>
</tr>
<tr>
<td>10-20</td>
<td>Loamy sand</td>
<td>40</td>
<td>6.7</td>
<td>0.108</td>
<td>1</td>
<td>0.35</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>146</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details
3.2.16 Site N16

Site Details: Minor drainage line

GPS Coordinates: 0198541 mN 7689119 mE

**Texture:** Clayey sand through top 20cm of profile. Profile dominated by sub-angular and sub-rounded coarse fragments 5-150mm in size.

**Structure:** Apedal, single grained throughout profile surface. Sandy fabric and weak consistence throughout top 20cm of profile.

**Root growth:** Few roots, penetration throughout soil matrix.

**Vegetation Classification:** D7 Acacia tumida var. pilbarensis open scrub to high shrubland over Triodia epactia open hummock grassland.

Plate 48 Soil sample Site N16

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>75</td>
<td>6.7</td>
<td>0.015</td>
<td>1</td>
<td>0.37</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>114</td>
<td>2.2</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
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<td>1</td>
<td>1</td>
<td>5</td>
<td>145</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* See Appendix B for Root Abundance Scoring details

Table 40 Soil sample characteristics - Site N16
3.2.17 Site N17

Site Details: Valley floor / flat

GPS Coordinates: 0198502 mN
7691007 mE

*See Appendix B for Root Abundance Scoring details

Texture: Clayey sand through top 20cm of profile. Approximately 10% sub-angular and sub-rounded coarse fragments 5-50mm in size.

Structure: Thin surface crust present, overlying apedal, single grained soil to 20cm. Sandy fabric and weak consistence throughout top 20cm of profile.

Root growth: Few roots, penetration throughout soil matrix.

Vegetation Classification: P9 Mixed Grevillea and Acacia scattered tall shrubs over Triodia epactia hummock grassland.

Plate 49 Soil sample Site N17

<table>
<thead>
<tr>
<th>Sample Depth (cm)</th>
<th>Soil texture</th>
<th>% Coarse (&gt;2mm)</th>
<th>pH (H₂O)</th>
<th>EC (dS/m)</th>
<th>Root Score*</th>
<th>Org C (%)</th>
<th>Nitrate N (mg/kg)</th>
<th>Amm. N (mg/kg)</th>
<th>Avail. P (mg/kg)</th>
<th>Avail. K (mg/kg)</th>
<th>Avail. S (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Clayey sand</td>
<td>10</td>
<td>6.8</td>
<td>0.014</td>
<td>1</td>
<td>0.35</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>151</td>
<td>2.1</td>
</tr>
<tr>
<td>10-20</td>
<td>Clayey sand</td>
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<td>6.8</td>
<td>0.016</td>
<td>1</td>
<td>0.29</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>158</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 41 Soil sample characteristics - Site N17
3.3 Soil Profile Morphology

The majority of the surface soils and soil profiles examined within the area south of the Talga Range were similar in morphology, with most soil profiles showing little pedological organisation or structure, or only very weak aggregation and slight textural differences. Most profiles consisted of a shallow loamy or clayey sand to sandy loam A-horizon, overlying a B-horizon dominated by a high coarse fraction (>2mm) percentage. The coarse fraction was most often dominated by sub-angular and sub-rounded material, usually increasing in size and abundance with increasing depth.

The greatest variation in profile morphology amongst the southern sites, was the depth to fractured or solid rock. Shallow, skeletal soils were identified on the upper ridge slopes and ridge crests of the study area where there was a minimal cover of soil over fractured or solid rock, which was often exposed at the surface. The depth of ‘soil’ generally increased slightly lower in the landscape.

The soils within the drainage lines were more variable (see OES 2006b for greater detail), with areas of relatively deep sandy material, concentrated coarse fragments (>2mm), and areas of concentrated silt and clay present within creek beds.

The surface soils (0-20cm) of the northern Project Area also showed little pedological organisation or structure, with weak aggregation only present in some of the soils within the drainage lines sampled.

3.4 Soil Structure

Soil structure describes the arrangement of solid particles and void space in a soil. It is an important factor influencing the ability of soil to support plant growth, store and transmit water and resist erosional processes. A well-structured soil is one with a range of different sized aggregates, with component particles bound together to give a range of pore sizes facilitating root growth and the transfer of air and water. Soil structure can be influenced by the particle size distribution, chemical composition and organic matter content of a soil, and is often affected by root growth, stock and vehicle compaction.

The structure of the surface soil materials within the northern and southern survey areas is generally classed as single grained, meaning that there is very little aggregation of soil particles. This is typical of the coarse surface soil materials throughout the Pilbara region of Western Australia. There was a weak, thin surface crust present at some sites, and some aggregation of soil particles within the finer textured soils along the drainage lines sampled. There was also some degree of weak aggregation within some of the deeper materials sampled within the southern area, corresponding to the higher clay fraction of these materials. No physical soil impedances to root penetration were observed.
3.5 Soil Texture

The particle size distribution and resulting textural class of soil materials is an important factor influencing most physical and many chemical and biological properties. Soil structure, water holding capacity, hydraulic conductivity, soil strength, fertility, erodibility and susceptibility to compaction are some of the factors closely linked to soil texture.

Generally, as would be expected, the soils from lower positions in the landscape within the study area generally exhibited finer textures, with higher percentages of clay materials being distributed through these soil profiles, although the major drainage lines in the area were also inter-dispersed by areas of sandy material. Topsoil materials were generally slightly coarser in texture than underlying soil materials, with the percentage of clay material increasing with depth at most sites. The percentage of coarse material (>2mm) also generally increased with depth.

3.6 Soil pH

The soil pH gives a measure of the soil acidity or alkalinity. The ideal pH range for plant growth of most agricultural species is considered to be between 5.0 and 7.5 (Moore 1998), with the availability of some nutrients being affected outside of this range, and various metal toxicities (e.g. Al and Mn) becoming important at low pH. Obviously, many native plant species have adapted to, and are able to tolerate, soil pH values outside of the ‘ideal’ range.

The soil materials sampled indicated a wide range of pH values (Figure 2), ranging from 6.3 to 9.6. There was little consistency between soil pH and position within the landscape, with all landform units exhibiting a relatively large range of pH values. While the average pH values were lowest for the lower lying areas of ‘valley floor’ and ‘drainage lines’, these sites also exhibited the widest range of soil pH values, with the highest pH (most alkaline) soil also sampled from within a drainage line (Site 12).

There was generally a slight increase in soil pH with increasing depth.
3.7 Electrical Conductivity

The electrical conductivity (EC) of the majority of materials sampled was considered to be non-saline (0 – 0.2 dS/m) based on the standard USDA and CSIRO categories (Appendix C). There was little consistent correlation between electrical conductivity and position within the landscape, or with depth within the soil profile (Figure 3), with a high amount of variation present within each landform unit. As would be expected, the highest value for electrical conductivity was measured in a low-lying drainage area (Site S12, 0-5cm, EC = 1.6 dS/m), although this was not consistent for all drainage lines sampled.
Figure 3  Electrical Conductivity (EC) values with corresponding sample depth, grouped into landform: a) Complete range of EC values measured, b) greater detail of values within 0 – 0.3 dS/m range, and c) Average values for each landscape unit.
3.8 Soil Nutrient Status

Soil nutrient analyses were conducted on the <2mm fraction of sampled material. The amount of nutrients held within the soil materials sampled was generally low, as is typical of native soils in a low nutrient-cycling environment.

There appears to be little consistent trend in nutrient level (total N, available P, K and S) corresponding to position within the landscape (Figures 4 to 7), or to particular vegetation community. As with other soil chemical parameters, nutrient levels were inconsistent, with a high amount of variation present within each landscape unit. As would be expected, the level of all measured nutrients generally decreased slightly with depth through the soil profile.

Figure 4 Individual and average nitrate N (mg/kg) levels with corresponding sample depth, grouped into landscape unit.
Figure 5  Individual and average ammonium N (mg/kg) levels with corresponding sample depth, grouped into landscape unit.

Figure 6  Available phosphorus (mg/kg) of individual samples and average values with corresponding sample depth, grouped into landscape unit.
Although the levels of plant-available sulphur measured on collected samples were variable, the average values for each landform unit indicated a slightly higher average for the lower / mid slopes on the southern side of the Talga Range (Figure 8). Two of the collected samples recorded relatively high levels of available sulphur (both on southern lower slope sites). Site S24 registered an available S level of 145 mg/kg at the surface (0-5cm), and Site S7 measured 512 mg/kg at a depth of 80-90cm (both excluded from mean value calculation in Figure 8).

Figure 7  Available potassium (mg/kg) of individual samples and average values with corresponding sample depth, grouped into landscape unit.

Figure 8  Available sulphur (mg/kg) of individual samples and average values with corresponding sample depth, grouped into landscape unit. (Two samples registered higher than indicated on figure: Site S24, 0-5cm = 145 mg/kg, Site S7, 80-90cm = 512 mg/kg)
3.9 Root Growth

Root penetration, although relatively sparse in some areas, extended beyond the depth of all investigations, with no apparent chemical or physical restrictions to root penetration observed in any of the profiles. Whilst the abundance of roots generally dropped rapidly with depth, there were roots penetrating the base of each profile where deeper examination was possible.

3.10 Baseline Soil Metal Concentrations

Measurements of water soluble metal concentrations of the surface samples collected indicated that only very low levels of Al, As, Cd, Cu, Pb, Mn, Mo and Zn were present in the southern (Table 42) and northern soils (Table 43). Most materials sampled were below the detectable limit for the bulk of the elements measured, with only Al regularly occurring at a detectable level (yellow highlight). For the metals detected, there was no apparent correlation with landform or vegetation unit. Low levels of Mn were detected at some sites, both north and south of the Talga Range, with Cu and Mo recorded at a detectable level at two of the southern sites.
Table 42  Water soluble metal concentrations of soil materials from southern sites (yellow highlight indicates detectable level).

<table>
<thead>
<tr>
<th>Site #</th>
<th>Sample Depth (cm)</th>
<th>Al mg/kg</th>
<th>As mg/kg</th>
<th>Cd mg/kg</th>
<th>Cu mg/kg</th>
<th>Pb mg/kg</th>
<th>Mn mg/kg</th>
<th>Mo mg/kg</th>
<th>Zn mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0-5</td>
<td>6</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>S1</td>
<td>10-20</td>
<td>13</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>S2</td>
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<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td>S2</td>
<td>10-20</td>
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<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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</tr>
<tr>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
<td>&lt;0.1</td>
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</tr>
<tr>
<td>S6</td>
<td>0-5</td>
<td>6</td>
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<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<td>0.2</td>
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</tr>
<tr>
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<td>&lt;0.1</td>
<td>&lt;0.1</td>
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</tr>
<tr>
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<td>&lt;0.1</td>
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</tr>
<tr>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
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<td>0-5</td>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
</tr>
<tr>
<td>S10</td>
<td>10-20</td>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
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<tr>
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<td>40-50</td>
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<td>&lt;0.1</td>
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Table 43 Water soluble metal concentrations of soil materials from northern sites (yellow highlight indicates detectable level).

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<tr>
<th>Site</th>
<th>Sample Depth (cm)</th>
<th>Al (mg/kg)</th>
<th>As (mg/kg)</th>
<th>Cd (mg/kg)</th>
<th>Cu (mg/kg)</th>
<th>Pb (mg/kg)</th>
<th>Mn (mg/kg)</th>
<th>Mo (mg/kg)</th>
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4.0 CONCLUSIONS AND RECOMMENDATIONS

The soil materials sampled within the Project Area at Spinifex Ridge are relatively homogenous. Whilst some slight differences in texture and soil chemical characteristics were identified, there is little consistent trend with any of the measured parameters and position within the landscape, or with vegetation community. Based on soil chemical properties, no potentially problematic soils have been consistently identified.

Many regolith and waste rock materials, once disturbed and brought to the surface during mining operations, will behave differently to how they would in their natural setting. Such materials often have intrinsic properties that make their management and incorporation into rehabilitation designs difficult. The difficulties faced in restoring functioning ecosystems on such landforms, often under extreme ranges of temperature and rainfall, is often exacerbated by the properties of the waste material. The way in which these materials are likely to weather and develop over time should be taken into account when planning final landform designs.

The general increase in clay content with depth through most of the deeper profiles examined, indicates that the soil materials from depth may potentially be prone to erosion if exposed and placed on relatively steep slopes. It is recommended that, during project development, such materials be stockpiled / rehabilitated in such a way as to mitigate their potential erodibility. It is also recommended that topsoil material (approximately 0-15cm), be collected and stockpiled separately to preserve the seed store and the generally-higher nutrient levels that are present. Wherever possible, these topsoils should be re-spread immediately after stripping. If this is not possible, then shallow stockpiles (<2m) that are promptly revegetated are recommended. Paddock dumping is an effective method to meet this recommendation.

The baseline levels of water soluble metals in surface soils are low. It is recommended however, that the heavy metal content of deeper, untested, regolith material be measured as the project develops. This will allow any potential impact on the surrounding environment to be predicted and monitored over time.
4.1 REFERENCES


Glossary of Terms

*Aggregate (or ped)*
A cluster of primary particles separated from adjoining peds by natural planes of weakness, voids (cracks) or cutans.

*Bulk density*
Mass per unit volume of undisturbed soil, dried to a constant weight at 105°C.

*Cation exchange capacity (CEC)*
The total potential of soils for adsorbing cations, expressed in millimoles of charge per kg (mmolc/kg) of soil.

*Clay*
The fraction of mineral soil finer than 0.002mm (2µm).

*Coarse fragments*
Particles greater than 2mm in size.

*Consistence*
The strength of cohesion and adhesion in soil.

*Cutan*
Coatings or deposits of clay material on the surface of peds, stones, etc.

*Dispersion*
The process whereby the structure or aggregation of the soil is destroyed, breaking down into primary particles.

*Electrical conductivity*
How well a soil conducts an electrical charge, related closely to the salinity of a soil.

*Exchangeable Sodium Percentage (ESP)*
Is calculated as the proportion of the cation exchange capacity occupied by the sodium ions and is expressed as a percentage. Sodic soils are categorised as soils with an ESP of 6-14%, and strongly sodic soils have an ESP of greater than 15%.

*Organic Carbon*
Carbon residue retained by the soil in humus form. Can influence many physical, chemical and biological soil properties.
**Plant available water**  
The ability of a soil to hold that part of the water that can be absorbed by plant roots. Available water is the difference between field capacity and permanent wilting point.

**Slaking**  
The partial breakdown of soil aggregates in water due to the swelling of clay and the expulsion of air from pore spaces.

**Soil horizon**  
Relatively uniform materials that extend laterally, continuously or discontinuously throughout the profile, running approximately parallel to the surface of the ground and differs from the related horizons in chemical, physical or biological properties.

**Soil pH**  
The negative logarithm of the hydrogen ion concentration of a soil solution. The degree of acidity or alkalinity of a soil expressed in terms of the pH scale, from 2 to 10.

**Soil structure**  
The distinctness, size, shape and arrangement of soil aggregates (or peds) and voids within a soil profile. Can be classed as ‘apedal’, having no observable peds, or ‘pedal’, having observable peds.

**Soil strength**  
The resistance of a soil to breaking or deformation. ‘Hardsetting’ refers to a high soil strength upon drying.

**Soil texture**  
The size distribution of individual particles of a soil.

**Subsoil**  
The layer of soil below the topsoil or A horizons, often of finer texture (i.e. more clayey), denser and stronger in colour. Generally considered to be the ‘B-horizons’ above partially weathered or un-weathered material.

**Topsoil**  
Soil consisting of various mixtures of sand, silt, clay and organic matter; considered to be the nutrient-rich top layer of soil – The ‘A-horizon’.
Appendix B

Root Scoring Categories
Scoring of root abundance.

Root abundance is scored on a visual basis within the categories defined by McDonald et al., 1998:

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<th>Score</th>
<th>Roots per 10 cm²</th>
<th>Very fine and fine roots</th>
<th>Medium and coarse roots</th>
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<td>0 – No roots</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 – Few</td>
<td>1 - 10</td>
<td>1 or 2</td>
<td></td>
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<tr>
<td>2 – Common</td>
<td>10 - 25</td>
<td>2 – 5</td>
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</tr>
<tr>
<td>3 – Many</td>
<td>25 - 200</td>
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<td></td>
</tr>
<tr>
<td>4 - Abundant</td>
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<td>&gt;5</td>
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Appendix C

Soil Electrical Conductivity Classes
Soil Electrical Conductivity Classes (based on standard USDA and CSIRO categories) adapted from Moore (1998).

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<th>Sand</th>
<th>Sandy loam</th>
<th>Loam</th>
<th>Clay loam</th>
<th>L/Med Clay</th>
<th>Heavy Clay</th>
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<td>0.20-0.40</td>
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<tr>
<td>Moderately Saline</td>
<td>0.26-0.52</td>
<td>0.33-0.67</td>
<td>0.40-0.80</td>
<td>0.44-0.89</td>
<td>0.50-1.00</td>
<td>0.67-1.33</td>
</tr>
<tr>
<td>Very Saline</td>
<td>0.52-1.06</td>
<td>0.67-1.33</td>
<td>0.80-1.60</td>
<td>0.89-1.78</td>
<td>1.00-2.00</td>
<td>1.33-2.67</td>
</tr>
<tr>
<td>Extremely Saline</td>
<td>&gt;1.06</td>
<td>&gt;1.33</td>
<td>&gt;1.60</td>
<td>&gt;1.78</td>
<td>&gt;2.00</td>
<td>&gt;2.67</td>
</tr>
</tbody>
</table>