

# The sand and gravel resources of the country east of Colchester, Essex

Description of 1:25 000 resource sheet TM 02

J. D. Ambrose, BSc

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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 Mineral Assessment Unit began systematic surveys in 1968. The work is now being financed by the Department of the Environment and is being undertaken with the cooperation of the Sand and Gravel Association of Great Britain.

This Report describes the resources of sand and gravel of 96.4 km<sup>2</sup> of country east of Colchester, shown on the accompanying 1:25 000 resource map TM 02. The survey was conducted by the late Mr J. D. Ambrose, assisted by Mr N. E. Bradbury as field officer who supervised the drilling and sampling programme and by Mr G. M. Bladon who helped in the preparation of data for this publication. The work is based on geological surveys at the one-inch scale by W. H. Dalton and W. Whitaker, published in 1882 and 1883, amended in the light of resource survey results and of additional mapping by the author.

Mr J. W. Gardner, CBE (Land Agent) has been responsible for negotiating access to land for drilling. The ready cooperation of land owners and tenants in this work is gratefully acknowledged.

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## Summary

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 82 boreholes drilled for the Mineral Assessment Unit, form the basis of the assessment of sand and gravel resources of the country east of Colchester, Essex.

All deposits in the area which 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 seven resource blocks, containing between 8.4 and 12.2 km<sup>2</sup> of sand and gravel. For each block the geology of the deposits is described and the mineral-bearing area, the mean thicknesses 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 TM 02.

## Sommaire

Les sources des renseignements qui constituent la base de l'évaluation des ressources en sable et en gravier dans la région à l'est de Colchester, Essex, comprennent les cartes géologiques de l'Institute of Geological Sciences, des données obtenues de trous de sonde déjà en existence et 82 trous de sonde forés pour le Mineral Assessment Unit.

Tous les dépôts dans la région qui pourraient être exploités pour le sable et le gravier ont été étudiés et on s'est servi d'une méthode statistique simple pour en évaluer le volume. Les évaluations de volume ont été tenues d'être à 95 pour cent exactes.

La carte 1:25 000 est divisée en sept blocs de ressources avec d'entre 8.4 et 12.2 km<sup>2</sup> de sable et de gravier. Pour chaque bloc on décrit la géologie des dépôts et on donne l'étendue du terrain minéralisé, l'épaisseur moyenne de recouvrement et de minéral et les triages moyens. Des données détaillées des trous de sonde aussi présentées. La géologie, la situation des trous de sonde et les profils des blocs de ressources sont montrées sur la carte TM 02.

## Zusammenfassung

Die geologischen Karten vom Institute of Geological Sciences, vorher-existierende Information, und 82 für die Mineral Assessment gebohrten Bohrlöcher, bilden den Grund der Einschätzung von Sand- und Schottermittel vom Gebiet, östlich von Colchester, Essex.

Alle Ablagerungen im Gebiet, die möglich bearbeitbar für Sand und Schotter sind, wurden untersucht, und eine einfache statistische Methode wurde benutzt, um den Volumen zu schätzen. Man gibt die Zuverlässigkeit der Volumenschätzungen mit symmetrischen 95 Prozent Vertrauenswerten.

Man teilt die 1:25 000 Karte in 7 Mittelsblöcke, die zwischen 8.4 und 12.2 km<sup>2</sup> von Sand und Schotter umfassen. Für jeden Block beschreibt man die Geologie der Ablagerungen, und das mineralhaltige Gebiet, die mittleren Dicken von Überlastung und Mineral und die mittleren Klassifizierungen werden erklärt. Ausführliche Bohrlöcherdaten werden auch gegeben. Die Geologie die Lage der Bohrlöcher und die Skizzen der Mittelsblöcke werden auf der Begleitkarte gezeigt.

# The sand and gravel resources of the country east of Colchester, Essex

## Description of 1 : 25 000 resource sheet TM 02

J. D. AMBROSE, BSc<sup>1</sup>

### 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, both the economic and the social factors used to decide whether a deposit may be workable in the future cannot 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).

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 geological evidence. The sites available for inspection, measurement, and sampling are too widely spaced to permit the mineral bodies to be outlined completely or the grade established throughout" (Anon., 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:

<sup>1</sup>The late J. D. Ambrose carried out the work described in this Report at the Institute of Geological Sciences, 199 Knightsbridge, London SW7 1DZ

- 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. 200 mesh BS sieve, about 1/16 mm) should not exceed 40 per cent.
- d. The deposit must 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.

If a deposit of sand and gravel broadly meets these criteria, it 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.

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale 1/16 mm, 1/4 mm, 1 mm, 4 mm, 16 mm has been adopted. The boundaries between fines (that is, the clay and silt fractions) and sand, and between sand and gravel grade material, are placed at 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 km<sup>2</sup> of sand and gravel. No account is taken of any factors, for example, roads, villages and 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 the mineral in parts of a block, except in the immediate vicinity of the actual sample points.

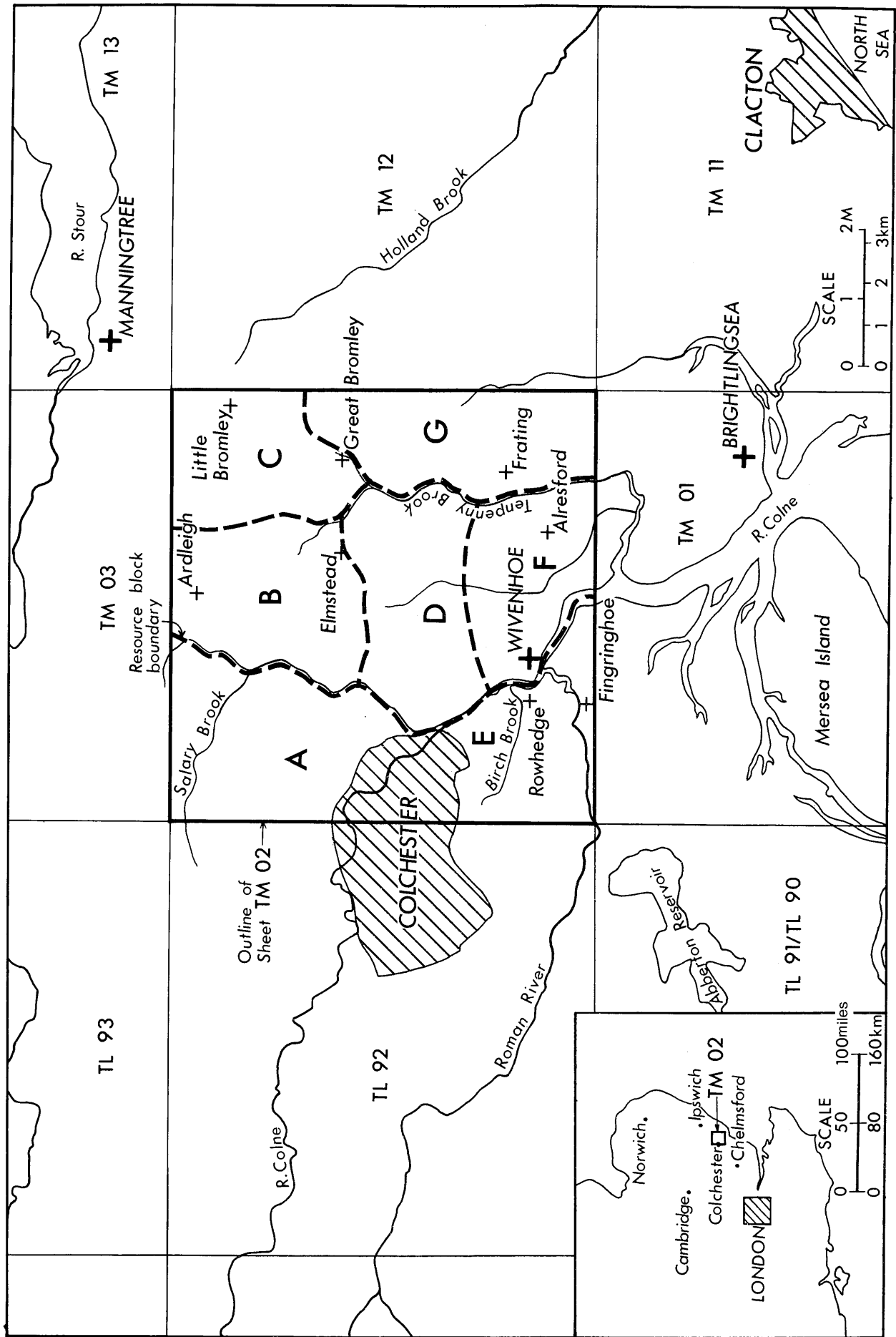


Fig. 1. Sketch map showing the location of sheet TM 02 and the position of the resource block boundaries



## Description of Sheet TM 02

### GENERAL

The area covered by this report is in north-east Essex, immediately east of the town of Colchester. It is mainly agricultural and is well served by road and rail communications joining London with the important cross-channel port of Harwich, with the popular holiday area around Clacton and Frinton and with east coast ports farther north in Norfolk and Suffolk.

The urban area of Colchester, which covers about 3.6 km<sup>2</sup> in the extreme west, is the only part of this 1:25 000 sheet excluded from the assessment. The remaining 96.4 km<sup>2</sup> has been divided into seven resource blocks.

### TOPOGRAPHY

A gently sloping plateau falls from over 150 ft (45.7 m) in the north-west to below 100 ft (30.5 m) in the south-east. It is dissected by the River Colne flowing south-eastwards from Colchester, its lowest bridging-point, to Wivenhoe and beyond, and by its tributaries including Salary Brook and Tenpenny Brook on the left bank and Birch Brook and the Roman River on the right bank.

### GEOLOGY

The geological classification given in Table 1 is a slightly amended version of that adopted for the original survey (Dalton, 1880, p. 1; Whitaker, 1885, p. 3).

Table 1. Geological classification.

Recent and Pleistocene	
Alluvium	
River Brickearth	
River Terrace Deposits	
Channel-fill Deposits (proved only in borehole SE 1)	
Loam	
Glacial Sand and Gravel	
Red Crag (proved only in boreholes)	
Eocene	
London Clay	
Woolwich and Reading Beds (proved only in Thanet Beds)	boreholes
Cretaceous	
Upper Chalk (proved only in boreholes)	

#### London Clay

This constitutes the bedrock over the whole of the sheet and outcrops in the valleys of the River Colne and its tributaries. When fresh, the clay is stiff, bluish-grey, but the uppermost few feet are almost always weathered

to a softer, streaky, brown clay in which more than a quarter of the assessment boreholes were stopped.

Borehole evidence suggests that the surface of the London Clay falls from over 150 ft (45.7 m) above OD in the north-west to less than 60 ft (18.3 m) above OD in the south-east (Fig. 2).

However, the surface is modified by an irregular series of depressions, the most conspicuous of which is elongated along an axis which coincides roughly with the present course of the River Colne. Within this depression the London Clay surface is at 5 ft (1.5 m) below OD, its lowest recorded level, in borehole SW 4. There are shallower depressions near Little Bromley and Arlesford.

#### Red Crag

Although the Red Crag is extensively exposed in Suffolk (Allender and Hollyer, 1972; 1973; Hollyer, 1974), it has not been found at the surface or assessed in this area. It has been recorded only at Little Bromley where assessment borehole NE 20 proved 18 ft (5.5 m) of grey, mainly medium grained sand, with a high proportion of comminuted shells, immediately overlying the London Clay (see notes on Block C). This shelly sand has been preserved in a hollow in the London Clay surface.

#### Glacial Sand and Gravel

The Glacial Sand and Gravel constitutes part of an extensive tract of outwash material which covers much of Essex, other parts of which have been assessed on adjacent 1:25 000 sheets (Ambrose, 1973a; 1973b; 1974; Eaton, 1973; Haggard, 1972).

The deposit forms a more or less continuous spread, normally between 15 ft (4.6 m) and 20 ft (6.1 m) in thickness, and consists of sands containing variable amounts of mainly flint and quartz gravel and rare interbedded thin clay seams. The sands often become increasingly 'clayey' (see Appendix C) upwards and may pass gradually into the Loam, beneath which they are normally concealed. This cover is absent in the main river valleys and south-west of the River Colne, although in the latter area the uppermost 10 ft (3.0 m) or so of the Glacial Sand and Gravel is 'very clayey', perhaps due to contamination from a former cover of loam.

#### Loam

This deposit normally rests on the Glacial Sand and Gravel, although in places it is more extensive and lies directly on London Clay. It is very variable in composition and is up to

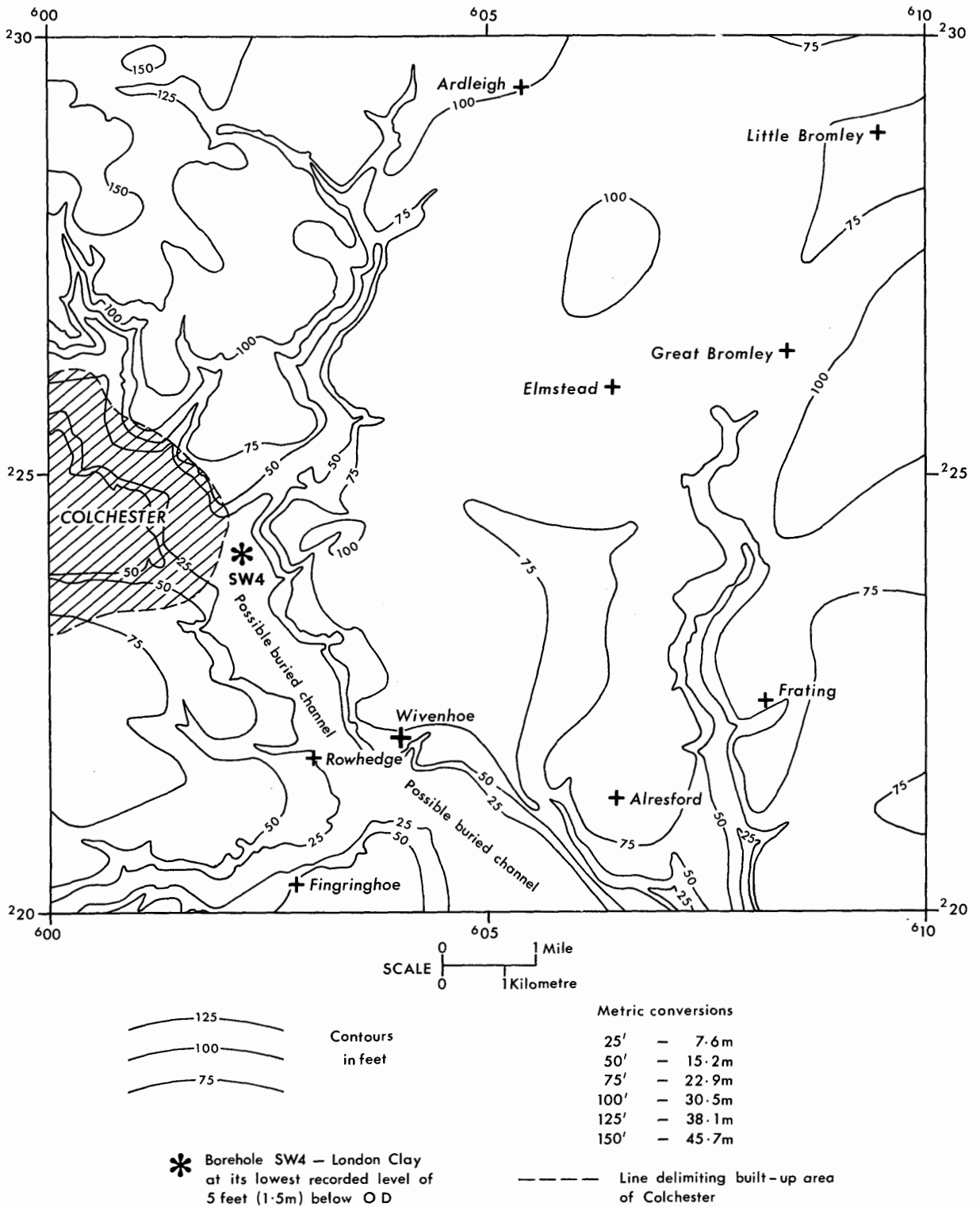


Fig. 2. Contour map of the upper surface of the London Clay

22 ft (6.7 m) in thickness. It is predominantly brown, sandy clay or clay, containing some gravel and silt.

It is probably allied in origin to the extensive sheet of Chalky Boulder Clay to the north and west of this area, which was the product of an ice sheet that extended over much, if not all, of this district.

#### *River Terrace Deposits*

These deposits (recorded as 'Gravel and Sand' on the Old Series geological maps) are present in the Colne Valley at a level close to that of the present Alluvium. Two small patches, together amounting to less than 0.5 km<sup>2</sup>, occur near Colchester and a third, smaller patch [038 216] of less than 0.25 km<sup>2</sup> occurs under the southern end of Wivenhoe. They are of too limited extent to be assessed within the terms of this survey.

#### *River Brickearth*

River Brickearth is restricted to a small outcrop north of the railway at Colchester [009 265]; 4 ft (1.2 m) of brown, silty clay in borehole SE 12 [078 230] may be River Brickearth.

#### *Alluvium*

Alluvium occurs mainly in the Colne Valley and as small, sinuous deposits in some of the tributary valleys. It was recorded in only one assessment borehole, SW 4 [022 243], in which 14 ft (4.3 m) of brown, silty clay overlies 3 ft (0.9 m) of 'very clayey' gravel which rests on London Clay. As the overburden to sand and gravel ratio exceeds 3 to 1, the deposit is not considered to be potentially workable and no assessment is offered.

#### **COMPOSITION OF THE SAND AND GRAVEL**

The weighted mean grading of the assessed mineral (all Glacial Sand and Gravel) is fines 5 per cent, sand 61 per cent, gravel 34 per cent. The blocks show the following variations: fines 3 to 7 per cent, sand 53 to 70 per cent, gravel 24 to 42 per cent. The mean grading at 77 borehole sites proving Glacial Sand and Gravel is shown graphically on Fig. 3. In nine boreholes that prove mineral, the Glacial Sand and Gravel is classified as 'clayey', that is, more than 10 per cent but less than 20 per cent of material is below 1/16 mm in size. The upper part of the Glacial Sand and Gravel in over a third of the boreholes contains more than 40 per cent fines and consequently is not considered to be mineral. Clay seams, commonly gravelly, are present but only when they exceed 0.9 m (3.0 ft) in thickness have they been used to separate the mineral horizons, for example, in NE 6. In NE 5 the whole of the Glacial Sand and Gravel

contains too high a proportion of fines to be classified as mineral.

The sand fraction of the mineral, mainly quartz with subsidiary flint, is predominantly medium grained.

The gravel fraction normally contains both fine and coarse grades with the former slightly predominant. The most common constituents are quartz and flint; apart from quartzite other rock types, for example, jasper and limestone, are rare. The pebbles are commonly subrounded to subangular, sometimes rounded, but rarely angular. Cobble-size material is uncommon.

Lateral trends in size distribution are difficult to distinguish. However Fig. 3 shows that except in borehole SW 3 gravel occurs along the eastern sides of the major river valleys and coincides generally with an increase in gradient of the buried London Clay surface (Fig. 2). The percentage of gravel proved in the boreholes appears to decrease towards the north-west; borehole NW 56 contains only 3 per cent and is classified as sand.

#### **THE MAP**

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

#### *Geological Data*

The geological boundary lines, symbols etc. shown are taken from the geological map Old Series Quarter Sheets 48 NW and SW of this area, which was surveyed at the one-inch scale by W. H. Dalton and W. Whitaker and published in 1882 and 1883. Minor corrections resulting from the sand and gravel survey have been incorporated. Borehole data, which includes the stratigraphic relations and mean particle size distribution of the sand and gravel samples collected during the assessment survey, is also shown.

The geological boundaries show the best interpretation of the information available at the time of survey. However, it is inevitable, particularly with glacial deposits which change rapidly vertically and laterally, that local irregularities or discrepancies will be revealed by some boreholes (for example, at boreholes NW 54 and SE 1). These are taken into account in the assessment of resources (see below and Appendix B).

#### *Mineral Resource Information*

The mineral-bearing ground is subdivided

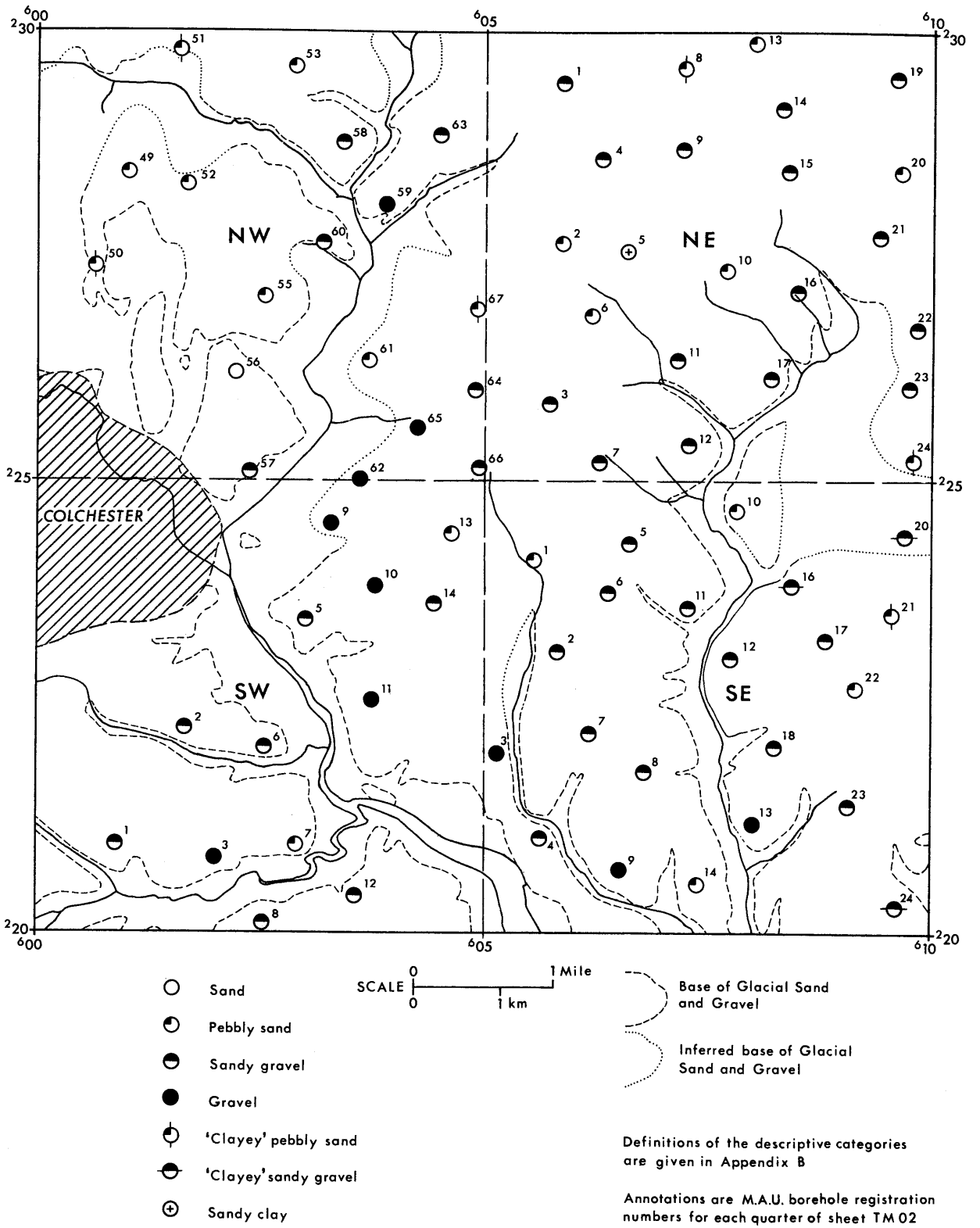


Fig. 3. Grading characteristics of the Glacial Sand and Gravel, based on the mean grading results from 77 assessment boreholes

Table 2. The sand and gravel resources of sheet TM 02.

BLOCK	No of sample points on which calculations are based	AREA		MEAN THICKNESS				VOLUME OF MINERAL				MEAN GRADING PERCENTAGES		
		BLOCK km <sup>2</sup>	MINERAL km <sup>2</sup>	OVERBURDEN		MINERAL		million m <sup>3</sup>	million yd <sup>3</sup>	Limits at the 95% probability level		FINES -1/16 mm	SAND +1/16 -4mm	GRAVEL +4 mm
				m	ft	m	ft			+	-			
A	13	16.8	8.6	3.3	11	3.7	12	32	42	37	12	6	70	24
B	14	15.0	12.2	2.5	8	5.2	17	63	83	30	19	5	61	34
C	13	11.8	11.3	2.5	8	6.0	19.5	68	89	20	14	5	65	30
D	14	12.6	10.0	4.9	16	4.0	13	40	52	38	15	4	57	39
E	8	13.1	8.4	3.0	10	6.8	22.5	57	75	41	23	3	60	37
F	12	12.3	8.7	1.3	4.5	5.5	18	48	63	38	18	5	53	42
G	13	14.8	10.4	1.7	5.5	4.4	14.5	46	60	36	17	7	62	31
TOTAL	87	96.4	69.6					354	464	12	42	5	61	34
COLCHESTER		3.6	URBAN AREA - NOT ASSESSED											

into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is 'exposed' and areas where it is present in continuous (or almost continuous) spreads beneath overburden. The mineral is identified as 'exposed' where the overburden, commonly consisting only of soil and subsoil, averages less than 1.0 m (3.5 ft) in thickness. Beneath overburden the mineral may be continuous (or almost continuous) or discontinuous. The recognition of these categories is dependent upon the importance attached to the proportion of boreholes which did not find potentially workable sand and gravel and the distribution of barren boreholes within a block. The mineral is described as 'almost continuous' if it is present in 75 per cent or more of the boreholes in a resource block. The 'discontinuous' category has not been recognised on the present sheet.

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

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

## RESULTS

The statistical results are summarised in Table 2. Fuller grading particulars are shown in Fig. 4.

### *Accuracy of Results*

For the seven resource blocks the accuracy of the results at the symmetrical 95 per cent probability level varies between 20 per cent and 41 per cent (that is, it is probable that 19 times

out of 20 the true volumes present lie within these limits). However, the true values are more likely to be nearer the figures estimated than the limits. Moreover, it is probable that in each block roughly the same percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say, 200 acres) containing similar sand and gravel deposits if the results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for 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 on this sheet. The volume (354 million m<sup>3</sup>) can be estimated to limits of  $\pm 12$  per cent at the 95 per cent probability level, by a calculation based on the data from 87 sample points spread across the seven resource blocks.

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

## NOTES ON THE RESOURCE BLOCKS

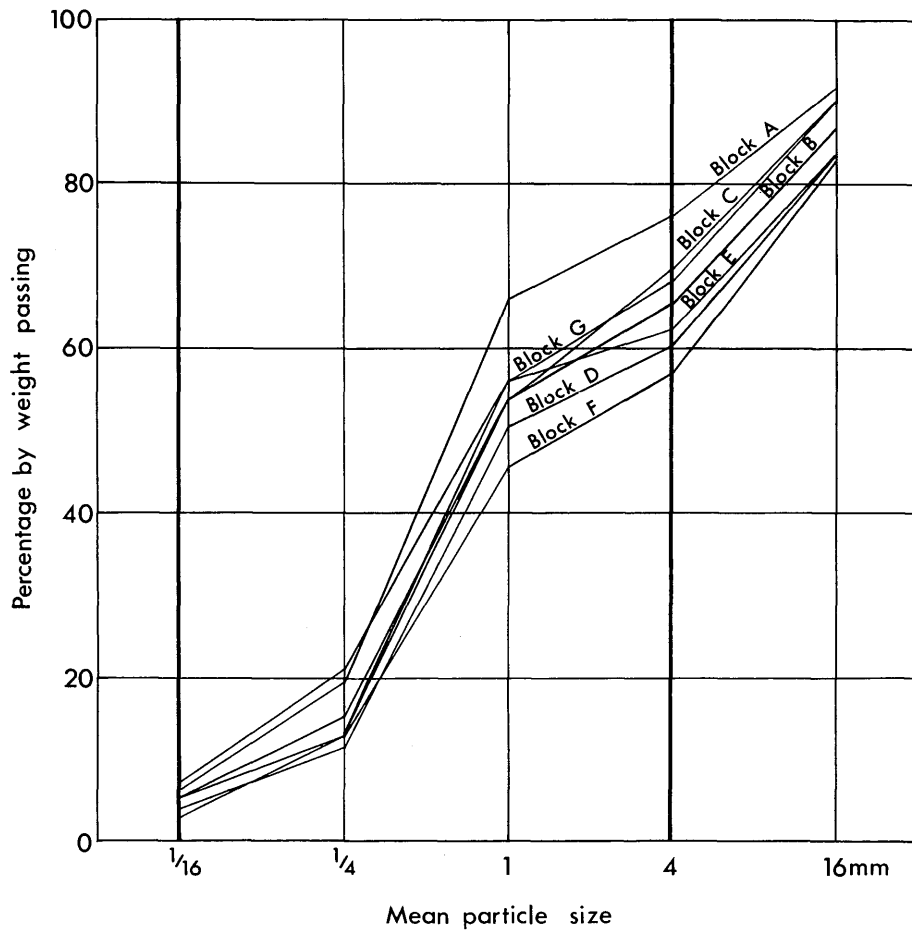
### *Block A*

The Glacial Sand and Gravel in this block outcrops mainly on the valley sides. Its junction with the underlying London Clay is concealed in places by Loam.

The computation of resources is based on 12 assessment boreholes and one site investigation record. Two boreholes did not prove mineral: in borehole NW 48 5 ft (1.5 m) of clay with gravel has been tentatively identified as a locally clayey development of Glacial Sand and Gravel, but in NW 54 Glacial Sand and Gravel is absent.

The mineral, of mean thickness 12 ft (3.7 m), is overlain by overburden with a mean thickness of 11 ft (3.3 m). The assessed mineral thickness varies from 7 ft (2.1 m) in NW 50 to 27 ft (8.2 m) in NW 53. The overburden ranges in thickness from 7 ft (2.1 m) in NW 56 to 15 ft (4.6 m) in NW 60. It is normally Loam, but the upper part of the Glacial Sand and Gravel has also been classified as overburden where it is sufficiently contaminated by clay and silt as it passes, often gradually, upwards into the Loam. In this block, the thickness of this contaminated ('dirty') sand and gravel rarely exceeds 5 ft (1.5 m).

The mean grading of the mineral in the block



Block	Percentage by weight passing				
	1/16mm	1/4mm	1mm	4mm	16mm
A	6	20	66	76	92
B	5	13	54	66	87
C	5	15	54	70	90
D	4	12	51	61	84
E	3	15	56	63	84
F	5	13	46	58	83
G	7	21	56	69	90

Fig. 4. Particle size distribution for the assessed thickness of mineral in resource blocks A to G

as a whole is fines 6 per cent, sand 70 per cent and gravel 24 per cent. Most is classified as pebbly sand, but it is significantly more gravelly in boreholes NW 57 and NW 58. Although individual samples are often recorded as 'clayey', the mean fines content is rarely more than 10 per cent in any borehole.

The volume of mineral in this block is estimated to be 32 million  $m^3 \pm 37$  per cent. All limits quoted in this report are calculated at the symmetrical 95 per cent probability level.

#### *Block B*

Glacial Sand and Gravel outcrops on the valley sides in the north-west of this block, near Ardleigh, and in a thin strip running south-eastwards from Ardleigh Park [057 274] to near Elmstead [069 262]. Loam rests directly on the London Clay, which floors most of the valleys, thus concealing the base of the Glacial Sand and Gravel on the east side of the valley of Salary Brook. In such cases the extent of mineral beneath cover has been inferred.

Twelve assessment boreholes and two Hydrogeological Department records form the basis of the calculation of resources. Mineral is absent only in borehole NE 5 where 7 ft (2.1 m) of Glacial Sand and Gravel has been classified as waste because the fines exceed 40 per cent.

The thickness of mineral recorded in the assessment boreholes ranges from 3 ft (0.9 m) in NE 6 to 26 ft (7.9 m) in NW 63, with a mean of 17 ft (5.2 m), and of overburden from 5 ft (1.5 m) in NW 65 and NE 1 to 19 ft (5.8 m) in NW 61, with a mean of 8 ft (2.5 m). The overburden normally consists of Loam, although in borehole NW 59 the upper 10 ft (3.0 m) of the Glacial Sand and Gravel are also included.

The mean grading for the block as a whole is fines 5 per cent, sand 61 per cent and gravel 34 per cent but there are wide variations between boreholes. The mineral in boreholes NW 59 and NW 65 contains 57 and 50 per cent respectively of gravel, in contrast with 7 per cent in borehole NW 61, the balance of 93 per cent being entirely sand, no fines being recorded. Within the sand and gravel, fines rarely exceed 10 per cent. Separate bands of waste are sometimes present, for example, the bottom 4 ft (1.2 m) of Glacial Sand and Gravel in borehole NE 6, and the 7 ft (2.2 m) of silt and clayey silt which divides the mineral in borehole NE 4.

The calculated volume of mineral in this block is 63 million  $m^3 \pm 30$  per cent.

#### *Block C*

Most of this block is mantled by Loam, but the underlying Glacial Sand and Gravel and London Clay reach the surface in the south near Great Bromley.

Information from 12 assessment boreholes and one Hydrogeological Department record has been used to evaluate the resources. Mineral is recorded in the Glacial Sand and Gravel in all the boreholes and in the Red Crag in borehole NE 20. The 18 ft (5.5 m) of Crag beneath Glacial Sand and Gravel consists of greyish, mainly medium grained quartz sand mixed with comminuted shells, mainly of bivalves. In common with the deposit in adjacent areas it is regarded as potentially workable (Allender and Hollyer, 1972; 1973; Hollyer, 1974) although no assessment has been attempted as its extent is unknown (see Geology Section).

The Glacial Sand and Gravel varies in thickness from 14 ft (4.3 m) to 32 ft (9.8 m), with a mean of 19.5 ft (6.0 m). No consistent trends in thickness can be distinguished, but two boreholes in the north (NE 13 and NE 14) contain material considerably thicker than the mean.

The overburden varies in thickness from 2.5 ft (0.8 m) to 17 ft (5.2 m), with a mean of 8 ft (2.5 m). It is mainly loam but in many boreholes, for example, NE 10 and NE 13, the upper part of the Glacial Sand and Gravel is classified as overburden because of its excessive fines content. Field evidence suggests that all of the overburden in borehole NE 17 is probably Glacial Sand and Gravel. In boreholes NE 9, NE 14 and NE 20, the overburden consists of soil and made ground; in NE 16 soil overlies mineral. The 11 ft (3.4 m) of made ground on the mineral in borehole NE 20 is the filling of a former pond.

The mean grading figures for the block are fines 5 per cent, sand 65 per cent, gravel 30 per cent. The fines content of the mineral is greater than 10 per cent in only one borehole, NE 8, but a distinct bed of waste, 3.2 m (10.5 ft) in thickness, divides the mineral in borehole NE 9.

The estimate of total volume of mineral within the block is 68 million  $m^3 \pm 20$  per cent.

#### *Block D*

Except at the extreme eastern and western margins, Glacial Sand and Gravel is present over the whole of this block: it rests on London Clay and frequently is overlain by Loam. North of Wivenhoe Park [033 242], where the Loam lies directly on London Clay, the extent of the mineral has been inferred. Borehole SW 4 was sited on Alluvium near the confluence of the



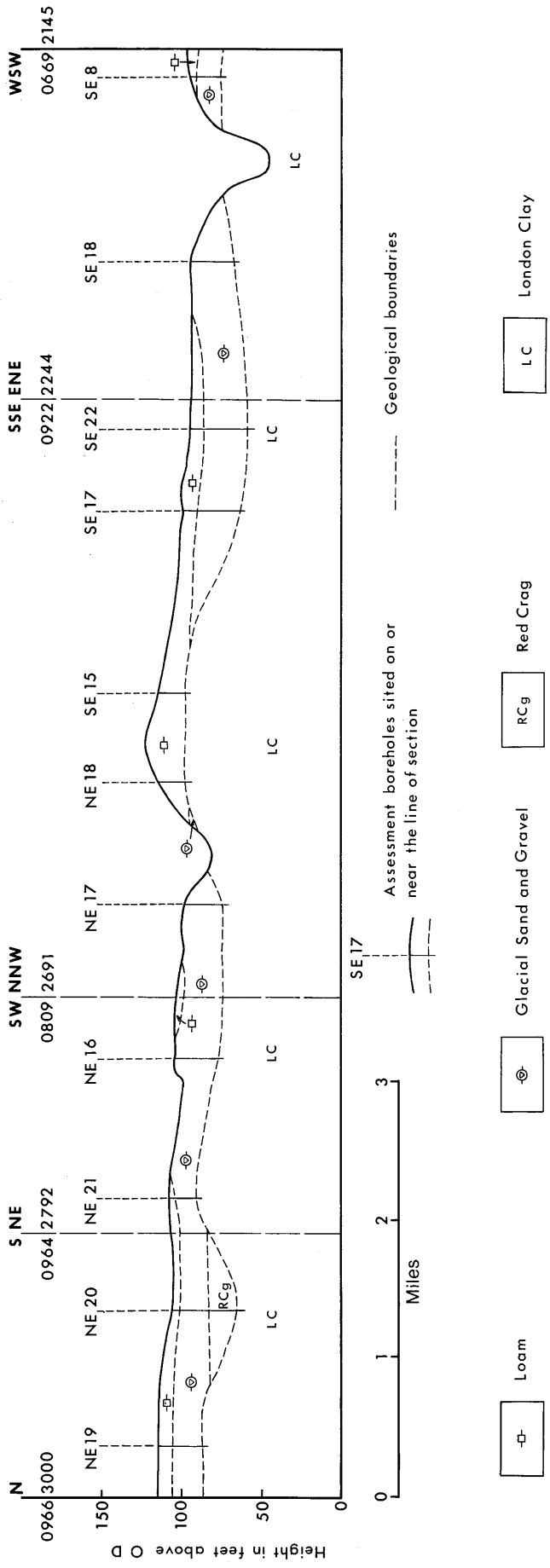


Fig. 5. Sketch-section across parts of resource blocks C and G

River Colne and the lower reaches of Salary Brook: it proved 14 ft (4.3 m) of overburden overlying 'very clayey' gravel only 3 ft (0.9 m) thick which, therefore, is not classified as potentially workable.

Potentially workable sand and gravel was proved in 11 of the remaining 13 boreholes, but in the other two, NE 7 and SE 1, the overburden ratio was greater than 3:1 so that the sand and gravel is not considered to be potentially workable.

The 39 ft (11.9 m) of brown silty clay and grey silt which were proved in borehole SE 1 have been identified tentatively as glacial Channel-fill Deposits. However, there is insufficient information to outline the extent and orientation of the channel.

The distribution of borehole data does not permit a barren area to be outlined and consequently 'nil thicknesses' (for boreholes where sand and gravel is not considered to be potentially workable) are included in the calculation of mean thickness.

The mean thickness of overburden and mineral is 16 ft (4.9 m) and 13 ft (4.0 m) respectively. The thickness of overburden in boreholes proving mineral varies from 4 ft (1.2 m) in NW 66 to 22 ft (6.7 m) in SW 10; mineral thickness ranges from 9 ft (2.7 m) in SW 14 to 27 ft (8.2 m) in SE 6. The overburden commonly consists of Loam but in boreholes SW 5, SE 5, SE 11 and NE 12, thicknesses of 3 ft (0.9 m), 5 ft (1.5 m), 6 ft (1.8 m) and 9 ft (2.7 m) respectively of Glacial Sand and Gravel are classified as overburden because of their excessive fines content. No consistent trends in thickness can be established, either for mineral or overburden.

The mean grading figures for the mineral in the block are fines 4 per cent, sand 57 per cent, gravel 39 per cent. The highest percentage of gravel occurs in borehole NW 62; broadly there appears to be a decrease in gravel content and a corresponding increase in the proportion of sand in the boreholes from west to east. There is consistently less than 10 per cent fines, without any discernible trends in distribution.

The estimated volume of mineral in the block is 40 million m<sup>3</sup> ± 38 per cent.

#### *Block E*

This block, south-west of the River Colne and south of the urban area of Colchester, is occupied by Glacial Sand and Gravel, overlain by a patch of Loam in the south at Fingringhoe. London Clay outcrops on the sides of the valleys of the River Colne and its tributaries, the floors of which are occupied by thin spreads of silty

Alluvium.

Seven assessment boreholes and one Hydrogeological Department record were used to assess resources. The thickness of mineral ranges from 39 ft (11.9 m) in SW 2 to 12 ft (3.7 m) in SW 6, the mean being 22.5 ft (6.8 m). As on the adjoining sheet to the west (Ambrose, 1974) the upper part of the Glacial Sand and Gravel is consistently recorded as being sufficiently clayey to be regarded as overburden, ranging in thickness from 8 ft (2.4 m) in SW 7 to 13 ft (4.0 m) in SW 3, with a mean of 10 ft (3.0 m). No consistent trend in the variation of thickness of the mineral or of the overburden can be distinguished.

The mean grading of the mineral in the block as a whole is fines 3 per cent, sand 60 per cent and gravel 37 per cent. In most of the boreholes it is classified as sandy gravel, but there is a considerable range in the proportion of gravel, for example, there is 55 per cent in SW 3 but only 25 per cent in SW 7.

The volume of mineral in the block is estimated to be within ± 41 per cent of 57 million m<sup>3</sup>, the wide limits reflecting the substantial range of the thicknesses proved.

#### *Block F*

This block comprises the area lying between the valleys of the River Colne and the Tenpenny Brook, in both of which the London Clay bedrock is exposed. In the Colne valley it is overlain by a broad spread of Alluvium and by a small patch of River Terrace Deposits at Wivenhoe [039 215], neither of which contain potentially workable sand and gravel.

Eight assessment boreholes and four Hydrogeological Department records form the basis of the calculation of the resources. Mineral recorded in the assessment boreholes ranges in thickness from 10 ft (3.0 m) in SW 11 to 35 ft (10.7 m) in SE 4 with a mean of 18 ft (5.5 m). In the four Hydrogeological Department records the thickness of the sand and gravel ranges from 12 ft (3.7 m) in 224/79 and 224/172b, to 43 ft (13.1 m) in 224/135.

The thickness of overburden, commonly Loam and soil, ranges from 1 ft (0.3 m) to 14 ft (4.3 m) in SE 2: the mean is 4.5 ft (1.3 m). In boreholes SW 11 and SE 2 parts of the Glacial Sand and Gravel contain excessive fines and are classified as overburden.

The mean grading of the mineral in the assessment boreholes, fines 5 per cent, sand 53 per cent and gravel 42 per cent, indicates that there is a higher proportion of gravel in this

block than in the other six. The mineral normally consists of sandy gravel but in several boreholes close to the Colne Valley it is classified as gravel. The mineral is classified as pebbly sand only in borehole SE 14.

The estimate of total volume of mineral is 48 million m<sup>3</sup> ± 38 per cent.

#### *Block G*

The valley of the Tenpenny Brook is floored by London Clay, overlain by a very narrow strip of Alluvium in the extreme south-west. On the valley sides Glacial Sand and Gravel outcrops continuously south of Moreham's Hall [085 239], but to the north its junction with the London Clay is partly concealed by Loam and the edge of the mineral is inferred.

Assessment boreholes NE 18, SE 15 and SE 20, which indicate that in the vicinity of Hare Green [093 249] sand and gravel is absent or covered by overburden in a ratio greater than 1:3, have been used to outline on the map an area which is judged not to be potentially workable. The area may be more or less extensive than indicated.

The 13 boreholes proving mineral have been used to compute the resources. The mineral ranges in thickness from 4 ft (1.2 m) in SE 10 and SE 16, to 28 ft (8.5 m) in SE 18, with a mean of 14.5 ft (4.4 m). It is thickest in boreholes SE 22, SE 18, SE 12 and SE 23, in the Frating area.

Overburden thicknesses range from 0.6 m (2 ft) in SE 23 to 11 ft (3.4 m) in SE 22 with a mean of 5.5 ft (1.7 m). The overburden normally is Loam, but in boreholes SE 17 and SE 18 it consists partly of Glacial Sand and Gravel considered to be unworkable due to contamination by excess clay and silt. The 4 ft (1.2 m) of brown, silty clay recorded at the surface in borehole SE 12 is probably River Brickearth, too thin and localised to be shown on the map.

The mean grading of the mineral in the block as a whole is fines 7 per cent, sand 62 per cent and gravel 31 per cent and it is commonly classified in the boreholes as 'sandy gravel', although local variations occur. For example, in borehole SE 13 the mineral contains over 50 per cent of pebbles and is classified as gravel, while pebbly sand is recorded in several boreholes, for example NE 13 and SE 22 (which contain at least 75 per cent sand). The fines exceed 10 per cent in only four boreholes, the highest figure being 17 per cent in borehole NE 24.

The estimate of total volume of mineral in the block is 46 million m<sup>3</sup> ± 36 per cent.

## Appendix A: Field Procedure

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, 10 km<sup>2</sup>, 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 British Standard 1377 (Anon., 1967). Random checks on the accuracy of the grading are made in the laboratories of the Institute's Geochemical Division.

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 F.

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

## Appendix B: Statistical Procedure

### *STATISTICAL ASSESSMENT*

1. A statistical assessment is made of an area of mineral greater than 2 km<sup>2</sup>, if there is a minimum of five evenly spaced boreholes in the resource block (for smaller areas see para. 12 below).
2. The simple methods used in the calculations are consistent with the amount of data provided by the survey. Conventional symmetrical confidence limits are calculated for the 95 per cent probability level. That is there is a 5 per cent or one in twenty

chance of a result falling outside the stated limits.

- The volume estimate (V) for the mineral in a given block is the product of the 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

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

- The above relationship may be transposed such that

$$S_V = S_{\bar{l}_m} \sqrt{1 + \frac{S_A^2}{S_{\bar{l}_m}^2}} \dots\dots(2)$$

From this it can be seen that as  $\frac{S_A^2}{S_{\bar{l}_m}^2}$  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 mean thickness, the standard deviation for volume approximates to that for mean thickness.

- Given that the number of approximately evenly spaced sample points in the sampled area is n, with mineral thickness measurements  $l_{m_1}, l_{m_2}, \dots, l_{m_n}$ , then the best

estimate of mean thickness,  $\bar{l}_m =$

$$\frac{\sum (l_{m_1} + l_{m_2} \dots\dots l_{m_n})}{n}$$

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

$$S_{\bar{l}_m} = \frac{1}{\bar{l}_m} \sqrt{\frac{(l_m - \bar{l}_m)^2}{(n - 1)}}$$

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

- 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

$$\frac{S_A}{S_{\bar{l}_m}} \leq 1/3 \text{ is assumed in all cases}$$

It follows from equation (2) that

$$S_{\bar{l}_m} \leq S_V \leq 1.05 S_{\bar{l}_m} \dots\dots(3)$$

- The limits on the estimate of mean thickness of mineral,  $L_{\bar{l}_m}$ , may be expressed in absolute units

$$\pm \frac{t}{\sqrt{n}} \times S_{\bar{l}_m}$$

or as a percentage

$$\pm \frac{t}{\sqrt{n}} \times S_{\bar{l}_m} \times \frac{100}{\bar{l}_m} \text{ per cent}$$

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).

- 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	∞	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, Biometrika Tables for Statisticians, Volume 1, Second Ed. Cambridge University Press, 1962). When n is greater than 20, 1.96 is used (the value of t when n is infinity).

- In calculating confidence limits for volume,  $L_V$ , the following inequality corresponding to equation (3) is applied:

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

Block Calculation 1:25 000 } Fictitious (See Fig 7 for map)  
 Block

Area Block: 11.08 km<sup>2</sup> Volume Overburden: 21 million m<sup>3</sup>  
 Mineral: 8.32 km<sup>2</sup> Mineral: 54 million m<sup>3</sup>

Mean Thickness Overburden: 2.5 m Confidence limits of the estimate of mineral volume  
 Mineral: 6.5 m at the 95 per cent probability level: ± 20 per cent  
 That is, the volume of mineral (with 95 per cent  
 probability): 54 ± 11 million m<sup>3</sup>

Thickness estimate: measurements in metres  
 $l_o$  = overburden thickness  $l_m$  = mineral thickness

Sample point	Weighting w	Overburden		Mineral		Remarks
		$l_o$	$wl_o$	$l_m$	$wl_m$	
SE 14	1	1.5	1.5	9.4	9.4	} MAU boreholes
SE 18	1	3.3	3.3	5.8	5.8	
SE 20	1	nil	-	6.9	6.9	
SE 22	1	0.7	0.7	6.4	6.4	
SE 23	1	6.2	6.2	4.1	4.1	
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	$\frac{1}{2}$	1.2	1.6	9.8	7.2	
123/45	$\frac{1}{2}$	2.0		4.6		
1	$\frac{1}{4}$	2.7	2.5	7.3	5.8	} Close group of four boreholes (commercial)
2	$\frac{1}{4}$	4.5		3.2		
3	$\frac{1}{4}$	0.4		6.8		
4	$\frac{1}{4}$	2.8		5.9		
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.1$		$\Sigma wl_m = 52.0$		
Means		$\bar{l}_o = 2.5$		$\bar{l}_m = 6.5$		

Calculation of confidence limits

$l_m$	$(l_m - \bar{l}_m)$	$(l_m - \bar{l}_m)^2$
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

$$\Sigma(l_m - \bar{l}_m)^2 = 15.82$$

$$n = 8$$

$$t = 2.365$$

$L_V$  is calculated as

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

$$= 1.05 \times \frac{2.365}{6.5} \sqrt{\frac{15.82}{8 \times 7}} \times 100$$

$$= 20.3$$

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

Fig. 6. Example of resource block assessment: calculation and results

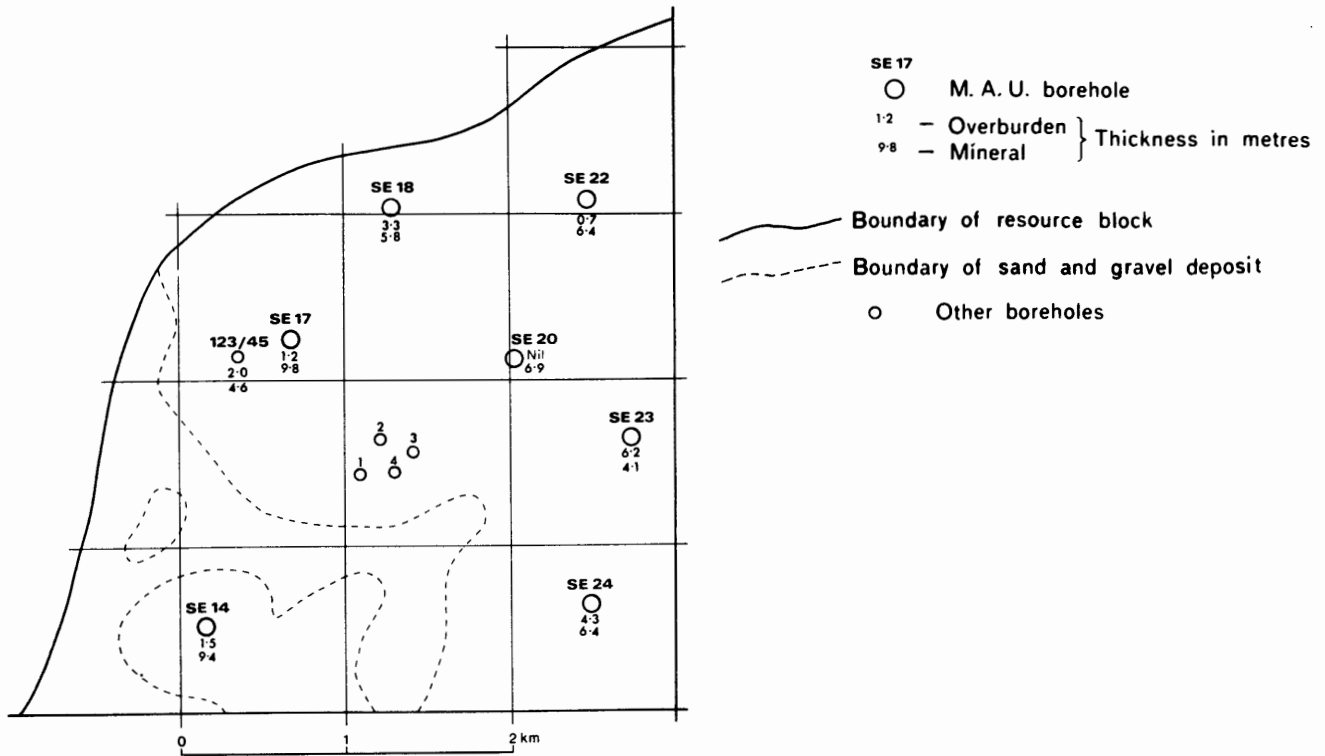


Fig. 7. Example of resource block assessment: map of fictitious block

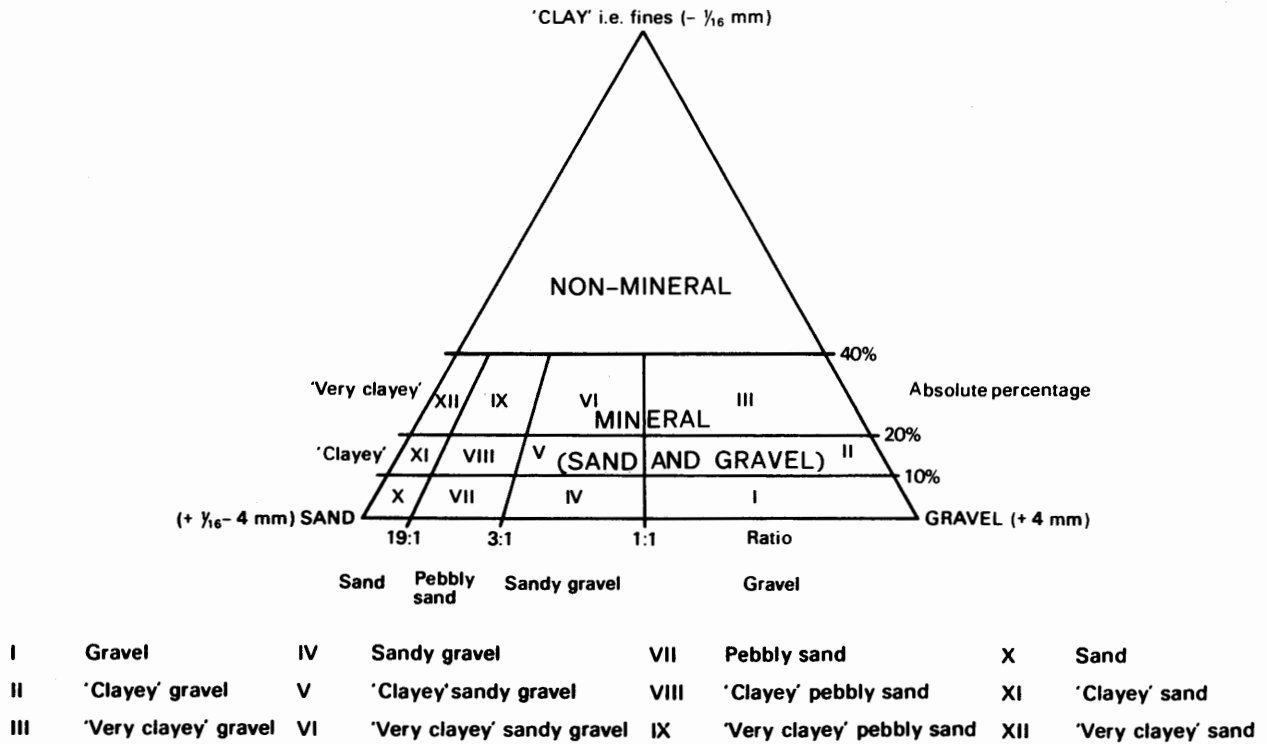


Fig. 8. Diagram to show the descriptive categories used in the classification of sand and gravel.

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

$$\frac{1.05 \times t}{\bar{l}_m} \times \sqrt{\frac{\sum(l_m - \bar{l}_m)^2}{n(n-1)}} \times 100 \text{ per cent}$$

and when  $n$  is greater than 20, as

$$\frac{1.05 \times 1.96}{\bar{l}_m} \times \sqrt{\frac{\sum(l_m - \bar{l}_m)^2}{n(n-1)}} \times 100 \text{ per cent}$$

11. The application of this procedure to a fictitious area is illustrated in Figs. 6 and 7.

### INFERRED ASSESSMENT

12. If the sampled area of mineral in a resource block is between 0.25 km<sup>2</sup> and 2 km<sup>2</sup> an assessment is inferred, based on 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<sup>2</sup>.
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 need 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 within the zone as the weighting factor.

## 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 (less than 1/16 mm) and coarser than pebbles (more than 64 mm 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 not considered to be 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 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 Fig. 8). The procedure is as follows:

1. Classify according to ratio of sand to gravel;
2. Describe 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 Note 11, p. 21).

Many differing proposals exist 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 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 (Table 3), which is used in this 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 ( $-\frac{1}{4}$  +1/16 mm), medium ( $-1$  + $\frac{1}{4}$  mm) and coarse ( $-4$  +1 mm). The boundary at 16 mm distinguishes a range of finer gravel ( $-16$  +4 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 Standard 1377 (Anon., 1967)). In this report the grading is tabulated on the borehole record sheets (Appendix F), the intercepts corresponding with the simple geometric scale 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 very approximate equal proportions with neither constituent accounting for less than about 25 per cent of the whole; 'flint with quartz' indicates that flint is dominant and quartz, the principal accessory rock type, comprises 5 to 25 per cent of the whole. Where the accessory material accounts for less than 5 per cent of the whole, but is still readily apparent, the phrase 'with some' has been used. Rare constituents are referred to as

'trace'.

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

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

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

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

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

Well-rounded: no 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.

Table 3. Classification of gravel, sand and fines

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

# Appendix D: Explanation of the Borehole Records

## ANNOTATED EXAMPLE

TM 02 NE 17<sup>1</sup>                      0823 2622<sup>2</sup>                      Opposite Great Bromley Hall<sup>3</sup>                      Block C

Surface level (+30.5 m) +100 ft<sup>4</sup>                      7 Overburden (2.1 m) 7 ft  
 Water struck at (+26.5 m) +87 ft<sup>5</sup>                      Mineral (5.5 m) 18 ft  
 Wirth B0, 8-inch diameter<sup>6</sup>                      Waste (0.3 m) 1 ft  
 December 1969                      Bedrock (0.9 m+) 3 ft+<sup>9</sup>

### LOG

		Thickness		Depth <sup>8</sup>	
		(m)	ft	(m)	ft
Glacial Sand <sup>10</sup> and Gravel	Soil and brown clay	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. 'Very clayey' between <sup>11</sup> 22 ft (6.7 m) and 25 ft (7.6 m). Gravel: mainly fine, becoming fine to coarse at base; subangular to sub- rounded flints. Sand: rust brown to yellowish-brown; coarse with medium becoming mainly medium below.	(5.5)	18	(7.6)	25
	Very silty sand with some gravel.	(0.3)	1	(7.9)	26
London Clay	Brown, weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(8.8)	29

### GRADING

	%	mm	%	<sup>12</sup> Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel <sup>13</sup>
<sup>15</sup> Gravel	31	+16	: 10	7 - 10	No grading available <sup>14</sup>		
		-16+4	: 21	10 - 13	0	82	18
				13 - 16	No grading available		
Sand	61	-4+1	: 34	16 - 19	0	57	43
		-1+ $\frac{1}{4}$	: 24	19 - 22	0	56	44
		- $\frac{1}{4}$ +1/16	: 3	22 - 25	32	47	21
Fines	8	-1/16	: 8				

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

#### 1. Borehole Registration Number.

Each Mineral Assessment Unit (MAU) borehole is identified by a Registration Number. This consists of two statements.

- 1) The number of the 1:25 000 sheet on which the borehole lies, for example, TM 02.
- 2) The quarter of the 1:25 000 sheet on which the borehole lies and its number in a series for that quarter, for example, NE 17.

Thus the full Registration Number is TM 02 NE 17. Usually this is abbreviated to NE 17 in the text.

#### 2. The National Grid Reference

All National Grid References in this publication lie within the 100 km square TM 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 approximate locations, for example, for farms).

#### 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 it 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. An asterisk indicates that the surface level has been estimated.

#### 5. Groundwater Conditions

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

#### 6. Type of Drill and Date of Drilling

Two types of drilling machine have been used in this survey; a shell and auger rig and a Wirth (a cased power auger). The type of machine, the external diameter of the casing used, and the month and year of completion of the borehole 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. Thickness and Depth

Although most measurements were made in feet, some were recorded in metres; the conversions appear in brackets. Metric conversions, the thicknesses of beds and the depth from the surface of their bases have been rounded off to the nearest 0.1 m because quotation to two places of decimals would imply a higher order of accuracy than could be justified by the original figures. Similarly conversions from metres to feet have been rounded off to the nearest 0.5 ft. Where figures have been rounded in this way there may be a discrepancy between the sum of the thicknesses and the recorded depths.

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

#### 10. Geological Classification

The geological classification (p. 3) is given whenever possible.

#### 11. Lithological Description

When sand and gravel is recorded a general description based on the mean grading characteristics (for details see Appendix C) is followed by more detailed particulars. The description of other rocks is based on visual examination, in the field.

#### 12. Sampling

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 within the sand and gravel or at every 3 ft or 1 m of depth.

#### 13. Grading Results

The limits are as follows: gravel, +4 mm; sand, -4+1/16 mm; fines, -1/16 mm.

14. If, exceptionally, grading results are not available, no attempt is made to estimate the probable grading (and the grading diagram may not be shown on the map).

#### 15. Mean Grading

The grading of the full thickness of the mineral horizon identified in the log is the mean of the individual sample gradings weighted by the thicknesses represented, if these vary. The classification used is shown in Table 3.

Fully representative sampling of sand and gravel is difficult to achieve particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures suggests that in borehole samples the proportion of sand may be higher and the proportions of fines and coarse gravel (+16 mm) may be lower.

## Appendix E: List of Boreholes Used in the Assessment of Resources

### Mineral Assessment Unit Boreholes

Borehole Number	Grid Reference	Borehole Number	Grid Reference
TM 02 NW		TM 02 SW	
48	0040 2974	1	0086 2100
49	0100 2853	2	0163 2232
50	0060 2745	3	0197 2082
51	0156 2987	4	0224 2434
52	0166 2833	5	0302 2352
53	0287 2970	6	0252 2211
54	0235 2829	7	0287 2098
55	0257 2714	8	0249 2012
56	0224 2629	9	0327 2461
57	0236 2515	10	0378 2386
58	0342 2886	11	0374 2260
59	0390 2821	12	0352 2042
60	0320 2771	13	0464 2453
61	0368 2644	14	0445 2366
62	0361 2510		
63	0454 2895	TM 02 SE	
64	0489 2613	1	0558 2414
65	0426 2568	2	0584 2314
66	0494 2524	3	0516 2197
67	0492 2704	4	0562 2107
TM 02 NE		5	0667 2432
1	0592 2955	6	0640 2381
2	0588 2777	7	0619 2223
3	0571 2595	8	0680 2179
4	0634 2869	9	0653 2070
5	0661 2768	10	0792 2468
6	0619 2694	11	0734 2361
7	0630 2527	12	0778 2303
8	0725 2969	13	0802 2119
9	0725 2879	14	0739 2054
10	0775 2743	15	0882 2470
11	0717 2645	16	0846 2382
12	0729 2548	17	0884 2324
13	0805 2995	18	0826 2206
14	0835 2922	19	0842 2047
15	0843 2855	20	0974 2444
16	0852 2719	21	0959 2349
17	0823 2622	22	0916 2268
18	0849 2533	23	0911 2137
19	0966 2958	24	0962 2025
20	0965 2852		
21	0941 2777		
22	0986 2677		
23	0975 2612		
24	0981 2530		

### OTHER BOREHOLES

1. Hydrogeological Department Boreholes (Standon-Batt, 1969): 224/29; 224/70; 224/79; 224/80; 224/125; 224/135; 224/172b; 224/254a. (Details of the last borehole are held in the National Well Record Collection of the Hydrogeological Department of the Institute, and may be inspected upon application to the Director, Institute of Geological Sciences, Exhibition Road, London, SW7 2DE).

2. Site Investigation Records, Colchester Northern Bypass (47 boreholes).

## Appendix F: Mineral Assessment Unit Borehole Records

TM 02 NW 48		0040 2974	Near Runkin's Corner		Block A	
Surface level (+45.1 m) +148 ft *			Waste (3.4 m) 11 ft			
Water not struck			Bedrock (0.9 m+) 3 ft+			
Wirth B0, 8 inch diameter						
November 1969						
		Thickness		Depth		
		(m)	ft	(m)	ft	
Loam	Soil and brown, sandy clay	(1.8)	6	(1.8)	6	
?Glacial Sand and Gravel	Clay with gravel	(1.5)	5	(3.4)	11	
London Clay	Weathered, brown clay	(0.9+)	3+	(4.3)	14	

TM 02 NW 49		0100 2853	Severalls Lane		Block A	
Surface level (+47.2 m) +155 ft *			Overburden (4.3 m) 14 ft			
Water struck at (+42.8 m) +138 ft			Mineral (4.6 m) 15 ft			
Wirth B0, 8 inch diameter			Bedrock (0.9 m+) 3 ft+			
December 1969						
		Thickness		Depth		
		(m)	ft	(m)	ft	
Loam	Soil and brown clay.	(3.4)	11	(3.4)	11	
Glacial Sand and Gravel	Very clayey sand.	(0.9)	3	(4.3)	14	
	?Pebbly Sand. Fines content significant throughout the deposit. Sand: greyish-brown to rust brown; medium to coarse down to 20 ft (6.1 m); mainly medium below. Gravel: mostly fine; subangular to subrounded flints with occasional quartzites and quartz.	(4.6)	15	(8.8)	29	
London Clay	Weathered brown clay.	(0.9+)	3+	(9.8)	32	

No grading information available.

TM 02 NW 50

0060 2745

Near Myland Hall

Block A

Surface level (+38.7 m) +127 ft \*  
 Water struck at (+34.4 m) +113 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.4 m) 11 ft  
 Mineral (2.1 m) 7 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay.	(2.4)	8	(2.4)	8
Glacial Sand and Gravel	Sandy clay.	(0.9)	3	(3.4)	11
	'Clayey' pebbly sand. Fines content increases with depth becoming 'clayey' below 14 ft (4.3 m). Sand: brown; mainly medium with some coarse grade. Gravel: mostly fine; subangular to subrounded flints and quartz.	(2.1)	7	(5.5)	18
London Clay	Brown weathered clay.	(0.9+)	3+	(6.4)	21

			Depth below surface (ft)	Percentages		
%	mm	%		Fines	Sand	Gravel
Gravel 17	+16	: 3	11 - 14	9	71	20
	-16+4	: 14	14 - 17	11	74	15
			17 - 18	13	75	12
Sand 73	-4+1	: 22				
	-1+ $\frac{1}{4}$	: 43				
	- $\frac{1}{4}$ +1/16	: 8				
Fines 10	-1/16	: 10				

TM 02 NW 51

0156 2987

North of Salary Brook

Block A

Surface level (+47.2 m) +155 ft \*  
 Water struck at (+43.6 m) +143 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.7 m) 12 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Made ground, soil and brown clay.	(3.7)	12	(3.7)	12
Glacial Sand and Gravel	'Clayey' pebbly sand. A few cobbles present in the top 6 ft (1.8 m), gravel content decreases with depth whilst fines content increases. Sand: brown; medium with some fine and coarse. Gravel: fine and coarse; subangular to subrounded flints, quartzites and quartz.	(3.7)	12	(7.3)	24
London Clay	Brown weathered clay.	(0.9+)	3+	(8.2)	27

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel 18		+64	: 1	12 - 15	6	53	41
		-64+16	: 7	15 - 18	11	69	20
		-16+4	: 10	18 - 21	20	72	8
Sand 69		-4+1	: 9	21 - 24	14	83	3
		-1+ $\frac{1}{4}$	: 46				
		- $\frac{1}{4}$ +1/16	: 14				
Fines 13		-1/16	: 13				

TM 02 NW 52

0166 2833

Alongside Ipswich Road, Colchester Block A

Surface level (+41.1 m) +135 ft\*  
 Water struck at (+36.0 m) +118 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (3.7 m) 12 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Very clayey fine sand.	(0.9)	3	(3.7)	12
	Pebbly sand. 'Clayey' between 15 ft (4.6 m) and 18 ft (5.5 m) and below 21 ft (6.4 m). Cobbles present between 15 ft (4.6 m) and 18 ft (5.5 m). Sand: rust brown; mainly medium. Gravel: fine and coarse; subangular to subrounded flints.	(3.7)	12	(7.3)	24
London Clay	Brown weathered clay becoming blue.	(0.9+)	3+	(8.2)	27

	%	mm	%	Depth below surface (ft)	Percentages			
					Fines	Sand	Gravel	
Gravel	12	+64	:	1	12 - 15	3	90	7
		-64+16	:	4	15 - 18	14	69	17
		-16+4	:	7	18 - 21	2	87	11
					21 - 24	12	79	11
Sand	80	-4+1	:	11				
		-1+1/4	:	59				
		-1/4+1/16	:	10				
Fines	8	-1/16	:	8				



TM 02 NW 53

0287 2970

Near Ardleigh Wick

Block A

Surface level (+41.1 m) +135 ft\*  
 Water struck at (+38.7 m) +127 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.0 m) 10 ft  
 Mineral (8.2 m) 27 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay.	(3.0)	10	(3.0)	10
Glacial Sand and Gravel	Pebbly sand. Very sandy in top 3 ft (0.9 m). 'Clayey' from 25 ft (7.6 m) to 28 ft (8.5 m). Sand: yellowish-white; fine with medium in top 3 ft (0.9 m); mainly medium below. Gravel: fine with very little coarse; flints and quartz.	(8.2)	27	(11.3)	37
London Clay	Brown weathered clay.	(0.9+)	3+	(12.2)	40

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	20	+16	: 4	10 - 13	2	93	5
		-16+4	: 16	13 - 16	0	80	20
				16 - 19	5	80	15
Sand	77	-4+1	: 10	19 - 22	3	82	15
		-1+1/4	: 52	22 - 25	2	68	30
		-1/4+1/16	: 15	25 - 28	13	67	20
				28 - 31	1	71	28
Fines	3	-1/16	: 3	31 - 34	1	77	22
				34 - 37	0	77	23

TM 02 NW 54    0235 2829                          South-east of Plains Farm                          Block A

Surface level (+39.6 m) +130 ft\*  
 Water not struck  
 With B0, 8 inch diameter  
 November 1969

Waste (4.0 m) 13 ft  
 Bedrock (2.1 m+) 7 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Made ground, soil and brown clay with occasional calcareous fragments (possibly derived from London Clay?).	(4.0)	13	(4.0)	13
London Clay	Brown weathered clay.	(2.1+)	7+	(6.1)	20

TM 02 NW 55    0257 2714                          Opposite entrance to Shaw's Farm                          Block A

Surface level (+38.1 m) +125 ft\*  
 Water struck at (+32.9 m) +108 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.7 m) 9 ft  
 Mineral (5.5 m) 18 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Pebbly sand. Gravelly in the top 6 ft (1.8 m), becoming sandy below and gravelly again towards the base of the deposit. 'Clayey' between 21 ft (6.4 m) and 24 ft (7.3 m). Sand: brown; mainly medium in top 6 ft (1.8 m); fine to medium below becoming mainly medium again in bottom 3 ft (0.9 m). Gravel: mainly fine, with some coarse; subrounded and subangular flints and occasional subrounded quartz.	(5.5)	18	(8.2)	27
London Clay	Blue clay, weathered brown for a few inches below the surface.	(0.9+)	3+	(9.1)	30

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	26	+16	: 8	9 - 12	9	45	46
		-16+4	: 18	12 - 15	7	58	35
				15 - 18	7	88	5
Sand	66	-4+1	: 8	18 - 21	No grading available		
		-1+1/4	: 37	21 - 24	11	73	16
		-1/4+1/16	: 21	24 - 27	4	69	27
Fines	8	-1/16	: 8				

TM 02 NW 56

0224 2629

Parson's Heath

Block A

Surface level (+35.1 m) +115 ft\*  
 Water struck at (+32.0 m) +105 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.1 m) 7 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and subsoil		(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Very clayey sand.	(0.9)	3	(2.1)	7
	Sand. Gravel is present in the top 6 ft (1.8 m) only.	(3.7)	12	(5.8)	19
	Sand: yellowish-brown; medium grade with some fine. Gravel: fine to coarse; subrounded flints and quartz.				
London Clay	Blue clay weathered brown for a few inches below the surface.	(0.9+)	3+	(6.7)	22

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	3	+16	: 1	7 - 10	4	90	6
		-16+4	: 2	10 - 13	3	94	3
				13 - 16	2	98	0
Sand	94	-4+1	: 1	16 - 19	1	99	0
		-1+ $\frac{1}{4}$	: 68				
		- $\frac{1}{4}$ +1/16	: 25				
Fines	3	-1/16	: 3				

TM 02 NW 57

0236 2515

Opposite Park Farm

Block A

Surface level (+27.1 m) +89 ft  
 Water struck at (+23.2 m) +76 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (2.7 m) 9 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and subsoil		(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy clay with gravel.	(1.5)	5	(2.7)	9
	Sandy gravel. The gravel content increases with depth at the expense of the sand. Cobbles occur in the bottom 2 ft (0.6 m). Fines only recorded between 12 ft (3.7 m) and 18 ft (15.5 m). Gravel: mainly fine at top, becoming increasingly coarse with depth; sub-angular to subrounded flint and quartz. Sand: brown; medium with fine and coarse.	(4.3)	14	(7.0)	23
London Clay	Brown weathered clay.	(0.9+)	3+	(7.9)	26

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	48	+16	: 21	9 - 12	0	62	38
		-16+4	: 27	12 - 15	5	63	32
				15 - 18	5	50	45
Sand	50	-4+1	: 10	18 - 21	0	42	58
		-1+ $\frac{1}{4}$	: 31	21 - 23	0	34	66
		- $\frac{1}{4}$ +1/16	: 9				
Fines	2	-1/16	: 2				

TM 02 NW 58

0342 2886

Near Hillhouse Farm

Block A

Surface level (+38.1 m) +125 ft\*  
 Water struck at (+33.8 m) +111 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.7 m) 9 ft  
 Mineral (4.6 m) 15 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown, sandy, silty clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Sandy gravel. 'Clayey' in the top 3 ft (0.9 m). Gravel: fine with some coarse towards the top; flints and quartz, mainly well rounded in top 3 ft (0.9 m), subangular and occasionally subrounded below. Sand: rust brown becoming fawn below 12 ft (3.7 m); medium with some fine and coarse.	(4.6)	15	(7.3)	24
London Clay	Brown weathered clay.	(0.9+)	3+	(8.2)	27

			Depth below surface (ft)	Percentages		
%	mm	%		Fines	Sand	Gravel
Gravel 40	+16	: 14	9 - 12	11	48	41
	-16-4	: 26	12 - 15	6	45	49
			15 - 18	5	50	45
Sand 54	-4+1	: 10	18 - 21	4	62	34
	-1+1/4	: 35	21 - 24	3	68	29
	-1/4+1/16	: 9				
Fines 6	-1/16	: 6				

TM 02 NW 59

0390 2821

Opposite De Bois Hall

Block B

Surface level (+36.6 m) +120 ft\*  
 Water struck at (+33.8 m) +111 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.0 m) 10 ft  
 Mineral (4.6 m) 15 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil overlying yellowish-brown, sandy clay.	(3.0)	10	(3.0)	10
	Gravel. A few cobbles are present in the middle of the deposit. Gravel: fine and coarse, mostly fine in top 3 ft (0.9 m); subangular to sub-rounded flints and quartz, high proportion of subangular pebbles below 13 ft (4.0 m). Sand: yellowish-brown; medium with coarse and a trace of fine.	(4.6)	15	(7.6)	25
London Clay	Blue clay, weathered brown for a few inches below the surface.	(0.9+)	3+	(8.5)	28

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	57	+16	: 25	10 - 13	8	40	52
		-16+4	: 32	13 - 16	5	28	67
				16 - 19	1	39	60
Sand	37	-4+1	: 11	19 - 22	8	50	42
		-1+ $\frac{1}{4}$	: 22	22 - 25	6	29	65
		- $\frac{1}{4}$ +1/16	: 4				
Fines	6	-1/16	: 6				

TM 02 NW 60	0320 2771	Fox Street	Block A
Surface level (+34.1 m) +112 ft *		Overburden (4.6 m) 15 ft	
Water not struck		Mineral (3.7 m) 12 ft	
Wirth B0, 8 inch diameter		Bedrock (0.9 m+) 3 ft+	
October 1969			
		<b>Thickness</b>	<b>Depth</b>
		(m) ft	(m) ft
Loam	Soil and brown sandy silty giving way to grey silt below 9 ft (2.7 m).	(4.6) 15	(4.6) 15
Glacial Sand and Gravel	?Sandy gravel. Gravel: fine to coarse; subangular to subrounded flints and quartz, with some quartzites. Sand: rust brown becoming grey; fine, medium and coarse.	(3.7) 12	(8.2) 27
London Clay	Brown weathered clay.	(0.9+) 3+	(9.1) 30
No grading information available			

TM 02 NW 61	0368 2644	Crockleford Heath	Block B
Surface level (+36.0 m) +118 ft *		Overburden (5.8 m) 19 ft	
Water struck at (+28.7 m) +94 ft		Mineral (3.7 m) 12 ft	
Wirth B0, 8 inch diameter		Bedrock (0.9 m+) 3 ft+	
November 1969			
		<b>Thickness</b>	<b>Depth</b>
		(m) ft	(m) ft
Loam	Soil and brown silty clay.	(5.8) 19	(5.8) 19
Glacial Sand and Gravel	Pebbly sand. Sand: brown; medium with a little fine and coarse. Gravel: fine and coarse; subangular to subrounded flints.	(3.7) 12	(9.4) 31
London Clay	Blue clay, weathered brown for a few inches below the surface.	(0.9+) 3+	(10.4) 34

			<b>Depth below surface (ft)</b>		<b>Percentages</b>		
	%	mm	%		Fines	Sand	Gravel
Gravel	7	+16	:	2	No grading available		
		-16+4	:	5	0	92	8
				25 - 28	0	94	6
Sand	93	-4+1	:	9	0	92	8
		-1+ $\frac{1}{4}$	:	75			
		- $\frac{1}{4}$ +1/16	:	9			
Fines	0	-1/16	:	0			

TM 02 NW 62

0361 2510

Near Colleer's Farm

Block D

Surface level (+33.5 m) +110 ft  
 Water struck at (+29.6 m) +97 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.7 m) 12 ft  
 Mineral (3.0 m) 10 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay with gravel.	(3.7)	12	(3.7)	12
Glacial Sand and Gravel	Gravel. Gravel: fine and coarse; subangular to subrounded flints and some quartz. Sand: brown; medium with some coarse.	(3.0)	10	(6.7)	22
London Clay	Blue clay, weathered brown for a few inches below the surface.	(0.9+)	3+	(7.6)	25

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	56	+16	: 33	12 - 15	1	49	50
		-16+4	: 23	15 - 18	0	31	69
				18 - 21	0	53	47
Sand	44	-4+1	: 8	21 - 22	0	29	71
		-1+ $\frac{1}{4}$	: 31				
		- $\frac{1}{4}$ +1/16	: 5				
Fines	0	-1/16	: 0				



Surface level (+37.5 m) +123 ft \*  
 Water struck at (+33.2 m) +109 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.1 m) 7 ft  
 Mineral (7.9 m) 26 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and orange-brown, sandy, silty clay.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. Gradual increase in gravel content through the top 10 ft (3.0 m); sandy below 17 ft (5.2 m). The fines content is negligible below 14 ft (4.3 m). Gravel: fine to coarse in the top 10 ft (3.0 m), mainly fine below; frequently well rounded, flints and occasional quartz. Sand: fawn; mainly medium becoming medium to coarse downwards.	(7.9)	26	(10.1)	33
London Clay	Brown weathered clay.	(0.9+)	3+	(11.0)	36

	%	mm	%	Depth below surface (ft)	Percentages			
					Fines	Sand	Gravel	
Gravel	43	+16	: 13	7 - 11	7	48	45	
		-16+4	: 30	11 - 14	6	40	54	
				14 - 17	0	37	63	
Sand	54	-4+1	: 18	17 - 20	0	63	37	
		-1+1/4	: 32	20 - 23	3	62	35	
		-1/4+1/16	: 4	23 - 26	2	60	38	
				26 - 29	1	68	31	
Fines	3	-1/16	:	3	29 - 32	3	56	41
					32 - 33	No grading available		

Surface level (+35.1 m) +115 ft\*  
 Water struck at (+32.6 m) +107 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.7 m) 9 ft  
 Mineral (5.5 m) 18 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and silty clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Sandy gravel. Sandy in the top 6 ft (1.8 m), becoming gravelly below and then more sandy again towards the base. Fines are absent below 15 ft (4.6 m). Gravel: fine, with traces of coarse, subrounded flints and quartz in the top 6 ft (1.8 m); fine and coarse, sub-angular to subrounded flints and quartz below. Sand: grey to greyish-brown, medium with some coarse.	(5.5)	18	(8.2)	27
London Clay	Brown weathered clay.	(0.9+)	3+	(9.1)	30

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	36	+16	: 16	9 - 12	1	81	18
		-16+4	: 20	12 - 15	5	77	18
				15 - 18	0	49	51
Sand	63	-4+1	: 13	18 - 21	0	56	44
		-1+ $\frac{1}{4}$	: 44	21 - 24	0	56	44
		- $\frac{1}{4}$ +1/16	: 6	24 - 27	0	62	38
Fines	1	-1/16	: 1				

TM 02 NW 65

0426 2568

Pyecat's Farm

Block B

Surface level (+33.2 m) +109 ft  
 Water struck at (+30.2 m) +99 ft  
 Wirth B1, 8 inch diameter  
 May 1970

Overburden (1.5 m) 5 ft  
 Mineral (5.5 m) 18 ft  
 Bedrock (0.6 m+) 2 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and soft, brown, sandy clay.	(1.5)	5	(1.5)	5
Glacial Sand and Gravel	Gravel. Becoming more sandy and less gravelly with depth. 'Clayey' in top 3 ft (0.9 m). Gravel: fine and coarse; subangular to sub-rounded flint and quartz. Sand: grey, medium with coarse and some fine.	(5.5)	18	(7.0)	23
London Clay	Blue clay.	(0.6+)	2+	(7.6)	25

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	50	+16	: 21	5 - 8	12	24	64
		-16+4	: 29	8 - 11	6	33	61
				11 - 14	4	39	57
Sand	44	-4+1	: 10	14 - 17	4	47	49
		-1+ $\frac{1}{4}$	: 27	17 - 20	4	60	36
		- $\frac{1}{4}$ +1/16	: 7	20 - 23	4	64	32
Fines	6	-1/16	: 6				

TM 02 NW 66

0494 2524

Tye Road Junction

Block D

Surface level (+32.9 m) +108 ft  
 Water struck at (+30.2 m) +99 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (1.2 m) 4 ft  
 Mineral (4.6 m) 15 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy gravel. 'Clayey' near the surface, with thin greenish-grey bands of sandy clay occurring between 7 ft (2.1 m) and 10 ft (3.0 m). Gravel: fine and coarse (some approaching cobble size) becoming finer towards base; subangular to rounded flint with occasional rounded quartz. Sand: brown, medium with coarse and some fine; subangular to subrounded quartz and flint.	(4.6)	15	(5.8)	19
London Clay	Blue clay.	(0.9+)	3+	(6.7)	22

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	41	+16	: 18	4 - 7	10	48	42
		-16+4	: 23	7 - 10	11	45	44
				10 - 13	7	53	40
Sand	52	-4+1	: 10	13 - 16	3	48	49
		-1+ $\frac{1}{4}$	: 35	16 - 19	3	68	29
		- $\frac{1}{4}$ +1/16	: 7				
Fines	7	-1/16	: 7				

Surface level (+35.4 m) +116 ft\*  
 Water struck at (+32.3 m) +106 ft  
 Wirth B0, 8 inch diameter  
 January 1970

Overburden (2.1 m) 7 ft  
 Mineral (6.4 m) 21 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clayey silt with some sand and traces of gravel.	(0.9)	3	(0.9)	3
	Brown sandy clay with gravel.	(1.2)	4	(2.1)	7
Glacial Sand and Gravel	'Clayey' pebbly sand. Gravel content is highest in the basal 3 ft (0.9 m), where there are occasional cobbles, and is reduced to a trace between 22 ft (6.2 m) and 25 ft (7.6 m). 'Clayey' in the top 3 ft (0.9 m) and again in the middle. Sand: yellowish-brown becoming buff below 16 ft (4.9 m); medium to fine in the top 3 ft (0.9 m), mainly medium below, becoming finer from 19 ft (5.8 m) and coarser in the bottom 3 ft (0.9 m). Gravel: fine to coarse; subangular to subrounded flints, and occasional quartz, with quartzites towards the base.	(6.4)	21	(8.5)	28
London Clay	Blue clay, weathered brown for a few inches below the surface.	(0.9+)	3+	(9.4)	31

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	17	+16	: 6	7 - 10	13	72	15
		-16+4	: 11	10 - 13	7	79	14
				13 - 16	10	74	16
Sand	73	-4+1	: 10	16 - 19	20	51	29
		-1+1/4	: 44	19 - 22	10	80	10
		-1/4+1/16	: 19	22 - 25	4	93	3
Fines	10	-1/16	: 10	25 - 28	2	67	31

TM 02 NE 1

0592 2955

Glebe Corner

Block B

Surface level (+36.9 m) +121 ft  
 Water not struck  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (1.5 m) 5 ft  
 Mineral (5.5 m) 18 ft  
 Bedrock (2.4 m+) 8 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and soft, brown, sandy clay.	(1.5)	5	(1.5)	5
Glacial Sand and Gravel	Sandy gravel. Gravel content highest in the top 3 ft (0.9 m). 'Clayey' between 8 ft (2.4 m) and 11 ft (3.4 m). Sand: brown; subangular to subrounded quartz with some flint; fine to medium in the top 3 ft (0.9 m); medium with coarse below. Gravel: fine and coarse in the top 3 ft (0.9 m), mostly fine below; subangular to rounded flints with occasional rounded quartz.	(5.5)	18	(7.0)	23
London Clay	Blue clay.	(2.4+)	8+	(9.4)	31

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	25	+16	: 9	5 - 8	2	52	46
		-16+4	: 16	8 - 11	15	64	21
				11 - 14	8	67	25
Sand	67	-4+1	: 13	14 - 17	9	61	30
		-1+1/4	: 44	17 - 20	5	79	16
		-1/4+1/16	: 10	20 - 23	6	79	15
Fines	8	-1/16	: 8				

TM 02 NE 2

0588 2777

Park Farm

Block B

Surface level (+35.4 m) +116 ft  
 Water struck at (+31.4 m) +103 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (4.0 m) 13 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(4.0)	13	(4.0)	13
Glacial Sand and Gravel	Pebbly sand. Sand: brown to yellowish-brown; mostly subrounded quartz with some subangular to subrounded flint; mainly medium. Gravel: mostly fine; subangular to rounded flints becoming increasingly rounded with depth, and some rounded quartz.	(3.7)	12	(7.6)	25
London Clay	Blue clay.	(0.9+)	3+	(8.5)	28

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	17	+16	:	4	8	75	17
		-16+4	:	13			
Sand	76	-4+1	:	14	7	74	19
		-1+ $\frac{1}{4}$	:	51	7	78	15
		- $\frac{1}{4}$ +1/16	:	11			
Fines	7	-1/16	:	7			

Surface level (+34.1 m) +112 ft  
 Water struck at (+32.0 m) +105 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.1 m) 7 ft  
 Mineral (7.3 m) 24 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and clay with gravel	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. Becoming increasingly sandy with depth except for relatively gravelly band between 22 ft (6.7 m) and 25 ft (7.6 m). Gravel: fine to coarse; subangular to subrounded flints with subrounded quartzites and quartz. Sand: yellowish-brown; medium.	(7.3)	24	(9.4)	31
London Clay	Blue clay, weathered brown in the top few inches.	(0.9+)	3+	(10.4)	34

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 16	7 - 10	0	55	45
		-16+4	: 19	10 - 13	0	62	38
				13 - 16	0	66	34
Sand	65	-4+1	: 6	16 - 19	0	64	36
		-1+ $\frac{1}{4}$	: 51	19 - 22	0	80	20
		- $\frac{1}{4}$ +1/16	: 8	22 - 25	0	54	46
				25 - 28	0	64	36
Fines	0	-1/16	: 0	28 - 31	0	77	23



Surface level (+35.7 m) +117 ft  
 Water struck at (+34.0 m) +112 ft  
 Shell and Auger, 6 inch diameter  
 December 1970

Overburden 2.2 m (7 ft)  
 Mineral 1.6 m (5 ft)  
 Waste 2.2 m (7 ft)  
 Mineral 1.7 m (5.5 ft)  
 Bedrock 0.8 m+ (2.5 ft+)

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and pale grey-brown and red-brown mottled clay, with silt and sand and traces of gravel.	1.7	(5.5)	1.7	(5.5)
Glacial Sand and Gravel	Clayey, brown quartz sand with occasional pebbles of up to 60 mm diameter.	0.5	(1.5)	2.2	(7)
(a)	Sandy gravel. Less sandy and more 'clayey' towards base. Gravel: mainly fine, but with some cobbles towards base; rounded flints and quartz with some quartzite; iron-stained below 3.0 m (10 ft). Sand: medium to coarse, becoming coarser downwards; mainly quartz with some flint.	1.6	(5)	3.8	(12.5)
	Thinly banded grey and orange or yellow-brown clayey silt passing into blue-grey micaceous silt at 4.2 m (14 ft), the latter becoming pebbly in the bottom 0.2 m (0.5 ft).	2.2	(7)	6.0	(19.5)
(b)	Sandy gravel. Gravel: mostly fine, with some coarse and a few cobbles; flint with occasional quartz and quartzite; mostly rounded pebbles with some subrounded and sub-angular fragments also. Sand: medium with some coarse; quartz and flint; dark brown, becoming paler downwards with greenish-grey sandy clay band at about 6.8 m (22.5 ft) depth.	1.7	(5.5)	7.7	(25.5)
London Clay	Blue clay, weathered brown in top 0.2 m (0.5 ft).	0.8+	(2.5+)	8.5	(28)

Mean (a) + (b)

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	43	+64	: 1	(a) 2.2 - 3.2	2	56	42
		-64+16	: 12	3.2 - 3.8	18	38	42
		-16+4	: 30	Mean	<u>7</u>	<u>50</u>	<u>42</u>
Sand	52	-4+1	: 19	(b) 6.0 - 7.0	3	51	46
		-1+1/4	: 30	7.0 - 7.7	2	63	35
		-1/4+1/16	: 3	Mean	<u>3</u>	<u>56</u>	<u>41</u>
Fines	5	-1/16	: 5				

TM 02 NE 5                                      0661 2768                                      Near Bromely Cross                                      Block B

Surface level(+36.9 m) +121 ft  
 Water not struck  
 Wirth B0, 8 inch diameter  
 November 1969

Waste (5.5 m) 18 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and yellowish-brown, sandy clay with streaks of blue silt.	(3.4)	11	(3.4)	11
?Glacial Sand and Gravel	Yellowish-brown, very sandy clay.	(2.1)	7	(5.5)	18
London Clay	Blue clay weathered brown on the surface and for a few inches below.	(0.9+)	3+	(6.4)	21

TM 02 NE 6                                      0619 2694                                      Near Collierswood Farm                                      Block B

Surface level (+35.7 m) +117 ft  
 Water struck at (+32.6 m) +107 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (2.7 m) 9 ft  
 Mineral (0.9 m) 3 ft  
 Waste (1.2 m) 4 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Pebbly sand. Sand: yellow; medium with coarse. Gravel: fine and coarse; mostly sub-angular flints and quartz.	(0.9)	3	(3.7)	12
	Sandy clay with gravel giving way to clayey gravel for 1 ft (0.3 m) at the bottom.	(1.2)	4	(4.9)	16
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(5.8)	19

		Depth below surface (ft)		Percentages		
				Fines	Sand	Gravel
Gravel	22	+16 : 8	9 - 12	3	75	22
		-16+4 : 14				
Sand	75	-4+1 : 15				
		-1+ $\frac{1}{4}$ : 52				
		- $\frac{1}{4}$ +1/16 : 8				
Fines	3	-1/16 : 3				

TM 02 NE 7                                      0630 2527                                      Near Parsonage Farm                                      Block D

Surface level (+33.5 m) +110 ft                                      Waste (6.4 m) 21 ft  
 Water struck at (+29.0 m) +95 ft                                      Bedrock (0.9 m+) 3 ft+  
 Wirth B1, 8 inch diameter  
 February 1970

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay and sandy clay.	(5.5)	18	(5.5)	18
Glacial Sand and Gravel	Sandy gravel. Gravel: fine with coarse; subangular to rounded flint and occasional rounded quartz. Sand: brown; medium and some coarse; subangular to subrounded quartz and flint.	(0.9)	3	(6.4)	21
London Clay	Blue clay.	(0.9+)	3+	(7.3)	24

TM 02 NE 8                                      0725 2969                                      Near Hungerdowns                                      Block C

Surface level (+36.9 m) +121 ft                                      Overburden (5.2 m) 17 ft  
 Water struck at (+30.8 m) +101 ft                                      Mineral (4.6 m) 15 ft  
 Wirth B0, 8 inch diameter                                      Bedrock (0.9 m+) 3 ft+  
 December 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Made ground, soil and brown sandy clay.	(4.3)	14	(4.3)	14
Glacial Sand and Gravel	Clay with gravel. 'Clayey' pebbly sand. Fines present throughout, increasing in quantity towards the base. Sand: yellow to yellowish-brown; mainly medium with some coarse. Gravel: mostly fine grade; subrounded flints and quartz.	(0.9)	3	(5.2)	17
		(4.6)	15	(9.8)	32
London Clay	Blue clay, weathered brown at the top, with thin peat layer separating it from the overlying sand.	(0.9+)	3+	(10.7)	35

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	19	+16	: 5	17 - 20	8	73	19
		-16+4	: 14	20 - 23	7	79	14
				23 - 26	No grading available		
Sand	69	-4+1	: 17	26 - 29	No grading available		
		-1+1/4	: 45	29 - 32	20	55	25
		-1/4+1/16	: 7				
Fines	12	-1/16	: 12				

Surface level (+36.0 m) +118 ft  
 Water struck at +32.0 m (+105 ft)  
 Shell and Auger, 6 inch diameter  
 December 1970

Overburden 1.1 m (3.5 ft)  
 Mineral 3.4 m (11 ft)  
 Waste 3.2 m (10.5 ft)  
 Mineral 1.4 m (4.5 ft)  
 Bedrock 0.8 m+ (2.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Topsoil and made ground.		1.1	(3.5)	1.1	(3.5)
Glacial Sand and Gravel	(a) Sandy gravel. Gravel: mainly fine; subangular to sub-rounded brown and red flints, with rounded quartzites. Sand: medium with coarse; brown.	3.4	(11)	4.5	(15)
	Yellow-brown, laminated, silty sand, becoming blue-grey with carbonaceous material, and then dark brown with occasional flints and quartzite below 6.9 m (22.5 ft).	3.2	(10.5)	7.7	(25.5)
	(b) Sandy gravel. Becoming increasingly gravelly downwards. Gravel: fine with some coarse; subrounded to rounded; flints and quartzite with a few jasper pebbles. Sand: medium and coarse, becoming mainly medium towards base; grey-brown.	1.4	(4.5)	9.1	(30)
London Clay	Blue clay, weathered brown in top 0.6 m (2 ft).	0.8+	(2.5+)	9.9	(32.5)

Mean (a) + (b)

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	41	+16	: 13	(a) 1.1 - 2.1	2	51	47
		-16+4	: 28	2.1 - 3.1	1	67	32
				3.1 - 4.1	2	56	42
Sand	57	-4+1	: 19	4.1 - 4.5	2	65	33
		-1+1/4	: 33	Mean	2	59	39
		-1/4+1/16	: 5	(b) 7.7 - 8.7	2	53	45
Fines	2	-1/16	: 2	8.7 - 9.1	1	49	50
				Mean	2	52	46

TM 02 NE 10

0775 2743

Near Carrington Farm

Block C

Surface level (+33.5 m) +110 ft\*  
 Water struck at (+31.7 m) +104 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (3.0 m) 10 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and Loam	Soil on grey silty clay.	(2.0)	6.5	(2.0)	6.5
Glacial Sand and Gravel	Sandy gravelly clay.	(1.1)	3.5	(3.0)	10
	Pebbly sand. Becoming more gravelly with depth. Sand: yellowish-brown; medium with a little coarse and fine; subangular to subrounded quartz and flint. Gravel: mostly fine near the top and the bottom; fine and coarse between; flint and occasional quartz; subangular to subrounded in the top 9 ft (2.7 m); subangular to rounded below.	(4.3)	14	(7.3)	24
London Clay	Blue clay.	(0.9+)	3+	(8.2)	27

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	23	+16	: 10	10 - 13	8	79	13
		-16+4	: 13	13 - 16	7	76	17
				16 - 19	8	69	23
Sand	70	-4+1	: 13	19 - 22	9	70	21
		-1+1/4	: 47	22 - 24	3	50	47
		-1/4+1/16	: 10				
Fines	7	-1/16	: 7				

TM 02 NE 11

0717 2645

Near Bush Farm

Block C

Surface level (+32.0 m) +105 ft\*  
 Water struck at (+27.7 m) +91 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (3.7 m) 12 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Clay with gravel.	(0.9)	3	(3.7)	12
	Sandy gravel. Very gravelly in the bottom 2 ft (0.6 m). Fines virtually absent below 15 ft (4.6 m). Gravel: fine with coarse; subangular to subrounded flints and occasional quartz. Sand: pale yellowish-brown mostly medium increasingly coarse in the bottom 5 ft (1.5 m).	(4.3)	14	(7.9)	26
London Clay	Brown weathered clay.	(0.9+)	3+	(8.8)	29

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	39	+16	: 15	12 - 15	9	52	39
		-16+4	: 24	15 - 18	0	63	37
				18 - 21	0	74	26
Sand	59	-4+1	: 10	21 - 24	2	62	36
		-1+1/4	: 42	24 - 26	0	41	59
		-1/4+1/16	: 7				
Fines	2	-1/16	: 2				

TM 02 NE 12

0729 2548

Near Elmstead Lodge

Block D

Surface level (+31.4 m) +103 ft\*  
 Water struck at (+26.8 m) +88 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (2.7 m) 9 ft  
 Mineral (4.9 m) 16 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
?Glacial Sand and Gravel	Soil and brown sandy clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Sandy gravel. Some cobble size material present in places. Fines present throughout; 'Clayey' between 15 ft (4.6 m) and 18 ft (5.5 m). Gravel: mostly fine at the top, fine and coarse below; subangular to subrounded flints with occasional quartz and calcareous pebbles. Sand: yellowish-brown; mostly medium with coarse, but fine to medium from 18 ft (5.5 m) to 21 ft (6.4 m).	(4.9)	16	(7.6)	25
London Clay	Blue clay, weathered brown in the top few inches.	(0.9+)	3+	(8.5)	28

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel 32		+64	: 2	9 - 12	10	69	21
		-64+16	: 11	12 - 15	6	55	39
		-16+4	: 19	15 - 18	12	63	25
				18 - 21	4	66	30
Sand 61		-4+1	: 15	21 - 24	5	56	39
		-1+1/4	: 36	24 - 25	5	52	43
		-1/4+1/16	: 10				
Fines 7		-1/16	: 7				

Surface level (+36.6 m) +120 ft  
 Water struck at (+30.4 m) +100 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (3.4 m) 11 ft  
 Mineral (9.8 m) 32 ft  
 Bedrock (1.2 m+) 4 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Dark brown 'very clayey' sand with some gravel.	(0.6)	2	(3.4)	11
	Pebbly sand. Gravelly in top 6 ft (1.8 m); very sandy below but becoming gravelly again at bottom. 'Clayey' between 14 ft (4.3 m) and 17 ft (5.2 m). Gravel: fine with coarse layer at base; subangular to subrounded flints, often stained, with subordinate quartz and quartzites. Sand: rust brown to yellowish-brown; medium with coarse down to 17 ft (5.2 m); medium or fine to medium below.	(9.8)	32	(13.1)	43
London Clay	Brown weathered clay passing down into fresh blue clay	(1.2+)	4+	(14.3)	47

	%	mm	%	Depth below surface (ft)	Percentages			
					Fines	Sand	Gravel	
Gravel	18	+16	: 5	11 - 14	8	70	22	
		-16+4	: 13	14 - 17	13	64	23	
				17 - 20	0	94	6	
Sand	78	-4+1	: 10	20 - 23	1	94	5	
		-1+1/4	: 58	23 - 26	3	89	8	
		-1/4+1/16	: 10	26 - 29	5	87	8	
Fines	4	-1/16	:	4	29 - 32	1	86	13
					32 - 35	No grading available		
					35 - 38	2	72	26
					38 - 41	3	69	28
					41 - 43	2	48	50



Surface level (+35.4 m) +116 ft  
 Water struck at +32.6 m (+107 ft)  
 Pilcon Shell, 6 inch diameter  
 December 1970

Overburden 1.6 m (5 ft)  
 Mineral 8.5 m (28 ft)  
 Bedrock 0.5 m+ (1.5 ft+)

		Thickness		Depth	
		(m)	ft	(m)	ft
Topsoil and made ground.		0.7	(2.5)	0.7	(2.5)
Loam	Silty and clayey sand with some gravel. Sand orange-brown in colour; mainly medium; rounded to subangular quartz. Gravel composed of fine grade, rounded to subangular flint and quartz.	0.9	(3)	1.6	(5)
Glacial Sand and Gravel	Sandy gravel. Gravelly down to 6.6 m (21.5 ft), becoming very sandy below. Gravel: mainly fine with some coarse and a few cobbles down to 6.6 m (21.5 ft), traces only of fine to coarse below; rounded, subrounded and subangular flint with subordinate quartz and quartzite. Sand: medium with coarse to 6.6 m (21.5 ft), becoming fine with medium below; brown to orange-brown colour; thin, pale grey, clay band at about 8.5 m (28 ft).	8.5	(28)	10.1	(33)
London Clay	Blue-grey, stiff clay.	0.5+	(1.5+)	10.6	(35)

	%	mm	%	Depth below surface (m)	Percentages		
					Fines	Sand	Gravel
Gravel	30	+64	: 1	1.6 - 2.6	4	60	36
		-64+16	: 10	2.6 - 3.6	1	63	36
		-16+4	: 19	3.6 - 4.6	0	56	44
				4.6 - 5.6	1	37	62
Sand	68	-4+1	: 10	5.6 - 6.6	2	54	44
		-1+1/4	: 33	6.6 - 7.6	3	96	1
		-1/4+1/16	: 25	7.6 - 8.6	1	95	4
Fines				8.6 - 9.6	2	76	22
	2	-1/16	: 2	9.6 - 10.1	2	93	5

TM 02 NE 15

0843 2855

Opposite Rudkin's Farm

Block C

Surface level (+34.4 m) +113 ft\*  
 Water struck at (+31.7 m) +104 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.7 m) 9 ft  
 Mineral (6.4 m) 21 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown, sandy clay.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Sandy gravel. Very sandy near top and gravelly between 24 ft (7.3 m) and 27 ft (8.2 m). Gravel: fine subangular flint and quartz, with coarse, subangular to subrounded flint, the latter approaching cobble size between 24 ft (7.3 m) and 27 ft (8.2 m), where coarse gravel is predominant. Sand: reddish-brown; medium, with some coarse.	(6.4)	21	(9.1)	30
London Clay	Brown, weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(10.1)	33

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	40	+16	: 18	9 - 12	8	75	17
		-16+4	: 22	12 - 15	2	53	45
				15 - 18	0	67	33
Sand	57	-4+1	: 12	18 - 21	4	57	39
		-1+ $\frac{1}{4}$	: 40	21 - 24	0	63	37
		- $\frac{1}{4}$ +1/16	: 5	24 - 27	0	33	67
				27 - 30	4	58	38
Fines	3	-1/16	: 3				

TM 02 NE 16

0852 2719

East of Carrington Farm

Block C

Surface level (+32.0 m) +105 ft\*  
 Water struck at (+30.5 m) +100 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.2 m) 4 ft  
 Mineral (7.3 m) 24 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and subsoil		(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy gravel. Most gravelly between 22 ft (6.7 m) and 25 ft (7.6 m). Fines notable in top 3 ft (0.9 m). Gravel: varying amounts of fine and coarse; subangular to rounded flint with subrounded to rounded quartzite and quartz. Sand: yellowish-brown and brown; medium with fine and coarse becoming medium with coarse below 19 ft (5.8 m); subangular to subrounded quartz and subangular flint.	(7.3)	24	(8.5)	28
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(9.4)	31

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	36	+16	: 13	4 - 7	10	60	30
		-16+4	: 23	7 - 10	6	65	29
				10 - 13	2	60	38
Sand	60	-4+1	: 12	13 - 16	3	74	23
		-1+ $\frac{1}{4}$	: 38	16 - 19	3	63	34
		- $\frac{1}{4}$ +1/16	: 10	19 - 22	1	58	41
				22 - 25	3	39	58
Fines	4	-1/16	: 4	25 - 28	5	62	33

Surface level (+30.5 m) +100 ft  
 Water struck at (+26.5 m) +87 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (2.1 m) 7 ft  
 Mineral (5.5 m) 18 ft  
 Waste (0.3 m) 1 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
?Glacial Sand and Gravel	Soil and brown clay.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. 'Very clayey' between 22 ft (6.7 m) and 25 ft (7.6 m). Gravel: mainly fine, becoming fine to coarse at base; subangular to sub-rounded flints. Sand: rust brown to yellowish-brown; coarse with medium becoming mainly medium below.	(5.5)	18	(7.6)	25
	Very silty sand with some gravel.	(0.3)	1	(7.9)	26
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(8.8)	29

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	31	+16	: 10	7 - 10	No grading available		
		-16+4	: 21	10 - 13	0	82	18
				13 - 16	No grading available		
Sand	61	-4+1	: 34	16 - 19	0	57	43
		-1+1/4	: 24	19 - 22	0	56	44
		-1/4+1/16	: 3	22 - 25	32	47	21
Fines	8	-1/16	: 8				

TM 02 NE 18                      0849 2533                      Near Hamilton Lodge                      Block G

Surface level (+34.7 m) +114 ft                      Waste (4.6 m) 15 ft  
 Water struck at (+31.1 m) +102 ft                      Bedrock (0.9 m+) 3 ft+  
 Wirth B0, 8 inch diameter  
 December 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay with flint gravel.	(3.7)	12	(3.7)	12
Glacial Sand and Gravel	Very clayey, fine sand.	(0.9)	3	(4.6)	15
London Clay	Brown weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(5.5)	18

TM 02 NE 19                      0966 2958                      Near Hollylodge Farm                      Block C

Surface level (+34.4 m) +113 ft                      Overburden (2.1 m) 7 ft  
 Water struck at (+31.7 m) +104 ft                      Mineral (5.8 m) 19 ft  
 Wirth B0, 8 inch diameter                      Bedrock (0.9 m+) 3 ft+  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. Becoming increasingly gravelly with depth. Fines content appreciable throughout. Gravel: fine with a little coarse; mainly rounded to subrounded with some subangular; quartz with some flint. Sand: off-white to greyish-brown; medium with coarse.	(5.8)	19	(7.9)	26
London Clay	Brown weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(8.8)	29

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 7	7 - 10	6	71	23
		-16+4	: 28	10 - 13	No grading available		
				13 - 16	8	68	24
Sand	60	-4+1	: 18	16 - 19	9	59	32
		-1+ $\frac{1}{4}$	: 36	19 - 22	4	47	49
		- $\frac{1}{4}$ +1/16	: 6	22 - 25	0	58	42
				25 - 26	4	47	49
Fines	5	-1/16	: 5				

TM 02 NE 20                      0965 2852                      Opposite Newhouse Farm, Little Bromley                      Block C

Surface level (+32.6 m) +107 ft                      Overburden (3.4 m) 11 ft  
 Water struck at (+29.9 m) +98 ft                      Mineral (4.3 m) 14 ft  
 Wirth B0, 8 inch diameter                      Mineral (5.5 m) 18 ft  
 November 1969                      Bedrock (0.9 m+) 3 ft+

			Thickness		Depth	
			(m)	ft	(m)	ft
Soil and made ground.			(3.4)	11	(3.4)	11
Glacial Sand and Gravel	(a)	Pebbly sand. Some fines present throughout. Gravel: fine, subangular quartz and flints, with occasional coarse; subangular to subrounded flints.  Sand: reddish-brown; medium with coarse and some fine.	(4.3)	14	(7.6)	25
Red Crag	(b)	Sand. Gravel: almost absent except for traces of large shell fragments.  Sand: grey; mainly medium but with substantial proportions of fine and coarse; quartz intermixed with comminuted shell debris.	(5.5)	18	(13.1)	43
London Clay		Blue clay.	(0.9+)	3+	(14.0)	46

	%	mm	%	Depth below Surface (ft)	Percentages			
					Fines	Sand	Gravel	
(a) Gravel	25	+16	: 6	11 - 14	5	66	29	
		-16+4	: 19	14 - 17	3	75	22	
	Sand	72	-4+1	: 18	17 - 20	3	64	33
			-1+ $\frac{1}{4}$	: 42	20 - 23	3	79	18
		- $\frac{1}{4}$ +1/16	: 12	23 - 25	3	73	24	
Fines	3	-1/16	: 3					
(b) Gravel	5	+16	: 2	25 - 28	No grading available			
		-16+4	: 3	28 - 31	2	95	3	
	Sand	93	-4+1	: 22	31 - 34	0	98	2
			-1+ $\frac{1}{4}$	: 43	34 - 37	3	93	4
		- $\frac{1}{4}$ +1/16	: 28	37 - 40	2	90	8	
				40 - 43	2	90	8	
Fines	2	-1/16	: 2					

TM 02 NE 21

0941 2777

Near Little Bromley Rectory

Block C

Surface level (+33.2 m) +109 ft  
 Water struck at (+30.8 m) +101 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (1.2 m) 4 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy gravel. Fines content highest in uppermost 6 ft (1.8 m). Gravel: fine with traces of coarse; subangular to rounded flints and occasional quartz. Sand: yellowish-brown; medium with some fine and coarse; subangular to subrounded quartz and occasional flint.	(4.3)	14	(5.5)	18
London Clay	Blue clay.	(0.9+)	3+	(6.4)	21

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	27	+16	: 7	4 - 7	10	66	24
		-16+4	: 20	7 - 10	10	60	30
				10 - 13	4	69	27
Sand	66	-4+1	: 16	13 - 16	3	71	26
		-1+ $\frac{1}{4}$	: 42	16 - 18	6	61	33
		- $\frac{1}{4}$ +1/16	: 8				
Fines	7	-1/16	: 7				

TM 02 NE 22                      0986 2677                      Near Sparling's Hall                      Block G

Surface level (+37.5 m) +123 ft                      Overburden (2.1 m) 7 ft  
 Water struck at (+32.6 m) +107 ft                      Mineral (4.0 m) 13 ft  
 Wirth B0, 8 inch diameter                      Bedrock (0.9 m+) 3 ft+  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown, streaky, sandy clay.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	?Sandy gravel. Fines present throughout the deposit. Gravel: fine with some coarse subangular to subrounded flints and quartz. Sand: reddish-brown, mainly medium with some coarse.	(4.0)	13	(6.1)	20
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(7.0)	23

No grading information available

TM 02 NE 23                      0975 2612                      Near 'The Chase'                      Block G

Surface level (+37.5 m) +123 ft                      Overburden (2.1 m) 7 ft  
 Water struck at (+35.4 m) +116 ft                      Mineral (2.7 m) 9 ft  
 Wirth B0, 8 inch diameter                      Bedrock (0.9 m+) 3 ft+  
 February 1970

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown, sandy clay with gravel.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Sandy gravel. 'Clayey' in the top 3 ft (0.9 m). Gravel: fine with some coarse; angular to subrounded flint, with subrounded and rounded quartz, and traces of quartzites. Sand: brown, medium with some coarse and fine; subangular to subrounded quartz with subangular flint.	(2.7)	9	(4.9)	16
London Clay	Brown, weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(5.8)	19

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	32	+16	: 10	7 - 10	11	64	25
		-16+4	: 22	10 - 13	7	47	46
				13 - 16	8	66	26
Sand	59	-4+1	: 15				
		-1+ $\frac{1}{4}$	: 36				
		- $\frac{1}{4}$ +1/16	: 8				
Fines	9	-1/16	: 9				



TM 02 NE 24

0981 2530

Near Wright Kings

Block G

Surface level (+35.7 m) +117 ft  
 Water struck at (+32.9 m) +108 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.8 m) 6 ft  
 Mineral (2.7 m) 9 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(1.8)	6	(1.8)	6
Glacial Sand and Gravel	'Clayey' pebbly sand. Gravel almost absent in top 3 ft (0.9 m). Gravel: fine and coarse; angular to sub-angular brown and black flint with sub-rounded quartz and quartzites. Sand: grey to brown; medium and fine; subrounded to rounded quartz with traces of angular flint.	(2.7)	9	(4.6)	15
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(5.5)	18

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	8	+16	: 3	6 - 9	23	75	2
		-16+4	: 5	9 - 12	11	78	11
				12 - 15	17	71	12
Sand	75	-4+1	: 4				
		-1+ $\frac{1}{4}$	: 37				
		- $\frac{1}{4}$ +1/16	: 34				
Fines	17	-1/16	: 17				

TM 02 SW 1

0086 2100

Near Roman Hill House

Block E

Surface level (+27.4 m) +90 ft\*  
 Water struck at (+21.6 m) +71 ft  
 Wirth B0, 8 inch diameter  
 October 1969

Overburden (2.7 m) 9 ft  
 Mineral (6.4 m) 21 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and brown sandy clay.	(2.7)	9	(2.7)	9
	Sandy gravel. Gravel content increases from traces only down to 18 ft (5.5 m) to more than 50 per cent towards base. Gravel: fine and coarse; subangular to subrounded flints and quartz, with some quartzite and traces of chalk towards the base. Sand: yellowish-brown to brown; medium and fine down to 21 ft (6.4 m); mainly medium below.	(6.4)	21	(9.1)	30
London Clay	Brown weathered clay.	(0.9+)	3+	(10.1)	33

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	30	+16	: 16	9 - 12	0	99	1
		-16+4	: 14	12 - 15	4	96	0
				15 - 18	1	93	6
Sand	68	-4+1	: 4	18 - 21	2	53	45
		-1+ $\frac{1}{4}$	: 43	21 - 24	1	46	53
		- $\frac{1}{4}$ +1/16	: 21	24 - 27	4	43	53
				27 - 30	4	44	52
Fines	2	-1/16	: 2				

TM 02 SW 2

0163 2232

Near Donyland Lodge

Block E

Surface level (+22.9 m) +75 ft\*  
 Water struck at (+14.6 m) +48 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.7 m) 12 ft  
 Mineral (11.9 m) 39 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and brown sandy clay.	(3.7)	12	(3.7)	12
	Sandy gravel. Very sandy in top 3 ft (0.9 m) and between 33 ft (10.1 m) and 39 ft (11.9 m). Gravel: fine and coarse becoming mostly fine towards base; subangular to sub-rounded flints with quartz and quartzites. Sand: yellowish-brown, medium with traces of fine and coarse to 39 ft (11.9 m); brown, medium and coarse below.	(11.9)	39	(15.5)	51
London Clay	Brown weathered clay.	(0.9+)	3+	(16.5)	54

	%	mm	%	Depth below surface (ft)	Percentages			
					Fines	Sand	Gravel	
Gravel	43	+16	: 16	12 - 15	1	77	22	
		-16+4	: 27	15 - 18	1	46	53	
				18 - 21	0	43	57	
Sand	56	-4+1	: 10	21 - 24	2	42	56	
		-1+ $\frac{1}{4}$	: 39	24 - 27	1	59	40	
		- $\frac{1}{4}$ +1/16	: 7	27 - 30	0	31	69	
				30 - 33	0	59	41	
Fines	1	-1/16	:	1	33 - 36	0	88	12
					36 - 39	1	88	11
					39 - 42	0	54	46
					42 - 45	3	36	61
					45 - 48	0	41	59
		48 - 51	0	68	32			

TM 02 SW 3

0197 2082

Near Donyland Wood

Block E

Surface level (+23.8 m) +78 ft\*  
 Water struck at (+18.0 m) +59 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (4.0 m) 13 ft  
 Mineral (4.6 m) 15 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and brown fine clayey sand with gravel.	(4.0)	13	(4.0)	13
	Gravel. More gravelly and less sandy with depth. Gravel: fine and coarse; subrounded, with some subangular flints, quartzites and quartz. Sand: grey to brown; medium with a little fine and coarse.	(4.6)	15	(8.5)	28
London Clay	Brown clay, passing down into blue clay.	(0.9+)	3+	(9.4)	31

	% mm	%	Depth below surface (ft)	Percentages		
				Fines	Sand	Gravel
Gravel	55 +16	: 27	13 - 16	8	53	39
	-16+4	: 28	16 - 19	0	48	52
			19 - 22	5	38	57
Sand	41 -4+1	: 8	22 - 25	3	32	65
	-1+1/4	: 27	25 - 28	4	36	60
	-1/4+1/16	: 6				
Fines	4 -1/16	: 4				

TM 02 SW 4                                0224 2434                        Salarybrook Farm                                Block D

Surface level (+3.7 m) +12 ft  
Groundwater conditions not recorded  
Wirth B0, 8 inch diameter  
November 1969

Waste (5.2 m) 17 ft  
Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Alluvium	Soil and brown silty clay.	(4.3)	14	(4.3)	14
Sub-Alluvium Gravel	'Very clayey' gravel.	(0.9)	3	(5.2)	17
London Clay	Brown weathered clay.	(0.9+)	3+	(6.1)	20

TM 02 SW 5                                0302 2352                        Near Wivenhoe Lodge                                Block D

Surface level (+32.2 m) +105 ft\*  
Water struck at (+27.7 m) +91 ft  
Wirth B0, 8 inch diameter  
November 1969

Overburden (4.3 m) 14 ft  
Mineral (5.8 m) 19 ft  
Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	'Very clayey' gravel.	(0.9)	3	(4.3)	14
	Sandy gravel. Cobbles occur between 26 ft (7.9 m) and 29 ft (8.8 m). Very gravelly between 17 ft (5.2 m) and 23 ft (7.0 m) and at base. Gravel: fine at top becoming fine to coarse below; subangular flints and occasional quartz and quartzites, with large sub-rounded flints. Sand: brown, fine and medium in top 3 ft (0.9 m); medium with some coarse below.	(5.8)	19	(10.1)	33
London Clay	Brown weathered clay.	(0.9+)	3+	(11.0)	36

	% mm	%	Depth surface surface (ft)	Percentages		
				Fines	Sand	Gravel
Gravel 44	+16	: 19	14 - 17	2	68	30
	-16+4	: 25	17 - 20	1	34	65
			20 - 23	5	42	53
Sand 54	-4+1	: 9	23 - 26	5	55	40
	-1+ $\frac{1}{4}$	: 35	26 - 29	0	67	33
	- $\frac{1}{4}$ +1/16	: 10	29 - 32	0	65	35
			32 - 33	0	44	56
Fines 2	-1/16	: 2				

TM 02 SW 6

0252 2211

Near Battleswick Farm

Block E

Surface level (+19.8 m) +65 ft\*  
 Water struck at (+16.5 m) +54 ft  
 Wirth B0, 8 inch diameter  
 October 1969

Overburden (2.7 m) 9 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
?Glacial Sand and Gravel	Soil and sand with clay and silt	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Sandy gravel. Very sandy in top 3 ft (0.9 m); gravelly below. Gravel: subangular to subrounded flints and quartz; fine at the top, becoming fine and coarse below. Sand: buff to brown; medium with fine and a little coarse.	(3.7)	12	(6.4)	21
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(7.3)	24

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	41	+16	: 19	9 - 12	4	78	18
		-16+4	: 22	12 - 15	1	47	52
				15 - 18	2	48	50
Sand	55	-4+1	: 7	18 - 21	8	47	45
		-1+ $\frac{1}{4}$	: 37				
		- $\frac{1}{4}$ +1/16	: 11				
Fines	4	-1/16	: 4				

TM 02 SW 7

0287 2098

East Donyland Hall

Block E

Surface level (+16.8 m) +55 ft\*  
 Water struck at (+10.7 m) +35 ft\*  
 Wirth B0, 8 inch diameter  
 October 1969

Overburden (2.4 m) 8 ft  
 Mineral (7.0 m) 23 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and sand with a high organic content.	(2.4)	8	(2.4)	8
	Pebbly sand. Very sandy in the top 6 ft (1.8 m), becoming gravelly in the middle of the deposit but less gravelly again towards base.	(7.0)	23	(9.4)	31
	Gravel: fine with coarse; subangular to subrounded flints and quartz; coarsest between 17 ft (5.2 m) and 23 ft (7.0 m) and from 26 ft (7.9 m) to 29 ft (8.8 m). Sand: brown; medium with fine in the top 9 ft (2.7 m); mostly medium below.				
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(10.4)	34

	%	mm	Depth below		Percentages		
			%	surface (ft)	Fines	Sand	Gravel
Gravel	25	+16	: 12	8 - 11	1	98	1
		-16+4	: 13	11 - 14	1	93	6
				14 - 17	1	79	20
Sand	74	-4+1	: 4	17 - 20	1	42	57
		-1+1/4	: 57	20 - 23	2	56	42
		-1/4+1/16	: 13	23 - 26	2	81	17
				26 - 29	2	61	37
Fines	1	-1/16	: 1	29 - 31	2	84	14

Surface level (+22.9 m) +75 ft \*  
 Water struck at (+12.5 m) +41 ft  
 Wirth B0, 8 inch diameter  
 October 1969

Overburden (3.4 m) 11 ft  
 Mineral (9.1 m) 30 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness (m)	ft	Depth (m)	ft
?Glacial Sand and Gravel	Soil and brown sandy clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	Sandy gravel. A few subrounded flint cobbles occur within the top 9 ft (2.7 m). Very sandy between 20 ft (6.1 m) and 23 ft (7.0 m). Gravel: subangular to subrounded flints and subrounded quartz with occasional quartzite and traces of chalk; mainly fine with coarse. Sand: brown to yellowish-brown; fine to medium in the top 3 ft (0.9 m); mainly medium below.	(9.1)	30	(12.5)	41
London Clay	Brown weathered clay passing down into fresh blue clay.	(0.9+)	3+	(13.4)	44

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 14	11 - 14	5	74	21
		-16+4	: 21	14 - 17	2	46	52
				17 - 20	1	73	26
Sand	63	-4+1	: 6	20 - 23	1	91	8
		-1+ $\frac{1}{4}$	: 47	23 - 26	0	67	33
		- $\frac{1}{4}$ +1/16	: 10	26 - 29	0	58	42
				29 - 32	6	57	37
Fines	2	-1/16	: 2	32 - 35	1	58	41
				35 - 38	2	55	43
				38 - 41	1	53	46



TM 02 SW 9

0327 2461

Home Farm

Block D

Surface level (+34.1 m) +112 ft  
 Water struck at (+28.3 m) +93 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (5.8 m) 19 ft  
 Mineral (7.3 m) 24 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(3.4)	11	(3.4)	11
	Grey silt.	(2.4)	8	(5.8)	19
Glacial Sand and Gravel	Gravel. Very sandy at top. Increase in fines content towards base. Gravel: fine; subrounded flints with quartz and quartzite, with some coarse; subangular to subrounded flints. Sand: brown; medium with traces of fine and coarse in places.	(7.3)	24	(13.1)	43
London Clay	Brown weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(14.0)	46

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	49	+16	: 21	19 - 22	0	71	29
		-16+4	: 28	22 - 25	5	39	56
				25 - 28	1	42	57
Sand	47	-4+1	: 8	28 - 31	3	46	51
		-1+ $\frac{1}{4}$	: 32	31 - 34	2	50	48
		- $\frac{1}{4}$ +1/16	: 7	34 - 37	7	46	47
				37 - 40	7	31	62
Fines	4	-1/16	: 4	40 - 43	8	47	45

TM 02 SW 10

0378 2386

Opposite entrance to Wivenhoe Lodge

Block D

Surface level (+35.1 m) +115 ft \*  
 Water struck at (+31.4 m) +103 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (6.7 m) 22 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(5.5)	18	(5.5)	18
	Grey silt.	(1.2)	4	(6.7)	22
Glacial Sand and Gravel	Gravel. The gravel content increases downwards at the expense of the sand. Gravel. fine and coarse; subangular flints and quartz with subrounded quartz and quartzite. Sand: pale grey, medium with traces of coarse and fine.	(3.7)	12	(10.4)	34
London Clay	Brown weathered clay.	(0.9+)	3+	(11.3)	37

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	51	+16	: 24	22 - 25	0	65	35
		-16+4	: 27	25 - 28	1	42	57
Sand	49	-4+1	: 8	28 - 31	0	48	52
		-1+ $\frac{1}{4}$	: 35	31 - 34	0	40	60
		- $\frac{1}{4}$ +1/16	: 6				
Fines	0	-1/16	: 0				

TM 02 SW 11

0374 2260

Spring Lane, Wivenhoe

Block F

Surface level (+25.9 m) +85 ft\*  
 Water struck at (+22.9 m) +75 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (2.7 m) 9 ft  
 Mineral (3.0 m) 10 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness (m)	ft	Depth (m)	ft
?Glacial Sand and Gravel	Soil and gravel with black clay and silt.	(2.7)	9	(2.7)	9
Glacial Sand and Gravel	Gravel. Becoming more sandy and less gravelly with depth. Gravel: fine and coarse; subangular to subrounded flints with subrounded quartz and quartzite. Sand: brown; mainly medium and coarse.	(3.0)	10	(5.8)	19
London Clay	Brown weathered clay.	(0.9+)	3+	(6.7)	22

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	68	+16	: 30	9 - 12	0	27	73
		-16+4	: 38	12 - 15	1	31	68
				15 - 18	0	34	66
Sand	32	-4+1	: 12	18 - 19	0	42	58
		-1+1/4	: 16				
		-1/4+1/16	: 4				
Fines	0	-1/16	: 0				

TM 02 SW 12

0352 2042

Near High Park Corner, Fingrinhoe

Block E

Surface level (+21.3 m) +70 ft\*  
 Water struck at (+17.1 m) +56 ft  
 Wirth B0, 8 inch diameter  
 October 1969

Overburden (3.4 m) 11 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
?Glacial Sand and Gravel	Soil and sandy clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	Sandy gravel. 'Clayey' in the top 3 ft (0.9 m) with traces only of gravel. A few cobbles between 14 ft (4.3 m) and 17 ft (5.2 m). Gravel: mainly fine, but fine to coarse between 14 ft (4.3 m) and 20 ft (6.1 m); subangular to subrounded quartz, flint and traces of chalk, with some rounded quartz and flint. Sand: buff to brown; medium and fine for 3 ft (0.9 m) at the top; mainly medium below.	(4.3)	14	(7.6)	25
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(8.5)	28

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	23	+16	: 9	11 - 14	14	81	5
		-16+4	: 14	14 - 17	1	68	31
				17 - 20	5	63	32
Sand	70	-4+1	: 7	20 - 23	No grading available		
		-1+ $\frac{1}{4}$	: 43	23 - 25	8	65	27
		- $\frac{1}{4}$ +1/16	: 20				
Fines	7	-1/16	: 7				

Surface level (+33.2 m) +109 ft                      Overburden (5.5 m) 18 ft  
 Water struck at (+26.8 m) +88 ft                      Mineral (4.3 m) 14 ft  
 Wirth B0, 8 inch diameter                      Bedrock (0.9 m+) 3 ft+  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay with gravel.	(3.4)	11	(3.4)	11
	Gravel contaminated by a high percentage of grey silt and clay.	(2.1)	7	(5.5)	18
Glacial Sand and Gravel	Pebbly sand. 'Clayey' for 3 ft (0.9 m) at the top. Gravelly near top and base. Gravel: fine with some coarse; subangular to subrounded flints and quartz with some trace of chalk in places. Sand: brown, medium with coarse in the top 3 ft (0.9 m); greyish-brown, medium with fine below.	(4.3)	14	(9.8)	32
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(10.7)	35

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	24	+16	: 9	18 - 21	12	64	24
		-16+4	: 15	21 - 24	0	88	12
				24 - 27	2	90	8
Sand	73	-4+1	: 9	27 - 30	0	65	35
		-1+ $\frac{1}{4}$	: 49	30 - 32	3	55	42
		- $\frac{1}{4}$ +1/16	: 15				
Fines	3	-1/16	: 3				

Surface level (+33.5 m) +110 ft\*  
 Water struck at (+30.2 m) +99 ft  
 Wirth B0, 8 inch diameter  
 November 1970

Overburden (4.6 m) 15 ft  
 Mineral (2.7 m) 9 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and gravel contaminated by black clay and silt.	(4.0)	13	(4.0)	13
	Grey silt.	(0.6)	2	(4.6)	15
Glacial Sand and Gravel	Sandy gravel. Gravel: fine with some coarse; sub-angular to subrounded flints and sub-rounded quartzites and quartz. Sand: pale brown, mostly medium.	(2.7)	9	(7.3)	24
London Clay	Brown weathered clay.	(0.9+)	3+	(8.2)	27

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	48	+16	: 17	15 - 18	2	52	46
		-16+4	: 31	18 - 21	1	51	48
				21 - 24	1	49	50
Sand	51	-4+1	: 6				
		-1+ $\frac{1}{4}$	: 36				
		- $\frac{1}{4}$ +1/16	: 9				
Fines	1	-1/16	: 1				

TM 02 SE 1                      0558 2414                      Fen Farm                      Block D

Surface level (+30.5 m) +100 ft                      Waste (13.7 m) 45 ft  
 Water struck at (+20.1 m) +66 ft                      Bedrock (0.9 m+) 3 ft+  
 Wirth B0, 8 inch diameter  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Drift (Channel Fill?)	Soil and brown silty clay.	(6.1)	20	(6.1)	20
	Grey silt.	(5.8)	19	(11.9)	39
Glacial Sand and Gravel	Pebbly sand; brown, medium sand with scattered, fine, subrounded quartz gravel.	(1.8)	6	(13.7)	45
London Clay	Brown weathered clay passing down into fresh blue clay.	(0.9+)	3+	(14.6)	48

TM 02 SE 2                      0584 2314                      Near Charity Farm                      Block F

Surface level (+30.8 m) +101 ft                      Overburden (4.3 m) 14 ft  
 Water struck at (+25.0 m) +82 ft                      Mineral (5.5 m) 18 ft  
 Wirth B0, 8 inch diameter                      Bedrock (0.9 m+) 3 ft+  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	Gravel and sand contaminated by clay and silt.	(0.9)	3	(4.3)	14
	Sandy gravel. Becoming increasingly sandy and less gravelly from 20 ft (6.1 m) to base. Gravel: fine with coarse becoming mainly fine near base; subangular to subrounded flints and subrounded quartz. Sand: dark brown to pale brown; medium with coarse to 23 ft (7.0 m) becoming mostly medium below.	(5.5)	18	(9.8)	32
London Clay	Brown weathered clay.	(0.9+)	3+	(10.7)	35

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 13	14 - 17	1	62	37
		-16+4	: 22	17 - 20	0	45	55
				20 - 23	4	57	39
Sand	64	-4+1	: 11	23 - 26	0	64	36
		-1+ $\frac{1}{4}$	: 48	26 - 29	1	74	25
		- $\frac{1}{4}$ +1/16	: 5	29 - 32	1	81	18
Fines	1	-1/16	: 1				

TM 02 SE 3

0516 2197

Sunnymede Farm

Block F

Surface level (+29.3 m) +96 ft  
 Water struck at (+26.2 m) +86 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.4 m) 4.5 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and subsoil .		(1.4)	4.5	(1.4)	4.5
Glacial Sand and Gravel	Gravel. Becoming increasingly gravelly and less sandy downwards. Gravel: fine with coarse; subangular to subrounded flints with occasional quartzites. Sand: brown; mainly medium; subangular to subrounded quartz and flint.	(3.7)	12	(5.0)	16.5
London Clay	Blue clay.	(0.9+)	3+	(5.9)	19.5

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	63	+16	: 27	4.5 - 7.5	4	57	39
		-16+4	: 36	7.5 - 10.5	4	34	62
Sand	34	-4+1	: 9	10.5 - 13.5	2	25	73
		-1+ $\frac{1}{4}$	: 20	13.5 - 16.5	2	21	77
		- $\frac{1}{4}$ +1/16	: 5				
Fines	3	-1/16	: 3				



Surface level (+25.3 m) +83 ft  
 Water struck at (+15.5 m) +51 ft  
 Wirth B0, 8 inch diameter  
 May 1970

Overburden (0.3 m) 1 ft  
 Mineral (10.7 m) 35 ft  
 Bedrock (0.3 m+) 1 ft+

Soil.	Description	Thickness		Depth	
		(m)	ft	(m)	ft
Soil.		(0.3)	1	(0.3)	1
Glacial Sand and Gravel	Sandy gravel. 'Clayey' in the top 6 ft (1.8 m) and at the base. The gravel content increases with depth. Gravel: fine at the top, becoming fine and coarse below, and mainly coarse towards the base. Subangular to rounded flints with occasional quartzites. Sand: yellow to orange-brown; medium and fine at the top; becoming mainly medium and then medium to coarse below.	(10.7)	35	(11.0)	36
London Clay	Brown, weathered clay with blue streaks.	(0.3+)	1+	(11.3)	37

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	44	+16	: 20	1 - 4	11	79	10
		-16+4	: 24	4 - 7	19	76	5
				7 - 10	3	73	24
Sand	50	-4+1	: 10	10 - 13	3	59	38
		-1+1/4	: 28	13 - 16	5	52	43
		-1/4+1/16	: 12	16 - 19	3	46	51
				19 - 22	3	43	54
Fines	6	-1/16	: 6	22 - 25	0	43	57
				25 - 28	3	34	63
				28 - 31	4	33	63
				31 - 34	9	28	63
				34 - 36	13	22	65

TM 02 SE 5

0667 2432

Near White Barn, Elmstead Market

Block D

Surface level (+31.1 m) +102 ft  
 Water struck at (+25.3 m) +83 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (4.0 m) 13 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown silty clay.	(2.4)	8	(2.4)	8
Glacial Sand and Gravel	Gravel contaminated by excess clay and silt.	(1.5)	5	(4.0)	13
	Sandy gravel. Gravel: fine with some coarse; sub- angular to subrounded flints and sub- rounded quartz. Sand: brown, medium with traces of coarse.	(4.3)	14	(8.2)	27
London Clay	Brown weathered clay.	(0.9+)	3+	(9.1)	30

	% mm	%	Depth below surface (ft)	Percentages		
				Fines	Sand	Gravel
Gravel	33 +16	: 11	13 - 16	3	64	33
	-16+4	: 22	16 - 19	1	73	26
			19 - 22	0	60	40
Sand	65 -4+1	: 13	22 - 25	5	56	39
	-1+1/4	: 46	25 - 27	0	78	22
	-1/4+1/16	: 6				
Fines	2 -1/16	: 2				

Surface level (+31.4 m) +103 ft  
 Water struck at (+28.3 m) +93 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (3.4 m) 11 ft  
 Mineral (8.2 m) 27 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Made ground, soil, and brown silty clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	Sandy gravel. Gravelly at top becoming sandy towards centre and more gravelly again at base. Gravel: fine with some coarse; subangular to subrounded flints and quartz, frequently iron-stained in the top 4 ft (1.2 m), and occasional, subrounded quartzite. Sand: reddish-brown, medium and coarse to 15 ft (4.6 m); yellowish-brown, medium with some fine and coarse to 33 ft (10.1 m); silver grey medium with coarse to base.	(8.2)	27	(11.6)	38
London Clay	Brown weathered clay, passing down into fresh, blue clay.	(0.9+)	3+	(12.5)	41

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	33	+16	: 11	11 - 12	8	57	35
		-16+4	: 22	12 - 15	3	52	45
				15 - 18	3	63	34
Sand	64	-4+1	: 13	18 - 21	3	74	23
		-1+ $\frac{1}{4}$	: 42	21 - 24	4	77	19
		- $\frac{1}{4}$ +1/16	: 9	24 - 27	1	73	26
				27 - 30	3	58	39
Fines	3	-1/16	: 3	30 - 33	2	64	34
				33 - 36	1	63	36
				36 - 38	1	48	51

Surface level (+29.9 m) +98 ft  
 Water struck at (+27.7 m) +91 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (1.2 m) 4 ft  
 Mineral (9.1 m) 30 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness (m)	ft	Depth (m)	ft
Loam	Soil and brown sandy clay.	(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy gravel. 'Clayey' in the top 3 ft (0.9 m). A few cobbles occur between 25 ft (7.6 m) and 28 ft (8.5 m). Most sandy between 10 ft (3.0 m) and 13 ft (4.0 m) and between 28 ft (8.5 m) and 31 ft (9.4 m). Gravel: fine with some coarse; subangular to rounded flint with occasional rounded quartz. Sand: yellowish-brown, medium with some coarse; subangular to subrounded quartz and a small proportion of flint.	(9.1)	30	(10.4)	34
London Clay	Blue clay.	(0.9+)	3+	(11.3)	37

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 12	4 - 7	12	54	34
		-16+4	: 23	7 - 10	6	64	30
				10 - 13	5	70	25
Sand	60	-4+1	: 13	13 - 16	3	59	38
		-1+1/4	: 39	16 - 19	4	51	45
		-1/4+1/16	: 8	19 - 22	3	57	40
				22 - 25	3	56	41
Fines	5	-1/16	: 5	25 - 28	4	58	38
				28 - 31	6	79	15
				31 - 34	4	53	43

TM 02 SE 8

0680 2179

Elmstead Row, Alresford

Block F

Surface level (+29.0 m) +95 ft  
 Water struck at (+24.7 m) +81 ft  
 Wirth B0, 8 inch diameter  
 May 1970

Overburden (2.4 m) 8 ft  
 Mineral (4.0 m) 13 ft  
 Bedrock (0.6 m+) 2 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(2.4)	8	(2.4)	8
Glacial Sand and Gravel	Sandy gravel. Gravel: mainly coarse at the top, becoming finer with depth; mainly subangular to subrounded flints with some rounded flints below 17 ft (5.2 m). Sand: grey to greyish-brown; medium with fine in the top 3 ft (0.9 m), medium with coarse below.	(4.0)	13	(6.4)	21
London Clay	Brown weathered clay.	(0.6+)	2+	(7.0)	23

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	25	+16	: 10	8 - 11	4	79	17
		-16+4	: 15	11 - 14	5	67	28
				14 - 17	3	64	33
Sand	71	-4+1	: 11	17 - 20	3	74	23
		-1+ $\frac{1}{4}$	: 49	20 - 21	No grading available		
		- $\frac{1}{4}$ +1/16	: 11				
Fines	4	-1/16	: 4				

TM 02 SE 9

0653 2070

South of Church Farm

Block F

Surface level (+25.3 m) +83 ft  
 Water struck at (+22.3 m) +73 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (0.6 m) 2 ft  
 Mineral (4.9 m) 16 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil.		(0.6)	2	(0.6)	2
Glacial Sand and Gravel	Gravel. Gravel content increases downwards. Gravel: mainly fine, becoming coarser with depth and approaching cobble size in places; subangular to subrounded flints with some subrounded quartz and traces of quartzite. Sand: brown to yellowish-brown; mainly medium; subangular to subrounded quartz and flint.	(4.9)	16	(5.5)	18
London Clay	Brown weathered clay, passing down into fresh, bluish-grey clay.	(0.9+)	3+	(6.4)	21

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	54	+16	: 22	2 - 5	7	60	33
		-16+4	: 32	5 - 8	5	46	49
				8 - 11	3	35	62
Sand	41	-4+1	: 11	11 - 14	5	41	54
		-1+1/4	: 25	14 - 18	3	28	69
		-1/4+1/16	: 5				
Fines	5	-1/16	: 5				

TM 02 SE 10                      0792 2468                      Near Broughton                      Block G

Surface level (+31.1 m) +102 ft  
 Water not  
 Wirth B0, 8 inch diameter  
 December 1969

Overburden (2.4 m) 8 ft  
 Mineral (1.2 m) 4 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and sandy clay with gravel.	(2.4)	8	(2.4)	8
Glacial Sand and Gravel	Medium to coarse sand with fine to coarse gravel.	(1.2)	4	(3.7)	12
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(4.6)	15

No grading information available

TM 02 SE 11                      0734 2361                      Blue Barn, Elmstead Market                      Block D

Surface level (+26.2 m) +86 ft  
 Water struck at (+22.6 m) +74 ft  
 Wirth B1, 8 inch diameter  
 February 1970

Overburden (1.8 m) 6 ft  
 Mineral (3.4 m) 11 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and brown sand with gravel, contaminated by excess clay and silt.	(1.8)	6	(1.8)	6
	Pebbly sand. Band of pale blue clay between 11 ft (3.4 m) and 12 ft (3.7 m). 'Clayey' above 11 ft (3.4 m), and more sandy from 12 ft (3.7 m) to base. Gravel: mostly fine with traces of coarse; angular to well rounded flints with some subangular to rounded quartz. Sand: mainly medium; subangular to sub-rounded quartz with some flint.	(3.4)	11	(5.2)	17
London Clay	Blue clay.	(0.9+)	3+	(6.1)	20

	%	mm	Depth below		Fines	Percentages	
			%	Surface (ft)		Sand	Gravel
Gravel	19	+16	: 4	6 - 9	11	62	27
		-16+4	: 15	9 - 11	13	71	16
Sand	73	-4+1	: 11	1 ft Clay band between 11 ft and 12 ft			
		-1+ $\frac{1}{4}$	: 55				
		- $\frac{1}{4}$ +1/16	: 7	12 - 14	7	77	16
				14 - 17	3	82	15
Fines	8	-1/16	: 8				

TM 02 SE 12

0778 2303

Near Frating Lodge

Block G

Surface level (+31.4 m) +103 ft  
 Water struck at (+29.3 m) +96 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.2 m) 4 ft  
 Mineral (6.1 m) 20 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
?River Brickearth	Soil and brown silty clay.	(1.2)	4	(1.2)	4
Glacial Sand and Gravel	Sandy gravel. 'Clayey' at the top. Very gravelly at the base. Gravel: mostly fine with coarse, but mainly coarse with traces of cobble size at the bottom; subangular to rounded flints with some rounded quartz. Sand: brown to yellowish-brown; medium with some coarse and fine; mostly subangular and subrounded quartz, with some subangular flint.	(6.1)	20	(7.3)	24
London Clay	Brown clay, passing down into blue clay.	(0.9+)	3+	(8.2)	27

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	26	+16	: 11	4 - 7	11	72	17
		-16+4	: 15	7 - 10	10	74	16
				10 - 13	8	71	21
Sand	67	-4+1	: 10	13 - 16	6	62	32
		-1+ $\frac{1}{4}$	: 45	16 - 19	6	73	21
		- $\frac{1}{4}$ +1/16	: 12	19 - 22	4	68	28
				22 - 24	2	38	60
Fines	7	-1/16	: 7				



TM 02 SE 13

0802 2119

Near Brook Farm

Block G

Surface level (+20.1 m) +66 ft  
 Water not struck  
 Wirth B1, 8 inch diameter  
 February 1970

Mineral (2.7 m) 9 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Gravel. Becoming more gravelly and less sandy downwards. Noticeable proportion of fines present throughout. Gravel: fine; subangular to rounded flints with a little quartz. Sand: brown; medium and coarse; subangular to subrounded quartz and some flint.	(2.7)	9	(2.7)	9
London Clay	Blue clay.	(0.9+)	3+	(3.7)	12

			Depth below surface (ft)	Percentages								
%	mm	%		Fines	Sand	Gravel						
Gravel	51	+16	:	11	0 - 3	10	50	40				
		-16+4	:	40					3 - 6	9	40	51
			:						6 - 9	8	31	61
Sand	40	-4+1	:	17								
		-1+ $\frac{1}{4}$	:	19								
		- $\frac{1}{4}$ +1/16	:	4								
Fines	9	-1/16	:	9								

TM 02 SE 14

0739 2054

Alresford Hall Farm

Block F

Surface level (+25.3 m) +83 ft  
 Water struck at (+24.1 m) +79 ft  
 Wirth B1, 8 inch diameter  
 May 1970

Overburden (0.6 m) 2 ft  
 Mineral (3.7 m) 12 ft  
 Bedrock (0.3 m+) 1 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil.		(0.6)	2	(0.6)	2
Glacial Sand and Gravel	Pebbly sand. Becoming more gravelly downwards.	(3.7)	12	(4.3)	14
	Gravel: fine with coarse; subangular to subrounded flints with subrounded quartz. Sand: brown; medium with a little coarse, and fine; subangular quartz.				
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(8.2)	27

	% mm	%	Depth below surface (ft)	Percentages		
				Fines	Sand	Gravel
Gravel 17	+16	: 8	6 - 9	18	82	0
	-16+4	: 9	9 - 12	19	80	1
			12 - 15	20	79	1
Sand 68	-4+1	: 2	15 - 18	11	56	33
	-1+ $\frac{1}{4}$	: 18	18 - 21	No grading available		
	- $\frac{1}{4}$ +1/16	: 48	21 - 24	6	46	48
Fines 15	-1/16	: 15				

TM 02 SE 15                      0882 2470                      Black Boy Garage, Harwich Road                      Block G

Surface level (+34.4 m) +113 ft  
 Water struck at (+32.0 m) +105 ft  
 Wirth B0, 8 inch diameter  
 December 1969

Waste (4.6 m) 15 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(1.8)	6	(1.8)	6
	Grey silt.	(1.2)	4	(3.0)	10
	Brownish-grey silty clay.	(1.5)	5	(4.6)	15
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(5.5)	18

TM 02 SE 16                      0846 2382                      Morehams Hall, Frating Green                      Block G

Surface level (+29.9 m) +98 ft  
 Water struck at (+27.4 m) +90 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.5 m) 5 ft  
 Mineral (1.2 m) 4 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and sandy clay.	(1.5)	5	(1.5)	5
Glacial Sand and Gravel	'Clayey' sandy gravel. Appreciable fines content throughout. Gravel: fine with coarse; subangular to rounded flint with quartz. Sand: brown; mainly medium; subangular to subrounded quartz, with a little subangular flint.	(1.2)	4	(2.7)	9
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(3.7)	12

			Depth below surface (ft)	Percentages		
%	mm	%		Fines	Sand	Gravel
Gravel 42	+16	: 17	5 - 8	10	47	43
	-16+4	: 25	8 - 9	9	50	41
Sand 48	-4+1	: 9				
	-1+1/4	: 33				
	-1/2+1/16	: 6				
Fines 10	-1/16	: 10				

TM 02 SE 17

0884 2324

Near Holly Farm, Frating Green

Block G

Surface level (+30.2 m) +99 ft\*  
 Water struck at (+22.3 m) +73 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.0 m) 10 ft  
 Mineral (1.8 m) 6 ft  
 Waste (7.0 m) 23 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and streaky brown clay.	(2.1)	7	(2.1)	7
Glacial Sand and Gravel	Reddish-brown clay with gravel.	(0.9)	3	(3.0)	10
	Sandy gravel.	(1.8)	6	(4.9)	16
	Gravel: fine with coarse; subangular to subrounded flint and quartz.				
	Sand: reddish-brown; medium with some coarse.				
	Grey silt.	(6.7)	22	(11.6)	38
	Dirty clay with fine and coarse gravel.	(0.3)	1	(11.9)	39
London Clay	Brown weathered clay passing down into fresh blue clay.	(0.9+)	3+	(12.8)	42

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	35	+16	: 13	10 - 13	3	62	35
		-16+4	: 22	13 - 16			
Sand	62	-4+1	: 12		No grading available		
		-1+ $\frac{1}{4}$	: 43				
		- $\frac{1}{4}$ +1/16	: 7				
Fines	3	-1/16	: 3				

Surface level (+29.3 m) +96 ft  
 Water struck at (+27.1 m) +89 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (0.9 m) 3 ft  
 Mineral (8.5 m) 28 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and brown sand contaminated by excess clay.	(0.9)	3	(0.9)	3
	Sandy gravel. Sandy to 13 ft (4.0 m), gravelly below. A few subangular cobbles occur in the bottom 9 ft (2.7 m). Gravel: fine with some coarse; subangular to rounded flints with a little rounded quartz to 25 ft (7.6 m); predominantly subangular flints below. Sand: yellowish-brown; mainly medium, becoming medium to coarse and then mainly coarse below 19 ft (5.8 m); subangular to subrounded quartz with subangular flint.	(8.5)	28	(9.4)	31
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(10.4)	34

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	45	+16	: 12	3 - 7	No grading available		
		-16+4	: 33	7 - 10	5	68	27
				10 - 13	4	74	22
Sand	52	-4+1	: 19	13 - 16	1	55	44
		-1+ $\frac{1}{4}$	: 26	16 - 19	3	52	45
		- $\frac{1}{4}$ +1/16	: 7	19 - 22	3	47	50
				22 - 25	2	36	62
Fines	3	-1/16	: 3	25 - 28	2	41	57
				28 - 31	3	40	57

TM 02 SE 19                      0842 2047                      Tenpenny Hill, Thorrington                      Block G

Surface level (+22.6 m) +74 ft                      Waste (1.2 m) 4 ft  
 Water struck at (+21.6 m) +71 ft                      Bedrock (1.8 m+) 6 ft+  
 Wirth B0, 8 inch diameter  
 February 1970

		Thickness		Depth	
		(m)	ft	(m)	ft
Soil and made ground.		(1.2)	4	(1.2)	4
?London Clay	Brown silty clay.	(0.9)	3	(2.1)	7
London Clay	Brown weathered clay.	(0.9+)	3+	(3.0)	10

TM 02 SE 20                      0974 2444                      Near Balls Green                      Block G

Surface level (+30.8 m) +101 ft                      Waste (5.2 m) 17 ft  
 Water struck at (+27.1 m) +89 ft                      Bedrock (0.9 m+) 3 ft+  
 Wirth B0, 8 inch diameter  
 November 1969

		Thickness		Depth	
		(m)	ft	(m)	ft
Glacial Sand and Gravel	Soil and gravel contaminated by excess clay content.	(2.1)	7	(2.1)	7
	Grey silty clay with gravel.	(2.1)	7	(4.3)	14
	'Clayey' sandy gravel. Fine and coarse; subangular to subrounded flint gravel, and brown to greyish-brown, medium with fine sand intermixed with blue silt and clay.	(0.9)	3	(5.2)	17
London Clay	Brown weathered clay.	(0.9+)	3+	(6.1)	20

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	32	+16 -16+4	: 16 : 16	14 - 17	18	50	32
Sand	50	-4+1 -1+ $\frac{1}{4}$ - $\frac{1}{4}$ +1/16	: 3 : 32 : 15				
Fines	18	-1/16	: 18				

TM 02 SE 21

0959 2349

Frating Green

Block G

Surface level (+26.5 m) +87 ft  
 Water struck at (+22.3 m) +73 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (1.8 m) 6 ft  
 Mineral (5.5 m) 18 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay.	(1.8)	6	(1.8)	6
Glacial Sand and Gravel	'Clayey' pebbly sand. High fines content and very little gravel in the top 9 ft (2.7 m), becoming more gravelly below. Gravel: traces of fine to 15 ft (4.6 m); fine and coarse below; subangular to subrounded flints and quartz. Sand: orange-brown; fine, becoming medium below 15 ft (4.6 m).	(5.5)	18	(7.3)	24
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.3+)	1+	(4.6)	15

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	23	+16	: 8	2 - 5	10	77	13
		-16+4	: 15	5 - 8	6	77	17
				8 - 11	4	70	26
Sand	71	-4+1	: 12	11 - 14	3	59	38
		-1+1/4	: 51				
		-1/4+1/16	: 8				
Fines	6	-1/16	: 6				

Surface level (+29.6 m) +97 ft  
 Water struck at (+24.7 m) +81 ft  
 Wirth B0, 8 inch diameter  
 November 1969

Overburden (3.4 m) 11 ft  
 Mineral (8.2 m) 27 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown clay.	(3.4)	11	(3.4)	11
Glacial Sand and Gravel	Pebbly sand. 'Clayey' for 3 ft (0.9 m) at the top. Gravelly from 29 ft (8.8 m) to 32 ft (9.8 m). Sand: pale brown, mainly medium throughout, with varying amounts of fine and coarse. Gravel: mostly fine but quite coarse below 29 ft (8.8 m); subangular to subrounded flints and quartz with some rounded quartz.	(8.2)	27	(11.6)	38
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(12.5)	41

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	20	+16	: 7	11 - 14	14	70	16
		-16+4	: 13	14 - 17	8	82	10
				17 - 20	6	89	5
Sand	76	-4+1	: 11	20 - 23	5	83	12
		-1+1/4	: 53	23 - 26	0	90	10
		-1/4+1/16	: 12	26 - 29	0	84	16
				29 - 32	0	51	49
Fines	4	-1/16	: 4	32 - 35	2	83	15
				35 - 38	1	49	50



Surface level (+28.3 m) +93 ft  
 Water struck at +25.1 m (+82.5 ft)  
 Pilcon Shell, 8 inch diameter  
 December 1970

Overburden 0.6 m (2 ft)  
 Mineral 6.6 m (21.5 ft)  
 Bedrock 0.3 m+ (1 ft+)

		Thickness		Depth	
		m	(ft)	m	(ft)
Loam	Soil and pale brown sandy clay.	0.6	(2)	0.6	(2)
Glacial Sand and Gravel	Sandy gravel. Sandy and 'clayey' at top becoming gravelly towards middle and sandy again at base. Gravel: mainly fine, with some coarse towards middle; angular to rounded flints with subordinate subangular to subrounded quartz and some quartzite; traces of iron nodules towards base. Sand: mainly medium, with some coarse and a little fine; orange to pale, brownish-yellow; subangular to sub-rounded flint and quartz.	6.6	(21.5)	7.2	(23.5)
London Clay	Reddish-brown clay, passing down to stiff, bluish-grey clay.	0.3+	(1+)	7.5	(24.5)

	%	mm	%	Depth below surface (m)	Percentages		
					Fines	Sand	Gravel
Gravel	38	+16	: 12	0.6 - 1.4	16	71	13
		-16+4	: 26	1.4 - 2.4	1	64	35
				2.4 - 3.4	2	49	49
Sand	59	-4+1	: 16	3.4 - 4.4	1	46	53
		-1+ $\frac{1}{4}$	: 36	4.4 - 5.4	1	55	44
		- $\frac{1}{4}$ +1/16	: 7	5.4 - 6.4	0	63	37
				6.4 - 7.2	2	73	25
Fines	3	-1/16	: 3				

Surface level (+26.5 m) +87 ft  
 Water struck at (+24.7 m) +81 ft  
 Wirth B0, 8 inch diameter  
 February 1970

Overburden (1.5 m) 5 ft  
 Mineral (4.3 m) 14 ft  
 Bedrock (0.9 m+) 3 ft+

		Thickness		Depth	
		(m)	ft	(m)	ft
Loam	Soil and brown sandy clay.	(1.5)	5	(1.5)	5
Glacial Sand and Gravel	'Clayey' sandy gravel. 'Clayey' at the top. Very sandy from 8 ft (2.4 m) to 11 ft (3.4 m). Gravel: fine with a little coarse; sub-rounded to rounded flints, becoming more angular towards the bottom, with a little rounded quartz. Sand: yellowish-brown; medium with some coarse; subangular to subrounded quartz and subangular flint.	(4.3)	14	(5.8)	19
London Clay	Brown weathered clay, passing down into fresh blue clay.	(0.9+)	3+	(6.7)	22

	%	mm	%	Depth below surface (ft)	Percentages		
					Fines	Sand	Gravel
Gravel	38	+16	: 11	5 - 8	17	47	36
		-16+4	: 27	8 - 11	10	71	19
				11 - 14	7	42	51
Sand	52	-4+1	: 13	14 - 17	5	56	39
		-1+ $\frac{1}{4}$	: 32	17 - 19	9	40	51
		- $\frac{1}{4}$ +1/16	: 7				
Fines	10	-1/16	: 10				

## Appendix G: List of Workings

The following workings were seen during the survey:

Table 4. List of workings on sheet TM 02, with their locations

Rowhedge	030 213	} All working pits
Fingringhoe	042 208	
Martell's Pit, near Ardleigh	050 282	
Wivenhoe	048 225	
Alresford	062 202	

## Appendix H: Conversion Table, Metres to Feet (to nearest 0.5 ft)

m	ft	m	ft	m	ft	m	ft	m	ft
0.1	0.5	6.1	20	12.1	39.5	18.1	59.5	24.1	79
0.2	0.5	6.2	20.5	12.2	40	18.2	59.5	24.2	79.5
0.3	1	6.3	20.5	12.3	40.5	18.3	60	24.3	79.5
0.4	1.5	6.4	21	12.4	40.5	18.4	60.5	24.4	80
0.5	1.5	6.5	21.5	12.5	41	18.5	60.5	24.5	80.5
0.6	2	6.6	21.5	12.6	41.5	18.6	61	24.6	80.5
0.7	2.5	6.7	22	12.7	41.5	18.7	61.5	24.7	81
0.8	2.5	6.8	22.5	12.8	42	18.8	61.5	24.8	81.5
0.9	3	6.9	22.5	12.9	42.5	18.9	62	24.9	81.5
1.0	3.5	7.0	23	13.0	42.5	19.0	62.5	25.0	82
1.1	3.5	7.1	23.5	13.1	43	19.1	62.5	25.1	82.5
1.2	4	7.2	23.5	13.2	43.5	19.2	63	25.2	82.5
1.3	4.5	7.3	24	13.3	43.5	19.3	63.5	25.3	83
1.4	4.5	7.4	24.5	13.4	44	19.4	63.5	25.4	83.5
1.5	5	7.5	24.5	13.5	44.5	19.5	64	25.5	83.5
1.6	5	7.6	25	13.6	44.5	19.6	64.5	25.6	84
1.7	5.5	7.7	25.5	13.7	45	19.7	64.5	25.7	84.5
1.8	6	7.8	25.5	13.8	45.5	19.8	65	25.8	84.5
1.9	6	7.9	26	13.9	45.5	19.9	65.5	25.9	85
2.0	6.5	8.0	26	14.0	46	20.0	65.5	26.0	85.5
2.1	7	8.1	26.5	14.1	46.5	20.1	66	26.1	85.5
2.2	7	8.2	27	14.2	46.5	20.2	66.5	26.2	86
2.3	7.5	8.3	27	14.3	47	20.3	66.5	26.3	86.5
2.4	8	8.4	27.5	14.4	47	20.4	67	26.4	86.5
2.5	8	8.5	28	14.5	47.5	20.5	67.5	26.5	87
2.6	8.5	8.6	28	14.6	48	20.6	67.5	26.6	87.5
2.7	9	8.7	28.5	14.7	48	20.7	68	26.7	87.5
2.8	9	8.8	29	14.8	48.5	20.8	68	26.8	88
2.9	9.5	8.9	29	14.9	49	20.9	68.5	26.9	88.5
3.0	10	9.0	29.5	15.0	49	21.0	69	27.0	88.5
3.1	10	9.1	30	15.1	49.5	21.1	69	27.1	89
3.2	10.5	9.2	30	15.2	50	21.2	69.5	27.2	89
3.3	11	9.3	30.5	15.3	50	21.3	70	27.3	89.5
3.4	11	9.4	31	15.4	50.5	21.4	70	27.4	90
3.5	11.5	9.5	31	15.5	51	21.5	70.5	27.5	90
3.6	12	9.6	31.5	15.6	51	21.6	71	27.6	90.5
3.7	12	9.7	32	15.7	51.5	21.7	71	27.7	91
3.8	12.5	9.8	32	15.8	52	21.8	71.5	27.8	91
3.9	13	9.9	32.5	15.9	52	21.9	72	27.9	91.5
4.0	13	10.0	33	16.0	52.5	22.0	72	28.0	92
4.1	13.5	10.1	33	16.1	53	22.1	72.5	28.1	92
4.2	14	10.2	33.5	16.2	53	22.2	73	28.2	92.5
4.3	14	10.3	34	16.3	53.5	22.3	73	28.3	93
4.4	14.5	10.4	34	16.4	54	22.4	73.5	28.4	93
4.5	15	10.5	34.5	16.5	54	22.5	74	28.5	93.5
4.6	15	10.6	35	16.6	54.5	22.6	74	28.6	94
4.7	15.5	10.7	35	16.7	55	22.7	74.5	28.7	94
4.8	15.5	10.8	35.5	16.8	55	22.8	75	28.8	94.5
4.9	16	10.9	36	16.9	55.5	22.9	75	28.9	95
5.0	16.5	11.0	36	17.0	56	23.0	75.5	29.0	95
5.1	17	11.1	36.5	17.1	56	23.1	76	29.1	95.5
5.2	17	11.2	36.5	17.2	56.5	23.2	76	29.2	96
5.3	17.5	11.3	37	17.3	57	23.3	76.5	29.3	96
5.4	17.5	11.4	37.5	17.4	57	23.4	77	29.4	96.5
5.5	18	11.5	37.5	17.5	57.5	23.5	77	29.5	97
5.6	18.5	11.6	38	17.6	57.5	23.6	77.5	29.6	97
5.7	18.5	11.7	38.5	17.7	58	23.7	78	29.7	97.5
5.8	19	11.8	38.5	17.8	58.5	23.8	78	29.8	98
5.9	19.5	11.9	39	17.9	58.5	23.9	78.5	29.9	98
6.0	19.5	12.0	39.5	18.0	59	24.0	78.5	30.0	98.5

## References

- ALLEN, V. T. 1936. Terminology of medium-grained sediments. Rep. natn. Res. Coun. Wash. 1935-1936 App. 1 Rep. Comm. on sedimentation, pp. 18-47.
- ALLENDER, R. and HOLLYER, S. E. 1972. The sand and gravel resources of the area south and west of Woodbridge, Suffolk: Description of 1:25 000 resource sheet TM 24. Rep. Inst. Geol. Sci., No. 72/9. 128 pp.
- 1973. The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Description of 1:25 000 resource sheet TM 23. Rep. Inst. Geol. Sci., No. 73/13. 71 pp.
- AMBROSE, J. D. 1973 (a) The sand and gravel resources of the country around Maldon, Essex: Description of 1:25 000 resource sheet TL 80. Rep. Inst. Geol. Sci., No. 73/1. 60 pp.
- 1973 (b) The sand and gravel resources of the country around Layer Breton and Tolleshunt D'Arcy, Essex: Description of 1:25 000 resource sheet TL 91 and part of TL 90. Rep. Inst. Geol. Sci., No. 73/8. 34 pp.
- 1974. The sand and gravel resources of the country west of Colchester, Essex: Description of 1:25 000 resource sheet TL 92. Rep. Inst. Geol. Sci., No. 74/6. 68 pp.
- ANON. 1948. Mineral Resources of the United States. Bur. M. and geol. Surv., pp. 14-17. (Public Affairs Press, Washington, D. C.).
- 1967. B.S. 1377: Methods of testing soils for civil engineering purposes. (London: British Standards Institute) 234 pp.
- 1970. Metrication: two opposing views. Quarry Mgrs' J., Vol. 54, No. 6, p. 230.
- ARCHER, A. A. 1969. Background and problems of an assessment of sand and gravel resources in the United Kingdom. Proc. 9th Commonw. Min. Metall. Congr. 1969, Vol. 2. Mining and Petroleum Geology. Pp. 495-508. (London: The Institution of Mining and Metallurgy).
- 1970a. Standardisation of the size classification of naturally occurring particles. Géotechnique, Vol. 20, pp. 103-107.
- 1970b. Making the most of metrication. Quarry Mgrs' J., Vol. 54, No. 6, pp. 223-227.
- ATTERBERG, A. 1905. Die rationelle Klassifikation der Sande und Kiese. Chem. Z., Vol. 29, pp. 195-198.
- DALTON, W. H. 1880. The geology of the neighbourhood of Colchester. Mem. Geol. Surv. G. B.
- EATON, C. H. 1973. The sand and gravel resources of the country around Terling, Essex: Description of 1:25 000 resource sheet TL 71. Rep. Inst. Geol. Sci., No. 73/5. 120 pp.
- HAGGARD, H. J. E. 1972. The sand and gravel resources of the country around Witham, Essex: Description of 1:25 000 resource sheet TL 81. Rep. Inst. Geol. Sci., No. 72/6. 99 pp.
- HOLLYER, S. E. 1974. The sand and gravel resources of the country around Tatingstone, Suffolk: Description of 1:25 000 resource sheet TM 13. Rep. Inst. Geol. Sci., No. 74/9. 86 pp.
- LANE, E. W. and others. 1947. Report of the sub-committee on sediment terminology. Trans. Am. Geophys. Un., Vol. 28, pp. 936-938.
- PETTIJOHN, F. J. 1957. Sedimentary Rocks. 2nd Ed. (London: Harper and Row).
- STANDON-BATT, L. and others. 1969. Records of Wells in the Area of New Series One-Inch (Geological) Colchester (224) and Felixstowe (225) sheets. Water Supply Pap. Inst. Geol. Sci. Well Cat. Ser.
- THURRELL, R. G. 1971. The assessment of mineral resources with particular reference to sand and gravel. Quarry Mgrs' J., Vol. 55, pp. 19-25.
- TWENHOFEL, W. H. 1937. Terminology of the fine-grained mechanical sediments. Rep. Natn. Res. Coun. Wash. 1936-1937. App. 1, Rep. Comm. on Sedimentation, pp. 81-104.
- UDDEN, J. A. 1914. Mechanical composition of clastic sediments. Bull. Geol. Soc. Amer., Vol. 25, pp. 655-744.
- WENTWORTH, C. K. 1922. A scale of grade and class terms for clastic sediments. J. Geol., Vol. 30, pp. 377-392.
- 1935. The terminology of coarse sediments. Bull. Natn. Res. Coun. Wash., No. 98, pp. 225-246.
- WHITAKER, W. 1885. The Geology of the country around Ipswich, Hadleigh, and Felixstowe. Mem. Geol. Surv. G. B.

WILLMAN, H. B. 1942. Geology and mineral resources of the Marseilles, Ottawa, and Streator quadrangles. Bull. Illinois State Geol. Surv., No. 66, pp. 343-344.

The following reports of the Institute relate particularly to sand and gravel resources:

## REPORTS OF THE INSTITUTE OF GEOLOGICAL SCIENCES

### *Assessment of British Sand and Gravel Resources*

- No. 1 The sand and gravel resources of the country south-east of Norwich, Norfolk: Description of 1:25 000 resource sheet TG 20. By E. F. P. Nickless. Price £1.15. Report No. 71/20
- No. 2 The sand and gravel resources of the country around Witham, Essex: Description of 1:25 000 resource sheet TL 81. By H. J. E. Haggard. Price £1.20. Report No. 72/6
- No. 3 The sand and gravel resources of the area south and west of Woodbridge, Suffolk: Description of 1:25 000 resource sheet TM 24. By R. Allender and S. E. Hollyer. Price £1.70. Report No. 72/9
- No. 4 The sand and gravel resources of the country around Maldon, Essex: Description of 1:25 000 resource sheet TL 80. By J. D. Ambrose. Price £1.20. Report No. 73/1
- No. 5 The sand and gravel resources of the country around Hethersett, Norfolk: Description of 1:25 000 resource sheet TG 10. By E. F. P. Nickless. Price £1.60. Report No. 73/4
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- No. 8 The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Description of 1:25 000 resource sheet TM 23. By R. Allender and S. E. Hollyer. Price £1.60. Report No. 73/13
- No. 9 The sand and gravel resources of the country around Attlebridge, Norfolk: Description of 1:25 000 resource sheet TG 11. By E. F. P. Nickless. Price £1.85. Report No. 73/15
- No. 10 The sand and gravel resources of the country west of Colchester, Essex: Description of 1:25 000 resource sheet TL 92. By J. D. Ambrose. Price £1.45. Report No. 74/6
- No. 11 The sand and gravel resources of the country around Tattingstone, Suffolk: Description of 1:25 000 resource sheet TM 13. By S. E. Hollyer. Price £1.95. Report No. 74/9
- No. 12 The sand and gravel resources of the country around Gerrards Cross, Buckinghamshire: Description of 1:25 000 resource sheets SU 98, SU 99, TQ 08 and TQ 09. By H. C. Squirrell. Price £2.20. Report No. 74/14

## MINERAL ASSESSMENT REPORTS

- No. 13 The sand and gravel resources of the country east of Chelmsford, Essex. Description of 1:25 000 resource sheet TL 70. By M. R. Clarke. Price £3.50.

## REPORTS OF THE INSTITUTE OF GEOLOGICAL SCIENCES

### *Other Reports*

- No. 69/9 Sand and gravel resources of the inner Moray Firth. By A. L. Harris and J. D. Peacock. Price 35p.
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THE SAND AND GRAVEL RESOURCES OF SHEET TM 02 (EAST OF COLCHESTER, ESSEX)

Scale 1:25 000 or about 2 1/2 Inches to 1 Mile

ORDNANCE SURVEY SHEET TM 02 SECOND SERIES

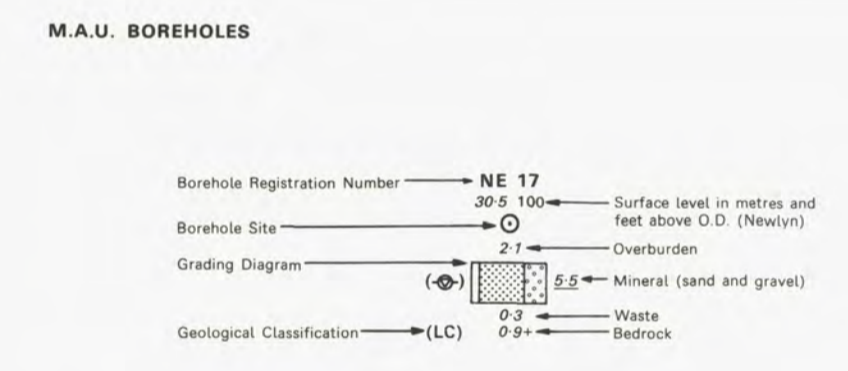
This map should be read in conjunction with the accompanying Report which contains details of the assessment of resources.

14 EXPLANATION OF SYMBOLS AND ABBREVIATIONS

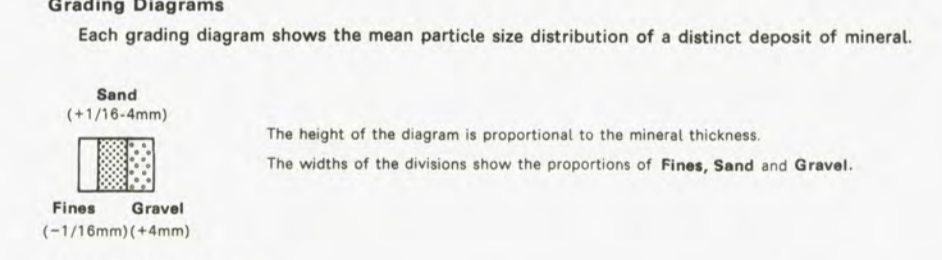
- DRIFT
A-7 Alluvium - silt and clay with some gravel in places.
RB-3 River Brickearth - sandy clay and silt.
RT-1 River Terrace Deposit - undifferentiated; minor spreads of clayey and sandy gravel.
LD-1 Loam - brown clay, containing variable amounts of silt, sand and gravel.
GS-9 Glacial Sand and Gravel - sandy flint and quartzite gravel.
SOLID
RCg Red Crag - reddish-brown, shelly sand. (Proved in boreholes only).
LC London Clay - bluish-grey clay, weathering brown.
WRB Woolwich and Reading Beds - sands with lenticular masses of clay. (Proved in boreholes only).
WO-4 Worked out ground (sand and gravel).

- BOUNDARY LINES
Geological boundary, Drift.
Geological boundary, Solid.
Inferred boundary between categories of deposits recognised.
Resource Block boundary.

- BOREHOLE DATA
SITE LOCATIONS
Mineral Assessment Unit (M.A.U.) Boreholes.
Other Boreholes.



Note:
1. Figures underlined denote thicknesses used in the assessment of resources.
2. The + sign indicates that the base of the deposit was not reached.
3. The figures in italics are conversions to metres of measurements recorded in feet.
4. The Geological Classification is given only for mineral and bedrock.



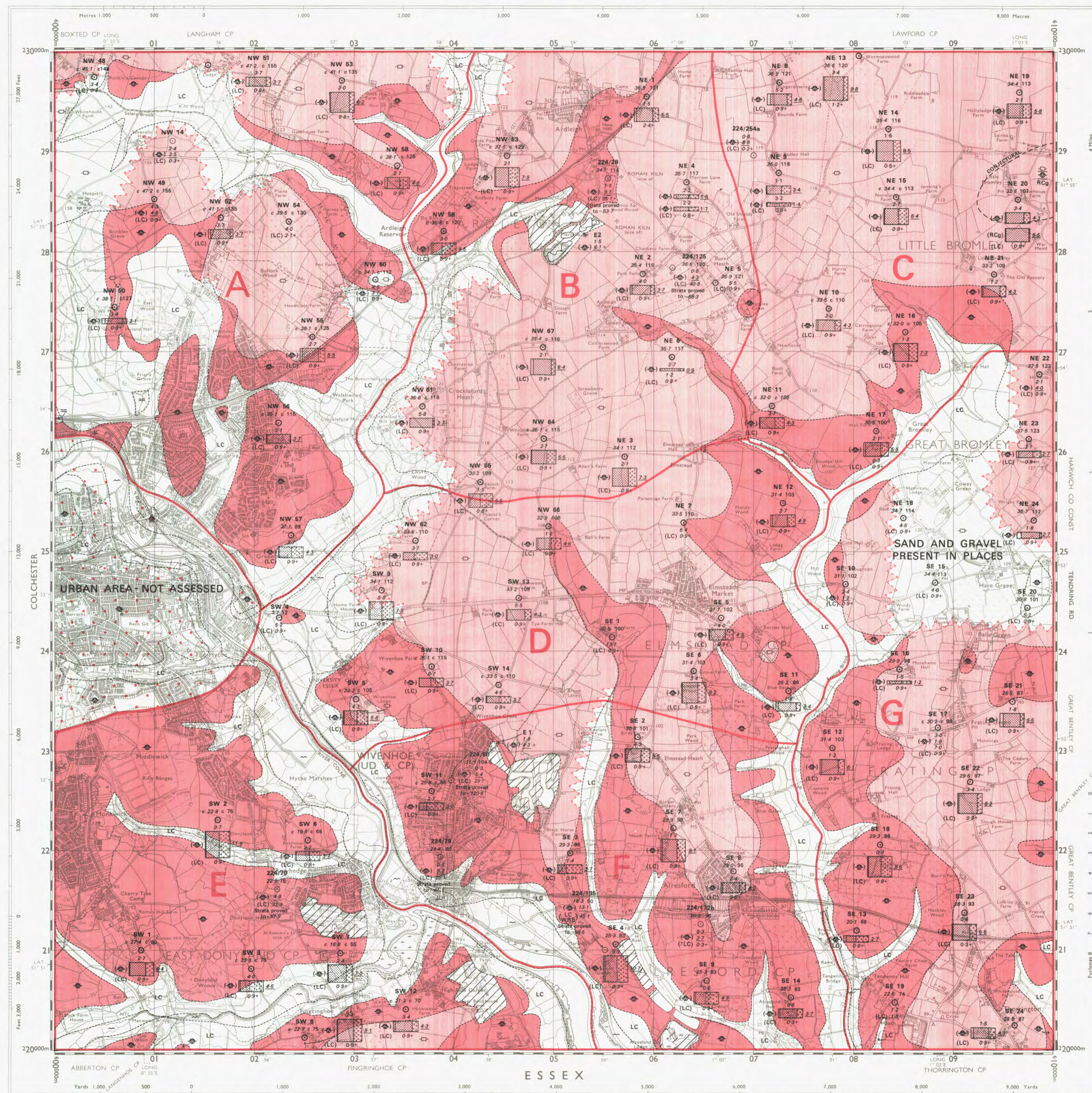
OTHER BOREHOLES
The layout of information is the same as for M.A.U. boreholes, although data available may not be as comprehensive. They are registered in the same series, except for records in the Hydrogeological Department: for example, 224/125 signifies Hydrogeological Department borehole 125 on New series One-Inch Geological Sheet 224. The final depth of deep boreholes is quoted in metres below (-) O.D.

EXPOSURE RECORDS
Information from the inspection of exposures is shown in the same way as for boreholes, but they are located by an asterisk, thus \*. Reference number and details of thickness are shown.

- CATEGORIES OF DEPOSITS
Exposed mineral, assessed. CAT-E2
Continuous, or almost continuous, spreads of mineral beneath overburden. CAT-C1
Sand and gravel either not potentially workable (see Report) or absent. CAT-A2
Sand and gravel not assessed CAT-N1
Where appropriate on other sheets a fifth category, 'Discontinuous spreads of mineral beneath overburden' is recognised.

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

Detailed records may be consulted on application to the Head, Mineral Assessment Unit, Institute of Geological Sciences, Exhibition Road, London SW7 2DE



Geological lines from a survey on the one-inch scale by W. H. Dalton, under the superintendence of W. Whitaker, H. W. Bristol, F.R.S., Senior Director, Sir A. C. Ramsay, L.D., F.R.S., Director General. The geology published 1883 A. Geikie, L.D., F.R.S., Director General. Minor amendments by J. D. Ambrose 1972. Included in 1:50 000 sheet 224 (Colchester).

Sand and Gravel Survey by J. D. Ambrose and N. E. Bradbury in 1969-70. R. G. Thurrell, Head, Mineral Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1975. Sir Kingsley Dunham, D.Sc., F.R.S., Director, Institute of Geological Sciences, incorporating the Geological Survey of Great Britain, the Museum of Practical Geology, and Overseas Geological Surveys.

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.

Compiled from 6" sheets last revised 1950-63. Boundaries revised 1964. Contour values are in feet. Major roads revised 1964-66. 1 square inch on this map represents 99.639 acres on the ground.

Table showing the relation of the National Grid 1:25 000 sheets with the One-Inch Geological Sheets 223 and 224.