SUMMARY

A study and survey of 16 ha of agricultural land to the west of Collyweston Quarry in Northamptonshire has shown that the land mainly has shallow stony soils over limestone, with deeper soils in places. Doughtiness is the principal limitation to agricultural land quality and almost 90% is of moderate or poor quality, mainly sub-grade 3b but with a small area of grade 4. The rest is of best and most versatile quality in sub-grade 3a.

One stony heavy clay loam topsoil resource has been identified, and one heavy clay loam subsoil resource of limited extent.
1.0 Introduction

1.1 This report provides information on the soil resources and agricultural quality and use of an area of 16 ha of land west of Collyweston Quarry, Northamptonshire, proposed for a quarry extension. The report is based on a soil and agricultural desk study, and a survey of the land in July 2013.

SITE ENVIRONMENT

1.2 The land is in one block of five fields to the west of the current quarry workings which form the eastern boundary. The western and northern edges of the site is an arbitrary line, whilst the southern boundary is a track and field hedge.

1.3 The land is gently undulating and slopes gently to the west at around 70 m aOD.

AGRICULTURAL USE

1.4 The land is in arable use farmed from Manor Farm, Stamford, and is subject to an Entry Level Environmental Stewardship agreement. There were wheat, barley and sugar beet crops on the land at the time of the survey.

PUBLISHED INFORMATION

1.5 The 1:50,000 BGS geological information shows the area is underlain by Lower Lincolnshire Limestone, with no recorded drift cover.

1.6 The national soil map\(^1\) at 1:250,000 scale shows that the land mainly has soils of the Elmton 1 Association comprising shallow well drained brashy soils over limestone, with some similar deeper soils.

1.7 Reconnaissance agricultural land classification (ALC) mapping carried out in the 1970s shows the agricultural land of the study area as grade 3. Reconnaissance mapping carried out by MAFF in the 1990’s using the modern (post 1988) classification shows grade 4 land fringing the site to the west.

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2.0 Soils

2.1 The Defra Soil Strategy\(^2\) points out that soils deliver a range of vital functions for human activities including food and fibre production support for ecosystems and habitats, and environmental services that play a vital role in the global carbon cycle, stabilising and degrading contaminants and providing clean water. One of the strategy’s objectives is to ensure that soil functions (soil ecosystem services) are fully valued in the planning process.

2.2 A detailed soil resource and agricultural quality survey was carried out in July 2013. 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 down to rock. A log of the sampling points and a map (Map 3) showing their location is in an appendix to this report.

2.3 The survey showed mainly thin brashy soils over limestone at shallow depth The topsoil is very calcareous heavy clay loam and stony, ranging from 10% stone content to over 40% in some areas. At around 30 cm depth it overlies rubbly limestone, the upper layers of which are in a brown heavy clay loam matrix.

2.4 An example profile from a pit at SK 99397 00646 (Map 3) is described below:

| 0-26 cm | Brown to dark brown (10YR 4/3) very calcareous heavy clay loam; 12% small and medium tabular and subangular limestone stones; weakly to moderately developed medium subangular blocky structure; friable; 5% fine pores; common fine fleshy roots; abrupt smooth boundary to: |
| 26-34 cm | Rubbly limestone in a strong brown (7.5YR 5/6 and 7.5YR 4/6) extremely calcareous heavy clay loam matrix: |
| 34+ cm | Rubbly limestone. |

2.5 In a dry valley and on slopes the soils are deeper. The topsoil is calcareous heavy clay loam with less stones than the shallower type. The soils are formed in colluvium, so that the topsoil overlies a similar organic enriched layer passing to 40-45 cm depth. The subsoil below is brown heavy clay loam and calcareous, and overlies limestone at various depths, the deepest being in

\(^2\) Safeguarding our Soils: a Strategy for England (Defra, 2009)
valley bottoms.

2.6 An example profile from a pit at SK 99352 00826 (Map 3) is described below:

0-26 cm  Brown to dark brown (10YR 4/4) calcareous heavy clay loam; 8% small and medium tabular and subangular limestone stones; moderately developed medium and fine subangular blocky structure; friable; 5% fine pores; common fine fleshy roots; clear smooth boundary to:

26-48 cm  Brown to dark brown (10YR 4/3) calcareous heavy clay loam; 5% small and medium tabular and subangular limestone stones; weakly developed medium subangular blocky structure; friable; 5% fine and medium pores; common fine fleshy roots; clear smooth boundary to:

48-78 cm  Strong brown (7.5YR 5/6) calcareous heavy clay loam; 5% small and medium tabular and subangular limestone stones; weakly developed medium subangular blocky structure; firm; 1% fine pores; rare roots; merging to:

78+ cm  Rubbly limestone.

2.7 These soils are permeable, (wetness class I). They have a good capacity to absorb excess winter rainfall, but the shallower types have limited functionality in attenuating pollution falling on the soil surface. They are limited by stoniness and droughtiness in the range of food and fibre that they can support. They provide dry, calcareous habitats for plant communities.

2.8 The soil resources are shown on Map 1.
3.0 Agricultural Quality

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 Agricultural Land Classification (ALC) system classifies land into five grades numbered 1 to 5, with grade 3 divided into two sub-grades (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\(^3\). The relevant site data for an average elevation of 70 m is given below.

- Average annual rainfall: 603 mm
- January-June accumulated temperature >0°C: 1381 day°
- Field capacity period (when the soils are fully replete with water): 122 days, late Nov—early April
- Summer moisture deficits for: wheat: 107 mm, potatoes: 199 mm

3.3 The survey described in the previous section was used in conjunction with the agroclimatic data above to classify the site using the revised guidelines for agricultural land classification issued in 1988 by the Ministry of Agriculture, Fisheries and Food\(^4\).

SURVEY RESULTS

3.4 The agricultural quality in most of the survey area is determined by the ability of the soils to provide adequate moisture for crop growth. This is a function of soil texture and depth to limestone rock. Land of grades 3 and 4 agricultural quality exists on the site.

\(^3\) Climatological Data for Agricultural Land Classification. Meteorological Office, 1989

Grade 3a
3.5 There are 1.5 ha of this land mainly in a dry valley with the deeper type of soil described in paragraph 2.6. Crop yields are limited by slight droughtiness because of lack of an exploitable thickness of soil.

Sub-grade 3b
3.6 There are 12 ha of this sub-grade and it is the most common land grade on the site, accounting for over 70% of the area. The soils are similar to those described in paragraph 2.4, and the shallowness limits rooting depth so that the land is moderately droughty for most crops in the summer.

Grade 4
3.7 This grade accounts for 1 ha on land with soils similar to those described in paragraph 2.4, but with very large stone content in the topsoil as illustrated on page 4. This increases the droughtiness limitation and causes problems in cultivation and harvesting.

Other land
3.8 The north easternmost field and parts of the southern field are covered in large soil stockpiles, and are not in agriculture.

Grade areas
3.9 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 within the survey area occupied by the different land grades

<table>
<thead>
<tr>
<th>Grade/sub-grade</th>
<th>Area (ha)</th>
<th>% of agricultural land</th>
<th>% of the site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-grade 3a</td>
<td>1.6</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Sub-grade 3b</td>
<td>11.8</td>
<td>82</td>
<td>73</td>
</tr>
<tr>
<td>Grade 4</td>
<td>0.9</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Other land</td>
<td>1.8</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>16.1</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
4.0 Soil resources and their use

4.1 Government policy as outlined in the Defra Soil Strategy for England and Mineral Planning Guidance No 7 Reclamation of Mineral Workings is to protect valuable soil resources from loss or damage during land disturbance and ensure that stripped soils are used to either for land reinstatement after quarrying or other beneficial use off-site.

4.2 There are two soil resource units, one topsoil and one subsoil, which are described below and shown on Map 1.

Topsoil

4.3 Most of the soils of the site have more or less stony heavy clay loam topsoils. There are patches of very stony material locally, but in general the topsoil can be considered as one resource. It is resilient but needs careful handling to retain its structure. Most of the topsoils are around 300 mm thick, giving an estimated yield of 43,000 m$^3$ from the agricultural land.

Subsoil

4.4 Over much of the site there is no usable subsoil, but small areas in dry valleys and on some lower slopes have a brown heavy clay loam subsoil of various thickness which should be stripped and stored separately. This very calcareous material is also resilient, but need careful handling to maintain structure.

Soil Handling and restoration

4.5 All soil resources are easily damaged by being stripped or moved when wet. Consequently, stripping should only take place in the driest parts of the year, using the excavator and dumper method as described by Sheet 1 in the MAFF Good Practice Guide for Handling Soils$^1$.

4.6 If direct placement of stripped soils onto areas being restored is not possible, the resources should be stripped and stored separately in low bunds (no more than 3 m high for topsoil). Topsoil should be stripped from areas designated

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$^1$ MAFF Good Practice Guide for Handling Soils, (www.defra.gov.uk/farm/environment/land-use/soilguid/)
for storing subsoil. The bunds should be constructed either by excavator or bulldozer (Sheets 2 and 14 in the MAFF Good Practice Guide) avoiding over-compaction. They should be sown with grass to help maintain biological activity and prevent water erosion.

4.7 The soils should be removed from storage (Sheet 3 in the MAFF Good Practice Guide) and replaced by excavator during the summer using the loose tipping technique (Sheet 4 in MAFF Good Practice Guide), which avoids traffic on the restored surfaces.

4.8 Over most of the site it will only be possible to restore the land to moderate quality by placing 300 mm of topsoil over limestone. The very stony topsoil resource would be improved by screening to remove at least the large stones. Small areas could be restored to best and most versatile quality by adding a 250 mm layer of the subsoil resource below the topsoil.

4.9 The restored land should be sown to ensure that a ground cover of vegetation is established before the ensuing winter.
5.0 Conclusions

5.1 A study and survey of 16 ha of agricultural land to the west of Collyweston Quarry in Northamptonshire has shown that

- The land mainly has shallow stony soils over limestone, with deeper soils in places.
- Droughtiness is the principal limitation to agricultural land quality and almost 90% is of moderate or poor quality mainly sub-grade 3b but with a small area of grade 4. The rest is of best and most versatile quality in sub-grade 3a.
- One stony heavy clay loam topsoil resource has been identified, and one heavy clay loam subsoil resource of limited extent.
APPENDIX

LOCATION AND DETAILS OF OBSERVATIONS
### Land near Collyweston Quarry: ALC and soil resources survey July 2013 - Details of observations at each sampling point

<table>
<thead>
<tr>
<th>No</th>
<th>Topsoil</th>
<th>Upper subsoil</th>
<th>Lower subsoil</th>
<th>Slope</th>
<th>Wetness</th>
<th>Agricultural quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth (cm)</td>
<td>Texture</td>
<td>Stones (%)</td>
<td>Depth (cm)</td>
<td>Texture</td>
<td>Depth (cm)</td>
</tr>
<tr>
<td>1</td>
<td>0-30</td>
<td>ca HCL</td>
<td>15</td>
<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
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<tr>
<td>2</td>
<td>0-30</td>
<td>ca HCL</td>
<td>6</td>
<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0-30</td>
<td>ca HCL</td>
<td>20</td>
<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>no in agriculture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0-20</td>
<td>ca MCL</td>
<td>15</td>
<td>20+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>0-30</td>
<td>ca HCL</td>
<td>15</td>
<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>0-25</td>
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<td>30</td>
<td>25+</td>
<td>rubbly limestone</td>
<td>4</td>
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<tr>
<td>8</td>
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<td>30+</td>
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<tr>
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<tr>
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<td>20+</td>
<td>rubbly limestone</td>
<td>4</td>
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<tr>
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<td>25+</td>
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<tr>
<td>13</td>
<td>0-30</td>
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<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>0-32</td>
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<td>6</td>
<td>32-60</td>
<td>ca HCL</td>
<td>o</td>
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<td>15</td>
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<td>30+</td>
<td>rubbly limestone</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>0-22</td>
<td>ca HCL</td>
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<td>22-50</td>
<td>ca C</td>
<td>xx(x)</td>
</tr>
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<td>17</td>
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<td>br ca MCL</td>
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<td>18</td>
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<td>ca HCL</td>
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<td>30+</td>
<td>rubbly limestone</td>
<td>2</td>
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<tr>
<td>19</td>
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<td>ca HCL</td>
<td>15</td>
<td>30+</td>
<td>rubbly limestone</td>
<td>1</td>
</tr>
</tbody>
</table>

### 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)

**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

**Limitations:**
- W - wetness/workability
- D - droughtiness
- De - depth
- St - stoniness
- SI - slope
- T - topography/microrelief
- ca – calcareous; x-extremely, v-very, sl-slightly
- (ca) – marginally calcareous
- at – stony, v-st – very stony
- (org) – borderline to organic
- gr – greyish, br – brownish, r - reddish

**Texture suffixes & prefixes:**
- S - sand (F-fine, M-medium, C-coarse)
- P - peat (H-humified, SF-semi-fibrous, F-fibrous)
- LP - loamy peat; PL - peaty loam