

The sand and gravel resources of the country north and west of Woodhall Spa, Lincolnshire

Description of 1:25 000 resource sheet TF 16 and part of TF 17

I. Jackson

The first twelve reports on the assessment of British sand and gravel resources appeared in the Report Series of the Institute of Geological Sciences as a subseries. Report No. 13 and subsequent reports appear as Mineral Assessment Reports of the Institute.

Details of published reports appear at the end of this Report.

Any enquiries concerning this report may be addressed to Head, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Keyworth, Nottingham NG12 5GG.

* The asterisk on the front cover indicates that part of a sheet adjacent to the one cited is described in this report.

PREFACE

National resources of many industrial minerals may seem so large that stocktaking appears unnecessary, but the demand for minerals and for land for all purposes is intensifying and it has become increasingly clear in recent years that regional assessments of the resources of these minerals should be undertaken. The publication of information about the quantity and quality of deposits over large areas is intended to provide a comprehensive factual background against which planning decisions can be made.

Sand and gravel, considered together as naturally occurring aggregate, was selected as the bulk mineral demanding the most urgent attention, initially in the south-east of England, where about half the national output is won and very few sources of alternative aggregates are available. Following a short feasibility project, initiated in 1966 by the Ministry of Land and Natural Resources, the Industrial Minerals Assessment Unit (formerly the Mineral Assessment Unit) began systematic surveys in 1968. The work is now being financed by the Department of the Environment and is being undertaken with the cooperation of the Sand and Gravel Association of Great Britain.

This report describes the resources of sand and gravel of 140 km² of country north and west of Woodhall Spa, Lincolnshire, shown on the accompanying resource map. The survey was conducted by Mr I. Jackson. The work is based on a one-inch geological survey published in 1886 on Old Series Sheet 83, republished in part on the 1:50 000 scale in 1973. Mr K. S. Siddiqui performed some detailed petrographical analyses on selected samples.

Mr W. N. Pierce, ARICS, and Mr J. D. Burnell, ISO, FRICS, (Land Agents) were responsible for negotiating access to land for drilling. The ready cooperation of landowners and tenants in this work and the assistance of officials of the Anglian Water Authority, British Gas Corporation, Central Electricity Generating Board, East Midlands Electricity Board, Post Office Telecommunications and the Lincolnshire County Councils are gratefully acknowledged.

G. M. Brown
Director

Institute of Geological Sciences
Exhibition Road
London SW7 2DE

15 May 1981

CONTENTS

Summary	1
Introduction	1
Description of the district	2
Topography	3
Geology	3
Composition of the sand and gravel deposits	4
Physical and mechanical properties	7
The map	7
Results	8
Notes on the resource blocks	8
Conclusions	18
References	19
Appendix A: Field and laboratory procedures	20
Appendix B: Statistical procedure	21
Appendix C: Classification and description of sand and gravel	22
Appendix D: Explanation of the borehole records	24
Appendix E: Industrial Minerals Assessment Unit boreholes records	26

FIGURES

1 Sketch map showing the location of TF 16 and part of TF 17	2
2 Mean lithological composition of the sand and gravel deposits	4
3 Mean grading and thickness of the sand and gravel deposits	6
4 Mean grading of the sand and gravel deposits in individual boreholes	6
5 Lithological composition of the sand and gravel deposits from representative boreholes	7
6 Mean particle-size distribution for the assessed thickness of sand and gravel in resource blocks A ₁ to B ₄	10
7 Map showing the relationship between the principal sand and gravel deposits and the resource block boundaries	11
8 Grading characteristics of the mineral in block A ₁	12
9 Grading characteristics of the mineral in block A ₂	12
10 Grading characteristics of the mineral in block A ₃	12
11 Grading characteristics of the mineral in block B ₁	12
12 Grading characteristics of the mineral in block B ₂	16
13 Grading characteristics of the mineral in block B ₃	16
14 Grading characteristics of the mineral in block B ₄	16

MAP

The sand and gravel resources of sheet TF 16 and part of TF 17 **in pocket**

TABLES

1 Geological sequence	3
2 Results of X-ray diffraction analysis of fines from selected boreholes	5
3 Physical and mechanical properties	5
4 Sand and gravel resources of the district	9
5 Block A ₁ : data from assessment boreholes	13
6 Block A ₂ : data from assessment boreholes	13
7 Block A ₃ : data from assessment boreholes	14
8 Block B ₁ : data from assessment boreholes	14
9 Block B ₂ : data from assessment boreholes	15
10 Block B ₃ : data from assessment boreholes	17
11 Block B ₄ : data from assessment boreholes	18

The sand and gravel resources of the country north and west of Woodhall Spa, Lincolnshire

Description of 1:25 000 resource sheet TF 16 and part of TF 17

I. JACKSON

SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 79 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the area north and west of Woodhall Spa, Lincolnshire.

The survey proved the existence of a broad buried valley beneath the Fenland which is infilled by an extensive deposit of sand and gravel up to 11.3 m in thickness. Potentially workable deposits on the flanks of the Fenland proved to be less extensive, discontinuous and much thinner.

The deposits of the district are divided into 7 resource blocks, containing between 3.1 and 13.3 km² of potentially workable sand and gravel. For each block the geology of the deposits is described, and the mineral-bearing area, the mean thickness of overburden and mineral and the mean gradings are stated. Detailed borehole data are also given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying map.

Notes

Each borehole registered with the Institute is identified by a four-element code (e.g. TF 16 NW 35). The first two elements define the 10-km square (of the National Grid) in which the borehole is situated; the third element defines a quadrant of that square, and the fourth is the accession number of the borehole. In the text of the report the borehole is normally referred to by the last three elements alone (e.g. 16 NW 35).

All National Grid references in this publication lie within the 100-km square TF unless otherwise stated. Grid references are given to eight figures, accurate to within 10 m for borehole locations (In the text, four- and six-figure grid references are used for more extensive locations, for example for farms).

Bibliographical reference

JACKSON, I. 1982. The sand and gravel resources of the country north and west of Woodhall Spa, Lincolnshire: description of 1:25 000 resource sheet TF 16 and part of TF 17. *Miner. Assess. Rep. Inst. Geol. Sci.*, No. 94.

Author

I. Jackson, BSc
Institute of Geological Sciences
Keyworth, Nottingham NG12 5GG

INTRODUCTION

The survey is concerned with the estimation of resources, which include deposits that are not currently exploitable but have a foreseeable use, rather than reserves, which can only be assessed in the light of current, locally prevailing, economic considerations. Clearly, neither the economic nor the social factors used to decide whether a deposit may be workable in the future can be predicted; they are likely to change with time. Deposits not currently economically workable may be exploited as demand increases, as higher-grade or alternative materials become scarce, or as improved processing techniques are applied to them. The improved knowledge of the main physical properties of the resource and their variability, which this survey seeks to provide, will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971, 1981; Harris and others, 1974).

The survey provides information at the 'indicated' and 'inferred' levels of assessment. In the former 'tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout'.

At the inferred level 'quantitative estimates are based largely on broad knowledge of the geologic character of the deposits and for which there are few, if any, samples or measurements. The estimates are based on assumed continuity or repetition, of which there is geologic evidence: this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence, (Bureau of Mines and Geological Survey, 1948, p. 15).

It follows that the whereabouts of reserves must still be established and their size and quality proved by the customary detailed exploration and evaluation undertaken by the industry. However, the information provided by this survey should assist in the selection of the best targets for such further work. The following arbitrary physical criteria have been adopted:

- a The deposit should average at least 1 m in thickness.
- b The ratio of overburden to sand and gravel should be no more than 3:1.
- c The proportion of fines (particles passing the No. 240-mesh B.S. sieve, about 1/16 mm) should not exceed 40 per cent.
- d The deposit should lie within 25 m of the surface, this being taken as the likely maximum working depth under most circumstances. It follows from the second criterion that boreholes are drilled no deeper than 18 m if no sand and gravel has been proved.

A deposit of sand and gravel that broadly meets these criteria is regarded as 'potentially workable' and is described and assessed as 'mineral' in this report.

Pre-Pleistocene rocks, which are usually consolidated and devoid of potentially workable sand and gravel, are referred to as 'bedrock'; 'waste' is any material other than bedrock or mineral; 'overburden' is waste that occurs between the surface and an underlying body of mineral.

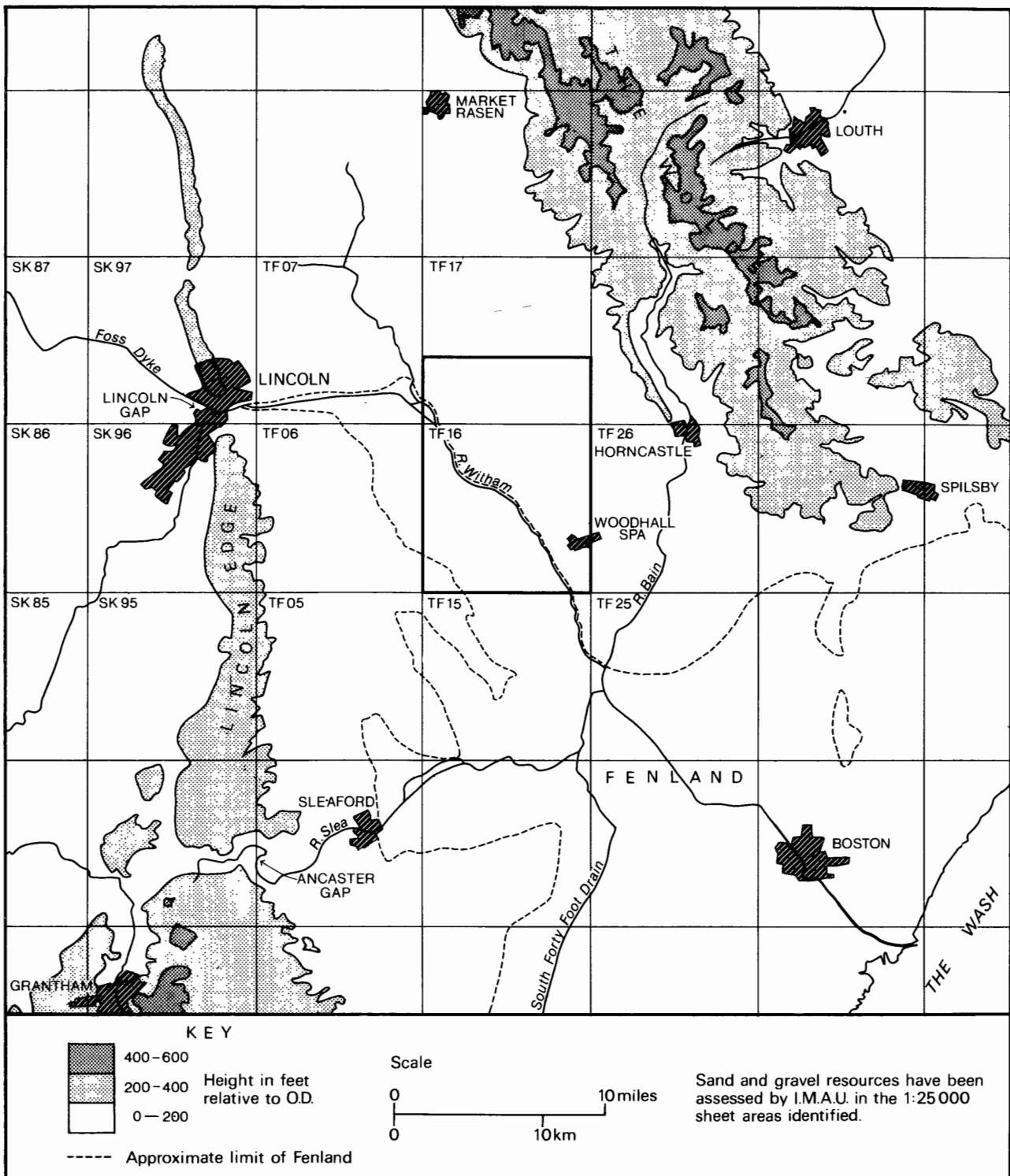


Figure 1 Sketch map showing the location of sheet TF 16 and part of TF 17.

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm, 64 mm has been adopted. The boundaries between fines (that is, the clay and silt fractions) and sand, and between sand and gravel material, are placed at $\frac{1}{16}$ mm and 4 mm respectively (see Appendix C).

The volume and other characteristics are assessed within resource blocks, each of which, ideally, contains approximately 10 km² of sand and gravel. No account is taken of any factors, for example roads, villages or land of high agricultural or landscape value, which might stand in the way of sand and gravel being exploited, although towns are excluded. The estimated total volume

therefore bears no simple relationship to the amount that could be extracted in practice.

It must be emphasised that the assessment applies to the resource block as a whole; valid conclusions cannot be drawn about mineral in parts of a block, except in the immediate vicinity of the actual sample points.

DESCRIPTION OF THE DISTRICT

The district is situated 15 km east of Lincoln (Figure 1) and includes in its south-western part the rich arable land of the northern Fenland. It is entirely rural with no large settlements. However, the village of Bardney in

the north-west [120 695] has sugar beet and pea-processing industries and in the south-east Woodhall Spa [192 630] was historically popular because of its mineral waters. No operational railways or trunk roads cross the district, but the River Witham is bridged by minor roads at both Bardney and Kirkstead [177 620].

TOPOGRAPHY

The district lies within the clay vale between the Lincoln Escarpment and the Lincolnshire Wolds and is divided into two almost equal parts by the River Witham (Figure 1). South-west of the Witham the dominant physiographical feature is an extensive tract of low-lying Fenland approximately 5 km wide and generally less than 10 ft (3 m) above OD. The Fenland is bounded in the south-west by the relatively steep edge of a bevelled till plateau which has a height of about 60 ft (18 m) OD. North and east of the Witham a gently undulating land surface, dissected by minor streams, rises gradually to over 100 ft (30 m) OD.

Prior to 1762 the Fenland was rich but poorly drained pasture subject to flooding for three to four months of the year (Darby, 1940, p. 148). However, an Act passed at that time to improve the drainage and navigation instigated the construction of an orderly network of drains, dikes and delphs feeding a much modified River Witham, and the region has become one of the most fertile arable areas in the country.

GEOLOGY

The geological sequence is summarised in Table 1 where deposits are listed as far as possible in order of increasing age.

Table 1 Geological sequence.

DRIFT	
Quaternary	
Recent and Pleistocene	Alluvium Marine or Estuarine Alluvium River Gravels, undifferentiated Fluvio-glacial and Older River Sand and Gravel 'Peat' Till
SOLID	
Jurassic	Ancholme Clay Group

Solid

Ancholme Clay Group Within this district the Ancholme Clay Group comprises approximately 200 m of Upper Jurassic strata previously termed the Oxford, Amptill and Kimmeridge clays. The rocks dip gently eastward; they are exposed sporadically in valley sides north-east of the Witham but elsewhere are concealed by drift. In IMAU boreholes the Group is represented by silty clays and clayey silts which are commonly greenish black or dark greenish grey in colour, although other shades of grey were recorded. The clays are laminated in part and are commonly fossiliferous.

Drift

The present account attempts to reconcile the lithostratigraphy in the IMAU boreholes with the Old Series mapping of 1886. However, the detailed relationships of the drift deposits, particularly the fluvial sands and gravels, are not fully understood and further field and laboratory investigations are necessary.

Till Till probably once completely mantled the district and infilled a broad valley in bedrock which deepened

towards the south (see diagram A on map margin). However, fluvial erosion has subsequently removed almost all the glacial deposits from beneath the Fenland together with substantial quantities from the ground north-east of the Witham. As a result the recorded thickness of till varies widely, from less than 5 m in the east up to 16.3 m in the extreme south-west. The deposit usually consists of clay and silty clay, in varying shades of dark grey, with fine gravel and coarse sand-sized clasts of chalk, flint, sandstone, siltstone and Jurassic clay; the last-named are usually tabular and increase in abundance towards bedrock. Only at one borehole site (16 NW 35) was sand and gravel recorded within the till sequence. The till, termed the Wragby Till by Straw (1966, p. 149), is thought by several authors (for example, Perrin et al, 1979, p. 547) to be continuous with the pre-Devensian Chalky Boulder Clay of East Anglia.

'Peat' In IMAU borehole 16 NE 19 near Coronation Farm, 2.0 m of peaty clay and silt was found beneath 4.4 m of Fluvio-glacial and Older River Sand and Gravel on 0.4 m of pebbly clay. The last-named, which is similar in composition to the Wragby Till, is probably a solifluxion deposit from the sides of the basin rather than a true till. Preliminary results of examinations of pollen and beetle assemblages present in this peaty deposit suggest a temperate, swamp environment within the last, Ipswichian, interglacial period, (S. Peglar, Cambridge University and R. G. Coope, Birmingham University, 1980, personal communications), a conclusion supported by a radiocarbon date in excess of 48,000 years B.P. (SRR 1532)*. Peat *sensu stricto* also occurs within the Marine or Estuarine Alluvium (see below).

Fluvio-glacial and Older River Sand and Gravel These sediments (termed Ancient Gravel of Old Rivers and Plateau Gravel on Old Series Sheet 83, and 'Older river sand and gravel' on New Series Sheet 114) appear to be eroded remnants of previously more widespread deposits on the higher ground both to the north-east and south-west of the Fenland. In the south-west they cap the bevelled till plateau (Figure 7) and consist chiefly of quartzitic sands and gravels up to 2.8 m in thickness. These deposits, termed the Martin Terrace by Straw (1958, p. 37), are considered by several authors (for example, Jukes-Browne, 1883, pp. 607-8; Pocock, 1929, p. 313; Swinnerton, 1937, p. 149) to correlate with sand and gravel present at a commensurate height west of the Lincoln Gap (Figure 1); this in turn has been equated with the Hilton Terrace of the upper and middle Trent (Clayton, 1957, p. 38). Therefore, this quartzitic material was probably laid down by a river which drained the outcrop of the 'Bunter' (Sherwood Sandstone Group) and flowed through the Lincoln Gap towards the Wash.

North-east of the River Witham, the Fluvio-glacial and Older River Sand and Gravel overlies till at a variety of altitudes and is also less uniform in grade and lithology. In many of these outliers flint is the principal component, but in others 'Bunter'-derived quartzite pebbles predominate. Up to 5.5 m of sand and gravel have been proved but thicknesses are commonly less than 2.0 m. Because of the differing altitudes and composition, it seems likely that these sands and gravels represent more than one phase of deposition. Straw (1958, p. 37) considered several of the lower-level outcrops to be composed primarily of 'Bunter' material and termed them the Southrey Terrace, a correlative of the Beeston Terrace of the Middle Trent. However, many of these gravels consist predominantly of flint pebbles and therefore appear to be of relatively local origin.

River Gravels River Gravels are mostly concealed by alluvial sediments of the Fenland but some sand and

*Registration number assigned by the Scottish Universities Research and Reactor Centre.

gravel of fluvial origin is exposed in the north-west of the district. The extensive deposits beneath the Fenland infill a flat-floored channel cut into bedrock, (suspected by Jukes-Browne, in *Ussher and others*, 1888, p. 169, and confirmed by this survey) which is approximately 5 km in width and declines southward to a maximum depth in this district of about 43 ft (13 m) below OD (see diagram A on map margin). IMAU boreholes show that in most places these buried sands and gravels are divisible into two compositional units, a widespread, lower, quartzitic unit and a less well-developed and less homogeneous upper unit characterised by substantial numbers of pebbles of local origin, for example flint and oolitic limestone. The basal gravels have a proven thickness ranging from 1.5 to 8.5 m but are generally closer to the mean of 4.5 m. The upper 'local' material, however, is usually less than 2.0 m in thickness and in parts may be absent or exist only as a thin veneer.

The 'Bunter'-derived, quartzite-rich gravels are contiguous with similar deposits west of the Lincoln Gap and these (equated with the Floodplain Terrace of the River Trent by Clayton, 1957, p. 38) are thought to mark a former, and perhaps the final, phase of Trent drainage through the Gap to the Wash. The presence of increased amounts of flint and other local rocks in the upper unit of the River Gravels may indicate a reduction or cessation of the flow of water from the west and a relative increase in deposition from proximal sources such as the Langworth river and other small streams in the clay vale.

Marine or Estuarine Alluvium The complex series of Recent deposits which underlies the Fenland varies greatly both in thickness and sediment-type but is chiefly characterised by the presence of organic debris, often in comminuted form. The thickest sequences of peaty sediments occur to the north-west of Kirkstead Bridge [160 630] but the basal part of these may be unrelated to the most recent phase of alluviation. Elsewhere thicknesses of 4.0 to 5.0 m are common, but west of Southrey [115 665] and in the region of Metheringham Fen [110 630] River Gravels are nearer the surface.

Olive-grey clays and silts with disseminated plant remains form the bulk of the deposits but discrete peat bands (up to 1 m in thickness) are commonly recorded towards the base and silty sands may predominate

locally. This variable sequence is probably an attenuated continuation of Recent sediments to the south and results both directly and indirectly from oscillations of sea level (see Godwin, 1978, p.5).

Alluvium Alluvium is present in the valleys of the small streams north-east of the River Witham; however, no boundary has been mapped between this deposit and the marine and estuarine sediments. The Alluvium is not consistent in composition and although as much as 0.9 m of 'very clayey' sandy gravel has been recorded, it may consist of only a thin veneer of clays, silts or sands.

COMPOSITION OF THE SAND AND GRAVEL DEPOSITS
The potentially workable deposits of the district are Fluvio-glacial and Older River Sand and Gravel, River Gravels and Marine or Estuarine Alluvium. In addition to particle-size and pebble-type analyses, certain physical and mechanical properties of samples typical of the different gravels encountered were measured, and selected sand and fines samples were subjected to a more detailed petrographic examination by Mr K. S. Siddiqui of the Institute's Petrology Unit. Data relating to the composition of sand and gravel are represented in graphic and tabular form in Figures 2 to 5 and Tables 2 and 3.

Fluvio-glacial and Older River Sand and Gravel Two boreholes (16 SW 17 and 16 SW 21) drilled into those sand and gravel deposits known as the Martin Terrace proved pebbly sand and sandy gravel with a mean grading of fines 6 per cent, sand 67 per cent, gravel 27 per cent. The gravel is predominantly fine-grained and consists chiefly of subrounded quartzite with rounded quartz, subrounded sandstone and limestone* and subangular flint. The sand fraction is mainly medium-grained, rounded to subrounded, and comprises quartz with subordinate feldspar and hematite, and minor amounts of muscovite and ankerite. In the coarser grades, grains of limestone, greyish black flint and grit are present.

* Limestone pebbles within this district are commonly from the Jurassic but may, in places, be chalk, i.e. Cretaceous.

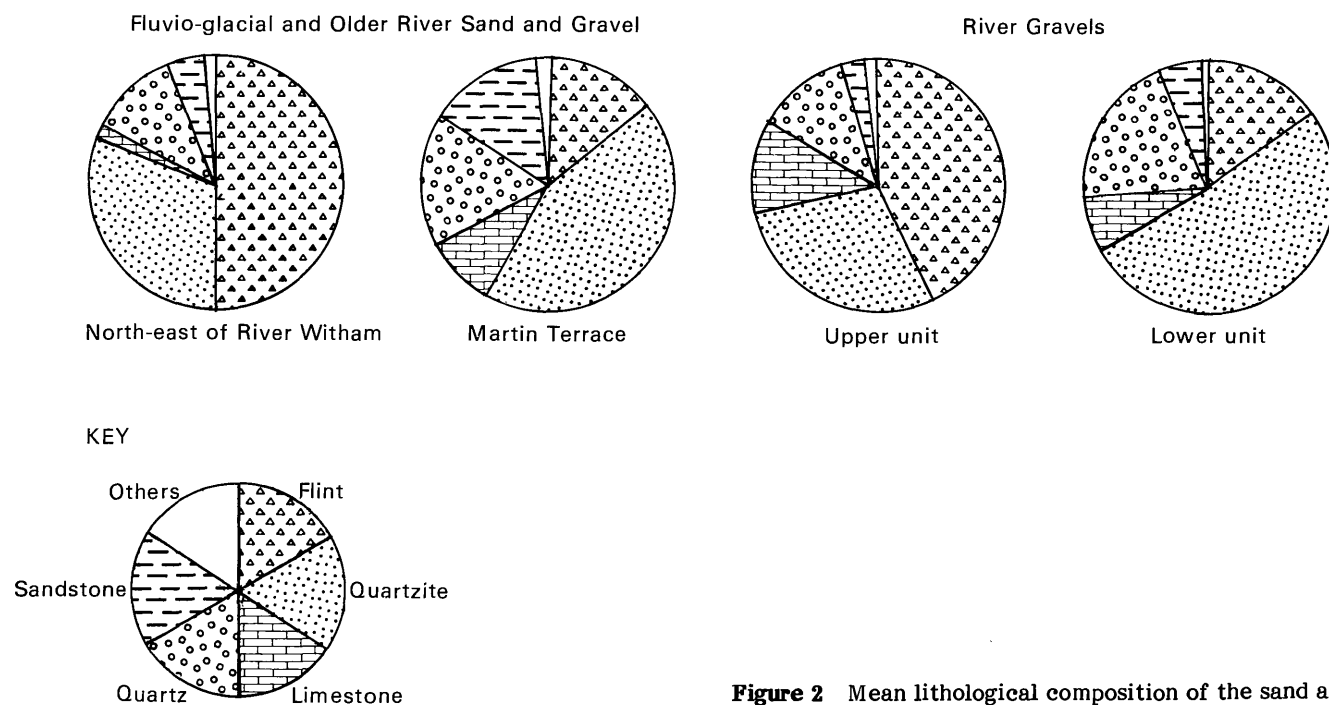


Figure 2 Mean lithological composition of the sand and gravel deposits (based on weighted means from representative boreholes).

Table 2 Results of X-ray diffraction analyses of fines from selected boreholes.

Deposit and borehole number	Abundance*							
	Ankerite	Calcite	Chlorite	Feldspar	Illite	Kaolinite	Muscovite	Quartz
River Gravels								
Upper unit (16 SE 28)	trace	6	1	5	0	2	3	4
Lower unit (16 SW 4)	trace	5	1	6	3	2	0	4
Fluvio-glacial and Older River Sand and Gravel								
Martin Terrace (16 SW 17)	0	5	1	4	2	0	0	3

* The figures denote the relative order of abundance.

Table 3 Physical and mechanical properties.

RESULTS

Deposit	Sample number	Aggregate Impact Value	10% Fines (kN)	Water Absorption (% of dry mass)	Relative Density		
					Oven-dried	Saturated and surface-dried	Apparent
Lower, quartzitic, unit of the River Gravels	I	19	300	1.3	2.56	2.59	2.65
	II	20	280	1.4	2.55	2.59	2.65
	III	23	230	1.6	2.53	2.58	2.65
Flint-rich Fluvio-glacial and Older River Sand and Gravel and River Gravels	IV	24	220	2.7	2.47	2.53	2.64
Quartzite-rich Fluvio-glacial and Older River Sand and Gravel (Martin Terrace)	V	20	270	1.9	2.51	2.55	2.63

LITHOLOGY OF THE SAMPLES

Sample number	Percentages in the 8- to 16-mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
I	16	52	6	21	4	trace	trace	1	trace
II	14	52	6	20	6	trace	1	trace	trace
III	14	50	12	19	3	trace	1	trace	trace
IV	69	13	14	2	trace	0	1	trace	0
V	14	44	9	18	14	trace	trace	trace	trace

SOURCE OF THE SAMPLES

I 16 NW 33, 16 NW 44, and 16 SW 3; II 16 SW 13 and 16 SW 16; III 16 SW 23; IV 16 SE 35 and 17 SW 36 V; 16 SW 17 and 16 SW 21.

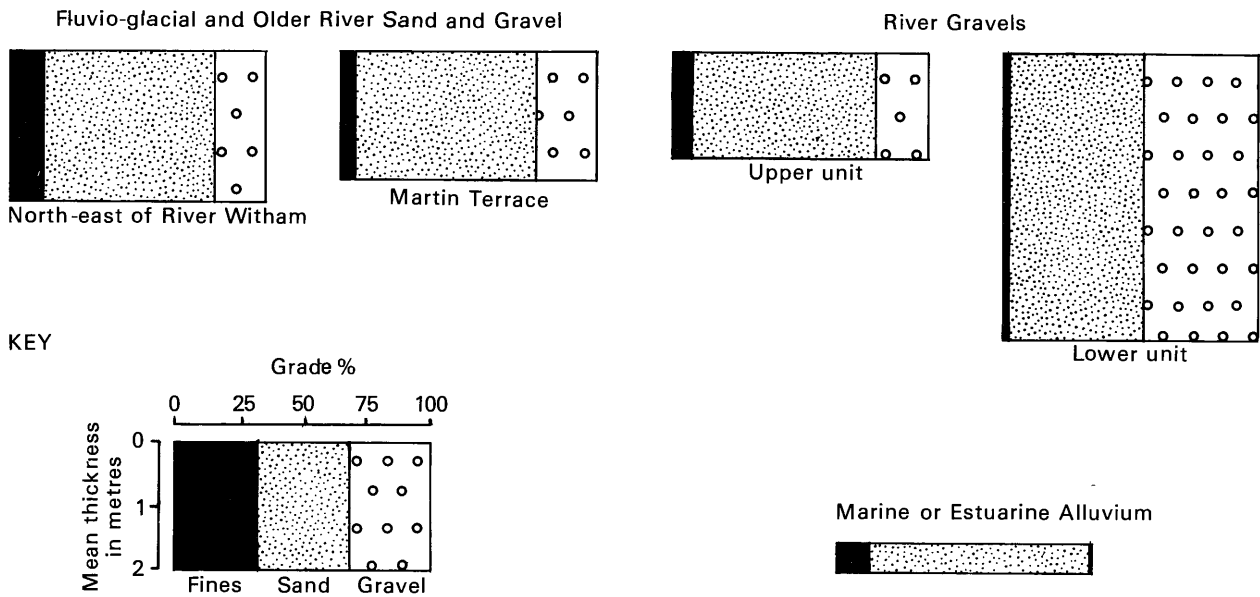


Figure 3 Mean grading and thickness of the sand and gravel deposits. The mean gradings are based on weighted means from all IMAU boreholes; the mean thicknesses are based on data from IMAU and other boreholes.

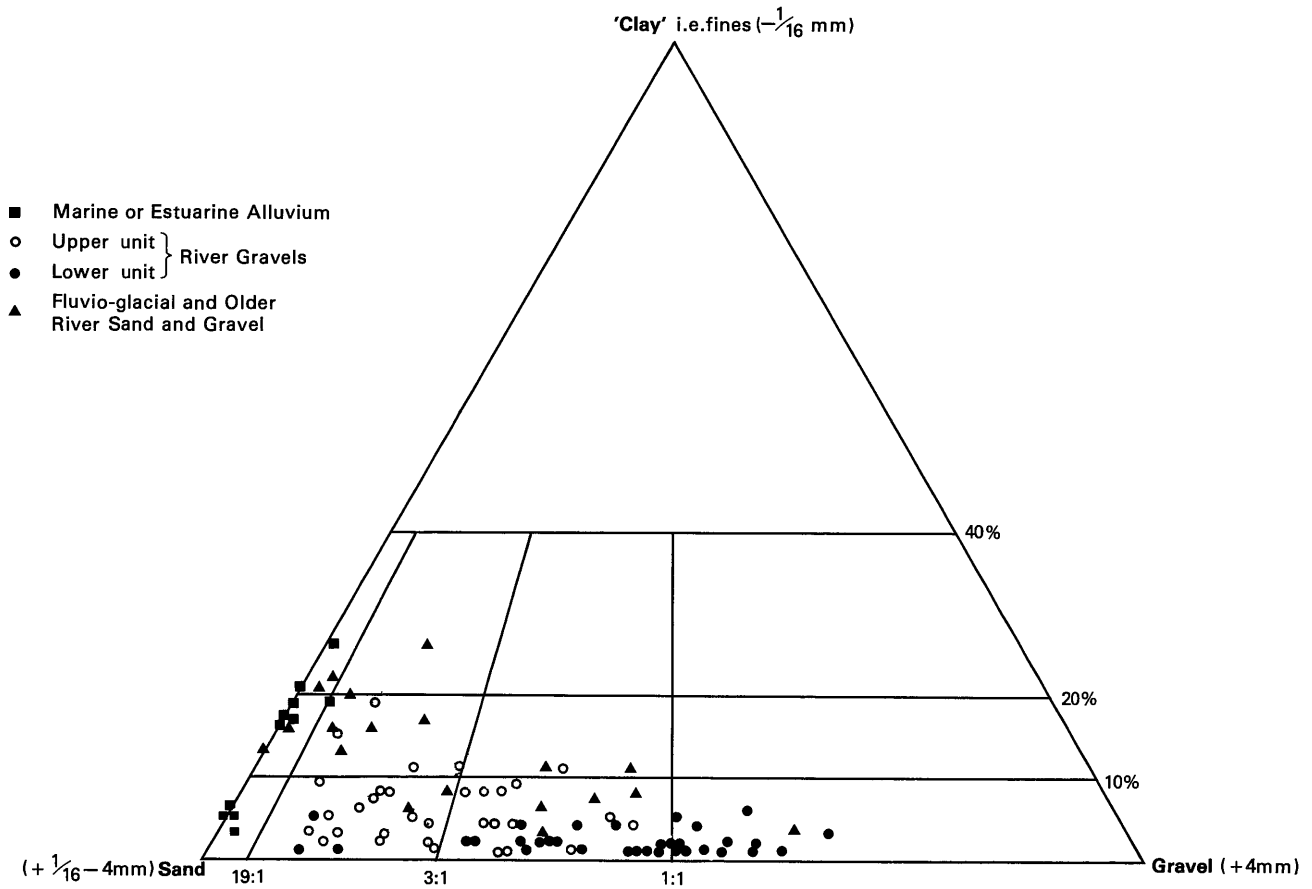


Figure 4 Mean grading of the sand and gravel deposits in individual boreholes (for explanation of the categories of mineral, see Appendix C).

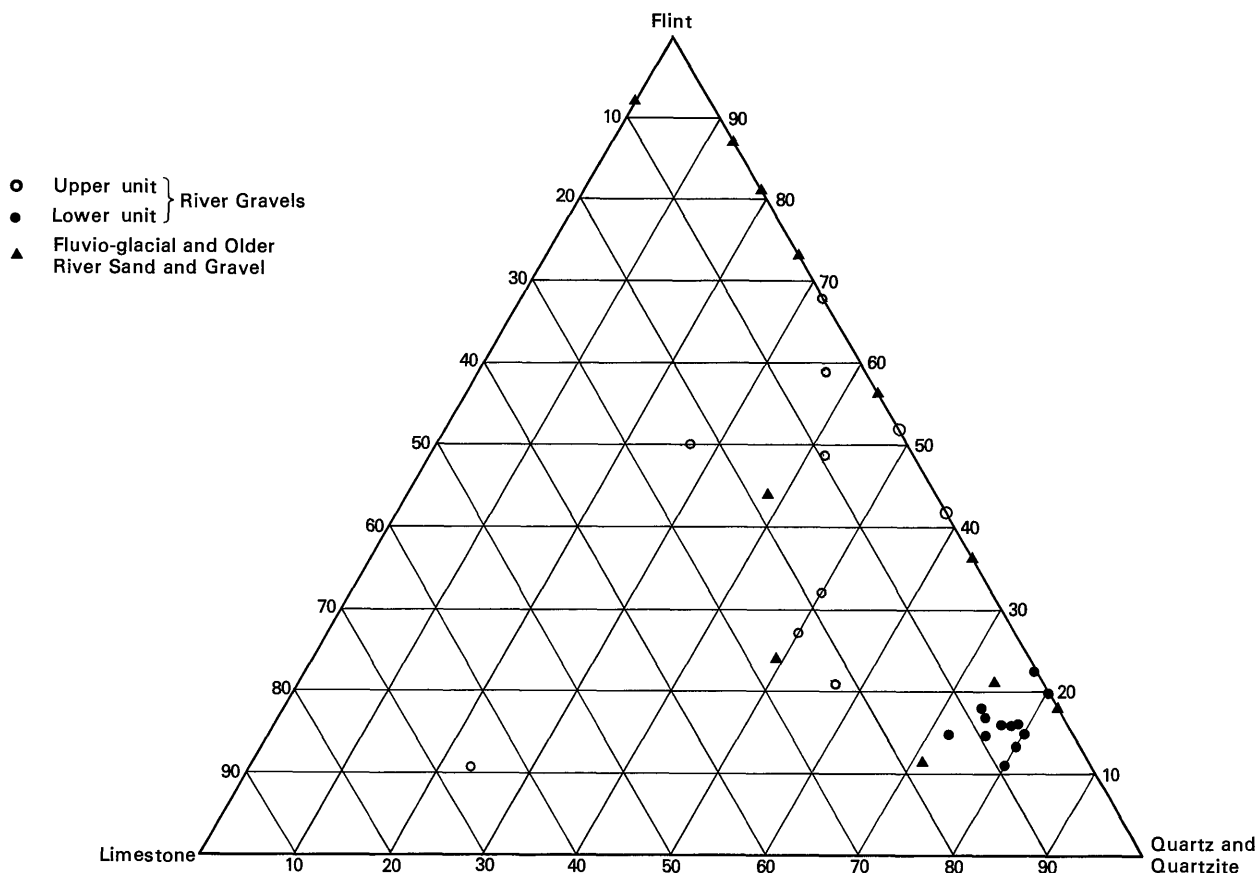


Figure 5 Lithological composition of the sand and gravel deposits from representative boreholes, expressed in terms of percentages of the components Limestone, Flint, and Quartz and quartzite.

As stated above the Fluvio-glacial and Older River Sand and Gravel north-east of the River Witham varies both in grade and lithology. 17 boreholes sited upon these scattered deposits record gradings ranging from 'very clayey' sand to gravel with a fines fraction in excess of 10 per cent in 11 of them. The mean grading of all the samples is fines 13 per cent, sand 68 per cent, gravel 19 per cent. The gravel fraction is fine-grained and is commonly dominated by subangular flint but at three boreholes sites (16 NW 34, 16 NW 38 and 16 SE 29) subrounded quartzite is the major component and in one instance (16 SE 35) a flint-rich deposit overlies a quartzite-rich one. Quartz, sandstone and limestone are also relatively common, whereas mudstone, ironstone and igneous rocks are usually only present in trace quantities. The medium- and fine-grained sand consists mainly of rounded to subrounded quartz and accessory components essentially similar to those of the Martin Terrace.

River Gravels The mean grading of the lower, quartzitic unit of these deposits is fines 2 per cent, sand 53 per cent, gravel 45 per cent. The majority of boreholes proved gravel or sandy gravel but locally pebbly sand was recorded. On average 66 per cent of the pebbles fall in the fine gravel fraction; cobbles are rare. Lithologically the sediments are very uniform; subrounded quartzite dominates, rounded quartz and subangular flint are the principal subsidiary rock types and subrounded sandstone and limestone rarely exceed 12 per cent of the total. Mudstone, ironstone and igneous rocks are all minor constituents.

The upper unit and the small area of exposed River Gravels in the north-west have a mean grading of fines 6 per cent, sand 72 per cent, gravel 22 per cent, and consist mainly of pebbly sand or sandy gravel, which may be sporadically 'clayey'. The relative proportions of the rock types in the gravel are less constant; flint, and to a

lesser degree limestone, are much more prevalent than in the underlying deposit but quartzite is still a significant component. Quartz and sandstone are present in only subordinate amounts.

The sand fraction of both units is medium-grained and is petrologically similar to the Fluvio-glacial and Older River Sand and Gravel.

Marine or Estuarine Alluvium The potentially workable deposits within these sediments comprise sand, 'clayey' sand and 'very clayey' sand, producing a mean grading of fines 13 per cent, sand 86 per cent, gravel 1 per cent. They are predominantly fine-grained and consist mainly of rounded to subrounded quartz with some feldspar and minor amounts of calcite, dolomite and kaolinite. Organic matter is common and includes plant, shell and wood debris.

PHYSICAL AND MECHANICAL PROPERTIES (Table 3)

A number of tests were carried out on standard sized material (+10-14 mm) in accordance with BS 812:1975, Parts 2 and 3. The five samples tested were prepared from several boreholes and are representative of the major lithological divisions encountered.

THE MAP

The sand and gravel resource map is folded into the pocket at the end of this report. The base map is the Ordnance Survey 1:25 000 Outline Edition in grey, on which the geological data are shown in black and the mineral resource information in shades of red.

Geological data The geological boundaries shown are based on a one-inch geological survey of Old-Series Sheet 83, published in 1886. The map was redrawn in part

on the 1:50 000 scale as New-Series Sheet 114 (Lincoln) and published in 1973. The resource map incorporates some amendments to the stratigraphical nomenclature.

The geological boundaries are the best interpretation of the information available at the time of survey. However, it is inevitable that local irregularities and discrepancies will be revealed as new evidence from boreholes and excavations becomes available.

Borehole data, which include the stratigraphical relations, thicknesses and mean particle size distribution of the sand and gravel samples collected during the assessment survey, are also shown on the map.

Mineral resource information The mineral-bearing ground is divided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is exposed, that is where the overburden averages less than 1 m in thickness, and areas where it is present in continuous spreads beneath overburden. Beneath overburden the mineral may be continuous (or almost continuous) or discontinuous. The recognition of these categories is dependent upon the importance attached to the proportion of boreholes which did not find potentially workable sand and gravel and the distribution of barren boreholes within a block. The mineral is described as 'almost continuous' if it is present in 75 per cent or more of the boreholes in a resource block. The 'discontinuous' category has not been recognised on this sheet.

Areas where bedrock crops out, where boreholes indicate absence of sand and gravel beneath cover and where sand and gravel beneath cover is interpreted to be not potentially workable, are uncoloured on the map; where appropriate, the relevant criterion is noted. In such cases it has been assumed that mineral is absent except in infrequent and relatively minor patches that can neither be outlined nor assessed quantitatively in the context of this survey. Areas of unassessed sand and gravel, for example in built-up areas, are indicated by a red stipple.

The area of the mineral-bearing ground is measured, where possible, from the mapped geological boundary lines. The whole of this area is considered as mineral-bearing, even though it may include small areas where sand and gravel is not present or is not potentially workable. Inferred boundaries have been inserted to delimit areas where sand and gravel beneath cover is interpreted to be not potentially workable or absent. Such boundaries (for which a distinctive zigzag symbol is used) are drawn primarily for the purpose of volume estimation. The symbol is intended to indicate an approximate location within a likely zone of occurrence rather than to represent the breadth of the zone, its size being determined only by cartographic considerations. For the purpose of measuring areas the centre line of the symbol is used.

RESULTS

The statistical results are summarised in Table 4. Fuller grading particulars are shown in Figure 6 and the mean gradings and 'grading envelopes' for each resource block are given in Figures 8 to 14.

Accuracy of results For each of the blocks, the accuracy of the results at the 95 per cent probability level (that is, on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral) varies between 23 per cent and 40 per cent (Appendix B). However, the true volumes are more likely to be nearer the figure estimated than either of the limits. Moreover, it is probable that roughly the same percentage limits would apply for the statistical estimate of mineral volume within a very much smaller parcel of ground (say 100 hectares) containing similar sand and gravel deposits, if the results

from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for quotation of reserves, data from more sample points would be required, even if the area were quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel in Blocks B₁ to B₄. The total volume (294 million m³) can be estimated to limits of ± 10 per cent at the 95 per cent probability level by a calculation based on the data from the 42 sample points spread across these four resource blocks. However, it must be emphasised that the quoted volume of mineral has no simple relationship with the amount that could be extracted in practice, as no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of the land for mineral working.

NOTES ON THE RESOURCE BLOCKS

The sheet has been divided into seven resource blocks (Figure 7). Those prefixed A contain exposed sand and gravel on the flanks of the Fenland, usually Fluvio-glacial and Older River Sand and Gravel. Those prefixed B encompass the concealed mineral deposits of the River Gravels and Marine or Estuarine Alluvium. Block A₃ isolates the deposits of the Martin Terrace but the boundaries between A₁ and A₂ and B₁₋₄ are somewhat arbitrarily drawn along lines of drainage in order to conform approximately to the ideal size of a resource block (see Introduction).

Groundwater information in this report is restricted to the depth at which water was first encountered in the borehole. These records show that River Gravels beneath the Fenland lie below a water table which is generally confined by the impervious sediments of Marine or Estuarine Alluvium. Boreholes in Fluvio-glacial and Older River Sand and Gravel rarely struck water.

Block A₁ (Table 5; Figure 8)

This block occupies 46.9 km² in the north of the district but only 11.4 km², comprising scattered outcrops of Fluvio-glacial and Older River Sand and Gravel and a small area of River Gravels, is mineral-bearing. No assessment has been attempted for the isolated areas of Fluvio-glacial and Older River Sand and Gravel less than 0.25 km², for example near High Cell House [158 700] and Grange Farm [315 719]. Boreholes sited directly on till proved no mineral within the glacial sequence, although at borehole 16 NW 35, 0.6 m of 'clayey' gravel was encountered. Similarly, several boreholes sited on alluvium proved only silts and clays with peat, and in borehole 16 NE 17, thin (0.6 m) 'clayey' pebbly sand. However, as one of those boreholes, 17 SW 5, occurs within an area considered overall to be mineral-bearing, a nil-thickness has been entered in the calculations.

Eleven IMAU boreholes and one other proved mineral between 1.0 m and 5.5 m in thickness but most of the boreholes proved thicknesses nearer to the mean of 2.3 m. The estimated volume of mineral is 26 million m³ ± 38 per cent. The grade of the Fluvio-glacial and Older River Sand and Gravel varies irregularly from 'very clayey' sand to gravel but the fines content commonly exceeds 10 per cent. In contrast, mineral within the River Gravel deposits has a mean fines content of only 4 per cent and its gravel content is less variable (15 to 41 per cent compared to 1 to 52 per cent). The mean grading of the block as a whole is fines 10 per cent, sand 67 per cent, gravel 23 per cent.

Overburden exceeds 1 m in thickness at 50 per cent of the borehole sites, reaching a maximum of 2.8 m in borehole 16 NW 38. Waste (see Introduction), consisting of 0.6 m of silt, was recorded within mineral at borehole 17 SW 34.

Table 4 Sand and gravel resources of the district.

Block and Deposit	Area		Mean thickness		Volume of sand and gravel			Mean grading percentage		
	Block	Mineral	Over-burden†	Mineral	Limits at the 95% probability level			Fines	Sand	Gravel
	km ²	km ²	m	m	m ³ × 10 ⁶	± %	± m ³ × 10 ⁶	- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ -4 mm	+4 mm
Block A ₁ Fluvio-glacial and Older River Sand and Gravel and River Gravels	46.9	11.4	1.1	2.3	26	38	10	10	67	23
Block A ₂ Fluvio-glacial and Older River Sand and Gravel	40.1	11.3	0.5	2.3	26	40	10	12	68	20
Block A ₃ Fluvio-glacial and Older River Sand and Gravel	4.9	3.1*	0.7	2.1	7	Inferred		6	67	27
Block A₁-A₃	91.9	25.8	0.8	2.3	59	23	14	10	68	22
Block B ₁ All deposits	9.7	8.1	3.0	7.1	57	31	18	4	63	33
Marine or Estuarine Alluvium River Gravels			1.8	0.9	7	Speculative		7	92	1
Upper unit			4.0†	1.6	13	52	7	8	74	18
Lower unit			5.4†	4.6	37	32	12	2	54	44
Block B ₂ All deposits	13.4	13.3	3.2	7.0	93	26	24	4	62	34
Marine or Estuarine Alluvium River Gravels			2.4	0.7	9	Speculative		16	84	0
Upper unit			4.3†	1.6	21	51	11	5	71	24
Lower unit			5.5†	4.7	63	23	15	2	55	43
Block B ₃ All deposits	11.3	10.3	4.7	6.3	65	23	15	4	57	39
Marine or Estuarine Alluvium River Gravels			1.9	0.5	5	Speculative		16	84	0
Upper unit			4.8†	1.6	17	63	11	6	73	21
Lower unit			7.1†	4.2	43	29	13	2	49	49
Block B ₄ All deposits	13.7	12.1	5.3	6.5	79	25	17	3	60	37
Marine or Estuarine Alluvium River Gravels			4.5	0.2	2	Speculative		15	84	1
Upper Unit			5.2†	1.8	22	47	10	5	73	22
Lower Unit			7.3†	4.5	55	32	18	2	52	46
Blocks B₁-B₄, all deposits	48.1	43.8	4.1	6.7	294	10	29	4	60	36
Blocks A₁-B₄, all deposits	140	69.6	2.9	5.1	353					

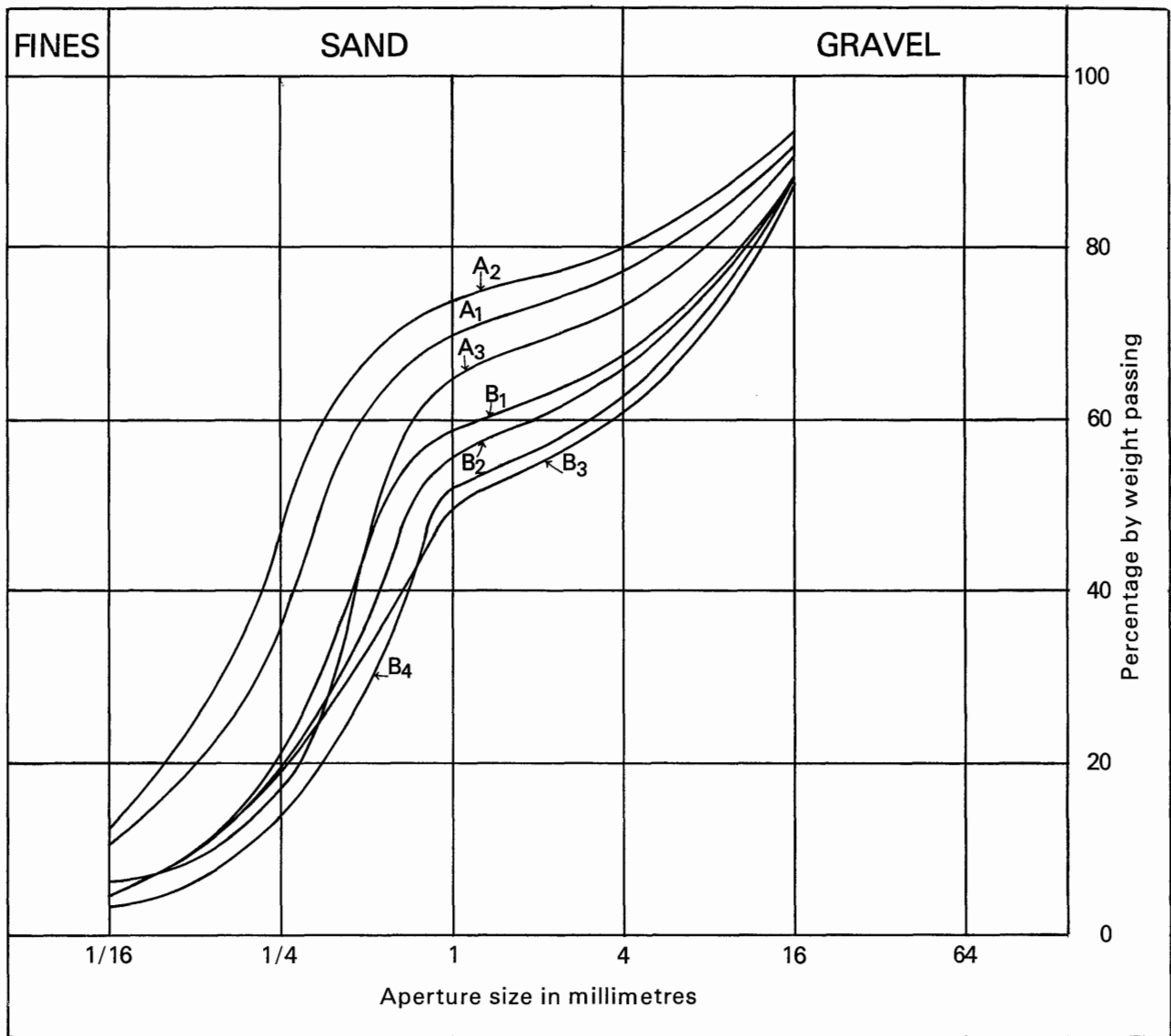
* Inferred assessment.

† Where appropriate, depth of burial is quoted.

Block A₂ (Table 6; Figure 9)

Block A₂ encompasses 11.3 km² of mineral in the east of the district and includes two relatively large and several smaller outcrops of Fluvio-glacial and Older River Sand and Gravel. Isolated areas of sand and gravel less than 0.25 km² (for example near High Ridge [198 661] and The Plantation [182 635]) have again been excluded from the assessment. As with Block A₁, no mineral was recorded within till; borehole 16 NE 14 drilled on ground mapped as till proved 1.8 m of 'clayey' sandy gravel at the

surface but the area occupied by this ?alluvial deposit is too small to be shown on the map. However, boreholes 16 NE 13, 16 SE 25 and 16 SE 30 sited to investigate areas mapped as sand and gravel proved only waste; the first site has been separated by an inferred boundary, but at the other two the extent of the barren ground is uncertain and cannot be delineated; thus the absence of mineral has been taken into account by entering nil-thicknesses in the volume calculation. The alluvium appears to contain thin and impersistent sand and gravel



Block	Percentage by weight passing				
	16 mm	4 mm	1 mm	1/4 mm	1/16 mm
A ₁	92	77	70	35	10
A ₂	94	80	74	46	12
A ₃	91	73	65	16	6
B ₁	89	67	59	21	4
B ₂	89	66	56	19	4
B ₃	88	61	50	19	4
B ₄	89	63	52	14	3

Figure 6 Mean particle-size distribution for the assessed thickness of sand and gravel in resource blocks A₁ to B₄.

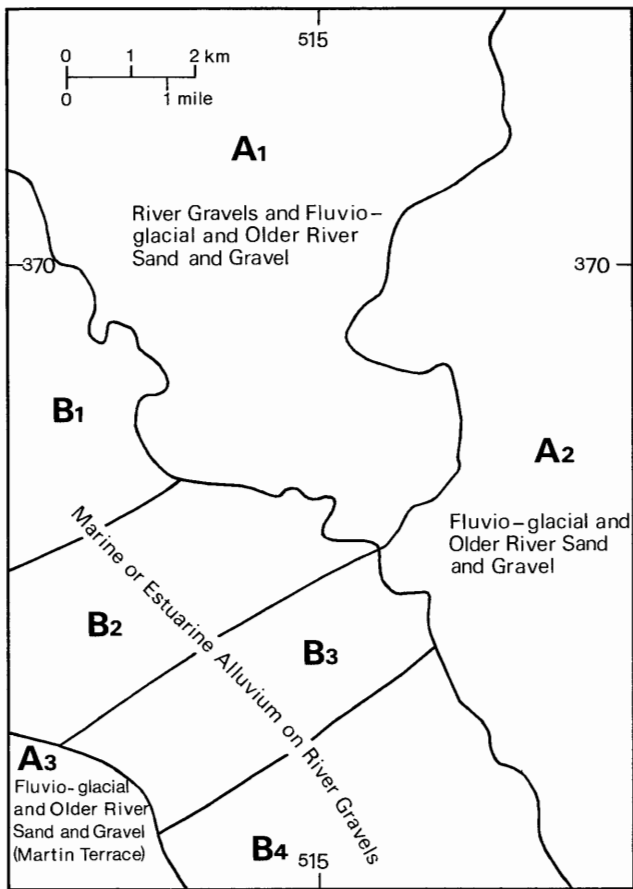


Figure 7 Map showing the relationship between the principal sand and gravel deposits and the resource block boundaries.

deposits and in borehole 16 NE 22 was represented by only 0.9 m of 'clayey' sandy gravel.

Up to 5.5 m (borehole 16 SE 35) of mineral was recorded from the Fluvio-glacial and Older River Sand and Gravel deposit around Woodhall Spa, but within this area there may be local thinning to less than 2.0 m (boreholes 16 SE 24 and 16 SE 29). Elsewhere in the block mineral does not usually attain even that thickness and this fact is reflected in the mean of 2.3 m. The estimated volume of mineral is 26 million m³ ± 40 per cent. The mean grading of the block is fines 12 per cent, sand 68 per cent, gravel 20 per cent but the mean grading of samples from individual boreholes is very variable. However, in only one third of the boreholes is the fines fraction less than 10 per cent and it is at these sites (16 NE 21, 16 SE 29 and 16 SE 35) where the highest proportion of gravel is recorded. In the remaining boreholes +4 mm material (i.e. gravel) does not exceed 15 per cent of the total. In borehole 16 SE 29 the sand and gravel was found to be very compact and iron-cemented and may represent part of a discontinuous iron pan identified over approximately 2 km² of country south of Woodhall Spa (Soil Survey of England and Wales 1:25 000 sheet TF 16).

Overburden, with one exception (borehole 16 NE 23), consisted only of soil and subsoil and on average it is 0.5 m thick. Waste partings were not encountered in the IMAU boreholes.

Block A₃ (Table 7; Figure 10)

An inferred assessment is offered for the small area (3.1 km²) of Fluvio-glacial and Older River Sand and Gravel (that is, the Martin Terrace) in the extreme south-west of the district. Three boreholes prove thicknesses of between 1.6 and 2.8 m, giving an inferred estimate of volume of 7 million m³. Samples from two

boreholes produce a mean grading of fines 6 per cent, sand 67 per cent, gravel 27 per cent. Waste within mineral was not encountered and overburden does not exceed 0.8 m.

Block B₁ (Table 8; Figure 11)

This block, which is approximately 9.7 km² in area with 8.1 m of mineral, contains the northern part of the concealed mineral within the River Gravels and the Marine or Estuarine Alluvium. Whereas the eastern block boundary has been drawn along the edge of the alluvium, four pre-existing boreholes place the margin of the mineral to the west of this line and an inferred boundary has been inserted accordingly.

All eight IMAU boreholes prove the lower, quartzitic unit of the River Gravels; this ranges in thickness from 3.3 to 8.5 m but is less than 5.0 m in seven of the boreholes. With the exception of borehole 16 NW 36, which proved sand, IMAU boreholes proved sandy gravel or gravel with an average gravel content of 44 per cent; fines never account for more than 5 per cent of the total. The upper unit of the River Gravels was found at seven sites and varied in thickness from 1.0 to 3.0 m, with a mean of 1.6 m. Pebbly sands, 'clayey' in part, are prevalent but two boreholes, 16 NW 39 and 16 NW 46, proved sandy gravel. Mineral within Marine or Estuarine Alluvium occurs sporadically and was recorded in only 3 boreholes: 16 NW 42 proved the maximum thickness, 5.3 m of sand, but at the other boreholes (16 NW 44 and 16 NW 46) just 1.0 m of sand and 'clayey' sand was encountered. The combined mineral deposits of this block have a mean grading of fines 4 per cent, sand 63 per cent, gravel 33 per cent. The mean thickness is calculated at 7.1 m and the estimated total volume is 57 million m³ ± 31 per cent.

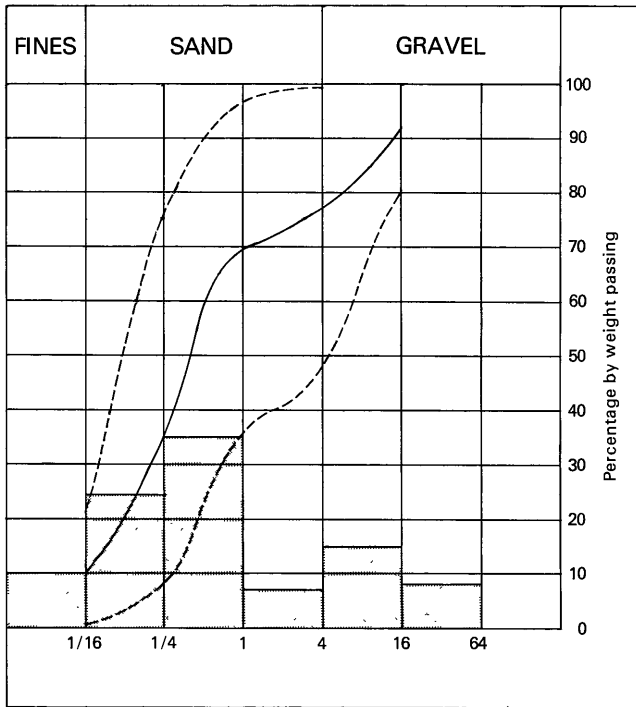


Figure 8 Grading characteristics of the mineral in Block A₁. The continuous line is the cumulative frequency curve of the mean grading of the block as a whole; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading of the block is also shown as a bar graph.

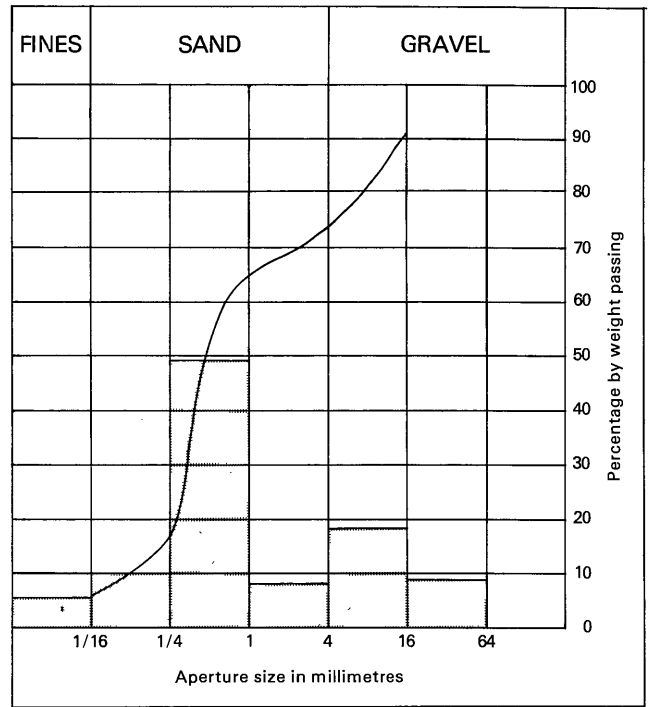


Figure 10 Grading characteristics of the mineral in Block A₃ (for explanation, see Figure 8).

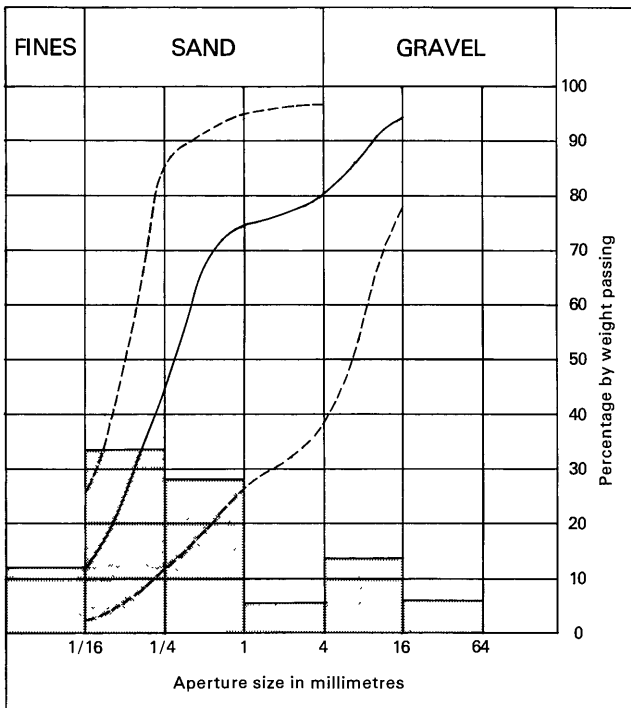
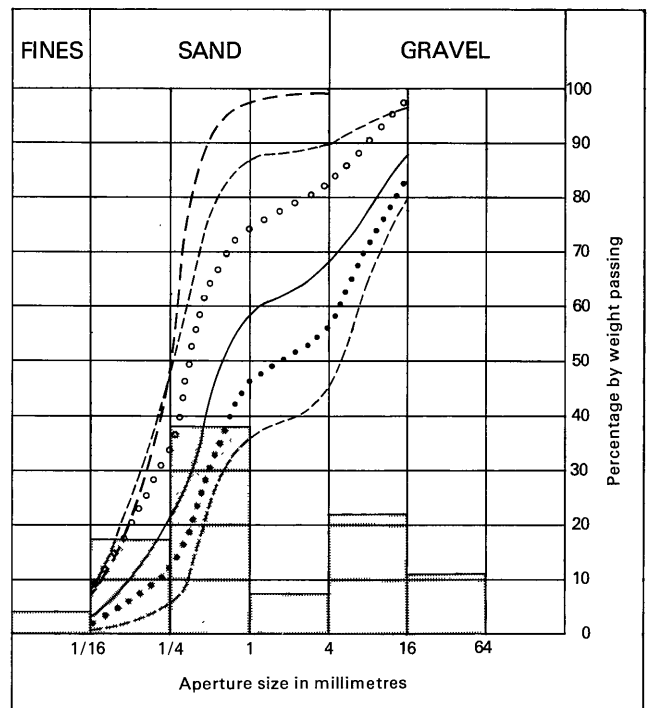


Figure 9 Grading characteristics of the mineral in Block A₂ (for explanation, see Figure 8).



- - - Marine or Estuarine Alluvium } Mean grading curves for individual
 ••••• Upper unit } River Gravels } deposits within the block
 ○○○○○ Lower unit }

Figure 11 Grading characteristics of the mineral in Block B₁ (for explanation, see Key and Figure 8).

Table 5 Block A₁: data from assessment boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{8}$ mm	+ $\frac{1}{8}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
16 NW 34	5.5	0.4	16	59	13	2	5	5
16 NW 35	1.2	0.8	11	9	17	13	31	19
16 NW 37	absent							
16 NW 38	1.7	2.8	8	6	22	12	37	15
16 NW 41	1.4	1.4	11	19	34	5	14	17
16 NW 45	1.0	1.3	16	19	57	2	3	3
16 NE 16	absent							
16 NE 17	absent							
16 NE 19	4.4	0.2	8	18	41	11	16	6
16 NE 20	1.5	0.5	21	33	43	1	2	
17 SW 33	2.2	1.0	16	35	46	2	1	
17 SW 34	2.0*	1.1	5	19	49	7	16	4
17 SW 35	absent							
17 SW 36	5.3	0.5	1	7	41	10	25	16
17 SW 37	absent							
17 SW 38	2.4	0.6	8	26	43	8	13	2
Mean	2.3†	1.1†	10	25	35	7	15	8

* Excludes a 0.6-m waste parting.

† Based on data from 11 IMAU and 2 other boreholes.

Table 6 Block A₂: data from assessment boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{8}$ mm	+ $\frac{1}{8}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
16 NE 12	absent							
16 NE 13	absent							
16 NE 14	absent							
16 NE 15	1.5	0.5	20	44	28	2	5	1
16 NE 18	absent							
16 NE 21	2.5	0.3	6	16	35	10	23	10
16 NE 22	absent							
16 NE 23	0.7	1.4	no grading data available					
16 NE 24	1.3	0.5	13	16	57	6	8	0
16 SE 16	1.4	0.3	17	35	27	6	9	6
16 SE 17	1.7	0.5	22	63	10	2	2	1
16 SE 20	4.8	0.3	13	67	19	1		
16 SE 24	1.9	0.2	26	34	26	3	5	6
16 SE 25	absent							
16 SE 29	1.9	0.5	4	8	14	13	40	21
16 SE 30	absent							
16 SE 35	5.5	0.6	3	13	38	11	25	10
Mean	2.3*	0.5*	12	34	28	6	14	6

* Based on data from 12 IMAU and 5 other boreholes.

Table 7 Block A₃: data from assessment boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Overburden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
16 SW 17	1.9	0.6	7	8	37	10	26	12
16 SW 21	2.8	0.7	6	12	57	6	12	7
16 SW 22	1.6	0.8	no grading data available					
Mean	2.1	0.7	6	10	49	8	18	9

Table 8 Block B₁: data from assessment boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Overburden†	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
Marine or Estuarine Alluvium								
16 NW 42	5.3*	0.8	5	39	54	1	1	0
16 NW 44	1.0	1.2	19	41	34	2	4	0
16 NW 46	1.0	3.5	6	44	49	1	0	0
Mean	0.9	1.8	7	40	51	1	1	0
River Gravels, Upper unit								
16 NW 33	3.0	4.0	6	29	47	4	13	1
16 NW 36	1.4	4.6	15	42	28	8	6	1
16 NW 39	2.2	4.9	2	21	40	10	23	4
16 NW 40	1.9	1.8	19	29	40	3	5	4
16 NW 42	1.0	6.1†	1	12	52	12	20	3
16 NW 44	1.0	2.2†	11	17	49	6	15	2
16 NW 46	2.0	4.5†	4	22	36	9	24	5
Mean	1.6	4.0†	8	26	41	7	15	3
River Gravels, Lower unit								
16 NW 33	3.3	7.0†	1	8	33	11	30	17
16 NW 36	3.8	6.0†	5	38	45	2	5	5
16 NW 39	4.7	7.1†	2	11	53	7	16	11
16 NW 40	8.5	3.7†	3	3	20	9	43	22
16 NW 42	4.9	7.1†	1	5	31	13	32	18
16 NW 43	3.9	2.8	1	5	30	12	33	19
16 NW 44	3.7	3.2†	4	11	33	10	25	17
16 NW 46	3.9	6.5†	2	5	45	11	26	11
Mean	4.6	5.4†	2	10	35	9	28	16
All deposits								
16 NW 33	6.3	4.0	3	18	38	9	22	10
16 NW 36	5.2	4.6	8	39	40	3	6	4
16 NW 39	6.9	4.9	2	14	49	8	18	9
16 NW 40	10.4*	1.8	6	8	23	8	36	19
16 NW 42	11.2*	0.8	3	22	44	7	16	8
16 NW 43	3.9	2.8	1	5	30	12	33	19
16 NW 44	5.7	1.2	8	17	36	8	20	11
16 NW 46	6.9	3.5	3	16	43	8	22	8
Mean	7.1	3.0	4	17	38	8	22	11

* Excludes a 0.3-m waste parting.

† Where appropriate, depth of burial is quoted.

Table 9 Block B₂: data from assessment boreholes.

Borehole	Recorded thickness (m)			Mean grading percentage					
	Mineral	Overburden	Waste	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
				- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm
Marine or Estuarine Alluvium									
16 SW 49	1.7	0.5		17	54	26	2	1	0
16 SW 8	1.0	3.0		21	70	8	1	0	0
16 SW 9	1.5	3.3		5	32	62	1	0	0
16 SW 10	2.5	2.8		19	80	1	0	0	0
Mean	0.7	2.4		16	61	22	1	0	0
River Gravels, Upper unit									
16 NW 48	1.3	3.2		8	18	55	4	10	6
16 SW 3	2.0	4.4		3	26	49	9	11	2
16 SW 4	1.5	4.0		11	22	39	6	17	5
16 SW 5	1.0	3.8		9	12	39	11	27	2
16 SW 6	2.0	5.5		4	9	31	12	30	14
16 SW 8	3.2	4.0*		3	32	50	5	8	2
16 SW 9	2.3	4.8*		2	21	40	10	23	4
16 SW 10	3.0	5.3*		4	16	38	11	23	8
Mean	1.6	4.3*		5	21	42	8	18	6
River Gravels, Lower unit									
16 NW 47	5.2	1.6		4	7	41	10	24	14
16 NW 48	1.5	4.5*		1	7	72	10	10	0
16 NW 49	4.8	2.2*		2	5	27	18	37	11
16 SW 3	4.7	6.4*	1.0	3	7	43	12	23	12
16 SW 4	4.7	5.5*		5	8	29	10	31	17
16 SW 5	6.7	4.8*	0.3	1	4	27	10	34	24
16 SW 6	3.4	7.5*		1	3	28	13	41	14
16 SW 8	5.8	7.2*		1	6	44	15	24	10
16 SW 9	4.3	7.1*		1	18	61	6	10	4
16 SW 10	5.8	8.3*		1	4	26	11	38	20
Mean	4.7	5.5*		2	7	37	11	29	14
All Deposits									
16 NW 47	5.2	1.6		4	7	41	10	24	14
16 NW 48	2.8	3.2		4	12	64	7	10	3
16 NW 49	6.5	0.5	2.9	6	18	27	14	27	8
16 SW 3	6.7	4.4	1.0	3	12	45	11	20	9
16 SW 4	6.2	4.0	0.6	6	11	32	9	28	14
16 SW 5	7.7	3.8	0.3	2	5	29	10	33	21
16 SW 6	5.4	5.5		2	5	29	13	37	14
16 SW 8	10.0	3.0		3	21	42	11	16	7
16 SW 9	8.1	3.3		2	21	55	6	12	4
16 SW 10	11.3	2.8		6	24	23	9	25	13
Mean	7.0	3.2		4	15	37	10	23	11

* Where appropriate, depth of burial is quoted.

In the northern part of the block the boreholes proved overburden thicknesses of between 4.0 and 4.9 m but in the southern part three out of five boreholes record less than 2.0 m (see diagram B on map margin). Thin waste partings (0.3 m) were noted at boreholes 16 NW 40 and 16 NW 42.

Block B₂ (Table 9; Figure 12)

Block B₂ encompasses 13.3 km² of potentially workable sand and gravel between Nocton Delph and Metheringham Delph. Mineral was absent in boreholes 16 NW 18 and 16 NE 7 and inferred boundaries exclude barren ground around these sites.

As in Block B₁, the quartzitic unit of the River Gravels was encountered in all (10) IMAU boreholes and ranges in thickness from 1.5 m in borehole 16 NW 48 to 6.7 m in borehole 16 SW 5. It consists chiefly of gravels and sandy gravels, but pebbly sand occurs locally (boreholes 16 NW 48 and 16 SW 9); fines are again present in only small amounts (<5 per cent). The upper unit, proved at eight sites, does not exceed 3.2 m in thickness and has a mean of 1.6 m. Sandy gravels and

pebbly sands predominate with the gravel fraction varying between 13 and 44 per cent. In only one borehole (16 SW 4) is the fines fraction greater than 10 per cent.

Four IMAU boreholes record mineral within Marine or Estuarine Alluvium; it varies in thickness between 1.0 and 2.5 m and ranges between sand and 'very clayey' sand. In total the mineral deposits of Block B₂ have a mean grading of fines 4 per cent, sand 62 per cent, gravel 34 per cent; the mean thickness is 7.0 m and the estimated volume is 93 million m³ \pm 26 per cent.

Overburden, generally clays and silty clays of Marine or Estuarine Alluvium, has a mean thickness of 3.2 m. However, it is notably thinner in borehole 16 NW 49, where mineral within the deposit is present, and in the extreme west of the block, where a limestone-rich gravel belonging to the upper unit and originating from the west, (Crofts, *in press*) fans out over the quartzitic gravels. Waste partings are present within the River Gravels in three boreholes and range in thickness from 0.3 m to 1.0 m. At borehole 16 NW 49, 2.9 m of waste separates mineral within Marine or Estuarine Alluvium from the River Gravels.

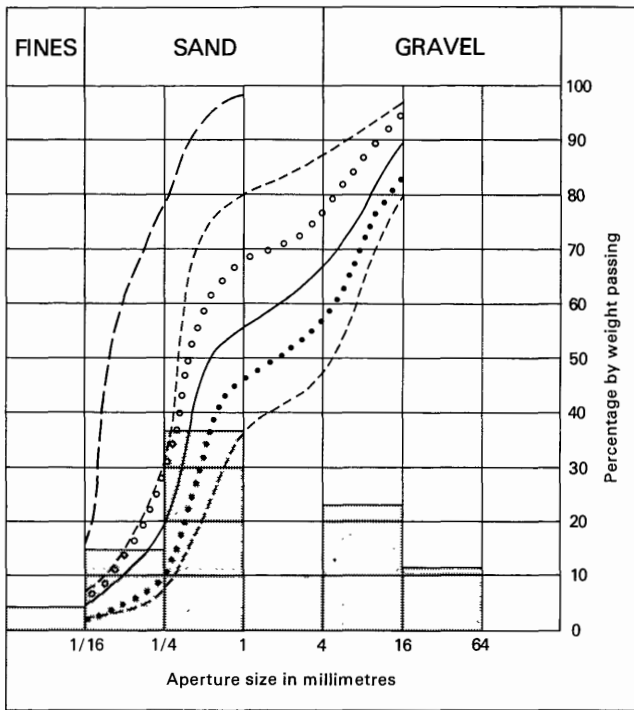


Figure 12 Grading characteristics of the mineral in Block B₂ (for explanation, see Figures 8 and 11).

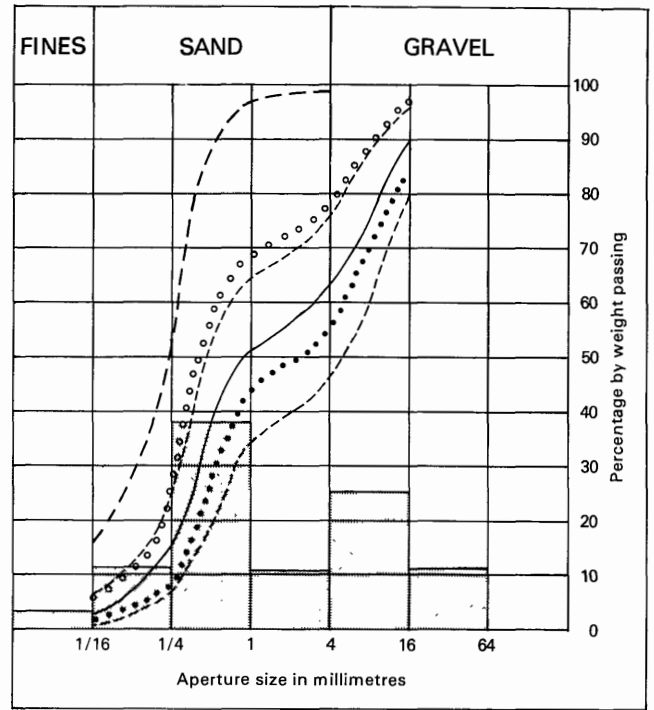


Figure 14 Grading characteristics of the mineral in Block B₄ (for explanation, see Figures 8 and 11).

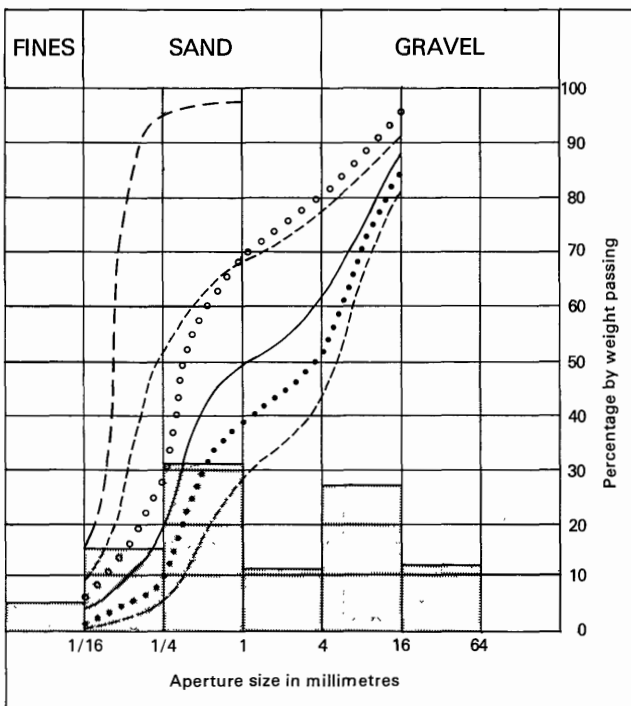


Figure 13 Grading characteristics of the mineral in Block B₃ (for explanation, see Figures 8 and 11).

Block B₃ (Table 10; Figure 13)

Block B₃, lying between Metheringham Delph and Linwood Drain, includes 10.3 km² of concealed mineral. Towards the eastern margin of the block River Gravels tend to decrease in thickness beneath an increasing thickness of overburden and in borehole 16 SE 19, in the extreme east, mineral is absent altogether – an inferred boundary delineates the area assumed to be barren.

The remaining ten IMAU boreholes all prove the lower quartzitic unit of the River Gravels. This varies in thickness from 2.3 m in borehole 16 SE 18 to 6.0 m in 16 SE 7, but thicknesses over 4.0 m are usual. Gravels and sandy gravels predominate and the gravel fraction is never less than 33 per cent. The upper unit, proved in eight IMAU boreholes (but not in boreholes 16 SW 15 and 16 SE 15), may have been recorded in two pre-existing boreholes (16 NE 1 and 16 NE 2) in the north-east of the block. The pebbly sands and sandy gravels of this unit are again less well-developed with a mean thickness of 1.6 m. Only one IMAU borehole (16 SE 11) proved mineral within Marine or Estuarine Alluvium; this comprised 4.3 m of fine 'clayey' sand. The two pre-existing boreholes referred to above record 0.9 m and 1.4 m of mineral within alluvium.

For the block as a whole, the mean grading is fines 4 per cent, sand 57 per cent, gravel 39 per cent; the mean thickness is 6.3 m and the estimate of volume is 65 million m³ ± 23 per cent.

Overburden thicknesses range from 0.3 m in the north, where mineral within alluvium is present, to 9.5 m in the east where a thicker sequence of recent clays and silts directly overlies the lower, quartzitic unit of the River Gravels. Elsewhere the variation is less marked and the mean for the block is 4.9 m. Thin waste partings (ranging from 0.2 m to 0.9 m) were encountered in boreholes 16 NE 1, 16 NE 2 and 16 SE 18.

Block B₄ (Table 11; Figure 14)

Block B₄ lies between Linwood Drain and the southern margin of the district. The block area is 13.7 km²,

Table 10 Block B₃: data from assessment boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
			Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
	Mineral	Overburden	- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
Marine or Estuarine Alluvium								
16 SW 11	4.3	2.8	16	79	3	2	0	0
River Gravels, Upper unit								
16 SW 7	2.1	4.0	5	7	31	16	30	11
16 Sw 11	0.8	7.1‡	2	44	36	6	10	2
16 SW 12	2.0	3.1	2	11	52	12	16	7
16 SW 13	1.0	6.0	8	10	39	15	25	3
16 SW 14	1.0	6.8	11	16	29	11	26	7
16 SW 16	1.0	6.4	3	16	33	13	28	7
16 SW 18	3.2	3.6	2	15	51	14	17	1
16 SE 18	4.7*	4.6	9	40	39	4	7	1
Mean	1.6x	4.8‡x	6	22	41	10	17	4
River Gravels, Lower Unit								
16 SW 7	6.0	6.1‡	1	3	20	15	41	20
16 SW 11	4.3	7.9‡	6	5	23	11	36	19
16 SW 12	5.1	5.1‡	1	2	34	15	37	11
16 SW 13	4.4	7.0‡	1	6	35	13	36	15
16 SW 14	5.7	7.8‡	4	6	28	11	34	17
16 SW 15	5.1	3.8	2	12	41	9	25	11
16 SW 16	4.4	7.4‡	1	8	27	11	33	20
16 SW 18	5.1	6.8‡	2	11	45	9	20	13
16 SE 15	3.8	9.5	1	7	22	12	46	12
16 SE 18	2.3	9.3‡	2	2	23	15	32	26
Mean	4.2x	7.1‡x	2	7	30	12	33	16
All deposits								
16 SW 7	8.1	4.0	2	4	23	15	38	18
16 SW 11	9.4	2.8	10	42	15	7	17	9
16 SW 12	7.1	3.1	1	4	39	14	32	10
16 SW 13	5.4	6.0	2	6	36	14	29	13
16 SW 14	6.7	6.8	5	8	28	11	33	15
16 SW 15	5.1	3.8	2	12	41	9	25	11
16 SW 16	5.4	6.4	2	10	29	10	32	17
16 SW 18	8.3	3.6	2	12	47	11	19	9
16 SE 15	3.8	9.5	1	7	22	12	46	12
16 SE 18	7.0£	4.6	7	28	34	8	14	9
16 SE 19	absent							
Mean	6.3x	4.7x	4	15	31	11	27	12

* Excludes 0.4 m waste parting.

£ Excludes 0.4 and 0.9 m waste partings.

‡ Where appropriate, depth of burial is quoted.

x Based on data from 10 IMAU boreholes and 2 other boreholes.

12.1 km² of which is mineral-bearing. A barren area, delineated in the east of the block on the basis of data from borehole 16 SE 23, continues southwards from block B₃; a small area in the west of the block around borehole 16 SE 1 has also been classified as non-mineral.

With the exception of borehole 16 SE 34, 12 IMAU boreholes encountered between 1.5 and 7.3 m of the lower, quartzitic unit which graded as either sandy gravel or gravel, with a mean gravel content of 46 per cent. The upper unit of the River Gravels, proved in ten boreholes, was commonly less than 3.0 m in thickness and again comprised pebbly sand and sandy gravel, with a mean gravel content of 22 per cent. Thin (1.0 m) mineral

was recorded within Marine or Estuarine Alluvium at three boreholes but contained virtually no gravel and was largely 'clayey'.

Considering the mineral of the block as a whole, the mean grading is fines 3 per cent, sand 60 per cent, gravel 37 per cent; the mean thickness is 6.5 m and the estimate of total volume is 79 million m³ ± 25 per cent.

Overburden, alluvial clays and silts with peat, has a mean thickness of 5.3 m and is thickest in the north and east of the block, reaching 9.2 m in borehole 16 SE 22. Borehole 16 SE 28 proved a 1.7 m waste parting between the upper and lower units of the River Gravels.

Table 11 Block B₄: data from assessment boreholes.

Borehole or section	Recorded thickness (m)		Mean grading percentage					
			Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
	Mineral	Overburden	- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 mm
Marine or Estuarine Alluvium								
16 SW 19	1.0	5.0	3	33	60	2	2	0
16 SW 23	1.0	4.5	17	51	31	1	0	0
16 SE 26	1.0	4.1	26	30	42	1	1	0
Mean	0.2	4.5	15	38	44	2	1	0
River Gravels, Upper unit								
16 SW 19	1.0	6.0†	1	13	33	14	30	2
16 SW 20	1.5	6.0	3	21	50	8	14	4
16 SW 23	1.0	5.5†	1	11	36	10	32	0
16 SW 24	2.0	4.9	5	29	49	6	11	0
16 SE 26	3.2	5.1†	4	25	42	7	19	3
16 SE 28	2.0	3.1	8	14	46	6	16	10
16 SE 31	2.2	5.8	4	26	33	9	23	5
16 SE 32	3.0	4.9	5	27	50	8	9	1
16 SE 33	4.6	5.9	8	20	36	12	19	5
16 SE 34	2.4	4.2	2	14	46	11	21	6
Mean	1.8	5.2†	5	21	43	9	18	4
River Gravels, Lower Unit								
16 SW 19	5.4	7.0†	1	4	37	12	31	15
16 SW 20	4.6	7.5†	2	5	51	14	24	4
16 SW 23	6.4	6.4†	1	4	42	12	27	14
16 SW 24	4.9	6.9†	2	8	44	9	25	12
16 SE 21	6.1	5.9	2	9	30	14	34	11
16 SE 22	3.9	9.2	2	4	28	11	35	20
16 SW 26	2.5	8.3†	1	3	37	11	32	16
16 SE 27	7.1	6.0	2	7	33	8	29	21
16 SE 28	1.6	5.1†	4	9	46	9	21	11
16 SE 31	.3	8.0†	1	3	29	12	35	20
16 SE 32	6.8	7.9†	1	4	31	14	36	14
16 SE 33	1.5	10.5†	2	6	30	12	32	18
Mean	4.5	7.3†	2	5	36	11	31	15
All deposits								
16 SW 19	7.4	5.0	1	9	40	11	28	11
16 SW 20	6.1	6.0	2	10	51	12	21	4
16 SW 23	8.4	4.5	3	11	40	11	24	11
16 SW 24	6.9	4.9	2	14	46	8	21	9
16 SE 21	6.1	5.9	2	9	30	14	34	11
16 SE 22	3.9	9.2	2	4	28	11	35	20
16 SE 23	absent							
16 SE 26	7.7	4.1	5	16	40	8	23	3
16 SE 27	7.1	5.5	2	7	33	8	29	21
16 SE 28	3.6*	3.1	6	12	46	7	18	11
16 SE 31	9.5	5.8	1	9	30	11	32	17
16 SE 32	9.8	4.9	2	11	37	12	28	10
16 SE 33	6.1	5.9	6	16	35	12	23	8
16 SE 34	2.4	4.2	2	14	46	11	21	6
Mean	6.5	5.3	3	11	38	11	26	11

* Excludes a 1.7-m waste parting.

† Where appropriate, depth of burial is quoted.

CONCLUSIONS

- Mineral within resource blocks A₁ to A₃ occurs mainly as scattered deposits of Fluvio-glacial and Older River Sand and Gravel between 0.25 km² and 6.7 km² in area, most of which lie above the water table. The deposits vary laterally both in thickness and grade from 1.5 m of 'very clayey' sand to 5.5 m of sandy gravel. Overburden usually comprises only thin soil with a mean thickness of 0.8 m.
- Mineral within resource blocks B₁ to B₄ consists mainly of River Gravels. The widespread (44 km²) lower quartzitic unit ranges from 1.5 to 8.5 m in thickness with a mean of 4.5 m. It grades consistently as either sandy gravel or gravel (with a mean gravel content of 45 per cent). Index physical tests on the +10-14 mm fraction indicate that the aggregate is of good quality. The upper unit is marginally less extensive and invariably thinner (mean thickness of 1.7 m) and contains relatively less durable material. Both deposits lie beneath the water table and carry overburden whose average thickness is 4.2 m.
- Mineral occurs only sporadically within the Marine or Estuarine Alluvium in resource blocks B₁ to B₄. It is generally thin (mean thickness of 0.5 m) and consists of 'clayey' sand with variable amounts of disseminated organic material.
- No mineral was proved within the till of the district.

REFERENCES

- ALLEN, V. T. 1936. Terminology of medium-grained sediments. **Rep. Natl. Res. Council., Washington, 1935-1936, App. 1, Rep. Comm. Sediment.**, 18-47.
- ARCHER, A. A. 1969. Background and problems of an assessment of sand and gravel resources in the United Kingdom. **Proc. 9th Commonw. Min. & Metall. Congr., 1969**, Vol. 2: Mining and petroleum geology, 495-508. (London: Institution of Mining and Metallurgy.)
- 1970a. Standardisation of the size classification of naturally occurring particles. **Geotechnique**, Vol. 20, 103-107.
- 1970b. Making the most of metrication. **Quarry Managers' J.**, Vol. 54, No. 6, 223-227.
- ATTERBERG, A. 1905. Die rationelle Klassifikation der Sande und Kiese. **Chem. Z.**, Vol. 29, 195-198.
- BIOMETRIKA. 1962. Tables for statisticians. Vol. 1. 2nd edition. (Cambridge: CUP.)
- BRITISH STANDARDS INSTITUTION. 1967. **B.S.1377: Methods of testing soils for civil engineering purposes.** (London: British Standards Institution.)
- 1975. **B. S. 812. Methods for sampling and testing of Mineral aggregates, sands and fillers. Part 2: Physical properties and Part 3: Mechanical properties.** (London: British Standards Institution.)
- BUREAU OF MINES AND GEOLOGICAL SURVEY. 1948. Pp. 14-17 in **Mineral resources of the United States.** (Washington, DC: Public Affairs Press.)
- CLAYTON, K. M. 1957. The differentiation of the glacial drifts of the East Midlands. **East Midl. Geogr.**, No. 7, 31-40.
- CROFTS, R. G. **In press.** The sand and gravel resources of the country around Potter Hanworth and Reepham, Lincolnshire. Description of 1:25 000 resource sheet TF 06 and TF 07. **Miner. Assess. Rep. Inst. Geol. Sci.**
- DARBY, H. C. 1940. **The draining of the Fens.** (Cambridge: CUP.)
- GODWIN, H. 1978. Fenland: its ancient past and uncertain future (Cambridge: CUP.)
- HARRIS, P. M., THURRELL, R. G., HEALING, R. A., and ARCHER, A. A. 1974. Aggregates in Britain. **Proc. R. Soc.**, Ser. A, Vol. 339, 329-353.
- HULL, J. H. 1981. Methods of calculating the volume of resources of sand and gravel. **Appendix** (pp. 192-193) to THURRELL, R. G. 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. **Quarry Management**, for March 1981, 181-193.
- JUKES-BROWNE, A. J. 1883. On the relative age of certain river valleys. **Q. J. Geol. Soc. London**, Vol. 39, 596-610.
- LANE, E. W., and others. 1947. Report of the sub-committee on sediment terminology. **Trans. Am. Geophys. Union**, Vol. 28, 936-938.
- PERRIN, R. M. S., ROSE, J., and DAVIES, H. 1979. The distribution, variation and origins of pre-Devensian tills in eastern England. **Philos. Trans. R. Soc. London**, Ser. B., Vol. 287, 535-570
- PETTIJOHN, F. J. 1957. **Sedimentary rocks.** 2nd edition. (London: Harper and Row.)
- POCOCK, T. L. 1929. The Trent Valley in the Glacial Period. **Z. Gletscherkd.**, Vol. 17, 302-318.
- STRAW, A. 1958. The glacial sequence in Lincolnshire. **East Midl. Geogr.**, Vol. 1, 29-40.
- 1966. The development of the middle and lower Bain Valley, east Lincolnshire. **Trans. Inst. Br. Geogr.** Vol. 40, 145-154.
- SWINNERTON, H. H. 1937. The problem of the Lincoln Gap. **Trans. Lincolnshire Nat. Union**, Vol. 9, 145-153.
- THURRELL, R. G. 1971. The assessment of mineral resources with particular reference to sand and gravel. **Quarry Managers' J.**, Vol. 55, 19-25.
- 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. **Quarry Management**, for March 1981, 181-193.
- TWENHOFEL, W. H. 1937. Terminology of the fine-grained mechanical sediments. **Rep. Natl. Res. Council., Washington, 1936-37, App. 1, Rep. Comm. Sediment.**, 81-104.
- UDDEN, J. A. 1914. Mechanical composition of clastic sediments. **Bull. Geol. Soc. Am.**, Vol. 25, 655-744.
- USSHER, W. A. E., JUKES-BROWNE, A. J., and STRAHAN, A. 1888. The geology of the country around Lincoln. **Mem. Geol. Surv. G. B.**
- WENTWORTH, C. K. 1922. A scale of grade and class terms for clastic sediments. **J. Geol.**, Vol. 30, No. 5 377-392.
- 1935. The terminology of coarse sediments. **Bull. Natl. Res. Council. Washington**, No. 98, 225-246.
- WILLMAN, H. B. 1942. Geology and mineral resources of the Marseilles, Ottawa and Streator quadrangles. **Bull. Illinois State Geol. Surv.**, No. 66, 343-344.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

Trial and error during initial studies of the complex and variable glacial deposits of East Anglia and Essex showed that an absolute minimum of five sample points evenly distributed across the sand and gravel are needed to provide a worthwhile statistical assessment, but that, where possible, there should be not less than ten. Sample points are any points for which adequate information exists about the nature and thickness of the deposit and may include boreholes other than those drilled during the survey and exposures. In particular, the cooperation of sand and gravel operators ensures that boreholes are not drilled where reliable information is already available; although this may be used in the calculations, it is held confidentially by the Institute and cannot be disclosed.

The mineral shown on each 1:25 000 sheet is divided into resource blocks. The arbitrary size selected is a compromise to meet the aims of the survey by providing sufficient sample points in each block. As far as possible the block boundaries are determined by geological boundaries so that, for example, glacial and river terrace gravels are separated. Otherwise division is by arbitrary lines, which may bear no relationship to the geology. The blocks are drawn provisionally before drilling begins.

A reconnaissance of the ground is carried out to record any exposures and inquiries are made to ascertain what borehole information is available. Borehole sites are then selected to provide an even pattern of sample points at a density of approximately one per square kilometre. However, because broad trends are independently overlain by smaller-scale characteristically random variations, it is unnecessary to adhere to a square grid pattern. Thus such factors as ease of access and the need to minimise disturbance to land and the public are taken into account in siting the holes; at the same time it is necessary to guard against the possibility that ease of access (that is, the positions of roads and farms) may reflect particular geological conditions, which may bias the drilling results.

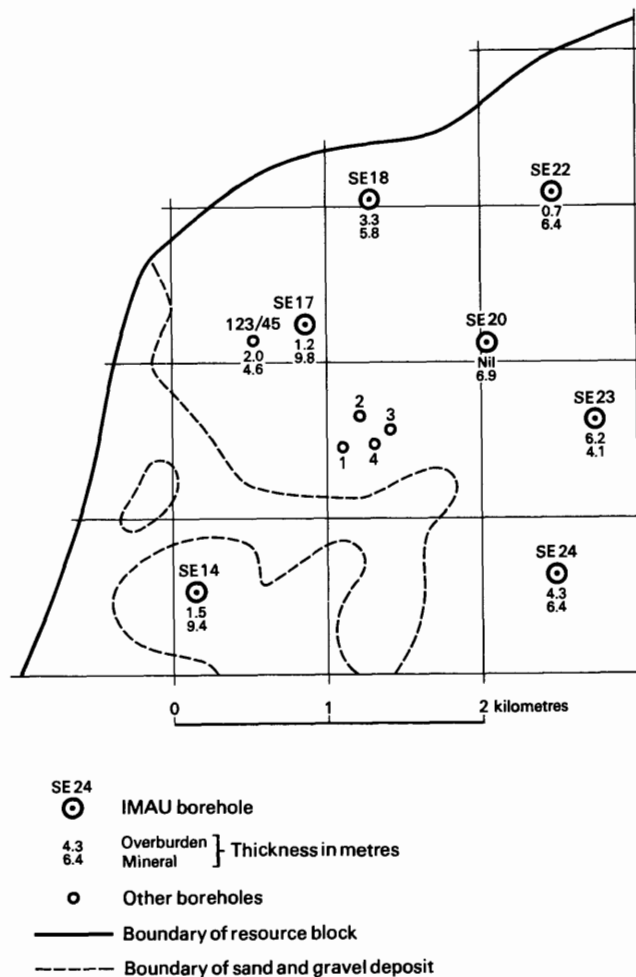
The drilling machine employed should be capable of providing a continuous sample representative of all unconsolidated deposits, so that the in-situ grading can be determined, if necessary, to a depth of 30 m (100 ft) at a diameter of about 200 mm (8 in), beneath different types of overburden. It should be reliable, quiet, mobile and relatively small (so that it can be moved to sites of difficult access). Shell and auger rigs have proved to be almost ideal.

The rigs are modified to enable deposits above the water table to be drilled 'dry', instead of with water added to facilitate the drilling, to minimise the amount of material drawn in from outside the limits of the hole. The samples thus obtained are representative of the in-situ grading, and satisfy one of the most important aims of the survey. Below the water table the rigs are used conventionally, although this may result in the loss of some of the fines fraction and the pumping action of the bailer tends to draw unwanted material into the hole from the sides or the bottom.

A continuous series of bulk samples is taken throughout the sand and gravel. Ideally samples are composed exclusively of the whole of the material encountered in the borehole between stated depths. However, care is taken to discard, as far as possible, material which has caved or has been pumped from the bottom of the hole. A new sample is commenced whenever there is an appreciable lithological change within the sand and gravel, or at every 1 m (3.3 ft) depth. The samples, each weighing between 25 and 45 kg (55 and 100 lb), are despatched in heavy-duty polythene bags to a laboratory for grading. The grading procedure is based on B.S. 1337 (British Standards Institution, 1967). Random checks of the accuracy of the grading are made in the Institute's laboratories.

All data, including mean grading analysis figures calculated for the total thickness of the mineral, are entered on standard record sheets, abbreviated copies of which are reproduced in Appendix E.

Detailed records may be consulted at the appropriate offices of the Institute, upon application to the Head, Industrial Minerals Assessment Unit.



Example of resource block assessment: map of a fictitious block

APPENDIX B

STATISTICAL PROCEDURE

Statistical assessment

1 A statistical assessment is made of an area of mineral greater than 2 km², if there are at least five evenly spaced boreholes in the resource block (for smaller areas, see Paragraph 12 below).

2 The simple methods used in the calculations are consistent with the amount of data provided by the survey (Hull, 1981). Conventional symmetrical confidence limits are calculated for the 95 per cent probability level, that is, on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral.

3 The volume estimate (V) for the mineral in a given block is the product of two variables, the sampled areas (A) and the mean thickness (\bar{l}_m) calculated from the individual thicknesses at the sample points. The standard deviations for these variables are related such that

$$S_V = \sqrt{S_A^2 + S_{\bar{l}_m}^2} \quad [1]$$

4 The above relationship may be transposed such that

$$S_V = S_{\bar{l}_m} \sqrt{1 + S_A^2 / S_{\bar{l}_m}^2} \quad [2]$$

From this it can be seen that as $S_A^2 / S_{\bar{l}_m}^2$ tends to 0, S_V tends to $S_{\bar{l}_m}$.

If, therefore, the standard deviation for area is small with respect to that for thickness, the standard deviation for volume approximates to that for mean thickness.

5 Given that the number of approximately evenly spaced sample points in the sampled area is n with mineral thickness measurements $l_{m1}, l_{m2}, \dots, l_{mn}$, then the best estimate of mean thickness, \bar{l}_m , is given by

$$\bar{l}_m = (\sum (l_{m1} + l_{m2} \dots l_{mn}) / n).$$

For groups of closely spaced boreholes a discretionary weighting factor may be applied to avoid bias (see note on weighting below). The standard deviation for mean thickness $S_{\bar{l}_m}$, expressed as a proportion of the mean thickness, is given by

$$S_{\bar{l}_m} = (\bar{l}_m) \sqrt{[\sum (l_m - \bar{l}_m)^2 / (n - 1)]}$$

where l_m is any value in the series l_{m1} to l_{mn} .

6 The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of a deposit). Where the area is not defined by a mapped boundary, that is, where the boundary is inferred, a distinctive symbol is used. Experience suggests that the errors in determining area are small relative to those in thickness. The relationship $S_A / S_{\bar{l}_m} \leq 0.3$ is assumed in all cases. It follows from Equation [2] that

$$S_{\bar{l}_m} \leq S_V \leq 1.05 S_{\bar{l}_m} \quad [3]$$

7 The limits on the estimate of mean thickness of mineral, $L_{\bar{l}_m}$, may be expressed in absolute units $\pm (t/\sqrt{n}) \times S_{\bar{l}_m}$ or as a percentage $\pm (t/\sqrt{n}) \times S_{\bar{l}_m} \times (100/\bar{l}_m)$ per cent, where t is Student's t at the 95 per cent probability level for $(n - 1)$ degrees of freedom, evaluated by reference to statistical tables. (In applying Student's t it is assumed that the measurements are distributed normally).

8 Values of t at the 95 per cent probability level for values of n up to 20 are as follows:

n	t	n	t
1	infinity	11	2.228
2	12.706	12	2.201
3	4.303	13	2.179
4	3.182	14	2.160
5	2.776	15	2.145
6	2.571	16	2.131
7	2.447	17	2.120
8	2.365	18	2.110
9	2.306	19	2.101
10	2.262	20	2.093

(from Table 12 in *Biometrika Tables for Statisticians*, Volume 1, Second Edition, Cambridge University Press, 1962). When n is greater than 20, 1.96 is used (the value of t when n is infinity).

9 In calculating confidence limits for volume, L_V , the following inequality, corresponding to Equation [3], is applied:

$$L_{\bar{l}_m} \leq L_V \leq 1.05 L_{\bar{l}_m}.$$

10 In summary, for values of n between 5 and 20, L_V is calculated as

$$[(1.05 \times t) / \bar{l}_m] \times [\sqrt{\sum (l_m - \bar{l}_m)^2 / n} (n - 1)] \times 100$$

per cent,

and when n is greater than 20, as

$$[(1.05 \times 1.96) / \bar{l}_m] \times [\sqrt{\sum (l_m - \bar{l}_m)^2 / n} (n - 1)] \times 100$$

per cent.

11 The application of this procedure to a fictitious area is illustrated in the accompanying Figure and example of a block calculation.

Inferred assessment

12 If the sampled area of mineral in a resource block is between 0.25 km² and 2 km², an assessment is inferred on the basis of geological and topographical information, usually supported by the data from one or two boreholes. The volume of mineral is calculated as the product of the area, measured from field data, and the estimated thickness. Confidence limits are not calculated.

13 In some cases a resource block may include an area left uncoloured on the map, within which mineral (as defined) is interpreted to be generally absent. If there is reason to believe that some mineral may be present, an inferred assessment may be made.

14 No assessment is attempted for an isolated area of mineral less than 0.25 km².

15 Note on weighting The thickness of a deposit at any point may be governed solely by the position of the point in relation to a broad trend. However, most sand and gravel deposits also exhibit a random pattern of local, and sometimes considerable, variation in thickness. Thus the distribution of sample points needs to be only approximately regular and in estimating the mean thickness only simple weighting is necessary. In practice, equal weighting can often be applied to thicknesses at all sample points. If, however, there is a distinctly unequal distribution of points, bias is avoided by dividing the sampled area into broad zones, to each of which a value roughly proportional to its area is assigned. This value is then shared between the data points with the zone as the weighting factor.

Block calculation

Scale: 1:25 000
Block: Fictitious

Area
Block: 11.08 km²
Mineral: 8.32 km²

Mean thickness
Overburden: 2.5 m
Mineral: 6.5 m

Volume
Overburden: 21 million m³
Mineral: 54 million m³

Confidence limits of the estimate of mineral volume at the 95 per cent probability level: ± 20 per cent
That is, the volume of mineral (with 95 per cent probability): 54 ± 11 million m³

Thickness estimate (measurements in metres)
 l_o = overburden thickness l_m = mineral thickness

Sample point	Weighting w	Overburden		Mineral		Remarks
		l_o	wl_o	l_m	wl_m	
SE 14	1	1.5	1.5	9.4	9.4	IMAU boreholes
SE 18	1	3.3	3.3	5.8	5.8	
SE 20	1	nil	-	6.9	6.9	
SE 22	1	0.7	0.7	6.4	6.4	
SE 23	1	6.2	6.2	4.1	4.1	
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	$\frac{1}{2}$	1.2	1.6	9.8	7.2	Hydrogeology Unit record
123/45	$\frac{1}{2}$	2.0		4.6		
1	$\frac{1}{4}$	2.7	2.6	7.3	5.8	Close group of four boreholes (commercial)
2	$\frac{1}{4}$	4.5		3.2		
3	$\frac{1}{4}$	0.4		6.8		
4	$\frac{1}{4}$	2.8		5.9		
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.2$		$\Sigma wl_m = 52.0$		
Means		$\overline{wl_o} = 2.5$		$\overline{wl_m} = 6.5$		

Calculation of confidence limits

wl_m	$ (wl_m - \overline{wl_m}) $	$(wl_m - \overline{wl_m})^2$
9.4	2.9	8.41
5.8	0.7	0.49
6.9	0.4	0.16
6.4	0.1	0.01
4.1	2.4	5.76
6.4	0.1	0.01
7.2	0.7	0.49
5.8	0.7	0.49

$$\Sigma (wl_m - \overline{wl_m})^2 = 15.82$$

$$n = 8$$

$$t = 2.365$$

L_V is calculated as

$$1.05 (t / \overline{wl_m}) \sqrt{[\Sigma (wl_m - \overline{wl_m})^2 / n(n-1)] \times 100}$$

$$= 1.05 \times (2.365/6.5) \sqrt{[15.82/(8 \times 7)] \times 100}$$

$$= 20.3$$

$$\approx 20 \text{ per cent.}$$

APPENDIX C

CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

For the purposes of assessing resources of sand and gravel a classification should take account of economically important characteristics of the deposit, in particular the absolute content of fines and the ratio of sand to gravel.

The terminology commonly used by geologists when describing sedimentary rocks (Wentworth, 1922) is not entirely satisfactory for this purpose. For example, Wentworth proposed that a deposit should be described as a 'gravelly sand' when it contains more sand than gravel and there is at least 10 per cent of gravel, provided that there is less than 10 per cent of material finer than sand ($< \frac{1}{16}$ mm) and coarser than pebbles (> 64 mm in diameter). Because deposits containing more than 10 per cent fines are not embraced by this system, a modified binary classification based on Willman (1942) has been adopted.

When the fines content exceeds 40 per cent the material is considered to be not potentially workable and falls outside the definition of mineral. Deposits which contain 40 per cent fines or less are classified primarily on the ratio of sand to gravel but qualified in the light of the fines content, as follows: less than 10 per cent fines - no qualification; 10 per cent or more but less than 20 per cent fines - 'clayey'; 20 to 40 per cent fines - 'very clayey'.

The term 'clay' (as written, with single quote marks) is used to describe all material passing $\frac{1}{16}$ mm. Thus it has no mineralogical significance and includes particles falling within the size range of silt. The normal meaning applies to the term clay where it does not appear in single quotation marks.

The ratio of sand to gravel defines the boundaries between sand, pebbly sand, sandy gravel and gravel (at 19:1, 3:1 and 1:1).

Thus it is possible to classify the mineral into one of twelve descriptive categories (see the accompanying Figure). The procedure is as follows:

- 1 Classify according to the ratio of sand to gravel.
- 2 Describe the fines.

For example, a deposit grading 11 per cent gravel, 70 per cent sand and 19 per cent fines is classified as 'clayey' pebbly sand. This short description is included in the borehole log (see Appendix D)

Many differing proposals have been made for the classification of the grain size of sediments (Atterberg, 1905; Udden, 1914; Wentworth, 1922; Wentworth, 1935; Allen, 1936; Twenhofel, 1937; Lane and others, 1947). As Archer (1970a, b) has emphasised, there is a pressing need for a simple metric scale acceptable to both scientific and engineering interests, for which the class limit sizes correspond closely with certain marked changes in the natural properties of mineral particles. For example, there is an important change in the degree of cohesion between particles at about the $\frac{1}{16}$ -mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology (see the accompanying table), which is used in the Report.

The fairly wide intervals in the scale are consistent with the general level of accuracy of the qualitative assessments of the resource blocks. Three sizes of sand are recognised, fine ($+\frac{1}{16} - \frac{1}{4}$ mm), medium ($+\frac{1}{4} - 1$ mm) and coarse ($+1 - 4$ mm). The boundary at 16 mm distinguishes a range of finer gravel ($+4 - 16$ mm), often characterised by abundance of worn tough pebbles of vein quartz, from larger pebbles, often of notably different materials. The boundary at 64 mm distinguishes pebbles from cobbles. The term 'gravel' is used loosely to denote both pebble-sized and cobble-sized material.

The size distribution of borehole samples is determined by sieve analysis, which is presented by the laboratory as logarithmic cumulative curves (see, for example, British Standards Institution, 1967). In this report the grading is tabulated on the borehole record sheets (Appendix E), the intercepts corresponding with the simple geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm and so on as required. Original sample grading curves are available for reference at the appropriate office of the Institute.

Each bulk sample is described, subjectively, by a geologist at the borehole site. Being based on visual examination, the description of the grading is inexact, the accuracy depending on the experience of the observer. The descriptions recorded are modified, as necessary, when the laboratory results become available.

The relative proportions of the rock types present in the gravel fraction are indicated by the use of the words 'and' or 'with'. For example, 'flint and quartz' indicates roughly equal proportions with neither constituent accounting for less than about 25 per cent of the whole; 'flint with quartz' indicates that flint is dominant and quartz, the principal accessory rock type, comprises 5 to 25 per cent of the whole. Where the accessory material accounts for less than 5 per cent of the whole, but is still readily apparent, the phrase 'with some' has been used. Rare constituents are referred to as 'trace'.

The terms used in the field to describe the degree of rounding of particles, which is concerned with the sharpness of the edges and corners of a clastic fragment and not the shape (after Pettijohn, 1957), are as follows.

Angular: showing little or no evidence of wear; sharp edges and corners.

Subangular: showing definite effects of wear. Fragments still have their original form but edges and corners begin to be rounded off.

Subrounded: showing considerable wear. The edges and corners are rounded off to smooth curves. Original grain shape is still distinct.

Rounded: original faces almost completely destroyed, but some comparatively flat surfaces may still remain. All original edges and corners have been smoothed off to rather broad curves. Original shape is still apparent.

Well rounded: not original faces, edges or corners left. The entire surface consists of broad curves; flat areas are absent. The original shape is suggested by the present form of the grain.

Classification of gravel, sand and fines

Size limits	Grain-size description	Qualification	Primary classification
64 mm	Cobble		
16 mm	Pebble	Coarse	Gravel
4 mm		Fine	
1 mm		Coarse	
$\frac{1}{4}$ mm	Sand	Medium	Sand
$\frac{1}{16}$ mm		Fine	
	Fines (silt and clay)		Fines

- I Gravel
- II 'Clayey' gravel
- III 'Very clayey' gravel
- IV Sandy gravel
- V 'Clayey' sandy gravel
- VI 'Very clayey' sandy gravel
- VII Pebbly sand
- VIII 'Clayey' pebbly sand
- IX 'Very clayey' pebbly sand
- X Sand
- XI 'Clayey' sand
- XII 'Very clayey' sand

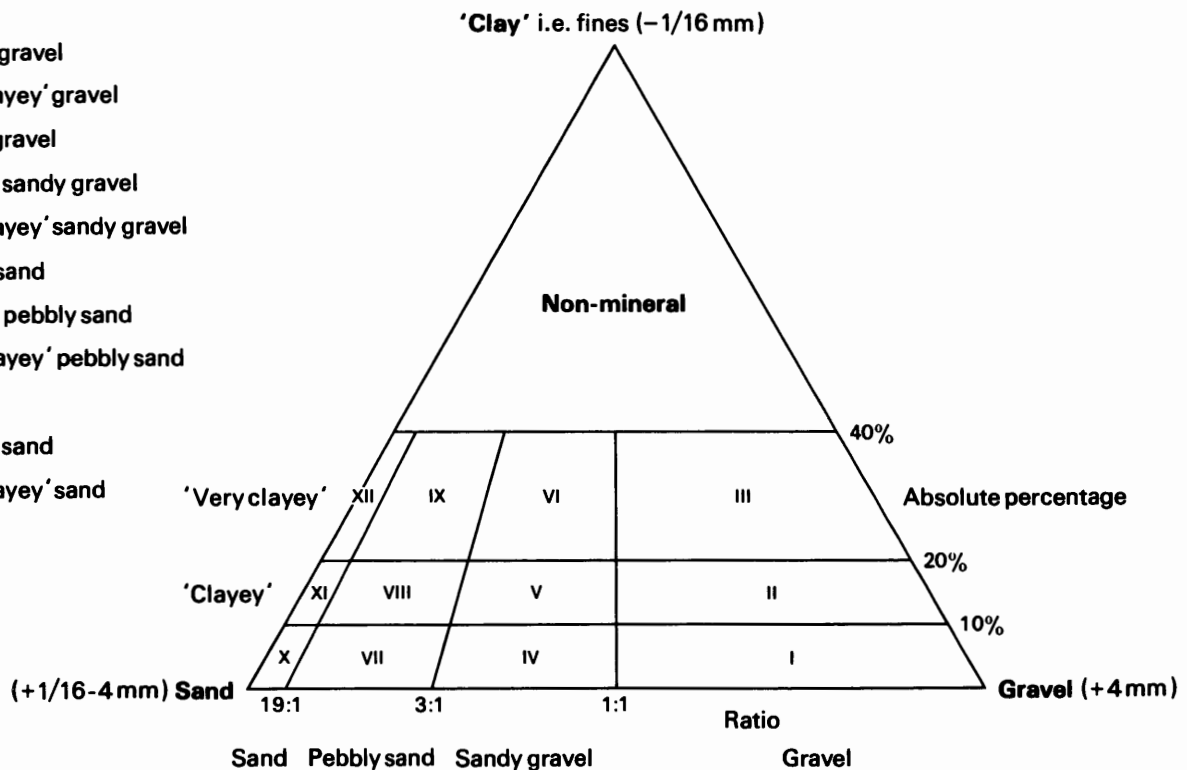


Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D

EXPLANATION OF THE BOREHOLE RECORDS

Annotated fictitious example

CK 66 NW 5¹ 6191 6962² Northfields³

Surface level (+49.7 m) +163 ft⁴
 Water struck at +45.9 m⁵
 October 1972⁶

Block B

Overburden	7	2.8 m
Mineral		5.4 m
Waste		1.1 m
Mineral		1.4 m
Bedrock		0.7 m ⁸

LOG

Geological classification	Lithology ⁹	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	Clay, silty, dark brown	2.6	2.8
River Terrace Deposits	a Gravel Gravel: fine to coarse, with cobbles towards base, angular to rounded flint and limestone with ironstone and some quartz and chalk Sand: medium with coarse and some fine, quartz and limestone	5.4	8.2
Boulder Clay	Clay, sandy and pebbly, red-brown	1.1	9.3
Glacial Sand and Gravel	b Sand, 'clayey' in part: fine, subangular to rounded, quartz with some coal	1.4	10.7
Lias	Mudstone, blue-grey, fossiliferous	0.7+	11.4

GRADING¹⁰

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines				Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	5	46	49	2.8-3.9	20	14	62	2	2	0	0
				3.8-4.8	2	2	12	18	42	24	0
				4.8-5.8	1	3	24	13	35	24	0
				5.8-6.8	0	4	21	20	26	29	0
				6.8-8.2	4	3	23	10	23	30	7
				Mean	5	5	28	13	25	22	2
b	5	95	0	9.3-10.3	3	73	23	1	0	0	0
				10.3-10.7	9	85	5	1	0	0	0
				Mean	5	77	17	1	0	0	0
a+b	5	56	39	Mean	5	20	26	10	20	17	2

COMPOSITION¹¹

Depth below surface (m)	percentages by weight in the 8-16 mm fraction				
	Flint	Quartz	Limestone	Chalk	Ironstone
3.8-4.8	41	5	50	1	3
4.8-5.8	39	3	45	5	8
5.8-6.8	45	2	42	5	6
6.8-8.2	19	6	61	3	11
Mean	35	4	51	3	7

The numbered paragraphs below correspond with the annotations given on the specimen record opposite.

1 Borehole Registration Number

Each Industrial Minerals Assessment Unit (IMAU) borehole is identified by a Registration Number. This consists of two statements.

- a The number of the 1:25 000 sheet on which the borehole lies, here CK 66.
- b The quarter of the 1:25 000 sheet on which the borehole lies and the number of the borehole in a series for that quarter, here NW 5.

Thus the full Registration Number is CK 66 NW 5.

2 National Grid Reference

All National Grid References fall in the 100 km square identified by the first two letters of the Registration Number. Grid references are given to eight figures, accurate to within 10 m.

3 Location

The position of the borehole is generally referred to the nearest named locality on the 1:25 000 base map and the resource block in which the borehole lies is stated.

4 Surface level

The surface level at the borehole site is given in metres and feet above Ordnance Datum. All measurements were made in feet; approximate conversions to metres are given in brackets.

5 Groundwater conditions

If groundwater was present the level at which it was encountered is normally given (in metres relative to Ordnance Datum).

6 Type of drill and date of drilling

Unless otherwise stated the borehole was drilled by a shell and auger rig using 152 mm diameter casing. The month and year of completion of drilling are stated.

7 Overburden, mineral, waste and bedrock

Mineral is sand and gravel which, as part of a deposit, falls within the arbitrary definition of potentially workable material (see p. 1). Bedrock is the 'formation', 'country rock' or 'rock head' below which potentially workable sand and gravel will not be found. Waste is any material other than bedrock or mineral. Where waste occurs between the surface and mineral it is classified as overburden.

8 The plus sign (+) indicated that the base of the deposit was not reached during drilling.

9 Lithological description

When sand and gravel is recorded a general description based on the grading characteristics (for details see Appendix C) is followed by more detailed particulars of the gravel and/or sand fraction. Where more than one bed of mineral is recognised each is designated by a letter, e.g. **a**, **b**, etc. The description of other deposits is based on visual examination in the field.

10 Grading data

A continuous series of bulk samples is taken throughout the thickness of sand and gravel. A new sample is commenced whenever there is an appreciable lithological change or at every 1 m of depth.

For each bulk sample the percentages of fines ($-\frac{1}{16}$ mm), fine sand ($+\frac{1}{16}-\frac{1}{4}$ mm), medium sand ($+\frac{1}{4}-1$ mm), coarse sand ($+1-4$ mm), fine gravel ($+4-16$ mm) and coarse and cobble gravel ($+16$ mm) are stated.

The mean grading of groups of samples making up an identified bed of mineral are also given in detail and in summary. Where more than one bed is recognised the

mean grading for the whole of the mineral in the borehole may be given. Where necessary, in calculating mean gradings, data for individual samples are weighted by the thickness represented.

Fully representative sampling of sand and gravel is difficult to achieve, particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures commonly suggests that in borehole samples the proportion of sand may be higher and the proportion of fines and coarse gravel may be lower.

11 Composition

Details of the composition of selected samples or groups of samples may be given. Where appropriate the calculated weighted mean composition of groups of samples may be quoted.

APPENDIX E

INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS

TF 16 NW 33	1083 6915	Bardney	Block B₁
Surface level (+2.5 m) +8 ft			Overburden 4.0 m
Water struck at -1.5 m			Mineral 6.3 m
March 1979			Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	1.4	1.4
Marine or Estuarine Alluvium	Peat, sandy and silty, dark brown; clayey to base	1.5	2.9
	Clay, pale brown, becoming bluish grey mottled with olive grey; some pockets of fine gravel and sand	1.1	4.0
River Gravels	a Sandy gravel Gravel: fine, subangular to subrounded white flint with subrounded limestone and rounded quartzite and quartz Sand: medium and fine quartz with coarse white flint	1.0	5.0
	b Sand, pebbly in part Gravel: fine, subrounded cream limestone and rounded quartzite with subangular flint Sand: medium with fine quartz with some coarse flint and limestone	2.0	7.0
	c Sandy gravel Gravel: mainly fine, subrounded to rounded quartzite with subangular flint, rounded to well rounded quartz, some subrounded limestone, sandstone and ironstone and trace mudstone and igneous Sand: medium, quartz with some flint, limestone and quartzite	3.3	10.3
Ancholme Clay Group	Clay, silty, dark greenish grey	0.6+	10.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	5	60	35	4.0-5.0	5	21	30	9	31	4	0
b	6	91	3	5.0-7.0	6	33	56	2	3	0	0
c	1	52	47	7.0-8.0	1	11	38	8	23	19	0
				8.0-9.0	1	6	43	10	27	13	0
				9.0-10.3	1	9	23	12	37	18	0
				Mean	1	8	33	11	30	17	0
a+b+c	3	65	32	Mean	3	18	38	9	22	10	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a+b	4.0-5.0	58	13	18	11	0	0	0	0	0
	5.0-7.0	14	32	52	0	0	0	0	0	0
	Mean	50	18	23	9	0	0	0	0	0
c	7.0-8.0	16	51	12	18	0	0	3	trace	0
	8.0-9.0	21	50	7	16	3	0	2	1	0
	9.0-10.3	14	51	6	24	3	trace	1	1	0
	Mean	16	51	8	21	2	trace	1	1	0
a+b+c	Mean	23	44	11	18	2	trace	1	1	0

TF 16 NW 34 1232 6904 Bardney Block A₁

Surface level (+12.0 m) +39 ft
 Water struck at +8.4 m
 April 1979

Overburden 0.4 m
 Mineral 5.5 m
 Waste 3.5 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	a 'Clayey' sand, pebbly at top Gravel: coarse Sand: fine with medium, quartz Fines: dark yellowish orange silt, with some pale grey silt bands at 2.3 m	4.1	4.5
	b Sandy gravel, 'clayey' to 5.5 m Gravel: fine with coarse, subrounded to rounded quartzite with subrounded chalk and limestone, angular to sub-angular flint and some quartz, sandstone and trace ironstone Sand: fine, quartz with some chalk, limestone and flint	1.4	5.9
Till	Clay, dark bluish grey with flint, chalk and tabular mudstone and siltstone pebbles	3.5	9.4
Ancholme Clay Group	Clay, very dark greenish grey, some fossils observed	0.8+	10.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	19	78	3	0.4-1.5	11	42	32	1	4	10	0
				1.5-2.5	19	57	22	2	0	0	0
				2.5-3.5	27	72	1	0	0	0	0
				3.5-4.5	18	78	4	0	0	0	0
				Mean	19	62	15	1	1	2	0
b	9	60	31	4.5-5.5	12	63	3	2	12	8	0
				5.5-5.9	5	17	7	11	33	27	0
				Mean	9	50	5	5	18	13	0
a+b	16	74	10	Mean	16	59	13	2	5	5	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
4.5-5.5	23	35	26	11	5	0	0	0	0
5.5-5.9	23	37	26	9	3	0	2	0	0
Mean	23	36	26	10	4	0	1	0	0

TF 16 NW 35 1333 6941 Bardney Common Block A₁

Surface level (+5.4 m) +18 ft Overburden 0.8 m
 Water struck at +2.0 m Mineral 1.2 m
 March 1979 Waste 2.0 m
 Bedrock 2.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel Gravel: fine, angular to subangular flint with some rounded quartzite, quartz and sandstone and trace mudstone and ironstone Sand: medium quartz with medium and coarse flint	1.2	2.0
Till	Clay, silty and sandy, banded light olive brown and greenish grey becoming bluish grey and pebbly	1.4	3.4
	'Clayey' gravel Gravel: fine to coarse, subrounded flint, chalk and limestone with some quartz, quartzite and sandstone Sand: medium to coarse, quartz and rock fragments	0.6	4.0
Ancholme Clay Group	Clay, silty, greenish black	2.6+	6.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
5	49	46	0.8-0.2	5	9	25	15	37	9	0
11	39	50	3.4-4.0	11	9	17	13	31	19	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.8-2.0	70	16	0	10	4	trace	trace	0	0
3.4-4.0	56	4	35	3	2	0	0	0	trace
Mean	66	12	11	8	3	trace	trace	0	trace

Surface level (+1.5 m) +5 ft
 Water struck at -1.5 m
 February 1979

Overburden 4.6 m
 Mineral 5.2 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.5	1.5
Marine or Estuarine Alluvium	Silty clay, grey with sandy peat bands	0.5	2.0
	Sandy peat, dark brown; fine quartz sand	1.4	3.4
	Silty clay, pale grey and chocolate brown with dark brown sand layers; poorly laminated with some plant remains	1.2	4.6
River Gravels	a 'Clayey' pebbly sand Gravel: fine, subangular to subrounded, flint and chalk Sand: fine, quartz Fines: pale grey brown	1.4	6.0
	b Sand, fine and medium, quartz	3.0	9.0
	c Gravel Gravel: fine and coarse, subrounded to rounded quartzite with subangular flint and subrounded to rounded quartz and sandstone and some limestone Sand: medium, quartz with some quartzite and flint	0.8	9.8
Ancholme Clay Group	Clayey silt, dark greenish grey	0.8+	10.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	15	78	7	4.6-5.0	11	49	32	5	3	0	0
				5.0-6.0	17	40	26	9	7	1	0
				Mean	15	42	28	8	6	1	0
b	5	95	0	6.0-9.0	5	47	48	0	0	0	0
c	3	47	50	9.0-9.8	3	6	33	8	26	24	0
a+b+c	8	82	10	Mean	8	39	40	3	6	4	0

TF 16 NW 37 1368 6780

Southrey Wood

Block A₁

Surface level (+7.9 m) +26 ft
Water not struck
March 1979

Waste 8.9 m
Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, silty, dark olive grey, mottled with light olive brown; pebbles of chalk and flint and some sandy bands; becomes greenish black below 4.0 m with gradual decrease in chalk and increase in tabular greenish black mudstone pebbles	8.7	8.9
Ancholme Clay Group	Clay, silty, greenish grey with sporadic fossils	1.1+	10.0

TF 16 NW 38 1400 6889

Tupholme Holt

Block A₁

Surface level (+5.1 m) +17 ft
Water struck at +2.3 m
March 1979

Overburden 2.8 m
Mineral 1.7 m
Bedrock 2.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	Clay, very sandy and silty, dark yellowish orange with some pebbles	2.4	2.8
	Gravel Gravel: fine, subrounded to rounded quartzite with rounded quartz, angular flint and some subrounded sandstone and trace ironstone Sand: medium, quartz Fines: very dark yellowish orange silt	1.7	4.5
Ancholme Clay Group	Clay, silty, greenish black with some shell fragments	2.0+	6.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
8	40	52	2.8-4.5	8	6	22	12	37	15	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
2.8-4.5	17	56	0	21	6	0	trace	0	0

Surface level (+2.6 m) +9 ft
 Water struck at -2.4 m
 February 1979

Overburden 4.9 m
 Mineral 6.9 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.4	1.4
Marine or Estuarine Alluvium	Clay, silty, olive grey with greyish black partings, peat bands and other disseminated organic matter	1.4	2.8
	Sandy silt, grey, medium and fine sand with some organic material	0.4	3.2
River Gravels	Clay, silty, grey with organic material to 3.8 m, then firm, reddish brown and poorly laminated	1.7	4.9
	a Sandy gravel Gravel: fine, subrounded chalk and flint with subrounded to well rounded quartzite and quartz and some igneous, limestone and mudstone Sand: medium with fine, quartz with some lithic grains in coarser grades	2.2	7.1
	b Sandy gravel Gravel: fine to coarse, subrounded quartzitic sandstones, rounded quartz with subrounded chalk and flint Sand: medium, quartz with some lithic grains in coarser grades	2.4	9.5
	c Pebbly sand Gravel: fine and coarse, subrounded quartzitic sandstone, rounded quartz with some flint Sand: medium, quartz with lithic grains in coarser grades	2.3	11.8
Ancholme Clay Group	Clayey silt, dark greenish grey	0.9+	12.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	2	71	27	4.9-5.9	3	23	41	9	21	3	0
				5.9-7.1	1	18	39	12	25	5	0
				Mean	2	21	40	10	23	4	0
b	1	57	42	7.1-8.1	1	11	33	10	26	19	0
				8.1-9.5	0	7	41	11	26	15	0
				Mean	1	9	38	10	25	17	0
c	3	85	12	9.5-10.5	3	12	69	4	9	3	0
				10.5-11.8	2	14	70	2	4	8	0
				Mean	3	13	69	3	6	6	0
a+b+c	2	61	27	Mean	2	14	49	8	18	9	0

Surface level (+1.4 m) +5 ft
 Water struck at -2.6 m
 February 1979

Overburden 1.8 m
 Mineral 1.9 m
 Waste 0.3 m
 Mineral 8.5 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.0	1.0
Marine or Estuarine Alluvium	Silt, sandy and peaty; grey and brown	0.8	1.8
River Gravels	a 'Clayey' pebbly sand Gravel: fine to coarse Sand: medium and fine, quartz Fines: greyish brown disseminated silt	1.9	3.7
	Clay, silty, grey with reddish brown patches	0.3	4.0
	b Gravel Gravel: fine with coarse, subrounded to rounded quartzite with rounded quartz, subangular flint and trace igneous and limestone Sand: medium quartz with some coarse lithic grains	8.5	12.5
Ancholme Clay Group	Clayey silt, dark greenish grey	0.9+	13.4

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	19	72	9	1.8-2.8	16	36	41	3	4	0	0
				2.8-3.7	22	21	39	3	7	8	0
				Mean	19	29	40	3	5	4	0
b	3	32	65	4.0-5.0	3	3	12	7	48	27	0
				5.0-6.5	1	3	20	7	37	32	0
				6.5-7.5	1	3	23	12	49	12	0
				7.5-8.5	2	4	24	16	40	14	0
				8.5-9.5	1	2	18	11	42	26	0
				9.5-10.5	12	2	18	7	27	33	1
				10.5-11.5	1	3	27	6	45	18	0
				11.5-12.5	3	3	18	6	58	12	0
				Mean	3	3	20	9	43	22	0
a+b	6	39	55	Mean	6	8	23	8	36	19	0

Surface level (+8.6 m) +28 ft
 Water not struck
 March 1979

Overburden 1.4 m
 Mineral 1.4 m
 Waste 5.6 m
 Bedrock 0,7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	Silt, dark yellowish orange and greyish green, clayey, sandy and pebbly	1.0	1.4
	'Clayey' sandy gravel Gravel: coarse to fine, subangular flint with subrounded quartz, chalk, limestone, quartzite and sandstone Sand: medium with fine, quartz with some dark lithic grains and flint	1.4	2.8
Till	Clay, silty, greenish black, with fine subrounded chalk and some flint and tabular mudstone pebbles	5.6	8.4
Ancholme Clay Group	Silt, clayey, greenish grey	0.7+	9.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
11	58	31	1.4-2.8	11	19	34	5	14	17	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
1.4-2.8	39	11	16	23	11	0	0	0	0

Surface level (+2.4 m) +8 ft
 Water struck at -1.8 m
 February 1979

Overburden 0.8 m
 Mineral 4.2 m
 Waste 0.3 m
 Mineral 7.0 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	0.5	0.5
Marine or Estuarine Alluvium	Peaty silt, dark brown	0.3	0.8
	a Sand, peaty and dark brown to 1.3 m with a thin peat band at 4.0 m; orange-brown from 1.3-4.0 m, greyish brown below; medium to fine quartz with lithic grains	4.2	5.0
	Clayey silt, purplish, reddish brown, firm with rootlets	0.3	5.3
River Gravels	b Sand, with reeds and other plant debris at top; medium to fine quartz with some chalk, white limestone and flint pebbles to base	1.1	6.4
	c Pebbly sand Gravel: fine, subrounded quartzite, chalk, quartz and white flint and limestone with trace mudstone and ironstone Sand: medium, quartz with some lithic grains	1.0	7.4
	d Gravel Gravel: fine with coarse, subrounded to rounded quartzite with rounded quartz and some subangular flint, subrounded limestone and sandstone and trace ironstone and igneous Sand: medium, quartz with some lithic grains	4.9	12.3
	Ancholme Clay Group	Clayey silt, olive grey, poorly laminated in parts	0.8+

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Gravel						
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	6	94	0	0.8-3.2	6	40	53	1	0	0	0
				3.2-5.0	4	42	53	1	0	0	0
				Mean	6	40	53	1	0	0	0
b	2	94	4	5.3-6.4	2	36	56	2	4	0	0
c	1	76	23	6.4-7.4	1	12	52	12	20	3	0
d	1	49	50	7.4-8.4	2	11	36	10	26	15	0
				8.4-9.4	1	8	38	16	32	5	0
				9.4-10.4	0	4	27	12	27	30	0
				10.4-11.4	0	3	28	13	34	22	0
				11.4-12.3	0	1	25	16	40	18	0
Mean	1	5	31	13	32	18	0				
a-d	3	73	24	Mean	3	22	44	7	16	8	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
c	6.4-7.4	20	38	21	16	4	0	1	0	0
d	7.4-8.4	10	50	15	15	8	0	2	trace	0
	8.4-9.4	15	45	8	22	6	0	1	0	3
	9.4-10.4	7	58	4	27	3	0	1	0	0
	10.4-11.4	10	55	6	19	8	0	2	0	0
	11.4-12.3	7	57	6	23	6	0	1	trace	0
	Mean	10	53	8	22	6	0	1	trace	0
c+d	Mean	11	51	9	22	6	0	1	trace	trace

TF 16 NW 43 1115 6607 Hares Head Drain Block B₁

Surface level (+2.5 m) +8 ft Overburden 2.8 m
 Water struck at -0.3 m Mineral 3.9 m
 February 1979 Bedrock 1.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.3	1.3
Marine or Estuarine Alluvium	Clay, silty, peaty in part, olive grey with rust-brown and greyish black lenses	0.7	2.0
	Silt, clayey, grey, soft with sand partings	0.5	2.5
	Clay, silty, greyish brown, stiff with sand partings	0.3	2.8
River Gravels	Gravel	3.9	6.7
	Gravel: mainly fine, coarse material increases to base; subrounded quartzite and quartz with some subangular flint, subrounded limestone and sandstone and trace igneous Sand: medium quartz with some coarse rock fragments		
Ancholme Clay Group	Silt, clayey, dark greenish grey, massive	1.9+	8.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
1	47	52	2.8-3.8	4	10	45	8	23	10	0
			3.8-4.8	1	4	27	14	40	14	0
			4.8-5.8	0	3	25	11	35	26	0
			5.8-6.7	0	2	23	13	35	27	0
			Mean	1	5	30	12	33	19	0

Surface level (+1.9 m) +6 ft
 Water struck at -1.6 m
 February 1979

Overburden 1.2 m
 Mineral 5.7 m
 Bedrock 1.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.2	1.2
Marine or Estuarine Alluvium	a 'Clayey' sand, fine with medium quartz; peaty in part with silty bands	1.0	2.2
River Gravels	b 'Clayey' pebbly sand Gravel: fine, subangular flint and subrounded to rounded quartzite with some quartz and sandstone Sand: medium, quartz with some lithic grains Fines: olive grey	1.0	3.2
	c Sandy gravel Gravel: fine with coarse, subrounded to rounded quartzite with subangular flint, rounded quartz and some sandstone Sand: medium, quartz with some lithic grains	3.7	6.9
Ancholme Clay Group	Silt, clayey, greyish olive becoming dark greenish grey	1.3+	8.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	19	77	4	1.2-2.2	19	41	34	2	4	0	0
b	11	72	17	2.2-3.2	11	17	49	6	15	2	0
c	4	54	42	3.2-4.2	4	6	29	15	32	14	0
				4.2-5.2	3	10	40	7	21	19	0
				5.2-6.2	1	21	40	5	18	15	0
				6.2-6.9	7	6	23	12	31	19	2
			Mean	4	11	33	10	25	17	0	
a+b+c	8	61	31	Mean	8	17	36	8	20	11	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
b	2.2-3.2	44	40	0	8	8	0	0	0	0
c	3.2-4.2	23	44	0	26	5	0	0	2	0
	4.2-5.2	20	51	0	24	5	0	trace	0	0
	5.2-6.2	17	52	0	23	6	0	trace	2	0
	6.2-6.9	12	59	0	20	7	0	trace	2	0
	Mean	18	51	0	23	6	0	trace	2	0
b+c	Mean	22	50	0	21	6	0	trace	1	0

TF 16 NW 45 1353 6678

Southrey

Block A₁

Surface level (+7.4 m) +24 ft
 Water struck at +6.0 m
 March 1979

Overburden 1.3 m
 Mineral 1.0 m
 Waste 1.7 m
 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	Clay, very sandy, pebbly and silty with alternating dark yellowish orange sandy bands and greyish yellowish green silt partings; pebbles are of flint and quartzite	0.7	1.3
	'Clayey' pebbly sand Gravel: fine and coarse, subangular flint and some subrounded quartzite Sand: medium quartz Fines: dark yellowish orange, disseminated	1.0	2.3
Till	Clay, silty, very dark greenish grey with fine subrounded chalk and some siltstone, sandstone and flint pebbles	1.7	4.0
Ancholme Clay Group	Silt, clayey, greenish grey, sporadic fossils	1.1+	5.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
16	78	6	1.3-2.3	16	19	57	2	3	3	0

TF 16 NW 46 1007 6551

Hares Head Drain

Block B₁

Surface level (+2.0 m) + 6 ft
 Water struck at -1.5 m
 February 1979

Overburden 3.5 m
 Mineral 6.9 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.2	1.2
Marine or Estuarine Alluvium	Clay, silty, olive grey with steel grey and rust brown mottling; some dark grey lenses	1.7	2.9
	Peat, dark brown	0.4	3.3
	Clay, silty, grey and reddish brown with sandy partings	0.2	3.5
	a Sand, medium and fine, quartz; olive silt	1.0	4.5
River Gravels	b Sandy gravel Gravel: fine, subangular to subrounded flint and subrounded chalk and limestone with some rounded quartzite and quartz Sand: medium with fine, quartz with some lithics	2.0	6.5

c	Sandy gravel	3.9	10.4
	Gravel: fine with coarse, rounded quartzite with some well rounded quartz and subangular to subrounded flint and limestone		
	Sand: medium, some coarse, quartz with lithic grains		

Ancholme Clay Group	Silt, clayey, dark greenish grey	0.8+	11.2
---------------------	----------------------------------	------	------

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines				Gravel		
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	6	94	0	3.5-4.5	6	44	49	1	0	0	0
b	4	67	29	4.5-5.5	4	26	39	6	21	4	0
				5.5-6.5	4	18	33	11	28	6	0
				Mean	4	22	36	9	24	5	0
c	2	61	37	6.5-7.5	1	10	44	9	27	9	0
				7.5-8.5	5	5	60	10	15	5	0
				8.5-9.5	1	3	27	10	37	22	0
				9.5-10.4	0	3	51	15	25	6	0
				Mean	2	5	45	11	26	11	0
a+b+c	3	67	30	Mean	3	16	43	8	22	8	0

TF 16 NW 47	1192 6535	Garden Farm	Block B₂
Surface level (+1.0 m) +3 ft		Overburden 1.6 m	
Water struck at -1.7 m		Mineral 5.2 m	
February 1979		Bedrock 1.9 m+	

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.4	1.4
Marine or Estuarine Alluvium	Clay, silty greenish grey with rust brown mottling; some plant remains	0.2	1.6
River Gravels	Sandy gravel, 'clayey' in first metre, gravel at base Gravel: fine but coarsens to base, subrounded to rounded quartzite with rounded quartz, subangular flint and trace igneous and limestone Sand: medium, quartz with some lithic grains	5.2	6.8
Ancholme Clay Group	Silt, clayey, dark greenish grey	1.9+	8.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines				Gravel		
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
	4	58	38	1.6-2.6	12	11	46	7	17	7	0
				2.6-3.6	4	9	48	11	24	4	0
				3.6-4.6	1	7	47	13	26	6	0
				4.6-5.6	2	3	36	9	28	22	0
				5.6-6.8	1	3	30	12	24	30	0
				Mean	4	7	41	10	24	14	0

Surface level (+1.7 m) + 6 ft
 Water struck at -1.9 m
 April 1979

Overburden 3.2 m
 Mineral 2.8 m
 Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, fill and peaty subsoil	1.2	1.2
Marine or Estuarine Alluvium	Silt, very dark brown, peaty and sandy with thin olive grey and rust brown clay seams	1.1	2.3
	Clay, mottled and banded greenish grey and dark yellowish brown; flint pebbles and fine sand layers	0.9	3.2
River Gravels	a Pebbly sand Gravel: fine with coarse, subangular to subrounded flint with subrounded white limestone and subrounded quartzite Sand: medium, quartz with some lithic grains	1.3	4.5
	b Pebbly sand Gravel: fine, subrounded to rounded quartzite with rounded to well rounded quartz, subangular flint and some limestone, sandstone and trace mudstone and igneous Sand: medium, quartz with some lithic grains	1.5	6.0
Ancholme Clay Group	Clay, olive black, fossiliferous	0.7+	6.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Sand		Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$		+4 -16	+16 -64	+64 mm	
						+ $\frac{1}{4}$ -1	+1 -4				
a	8	76	16	3.2-4.5	8	18	55	4	9	6	0
b	1	89	10	4.5-5.5	0	7	78	8	7	0	0
				5.5-6.0	3	6	61	13	15	2	0
				Mean	1	7	72	10	10	0	0
a+b	4	83	13	Mean	4	12	64	7	10	3	0

Surface level (+2.9 m) +10 ft
 Water level not recorded
 March 1979

Overburden 0.5 m
 Mineral 1.7 m
 Waste 2.9 m
 Mineral 4.8 m
 Bedrock 2.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Marine or Estuarine Alluvium	a 'Clayey' sand Sand: fine quartz Fines: very pale greenish grey silt bands	1.7	2.2
	Clay, pale greenish grey, silty with many sand partings	0.8	3.0
	Clay, dark greenish grey with thin peat band at base	1.0	4.0
	Silt, very dark greenish grey, sandy and clayey with many plant remains to 4.5 m then peat-free	1.1	5.1
River Gravels	b Sandy gravel Gravel: fine with coarse, subrounded to rounded quartzite with rounded quartz, subangular flint, some subrounded limestone, sandstone and trace igneous, ironstone and mudstone Sand: medium with coarse, quartz and lithic grains	4.8	9.9
Ancholme Clay Group	Clay, silty, greenish black, poorly bedded, sporadic shell fragments	2.9+	12.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	17	82	1	0.5-2.2	17	54	26	2	1	0	0
b	2	50	48	5.1-6.1	4	11	32	7	29	17	0
				6.1-7.1	2	4	35	16	34	9	0
				7.1-8.1	2	4	31	24	34	5	0
				8.1-9.1	1	2	20	24	42	11	0
				9.1-9.9	2	2	14	21	47	14	0
			Mean	2	5	27	18	37	11	0	
a+b	6	59	35	Mean	6	18	27	14	27	8	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
b	5.1-6.1	17	61	1	17	4	0	0	0	0
	6.1-7.1	16	57	4	17	6	trace	0	0	0
	7.1-8.1	16	59	7	13	5	0	0	0	0
	8.1-9.1	18	49	10	17	5	0	trace	trace	0
	9.1-9.9	19	47	11	16	4	0	0	1	2
	Mean	17	54	7	16	5	trace	trace	trace	trace

TF 16 NE 12 1853 6929 Manor Farm Block A₂
 Surface level (+13.5 m) +44 ft Waste 1.8 m
 Water not struck Bedrock 3.2 m+
 May 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	Clay, sandy, greenish grey mottled with dark yellowish orange; very sandy with flint pebbles and discrete sand bands below 1.0 m	1.4	1.8
Ancholme Clay Group	Clay, olive grey mottled with ochreous brown becoming uniform dark blue grey with pale olive brown patches; laminated in part	3.2+	5.0

TF 16 NE 13 1957 6949 Glebe Farm Block A₂
 Surface level (+16.1 m) +53 ft Waste 5.4 m
 Water not struck Bedrock 1.0 m+
 March 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Till	Clay, silty; 0.6-0.8 m - light olive brown mottled with greyish olive, pebble-free and poorly laminated; 0.8-5.3 m - greyish olive with olive brown mottling, much soft chalk and some flint; 5.3-5.4 m - intensely chalky and very friable with olive grey sandy partings and dark siltstone pebbles	4.8	5.4
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous, bedded	1.0+	6.4

TF 16 NE 14 1670 6890 Bucknall Block A₂
 Surface level (+6.9 m) +23 ft Overburden 0.5 m
 Water not struck Mineral 1.8 m
 March 1979 Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and gravel fill	0.5	0.5
Alluvium	'Clayey' sandy gravel Gravel: fine and coarse, subangular to subrounded flint with subrounded to rounded quartzite and limestone and some subrounded to rounded quartz and sandstone Sand: mainly fine, quartz with some flint especially in coarse fraction	1.8	2.3
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous	1.5+	3.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
14	46	40	0.5-2.3	14	19	16	11	20	20	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.5-2.3	65	21	10	2	2	trace	0	0	0

TF 16 NE 15 1851 6825 Horsington Block A₂

Surface level (+13.6 m) +45 ft
 Water not struck
 March 1979

Overburden 0.5 m
 Mineral 1.5 m
 Waste 4.0 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness	Depth
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	'Very clayey' pebbly sand Gravel: fine, subangular flint with some subrounded limestone Sand: fine with medium, quartz Fines: dark yellowish brown to very dark yellowish orange silt bands	1.5	2.0
Till	Clay, silty, initially greyish olive streaked with olive black then greenish black; fine pebbles of chalk and flint, and tabular silty clay to base	4.0	6.0
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous	0.9+	6.9

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
20	74	6	0.5-2.0	20	44	28	2	5	1	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.5-2.0	92	0	8	0	0	0	0	0	0

TF 16 NE 16		1501 6758	Abbey Warren Farm	Block A₁	
Surface level (+5.3 m) +17 ft Water not struck April 1979				Waste 4.2 m Bedrock 1.1 m+	
LOG					
Geological classification	Lithology		Thickness m	Depth m	
	Soil		0.2	0.2	
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: fine, angular flint Sand: fine and medium quartz with some coarse flint		0.3	0.5	
Till	Sandy clay, olive greenish grey with rust red partings and some flint pebbles		0.7	1.2	
	Clay, light bluish grey with very dark yellowish brown mottling; pebbly with sandy partings; at 2.3 m transition to greenish black and olive grey with some rootlets		3.0	4.2	
Ancholme Clay Group	Clay, olive black, fossiliferous, laminated		1.1+	5.3	
TF 16 NE 17		1690 6685	Duckpool Bridge	Block A₁	
Surface level (+2.0 m) +7 ft Water not struck April 1979				Waste 1.2 m Bedrock 1.9 m+	
LOG					
Geological classification	Lithology		Thickness m	Depth m	
	Soil		0.6	0.6	
Alluvium	'Clayey' pebbly sand Gravel: mainly fine, subangular flint with some subrounded limestone and white flint Sand: fine with medium quartz and coarse subangular flint and subrounded white flint and limestone Fines: dark yellowish orange		0.6	1.2	
Ancholme Clay Group	Clay, very dark greenish grey mottled with light olive brown, soft with some rootlets; becoming firm and uniform very dark greenish grey and greenish black		1.9+	3.1	
TF 16 NE 18		1942 6781	The Grange	Block A₂	
Surface level (+11.3 m) + 37 ft Water not struck April 1979				Waste 3.1 m Bedrock 0.9 m+	
LOG					
Geological classification	Lithology		Thickness m	Depth m	
	Soil		0.2	0.2	
Till	Clay, silty at top, light olive grey with light olive brown mottling; pebbles of chalk, flint and dark mudstone and at 2.4 m greyish green sandy band		2.9	3.1	
Ancholme Clay Group	Clay, greenish black, fossiliferous		0.9+	4.0	

Surface level (+5.7 m) +19 ft
 Water not struck
 April 1979

Overburden 0.2 m
 Mineral 4.4 m
 Waste 2.4 m
 Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand, sandy gravel to 2.1 m Gravel: fine, angular flint with some subrounded quartzite, rounded quartz and trace limestone, sandstone and mudstone Sand: medium quartz with some coarse flint Fines: dark yellowish brown, disseminated and in partings	4.4	4.6
?Wash	Clay, olive grey mottled with rust brown becoming greenish black; pebbles of flint, chalk, sandstone and some mudstone	0.4	5.0
Peat	Peaty clay and silt, olive grey with many plant remains and assorted organic debris; becomes silty and sandy to base	1.7	6.7
	Clay, very sandy and pebbly with some organic debris	0.3	7.0
Ancholme Clay Group	Clay, olive black, very fossiliferous	0.7+	7.7

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Sand			Gravel			
				- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
8	70	22	0.2-2.1	7	11	33	13	27	9	0
			2.1-3.5	8	11	56	13	10	2	0
			3.5-4.6	10	38	37	4	8	3	0
			Mean	8	18	41	11	16	6	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.2-2.1	92	5	0	2	1	0	0	0	0
2.1-3.5	64	33	0	3	0	0	0	0	0
3.5-4.6	74	10	1	5	trace	1	0	0	9
Mean	86	10	trace	3	trace	trace	0	0	1

TF 16 NE 20 1583 6604

Horsington Holmes

Block A₁

Surface level (+5.3 m) +17 ft
Water not struck
April 1979

Overburden 0.5 m
Mineral 1.5 m
Waste 3.9 m
Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil with some fill	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	'Very clayey' sand, pebbly in part Gravel: fine, flint and some limestone Sand: medium and fine, quartz and some coarse flint Fines: very dark yellowish orange	1.5	2.0
Till	Clay, olive grey to olive black and greenish black with pebbles of flint, chalk, green sandstone and tabular dark mudstone (which increases in amount to base)	3.9	5.9
Ancholme Clay Group	Clay, very dark greenish grey, fossiliferous	1.5+	7.4

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
21	77	2	0.5-2.0	21	33	43	1	2	0	0

TF 16 NE 21 1751 6607

Abbey Farm

Block A₂

Surface level (+13.8 m) +45 ft
Water-seepage in gravel
April 1979

Overburden 0.3 m
Mineral 2.5 m
Waste 6.2 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel Gravel: fine, angular flint with quartzite and some quartz and sandstone Sand: medium quartz with some coarse flint Fines: very dark yellowish orange	2.5	2.8
Till	Clay, dark olive grey to olive black with pebbles of chalk, flint and sandstone	6.2	9.0
Ancholme Clay Group	Clay, greenish black, very firm	0.3+	9.3

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
6	61	33	0.3-1.3	6	19	38	4	19	14	0
			1.3-2.8	6	14	32	14	25	9	0
			Mean	6	16	35	10	23	10	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.3-1.3	86	8	0	2	0	0	0	0	4
1.3-2.8	71	17	0	6	6	0	0	0	0
Mean	77	14	0	4	4	0	0	0	1

TF 16 NE 22 1977 6687 Poolham Ings Block A₂

Surface level (+6.2 m) +20 ft Waste 1.5 m
 Water not struck Bedrock 3.3 m+
 March 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Allvium	'Clayey' sandy gravel Gravel: fine with coarse, subangular to subrounded, flint with trace quartz and limestone Sand: medium with fine, quartz and some flint Fines: dark yellowish brown silt	0.9	1.5
Ancholme Clay Group	Clay, silty, dark greenish grey with olive grey mottling at top	3.3+	4.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
12	47	41	0.6-1.5	12	16	22	9	24	17	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.6-1.5	96	0	2	2	0	0	0	0	0

TF 16 NE 23 1677 6518

Newstead House

Block A₂

Surface level (+7.6 m) +25 ft
 Water struck at +3.5 m
 April 1979

Overburden 1.4 m
 Mineral 0.7 m
 Waste 3.1 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	Clay, dark yellowish brown, very sandy with flint pebbles	0.9	1.4
	'Clayey' pebbly sand Gravel: fine, angular and subangular flint Sand: medium and fine quartz Fines: very dark yellowish orange	0.7	2.1
Till	Clay, dark greenish grey with pebbles of chalk and limestone	3.1	5.2
Ancholme Clay Group	Clay, dark greenish grey, fossiliferous	0.5+	5.7
No grading data available.			

TF 16 NE 24 1774 6529

Stixwold

Block A₂

Surface level (+6.4 m) +21 ft
 Water-seepage at +4.9 m
 April 1979

Overburden 0.5 m
 Mineral 1.3 m
 Waste 0.4 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	'Clayey' pebbly sand Gravel: fine, subangular flint Sand: medium quartz Fines: dark yellowish brown	1.3	1.8
	Till	Clay, greenish black with many greenish black tabular clay fragments and some subrounded quartzite and chalk pebbles	0.4
Ancholme Clay Group	Clay, greenish black	0.9+	3.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
13	79	8	0.5-1.8	13	16	57	6	8	0	0

Surface level (+2.1 m) +7 ft
 Water struck at -2.3 m
 February 1979

Overburden 4.4 m
 Mineral 5.1 m
 Waste 1.0 m
 Mineral 1.6 m
 Bedrock 1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Marine or Estuarine Allvium	Clay, silty, grey with plant remains and a thin peat band at 3.5 m; sandy to base	3.4	4.4
River Gravels	a Pebbly sand Gravel: fine, subrounded limestone, quartzite and sub-angular flint with some rounded quartz Sand: medium with fine, quartz with lithic grains	2.0	6.4
	b Sandy gravel Gravel: fine with coarse, subrounded to rounded quartzite with rounded quartz, subangular flint and some limestone and sandstone Sand: medium, quartz with lithic grains	3.1	9.5
	Clay, silty, grey, poorly laminated	1.0	10.5
	c Sandy gravel, as b	1.6	12.1
Ancholme Clay Group	Silt, clayey, dark greenish grey	1.4+	13.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	Sand		Gravel			
						+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	3	84	13	4.4-5.4	5	35	43	10	7	0	0
				5.4-6.4	2	17	55	9	14	3	0
				Mean	3	26	49	9	11	2	0
b	2	63	35	6.4-7.4	2	7	51	16	19	5	0
				7.4-9.0	2	5	38	14	24	17	0
				9.0-9.5	4	7	41	10	22	16	0
				Mean	2	6	43	14	22	13	0
c	4	60	36	10.5-11.5	3	8	46	8	27	8	0
				11.5-12.1	4	8	41	7	21	19	0
				Mean	4	8	44	8	25	11	0
a+b+c	3	68	29	Mean	3	12	45	11	20	9	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a	4.4-5.4	39	28	28	5	0	0	0	0	0
	5.4-6.4	23	38	20	15	2	1	1	0	0
	Mean	26	36	22	13	2	trace	trace	0	0
b+c	6.4-7.4	16	49	8	20	5	0	2	trace	trace
	7.4-9.0	17	47	10	20	5	0	1	trace	0
	9.0-9.5	7	64	5	23	trace	0	trace	trace	0
	10.5-11.5	13	53	9	20	3	1	trace	trace	0
	11.5-12.1	10	66	14	10	0	0	0	0	0
	Mean	14	54	9	19	3	trace	trace	trace	trace
a+b+c	Mean	15	51	11	18	3	trace	1	trace	trace

TF 16 SW 4 1185 6418 Metherringham Fen Lane Block B₂

Surface level (+0.8 m) +3 ft
 Water struck at -2.7 m
 March 1979

Overburden 4.0 m
 Mineral 1.5 m
 Waste 0.6 m
 Mineral 4.7 m
 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Marine or Estuarine Alluvium	Clay, silty, moderate yellowish brown, weathered passing into dark greenish grey; some plant fragments	2.9	3.1
	Peat	0.4	3.5
	Sandy silt - 'very clayey' sand; dark greenish grey	0.5	4.0
River Gravels	a 'Clayey' pebbly sand Gravel: fine, rounded quartzite, subangular flint and subangular limestone Sand: medium with fine, quartz and lithic grains	1.5	5.5
	Clay, silty, passing into 'very clayey' sand	0.6	6.1
	b Gravel, 'clayey' in first 0.7 m Gravel: fine with coarse, rounded to subrounded quartzite with rounded quartz, subangular flint and some subangular limestone Sand: medium, quartz with lithic grains	4.7	10.8
Ancholme Clay Group	Clay, olive grey	1.1+	11.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	11	67	22	4.0-5.0	14	23	42	5	14	2	0
				5.0-5.5	3	21	34	8	22	12	0
				Mean	11	22	39	6	17	5	0
b	5	47	48	6.1-7.2	15	15	37	8	18	7	0
				7.2-8.2	4	8	33	13	33	9	0
				8.2-9.2	1	4	30	12	32	21	0
				9.2-10.2	1	2	16	11	42	28	0
				10.2-10.8	2	5	29	9	32	23	0
				Mean	5	8	29	10	31	17	0
a+b	6	52	42	Mean	6	11	32	9	28	14	0

TF 16 SW 5	1322 6498	Ash House Farm	Block B₂
Surface level (+3.3 m) +11 ft			Overburden 3.8 m
Water struck at -0.5 m			Mineral 4.8 m
February 1979			Waste 0.3 m
			Mineral 2.9 m
			Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
Marine or Estuarine Alluvium	Silt, clayey, chocolate brown through mottled greys, yellows and browns to uniform grey; many plant remains and a thin peat band at 3.0 m	2.9	3.8
River Gravels	a Sandy gravel, 'clayey' in part Gravel: fine, angular to subangular flint with subrounded quartzite and some quartz Sand: medium, quartz with lithic grains	1.0	4.8
	b Gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint and some sandstone Sand: medium, quartz with lithic grains	3.8	8.6
	Silt, clayey, greyish brown with sandy partings and some pebbles	0.3	8.9
	c Gravel, as b	2.9	11.8
Ancholme Clay Group	Silt, clayey, dark greenish grey	1.2+	13.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	2	47	51	3.8-4.8	9	12	39	11	27	2	0
b	0	42	58	4.8-5.8	1	5	41	14	35	4	0
				5.8-6.8	0	2	25	10	41	22	0
				6.8-7.8	0	2	19	9	43	27	0
				7.8-8.6	1	5	26	9	24	35	0
				Mean	0	3	28	11	36	22	0
c	3	40	57	8.9-10.0	3	4	26	11	29	27	0
				10.0-11.0	3	5	25	8	37	22	0
				11.0-11.8	1	6	26	9	27	31	0
				Mean	3	5	26	9	31	26	0
a+b+c	2	44	54	Mean	2	5	29	10	33	21	0

TF 16 SW 6

1336 6410

Tanvats

Block B₂

Surface level (+2.2 m) +7 ft
 Water struck at -2.8 m
 March 1979

Overburden 5.5 m
 Mineral 5.4 m
 Bedrock 1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
Marine or Estuarine Alluvium	Clay, silty, brown, mottled, grey below 2.8 m; sandy patches, micaceous	4.6	5.5
River Gravels	a Sandy gravel Gravel: fine, angular flint with subrounded quartzite and some quartz, limestone and sandstone Sand: medium, quartz with lithic grains	2.0	7.5
	b Gravel Gravel: fine, subrounded quartzite with angular flint, rounded quartz and some limestone and sandstone Sand: medium, quartz with lithic grains	3.4	10.9
Ancholme Clay Group	Clay, silty, dark grey	1.4+	12.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	4	52	44	5.5-6.5	4	7	17	13	40	19	0
				6.5-7.5	5	11	45	10	20	9	0
				Mean	4	9	31	12	30	14	0
b	1	44	55	7.5-8.5	2	4	42	10	26	16	0
				8.5-9.5	1	3	24	14	45	13	0
				9.5-10.9	0	2	20	16	49	13	0
				Mean	1	3	28	13	41	14	0
a+b	2	47	51	Mean	2	5	29	13	37	14	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a	5.5-6.5	69	16	7	4	3	0	trace	trace	trace
	6.5-7.5	42	35	2	14	7	0	0	trace	trace
	Mean	56	25	4	9	5	0	trace	trace	trace
b	7.5-8.5	18	51	2	21	6	0	0	2	trace
	8.5-9.5	15	51	7	19	7	trace	0	trace	0
	9.5-10.9	13	52	7	22	6	trace	0	trace	trace
	Mean	15	51	6	21	6	trace	0	trace	trace
a+b	Mean	29	42	6	17	6	trace	trace	trace	trace

TF 16 SW 7 1436 6429 Metheringham Delph Block B₃

Surface level (+2.7 m) +9 ft Overburden 4.0 m
 Water struck at -1.3 m Mineral 8.1 m
 March 1979 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Marine or Estuarine Alluvium	Clay, silty, olive grey with pale brown mottling below 3.2 m; peaty with distinct peat and sand bands	3.6	4.0
River Gravels	a Sandy gravel 'clayey' in upper part Gravel: fine, subangular to subrounded flint with subrounded quartzite and rounded quartz Sand: medium, quartz with lithic grains	2.1	6.1
	b Gravel Gravel: fine with coarse, subrounded quartzite with subangular flint, rounded quartz and some subrounded sandstone and limestone Sand: medium with fine, quartz with lithic grains	6.0	12.1
Ancholme Clay Group	Clay, silty, dark greenish grey	0.9+	13.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	5	54	41	4.0-5.1	9	10	29	14	27	11	0
				5.1-6.1	0	5	34	18	31	12	0
				Mean	5	7	31	16	30	11	0
b	1	38	61	6.1-7.1	2	5	28	14	38	13	0
				7.1-8.1	1	3	19	15	44	18	0
				8.1-9.1	0	3	23	15	37	22	0
				9.1-10.1	0	3	19	15	41	22	0
				10.1-11.1	1	1	16	17	47	18	0
				11.1-12.1	1	2	18	12	39	28	0
				Mean	1	3	20	15	41	20	0
a+b	2	42	56	Mean	2	4	23	15	38	18	0

Surface level (+3.0 m) +10 ft
 Water struck at OD
 February 1979

Overburden 3.0 m
 Mineral 10.0 m
 Bedrock 1.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	0.5	0.5
Marine or Estuarine Alluvium	Clay, silty in part, greenish grey to dark grey at base, sandy in parts	2.5	3.0
	a 'Very clayey' sand Sand: fine quartz Fines: grey to brown disseminated silt	1.0	4.0
River Gravels	b Sand: some pebbles to base; fine to 5.0 m, medium below, quartz	2.2	6.2
	c Sandy gravel Gravel: fine, subrounded to rounded limestone and flint some quartzite and quartz Sand: medium, quartz with lithic grains	1.0	7.2
	d Sandy gravel Gravel: fine with coarse, subrounded to rounded quartzite with some rounded quartz, subangular flint and some limestone, siltstone and igneous Sand: medium, quartz with lithic grains	5.8	13.0
Ancholme Clay Group	Silt, clayey, dark greenish grey	1.3+	14.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages								
	Fines	Sand	Gravel										
					Fines			Sand			Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm		
a	21	79	0	3.0-4.0	21	70	8	1	0	0	0		
b	4	94	2	4.0-5.0	6	69	24	1	0	0	0		
				5.0-6.2	2	16	74	4	4	0	0		
				Mean	4	40	52	2	2	0	0		
c	2	72	26	6.2-7.2	2	14	45	13	21	5	0		
d	1	65	34	7.2-8.2	1	10	42	9	26	12	0		
				8.2-9.2	1	8	67	9	9	6	0		
				9.2-10.2	2	4	49	13	20	12	0		
				10.2-11.2	0	3	33	23	31	10	0		
				11.2-12.2	0	3	34	24	29	10	0		
12.2-13.0	0	7	36	14	29	14	0						
Mean	1	6	44	15	24	10	0						
a-d	3	74	23	Mean	3	21	42	11	16	7	0		

Surface level (+2.8 m) + 9 ft
 Water struck at -1.0 m
 March 1979

Overburden 3.3 m
 Mineral 8.1 m
 Bedrock 1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	0.4	0.4
Marine or Estuarine Alluvium	Clay, dark yellowish brown to 1.7 m, olive grey below; peaty in part	2.9	3.3
	a Sand: medium and fine quartz; dark greenish grey and light olive brown fines	1.5	4.8
River Gravel	b Sandy gravel Gravel: fine, subangular to subrounded limestone with subangular flint and rounded quartzite and quartz Sand: medium with fine, quartz with lithic grains	2.3	7.1
	c Sandy gravel Gravel: fine with coarse, rounded quartzite with rounded quartz, subangular flint and some subrounded limestone and sandstone Sand: medium with fine, quartz with lithic grains	1.9	9.0
	d Sand, pebbly to base; medium quartz with lithic grains	2.4	11.4
Ancholme Clay Group	Clay, dark greenish grey	1.4+	12.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	5	94	1	3.3-4.8	5	32	62	1	0	0	0
b	2	71	27	4.8-6.1	2	25	44	10	19	0	0
				6.1-7.1	1	17	35	10	29	8	0
				Mean	2	21	40	10	23	4	0
c	1	71	28	7.1-8.0	2	22	40	7	19	10	0
				8.0-9.0	0	20	45	8	19	8	0
				Mean	1	21	43	7	19	9	0
d	1	96	3	9.0-10.0	1	20	74	3	2	0	0
				10.0-10.9	1	10	82	6	1	0	0
				10.9-11.4	3	16	68	6	5	2	0
				Mean	1	15	76	5	2	1	0
a-d	2	82	16	Mean	2	21	55	6	12	4	0

TF 16 SW 10 1250 6384

Tanvats

Block B₂

Surface level (+3.7 m) +12 ft
 Water struck at +0.1 m
 March 1979

Overburden 2.8 m
 Mineral 11.3 m
 Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Marine or Estuarine Alluvium	Silt, sandy, orange-brown passing into grey, increasingly sandy below 2.6 m	2.1	2.8
	a 'Clayey' sand Sand: fine quartz Fines: disseminated greyish brown silt	2.5	5.3
River Gravel	b Sandy gravel Gravel: fine, subrounded limestone with subrounded quartzite, subangular flint and rounded quartz Sand: mainly medium, quartz with lithic grains	3.0	8.3
	c Gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint, subrounded limestone and sandstone and trace igneous Sand: medium, quartz with lithic grains	5.8	14.1
Ancholme Clay Group	Clay, silty, finely laminated	1.5+	15.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	19	81	0	2.8-4.3	19	80	1	0	0	0	0
				4.3-5.3	20	79	1	0	0	0	0
				Mean	19	80	1	0	0	0	0
b	4	65	31	5.3-6.3	5	24	56	5	6	4	0
				6.3-7.3	2	13	30	17	31	7	0
				7.3-8.3	5	11	28	11	31	14	0
				Mean	4	16	38	11	23	8	0
c	1	41	58	8.3-9.3	1	6	31	12	40	10	0
				9.3-10.3	2	9	49	13	19	8	0
				10.3-11.3	1	4	21	11	43	20	0
				11.3-12.3	1	3	16	11	41	28	0
				12.3-13.3	1	2	19	9	38	31	0
				13.3-14.1	0	2	17	12	45	24	0
				Mean	1	4	26	11	38	20	0
a+b+c	6	56	38	Mean	6	24	23	9	25	13	0

Surface level (+2.2 m) +7 ft
 Water struck at -1.0 m
 March 1979

Overburden 2.8 m
 Mineral 9.4 m
 Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Marine or Estuarine Alluvium	Silt, dark yellowish brown mottled with rust brown, micaceous	2.2	2.8
	a 'Clayey' sand Sand: fine quartz Fines: olive grey silt	4.3	7.1
River Gravel	b Pebbly sand (some recent bivalves) Gravel: fine, subrounded limestone and flint with some subangular flint, subrounded quartzite and rounded quartz Sand: fine with medium, quartz and some lithics	0.8	7.9
	c Gravel, silt bands in first metre Gravel: fine with coarse, subrounded quartzite with subangular flint, subrounded limestone and some rounded quartz and trace igneous Sand: medium, quartz with lithic grains	4.3	12.2
Ancholme Clay Group	Clay, silty, dark greenish grey	0.7+	12.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	16	84	0	2.8-7.1	16	79	3	2	0	0	0
b	2	86	12	7.1-7.9	2	44	36	6	10	2	0
c	6	39	55	7.9-9.0	22	9	19	5	26	19	0
				9.0-10.0	1	4	28	12	33	22	0
				10.0-11.0	0	3	28	15	38	16	0
				11.0-12.2	0	3	20	14	45	18	0
			Mean	6	5	23	11	36	19	0	
a+b+c	10	64	26	Mean	10	42	15	7	17	9	0

Surface level (+1.8 m) +6 ft
 Water struck at -1.2 m
 March 1979

Overburden 3.1 m
 Mineral 7.1 m
 Bedrock 1.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Marine or Estuarine Alluvium	Clay, silty, olive grey with plant remains throughout and a thin peat band at 2.5 m	2.0	2.5
	Silt, clayey and sandy, olive grey, some plant remains	0.6	3.1
River Gravel	a Pebbly sand Gravel: fine, subrounded flint and limestone with sub-angular flint, subrounded quartzite, rounded quartz and some sandstone Sand: medium, quartz with lithic grains	2.0	5.1
	b Sandy gravel, some wood fragments between 5.1 and 6.1 m Gravel: fine, subrounded quartzite with rounded quartz, subangular flint and some limestone and sandstone Sand: medium, quartz with lithic grains	5.1	10.2
Ancholme Clay Group	Clay, silty, greyish black	1.9+	12.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand		Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm	
a	2	75	23	3.1-4.1	3	16	46	9	16	10	0	
				4.1-5.1	2	7	58	14	16	3	0	
				Mean	2	11	52	12	16	7	0	
b	1	51	48	5.1-6.1	1	1	41	17	31	9	0	
				6.1-7.1	0	1	14	15	56	14	0	
				7.1-8.1	1	2	37	19	38	3	0	
				8.1-9.1	1	2	39	13	35	10	0	
				9.1-10.2	2	2	37	12	29	18	0	
				Mean	1	2	34	15	37	11	0	
a+b	1	57	42	Mean	1	4	39	14	32	10	0	

Surface level (+2.4 m) +8 ft
 Water struck at -2.4 m
 March 1979

Overburden 6.0 m
 Mineral 5.4 m
 Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Marine or Estuarine Alluvium	Silt, clayey, dark yellowish brown passing into olive grey and dark greenish grey with moderate brown patches	3.7	4.3
	'Very clayey' pebbly sand - sandy, pebbly clay, some shells Gravel: fine, subangular to subrounded flint Sand: fine, some medium, quartz Fines: olive black	0.3	4.6
	Clay, dark yellowish brown, sandy in part, laminated	0.9	5.5
	Silt, moderate brown, massive	0.5	6.0
River Gravels	a Sandy gravel Gravel: fine subrounded limestone with subangular to angular flint and rounded to well rounded quartzite and quartz Sand: medium, quartz with lithic grains	1.0	7.0
	b Sandy gravel Gravel: fine, subrounded quartzite with rounded quartz subangular flint and some subrounded limestone, sandstone and ironstone Sand: medium quartz with lithic grains	4.4	11.4
Ancholme Clay Group	Clay, greenish grey	0.7+	12.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	+1 -4	+4 -16	+16 -64	+64 mm
a	8	64	28	6.0-7.0	8	10	39	15	25	3	0
b	1	54	45	7.0-8.0	1	9	41	13	25	11	0
				8.0-9.0	1	6	35	13	31	14	0
				9.0-10.0	0	3	33	12	32	20	0
				10.0-11.0	2	3	29	15	31	20	0
				11.0-11.4	4	7	44	16	26	3	0
			Mean	1	6	35	13	30	15	0	
a+b	2	56	42	Mean	2	6	36	14	29	13	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a	6.0-7.0	11	12	65	11	1	0	trace	0	0
b	7.0-8.0	14	33	21	23	6	trace	3	trace	0
	8.0-9.0	10	49	7	22	9	trace	2	trace	0
	9.0-10.0	9	52	5	23	9	trace	1	1	trace
	10.0-11.0	14	52	3	22	6	0	3	0	0
	11.0-11.4	25	36	8	18	9	0	4	0	0
	Mean	13	46	8	22	8	trace	3	trace	trace
a+b	Mean	12	42	16	21	7	trace	2	trace	trace

Surface level (+2.7 m) +9 ft
 Water level not recorded
 March 1979

Overburden 6.8 m
 Mineral 6.7 m
 Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	0.9	0.9
Marine or Estuarine Alluvium	Silt, dark yellowish brown, micaceous, laminated, coarsening to base	1.7	2.6
	Clay, silty, olive grey with peat and wood fragments	2.1	4.7
	Clay, silty, greyish brown, micaceous, some limestone granules	2.1	6.8
River Gravels	a 'Clayey' sandy gravel Gravel: fine, subrounded limestone and subangular to subrounded flint with rounded quartzite and quartz Sand: mainly medium, quartz with lithic grains Fines: greyish brown silt bands	1.0	7.8
	b Gravel 'clayey' in part Gravel: fine with coarse, subrounded quartzite with some sub-rounded flint and limestone and rounded to well rounded quartz Sand: medium, quartz with lithic grains	5.7	13.5
Ancholme Clay Group	Clay, greenish grey, bedded	0.6+	14.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	11	56	33	6.8-7.8	11	16	29	11	26	7	0
b	4	45	51	7.8-9.1	1	11	35	7	31	15	0
				9.1-10.1	18	7	24	9	27	15	0
				10.1-11.4	0	15	35	13	30	17	0
				11.4-12.4	1	4	23	13	38	21	0
				12.4-13.5	2	4	18	14	46	16	0
			Mean	4	6	28	11	34	17	0	
a+b	5	47	48	Mean	5	8	28	11	33	15	0

TF 16 SW 15 1352 6236 Blankney Drove Block B₃

Surface level (+1.3 m) +4 ft Overburden 3.8 m
 Water struck at -2.5 m Mineral 5.1 m
 March 1979 Bedrock 1.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Marine or Estuarine Alluvium	Clay, silty, dark yellowish brown mottled with light brown and moderate yellowish brown to 2 m, olive grey to 3.2 m, greyish brown below; plant remains common and peat band at 3.2 m	3.5	3.8
River Gravels	Sandy gravel Gravel: fine with coarse to base, subrounded quartzite with subangular to subrounded flint and some rounded quartz and subrounded limestone Sand: medium, quartz with lithic grains	5.1	8.9
Ancholme Clay Group	Clay, silty, dark greenish grey, fossiliferous	1.7+	10.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages							
Fines	Sand	Gravel		Fines		Sand		Gravel			
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm	
2	62	36	3.8-5.6	4	15	52	7	18	4	0	
			5.6-6.6	3	19	34	10	28	6	0	
			6.6-7.6	1	8	43	11	28	9	0	
			7.6-8.9	0	4	29	8	32	27	0	
			Mean	2	12	41	9	25	11	0	

TF 16 SW 16 1447 6302 Blankney Fen Block B₃

Surface level (+3.0 m) +10 ft Overburden 6.4 m
 Water struck at -3.4 m Mineral 5.4 m
 March 1979 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Marine or Estuarine Alluvium	Silt, sandy, moderate yellowish brown with light olive grey banding; becoming olive grey and olive black; some peaty pockets	4.7	5.2
	Clay, moderate brown with pale grey mottling to base; some sand and silty partings and peaty pockets	1.2	6.4
River Gravels	a Sandy gravel Gravel: fine, angular and subrounded flint with subrounded quartzite and some quartz and sandstone Sand: medium, quartz with lithic grains	1.0	7.4
	b Gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint and some subrounded limestone and sandstone Sand: medium, quartz with lithic grains	4.4	11.8
Ancholme Clay Group	Clay, silty, very dark greenish grey, fossiliferous	0.9+	12.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	3	62	35	6.4-7.4	3	16	33	13	28	7	0
b	1	46	53	7.4-8.6	1	8	32	9	32	18	0
				8.6-9.6	2	11	25	7	28	27	0
				9.6-11.8	1	7	26	13	36	17	0
				Mean	1	8	27	11	33	20	0
a+b	2	49	49	Mean	2	10	29	10	32	17	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction									
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others	
a	6.4-7.4	65	27	trace	4	4	0	0	0	0	
b	7.4-8.6 8.6-9.6 9.6-11.8 Mean	21	56	6	13	4	0	0	0	0	
		14	54	4	21	6	trace	0	0	0	
		11	57	6	21	4	0	trace	trace	trace	
		15	57	5	18	4	trace	trace	trace	trace	
a+b	Mean	23	52	4	16	4	trace	trace	trace	trace	

TF 16 SW 17 1080 6135 Blankney Barff Airfield

Block A₃

Surface level (+18.5 m) +61 ft
Water struck at +17.2 m
March 1979

Overburden 0.6 m
Mineral 1.9 m
Waste 17.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and hardcore	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel, 'clayey' in first metre Gravel: fine with coarse, subrounded quartzite with sub-rounded sandstone, rounded quartz, subangular flint and some limestone and ironstone Sand: medium quartz with lithic grains	1.9	2.5
Till	Clay, silty, dark greenish grey; olive grey below 6.5 m; pebbles of chalk, flint, sandstone and soft mudstone	13.5	16.0
	Clay, olive grey, stone-free, finely laminated; some pockets of fine and medium sand and chalk granules	1.2	17.2
	Clay, silty, pebbly with mudstone and siltstone fragments common to base	2.8+	20.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
	7	55	38	0.6-1.6	10	8	40	10	24	8	0
				1.6-2.5	4	6	34	11	28	17	0
				Mean	7	8	37	10	26	12	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.6-1.6	18	37	1	22	21	0	0	0	1
1.6-2.5	16	46	7	14	14	trace	2	trace	1
Mean	17	42	4	18	18	trace	1	trace	1

TF 16 SW 18 1252 6173 Blankney Drove Block B₃
 Surface level (+1.4 m) +5 ft Overburden 3.6 m
 Water struck at -2.1 m Mineral 8.3 m
 March 1979 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Marine or Estuarine Alluvium	Clay, silty, olive grey, mottled with dark yellowish brown to top	2.6	3.2
	Peat, dark brown, fibrous	0.1	3.3
	Silt, clayey, olive grey, some plant remains and thin shell fragments	0.3	3.6
River Gravels	a Pebbly sand Gravel: fine, subrounded limestone with some quartzite, flint and quartz Sand: medium, quartz with lithic grains	3.2	6.8
	b Pebbly sand Gravel: fine with coarse to base, subrounded quartzite with some flint, limestone and quartz Sand: medium, quartz with lithic grains	3.1	9.9
	c Gravel Gravel: fine and coarse, constituents as above Sand: as above	2.0	11.9
Ancholme Clay Group	Clay, silty, dark greenish grey, bedded	0.9+	12.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand		Gravel			
					-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm	
a	2	80	18	3.6-4.8	3	23	60	5	9	0	0	
				4.8-5.8	2	12	41	21	24	0	0	
				5.8-6.8	3	8	49	16	21	3	0	
				Mean	2	15	51	14	17	1	0	
b	2	80	18	6.8-8.8	2	19	57	8	14	0	0	
				8.8-9.9	0	10	57	7	14	12	0	
				Mean	2	16	57	7	14	4	0	
c	1	41	58	9.9-10.9	2	3	29	8	25	31	2	
				10.9-11.9	1	3	24	14	34	24	0	
				Mean	1	3	27	11	29	28	1	
a+b+c	2	70	28	Mean	2	12	47	11	19	9	0	

Surface level (+2.3 m) +8 ft
 Water level not recorded
 March 1979

Overburden 5.0 m
 Mineral 7.4 m
 Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Hardcore	0.8	0.8
Marine or Estuarine Alluvium	Clay, silty, olive grey, mottled at top, peaty at base	3.2	4.0
	Peat, dark brown, fibrous, sandy and silty at base	1.0	5.0
River Gravels	a Sand, medium with fine, quartz; olive grey silt	1.0	6.0
	b Sandy gravel Gravel: fine, subangular flint and subrounded limestone with some subrounded quartzite, rounded quartz and trace siltstone Sand: medium, quartz with lithic grains	1.0	7.0
	c Sandy gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint and subrounded limestone Sand: medium, quartz with lithic grains	5.4	12.4
Ancholme Clay Group	Clay, silty, dark greenish grey	0.6+	13.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand			Gravel		
					- $\frac{1}{16}$		+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	3	95	2	5.0-6.0	3	33	60	2	2	0	0	
b	1	60	39	6.0-7.0	1	13	33	14	37	2	0	
c	1	53	46	7.0-8.0	0	8	44	13	29	6	0	
				8.0-9.0	2	5	42	15	28	8	0	
				9.0-10.0	0	3	34	12	30	21	0	
				10.0-11.0	2	3	36	9	31	19	0	
				11.0-12.4	2	3	31	13	33	18	0	
			Mean	1	4	37	12	31	15	0		
a+b+c	1	60	39	Mean	1	9	40	11	28	11	0	

Surface level (+1.0 m) +3 ft
 Water struck at -3.5 m
 March 1979

Overburden 6.0 m
 Mineral 6.1 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill and soil	0.9	0.9
Marine or Estuarine Alluvium	Clay, silty, olive grey and dark greenish grey, mottled, with scattered plant remains and a thin peat band at 3.7 m	3.3	4.2
	Silt, sandy, dark greenish grey	1.8	6.0
River Gravels	a Pebbly sand Gravel: fine, subrounded flint and limestone with some subrounded quartzite and subangular flint Sand: medium with fine, quartz with lithic grains	1.5	7.5
	b Sandy gravel, much less gravel at base Gravel: fine, subrounded quartzite with rounded quartz, subangular flint and subrounded limestone Sand: medium, quartz with lithic grains	4.6	12.1
Ancholme Clay Group	Clay, silty, dark greenish grey	0.9+	13.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines				Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	3	79	18	6.0-7.0	3	24	39	9	19	6	0
7.0-7.5				2	17	72	6	3	0	0	
Mean				3	21	50	8	14	4	0	
b	2	70	28	7.5-8.0	1	7	34	10	29	19	0
8.0-9.0				2	7	47	14	25	5	0	
9.0-10.0				0	5	32	14	45	4	0	
10.0-12.1				3	5	66	14	12	0	0	
Mean				2	5	51	14	24	4	0	
a+b	2	73	25	Mean	2	10	51	12	21	4	0

Surface level (+ 18.1 m) +59 ft
 Water struck at +16.6 m
 March 1979

Overburden 0.7 m
 Mineral 2.8 m
 Waste 13.8 m
 Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand, 'clayey' to 1.5 m Gravel: fine with coarse, subrounded quartzite with subrounded limestone, rounded quartz, subangular flint and subrounded sandstone Sand: medium, quartz with lithic grains	2.8	3.5
Till	Clay, silty, chiefly olive grey with reddish brown patches at 16 m; pebbles of chalk, flint and mudstone (common to base)	13.8	17.3
Ancholme Clay Group	Silt, clayey, dark greenish grey, laminated in part, fossiliferous	1.2+	18.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
6	75	19	0.7-1.5	14	19	51	4	8	4	0
			1.5-3.5	2	9	59	7	14	9	0
			Mean	6	12	57	6	12	7	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.7-1.5	9	55	0	17	19	0	0	0	0
1.5-3.5	10	44	20	17	7	0	0	2	0
Mean	10	46	16	17	9	0	0	2	0

TF 16 SW 22 **1151 6039** **North Moor House** **Block A₃**

Surface level (+15.6 m) +51 ft
 Water not struck
 March 1979

Overburden 0.8 m
 Mineral 1.6 m
 Waste 15.3 m
 Bedrock 1.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Fluvio-glacial and Older River Sand and Gravel	'Clayey' sandy gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz and subangular flint Sand: medium with fine, quartz and lithic grains Fines: ochreous brown silt with greyish brown and black siltbands to base	1.6	2.4
Till	Clay, silty, dark greenish grey, olive grey to base with pebbles of flint, chalk, mudstone and sandstone; some pockets of reddish brown sandy clay between 15.0 and 15.7 m	15.3	17.7
Ancholme Clay Group	Clay, silty, dark greenish grey, fossiliferous	1.3+	19.0
No grading results available			

TF 16 SW 23 **1325 6052** **Martin Fen** **Block B₄**

Surface level (+1.4 m) +5 ft
 Water struck at -2.9 m
 March 1979

Overburden 4.5 m
 Mineral 8.4 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Marine or Estuarine Alluvium	Clay, silty, olive grey, mottled and banded at top, some plant remains	3.3	3.7
	Peat, fibrous, deep reddish brown	0.6	4.3
	Clay, peaty and silty with sandy partings, olive grey	0.2	4.5
	a 'Clayey' sand Sand: fine with medium, quartz with lithic grains Fines: greyish brown silt	1.0	5.5
River Gravels	b Sandy gravel Gravel: fine, subrounded quartzite, subangular to subrounded flint, subrounded limestone and rounded quartz Sand: medium, quartz with lithic grains	1.0	6.5
	c Sandy gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint, subrounded limestone and some sandstone Sand: medium, quartz with lithic grains	6.4	12.9
Ancholme Clay Group	Clay, silty, greenish grey	1.0+	13.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	17	83	0	4.5-5.5	17	51	31	1	0	0	0
b	1	59	40	5.5-6.5	1	11	38	10	40	0	0
c	1	58	41	6.5-7.5	2	8	44	14	24	8	0
				7.5-8.5	1	4	27	12	31	25	0
				8.5-9.5	0	4	37	11	32	16	0
				9.5-10.5	0	4	34	11	31	20	0
				10.5-11.5	1	4	51	14	24	6	0
				11.5-12.9	3	3	53	10	21	8	2
				Mean	1	4	42	12	27	13	1
a+b+c	3	62	35	Mean	3	11	40	11	24	11	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
b	5.5-6.5	30	35	17	12	6	0	0	trace	0
c	6.5-7.5	16	46	16	17	3	trace	1	trace	0
	7.5-8.5	18	49	13	15	4	0	1	0	0
	8.5-9.5	10	55	8	20	3	1	3	trace	0
	9.5-10.5	9	51	12	24	3	0	1	0	0
	10.5-11.5	16	44	17	18	3	trace	0	2	0
	11.5-12.9	17	52	7	19	2	0	0	trace	3
	Mean	14	50	12	19	3	trace	1	trace	trace
b+c	Mean	17	48	13	18	3	trace	1	trace	trace

TF 16 SW 24 1430 6111

Martin North Drove

Block B₄

Surface level (+1.3 m) +4 ft
Water struck at -3.6 m
March 1979

Overburden 4.9 m
Mineral 6.9 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Marine or Estuarine Alluvium	Clay, silty, pale grey and rust brown passing into olive grey, many plant remains	3.5	3.8
	Silt, very sandy, reddish brown, some plant matter	1.1	4.9
River Gravels	a Pebbly sand, 'clayey' at top Gravel: fine, subangular to subrounded flint, with some sub-rounded quartzite and rounded quartz Sand: medium with fine, quartz with lithic grains	2.0	6.9
	b Sandy gravel Gravel: fine with coarse, subrounded quartzite with some sub-angular flint, subrounded limestone and rounded quartz Sand: medium, quartz with lithic grains	4.9	11.8
Ancholme Clay Group	Clay, silty, dark greenish grey	0.7+	12.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages								
	Fines	Sand	Gravel		Fines			Sand			Gravel		
					-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm		
a	5	84	11	4.9-5.9	8	39	45	3	5	0	0		
				5.9-6.9	2	20	53	9	16	0	0		
				Mean	5	29	49	6	11	0	0		
b	2	61	37	6.9-7.9	1	9	52	12	22	4	0		
				7.9-8.9	2	13	55	6	14	10	0		
				8.9-9.9	2	8	44	7	25	14	0		
				9.9-10.9	2	7	45	6	25	15	0		
				10.9-11.8	1	3	23	12	40	21	0		
				Mean	2	8	44	9	25	12	0		
a+b	2	68	30	Mean	2	14	46	8	21	9	0		

TF 16 SE 15

1550 6419

Blankney Dales

Block B₃

Surface level (+1.9 m) +6 ft
Water struck at -2.7 m
March 1979

Overburden 9.5 m
Mineral 3.8 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill and soil	0.8	0.8
Marine or Estuarine Alluvium	Silt, clayey, moderate yellowish brown	0.5	1.3
	Silt, dark greenish grey	0.9	2.2
	Peat and wood	0.2	2.4
	Silt, dark greenish grey	0.7	3.1
	Clay, sandy, light greenish grey with flint pebbles to 3.4 m then moderate brown, sandy and silty; at 3.6 m becomes partly oxidised, medium grey and at 4.5 m pale brown, sandy with 2-mm chalk fragments	1.5	4.6
?River Gravels	Gravel Gravel: fine, angular and subangular flint, subangular Jurassic limestone and subrounded quartzite	0.4	5.0
?	Clay, olive grey with carbonaceous fragments; pebbly with a 10 cm peat band at 7.5 m; many wood fragments to 8.0 m	4.5	9.5
River Gravels	Gravel Gravel: fine, subrounded to rounded quartzite with rounded quartz, subangular flint, some limestone and sandstone and trace mudstone, ironstone and igneous Sand: medium with coarse, quartz with lithic grains	3.8	13.3
Ancholme Clay Group	Clay, dark greenish grey	0.8+	14.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
1	41	58	9.5-10.5	1	4	29	15	36	15	0
			10.5-11.6	1	6	18	14	46	15	0
			11.6-12.5	1	10	15	8	58	8	0
			12.5-13.3	2	9	24	9	46	10	0
			Mean	1	7	22	12	46	12	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction									
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others	
9.5-10.5	21	45	5	20	8	0	1	trace	0	
10.5-11.6	13	51	4	23	8	0	0	0	1	
11.6-12.5	12	49	8	25	5	trace	0	trace	trace	
12.5-13.3	10	59	6	19	6	trace	trace	trace	0	
Mean	14	51	5	22	7	trace	trace	trace	trace	

TF 16 SE 16	1753 6446	Bergamoor	Block A₂
Surface level (+4.9 m) +16 ft			Overburden 0.3 m
Water not struck			Mineral 1.4 m
March 1979			Waste 1.6 m
			Bedrock 1.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Fluvio-glacial and Older River Sand and Gravel	'Clayey' pebbly sand Gravel: fine with coarse, flint Sand: fine with medium, quartz Fines: pale ochreous brown and pale grey-green silt bands	1.4	1.7
?Till	Clay, silty, dark bluish grey mottled with light olive brown; light olive grey lenses to base; only sporadic pebbles	1.6	3.3
Ancholme Clay Group	Clay, silty, greenish black; thin-shelled bivalves	1.7+	5.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
17	68	15	0.3-1.7	17	35	27	6	9	6	0

TF 16 SE 17 1848 6499

Moorside Farm

Block A₂

Surface level (+7.7 m) +25 ft
Water not struck
March 1979

Overburden 0.5 m
Mineral 1.7 m
Waste 0.3 m
Bedrock 2.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	'Very clayey' sand Sand: fine quartz Fines: brown silt becoming pale greyish green to base	1.7	2.2
?Till	Clay, silty, greenish black with sporadic chalk, quartzite and flint pebbles	0.3	2.5
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous	2.0+	4.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
22	75	3	0.5-2.2	22	63	10	2	2	1	0

TF 16 SE 18 1537 6334

Blankney Dales

Block B₃

Surface level (+2.4 m) +8 ft
Water struck at -2.1 m
March 1979

Overburden 4.6 m
Mineral 1.4 m
Waste 0.4 m
Mineral 3.3 m
Waste 0.9 m
Mineral 2.3 m
Bedrock 1.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and fill	1.0	1.0
Marine or Estuarine Alluvium	Clay, silty, olive brown with rust brown patches, laminated at top; plant remains throughout	2.0	3.0
	Peat, dark brown, fibrous, many reeds	0.2	3.2
	Clay, silty, olive grey, with some reed remains; sandy lenses and pebbles to base	0.4	3.6
?River Gravels	a 'Clayey' pebbly sand Gravel: fine, subrounded white flint and limestone; some subangular flint and trace subrounded quartzite Sand: fine and medium, quartz with some lithic grains	1.4	6.0
	Silt, sandy, olive grey	0.4	6.4
	b Sand, fine and medium, quartz; fines - greyish brown to 8.2 m then brown	3.3	9.7

?	Clay, silty, olive grey with peaty laminae and patches and thin-shelled molluscs	0.9	10.6
River Gravels	c Gravel Gravel: fine and coarse, subrounded to rounded quartzite with subangular flint, rounded to well rounded quartz and some subrounded limestone and sandstone Sand: medium with coarse, quartz with lithic grains	2.3	12.9
Ancholme Clay Group	Clay, silty, greenish black, laminated with fine shell fragments; towards base becomes well-bedded mudstone	1.6+	14.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	13	65	22	4.6-6.0	13	28	24	13	20	2	0
b	7	92	1	6.4-8.2	8	52	38	1	1	0	0
				8.2-9.7	6	40	53	1	0	0	
				Mean	7	46	45	1	1	0	0
c	2	40	58	10.6-11.7	4	2	24	16	30	24	0
				11.7-12.9	0	3	21	15	32	29	0
				Mean	2	2	23	15	32	26	0
a+b+c	7	70	23	Mean	7	28	34	8	14	9	0

TF 16 SE 19 1639 6371 Blankney Dales Block B₃

Surface level (+1.8 m) +6 ft Waste 7.3 m
Water struck at -1.4 m Bedrock 3.7 m+
March 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.1	1.1
Marine or Estuarine Alluvium	Clay, silty, olive grey with ochreous brown mottling; many plant remains; becoming progressively sandier with colour changing through pale greyish green to dark greenish grey	3.4	4.5
	Silt, clayey, peaty and sandy, olive black with wood fragments, some pebbles and fine shell debris	0.9	5.4
	Clay, silty with gritty lenses, pebbles and some plant fragments	1.9	7.3
Ancholme Clay Group	Clay, silty, greenish black, well laminated with shell fragments and ammonite casts	3.7+	11.0

TF 16 SE 20 1951 6348 Victoria Baths

Block A₂

Surface level (+9.8 m) +32 ft
Water struck at +9.3 m
March 1979

Overburden 0.3 m
Mineral 4.8 m
Bedrock 2.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Fluvio-glacial and Older River Sand and Gravel	'Clayey' sand Sand: fine quartz Fines: dark yellowish orange silt with thin very pale greyish green silt bands at 1.5 m	4.8	5.1
Ancholme Clay Group	Clay, silty, greenish black, initially very well laminated becoming bedded with thin-shelled fossils to base	2.1+	7.2

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
13	87	0	0.3-4.0	14	66	20	0	0	0	0
			4.0-5.1	9	74	15	1	1	0	0
			Mean	13	67	19	1	0	0	0

TF 16 SE 21 1549 6223 Dales Head Bank

Block B₄

Surface level (+1.5 m) +5 ft
Water struck at -4.1 m
March 1979

Overburden 5.9 m
Mineral 6.1 m
Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Marine or Estuarine Alluvium	Silt, clayey, olive brown with olive grey mottling; grey and sandier at 2.3 m	2.9	3.6
	Peat, dark brown	1.0	4.6
	Silt, clayey, olive brown with olive grey mottling	1.3	5.9
River Gravels	Sandy gravel Gravel: fine with coarse, subrounded quartzite with angular flint, well rounded quartz and some limestone and dark igneous rocks Sand: medium, quartz with lithic grains	6.1	12.0
Ancholme Clay Group	Clay, silty, dark greenish grey with some thin-shelled bivalves	1.0+	13.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
2	53	45	5.9-6.9	4	22	20	12	33	9	0
			6.9-7.9	3	17	36	7	20	17	0
			7.9-8.9	1	9	55	14	18	3	0
			8.9-9.9	1	4	26	15	44	10	0
			9.9-10.9	2	2	20	21	43	12	0
			10.9-12.0	0	4	22	16	43	15	0
			Mean	2	9	30	14	34	11	0

TF 16 SE 22 1616 6274 Martin Dales Block B₄

Surface level (+1.2 m) +4 ft Overburden 9.2 m
 Water struck at -4.9 m Mineral 3.9 m
 March 1979 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Marine or Estuarine Alluvium	Clay, silty, greyish brown, mottled becoming olive black; some plant remains at top	2.2	3.0
	Peat, dark reddish brown, fibrous with wood fragments	0.4	3.4
	Clay, silty, pale brown with dark greenish grey lenses and patches, sporadic sandy bands and pebbles; peaty at top with some plant fragments throughout	1.6	5.0
River Gravels	'Very clayey' gravel Gravel: fine, flint and quartzite	0.6	5.6
?	Silt, peaty, greenish grey, with sandy and pebbly bands to base and thin shells throughout	3.6	9.2
River Gravels	Gravel Gravel: fine with coarse to base, subrounded to rounded quartzite with rounded quartz, subangular flint and some subrounded limestone and sandstone Sand: medium, quartz with lithic grains	3.9	13.1
Ancholme Clay Group	Clay, silty, very dark greenish black, well laminated with beige-pink thin shell fragments	1.1+	14.2

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
2	43	55	9.2-10.2	3	4	34	11	36	12	0
			10.2-11.2	1	3	28	11	39	18	0
			11.2-12.2	1	4	27	11	36	21	0
			12.2-13.1	3	4	23	11	30	29	0
			Mean	2	4	28	11	35	20	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
9.2-10.2	13	59	8	14	6	trace	0	0	trace
10.2-11.2	11	55	7	20	7	0	0	0	0
11.2-12.2	14	51	6	25	4	0	0	0	0
12.2-13.1	13	62	4	18	3	0	0	0	0
Mean	13	57	6	19	5	trace	0	0	trace

TF 16 SE 23 1746 6225 Martin Dales Block B₄
 Surface level (+1.5 m) +5 ft Waste 10.8 m
 Water level not recorded Bedrock 1.1 m+
 March 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Marine or Estuarine Alluvium	Clay, silty in part, greenish grey, with carbonaceous patches and sandy pockets	1.8	2.5
	Clay, medium bluish grey mottled with light olive brown; some flint pebbles	2.0	4.5
?	Clay, silty, greyish olive, bedded, with many plant remains and some thin pale shells	2.9	7.4
	Clay, sandy, dark greenish grey	3.4	10.8
Ancholme Clay Group	Clay, dark greenish grey, some thin-shelled fossils	1.1+	11.9

TF 16 SE 24 1832 6295 Witham Farm Block A₂
 Surface level (+6.3 m) +21 ft Overburden 0.2 m
 Water not struck Mineral 1.9 m
 March 1979 Waste 4.2 m
 Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial and Older River Sand and Gravel	'Very clayey' pebbly sand Gravel: fine and coarse, Sand: fine with medium, quartz with some lithic grains Fines: reddish brown laminated silt bands	1.9	2.1
Till	Clay, silty, greenish black with pebbles of chalk, sandstone and many tabular mudstone fragments	4.2	6.3
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous	1.5+	7.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
26	63	11	0.2-2.1	26	34	26	3	5	6	0

TF 16 SE 25 1938 6240 Kirkstead Hall Block A₂
 Surface level (+7.0 m) +23 ft Waste 5.4 m
 Water not struck Bedrock 1.3 m+
 March 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
	Clay, very sandy and pebbly	0.2	1.2
Till	Clay, silty, chiefly greenish black with pebbles of chalk and some quartzitic sandstone and siltstone; many tabular mudstone clasts towards base	4.2	5.4
Ancholme Clay Group	Clay, silty, greenish black with many thin-shelled fossils	1.3+	6.7

TF 16 SE 26 1532 6118 Martin Town Dike Block B₄
 Surface level (+0.6 m) +2 ft Overburden 4.1 m
 Water struck at -3.4 m Mineral 7.7 m
 March 1979 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Marine or Estuarine Alluvium	Clay, silty, olive grey with rust brown patches; some plant remains and sporadic sandy pockets	3.5	3.8
	Peat, brown, fibrous, silty and sandy to base	0.3	4.1
	a 'Very clayey' sand Sand: medium with fine, quartz and some dark lithic grains Fines: olive grey disseminated silt and thin pale greenish grey silt bands	1.0	5.1
River Gravels	b Pebbly sand Gravel: fine, subangular to subrounded white flint with subrounded to rounded quartzite, rounded quartz and some limestone and sandstone Sand: medium with fine, quartz with lithic grains	3.2	8.3
	c Sandy gravel Gravel: fine, subrounded to rounded quartzite with rounded to well rounded quartz, subangular flint, and some subrounded sandstone and limestone Sand: medium, quartz with lithic grains	3.5	11.8
Ancholme Clay Group	Clay, silty, greenish grey, some fossil casts	0.8+	12.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	26	73	1	4.1-5.1	26	30	42	1	1	0	0
b	4	74	22	5.1-6.1	9	33	47	4	7	0	0
				6.1-8.3	2	22	40	8	24	4	0
				Mean	4	25	42	7	19	3	0
c	1	51	48	8.3-9.5	0	4	45	15	23	13	0
				9.5-10.5	0	3	32	7	33	25	0
				10.5-11.5	1	2	33	12	42	10	0
				11.5-11.8	1	2	31	11	37	18	0
				Mean	1	3	37	11	32	16	0
a+b+c	5	64	31	Mean	5	16	40	8	23	8	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
b	5.1-6.1	73	9	0	5	13	0	0	0	0
	6.1-8.3	44	27	10	16	2	0	0	1	0
	Mean	47	25	9	15	3	0	0	1	0
c	8.3-9.5	17	44	7	23	8	trace	trace	0	trace
	9.5-10.5	12	54	4	24	6	trace	trace	0	0
	10.5-11.5	17	44	4	26	8	0	1	0	0
	11.5-11.8	12	49	9	20	8	0	2	0	0
	Mean	15	48	5	24	7	trace	trace	0	trace
b+c	Mean	25	41	6	21	6	trace	trace	trace	trace

TF 16 SE 27 1607 6192 Dales Head Dike Block B₄

Surface level (+1.7 m) +6 ft Overburden 5.5 m
 Water struck at -3.8 m Mineral 7.1 m
 March 1979 Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Marine or Estuarine Alluvium	Silt, very sandy, moderate yellowish brown with light brown laminations and mottling, bedded and micaceous	2.6	3.1
	Silt, olive black with some fine sand	2.4	5.5
River Gravels	Gravel Gravel: fine with coarse, subrounded quartzite with rounded quartz, subangular flint and some subrounded limestone, mudstone and trace igneous; flint is dominant in the first 0.5 m Sand: medium, quartz with lithic grains	7.1	12.6
Ancholme Clay Group	Clay, silty, greenish black with beige-pink shell fragments	0.4+	13.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Gravel			
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
2	48	50	5.5-8.0	5	13	38	6	24	12	2
			8.0-9.0	1	6	39	4	27	23	0
			9.0-10.0	0	3	30	9	32	26	0
			10.0-11.0	0	5	32	7	27	26	3
			11.0-12.6	0	3	24	13	37	23	0
			Mean	2	7	33	8	29	20	1

TF 16 SE 28

1747 6158

Kirkstead

Block B₄

Surface level (+2.3 m) +8 ft
Water struck at -0.8 m
March 1979

Overburden 3.1 m
Mineral 2.0 m
Waste 1.7 m
Mineral 1.6 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Marine or Estuarine Alluvium	Clay, silty, dark yellowish brown with olive grey, some plant remains	1.7	2.4
	Silt, clayey, with sandy partings and thin peat bands	0.7	3.1
River Gravels	a Sandy gravel, 'clayey' in first 1.0 m Gravel: fine with coarse, subangular dark flint with sub-rounded quartzite and rounded to well rounded quartz Sand: medium, quartz with lithic grains Fines: olive grey silt sometimes occurring in silty sand bands	2.0	5.1
	Silt, sandy, pebbly and clayey, brown	1.7	6.8
	b Sandy gravel Gravel: fine with coarse, subrounded quartzite with sub-angular flint, rounded to well rounded quartz and some limestone and sandstone Sand: medium, quartz with lithic grains	1.6	8.4
Ancholme Clay Group	Clay, silty, dark greenish grey, bedded	0.6+	9.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages							
Fines	Sand	Gravel		Fines			Gravel				
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm	
a	8	66	26	3.1-4.1	10	15	43	6	18	8	0
				4.1-5.1	5	14	50	5	14	12	0
				Mean	8	14	46	6	16	10	0
b	4	64	32	6.8-8.4	4	9	46	9	21	11	0
a+b	6	65	29	Mean	6	12	46	7	18	11	0

Surface level (+8.2 m) +27 ft
 Water not struck
 March 1979

Overburden 0.5 m
 Mineral 1.9 m
 Waste 5.0 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	Gravel, very compact, iron-stained Gravel: fine with coarse, subrounded to rounded quartzite and subangular flint with well rounded quartz and some subrounded sandstone Sand: medium and coarse, quartz and lithic grains Fines: orange-brown silt	1.9	2.4
Till	Clay, silty, greenish black with chalk and sandstone pebbles and tabular silty clay clasts	5.0	7.4
Ancholme Clay Group	Clay, greenish black, fossiliferous	0.9+	8.3

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
4	35	61	0.5-2.4	4	8	14	13	40	21	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.5-2.4	34	40	trace	20	5	0	trace	0	0

Surface level (+3.7 m) +12 ft
 Water not struck
 March 1979

Waste 5.5 m
 Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Till	Clay, silty, olive grey but greenish black to base; many tabular greenish black silty clay clasts with chalk, flint and sandstone pebbles	4.8	5.5
Ancholme Clay Group	Clay, silty, greenish black, fossiliferous	1.5+	7.0

Surface level (+2.1 m) +7 ft
 Water struck at -2.9 m
 February 1979

Overburden 5.8 m
 Mineral 9.5 m
 Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	1.4	1.4
Marine or Estuarine Alluvium	Silt, greyish brown to greyish black, poorly laminated with scattered organic matter and a thin peat band at c. 4.0 m	3.7	5.1
	Sand, greyish brown	0.1	5.2
	Clay, silty, chocolate brown with grey lenses, poorly laminated with 2 mm chalk granules	0.6	5.8
River Gravels	a Sandy gravel Gravel: fine, subrounded to rounded quartzite, sub-angular flint, subrounded limestone and well rounded quartz Sand: medium with fine, quartz and lithic grains	2.2	8.0
	b Gravel Gravel: fine with coarse, subrounded to rounded quartzite with subangular flint, rounded quartz and some sub-rounded sandstone and limestone Sand: medium, quartz with lithic grains	7.3	15.3
Ancholme Clay Group	Silt, clayey, steel grey, rare shell fragments	1.2+	16.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	4	68	28	5.8-7.0	6	36	33	6	16	3	0
				7.0-8.0	1	15	33	12	31	8	0
				Mean	4	26	33	9	23	5	0
b	1	44	55	8.0-9.0	1	5	17	8	32	37	0
				9.0-10.0	0	4	25	16	34	21	0
				10.0-11.0	0	3	30	14	40	13	0
				11.0-12.0	0	3	31	11	31	24	0
				12.0-13.0	0	4	32	10	42	12	0
				13.0-14.0	0	3	29	12	36	20	0
				14.0-15.3	1	3	38	12	30	15	1
				Mean	1	3	29	12	35	20	0
a+b	1	50	49	Mean	1	9	30	11	32	17	0

TF 16 SE 32 1630 6114

Martin South Drove

Block B₄

Surface level (+2.0 m) +7 ft
 Water struck at -2.9 m
 March 1979

Overburden 4.9 m
 Mineral 9.8 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Marine or Estuarine Alluvium	Clay, silty, greenish grey to olive grey, mottled, many plant remains and some thin peat bands	3.2	3.6
	Peat, dark brown, fibrous	0.4	4.0
	Clay, silty, olive grey, some plant remains	0.3	4.3
	Clay, pale brown, laminated with grey sandy bands to base	0.6	4.9
River Gravels	a Pebbly sand, 'clayey' in first metre Gravel: fine, subangular to subrounded white flint with some cream limestone and rounded to well rounded quartzite and quartz Sand: medium with fine, quartz and lithic grains Fines: greyish brown silt bands to 5.9 m	3.0	7.9
	b Gravel Gravel: fine with coarse, subrounded to rounded quartzite with some quartz, flint and limestone and trace igneous and siltstone Sand: medium, quartz with lithic grains	6.8	14.7
Ancholme Clay Group	Clay, silty, greenish black	1.0+	15.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Sand		Gravel	
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	5	85	10	4.9-5.9	11	34	40	7	8	0	0
				5.9-6.9	4	34	48	9	5	0	0
				6.9-7.9	1	12	62	8	16	1	0
				Mean	5	27	50	8	9	1	0
b	1	49	50	7.9-8.9	2	11	50	11	21	5	0
				8.9-9.9	1	6	37	16	30	10	0
				9.9-11.4	2	3	31	14	34	16	0
				11.4-12.4	1	3	23	15	38	18	2
				12.4-13.4	0	2	23	18	42	15	0
				13.4-14.7	1	2	21	10	51	15	0
				Mean	1	4	31	14	36	14	0
a+b	2	60	38	Mean	2	11	37	12	28	10	0

Surface level (+2.0 m) +7 ft
 Water struck at -3.0 m
 March 1979

Overburden 5.9 m
 Mineral 6.1 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Marine or Estuarine Alluvium	Clay, silty, olive grey mottled with brown at top, some plant remains	1.8	2.8
	Peat, dark brown fibrous	0.3	3.1
	Clay, silty, olive grey with peaty and carbonaceous bands becoming brown with bluish grey patches; sandy to base	2.8	5.9
River Gravels	a Sandy gravel Gravel: fine, subangular flint with subrounded quartzite and rounded quartz and some sandstone Sand: medium and coarse, quartz and lithic grains	1.0	6.9
	b Pebbly sand with reddish brown silt bands Gravel: fine, subrounded quartzite, subangular flint and rounded quartz Sand: medium with fine, quartz with lithic grains	3.6	10.5
	c Gravel Gravels: fine with coarse, subrounded quartzite with subangular flint and rounded quartz and some sandstone Sand: medium, quartz with lithic grains	1.5	12.0
Ancholme Clay Group	Clay, silty, dark greenish grey with fine shells	1.0+	13.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel								
					Fines		Sand			Gravel	
					- $\frac{1}{8}$	$+\frac{1}{8}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	2	56	42	5.9-6.9	2	16	20	20	35	7	0
b	9	71	20	6.9-10.5	9	21	41	9	15	5	0
c	2	48	50	10.5-11.5	2	7	30	12	34	15	0
				11.5-12.0	1	5	30	10	30	24	0
				Mean	2	6	30	12	32	18	0
a+b+c	6	63	31	Mean	6	16	35	12	23	8	0

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a	5.9-6.9	53	30	trace	15	2	0	0	trace	0
b	6.9-10.5	38	43	0	17	2	trace	trace	0	0
c	10.5-11.5	24	54	0	18	4	trace	trace	trace	0
	11.5-12.0	18	55	trace	24	3	0	trace	trace	0
	Mean	22	54	trace	20	4	trace	trace	trace	0
a+b+c	Mean	35	44	trace	18	3	trace	trace	trace	0

TF 16 SE 34 1805 6080 Timberland Dales

Block B₄

Surface level (+1.8 m) +6 ft
 Water struck at -1.3 m
 March 1979

Overburden 4.2 m
 Mineral 2.4 m
 Bedrock 2.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Marine or Estuarine Alluvium	Clay, silty, mottled olive grey and greenish grey to olive grey with depth; some plant remains and thin peat bands	2.6	3.1
	'Clayey' gravel Gravel: mainly fine, subrounded quartzite, subangular flint and some rounded quartz Sand: fine and medium, quartz Fines: olive grey silty clay bands	0.4	3.5
	Silt, greenish grey, sandy, pebbly and clayey	0.7	4.2
River Gravels	Sandy gravel Gravel: fine, subrounded quartzite, subangular flint and some rounded quartz Sand: medium, quartz with lithic grains	2.4	6.6
Ancholme Clay Group	Clay, silty, well laminated at top, greenish black	2.7+	9.3

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages							
Fines	Sand	Gravel		Fines		Sand		Gravel			
				-1/8	+1/8 - 1/4	+1/4 - 1/2	+1/2 - 1	+1 - 2	+2 - 4	+4 - 7.5	+7.5 mm
2	71	27	4.2-5.2	4	16	37	10	25	8	0	
			5.2-6.6	2	12	52	12	18	4	0	
			Mean	2	14	46	11	21	6	0	

TF 16 SE 35 1906 6032 Mill Farm

Block A₂

Surface level (+5.3 m) +17 ft
 Water struck at +2.5 m
 April 1979

Overburden 0.6 m
 Mineral 5.5 m
 Waste 3.7 m
 Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill and soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	a Pebbly sand, some dark yellowish orange silt Gravel: fine, angular flint with some rounded quartzite, quartz and sandstone Sand: medium, quartz with lithic grains	2.8	3.4
	b Sandy gravel Gravel: fine with coarse, rounded quartzite with angular to subangular flint, rounded to well rounded quartz, some sandstone and trace igneous Sand: medium, quartz with lithic grains	2.7	6.1
Till	Clay, very dark greenish grey with pebbles of soft mudstone, white flint and some chalk	3.7	9.8
Ancholme Clay Group	Clay, very dark greenish grey to greenish black, fossiliferous	0.7+	10.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand			Gravel		
					- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm	
a	4	72	24	0.6-1.6	3	18	31	14	30	4	0	
				1.6-2.6	3	20	55	7	12	3	0	
				2.6-3.4	7	20	46	5	14	8	0	
				Mean	4	19	44	9	19	5	0	
b	2	52	46	3.4-4.4	4	12	30	8	29	17	0	
				4.4-5.4	0	2	35	16	34	13	0	
				5.4-6.1	1	5	31	15	28	20	0	
				Mean	2	7	32	13	30	16	0	
a+b	3	62	35	Mean	3	13	38	11	25	10	0	

COMPOSITION

	Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
		Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
a	0.6-1.6	82	14	0	2	1	0	trace	trace	0
	1.6-2.6	88	3	0	7	2	0	0	0	0
	2.6-3.4	43	38	0	11	6	0	0	2	0
	Mean	75	17	0	5	2	0	trace	1	0
b	3.4-4.4	22	50	0	12	12	0	0	4	0
	4.4-5.4	20	53	0	19	7	0	trace	trace	0
	5.4-6.1	19	52	0	20	8	0	0	trace	trace
	Mean	21	52	0	16	9	0	trace	2	trace
a+b	Mean	42	38	0	12	7	0	trace	1	trace

TF 17 SW 33 1294 7280 Lodge Farm

Block A₁

Surface level (+15.5 m) +51 ft
Water not struck
May 1979

Overburden 1.0 m
Mineral 2.2 m
Waste 5.6 m Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Fluvio-glacial and Older River Sand and Gravel	'Clayey' sand Sand: medium and fine quartz Fines: very dark yellowish orange and yellowish grey clay bands at 1.9 m	2.2	3.2
?	Clay, greenish grey, very sandy, pebble-free to 4.5 m then pockets of grey flint and sand and carbonaceous material	2.6	5.8
Till	Clay, medium dark grey, with tabular mudstone, flint and chalk	3.0	8.8
Ancholme Clay Group	Clay, dark bluish grey, fossiliferous	1.1+	9.9

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
16	83	1	1.0-3.2	16	35	46	2	1	0	0

TF 17 SW 34	1063 7191	The Hermitage	Block A₁
Surface level (+5.3 m) +17 ft			Overburden 1.1 m
Water level not recorded			Mineral 1.1 m
May 1979			Waste 0.6 m
			Mineral 0.9 m
			Waste 7.4 m
			Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.1	1.1
River Gravels	a Pebbly sand Gravel: mainly fine angular flint Sand: medium with fine, quartz with lithic grains	1.1	2.2
	Silt, clayey, olive grey with carbonaceous patches, becoming greenish grey and sandy	0.6	2.8
	b Pebbly sand Gravel: fine, angular flint with subrounded limestone Sand: medium with fine, quartz with lithic grains	0.9	3.7
?	Silt, clayey, chiefly olive grey with carbonaceous lenses and some organic matter; sandy with flint pebbles to base	1.5	5.2
	Clay, bluish grey with olive brown patches, sandy to base	1.6	6.8
	Clay, silty, passing into silt at 8.0 m, olive grey with thin white gastropod shells, wood fragments and other plant debris; pebbly below 10.0 m	4.3	11.1
Ancholme Clay Group	Clay, greenish grey, bedded	1.1+	12.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
a	4	74	22	1.1-2.2	4	20	47	7	16	6	0
b	5	76	19	2.8-3.7	5	17	52	7	17	2	0
a+b	5	75	20	Mean	5	19	49	7	16	4	0

TF 17 SW 35 1408 7176

Austacre Wood

Block A₁

Surface level (+13.0 m) +43 ft
Water not struck
May 1979

Waste 6.5 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, greenish grey mottled with very dark yellowish orange; light bluish grey and sandy to base	1.4	1.7
	Clay, olive grey and bluish grey to dark grey, with fine chalk and some flint pebbles and an increasing amount of tabular mudstone fragments to base	4.8	6.5
Ancholme Clay Group	Clay, dark grey, bedded	0.7+	7.2

TF 17 SW 36 1066 7105

Sloam Hill Cottages

Block A₁

Surface level (+4.5 m) +15 ft
Water struck at +2.0 m
May 1979

Overburden 0.5 m
Mineral 5.3 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
River Gravels	a Pebbly sand Gravel: fine with coarse, angular to subangular flint with some rounded to subrounded quartzite and subrounded limestone Sand: medium, quartz with lithic grains	3.0	3.5
	b Gravel Gravel: fine with coarse, constituents as above Sand: medium with quartz and lithic grains	2.3	5.8
Ancholme Clay Group	Clay, dark grey, fossiliferous, becoming medium dark grey and barren	0.7+	6.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	1	76	23	0.5-1.5	2	9	60	10	14	5	0
				1.5-2.5	1	14	66	5	10	4	0
				2.5-3.5	0	10	52	4	18	16	0
				Mean	1	11	59	6	14	9	0
b	2	34	64	3.5-4.3	3	3	26	12	35	21	0
				4.3-5.3	1	1	14	16	45	23	0
				5.3-5.8	2	2	13	14	37	32	0
				Mean	2	2	18	14	40	24	0
a+b	1	58	41	Mean	1	7	41	10	25	16	0

COMPOSITION

Depth below surface (m)	Percentages by weight in +8 -16 mm fraction								
	Flint	Quartzite	Limestone	Quartz	Sandstone	Mudstone	Ironstone	Igneous	Others
0.5-5.8	69	13	15	2	0	0	1	0	0

TF 17 SW 37 1185 7131 Snakeholme House Block A₁
 Surface level (+3.9 m) +13 ft Waste 1.8 m
 Water not struck Bedrock 2.6 m+
 May 1979

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	Clay, olive grey mottled with dark yellowish orange; with sandy bands and granules of white limestone	1.5	1.8
Ancholme Clay Group	Clay, light grey and mottled passing into medium dark grey, sporadic fossils	2.6+	4.4

TF 17 SW 38 1230 7058 King's Hill Close Block A₁
 Surface level (+9.3 m) +31 ft Overburden 0.6 m
 Water not struck Mineral 2.4 m
 May 1979 Waste 4.9 m
 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
River Gravels	Pebbly sand, 'clayey' below 2.4 m Gravel: fine, angular flint Sand: medium with fine, quartz with lithic grains Fines: dark yellowish orange and yellowish brown	2.4	3.0
	Clay, greenish grey, very sandy	0.2	3.2
Till	Clay, dark grey, many tabular mudstone fragments with chalk granules and sporadic sandstone and siltstone pebbles	4.7	7.9
Ancholme Clay Group	Clay, greyish black	1.1+	9.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
8	77	15	0.6-2.4	5	20	46	10	16	3	0
			2.4-3.0	18	43	34	3	2	0	0
			Mean	8	26	43	8	13	2	0

The following reports of the Institute relate particularly to bulk mineral resources

Reports of the Institute of Geological Sciences

Assessment of British Sand and Gravel Resources

- 1 The sand and gravel resources of the country south-east of Norwich, Norfolk: Resource sheet TG 20.
E. F. P. Nickless.
Report 71/20 ISBN 0 11 880216 X £1.15
- 2 The sand and gravel resources of the country around Witham, Essex: Resource sheet TL 81. H. J. E. Haggard.
Report 72/6 ISBN 0 11 880588 6 £1.20
- 3 The sand and gravel resources of the area south and west of Woodbridge, Suffolk: Resource sheet TM 24.
R. Allender and S. E. Hollyer.
Report 72/9 ISBN 0 11 880596 7 £1.70
- 4 The sand and gravel resources of the country around Maldon, Essex: Resource sheet TL 80. J. D. Ambrose.
Report 73/1 ISBN 0 11 880600 9 £1.20
- 5 The sand and gravel resources of the country around Hethersett, Norfolk: Resource sheet TG 10.
E. F. P. Nickless.
Report 73/4 ISBN 0 11 880606 8 £1.60
- 6 The sand and gravel resources of the country around Terling, Essex: Resource sheet TL 71. C. H. Eaton.
Report 73/5 ISBN 0 11 880608 4 £1.20
- 7 The sand and gravel resources of the country around Layer Breton and Tolleshunt D'Arcy, Essex: Resource sheet TL 91 and part of TL 90. J. D. Ambrose.
Report 73/8 ISBN 0 11 880614 9 £1.30
- 8 The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Resource sheet TM 23.
R. Allender and S. E. Hollyer.
Report 73/13 ISBN 0 11 880625 4 £1.60
- 9 The sand and gravel resources of the country around Attlebridge, Norfolk: Resource sheet TG 11.
E. F. P. Nickless.
Report 73/15 ISBN 0 11 880658 0 £1.85
- 10 The sand and gravel resources of the country west of Colchester, Essex: Resource sheet TL 92. J. D. Ambrose.
Report 74/6 ISBN 0 11 880671 8 £1.45
- 11 The sand and gravel resources of the country around Tattingstone, Suffolk: Resource sheet TM 13. S. E. Hollyer.
Report 74/9 ISBN 0 11 880675 0 £1.95
- 12 The sand and gravel resources of the country around Gerrards Cross, Buckinghamshire: Resource sheet SU 99, TQ 08 and TQ 09. H. C. Squirrell.
Report 74/14 ISBN 0 11 880710 2 £2.20

Mineral Assessment Reports

- 13 The sand and gravel resources of the country east of Chelmsford, Essex: Resource sheet TL 70. M. R. Clarke.
ISBN 0 11 880744 7 £3.50
- 14 The sand and gravel resources of the country east of Colchester, Essex: Resource sheet TM 02. J. D. Ambrose.
ISBN 0 11 880745 5 £3.25
- 15 The sand and gravel resources of the country around Newton on Trent, Lincolnshire: Resource sheet SK 87.
D. Price.
ISBN 0 11 880746 3 £3.00
- 16 The sand and gravel resources of the country around Braintree, Essex: Resource sheet TL 72. M. R. Clarke.
ISBN 0 11 880747 1 £3.50
- 17 The sand and gravel resources of the country around Besthorpe, Nottinghamshire: Resource sheet SK 86 and part of SK 76. J. R. Gozzard.
ISBN 0 11 880748 X £3.00
- 18 The sand and gravel resources of the Thames Valley, the country around Cricklade, Wiltshire: Resource sheet SU 09/19

and parts of SP 00/10. P. R. Robson.
ISBN 0 11 880749 8 £3.00

- 19 The sand and gravel resources of the country south of Gainsborough, Lincolnshire: Resource sheet SK 88 and part of SK 78. J. H. Lovell.
ISBN 0 11 880750 1 £2.50
- 20 The sand and gravel resources of the country east of Newark upon Trent, Nottinghamshire: Resource sheet SK 85.
J. R. Gozzard.
ISBN 0 11 880751 X £2.75
- 21 The sand and gravel resources of the Thames and Kennet Valleys, the country around Pangbourne, Berkshire: Resource sheet SU 67. H. C. Squirrell.
ISBN 0 11 880752 8 £3.25
- 22 The sand and gravel resources of the country north-west of Scunthorpe, Humberside: Resource sheet SE 81.
J. W. C. James.
ISBN 0 11 880753 6 £3.00
- 23 The sand and gravel resources of the Thames Valley, the country between Lechlade and Standlake: Resource sheet SP 30 and parts of SP 20, SU 29 and SU 39. P. Robson.
ISBN 0 11 881252 1 £7.25
- 24 The sand and gravel resources of the country around Aldermaston, Berkshire: Resource sheet SU 56 and SU 66. H. C. Squirrell.
ISBN 0 11 881253 X £5.00
- 25 The celestite resources of the area north-east of Bristol: Resource sheet ST 68 and parts of ST 59, 69, 79, 58, 78, 68 and 77. E. F. P. Nickless, S. J. Booth and P. N. Mosley.
ISBN 0 11 881262 9 £5.00
- 26 The limestone and dolomite resources of the country around Monyash, Derbyshire: Resource sheet SK 16.
F. C. Cox and D. McC. Bridge.
ISBN 0 11 881263 7 £7.00
- 27 The sand and gravel resources of the country west and south of Lincoln, Lincolnshire: Resource sheets SK 95, SK 96 and SK 97. I. Jackson.
ISBN 0 11 884003 7 £6.00
- 28 The sand and gravel resources of the country around Eynsham, Oxfordshire: Resource sheet SP 40 and part of SP 41. W. J. R. Harries.
ISBN 0 11 884012 6 £3.00
- 29 The sand and gravel resources of the country south-west of Scunthorpe, Humberside: Resource sheet SE 80.
J. H. Lovell.
ISBN 0 11 884013 4 £3.50
- 30 Procedure for the assessment of limestone resources.
F. C. Cox, D. McC. Bridge and J. H. Hull.
ISBN 0 11 884030 4 £1.25
- 31 The sand and gravel resources of the country west of Newark upon Trent, Nottinghamshire: Resource sheet SK 75.
D. Price and P. J. Rogers.
ISBN 0 11 884031 2 £3.50
- 32 The sand and gravel resources of the country around Sonning and Henley, Berkshire, Oxfordshire and Buckinghamshire: Resource sheet SU 77 and SU 78.
H. C. Squirrell.
ISBN 0 11 884032 0 £5.25
- 33 The sand and gravel resources of the country north of Gainsborough, Lincolnshire: Resource sheet SK 89.
J. R. Gozzard and D. Price
ISBN 0 11 884033 9 £4.50
- 34 The sand and gravel resources of the Dengie Peninsula, Essex: Resource sheet TL 90, etc. M. B. Simmons.
ISBN 0 11 884081 9 £5.00
- 35 The sand and gravel resources of the country around Darvel, Strathclyde: Resource sheet NS 53, 63, etc.
E. F. P. Nickless, A. M. Aitken and A. A. McMillan.
ISBN 0 11 884082 7 £7.00

- 36 The sand and gravel resources of the country around Southend-on-Sea, Essex: Resource sheets TQ 78, 79 etc. S. E. Hollyer and M. B. Simmons. ISBN 0 11 884083 5 £7.50
- 37 The sand and gravel resources of the country around Bawtry, South Yorkshire: Resource sheet SK 69. A. R. Clayton ISBN 0 11 884053 3 £5.75
- 38 The sand and gravel resources of the country around Abingdon, Oxfordshire: Resource sheet SU 49, 59, SP 40, 50. C. E. Corser. ISBN 0 11 884084 5 £5.50
- 39 The sand and gravel resources of the Blackwater Valley (Aldershot) area: Resource sheet SU 85, 86, parts SU 84, 94, 95, 96. M. R. Clarke, A. J. Dixon and M. Kubala. ISBN 0 11 884085 1 £7.00
- 40 The sand and gravel resources of the country west of Darlington, County Durham: Resource sheet NZ 11, 21. A. Smith. ISBN 0 11 884086 X £5.00
- 41 The sand and gravel resources of the country around Garmouth, Grampian Region: Resource sheet NJ 36. A. M. Aitken, J. W. Merritt and A. J. Shaw. ISBN 0 11 884090 8 £8.75
- 42 The sand and gravel resources of the country around Maidenhead and Marlow: Resource sheet SU 88, parts SU 87, 97, 98. P. N. Dunkley. ISBN 0 11 884091 6 £5.00
- 43 The sand and gravel resources of the country around Misterton, Nottinghamshire: Resource sheet SK 79. D. Thomas and D. Price. ISBN 0 11 884092 4 £5.25
- 44 The sand and gravel resources of the country around Sedgfield, Durham: Resource sheet NZ 32. M. D. A. Samuel. ISBN 0 11 884093 2 £5.75
- 45 The sand and gravel resources of the country around Brampton, Cumbria: Resource sheet NY 55, part 56. I. Jackson. ISBN 0 11 884094 0 £6.75
- 46 The sand and gravel resources of the country around Harlow, Essex: Resource sheet TL 41. P. M. Hopson. ISBN 0 11 884107 6 £9.50
- 47 The limestone and dolomite resources of the country around Wirksworth, Derbyshire: Resource sheet SK 25, part 35. F. C. Cox and D. J. Harrison. ISBN 0 11 884108 4 £15.00
- 48 The sand and gravel resources of the Loddon Valley area: Resource sheet SU 75, 76, parts 64, 65, 66 and 74. M. R. Clarke, E. J. Raynor and R. A. Sobey. ISBN 0 11 884109 2 £8.75
- 49 The sand and gravel resources of the country around Lanark, Strathclyde Region: Resource sheet NS 94, part 84. J. L. Laxton and E. F. P. Nickless. ISBN 0 11 884112 2 £11.00
- 50 The sand and gravel resources of the country around Fordingbridge, Hampshire: Resource sheet SU 11 and parts of SU 00, 01, 10, 20 and 21. M. Kubala. ISBN 0 11 884111 4 £7.75
- 51 The sand and gravel resources of the country north of Bournemouth, Dorset: Resource sheet SU 00, 10, 20, SZ 09, 19 and 29. M. R. Clarke. ISBN 0 11 884110 6 £9.75
- 52 The sand and gravel resources of the country between Hatfield Heath and Great Waltham, Essex: Resource sheet TL 51 and 61. R. J. Marks. ISBN 0 11 884113 0 £8.00
- 53 The sand and gravel resources of the country around Cottenham, Cambridgeshire: Resource sheet TL 46 and 47. A. J. Dixon. ISBN 0 11 884114 9 £9.25
- 54 The sand and gravel resources of the country around Huntingdon and St Ives. Cambridgeshire: Resource sheets TL 16, 17, 26, 27, 36 and 37. R. W. Gatliff. ISBN 0 11 884115 7 £8.75
- 55 The sand and gravel resources of the country around Ipswich, Suffolk: Resource sheet TM 14. R. Allender and S. E. Hollyer. ISBN 0 11 884116 5 £10.00
- 56 Procedure for the assessment of the conglomerate resources of the Sherwood Sandstone Group. D. P. Piper and P. J. Rogers. ISBN 0 11 884143 2 £1.25
- 57 The conglomerate resources of the Sherwood Sandstone Group of the country around Cheadle, Staffordshire: Resource sheet SK 04. P. J. Rogers, D. P. Piper and T. J. Charsley. ISBN 0 11 884144 0 £7.75
- 58 The sand and gravel resources of the country west of Peterhead, Grampian Region: Resource sheet NK 04 and parts of NJ 94 and 95, NK 05, 14 and 15. A. A. McMillan and A. M. Aitken. ISBN 0 11 884145 9 £12.00
- 59 The sand and gravel resources of the country around Newbury, Berkshire: Resource sheet SU 46 and 57, parts of SU 36, 37 and 47. J. R. Gozzard. ISBN 0 11 884146 7 £11.50
- 60 The sand and gravel resources of the country south-west of Peterborough, in Cambridgeshire and east Northamptonshire: Resource sheet TL 09 and 19 and SP 98 and TL 08. A. M. Harrison. ISBN 0 11 884147 5 £15.50
- 61 The sand and gravel resources of the country north of Wrexham, Clwyd: Resource sheet SJ 35 and part of SJ 25. P. N. Dunkley. ISBN 0 11 884148 3 £11.75
- 62 The sand and gravel resources of the country around Dolphinton, Strathclyde Region, and West Linton, Borders Region: Resource sheet NT 04 and 14, parts of NT 05 and 15. A. A. McMillan, J. L. Laxton and A. J. Shaw. ISBN 0 11 884149 1 £8.00
- 63 The sand and gravel resources of the valley of the Douglas Water, Strathclyde Region: Resource sheet NS 83 and parts of NS 82, 92 and 93. A. J. Shaw and E. F. P. Nickless. ISBN 0 11 884150 5 £11.50
- 64 The sand and gravel resources of the country between Wallingford and Goring, Oxfordshire: Resource sheet SU 68 and part of SU 58. C. E. Corser. ISBN 0 11 884151 3 £11.50
- 65 The sand and gravel resources of the country around Hexham, Northumberland: Resource sheet NY 86 and 96. J. H. Lovell. ISBN 0 11 884152 1 £7.50
- 66 The sand and gravel resources of the country west of Chelmsford, Essex: Resource sheet TL 60. P. M. Hopson. ISBN 0 11 884153 X £8.50
- 67 The sand and gravel resources of the country around Hatfield and Cheshunt, Hertfordshire: Resource sheet TL 20 and 30, and parts of TQ 29 and 39. J. R. Gozzard. ISBN 0 11 884167 X £10.00
- 68 The sand and gravel resources of the country north-east of Halstead, Essex: Resource sheet TL 83. R. J. Marks and J. W. Merritt. ISBN 0 11 884168 8 £13.25
- 69 The sand and gravel resources of the country around Welwyn Garden City, Hertfordshire: Resource sheet TL 11 and 21. J. R. Gozzard. ISBN 0 11 884169 6 £10.50
- 70 The sand and gravel resources of the country east of Harrogate, North Yorkshire: Resource sheet SE 35. D. L. Dundas. ISBN 0 11 884170 7 £15.50

- 71 The sand and gravel resources of the country around Hemel Hempstead, St Albans and Watford: Resource sheet TL 00, 10, and parts TQ 09, 19. W. J. R. Harries, S. E. Hollyer and P. M. Hopson. ISBN 0 11 884171 8 *not yet priced*
- 72 The sand and gravel resources of the country around Bury St Edmunds Suffolk: Resource sheet TL 86. M. P. Hawkins. ISBN 0 11 884172 6 £10.50
- 73 The sand and gravel resources of the country between Ely and Cambridge, Cambridgeshire: Resource sheet TL 56, 57. A. R. Clayton. ISBN 0 11 884173 4 £9.50
- 74 The sand and gravel resources of the country around Blaydon, Tyne and Wear: Resource sheet NZ 06, 16. J. R. A. Giles. ISBN 0 11 884174 2 £10.50
- 75 The sand and gravel resources of the country around Stokesley, North Yorkshire: Resource sheet NZ 40, 50 and parts 41, 51. R. G. Crofts. ISBN 0 11 884175 0 £11.50
- 76 The sand and gravel resources of the country around Ellon, Grampian Region: Resource sheets NJ 93 with parts 82, 83, 92, and NK 03 with parts 02, 13. J. W. Merrit. ISBN 0 11 884176 9 £15.00
- 77 The limestone and dolomite resources of the country around Buxton, Derbyshire: Resource sheet SK 07 and parts 06, 08. D. J. Harrison. ISBN 0 11 884177 7 £13.50
- 78 The sand and gravel resources of the country west of Boroughbridge, North Yorkshire: Resource sheet SE 36. D. A. Abraham. ISBN 0 11 884178 5 £12.75
- 79 The limestone and dolomite resources of the country around Bakewell, Derbyshire: Resource sheet SK 26 and part 27. D. McC. Bridge and J. R. Gozzard. ISBN 0 11 884179 3 £10.50
- 80 The sand and gravel resources of the country between Stamford, Lincolnshire, and Peterborough, Cambridgeshire: Resource sheet TF 00, 10. S. J. Booth. ISBN 0 11 884180 7 £14.50
- 81 The sand and gravel resources of the country of the Thames and Thame valleys, the country around Dorchester and Watlington, Oxfordshire: Resource sheet SU 69 and part 59. C. E. Corser. ISBN 0 11 884204 8 £14.25
- 82 The sand and gravel resources of the country around Sible Hedingham, Essex: Resource sheet TL 73. R. J. Marks and D. W. Murray. ISBN 0 11 884205 6 £10.75
- 83 The sand and gravel resources of the country around Hollesley, Suffolk: Resource sheet TM 34. S. E. Hollyer and R. Allender. ISBN 0 11 884206 4 £13.25
- 84 The sand and gravel resources of the country around Kirk Hammerton, North Yorkshire: Resource sheet SE 45. J. R. A. Giles. ISBN 0 11 884207 2 £10.00
- 85 The sand and gravel resources of the country around Nayland, Suffolk: Resource sheet TL 93. P. M. Hopson. ISBN 0 11 884208 0 £11.25
- 86 The sand and gravel resources of the country around Wem, Shropshire: Resource sheet SJ 42, 52. B. Cannell and W. J. R. Harries. ISBN 0 11 884209 9 £15.50
- 87 The sand and gravel resources of the country around Ranskill and East Retford, Nottinghamshire: Resource sheet SK 68 and part 78. D. Thomas. ISBN 0 11 884210 2 £8.50
- 88 The sand and gravel resources of the country around Tholthorpe, North Yorkshire: Resource sheet SE 46. R. Stanczyszyn. ISBN 0 11 884211 0 *not yet priced*
- 89 The sand and gravel resources of the country around Newport-on-Tay, Fife Region: Resource sheet NO 42 and parts 32, 52. J. L. Laxton and D. L. Ross. ISBN 0 11 887413 6 £12.75
- 90 The sand and gravel resources of the country around Shrewsbury, Shropshire: Resource sheet SJ 41, 51. B. Cannell. ISBN 0 11 884213 7 £17.00
- 91 The conglomerate resources of the Sherwood Sandstone Group of the country east of Stoke-on-Trent, Staffordshire: Resource sheet SJ 94. D. Piper. ISBN 0 11 884214 5 *not yet priced*
- 92 The sand and gravel resources of the country around Armthorpe, South Yorkshire: Resource sheet SE 60. D. Price and D. P. Best. ISBN 0 11 884215 3 £10.00
- 93 The sand and gravel resources of the country around Whittlesey, Cambridgeshire: Resource sheet TF 20, TL 29. S. J. Booth. ISBN 0 11 884216 1 £12.50
- 94 The sand and gravel resources of the country north and west of Woodhall Spa, Lincolnshire: Resource sheet TF 16 and part 17. I. Jackson. ISBN 0 11 884217 X £14.75
- 95 The sand and gravel resources of the country around Biggar, Strathclyde Region: Resource sheet NS 93, NT 03, and parts NS 92, NT 02. A. J. Shaw and J. W. Merritt. ISBN 0 11 887414 4 £15.00
- 96 The sand and gravel resources of the country around Potter Hanworth and Reepham, Lincolnshire: Resource sheet TF 06, 07. R. G. Crofts. ISBN 0 11 884216 6 £9.75
- 97 The sand and gravel resources of the country around Clare, Suffolk: Resource sheet TL 74. R. Marks. ISBN 0 11 884297 8 £10.00
- 98 The limestone and dolomite resources of the country around Tideswell, Derbyshire: Resource sheet SK 17 and parts 18, 27. R. W. Gatliff. ISBN 0 11 884298 6 *not yet priced*
- 99 The sand and gravel resources of the country north and west of Billingham, Cleveland: Resource sheet NZ 42 and part 52. J. W. C. James. ISBN 0 11 884299 4 £10.50
- 100 The sand and gravel resources of the country around Billingham, Lincolnshire: Resource sheet TF 15 and part 05. J. B. L. Wild. ISBN 0 11 884300 1 £13.75
- 101 The sand and gravel resources of the country around Glenrothes, Fife Region: Resource sheet NO 20 and parts 21, 30, 31. A. M. Aitken. ISBN 0 11 8847415 2 £15.00
- 102 The sand and gravel resources of the country around Coggeshall, Essex: Resource sheet TL 82. S. J. Booth and J. W. Merritt. ISBN 0 11 887416 0 £16.00
- 103 The sand and gravel resources of the country between Dorchester and Wareham, Dorset: Resource sheets comprising parts of SY 68, 69, 78, 79, 88, 89, 98, 99. S. J. Mathers. ISBN 0 11 884303 6 £17.00
- 104 The sand and gravel resources of the country around Stansted Mountfitchet, Essex: Resource sheet TL 52. P. M. Hopson. ISBN 0 11 884304 4 £11.75

105 The sand and gravel resources of the country around Welshampton area, Shropshire and Clwyd: Resource sheet SJ 43. S. J. Mathers and A. C. Wilson.
ISBN 0 11 884305 2 *not yet priced*

106 The sand and gravel resources of the country around south of Wrexham, Clwyd: Resource sheet SJ 34, and part 24. D. F. Ball.
ISBN 0 11 884306 0 £11.00

107 The sand and gravel resources of the country between Rugby and Northampton, Warwickshire and Northamptonshire: Resource sheet SP 66 and parts 56, 57, 65, 67, 75 and 76. M. R. Clarke and E. R. Moczarski.
ISBN 0 11 884307 9 £20.00

108 The sand and gravel resources of the country south of Horncastle, Lincolnshire: Resource sheet TF 26. G. Power and J. B. L. Wild.
ISBN 0 11 884308 7 *not yet priced*

109 The sand and gravel resources of the country around Great Dunmow, Essex: Resource sheet TL 62. C. W. Thomas.
ISBN 0 11 884309 5 *not yet priced*

110 The sand and gravel resources of the country north of Newmarket, Cambridgeshire and Suffolk: Resource sheet TL 67 and part 66. C. E. Corser.
ISBN 0 11 884310 9 £14.50

111 The sand and gravel resources of the country east and south-east of Darlington, Durham: Resource sheet NZ 30, 31. J. R. Gozzard and D. Price.
ISBN 0 11 884311 7 *not yet priced*

112 The sand and gravel resources of the country around Hertford, Hertfordshire: Resource sheet TL 31. P. M. Hopson and M. D. A. Samuel.
ISBN 0 11 884312 5 *not yet priced*

113 The sand and gravel resources of the country around Mold, Clwyd: Resource sheet SJ 26 and part 16. D. F. Ball and K. A. McL. Adlam.
ISBN 0 11 884313 3 *not yet priced*

77/9 Sand and gravel resources of the Central Region, Scotland. M. A. E. Browne.
ISBN 0 11 884016 9 £1.35

77/19 Sand and gravel resources of the Borders Region, Scotland. A. D. McAdam.
ISBN 0 11 884025 8 £1.00

77/22 Sand and gravel resources of the Dumfries and Galloway Region of Scotland. I. B. Cameron.
ISBN 0 11 884021 5 £1.20

78/1 Sand and gravels of the Lothian Region of Scotland. A. D. McAdam.
ISBN 0 11 884042 8 £1.00

78/8 Sand and gravel resources of the Highland Region. W. Mykura, D. L. Ross and F. May.
ISBN 0 11 884050 9 £3.00

Reports of the Institute of Geological Sciences

Other Reports

69/9 Sand and gravel resources of the Inner Moray Firth. A. L. Harris and J. D. Peacock.
ISBN 0 11 880106 6 35p

70/4 Sands and gravels of the southern counties of Scotland. G. A. Goodlet.
ISBN 0 11 880105 8 90p

72/8 The use and resources of moulding sand in Northern Ireland. R. A. Old.
ISBN 0 11 881594 0 30p

73/9 The superficial deposits of the Firth of Clyde and its sea lochs. C. E. Deegan, R. Kirby, I. Rae and R. Floyd.
ISBN 0 11 880617 3 95p

77/1 Sources of aggregate in Northern Ireland (2nd edition). I. B. Cameron.
ISBN 0 11 881279 3 70p

77/2 Sand and gravel resources of the Grampian Region. J. D. Peacock and others.
ISBN 0 11 881282 3 80p

77/5 Sand and gravel resources of the Fife Region. M. A. E. Browne.
ISBN 0 11 884004 5 60p

77/6 Sand and gravel resources of the Tayside Region. I. B. Paterson.
ISBN 0 11 884008 8 £1.40

77/8 Sand and gravel resources of the Strathclyde Region. I. B. Cameron and others.
ISBN 0 11 884028 2 £2.50

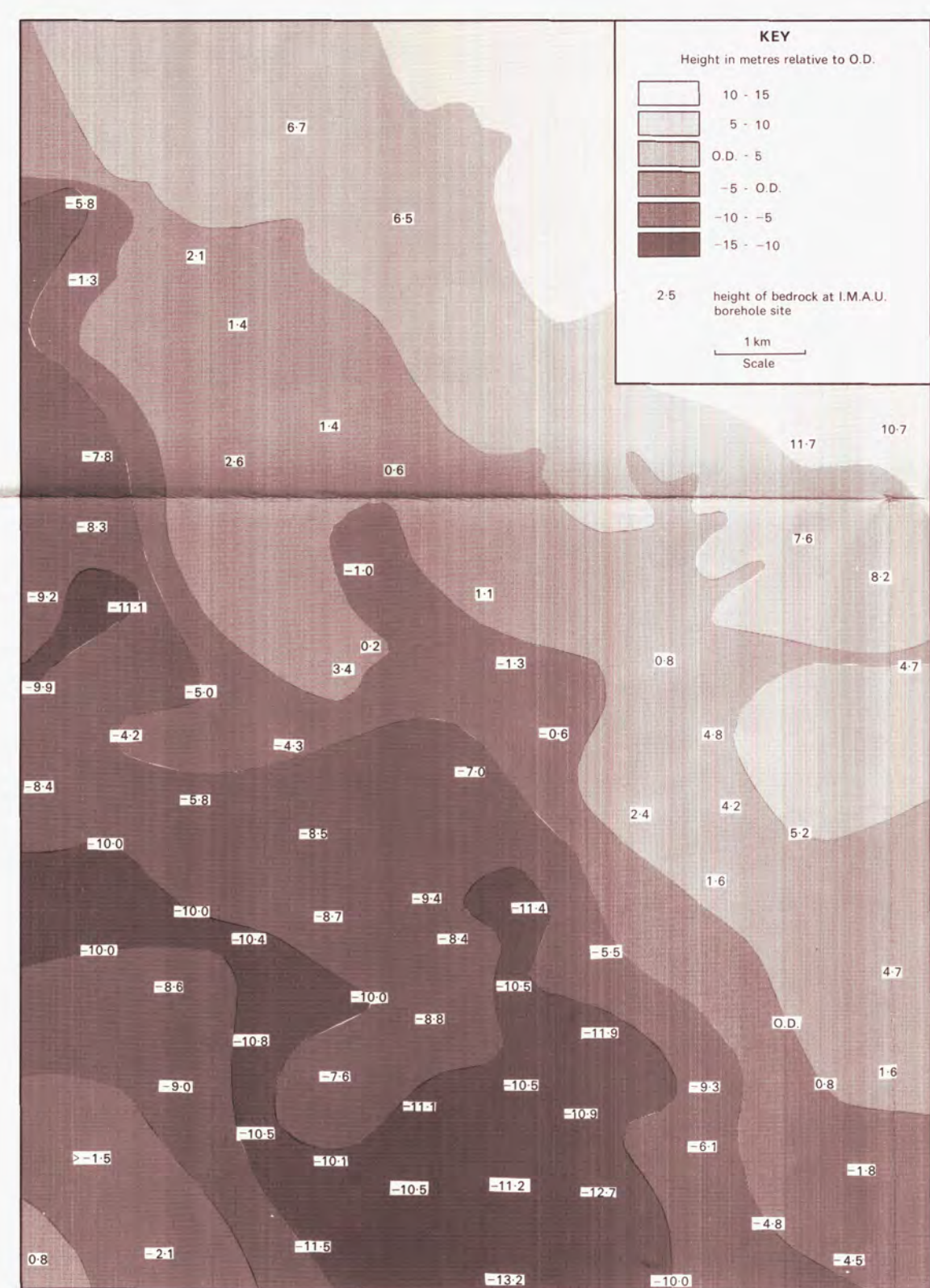
Dd 696815 K8

Printed in England for Her Majesty's Stationery Office
by Commercial Colour Press, London E7

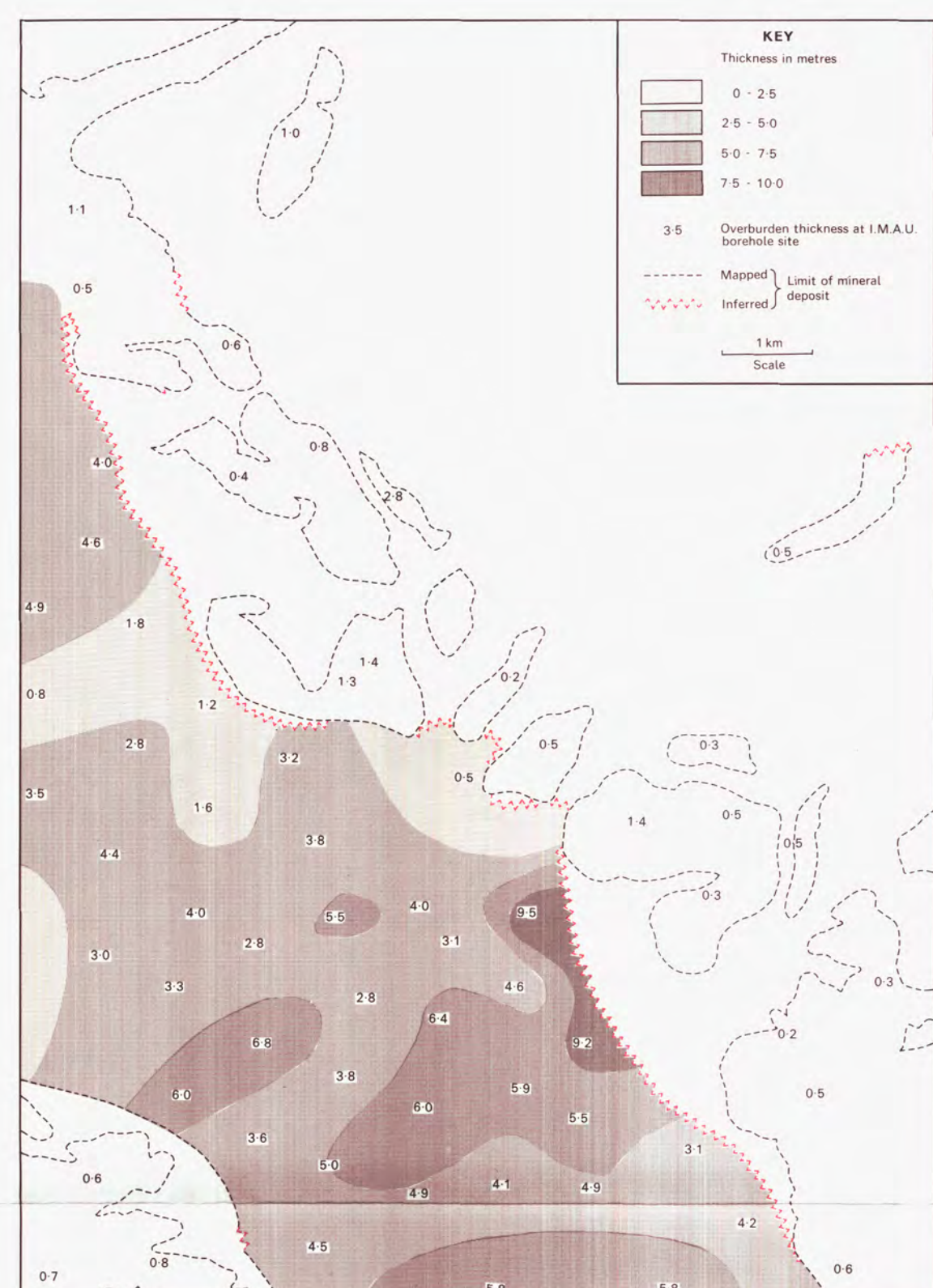
THE SAND AND GRAVEL RESOURCES NORTH AND WEST OF WOODHALL SPA, LINCS.

Scale 1:25 000 or about 2½ Inches to 1 Mile

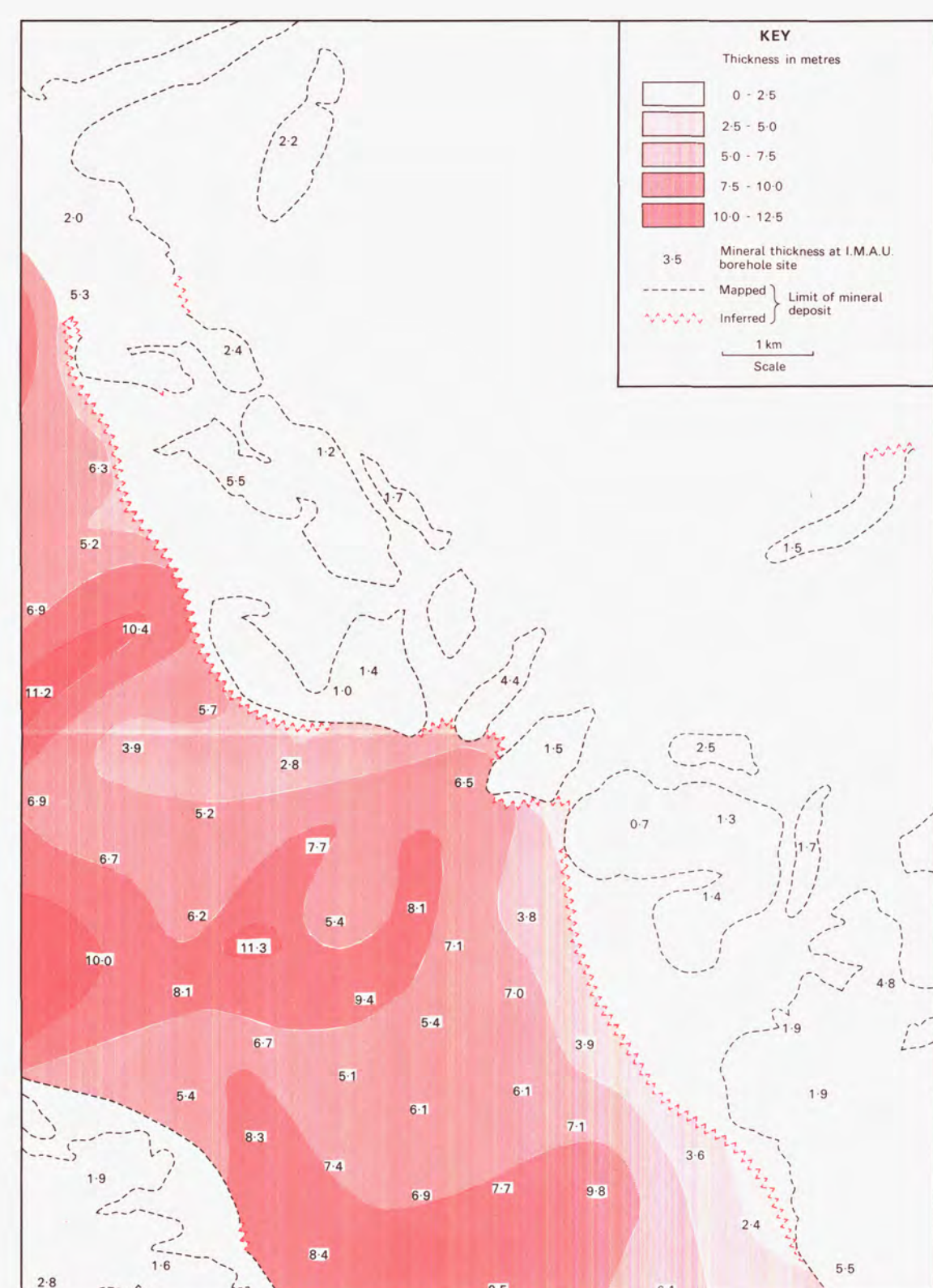
ORDNANCE SURVEY
SHEET TF 16 & PART OF TF 17
PROVISIONAL EDITION



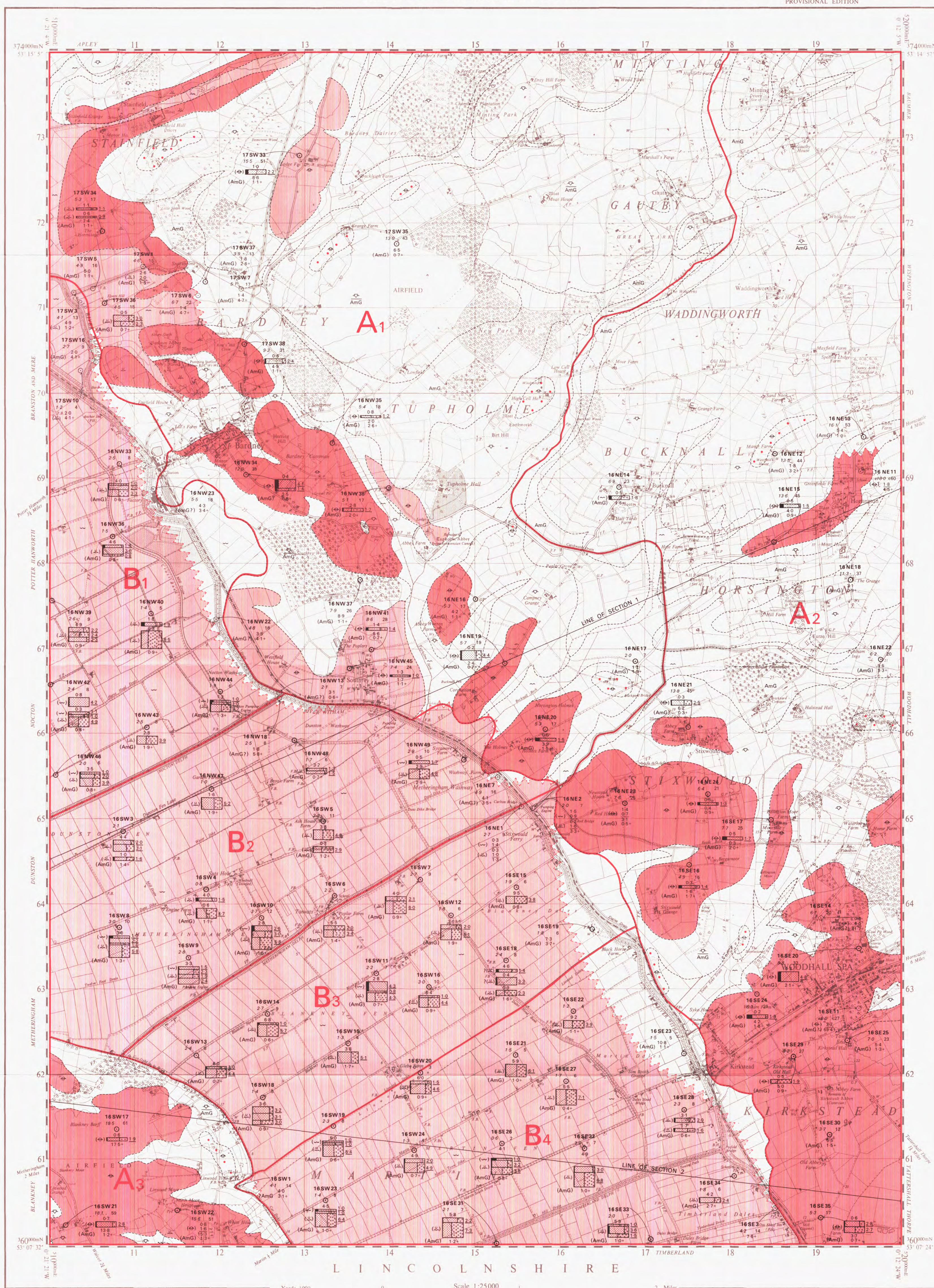
A ISOPLETHS ON THE BEDROCK SURFACE



B OVERBURDEN THICKNESS Overburden thickness in Marine or Estuarine Alluvium indicated by point-source data and isopachytes; elsewhere overburden thickness indicated by point-source data only.



C MINERAL THICKNESS Mineral thickness within and beneath Marine or Estuarine Alluvium indicated by point-source data and isopachytes; elsewhere mineral thickness indicated by point-source data only.



Geological data from a survey on the site, which was by W. H. Peatling, W. H. Dobson, J. C. O'Brien, W. H. E. Hetherington, J. J. Hetherington and A. S. Hetherington. Published in 1982 as part of the Survey Sheet 83 (Lincoln). Part revised and published in the 1:25 000 Scale in 1982 as New Series Sheet 114 (Lincoln).

Sand and Gravel Survey by J. Jackson in 1979. © D. Thorne, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet Published in 1982. © H. M. Brown, G. S. T. B. Director, Institute of Geological Sciences, 1982.

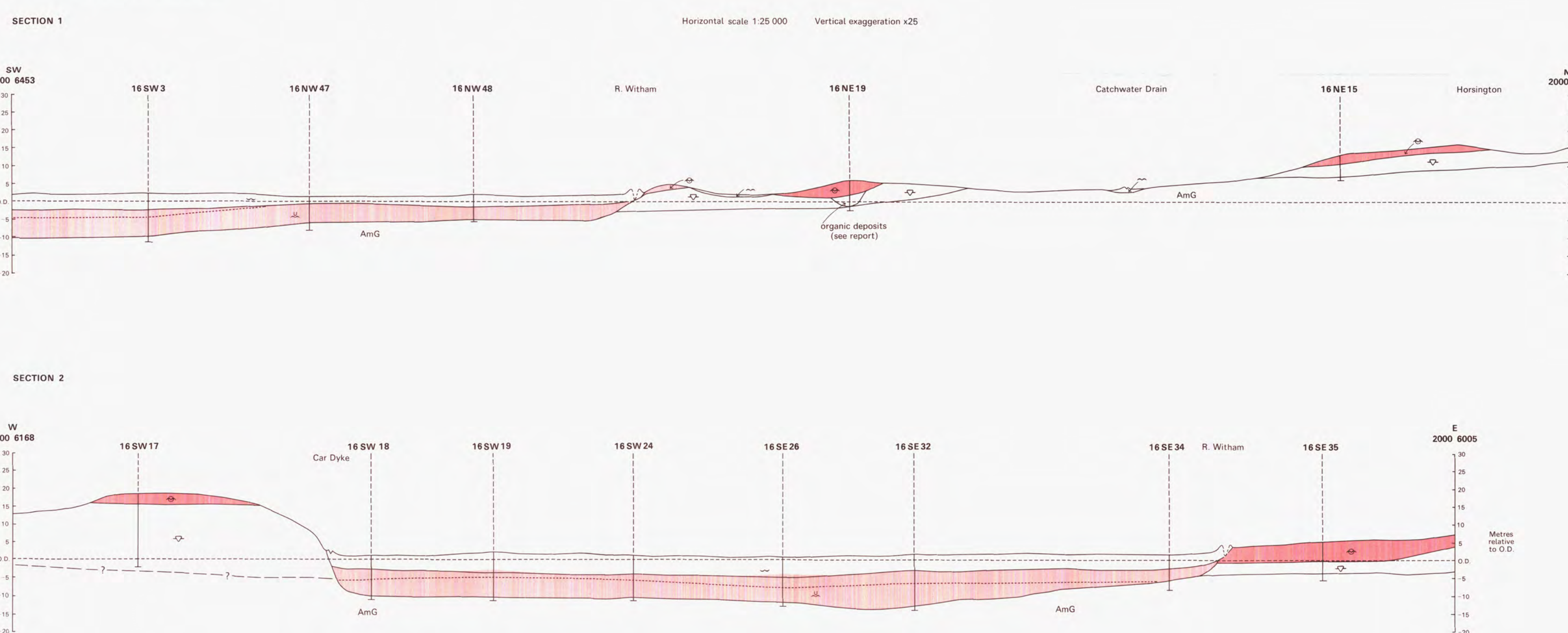
The GRID lines on this sheet are at 1 kilometre intervals. (Grid lines on other sheets are at 1 kilometre intervals.) Other partial systematic revisions (1958-62) have been incorporated.

Completed from 8' sheets fully revised 1948-65. Other partial systematic revisions (1958-62) have been incorporated.

Data quoted for an individual borehole refer strictly to that site; reliable conclusions cannot be drawn about the thickness and grading elsewhere in the deposit, particularly in material as variable as sand and gravel. However, estimates of the volume and mean grading of the mineral as a whole in each Resource Block are given in the Report.

© Crown copyright 1982.

GENERALIZED HORIZONTAL SECTIONS



Note that the boundary between the upper and lower units of the River Gravels is shown as a dotted line.

94

This map should be read in conjunction with the accompanying Report which contains details of the assessment of resources.

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

DRIFT	Alluvium - clays and silts with some sand and gravel	A-47	QUATERNARY PLISTOCENE	ME-9 RG-3 FL-15
—	Marine or Estuarine Alluvium with some peat - silts and clays with some sand and peat			
—	River Gravels, undifferentiated - sandy gravels			
—	Fluvio-glacial and Older River Sand and Gravel - pebbly sands and sandy gravels, 'clayey' in part			
—	Till - stony clay	TL-9		
SOLID	Anchoise Clay Group - silty clays		JURASSIC	

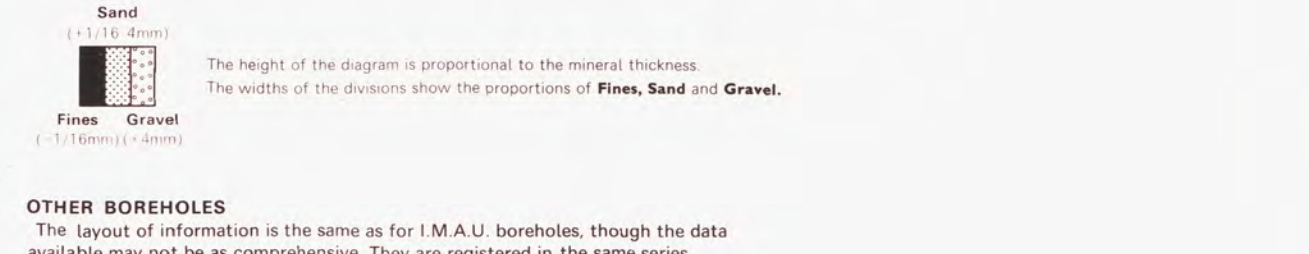
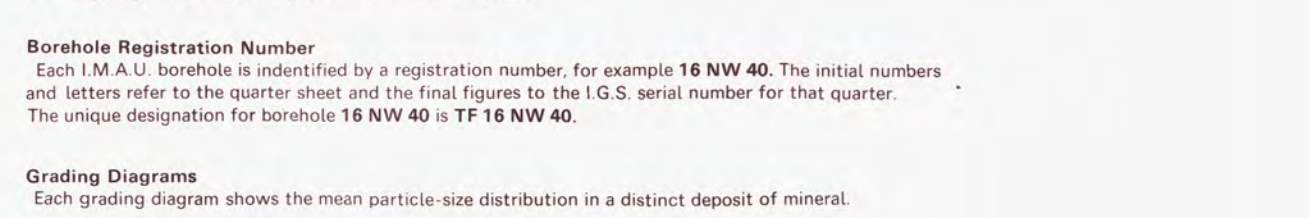
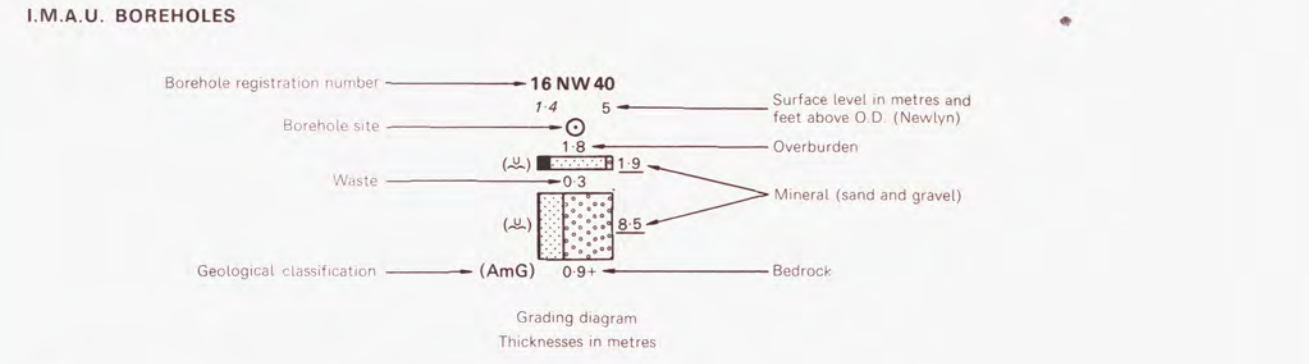
BOUNDARY LINES

- Geological boundary: Drift
- Inferred boundary between recognised categories of deposits
- Resource Block boundary

BOREHOLE DATA

SITE LOCATIONS

- Industrial Minerals Assessment Unit (I.M.A.U.) boreholes
- Other boreholes



CATEGORIES OF DEPOSITS

- Exposed mineral CAT-E6
- Continuous or almost continuous spreads of mineral beneath overburden CAT-C1
- Sand and gravel either not potentially workable (see Report) or absent CAT-A2
- Sand and gravel not assessed CAT-N1

Where appropriate on other sheets a category 'Discontinuous spreads of mineral beneath overburden' is recognised.

RESOURCE BLOCKS

For the purpose of assessment the mineral is divided into Resource Blocks (see Report). Each is designated by a letter and subscript figure.

Detailed records may be consulted on application to the Head, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Keeworth, Nottingham, NG21 8QP.

Made and published by the Ordnance Survey, Southampton, for the Institute of Geological Sciences, Natural Environment Research Council.

TF 08	TF 18	TF 28
102	109	116
TF 07	TF 17	TF 27
114	121	128
TF 06	TF 16	TF 26
127	134	141
TF 05	TF 15	TF 25
139	146	153

Diagram showing the relationship of the National Grid 1:25 000 sheets to the Geological Sheet 102, 103, 114, 115, 127 and 128.

