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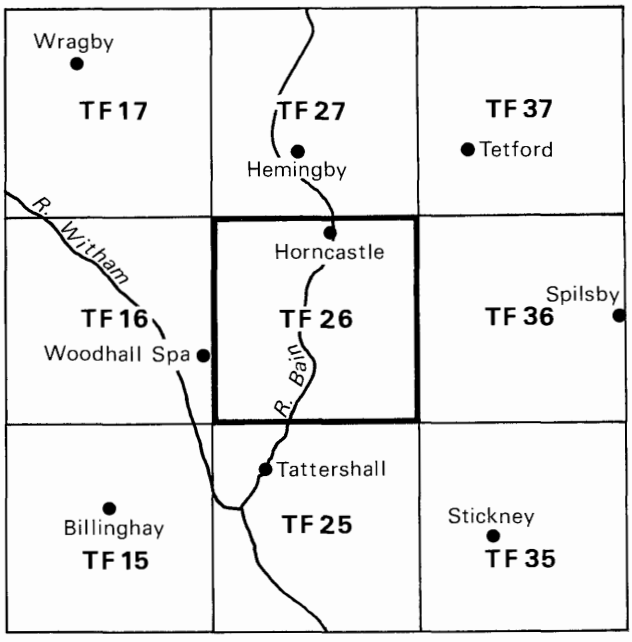

The sand and gravel resources of the country south of Horncastle, Lincolnshire

Description of 1:25 000 resource sheet TF 26

G. Power and J. B. L. Wild

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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.

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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 sand and gravel resources of the country south of Horncastle, Lincolnshire, shown on the accompanying 1:25 000 resource map TF 26. The survey, which was supervised by B. J. Taylor, was carried out by G. Power in 1977 with the assistance of J. B. L. Wild. The work is based on one-inch geological surveys published on Old Series Sheets 83 (Lincoln) and 84 (Boston) in 1887 and 1888. The geological lines, now presented at the 1:25 000 scale, incorporate amendments by T. P. Fletcher (Yorkshire and East Midlands Unit) who also contributed to the account of the geology of the area.

J. D. Burnell, ISO (Land Agent) was responsible for negotiating access to land for drilling. The ready cooperation of landowners and tenants in this work is gratefully acknowledged.

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The sand and gravel resources of the country south of Horncastle, Lincolnshire

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SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 48 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the country south of Horncastle, Lincolnshire.

All the deposits in the resource sheet area that might be potentially workable for sand and gravel have been investigated and a simple statistical method has been used to estimate the volume. The reliability of the volume estimates is given at the symmetrical 95 per cent probability level.

The 1:25 000 map is divided into three resource blocks containing between 8.2 and 17.0 km^2 of 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 26 NW 6). 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 two elements alone (e.g. NW 6).

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, six-figure grid references are used for more extensive locations, for example, farms).

Bibliographical reference

POWER, G. and WILD, J. B. L. 1982. The sand and gravel resources of the country south of Horncastle, Lincolnshire: description of 1:25 000 resource sheet TF 26. **Miner. Assess. Rep. Inst. Geol. Sci.**, No. 108.

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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' level "for which 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" (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 $\frac{1}{16}$ 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. As the assessment is at the indicated level, parts of such a deposit may not satisfy all the criteria.

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.

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 RESOURCE SHEET AREA

General

Situated mid-way between Lincoln and Skegness, the resource sheet area (Figure 1) forms part of the Lincoln Clay Vale. As such, the topography is gently undulating and falls progressively from north to south from 125 m above OD near High Toynton [284 699] to 3 m above OD south of Mareham le Fen [280 610]. The River Bain bisects the resource sheet area and flows southwards through Horncastle [260 695] and Kirkby on Bain [243 624] to join the River Witham south of Tattershall.

Horncastle is the commercial centre for the district and offers marketing facilities for a wide range of local agricultural products. Moreover, several light engineering firms provide technical support to the farming community. Sand and gravel is currently being worked south of Kirkby on Bain.

Geology

The geology of the district was first investigated by the Geological Survey as part of the one-inch survey of Old-Series sheets 83 and 84 (Jukes-Browne, 1887; Ussher and others, 1888). This survey proved bedrock to be extensively overlain by Drift deposits consisting of till overlain in places by fluviatile and glacial sands and gravels. Straw (1957, 1958, 1969), in discussing the origins and relative ages of the Drift, maintained that the fluviatile deposits of the Bain could be correlated with those of the River Witham. The fauna and dating of the sand and gravel deposits at Tattershall Thorpe [228 605] have been discussed by Girling (1977) and Rackham (1978).

The preliminary results of the sand and gravel survey necessitated the re-mapping (at the six-inch scale by T. P. Fletcher of the Institute's Yorkshire and East

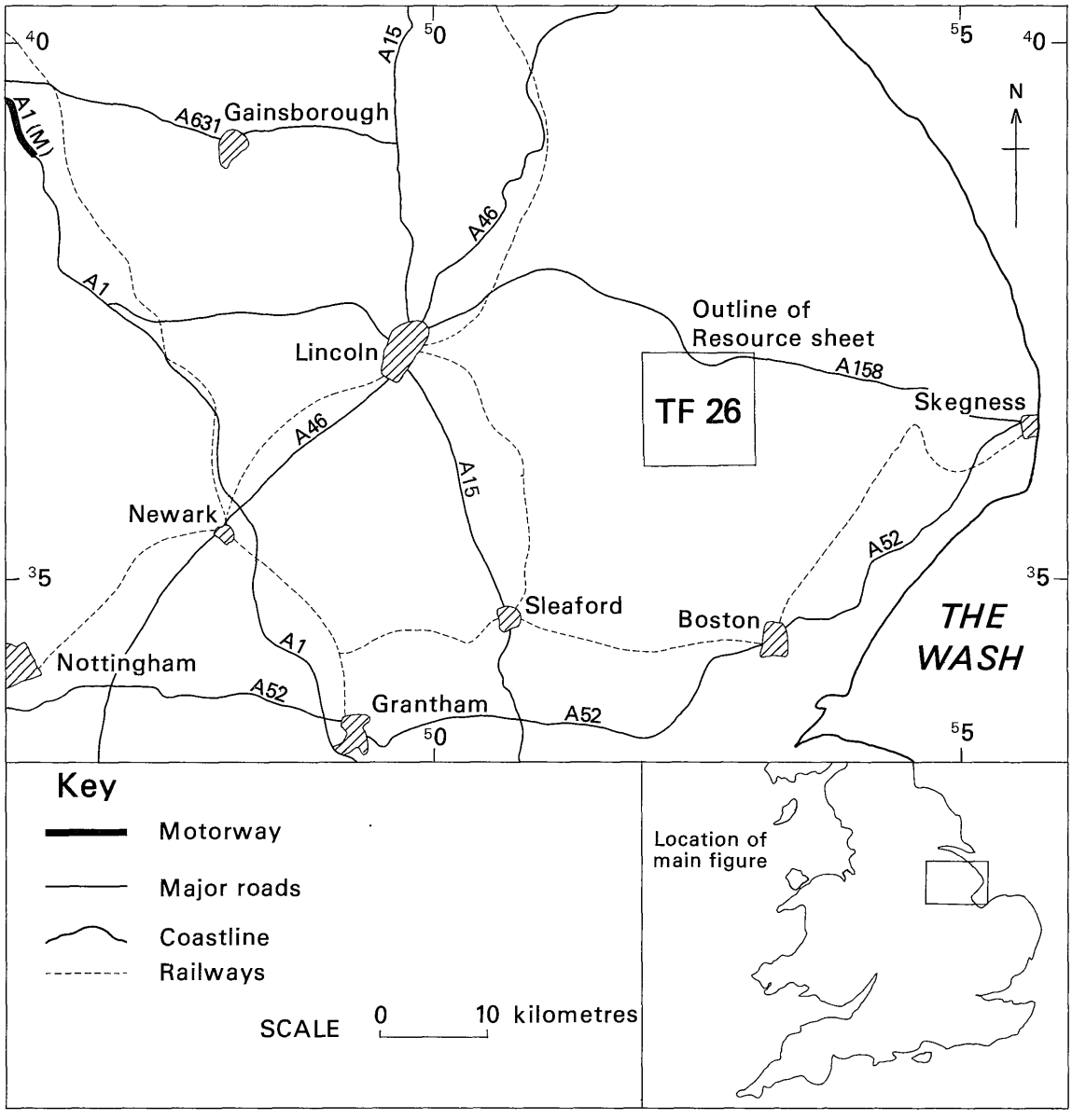


Figure 1 Locality map.

Midlands Unit) of deposits near Langton [235 688] and Thornton [246 675] formerly mapped as Fluvio-glacial and Older River Sand and Gravel. Accordingly, the Drift boundaries have been revised and the deposits referred to as Glacial Sand and Gravel.

The geological succession is summarised in Table 1, and brief descriptions of the deposits follow. More detailed information may be obtained from the East Lincolnshire Memoir (Jukes-Browne, 1887), the Lincoln Memoir (Ussher and others, 1888) and the Regional Guide (Kent, 1980). A schematic section across part of the assessed area (Figure 2) illustrates the relationships between the deposits, and the corresponding line of section is marked on the resource map.

Table 1 Geological succession.

DRIFT	
Quaternary	Alluvium
Recent and Pleistocene	River Gravels, undifferentiated
	Fluvio-glacial and Older River Sand and Gravel
	Glacial Sand and Gravel
	Till
SOLID	
Upper Jurassic	Spilsby Sandstone
	Ancholme Clay Group

Solid

Ancholme Clay Group The term Ancholme Clay Group has recently been introduced to include what were formerly the Oxford, Ampthill and Kimmeridge Clays (Geological Survey Sheet 89 (Brigg), in press). The 23 IMAU boreholes that penetrated bedrock proved grey to dark grey fossiliferous mudstones with rare thin bands of limestone. The varied fauna includes ammonites and belemnites. In the resource sheet area up to 200 m of the Group may be present.

Spilsby Sandstone The Spilsby Sandstone is a soft green and yellow glauconitic quartzose sand with thin bands of grey clay. A somewhat attenuated sequence crops out beneath Drift in the extreme north-east of the resource sheet area, but elsewhere thicknesses of up to 20 m have been proved.

Drift

Till The till is a distinctive grey chalky clay formerly referred to as a 'Chalky' or 'Intensely Chalky' Boulder Clay (Ussher and others, 1888). The deposit was thought to be one of many comprising part of the 'Older Drift' of Lincolnshire; these were separated from a younger sequence or 'Newer Drift' (present farther east) by a prolonged interglacial characterised by severe denudation. More recently, this till sheet, subdivided by Straw (1969) into the Calcethorpe and Wragby tills, has been equated with the pre-Devensian Chalky Boulder Clay of East Anglia (Perrin et al, 1979, p. 547).

The till overlies bedrock throughout the resource sheet area and appears to thicken towards the east where it may exceed 40 m (see Figure 2). It chiefly consists of grey silt and clay with a variable number of chalk and flint fragments; large cobbles of flint and blocks of chalk and Jurassic limestones are also seen where the clay is exposed in gravel pits in the south-west of the sheet area, for example at [229 607] and [233 614].

Glacial Sand and Gravel Recent six-inch mapping has identified patches of glacial sands up to 1 m thick near Langton and Thornton and sand and gravel near Martin [239 668]. Additionally, two assessment boreholes (26 SW 11 and 26 SE 9) proved beds (0.9 and 1.1 m thick respectively) of Glacial Sand and Gravel within the till. However, a more extensive revision of the mapping is necessary before all the outcrops of Glacial Sand and Gravel can be satisfactorily delineated.

Fluvio-glacial and Older River Sand and Gravel These deposits were formerly referred to as the Ancient Gravels of old Rivers and as Plateau Gravels on Old Series sheets 83 and 84. They occupy a considerable area in the south and south-western parts of the resource sheet area, where they are between 1.0 and 14.6 m thick. The predominantly sandy sequence to the west and north-west of Kirkby on Bain has been termed the Kirkby Moor Sands by Straw (1958) and is thought by him to represent the relicts of a dissected delta of the River Bain. However, in a section [228 630] west of Kirkby on Bain, there is up to 10 m of fine- and medium-grained quartz sand showing none of the structures normally associated with deltaic deposition. On the contrary, sedimentation may have been influenced by the underlying till surface, which boreholes and sections have shown to be irregular. The material may also have been derived from several sources and deposited by tributaries of the larger drainage system to the west.

The origin of the deposits around Mareham le Fen is unclear. Straw (1958) thought they formed part of the Martin Terrace of the River Witham. However, the predominance of flint and chalk pebbles, and a corresponding paucity of quartzite pebbles (Wild, 1982) suggests a greater affinity with the material to the west of Kirkby on Bain; it is possible that these sediments may have accumulated as a continuous spread over the resource sheet area, and only the eroded remnants now remain.

River Gravels The sands and gravels flanking the valley of the Bain south of Horncastle represent terrace deposits laid down by the River Bain. In the gravel pit [227 604] operated by Bain Aggregates, thicknesses of 1.0-7.2 m were recorded. Here, the irregular junction between the River Gravels and the till is such that in places the former may vary in thickness from 1.0 to 5.0 m over a distance of about 10 m.

The gravel pit's well-documented vertebrate fauna (together with shells and insects) and the radiocarbon dating of silt bands near the base of the River Gravels (Girling, 1977; Rackham, 1978) indicate a Mid-Devensian age for these sediments. Furthermore, the predominance of mammoth and woolly rhinoceros bones suggests that the deposits are related to the later part of the 'Upton Warren Interstadial Complex' (Rackham, 1978, p. 2).

Alluvium Silts and clays occupy much of the valley floor of the River Bain. Borehole SW 1, drilled by the Lincolnshire River Board near Kirkby on Bain, proved 2 m of variegated clays overlying 1.8 m of River Gravels. Small discontinuous alluvial deposits consisting mainly of silty clays also occur in the tributary valleys on both the western and the eastern margin of the resource sheet area.

Composition of the Sand and Gravel Deposits

The potentially workable sand and gravel deposits of the resource sheet area are Glacial Sand and Gravel, Fluvio-glacial and Older River Sand and Gravel, and River Gravels. The composition of selected gravel (+4 mm) samples from IMAU boreholes in the above deposits is presented in Table 2 and in detail at the foot of the appropriate borehole log (Appendix E), indicating possible lithological variations within the gravels.

Glacial Sand and Gravel These deposits were encountered in three IMAU boreholes but in only two (NW 12, SE 9) were they classified as mineral. The distribution

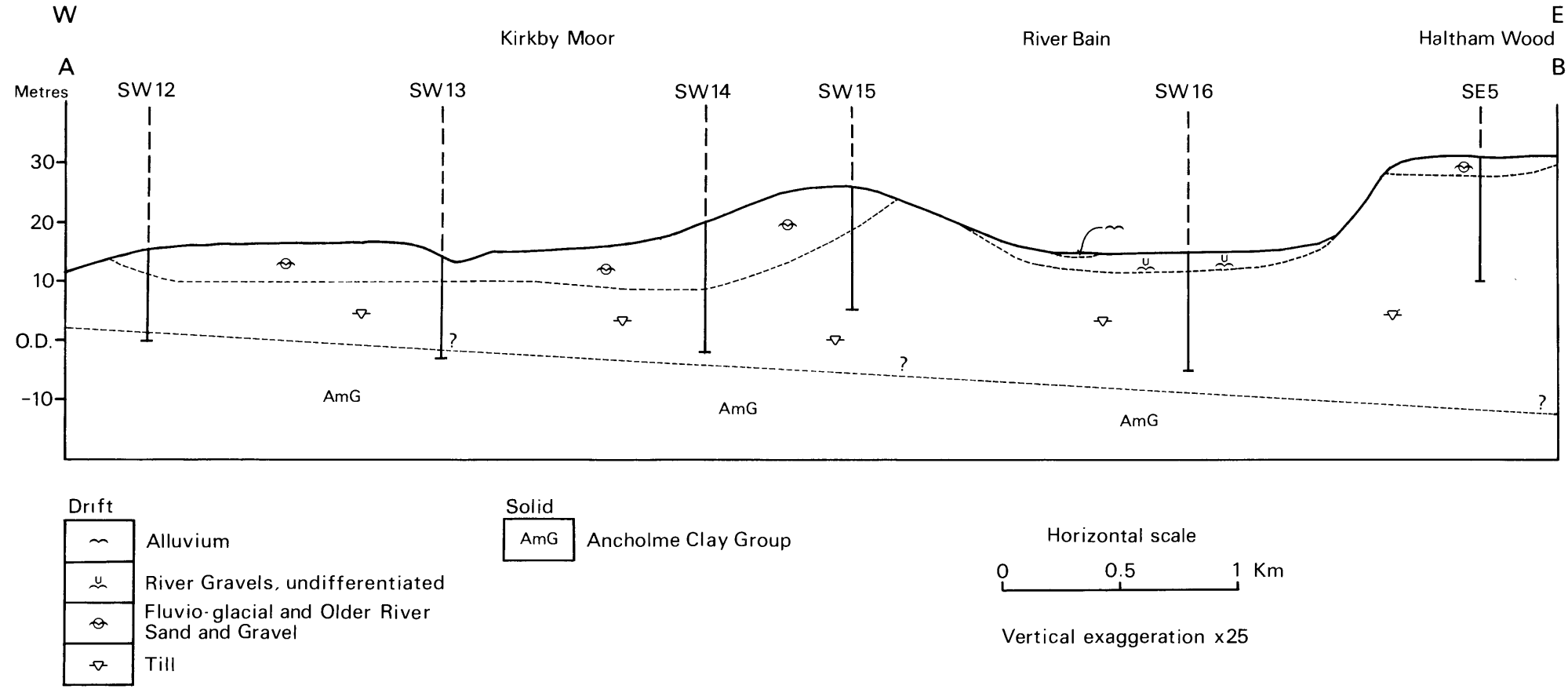


Figure 2 Generalised section across the assessed area.

Table 2 Pebble-type analyses of selected samples (percentage by weight).

Deposit and borehole number	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
Glacial Sand and Gravel							
NW 12	7	86	trace	trace	1	6	0
Fluvio-glacial and Older River Sand and Gravel							
SW 9	0	95	3	0	2	0	0
SW 12	0	24	55	1	20	0	trace
SW 20	0	74	15	0	8	0	3
SW 22	0	54	34	trace	12	0	0
SW 24	0	99	trace	0	1	0	trace
SW 26	0	92	6	0	2	0	trace
SE 5	1	97	trace	trace	1	1	0
SE 12	13	80	3	2	1	1	trace
River Gravels							
NW 11	13	73	5	3	1	3	2
SW 23	12	77	6	1	2	1	1
SE 6	3	92	3	0	2	trace	trace

of Glacial Sand and Gravel is patchy and only one area, around Martin, is included in the assessment; consequently this deposit forms only about one per cent of the total volume of potentially workable sand and gravel of the resource sheet area. The mean grading is fines 13 per cent, sand 44 per cent and gravel 43 per cent, making the deposit as a whole a 'clayey' sandy gravel.

The gravel fraction contains both fine and coarse pebbles, predominantly of angular flint with subordinate amounts of subrounded chalk, subangular limestone and rounded quartzite. The sand fraction is mainly medium-grained (+¼ -1 mm) and consists predominantly of angular to subangular quartz.

Fluvio-glacial and Older River Sand and Gravel This deposit, which forms the bulk of the potentially workable sand and gravel in the resource sheet area, consists predominantly of pebbly sands and sandy gravels, although in seven boreholes the fines content exceeded 10 per cent. The mean grading is fines 5 per cent, sand 80 per cent and gravel 15 per cent, making the deposit as a whole a pebbly sand. However, considerable spatial variations occur about this mean; for example, the deposits between Roughton and Tattershall Thorpe are predominantly pebbly sands, whereas those east of the Bain valley around Mareham le Fen are proportionately more 'clayey' and pebbly.

The gravel fraction comprises predominantly fine (+4 -16 mm) and coarse (+16 -64 mm) angular grey flint (for further information regarding the properties of flint in concrete, see Roeder, 1977). However, locally (for example, in boreholes 26 SW 12, 26 SW 13, 26 SW 22 and 26 SE 12), subrounded pebbles of sandstone, chalk and quartzite also occur. The sand fraction consists of approximately equal proportions of fine- (+1/16 -¼ mm) and medium-grained (+¼ -1 mm) subangular to angular quartz.

River Gravels These sediments flank the margins of the Bain valley and were encountered in seven IMAU boreholes. Except for 26 NE 10 (which proved pebbly sand), the deposits consisted of sandy gravel with a mean grading of fines 3 per cent, sand 67 per cent and gravel 30 per cent.

The gravel contains equal proportions of fine and coarse pebbles, comprising mainly angular grey and black flint with some subangular chalk and subrounded sandstone. Mudstone, quartzite, limestone and igneous rocks are also present but rarely account for more than three per cent by weight of the total (Table 2). The sand fraction is mainly medium-grained and consists of angular to subrounded quartz with some angular flint and rock fragments.

The Map

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

Geological data

The geological boundary lines shown are based on one-inch scale geological surveys of Old Series sheets 83 and 84, published in 1887 and 1888. The assessment map incorporates amendments resulting from the sand and gravel survey. The geological boundary lines represent the best interpretation of the information available at the time of the survey. However, it is inevitable, considering the scale of the original surveys and the nature of the Drift deposits represented, that local irregularities and discrepancies will be re-vealed as new evidence from boreholes and excavations becomes available.

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

Mineral Resource Information

For assessment purposes the Map is divided into resource blocks within which there are areas of mineral and areas where sand and gravel is not potentially workable, absent or not assessed (for definitions of 'mineral' and 'potentially workable' see p. 1; for resource block, see Appendix A). Where mineral is shown it is further subdivided into categories where it is exposed (except for thin soil) and areas where it is present in 'continuous (or almost continuous) spreads beneath overburden'. However, within both these categories there may be small patches where sand and gravel is absent or not potentially workable. Areas where bedrock crops out, where superficial deposits do not contain mineral and where sand and gravel is deemed not to be potentially workable are shown uncoloured. Unassessed sand and gravel in built-up areas (for example Horncastle) is stippled.

Results

The statistical results are summarised in Table 3. Further grading particulars are shown in Figure 3 and the mean gradings and grading 'envelopes' for each resource block are given in Figures 4 to 6.

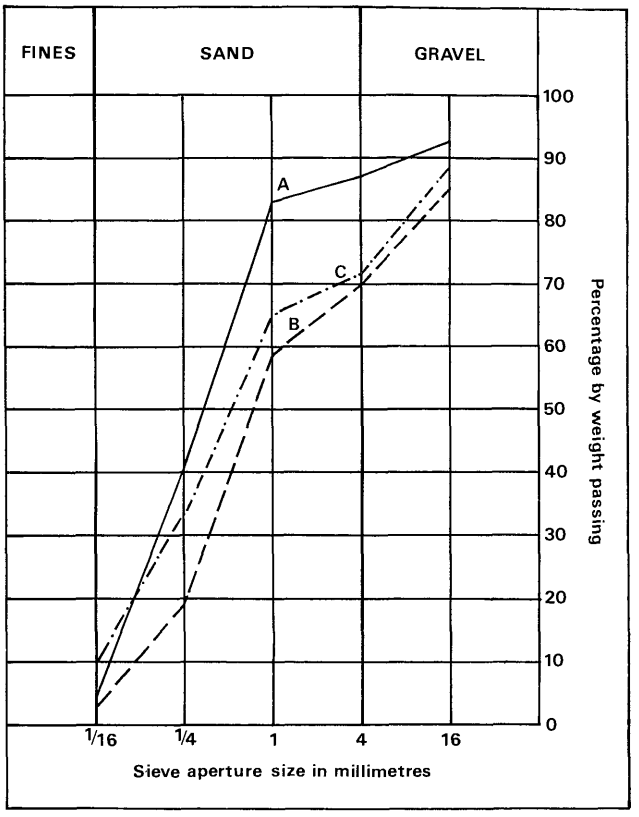
The three resource blocks (A, B, and C) have been statistically assessed at the indicated level. For the estimates of the volume of mineral in these blocks, the confidence limits at the symmetrical 95 per cent probability level range from 38 to 59 per cent (that is, it is probable that 19 times out of 20 the true volume lies within the given limits). However, the true values are more likely to be nearer the figures estimated rather than the limits. Moreover, it is probable that in each block approximately the same percentage limits would apply for the estimates of volume of 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 required for the quotation of reserves of part of a block, it can be expected that data from more than ten sample points will be required, even if the area is quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel in blocks A, B, and C. The total volume (132 million m^3) can be estimated to limits of ±29 per cent at the 95 per cent probability level by a calculation based on the data from the 38 sample points spread across the three resource blocks.

It must again be emphasised that the quoted volume of sand and gravel has no simple relationship with the amount that could be extracted in practice, because no allowance has been made in the calculations for any restraints (such as existing buildings and roads, etc.) on the use of land for mineral working.

Notes on the Resource Blocks

The sand and gravel deposits of the resource sheet area are divided into three resource blocks. The mineral in blocks A and C is assessed as exposed and consists (except for a small area of Glacial Sand and Gravel in block A) of Fluvio-glacial and Older River Sand and Gravel overlying a thick sequence of till. In block B the mineral consists of River Gravels, overlain in part by Alluvium, also resting on till.

Pits totalling 0.8 km^2 in area are currently being worked for sand and gravel south-west and west of Kirkby on Bain. Furthermore, approximately 2 km^2 of potentially workable sand and gravel has been sterilised by the built-up area of Horncastle.



Block	Percentage by weight passing					
	1/16 mm	1/4 mm	1 mm	4 mm	16 mm	64 mm
A	5	41	83	87	93	100
B	3	19	59	70	85	100
C	10	34	65	72	89	100

Figure 3 Mean particle-size distribution for the assessed thickness of sand and gravel in resource blocks A to C.

Block A (Table 4, Figure 4)

Block A occupies most of the western half of the resource sheet area and is bounded on its eastern margin by block B. The block is 43.5 km^2 in area of which 17.0 km^2 is mineral-bearing. The potentially workable sand and gravel consists mainly of Fluvio-glacial and

Table 3 Sand and gravel resources of the assessed area.

Assessment of blocks A, B, and C at the indicated level

Block	Area(km^2)		Mean thickness(m)		Volume of mineral			Mean grading percentage		
	Block	Mineral	Over-burden	Mineral		Limits at the 95% confidence level		Fines	Sand	Gravel
						±%	±Million m^3	-1/16 mm	+1/16-4 mm	+4-64 mm
A[19]*	43.5	17.0	0.6	5.1	87	39	34	5	82	13
B [8]	8.3	8.2	0.8	3.4	28	38	11	3	67	30
C [11]	46.2	9.5	0.7	1.7	16	59	10	10	62	28
TOTAL [38]	98.0	34.7	0.7†	3.8†	132	29	38	5†	76†	19†

* Figures in square brackets show the number of sample points used in the assessment of the volume of the resources.

† These totals are derived by weighting and rounding-off calculations.

Table 4 Data from IMAU assessment boreholes: Block A.

Borehole number	Recorded thickness (m)		Mean grading percentage					
	Mineral	Overburden	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	Coarse gravel +16-64mm
26 NW 12	1.1	0.6	22	14	15	5	16	28
26 NW 14	5.7	1.0	3	23	51	8	11	4
26 NW 16	5.7	0.4	4	25	48	4	6	13
26 SW 7	1.6	0.5	15	56	24	2	1	2
26 SW 8	14.6	0.8	4	59	34	1	1	1
26 SW 9	6.8	0.5	3	21	42	4	13	17
26 SW 10	3.8	0.6	4	31	54	3	5	3
26 SW 12	3.7	0.4	3	19	65	6	5	2
26 SW 13	3.3	0.7	4	40	35	5	7	9
26 SW 14	11.3	0.5	2	35	40	3	5	15
26 SW 15	6.4	0.6	2	51	45	1	1	0
26 SW 17	1.8	0.6	14	34	29	5	10	8
26 SW 18	11.3	0.4	3	34	45	2	7	9
26 SW 20	5.5	0.5	8	29	46	5	7	5
26 SW 21	2.8	1.0	11	21	38	8	15	7
26 SW 22	8.1	0.4	6	43	35	4	7	5
26 SW 26	1.6	0.8	7	17	42	6	14	14
Mean	**5.1**	**0.6**	**5**	**36**	**42**	**4**	**6**	**7**

Older River Sand and Gravel, but a small area (approximately 1 km^2) of Glacial Sand and Gravel around the hamlet of Martin has also been included in the assessment. In the northern part of the block, several boreholes sited to determine whether Glacial Sand and Gravel was present in quantity within the till proved to be barren. Moreover, borehole data from other resource blocks (26 SW 11 in block B and 26 SE 9 in block C) indicate that the distribution of Glacial Sand and Gravel within the till is sporadic and therefore unlikely to be potentially workable.

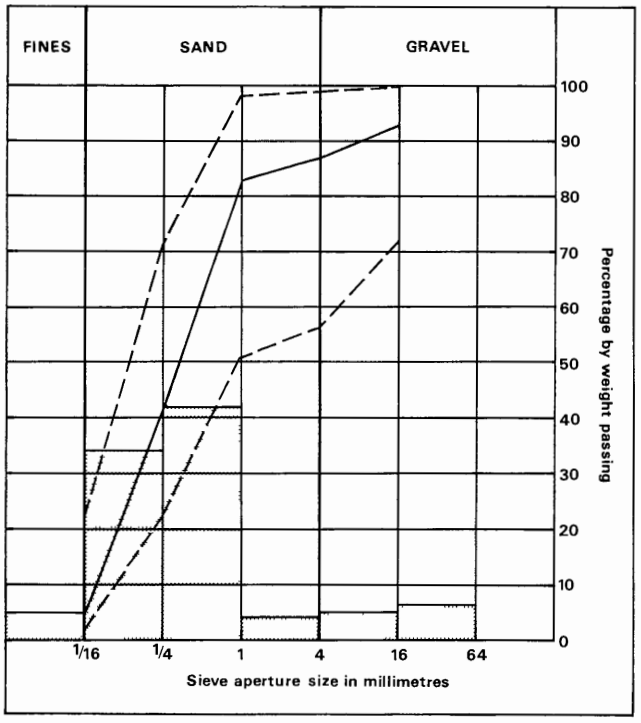


Figure 4 Grading charateristics of the mineral in Block A. (The continuous line is the cumulative frequency curve of the mean grading of the block as a whole: the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading of the block is also given as a distogram.)

The assessment of resources is based on information from 27 IMAU boreholes and one other record. The mineral, which is present in 18 of these, varies in recorded thickness between 1.1 m (borehole 26 NW 12) and 14.6 m (borehole 26 SW 8) with a mean of 5.1 m. The estimated volume of mineral is 87 million m^3 $\pm$ 39 per cent at the 95 per cent confidence level. The mean thickness of overburden is 0.6 m and consequently the mineral has been designated as exposed.

In the 18 IMAU boreholes that proved mineral the fines content ranged from 2 per cent (boreholes 26 SW 14 and 26 SW 15) to 15 per cent (borehole 26 SW 7) in all but one borehole (26 NW 12) in which it was 22 per cent. The proportion of sand ranged from 34 per cent (borehole 26 NW 12) to 97 per cent (borehole 26 SW 15) and the gravel proportion ranged from 1 per cent (borehole 26 SW 15) to 44 per cent (borehole 26 NW 12).

The mean grading for the block is fines 5 per cent, sand 82 per cent and gravel 13 per cent, making the mineral of the block as a whole a pebbly sand.

Block B (Table 5, Figure 5)

This block occupies 8.3 km^2 to the south of Horncastle, of which 8.2 km^2 is mineral-bearing. The block boundaries correspond approximately with those of the valley of the River Bain and two tributary valleys that join it from the east. The block also serves to divide the resource sheet in half with the two larger blocks, A and C, lying to the west and east, respectively.

The potentially workable sand and gravel consists of River Gravels, which are distributed along the margins of the Bain valley and continue beneath the Alluvium of the valley floor.

The assessment of resources is based on information from 7 IMAU boreholes and one other record. Mineral is present in all of these and varies in thickness from 1.8 m in borehole 26 SW 1 to 6.4 m in borehole 26 SW 23. The mean thickness of mineral is 3.4 m and the estimated volume is 28 million m^3 $\pm$38 per cent at the 95 per cent confidence level. Over most of this block, the recorded

Table 5 Data from IMAU assessment boreholes: Block B.

Borehole number	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	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	Coarse gravel +16-64mm
26 NW 11	3.9	1.0	4	8	34	13	20	21
26 NE 10	4.3	0.6	3	24	60	7	5	1
26 SW 1	1.8	2.0	No grading data available					
26 SW 11	2.8	0.4	2	16	33	12	17	20
26 SW 16	2.5	0.8	3	17	42	8	12	18
26 SW 23	6.4	0.7	4	18	42	9	13	14
26 SW 27	3.1	0.9	4	12	31	13	20	20
26 SE 6	2.4	0.2	3	12	30	15	24	16
Mean	**3.4**	**0.8**	**3**	**16**	**40**	**11**	**15**	**15**

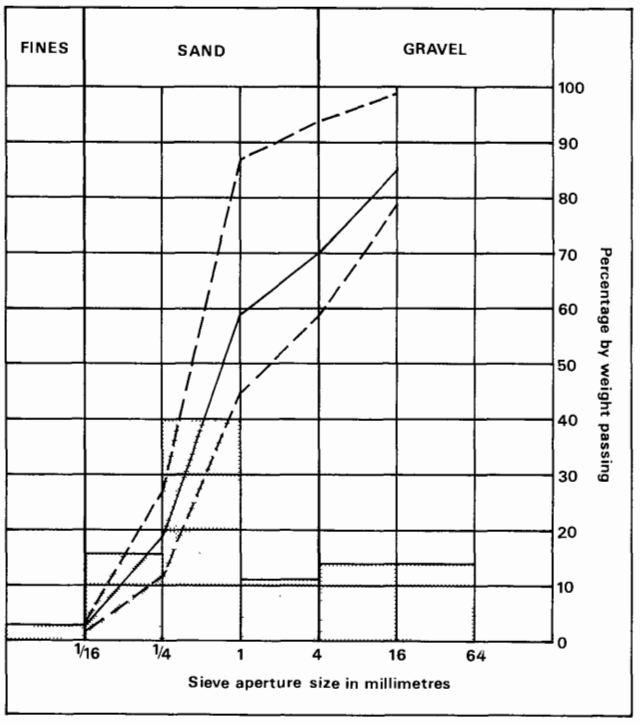


Figure 5 Grading characteristics of the mineral in Block B (for explanation see Figure 4).

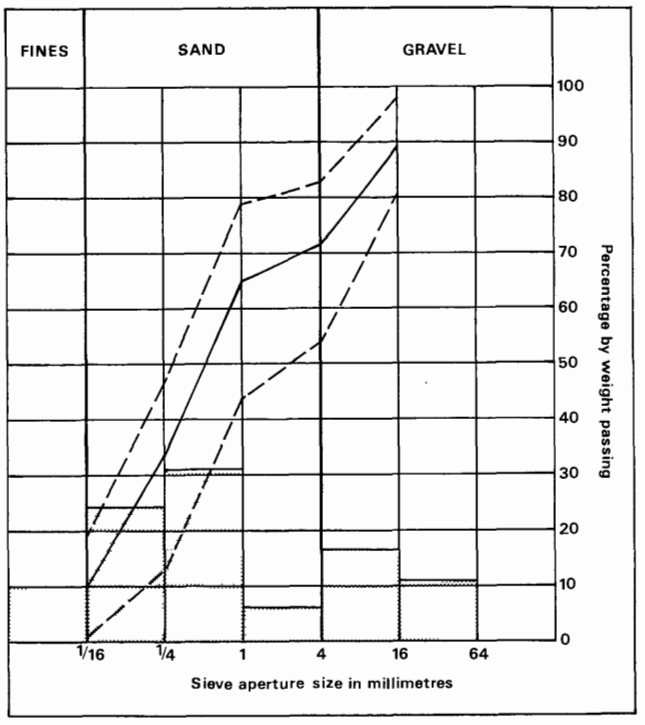


Figure 6 Grading characteristics of the mineral in Block C (for explanation see Figure 4).

thickness of overburden is less than 1.0 m; however, because borehole 26 SW 1, the only one sited on Alluvium, proved River Gravels lying beneath 2.0 m of Alluvium, the whole area of River Gravels lying beneath the Alluvium is assessed as 'continuous or almost continuous spreads of mineral beneath overburden', and is shown as such on the resource map.

Except for 4.3 m of pebbly sand in borehole 26 NE 10, all other boreholes proved sandy gravel. In the seven IMAU boreholes that proved mineral, fines ranged from 2 per cent (borehole 26 SW 11) to 4 per cent (boreholes 26 NW 11, 26 SW 23 and 26 SW 27). The proportion of sand varies between 55 per cent (borehole 26 NW 11) and 69 per cent (borehole 26 SW 23) in all but one borehole (26 NE 10), where it is 91 per cent; the gravel content ranged from 6 per cent (borehole 26 NE 10) to 41 per cent (borehole 26 NW 11).

The mean grading for the block is fines 3 per cent, sand 67 per cent and gravel 30 per cent making the mineral of the block as a whole a sandy gravel.

Block C (Table 6, Figure 6)

This block, which occupies the whole of the eastern half of the resource sheet area, is bounded on its western margin by block B. Only 9.5 km^2 in the southern part is mineral-bearing. The barren area consists mainly of till with sporadic intercalations of Glacial Sand and Gravel, and exposures of thin Fluvio-glacial and Older River Sand and Gravel; neither is regarded as potentially workable.

The potentially workable sand and gravel consists of Fluvio-glacial and Older River Sand and Gravel occurring mainly around Mareham le Fen, and two smaller areas to the north-west.

The assessment of resources is based on information from 14 IMAU boreholes and one other record. The mineral, which is present in ten of these, varies in thickness from 1.0 m (boreholes 26 SW 24 and 26 SE 14) to 4.6 m (borehole 26 SE 10), but it is usually closer in thickness to the mean of 1.7 m. The estimated volume of mineral is 16 million $m^3 \pm 59$ per cent at the 95 per cent

Table 6 Data from IMAU assessment boreholes: Block C.

Borehole number	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	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	Coarse gravel +16-64 mm
26 SW 24	1.0	0.4	3	10	35	12	23	17
26 SE 2	1.1	0.5	No grading data available					
26 SE 5	1.8	1.0	5	36	38	4	5	12
26 SE 9	1.1	1.7	4	16	27	10	24	19
26 SE 10	4.6	0.7	19	28	28	4	10	11
26 SE 11	1.1	0.5	15	25	28	11	19	2
26 SE 12	4.3	0.5	2	19	38	9	18	14
26 SE 13	1.6	0.5	14	27	34	7	14	4
26 SE 14	1.0	0.6	11	22	21	9	28	9
26 SE 15	1.3	0.5	7	20	17	10	36	10
Mean	**1.7**	**0.7**	**10**	**24**	**31**	**7**	**17**	**11**

confidence level. As in blocks A and B, the overburden is thin (0.7 m) and the mineral has therefore been classified as exposed.

In the 9 IMAU boreholes that proved mineral the mean proportion of fines (10 per cent) was the highest of any of the resource blocks. This increase in fines may be derived, in part, from the underlying till which is often within 2 m of the surface in this area. The sand content varies from 47 per cent (borehole 26 SE 15) to 78 per cent (borehole 26 SE 5) and the gravel ranged from 17 per cent (borehole 26 SE 5) to 46 per cent (borehole 26 SE 15).

The mean grading for the block is fines 10 per cent, sand 62 per cent and gravel 28 per cent, making the mineral of the block as a whole a sandy gravel.

Conclusions

1 Most of the potentially workable sand and gravel occurs within resource blocks A and C, and consists mainly of Fluvio-glacial and Older River Sand and Gravel. These deposits occupy an area of 26.5 km^2 to the east and west of the River Bain and range in thickness from 1.0 to 14.6 m. In block A the Fluvio-glacial and Older River Sand and Gravel tends to be sandier, particularly north of Ostler's Plantation [212 636], whereas in block C (mainly around Mareham le Fen) the deposit contains a higher proportion of fines. Flint is the predominant pebble type in the gravel fraction.

2 River Gravels occur along the flanks of the Bain valley and beneath overburden on the valley floor, and constitute the potentially workable sand and gravel of block B. They occupy an area of 8.2 km^2 and range in thickness from 1.8 to 6.4 m. The deposit grades consistently as a sandy gravel and contains pebbles of flint, chalk and sandstone in the gravel fraction.

3 A small area of Glacial Sand and Gravel cropping out around Martin is included in the assessment, but the distribution of this deposit within the till is sporadic and its occurrence here is not regarded as potentially workable.

4 Because the sand and gravel deposits of the resource sheet area rest directly on an irregular till surface, the thickness of sand and gravel often varies unpredictably.

List of Workings

Site	Grid reference	Oprerator
Moor Lane Kirkby on Bain	227 630	Butterly Aggregates Ltd
Tattershall Road Kirkby on Bain	227 604	Bain Aggregates Ltd
Tattershall Road Kirkby on BAin	232 601	Woodhall Spa Sand and Gravel Co. Ltd

All pits are actively being worrked.

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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.

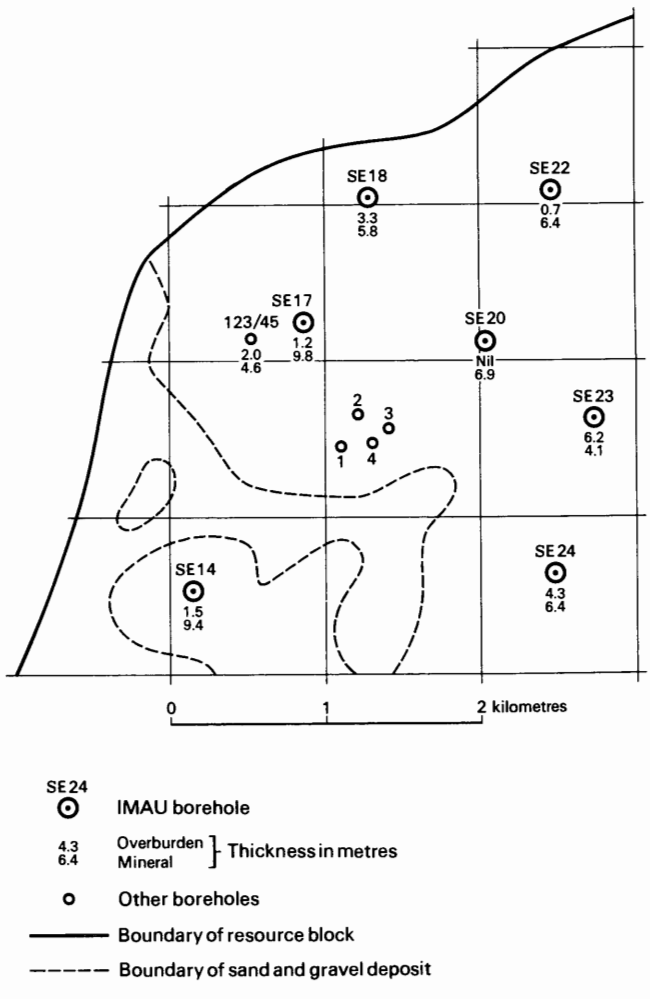
The drilling machine employed should be capable of providing a continuous sample representative of all unconsolidated deposits, so that the in-situ grading can be determined, if necessary, to a depth of 30 m (100 ft) at a diameter of about 200 mm (8 in), beneath different types of overburden. It should 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 km^2, 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

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

4 The above relationship may be transposed such that

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

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 $l_{m_1}, l_{m_2}, \ldots l_{m_n}$, then the best estimate of mean thickness, $\bar{l}_m$, is given by

$$\Sigma\ (l_{m_1} + l_{m_2} \ldots l_{m_n}) / n .$$

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

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

where l_m is any value in the series l_{m_1} to l_{m_n}.

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 $S_A / S_{\bar{l}_m} \leqq 0.\dot{3}$ is assumed in all cases. It follows from Equation [2] that

$$S_{\bar{l}_m} \leqq S_V \leqq 1.05\ S_{\bar{l}_m} \qquad [3]$$

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:

$$L_{\bar{l}_m} \leqq L_V \leqq 1.05\, L_{\bar{l}_m}.$$

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

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

per cent,

and when n is greater than 20, as

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

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 km^2 and 2 km^2, 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 km^2.

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 l_o	Overburden wl_o	Mineral l_m	Mineral wl_m	Remarks
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	½	1.2	1.6	9.8	7.2	Hydrogeology Unit record
123/45	½	2.0		4.6		
1	¼	2.7	2.6	7.3	5.8	Close group of four boreholes (commercial)
2	¼	4.5		3.2		
3	¼	0.4		6.8		
4	¼	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	$\lvert(wl_m - \overline{wl}_m)\rvert$	$(wl_m - \overline{wl}_m)^2$
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

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

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

$= 20.3$

$\simeq 20$ 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 constitutents 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, 1975), 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
	Cobble		
64 mm			
		Coarse	Gravel
16 mm	Pebble		
		Fine	
4 mm			
		Coarse	
1 mm			
	Sand	Medium	Sand
$\frac{1}{4}$ mm			
		Fine	
$\frac{1}{16}$ mm			
	Fines (silt and clay)		Fines

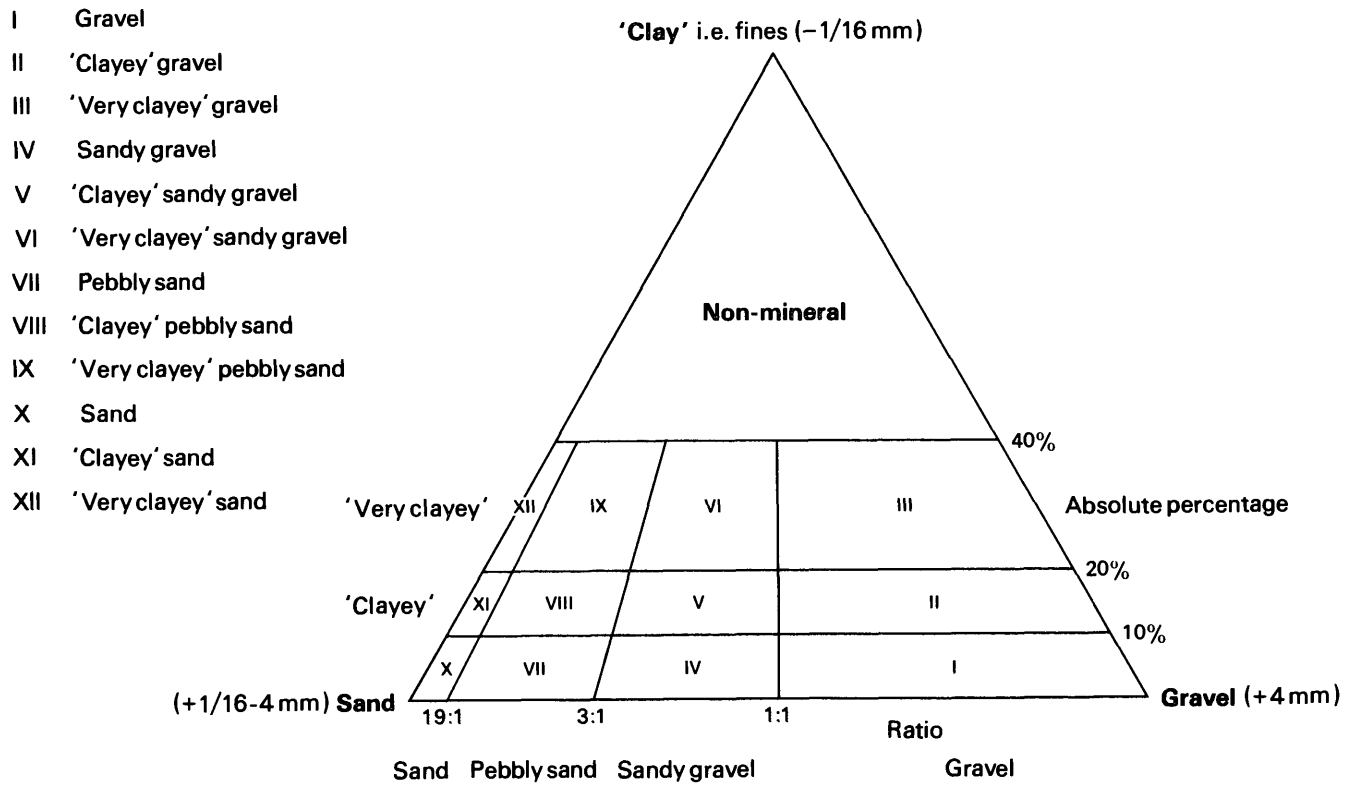


Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D

EXPLANATION OF THE BOREHOLE RECORDS

Annotated fictitious example

CK 66 NW 5[1] **6191 6962**[2] **Northfields**[3] **Block B**

Surface level (+49.7 m) +163 ft[4]
Water struck at +45.9 m[5]
October 1972[6]

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

GRADING[10]

	Mean for deposit percentages			Depth below[11] 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	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**

COMPOSITION[12]

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 Sampling
A continuous series of bulk samples is taken throughout the thickness of sand and gravel. A new sample is taken wherever there is an appreciable lithological change within the sand and gravel or at every 1 m of depth. Samples obtained by bailing are indicated by an asterisk (*).

12 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 26 NW 6 **2087 6976** **Page Walk Farm** **Block A**

Surface level +23.6 m (+88 ft)
Water struck at +15.6 m
August 1977

Waste 18.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Till	Clay, blue-grey, stiff, containing pebbles of subangular chalk with some angular grey flint and trace angular shale	9.4	9.5
	Clay, pale grey, stiff to firm, silty with pebbles of subangular chalk and some flint, quartzite and mudstone. Thin seams of pebbly sand	7.0	16.5
	Clay, blue-grey, stiff, containing much subangular chalk gravel	1.8+	18.3

TF 26 NW 7 **2360 6987** **Thimbleby** **Block A**

Surface level +50.0 m (+160 ft)
Water not struck
October 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Till	Pebbly clay, grey, stiff and silty. Pebbles of subangular chalk with some angular flint and trace mudstone	17.5+	18.0

TF 26 NW 8 **2385 6902** **Glebe Farm** **Block A**

Surface level +47.5 m (+151 ft)
Water struck at +47.5 m
August 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Till	Pebbly clay, yellowish-brown becoming grey below 4.0 m, firm and silty. Pebbles of subangular chalk with some flint, mudstone and quartzite	17.0+	18.0

TF 26 NW 9 **2333 6804** **Langton** **Block A**

Surface level +35.3 m (+111 ft)
Water not struck
August 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Till	Pebbly clay, grey, firm to stiff, pebbles of subangular chalk with some angular grey flint	17.2+	18.0

TF 26 NW 10 **2383 6769** **Thornton** **Block A**

Surface level +39.2 m (+121 ft)
Water not struck
August 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.7	1.7
Till	Pebbly clay, dark grey, stiff. Pebbles of subangular chalk with some angular grey flint, trace mudstone, quartz and glauconitic sandstone	16.3+	18.0

TF 26 NW 11 **2475 6690** **Sewage Farm** **Block B**

Surface level +21.3 m (+70 ft)
Water struck at +18.5 m
August 1977

Overburden	1.0 m
Mineral	3.9 m
Waste	4.2 m
Bedrock	1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
River Gravels	Sandy gravel, 'clayey' upper margin Gravel: fine and coarse, angular flint with some subangular chalk, subrounded sandstone and mudstone Sand: medium, subrounded quartz with some coarse angular flint and subangular chalk	3.9	4.9
Till	Pebbly clay, dark grey, stiff, with pebbles of chalk	4.2	9.1
Ancholme Clay Group	Clay, dark grey, firm, with fossil fragments	1.4+	10.5

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
4	55	41	1.0-2.1	10	12	30	12	19	17	0
			2.1-3.1	4	6	27	15	23	25	0
			3.1-4.1	1	7	42	13	21	16	0
			4.1-4.9	1	6	37	13	14	29	0
			Mean	**4**	**8**	**34**	**13**	**20**	**21**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
1.0-2.1	10	77	3	4	2	2	2
2.1-3.1	12	71	9	1	2	3	2
3.1-4.1	21	66	3	4	0	4	2
4.1-4.9	11	80	3	2	1	2	1
Mean	**13**	**73**	**5**	**3**	**1**	**3**	**2**

TF 26 NW 12 **2382 6681** **Martin** **Block A**

Surface level +36.3 m (+119 ft)
Water not struck
August 1977

Overburden	0.6 m
Mineral	1.1 m
Waste	4.1 m
Bedrock	0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Glacial Sand and Gravel	'Very clayey' gravel Gravel: coarse with some fine, angular flint with some subrounded chalk and subangular limestone Sand: medium and fine, subangular quartz with some coarse lithic grains	1.1	1.7
Till	Pebbly clay, light grey, stiff	4.1	5.8
Ancholme Clay Group	Limestone, grey, fossiliferous	0.5+	6.3

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
22	34	44	0.6-1.7	22	14	15	5	16	28	0

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.6-1.7	7	86	trace	trace	1	6	0

TF 26 NW 13 **2118 6684** **Darwood House** **Block A**

Surface level +14.7 m (+48 ft)
Water not struck
August 1977

Waste	13.0 m
Bedrock	0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Till	Pebbly clay, olive-grey becoming grey at 4.2 m, stiff, sandy, with pebbles of subangular chalk with angular grey flint, trace shale and glauconitic sandstone	12.4	13.0
Ancholme Clay Group	Clay, very dark grey to black, very stiff	0.7	13.7
	Limestone, grey, fossiliferous	0.1+	13.8

TF 26 NW 14 **2119 6511** **Highall Farm** **Block A**

Surface level +16.2 m (+53 ft)
Water struck at +14.4 m
August 1977

Overburden	1.0 m
Mineral	5.7 m
Waste	9.4 m
Bedrock	0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: fine with coarse, angular grey flint and rounded quartzite with some sandstone Sand: medium with fine, subrounded quartz with some coarse lithic grains	5.7	6.7
Till	Pebbly clay, dark grey, stiff	9.4	16.1
Ancholme Clay Group	Clay, dark grey, stiff, with bivalve fragments	0.9+	17.0

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
3	82	15	1.0-3.5	4	37	40	4	10	5	0
			3.5-4.5	2	12	51	15	14	6	0
			4.5-5.5	1	12	70	9	7	1	0
			5.5-6.7	2	11	63	8	12	4	0
			Mean	**3**	**23**	**51**	**8**	**11**	**4**	**0**

TF 26 NW 15 **2238 6512** **White Hall Farm** **Block A**

Surface level +25.1 m (+83 ft)
Water not struck
August 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Till	Pebbly clay, grey, firm to stiff. Pebbles mainly subrounded chalk with angular flint and mudstone, trace glauconitic sandstone	17.2+	18.0

TF 26 NW 16 **2362 6514** **Roughton** **Block A**

Surface level +25.4 m (+84 ft)
Water struck at +22.3 m
August 1977

Overburden 0.4 m
Mineral 5.7 m
Waste 18.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	**a** Sand: medium with fine, subangular quartz	3.1	3.5
	b Sandy gravel Gravel: coarse and fine, angular flint with some rounded quartzite and sandstone Sand: medium, subrounded quartz with some angular flint and lithic grains	2.6	6.1
Till	Pebbly clay, dark grey, stiff	18.9+	25.0

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	6	91	3	0.4-1.4	8	37	52	1	1	1	0
				1.4-2.4	6	36	53	1	1	3	0
				2.4-3.5	5	34	58	1	1	1	0
				Mean	**6**	**36**	**54**	**1**	**1**	**2**	**0**
b	2	60	38	3.5-4.5	2	18	54	2	6	18	0
				4.5-5.5	2	11	30	6	15	36	0
				5.5-6.1	3	7	35	17	16	22	0
				Mean	**2**	**13**	**40**	**7**	**12**	**26**	**0**
a+b	**4**	**77**	**19**	**Mean**	**4**	**25**	**48**	**4**	**6**	**13**	**0**

TF 26 NE 8 **2554 6800** **Thornton Lodge Farm** **Block A**

Surface level +31.4 m (+103 ft)
Water not struck
October 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Till	Pebbly clay, pale yellow becoming grey at 3.5 m, firm. Pebbles of subangular chalk with some angular grey flint	17.5+	18.0

TF 26 NE 9 **2770 6790** **Mareham on the Hill** **Block C**

Surface level +66.0 m (+217 ft)
Water struck at +55.2 m
October 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Till	Pebbly clay, pale grey, stiff to firm. Pebbles of subangular chalk with some flint and dark grey mudstone	17.5+	18.0

TF 26 NE 10 **2522 6654** **Dalderby** **Block B**

Surface level +24.6 m (+81 ft)
Water struck at +20.4 m
October 1977

Overburden	0.6 m
Mineral	4.3 m
Waste	13.9 m
Bedrock	1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
River Gravels	Pebbly sand Gravel: mainly fine, angular flint with some subrounded quartzite and sandstone Sand: medium with fine, angular quartz and flint with some lithic grains	4.3	4.9
Till	Pebbly clay, grey, stiff	13.9	18.8
Ancholme Clay Group	Clay, shaly, with ammonite fragments	1.2+	20.0

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
3	91	6	0.6-1.6	5	32	52	3	5	3	0
			1.6-2.6	3	17	62	10	7	1	0
			2.6-3.6	5	20	57	9	8	1	0
			3.6-4.9	1	25	68	5	1	0	0
			Mean	**3**	**24**	**60**	**7**	**5**	**1**	**0**

TF 26 NE 11 **2650 6596** **Scrivelsby** **Block C**

Surface level +43.2 m (+142 ft)
Water struck at +35.2 m
October 1977

Waste	18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Till	Pebbly clay, grey, stiff to firm. Pebbles of subangular chalk with some angular, flint and dark grey mudstone	17.3+	18.0

TF 26 SW 7 **2044 6481** **Reeds Beck** **Block A**

Surface level +14.0 m (+46 ft)
Water struck at +12.7 m
September 1977

Overburden	0.5 m
Mineral	1.6 m
Waste	9.4 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	'Clayey' sand: with some pebbles of subrounded quartzite, otherwise mainly fine with medium, subangular quartz sand	1.6	2.1
Till	Pebbly clay, grey, stiff, with thin sandy lenses	9.4	11.5
Ancholme Clay Group	Mudstone, greyish-black, with ammonite fragments	1.0+	12.5

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
15	82	3	0.5-2.1	15	56	24	2	1	2	0

TF 26 SW 8 **2147 6433** **Tower Farm** **Block A**

Surface level +28.1 m (+92 ft)
Water struck at +16.5 m
October 1977

Overburden	0.8 m
Mineral	13.5 m
Waste	2.0 m
Mineral	1.1 m
Waste	6.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Fluvio-glacial and Older River Sand and Gravel	**a** Sand: fine with medium, subangular quartz	13.5	14.3
	Clay, dark brown, soft and silty	2.0	16.3
	b 'Clayey' pebbly sand Gravel: fine, subrounded to rounded sandstone and quartzite with some angular flint Sand: medium with fine, subangular quartz	1.1	17.4
Till	Pebbly clay, dark grey, stiff	6.6+	24.0

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	0.8-1.8	2	49	47	0	1	1	0
				1.8-2.8	1	42	56	1	0	0	0
				2.8-3.8	3	43	54	0	0	0	0
				3.8-4.8	5	56	39	0	0	0	0
				4.8-5.8	3	56	41	0	0	0	0
				5.8-6.8	1	49	45	1	2	2	0
				6.8-7.8	2	56	40	0	1	1	0
				7.8-8.8	2	95	1	0	0	2	0
				8.8-9.8	4	64	24	1	2	5	0
				9.8-10.8	3	73	22	0	1	1	0
				10.8-11.8	5	75	20	0	0	0	0
				11.8-12.8	4	80	16	0	0	0	0
				12.8-14.3	3	70	27	0	0	0	0
				Mean	**3**	**62**	**33**	**trace**	**1**	**1**	**0**
b	12	77	11	16.3-17.4	12	22	51	4	11	0	0
a+b	**4**	**94**	**2**	**Mean**	**4**	**59**	**34**	**1**	**1**	**1**	**0**

TF 26 SW 9 **2277 6431** **Wellsyke Wood** **Block A**

Surface level +20.2 m (+67 ft)
Water struck at +18.0 m
September 1977

Overburden	0.5 m
Mineral	6.8 m
Waste	2.4 m
Bedrock	0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	**a** Sand: medium and fine, subangular flint	2.0	2.5
	b Sandy gravel, pebbly clay between 6.5 m and 6.9 m Gravel: coarse and fine, angular flint with some subrounded sandstone and quartzite Sand: medium with fine subangular quartz with some angular flint	4.8	7.3
Till	Pebbly clay, dark grey, stiff	2.4	9.7
Ancholme Clay Group	Limestone, dark grey, with shell fragments	0.2+	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
a	4	96	0	0.5-1.5	5	34	59	1	1	0	0
				1.5-2.5	3	34	62	1	0	0	0
				Mean	**4**	**34**	**61**	**1**	**trace**	**0**	**0**
b	3	54	43	2.5-3.5	2	24	57	2	5	10	0
				3.5-4.5	1	11	36	7	29	16	0
				4.5-5.5	6	15	25	3	20	31	0
				5.5-6.5	1	11	21	6	20	41	0
				6.9-7.3	3	10	23	16	27	21	0
				Mean	**3**	**15**	**33**	**6**	**19**	**24**	**0**
a+b	**3**	**67**	**30**	**Mean**	**3**	**21**	**42**	**4**	**13**	**17**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.5-1.5	0	65	5	0	30	0	0
2.5-3.5	0	98	1	0	1	0	0
3.5-4.5	0	96	2	0	2	0	0
4.5-5.5	0	96	2	0	2	0	0
5.5-6.5	0	94	5	0	1	0	0
6.9-7.3	0	95	2	0	2	0	1
Mean	**0**	**95**	**3**	**0**	**2**	**0**	**0**

TF 26 SW 10 **2345 6446** **Glebe Farm** **Block A**

Surface level +29.2 m (+96 ft)
Water struck at +25.0 m
September 1977

Overburden	0.6 m
Mineral	3.8 m
Waste	15.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: fine and coarse, mainly angular flint with some subrounded sandstone and rounded quartzite Sand: medium and fine, subangular quartz	3.8	4.4
Till	Pebbly clay, very dark grey, stiff	15.6+	20.0

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
4	88	8	0.6-1.6	5	33	46	5	10	1	0
			1.6-2.6	2	34	57	2	3	2	0
			2.6-3.6	5	29	58	2	4	2	0
			3.6-4.4	2	26	56	2	4	10	0
			Mean	**4**	**31**	**54**	**3**	**5**	**3**	**0**

TF 26 SW 11 **2416 6405** **Roughton** **Block B**

Surface level +16.5 m (+54 ft)
Water struck at +15.3 m
September 1977

Overburden	0.4 m
Mineral	2.8 m
Waste	16.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
River Gravels	Sandy gravel Gravel: coarse with fine, mainly angular flint Sand: medium with fine and coarse, subangular quartz with coarse angular flint and lithic grains	2.8	3.2
Till	Pebbly clay, very dark grey, stiff	3.2	6.4
Glacial Sand and Gravel	Gravel Gravel: coarse and fine, angular flint with some subrounded sandstone, quartzite and chalk Sand: medium and coarse, angular quartz and flint	0.9	7.3
Till	Pebbly clay, dark grey, stiff, sandy, with chalk and flint pebbles	12.1+	19.4

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
2	61	37	0.4-1.2	4	45	37	5	6	3	0
			1.2-2.2	1	5	32	16	25	21	0
			2.2-3.2	1	5	31	13	17	35	0
			Mean	**2**	**16**	**33**	**12**	**17**	**20**	**0**

TF 26 SW 12 **2034 6394** **Thornton Moor** **Block A**

Surface level +15.8 m (+52 ft)
Water struck at +14.1 m
September 1977

Overburden	0.4 m
Mineral	3.7 m
Waste	9.5 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: fine, subrounded sandstone with angular flint and subrounded quartzite Sand: medium with fine, quartz with angular lithic grains	3.7	4.1
Till	Pebbly clay, dark grey, firm, with pebbles of chalk and some flint	9.5	13.6
Ancholme Clay Group	Clay, dark grey, with fossil fragments	1.0+	14.6

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
3	90	7	0.4-1.4	4	27	63	2	3	1	0
			1.4-2.4	2	11	64	11	8	4	0
			2.4-3.4	3	18	66	6	4	3	0
			3.4-4.1	4	23	63	5	4	1	0
			Mean	**3**	**19**	**65**	**6**	**5**	**2**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.4-1.4	0	36	28	6	30	0	0
1.4-2.4	0	24	51	0	24	0	1
2.4-3.4	0	15	76	0	8	0	1
3.4-4.1	0	27	54	0	18	0	1
Mean	**0**	**24**	**55**	**1**	**20**	**0**	**trace**

TF 26 SW 13 **2152 6358** **Roughton Moor** **Block A**

Surface level +14.0 m (+46 ft)
Water struck at +12.5 m
September 1977

Overburden	0.7 m
Mineral	3.3 m
Waste	11.6 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: coarse and fine, subrounded quartzite and sandstone with some angular flint Sand: fine and medium, subangular quartz	3.3	4.0
Till	Clay, dark grey, firm	0.8	4.8
	Pebbly clay, grey, stiff, silty, with pebbles of chalk and some flint	10.8	15.6
Ancholme Clay Group	Clay, stiff, shaly, fossiliferous	1.0+	16.6

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
4	80	16	0.7-1.7	7	70	22	1	0	0	0
			1.7-2.7	2	18	38	5	14	23	0
			2.7-4.0	4	34	43	7	8	4	0
			Mean	**4**	**40**	**35**	**5**	**7**	**9**	**0**

TF 26 SW 14 **2261 6352** **Moor Farm** **Block A**

Surface level +20.3 m (+67 ft)
Water struck at +17.7 m
September 1977

Overburden	0.5 m
Mineral	11.3 m
Waste	10.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	**a** Sand: medium and fine, subangular quartz	3.0	3.5
	b Pebbly sand Gravel: coarse, angular flint with subrounded chalk and sandstone Sand: medium and fine, subangular quartz with angular lithic grains	5.0	8.5
	c Sandy gravel Gravel: coarse with fine, angular flint and subrounded sandstone with some subrounded chalk and rounded quartzite Sand: medium and fine, subangular quartz	3.3	11.8
Till	Pebbly clay, dark grey, stiff, with pebbles of chalk and some flint	10.2+	22.0

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	2	96	2	0.5-1.5	3	38	55	0	1	3	0
				1.5-2.5	2	48	48	0	1	1	0
				2.5-3.5	2	48	48	1	1	0	0
				Mean	**2**	**45**	**51**	**trace**	**1**	**1**	**0**
b	2	81	17	3.5-4.5	1	28	49	3	4	15	0
				4.5-5.5	1	16	38	8	5	32	0
				5.5-6.5	1	48	34	2	2	13	0
				6.5-7.5	3	51	45	0	1	0	0
				7.5-8.5	3	46	34	1	4	12	0
				Mean	**2**	**38**	**40**	**3**	**3**	**14**	**0**
c	2	57	41	8.5-9.5	2	29	19	3	14	33	0
				9.5-10.5	2	18	30	7	12	31	0
				10.5-11.8	2	18	42	5	12	21	0
				Mean	**2**	**21**	**31**	**5**	**13**	**28**	**0**
a+b+c	**2**	**78**	**20**	**Mean**	**2**	**35**	**40**	**3**	**5**	**15**	**0**

TF 26 SW 15 **2324 6376** **Kirkby House** **Block A**

Surface level +26.3 m (+87 ft)
Water struck at +20.5 m
September 1977

Overburden	0.6 m
Mineral	6.4 m
Waste	13.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	Sand: fine and medium, subangular quartz	6.4	7.0
Till	Pebbly clay, dark grey, stiff, with pebbles of chalk and some flint	13.5+	20.5

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
2	97	1	0.6-1.6	2	46	47	1	2	2	0
			1.6-2.6	3	53	44	0	0	0	0
			2.6-3.6	2	49	48	1	0	0	0
			3.6-4.6	1	47	51	1	0	0	0
			4.6-5.6	2	52	45	0	1	0	0
			5.6-6.6	2	61	37	0	0	0	0
			6.6-7.0	5	52	37	1	2	3	0
			Mean	**2**	**51**	**45**	**1**	**1**	**trace**	**0**

TF 26 SW 16 **2464 6349** **Haltham** **Block B**

Surface level +14.8 m (+49 ft)
Water struck at +11.8 m
October 1977

Overburden	0.8 m
Mineral	2.5 m
Waste	17.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
River Gravels	Sandy gravel Gravel: coarse and fine, angular flint with some subangular sandstone Sand: medium, subangular quartz with angular flint and subangular lithic grains	2.5	3.3
Till	Pebbly clay, dark grey, firm becoming hard, with pebbles of chalk and some flint	17.0+	20.3

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
3	67	30	0.8-1.8	3	22	40	6	12	17	0
			1.8-3.0	4	16	49	8	11	12	0
			3.0-3.3	3	5	19	11	20	42	0
			Mean	**3**	**17**	**42**	**8**	**12**	**18**	**0**

TF 26 SW 17 **2063 6218** **High Park Farm** **Block A**

Surface level +12.1 m (+40 ft)
Water struck at +9.7 m
September 1977

Overburden	0.6 m
Mineral	1.8 m
Waste	8.7 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	'Clayey' pebbly sand Gravel: fine and coarse, angular flint with some subrounded quartzite and sandstone Sand: fine and medium, subangular quartz	1.8	2.4
Till	Pebbly clay, dark grey, stiff, silty, with pebbles of chalk and some flint	8.7	11.1
Ancholme Clay Group	Clay, dark grey, stiff, fossiliferous	1.0+	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
14	68	18	0.6-2.0	15	37	28	5	9	6	0
			2.0-2.4	10	22	33	6	15	14	0
			Mean	**14**	**34**	**29**	**5**	**10**	**8**	**0**

TF 26 SW 18 **2158 6256** **Ostler's Plantation** **Block A**

Surface level +19.2 m (+63 ft)
Water struck at +3.8 m
September 1977

Overburden	0.4 m
Mineral	11.3 m
Waste	4.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	**a** Sand, with sporadic pebbles Sand: medium and fine, subangular quartz	9.0	9.4
	b Gravel Gravel: coarse and fine, angular to subangular flint and subrounded sandstone with some quartzite Sand: medium and fine subangular quartz with some lithic grains	2.3	11.7
Till	Pebbly clay, grey, firm and silty, with pebbles of chalk and some flint	4.3+	16.0
	Hole abandoned		

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	0.4-1.4	4	56	38	1	1	0	0
				1.4-2.4	5	45	50	0	0	0	0
				2.4-3.4	3	37	56	1	2	1	0
				3.4-4.4	2	24	72	1	1	0	0
				4.4-5.4	1	32	64	1	1	1	0
				5.4-6.4	2	39	54	1	2	2	0
				6.4-7.4	4	42	53	1	0	0	0
				7.4-9.4	5	44	43	2	3	3	0
				Mean	**3**	**40**	**54**	**1**	**1**	**1**	**0**
b	1	32	67	9.4-10.4	1	11	20	6	24	38	0
				10.4-11.7	1	5	15	7	35	37	0
				Mean	**1**	**8**	**17**	**7**	**30**	**37**	**0**
a+b	**3**	**81**	**16**	**Mean**	**3**	**34**	**45**	**2**	**7**	**9**	**0**

TF 26 SW 19 **2359 6216** **Kirkby on Bain** **Block A**

Surface level +13.4 m (+44 ft)
Water not struck
September 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Till	Pebbly clay, yellowish-brown becoming grey or pale grey with depth, with pebbles of subangular chalk and some grey flint with trace quartzite, mudstone and red sandstone	17.0+	18.0

TF 26 SW 20 **2039 6090** **Harbour Wood** **Block A**

Surface level +8.2 m (+27 ft)
Water struck at +5.6 m
September 1977

Overburden	0.5 m
Mineral	1.0 m
Waste	0.4 m
Mineral	4.5 m
Waste	5.0 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	**a** 'Clayey' pebbly sand Gravel: mainly fine, angular flint with some subrounded quartzite and sandstone Sand: medium and fine, subangular quartz	1.0	1.5
	Clayey silt, yellowish-brown, soft	0.4	1.9
	b Pebbly sand, 'clayey' at top Gravel: fine and coarse, angular flint with some subrounded sandstone and rounded quartzite Sand: medium and fine, subangular quartz with some flint and lithic grains	4.5	6.4
Till	Pebbly clay, dark grey, stiff, with pebbles of chalk and some flint	5.0	11.4
Ancholme Clay Group	Clay, dark grey, stiff, fossiliferous	1.0+	12.4

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	12	76	12	0.5-1.5	12	32	38	6	9	3	0
b	7	81	12	1.9-2.5	11	32	44	4	8	1	0
				2.5-3.5	13	44	42	1	0	0	0
				3.5-4.5	7	36	53	2	2	0	0
				4.5-5.8	3	17	56	7	9	8	0
				5.8-6.4	1	7	39	15	19	19	0
				Mean	**7**	**28**	**48**	**5**	**7**	**5**	**0**
a+b	**8**	**80**	**12**	**Mean**	**8**	**29**	**46**	**5**	**7**	**5**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.5-1.5	0	88	8	0	4	0	0
1.9-2.5	0	94	3	2	1	0	0
3.5-4.5	0	80	16	0	4	0	0
4.5-5.8	0	67	22	0	11	trace	0
5.8-6.4	0	69	14	0	10	0	7
Mean	**0**	**74**	**15**	**0**	**8**	**0**	**3**

TF 26 SW 21 **2138 6142** **Airfield** **Block A**

Surface level +13.8 m (+46 ft)
Water struck at +11.2 m
September 1977

Overburden	1.0 m
Mineral	2.8 m
Waste	13.0 m
Bedrock	1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Fluvio-glacial and Older River Sand and Gravel	**a** 'Clayey' pebbly sand Gravel: fine, angular flint with rounded quartzite Sand: fine and medium, subangular quartz	1.5	2.5
	b Sandy gravel Gravel: fine and coarse, angular flint and subrounded sandstone with some rounded quartzite Sand: medium with coarse, subangular quartz with flint and lithic grains	1.3	3.8
Till	Pebbly clay, grey to dark grey, stiff and silty, with pebbles of chalk and some flint	13.0	16.8
Ancholme Clay Group	Clay, stiff and shaly, with ammonite fragments	1.0+	17.8

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
a	19	72	9	1.0-2.5	19	35	34	3	7	2	0
b	2	61	37	2.5-3.8	2	5	42	14	25	12	0
a+b	**11**	**67**	**22**	**Mean**	**11**	**21**	**38**	**8**	**15**	**7**	**0**

TF 26 SW 22 **2236 6218** **Fox Hill** **Block A**

Surface level +17.7 m (+58 ft)
Water struck at +15.4 m
September 1977

Overburden	0.4 m
Mineral	8.1 m
Waste	12.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	**a** Sand, with scattered pebbles of flint and sandstone Sand: fine and medium, subangular quartz	4.0	4.4
	b 'Clayey' sand, with scattered pebbles of sandstone with flint Sand: fine and medium, subangular quartz	2.0	6.4
	c Sandy gravel Gravel: fine and coarse, angular flint and subrounded sandstone with quartzite Sand: medium with coarse and fine, quartz with flint and lithic grains	2.1	8.5
Till	Pebbly clay, very dark grey, firm, with pebbles of chalk and some flint	12.5+	21.0

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	92	3	0.4-1.4	3	55	36	1	1	4	0
				1.4-2.4	5	67	28	0	0	0	0
				2.4-3.4	5	56	34	2	2	1	0
				3.4-4.4	9	59	27	1	2	2	0
				Mean	**5**	**60**	**31**	**1**	**1**	**2**	**0**
b	10	88	2	4.4-5.4	10	58	30	2	0	0	0
				5.4-6.4	10	38	47	2	3	0	0
				Mean	**10**	**47**	**39**	**2**	**2**	**0**	**0**
c	2	60	38	6.4-7.4	2	10	32	10	25	21	0
				7.4-8.5	2	8	44	14	18	14	0
				Mean	**2**	**9**	**39**	**12**	**21**	**17**	**0**
a+b+c	**6**	**82**	**12**	**Mean**	**6**	**43**	**35**	**4**	**7**	**5**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
6.4-7.4	0	48	39	1	12	0	0
7.4-8.5	0	58	29	0	12	0	0
Mean	**0**	**54**	**34**	**trace**	**12**	**0**	**0**

TF 26 SW 23 **2389 6168** **Jeffs Farm** **Block B**

Surface level +12.0 m (+40 ft)
Water struck at +8.5 m
September 1977

Overburden	0.7 m
Mineral	6.4 m
Waste	11.9 m
Bedrock	1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
River Gravels	Sandy gravel Gravel: fine and coarse, angular flint with some subrounded sandstone and quartzite, chalk pebbles present towards base Sand: medium with fine, quartz with some flint and lithic grains	6.4	7.1
Till	Pebbly clay, grey, stiff, with pebbles of chalk and some flint	11.9	19.0
Ancholme Clay Group	Clay, stiff, with ammonite fragments	1.1+	20.1

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
4	69	27	0.7-1.7	7	42	38	3	6	4	0
			1.7-2.9	7	23	39	6	12	13	0
			2.9-3.7	7	10	36	13	24	10	0
			3.7-4.7	1	7	35	17	21	19	0
			4.7-5.7	1	14	68	8	6	3	0
			5.7-7.1	1	10	39	8	12	30	0
			Mean	**4**	**18**	**42**	**9**	**13**	**14**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.7-1.7	0	92	4	1	2	0	1
1.7-2.9	2	91	5	0	2	0	0
2.9-3.7	10	78	4	2	2	3	1
3.7-4.7	18	73	1	2	2	3	1
4.7-5.7	37	47	6	3	2	4	1
5.7-7.1	10	76	10	trace	2	trace	2
Mean	**12**	**77**	**6**	**1**	**2**	**1**	**1**

TF 26 SW 24 **2468 6158** **Fulsby Wood** **Block C**

Surface level +21.4 m (+70 ft)
Water struck at +8.7 m
November 1977

Overburden	0.4 m
Mineral	1.0 m
Waste	17.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel: Gravel: fine and coarse, angular flint with some quartzite Sand: medium with coarse and fine, quartz with some flint and lithic grains	1.0	1.4
	Clay, silty, with plant fragments, 0.8 m of 'clayey' sandy gravel at base	12.1	13.5
Till	Pebbly clay, grey, stiff, with pebbles of chalk and some flint	5.5+	19.0

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
3	57	40	0.4-1.4	3	10	35	12	23	17	0

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.4-1.4	0	99	trace	0	1	0	trace

TF 26 SW 25 **2151 6041** **Tattershall Thorpe** **Block A**

Surface level +7.8 m (+26 ft)
Water struck at +6.0 m
September 1977

Waste	10.4 m
Bedrock	0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.5	1.5
Fluvio-glacial and Older River Sand and Gravel	'Very clayey' pebbly sand Gravel: fine with coarse, angular flint Sand: medium with fine, angular to subangular quartz	0.4	1.9
Till	Pebbly clay, dark grey, stiff, with pebbles of chalk and some flint	8.5	10.4
Ancholme Clay Group	Clay, firm, fossiliferous	0.9+	11.3

TF 26 SW 26 **2234 6088** **Tattershall Thorpe** **Block A**

Surface level +13.0 m (+43 ft)
Water struck at +10.8 m
September 1977

Overburden	0.8 m
Mineral	1.6 m
Waste	16.5 m
Bedrock	1.1 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 and coarse, angular flint with some sandstone and quartzite, trace igneous pebbles Sand: medium with fine, subangular quartz with some flint and lithic grains	1.6	2.4
Till	Clay, dark grey, firm, with pebbles of chalk and some flint below 9.5 m	16.5	18.9
Ancholme Clay Group	Clay, dark grey, stiff, shaly and fossiliferous	1.1+	20.0

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
7	65	28	0.8-1.8	8	17	41	5	15	14	0
			1.8-2.4	5	17	45	7	13	13	0
			Mean	**7**	**17**	**42**	**6**	**14**	**14**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.8-1.8	0	91	7	0	2	0	trace
1.8-2.4	0	95	3	0	2	0	trace
Mean	**0**	**92**	**6**	**0**	**2**	**0**	**trace**

TF 26 SW 27 **2311 6021** **Tattershall Thorpe** **Block B**

Surface level +9.1 m (+30 ft)
Water struck at +14.7 m
September 1977

Overburden	0.9 m
Mineral	3.1 m
Waste	9.9 m
Bedrock	1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
River Gravels	Sandy gravel Gravel: fine and coarse, angular flint with some subrounded quartzite and subangular chalk Sand: medium with coarse and fine, angular quartz with flint and lithic grains	3.1	4.0
Till	Pebbly clay, grey, stiff, with pebbles of chalk and some flint	9.9	13.9
Ancholme Clay Group	Clay, stiff, with ammonite fragments	1.1+	15.0

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
4	56	40	0.9-1.9	4	21	31	6	16	22	0
			1.9-2.9	6	10	32	18	23	11	0
			2.9-4.0	1	5	30	16	22	26	0
			Mean	**4**	**12**	**31**	**13**	**20**	**20**	**0**

TF 26 SW 28 **2426 6017** **Tumby** **Block C**

Surface level +12.4 m (+41 ft)
Water not struck
November 1977

Waste 18.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
Till	Pebbly clay, yellowish grey, soft and sandy with pebbles of angular flint and quartzite	1.3	2.2
	Pebbly clay, grey,stiff, with pebbles of subangular chalk and some flint	15.8+	18.0

TF 26 SE 5 **2583 6363** **Haltham Wood** **Block C**

Surface level +30.0 m (+99 ft)
Water struck at +28.2 m
October 1977

Overburden 1.0 m
Mineral 1.8 m
Waste 16.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Fluvio-glacial and Older River Sand and Gravel	Pebbly sand Gravel: coarse with fine, angular flint with some chalk, quartzite and limestone Sand: fine and medium, angular quartz	1.8	1.8
Till	Pebbly clay, very dark grey, firm, with pebbles of chalk and flint	16.7+	19.5

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
5	78	17	1.0-2.0	5	39	37	1	2	16	0
			2.0-2.8	6	32	41	7	8	6	0
			Mean	**5**	**36**	**38**	**4**	**5**	**12**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
1.0-2.0	0	100	0	0	0	0	0
2.0-2.8	3	91	1	1	2	2	0
Mean	**1**	**97**	**trace**	**trace**	**1**	**1**	**0**

TF 26 SE 6 **2630 6398** **Haltham** **Block B**

Surface level +20.4 m (+67 ft)
Water struck at +18.0 m
October 1977

Overburden	0.2 m
Mineral	2.4 m
Waste	11.0 m
Bedrock	1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
River Gravels	Sandy gravel Gravel: fine and coarse, angular flint with some sandstone, chalk and quartzite Sand: medium with coarse and fine, angular to subangular quartz with flint and some lithic grains	2.4	2.6
Till	Pebbly clay, grey, firm to stiff, with pebbles of chalk and some flint	11.0	13.6
Ancholme Clay Group	Clay, dark grey, stiff, with sporadic shell fragments	1.4+	15.0

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
3	57	40	0.2-1.2	4	18	26	7	25	20	0
			1.2-2.6	3	7	32	21	24	13	0
			Mean	**3**	**12**	**30**	**15**	**24**	**16**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.2-1.2	0	95	3	0	2	0	trace
1.2-2.6	5	90	3	0	2	trace	trace
Mean	**3**	**92**	**3**	**0**	**2**	**trace**	**trace**

TF 26 SE 7 **2775 6386** **Vintner's Farm** **Block C**

Surface level +33.0 m (+108 ft)
Water not struck
October 1977

Waste 18.0 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: medium, angular to subangular quartz and lithic grains	0.3	0.8
Till	Pebbly clay, grey, stiff, with pebbles of chalk and some flint and grey mudstone	17.2+	18.0

TF 26 SE 8 **2793 6236** **Enderby Hill Farm** **Block C**

Surface level +31.6 m (+104 ft)
Water not struck
October 1977

Waste 18.0 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, mostly angular grey flint with subangular chalk Sand: fine with medium, quartz with lithic grains	0.8	1.1
Till	Pebbly clay, pale grey, stiff to firm, silty. Pebbles of subangular chalk with some angular flint	16.9+	18.0

TF 26 SE 9 **2567 6116** **Fulsby Wood** **Block C**

Surface level +9.6 m (+32 ft)
Water struck at +7.1 m
October 1977

Overburden 1.7 m
Mineral 1.1 m
Waste 16.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Till	Pebbly clay, grey and sandy with pebbles of chalk	0.7	1.7
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse, angular flint with some sandstone and chalk Sand: medium, angular to subangular quartz with coarse flint and lithic grains	1.1	2.8
Till	Pebbly clay, grey, firm to stiff, with pebbles of chalk and some flint	16.2+	19.0

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
4	53	43	1.7-2.8	4	16	27	10	24	19	0

TF 26 SE 10 **2645 6109** **Mareham Moor** **Block C**

Surface level +7.6 m (+25 ft)
Water struck at +4.0 m
October 1977

Overburden	0.7 m
Mineral	4.6 m
Waste	5.4 m
Bedrock	0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Fluvio-glacial and Older River Sand and Gravel	**a** Sandy gravel Gravel: fine and coarse, angular flint with some subrounded sandstone and subangular chalk Sand: medium and fine, quartz with some flint and lithic grains	2.3	3.0
	b 'Very clayey' sand: fine and medium, subangular quartz	2.3	5.3
Till	Pebbly clay, grey, firm to stiff, with pebbles of chalk and some flint	5.4	10.7
Ancholme Clay Group	Limestone, grey and fossiliferous	0.3+	11.0

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	0.7-1.7	10	30	36	4	14	6	0
				1.7-3.0	1	9	26	7	24	33	0
				Mean	**5**	**18**	**30**	**6**	**20**	**21**	**0**
b	34	66	0	3.0-4.0	32	40	27	1	0	0	0
				4.0-5.3	35	35	26	4	0	0	0
				Mean	**34**	**37**	**26**	**3**	**0**	**0**	**0**
a+b	**19**	**60**	**21**	**Mean**	**19**	**28**	**28**	**4**	**10**	**11**	**0**

TF 26 SE 11 **2880 6120** **Mareham le Fen** **Block C**

Surface level +5.8 m (+19 ft)
Water not struck
October 1977

Overburden	0.5 m
Mineral	1.1 m
Waste	0.9 m
Bedrock	1.1 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, angular to subangular flint, with some sandstone Sand: medium and fine, subangular quartz with some flint	1.1	1.6
Till	Pebbly clay, stiff, dark grey, with pebbles of chalk and some flint	0.9	2.5
Ancholme Clay Group	Clay, dark grey, firm to stiff	1.1+	3.6

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
15	64	21	0.5-1.6	15	25	28	11	19	2	0

TF 26 SE 12 **2554 6026** **Tumby Gates** **Block C**

Surface level +7.6 m (+25 ft)
Water struck at +5.3 m
October 1977

Overburden	0.5 m
Mineral	4.3 m
Waste	11.2 m
?Bedrock	0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel Gravel: fine and coarse, angular flint with some chalk, sandstone and quartzite Sand: medium, subangular quartz	4.3	4.8
Till	Pebbly clay, grey, stiff, with pebbles of chalk and some flint	11.2	16.0
?Ancholme Clay Group	Drilling terminated by ?bedrock obstruction - no recovery of material	0.3+	16.3

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
2	66	32	0.5-1.0	9	29	42	5	9	6	0
			1.0-2.0	1	10	34	7	20	28	0
			2.0-3.0	2	30	50	6	7	5	0
			3.0-4.0	1	14	30	13	28	14	0
			4.0-4.8	2	15	37	15	20	11	0
			Mean	**2**	**19**	**38**	**9**	**18**	**14**	**0**

COMPOSITION

Depth below surface (m)	percentages by weight in 4-16 mm gravel fraction						
	Chalk	Flint and Chert	Sandstone	Mudstone and Siltstone	Quartzite	Limestone	Igneous
0.5-1.0	0	94	4	0	2	0	trace
1.0-2.0	0	95	2	1	1	1	trace
2.0-3.0	12	80	3	1	1	3	0
3.0-4.0	21	70	2	4	1	1	1
4.0-4.8	24	65	4	4	2	0	1
Mean	**13**	**80**	**3**	**2**	**1**	**1**	**trace**

TF 26 SE 13 **2679 6022** **Mareham le Fen** **Block C**

Surface level +3.6 m (+12 ft)
Water struck at O D
October 1977

Overburden	0.5 m
Mineral	1.6 m
Waste	5.6 m
Bedrock	1.3 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, angular flint with some sandstone and quartzite Sand: medium and fine, subangular quartz	1.6	2.1
Till	Pebbly clay, grey, firm. Pebbles of chalk with some flint	5.6	7.7
Ancholme Clay Group	Clay, dark grey, firm, scattered shell fragments	1.3+	9.0

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
14	68	18	0.5-1.5	10	26	35	8	17	4	0
			1.5-2.1	20	29	31	6	9	5	0
			Mean	**14**	**27**	**34**	**7**	**14**	**4**	**0**

TF 26 SE 14 **2784 6021** **Mareham le Fen** **Block C**

Surface level +3.9 m (+13 ft)
Water not struck
October 1977

Overburden	0.6 m
Mineral	1.0 m
Waste	4.0 m
Bedrock	1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvio-glacial and Older River Sand and Gravel	'Clayey' sandy gravel Gravel: fine, angular flint with some sandstone Sand: fine and medium, subangular quartz	1.0	1.6
Till	Pebbly clay, grey and stiff. Pebbles of chalk with some flint	4.0	5.6
Ancholme Clay Group	Clay, grey, stiff, shaly and fossiliferous	1.4+	7.0

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
11	52	37	0.6-1.6	11	22	21	9	28	9	0

TF 26 SE 15 **2953 6048** **West Lane Bridge** **Block C**

Surface level +3.0 m (+10 ft)
Water not struck
October 1977

Overburden	0.5 m
Mineral	1.3 m
Waste	0.6 m
Bedrock	3.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Fluvio-glacial and Older River Sand and Gravel	Sandy gravel Gravel: fine with coarse, angular flint with some quartz Sand: fine to coarse, quartz with some lithic grains	1.3	1.8
	Clay, dark grey, stiff, with incorporated plant material	0.6	2.4
Ancholme Clay Group	Clay, dark grey, stiff to firm, shaly and fossiliferous	3.0+	5.4

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
7	47	46	0.5-1.8	7	20	17	10	36	10	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.
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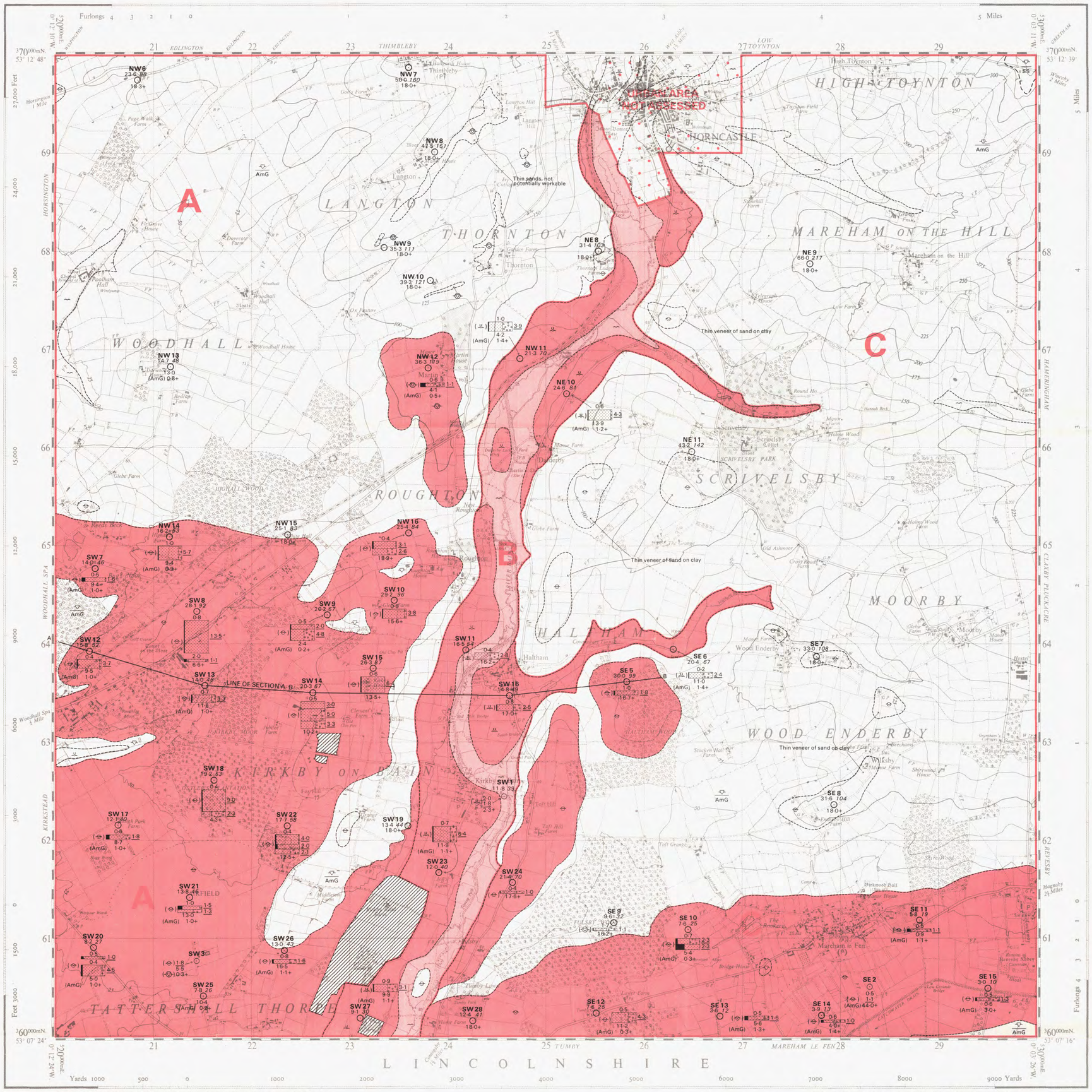
INSTITUTE OF GEOLOGICAL SCIENCES

INDUSTRIAL MINERALS ASSESSMENT UNIT

THE SAND AND GRAVEL RESOURCES OF THE AREA SOUTH OF HORNCASTLE, LINCOLNSHIRE

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

ORDNANCE SURVEY
SHEET TF 26
PROVISIONAL EDITION



The representation on this map of a Road, Track, or Footpath, is no evidence of the existence of a right of way.

The GRID lines on this sheet are at 1 Kilometre interval.
Heights are in feet above Mean Sea Level at Newlyn.
Contours values are in feet.
1 square inch on this map represents 99·630 acres on the ground.

Compiled from 6" sheets last fully revised 1904.
Other partial systematic revision 1946 – 53 has been incorporated.

Made and published by the Director General of the Ordnance Survey, Chessington, Surrey. Reprinted with minor corrections 1959.

Original geological survey on the one-inch scale by A.J. Jukes-Browne, and W.A.E. Ussher, A.J. Jukes-Browne and A. Strahan. Published in 1887 and 1888 on Old Series Sheets 83 and 84.
Part surveyed on the six-inch scale by T.P. Fletcher in 1979. E.G. Smith, District Geologist.

Sand and Gravel Survey by G. Power and J.B.L. Wild in 1977 under the supervision of B.J. Taylor.
R.G. Thurrell, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1982.
G.M. Brown F.R.S., *Director, Institute of Geological Sciences.*

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.

TF 17	TF 27	TF 37
TF 16	TF 26	TF 36
	83 84	
TF 15	TF 25	TF 35
	70 69	

Diagram showing the relation of this sheet with the National Grid 1:25 000 sheets and the Old Series One-Inch Geological sheets 69, 70, 83 and 84.

THE SAND AND GRAVEL RESOURCES OF THE AREA SOUTH OF HORNCASTLE, LINCOLNSHIRE

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

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

QUATERNARY — RECENT / PLEISTOCENE — UPPER JURASSIC

DRIFT

- **Alluvium** – clay, silt and fine sand — A-18
- **River Gravels, undifferentiated** – sandy gravel — RG-3
- **Fluvio-glacial and Older River Sand and Gravel** – medium sands with gravel in places — FL-20
- **Glacial Sand and Gravel** – 'clayey' sands and gravels — GS-72
- **Till** – chalky clay with pebbles — TL-14

SOLID

- SS — **Spilsby Sandstone** – sandstone with thin clay bands
- AmG — **Ancholme Clay Group** – mudstone with thin limestones

Worked areas of sand and gravel — WO-9

BOUNDARY LINES

- Geological boundary, Drift
- Geological boundary, Solid
- Resource Block boundary

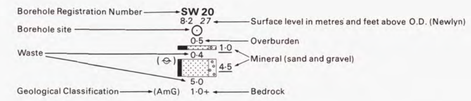
Broken lines denote uncertainty

BOREHOLE DATA

SITE LOCATIONS

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

I.M.A.U. BOREHOLES



Grading Diagram
Thicknesses in metres

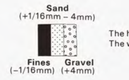
Note:
(i) Figures underlined denote thicknesses used in the assessment of resources.
(ii) The + sign indicates that the base of the deposit was not reached.
(iii) The figures in *italics* are the conversions to feet of the measurements made in metres
(iv) The Geological Classification is given only for mineral and bedrock.

Borehole Registration Number

Each I.M.A.U. borehole is identified by a Registration Number, e.g. **SW 20**. The letters refer to the quarter sheet and the figure to the I.G.S. serial number for that quarter. The unique designation for borehole **SW 20** is **TF 26 SW 20**.

Grading Diagrams

Each grading diagram shows the mean particle-size distribution in a distinct deposit of mineral.



The height of the diagram is proportional to the mineral thickness.
The widths of the divisions show the proportions of **Fines, Sand** and **Gravel**.

OTHER BOREHOLES

The layout of information is the same as for I.M.A.U. boreholes, though the data available may not be as comprehensive. They are registered in the same series.

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

RESOURCE BLOCKS

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

A horizontal section showing the general relations of the drift deposits along the line shown (A-B), constitutes Figure 2 of the Report.

Detailed records may be consulted on application to the Head, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Keyworth, Nottingham. NG12 5GG.

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