

**SOILS AND  
AGRICULTURAL QUALITY  
OF LAND AT AXIS 50  
NEAR WILLINGTON**

Report 1420/1

26<sup>th</sup> April, 2018

**SOILS AND AGRICULTURAL QUALITY  
OF LAND AT AXIS 50, NEAR WILLINGTON**

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Report 1420/1  
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26<sup>th</sup> April, 2018

## **SUMMARY**

A soil and agricultural quality survey has been undertaken of 31.4 ha of land at Axis 50, near Willington.

The land has three main soil types: slowly permeable soils; permeable loams and; made ground (medium loams over fly ash). The site is mainly of subgrade 3b and grade 4 with an area of subgrade 3a land in the south. The land quality is limited by either droughtiness, wetness or presence of potentially toxic elements in the sub-layers.

Were the site to be developed, the medium loamy topsoils are a high quality resource for reuse in landscaping and gardens. The heavy clay loam topsoils overlying the slowly permeable soils are a moderate quality resource for reuse that should be stripped and stockpiled separately. Care should be taken to avoid incorporation of the fly ash material with topsoil.

## 1.0 Introduction

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- 1.1 This report provides information on the soils and agricultural quality of 31.4 ha of land at Axis 50, near Willington. The report is based on a survey of the land in April 2018.

### **SITE ENVIRONMENT**

- 1.2 The site investigated comprises six grassland fields. The site is bordered to the east by Etwall Road (B5008), to the south by a trainline, to the west by Burton Road (A38) and to the north by Toyota Island and the Derby Southern Bypass (A50).
- 1.3 The site is level in the north and gently sloping in the south (from north downwards to the south), with an average elevation of approximately 55 m AOD.

### **AGRICULTURAL USE**

- 1.4 At the time of survey the land was all under sheep grazing.
- 1.5 The land is not registered under any agri-environment schemes.

### **PUBLISHED INFORMATION**

- 1.6 1:50,000 scale BGS information records the solid geology as Gunthorpe Member mudstone. The bedrock is recorded to be overlain by superficial deposits Findern Clay (clay, silt and sand) in the north and an area of Egginton Common Sand and Gravel Member in the south.
- 1.7 The National Soil Map (published at 1:250,000 scale) shows the land as Arrow Association, mainly deep permeable coarse loamy soils affected by groundwater<sup>1</sup>.
- 1.8 Reconnaissance Agricultural Land Classification (ALC) mapping shows the land as grade 3. No more recent survey to current guidelines (post 1988) has been completed although land to the west of the site has been recorded as a mixture of subgrade 3a and 3b agricultural quality.

<sup>1</sup>Ragg, J.M et al., 1984. *Soils and their use in Midland and Western England: Soil Survey Bulletin No. 12*, Harpenden.

## 2.0 Soils

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2.1 A detailed soil resource and agricultural quality survey was carried out in April 2018. It was based on observations at intersects of a 100 m grid, giving a sampling density of one observation per hectare. During the survey, soils were examined by a combination of pits and augerings to a maximum depth of 1.2 m. A log of the sampling points and a map (Map 1) showing their location is in an appendix to this report.

2.2 Three main soil types were identified: slowly permeable soils; permeable loamy soils and; made ground (medium loams over fly ash). See Map 2 in an appendix to this report for their distribution.

### **SLOWLY PERMEABLE SOILS**

2.3 These soils are located in the north and east of the site where heavy or medium loams overlie a dense lower subsoil that is gleyed (greyish and ochreous mottled colours) and slowly permeable indicating seasonal waterlogging. In some places the topsoil is underlain by a permeable gleyed upper subsoil.

2.4 An example profile is described below from observation 3 (Map 1).

|            |                                                                                                                                                                                                                                                                  |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0-30 cm    | Very dark grey (7.5YR 3/1) heavy clay loam; slightly stony (small and medium quartzite pebbles); well developed medium subangular blocky structure; friable; smooth clear boundary to:                                                                           |
| 30-65 cm   | Very pale brown (10YR 8/2) heavy clay loam with common large distinct reddish yellow (7.5YR 6/8) and light grey (10YR 7/1) mottles; weakly developed coarse prismatic structure; firm; slightly stony medium rounded quartzite pebbles; smooth gradual boundary: |
| 65-120 cm+ | Reddish yellow (5YR 6/8) clay with common large prominent light grey (10YR 7/2) and reddish yellow (7.5YR 7/8) mottles; very slightly stony with medium rounded quartzite pebbles; massive (structureless); firm.                                                |

2.5 These soils are imperfectly to poorly-draining (Soil Wetness Class III/IV) with a low capacity to absorb excess winter rainfall.

### **PERMEABLE LOAMY SOILS**

2.6 These soils are located in the south of the site where the superficial deposits of Egginton Common sand and gravel are marked. They typically comprise medium sandy loam topsoils over a gravelly coarse sand subsoil.

2.7 An example profile is described below from observation 27 (Map 1).

|            |                                                                                                                                                                                                       |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0-32 cm    | Very dark greyish brown (10YR 3/2) medium sandy loam; slightly stony (small and medium quartzite pebbles) moderately developed medium subangular blocky structure; friable; smooth clear boundary to: |
| 32-110 cm+ | Greyish brown (10YR 3/2) loamy coarse sand with common distinct fine yellowish brown (10YR 5/8) mottles; weakly developed fine subangular                                                             |

blocky structure; very friable; 50% fine and medium quartzite pebbles; saturated below 55 cm depth.

- 2.8 These soils are mainly freely-draining (Soil Wetness Class I) with a high capacity to absorb excess winter rainfall.

**MADE GROUND (MEDIUM LOAMS OVER FLY ASH)**

- 2.9 The central area of the site is formed of made ground of fly ash (from a coal fired power station) with a thin reinstated medium clay or sandy loam topsoil of approximately 20 cm depth overlying it. The fly ash is often compacted at around 60 cm depth where layers become cemented.

- 2.10 An example profile is described below from observation 18 (Map 1).

|            |                                                                                                                                                                               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0-26 cm    | Dark brown (7.5YR 3/2) medium sandy loam; slightly stony (small quartzite pebbles); moderately developed fine subangular blocky structure; friable; smooth sharp boundary to: |
| 26-92 cm   | Bluish grey (Gley2 5/1) medium sandy silt loam; stoneless; weak medium and coarse subangular blocky structure; friable; smooth clear boundary to:                             |
| 92-110 cm+ | Very dark grey (7.5YR 3/1) loamy medium sand; organic; moderately stony (fine sandstones and gravel); weakly developed medium angular structure to single grain; loose.       |

- 2.11 These soils are moderately-freely to imperfectly-draining (Soil Wetness Class II/III) with a moderate capacity to absorb excess winter rainfall.

### 3.0 Agricultural land quality

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3.1 To assist in assessing land quality, the Ministry of Agriculture, Fisheries and Food (MAFF) developed a method for classifying agricultural land by grade according to the extent to which physical or chemical characteristics impose long-term limitations on agricultural use for food production. The MAFF ALC system classifies land into five grades numbered 1 to 5, with grade 3 divided into two subgrades (3a and 3b). The system was devised and introduced in the 1960s and revised in 1988.

3.2 The agricultural climate is an important factor in assessing the agricultural quality of land and has been calculated using the Climatological Data for Agricultural Land Classification<sup>2</sup>. The relevant site data for an average elevation of 55 m is given below.

- Average annual rainfall: 643 mm
- January-June accumulated temperature >0°C 1401 day°
- Field capacity period 146 days  
(when the soils are fully replete with water) late Nov – early Apr
- Summer moisture deficits for: wheat: 103 mm  
potatoes: 94 mm

3.3 The survey described in the previous section was used in conjunction with the agro-climatic data above to classify the site using the revised guidelines for ALC issued in 1988 by MAFF<sup>3</sup>. There are no climatic limitations in this locality.

#### **SURVEY RESULTS**

3.4 The agricultural quality of the land is mainly determined by wetness or droughtiness. Land of grade 3 has been identified.

#### **Subgrade 3a**

3.5 This land grade is made up of soils limited by wetness or droughtiness. Land with lighter-textured topsoil (sandy clay loam) and permeable upper subsoil overlying the dense subsoil is restricted by wetness as access will be limited over winter. Autumn sowing of crops will be possible every year with spring cropping achievable in most years.

<sup>2</sup>Meteorological Office, (1989). *Climatological Data for Agricultural Land Classification*.

<sup>3</sup>MAFF, (1988). *Agricultural Land Classification for England and Wales: Guidelines and Criteria for Grading the Quality of Agricultural Land*.

- 3.6 Land with a sandy clay loam soil profile that is gravelly at depth has slight droughtiness limitations as the subsoil will hold restricted moisture reserves for crop uptake therefore affecting yields in dry years.

#### **Subgrade 3b**

- 3.7 The poorly-draining soils in the north and east of the site of this land grade are limited by wetness. The combination of a high clay content topsoil and slowly permeable subsoil means that access with farm machinery for spring cropping is rarely possible; therefore land use is mainly limited to autumn-sown cereal-based rotations.
- 3.8 Land in the south of the site with gravelly soils is also limited to this subgrade on droughtiness. The gravelly sandy loam subsoils of this land have limited moisture storing capacity which will restrict crop growth and therefore yields. Land with fly ash subsoil that has cemented at around 50 cm depth is also restricted by droughtiness due to poor moisture retention in the thin subsoil exacerbated by limited plant root penetration.

#### **Grade 4**

- 3.9 All of the made ground is included in this grade. Although the placement of fly ash has often reduced wetness limitations of the land, the presence of potentially toxic elements in the fly ash sub-layers (e.g. arsenic, cadmium and lead) constrains the agricultural use. Cultivation of the land is not possible without incorporating the fly ash into the topsoil and so it is considered unsuitable for growing crops for direct human consumption and places restrictions on grazing due to problems of livestock ingesting potentially toxic soil. Therefore, use of the land is likely to be restricted to uncultivated grazing land.

#### **Non Agricultural**

- 3.10 This land comprises two barns, farm track and hard-standing in the south-east of the site.

### **Grade areas**

- 3.11 The boundaries between the different grades of land are shown on Map 3 and the areas occupied by each are shown below.

**Table 1: Areas occupied by the different land grades**

| <i><b>Grade/subgrade</b></i> | <i><b>Area (ha)</b></i> | <i><b>% of the land</b></i> |
|------------------------------|-------------------------|-----------------------------|
| <b>Subgrade 3a</b>           | 3.5                     | 11                          |
| <b>Subgrade 3b</b>           | 14.5                    | 46                          |
| <b>Grade 4</b>               | 13.1                    | 42                          |
| <b>Non Agricultural</b>      | 0.3                     | 1                           |
| <b>Total</b>                 | 31.4                    | 100                         |

## 4.0 Soil resources and their use

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- 4.1. As part of the Government's 'Safeguarding our Soils' Strategy, the Department for Environment, Food and Rural Affairs (Defra) published a code of practice on the sustainable use of soils on construction sites, which can be helpful in design of developments and setting planning conditions. An Environment Agency strategy Soil a Precious Resource: Our strategy for protecting, managing and restoring soil (Environment Agency, 2007) has complementary aims.

### **Topsoil**

- 4.2. The predominantly heavy clay loam topsoils across the site are of moderate quality for reuse. Due to their relatively high clay content the topsoils are difficult to handle with machinery and are highly susceptible to compaction damage when wet.
- 4.3. The medium topsoils in the south of the site are a high quality resource for reuse in landscaping and gardens and should be stripped and stockpiled separately to the heavy clay loams.
- 4.4. If the site were to be developed, soil handling would be best performed between May and October when the soils are likely to be drier.

### **Subsoil**

- 4.5. The subsoils are susceptible to compaction during construction activities which could result in restricted rooting depth, increased droughtiness and risk of localised flooding. If compacted during construction, subsoils should be loosened before any topsoil is spread on them.

### **Soil Handling**

- 4.6. Areas not being built over (e.g. environmental buffers and landscape areas) should not be trafficked by construction vehicles as this will render the soils impermeable, preventing percolation of rainfall beyond the base of the topsoil, which will quickly become saturated.
- 4.7. Stripped topsoil should be stored in separate resource bunds no more than 3 m high and kept grassed and free from construction traffic until required for re-use. The Construction Code of Practice for Sustainable Use of Soils on Construction Sites (Defra, 2009) provides guidance on good practice in soil handling.

**APPENDIX**  
**MAPS AND DETAILS OF OBSERVATIONS**

**Land at Axis 50: ALC and soil resources survey – Details of observations at each sampling point**

| Obs | Topsoil    |         |                   | Upper subsoil |                               |          | Lower subsoil    |                               |            | Slope | Wetness | Agricultural quality |                 |
|-----|------------|---------|-------------------|---------------|-------------------------------|----------|------------------|-------------------------------|------------|-------|---------|----------------------|-----------------|
| No  | Depth (cm) | Texture | Stones >20 mm (%) | Depth (cm)    | Texture                       | Mottling | Depth (cm)       | Texture                       | Mottling   | (°)   | Class   | Grade                | Main limitation |
| 1   | 0-26       | HCL     | 5                 | 26-60         | SCL                           | xxx      | 60-70<br>70+     | SCL<br>Stopped on stone       | xxx        | 0     | III     | 3b                   | W               |
| 2   | 0-27       | H/MCL   | 5                 | 27-52         | SCL                           | xxx      | 52-90+           | SCL                           | xxx        | 0     | III     | 3a/b                 | W               |
| 3   | 0-30       | HCL     | 5                 | 30-65         | HCL mod st                    | xxx      | 65-80<br>80-100+ | SCL<br>Cr                     | xxx<br>xxx | 0     | IV      | 3b                   | W               |
| 4   | 0-30       | MCL     | 10-15             | 30-70+        | SCL (topsoil?)<br>mod st      | o        | 70+              | Stopped on stone              |            | 0     | I       | 2                    | D               |
| 5   | 0-20       | MCL     | 5-10              | 20-40         | MSZL – fly ash                | o        | 40-60<br>60+     | CS / gravel<br>MSZL – fly ash | o<br>o     | 0     | I       | 4                    | PTE in fly ash  |
| 6   | 0-20       | MCL     | 5-10              | 20-70+        | MSZL – fly ash                | o        | 70+              | dense fly ash                 | o          | 0     | II      | 4                    | PTE in fly ash  |
| 7   | 0-20       | SCL     | 5                 | 20-60+        | MSZL – fly ash                | o        | 60+              | dense fly ash                 | o          | 1     | II      | 4                    | PTE in fly ash  |
| 8   | 0-20       | MCL     | 5                 | 20-50         | MSZL – fly ash                | o        | 50+              | dense fly ash                 | o          | 0     | III     | 4                    | PTE in fly ash  |
| 9   | 0-31       | SCL     | 5                 | 31-45         | C                             | xxx      | 45-70+           | MSZL – fly ash<br>plus gravel | o          | 0     | IV      | 4                    | PTE in fly ash  |
| 10  | 0-25       | MCL     | 5                 | 25-50         | MSZL – fly ash                | o        | 50+              | dense fly ash                 | o          | 0     | III     | 4                    | PTE in fly ash  |
| 11  | 0-20       | SCL     | 5-10              | 20-70+        | MSZL – fly ash                | o        |                  |                               |            | 1     | I       | 4                    | PTE in fly ash  |
| 12  | 0-20       | SCL     | 5-10              | 20-65         | MSZL – fly ash                | o        | 65+              | dense fly ash                 | o          | 1     | II      | 4                    | PTE in fly ash  |
| 13  | 0-30       | HCL     | 5                 | 30-47         | HCL                           | xxx      | 47-80+           | SCL                           | xxx        | 2     | III     | 3b                   | W               |
| 14  | 0-35       | SCL     | <5                | 35-52         | SCL                           | xxx      | 52-90+           | HCL/Cr                        | xxx        | 2     | III     | 3a                   | W               |
| 15  | 0-28       | HCL     | 5                 | 28-80+        | Cr                            | xxx      |                  |                               |            | 2     | IV      | 3b                   | W               |
| 16  | 0-26       | MSL     | 5-10              | 26-55         | MSZL – fly ash<br>plus gravel | o        | 55-110+          | dense fly ash                 | o          | 2     | II      | 4                    | PTE in fly ash  |
| 17  | 0-25       | MSL     | 5-10              | 25-90+        | MSZL – fly ash                | o        |                  |                               |            | 2     | I       | 4                    | PTE in fly ash  |
| 18  | 0-26       | MSL     | 5                 | 26-92         | MSZL – fly ash                | o        | 92-110           | LMS org. / gravelly           | o          | 1     | I       | 4                    | PTE in fly ash  |
| 19  | 0-28       | HCL     | 5                 | 28-90+        | HCL (wet at<br>57 cm)         | xxx      |                  |                               |            | 1     | IV      | 3b                   | W               |
| 20  | 0-33       | HCL     | 5                 | 33-44         | HCL                           | xxx      | 44-90+           | HCL                           | xxx        | 0     | III     | 3b                   | W               |
| 21  | 0-31       | HCL/SCL | <5                | 31-42         | HCL                           | xxx      | 42-90+           | HCLr                          | xxx        | 2     | III     | 3b/a                 | W               |
| 22  | 0-30       | SCL     | 10                | 30-80+        | CS / gravel                   | xxx      |                  |                               |            | 3     | I       | 3b                   | D               |
| 23  | 0-30       | SCL     | 5                 | 30-57+        | CSLr gravel                   | o        |                  |                               |            | 1     | I       | 3a                   | D               |
| 24  | 0-30       | SCL     | 5                 | 30-35         | CSr                           | o        | 35-70+           | Cr                            | xxx        | 0     | IV      | 3b                   | W               |
| 25  | 0-26       | SCL     | 5                 | 26-43         | LMSr                          | x        | 43-66+           | SCL v st                      | xxx        | 2     | III     | 3a                   | W               |
| 26  | 0-28       | HCL     | 5-10              | 28-50         | HCL gravelly                  | xxx      | 50-100+          | Cr                            | xxx        | 0     | IV      | 3b                   | W               |
| 27  | 0-32       | MSL     | 5                 | 32-110        | LCS                           | xxx      |                  |                               |            | 0     | I       | 3b                   | D               |
| 28  | 0-27       | SCL     | <5                | 27-100+       | SCLr (gravelly<br>40%)        | xxx      |                  |                               |            | 2     | II      | 3a                   | D               |
| 29  | 0-27       | SCL     | <5                | 27-62         | SCL                           | xxx      | 62-70+           | SCL                           | xxx        | 0     | III     | 3a                   | W               |
| 30  | 0-35       | HCL     | <5                | 35-56         | HCL                           | xxx      | 56-90+           | Cr                            | xxx        | 0     | III/IV  | 3b                   | W               |
| 31  | 0-30       | SCL     | <5                | 30-47         | SCL                           | xxx      | 47-90+           | HCL                           | xxx        | 1     | III/IV  | 3a/b                 | W               |

### **Key to table**

#### *Mottle intensity:*

- o unmottled
- x few to common rusty root mottles (topsoils)  
or a few ochreous mottles (subsoils)
- xx common to many ochreous mottles and/or dull structure faces
- xxx common to many greyish or pale mottles (gleyed horizon)
- xxxx dominantly grey, often with some ochreous mottles (gleyed horizon)

a depth underlined (e.g. 50) indicates the top of a slowly permeable layer  
(a wavy underline indicates the top of a layer borderline to slowly permeable)

#### *Texture:*

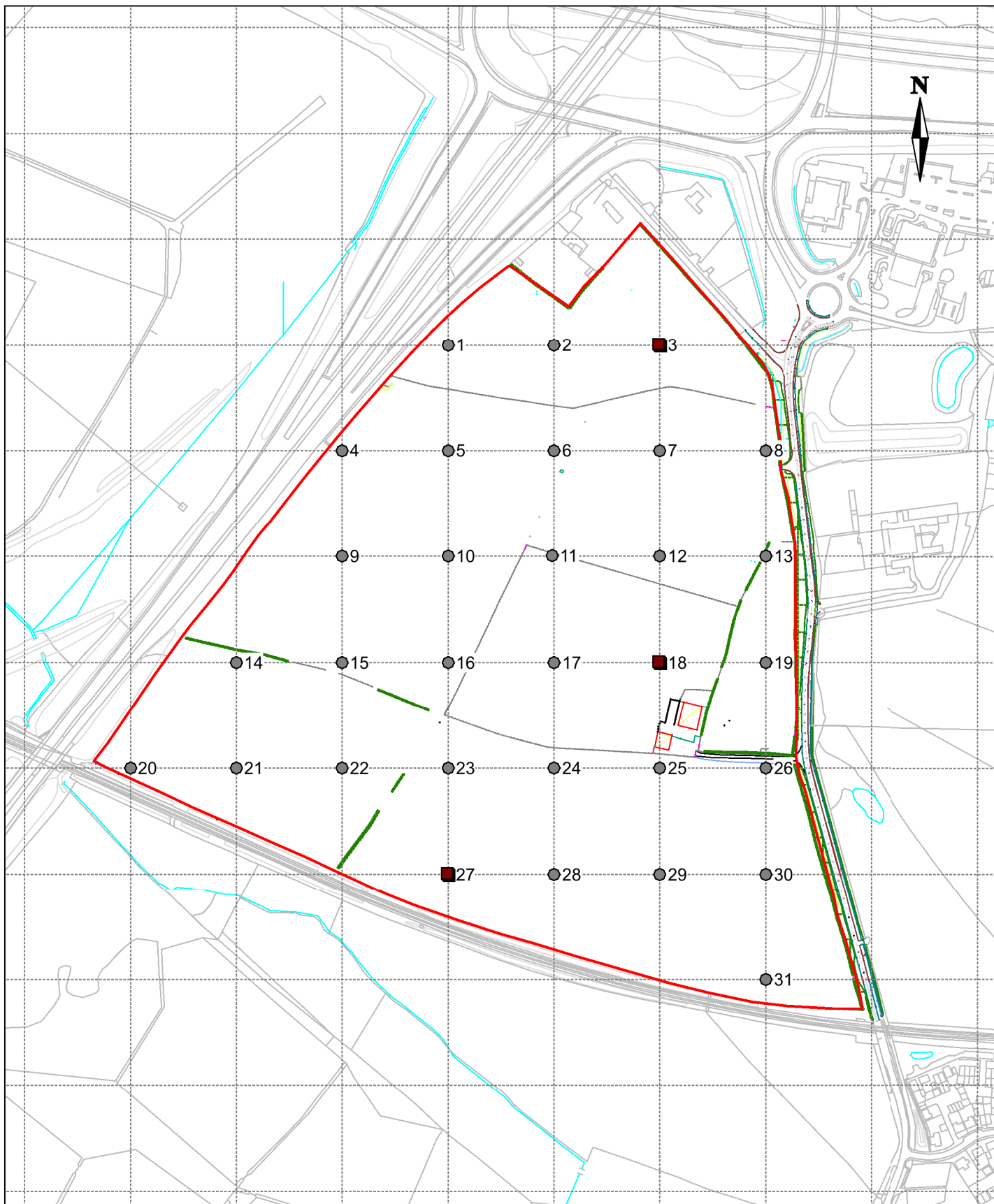
- C - clay
- ZC - silty clay
- SC - sandy clay
- CL - clay loam (H-heavy, M-medium)
- ZCL - silty clay loam (H-heavy, M-medium)
- SCL - sandy clay loam
- SZL - sandy silt loam (F-fine, M-medium, C-coarse)
- SL - sandy loam (F-fine, M-medium, C-coarse)
- LS - loamy sand (F-fine, M-medium, C-coarse)
- S - sand (F-fine, M-medium, C-coarse)
- P - peat (H-humified, SF-semi-fibrous, F-fibrous)
- LP - loamy peat; PL - peaty loam
- R - bedrock

#### *Limitations:*

- W - wetness/workability
- D - droughtiness
- De - depth
- St – stoniness
- Sl – slope
- F - flooding
- T – topography/microrelief

#### *Texture suffixes & prefixes:*

- ca – calcareous: x-extremely, v-very, sl-slightly
- (ca) marginally calcareous
- mn - ferrimanganiferous concentrations
- gn – greenish, yb – yellowish brown, rb – reddish brown
- r – reddish; (v)st – (very) stony; sdst–sandstone; lst - limestone
- dist - disturbed soil layer; mdst - mudstone



Client:



Project:

**Land at Axis 50,  
near Willington**

Map title:

**Map 1  
Survey observations**

# **KEY**

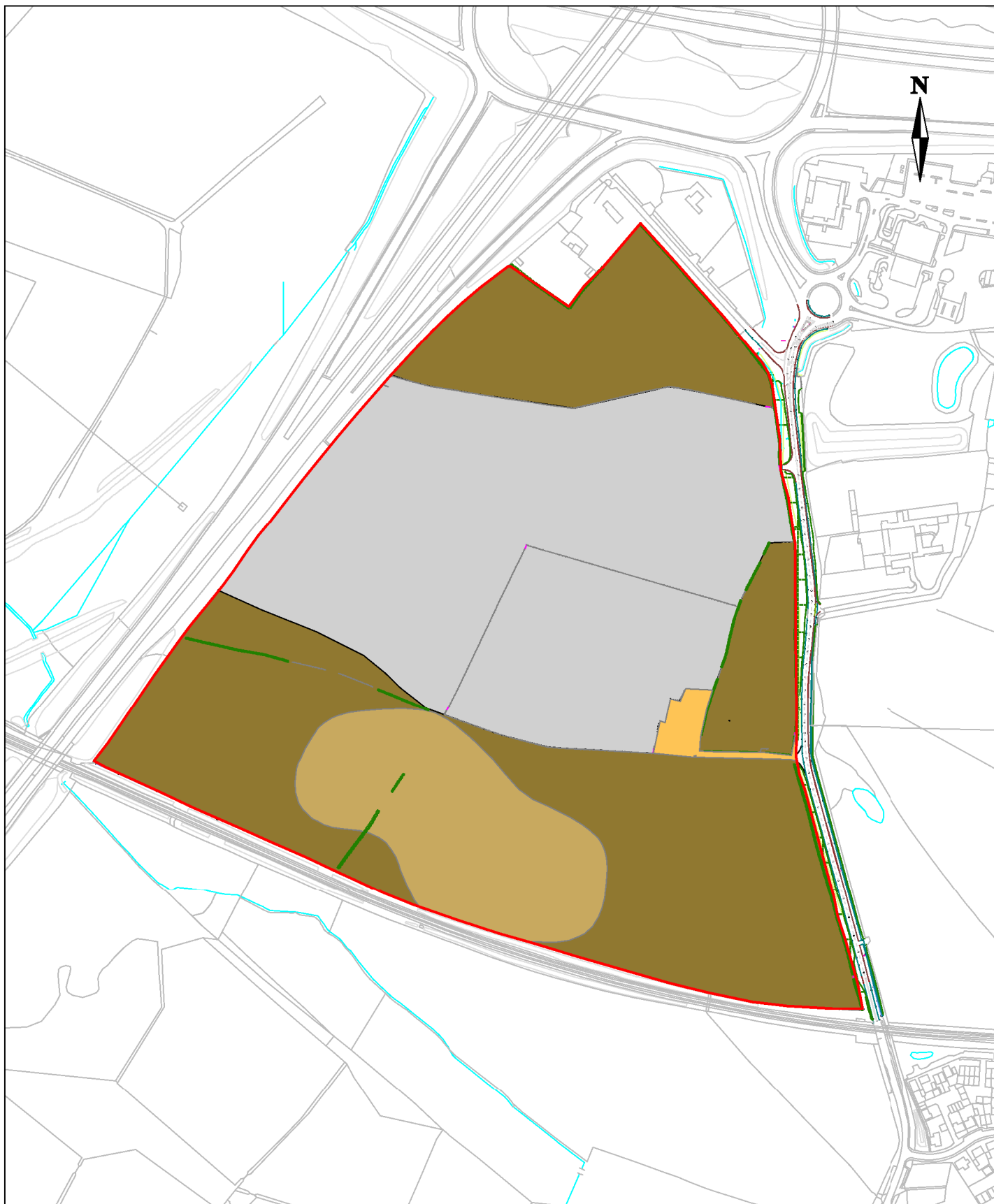
- Survey observation
- Soil/land grade description pit
- Survey area

Scale: 1:5,000 at A4

Date: 27/4/2018

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Research  
ASSOCIATES**

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Client:



Project:

**Land at Axis 50,  
near Willington**

Map title:

**Map 2  
Soil resources**

# **KEY**

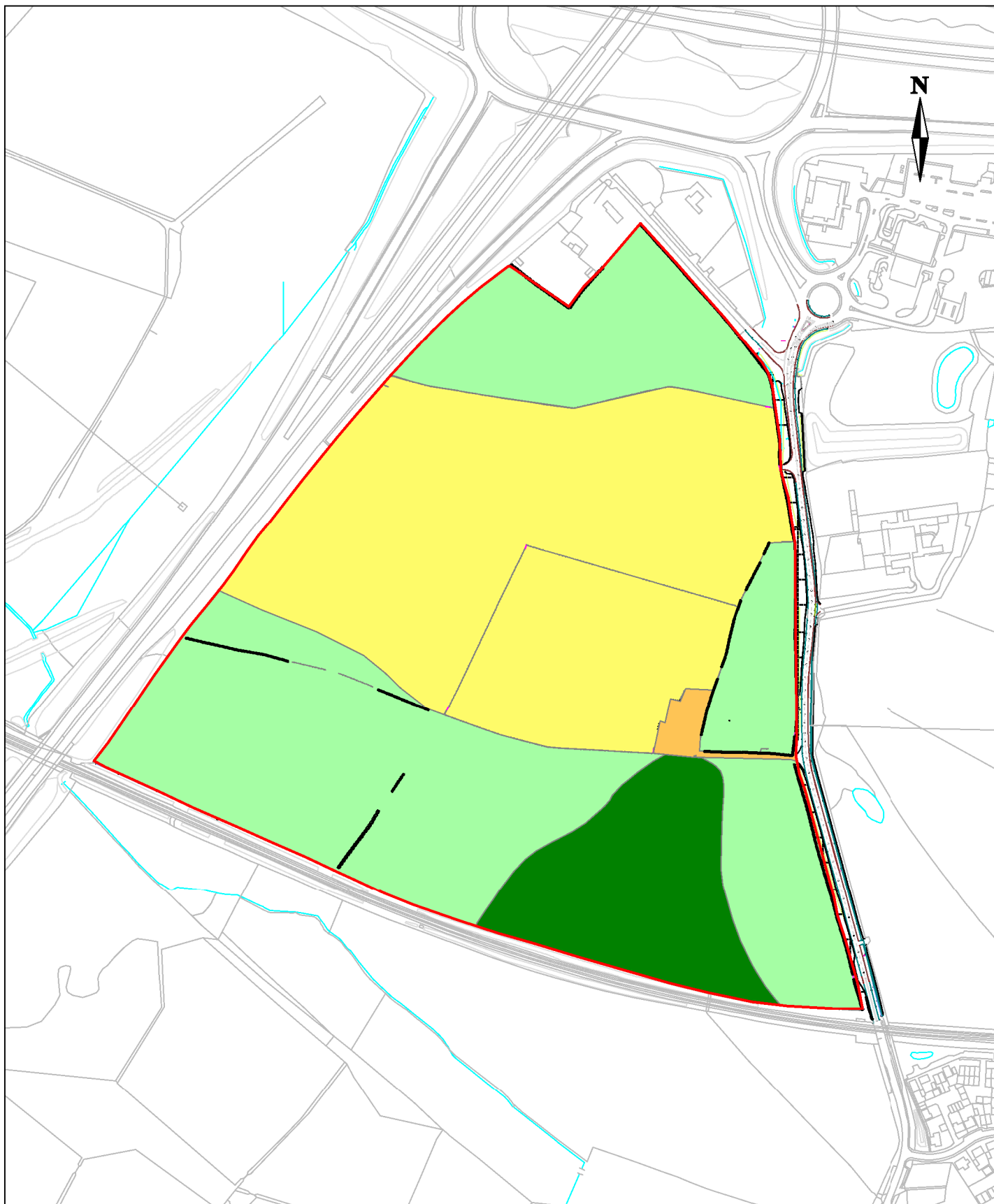
-  Permeable loams
-  Slowly permeable soils
-  Loamy soils over fly ash
-  Non agricultural
-  Survey area

Scale: 1:5,000 at A4

Date: 27/4/2018

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Client:



Project:

**Land at Axis 50,  
near Willington**

Map title:

**Map 3  
Agricultural Land Classification**

# **KEY**

-  Subgrade 3a
-  Subgrade 3b
-  Grade 4
-  Non agricultural
-  Survey area

Scale: 1:5,000 at A4

Date: 27/4/2018

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