

## The sand and gravel resources of the country between Bourne and Crowland, Lincolnshire

Description of 1:25 000 sheet TF 11 and parts of 01 and 21

S. J. Booth

## Institute of Geological Sciences

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### CORRECTIONS

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

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

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

The asterisk on the cover indicates that parts of sheets adjacent to the one cited are described in this report.

## **PREFACE**

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

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

This report describes the resources of sand and gravel of 200.0 km<sup>2</sup> of country between Bourne and Crowland, Lincolnshire, shown on the accompanying 1:25 000 resource map TF 11 and parts of TF 01 and TF 21. The survey was conducted during 1979–1980 by S. J. Booth who supervised the drilling and sampling programme. The assistance of J. R. Gozzard in the field and B. Cannell in compiling the report are gratefully acknowledged.

The work is based on six-inch scale geological surveys carried out by members of the Institute's Field Staff, notably R. J. Wyatt.

G. I. Coleman, ARICS, IGS Land Agent, was responsible for negotiating access to land for drilling. The ready cooperation of landowners, tenants and gravel companies in this work and the assistance of officials of the Anglian Water Authority, East Midlands Electricity Board, East Midlands Gas Council and the Lincolnshire County Council are gratefully acknowledged.

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# The sand and gravel resources of the country between Bourne and Crowland, Lincolnshire

Description of 1:25 000 sheet TF 11 and parts of 01 and 21

S. J. Booth

## SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 161 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the country between Bourne and Crowland, Lincolnshire.

All the deposits in the resource sheet area that might be potentially workable for sand and gravel have been investigated and a simple statistical method has been used to estimate the volume.

The accompanying 1:25 000 map is divided into six main resource blocks. The geology of the deposits is described and the mineral-bearing areas within each block are distinguished by sub-blocks. The mean thicknesses of overburden and mineral and the mean gradings, together with detailed borehole data, are also given. The geological lines, cross-sections and symbols, the positions of selected non-confidential boreholes used in the assessment (and grading information for most IMAU boreholes), the outlines of the resource blocks and sub-blocks, and diagrams showing the variations of mineral thickness and bedrock surface contours are shown on the accompanying map.

The principal mineral resources are First Terrace fluvial gravels (up to 7.0 m thick) and their marine/estuarine facies; boreholes indicate that the latter is more extensive than hitherto known. Overburden, comprising mainly silts and peat, increases in thickness towards the east and north-east.

The drilling occasionally encountered a 'leaf' of the Lower Peat and confirmed the widespread but discontinuous sub-crop of Boulder Clay flooring the Fenland.

## Notes

Each borehole registered with the Institute is identified by a four-element code (e.g. TF 11 SE 29). The first two elements define the 10-km square (of the National Grid) in which the borehole is situated; the third element defines a quadrant of that square, and the fourth is the accession number of the borehole. In the text of the report the borehole is normally referred to by the last three elements alone (e.g. 11 SE 29).

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

## *Bibliographical reference*

BOOTH, S. J. 1983. The sand and gravel resources of the country between Bourne and Crowland, Lincolnshire: description of 1:25 000 sheet TF 11 and parts of TF 01 and TF 21. *Miner. Assess. Rep. Inst. Geol. Sci.*, No. 130.

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## INTRODUCTION

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

In this report the assessment is in most cases calculated at the 'indicated' level of assurance. However, in those areas where the available information is insufficient the assessment is conducted at the 'inferred' level (see Appendix B, para. 12). In the former "tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout."

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

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

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

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

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

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

The characteristics of the sand and gravel are assessed within resource blocks and, generally, deposits thought to be of the same formation (and of approximately the same age) throughout the assessed area are given the same block letter, whether they contain potentially workable sand and gravel or not: for example, block F embraces all First Terrace deposits (Table 6).

Those parts of a block containing mineral are designated as sub-blocks and are identified by a subscript figure, for example F<sub>1</sub>.

Resource block O, the exception to this scheme, is an omnibus block which, in this area, contains mainly Glacial Sand and Gravel together with Glacial Drift, undifferentiated, Head deposits and Jurassic clay and limestone bedrock.

In the assessment of mineral no account is taken of factors such as roads, villages and land of high agricultural or landscape value, which might stand in the way of sand and gravel exploitation, although towns are excluded. The estimated total volume of mineral, therefore, bears no simple relationship to the amount that could be extracted in practice.

*It must be emphasised that the quantitative assessment applies to the mineral in a sub-block as a whole. Valid conclusions cannot be drawn about parts of the mineral area except in the immediate vicinity of the actual sample points.*

## DESCRIPTION OF THE RESOURCE SHEET AREA

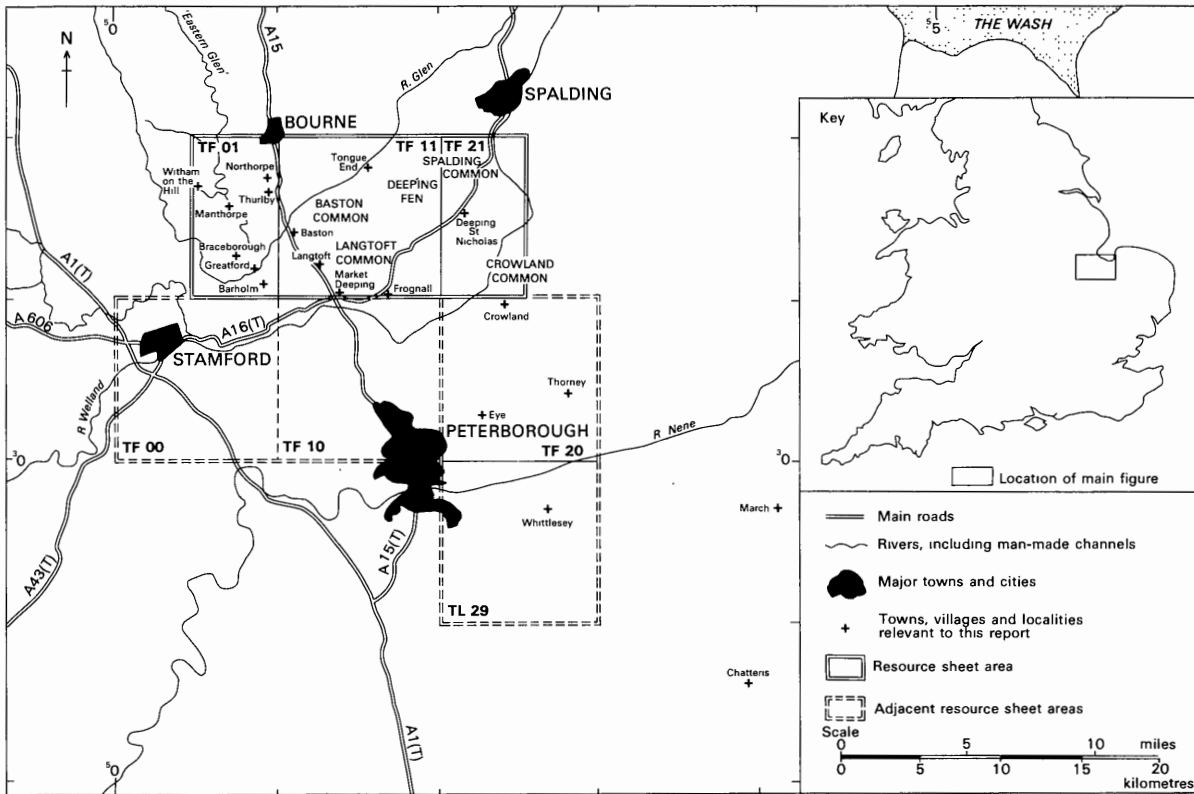
### GENERAL

Sheet TF11 and parts of TF01 and TF21 comprise 200 km<sup>2</sup> of mostly low-lying Fenland between Bourne [TF 105 199] and Crowland [TF 240 100] (Figure 1). Of this area, 101.4 km<sup>2</sup> contains potentially workable sand and gravel.

### TOPOGRAPHY

The area, while characteristically flat, may be divided into two physiographical regions, 'the Upland' (after Seale, 1975) and the Fenland (Figure 2). The Upland, a dissected plateau with mature woodlands set in hedged-lined arable fields, is underlain mainly by Middle and Upper Jurassic clays and limestones. The ground is generally above 15 m (50 ft) above OD and rises to a maximum of 53 m+ (175 ft+) above OD near Ogrey Spinney [TF 081 186] and west of Witham on the Hill [TF 051 168]. The Upland is drained principally by the River Glen and a major unnamed tributary (known locally as the 'Eastern Glen'); the two rivers emerge onto the Fenland near Greatford [TF 090 119] and Braceborough [TF 081 132], respectively, becoming a single channel east of Wilsthorpe [TF 092 136].

By contrast, the Fenland usually lies below 4 m (13 ft) above OD and in places is near the sea-level datum (for example, borehole 11 NE 20 is at 0.52 m (1.5 ft) above OD). However, within a roughly triangular area between Greatford and west of the 25 ft (7.6 m) contour from Thetford [TF 111 149] to Market Deeping [TF 100 138] (Figure 2) the general surface level rises from 25 ft (7.6 m)



**Figure 1** Locality map

above OD to near 50 ft (15 m) above OD at the foot of the Upland. South of the area (for example near Chatteris [TL 395 860]), ground at a similar level and geographical position has been described as the 'marginal Fenland' by Seale (1975).

The extensive and characteristically dark soils are organically rich and hence the agricultural value of the land is high with intensive arable cropping of potatoes, sugar beet, other root crops and cereals.

Relatively few natural drainage systems occur apart from the 'fossil' traces of old river systems, that is, roddons (p.00), which are most easily seen on aerial photographs. Since the Roman occupation, several drainage schemes have been implemented (for example, the Car Dyke at Thetford; see also Skertchly, 1877, pp.1-17; Godwin, 1978, pp.134-144) resulting in a rectilinear network of ditches, drains and counter-drains. The waters of the most important of these are pumped into the River Glen (for example, at Thurlby Rails [TF 141 177]) in the north-west and into the River Welland (the Welland Bank) in the south-east and east of the Fenland.

## GEOLOGY

### Introduction and previous work

The resource sheet area was originally surveyed geologically on the one-inch scale by J. W. Judd with parts of the Drift surveyed by W. H. Holloway and the 'fen deposits' by S. B. J. Skertchly; this work was published as part of the Old Series Sheet 64 (Melton Mowbray) in 1872 (Solid) and 1877 (Drift). Skertchly's (1877) subsequent memoir on the Fenland, described by A. C. Ramsey (the then Director-General of the Geological Survey) as 'a masterly account', is still regarded as a classic of its kind today.

Parts of the area west of grid-line Easting 11 were geologically surveyed on the six-inch scale by W. B. Evans in 1946 and V. Wilson during 1953-54, and pub-

lished as parts of the New Series One-Inch Geological Sheets 157 (Stamford) in 1957 and 143 (Bourne) in 1964. Both sheets were reprinted with amendments by R. J. Wyatt based on extensive non-confidential commercial borehole information, the former as 1:50 000 Geological Sheet 157 in 1978 and the latter as New Series One-Inch Geological Sheet 143 in 1971. The remainder of the ground included in the present assessment was mapped on the six-inch scale by R. J. Wyatt during 1977-78.

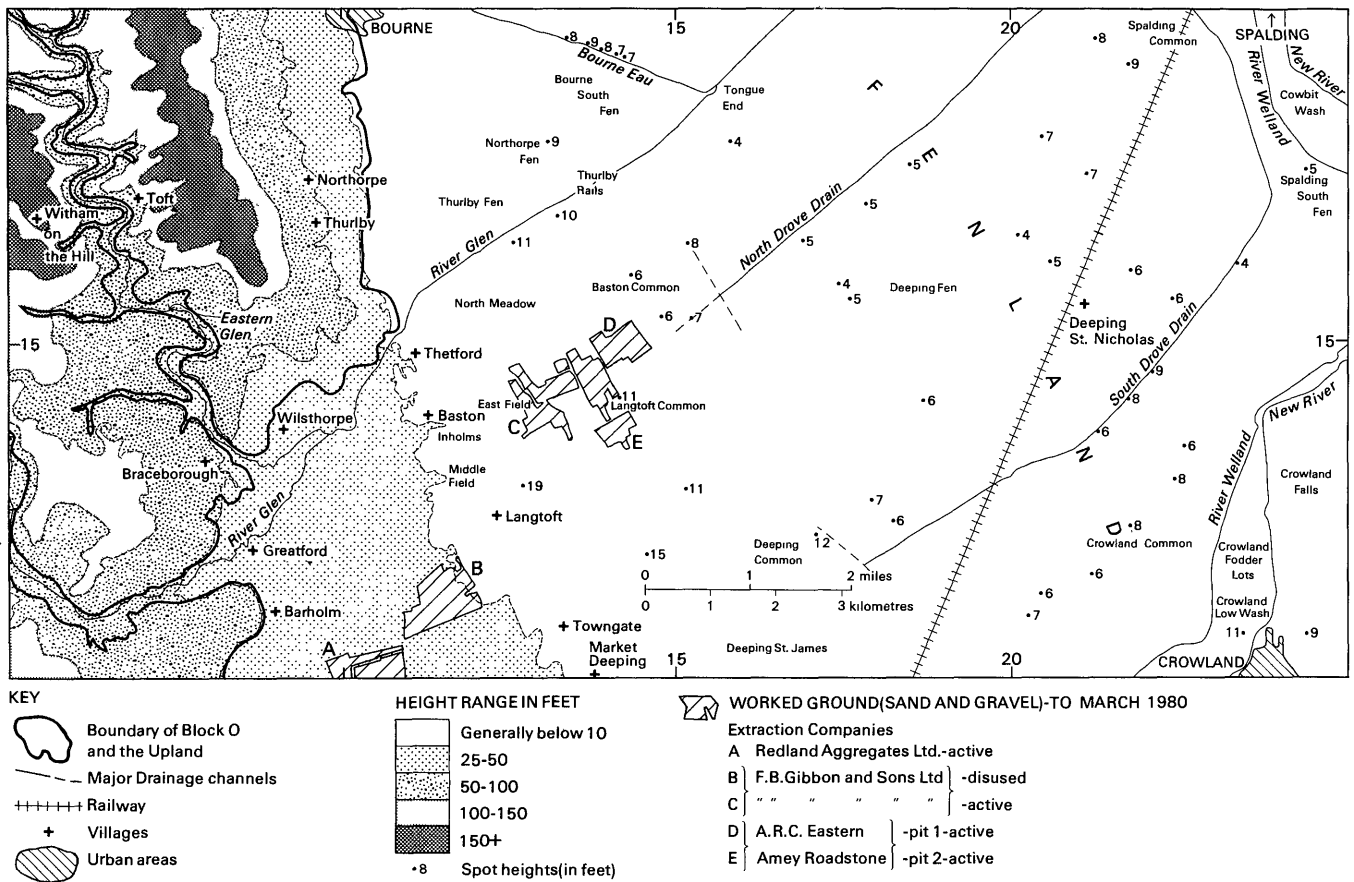
The following account is based on regional information provided by R. J. Wyatt and other members of the Institute's East Anglia and South-Eastern England Field Unit, and takes account (specifically within the Fenland) of IMAU borehole data. The deposits are listed (Table 1) and described in order of decreasing age.

### Structure

The solid formations outcropping in the area consist of Upper Lincolnshire Limestone to Oxford Clay strata of Middle to Upper Jurassic age. Non-IMAU boreholes proved strata older than the Middle Jurassic but they need not be considered further in this report.

The geological structure is relatively simple. The regional dip is uniformly to the east-south-east and does not exceed five degrees. Minor faulting mainly sub-parallel to the north-east-trending Tinwell-Marholm Fault south of the area (Booth, 1981; 1982) has affected the solid formations. For example, around Bourne, recent borehole information (including some IMAU data) has proved several small-scale faults, necessitating amendments to some of the sub-drift and exposed solid geological boundaries on the map accompanying this report compared with those shown on the One-Inch Geological Sheet 143 (Bourne). Near Thetford, two minor faults occur, the most extensive passing through Baston [TF 113 139] to Langtoft [TF 124 125] having an estimated downthrow to the south-west of 6 m.

As in adjacent areas, various superficial disturbances



**Figure 2** Relief, drainage and worked ground (sand and gravel)

have given rise to fractures parallel to the valley sides together with cambering on the slopes and bulging of disrupted formations in the valley floors (Hollingworth, Taylor and Kellaway, 1944; Horswill and Horton, 1976).

### Stratigraphy

#### SOLID

Much of the solid outcrop consists of relatively durable shelly and oolitic limestones which constitute a high percentage of the gravel component in the local drift deposits.

*Upper Lincolnshire Limestone* Outcrops of Upper Lincolnshire Limestone (the upper division of the Lincolnshire Limestone) are confined to the upper reaches of the valleys of the 'western' and 'eastern' River Glen. However, many wells and non-IMAU boreholes have been sunk into this formation because it is a useful aquifer. The limestone comprises freestones, coarse shelly oolites and pisolites with (locally) an abundance of shell debris (Hains and Horton, 1969, p.84).

*Upper Estuarine 'Series'* (including the Upper Estuarine Limestone). A freshwater sequence of clays, silts, and sands (details in Booth, 1981, p.7).

*Blisworth Limestone* This formation, which is exposed over an extensive area south of Witham on the Hill to Essendine Lodge Farm [TF 053 110], consists of blue-hearted, shelly, micritic limestones with minor beds of shelly marl and clay.

*Blisworth Clay* Clays with shells and ironstone nodules (details in Booth, 1981, p.7).

*Cornbrash* The Cornbrash comprises mainly indurated, bioclastic limestone which is blue-hearted and massive when unweathered but distinctively reddish brown and rubbly at outcrop. Locally, it produces gently inclined, bench-like features, for example around The Lodge [TF 083 137] and south of Bowthorpe Park Farm [TF 067 154]. The formation was encountered in four IMAU boreholes sited on the Upland but other boreholes and wells penetrated the Cornbrash beneath River Terrace Deposits in the Fenland, for example, east of Park Wood [TF 105 161].

*Kellaways Beds* These beds comprise dark grey, plastic, tenacious clays (Kellaways Clay) overlain by silts or fine-grained sands (Kellaways Sand) which are occasionally patchily cemented to form 'doggers'. The beds crop out principally on the eastern margin of the Upland dip slope, from Park Farm [TF 084 199] in the north to Kate's Bridge Farm [TF 108 152] in the south, and in the valleys of the 'eastern' and 'western' River Glen. The formation also occurs beneath the River Terrace Deposits of the Fenland and was encountered in 15 IMAU boreholes.

*Oxford Clay* The Oxford Clay comprises mainly bluish grey and greenish grey mudstone which weathers to a pale grey plastic clay that is completely decalcified at outcrop, typically to a depth of about a metre, and produces a heavy clay soil. For details on the composition, weathering and fauna of this formation see Booth, 1981, p.7.

The formation crops out over much of the eastern margin of the Upland dip slope and is present as an extensive subcrop beneath the Quaternary deposits throughout the Fenland. Most of the IMAU boreholes prove this deposit.

**Table 1** Geological succession proved at the surface and in IMAU boreholes

	Thickness (m) (recorded range)
DRIFT	
Quaternary	
<i>Recent and Pleistocene</i>	
Alluvium	0.3–1.4
Terrington Beds	1.3–7.1
Nordelph Peat (Upper Peat of some authors)	0.2–1.8
Barroway Drove Beds (including an intermediate ‘leaf’ of the Lower Peat and silty deposits — estuarine and marine alluvium — infilling roddons)	0.2–9.9
Lower Peat — proved only in boreholes	trace–1.2
River Terrace Deposits	
First Terrace* (including a ?marine/estuarine facies and an upper clayey deposit — the Crowland Bed)	0.5–7.0
Glacial Drift†, undifferentiated	1.8–3.8
Head	about 1.0
Boulder Clay	0.1–9.8
Glacial Sand and Gravel	1.5–4.9
	All Solid thickness data from published sources
SOLID	
Jurassic	
<i>Upper</i>	
Oxford Clay	up to 33.0
Kellaways Beds (includes Kellaways Sand and Kellaways Clay)	3.1–6.1
<i>Upper and Middle</i>	
Cornbrash	1.0–3.1
<i>Middle</i>	
Blisworth Clay‡	2.5–7.0
Blisworth Limestone‡	2.4–8.0
Upper Estuarine ‘Series’ (including Upper Estuarine Limestone)	6.1–12.1
Upper Lincolnshire Limestone	up to 21.0

\* Mapped as ‘Fen Gravel’ in some areas on One Inch Geological Sheet 143 (Bourne) and as ‘Fen and Terrace Gravel’ on 1:50000 Geological Sheet 157 (Stamford).

† Mapped as First Terrace on One Inch Geological Sheet 143 (Bourne).

‡ Mapped as Great Oolite Clay and Great Oolite Limestone, respectively, prior to 1971.

### Sub-drift surface within the Fenland

Beneath the Drift of the Fenland, bedrock surface contours (compiled from borehole data) show a generally sub-planar surface or ‘pediment’ (Dury, 1972) inclined  $<1^\circ$  towards the Wash (see map, Figure A). Superimposed on this surface is a major north-easterly trending channel which bifurcates, near the Upland, into branches that extend towards the valleys of the River Glen and its tributary.

The presence of channels flooring Midland river valleys (particularly that of the River Nene) was suggested by Dury (1954) but discounted by Castleden (1976) who demonstrated that the surface beneath the alluvial and terrace deposits of the River Nene between Northampton [SP 755 605] and Thrapston [SP 995 787] is generally sub-planar; he concluded (1976, p.45) that this bedform represented a periglacial pediment. Farther downstream near Peterborough [TF 200 000] (where the River Nene enters the Fenland) Castleden (1976) noted that ‘a buried channel can be discerned, apparently graded to a low Devensian sea level’. The previously unrecorded buried channel of the River

Glen, and its position downstream from the emergence of an Upland river into the Fenland, seems to corroborate Castleden’s observations on a similar reach of the neighbouring River Nene.

Farther out into the Fenland (near the north-eastern corner of the area) the bedrock surface is inclined at a steeper angle and this break of slope (see map, Figure A) forms a ‘bench-like’ feature (trending north-west to south-east) that gives rise to a deeper, subsidiary basin. This latter feature is partly infilled by boulder clay.

### DRIFT

#### *Pleistocene*

The most widespread Pleistocene deposits in this area comprise exposed river terrace sands and gravels and those beneath Flandrian deposits within the Fenland; less extensive outcrops of glacial material occur mainly on the Upland.

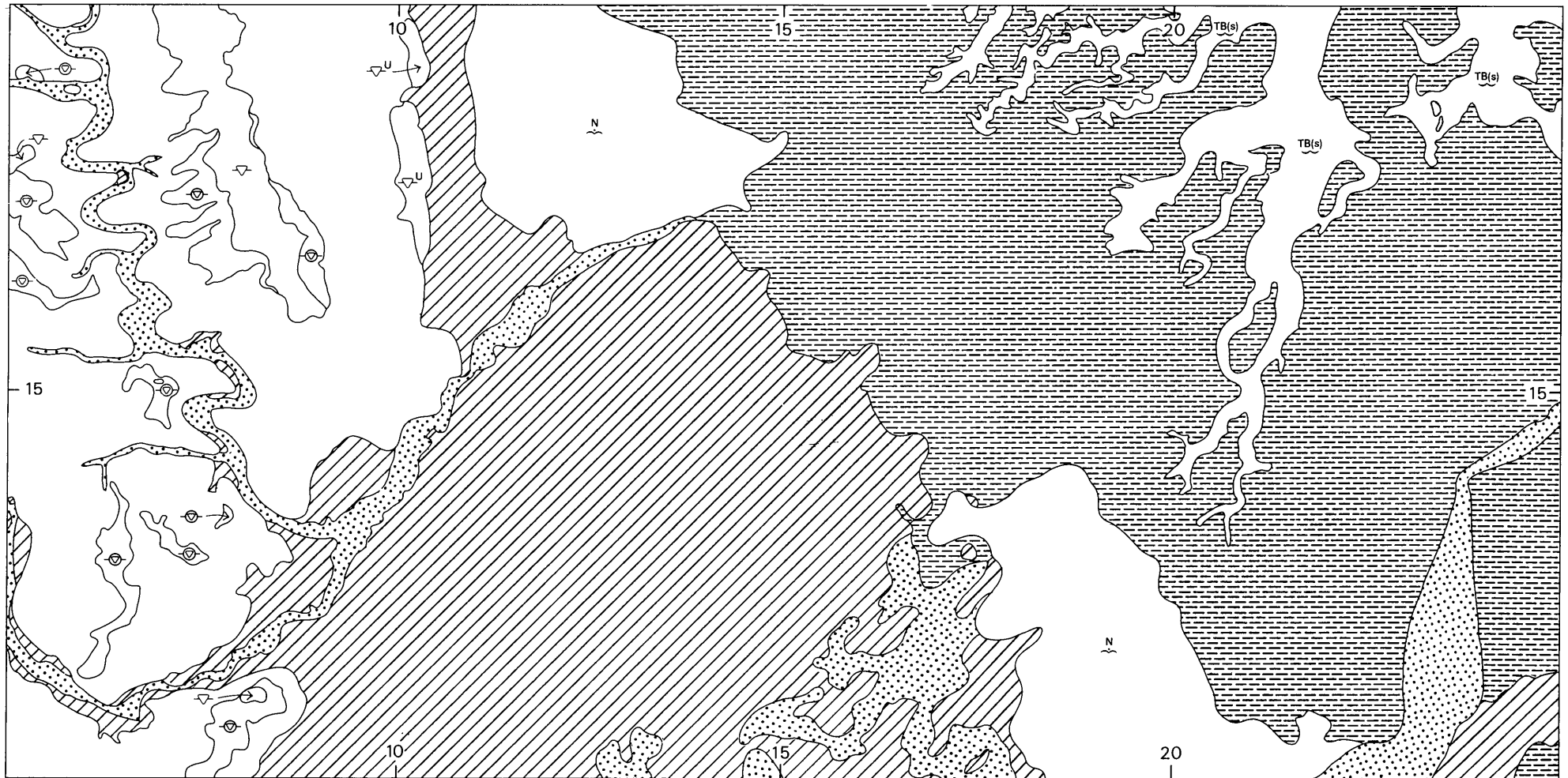
*Glacial Sand and Gravel* Glacial Sand and Gravel, which is confined to the Upland, comprises mainly small (up to 0.65 km<sup>2</sup>) isolated exposures. Locally, the deposits are overlain by Boulder Clay for example, from Auster Wood [TF 072 195] to near Dole Wood [TF 093 162]; however, borehole data (for example, 01 NE 63) indicate that the Glacial Sand and Gravel is impersistent beneath cover.

The deposits contain many pebbles of subrounded to rounded quartzite, sandstone and ironstone with subrounded oolitic, shelly and crystalline limestone and angular flint (see Composition of Sand and Gravel).

The mapped outcrops of Glacial Sand and Gravel south of Bowthorpe Park Farm and west of Braceborough Grange [TF 067 131] are up to 1.5 m thick (borehole 01 SE 72) and consist mainly of clayey pebbly sand. These and other outcrops form a relatively thin and localised veneer to the Jurassic Upland (see cross-section A).

*Boulder Clay* (the ‘Chalky Boulder Clay’ of Horton and others, 1974, p.51 and ‘Chalky/Jurassic till’ of Gallois, 1979, p.32). In the Upland, Boulder Clay occurs mainly associated with a ridge extending from Auster Wood to near Dole Wood, and as minor outcrops at [TF 051 180] and [TF 082 110]. The clay is generally grey to greyish blue, up to 9.8 m thick (borehole 01 NE 65) and contains abundant chalk and flint fragments, together with subrounded Bunter-derived quartzite pebbles, other far-travelled erratics (Sabine, 1949) and locally-derived rock debris; the clay weathers greyish brown to dark brown.

In the east of the area, principally around Spalding Common [TF 220 190] and Crowland Falls [TF 245 130], up to 5.3 m (borehole 21 NW 33) of chalky pebbly clay, interpreted as Boulder Clay, was proved in 32 IMAU boreholes beneath River Terrace Deposits and Flandrian deposits. These occurrences seem to coincide with the subsidiary basin in the bedrock surface referred to earlier. Boulder Clay flooring other parts of the adjacent Fenland was previously recorded by Skertchly (1877, pp.209–213) and Prentice (1950, p.136); more recent IGS fieldwork, together with well records and borehole data from this and an adjacent assessment area (Booth, 1982) confirm the widespread occurrence of this deposit in the Fenland. Wyatt (1971) recorded a major west to east trending, pre-Chalky Boulder Clay, drift-filled valley in the Upland from Melton Mowbray [SK 705 109] to Thurlby [TF 098 169]. The present-day valleys of the River Glen and its tribu-



**KEY**

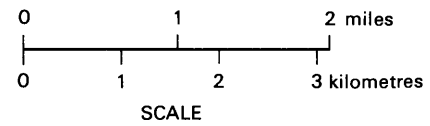
**DRIFT**

	Alluvium
	Terrington Beds
	Nordelph Peat
	Barroway Drove Beds

	First Terrace
	Glacial Drift, undifferentiated
	Boulder Clay
	Glacial Sand and Gravel

**SOLID**

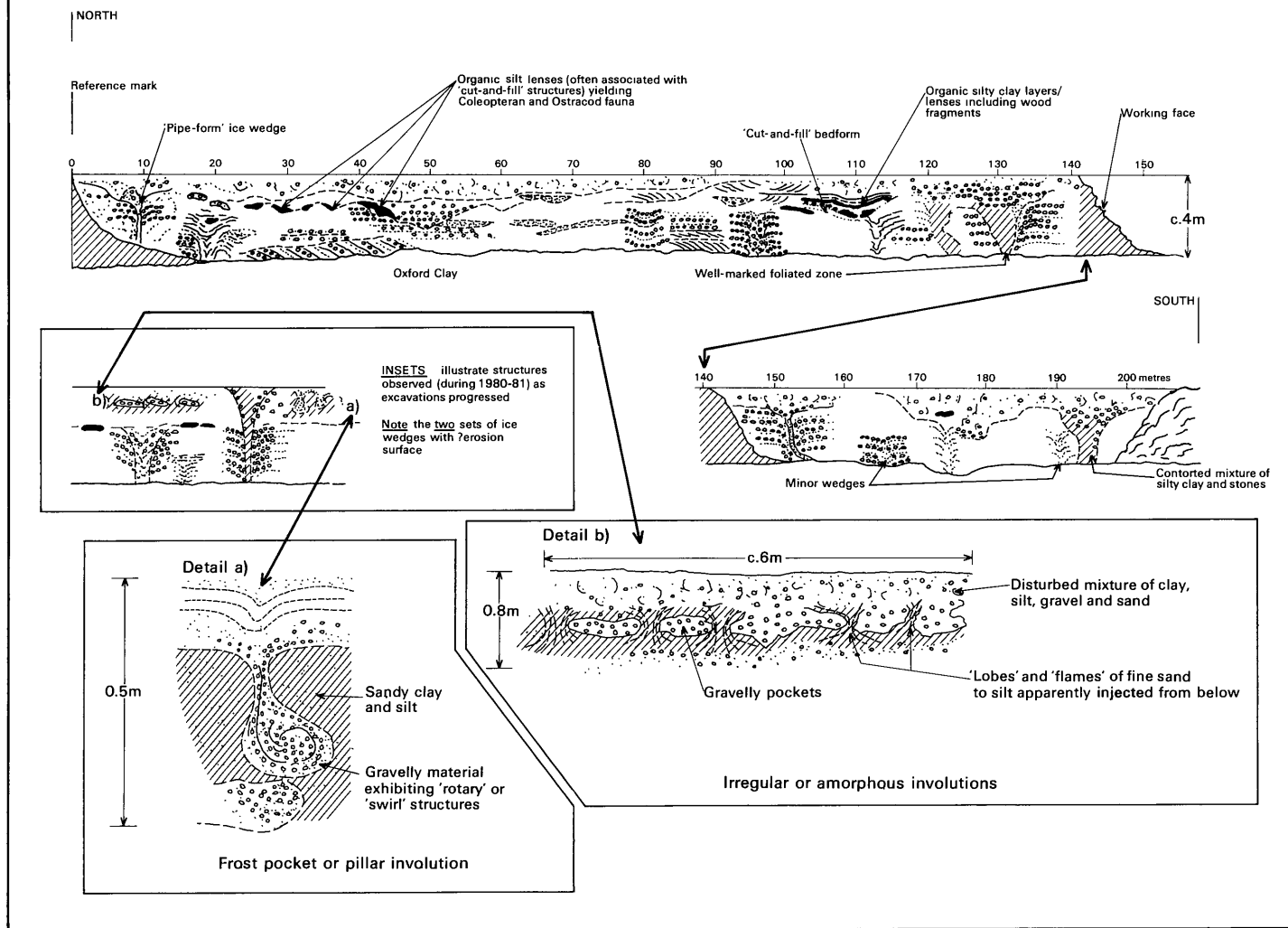
	Jurassic, undivided
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Geological lines simplified - for further information see the Map

**Figure 3** Drift deposits in the area (based on published one-inch geological maps and unpublished field maps)

# Baston Fen Pit (as recorded on 3rd. April 1981)



**Plate 1** A section in the First Terrace sands and gravels at Baston Pit [TF 126 143] as recorded on 3 April 1981, showing the position of organic silts and periglacial structures



tary transect this drift-filled valley which appears to extend eastwards beneath the Fenland. Horton (1981, p.28) considered that although the boulder clay deposits of the Upland and Fenland 'appear to lie at quite distinctive topographic levels' the 'modern erosional slope intersects the almost parallel palaeoslope on the base of the boulder clay'.

**Head** Small localised deposits occur on the Upland where they usually fill minor valley floors as at [TF 093 145] and [TF 056 116]. Because these deposits have accumulated through soil creep (or solifluction) their composition varies widely depending on the local parent rock. The deposits are often about 1 m thick but the maximum thickness of the deposit in the area is not known.

**Glacial Drift, undifferentiated** These deposits crop out at The Austerby [TF 101 199] and south of Elsea Wood [TF 101 184] on the eastern margin of the Upland. Three IMAU boreholes proved up to 3.8 m of mottled sandy pebbly clay with the gravel fraction comprising mainly limestone and flint.

This glacial drift was mapped as First Terrace deposits on the One-Inch Geological Sheet 143 (Bourne) but has since been re-interpreted by R. J. Wyatt as glacial based on similarities in composition and altimetric position with deposits mapped north of Bourne (for example, at [TF 100 213] and [TF 104 230]) by A. Horton in 1978.

**River Terrace Deposits** Sand and gravel deposits within the Fenland, other than those of presumed glacial origin, were formerly grouped together as 'fen gravel(s)' (Skertchly, 1877, p.184; Horton and others, 1974, pp.57–58), as 'Fen and Terrace Gravel' (1:50 000 Geological Sheet 157 (Stamford)) or as 'Fen-Margin Gravel' (Prentice, 1950, p.136).

More recent (1975–80) mapping by R. J. Wyatt and other members of the Institute's East Anglia and South-Eastern England Field Unit together with altimetric data from boreholes drilled in this and adjacent sand and gravel assessment areas (Booth, 1981; 1982) have shown that these fen margin gravels are laterally equivalent to First Terrace deposits of the rivers Nene, Welland and Glen.

A similar interpretation based on the Second and Third terraces of the River Nene was formulated by Castleden (1980, p.38) who, more specifically, linked these terraces with the gravel-capped Fenland 'islands' at Whittlesey [TL 270 971] and March [TL 417 968]. Although Skertchly described the gravel in the Fenland as 'undoubtedly marine' (1877, p.183), he subsequently (1877, p.184) subdivided the sequence into three parts, namely 'the remains of old valley gravels', 'flood-gravels' that 'run down into true beach gravels' and thirdly 'true marine gravels'. Representatives of all three types are to be found within the First Terrace deposits in this area.

First Terrace deposits were derived principally from the outwash of the River Glen and its tributary and to a lesser extent from the River Welland. Thickness variations (for a guide, see mineral thickness variations on the map, Figure B) indicate a crude outwash-fan attenuated to the north and east, probably from the coalescence of fans of sand and gravel which debouched onto the low-lying Fenland from narrow Upland valleys.

First Terrace sands and gravels between 0.5 and 7.0 m

thick occur over approximately 80 per cent of the area and constitute the major mineral resource. Approximately 60 per cent of the deposit is overlain by Flandrian sediments that thicken towards the east and north-east. The effects of drainage schemes on the present outcrops of the First Terrace deposits have been referred to elsewhere (Booth, 1982, p.8).

In organic silt lenses within First Terrace deposits at Baston Pit [TF 126 143], a cold, marshland environment is indicated by a molluscan fauna including *Pupilla muscorum* (Linné), *Oxyloma pfeifferi schumacheri* Andreae, *Lymnaea truncatula* (Müller) and *Pisidium* sp. (identified by D. H. Keene of Coventry (Lanchester) Polytechnic) and a coleopteran fauna (identified by G. R. Coope, University of Birmingham) comprising such boreal species as *Pycnoglypta lurida* Gyll., *Boreaphilus henningianus* Sahlb., *Simplocaria metallica* Sturm. and *Helophorus obscurellus* Popp.

In some IMAU boreholes east of gridline Easting 16, for example 11 NE 37, 11 SE 21 and 11 SE 25 (see Figure 7) (?) indigenous fragmentary shells (usually found towards the base of the deposit in association with a more sandy facies) including *Scrobicularia plana*, *Cerastoderma edule*, *Littorina saxatilis* and balanid and pholadacean fragments (identified by D. K. Graham of the Institute's Palaeontology Unit in Edinburgh) suggest a marine/estuarine environment of deposition. At Crowland, Skertchly (1877, p.202) recorded *Macoma* (formerly *Tellina*) *balthica* and *Turritella communis* which also suggest a similar environment.

On altimetric, grading and compositional data, the shelly gravels at Baston Pit and in the eastern part of the area appear to be laterally continuous with First Terrace deposits cropping out farther west. Furthermore, the shelly faunas seem to represent a transition between paludal and marine/estuarine conditions, reminiscent of Skertchly's (1877, p.184) original concept of the transitional nature of the fen gravels. However, because of insufficient evidence, the various facies are not distinguished in the borehole logs and the western limit of the marine/estuarine facies is not shown on the map (although shells, where present, are shown in cross-section B and in Figure 7).

At Baston, Skertchly (1877, pp.186–187) observed that the 'fen-gravel . . . was . . . cemented into compact beds by oxide of iron.' and that around Greatford, where the deposit was termed 'iron-gravel' it often required gunpowder to break it up. This assessment survey, for example in boreholes 11 NW 80, 11 NW 84 and 11 SW 21, also proved highly stained to iron-cemented sand and gravel over a fairly extensive area (from Greatford to Deeping St Nicholas [TF 210 151]), mostly in exposed First Terrace deposits. The iron cement was usually restricted to the uppermost metre of the deposit.

Over much of their outcrop, First Terrace deposits include a relatively thin layer (0.1 to 2.7 m in boreholes 11 NW 78 and 11 NW 69, respectively) of loamy sands, silts or clays containing scattered pebbles and occasional shells; this layer is interpreted either as the final stages of First Terrace aggradation (an 'older' alluvium) or as a soil resulting from the weathering of the terrace.

Where the First Terrace gravels are beneath Flandrian deposits, they also include a similar heterogeneous deposit — the Crowland Bed (Booth, 1982, p.8). In this report, the Crowland Bed is distinguished in the borehole logs.

Between the Crowland Bed and the base of the overlying Barroway Drove Beds, in a ditch section [TF 2701 9968] at the Dog-in-a-Doublet, D. H. Keene

(personal communication) sampled and identified a fauna containing mainly brackish-water molluscs (for example, *Hydrobia ulvae* (Pennant), *Hydrobia ventrosa* (Montagu) and *Scrobicularia plana* (da Costa) together with a few 'stunted' but 'fully marine' shells (for example, *Cerastoderma edule* (Linné)). Keene also noted large numbers of ostracods and foraminifera.

The two apparently dissimilar west to east facies variations within the 'older' alluvium/Crowland Bed may be comparable with the facies transition already described for the First Terrace as a whole.

#### Recent

These deposits, including the peats, silts and clays of the Fenland basin, collectively comprise the Flandrian Stage and represent several marine transgressions and regressions during the past 8000 years (Godwin, 1940, p.287; see also Willis, 1961).

*Lower Peat* The Lower Peat, less extensive than the

later Fenland deposits, was proved in boreholes (for example 11 NW 82, 11 NE 18 and 11 SE 35) and in some of the deeper drains. In much of the area, it is less than 0.5m thick and impersistent, but becomes thicker and more continuous towards the north-east where a maximum thickness of 1.2m was recorded (borehole 11 NE 38).

The Lower Peat *sensu stricto* overlies River Terrace Deposits whereas peat layers occasionally encountered in the Barroway Drove Beds (for example in boreholes 11 NE 27, 21 NW 21 and 21 SW 27) probably represent a 'leaf' of the Lower Peat (see Godwin and Clifford, 1938, p. 370, figure 27); these are classified in the borehole logs as ?Lower Peat.

*Barroway Drove Beds* (Gallois, 1979) The Barroway Drove Beds or 'buttery clay' (see Skertchly, 1877, p.173) crop out extensively in the flat lowlying Fenland roughly east of a line from Bourne to Crowland; east of Bourne the western boundary between the Barroway Drove

**Table 2** Detailed compositional data for +8–16 mm fraction, unless otherwise indicated  
a River Terrace Deposits (First Terrace)

Block/ sub-block	Borehole No.	Percentages by weight														
		Flint		Limestone				Ironstone	Quartzite	Fossil debris		Chalk	Sandstone		Igneous/ Metamorphic	Others
		Angular	Rounded	Crystalline	Oolitic	Shelly	Indigenous			Derived	Calcareous					
F <sub>1</sub>	11NW69	20	rare	13	18	14	5	7	nil	2	rare	4	17	nil	nil	
A <sub>1</sub>	11NW70	12	rare	12	18	28	2	3	nil	rare	2	2	21	nil	nil	
D <sub>1</sub>	11NW72	19	trace	9	27	11	3	11	nil	1	1	9	9	nil	nil	
F <sub>1</sub>	11SW20	12	trace	trace	26	13	4	3	nil	1	2	6	33	nil	nil	
F <sub>1</sub>	11SW22	13	trace	trace	20	15	9	4	nil	2	4	5	28	nil	nil	
F <sub>1</sub>	11SW33	17	nil	nil	20	10	11	6	nil	2	5	11	18	nil	nil	
E <sub>1</sub>	11NE25	18	rare	nil	27	16	2	6	nil	1	1	9	20	nil	nil	
F <sub>1</sub>	11SE15	23	trace	trace	23	7	6	18	nil	1	trace	7	15	nil	nil	
A <sub>1</sub>	11SE23	24	trace	nil	11	2	31	12	nil	trace	trace	3	17	nil	nil	
E <sub>1</sub>	11SE25	28	nil	16	20	13	3	9	trace	2	nil	3	6	trace	nil	
D <sub>1</sub>	11SE33	24	trace	trace	15	3	5	9	nil	trace	trace	7	37	nil	nil	
E <sub>1</sub>	11SE35	19	trace	nil	19	10	14	17	nil	1	trace	3	17	nil	nil	
E	21NW26	34	nil	10	15	8	1	8	nil	3	1	4	16	nil	nil	
E	21NW28	52	trace	3	1	1	trace	6	2	2	24	1	8	trace	trace	
E	21NW34	56	nil	12	6	4	1	5	nil	1	trace	4	11	nil	nil	
E*	21NW35	32	nil	16	15	11	2	8	trace	1	1	4	10	trace	nil	
C <sub>1</sub>	21SW16	23	nil	17	18	12	10	9	trace	1	nil	5	5	nil	nil	
A*	21SW37	17	nil	10	15	11	11	6	8	1	trace	21		trace	nil	
E*	21SW40	30	nil	15	11	10	8	7	1	2	3	12		trace	1	
F <sub>2</sub> *	21SW43	31	trace	1	7	41	4	6	trace	3	3	4		trace	nil	
	Mean	25	trace	7	17	12	7	8	1	1	2	5	15	trace	trace	

#### b Glacial Sand and Gravel

Block/ sub-block	Borehole No.	Percentages by weight														
		Flint		Limestone				Ironstone	Quartzite	Fossil debris		Chalk	Sandstone		Igneous/ Metamorphic	Others
		Angular	Rounded	Crystalline	Oolitic	Shelly	Indigenous			Derived	Calcareous					
O	01NE60	9	rare	4	9	2	29	30	nil	rare	nil	12	5	nil	nil	
O	01NE64	7	rare	3	13	3	24	30	nil	rare	nil	14	6	nil	nil	
	Mean	8	rare	4	11	3	26	30	nil	rare	nil	13	5	nil	nil	

\* Mean of +4–8 mm and +8–16 mm fractions

Beds and the underlying Nordelph Peat, based on IMAU borehole data, is shown on the map.

The Barroway Drove Beds consist mainly of soft clay laminae, often containing carbonaceous root traces and scattered shell fragments. A maximum thickness of 9.9 m was recorded in borehole 11 NE 34. These sediments were probably deposited in a salt marsh dissected by numerous silt-filled tidal creeks (locally known as roddons) which occur at various levels within the deposit (see cross-section B and Booth, 1982, p.8).

*Nordelph Peat* (Gallois, 1979) The Nordelph Peat (or Upper Peat of some authors, for example Skertchly, 1877, p. 128) crops out in two fairly extensive areas south and east of Bourne and around Stowgate Farm North [TF 1875 1169]; it usually overlaps the underlying Barroway Drove Beds to rest on either First Terrace or bedrock. Since the mid-eighteenth century much of the peat has been lost by shrinkage and erosion and original thicknesses are unknown, but the present survey proved up to 1.8 m in borehole 11 SE 33.

*Terrington Beds* (Gallois, 1979) These deposits crop out mostly in the north-eastern part of the area as infilled creek and river courses protruding above the general level of the Fenland. The mapped limits of the Terrington Beds within these channels are often arbitrary (R. J. Wyatt, personal communication), as the deposits are practically identical to the silt-filled roddons of the Barroway Drove Beds; furthermore, the deposits are thought by Wyatt to represent the re-working of former roddons in response to later eustatic rises of sea-level. Generally they comprise clays, silts and silty clays (up to 7.1 m proved in borehole 11 NE 37) with occasional shelly pockets containing *Cerastoderma edule* and *Macoma balthica*. East of the area, the deposits form more extensive spreads with shell banks (cheniers) suggesting an environment of intertidal mud flats and salt marshes.

*Alluvium* Alluvium (proved up to 1.4 m thick in borehole 21 SW 30) floors the valleys of the River Glen and its tributary; it also occurs in the Crowland Low Wash [TF 234 109]/Crowland Fodder Lots [TF 235 123] area as a result of deposition from flood waters confined within the artificial banks of the River Welland.

The deposit comprises mainly greyish brown to grey and brown clays (often much mottled or streaked) with plant debris and occasional pebbles, together with discontinuous beds of organic silt, peat and lenses of sand and gravel. Much of the alluvium overlies sub-alluvial gravels that are laterally continuous with First Terrace deposits elsewhere in the area.

#### COMPOSITION OF THE SAND AND GRAVEL DEPOSITS

Potentially workable sand and gravel is present in the River Terrace Deposits and in the Glacial Sand and Gravel. First Terrace deposits, including their marine/estuarine facies (see p.00), occupy 97 per cent of the mineral area and represent the major resource.

These different mineral deposits are broadly similar in composition (see Figures 4 to 8; 10 to 17 and Tables 2 to 4; 7 to 14 for summary information); thus in the following account, the deposits are not differentiated unless otherwise stated.

The five important components of the gravel fraction are, in order of decreasing abundance, limestone, flint,

sandstone, quartzite and ironstone. However, locally, the proportions may vary markedly.

In the assessed area, mean values for limestone vary from 5 to 49 per cent (boreholes 21 NW 28 and 21 SW 43, respectively) and flint from 7 to 56 per cent (boreholes 01 NE 64 and 21 NW 34, respectively). In the Glacial Sand and Gravel, the means for limestone and flint are 18 and 8 per cent compared with 36 and 25 per cent for the River Terrace Deposits. Sandstone and quartzite have means of 20 per cent and 10 per cent, respectively, for the mineral as a whole, although on the Upland, quartzite may dominate.

Ironstone occurs throughout the area from trace amounts (borehole 21 NW 28) to 31 per cent (borehole 11 SE 23). In the Fenland, amounts are usually less than 10 per cent compared with 29 per cent and 24 per cent proved in the Upland boreholes 01 NE 60 and 01 NE 64. Towards the north-east of the area, ironstone becomes a relatively minor constituent.

Limestone (mainly oolitic and shelly with subsidiary amounts of crystalline limestone) was derived from Jurassic rocks cropping out extensively to the west and south of the area. The clasts are generally subangular to subrounded and are often tabular; some are veneered with re-precipitated iron.

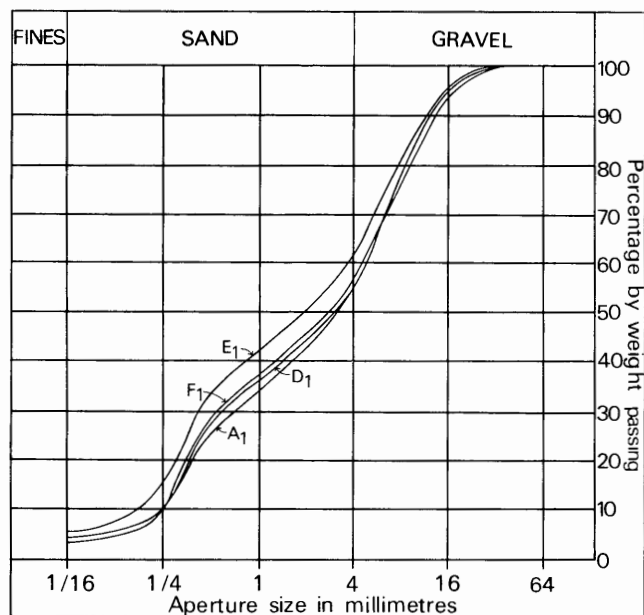
Flint is usually angular to subangular but rarely rounded. A quantitative assessment of flint colour variations (see Roeder, 1977; Figg, 1977 and Table 3) shows that over the assessed area, brown and white varieties predominate (with overall means of 48 and 38 per cent, respectively) with subsidiary black flint (14 per cent). Glacial Sand and Gravel includes a greater proportion of black flint than First Terrace deposits (38 per cent compared with 12 per cent, respectively) whereas the proportion of white (patinated) flint in both lithologies is approximately equal at about 40 per cent. Iron-staining commonly affects all varieties of flint although it is often more evident in the fairly extensive iron-cemented (hardpan) layers associated with the River Terrace Deposits (p.00). Most of the flint in the area was probably derived from a former widespread Boulder Clay cover (Horton and others, 1974, p.51), remnants of which cap the higher ground to the west.

The rounded to subrounded sandstone and quartzitic pebbles and cobbles were probably derived from the Sherwood Sandstone Group (formerly the 'Bunter Pebble Beds' and 'Bunter Sandstones') of the Midlands. They were probably transported within the Boulder Clay during an ice advance before later fluvial re-working and subsequent deposition.

The ironstone was derived principally from the sideritic facies of the Northampton Sand (Taylor, 1949, pp.1-2), which crops out on the higher ground west of the area above the valleys of the River Glen, its tributary and the River Welland. The pebbles generally comprise fine-grained, iron-cemented sand, and are irregularly shaped, moderately rounded and vary in colour from black to dark red dependent on the iron:quartz ratio of the ironstone. Subsidiary components include chalk (with an overall mean of 2 per cent), derived and (?) indigenous fossil fragments (2 per cent) and traces of igneous/metamorphic erratics. The relative scarcity of chalk (ranging from nil to 24 per cent in boreholes 11 SE 25 and 21 NW 28) has been referred to elsewhere (Booth, 1982, p.9).

Within the River Terrace Deposits and the Glacial Sand and Gravel, the fossils referred to above are mainly derived Oxfordian bivalves (for example, *Gryphaea*)

together with belemnites and often pyritised ammonites. Within the marine/estuarine facies of the First Terrace deposits i.e. east of grid-line Easting 16 (Figure 7), the sporadic fossil occurrences consist mainly of (?)indigenous bivalves and gastropods (see p.00). With ranges from rare to 3 per cent (boreholes 01 NE 60 and 21 SW 43, respectively) for the derived Oxfordian fauna and nil to 8 per cent (boreholes 11 SW 33 and 21 SW 37, respectively) for the (?)indigenous fauna, the proportions of shells are not considered to be deleterious (Chapman and Roeder, 1970).



Resource sub-block	Percentage by weight passing					Grading classification
	1/16mm	1/4mm	1mm	4mm	16mm	
A <sub>1</sub> (11)*	5	10	34	54	94	Sandy gravel
D <sub>1</sub> (16)	4	10	36	55	94	Sandy gravel
E <sub>1</sub> (27)	5	14	41	60	95	Sandy gravel
F <sub>1</sub> (37)	4	11	37	56	93	Sandy gravel
Mean (91)	4	11	37	56	94	Sandy gravel

\* Figures in brackets show the number of sample points for which grading data are available.

**Figure 4** Mean particle size distribution for the mineral in sub-blocks A<sub>1</sub>, D<sub>1</sub>, E<sub>1</sub> and F<sub>1</sub> (sample density at the 'indicated' level).

Skertchly (1877, p.186) noted 'worn fragments of hornblende schist' at Kate's Bridge [TF 1068 1496] and dark, fine-grained igneous and metamorphic erratics (Sabine, 1949) occur elsewhere in trace amounts although they are usually much weathered and not easily identified.

The mean grading data show little variation between the River Terrace Deposits and the Glacial Sand and Gravel (Figure 6) or between individual sub-blocks assessed at the 'indicated' level (Figure 4); the sand and gravel in each case is classified as sandy gravel. However, the mineral in sub-blocks C<sub>1</sub>, E<sub>2</sub>, F<sub>2</sub> and block O (assessed at the 'inferred' level) shows a slightly greater variation with mean gradings ranging from pebbly sand to sandy gravel (Figure 5).

Locally, wide variations occur between boreholes in the same sub-block; for example, in sub-block E<sub>1</sub>, borehole 11 NW 83 has fines:sand:gravel ratios of

6:33:61 compared with borehole 11 SE 25 with ratios of 6:78:16. Even greater variations in the same sub-block occur between individual samples within the same borehole (for example borehole 11 SW 21 has fines:sand:gravel ratios of 46:23:31 — classified as non-mineral — between 0.5 and 1.0 m compared with ratios of 1:49:50 — classified as gravel and between 2.0—3.0 m) — see the grading 'envelopes' for sub-blocks A<sub>1</sub> to F<sub>2</sub> and block O (Figures 10 to 17).

Within the Fenland the mean grading characteristics of the sand and gravel (see Figure 8) are remarkably uniform; however, a slight differentiation between more gravelly deposits in the west and more clayey deposits in the east was proved.

**Table 3** Flint colour variation for +8–16 mm fraction, unless otherwise indicated

a River Terrace Deposits (First Terrace)

Borehole No.	Colour variation (percentages by weight)		
	Black	Brown	White
11 NW 69	24	49	27
11 NW 70	11	45	44
11 NW 72	18	34	48
11 SW 20	17	47	36
11 SW 22	13	42	45
11 SW 33	14	33	53
11 NE 25	19	35	46
11 SE 15	10	41	49
11 SE 23	4	57	39
11 SE 25	10	40	50
11 SE 33	5	64	31
11 SE 35	10	38	52
21 NW 26	1	80	19
21 NW 28	24	31	45
21 NW 34	9	59	32
*21 NW 35	6	63	31
21 SW 16	6	61	33
*21 SW 37	33	46	21
*21 SW 40	15	52	33
*21 SW 43	2	79	19
Mean	12	50	38

b Glacial Sand and Gravel

Borehole No.	Colour variation (percentages by weight)		
	Black	Brown	White
01 NE 63	33	18	49
01 NE 64	42	24	34
Mean	38	21	41

\* Mean of +4–8 mm and +8–16 mm fractions.

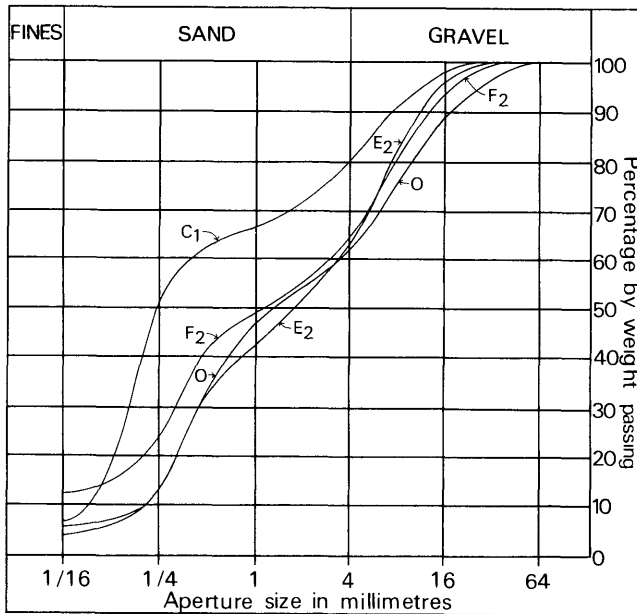
**THE MAP**

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, with the geological data in black and the mineral resource information in shades of red.

**Geological data** The geological boundary lines include those from previous surveys and the results of more detailed and recent mapping carried out in conjunction with this assessment (see p.00); in addition, cross-sections and a bedrock surface map are shown; as such,

they therefore represent the best interpretation of the information available. However, it is inevitable, particularly with deposits (such as those represented in this area) which change rapidly vertically and laterally, that local irregularities or discrepancies may occur. These are taken into account in the assessment of the resources (see Appendix B).

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



\*See Figure 4

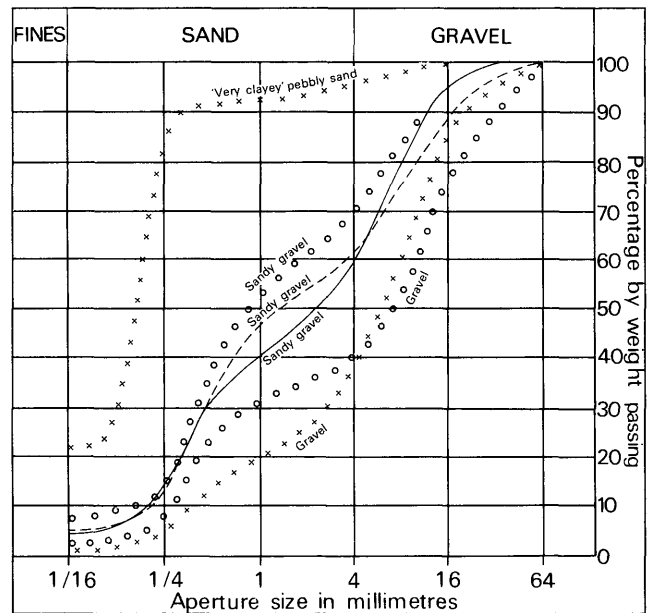
**Figure 5** Mean particle size distribution for the mineral in sub-blocks C<sub>1</sub>, E<sub>2</sub>, F<sub>2</sub> and block O (sample density at the 'inferred' level)

**Mineral resource information** For assessment purposes the map is divided into resource blocks within which there are areas of 'mineral' (that is, sub-blocks) and areas where sand and gravel is not potentially workable, absent or not assessed (for definitions of 'mineral' and 'potentially workable' and for discussion of resource blocks and sub-blocks, see Introduction).

Where 'mineral' is shown it is subdivided into one of two categories: 'exposed', where the thickness of overburden, commonly only soil and subsoil, averages less than 1m and as 'continuous or almost continuous spreads beneath overburden'. However, within both these categories there may be small areas where sand and gravel is absent or not potentially workable, for example around boreholes 11 SE 29 and 21 SW 18. Uncoloured parts of the map show bedrock outcrops, areas of non-mineral-bearing superficial deposits and sand and gravel considered to be not potentially workable.

For the most part the distribution of categories of deposits is based on the mapped geological boundaries. Where there is a transition from one category to another, which cannot be related to the geological mapping and which could not be accurately delineated during this survey, inferred boundaries have been inserted. Such boundaries are shown by a distinctive red zigzag symbol, which is intended to convey an approximate location within a likely zone of occurrence rather than to represent the breadth of the zone; its width is dictated by cartographical considerations. For the purpose of measuring areas the centre-line of the symbol is used. A mineral thickness (isopachyte) map is included.

The approximate extent is shown on the map of mineral workings and backfilled areas known up to March 1980. For further details of the workings, see below, Figure 2 and p. 00.



Key

- River Terrace Deposits (First Terrace) -mean
- x x x x River Terrace Deposits (First Terrace) -'envelope'\*
- Glacial Sand and Gravel -mean
- o o o o Glacial Sand and Gravel -'envelope'\*

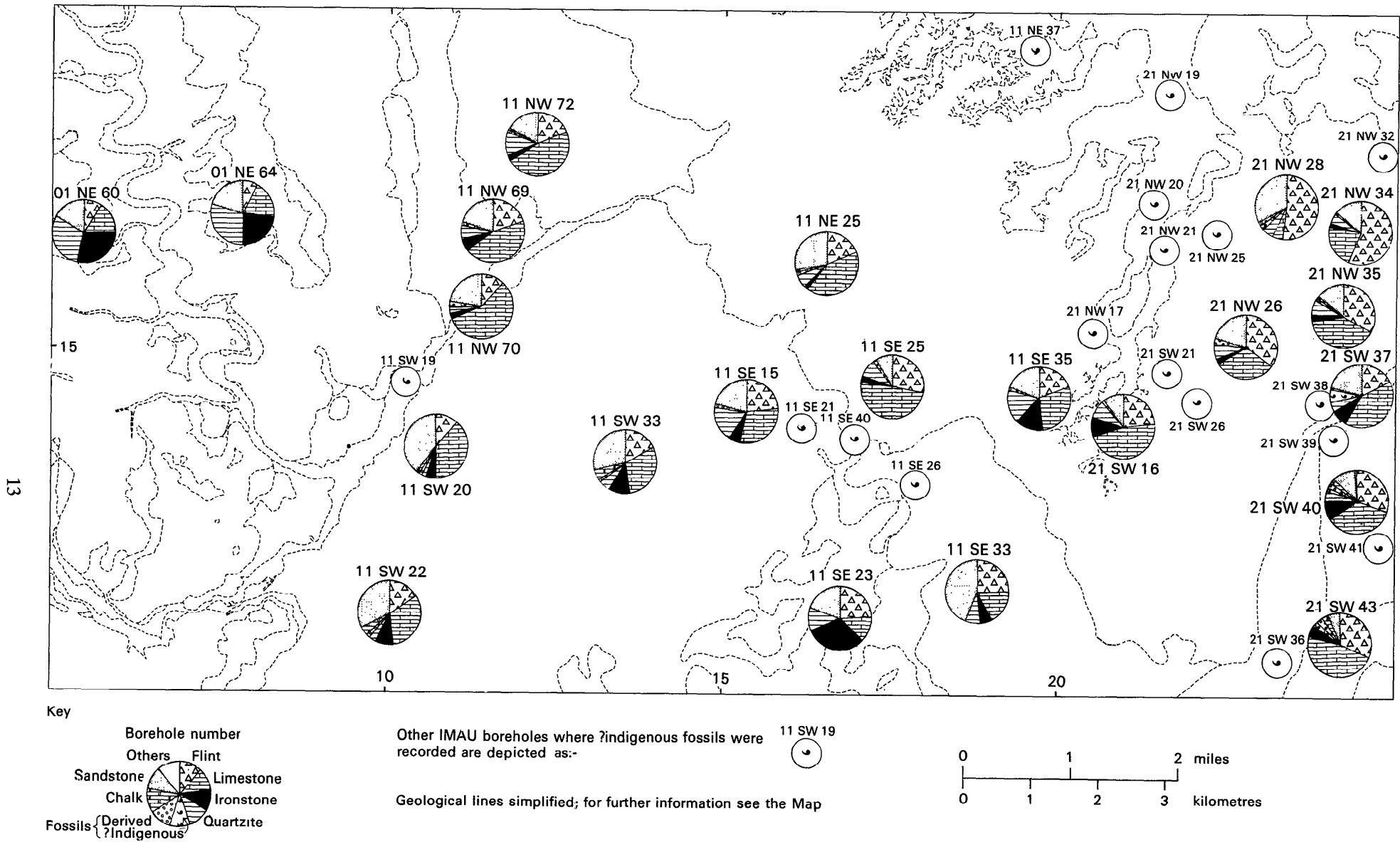
\*based on mean gradings from individual boreholes

**Figure 6** Mean particle size distribution of the mineral-bearing deposits

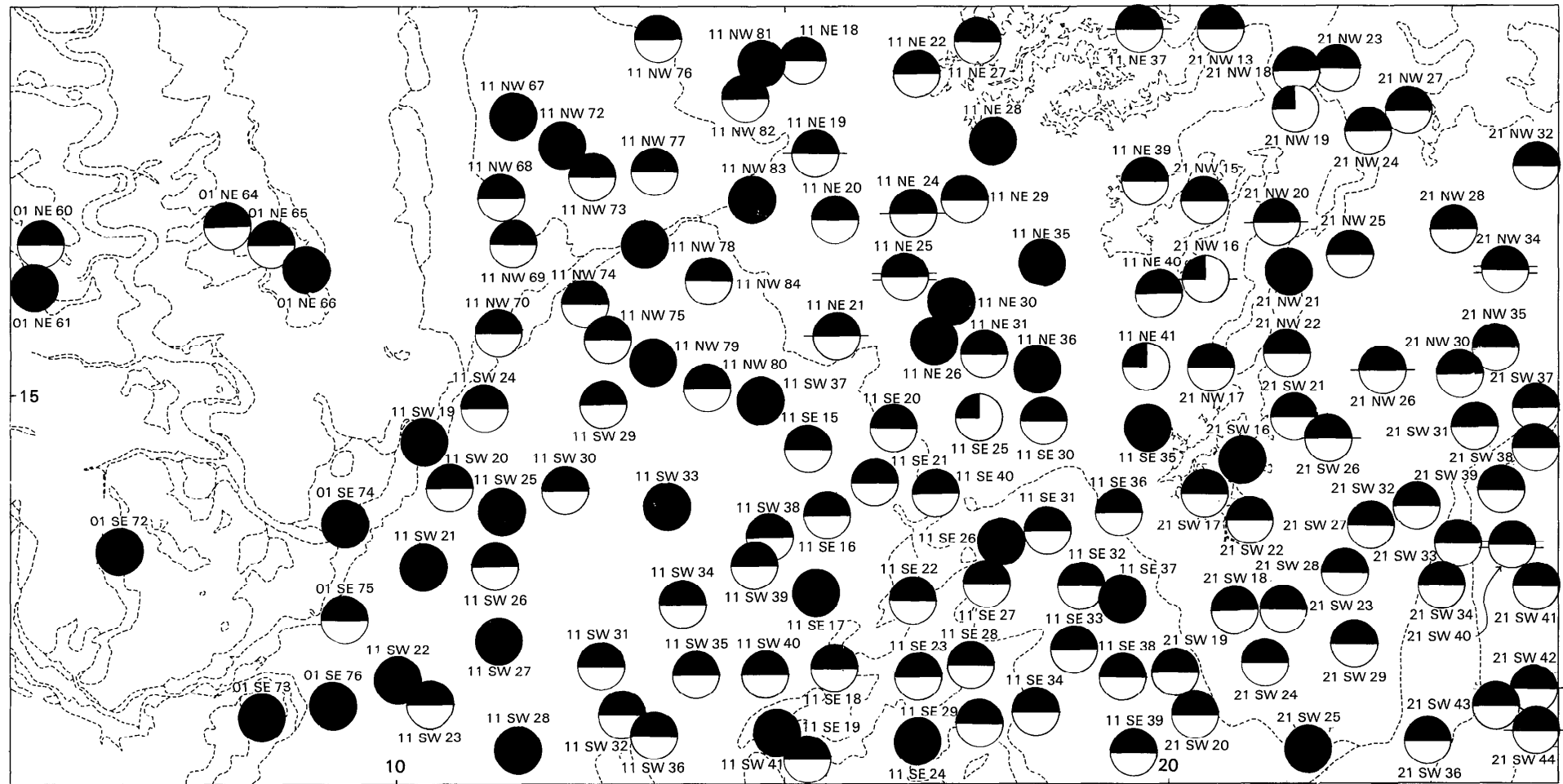
## RESULTS

The statistical results are summarised in Table 4. Additional compositional data are shown in Tables 2 to 3 and 7 to 14 and Figures 4 to 8 and 10 to 17.

**Accuracy of results** For the four resource sub-blocks where the volume assessment is calculated at the 'indicated' level (that is, in sub-blocks A<sub>1</sub>, D<sub>1</sub>, E<sub>1</sub> and F<sub>1</sub> extending over 90.9 km<sup>2</sup> - see Table 4a) the confidence limits at the symmetrical 95 per cent probability level range from 10 to 22 per cent (that is, it is probable that 19 times out of 20 the true volume lies within the given limits of the mean). However, the true values are more likely to be nearer the figures estimated than the limits. Where the mineral within a sub-block is subdivided, the

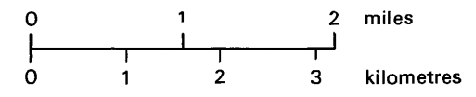


**Figure 7** Mean composition by weight of gravel (+8–16 mm fraction) in those IMAU boreholes where compositional data are available



Key

- |  |                       |  |                            |
|--|-----------------------|--|----------------------------|
|  | Pebbly sand           |  | 'Very clayey' sandy gravel |
|  | 'Clayey' pebbly sand  |  | Gravel                     |
|  | Sandy gravel          |  | Geological boundaries      |
|  | 'Clayey' sandy gravel |  |                            |



Note:  
 1. Simplified geological lines; for further information see the Map  
 2. Borehole display shown only where grading data available

Figure 8 Mean grading characteristics of the sand and gravel



**Table 4** Summary of results: the sand and gravel resources of the area assessed

Sub-block/ block*	Area		Mean thickness		Volume of mineral			Mean grading percentage (based on IMAU data)		
	Sub- block/ block km <sup>2</sup>	Mineral km <sup>3</sup>	Over- burden m	Mineral m	Limits at the 95% probability level m <sup>3</sup> × 10 <sup>6</sup>	±%		Fines - 1/16 mm	Sand + 1/16 - 4 mm	Gravel + 4 mm
						±%	±m <sup>3</sup> × 10 <sup>6</sup>			
a	Assessment of sub-blocks A <sub>1</sub> , D <sub>1</sub> , E <sub>1</sub> and F <sub>1</sub> at the 'indicated' level									
A <sub>1</sub> [22]*	7.4	7.4	1.2	2.8	20.7	14	2.9	5	50	45
D <sub>1</sub> [24]	14.5	14.5	2.0	2.1	30.5	22	6.7	4	51	45
E <sub>1</sub> [36]	24.8	24.8	3.2	2.1	52.1	18	9.4	5	55	40
F <sub>1</sub> [73]	47.0	44.2	0.9	3.8	167.9	10	16.8	4	52	44
Totals										
A <sub>1</sub> -F <sub>1</sub> [155]	93.7	90.9	1.7	2.9	263.6	9	23.7	4	52	44
b	Assessment of sub-blocks A <sub>2</sub> , C <sub>1</sub> , E <sub>2</sub> , F <sub>2</sub> , F <sub>3</sub> and block O at the 'inferred' level									
A <sub>2</sub> [5]	3.2	3.2	0.6	3.5	11.2	—	—	no data available		
C <sub>1</sub> [8]	0.8	0.8	6.6	4.0	3.2	—	—	6	72	22
E <sub>2</sub> [3]	1.0	1.0	6.4	2.3	2.3	—	—	4	58	38
F <sub>2</sub> [6]	1.4	1.4	1.2	2.8	3.9	—	—	12	51	37
F <sub>3</sub> [3]	1.2	1.2	0.3	7.1	8.5	—	—	no data available		
O [15]	41.6	2.9	0.3	2.3	6.7	—	—	6	56	38
Totals										
A <sub>2</sub> -O [40]	49.2	10.5	1.6	3.4	35.8	—	—	7	58	35

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

limits for each subdivision are usually greater than for the whole, thereby reflecting the variable thickness of the respective deposits and the reduced number of sample points available for the calculation. Moreover, it is probable that in each sub-block approximately the same percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say 100 hectares) containing similar sand and gravel deposits if the results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus if closer limits are needed for the quotation of the reserves in part of a sub-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 associated within the sub-blocks in the assessed area. The total volume (263.6 million m<sup>3</sup>) at the 'indicated' level can be estimated to limits of ±9 per cent at the 95 per cent probability level by a calculation based on data from 155 sample points spread across the four sub-blocks.

The total volume of mineral at the 'inferred' level of assessment in sub-blocks A<sub>2</sub>, C<sub>1</sub>, E<sub>2</sub>, F<sub>2</sub>, F<sub>3</sub> and block O (see Table 4b) is estimated at 35.8 million m<sup>3</sup> by a calculation based on data from 40 sample points; confidence limits are not quoted in this instance.

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

*Worked ground (sand and gravel): details* The area and estimated volume of worked-out sand and gravel deposits in the resource sheet area, to March 1980, are approximately 2.8 km<sup>2</sup> and 11 million m<sup>3</sup>, respectively. Some worked-out pits in sand and gravel have been restored to ground level by infilling with refuse or land-

scaped and allowed to fill with water so as to form lagoons suitable for recreational or wildlife conservation purposes. The locations of mineral workings in the area are shown in Figure 2, and active pits are listed in Table 5.

**Table 5** List of active sand and gravel pits (see also Figure 2)

Operator	Locality	Geological Formation	Grid Reference
Redlands Aggregates Ltd (Gravel Readymix)	West Deeping	Exposed First Terrace	[TF 105 103]
F. B. Gibbon and Sons Ltd	Baston	Exposed First Terrace	[TF 126 143]
ARCEastern (Amey Roadstone)	Baston	Exposed First Terrace	[TF 140 147] Pit 1 [TF 140 135] Pit 2

#### NOTES ON THE RESOURCE BLOCKS

The block letters (A-F) follow the approximate stratigraphical order of the superficial deposits mapped in the Bourne, Stamford [TF 030 070] and Peterborough 'project area' of which this report forms a part; for example, block A includes the most recent deposits (Alluvium) and block F the oldest deposits (First Terrace). Block O is the exception to this scheme: it contains scattered occurrences of glacial deposits and Jurassic clays. For further details regarding blocks, sub-blocks and subscript figures (see Introduction, Table 6 and Figure 9).



**Table 6** The relationship of the block letters to the classification of the Drift deposits

Block letter	Drift deposits covered by each block
A	Alluvium — generally overlying First Terrace
B*	Shell Marl (Whittlesey area)
C	Terrington Beds
D	Nordelph Peat
E	Barroway Drove Beds — overlying First Terrace
F	First Terrace — Rivers Glen and Welland
G*	Second Terrace (Whittlesey area)
H*	March Gravels (Whittlesey area)
I*	Third Terrace (Whittlesey area)
O	Other deposits — including patches of Glacial Sand and Gravel.

\* Not used in this report.

In this report there is no representative of blocks B, G, H and I because the deposits to which they refer (see Table 6) do not crop out in the present map area. However, they are incorporated in Table 6 in order to preserve the continuity between this resource scheme and the published reports concerned with the areas referred to previously.

For assessment purposes, where several mineral-bearing areas (sub-blocks) within a block are recognised, they are distinguished by subscript numbers; the subscript order (1–3) implies a degree of mineral potential of decreasing importance based on parameters such as mineral area, volume or data density.

Some occurrences of sand and gravel (for example in sub-block A<sub>1</sub> at [TF 147 102] and in sub-block F<sub>1</sub> at [TF 175 136, TF 174 129 and TF 175 103]) are theoretically too small to be included in any assessment (Appendix B, para. 14); however, their collective area and (in most cases) continuity with a larger adjacent mineral-bearing area justifies their assessment.

All registered non-confidential boreholes, used in the assessment but not drilled by the IMAU, are listed at the end of Appendix E. A selection of these is shown on the map.

**Block A** (including sub-blocks A<sub>1</sub> and A<sub>2</sub>) This block encompasses the floodplain deposits of the River Glen, the ‘Eastern Glen’, and the River Welland. These deposits, which include alluvial silts and clays, overlie Nordelph Peat, Barroway Drove Beds or First Terrace sands and gravels. Bedrock ranges from Upper Lincolnshire Limestone in the west (the oldest formation in the area) to Oxford Clay in the east.

The block, comprising nine separate units, is 13.3 km<sup>2</sup> in area of which 10.6 km<sup>2</sup> (described below in sub-blocks A<sub>1</sub> and A<sub>2</sub>; see also Figure 9) is assessed either as exposed mineral or as continuous or almost continuous mineral beneath overburden. No sand and gravel extraction is known to have taken place within the block.

The assessment is based on 16 IMAU boreholes and 16 others (of which four are held on a commercial-in-confidence basis).

**Sub-block A<sub>1</sub>** This sub-block (7.4 km<sup>2</sup> in area) is assessed as continuous or almost continuous mineral beneath overburden. It comprises five separate units of which

one (2.3 km<sup>2</sup> in area) extends along the Fenland edge of the Upland and includes the sub-alluvial sand and gravel (First Terrace deposits) of the River Glen and its tributary. The remaining units, sited in the middle and eastern parts of the area, relate to the River Welland.

Inferred boundaries within the area of Crowland Fodder Lots distinguish mineral from barren ground to the north and south; those associated with the upstream Glen and ‘Eastern Glen’ at [TF 082 134] and [TF 069 112] separate sub-block A<sub>1</sub> from A<sub>2</sub> on the basis of borehole density.

The assessment is based on 11 IMAU boreholes and 11 others. The recorded thickness of the overburden ranges from nil (boreholes 01 SE 68, 01 SE 69, 01 SE 70 and 01 SE 78) to 6.0 m (borehole 21 SW 33) with a mean of 1.2 m. The proven mineral ranges from 2.0 m (boreholes 01 SE 74 and 21 SW 33) to 5.6 m (borehole 01 SE 56) with a mean of 2.8 m.

The IMAU boreholes prove mineral classified either as gravel or sandy gravel (Figure 10, Table 7) with a mean fines fraction (<1/16 mm) not exceeding 8 per cent (boreholes 01 SE 74 and 11 SE 22); locally however, there were discrete layers of ‘very clayey’ pebbly sand within the deposit, for example between 1.0–1.5 m in borehole 11 SE 18. The gravel component (+4–64 mm fraction) consists mainly of shelly and oolitic limestone and calcareous sandstone with brown and white flint and some quartzite, ironstone and chalk.

The mean grading for the sub-block is gravel 45 per cent, sand 50 per cent and fines 5 per cent, with sandy gravel as the overall classification. The estimated volume of mineral at the ‘indicated’ level is 20.7 million m<sup>3</sup> ± 14 per cent at the 95 per cent confidence level.

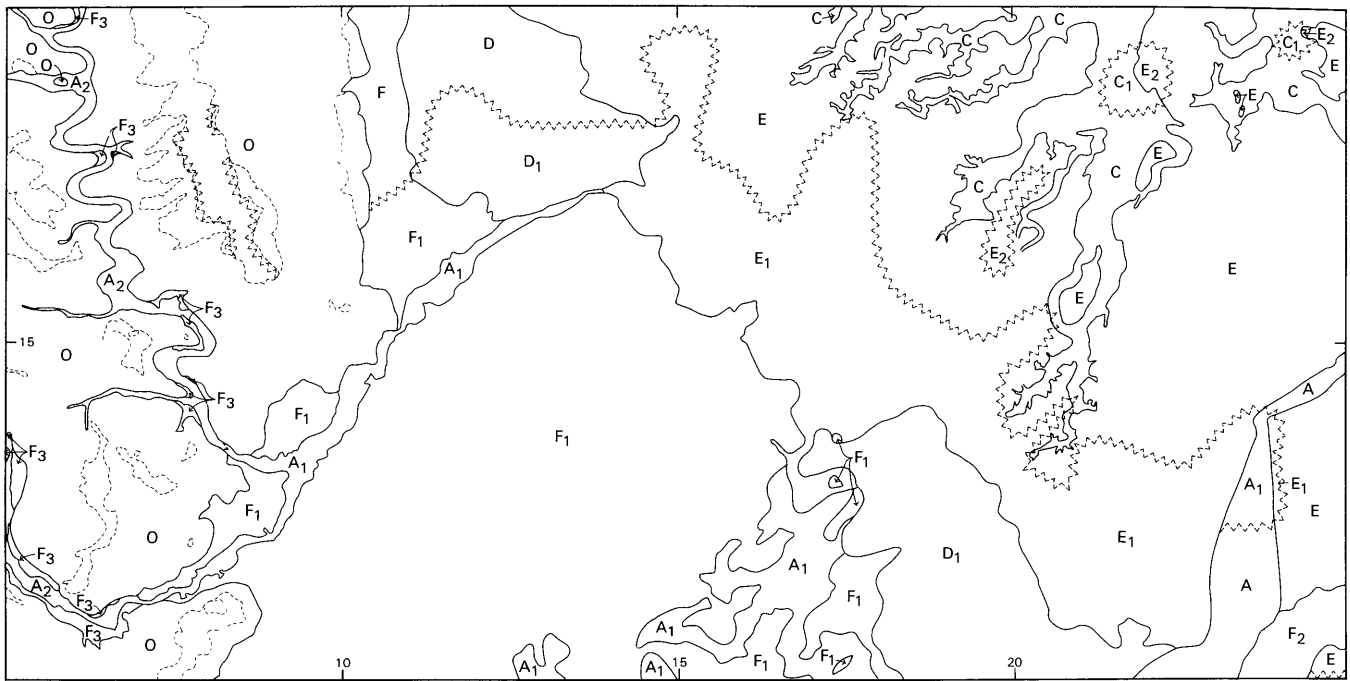
**Sub-block A<sub>2</sub>** This minor sub-block (3.2 km<sup>2</sup> in area) is confined to the upstream reaches of the River Glen and its tributary within the Upland, and comprises mainly sub-alluvial gravels assessed as exposed mineral. The ‘inferred’ assessment is based on five non-IMAU boreholes (of which four remain commercial-in-confidence).

Overburden ranges in thickness from nil to 1.5 m with a mean of 0.6 m. The proven mineral ranges from 3.8 to 7.0 m with a mean of 3.5 m. Mineral is absent in one borehole. The estimated volume of mineral at the ‘inferred’ level is 11.2 million m<sup>3</sup>.

**Block C** (including sub-block C<sub>1</sub>) Block C, which is 10.3 km<sup>2</sup> in area, encloses the outcrop of the Terrington Beds comprising mainly clays, silts and silty clays of infilled creeks and river courses. Beneath these deposits, First Terrace sand and gravel occurs over much of the block (for example in boreholes 21 NW 20, 21 NW 21, 21 NW 13) but this material is not assessed as mineral as it is generally overlain by waste in excess of the 3:1 overburden:mineral ratio. Locally (east of The Parks [TF 215 187] and around Tointon’s Farm [TF 243 196]), ground assessed as mineral-bearing (sub-block C<sub>1</sub>) is outlined by inferred boundaries. The bedrock formation is Oxford Clay but some boreholes (for example, 21 NW 3 and 21 NW 27) also proved Boulder Clay (up to 3.0 m thick in borehole 21 NW 18) underlying the sand and gravel deposits.

The assessment is based on 14 IMAU boreholes and 5 others.

**Sub-block C<sub>1</sub>** Sub-block C<sub>1</sub>, with an area of 0.8 km<sup>2</sup>, is the smallest of the sub-blocks in the area, and the ‘infer-

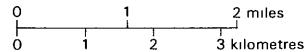


KEY

- Block/sub-block boundaries
- - - Geological boundaries
- ..... Inferred boundaries

Resource blocks are designated by letters according to the stratigraphical code shown in Table 6  
 Sub-blocks are identified by subscript numbers

Scale



**Figure 9** Location of resource blocks and sub-blocks

red' assessment is based on three IMAU boreholes and five others.

The recorded thickness of overburden ranges from 5.0 to 10.7 m (boreholes 21 SW 16 and 21 NW 7, respectively) with a mean of 6.6 m. Generally, thicknesses increase towards the north and east. The proven mineral ranges from 1.8 to 9.5 m (boreholes 21 SW 16 and 21 NW 3, respectively). Boreholes 21 NW 5 and 21 NW 7 (both included in the assessment calculations) did not prove mineral. Sand and gravel extraction is unknown within the sub-block.

The three IMAU boreholes for which grading data are available prove means for the boreholes ranging from pebbly sand to gravel (see Figure 11, Table 8). Exceptionally (borehole 21 NW 19), the mineral proves to be mostly sand (86 per cent) with 'clayey' layers (up to 17 per cent in the fines fraction — between 5.6 and 6.7 m); this sandy facies (the marine/estuarine facies of the First Terrace deposits) here and often elsewhere (see p.00) occurs with an (?) indigenous shelly fauna.

The mean grading for the sub-block is gravel 22 per cent, sand 72 per cent and fines 6 per cent — with pebbly sand as the overall classification. The estimated volume of mineral at the 'inferred' level is 3.2 million m<sup>3</sup>.

**Block D** (including sub-block D<sub>1</sub>) Block D is 18.8 km<sup>2</sup> in area, of which 14.5 km<sup>2</sup> is assessed as continuous or almost continuous mineral (First Terrace deposits) beneath overburden. The overburden comprises Nordelph Peat overlying Barroway Drove Beds which rest on either an impersistent intermediate peat (a leaf of the

Lower Peat) or the more persistent Lower Peat. Bedrock formations range from Kellaways Clay in the west to Oxford Clay in the east.

The block comprises two areas, one (7.7 km<sup>2</sup> in area) south and east of Bourne, the other between Chestnut House [TF 184 137] and Fleet Hall [TF 217 101]. In the former, inferred boundaries in the northern part determine the approximate limitations of the mineral. Sand and gravel extraction is unknown within the block.

The assessment is based on 19 IMAU boreholes and eight others.

**Sub-block D<sub>1</sub>** This sub-block, which is 14.5 km<sup>2</sup> in area, comprises a mineral-bearing area (4.4 km<sup>2</sup>) in the north (partially enclosed by inferred boundaries) and one (10.1 km<sup>2</sup>) in the south. The assessment is based on 16 IMAU boreholes and eight others.

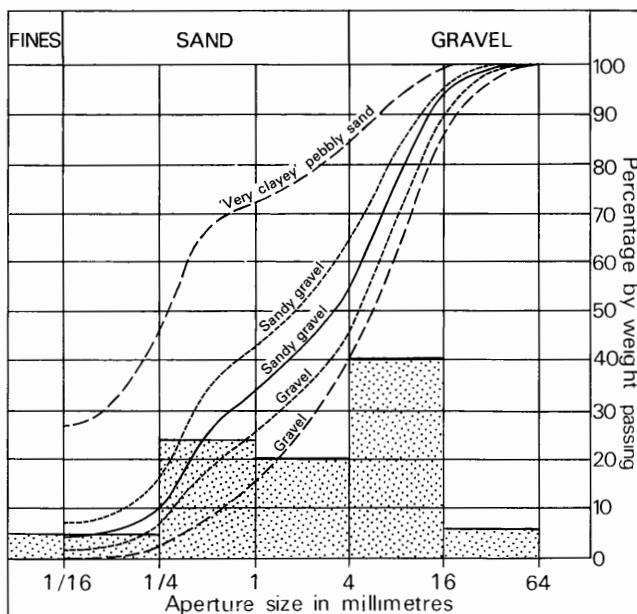
The recorded thickness of overburden ranges from nil to 4.0 m (boreholes 11 SE 10 and 11 NW 10, respectively) with a mean of 2.0 m; generally, thicknesses increase towards the east. The proven mineral ranges from 0.5 to 4.3 m (boreholes 11 NW 4c and 11 SE 10, respectively) with a mean of 2.1 m.

The mean grading for mineral in the IMAU boreholes ranges from sandy gravel to gravel (Figure 12, Table 9) with the fines fraction not exceeding 7 per cent (boreholes 11 NW 68 and 11 SE 39). However, locally there are discrete occurrences of 'clayey' material; for example, 'clayey' pebbly sand (with a fines fraction of 18 per cent) was proved in borehole 11 NW 68 between 1.6 and 2.2 m.

**Table 7** Sub-block A<sub>1</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading classification
	Overburden	Mineral	Fines - 1/16 mm	Fine sand + 1/16 - 1/4 mm	Medium sand + 1/4 - 1 mm	Coarse sand + 1 - 4 mm	Fine gravel + 4 - 16 mm	Coarse gravel + 16 mm	
01 SE 74	0.5	2.0	8	3	15	20	46	8	G
11 NW 70	0.3	3.2	3	7	33	16	35	6	SG
11 NW 78	1.0	2.7	5	9	20	18	41	7	G
11 SW 19	0.9	2.4	3	4	22	22	43	6	G
11 SW 41	1.3	3.1	3	4	22	18	43	10	G
11 SE 18	c1.0	c2.8	6	5	21	23	40	5	SG
11 SE 22	1.2	2.4	8	9	26	22	29	6	SG
11 SE 23	1.0	2.6	5	6	25	18	40	6	SG
11 SE 24	0.8	3.0	5	4	20	20	44	7	G
21 SW 33	6.0	2.0	7	3	21	25	39	5	SG
21 SW 34	5.0	2.9	2	7	29	25	33	4	SG
Mean	1.2*	2.8*	5	6	24	20	39	6	SG

\* Based on data from 22 boreholes.



**Figure 10** Grading characteristics of the resources within sub-block A<sub>1</sub> (based on 11 boreholes). The continuous line represents the weighted mean grading of the sub-block; the broken and pecked lines denote the envelopes containing the mean grading curves based on individual samples and individual boreholes, respectively. The grading of the sub-block is also shown as a histogram

Detailed compositional data are available for two IMAU boreholes; 11 NW 72 and 11 SE 33 (Table 2). The mineral (+8–16 mm fraction) comprises mainly oolitic and shelly limestone, flint (mostly brown and white) and calcareous sandstone. Quartzite and ironstone are important subsidiary components and there are rare chalk clasts. Locally (for example in borehole 11 SE 26), (?)indigenous shells occur within the sand and gravel (see p.00). Boreholes 11 SE 33 and 11 SE 38 proved iron-cemented nodules or conglomerate, generally in the

upper layers of the mineral and iron-stained gravel was recorded in borehole 21 SW 20 (see also p.00).

The mean grading for the sub-block is gravel 45 per cent, sand 51 per cent and fines 4 per cent, with sandy gravel as the overall classification. The estimated volume of mineral at the 'indicated' level is 30.5 million m<sup>3</sup> ± 22 per cent at the 95 per cent confidence level.

**Block E** (including sub-blocks E<sub>1</sub> and E<sub>2</sub>) Block E is 64.5 km<sup>2</sup> in area (the largest of the resource blocks, occupying approximately 32 per cent of the resource sheet area) of which 25.8 km<sup>2</sup> is assessed as continuous or almost continuous mineral (First Terrace deposits) beneath overburden. The block encloses the outcrop of the Barroway Drive Beds, an area (in part overlain by later Flandrian deposits) lying east of the First Terrace and Nordelph Peat outcrops and extending to the northern and eastern boundaries of the resource sheet.

For assessment purposes, the mineral-bearing areas are divided into two sub-blocks (E<sub>1</sub> and E<sub>2</sub>); sub-block E<sub>1</sub> is the larger and more continuous of the two, whereas sub-block E<sub>2</sub> comprises three discontinuous parts (see Figure 9). Where drawn, inferred boundaries are based primarily on borehole data or where (in the case of sub-block E<sub>2</sub>) the available data are insufficient to delineate the mineral accurately. Locally (at [TF 246 102]), additional inferred boundaries ensure a continuity between this resource sheet and the adjacent area to the south (Booth, 1982).

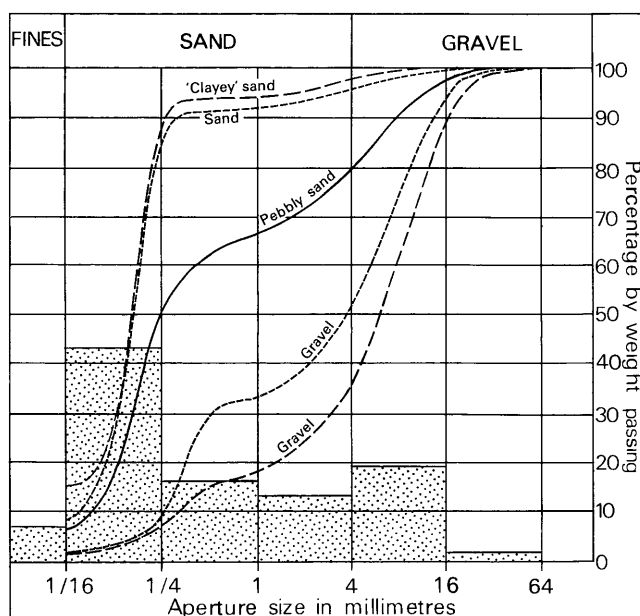
The overburden consists mainly of silts and clays (including discontinuous roddons) together with an impersistent intermediate peat (a leaf of the Lower Peat), the more extensive Lower Peat and (within much of the First Terrace deposits) a heterogeneous deposit of silty, sandy clays and clayey sand containing scattered pebbles — the Crowland Bed (see p.00). Throughout the area, the bedrock is Oxford Clay; however, Boulder Clay overlying this formation was proved in numerous boreholes (including 21 NW 16, 21 NW 22 and 21 NW 23) sited mainly in the north-eastern part of the block. Sand and gravel extraction is unknown within the block.

The assessment is based on 58 IMAU boreholes and nine others.

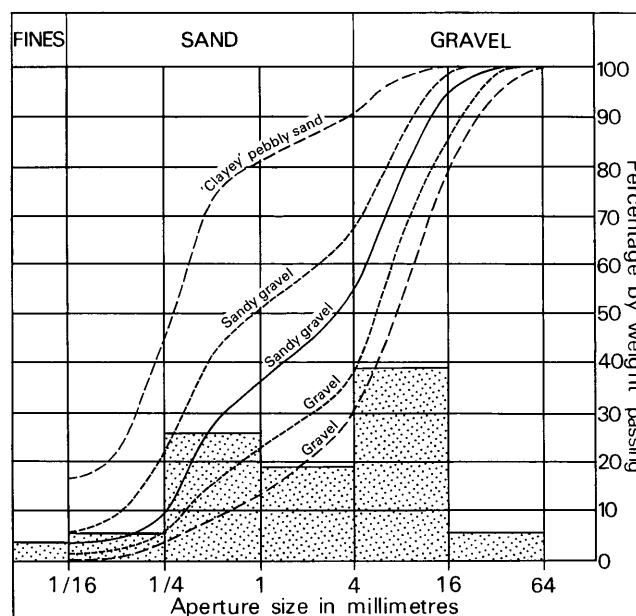
**Table 8** Sub-block C<sub>1</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage					Grading classification	
	Overburden	Mineral	Fines - 1/16 mm	Fine sand + 1/16 - 1/4 mm	Medium sand + 1/4 - 1 mm	Coarse sand + 1 - 4 mm	Fine gravel + 4 - 16 mm		Coarse gravel + 16 mm
21 NW 18	7.9	3.7	3	6	31	26	31	3	SG
21 NW 19	5.7	6.0+	9	75	8	3	4	1	PS
21 SW 16	5.0	1.8	7	16	10	18	43	6	G
Mean	6.6*	4.0*	6	43	16	13	19	3	PS

\* Based on data from eight boreholes.



**Figure 11** Grading characteristics of the resources within sub-block C<sub>1</sub> (based on 3 boreholes). For explanation see Figure 10



**Figure 12** Grading characteristics of the resources within sub-block D<sub>1</sub> (based on 16 boreholes). For explanation see Figure 10

**Sub-block E<sub>1</sub>** The sub-block is adjacent to those outcrops of Nordelph Peat and First Terrace deposits in the west whereas its eastern margin is determined by inferred boundaries. Much of the sub-block forms an almost continuous north-west to south-east strip separated from a small isolated area ([TF 240 135]—within Crowland Falls) which is also included in the assessment.

Mineral is present over approximately 24.8 km<sup>2</sup> of sub-block E<sub>1</sub> which ranks as the second largest mineral-bearing area within the resource sheet area. The assessment is based on 27 IMAU boreholes and nine others. Inferred boundaries are drawn primarily on the basis of borehole data.

The recorded thickness of overburden ranges from 0.6 m (borehole 11 SE 14) to 5.7 m (boreholes 21 SW 32 and 21 SW 12) with a mean of 3.2 m; generally, the greater thicknesses occur in the north and east of the assessed area. The proven mineral ranges from 0.9 m (boreholes 11 NE 20 and 21 SW 18) to 5.1 m (borehole 11 SE 14) with a mean of 2.1 m; waste partings are present in boreholes 11 NE 30 and 21 SW 23 (see Table 10).

The mean grading for mineral in the IMAU boreholes ranges from 'very clayey' pebbly sand to gravel (Figure

13, Table 10) with a maximum fines fraction of 26 per cent (borehole 11 NE 25); generally, the fines fraction does not exceed 7 per cent. Detailed compositional data are available for three IMAU boreholes; 11 NE 25, 11 SE 25 and 11 SE 35 (Table 2). The mineral (in the +8–16 mm fraction) comprises mainly oolitic and shelly limestone, angular white and brown flint with sandstone (mainly calcareous).

Quartzite and ironstone are locally important but are usually subsidiary. (?) Indigenous shells (see p.00) were recorded in boreholes 11 SE 25, 11 SE 40 and 21 NW 17, often associated with a more sandy (basal) facies of the mineral deposit.

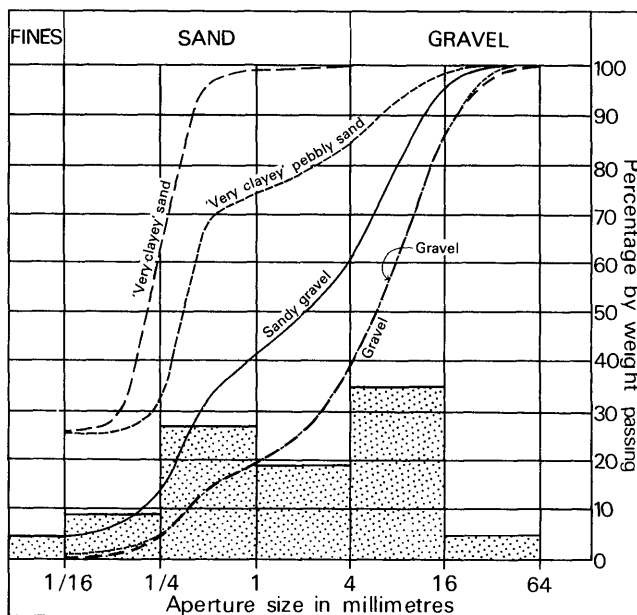
The mean grading for the sub-block is gravel 40 per cent, sand 55 per cent and fines 5 per cent, with sandy gravel as the overall classification. The volume of mineral at the 'indicated' level is estimated at 52.1 million m<sup>3</sup> ± 18 per cent at the 95 per cent confidence level.

**Sub-block E<sub>2</sub>** Sub-block E<sub>2</sub> comprises three small units (with a total area of 1 km<sup>2</sup>) in the north-east of the area. The 'inferred' assessment is based on three IMAU boreholes.

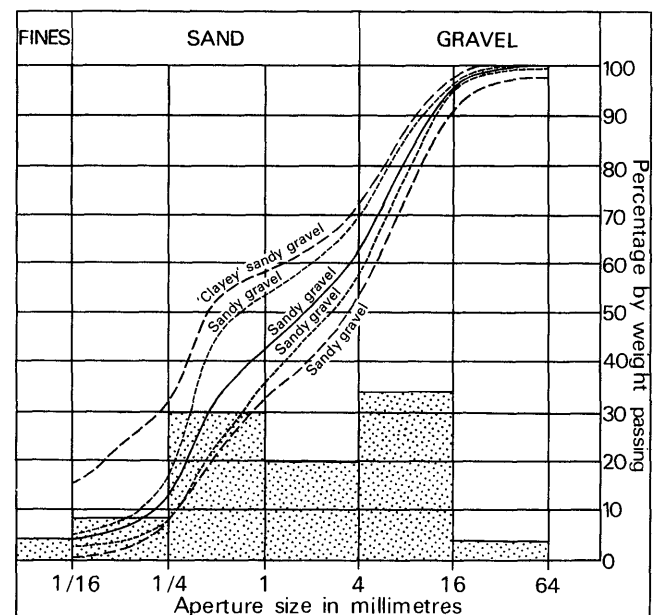
**Table 9** Sub-block D<sub>1</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage					Grading Classification	
			Fines	Fine sand	Medium sand	Coarse sand	Fine gravel		Coarse gravel
	Over-burden	Mineral	- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm		+16 mm
11 NW 67	1.9	0.9	5	7	14	25	47	2	G
11 NW 68	1.6	2.1	7	15	20	19	36	3	SG
11 NW 72	1.6	1.3	5	5	13	15	56	6	G
11 NW 73	2.1	1.1	5	3	25	24	40	3	SG
11 NW 77	1.1	2.2	3	6	23	22	43	3	SG
11 SE 26	1.9	2.9	3	4	19	17	45	12	G
11 SE 31	2.5	1.2	3	9	32	15	37	4	SG
11 SE 32	1.8	c4.2	4	6	29	18	37	6	SG
11 SE 33	1.8	2.0	3	8	31	18	37	3	SG
11 SE 34	1.7	3.1	4	6	41	16	30	3	SG
11 SE 37	2.5	1.1	3	4	16	20	42	15	G
11 SE 38	1.9	1.3	3	4	27	21	39	6	SG
11 SE 39	1.8	1.2	7	4	28	23	34	4	SG
21 SW 19	1.9	1.0	2	7	27	22	39	3	SG
21 SW 20	2.4	3.4	3	4	28	18	42	5	SG
21 SW 25	3.6	3.2	3	4	26	17	42	8	G
Mean	2.0*	2.1*	4	6	26	19	40	5	SG

\* Based on data from 24 boreholes.



**Figure 13** Grading characteristics of the resources within sub-block E<sub>1</sub> (based on 27 boreholes). For explanation see Figure 10



**Figure 14** Grading characteristics of the resources within the sub-block E<sub>2</sub> (based on 3 boreholes). For explanation see Figure 10

The recorded thickness of overburden ranges from 6.2 to about 7.3 m (boreholes 21 NW 15 and 21 NW 23, respectively) with a mean of 6.4 m. The proven mineral ranges from 1.9 to about 2.7 m (boreholes 11 NE 40 and 21 NW 23, respectively) with a mean of 2.3 m. The mineral as assessed in all the three boreholes graded as a sandy gravel but locally, a maximum of 15 per cent fines (between 9.3 and 10.0 m) in borehole 21 NW 23, graded as a 'clayey' sandy gravel (Figure 14, Table 11).

The mean grading for the sub-block is gravel 38 per cent, sand 58 per cent and fines 4 per cent, with sandy gravel as the overall classification. The volume of mineral at the 'inferred' level is estimated at 2.3 million m<sup>3</sup>.

**Block F** (including sub-blocks F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub>) Block F, which includes all First Terrace deposits, is 51.5 km<sup>2</sup> in area (the second largest of the resource blocks) of which 46.8 km<sup>2</sup> (90.9 per cent) is assessed as mineral-bearing. The remaining 4.7 km<sup>2</sup> comprises non-mineral areas including 1.9 km<sup>2</sup> south of Bourne and worked-out sand and gravel pits (2.8 km<sup>2</sup> in area) around Rectory Farm [TF 116 104], near Langtoft and east of Baston (see Figure 2 (Table 5)).

First Terrace deposits are present as numerous, small discrete outcrops flanking the floodplain of the Upland valleys, as an arcuate outcrop of sand and gravel (centered on Crowland) and as an extensive delta-shaped

**Table 10** Sub-block E<sub>1</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading Classification
	Overburden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	
			– $\frac{1}{8}$ mm	– $\frac{1}{8}$ – $\frac{1}{4}$ mm	– $\frac{1}{4}$ –1 mm	+1–4 mm	+4–16 mm	+16 mm	
11 NW 81	3.0	2.1	2	3	24	21	45	5	G
11 NW 83	1.9	1.0	6	3	11	19	46	15	G
11 NE 18	4.0	1.5	2	6	25	19	40	8	SG
11 NE 20	2.1	0.9	5	8	18	22	43	4	SG
11 NE 21	2.6	1.4	13	7	21	17	37	5	CSG
11 NE 25	2.6	1.2	26	3	20	17	29	5	VCSG
11 NE 26	c3.8	(c1.0)	4	4	20	21	47	4	G
11 NE 28	3.7	1.4	6	3	20	22	47	2	G
11 NE 29	3.9	1.3	3	6	30	23	35	3	SG
11 NE 30	3.0	1.3†	4	6	21	19	45	5	G
11 NE 31	1.7	3.8	6	9	29	17	36	3	SG
11 NE 36	3.7	1.7	2	5	24	19	43	7	G
11 SE 20	2.6	0.9	4	7	23	19	43	4	SG
11 SE 25	2.3	5.0	6*	27*	41*	10*	14*	2*	PS*
11 SE 30	2.2	2.9	2	3	30	22	37	6	SG
11 SE 35	3.7	1.7	6	3	20	22	43	6	G
11 SE 36	3.5	2.6	4	5	29	17	38	7	SG
11 SE 40	1.1	c2.5	9	21	30	16	21	3	SG
21 NW 17	3.8	1.6	4	4	36	21	32	3	SG
21 SW 17	2.9	2.0	7	10	33	25	21	4	SG
21 SW 18	2.9	(0.9)	5	7	36	20	28	4	SG
21 SW 22	4.1	1.5	5	15	25	13	37	5	SG
21 SW 23	3.2	2.6‡	3	6	28	22	36	5	SG
21 SW 24	3.2	1.7	2	3	23	24	42	6	SG
21 SW 28	4.8	2.0	2	5	27	20	40	6	SG
21 SW 29	5.1	3.1	5	7	23	21	38	6	SG
21 SW 32	5.7	2.2	2	8	27	23	36	4	SG
Mean	3.2§	2.1§	5	9	27	19	35	5	SG

\* The overall mean grading for two lithologies.

† Including a 0.1 mm waste parting.

‡ Sum of two beds separated by 0.6 m of waste.

§ Based on data from 36 boreholes.

( ) Brackets show that the sand and gravel in the individual borehole cannot be assessed as 'mineral' (see Introduction).

spread within the Fenland. These deposits were derived principally from the outwash of the River Glen and its tributary and to a lesser extent from the River Welland. Thickness variations of mineral (see the map, Figure B) show a crude form of outwash-fan attenuated to the north and east (see also p.00).

For assessment purposes the mineral-bearing ground has been divided into three sub-blocks F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> (Figure 9) within which sand and gravel is assessed as exposed mineral. The assessment is based on 42 IMAU boreholes and 42 others (of which 11 remain commercial-in-confidence).

The overburden comprises soil with either loamy sands, silts, sandy clays or clays with scattered pebbles. The bedrock ranges from Upper Lincolnshire Limestone in the west to Oxford Clay in the east.

**Sub-block F<sub>1</sub>** Sub-block F<sub>1</sub> is the most extensive of the sub-blocks in the resource sheet area both in terms of area (47.0 km<sup>2</sup>) and area of mineral-bearing ground (44.2 km<sup>2</sup>). More significantly, the sand and gravel is currently being extracted in a series of sand and gravel pits extending from [TF 105 100] in the south-west to Baston Common [TF 144 159] and Langtoft Common [TF 152 141] in the north-east (see Figure 2). Commercial operators have worked in the area since the early 1930's, when the resource was first discovered by itiner-

ant speculators digging on an 'ad hoc' basis (personal communication F. B. Gibbon of F. B. Gibbon and Sons Ltd).

The greater part of the sub-block is a delta-shaped spread of mineral extending north-eastwards into the Fenland from the base of the Upland; its eastern boundary is demarcated by an overlapping sequence of alluvium, peats and silts of Flandrian age. Also included within this sub-block are discrete outcrops of First Terrace deposits (for example at [TF 175 136], [TF 174 129] and [TF 175 103]) which collectively contain sufficient mineral-bearing ground to justify their assessment.

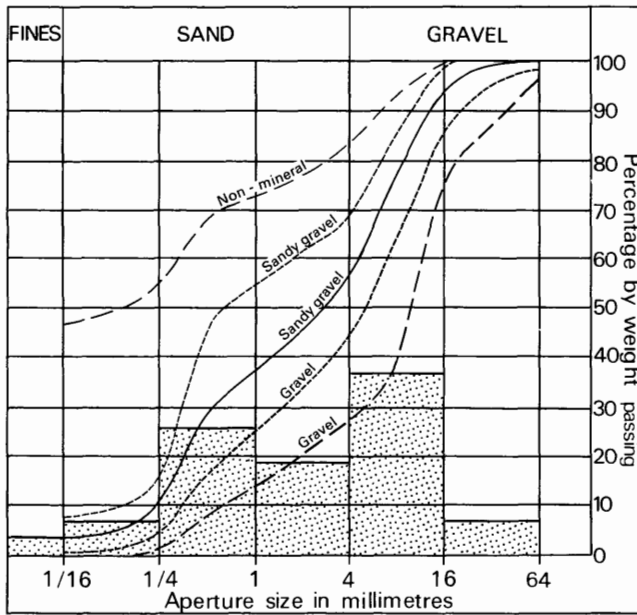
Overburden (where present) consists mainly of soil with clayey gravel and ranges from 0.2 to 5.0 m (boreholes 11 SW 18 and 11 NW 2, respectively) with a mean of 0.9 m; generally the overburden does not exceed 0.6 m but tends to be thickest in the northern part of the sub-block. The proven mineral ranges from 0.2 m (borehole 11 NW 45) to 6.5 m (in two commercial-in-confidence boreholes) with a mean of 3.8 m. Variations of mineral thickness are shown on the map, Figure B; generally, thicknesses become attenuated towards the north and east.

The mean grading for mineral in the IMAU boreholes ranges from sandy gravel to gravel (see Figure 15, Table 12), but exceptionally, the fines fraction exceeds 40 per cent, for example between 0.5 and 1.0 m in borehole

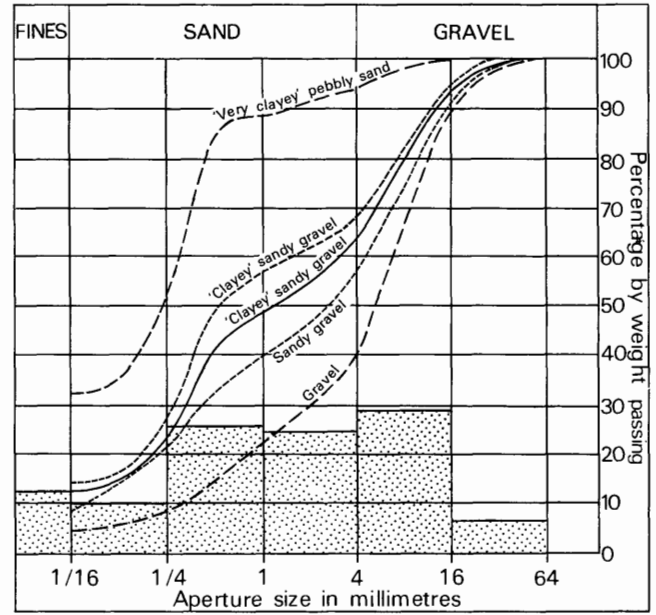
**Table 11** Sub-block E<sub>2</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading Classification
			Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	
	Overburden	Mineral	-1/16 mm	+1/16-1/4 mm	+1/4-1 mm	+1-4 mm	+4-16 mm	+16 mm	
11 NE 40	5.1	1.9	3	5	27	22	39	4	SG
21 NW 15	6.2	2.3	4	7	24	23	37	5	SG
21 NW 23	c7.3	c2.7	5	12	35	16	27	5	SG
Mean	6.4*	2.3*	4	8	30	20	33	5	SG

\* Based on data from three boreholes.



**Figure 15** Grading characteristics of the resources within sub-block F<sub>1</sub> (based on 37 boreholes). For explanation see Figure 10



**Figure 16** Grading characteristics of the resources within sub-block F<sub>2</sub> (based on 3 boreholes). For explanation see Figure 10

11 SW 21. Detailed compositional data are available for five IMAU boreholes (see Table 2). The mineral (in the +8–16 mm fraction) consists principally of oolitic and shelly limestone, sandstone (mainly calcareous) and angular, brown and white flint. Ironstone and quartzite are important subsidiary components.

Over much of the mineral-bearing area, the upper layers (0 to 2 m) are often strongly iron-stained (for example in boreholes 11 NW 80, 11 NW 84 and 11 SW 21), and in exposures at Baston Pit. Locally, the gravels include hardpan layers frequently comprising well-indurated iron-cemented conglomerates (see p.00; also Skertchly 1877, pp.186–187). The mean grading for the sub-block is gravel 44 per cent, sand 52 per cent and fines 4 per cent, with sandy gravel as the overall classification. The volume of mineral at the 'indicated' level is estimated at 167.9 million m<sup>3</sup> ± 10 per cent at the 95 per cent confidence level.

**Sub-block F<sub>2</sub>** Sub-block F<sub>2</sub>, 1.4 km<sup>2</sup> in area, comprises an arcuate outcrop of exposed mineral, which is an extension of First Terrace deposits north-eastwards from Peakirk [TF 169 067] outside the area. The 'infer-

red' assessment is based on three IMAU boreholes and three others.

The recorded thickness of overburden ranges from 0.6 to 3.0 m (boreholes 21 SW 44 and 21 SW 43, respectively) with a mean of 1.2 m. The proven mineral ranges from 1.3 to 3.8 m (boreholes 21 SW 45 and 21 SW 4, respectively) with a mean of 2.8 m.

The mean grading for mineral in the IMAU boreholes ranges from 'clayey' sandy gravel to sandy gravel (Figure 16, Table 13) with the fines fraction ranging from 9 per cent (borehole 21 SW 43) to 15 per cent (borehole 21 SW 44). A maximum fines of 48 per cent was recorded between 2.4 and 3.0 m in borehole 21 SW 43; consequently, the upper sand and gravel layers (that is, between 1.0 and 3.0 m) are classified as non-mineral and are excluded from the assessment. Elsewhere in the sub-block, 'very clayey' upper layers within mineral were also noted (for example, in borehole 21 SW 42, 33 per cent fines were recorded between 1.1 and 2.1 m and in borehole 21 SW 44, 29 per cent fines were recorded between 0.6 and 1.6 m). In the one IMAU borehole (21 SW 43, Table 2) for which detailed compositional data are available, the mineral (+8–16 mm fraction)



**Table 12** Sub-block F<sub>1</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading Classification
	Overburden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	
			– ½ mm	+ ½–¼ mm	+ ¼–1 mm	+ 1–4 mm	+ 4–16 mm	+ 16 mm	
01 SE 75	0.7	4.1	2	7	28	18	35	10	SG
01 SE 76	0.7	3.2	4	3	18	19	41	15	G
11 NW 69	2.7	c1.6	5	8	25	20	37	5	SG
11 NW 74	0.3	3.4	3	9	28	20	35	5	SG
11 NW 75	1.1	2.9	3	12	21	18	40	6	SG
11 NW 79	1.0	3.1	2	3	21	18	51	5	G
11 NW 80	0.6	2.9	2	6	25	20	43	4	SG
11 NW 84	0.9	2.7	3	6	21	22	38	10	SG
11 SW 20	1.0	3.6	8	6	24	17	35	10	SG
11 SW 21	0.5	4.5	8	6	21	17	39	9	G
11 SW 22	1.2	3.3	4	5	21	18	41	11	G
11 SW 23	0.4	2.7	3	4	22	23	40	8	SG
11 SW 24	1.1	3.1	3	8	25	17	38	9	SG
11 SW 25	0.9	3.0	3	4	21	21	44	7	G
11 SW 26	0.7	1.6	7	8	26	16	35	8	SG
11 SW 27	1.3	c1.0	2	6	22	17	42	11	G
11 SW 28	0.7	c3.0	5	5	21	19	39	11	G
11 SW 29	0.8	4.1	4	8	25	19	36	8	SG
11 SW 30	1.1	5.8	7	7	30	18	31	7	SG
11 SW 31	0.6	6.4	4	8	29	17	36	6	SG
11 SW 32	1.0	3.1	2	10	43	14	28	3	SG
11 SW 33	nil	4.8	2	5	20	22	42	9	G
11 SW 34	c1.0	c5.7	2	11	30	20	32	5	SG
11 SW 35	0.7	4.8	2	7	32	18	35	6	SG
11 SW 36	c1.0	c4.6	4	7	27	15	36	11	SG
11 SW 37	0.8	2.7	3	4	21	21	46	5	G
11 SW 38	0.6	4.3	1	8	33	21	36	1	SG
11 SW 39	0.4	4.0	5	8	29	19	35	4	SG
11 SW 40	1.0	4.4	5	7	28	18	38	4	SG
11 SE 15	0.9	2.1*	5	6	24	21	41	3	SG
11 SE 16	0.4	3.9	4	9	33	17	34	3	SG
11 SE 17	1.1	3.4	1	5	28	21	41	4	SG
11 SE 19	1.0	2.7	4	8	24	20	36	8	SG
11 SE 21	1.3	5.1	2	8	27	23	36	4	SG
11 SE 27	1.5	2.4	4	8	26	19	37	6	SG
11 SE 28	1.3	3.5	7	10	32	18	29	4	SG
11 SE 29	1.4	(0.8)‡	6	8	27	16	38	5	SG
Mean	0.9§	3.8§	4	7	26	19	37	7	SG

\* Including a 0.1 mm waste parting.

‡ Sum of two beds separated by 0.6 m of waste.

§ Based on data from 73 boreholes.

‡) Brackets show that the sand and gravel in the individual borehole cannot be assessed as ‘mineral’ (see Introduction).

comprises mostly shelly limestone with angular brown flint.

The mean grading for the sub-block is gravel 37 per cent, sand 51 per cent and fines 12 per cent, with ‘clayey’ sandy gravel as the overall classification. The volume of mineral at the ‘inferred’ level is estimated at 3.9 million m<sup>3</sup>.

*Sub-block F<sub>3</sub>* Sub-block F<sub>3</sub>, 1.2 km<sup>2</sup> in area, comprises 14 small discrete river terraces flanking the Upland valleys of the River Glen and its tributary (Figure 9). These have been assessed collectively and the ‘inferred’ assessment is based on three commercial-in-confidence boreholes.

The recorded thickness of overburden ranges from nil to 0.9 m with a mean of 0.3 m. The proven mineral ranges from 5.5 to 10.9 m with a mean of 7.1 m. No grading data are available.

The volume of mineral at the ‘inferred’ level is estimated at 8.5 million m<sup>3</sup>.

*Block O* Block O, the third largest block (41.6 km<sup>2</sup> in area) in the resource sheet area contains the least area of mineral-bearing ground (2.9 km<sup>2</sup>). It comprises three Upland units (in the western third of the resource sheet) separated by the valleys of the River Glen and its tributary.

The block consists mainly of outcrops of Jurassic rocks ranging in age from Upper Lincolnshire Limestone to Oxford Clay; these formations are overlain in part (especially on the higher ground) by isolated drapes of Glacial Sand and Gravel, Boulder Clay and Glacial Drift, undifferentiated. Of the Drift outcrops investigated, mineral was generally absent beneath Boulder Clay (for example in boreholes 01 NE 63, 01 NE 65 and 01 NE 62) and within the Glacial Drift, (for example, in boreholes 11 NW 61, 11 NW 62 and 11 NW 63). However, boreholes sited in Glacial Sand and Gravel around Witham on the Hill, east of Toft [TF 070 173] and west of Maidens’ Farm [TF 072 105] proved potential mineral-bearing ground. No data are available for the



**Table 13** Sub-block F<sub>2</sub>: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading Classification
	Over-burden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm	
21 SW 42	1.1	3.7	13	9	25	17	30	6	CSG
21 SW 43	1.0	1.8*	9	13	18	17	33	10	SG
21 SW 44	0.6	2.7*	15	12	29	11	27	6	CSG
Mean	1.2‡	2.8‡	12	11	25	15	30	7	CSG

\* Excluding 2.0 m of sand and gravel graded as non-mineral.

‡ Based on data from six boreholes.

**Table 14** Block O: data from IMAU boreholes

Borehole No.	Recorded thickness (m)		Mean grading percentage						Grading Classification
	Over-burden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm	
01 NE 60	0.2	4.7	5	9	39	17	24	6	SG
01 NE 61	0.4	2.8	8	6	22	12	33	19	G
01 NE 62	non-mineral	non-mineral	no grading data available						
01 NE 63									
01 NE 64	0.7	3.8	6	7	40	14	23	10	SG
01 NE 65	non-mineral		4	6	30	17	30	13	SG
01 NE 66	0.5	1.0	3	6	23	9	35	24	G
01 SE 72	non-mineral		5	5	16	16	32	26	G
01 SE 73	0.6	(0.3)							
11 NW 61	non-mineral	non-mineral	no grading data available						
11 NW 62									
11 NW 63									
Mean	0.3*	2.3*	6†	7†	34†	15†	27†	11†	SG†

\* Based on data from eight boreholes sited on exposed Glacial Sand and Gravel.

† Based on data from four IMAU boreholes.

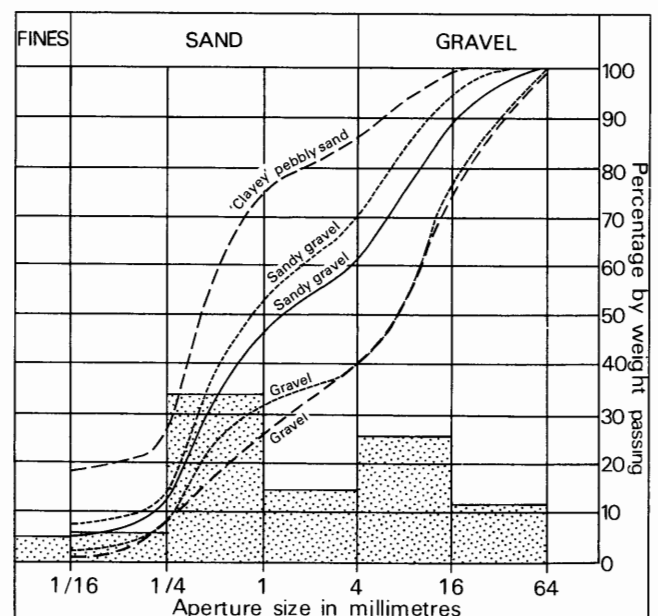
() Brackets show that the sand and gravel in the individual borehole cannot be assessed as 'mineral' (see Introduction).

small outcrop of Glacial Sand and Gravel at [TF 053 191] and the deposit is therefore unassessed.

Except for two areas of mineral overlain by small patches of Boulder Clay at [TF 052 180] and [TF 081 110] (assessed as continuous or nearly continuous mineral beneath overburden), the mineral-bearing ground is assessed as exposed mineral. Inferred boundaries from south of Toft Lodge [TF 077 190] to near Dole Wood imply areas where the extent of mineral beneath overburden is uncertain. An additional inferred boundary at [TF 074 100] preserves the continuity between this resource sheet and the adjacent area to the south (Booth, 1982).

The 'inferred' assessment is based on 12 IMAU boreholes (of which, only five proved mineral) and three commercial-in-confidence boreholes. Sand and gravel extraction is unknown with the block. However, sand is extracted near Little Bytham Lodge [TF 028 175] from Glacial Sand and Gravel deposits laterally continuous with the outcrop at Witham on the Hill.

The recorded thickness of overburden (where present) ranges from 0.2 to 0.7 m (boreholes 01 NE 60 and 01 NE 64, respectively) with a mean of 0.3 m. The proven mineral ranges from 0.3 to 4.7 m (boreholes 01 SE 73 and 01 NE 60, respectively) with a mean of 2.3 m.



**Figure 17** Grading characteristics of the resources within block O (based on 4 boreholes). For explanation see Figure 10.

The mean grading for mineral in the IMAU boreholes ranges from sandy gravel to gravel (Figure 17, Table 14) with the fines fraction not exceeding 8 per cent; however, locally up to 19 per cent fines was recorded within a 'clayey' pebbly sand layer between 0.2 and 0.9 m in borehole 01NE 60. Detailed compositional data from two IMAU boreholes are available for the Glacial Sand and Gravel (see Table 2). The mineral (+8–16 mm fraction) comprises mainly quartzite and ironstone with limestone (mainly oolitic) and sandstone (some calcareous); flint is a subsidiary component.

The mean grading for the block is gravel 38 per cent, sand 56 per cent and fines 6 per cent, with sandy gravel as the overall classification. The volume of mineral at the 'inferred' level is estimated at 6.7 million m<sup>3</sup>.

### CONCLUSIONS

The district between Bourne and Crowland is a region of prime agricultural land (mostly drained Fenland) underlain in the east by Boulder Clay and elsewhere by Jurassic clays and limestones.

The most widespread occurrences of sand and gravel are the Pleistocene First Terrace deposits of the proto-Glen and its tributary and their less extensive marine/estuarine facies; sand and gravel of glacial origin crops out only as localised patches on the high ground in the west. Compositionally, the First Terrace deposits and the Glacial Sand and Gravel are broadly similar and consist mainly of limestone and flint. Sand and gravel extraction began in the early 1930's and is currently centred around Baston and Langtoft.

The First Terrace deposits are usually thickest (up to 7.0 m) within an infilled bedrock channel which is overlain by a crude outwash fan: the fan represents a coalescence of sand and gravel that debouched from the narrow Upland valleys onto the Fenland. Altimetric data based on boreholes and well records prove a sub-planar pediment underlying the Fenland Drift which may be a periglacial phenomenon.

First Terrace faunas (mainly molluscan) observed in temporary pit exposures and IMAU boreholes indicate a west-east transition between paludal and marine/estuarine conditions.

Approximately east of a line from Bourne to Crowland, the First Terrace deposits are overlain by Flandrian sediments that thicken towards the east and north-east, whereas elsewhere in the Fenland these sand and gravel deposits are mostly exposed.

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## APPENDIX A

### FIELD AND LABORATORY PROCEDURES

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

The mineral shown on each 1:25 000 sheet is divided into resource blocks. The arbitrary size selected, 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. Exceptionally, other schemes for subdividing the resource sheet area (for example, the use of 'resource sub-blocks') may be used where these are considered to be more appropriate.

A reconnaissance of the ground is carried out to record and sample any exposures, and inquiries are made to ascertain what borehole information is available. In addition, shallow trenches may be cut to investigate the grading of deposits, particularly in very coarse material, and to test the geology prior to commencing the drilling programme. 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 (sometimes referred to as 'percussion' 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 deposit, or, ideally, 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 (1975). Random checks on the accuracy of the grading are made in the Institute's laboratories.

Other methods of drilling and sampling are occasionally employed, for example the Minuteman power auger rig, and downhole tests such as U4 and SPT may be carried out. The Minuteman, which is small and portable, is normally used when access to land with shell rigs would be difficult to arrange and when information is requested quickly.

The auger tool comprises a continuous-flight 76-mm (3-inch) spiral auger; the use of this equipment, as with all 'open-hole' drilling methods, inevitably leads to the mixing and contamination of the sampled material. Thus, data relating to depth and composition cannot always be accurately determined.

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

Detailed records may be consulted at the appropriate office of the Institute: the address is shown on page ii of this report, next to the preface.

## 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 paragraph 12 below).

2 The simple methods used in the calculations are consistent with the amount of data provided by the survey (Hull, pp. 192–193 in Thurrell, 1981). 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.

3 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

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

4 The above relationship may be transposed such that

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

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

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

5 Given that the number of approximately evenly spaced sample points in the sampled area is  $n$ , with mineral thickness measurements  $l_{m_1}, l_{m_2}, \dots, l_{m_n}$ , then the best estimate of mean thickness,  $\bar{l}_m$ , is given by

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

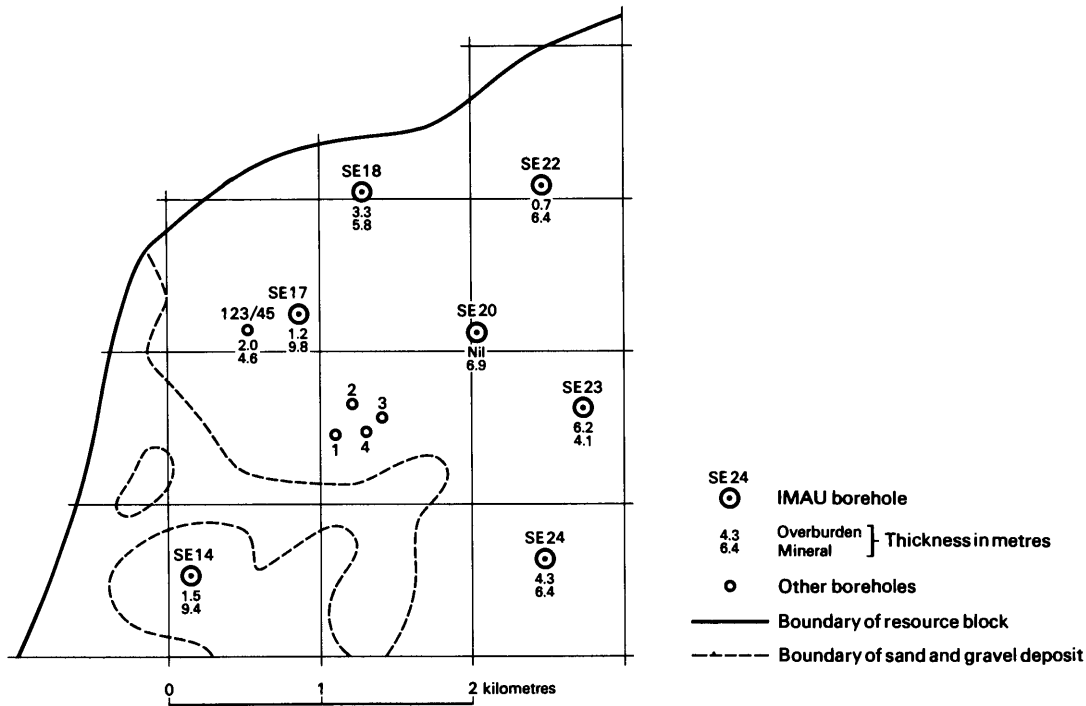
For groups of closely spaced boreholes a discretionary weighting factor may be applied to avoid bias (see note on weighting below). The standard deviation for mean thickness  $S_{l_m}$ , expressed as a proportion of the mean thickness, is given by

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

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

6 The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of deposit). Where the area

Example of resource block assessment: map of fictitious block, calculation and results.



**Block calculation** 1:25 000 block: Fictitious

Area  
 Block: 11.08 km<sup>2</sup>  
 Mineral: 8.32 km<sup>2</sup>

Mean thickness  
 Overburden: 2.5 m  
 Mineral: 6.5 m

Volume  
 Overburden: 21 million m<sup>3</sup>  
 Mineral: 54 million m<sup>3</sup>

Confidence limits of the estimate of mineral volume at the 95 per cent probability level:  $\pm 20$  per cent  
 That is, the volume of mineral (with 95 per cent probability):  $54 \pm 11$  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	IMAU boreholes
SE 18	1	3.3	3.3	5.8	5.8	
SE 20	1	nil	-	6.9	6.9	
SE 22	1	0.7	0.7	6.4	6.4	
SE 23	1	6.2	6.2	4.1	4.1	
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	$\frac{1}{2}$	1.2	1.6	9.8	7.2	Hydrogeology Unit record
123/45	$\frac{1}{2}$	2.0		4.6		
1	$\frac{1}{4}$	2.7	2.6	7.3	5.8	Close group of four boreholes (commercial)
2	$\frac{1}{4}$	4.5		3.2		
3	$\frac{1}{4}$	0.4		6.8		
4	$\frac{1}{4}$	2.8		5.9		
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.2$		$\Sigma wl_m = 52.0$		
Means		$\overline{wl_o} = 2.5$		$\overline{wl_m} = 6.5$		

Calculation of confidence limits

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

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

$$n = 8$$

$$t = 2.365$$

$L_v$  is calculated as

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

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

$$= 20.3$$

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

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 usually small relative to those in thickness. The relationship  $S_A/S_m \leq \frac{1}{3}$  is assumed in all cases. It follows from equation [2] that

$$S_m \leq S_i \leq 1.05 S_m \quad [3]$$

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

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

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

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

9 In calculating confidence limits for volume,  $L_i$ , the following inequality corresponding to equation [3] is applied:  $L_m \leq L_i \leq 1.05 L_m$ .

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

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

per cent, and when  $n$  is greater than 20, as

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

per cent (weighting factors may be included: see paragraph 15).

11 The application of this procedure to a fictitious area is illustrated in the diagram which accompanies this Appendix.

#### *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  $\frac{1}{16}$  mm) and coarser than pebbles (more than 64 mm in diameter). Because deposits containing more than 10 per cent fines are not embraced by this system a modified binary classification based on Willman (1942) has been adopted.

When the fines content exceeds 40 per cent the material is 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  $\frac{1}{16}$  mm. Thus it has no mineralogical significance and includes particles falling within the size range of silt. The normal meaning applies to the term clay where it does not appear in single quotation marks.

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

Thus it is possible to classify the mineral into one of twelve descriptive categories (illustrated at the end of this appendix). 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 the note on lithological description in Appendix D).

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  $\frac{1}{16}$ -mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology, which is used in this report, and which appears in the table at the end of this appendix.

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

The boundary at 64 mm distinguishes pebbles from cobbles. The term 'gravel' is used loosely to denote both pebble-sized and cobble-sized material.

The size distribution of borehole samples is determined by sieve analysis, which is presented by the laboratory as logarithmic cumulative curves (see, for example, British Standard 1377: 1975). In this report the grading is tabulated on the borehole record sheets (Appendix E), the intercepts corresponding with the simple geometric scale  $\frac{1}{16}$  mm,  $\frac{1}{4}$  mm, 1 mm, 4 mm, 16 mm and so on as required. Original sample grading curves are available for reference at the appropriate office of the Institute.

Each bulk sample is described subjectively by a geologist at the borehole site. Subsequently, the descriptive categories of the mineral for each borehole are modified according to the results obtained from the mean particle size analysis of the samples.

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, 1975), are as follows.

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

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

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

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

Well-rounded: 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.

Classification of gravel, sand and fines

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

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

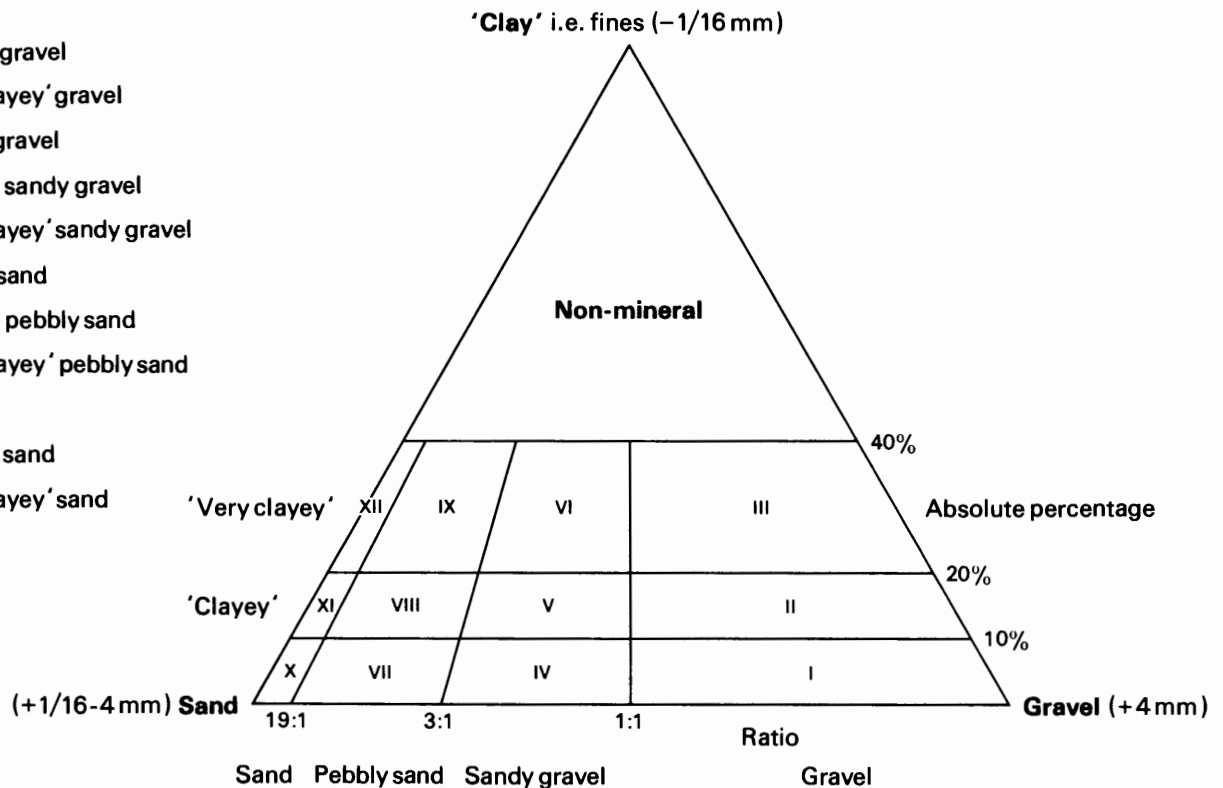


Diagram showing the descriptive categories used in the classification of sand and gravel

## APPENDIX D

### EXPLANATION OF THE BOREHOLE RECORDS

#### Annotated example

TF 11 SE 29 1753 1076 Near Frognall, Deeping St James<sup>1</sup>

Sub-block F<sub>1</sub>

Surface level +2.79 m (+9.0 ft)<sup>2</sup>  
 Water strike not recorded<sup>3</sup>  
 152 mm percussion<sup>4</sup>  
 January 1980

Overburden 1.4 m  
 Mineral 0.5 m  
 Waste 0.6 m  
 Mineral 0.3 m  
 Bedrock 1.1 m +<sup>5</sup>

#### LOG

Geological classification <sup>6</sup>	Lithology <sup>7</sup>	Thickness <sup>8</sup> m	Depth m
	Soil, clayey loam, very dark greyish brown [10 YR 4/1], with pockets of sand; fragments of brick in upper layers	0.8	0.8
River Terrace Deposits (First Terrace)	Clayey silt to sandy pebbly clay, mainly very fine-grade quartz sand to silt in upper c 0.4 m, becoming coarse-grade sand with pebbles of angular to subangular white flint; matrix of clayey material; upper part mottled, predominantly yellowish brown [10 YR 5/8]	0.6	1.4
	<b>a</b> Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular white and brown flint—rarely patinated; with subrounded irregular ironstone, particularly in the +4–8 mm fraction; with some subrounded quartzite and sandstone; traces of well-worn belemnite guards Sand: medium and coarse with fine; mainly oolitic limestone, ironstone and flint, with some quartz Fines: silty, light olive brown [2.5 Y 5/6]	0.5	1.9
	Clay, firm, greyish brown to dark greyish brown [2.5 Y 5/2–4/2], calcareous, with many flint and limestone pebbles	0.6	2.5
	<b>b</b> 'Clayey' sandy gravel—essentially as above	0.3	2.8
Oxford Clay	Clay, stiff, olive grey [5 Y 4/2], calcareous, abundant cream-coloured shell fragments	1.1 +	3.9

#### GRADING<sup>9</sup>

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64
<b>a</b>	2	52	46	1.4–1.9 1.9–2.5	2 WASTE	8	27	17	41	5	0
<b>b</b>	13	53	34	2.5–2.8	13	8	29	16	30	4	0
<b>a + b</b>	6	51	43	Mean	6	8	27	16	38	5	0

#### COMPOSITION<sup>10</sup>

Depth below surface (m) Percentage by weight in 8–16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris	Chalk	Sandstone	Igneous/ Meta- morphitic	Others		
	Angular	Rounded	Crystalline	Oolitic	Shelly									
													Indi- genous	
1.4–2.8	20	rare	13	18	14	5	7	nil	2	rare	4	17	nil	nil



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

#### 1 Location

The position of the borehole is generally referred to the nearest named locality on the 1:25 000 base map, followed by the resource block or sub-block in which it lies.

#### 2 Surface level

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

#### 3 Groundwater conditions

Four kinds of entry are made: the record indicates (1) the level at which the groundwater was struck (in metres above or below OD); or (2) that water was encountered but its level not recorded; or (3) that water was not struck; or (4) that no note of groundwater conditions was made.

#### 4 Type of drill and date of drilling

Shell rigs were used. The external diameter of the casing used, the type of machine and the month and year when the borehole was completed are stated.

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

#### 6 Geological classification

The geological classification (Table 1) is given wherever possible.

#### 7 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 of the gravel and/or sand and silt fraction. Where more than one mineral stratum is recognised, each is designated by a letter, for example, **a**, **b**, etc. The description of other deposits is based on visual examination in the field and, in some instances, laboratory inspection of special samples.

#### 8 Thickness and depth

All drilling measurements were made in metres.

#### 9 Grading data

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

For each bulk sample the percentages of fines ( $- \frac{1}{16}$  mm), fine sand ( $+ \frac{1}{16} - \frac{1}{4}$  mm), medium sand ( $+ \frac{1}{4} - 1$  mm), coarse sand ( $+ 1 - 4$  mm), fine gravel ( $+ 4 - 16$  mm), coarse gravel ( $+ 16 - 64$  mm) and cobbles ( $+ 64$  mm) are stated.

The mean grading of groups of samples making up an identified mineral horizon are also given in detail and in summary. Where more than one horizon is recognised the mean grading for the whole of the mineral in the borehole may be given. Where necessary, in calculating mean gradings, data for individual samples are weighted by the thickness represented.

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

10 Composition of gravel ( $+ 8 - 16$  mm fraction, unless otherwise stated). Details of the gravel composition of grouped samples from selected boreholes when available are given.

APPENDIX E

INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS

TF 01 NE 60 0535 1694 Witham on the Hill, Lincolnshire

Block O

Surface level +46.95 m (+154.0 ft)  
 Water not struck  
 203 mm percussion  
 February 1980

Overburden 0.2 m  
 Mineral 4.7 m  
 Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam with surface scatter of abundant flint and sandstone gravel; very dark greyish brown [10 YR 3/2] to dark brown [10 YR 3/3]	0.2	0.2
Glacial Sand and Gravel	Sandy gravel: 'clayey' in upper 0.9 m Gravel: fine with some coarse, mainly rounded to subrounded, quartzite and ironstone with sandstone and limestone (mostly oolitic); with some angular to subangular mainly white and black, with some brown flint. Trace belemnite and <i>Gryphaea</i> fragments Sand: medium with coarse with some fine, mainly subrounded ironstone with oolitic limestone in -4 +2 mm fraction; mainly subrounded to rounded quartz below 2 mm fraction Fines: silty to 'clayey', yellowish brown [10 YR 5/8]	4.7	4.9
Cornbrash	Limestone, rubby, weathered orange-brown to cream outer 'shell', pale bluish-grey inner 'core' bioclastic	0.1 +	5.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	65	30	0.2-0.9	19	8	47	12	11	3	0
			0.9-1.9	5	5	31	20	28	11	0
			1.9-2.9	3	6	34	16	33	8	0
			2.9-3.9	2	13	47	15	18	5	0
			3.9-4.9	3	11	35	22	28	1	0
			Mean	5	9	39	17	24	6	0

COMPOSITION

Depth below surface (m) Percentage by weight in 8-16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic		Others
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indigenous	Derived			Calcareous		
		rare												
0.2-4.9	9	rare	4	9	2	29	30	nil	rare	nil	12	5	nil	nil

Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8-16	0.2-4.9	33	18	49

Surface level + 51.94 m (+ 170.5 ft)  
 Water struck at + 49.6 m  
 203 mm percussion  
 February 1980

Overburden 0.4 m  
 Mineral 2.8 m  
 Bedrock 2.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam, friable, traces of subrounded substance and angular to subangular flint gravel; abundant fine to medium sand, very dark greyish brown [10 YR 3/2] to very dark brown [10 YR 2/2]	0.4	0.4
Glacial Sand and Gravel	Gravel: 'clayey' between 1.5 and 2.5 m Gravel: fine with coarse, trace cobble; mainly subrounded to tabular, cream to buff shelly limestone and subrounded to rounded sandstone with some subrounded ironstone, quartzite and vein-quartz; trace subangular grey flint. Trace well-worn <i>Gryphaea</i> and belemnite fragments Sand: medium with coarse with some fine; mainly subrounded limestone with ironstone and round quartz; quartz proportions increase below 2 mm fraction to dominate below 1 mm fraction Fines: silty to 'clayey', dark yellowish brown [10 YR 4/6]	2.8	3.2
Oxford Clay	Clay, firm to stiff, in upper 0.3 m varies from light olive grey [5 Y 6/2] to dark grey [5 Y 4/1]. Below 3.5 m becomes rather shaly and silty, dark olive grey [5 Y 3/2] with abundant cream-coloured ammonite impressions along bedding surfaces	2.5 +	5.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	40	52	0.4 - 1.5	4	8	23	13	30	22	0
			1.5 - 2.5	15	5	21	10	34	15	0
			2.5 - 3.2	6	5	24	13	32	20	0
			Mean	8	6	22	12	33	19	0

Surface level +19.26 m (+ 64.5ft)  
 Water not struck  
 203 mm percussion  
 February 1980

Waste 2.4 m  
 Bedrock 0.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty to clayey loam; dark greyish brown with abundant surface scatter of fine to coarse gravel of subangular to angular, brown and white flint and tabular, crystalline and shelly limestone; with some subrounded sandstone and quartzite up to cobble size	0.3	0.3
Boulder Clay	Clay, weathered in upper 2.0m, soft to firm, mottled yellowish brown [10 YR 6/6] to grey [5 Y 5/1], very slightly calcareous, with traces of pebbles of indurated, partially decalcified limestone; below 2.0m predominantly grey [5 Y 5/1] with rare pale yellow ? sulphide (? weathered pyrite) pockets and traces of selenite crystals	2.1	2.4
Cornbrash	Limestone, (fragments recovered only), rubbly, yellowish cream outer 'shell', grey inner core, bioclastic	0.1 +	2.5

Surface level +52.50 m (+ 172.5ft)  
 Water not struck  
 203 mm percussion  
 February 1980

Waste 7.7 m  
 Bedrock 0.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil (? made ground), soft clayey loam; dark greyish brown [2.5 Y 4/2], calcareous; with many brick and stone fragments	0.3	0.3
? Boulder Clay (? weathered)	Clay, firm; highly mottled olive brown [2.5 Y 4/4] with yellowish brown [10 YR 5/8], thin white root traces throughout	0.5	0.8
Boulder Clay	Clay, with erratic clasts; firm; upper 0.5 m mottled yellowish brown [10 YR 5/6] with light grey [5 Y 6/1] to light olive grey [5 Y 6/2], extremely calcareous; below 1.3 m predominantly dark grey [2.5 Y N 4/]; below 6.9 m becomes stiff to very stiff, very dark grey [10 YR 3/1]. Erratic clasts up to 16 mm throughout —predominantly subrounded chalk with sandstone (? 'Bunter'), siltstone and angular to subangular flint	6.9	7.7
Oxford Clay	Clay, soft to very stiff, dark grey [5 Y 4/1] to olive grey [5 Y 4/2], calcareous, with occasional cream-coloured shell fragments and traces of siltstone pellets	0.4 +	8.1

Surface level +49.76 m (+ 163.5 ft)  
 Water not struck  
 203 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral 3.8 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, clayey loam with traces of angular to subangular brown and white flint gravel, very dark greyish brown [2.5 Y 3/2]; below 0.3 m passes into yellowish brown [10 YR 3/4] sandy clay; calcareous	0.5	0.5
Glacial Sand and Gravel	Sandy pebbly clay, abundant fine to medium sand of subrounded to rounded quartz with some subrounded sandstone and angular to subangular white flint; strong brown [7.5 YR 4/6]	0.2	0.7
	Sandy gravel; with sandy clay layer between 2.7 and 3.7 m Gravel: mainly fine with coarse, trace cobble; in + 16 mm fraction mostly subrounded 'Bunter' sandstone and quartzite with some shelly and oolitic limestone; in + 4 - 16 mm fraction subrounded quartzite and ironstone with manganese-spotted shelly and oolitic limestone and subrounded sandstone; with some angular black, white and brown flint Sand: mainly medium with coarse with some fine; mainly subrounded ironstone with limestone and traces of angular flint; below 2 mm fraction subrounded to rounded, quartz dominant with some ironstone and limestone Fines: silty, generally strong brown [7.5 YR 4/6], with sandy clay layer with black carbonaceous fragments	3.8	4.5
Oxford Clay	Clay, firm to stiff, friable in parts, calcareous, traces of cream-coloured shell fragments	0.8+	5.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	61	33	0.7 - 1.7	7	7	34	14	29	9	0
			1.7 - 2.7	5	4	19	18	30	22	2
			2.7 - 3.7	4	10	56	14	12	4	0
			3.7 - 4.5	8	10	48	12	20	2	0
			Mean	6	7	40	14	23	10	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic		Others
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indigenous	Derived			Calcareous		
0.7 - 4.5	7	rare	3	13	3	24	30	nil	rare	nil	14	16	nil	nil

Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	0.7 - 4.5	42	24	34

Surface level + 54.82 m (+ 180.0 ft)  
 Water strike not recorded  
 203 mm percussion  
 February 1980

Waste 11.5 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, sandy clay with gravel, root traces throughout	0.2	0.2
?Boulder Clay (?weathered)	Clay, firm, slightly silty, predominantly olive brown [2.5 Y 4/4], mottled slightly by brown; rare cobble of subrounded sandstone (?‘Bunter’)	0.5	0.7
Boulder Clay	Clay, firm to stiff, calcareous; with some gravel-grade angular to subangular limestone and chalk throughout; with traces of sand (mainly coarse) in upper 1.0 m becoming abundant (fine to coarse) below 2.7 m, mainly of indurated chalk (mostly in 2 mm fraction) with dark grey siltstone, rotten sandstone and traces of angular to subangular, brown, occasionally patinated flint; below 9.5 m with rare iron-oxide ‘stained’ quartz sand—fine to medium grade	9.1	9.8
Glacial Sand and Gravel	Sandy gravel Gravel: mainly fine with coarse; coarse grade mostly of subrounded ‘Bunter’ sandstone with subangular to angular white and brown flints and trace shelly limestone. Below 16 mm fraction mainly subrounded and tabular shelly and oolitic limestone with subrounded irregular ironstone and angular to subangular brown, white and grey flint with some subrounded quartzite and sandstone. Traces of well-worn belemnite and <i>Gryphaea</i> fragments throughout. Rare green siltstone Sand: fine to coarse, mainly medium: in - 4 + 2 mm fraction mainly subrounded to subangular oolitic and shelly limestone with subrounded ironstone. Below 2 mm fraction mainly subrounded quartz with some ironstone and ooids Fines: silty, yellowish brown [10 YR 5/6] in upper 1.6 m becoming brown [7.5 YR 4/4]	1.7	11.5
Oxford Clay	Clay, firm to stiff, calcareous, olive grey [5 Y 4/2] with traces of compressed cream-coloured shell fragments—mostly ammonites	0.8 +	12.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	53	43	9.8 - 11.4	4	6	32	17	29	12	0
			11.4 - 11.5	5	4	23	15	36	17	0
			Mean	4	6	30	17	30	13	0

Surface level + 42.55 m (+ 139.5 ft)  
 Water strike not recorded  
 203 mm percussion  
 February 1980

Overburden 0.5 m  
 Mineral 1.0 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft to glutinous, clayey loam with surface scatter of subrounded. ?'Bunter' sandstone and quartzite; slightly calcareous; between dark greyish brown [2.5 Y 4/2] and olive brown [2.5 Y 4/4]	0.5	0.5
Glacial Sand and Gravel	Gravel with clay ?layer at c. 1.0 m Gravel: fine with coarse, trace cobble; mainly subrounded ?'Bunter' quartzite and sandstone, with some ironstone and subangular to angular black flint Sand: fine to coarse, mainly medium; mostly quartz, quartzite and sandstone with some subrounded to subangular ironstone and brown angular to subangular flint Fines: silty, yellowish brown [10 YR 5/8], with soft to firm clay ?layer, mottled yellowish brown [10 YR 5/3] with light olive grey [5 Y 6/2]	1.0	1.5
Oxford Clay	Clay, soft to stiff, calcareous; highly mottled in upper 0.4 m becoming predominantly olive grey [5 YR 4/2]; many fragments of annelids (? <i>Genicularia</i> sp.)	1.0+	2.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	38	59	0.5 - 1.5	3	6	23	9	35	24	0

Surface level + 33.07 m (+ 108.5 ft)  
 Water not struck  
 203 mm percussion  
 February 1980

Waste 1.5 m  
 Bedrock 0.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	Made ground, sand and gravel ballast with clay	0.2	0.2
	Clayey sand, soft to glutinous; abundant fine to medium quartz sand in calcareous clayey matrix; strong brown [7.5 YR 4/6]	0.4	0.6
	Sandy pebbly clay, firm; with fine to medium subrounded quartz sand; with pebbles of subangular white flint and subrounded quartzite; strong brown [7.5 YR 4/6] often mottled yellowish brown [10 YR 5/8]	0.8	1.4
	Gravel Gravel: fine with coarse; angular to subangular flint, subrounded to rounded quartzite and sandstone, angular to subrounded limestone, with some ironstone; rare 'granitic' clasts Sand: fine to coarse, little fine; mainly quartz Fines: silty, dark yellowish brown [10 YR 4/6]	0.1	1.5
Cornbrash	Limestone, (fragments recovered only) crystalline; brown-weathered margins with bluish-grey inner 'core'	0.1 +	1.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	37	58	1.4 - 1.5	5	5	16	16	32	26	0

Surface level + 24.83 m (+ 81.5 ft)  
 Water struck at + 24.13 m  
 203 mm percussion  
 February 1980

Waste 2.0 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel on Head	Soil, dark brown silty, pebbly loam	0.1	0.1
	Silt, with some fine subangular to rounded quartz sand, strong brown [7.5 YR 5/8]	0.6	0.7
Glacial Sand and Gravel	Gravel Gravel: fine to coarse; mostly subangular to subrounded brown and white flint with some subrounded oolitic and crystalline limestone with some sandstone and quartzite. Traces of <i>Gryphaea</i> shells Sand: medium to coarse with fine; mostly subangular white and brown flint, subrounded oolitic limestone and quartzite in coarse grade; mainly quartz below 2 mm fraction Fines: brown [7.5 YR 5/8]	0.3	1.0
	Pebbly clay, with fine gravel of subrounded limestone, quartzite, flint and ironstone; strong brown [7.5 YR 5/8]	1.0	2.0
Oxford Clay	Clay, predominantly yellowish brown [10 YR 5/6] mottled with grey, yellow and brown in upper 1.3 m; passes into dark greyish brown [2.5 Y 4/2]; shell debris common along shaly laminations	1.5 +	3.5



Surface level + 10.26 m (+ 34.0 ft)  
 Water struck at + 9.26 m  
 203 mm percussion  
 February 1980

Overburden 0.5 m  
 Mineral 2.0 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, dark brown, clayey loam	0.2	0.2
	Clay, dark grey [7.5 YR N4/] mottled brown; trace of fine grade, subrounded, oolitic limestone and flint gravel	0.3	0.5
River Terrace Deposits (First Terrace)	Gravel: 'clayey' in lower 1.0 m Gravel: mainly fine with coarse; sub-angular to rounded white, black and brown flint with subrounded to well-rounded fossiliferous, oolitic and crystalline limestone, with some subrounded to well-rounded sandstone and quartzite Sand: coarse and medium with some fine; mainly limestone in coarse fraction with subangular to rounded quartz and flint in medium to fine fractions	2.0	2.5
?Oxford clay or Kellaways Sand	Clay, dark grey [7.5 YR N 4/], very silty to 2.8 m	1.0+	3.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	38	54	0.5 - 1.5	2	2	13	24	50	9	0
			1.5 - 2.5	13	4	17	16	44	6	0
			Mean	8	3	15	20	47	7	0

Surface level + 12.37 m (+ 40.5 ft)  
 Water struck at + 11.37 m  
 203 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral 4.1 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown, sandy, clayey loam	0.3	0.3
River Terrace Deposits (First Terrace)	Sandy silt, dark brown [7.5 YR 4/4]; sand fine to medium grade, mainly subangular quartz with some flint; trace well-rounded flint pebble	0.4	0.7
	Sandy gravel Gravel: mainly fine with coarse and trace cobble; abundant subangular to well-rounded oolitic, fossiliferous with some crystalline limestone; with subangular to rounded, brown and white with some black flint; with some well-rounded quartzite and sandstone; with some ironstone—principally in fine grade Sand: medium with coarse with some fine; mainly subangular to rounded limestone in coarse grade; with quartz, flint and ironstone throughout; quartz with some ironstone dominant below 2 mm fraction Fines: strong brown [7.5 YR 5/6]	4.1	4.8
Oxford Clay	Clay, with shaly laminations; with traces of shell debris along laminae; very dark grey to very dark greyish brown [10 YR 3/1 to 3/2]	0.7 +	5.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	53	45	0.7 - 1.7	2	10	35	13	35	5	0
			1.7 - 2.7	1	9	33	16	38	3	0
			2.7 - 3.7	2	6	30	25	34	3	0
			3.7 - 4.8	2	3	17	16	37	23	2
			Mean	2	7	28	18	35	9	1

Surface level + 12.66 m (+ 41.5 ft)  
 Water struck at + 11.66 m  
 203 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral 3.2 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown, sandy loam	0.1	0.1
River Terrace Deposits (First Terrace)	Silt, soft; strong brown [7.5 YR 5/6], with some fine grade subangular to rounded quartz sand	0.6	0.7
	Gravel Gravel: mainly fine with coarse, traces of cobbles, abundant subrounded to well-rounded oolitic, crystalline and shelly limestone with some subangular to rounded brown and white flint—black flint confined to fine grade; with some subrounded to well-rounded sandstone and occasional well-rounded quartzite. Cobbles confined to near base with occasional belemnite and <i>Gryphaea</i> fragments Sand: coarse and medium with some fine; subangular to rounded; mainly limestone in coarse grade with flint and quartz. Traces of ironstone throughout Fines: silty, mostly brown [10 YR 5/1], however, olive yellow [2.5 Y 6/8] between 1.7 and 2.7 m	3.2	3.9
Oxford Clay	Clay, yellowish brown [10 YR 5/6] mottled to 4.2 m; becoming shaly and dark greyish brown [2.5 Y 4/2] to base	1.1 +	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	40	56	0.7 - 1.7	3	2	20	22	39	14	0
			1.7 - 2.7	4	4	19	21	44	8	0
			2.7 - 3.9	6	4	14	16	40	16	4
			Mean	4	3	18	19	41	13	2

Surface level +4.14 m (+ 13.5 ft)  
 Water not struck  
 152 mm percussion  
 December 1979

Waste 1.5 m  
 Bedrock 2.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, clayey loam with brick fragments and gravel	0.7	0.7
River Terrace Deposits (First Terrace)	Sand: fine to medium in upper 0.5 m, becoming very fine to silt grade below 1.2 m; mostly sub-rounded to rounded quartz with rare black carbonaceous grains below 1.2 m; with some gravel mostly of angular to subangular flint in upper 0.5 m; olive [5 Y 5/3] in upper 0.5 m becoming pale olive grey [5 Y 6/2] to olive grey [5 Y 5/2]—mottled throughout by dark brown root networks	0.8	1.5
Kellaways Clay	Clay, firm; predominantly dark grey, mottled with dark orange-brown oxidised patches and pale yellow, silty partings in upper 0.5 m, becoming dark grey [2.5 YR N4/] below 3.0 m, trace of yellowish green root fragments throughout; trace pyrite nodules towards base	2.6 +	4.1

Surface level +8.95 m (+ 29.5 ft)  
 Water struck at +8.55 m  
 152 mm percussion  
 January 1980

Waste 3.6 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam; dark greyish brown; much subangular to angular flint gravel	c 0.1	c 0.1
Glacial Drift, undifferentiated	Sandy, pebbly clay, indurated in upper 0.2 m becoming soft, glutinous; yellowish brown [10 YR 5/8] much mottled by pale orange and grey, becoming dark yellowish brown [10 YR 4/4] below 0.5 m; with abundant fine to coarse subrounded to rounded quartz sand and some subrounded limestone and angular to subangular flint gravel; lower c 0.1 m clast-free	3.7	3.8
Kellaways Sand	Silty clay, poor recovery; stiff to indurated, dark grey [5 Y 4/1] with pale grey to white silty partings	0.7 +	4.5

Surface level +7.25 m (+23.5 ft)  
 Water not struck  
 152 mm percussion  
 December 1979

Waste 1.8 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, orange-brown clay with hardcore	0.7	0.7
Glacial Drift, undifferentiated	Silt, soft; predominantly orange-brown mottled pale fawn; below 1.0 m becomes glutinous and thixotropic. Trace flint gravel	1.1	1.8
Kellaways Clay	Clay, firm to stiff; dark greyish brown [2.5 YR 4/2] becoming very dark grey [5 YR 3/1] below c2.5 m, mottled in part by orange silty pockets and by dark orange-brown oxidised root traces; becoming indurated and extremely silty in lower 0.2 m	0.9+	2.7

Surface level +10.71 m (+35.0 ft)  
 Water struck at +8.31 m  
 152 mm percussion  
 January 1980

Waste 2.4 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	? Made ground, greyish brown clayey loam overlying sand and gravel with clay	c0.1	c0.1
Glacial Drift, undifferentiated	Sandy pebbly clay, soft to stiff; yellowish brown [10 YR 5/6] in upper c0.9 m becoming brownish yellow [10 YR 6/8], mottled in part by orange iron-oxide and black ?carbonaceous material; much fine to medium subangular to subrounded quartz sand with some limestone and flint gravel in upper c0.9 m, becoming more pebbly towards base. Below 2.4 m gravel includes subrounded, indurated, ?silicified chalk with quartzite and sandstone	c2.3	2.4
Kellaways Sand	Silt to silty clay, soft to indurated, friable in parts brownish yellow [10 YR 6/6] in upper 0.2 m becoming dark grey [5 Y 4/1]; extremely silty throughout—in places grades to fine sand; slightly laminated	0.9+	3.3

Surface level + 4.24 m (+ 14.0 ft)  
 Water not struck  
 152 mm percussion  
 December 1979

Waste c 2.0 m  
 Bedrock c 1.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, soil, clay and bricks	0.5	0.5
River Terrace Deposits (First Terrace)	Silt to sandy clay, firm to stiff; predominantly brown [10 YR 5/3], much mottled with dark orange and pale grey; with much fine, subrounded to rounded quartz sand to silt	c 0.5	c 1.0
	Pebbly clay, firm to stiff; grey to dark grey [2.5 Y N4/ – N5/], mottled pale olive-brown to orange-brown; with some predominantly white subangular to subrounded, fine flint gravel; fine to medium grade quartz sand associated with mottled areas	c 1.0	c 2.0
Kellaways Clay	Clay, firm to stiff; dark grey [2.5 Y N5/], slightly mottled pale grey associated with selenite pockets also mottled bright yellow corresponding with trace ?weathered pyritic material	c 1.1	c 3.1
Cornbrash	Siltstone, poor recovery; indurated; grey [2.5 Y N4/]	c 0.5 +	c 3.6

Surface level + 1.54 m (+ 5.0 ft)  
 Water not struck  
 152 mm percussion  
 December 1979

Waste 2.4 m  
 Bedrock 1.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat and Lower Peat	Peat, with surface scatter of gravel; friable; dark greyish brown to black; slightly clayey to clayey especially near base; slight 'rank' odour; many root fragments	1.2	1.2
?River Terrace Deposits (?Crowland Bed or First Terrace)	Sandy, pebbly clay, soft, glutinous, grey to dark grey [5 Y 5/1 – 4/1] highly mottled with olive [5 Y 4/3]; with much subrounded to rounded fine quartz sand with occasional subangular to angular white and black flint gravel	0.6	1.8
	Clayey silt, soft, glutinous, dark grey [5 Y 4/1]	0.6	2.4
Oxford Clay	Clay, soft in upper 0.5 m becoming firm; grey to dark grey [2.5 Y N5/ – N4/]; with traces of pale yellowish brown to dark reddish brown root networks in upper 0.5 m	1.7 +	4.1

Surface level +2.81 m (+ 9.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 December 1979

Overburden 1.9 m  
 Mineral 0.9 m  
 Bedrock c 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat and Lower Peat	Peat, clayey loam in upper 0.2 m; soft, friable, fibrous; dark greyish brown to black; with occasional twig fragments; slightly sandy in parts—sand mainly quartz; with occasional pockets of dark orange-brown oxidised material	1.3	1.3
River Terrace Deposits (?Crowland Bed)	Clay, soft, slightly glutinous; grey [5 Y 5/1], slightly mottled by pale orange and dark grey; calcareous; with much fine sand to silt-grade quartz	0.6	1.9
(First Terrace)	Gravel Gravel: fine with some coarse; mainly subrounded and tabular shelly and oolitic limestone with angular to subangular, mainly grey with some white flint—trace patinated; and with some subrounded quartzite, sandstone and ironstone. Trace well-worn belemnite and <i>Gryphaea</i> fragments Sand: coarse with some medium and trace fine; mostly oolitic and shelly limestone with some brown and white subangular flint; below 2 mm fraction, quartz common with rare ironstone Fines: silty, occasional clay nodules; olive brown [2.5 Y 4/4]	0.9	2.8
Kellaways Sand	Silty clay, soft to firm, dark grey [5 Y 4/1], silty throughout, with pockets of pale grey silt to sand grade quartz; becomes indurated below c 3.5 m—with poor recovery	c 0.7 +	c 3.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	46	49	1.9 - 2.8	5	7	14	25	47	2	0

Surface level + 3.43 m (+ 11.0 ft)  
 Water struck at + 1.23 m  
 152 mm percussion  
 December 1979

Overburden 1.6 m  
 Mineral 2.1 m  
 Bedrock 0.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, peaty soil overlying brown clay with brick fragments	1.3	1.3
River Terrace Deposits (?Crowland Bed) (First Terrace)	Sandy clay, soft to firm; dark yellowish brown [10 YR 4/6], mottled brown and dark grey; calcareous; with much fine to medium quartz sand	0.3	1.6
	Sandy gravel; material 'stained' brown in upper 0.6 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with some angular to subangular white, grey and brown flint (some patinated), and ironstone, quartzite and sandstone with trace iron-oxide cemented pebbly concretion. Trace well-worn belemnite guards Sand: medium and coarse with fine; mostly subrounded oolitic and shelly limestone with white and brown angular flint; below 1 mm fraction much subrounded quartz and trace ironstone Fines: dark yellowish brown [10 YR 4/6] becoming greyish brown near base	2.1	3.7
Kellaways Clay	Clay, firm to stiff, dark grey [7.5 Y N4/], slightly silty in parts	0.2+	3.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	54	39	1.6 - 2.2	18	26	16	12	26	2	0
			2.2 - 3.7	2	10	21	22	41	4	0
			Mean	7	15	20	19	36	3	0



Surface level +3.68 m (+12.0 ft)  
 Water struck at +0.98 m  
 152 mm percussion  
 December 1979

Overburden 2.7 m  
 Mineral c 1.6 m  
 Bedrock c 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, sandy pebbly clay overlying peaty clay with some sand and gravel	1.5	1.5
River Terrace Deposits (First Terrace)	Sandy clay, soft, slightly glutinous; dark greyish brown [2.5 Y 4/2] with slight olive hue below c 2.5 m; calcareous; much fine to medium subrounded quartz sand with trace limestone gravel below 1.7 m	1.2	2.7
	Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular, oolitic, shelly and crystalline limestone with some calcareous sandstone and subangular to angular, mostly brown with some black and white flint—some patinated; with some to trace quartzite, ironstone and sandstone. Rare to trace well-worn belemnite guards and chalk fragments Sand: medium and coarse with some fine; mostly subrounded oolitic and shelly limestone with subangular brown, grey and white flint; with some ironstone throughout; below 2 mm fraction quartz and ooids dominate Fines: silty, dark greyish brown [2.5 Y 4/2]	c 1.6	c 4.3
Kellaways Sand	Sand, mostly clay in upper 0.1 m; very silty to fine-grained quartz sand, dark grey [5 Y 4/1]	c 1.0+	5.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand	Gravel				
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	53	42	2.7 - 3.7	5	7	27	21	35	5	0
			3.7 - 4.3	4	10	22	19	41	4	0
			Mean	5	8	25	20	37	5	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic			Shelly	Indigenous					Derived	Calcareous
2.7 - 4.3	20	rare	13	18	14	5	7	nil	2	rare	4	17	nil	nil

Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	2.7 - 4.3	24	49	29

Surface level + 5.22 m (+ 17 ft)  
 Water struck at + 4.22 m  
 203 mm percussion  
 February 1980

Overburden 0.3 m  
 Mineral 3.2 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, sandy, pebbly loam, dark brown	0.3	0.3
River Terrace Deposits (First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded to well-rounded shelly with oolitic and crystalline limestone and calcareous sandstone; with occasional subangular to rounded brown and white with some black flint and trace quartzite, sandstone, ironstone and chalk Sand: medium with coarse and some fine; subangular to rounded quartz, flint and shelly with oolitic limestones; ironstone common below 1 mm fraction Fines: slightly silty	3.2	3.5
Kellaways Clay	Clay, very dark grey [10 YR 3/1] with yellow mottles	0.9+	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	56	41	0.3 - 1.6	2	12	56	10	18	2	0
			1.6 - 2.6	2	3	17	22	50	6	0
			2.6 - 3.5	4	5	19	16	45	11	0
			Mean	3	7	33	16	35	6	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris	Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic	Shelly									
								Indi- genous	Derived	Calcareous				
0.3 - 3.5	12	rare	12	18	28	2	3	nil	rare	2	2	21	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	0.3 - 3.5	11	45	44

Surface level + 1.63 m (+ 5.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 December 1979

Waste 2.1 m  
 Bedrock 3.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Peat, soft, friable, dark grey to black, loamy in parts, clayey towards base	1.0	1.0
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft to firm; dark greyish brown [10 YR 4/2] becoming very dark grey [2.5 Y N3/] below 1.2 m mottled throughout by yellowish brown [10 YR 5/6]; below c 1.5 m with intercalatious of soft, glutinous, in part fibrous, black peaty material—recovery poor below c 1.5 m	c 0.6	c 1.6
Lower Peat (near base)			
River Terrace Deposits (Crowland Bed)	Clay slurry, glutinous; very dark greyish brown [2.5 Y 3/2]; with abundant fine to medium quartz and limestone guard—very poor recovery	c 0.5	2.1
Oxford Clay	Clay, firm to stiff, dark grey [5 Y 4/1] calcareous	3.1 +	5.2

Surface level + 1.91 m (+ 6.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 December 1979

Overburden 1.6 m  
 Mineral 1.3 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat with Lower Peat	Peaty loam, dark grey to black, becoming more fibrous and brown towards base, with abundant root material	1.1	1.1
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous; predominantly pale bluish grey mottled in part with dark grey, towards base becomes olive-grey; silty in part, calcareous; slight 'rank' odour associated with occasional pockets of pale yellowish brown reed/organic material; with fine to medium quartz sand pockets throughout; becomes sandy clay below 1.5 m	0.5	1.6
(First Terrace)	Gravel Gravel: fine with some coarse; mainly subrounded and tabular, oolitic, shelly and crystalline limestone with angular to subangular white, brown with black flint—trace patinated with subrounded quartzite, calcareous sandstone, sandstone and ironstone. Traces of chalk, belemnite guards and <i>Gryphaea</i> fragments Sand: coarse and medium with some fine; mainly oolitic and shelly limestone with grey and brown subangular flint with some subrounded ironstone Fines: silty, olive brown [2.5 Y 4/4]	1.3	2.9
Oxford Clay	Clay, firm to stiff, dark grey [5 Y 4/1] bedding planes well marked by cream-coloured and compressed ammonite and lamellibranch shells	1.5 +	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	33	62	1.6 - 2.9	5	5	13	15	56	6	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Metamorphic	Others	
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indigenous	Derived					Calcareous
	1.6 - 2.9	19	trace	9	27	11	3	11	nil	1	1	9	9	

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	1.6 - 2.9	18	34	48

Surface level +2.17 m (+7.0 ft)  
 Water struck at +0.07 m  
 152 mm percussion  
 January 1980

Overburden 2.1 m  
 Mineral 1.1 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat with Lower Peat	Peat, mixed with sand and gravel in upper 0.2 m; passes into friable, fibrous peat; dark brown to black; with much woody material. Mottled with orange-brown oxidised patches and occasional pockets of intense white and yellow ?decomposed mineralised organic material	c 1.9	c 1.9
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous; dark olive to olive grey, in part mottled by pale orange oxide and streaked with pale grey; abundant fine to medium subrounded quartz and limestone sand with some subrounded fine grade limestone gravel. Occasional carbonaceous pockets of material often with a 'rank' odour	c 0.2	2.1
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular, oolitic and shelly limestone with subangular to angular, black and white with some brown flint; with some ironstone, quartzite and sandstone Sand: medium and coarse with some fine; mainly subrounded to rounded oolitic and shelly limestone with subangular flint; below 2 mm fraction quartz becomes common to dominant. Ironstone throughout Fines: silty, dark greyish brown [2.5 Y 4/2]	1.2	3.2
Oxford Clay	Clay, stiff, greenish grey to olive-grey; calcareous, traces of shell fragments throughout some with pyrite veneer	1.2+	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	52	43	2.1 - 3.2	5	3	25	24	40	3	0

Surface level +3.69 m (+12.0 ft)  
 Water struck at +3.19 m  
 203 mm percussion  
 February 1980

Overburden 0.3 m  
 Mineral 3.4 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, clayey loam, dark brown	0.3	0.3
River Terrace Deposits (First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded to well-rounded oolitic, shelly and crystalline limestone with subangular to subrounded, mainly white with some brown and black flint; with some subrounded to well-rounded sandstone and quartzite. Trace ironstone Sand: medium and coarse with some fine; mostly oolitic and shelly limestone; quartz with some flint dominant below 2 mm fraction Fines: silty, strong brown [7.5 YR 5/6]	3.4	3.7
Oxford Clay	Clay, with shaly laminations, dark greyish brown [2.5 Y 4/2]	0.9 +	4.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	57	40	0.3 - 1.3	2	9	20	22	42	5	0
			1.3 - 2.3	1	12	35	17	32	3	0
			2.3 - 3.3	2	7	30	21	36	4	0
			3.3 - 3.7	13	6	22	16	31	12	0
			Mean	3	9	28	20	35	5	0

Surface level +4.07 m (+13.0 ft)  
 Waste struck at +2.97 m  
 203 mm percussion  
 February 1980

Overburden 1.1 m  
 Mineral 2.9 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.1	0.1
River Terrace Deposits (First Terrace)	Clay, silty in part, strong brown [7.5 YR 4/6]; with some fine, subangular, quartz sand	0.4	0.5
	Silt, yellowish brown [10 YR 5/8]; rare flint pebbles	0.6	1.1
	Sandy gravel; deposit indurated between 2.0 and 2.8 m—sand and gravel fractions cemented with calcium carbonate	2.9	4.0
	Gravel: fine with some coarse; abundant subrounded to well-rounded oolitic, shelly and crystalline limestone with subangular to rounded brown and white flint; with some sandstone and quartzite; trace ironstone, with some belemnite and <i>Gryphaea</i> fragments Sand: medium and coarse with fine, mostly subangular to rounded quartz and flint with some limestone in coarser fractions Fines: silty, brownish yellow [10 YR 6/6]		
Oxford Clay	Clay, shaly in part, dark greyish brown [2.5 Y 4/2]; with comminuted shell debris	1.1 +	5.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	51	46	1.1 - 2.1	3	17	17	15	45	3	0
			2.1 - 3.1	4	12	23	21	34	6	0
			3.1 - 4.0	2	5	24	19	41	9	0
			Mean	3	12	21	18	40	6	0

Surface level + 1.76 m (+ 5.5 ft)  
 Water struck at - 1.64 m  
 203 mm percussion  
 February 1980

Waste 4.4 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Clay, disturbed, soft to firm, between dark greyish brown to very dark greyish brown [10 YR 4/2 to 3/2]; slightly calcareous and glutinous in places, with occasional orange iron-oxide speckles	0.3	0.3
Nordelph Peat	Peat, friable, fibrous, very dark brown to black [10 YR 2/2 to 2/1]; slightly clayey and glutinous in upper 0.5 m; below 0.8 m with layers of peat containing leaves, twigs and roots	0.7	1.0
Barroway Drove Bed with Lower Peat	Peaty clay, slurry, soft extremely glutinous, grey [5 Y 5/1] with bluish grey hue, with many peat nodules	2.1	3.1
River Terrace Deposits (Crowland Bed)	Pebbly clay, soft, glutinous, grey [5 Y 5/1]; with occasional pebbles of subrounded and tabular limestone	c 0.3	c 3.4
(First Terrace)	Sandy gravel Gravel: fine with some coarse; subrounded and tabular oolitic and shelly limestone and subangular to angular grey flint—much patinated; with some subrounded quartzite; with traces of ironstone, belemnite and <i>Gryphaea</i> fragments Sand: mainly coarse with medium and some fine; mostly oolitic and shelly limestone with some angular to subangular flint; quartz dominant below 1 mm fraction Fines: silty with occasional clay nodules, olive [5 Y 4/3]	c 1.0	4.4
Oxford Clay	Clay, soft to firm, dark greyish brown [2.5 Y 4/2] to dark olive grey [5 Y 3/2]; extremely calcareous; with abundant cream-coloured shell fragments; slightly shaly below 5.0 m	0.7 +	5.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	61	36	3.4 - 4.4	3	3	18	40	31	5	0



Surface level +1.32 m (+ 4.0 ft)  
 Water struck at +0.22 m  
 152 mm percussion  
 December 1979

Overburden 1.1 m  
 Mineral 2.2 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat and Lower Peat	Peat, dark greyish brown peaty loam in upper 0.2 m; becomes fibrous, slightly clayey and black [2.5 Y 5/1]	0.7	0.7
River Terrace Deposits (Crowland Bed)	Clay, soft, slightly glutinous; grey [5 Y 5/1] becoming olive grey [5 Y 4/2] below 1.0 m; slightly silty with interbedded peaty material in upper 0.3 m; with much fine to medium, subrounded to rounded, oolitic limestone and quartz sand; with traces of gravel towards base	0.4	1.1
(First terrace)	Sandy gravel Gravel: fine with some coarse; mostly subrounded, tabular, oolitic with some shelly limestone and angular to subangular black, brown with some white flint—rarely patinated; with subrounded to rounded, quartzite and sandstone; with some well-worn belemnite guards Sand: medium and coarse with some fine; mainly subrounded oolitic and shelly limestone with angular to subangular grey, brown and white flint; with some quartz below 2 mm fraction Fines: slightly silty; pale olive brown [2.5 Y 5/6]	2.2	3.3
Oxford Clay	Clay, stiff, friable in parts, olive grey [5 Y 4/2]; with abundant cream-coloured shell impressions	1.1 +	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	51	46	1.1 - 2.1	3	5	25	19	46	2	0
			2.1 - 3.3	3	7	22	25	38	5	0
			Mean	3	6	23	22	43	3	0

Surface level +2.57 m (+ 8.0 ft)  
 Water struck at +2.17 m  
 203 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 2.7 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, silty, clayey loam, very dark greyish brown [10 YR 3/2], calcareous, with some fine to medium quartz sand	0.4	0.4
	Silt, mainly slurry—very poor recovery; very dark greyish brown [10 YR 3/2], calcareous	0.5	0.9
River Terrace Deposits (First Terrace)	Sandy, pebbly clay, soft, glutinous, light olive brown [2.5 Y5/6], with abundant fine to medium subrounded to rounded quartz sand with some gravel	0.1	1.0
	Gravel with dark grey laminated calcareous silt layer between c 3.1 m and 3.5 m; indigenous gastropod fragments throughout	2.7	3.7
	Gravel: mainly fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with some subangular to angular brown and white flint—some patinated; with minor amounts of subrounded to irregular limestone, subrounded sandstones and quartzite, trace subrounded indurated chalk and well-worn belemnite and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mainly cream-coloured limestone with ironstone in +2–4 mm fraction, mainly subrounded quartz below 2 mm fraction Fines: silty to very silty, light olive brown [2.5 Y 5/6] below 2.9 m because olive brown [2.5 Y 4/4]		
Oxford Clay	Clay, poor recovery; stiff, friable in parts, upper 0.2 m very dark greyish brown [2.5 YR 3/2] and unfossiliferous; below 3.9 m dark olive grey [5 Y 3/2] with many cream-coloured shell fragments	1.0+	4.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
5	47	48	1.0 – 2.1	6	4	18	23	45	4	0
			2.1 – 3.1	4	5	18	17	44	12	0
			3.1 – 3.7	6	24	29	12	23	6	0
			Mean	5	9	20	18	41	7	0

Surface level + 3.64 m (+ 12.0 ft)  
 Water struck at + 1.24 m  
 203 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 3.1 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, greyish brown sandy clayey loam, with surface scatter of gravel—mainly limestone with flint	0.3	0.3
River Terrace Deposits (First Terrace)	Clay, soft to firm, slightly silty; slightly mottled throughout by orange brown and grey, predominantly yellowish brown [10 YR 5/6]; calcareous; traces of root fragments	0.7	1.0
	Gravel: above 2.0 m much material coated with reddish brown iron-oxide Gravel: predominantly fine with some coarse, mostly subrounded and tabular oolitic and shelly limestone with some subrounded, irregular ironstone, subrounded sandstone, quartzite and angular to subangular brown and white flint. Trace subrounded indurated chalk. Occasional well-worn belemnite and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine, predominantly subrounded oolitic and shelly limestone with some ironstone in + 1 – 4 mm fraction; below 1 mm almost all subrounded quartz Fines: silty, predominantly yellowish brown [10 YR 5/8] below 3.0 m light olive brown [2.5 Y 5/6]	3.1	4.1
Oxford Clay	Clay, stiff, friable in parts, very dark grey [10 YR 3/1]; calcareous; with cream-coloured shell fragments	0.5 +	4.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
2	42	56	1.0 – 2.0	1	2	12	12	71	2	0
			2.0 – 3.0	3	4	20	24	41	8	0
			3.0 – 4.1	1	4	30	18	41	6	0
			Mean	2	3	21	18	51	5	0

Surface level +2.34 m (+7.5 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 0.6 m  
 Mineral 2.9 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
River Terrace Deposits (First Terrace)	Soil, ?made ground, indurated; greyish brown sandy clay with abundant flint and limestone gravel	0.5	0.5
	Sandy pebbly clay, firm to stiff, brownish yellow, with much fine to coarse oolitic and quartz sand and subangular to subrounded fine to coarse gravel	0.1	0.6
	Sandy gravel; hardpan layer at c 0.8 m with very fine sand to silt layer at c 3.4 m Gravel: fine with some coarse; mainly subrounded and tabular, oolitic and shelly limestone with subangular to angular brown flint; with some ironstone, sandstone and quartzite. Rare subrounded, indurated chalk and Collyweston Slate. Well-worn belemnite and <i>Gryphaea</i> fragments throughout Sand: medium and coarse with fine; mainly oolitic and shelly limestone with some ironstone; below 1 mm fraction, predominantly subrounded quartz. Trace subrounded ? chalk fragments throughout Fines: silty to slightly silty; above c 1.6 m yellowish brown becoming greyish brown to 2.6 m; becomes olive brown [2.5 Y 4/4]	2.9	3.5
Oxford Clay	Clay, firm to stiff, friable, dark grey to olive grey [5 Y 4/1 to 4/2], calcareous, with abundant cream-coloured shell fragments	1.1 +	4.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
2	51	47	0.6 - 1.6	2	6	26	20	43	3	0	
			1.6 - 2.6	1	5	23	21	43	7	0	
			2.6 - 3.5	3	7	27	19	42	2	0	
			Mean	2	6	25	20	43	4	0	

Surface level +0.70 m (+2.5 ft)  
 Water struck at -1.9 m  
 152 mm percussion  
 December 1979

Overburden 3.0 m  
 Mineral 2.1 m  
 Bedrock 0.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown to black, peaty, clayey loam, with much straw chaff	0.5	0.5
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft to firm, slightly glutinous in parts; dark greyish brown [10 YR 4/2] below 1.2 m becomes grey streaked with darker grey [overall colour 5 Y 4/1]; with mottled patches of oxidised material associated with root traces throughout	1.1	1.6
Lower Peat (?‘upper’ leaf)	Peat, fibrous, friable, dark brown to black, with fragments of twigs and bark, damp with slight ‘rank’ colour; rare pockets of fine-grained subrounded quartz sand in yellowish brown silty matrix	0.8	2.4
Barroway Drove Bed (‘Buttery Clay’)	Clay, generally as for clay above, glutinous throughout and slightly thixotropic, slightly silty	0.2	2.6
River Terrace Deposits (Crowland Bed)	Clay, soft to firm, slightly glutinous, grey to dark grey [5 Y 4/1 to 5/1], calcareous, slightly silty to fine sand towards base, trace gravel throughout	0.4	3.0
(First Terrace)	Gravel Gravel: fine with some coarse; mainly subrounded and tabular, oolitic and shelly limestone—mostly iron-oxide coated, with some angular to subangular mostly brown with black, grey and white flint—some patinated; with some ironstone, quartzite and sandstone and well-worn belemnite guards. Traces of worm tubes Sand: medium and coarse with some fine; mainly oolitic and shell limestone with some ironstone and flint; below 2 mm fraction quartz common Fines: silty, pale olive brown to olive brown [2.5 Y 5/4 to 4/4]	2.1	5.1
Oxford Clay	Clay, firm, olive grey to dark olive grey [5 Y 4/2 to 3/2], calcareous; shell fragments throughout	0.4 +	3.4

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	48	50	3.0 - 4.0	2	4	29	19	40	6	0
			4.0 - 5.1	2	3	20	24	46	5	0
			Mean	2	3	24	21	45	5	0

Surface level +1.40 m (+ 4.5 ft)  
 Water struck at -0.4 m  
 152 mm percussion  
 December 1979

Waste 4.4 m  
 Bedrock 0.6m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, ?made ground; soft and friable in upper 0.5 m, dark brownish grey peaty, clayey loam, with many brick and chaff fragments. Towards base becomes glutinous	1.0	1.0
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, greyish brown [2.5 Y 5/2], darker towards base, very slightly micaceous	0.3	1.3
Lower Peat	Peat, fibrous, dark brown to black; with some root and bark fragments; 'rank' odour	0.5	1.8
River Terrace Deposits (Crowland Bed)	Clay, very poor recovery, very soft, glutinous, dark greyish brown to pale olive, calcareous in parts, with much fine to medium-grade quartz sand	c 1.6	c 3.4
(First Terrace)	Sandy gravel, with gravel concretions up to cobble size Gravel: fine with some coarse, rare cobbles; mainly subrounded and tabular, oolitic and shelly limestone with subangular to angular, black and brown flint—little patination; with some subrounded ironstone, quartzite and sandstone, traces of indurated chalk clasts Sand: medium and coarse with fine; mostly subrounded to rounded oolitic and shelly limestone with subangular brown, white and grey flint; trace well-worn derived Oxford clay shell fragments; below 2 mm fraction mainly quartz Fines: silty, olive brown [2.5 YR 4/4]	c 1.0	4.4
Oxford Clay	Clay, firm, olive grey [5 YR 4/2], calcareous, with many cream-coloured shell fragments	0.6+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	54	42	3.4 - 4.4	4	8	23	23	38	4	0

Surface level + 1.16 m (+ 4.0 ft)  
 Water struck at - 0.74 m  
 152 mm percussion  
 November 1979

Overburden 1.9 m  
 Mineral 1.0 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown to black clayey loam, firm and friable in parts, many root traces, with some fine grade gravel of limestone and flint	1.0	1.0
Barroway Drove Beds ('Buttery Clay')	Clay, firm to soft, glutinous below 1.4 m; yellowish brown [10 YR 4/2] in upper 0.4 m becoming greyish brown below 1.4 m, variably mottled throughout; traces of fibrous organic material accompanied by slight 'rank' odour throughout; slightly micaceous	0.7	1.7
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, extremely glutinous; highly mottled khaki-grey, pale grey yellowish green with orange-brown; silty, with much fine to medium-grade quartz sand and fine gravel of limestone and flint	0.2	1.9
(First Terrace)	Gravel, with much iron-oxide coated material Gravel: fine with coarse, traces of pebbly concretions up to cobble-grade; mostly subrounded and tabular, oolitic and shelly limestone with angular to subangular, mostly brown with some white and grey flint—trace patination; with some subrounded quartzite, sandstone and ironstone; rare well-worn belemnite guards Sand: coarse with medium with some fine; mainly subrounded to subangular oolitic and shelly limestone; with some subangular brown and white flint with ironstone; below 2 mm fraction quartz common Fines: silty, brown	1.0	2.9
?Oxford Clay	Clay, firm, dark grey mottled with brown, calcareous, with much subrounded and tabular limestone	0.1	3.0
Oxford Clay	Clay, firm to stiff, greenish grey to grey, calcareous, with traces of cream-coloured molluscan fragments including ammonites	1.4 +	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	33	61	1.9 - 2.9	6	3	11	19	46	15	0

Surface level + 2.06 m (+ 7.0 ft)  
 Water struck at + 0.86 m  
 203 mm percussion  
 February 1980

Overburden 0.9 m  
 Mineral 2.7 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil with made ground	0.9	0.9
River Terrace Deposits (First Terrace)	Sandy gravel, with hardpan layer between 1.4 and 2.0 m Gravel: fine with coarse; mostly subrounded to well-rounded, oolitic and fossiliferous limestone with subangular brown and white flint with some subrounded to well-rounded quartzite and sandstone. Trace of iron-oxide cemented gravel concretions and <i>Gryphaea</i> fragments Sand: coarse and medium with fine; subangular to rounded quartz with flint and limestone, with some ironstone Fines: silty, strong brown [7.5 YR 5/8]	2.7	3.6
Oxford Clay	Clay, shaly, dark greyish brown [2.5 Y 4/2], with comminuted shell fragments	0.9+	4.5

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	49	48	0.9 - 1.9	3	9	24	21	37	6	0
			1.9 - 2.9	1	5	22	20	40	12	0
			2.9 - 3.6	5	4	17	26	35	13	0
			Mean	3	6	21	22	38	10	0



Surface level + 1.48 m (+ 5.0 ft)  
 Water struck at - 2.02 m  
 152 mm percussion  
 December 1979

Overburden 4.0 m  
 Mineral 1.5 m  
 Waste 0.1 m +  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown clayey loam with straw fragments to base	0.4	0.4
Barroway Drove Beds (?Roddon)	Silt, firm, predominantly dark greyish brown [2.5 Y 4/2] mottled with orange-brown oxidised pockets, becoming olive brown [2.5 Y 4/4] at depth; slightly micaceous; in parts rather clayey; below 1.0 m becomes soft, glutinous and calcareous in parts	1.6	2.0
('Buttery Clay')	Clay, soft, glutinous, slightly calcareous; dark grey [2.5 Y N4/] mottled with black carbonaceous material	0.3	2.3
Lower Peat	Peat, generally fibrous and friable with some compact layers of pale yellowish brown reeds; generally dark grey to black becoming reddish brown at depth; occasional bark and woody fragments	0.9	3.2
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, silty, thixotropic, with many vertical root traces throughout. Below 3.5 m becomes increasingly sandy with occasional fine-grade gravel—usually of black flint; generally grey to dark grey [5 Y 4/1 - 5/1], slightly mottled pale buff in sandy areas	0.8	4.0
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular, oolitic and shelly limestone (mostly stained brown) with subangular to angular white and brown flint (traces of black—often patinated), with some subrounded irregular ironstone, subangular to rounded quartzite, sandstone and vein-quartz. Traces of belemnite fragments Sand: medium and coarse with some fine; mainly oolitic and shelly limestone with ironstone and subangular flint in medium to coarse fractions; below 2 mm fraction mostly ooids, quartz and ironstone Fines: silty, olive brown [2.5 Y 4/4]	1.5	5.5
?Oxford Clay	Pebbly clay, firm, calcareous, olive grey to dark olive grey [5 Y 4/2 - 3/2] with some gravel—as above	0.1	5.6
Oxford Clay	Clay, firm to stiff, dark olive grey [5 Y 3/2], calcareous, with many cream-coloured fossil fragments	0.6 +	6.2

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	50	48	4.0 - 5.5	2	6	25	19	40	8	0

Surface level + 1.09 m (+ 3.5 ft)  
 Water struck at -0.91 m  
 152 mm percussion  
 December 1979

Waste 3.8 m  
 Bedrock 0.9m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown, clayey loam	0.9	0.9
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, grey, with peat intercalations	0.3	1.2
Lower Peat	Peat, generally fibrous, clayey in parts, dark grey to black	0.7	1.9
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, grey—in upper 0.1 m becoming a wet slurry of silt, clay, sand and gravel—mostly oolitic limestone and some flint. Recovery poor below 2.0 m to base	1.4	3.3
(First Terrace)	‘Clayey’ sandy gravel Gravel: fine with trace coarse; mostly subrounded tabular, oolitic and shelly limestone with angular to subangular brown with some white (rare black) flint. Occasional well-worn belemnite guards and <i>Gryphaea</i> shells. With some subrounded quartzite with rare indurated, subrounded ? chalk clasts Sand: medium and coarse with some fine; mainly subrounded, oolitic and shelly limestone with brown and white flint, traces of quartz in - 4 + 2 m fraction, quartz becoming common but not dominant below 2 mm fraction Fines: silty to clayey, brown	0.5	3.8
Oxford Clay	Clay, stiff, calcareous, greenish grey to grey; upper 0.1 m with some gravel	0.9+	4.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
11	53	36	3.3 - 3.8	11	5	24	24	35	1	0

Surface level +0.52 m (+ 1.5 ft)  
 Water struck at - 1.58 m  
 152 mm percussion  
 November 1979

Overburden 2.1 m  
 Mineral 0.9 m  
 Waste 0.2 m  
 Bedrock 1.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, slightly calcareous, clayey loam; dark grey to black slightly mottled greyish brown	0.5	0.5
Barroway Drove Beds ('Buttery Clay')	Clay, soft to firm, slightly glutinous in parts; predominantly greyish fawn but highly mottled (especially in upper 0.2 m) with dark orange oxidised patches; slightly calcareous and micaceous, slightly silty. Traces of ?indigenous shell fragments in upper 0.2 m	1.3	1.8
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, slightly glutinous, highly calcareous; dark bluish grey mottled in part with dark grey to black; generally sandy—mostly subangular to subrounded, fine to medium quartz with oolitic and shelly limestone, traces of fine gravel of subrounded, tabular oolitic limestone and angular to subangular flint, especially near base. Traces of wood at c 2.0 m	0.3	2.1
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded, tabular oolitic and shelly limestone with angular to subrounded, brown and white (with rare grey patinated) flint with some subrounded, irregular ironstone. Rare subrounded to subangular sandstone and quartzite. Occasional well-worn belemnite and <i>Gryphaea</i> fragments Sand: coarse and medium with fine; mainly subrounded to rounded oolitic and shelly limestone with ironstone, with some subangular, brown flint; quartz more common below 2 mm fraction Fines: very silty, greyish olive	0.9	3.0
?Oxford Clay	Pebbly clay, stiff, calcareous, pale olive-brown, with gravel as above	0.2	3.2
Oxford Clay	Clay, soft to stiff, greyish brown to greenish grey	1.8+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	48	47	2.1 - 3.0	5	8	18	22	43	4	0

Surface level + 2.22 m (+ 7.0 ft)  
 Water struck at - 0.78 m  
 152 mm percussion  
 November 1979

Overburden 2.6 m  
 Mineral 1.4 m  
 Waste 0.2 m  
 Bedrock 1.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to stiff, calcareous, brown, with abundant thin, white root fragments	1.3	1.3
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, slightly calcareous in upper part, dark grey [10 YR 4/1], with some peat intercalations	1.0	2.3
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, in parts slightly glutinous; olive brown [2.5 Y 4/4] mottled in parts yellowish brown to dark brown, with much fine to medium-grade sand of subrounded quartz with traces of gravel	0.3	2.6
(First Terrace)	‘Clayey’ sandy gravel Gravel: fine with some coarse; mainly subrounded, tabular oolitic and shelly limestone with angular to subangular, brown, white and grey flint (some patinated) with some subrounded quartzite and ironstone; occasional well-worn belemnite guards Sand: medium and coarse with fine; mainly subrounded to subangular oolitic and shelly limestone with some subangular flint. Ironstone throughout but more common with quartz below 2 mm fraction Fines: silty to clayey, olive brown [2.5 Y 4/4]	1.4	4.0
?Oxford Clay	Clay, stiff to indurated, extremely calcareous, grey; with much subrounded, tabular limestone and angular to subangular flint gravel	0.2	4.2
Oxford Clay	Clay, firm, extremely calcareous, dark greyish brown [2.5 Y 4/2]; traces of cream-coloured shell impressions throughout	1.6+	5.8

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
13	45	42	2.6 - 4.0	13	7	21	17	37	5	0

Surface level + 1.37 m (+ 4.5 ft)  
 Water struck at - 2.93 m  
 152 mm percussion  
 November 1979

Overburden 4.6 m  
 Mineral 1.8 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft, slightly glutinous, slightly calcareous clayey loam; dark greyish brown to black	1.2	1.2
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, slightly silty, with peat intercalations; grey [10 YR 5/1] becoming dark grey [2.5 Y N4/] with many pale brown reed stems (? <i>Phragmites</i> ) below 2.0m	1.8	3.0
Lower Peat	Peat, very clayey in parts, friable to soft and glutinous, grey to black with many yellowish brown reed fragments (? <i>Phragmites</i> ). Towards base becomes drier and fibrous with compact layers of reddish brown to yellowish brown organic matter	0.5	3.5
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, slightly silty in places; generally dark grey [2.5 Y N4/] with many pale yellowish brown reed stems often associated with ‘rank’ odour. Towards base becomes slurry of sandy pebbly clay intermixed with fibrous peaty material	1.1	4.6
(First Terrace)	Sandy gravel Gravel: fine with trace coarse; mainly subrounded to rounded and tabular oolitic and shelly limestone with angular to subangular grey, white and black flint—rarely patinated, with some rounded reddish grey quartzite and well-worn Oxford Clay shell fragments Sand: medium and coarse with fine; mainly subrounded to rounded oolitic and shelly limestone with some brown and grey subangular to subrounded flint. Quartz common below 2 mm fraction Fines: silty, greyish brown	1.8	6.4
Oxford Clay	Clay, stiff, calcareous, dark grey [5 Y 4/1]fossiliferous in parts	1.0+	7.4

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	60	37	4.6 - 6.4	3	8	30	22	36	1	0

Surface level +1.09 m (+ 3.5 ft)  
 Water struck at -2.31 m  
 152 mm percussion  
 November 1979

Waste 4.6 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm loam, greyish brown, with many fine white root traces	0.4	0.4
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm to compact (almost a ‘hardpan’); highly mottled pale yellow to fawn to orange-brown, slightly silty, micaceous; below 1.0 m less compact, below 2.0 m becomes soft	2.1	2.5
Lower Peat	Peat, with clay intercalations between 2.6 and 3.0 m; friable, fibrous, ‘rank’ odour, dark brown to black, with many bark/twig wood fragments and compact partings of ‘reed’ material	0.6	3.1
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, pale creamy grey mixed with dark brown peaty intercalations; sandy towards base	0.3	3.4
(First Terrace)	Pebbly clay, very poor recovery between 3.4 and 4.2 m; soft to firm, in parts a glutinous to slurry mixture; calcareous, brown to khaki brown, silty with much subrounded to angular gravel of shelly and oolitic limestone and flint with some sand	1.2	4.6
Oxford Clay	Clay firm to stiff, calcareous; pale brownish grey in upper 0.2 m, becoming grey to greenish grey; with traces of shell fragments in upper 0.2 m	1.2+	5.8

Surface level + 1.01 m (+ 3.0 ft)  
 Water struck at - 2.99 m  
 152 mm percussion  
 December 1979

Waste 4.8 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, in parts rather clayey; dark grey to black	0.6	0.6
Barroway Drove Beds (?Roddon)	Silt, soft to firm, calcareous, slightly micaceous; yellowish brown with dark orange and pale buff partings	1.4	2.0
('Buttery Clay')	Clay, soft, glutinous and calcareous, slightly silty and micaceous in parts; bluish grey to grey with darker grey to black mottles	1.1	3.1
Lower Peat	Peat, generally fibrous with some compact partings, 'rank' smelling, dark grey to black, occasional wood fragments; towards base, abundant fine-grade sand of subrounded quartz	0.5	3.6
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, glutinous; khaki-brown highly mottled with dark grey silty clay pockets; abundant sand with some subrounded to subangular limestone and flint gravel	0.4	4.0
(First Terrace)	'Clayey' sandy gravel Gravel: fine with some coarse; mostly subrounded and tabular oolitic and shelly limestone with subangular to angular brown and grey (traces of white) flint with some subrounded ironstone and quartzite Sand: medium with coarse with some fine; mainly subrounded oolitic and shelly limestone with subrounded ironstone and some subangular brown and white flint. Quartz common below 2 mm fraction Fines: silty, greyish brown	0.8	4.8;
Oxford Clay	Clay, stiff, calcareous, dark grey; traces of fossil fragments including ?scaphapods	0.8+	5.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
18	53	29	4.0 - 4.8	18	9	29	15	25	4	0

Surface level +0.94 m (+ 3.0 ft)  
 Water struck at - 1.56 m  
 152 mm percussion  
 November 1979

Overburden 2.6 m  
 Mineral 1.2 m  
 Bedrock 1.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam, dark grey	0.5	0.5
Barroway Drove Beds ('Buttery Clay')	Clay, firm especially at c. 1.3 m associated with a dark brown oxidised parting, becoming soft and glutinous below 1.3 m; generally dark greyish brown [10 YR 4/2] with much mottling, particularly in upper 0.8 m; slightly calcareous and micaceous in parts; many vertical hollow tubes (up to 1 mm diameter)—? former root system	1.1	1.6
Lower Peat	Peat, friable, fibrous, with compact partings of organic matter, traces of woody material, slight 'rank' odour, dark grey to black	0.2	1.8
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, very dark grey [2.5 Y N3/], with sandy peat intercalations; becoming sandy towards base	0.6	2.4
(?Crowland Bed)	Silty sand to sandy pebbly clay, predominantly fine- to medium-grade sand of subrounded quartz with grey silty matrix, in upper 0.1 m; becoming more gravelly and clayey below 2.5 m; mottled khaki-brown to khaki-yellow. Gravel of subrounded and tabular limestone with subangular brown flint	0.2	2.6
(First Terrace)	'Very clayey' sandy gravel Gravel: fine with some coarse; mostly subrounded and tabular oolitic and shelly limestone with calcareous sandstone and angular, mainly white with some brown and black flint, with some sandstone, quartzite and ironstone; occasional well-worn belemnite and Gryphaea fragments Sand: medium and coarse with some fine; mainly limestone with some ironstone and flint. Quartz common below 2 mm fraction Fines: silty to clayey, olive brown [2.5 Y 4/4]	1.2	3.8
Oxford Clay	Clay, stiff, grey and calcareous	1.6+	5.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
26	40	34	2.6 - 3.8	26	3	20	17	29	5	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris	Chalk	Sandstone	Igneous/ Meta-morphic	Others			
	Angular	Rounded	Crystalline	Oolitic								Shelly	Indigenous	Derived
2.6 - 3.8	18	rare	nil	27	16	2	6	nil	1	1	9	20	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	2.6 - 3.8	19	35	46



Surface level + 1.74 m (+ 6.0 ft)  
 Water struck at - 1.96 m  
 152 mm percussion  
 January 1980

Waste 4.8 m  
 Bedrock 1.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, clayey loam, calcareous; very dark greyish brown [10 YR 3/2]; to very dark brown [10 YR 2/2]; with some gravel and root fragments	0.9	0.9
Barroway Drove Beds (Roddon) ('Buttery Clay')	Silt, soft to firm, layered; yellowish brown [10 YR 5/8] slightly mottled grey; slightly micaceous and calcareous	1.4	2.3
	Clay, soft, glutinous, thixotropic; very dark grey [5 Y 3/1]; very silty in places, slightly micaceous and calcareous	1.4	3.7
River Terrace Deposits (Crowland Bed) (First Terrace)	Sandy pebbly clay, soft to firm, glutinous in parts, very dark grey [5 Y 3/1] mottled olive; with much fine to medium-grade sand of oolitic limestone and quartz, with traces of fine gravel towards base	c 0.1	c 3.8
	Gravel: with pebbly clay between c 4.6 and c 4.8 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone (much 'stained' by iron-oxide) with angular to subangular, mainly white with brown and grey flint—some patinated, with some subrounded quartzite, vein-quartz and sandstone; with traces of well-worn belemnite and <i>Gryphaea</i> , rare ironstone Sand: medium and coarse with some fine; mostly subrounded oolitic and shelly limestone with angular to subangular flint; with some ironstone. Below 2 mm, ironstone more common with quartz Fines: silty; pale olive brown [2.5 Y 5/4]	c 1.0	4.8
Oxford Clay	Clay, stiff, calcareous; dark grey [5 Y 4/1] with fossil traces	c 1.9+	6.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
4	45	51	3.8 - 4.8	4	4	20	21	47	4	0	

Surface level + 2.34 m (+ 7.5 ft)  
 Water struck at - 3.86 m  
 152 mm percussion  
 December 1979

Waste 7.9 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mixture of silty clay with brick rubble	0.5	0.5
Terrington Beds (Roddon)	Silt, soft, slightly glutinous and thixotropic, micaceous, dark yellowish brown [10 YR 4/4]; below 1.6 m becomes extremely thixotropic and olive grey [5 Y 4/2]; with traces of thin-shelled molluscs, occasional black carbonaceous wood fragments and silt nodules	3.7	4.2
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, dark grey [5 Y 4/1] with many darker grey mottles associated with carbonaceous material; calcareous throughout	0.4	4.6
?Lower Peat (? 'upper leaf')	Peat, friable, fibrous, dark grey to black, with traces of seed stems (? <i>Phragmites</i> )	0.3	4.9
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, dark grey [5 Y 4/1], mixed with much pale yellow reed/root material with associated 'rank' odour	0.8	5.7
Lower Peat (? 'lower leaf')	Peat, friable, fibrous, dark brown; 'rank' odour, speckled throughout with fine to medium-grade quartz sand	0.2	5.9
River Terrace Deposits (Crowland Bed)	Clay, soft to firm, glutinous in part, dark grey [2.5 Y 4/1]; calcareous below 6.1 m; much fine to coarse quartz sand and fine, subrounded oolitic and shelly limestone gravel	0.3	6.2
(First Terrace)	Sandy gravel, with pebbly clay partings between 6.8 and 7.2 m Gravel: fine with trace coarse; mainly subrounded to rounded, tabular, oolitic and shelly limestone with subangular flint, with some subrounded ironstone, quartzite and sandstone. Traces of belemnite guards Sand: medium and coarse with fine; mostly oolitic and shelly limestone with flint; below 2 mm fraction, quartz common with ironstone Fines: silty, greyish brown	1.7	7.9
Oxford Clay	Clay, upper 0.1 m greyish brown, with gravel; becoming grey, stiff and calcareous	1.1 +	9.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	61	35	6.2 - 7.3	4	13	24	26	32	1	0
			7.3 - 7.9	4	10	26	22	35	3	0
			Mean	4	12	25	24	33	2	0

Surface level +0.77 m (+ 2.5 ft)  
 Water struck at -2.73 m  
 152 mm percussion  
 November 1979

Overburden 3.7 m  
 Mineral 1.4 m  
 Bedrock 1.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam, dark grey	0.7	0.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm; predominantly grey, highly mottled with pale orange oxidised pockets; becoming soft and glutinous below 1.0 m	c 1.7	c 2.4
Lower Peat	Peat, friable, fibrous, dark brown to black, clayey in part; ‘rank’ smell, with root and wood fragments	c 0.4	c 2.8
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous; grey to bluish-grey with ‘rank’ smell; reed stems in upper 0.6 m and with peaty intercalations between c 3.4 and c 3.5 m; below c 3.6 m becoming gravelly	c 0.9	c 3.7
(First Terrace)	Gravel: much of the gravel fraction ‘stained’ grey Gravel: fine with trace coarse; mainly subrounded to rounded, oolitic and shelly limestone with angular to subangular, black, grey with traces of white flint, with some subrounded quartzite and sandstone; occasional well-worn belemnite guards Sand: coarse and medium with some fine; almost entirely shelly and oolitic limestones with some angular to subangular grey and black flint Fines: silty, dark greyish brown	1.4	5.1
Oxford Clay	Clay, firm to stiff; pale greenish grey with occasional buff to fawn silty traces; belemnite and ? <i>Gryphaea</i> fragments	1.6 +	6.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	45	49	3.7 - 5.1	6	3	20	22	47	2	0

Surface level +1.17 m (+4.0 ft)  
 Water struck at -1.93 m  
 152 mm percussion  
 November 1979

Overburden 3.9 m  
 Mineral 1.3 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, peaty loam, very dark greyish brown [2.5 Y 3/2], with traces of brick fragments and roots	1.4	1.4
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, pale grey to grey slightly mottled orange in upper 0.1 m; with many vertical reed stems (? <i>Phragmites</i> ) often associated with 'rank' odour	1.3	2.7
Lower Peat	Peat, friable, fibrous, in parts soft, glutinous and clayey, with root and bark fragments	0.4	3.1
River Terrace Deposits (Crowland Bed) (First Terrace)	Clay, soft, glutinous, with peaty material—very poor recovery  Sandy gravel Gravel: fine with some coarse; mainly subrounded to rounded and tabular, oolitic and shelly limestone, with angular to subangular white, grey with some brown flint and subrounded to rounded brown sandstone, quartzite and vein-quartz. Traces of well-worn Oxford Clay shell fragments, including crinoid stems Sand: medium and coarse with some fine; mainly subrounded to rounded, oolitic and shelly limestone with subangular flint, with some ironstone. Below 2 mm fraction, mostly subrounded to rounded quartz with ooids Fines: silty, greyish brown	0.8  1.3	3.9  5.2
Oxford Clay	Clay, firm to stiff, grey, calcareous with traces of shell fragments—? <i>Gryphaea</i>	1.2+	6.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	59	38	3.9 - 5.2	3	6	30	23	35	3	0

Surface level +0.98 m (+ 3.0 ft)  
 Water struck at -0.22 m  
 152 mm percussion  
 January 1980

Overburden 3.0 m  
 Mineral 1.3 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, peaty, clayey loam, dark grey to black, with traces of brick fragments	1.3	1.3
Barroway Drove Beds (‘Buttery Clay’)	Clay, very poor recovery, soft, glutinous, bluish grey	c 0.9	c 2.2
Lower Peat	Peat, clayey in parts, friable and fibrous in parts, black [5 Y 2.5/1], with traces of wood fragments and subrounded quartz sand	c 0.1	c 2.3
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, dark grey [2.5 Y N4/], slightly silty, becoming olive grey [5 Y 4/2], mottled pale yellow below c 2.9 m; with much fine to medium-grade sand of subrounded quartz and oolitic limestone, with some fine gravel	c 0.7	3.0
(First Terrace)	Gravel, with pebbly clay (?) layer between c 3.6 and 3.7 m Gravel: fine with some coarse; mainly subrounded, tabular oolitic and shelly limestone with subrounded ironstone and angular to subangular, grey, white with some brown flint—some patinated; with some subrounded quartzite and sandstone. Rare belemnite guards Sand: medium and coarse with some fine; oolitic and shelly limestone with some ironstone and brown flint Fines: silty, dark greyish brown [2.5 Y 4/2], with olive-grey pebbly clay layer	1.3	4.3
Oxford Clay	Clay, firm to stiff, greenish grey, calcareous, with shell traces	1.1+	4.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	46	50	3.0 - 3.6	4	5	22	18	46	5	0
			3.6 - 3.7	?Pebbly clay band						
			3.7 - 4.3	3	6	21	21	44	5	0
			Mean	4	6	21	19	45	5	0

Surface level +0.93 m (+3.0 ft)  
 Water struck at -1.07 m  
 152 mm percussion  
 January 1980

Overburden 1.7 m  
 Mineral 3.8 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, peaty, silty loam, black [5 Y 2.5/1]; slightly calcareous, much straw chaff	0.5	0.5
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm, grey [10 YR 5/1], highly mottled strong brown [7.5 YR 4/6]; below 0.8 m becomes soft to glutinous, very dark grey [10 YR 3/1] to very dark greyish brown [10 YR 3/2]; slightly calcareous and silty	0.7	1.2
Lower Peat	Peat, friable, fibrous, dark grey to black with traces of bark and twigs	0.1	1.3
River terrace deposits (Crowland bed)	Clay, soft, glutinous very dark greyish brown [10 YR 3/2]	0.4	1.7
(First terrace)	Sandy gravel, ‘clayey’ in upper 1.2 m Gravel: fine with some coarse; mainly subrounded and tabular, oolitic and shelly limestone with angular to subangular white and brown patinated flint, with some subrounded, irregular ironstone with subrounded quartzite and sandstone. Traces of vein-quartz and belemnite guards Sand: mostly medium and coarse; mainly subrounded to rounded oolitic and shelly limestone with subrounded ironstone and some subangular to angular brown and white flint. Traces of quartz Fines: ‘clayey’ to silty; olive [5 Y 4/3 – 4/4] in upper 0.4 m, becoming olive brown [2.5 Y 4/4]	3.8	5.5
Oxford Clay	Clay, stiff, dark grey [2.5 Y N4/], calcareous	0.9+	6.4

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	55	39	1.7 – 2.9	10	7	16	14	49	4	0
			2.9 – 3.9	3	8	30	20	37	2	0
			3.9 – 4.9	4	13	41	18	22	2	0
			4.9 – 5.5	3	7	34	14	38	2	2
			Mean	6	9	29	17	36	3	trace

Surface level + 1.93 m (+ 6.0 ft)  
 Water not struck  
 152 mm percussion  
 November 1979

Waste 4.9 m  
 Bedrock 3.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft to firm, silty loam; dark greyish brown mottled in places pale yellowish brown; slightly calcareous	0.3	0.3
Terrington Beds (Roddon)	Silt, soft, glutinous below 2.2 m; greyish brown [10 YR 5/2] to dark greyish brown [10 YR 4/2], slightly mottled orange in association with rootlets; with very small white to pale cream, thin-shelled lamellibranch and gastropod fragments (including ? <i>Macoma</i> ) in lower 0.4 m	2.3	2.6
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, grey to bluish-grey, slightly silty and calcareous; with many dark reddish brown root fragments often associated with 'rank' odour; traces of gastropod shells	0.7	3.3
Lower Peat	Peat, friable, dark reddish brown, 'rank' odour; with clay intercalations near base	0.6	3.9
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, slightly thixotropic; dark grey with many black mottles associated with nodular carbonaceous material; many root fragments and traces of shells; below 4.4 m with peat intercalations	1.0	4.9
Oxford Clay	Clay, soft becoming firm to stiff; predominantly pale grey mottled pale khaki-brown—mottled pale reddish brown associated with fine to medium sand-grade (?) selenite pockets; in parts mottled with black carbonaceous matter; calcareous throughout	c 1.0	c 5.9
Oxford Clay	Clay, stiff to indurated; in upper 2.2 m pale grey mottled khaki with many dark reddish brown root traces; below 8.1 m becomes pale greenish grey; selenite crystals throughout, abundant in upper 0.6 m; calcareous throughout	c 2.5+	8.4

Surface level +2.05 m (+ 7.0 ft)  
 Water not struck  
 152 mm percussion  
 November 1979

Waste 5.3 m  
 Bedrock 1.1 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, loam—clayey in upper 0.3 m becoming silty; dark brown with yellowish brown mottles	1.2	1.2
Terrington Beds (Roddon)	Silt, dry, friable, predominantly yellowish brown [10 YR 5/8] with dark orange and buff layers, slightly micaceous; below 2.6 m becomes soft, glutinous and thixotropic, very dark grey [10 YR 3/1], slightly calcareous with peaty intercalations	2.3	3.5
Lower Peat	Peat, friable, fibrous, dark brown to black, with some twig and bark fragments, 'rank' odour	0.5	4.0
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, pale greenish grey to grey; silty; with abundant pale yellowish brown reed stems (? <i>Phragmites</i> ) with associated 'rank' odour	0.2	4.2
Boulder Clay	Clay, firm to stiff, predominantly grey mottled pale khaki throughout; with many subrounded to rounded clasts of indurated chalk, crystalline limestone and rare ironstone ('boxstones'). Traces of reddish brown roots throughout; with pockets of fine to medium quartz sand	1.1	5.3
?Oxford Clay (?weathered)	Clay, pale grey slightly mottled orange-brown, calcareous, many dark reddish brown roots	c 0.7	c 6.0
Oxford Clay	Clay, stiff, greenish grey, calcareous; traces of shell impressions, principally ammonites; traces of selenite crystals often in pockets and rare pyrite nodules	c 0.4 +	6.4

Surface level +2.14 m (+ 7.0 ft)  
 Water struck at c - 0.56 m  
 152 mm percussion  
 January 1980

Waste 9.9 m  
 Bedrock 0.5 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, (?) made ground; silty, clayey loam, very dark greyish brown [10 YR 3/2], with sand-grade brick fragments throughout	1.0	1.0
Barroway Drove Beds (Roddon)	Silt, soft, glutinous, thixotropic; yellowish brown [10 YR 5/4] to dark yellowish brown [10 YR 4/4] in upper 1.7 m, becoming very dark greyish brown [2.5 Y 3/3]; whole deposit layered, micaceous and calcareous with abundant black carbonaceous wood fragments (sand-grade) throughout; becomes sandy towards base; in lower 7 m many molluscan fragments including <i>Littorina saxatilis</i> , <i>Cerastoderma edule</i> , <i>Macoma balthica</i> and <i>Mytilus edulis</i> . Other fragments include unidentified gastropods (extensively bored by (?) <i>Polydora</i> ) and rare decapod chelae. A few lamellibranch valves are encrusted with bryozoa	8.9	9.9
Oxford Clay	Clay, firm to stiff, grey [5 Y 5/1] to dark grey [5 Y 4/1], with traces of cream-coloured shell fragments, calcareous, slightly silty	0.5 +	10.4



Surface level + 1.17 m (+ 4.0 ft)  
 Water struck at - 2.83 m  
 152 mm percussion  
 October 1979

Waste 5.8 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, loam, greyish brown	0.5	0.5
Barroway Drove Beds (Roddon) (‘Buttery Clay’)	Silt, with layers of very fine-grade sand; orange-yellow to pale fawn, slightly mottled; micaceous Clay, soft, glutinous, predominantly grey, micaceous, with many reed stems associated with ‘rank’ odour	0.8 1.4	1.3 2.7
Lower Peat	Peat, friable, dark brown to black with many bark fragments; in part mixed with clay	0.3	3.0
River Terrace Deposits (Crowland Bed) (First Terrace)	Clay, soft, glutinous, predominantly grey, slightly mottled khaki-yellow below 3.9 m, with much subrounded to rounded fine-grade quartz sand and traces of angular to subrounded flint and limestone gravel in lower 0.5 m Gravel Gravel: fine with some coarse; mainly subrounded oolitic and shelly limestone with angular to subangular brown, white and black flint—rarely patinated, with some subrounded to rounded quartzite and ironstone, with occasional belemnite and <i>Gryphaea</i> fragments Sand: coarse and medium with some fine; mainly subrounded oolitic and shelly limestone with ironstone and flint. Below 2 mm fraction mainly quartz with ooids and ironstone Fines: silty, greyish brown	1.4 1.4	4.4 5.8
Oxford Clay	Clay, stiff, grey, calcareous	1.2+	7.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	44	50	4.4 - 5.8	6	8	17	19	46	4	0

Surface level + 1.15 m (+ 3.5 ft)  
 Water struck at -2.55 m  
 152 mm percussion  
 January 1980

Overburden 3.7 m  
 Mineral 1.7 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft, organic, clayey loam, black [5 Y 2.5/]	c 0.2	c 0.2
Barroway Drove Beds (?Roddon)	Clay, stiff to indurated in upper 1.4 m with silt partings and root fragments, dark brown with pale greenish grey mottles; below 1.6 m becomes soft, glutinous and greyish brown [10 YR 4/2] to very dark grey [2.5 Y N3/]; lower c 0.2 m with intercalated peat	c 2.4	c 2.6
River Terrace Deposits (Crowland Bed)	Clay, soft to firm, glutinous in lower part, predominantly olive grey [5 Y 4/2] mottled by black carbonaceous root material with associated 'rank' odour; below 3.0 m becomes very sandy and slightly calcareous; very poor recovery	c 1.1	3.7
(First Terrace)	Gravel Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular, white and brown flint—some patinated, with some subrounded to rounded, ironstone, quartzite, sandstone and vein-quartz. Traces of indurated, subrounded chalk and well-worn belemnite and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine; mainly subrounded oolitic and shelly limestone with ironstone; quartz common below 2 mm fraction Fines: silty, olive brown [2.5 Y 4/4] in upper 1.0 m, becoming pale olive brown [2.5 Y 5/4] near base	1.7	5.4
Oxford Clay	Clay, firm to stiff, dark grey [5 Y 4/1], calcareous	1.4+	6.8

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	48	50	3.7 - 4.7	2	6	25	17	42	8	0
			4.7 - 5.4	4	5	22	23	41	5	0
			Mean	2	5	24	19	43	7	0

Surface level + 2.32 m (+ 7.5 ft)  
 Water struck at - 5.08 m  
 152 mm percussion  
 November 1979

Waste 9.3 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable silty loam, dark greyish brown	0.4	0.4
Terrington Beds (Roddon)	Silt, dry, firm—upper 0.2 m almost a hardpan; yellowish brown [10 YR 5/4 - 5/6], highly mottled with pale orange, grey and black (the latter of carbonaceous material); below 1.9 m becomes damp, soft, increasingly glutinous and thixotropic, predominantly dark greyish brown [2.5 Y 4/2], slightly micaceous and calcareous, with traces of thin-shelled mollusca including <i>Macoma balthica</i> —some bored. Many sand-grade black, carbonaceous, woody fragments; traces of coarse sand to fine gravel, with peaty intercalations between 6.3 and 6.4 m	6.7	7.1
Lower Peat	Peat, with interbedded silt partings	0.3	7.4
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, grey, with much coarse quartz sand to fine gravel of oolitic and shelly limestone	0.1	7.5
(First Terrace)	'Clayey' sandy gravel; grading data not available for lower 0.8 m Gravel: fine with some coarse; mostly subrounded to rounded oolitic and shelly limestone with angular to subangular, grey and black flint, with some subrounded sandstone and quartzite, traces of ironstone, rare? indigenous molluscan shells including <i>Macoma balthica</i> and <i>Scrobicularia plana</i> Sand: medium with fine and coarse; mainly subrounded to rounded oolitic and shelly limestone with some flint and ironstone; quartz common below 2 mm fraction Fines: silty to 'clayey', dark greyish brown	1.8	9.3
Oxford Clay	Clay, soft in upper 0.1 m becoming stiff; grey to bluish grey, mottled in upper 0.1 m; calcareous	1.2+	10.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
12	65	23	7.5 - 8.5	12	21	27	17	23	trace	0
			8.5 - 9.3	No grading data available						
			Mean	12	21	27	17	23	trace	0

Surface level + 2.15 m (+ 7.0 ft)  
 Water not struck  
 152 mm percussion  
 November 1979

Waste 7.7 m  
 Bedrock 1.8 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground, dark grey peaty soil with brick fragments	1.7	1.7
Terrington Beds (Roddon)	Silt, soft, glutinous; brown to dark brown with grey to pale reddish brown laminae, with traces of reed stems at base	0.6	2.3
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, dark grey [2.5 Y N4/] with dark grey to black carbonaceous mottles; below 3.7 m with brown, fibrous peaty intercalations—often with 'rank' odour	2.0	4.3
Lower Peat	Peat, with clay intercalations, friable, fibrous, compact in parts, dark reddish brown with layers of yellow reed stems, 'rank' smelling, with clay/organic material intercalations between 4.6 and 5.0 m and 5.1 and 5.5 m	1.2	5.5
Boulder Clay	Clay, stiff; variegated olive-brown, pale grey and grey becoming predominantly greyish brown towards base; highly calcareous, with abundant subrounded chalk clasts (1 – 15 m maximum diameter), with traces of angular to subangular grey flint gravel, with some coarse sand	2.2	7.7
Oxford Clay	Clay, stiff, pale khaki-brown becoming grey to greenish grey below 8.8 m; traces of dark reddish brown roots in upper 1.1 m; selenite crystals near base	1.8+	9.5

Surface level + 2.3 m (+ 7.5 ft)  
 Water struck at - 3.0 m  
 152 mm percussion  
 January 1980

Overburden c 6.0 m  
 Mineral c 2.1 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, clayey loam with surface scatter of gravel	0.3	0.3
Barroway Drove Beds (?Roddon)	Silt, soft to firm, brown [10 YR 5/3] mottled in part with yellow and grey, calcareous, micaceous, with many vertical root holes usually 'haloed' with dark orange iron-oxide	1.1	1.4
('Buttery Clay')	Clay, soft, slightly glutinous, thixotropic, dark greyish brown [10 YR 4/2] to brown [10 YR 4/3], silty in parts, micaceous, very slightly calcareous	3.9	5.3
(?'Buttery Clay')	Clay, soft to firm, glutinous in part, very dark grey [2.5 Y N3/] mottled with black carbonaceous material	c 0.7	c 6.0
River Terrace Deposits (First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone, with angular to subangular brown, white and trace grey flint—rarely patinated, with some subrounded ironstone, quartzite and sandstone. Rare indurated chalk clasts and well-worn belemnite and <i>Gryphaea</i> fragments Sand: medium with coarse and some fine; mostly subrounded oolitic and shelly limestone with ironstone and angular to subangular brown and white flint, with some quartz below 2 mm fraction Fines: silty, dark greyish brown [2.5 Y 4/2] in upper 1.0 m becoming olive brown [2.5 Y 4/4] towards base	c 2.1	8.1
Oxford Clay	Clay, stiff, dark grey [5 Y 4/1], silty and calcareous; traces of shells, notably <i>Gryphaea</i> —shell surfaces often veneered with iron pyrites	1.2+	9.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	57	39	6.0 - 7.0	5	6	29	19	38	3	0
			7.0 - 8.1	3	7	30	22	35	3	0
			Mean	4	7	30	20	36	3	0

Surface level + 1.53 m (+ 5.0 ft)  
 Water struck at - 3.47 m  
 152 mm percussion  
 January 1980

Overburden 5.1 m  
 Mineral 1.9 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, loam black [5 Y 2.5/1]	0.6	0.6
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous in parts; brown [10 YR 5/3] mottled yellowish red [5 YR 4/6] in upper 1.7 m, becoming dark grey [7.5 YR N4/] mottled with black carbonaceous material below 2.3 m; slightly micaceous and silty in lower c 0.8 m with reed stems (? <i>Phragmites</i> ) towards base	2.5	3.1
Lower Peat	Peat, friable, fibrous, very dark greyish brown [10 YR 3/2]; rather clayey in parts; ‘rank’ smelling	c 0.2	c 3.3
River Terrace Deposits (Crowland Bed)	Clay, soft to firm, glutinous in parts especially near base; predominantly pale grey [5 Y 6/1] mottled pale olive brown [2.5 Y 5/4] to black (the latter associated with carbonaceous material), with vertical root traces throughout—often with ‘rank’ odour; becomes sandy and pebbly below 5.0 m; wood fragments at c 3.8 m	c 1.8	5.1
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular black, white and grey flint—rarely patinated, with some ironstone, quartzite, sandstone and vein-quartz; rare igneous clasts, occasional well-worn belemnite and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine; mainly subrounded oolitic and shelly limestone with ironstone Fines: silty, dark greyish brown [2.5 Y 4/2] in upper 1.0 m becoming olive brown [2.5 Y 4/4]	1.9	7.0
Oxford Clay	Clay, firm to stiff, slightly silty, dark grey [5 Y 4/1] calcareous	0.9+	7.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	54	43	5.1 - 6.1	2	6	29	23	36	4	0
			6.1 - 7.0	4	4	25	20	43	4	0
			Mean	3	5	27	22	39	4	0

Surface level + 1.41 m (4.5 ft)  
 Water struck at -2.49 m  
 152 mm percussion  
 October 1979

Waste 5.0 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, peaty loam, dark brown to black	1.2	1.2
Barroway Drove Bed (‘Buttery Clay’)	Clay, generally soft, glutinous, thixotropic, bluish grey to grey, with peaty intercalations	2.0	3.2
Lower Peat	Peat, very clayey, dark grey to black, with many thin-shelled, white lamellibranch fragments, occasional bark fragments	0.5	3.7
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, glutinous, olive-green in part mottled by bluish-grey, with fine to medium-grade sand and trace angular to subangular flint gravel	0.9	4.6
(First Terrace)	Pebbly sand Gravel: fine with trace coarse; subrounded to rounded oolitic limestone with angular to subangular brown and white flint with some ironstone. Traces of belemnite and <i>Gryphaea</i> fragments Sand: mostly medium with coarse and fine; mostly subrounded to rounded, quartz and oolitic limestone Fines: silty, grey	0.4	5.0
Oxford Clay	Clay, stiff, bluish-grey mottled brown in upper 0.2 m; calcareous, with ammonite traces	1.3 +	6.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	71	21	4.6 - 5.0	8	11	44	16	20	1	0

Surface level +8.58 m (+28.0 ft)  
 Water struck at +7.68 m  
 203 mm percussion  
 February 1980

Overburden 0.9 m  
 Mineral 2.4 m  
 Bedrock 1.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown silty loam	0.1	0.1
Alluvium	Silt, strong brown [7.5 YR 5/6], with some fine-grade subangular quartz sand and some plant rootlets	0.8	0.9
River Terrace Deposits (First Terrace)	Gravel Gravel: fine with coarse; abundant subrounded to well-rounded oolitic and shelly with some crystalline limestone, with subangular to subrounded white and brown flint and subrounded to well-rounded quartzite with some sandstone; traces of well-worn Oxford Clay bivalves and gastropods; rare (one specimen) broken ?Quaternary bivalve shell Sand: medium and coarse with some fine; oolitic limestone, quartz, flint with some ironstone Fines: silty	2.4	3.3
Oxford Clay	Clay, shaly, dark greyish brown [2.5 Y 4/2]	1.7+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	48	49	0.9 - 1.9	5	4	20	20	43	8	0
			1.9 - 2.9	2	4	24	24	43	3	0
			2.9 - 3.3	2	3	19	21	49	6	0
			Mean	3	4	22	22	43	6	0



Surface level +8.25 (+27.0 ft)  
 Water struck at +7.25 m  
 203 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 3.6 m  
 Bedrock 0.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, dark brown, silty, sandy loam	0.6	0.6
	Clay, firm, dark brown [7.5 YR 4/4], with abundant small bivalves, gastropods and (?) <i>Spirorbis</i>	0.4	1.0
River Terrace Deposits (First Terrace)	Sandy gravel, 'very clayey' in upper 0.8 m Gravel: fine with coarse, trace cobble; mainly subrounded to well-rounded shelly and oolitic limestone with calcareous sandstone with some angular to rounded brown and white with black flint, subrounded sandstone, quartzite and ironstone; traces of Oxford Clay shell fragments Sand: medium and coarse with fine; mostly subangular to rounded limestone with flint and quartz with some ironstone Fines: clayey to silty	3.6	4.6
Oxford Clay	Clay, shaly, dark greyish brown[2.5 YR 4/2]	0.4+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	47	45	1.0 - 1.8	21	10	22	11	33	3	0
			1.8 - 2.8	No grading data available						
			2.8 - 3.8	1	4	25	19	43	8	0
			3.8 - 4.6	5	3	23	19	31	19	0
			Mean	8	6	24	17	35	10	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic		Others
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indi-genous	Derived		Calcareous			
1.0 - 4.6	12	trace	trace	26	13	4	3	nil	1	2	6	33	nil	nil

**Flint colour variation (see Roeder, 1977)**

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	1.0 - 4.6	17	47	36

Surface level +9.31 m (+30.5 ft)  
 Water struck at +8.31 m  
 203 mm percussion  
 February 1980

Overburden 0.5 m  
 Mineral 4.5 m  
 Waste 0.9 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.5	0.5
River Terrace Deposits (First Terrace)	Gravel, extremely 'clayey' in upper 0.5 m, hard pan at 1.0 m Gravel: fine with coarse, mainly subangular to subrounded oolitic and crystalline limestone with angular to subrounded white and brown flint, with some ironstone and quartzite Sand: medium and coarse, mainly subangular to rounded quartz with flint Fines: clayey to silty, yellowish brown [10 YR 5/8]	4.5	5.0
?Oxford Clay	Pebbly clay, mixture of gravel as above and dark grey clay— ? Oxford clay	0.9	5.9
Oxford Clay	Clay, shaly laminations, dark grey [2.5 Y N4/] becoming dark greyish brown [2.5 Y 4/2]	0.7+	6.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	44	48	0.5 - 1.0	46	8	11	4	26	5	0
			1.0 - 2.0	2	4	20	18	50	6	0
			2.0 - 3.0	1	5	22	22	38	12	0
			3.0 - 4.0	5	6	21	19	43	6	0
			4.0 - 5.0	5	6	25	13	35	16	0
			Mean	8	6	21	17	39	9	0

Surface level +10.65 m (+ 35.0 ft)  
 Water struck at +9.15 m  
 203 mm percussion  
 February 1980

Overburden 1.2 m  
 Mineral 3.3 m  
 Bedrock 1.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown, sandy, clayey loam	0.4	0.4
River Terrace Deposit (First Terrace)	Silt, strong brown [7.5 YR 5/8], with some fine to medium subangular quartz sand	0.8	1.2
	Gravel Gravel: fine with coarse; mostly subrounded to well-rounded oolitic and shelly limestone with subangular to rounded white and brown with some black flint and calcareous sandstone, with some ironstone, quartzite sandstone and chalk; traces of well-worn Oxford Clay shells Sand: medium and coarse with some fine; subangular to rounded limestone, flint and quartz, with some ironstone Fines: silty	3.3	4.5
Oxford Clay	Clay, shaly laminations; predominantly yellowish brown [10 YR 5/6] mottled with brown and yellow to 4.7 m, becomes dark greyish brown [2.5 Y 4/2] towards base; abundant shell debris	1.9+	6.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	44	52	1.2 - 2.2	3	5	19	17	48	8	0
			2.2 - 3.2	5	6	27	18	35	9	0
			3.2 - 4.5	4	4	19	19	38	16	0
			Mean	4	5	21	18	41	11	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris	Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indi-genous	Derived	Calcareous				
1.2 - 4.5	13	trace	trace	20	15	9	4	nil	2	4	5	28	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	1.2 - 4.5	13	42	45

Surface level +9.19 m (+30.0 ft)  
 Water struck at +8.59 m  
 203 mm percussion  
 February 1980

Overburden 0.4 m  
 Mineral 2.7 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.2	0.2
River Terrace Deposits (First Terrace)	Pebbly silt, strong brown [7.5 YR 5/6] mottled in part, with some medium grade quartz sand and subangular flint pebbles; some rootlets	0.2	0.4
	Sandy gravel, 'clayey' in upper 0.8 m	2.7	3.1
	Gravel: fine with coarse; mostly subrounded to well-rounded shelly and oolitic limestone with subangular brown and white flint, with some sandstone and quartzite		
	Sand: coarse and medium with some fine; subangular limestone with flint in coarse-grade, with quartz and ironstone in finer grades		
	Fines: silty, brownish yellow [10 YR 6/6]		
Oxford Clay	Clay, shaly laminations, dark greyish brown [2.5 Y 4/2]; much comminuted shell material below 4.0 m	1.1 +	4.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	49	48	0.4 - 1.4	2	4	21	22	44	7	0
			1.4 - 2.4	6	4	18	21	40	11	0
			2.4 - 3.1	2	6	31	26	31	4	0
			Mean	3	4	22	23	40	8	0

Surface level + 7.38 m (+ 24.5 ft)  
 Water struck at + 5.88 m  
 152 mm percussion  
 January 1980

Overburden 1.1 m  
 Mineral 3.1 m  
 Bedrock 2.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy clayey loam, dark greyish brown [10 YR 3/2]; extremely calcareous with much fine quartz sand towards base	0.8	0.8
River Terrace Deposits (First Terrace)	Sandy pebbly clay, soft, slightly glutinous, light yellowish brown [2.5 Y 6/4]; extremely calcareous, with abundant fine to coarse, subrounded quartz sand and fine-grade gravel of flint and limestone	0.3	1.1
	Sandy gravel, much iron-oxide coated material below 1.5 m Gravel: fine with coarse; mostly subrounded and tabular oolitic and shelly ?limestone with subangular to angular brown and white flint—some patinated, with some sandstone, quartzite and ironstone; traces of vein-quartz and well-worn belemnite guards with <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mostly subrounded to rounded, oolitic and shelly limestone with some angular to subangular brown flint, trace ironstone; below 2 mm fraction mainly quartz Fines: 'clayey' to silty, light yellowish brown [2.5 Y 6/4] in upper 0.4 m, becoming yellowish brown to dark yellowish brown [10 YR 5/6 – 4/6]	3.1	4.2
Oxford Clay	Clay, firm, friable in parts, very dark grey [7.5 YR N3/]; many comminuted shell fragments—some with pyrite veneer; towards base becomes calcareous and extremely indurated—(?) 'dogger'	2.5 +	6.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/6	+ 1/6 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
3	50	47	1.1 – 1.5	12	15	26	12	26	9	0
			1.5 – 2.5	1	9	27	18	37	8	0
			2.5 – 3.5	2	6	27	19	39	7	0
			3.5 – 4.2	2	6	20	17	43	12	0
			Mean	3	8	25	17	38	9	0

Surface level +7.30 m (+24.0 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 0.9 m  
 Mineral 3.0 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty to sandy loam with surface scatter of pebbles; dark greyish brown [10 YR 4/2], becoming mottled with ?ochre in lower 0.1 m	0.9	0.9
River Terrace Deposit (First Terrace)	Gravel Gravel: fine with coarse; mostly subrounded and tabular oolitic and shelly limestone with angular to subangular white and brown with some grey flint—with slight patination, with some subrounded irregular ironstone; traces of belemnite and <i>Gryphaea</i> fragments, rare subrounded chalk clasts Sand: medium and coarse with some fine; mainly oolitic and shelly limestone with some subrounded ironstone and subangular brown flint; below 2 mm fraction subrounded quartz common; traces of <i>Gryphaea</i> fragments Fines: silty, brownish yellow in upper 1.0 m, becoming greyish brown	3.0	3.9
Oxford Clay	Clay, stiff, dark grey [10 YR 4/1], calcareous, with traces of shell fragments	1.3 +	5.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	46	51	0.9 - 1.9	4	5	21	18	47	5	0
			1.9 - 2.9	2	5	25	21	40	7	0
			2.9 - 3.9	2	3	17	25	43	10	0
			Mean	3	4	21	21	44	7	0

Surface level + 7.68 m (+ 25.5 ft)  
 Water struck at c + 6.98 m  
 152 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral 1.6 m  
 Bedrock 1.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, 'very clayey' sandy gravel mixed with brick rubble in upper part overlying an indurated iron-oxide cemented sand and gravel layer (?hardpan) to base	0.7	0.7
River Terrace Deposits (First Terrace)	Sandy gravel, 'very clayey' in upper 0.6 m Gravel: fine with coarse; mainly oolitic and shelly limestone with subangular to angular grey, white and brown flint—trace patination, with some subrounded, irregular ironstone, subrounded quartzite and sandstone, with traces of indurated, subrounded and tabular chalk Sand: medium and coarse with fine; mainly subrounded oolitic limestone with some ironstone and flint; below 2 mm fraction, quartz common Fines: silty, light olive brown [2.5 Y 5/6]	1.6	2.3
Oxford Clay	Clay, stiff, friable in parts, dark olive grey to light olive brown [5 Y 3/2 - 4/2], calcareous	1.9+	4.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	50	43	0.7 - 1.3	10	12	34	15	25	4	0
			1.3 - 2.3	5	5	20	17	42	11	0
			Mean	7	8	26	16	35	8	0

Surface level +7.58 m (+25.0 ft)  
 Water struck at +6.08 m  
 152 mm percussion  
 February 1980

Overburden c 1.3 m  
 Mineral c 1.0 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, clayey loam, olive brown [2.5 Y 4/4], extremely glutinous	0.4	0.4
River Terrace Deposits (First Terrace)	Sandy pebbly clay, soft, glutinous, brownish yellow [10 YR 6/8], calcareous, with abundant fine to medium-grade oolitic limestone and quartz sand, with some limestone and flint pebbles	c 0.9	c 1.3
	Gravel, deposit strongly iron-oxide 'stained' Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular mainly white with some brown flint, with some ironstone, sandstone and quartzite; traces of belemnite guards and <i>Gryphaea</i> stems Sand: medium and coarse with fine; mainly subrounded oolitic and shelly limestone, with some subrounded ironstone and subangular to angular flint; below 2 mm fraction mainly quartz with ironstone Fines: silty, strong brown [7.5 YR 5/6]	c 1.0	2.3
Oxford Clay	Clay, firm, upper 0.2 m dark greyish brown [2.5 Y 4/2] becoming dark grey [2.5 Y N4/]; laminated in part with iron-oxide-rich silt laminae; whole calcareous, with many cream-coloured shell fragments below c 2.8 m	0.8 +	3.1

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	45	53	1.3 - 2.3	2	6	22	17	42	11	0



Surface level +9.27 m (+30.5 ft)  
 Water struck at +8.57 m  
 152 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral c 3.0 m  
 Bedrock c 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft, friable to crumbly texture, sandy clayey loam, very dark greyish brown [10 YR 3/2], with abundant root traces and angular to subangular white (?)weathered flint pebbles, calcareous throughout; firmer towards base	0.5	0.5
River Terrace Deposits (First Terrace)	Sandy clay, soft, slightly glutinous, light olive brown [2.5 Y 5/4] mottled in part with reddish orange iron-oxide	0.2	0.7
	Gravel, 'clayey' in upper 0.2 m Gravel: fine with coarse and trace cobble—the latter mostly subrounded sandstone and angular to subangular flint; mainly subrounded and tabular oolitic and shelly limestone, with subrounded, irregular ironstone and angular to subangular white, brown and grey flint—slightly patinated, with some subrounded to rounded sandstone and quartzite; traces of subrounded, indurated chalk, with some belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine; mainly oolitic with some shelly limestone with ironstone; below 1 mm fraction almost wholly subrounded quartz Fines: silty, light olive brown [2.5 Y 5/4]	c 3.0	c 3.7
Oxford Clay	Clay, upper 0.1 m of (?)distorted layers interbedded with abundant shell fragments; firm, very dark greyish brown [10 YR 3/2] becoming dark olive grey [5 Y 3/2], calcareous, many cream-coloured thin-shelled fossil fragments	c 1.0+	4.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	45	50	0.7 - 1.7	0	3	20	20	50	7	0
			1.7 - 2.7	9	6	21	16	33	15	0
			2.7 - 3.7	7	5	24	20	34	10	0
			Mean	5	5	21	19	39	11	0

Surface level +4.61 m (+ 15.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden 0.8 m  
 Mineral 4.1 m  
 Bedrock 2.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
River Terrace Deposits (First Terrace)	Soil, firm, silty to fine-grade sandy loam, yellowish brown [10 YR 5/6] with slight dark grey mottles, traces of laminations, calcareous	0.3	0.3
	Silt to sandy pebbly clay, firm, friable in parts, yellowish brown [10 YR 5/8] slightly mottled reddish brown, becoming olive yellow [2.5 Y 6/8] below 0.7 m; upper 0.4 m of very fine to medium, subrounded quartz sand to silt; below 0.7 m becomes indurated, pebbly and clayey; pebbles of limestone, flint and sandstone	0.5	0.8
	Sandy gravel, with thin clay (?) layer at c 2.2 m Gravel: fine with coarse and trace cobble; mainly subrounded and tabular oolitic and shelly limestone—clasts in upper c 2.0 m coated with iron-oxide, with angular to subangular, mostly brown with some white and grey flint and subrounded irregular ironstone, with some subrounded quartzite, vein-quartz, sandstone and indurated chalk; traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mainly oolitic and shelly limestone—upper c 2.0 m coated with iron-oxide, with some flint and ironstone; below c 2.8 m with some indurated chalk; below 1 mm fraction, mainly subrounded quartz Fines: silty, clayey in parts, yellowish brown [10 YR 5/8] to light olive brown [2.5 Y 5/4]	4.1	4.9
Oxford Clay	Clay, stiff to firm, friable in part, very dark grey to dark olive grey [5 Y 3/1 – 3/2], calcareous, shell fragments throughout	2.0+	6.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	52	44	0.8 - 1.8	5	9	25	24	33	4	0
			1.8 - 2.8	6	6	20	18	40	10	0
			2.8 - 3.8	2	6	23	19	38	12	0
			3.8 - 4.9	3	12	31	15	32	7	0
			Mean	4	8	25	19	36	8	0

Surface level +7.08 (+23.5 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 1.1 m  
 Mineral 5.8 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
River Terrace Deposits (First Terrace)	Soil, soft and glutinous in upper 0.2 m becoming firm; brownish yellow [10 YR 5/8], calcareous, with much fine to medium quartz sand	0.3	0.3
	Sandy clay, firm, friable in part, slightly glutinous in part, predominantly yellowish brown [10 YR 5/3] highly mottled brownish yellow [10 YR 6/6], calcareous, with abundant subangular to subrounded fine quartz sand	0.8	1.1
	Sandy gravel, 'clayey' in upper 1.0 m; below 4.4 m much iron-oxide 'staining' Gravel: fine with coarse, trace cobble—the latter of flint and sandstone, mainly subrounded to tabular shelly and oolitic limestone with angular to subangular grey, brown and white flint, with some subrounded irregular ironstone, sandstone and quartzite. Traces of indurated chalk, well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mainly subrounded oolitic and shelly limestone with subrounded ironstone and subangular flint; quartz common below 2 mm fraction, dominant below 1 mm fraction; traces of Oxford Clay shell fragments Fines: 'clayey' to silty, brownish yellow [10 YR 6/8] to yellow [10 YR 7/6] to yellowish brown [10 YR 5/6]	5.8	6.9
Kellaways Sand	Clay, stiff, laminated with silt partings, overall colour very dark greyish brown [2.5 Y 3/2] with much iron-oxide material along intervening laminae in upper 0.1 m; traces of lamellibranchs and belemnite guards	1.0+	7.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	55	38	1.1 - 2.1	19	14	24	14	26	3	0
			2.1 - 3.4	9	6	24	23	32	6	0
			3.4 - 4.5	3	6	28	20	35	8	0
			4.5 - 5.5	2	6	24	21	38	9	0
			5.5 - 6.9	4	6	49	11	22	8	0
			Mean	7	7	30	18	31	7	0

Surface level + 6.63 m (+ 21.5 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 0.6 m  
 Mineral 6.4 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mixture of clay, brick rubble, sand and gravel with soil	0.6	0.6
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' between 2.6 and 3.7 m Gravel: fine with coarse, trace cobble—the latter usually sandstone; mainly subrounded and tabular oolitic and shelly limestone with subrounded irregular ironstone and angular to subangular white, grey with some brown flint—trace patination, with some subrounded to rounded quartzite, sandstone and vein-quartz; traces of well-worn belemnite guards (some ?bored) and <i>Gryphaea</i> ; rare ?igneous clast and indurated subrounded chalk Sand: medium and coarse with fine; mainly subrounded oolitic and shelly limestone with ironstone, trace chalk throughout; below 2 mm fraction, quartz common; below 1 mm fraction, quartz dominant Fines: 'clayey' to silty, light olive brown [2.5 Y 5/4]	6.4	7.0
Oxford Clay	Clay, stiff to indurated, friable in part, with pale grey silty laminae in upper 0.1 m; olive grey to dark olive grey [5 Y 4/2 – 3/2], calcareous, cream-coloured shell fragments throughout	1.1 +	8.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	54	42	0.6 - 1.6	2	4	22	18	47	7	0
			1.6 - 2.6	7	6	26	15	37	9	0
			2.6 - 3.7	11	9	26	12	32	10	0
			3.7 - 4.8	2	8	30	19	35	6	0
			4.8 - 5.8	1	14	46	14	23	2	0
			5.8 - 7.0	1	7	27	21	41	3	0
			Mean	4	8	29	17	36	6	0

Surface level +7.42 m (+24.5 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 3.1 m  
 Bedrock c 0.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty to fine to medium-grade sand, loamy, very dark greyish brown [2.5 YR 3/2] calcareous	0.6	0.6
River Terrace Deposits (First Terrace)	Sandy, pebbly clay, soft to firm, slightly glutinous in part; very dark greyish brown [2.5 Y 3/2] to light olive brown [2.5 Y 5/4]; yellowish brown [10 YR 5/8] with reddish brown iron-oxide mottle below 0.8 m; calcareous; with fine to medium-grade subrounded quartz sand; with some fine-grade subrounded to subangular oolitic limestone gravel	0.4	1.0
	Sandy gravel, very sandy below c 3.0 m Gravel: fine with some coarse, trace cobble; mainly subrounded and tabular oolitic and shelly limestone with subrounded irregular ironstone and subangular to angular, brown with some grey flint—slight patination; with some quartzite, sandstone and vein-quartz with indurated chalk; traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium with coarse and fine; mostly subrounded limestone, ironstone and flint; below 1 mm fraction, mainly subrounded to rounded quartz Fines: slightly silty, light olive brown [2.5 Y 5/4]	3.1	4.1
Oxford Clay	Clay, stiff; upper 0.1 m variegated light olive brown [2.5 YR 5/4] to yellowish brown [10 YR 5/8]; becoming very dark grey [2.5 Y N3/]; upper 0.1 m unfossiliferous passing into layers of abundant comminuted, white shell fragments; below c 4.3 m becomes extremely indurated—(?) 'dogger'	c 0.2+	c 4.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	67	31	1.0 - 2.0	2	4	26	19	43	6	0
			2.0 - 3.0	2	13	41	14	27	3	0
			3.0 - 4.1	2	13	58	11	15	1	0
			Mean	2	10	43	14	28	3	0

Surface level + 3.91 m (+ 13.0 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Mineral 4.8 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
River Terrace Deposits (First Terrace)	Gravel: sandy in upper 1.0 m Gravel: fine with coarse; subrounded to well-rounded oolitic and shelly limestone and calcareous sandstone; with angular to subangular white and brown with black flint; with ironstone, sandstone, quartzite and chalk; traces of belemnite guards and <i>Gryphaea</i> fragments Sand: coarse and medium with some fine; subangular to rounded quartz, flint and limestone in coarse grades, with ironstone in finer grades Fines: silty to slightly silty, strong brown [7.5 YR 5/8 – 5/6]	4.8	4.8
Oxford Clay	Clay, dark grey [7.5 YR N4/], with shaly laminations and interbedded shell fragments	1.2+	6.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/6	+ 1/6 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
2	47	51	0.0 – 1.0	5	13	33	21	27	1	0
			1.0 – 2.0	1	4	18	25	45	7	0
			2.0 – 3.0	1	3	23	21	42	10	0
			3.0 – 4.0	1	2	11	23	52	11	0
			4.00 – 4.8	0	2	12	21	47	18	0
			Mean	2	5	20	22	42	9	0

**COMPOSITION**

Depth below surface (m)	Percentage by weight in 8 – 16 mm fraction													
	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic		Others
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indigenous	Derived		Calcareous			
0 – 4.8	17	nil	nil	20	10	11	6	nil	2	5	11	18	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 – 16	0 – 4.8	14	33	53

Surface level +4.48 m (+ 15.0 ft)  
 Water struck at c + 3.48 m  
 152 mm percussion  
 February 1980

Overburden c 1.0 m  
 Mineral c 5.7 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, clayey loam, very dark greyish brown to dark brown [10 YR 3/2 – 3/3], slightly calcareous, with many white rootlets	0.5	0.5
River Terrace Deposits (First Terrace)	Clay to sandy pebbly clay, soft to firm, yellowish brown [10 YR 5/6] slightly mottled with iron-oxide in parts; upper 0.2 m mainly silty clay; below 0.7 m with abundant fine to medium sand of subrounded quartz and subrounded oolitic limestone—the latter strongly iron-oxide 'stained'	0.4	0.9
	Conglomerate (?) hardpan; fine to coarse-grade gravel cemented with iron-oxide	c 0.1	c 1.0
	Sandy gravel, strongly iron-oxide 'stained' to 1.4 m, sandy in lower 1.3 m Gravel: fine with some coarse, trace cobble—the latter mainly of flint; mainly oolitic and shelly limestone with angular to subangular, grey, white and brown flint—some patinated; with subrounded irregular ironstone; with some indurated subrounded chalk. Traces of belemnite guards and <i>Gryphaea</i> Sand: medium and coarse with fine; mainly subrounded oolitic and shelly limestone, with ironstone and flint with some chalk throughout; below 1 mm fraction, quartz dominant Fines: silty, yellowish brown [10 YR 5/6] in upper c 4.4 m becoming greyish brown to olive brown [2.5 Y 4/2 to 4/4]	c 5.7	6.7
Oxford Clay	Clay, firm to stiff, dark olive grey [5 Y 3/2], calcareous, with cream-coloured shell fragments	0.8 +	7.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/6	+ 1/6 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
2	61	37	1.0 – 1.4	6	6	21	24	40	3	0
			1.4 – 2.4	4	5	23	24	35	9	0
			2.4 – 3.4	2	5	29	25	35	4	0
			3.4 – 4.4	0	4	28	19	42	7	0
			4.4 – 5.4	0	4	32	23	38	3	0
			5.4 – 6.7	3	31	38	11	16	1	0
			Mean	2	11	30	20	32	5	0

Surface level + 5.28 m (+ 17.5 ft)  
 Water struck at + 4.18 m  
 152 mm percussion  
 February 1980

Overburden 0.7 m  
 Mineral 4.8 m  
 Bedrock 2.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.7	0.7
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' in upper 0.4 m Gravel: fine with coarse; mainly subrounded to well-rounded oolitic and shelly limestone with subangular to rounded white and brown with some black flint; with some subrounded to well-rounded quartzite and sandstone; traces of <i>Gryphaea</i> Sand: medium and coarse with fine; mostly quartz with flint and limestone Fines: 'clayey' to silty, strong brown [7.5 YR 5/8 to 5/6]	4.8	5.5
Kellaways Sand	Clay, dark greyish brown to dark grey [10 YR 4/2 to 4/1], silty to very silty with some calcite veining in upper 0.3 m, mottled with ?weathered pyrite throughout	2.0+	7.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	57	41	0.7 - 1.1	13	9	25	19	31	3	0
			1.1 - 2.1	3	5	26	19	39	8	0
			2.1 - 3.1	1	4	22	23	42	8	0
			3.1 - 4.1	1	6	28	18	40	7	0
			4.1 - 5.5	1	11	48	12	25	3	0
			Mean	2	7	32	18	35	6	0



Surface level + 7.32 m (+ 24.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden c 1.0 m  
 Mineral c 4.6 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to stiff, pebbly clayey loam, dark greyish brown [2.5 Y 3/2], slightly calcareous	0.4	0.4
River Terrace Deposits (First Terrace)	Silty to sandy pebbly clay, firm to stiff, yellowish brown [10 YR 5/6] to dark yellowish brown [10 YR 4/4], mottled throughout especially below 0.8 m; silty in upper 0.4 m, becoming more sandy and pebbly towards base	c 0.6	c 1.0
	Sandy gravel Gravel: fine with coarse; mostly subrounded and tabular, oolitic and shelly limestone with angular to subangular white and brown flint; with subangular to subrounded quartzite and ironstone; with some subrounded, indurated chalk and sandstone. Traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium with coarse and fine; mainly oolitic limestone with ironstone and flint with some chalk; below 2 mm fraction, mostly quartz Fines: silty, olive brown [2.5 Y 4/4]	c 4.6	5.6
Oxford Clay	Clay, stiff, friable in part, very dark grey [2.5 Y N3/], slightly calcareous, with abundant comminuted shell fragments; traces of nodular pyrite	0.8+	6.4

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	49	47	1.0 - 2.0	3	6	26	17	41	7	0
			2.0 - 3.0	2	9	26	16	40	7	0
			3.0 - 4.0	4	7	29	16	31	13	0
			4.0 - 5.0	3	5	30	17	35	10	0
			5.0 - 5.6	7	7	25	9	32	20	0
			Mean	4	7	27	15	36	11	0

Surface level +2.12 m (+7.0 ft)  
 Water strike not recorded  
 152 m percussion  
 February 1980

Overburden 0.8 m  
 Mineral 2.7 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft, fibrous, friable in part, dark brown to black peaty loam, with surface scatter of flint and limestone gravel	0.7	0.7
River Terrace Deposits (First Terrace)	Sandy pebbly clay, firm to indurated, light olive brown [2.5 Y 5/4 - 5/6] highly mottled, with much fine to medium-grade sand of subrounded to rounded quartz, with some subrounded to subangular limestone and flint gravel	0.1	0.8
	Gravel, much 'stained' with iron-oxide in upper c 1.1 m, with silt layer at c 2.4 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with subangular to angular brown and white flint—some patinated; with some ironstone, sandstone and indurated chalk. Traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium and coarse with some fine; mainly oolitic limestone with some subangular white flint and subrounded ironstone; below 1 mm fraction, mostly subrounded to rounded quartz Fines: silty, yellowish brown [10 YR 5/6] to 1.9 m becoming olive brown [2.5 Y 4/4]	2.7	3.5
Oxford Clay	Clay, firm to stiff, friable in parts, olive grey to dark olive grey [5 Y 4/2 to 3/2], calcareous, with abundant cream-coloured fragile shell fragments	1.0+	4.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	46	51	0.8 - 1.8	6	5	20	21	42	6	0
			1.8 - 2.8	1	2	19	22	52	4	0
			2.8 - 3.5	2	6	25	20	42	5	0
			Mean	3	4	21	21	46	5	0

Surface level +2.91 m (+9.5 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 0.6 m  
 Mineral 4.3 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft to firm, clayey, sandy loam, dark brown [10 YR 3/3], with surface scatter of flint and limestone gravel	0.5	0.5
River Terrace Deposits (First Terrace)	Pebbly sandy clay, soft to firm, yellowish brown [10 YR 5/8], with much fine to coarse quartz and oolitic limestone sand and some oolitic and shelly limestone and brown flint gravel	0.1	0.6
	Sandy gravel, with strong iron-oxide 'staining' in upper 0.5 m; silty clay layer between 1.7 and 1.8 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone, with angular to subangular white brown with some grey flint—traces of patination; with some subrounded ironstone, indurated chalk, quartzite and sandstone. Traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium and coarse with fine; mostly subrounded oolitic with some shelly limestone; with subrounded ironstone; with some subangular flint and indurated chalk; below 2 mm fraction; quartz common; below 1 mm fraction, quartz dominant Fines: 'clayey' in part to slightly silty, yellowish brown [10 YR 5/8] in upper 0.5 m becoming olive brown [2.5 Y 4/4] towards base	4.3	4.9
Oxford Clay	Clay, firm to stiff, dark grey [5 Y 4/1], calcareous, with abundant cream-coloured shell fragments	1.3 +	6.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
1	62	37	0.6 - 1.7	No grading data available						
			1.8 - 2.8	2	7	33	20	36	2	0
			2.8 - 3.8	1	9	37	20	32	1	0
			3.8 - 4.9	1	8	30	23	37	1	0
			Mean	1	8	33	21	36	1	0

Surface level + 3.54 m (+ 11.5 ft)  
 Water struck at + 2.64 m  
 152 mm percussion  
 February 1980

Overburden 0.4 m  
 Mineral 4.0 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' between 2.4 and 3.4 m Gravel: fine with some coarse; mainly angular to subrounded brown and white flint and well-rounded oolitic and crystalline limestone; with subrounded to well-rounded quartzite and sandstone, with some <i>Gryphaea</i> shells Sand: medium and coarse with some fine; subangular to rounded quartz, flint and limestone Fines: 'clayey' to silty, strong brown [7.5 YR 5/8 to 5/6]	4.0	4.4
Oxford Clay	Clay, shaly, laminated, dark greyish brown [10 YR 4/2], with some lamellibranch fragments	1.1 +	5.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	56	39	0.4 - 1.4	6	9	27	18	37	3	0
			1.4 - 2.4	1	6	21	22	44	6	0
			2.4 - 3.4	11	6	31	15	32	5	0
			3.4 - 4.4	1	11	39	21	27	1	0
			Mean	5	8	29	19	35	4	0

Surface level +4.51 m (+15.0 ft)  
 Water struck at +3.21 m  
 152 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 4.4 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft to firm, slightly silty to clayey loam, dark yellowish brown [10 YR 4/4], slightly calcareous, with root traces	0.7	0.7
River Terrace Deposits (First Terrace)	Clay, soft to firm, variegated light olive brown [2.5 Y 5/4] with yellowish red [5 YR 5/8], ?layered, slightly silty to silty; rare flint pebbles	0.3	1.0
	Sandy gravel, 'clayey' between 1.0 and 1.3 m and 3.3 and 4.3 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with subangular to angular brown, white and grey flint; with subrounded irregular ironstone; with some subrounded quartzite and sandstone; with traces of indurated chalk, vein-quartz and well-worn Oxford Clay shell fragments Sand: medium and coarse with fine; mainly cream-coloured subrounded limestone with ironstone, with some subangular to angular flint and chalk; below 2 mm fraction, quartz common; below 1 mm fraction, quartz dominant Fines: light olive brown [2.5 Y 5/4]	4.4	5.4
Kellaways Sand	Sand, fine to medium subrounded to rounded quartz; with silty to clayey matrix; dark olive grey [5 Y 4/2]; thixotropic	1.0	6.4
?Kellaways Sand or Kellaways Clay	Clay, stiff, dark grey [2.5 Y N4/]; silty partings; traces of pyrite crystals throughout	0.4+	6.8

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	53	42	1.0 - 1.3	16	12	27	14	26	5	0
			1.3 - 2.3	1	4	25	20	44	6	0
			2.3 - 3.3	2	8	26	18	39	7	0
			3.3 - 4.3	14	8	31	15	29	3	0
			4.3 - 5.4	1	4	29	22	42	2	0
			Mean	5	7	28	18	38	4	0

Surface level +4.82 m (+15.5 ft)  
 Water struck at +3.42 m  
 152 mm percussion  
 February 1980

Overburden 1.3 m  
 Mineral 3.1 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, silty to clayey loam, soft to firm, rather glutinous in places, predominantly olive brown [2.5 Y 4/4] mottled yellowish brown [10 YR 5/6]; with some coarse sand and fine-grade gravel throughout; with surface scatter of sandy gravel	0.7	0.7
	Clay, soft, slightly glutinous, variegated yellowish brown to dark yellowish brown [10 YR 5/6 to 4/4] with some iron-oxide 'staining'—especially towards base; traces of coarse sand throughout with rare pebbles; traces of vertical roots/stems	c 0.5	c 1.2
	Sand, mainly fine to medium; subrounded to rounded quartz; silty to clayey; matrix very dark grey to black [2.5 Y N3/ to N2/]; 'rank' smelling; abundant white thin-shelled lamellibranch valves with some complete gastropods; fragments of ?iron-impregnated wood	c 0.1	1.3
River Terrace Deposits (First Terrace)	Gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular grey and white flint—some patinated; with subrounded irregular ironstone; with some subrounded sandstone and quartzite; traces of belemnite guards and <i>Gryphaea</i> shells; with some indurated chalk Sand: medium and coarse with some fine; mainly limestone and ironstone with some flint and chalk in coarse fraction; below 2 mm fraction, mainly quartz Fines: silty, dark greyish brown [2.5 Y 4/2]	3.1	4.4
Oxford Clay	Clay, stiff to firm, very dark grey [5 Y 3/1], with some silty, iron-oxide-rich partings in upper c 0.1 m, calcareous, many shell impressions	1.3 +	5.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	44	53	1.3 - 2.3	6	4	18	18	43	11	0
			2.3 - 3.3	3	2	18	20	43	14	0
			3.3 - 4.4	2	5	30	16	40	7	0
			Mean	3	4	22	18	43	10	0

Surface level + 1.84 m (+ 6.0 ft)  
 Water not struck  
 152 mm percussion  
 February 1980

Overburden 0.9 m  
 Mineral 2.1 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, soft, friable in part, sandy loam, dark grey [2.5 Y N3/] to black [2.5 Y N2/], peaty, with surface scatter of sandy gravel	0.9	0.9
River Terrace Deposits (First Terrace)	Sandy gravel; 'clayey' in upper 0.1 m with some iron-oxide-cemented concretions; iron-oxide 'staining' throughout; with pebbly clay (?) layer between 1.5 and 1.6 m Gravel: fine with some coarse; traces of cobbles—mainly iron-oxide-cemented concretions; mostly oolitic and shelly limestone and angular to subangular white and brown with black flint—rare patination; with rounded to subrounded quartzite and sandstone—mainly calcareous; with some subrounded ironstone; with traces of subrounded indurated chalk, well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mainly subrounded oolitic limestone with some ironstone and flint in the coarse-grade; below 1 mm fraction, subrounded quartz dominant Fines: dark yellowish brown [10 YR 4/4], with firm to stiff, dark grey [5 Y 4/1] pebbly clay (?) layer	2.1	3.0
Oxford Clay	Clay, firm, friable in part, olive grey [5 Y 4/2], calcareous, slightly silty, with traces of shell impressions	1.1 +	4.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	51	44	0.9 - 1.5	3	6	24	22	43	2	0
			1.5 - 1.6	Waste						
			1.6 - 2.6	5	5	24	22	41	3	0
			2.6 - 3.0	6	6	23	19	42	4	0
			Mean	5	6	24	21	41	3	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others	
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indi-genous	Derived					Calcareous
0.9 - 3.0	23	trace	trace	23	7	6	18	nil	1	trace	7	15	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	0.9 - 3.0	10	41	49

Surface level + 2.11 m (+ 7.0 ft)  
 Water struck at + 1.01 m  
 152 mm percussion  
 February 1980

Overburden 0.4 m  
 Mineral 3.9 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam, very dark brown	0.4	0.4
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' in upper 0.7 m Gravel: fine with some coarse; mostly subrounded to well-rounded oolitic and shelly with some crystalline limestone; with subangular to rounded brown and white flint; with some sandstone and quartzite and traces of <i>Gryphaea</i> shells Sand: medium and coarse with fine; subangular to rounded limestone and flint with some quartz in coarse-grade; quartz with some ironstone common in finer grades Fines: strong brown [7.5 YR 5/8 to 5/6]	3.9	4.3
Oxford Clay	Clay, dark grey [10 YR 4/1]	0.7+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	59	37	0.4 - 1.1	18	12	30	16	23	1	0
			1.1 - 2.1	1	7	29	19	39	5	0
			2.1 - 3.1	1	8	31	17	40	3	0
			3.1 - 4.3	1	9	40	16	32	2	0
			Mean	4	9	33	17	34	3	0



Surface level + 2.84 m (+ 9.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden 1.1 m  
 Mineral 3.4 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
?Alluvium	Clay, firm, strong brown [7.5 YR 5/8] streaked grey, with some black carbonaceous patches, silty towards base	0.3	1.1
River Terrace Deposits (First Terrace)	Gravel Gravel: fine with some coarse; mainly angular to well-rounded oolitic and shelly limestone with angular to sub-rounded, brown and white with some black flint; with some subrounded to well-rounded quartzite, sandstone and ironstone; traces of belemnite guards and <i>Gryphaea</i> shells Sand: medium and coarse with fine; subangular to rounded quartz, flint and limestone Fines: slightly silty	3.4	4.5
Oxford Clay	Clay, with some shaly laminations, dark greyish brown to dark grey [10 YR 4/2 to 4/1]	1.5 +	6.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
1	54	45	1.1 - 2.1	2	5	24	20	42	7	0
			2.1 - 3.1	1	7	29	21	37	5	0
			3.1 - 4.5	0	4	30	23	41	2	0
			Mean	1	5	28	21	41	4	0

Surface level +3.93 m (+13.0 ft)  
 Water struck at +2.43 m  
 152 mm percussion  
 February 1980

Overburden c 1.0 m  
 Mineral c 2.8 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, soft, glutinous, clayey loam, very dark greyish brown [10 YR 3/2], calcareous, with traces of subrounded to rounded pebbles	c 0.9	c 0.9
	Sandy clay, soft to firm, glutinous in parts, light olive brown to olive brown [2.5 Y 5/4 to 4/4], calcareous, with fine to very fine, subrounded quartz sand	c 0.1	c 1.0
River Terrace Deposits (First Terrace)	Sandy gravel, 'very clayey' in upper 0.4 m Gravel: fine with coarse and trace cobble—the latter mainly subrounded quartzite and sandstone; mostly subrounded and tabular oolitic and shelly limestone with angular to subangular brown and white flint—trace patination; with some subrounded irregular ironstone, quartzite and sandstone; with traces of subrounded indurated chalk and well-worn belemnite guards; rare green (?) igneous clasts Sand: coarse and medium with fine; in coarse-grade mainly oolitic and shelly limestone with ironstone and flint; below 1 mm fraction, mostly subrounded to rounded quartz Fines: olive brown [2.5 Y 4/4]	c 2.8	3.8
Oxford Clay	Clay, stiff, friable towards base, dark olive grey [5 Y 3/2], calcareous, with abundant shell fragments and impressions—the latter often veneered with pyrite, crudely layered at base	1.5 +	5.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	49	45	1.0 - 1.5	20	6	22	19	32	1	0
			1.5 - 2.5	4	5	22	21	42	6	0
			2.5 - 3.8	2	4	20	27	42	5	0
			Mean	6	5	21	23	40	5	0

Surface level + 5.20 m (+ 17.0 ft)  
 Water struck at + 3.70 m  
 152 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 2.7 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
?Alluvium	Soil, silty, clayey loam, grey [5 Y 4/1]	0.4	0.4
	Silty clay, soft to firm, slightly glutinous, olive brown [2.5 Y 4/4] highly mottled with yellowish red [5 YR 4/6] below c 0.8 m; slightly calcareous with a layer of carbonised wood fragments at c 0.7 m	0.5	0.9
	Sandy clay, soft glutinous, brownish yellow [10 YR 6/6], crudely layered, with abundant fine to medium subrounded quartz sand and some gravel of limestone and flint	0.1	1.0
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' in upper 0.4 m, some iron-oxide 'staining', silt layer at base Gravel: fine with coarse, trace cobble—the latter mainly of sandstone; mostly subrounded and tabular oolitic and shelly limestone with subangular to angular brown and grey flint with subrounded ironstone; with some quartzite and sandstone; with traces of indurated chalk and well-worn belemnite guards Sand: medium and coarse with fine; in coarse-grade mainly oolitic limestone with ironstone and some flint; below 1 mm fraction, mainly quartz with ironstone and (?) carbonaceous wood fragments Fines: 'clayey' to silty, generally light olive brown [2.5 Y 5/4]; between c 3.6 and 3.7 m with a silty layer, laminated dark olive grey to black [5 Y 3/2 to 2.5/2]	2.7	3.7
Kellaways Sand	Silty clay, very poor recovery below 4.4 m; firm to soft to a slurry; very silty to fine sand in places; indurated layer at c 4.9 m—(?) 'dogger'	1.3+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	52	44	1.0 - 1.5	11	7	27	14	31	10	0
			1.5 - 2.6	1	3	21	20	43	12	0
			2.6 - 3.7	4	14	26	22	32	2	0
			Mean	4	8	24	20	36	8	0

Surface level + 1.22 m (+ 4.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden 2.6 m  
 Mineral 0.9 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
?Nordelph Peat	Soil, fibrous, peaty, clayey loam, dark brown [7.5 YR 3/2]	0.7	0.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, glutinous, grey [10 YR 5/1], with occasional peat layers	0.6	1.3
River Terrace Deposits (?Crowland Bed)	Sandy silt, soft, strong brown [7.5 YR 5/8]; with some fine-grade angular to subrounded, quartz sand; with a pebbly clay layer at c 1.8 m	1.3	2.6
(First Terrace)	Sandy gravel Gravel: fine with some coarse; subrounded to well-rounded oolitic and crystalline limestone with subangular to rounded, brown and white with some black flint; with some sandstone and quartzite Sand: medium and coarse with fine; subangular to rounded quartz, flint limestone and ironstone Fines: silty, strong brown [7.5 YR 5/6]	0.9	3.5
Oxford Clay	Clay, glutinous to indurated, grey [10 YR 5/1], with shaly laminations towards base	0.5 +	4.0

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	49	47	2.6 - 3.5	4	7	23	19	43	4	0

Surface level +2.07 m (+7.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 February 1980

Overburden 1.3 m  
 Mineral 5.1 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	1.1	1.1
?Alluvium	Peaty clay, fibrous, dark brown [7.5 YR 3/2], with occasional clay laminae—generally grey [10 YR 5/1]	0.1	1.2
River Terrace Deposits (First Terrace)	Sandy silt, soft, strong brown [7.5 YR 5/8], with some fine-grade angular to subrounded quartz sand	0.1	1.3
	Sandy gravel, with abundant (?)indigenous shell fragments, sandy towards base Gravel: fine with some coarse; mostly subrounded to well-rounded oolitic and crystalline limestone with subangular to rounded brown and white with some black flint; with some sandstone and quartzite and subrounded to well-rounded chalk; below 4.2 m abundant large and small <i>Gryphaea</i> shells; below 4.5 m with abundant mainly broken (?)indigenous gastropod shells— <i>Littorina saxatilis</i> , <i>Nucella ?lapillus</i> and <i>Turritella ?communis</i> and lamellibranchs— <i>Cerastoderma edule</i> and <i>Macoma balthica</i> Sand: medium and coarse with fine; subangular to rounded quartz, flint and limestone with some chalk Fines: silty, strong brown [7.5 YR 5/6] to 3.3 m, becoming yellowish brown [10 YR 5/4]	5.1	6.4
Oxford Clay	Clay, laminated, dark greyish brown [10 YR 4/1] with traces of shell fragments	0.6	7.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				— 1/6	+ 1/6 — 1/4	+ 1/4 — 1	+ 1 — 4	+ 4 — 16	+ 16 — 64	+ 64 mm
2	58	40	1.3 — 2.3	4	8	23	21	43	1	0
			2.3 — 3.3	0	4	27	21	44	4	0
			3.3 — 4.3	2	7	24	18	43	6	0
			4.3 — 5.3	2	10	30	28	27	3	0
			5.3 — 6.4	3	10	27	26	28	6	0
			Mean	2	8	27	23	36	4	0

Surface level +2.25 m (+7.5 ft)  
 Water struck at +0.55 m  
 152 mm percussion  
 February 1980

Overburden 1.2 m  
 Mineral 2.4 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, firm, very clayey passing into clay, strong brown [7.5 YR 5/8] mottled grey with small black carbonaceous mottles	1.2	1.2
River Terrace Deposits (First Terrace)	Sandy gravel, 'very clayey' in upper 0.5 m Gravel: fine with coarse; mostly subrounded to well-rounded oolitic and shelly with some crystalline limestone; with subangular to subrounded white and brown with some black flint and subrounded ironstone; with some subrounded to well-rounded quartzite and sandstone; with traces of <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mostly quartz and flint with limestone and ironstone Fines: 'very clayey' to silty	2.4	3.6
Oxford Clay	Clay, shaly, laminated, dark greyish brown [10 YR 4/2] to 4.0 m, becoming dark grey [10 YR 4/1] to base	1.4+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	57	35	1.2 - 1.7	28	18	26	12	14	2	0
			1.7 - 2.7	2	9	36	23	27	3	0
			2.7 - 3.6	2	4	15	27	41	11	0
			Mean	8	9	26	22	29	6	0

Surface level + 3.19 m (+ 10.5 ft)  
 Water struck at + 1.59 m  
 152 mm percussion  
 February 1980

Overburden 1.0 m  
 Mineral 2.6 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.8	0.8
Alluvium	Sandy silt, strong brown [7.5 YR 5/8] mottled grey, with thin sandy layers	0.2	1.0
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' in upper 0.6 m Gravel: fine with coarse; mostly subrounded irregular ironstone with angular to subangular brown and white with some black flint and well-rounded sandstone with quartzite; with subrounded oolitic and shelly limestone; traces of chalk and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mainly subangular to rounded quartz with flint and limestone Fines: strong brown [7.5 YR 5/6]	2.6	3.6
Oxford Clay	Clay, laminated, dark greyish brown to dark grey [10 YR 4/2 to 4/1]; abundant lamellibranch fragments	1.4 +	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	49	46	1.0 - 1.6	16	10	23	13	32	6	0
			1.6 - 2.6	2	5	25	21	42	5	0
			2.6 - 3.6	1	5	25	18	43	8	0
			Mean	5	6	25	18	40	6	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others	
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indigenous	Derived					Calcareous
1.0 - 3.6	24	trace	nil	11	2	31	12	nil	trace	trace	3	17	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	1.0 - 3.6	4	57	39

Surface level +3.62 m (+12.0 ft)  
 Water struck at +2.22 m  
 152 mm percussion  
 February 1980

Overburden 0.8 m  
 Mineral 3.0 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, dark brown, clayey loam	0.3	0.3
	Clay, firm, strong brown [7.5 YR 5/8] mottled grey, with small black carbonaceous mottles	0.5	0.8
River Terrace Deposits (First Terrace)	Gravel, 'very clayey' in upper 0.6 m Gravel, fine with coarse; mainly subrounded to well-rounded oolitic and shelly limestone with subangular to rounded white and brown with some black flint; with subrounded ironstone, quartzite and sandstone; traces of belemnite guards and <i>Gryphaea</i> fragments; below 3.4 m many Oxford Clay nodules Sand: medium and coarse with some fine; quartz with flint, ironstone and limestone Fines: 'very clayey' to silty	3.0	3.8
Oxford Clay	Clay, dark greyish brown [10 YR 4/2], with abundant lamellibranch shell debris along bedding planes	1.2+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	44	51	0.8 - 1.4	20	9	33	10	25	3	0
			1.4 - 2.4	2	5	22	21	43	7	0
			2.4 - 3.4	0	2	13	24	52	9	0
			3.4 - 3.8	3	2	14	23	47	11	0
			Mean	5	4	20	20	44	7	0



Surface level +1.07 m (+3.5 ft)  
 Water struck at c -1.03 m  
 152 mm percussion  
 January 1980

Overburden 2.3 m  
 Mineral 5.0 m  
 Bedrock 1.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, fibrous, friable, silty, peaty loam, dark grey to black [5 Y 4/1 to 2.5/1]	0.9	0.9
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm to soft, glutinous in parts, mottled yellowish brown [10 YR 5/6 – 5/8] with dark grey [10 YR 4/1]; with some very fine-grade colourless quartz sand, often associated with vertical root traces	1.2	2.1
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous, olive [5 Y 4/3] mottled black in parts; with abundant fine to medium-grade oolitic limestone and quartz sand, with traces of gravel towards base	0.2	2.3
(First Terrace)	<b>a</b> Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular oolitic crystalline and shelly limestone with angular to subangular white and brown with black flint; with some subrounded quartzite, sandstone and ironstone; traces of well-worn belemnite guards Sand: medium and coarse with fine; mainly subrounded oolitic and shelly limestone with ironstone and flint Fines: silty, upper 1.0m olive [5 Y 4/4], pale olive brown [2.5 Y 5/6] to base	2.0	4.3
	<b>b</b> Sand: with (?)indigenous shell fragments Gravel: rare, either of clay nodules, limestone or derived Oxford Clay shell fragments Sand: medium and fine with some coarse, progressively finer towards base; mostly subrounded to rounded quartz, with abundant (?)indigenous fragments of white thin-shelled lamellibranchs and gastropods, especially <i>Turritella ?communis</i> ; much fine to coarse-grade black carbonaceous ?woody fragments Fines: silty to ‘clayey’, light olive brown [2.5 Y 5/4] to dark greyish brown [2.5 Y 4/2]	3.0	7.3
Oxford Clay	Clay, stiff, dark grey [5 Y 4/1], calcareous, fossiliferous—including small pyritized ammonites ( <i>Kosmoceras ex gr spinosum</i> )	1.7 +	9.0

**GRADING**

	Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
	Fines	Sand	Gravel		Gravel						
					- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
<b>a</b>	2	60	38	2.3 – 3.3	3	9	27	18	40	3	0
				3.3 – 4.3	1	8	34	23	30	4	0
				Mean	1	8	31	21	35	3	0
<b>b</b>	8	91	1	4.3 – 5.3	4	25	61	8	2	0	0
				5.3 – 6.3	8	42	49	1	0	0	0
				6.3 – 7.3	13	49	37	1	0	0	0
				Mean	8	39	49	3	1	0	0
<b>a + b</b>	6	78	16	Mean	6	27	41	10	14	2	0

## COMPOSITION

Depth below surface (m) *Percentage by weight in 8 – 16 mm fraction*

	Flint		Limestone		Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta- morphic	Others		
	Angular	Rounded	Crystalline	Oolitic	Shelly		Indi- genous	Derived	Calcareous					
2.3 – 4.3	28	nil	16	20	13	3	9	trace	2	nil	3	6	trace	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 – 16	2.3 – 7.3	10	40	50

**TF 11 SE 26 1786 1308 The Poplars, Deeping St Nicholas**

**Sub-block D<sub>1</sub>**

Surface level + 1.52 m (+ 5.0 ft)  
Water struck at c – 0.38 m  
152 mm percussion  
January 1980

Overburden 1.9 m  
Mineral 2.9 m  
Bedrock 1.2 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, peaty clay, very dark greyish brown [10 YR 3/2], with much carbonised material	0.8	0.8
Barroway Drove Beds ('Buttery Clay')	Clay, glutinous, light olive brown [2.5 Y 5/4] mottled grey and black, silty at base, much root material	1.1	1.9
River Terrace Deposits (First Terrace)	Gravel with (?)indigenous shell fragments Gravel: fine with coarse; angular to well-rounded brown and white with some black flint and subrounded oolitic limestone; with some subrounded quartzite, traces of derived (?) Jurassic ammonites and abundant fragments of (?)indigenous lamellibranchs Sand: medium and coarse with some fine; mainly subangular to rounded quartz Fines: silty	2.9	4.8
Oxford Clay	Clay, firm, grey [7.5 YR N5/]	1.2+	6.0

## GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm	
3	40	57	1.9 – 2.9	5	7	23	19	41	5	0
			2.9 – 3.9	1	4	26	16	43	10	0
			3.9 – 4.8	3	3	8	17	48	21	0
			Mean	3	4	19	17	45	12	0

Surface level +2.31 m (+7.5 ft)  
 Water struck at c +0.81 m  
 152 mm percussion  
 January 1980

Overburden 1.5 m  
 Mineral 2.4 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty to sandy, clayey loam, dark greyish brown to black, calcareous, with surface scatter of gravel	0.7	0.7
?Alluvium	Clayey silt, firm, slightly glutinous in parts, predominantly grey mottled orange-brown, slightly calcareous, with very fine-grade subrounded to rounded quartz sand	0.5	1.2
River Terrace Deposits (First Terrace)	Sandy pebbly clay, soft, glutinous, yellowish brown [10 YR 5/8] mottled with iron-oxide particles; with much fine to medium-grade subrounded quartz sand with some fine to coarse flint and sandstone	0.3	1.5
	Sandy gravel, with clay (?) layer at c 3.2 m Gravel: fine with coarse; mostly subrounded and tabular oolitic and shelly limestone with angular to subangular brown and white flint—some patinated; with ironstone; with some subrounded quartzite and sandstone; traces of subrounded indurated chalk Sand: medium and coarse with fine; in coarse-grade, mainly oolitic limestone with ironstone with some flint; below 1 mm quartz dominant Fines: dark greyish brown [2.5 Y 4/2]	2.4	3.9
Oxford Clay	Clay, stiff, grey	1.1 +	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	53	43	1.5 - 2.6	4	4	25	22	39	6	0
			2.6 - 3.9	4	11	28	17	34	6	0
			Mean	4	8	26	19	37	6	0

Surface level +2.34 m (+7.5 ft)  
 Water struck at c +0.64 m  
 152 mm percussion  
 January 1980

Overburden 1.3 m  
 Mineral 3.5 m  
 Bedrock 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, clayey loam, very dark brown to dark brown [10 YR 3/2 – 3/3], with abundant flint and limestone gravel in upper layers	0.7	0.7
?Alluvium	Clay, firm to soft, slightly glutinous in places, predominantly light olive brown [2.5 Y 5/4] mottled by strong brown [7.5 Y 5/8] iron-oxide discolouration—often associated with near-vertical root traces	0.6	1.3
River Terrace Deposits (First Terrace)	Sandy gravel, upper 0.4 m 'very clayey' with clay (?) layer between c 3.4 and 3.7 m Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular white and brown flint—trace patination; with ironstone, particularly in +4 – 8 mm fraction; with some subrounded to rounded sandstone, quartzite and indurated chalk; traces of well-worn belemnite fragments Sand: medium with coarse and fine; mainly oolitic and shelly limestone with ironstone and flint; some quartz throughout Fines: 'clayey' to silty, olive brown to pale olive brown [2.5 Y 5/6 to 4/4]	3.5	4.8
Oxford Clay	Clay, stiff to firm, olive grey [5 Y 4/2], calcareous, with many cream-coloured shell fragments	1.5 +	6.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/6	+ 1/6 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
7	60	33	1.3 – 1.7	21	11	18	17	27	6	0
			1.7 – 2.7	2	7	34	20	32	5	0
			2.7 – 3.7	8	12	31	20	26	3	0
			3.7 – 4.8	4	10	36	17	30	3	0
			Mean	7	10	32	18	29	4	0

Surface level + 2.79 m (+ 9.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 January 1980

Overburden 1.4 m  
 Mineral 0.5 m  
 Waste 0.6 m  
 Mineral 0.3 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam, very dark greyish brown [10 YR 4/1], with pockets of sand; fragments of brick in upper layers	0.8	0.8
River Terrace Deposits (First Terrace)	Clayey silt to sandy pebbly clay, mainly very fine-grade quartz sand to silt in upper c 0.4 m, becoming coarse-grade sand with pebbles of angular to subangular white flint; matrix of clayey material; upper part mottled, predominantly yellowish brown [10 YR 5/8]	0.6	1.4
	<b>a</b> Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular white and brown flint—rarely patinated; with subrounded irregular ironstone, particularly in the + 4 – 8 mm fraction; with some subrounded quartzite and sandstone; traces of well-worn belemnite guards Sand: medium and coarse with fine; mainly oolitic limestone, ironstone and flint, with some quartz Fines: silty, light olive brown [2.5 Y 5/6]	0.5	1.9
	Clay, firm, greyish brown to dark greyish brown [2.5 Y 5/2 – 4/2], calcareous, with many flint and limestone pebbles	0.6	2.5
	<b>b</b> 'Clayey' sandy gravel—essentially as above	0.3	2.8
Oxford Clay	Clay, stiff, olive grey [5 Y 4/2], calcareous, abundant cream-coloured shell fragments	1.1 +	3.9

**GRADING**

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines				Gravel		
					– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16	+ 64 mm
<b>a</b>	2	52	46	1.4 – 1.9 1.9 – 2.5	2	8	27	17	41	5	0
<b>b</b>	13	53	34	2.5 – 2.8	13	8	29	16	30	4	0
<b>a + b</b>	6	51	43	Mean	6	8	27	16	38	5	0

Surface level + 1.10 m (+ 3.5 ft)  
 Water struck at - 1.10 m  
 152 mm percussion  
 January 1980

Overburden 2.2 m  
 Mineral 2.9 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
(?)Nordelph Peat	Soil, peaty, clayey loam, very dark greyish brown [2.5 Y 3/2], with some sand and gravel	0.7	0.7
	Peat, fibrous, friable, mixed in part with above	0.2	0.9
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic below c 1.2 m; in upper c 0.3 m predominantly brown [10 YR 3/3] mottled grey, below c 1.2 m predominantly dark grey to very dark grey [2.5 Y N4/ to N3/]; slightly silty, becoming sandy towards base	0.9	1.8
River Terrace Deposits (Crowland Bed)	Sandy clay, firm to soft, glutinous in parts, highly mottled with olive-grey, grey and olive-brown; with some fine to coarse sand and traces of gravel	0.4	2.2
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular black, brown and grey flint; with subrounded irregular ironstone; with some subrounded to rounded quartzite and sandstone; traces of well-worn belemnite guards and <i>Gryphaea</i> shells with some indurated chalk clasts Sand: medium and coarse with some fine; mainly subrounded to rounded oolitic and shelly limestone with ironstone and brown and white flint in coarse-grade; below 2 mm fraction, quartz common Fines: silty, olive [5 Y 4/3]	2.9	5.1
Oxford Clay	Clay, firm to stiff, dark grey [5 Y 4/1], calcareous	1.0+	6.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	55	43	2.2 - 3.4	2	4	31	16	39	8	0
			3.4 - 5.1	2	3	30	25	35	5	0
			Mean	2	3	30	22	37	6	0

Surface level + 1.56 m (+ 5.0 ft)  
 Water struck at - 0.94 m  
 152 mm percussion  
 January 1980

Overburden 2.5 m  
 Mineral 1.2 m  
 Bedrock 1.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mainly sand and gravel ballast	1.1	1.1
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, pale yellow to yellow [2.5 Y 7/2 - 7/4] in upper 0.3 m, becoming olive [5 Y 5/3] slightly mottled with dark grey to black associated with root traces, below 1.4 m calcareous, slightly silty and micaceous	0.9	2.0
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, extremely glutinous, becoming slurried, olive [5 Y 4/3], slightly calcareous with much fine to medium subrounded quartz sand, subrounded to subangular limestone and flint gravel	0.5	2.5
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded and tabular oolitic and shelly limestone with subrounded irregular ironstone and subangular to angular white, brown and grey flint; with some quartzite, sandstone and vein-quartz; traces of well-worn belemnite guards, <i>Gryphaea</i> shells and indurated subrounded chalk Sand: medium and coarse with fine; mostly oolitic and shelly limestone with ironstone and flint; quartz common below 2 mm fraction Fines: silty, olive brown [2.5 Y 4/4]	1.2	3.7
Oxford Clay	Clay, pebbly in upper 0.1 m, stiff, grey [5 Y 5/1], calcareous	1.7 +	5.4

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	56	41	2.5 - 3.7	3	9	32	15	37	4	0

Surface level + 1.11 m (+ 3.5 ft)  
 Water struck at -0.69 m  
 152 mm percussion  
 January 1980

Overburden 1.8 m  
 Mineral c 4.2 m  
 Bedrock c 1.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
(?)Nordelph Peat	Soil, peaty clayey loam, black [5 Y 2.5/2]; slightly calcareous; with some sand and gravel, traces of wheat chaff	1.3	1.3
Barroway Drove Beds ('Buttery Clay')	Clay, firm to soft, glutinous in parts, dark olive grey [5 Y 3/2] mottled orange-brown around root traces, with much very fine-grade quartz sand to silt	0.2	1.5
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, glutinous, slightly thixotropic olive [5 Y 4/3] mottled grey and orange-brown, with much fine to medium-grade sand of oolitic and shelly limestone and quartz; sand becomes coarser towards base with some gravel	0.3	1.8
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular white, brown and grey flint—some patinated; with subrounded irregular ironstone; with some subrounded to rounded quartzite, sandstone and vein-quartz; with traces of well-worn belemnite guards, <i>Gryphaea</i> shells and indurated chalk Sand: medium and coarse with fine; mostly subrounded oolitic and shelly limestone with ironstone and subangular to angular flint; quartz common below 2 mm fraction Fines: silty, olive brown [2.5 Y 4/4]	c 4.2	c 6.0
Oxford Clay	Clay, stiff, dark grey to olive grey [5 Y 4/1 to 4/2], calcareous, traces of shell fragments and part of a (?)crinoid columnal	cm, 1.5 +	7.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	53	43	1.8 - 2.9	2	7	28	20	37	6	0
			2.9 - 3.9	1	5	26	19	41	8	0
			3.9 - 5.0	2	9	39	16	31	3	0
			5.0 - 6.0	12	4	19	17	42	6	0
			Mean	4	6	29	18	37	6	0



Surface level + 1.52 m (+ 5.0 ft)  
 Water struck at - 0.38 m  
 152 mm percussion  
 February 1980

Overburden 1.8 m  
 Mineral 2.0 m  
 Bedrock 0.9 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, fibrous, peaty loam, very dark brown [10 YR 2/2]	0.7	0.7
	Peat, fibrous, very dark brown [10 YR 2/2], with some grey silt laminae near base	1.1	1.8
River Terrace Deposits (First Terrace)	Sandy gravel, with iron-oxide cemented conglomerate between 2.5 and 2.6 m Gravel: fine with some coarse; subrounded to rounded sandstone with oolitic and shelly limestone and angular to subangular brown and white with some black flint; with some quartzite and ironstone; traces of layered siltstone and derived Oxford Clay fossil fragments Sand: medium and coarse with fine; subangular to rounded quartz, flint and limestone with some ironstone Fines: silty, strong brown [7.5 YR 5/6]	2.0	3.8
Oxford Clay	Clay, laminated, dark grey [10 YR 4/1]	0.9+	4.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	57	40	1.8 - 2.8	3	7	27	18	42	3	0
			2.8 - 3.8	3	8	37	18	31	3	0
			Mean	3	8	31	18	37	3	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic			Shelly	Indigenous					Derived	Calcareous
1.8 - 3.8	24	trace	trace	15	3	5	9	nil	trace	trace	7	37	nil	nil

83 Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	1.8 - 3.8	5	64	31

Surface level + 2.28 m (+ 7.5 ft)  
 Water struck at + 0.48 m  
 152 mm percussion  
 January 1980

Overburden 1.7 m  
 Mineral 3.1 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Made ground, mixture of brown, peaty loam with brick fragments	1.4	1.4
River Terrace Deposits (Crowland Bed)	Sandy, pebbly clay, soft, glutinous, strong brown [7.5 YR 4/6], with dark orange-brown iron-oxide mottles, calcareous; with abundant fine to coarse oolitic and quartz sand; with some oolitic and shelly limestone with flint gravel	0.3	1.7
(First Terrace)	Sandy gravel, sandy in upper 1.1 m Gravel: fine with some coarse; mostly subrounded oolitic and shelly limestone with angular to subangular brown and white flint—some patinated; with some subrounded ironstone, sandstone and quartzite; traces of well-worn belemnite guards and <i>Gryphaea</i> fragments; rare subrounded chalk clasts and iron-oxide cemented concretions Sand: mainly medium with coarse and fine; in upper 1.1 m mostly subrounded to rounded quartz; below c 2.8 m mainly subrounded to rounded oolitic and shelly limestone with ironstone and subangular to angular flint in coarse-grade; quartz more common below 2mm fraction; traces of chalk below c 2.8 m Fines: silty, strong brown [7.5 YR 4/6] above c 2.5 m becoming olive brown [2.5 Y 5/4] to base	3.1	4.8
Oxford Clay	Clay, stiff, olive grey [5 Y 4/2], slightly silty, calcareous	1.1 +	5.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	63	33	1.7 - 2.8	6	10	64	10	10	0	0
			2.8 - 3.8	1	4	28	24	40	3	0
			3.8 - 4.8	4	5	25	17	42	7	0
			Mean	4	6	41	16	30	3	0

Surface level + 1.71 (+ 5.5 ft)  
 Water struck at - 1.59 m  
 152 mm percussion  
 October 1979

Overburden 3.7 m  
 Mineral 1.7 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, slightly peaty loam, brown, with some flint pebbles and barley chaff	0.9	0.9
Barroway Drove Beds ('Buttery Clay')	Clay, soft to firm in upper 0.1 m becoming soft and glutinous to base; layers of orange-red with pale grey and brown becoming predominantly very dark grey [5 Y 3/1]; with traces of a peaty (?) layer in upper 0.1 m; with carbonaceous wood fragments below 1.0 m; thixotropic in parts	1.9	2.8
Lower Peat	Peat, friable, dark grey to black, much organic matter with plant stems	0.2	3.0
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, predominantly grey; peaty fragments throughout	0.7	3.7
(First Terrace)	Gravel, 'clayey' in lower 0.5 m Gravel: fine with coarse; mainly subrounded to rounded oolitic and shelly limestone and sandstone (mainly calcareous) with angular to subangular white and brown with some black flint; with subrounded irregular ironstone; traces of subrounded to round chalk and well-worn belemnite guards and <i>Gryphaea</i> shells Sand: coarse and medium with some fine; mainly oolitic and shelly limestone with ironstone and some flint; quartz common below 2 mm fraction Fines: pale greyish brown	1.7	5.4
Oxford Clay	Clay, indurated; upper c 0.2 m khaki-brown becomes dark grey to base; pebbles in upper part; calcareous	0.5 +	5.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	45	49	3.7 - 4.9	3	3	21	23	43	7	0
			4.9 - 5.4	14	4	19	20	38	5	0
			Mean	6	3	20	22	43	6	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic			Shelly	Indigenous					Derived	Calcareous
3.7 - 5.4	19	trace	nil	19	10	14	17	nil	1	trace	3	17	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	3.7 - 5.4	10	38	52

Surface level + 2.12 m (+ 7.0 ft)  
 Water struck at - 1.38 m  
 152 mm percussion  
 January 1980

Overburden 3.5 m  
 Mineral 2.6 m  
 Bedrock 1.0 m+

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, clayey, peaty loam, black to very dark brown [10 YR 2/1 to 2/2], mixed in part with brick fragments	1.1	1.1
Barroway Drove Beds (?Roddon)	Silty, clay, soft, slightly glutinous in upper 1.0 m becoming glutinous to base; fawnish brown becoming brown [10 YR 4/3], below 2.1 m becomes very dark grey [2.5 Y N3/]; micaceous in upper c0.5 m, with some black carbonaceous material below 2.1 m	2.3	3.4
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft, glutinous, mottled olive brown with dark grey to black, slightly calcareous, 'rank' smelling, with much fine to medium-grade sand—mainly quartz, with some flint gravel	0.1	3.5
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly subrounded and tabular oolitic and shelly limestone with angular to subangular brown and white flint—rarely patinated; with subrounded irregular ironstone, quartzite and sandstone; traces of subrounded, indurated chalk with well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium with coarse and fine; mostly subrounded oolitic and shelly limestone with ironstone and angular to subangular brown and white flint; with some indurated chalk; below 2 mm fraction, quartz common Fines: silty, with occasional clay nodules, dark greyish brown [2.5 Y 4/2] in upper 1.0 m becoming olive brown [2.5 Y 4/4] to base	2.6	6.1
Oxford Clay	Clay, firm to stiff, very dark grey [5 Y 3/1], slightly silty, calcareous	1.0+	7.1

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	51	45	3.5 - 4.5	7	5	27	15	36	10	0
			4.5 - 5.5	2	4	29	19	42	4	0
			5.5 - 6.1	2	7	32	19	32	8	0
			Mean	4	5	29	17	38	7	0

Surface level + 1.22 m (+ 4.0 ft)  
 Water struck at - 1.58 m  
 152 mm percussion  
 February 1980

Overburden 2.5 m  
 Mineral 1.1 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.2	0.2
Nordelph Peat	Peat, fibrous, very dark brown [10 YR 2/2] with intercalations of dark grey [10 YR 4/] silt mottled brown	0.8	1.0
Barroway Drove Beds ('Buttery Clay')	Clay, glutinous, grey [10 YR 5/1], with some peaty layers and silt to fine sand laminae	1.5	2.5
River Terrace Deposits (First Terrace)	Gravel Gravel: fine with coarse; mostly subrounded to well-rounded oolitic with shelly and crystalline limestone; with subangular to subrounded brown and white with some black flint; with some subrounded to well-rounded quartzite and sandstone Sand: coarse and medium with some fine; subangular to rounded quartz, flint and limestone with some ironstone Fines: silty, strong brown [7.5 YR 5/6]	1.1	3.6
Oxford Clay	Clay, firm, grey [2.5 Y N6/], with traces of laminations	1.4+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	40	57	2.5 - 3.6	3	4	16	20	42	15	0

Surface level + 1.37 m (+ 4.5 ft)  
 Water struck at - 0.53 m  
 152 mm percussion  
 September 1979

Overburden 1.9 m  
 Mineral 1.3 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, friable, dark brown, peaty loam	0.4	0.4
	Peat, friable, brown, with some nodules of soft, glutinous clay	0.2	0.6
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm becoming soft, predominantly fawnish grey mottled throughout with orange to orange-red especially associated with dendritic networks of plant rootlets, micaceous throughout; below 1.6 m with black carbonaceous material; root network often associated with ‘clean’ fine-grade quartz sand	1.2	1.8
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous, khaki green mottled with grey, black and orange-yellow, with fine to medium-grade sand and pebbles of angular to subangular black flint, sandstone and oolitic limestone; ‘rank’ odour	0.1	1.9
(First Terrace)	Sandy gravel, with iron-oxide-cemented concretions Gravel: fine with coarse; mainly subrounded to rounded, tabular, oolitic and shelly limestone with angular to subangular brown and white with some black flint; with subrounded to rounded limestone, sandstone and quartzite; with traces of well-worn belemnite guards and <i>Gryphaea</i> shells; with some indurated (?) silicified chalk clasts; rare bored clasts Sand: medium and coarse with some fine; mainly subrounded to rounded, oolitic and shelly limestone with ironstone and flint; with some derived Oxford Clay shell fragments; below 2 mm fraction, quartz common Fines: silty, pale brown	1.3	3.2
Oxford Clay	Clay, indurated, pale khaki-brown mottled orange in upper 0.1 m, becoming pale greenish grey to bluish-grey, calcareous, traces of belemnite guards and ammonite impressions	1.3+	4.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	52	45	1.9 - 3.2	3	4	27	21	39	6	0

Surface level + 1.42 m (+ 4.5 ft)  
 Water struck at - 0.48 m  
 152 mm percussion  
 September 1979

Overburden 1.8 m  
 Mineral 1.2 m  
 Bedrock 2.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, greyish brown peaty loam; fragments of brick and stone in upper part	1.2	1.2
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm becoming soft and glutinous; pale greyish fawn slightly mottled orange-brown in association with root traces, becomes predominantly grey near base; thixotropic and calcareous with black carbonaceous fragments	0.2	1.4
Lower Peat	Peat, dark brown to black, with clayey pockets and iron-oxide ‘stained’ layers	0.1	1.5
River Terrace Deposits (Crowland Bed)	Sandy clay, khaki-brown mottled with grey and brown, calcareous, with fine to medium-grade oolitic limestone and flint sand, with traces of coarse gravel	0.3	1.8
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded, tabular oolitic and shelly limestone with angular to subangular grey and white with some brown flint—some patinated; with subrounded to rounded ironstone, sandstone and quartzite; with traces of indurated (?)chalk; rare (?)igneous clasts and worm casts of (?) <i>Spirorbis</i> Sand: medium and coarse with some fine; mainly oolitic limestone with ironstone with some flint; with traces of well-worn Oxford Clay shell fragments Fines: silty, pale greyish brown	1.2	3.0
Oxford Clay	Clay, firm to indurated, pale khaki-brown in upper 0.1 m becoming predominantly greenish grey to bluish grey, calcareous	2.0+	5.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	55	38	1.8 - 3.0	7	4	28	23	34	4	0

Surface level + 1.32 m (+ 4.5 ft)  
 Water struck at - 0.28 m  
 152 mm percussion  
 January 1980

Overburden 1.1 m  
 Mineral c 2.5 m  
 Bedrock c 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, silty loam, dark grey to dark greyish brown	0.4	0.4
Barroway Drove Beds (?Roddon)	Silt, friable, yellowish brown [10 YR 5/6]; slightly micaceous; calcareous	0.6	1.0
?River Terrace Deposits (?Crowland Bed)	Clay, soft to firm, glutinous in parts, yellowish brown [10 YR 5/8] mottled with pale grey, slightly micaceous, sandy at base	0.1	1.1
(First Terrace)	Sandy gravel, 'very clayey' in upper 0.5 m, (?)indigenous shells and sandy in lower 1.0 m Gravel: fine with some coarse, rare cobbles; mainly subrounded tabular oolitic and shelly limestone with subangular to angular brown and white flint with some subrounded ironstone, quartzite and sandstone; with traces of well-worn belemnite guards and <i>Gryphaea</i> shell fragments; below 2.6 m with abundant (?)indigenous lamellibranch shells including <i>Macoma ? balthica</i> , ? <i>Carastoderma</i> and gastropods—mainly <i>Turritella communis</i> , with rare fragments of balanid plates and unidentified pyritised worm 'tubes' Sand: medium with fine and coarse; mostly angular to subangular flint and ironstone with oolitic limestone; below 2 mm fraction, quartz common; below 2.6 m quartz and shell fragments in equal proportions Fines: 'very clayey' to silty, yellowish brown [10 Y 5/8] to 2.6 m becoming dark greyish brown [10 YR 4/2]	c 2.5	c 3.6
Oxford Clay	Clay, firm to stiff, dark grey [2.5 Y N4/], calcareous	c 1.3	4.9

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
9	67	24	1.1 - 1.6	24	10	23	12	29	2	0
			1.6 - 2.6	2	6	32	24	32	4	0
			2.6 - 3.6	7	39	33	12	7	2	0
			Mean	9	21	30	16	21	3	0



Surface level + 1.97 m (+ 6.5 ft)  
 Water struck at - 4.73 m  
 152 mm percussion  
 November 1979

Waste 12.1 m  
 Bedrock 0.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty loam, dark grey to greyish brown, mottled yellowish brown, with some brick fragments and root traces	0.5	0.5
Terrington Beds (Roddon)	Silt, firm to soft, becomes thixotropic below 2.3 m; upper c 1.5 m brown mottled with orange iron-oxide, pale yellow and grey, slightly thixotropic and micaceous; below 2.5 m to base becomes very dark greyish brown [2.5 Y 3/2], calcareous and micaceous; below 3.0 m with abundant lamellibranchs including <i>Cerastoderma edule</i> , <i>Macoma balthica</i> and the gastropod <i>Hydrobia ulvea</i> , with some pholadacean and balanid fragments; below 3.0 m with very black carbonaceous woody fragments, at c 6.0 m becomes peaty	5.8	6.3
Lower Peat	Peat, predominantly woody fragments, dark brown, 'rank' odour	0.4	6.7
River Terrace Deposit (Crowland Bed)	Sandy clay, soft, glutinous, pale greenish grey partially mottled by dark brown, becomes olive-green towards base, slightly calcareous, many root and wood fragments	1.2	7.9
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded to rounded tabular oolitic and shelly limestone with ironstone and subangular to angular brown and white flint; with some subrounded to rounded quartzite and sandstone; with traces of subrounded chalk Sand: medium with coarse and fine; mostly subrounded to rounded oolitic and shelly limestones with ironstone and angular to subangular brown flint; traces of well-worn Oxford Clay (?) scaphopod fragments; below 2 mm fraction, mainly subrounded to rounded quartz Fines: silty, olive-green to greyish brown	1.4	9.3
Boulder Clay	Clay, stiff, grey slightly mottled greenish grey, with abundant subrounded to rounded chalk clasts, with some gravel	2.8	12.1
Oxford Clay	Clay, stiff, greenish grey, slightly silty, traces of pyrite	0.4+	12.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	70	25	7.9-9.3	5	14	34	22	24	1	0

Surface level + 1.75 m (+ 6.0 ft)  
 Water struck at -0.35 m  
 152 mm percussion  
 November 1979

Waste 9.9 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mainly sand and gravel ballast with brick rubble	0.6	0.6
Terrington Beds (Roddon)	Silt; in upper 1.5 m—soft, friable, predominantly yellowish brown mottled orange, with intercalations of pale grey-buff, slightly micaceous and calcareous; below 2.1 m becomes glutinous, thixotropic and greyish brown; below 4.9 m with traces of thin-shelled lamellibranchs and woody fragments; below 5.1 m with many reed stems and peaty material with associated 'rank' odour	5.1	5.7
Lower Peat	Peat, fibrous, friable, brown, with much pale yellow woody material	0.4	6.1
(?)Lower Peat	Clay, soft to firm, dark brown, with much finely disseminated organic material, traces of root fragments	0.5	6.6
Boulder Clay	Clay, stiff; mottled khaki-olive with pale grey in upper part becoming predominantly grey to base; with abundant subrounded to subangular chalk clasts; with some gravel up to cobble-grade of subangular to subrounded black and grey flint, crystalline limestone and sandstone; with occasional pockets of glutinous sandy clay—sand of medium to coarse-grade (?)quartz	3.3	9.9
Oxford Clay	Clay, stiff, slightly friable, greenish grey, calcareous	0.5+	10.4

Surface level + 1.62 m (+ 5.0 ft)  
 Water struck at - 4.58 m  
 152 mm percussion  
 October 1979

Overburden 6.2 m  
 Mineral 2.3 m  
 Waste 0.1 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown to greyish brown silty loam, calcareous, root fragments common	0.6	0.6
Barroway Drove Beds (Roddon)	Silt, firm in upper 0.1 m becoming friable below 0.7 m, predominantly yellowish brown [10 YR 5/4 to 5/8] to brown [10 YR 4/3], micaceous	1.4	2.0
Barroway Drove Beds ('Buttery Clay')	Clay, soft glutinous, thixotropic, greyish brown [2.5 Y 5/2] with orange mottles becoming dark grey [2.5 Y N4/] below 1.8 m, with traces of fragile fragments and black carbonaceous material	c 3.9	c 5.9
(?) Lower Peat	Peaty clay, only fragments of organic material recovered	trace	c 5.9
River Terrace Deposits (Crowland Bed)	Clay, firm, mottled khaki with pale grey and greenish grey, becomes sandy and pebbly below 6.1 to base	c 0.3	6.2
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly rounded to subrounded tabular oolitic and shelly limestone with angular to subangular brown and white flint; with some subrounded ironstone, quartzite and sandstone; with traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium and coarse with fine; mainly oolitic and shelly limestone with ironstone; with some flint and quartz; quartz common below 2 mm fraction Fines: silty	2.3	8.5
(?) Boulder Clay	Clay, predominantly greenish grey slightly mottled orange-brown, with subrounded chalk clasts and subangular to angular flint gravel, with traces of lamellibranch shells	0.1	8.6
Oxford Clay	Clay, firm to stiff, grey mottled khaki becoming predominantly grey to base, calcareous, with occasional siltstone pellets, fossiliferous in upper part including <i>Gryphaea</i>	1.0 +	9.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	54	42	6.2 - 7.2	5	7	20	21	40	7	0
			7.2 - 8.5	4	7	27	26	33	3	0
			Mean	4	7	24	23	37	5	0

Surface level + 1.80 m (+ 6.0 ft)  
 Water struck at - 2.60 m  
 152 mm percussion  
 October 1979

Waste 7.3 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown loam, with occasional subrounded to rounded pebbles and brick fragments	1.4	1.4
Barroway Drove Beds ('Buttery Clay')	Clay, fine, soft and glutinous towards base, predominantly grey mottled with dark orange mainly in association with root fragments; with dark brown to black peaty layers near base; with black carbonaceous fragments throughout	3.0	4.4
River Terrace Deposits (Crowland Bed)	Sandy clay, very poor recovery, dark grey; much fine to medium-grade sand with traces of angular to subangular gravel	0.6	5.0
(First Terrace)	'Clayey' pebbly sand Gravel: fine with some coarse; mainly subrounded tabular oolitic and shelly limestone with angular, grey and brown flint—trace patination; with some vein-quartz and sandstone Sand: medium with fine and coarse; mainly subrounded oolitic limestone and ironstone with quartz Fines: grey	0.4	5.4
Boulder Clay	Clay, indurated to stiff, grey, with many subrounded to rounded clasts	1.9	7.3
Oxford Clay	Clay, stiff to indurated, grey, with some pyrite nodules, calcareous	0.7+	8.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
12	59	29	5.0 - 5.4	12	16	29	14	27	2	0

Surface level + 1.09 m (+ 3.5 ft)  
 Water struck at - 2.51 m  
 152 mm percussion  
 October 1979

Overburden 3.8 m  
 Mineral 1.6 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown peaty laom	0.7	0.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, generally soft and glutinous; upper 1.1 m mottled pale grey with brown and orange-brown, often associated with root fragments; below 1.6 m becomes predominantly dark grey [2.5 Y N4/]; thixotropic; with soft black carbonaceous particles throughout; at c 2.6 m large fragments of red-coloured wood (? <i>Yew</i> ) recorded with some peaty material	2.8	3.5
Lower Peat	Peat, friable, dark reddish brown to black, with intercalations of clay and ‘raffia-like’ reed material with associated ‘rank’ odour	0.1	3.6
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous, dark grey, much mottled by khaki below 3.7 m; with reed material in upper 0.1 m; below 3.7 m with abundant sand and traces of flint and limestone gravel	0.2	3.8
(First Terrace)	Sandy gravel with traces of gravel concretions and (?)indigenous infilled worm burrows and shell fragments Gravel: fine with some coarse, rare cobble; mainly subrounded to rounded and tabular oolitic and shelly limestone with angular to subangular grey and black with some brown flint—some patinated; with some subrounded irregular ironstone and quartzite with sandstone; traces of indurated chalk clasts and well-worn derived Oxford Clay shell fragments; with rare clusters of infilled worm burrows in a calcareous matrix Sand: medium and coarse with some fine; mostly subrounded to rounded oolitic and shelly limestone with ironstone and brown flint; below 2 mm fraction mostly subrounded to rounded quartz with ironstone; with abundant white, thin-shelled (?)indigenous ? lamellibranch fragments throughout Fines: silty, grey becoming brown in lower 0.4 m to base	1.6	5.4
Oxford Clay	Clay, stiff, pale khaki-brown becoming grey at depth, calcareous	0.6 +	6.0

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	61	35	3.8 - 5.4	4	4	36	21	32	3	0

Surface level + 2.40 m (+ 8.0 ft)  
 Water struck at - 0.30 m and - 5.30 m  
 152 mm percussion  
 November 1979

Overburden 7.9 m  
 Mineral 3.7 m  
 Waste 3.0 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown silty loam, becoming very silty towards base	0.4	0.4
Terrington Beds (Roddon)	Silt; in upper 2.3 m—dry, friable, predominantly yellowish brown [10 YR 5/6] mottled grey and dark greyish brown, micaceous; below 2.7 m becomes soft, glutinous, thixotropic, very dark grey [5 Y 3/1]; with abundant shell fragments of unidentified gastropods and lamellibranchs including <i>Cerastoderma edule</i> and <i>Macoma balthica</i> ; with some black carbonaceous fragments and white indurated siltstone pellets	3.6	4.0
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, grey, with much soft black carbonaceous material	c 2.2	c 6.2
Lower Peat ('upper leaf')	Peat, brown, with much woody material; 'rank' odour	c 0.1	6.3
Barroway Drove Beds ('Buttery Clay')	Clay, as above	0.5	6.8
Lower Peat ('lower leaf')	Peat, dark brown, with dark reddish brown woody fragments; 'rank' odour	c 0.6	c 7.4
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous, pale grey, slightly calcareous, with some 'raffia-like' reed fragments in upper 0.3 m; with some fine to medium subrounded to rounded quartz sand throughout	c 0.5	7.9
(First Terrace)	Sandy gravel, with some gravel concretions Gravel: fine with some coarse; mainly subrounded to rounded tabular oolitic and shelly limestone, with angular to subangular grey, black with some brown flint—trace patination; with some subrounded irregular ironstone, quartzite, vein-quartz and sandstone Sand: medium and coarse with fine; mostly oolitic and shelly limestone with ironstone and flint; below 2 mm fraction quartz common Fines: silty, greyish brown	3.7	11.6
Boulder Clay	Clay, soft to firm in upper c 0.1 m, sandy, grey mottled khaki, below c 11.7 m becomes stiff, predominantly grey; with abundant subrounded to rounded indurated chalk clasts	3.0	14.6
Oxford Clay	Clay, stiff, dark olive grey [5 Y 3/2], calcareous	0.5 +	15.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
3	63	34	7.9 - 8.9	2	5	26	30	35	2	0	
			8.9 - 9.9	4	7	32	28	27	2	0	
			9.9 - 11.6	3	7	33	22	30	5	0	
			Mean	3	6	31	26	31	3	0	

Surface level +2.57 m (+8.5 ft)  
 Water struck at +0.07 m  
 152 mm percussion  
 October 1979

Overburden 5.7 m  
 Mineral 6.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, pale brown, with rare brick fragments	0.4	0.4
Terrington Beds (Roddon)	Silt, friable to soft and clayey, yellowish brown to brown [10 YR 5/4 to 5/3]; below 2.5 m becomes predominantly grey, thixotropic, glutinous and micaceous; with many thin-shelled lamellibranch fragments throughout; below 3.0 m black carbonaceous particles common	5.3	5.7
River Terrace Deposits (First Terrace)	<p>Pebbly sand, 'clayey' in upper 1.0 m, mostly sand between 6.7 and 11.7 m, with abundant (?) indigenous shell fragments between 5.7 and c 8.7 m</p> <p>Gravel: some only; fine with trace coarse; mostly subrounded tabular, oolitic and shelly limestone with angular to subangular brown and white with some black flint—some patinated; with some ironstone, quartzite and sandstone; with abundant (?) indigenous molluscs including gastropods—<i>Gibulla cinararia</i> and <i>Hydrobia ulvae</i>, lamellibranchs—<i>Cerastoderma edule</i>, <i>Macoma balthica</i> and <i>Mytilus edulis</i>; and some pholadacean fragments.</p> <p>Sand: predominantly fine with medium and coarse; in coarse-grade mainly oolitic and shelly limestone with ironstone, flint and shell fragments; below 2 mm fraction mainly subrounded to rounded quartz with broken shells and abundant soft, black, carbonaceous wood fragments</p> <p>Fines: greyish brown</p> <p>Borehole abandoned due to rising sediment</p>	6.0+	11.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
9	86	5	5.7 - 6.7	17	51	12	9	10	1	0
			6.7 - 8.7	7	80	8	3	2	0	0
			8.7 - 11.7	8	77	8	2	3	2	0
			Mean	9	75	8	5	4	1	0

Surface level + 3.02 m (+ 10.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 October 1979

Waste 12 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground: indurated dark greyish brown clay with many brick fragments and some gravel	1.3	1.3
Terrington Beds (Roddon)	Silt, friable, layered, predominantly dark brown [10 YR 4/3] with laminae up to 2 mm thick of pale greyish brown to buff-brown, slightly micaceous	2.9	4.2
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, thixotropic, dark grey to grey, with very fine sand-grade white (?) shell fragments throughout	3.8	8.0
River Terrace Deposits (?Crowland Bed between 8.0 – c 9.0, First Terrace from c 9.0 – 10.4 m)	'Clayey' sandy gravel, 'very clayey' in upper 1.0 m, abundant (?) indigenous shell fragments Gravel: fine with some coarse; mainly subrounded, tabular oolitic and shelly limestone with angular to subangular brown and white flint; with some subrounded, irregular ironstone, quartzite and sandstone, rare rounded to subrounded chalk clasts; with (?) indigenous molluscs including the gastropod <i>Buccinum undatum</i> and lamellibranchs <i>Cerastoderma edule</i> and <i>Macoma balthica</i> , with some pholadacean fragments, rare decapod chlae; some bored shells and traces of well-worn Oxford Clay belemnite guards Sand: fine and coarse with medium; in coarse-grade mainly subrounded to rounded, oolitic limestone with ironstone, and angular to subangular flint and shell fragments; below 2 mm fraction, quartz common Fines: greyish brown to brown, with soft dark grey carbonaceous clay layer at base	2.4	10.4
Boulder Clay	Clay, firm to stiff, dark grey, calcareous, with many subrounded to rounded chalk clasts, with traces of flint and sandstone	1.6	12.0
Oxford Clay	Clay, firm to stiff, calcareous; with traces of shell fragments—particularly belemnite guards; 'gritty' due to small disseminated selenite crystals	0.5 +	12.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/6	+ 1/6 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
19	55	26	8.0 – 9.0	20	37	12	16	14	1	0
			9.0 – 10.4	18	10	10	26	29	7	0
			Mean	19	22	11	22	22	4	0



Surface level + 2.19 m (+ 7.0 ft)  
 Water strike at - 4.01 m  
 152 mm percussion  
 October 1979

Waste 10.3 m  
 Bedrock 0.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown loam, with roots and some brick fragments; becomes progressively silty and micaceous	0.6	0.6
Terrington Beds (Roddon)	Silt, firm, friable, orange-brown, calcareous, micaceous	1.9	2.5
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, thixotropic, grey streaked with black carbonaceous material, slightly micaceous	1.8	4.3
Lower Peat ('upper leaf')	Peat: black to brown, organic matter with much woody material, intermixed with clay as above, containing thin-shelled lamellibranch fragments	0.4	4.7
Barroway Drove Beds ('Buttery Clay')	Silt, soft to firm, thixotropic, orange-brown to pale brown mottled grey, micaceous	1.4	6.1
Lower Peat	Peat, silty, black, with much woody material	0.1	6.2
River Terrace Deposits (Crowland Bed)	Sandy clay, glutinous, grey, slightly mottled yellowish brown, with traces of fine-grade angular to subrounded limestone and flint gravel, calcareous	0.1	6.3
(First Terrace)	Gravel, with traces of (?)indigenous shell fragments Gravel: fine with coarse; mainly subrounded tabular oolitic and shelly limestone with angular to subangular brown and grey flint—cavernous and rarely patinated; with some subrounded, irregular ironstone; traces of well-worn Oxford Clay belemnite guards and <i>Gryphaea</i> shells; with traces of (?)indigenous lamellibranchs—? <i>Cerastoderma edule</i> Sand: medium and coarse with some fine; mostly subrounded to rounded, oolitic and shelly limestone with ironstone and brown subangular flint; below 2 mm fraction, quartz common with many white shell fragments Fines: silty, grey	1.4	7.7
Boulder Clay	Clay, stiff, brownish grey in upper 0.1 m becoming grey, with abundant chalk clasts and gravel of angular to subangular flint and sandstone	2.6	10.3
Oxford Clay	Clay, stiff, greenish grey, calcareous	0.3+	10.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	47	49	6.3 - 7.7	4	4	22	21	43	6	0

Surface level + 1.59 m (+ 5.0 ft)  
 Water struck at - 3.11 m  
 152 mm percussion  
 October 1979

Waste 7.0 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, stiff, greyish brown, many rootlets	1.6	1.6
Terrington Beds	Silt, soft to firm, generally brown, micaceous in part, calcareous	0.2	1.8
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, grey to dark grey, with black carbonaceous material	2.1	3.9
Lower Peat (‘upper leaf’)	Peat, friable, brown to black	0.1	4.0
Barroway Drove Beds (‘Buttery Clay’)	Clay—as above, with many seed fragments and associated ‘rank’ odour	0.3	4.3
Lower Peat (‘lower leaf’)	Peat, friable, much organic matter with bark fragments	0.4	4.7
River Terrace Deposits (Crowland Bed)	Sandy gravel, firm to glutinous, dark grey, with much fine-grade quartz sand and traces of angular to subangular flint and limestone	0.6	5.3
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded tabular oolitic and shelly limestone with angular to subangular brown, white and rare grey flint; with some ironstone, quartzite and vein-quartz; with traces of subrounded, indurated chalk clasts with well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine; in coarse-grade, mostly subrounded oolitic and shelly limestone and ironstone with some brown angular flint; below 2 mm fraction quartz common Fines: slightly silty, greyish brown	1.1	6.4
Boulder Clay	Clay, stiff, upper 0.2 m mottled greyish brown with brown, becomes bluish-grey below 6.6 m; with subrounded to rounded chalk clasts and traces of flint and limestone gravel	0.6	7.0
Oxford Clay	Clay, stiff, grey slightly mottled pale brown, calcareous, slightly silty, with patches of selenite crystals, tracks of shell fragments	1.0+	8.0

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	56	42	5.3 - 6.4	2	4	32	20	37	5	0

Surface level + 1.35 m (+ 4.5 ft)  
 Water struck at - 5.45 m  
 152 mm percussion  
 October 1979

Overburden c 7.3 m  
 Mineral c 2.7 m  
 Waste 3.0 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to stiff, dark greyish, brown clayey loam, slightly calcareous, with some sand and gravel	0.5	0.5
Barroway Drove Beds ('Buttery Clay')	Clay, firm in upper 0.8 m becoming soft and glutinous, upper part mottled orange-brown with buff, slightly micaceous and calcareous; below 1.3 m predominantly grey with orange-brown mottles associated with root networks—often with a 'rank' odour; occasional brown mudstone pellets and black carbonaceous woody fragments	5.4	5.9
Lower Peat	Peat, friable, dark brown, many wood fragments, some intermixing with clay near base	c 0.7	c 6.6
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, predominantly grey mottled orange-brown, very sandy; below 6.8 m with traces of fine-grade gravel of rounded to subrounded limestone	c 0.7	c 7.3
(First Terrace)	Sandy gravel, 'clayey' in lower 0.7 m Gravel: fine with some coarse, trace cobble in lower 0.7 m—mainly chalk; mainly rounded to subrounded, tabular oolitic, shelly with some crystalline limestone; with angular to subangular brown, white and grey flint—some patinated; with subrounded irregular ironstone and subrounded quartzite and sandstone; in lower 0.7 m with much subrounded to rounded, indurated chalk in fine to cobble-grade; with traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: medium with coarse and fine; mostly subrounded to rounded oolitic and shelly limestone with some ironstone and flint; below 2 mm fraction, quartz common with some well-worn derived Oxford Clay shell fragments Fines: upper 0.5 m very dark grey, becoming pale grey to greyish brown	c 2.7	c 10.0
Boulder Clay	Clay, stiff to indurated, grey to dark grey becoming greenish grey below 12.9 m; abundant rounded to subrounded chalk clasts—usually in the fine-gravel grade but up to cobble; with some gravel of flint, limestone and rare slate	3.0	13.0
Oxford Clay	Clay, indurated, greenish grey to grey, traces of belemnite guards and ammonite fragments—(?) <i>Kosmoceras</i> sp	1.0+	14.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	63	32	7.3 - 8.3	2	12	33	19	32	2	0
			8.3 - 9.3	1	7	48	16	25	3	0
			9.3 - 10.0	15	17	27	11	22	6	2
			Mean	5	12	35	16	27	4	1

Surface level + 1.80 m (+ 6.0 ft)  
 Water struck at - 6.3 m  
 152 mm percussion  
 November 1979

Waste 12.7 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, greyish brown silty loam, glutinous at base	0.5	0.5
Barroway Drove Beds (?Roddon) (‘Buttery Clay’)	Silt, soft to firm, predominantly yellowish brown slightly mottled pale grey	1.3	1.8
	Clay, glutinous, slightly thixotropic, dark grey with darker grey to black spots and mottles associated with soft carbonaceous material	0.6	2.4
Lower Peat (?‘upper leaf’)	Peat intercalated with clay as above	0.5	2.9
Barroway Drove Beds (‘Buttery Clay’)	Clay—as above	1.0	3.9
Lower Peat (?‘intermediate leaf’)	Peat, soft, friable, brown with much pale yellowish brown ‘raffia-like’ reed material; below 4.2 m with much intercalated clay	0.8	4.7
Barroway Drove Beds (‘Buttery Clay’)	Clay—essentially as above, extremely glutinous, with much reed material with associated ‘rank’ smell, towards base becomes slightly silty and micaceous	1.0	5.7
Lower Peat (?‘lower leaf’)	Peat, intermixed with clay	1.2	6.9
River Terrace Deposits (?Crowland Bed)	Clay, glutinous, thixotropic, dark grey, with peaty intercalations, becomes mottled brown below 8.1 m with fine to coarse sand of subangular to subrounded quartz and oolitic limestone; with trace gravel	1.3	8.2
(First Terrace)	Sandy gravel, ‘clayey’ in upper 1.0 m Gravel: fine with some coarse; mostly subrounded tabular oolitic and shelly limestone with subangular to angular brown and white flint; with subrounded irregular ironstone; with some subrounded to rounded quartzite and sandstone; with traces of indurated chalk and well-worn belemnite guards Sand: medium and coarse with fine; mostly subrounded to rounded, shelly and oolitic limestone and ironstone with some brown flint; below 2 mm fraction, quartz common Fines: dark greyish brown in upper 1.0 m, becoming pale brown	2.2	10.4
Boulder Clay	Clay, stiff, dark grey mottled brown, abundant chalk clasts and traces of quartzite and flint gravel	2.3	12.7
Oxford Clay	Clay, stiff, friable in part, greenish grey, slightly silty, calcareous, several fragmented shells of ? <i>Gryphaea</i>	0.6+	13.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	52	42	8.2 - 9.2	10	13	13	20	42	2	0
			9.2 - 10.4	3	8	28	22	35	4	0
			Mean	6	10	21	21	39	3	0

Surface level + 1.49 m (+ 5.0 ft)  
 Water struck at - 4.91 m and - 5.21 m  
 152 mm percussion  
 October 1979

Waste 10.0 m  
 Bedrock 0.5 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to stiff, silty, clayey loam, with many root traces	1.1	1.1
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm to soft, thixotropic in parts, glutinous below 1.2 m, highly mottled brown with orange often associated with root traces; below 1.2 m becomes predominantly dark grey with many soft black, carbonaceous woody fragments, with peaty intercalations (especially between 3.0 and 3.5 m) and pockets of ?reed material often with a ‘rank’ smell; rare nodules of brown siltstone	c 3.9	c 5.0
Lower Peat	Peat, friable, dark brown to grey, organic matter with ? <i>Birch</i> bark fragments	c 1.0	c 6.0
River Terrace Deposits (Crowland Bed)	Clay to sandy clay, firm to soft, glutinous, ?layered, grey mottled with khaki-brown; with much fine to medium, subrounded to rounded quartz sand and traces of gravel below 6.4 m; calcareous throughout	c 0.7	6.7
(First Terrace)	Sandy gravel, with traces of ?indigenous shell fragments Gravel: fine with some coarse; mostly subrounded to rounded oolitic and shelly limestone with angular to subangular brown and white flint; with some ironstone; with traces of indurated chalk and sandstone; with some well-worn belemnite guards, ammonite fragments and traces of ?indigenous cardiacean lamellibranchs; rare greenish crystalline ?igneous clasts Sand: medium and coarse with fine; mainly subrounded oolitic limestone with ironstone with some flint and quartz; below 2 mm fraction mostly subrounded to rounded quartz with ironstone and white shell fragments Fines: slightly silty, brown to greyish brown	1.0	7.7
Boulder Clay	Clay, firm to stiff, khaki-brown in upper part becoming greyish brown, with abundant chalk clasts and flint with sandstone gravel; rare pockets of orange-brown silty sand	2.3	10.0
Oxford Clay	Clay, stiff to indurated, grey, many sand-grade selenite crystals giving a ‘gritty’ texture, calcareous, with traces of shell fragments including belemnites and rare ammonites and crinoids	0.5 +	10.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	62	35	6.7 - 7.7	3	6	34	22	32	3	0

Surface level + 1.34 m (+ 4.5 ft)  
 Water struck at - 3.86 m  
 152 mm percussion  
 October 1979

Waste 8.0 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, stiff greyish brown loam, with many white rootlets; becomes silty and sandy towards base	1.2	1.2
Barroway Drove Beds (?Roddon)	Silt, firm becoming soft, glutinous and thixotropic towards base, grey mottled orange-brown with pale yellow sandy pockets in upper part, becoming dark grey [2.5 Y N4/] with traces of thin-shelled lamellibranchs and gastropods (including <i>Hydrobia ulvae</i> )	1.8	3.0
Lower Peat	Peat, friable, dark brown	0.2	3.2
River Terrace Deposit (?Crowland Bed)	Clay, soft, glutinous, thixotropic, dark grey [2.5 Y N4/], with much intercalated peaty material, becomes progressively sandy towards base	1.9	5.1
(First Terrace)	'Clayey' sandy gravel, 'very clayey' in upper 0.8 m, with traces of ?indigenous shell fragments in lower 0.9 m Gravel: fine with coarse; mainly angular, brown with white and trace black flint with calcareous sandstone and subrounded tabular oolitic, crystalline and shelly limestone, with some subrounded quartzite, ironstone and chalk, with traces of well-worn Oxford Clay belemnite guards and (?indigenous lamellibranch fragments (? <i>Cerastoderma sp</i> ) Sand: fine and medium with coarse; mainly subrounded to rounded oolitic limestone with ironstone, with some flint, quartz and chalk; below 2 mm fraction quartz and ironstone predominate with many fragments of thin-shelled lamellibranchs Fines: 'very clayey' to silty, brown	1.7	6.8
Boulder Clay	Clay, stiff, grey to dark grey, with many rounded to subrounded chalk clasts	1.2	8.0
Oxford Clay	Clay, stiff, bluish-grey, calcareous	0.6+	8.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
16	51	33	5.1 - 5.9	25	19	9	10	30	7	0
			5.9 - 6.8	9	18	25	19	24	5	0
			Mean	16	18	18	15	27	6	0

**COMPOSITION**

Depth below surface (m) Percentage by weight in 8 - 16 mm fraction

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others		
	Angular	Rounded	Crystalline	Oolitic			Shelly	Indi-genous					Derived	Calcareous
5.1 - 6.8	34	nil	10	15	8	1	8	nil	3	1	4	16	nil	nil

Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	5.1 - 6.8	1	80	19

Surface level +2.04 m (+ 6.5 ft)  
 Water struck at -6.36 m  
 152 mm percussion  
 November 1979

Waste 13.7 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, silty, calcareous	0.5	0.5
Terrington Beds (?Roddon)	Clay, soft, grey mottled orange-brown, slightly silty	0.7	1.2
	Silt, firm, layered, dark brown with pale yellow and black laminae with traces of organic matter	0.1	1.3
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, below 4.0 m becomes thixotropic, predominantly bluish grey with black carbonaceous, peaty matter throughout; between 3.5 and 4.0 m with much 'raffia-like' reed material with associated 'rank' odour	6.5	7.8
Lower Peat	Peat, friable dark reddish brown with many wood fragments, with intercalations of clay towards base	0.6	8.4
River Terrace Deposits (Crowland Bed)	Sandy clay, soft to firm, glutinous in parts, grey to dark grey, calcareous, with much medium to coarse sand subrounded to rounded oolitic limestone and traces of fine to coarse, angular to subangular black and grey flint	c 0.6	c 9.0
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly rounded to subrounded tabular shelly and oolitic limestone with angular to subangular brown and white flint—some patinated, with some ironstone, quartzite, sandstone and indurated chalk; traces of well-worn belemnite guards and <i>Gryphaea</i> shells Sand: coarse and medium with fine; mostly subrounded to rounded oolitic limestone with ironstone, with some flint and chalk; below 2 mm fraction, with quartz Fines: silty, greyish brown	c 1.0	10.0
Boulder Clay	Clay, firm to stiff, greyish brown to grey becoming dark grey to black below 12.6 m, with abundant chalk clasts, with gravel ?layers of flint, limestone and sandstone between 10.0 and 12.6 m and 13.3 and 13.7 m; between 12.6 and 13.3 m with clast-free clay, ?Oxford Clay 'raft'; ?carbonaceous, with many cream-coloured shell impressions	3.7	13.7
Oxford Clay	Clay, firm to stiff, friable in parts, greenish grey, calcareous, traces of shell fragments	0.8 +	14.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	53	43	9.0 - 10.0	4	7	22	24	39	4	0

Surface level + 1.25 m (+ 4.5 ft)  
 Water struck at - 0.95 m  
 152 mm percussion  
 October 1979

Overburden 7.3 m  
 Mineral 3.9 m  
 Waste 0.5 m  
 Bedrock 0.3 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mixture of grey mottled brown soil with clay and peat	1.3	1.3
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft to firm, glutinous below 1.7 m, mottled orange-brown and grey associated with peaty layers in upper 0.4 m, becoming dark grey [2.5 Y N4/] to base; at 3.5 m with thin (0.05 m) peaty layer; below c 3.5 m with many vertical ‘raffia-like’ brownish yellow reed stems, below 4.2 m with abundant thin-shelled lamellibranch fragments	c 3.4	c 4.7
Lower Peat	Peat, fibrous, black, ‘rank’ odour; intermixed with clay as above	c 1.0	c 5.7
River Terrace Deposits (?Crowland Bed)	Clay to sandy clay, soft to firm in upper 1.3 m, becoming stiff below c 7.0 m; predominantly grey mottled pale grey and khaki; becoming sandy below 6.3 m, with traces of angular to subangular gravel below 7.0 m; ?layered near base	c 1.6	7.3
(First Terrace)	Sandy gravel, very sandy 7.8 – 9.2 m, with abundant ?indigenous shells between 7.3 and 8.3 m and 9.2 and 11.1 m Gravel: fine with some coarse, rare cobbles below 9.2 m to base—the latter mainly of flint, sandstone and chalk; mainly angular to subangular white and brown with black flint—some patinated; with rounded to subrounded indurated chalk, with some sandstone (mostly calcareous), quartzite and crystalline, shelly and oolitic limestone; with traces of well-worn Oxford Clay serpulids including <i>Genicularia vertebralis</i> , belemnite guards and <i>Gryphaea</i> shell fragments with abundant ?indigenous molluscs including the gastropods— <i>Littorina ? saxatilis</i> , <i>Nassarius sp.</i> , <i>Turritella communis</i> , <i>Turritella cf. planispira</i> and the lamellibranchs— <i>Cerastoderma edule</i> , <i>Macoma balthica</i> , <i>Mya truncata</i> , <i>Mytilus edulis</i> , <i>Ostrea edulis</i> , with rare balanid fragments and several bored pebbles Sand: mainly fine with medium and coarse; mostly subangular to subrounded quartz and ironstone with abundant white shell fragments; between 7.8 and 9.2 m sand is particularly silty and thixotropic with many black carbonaceous woody fragments; below 9.2 m with much chalk Fines: silty, pale greyish brown	3.9	11.2
Boulder Clay	Clay, stiff, predominantly dark grey with khaki brown mottles, with much fine gravel-grade to coarse sand-grade subrounded chalk, with traces of angular to subangular grey flint	0.5	11.7
Oxford Clay	Clay, stiff, grey, calcareous	0.3+	12.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	68	25	7.3 - 7.8	6	5	35	17	26	11	0
			7.8 - 9.2	9	75	10	5	1	0	0
			9.2 - 10.2	8	25	19	22	23	3	0
			10.2 - 11.2	4	5	19	23	43	6	0
			Mean	7	35	18	15	21	4	0



## COMPOSITION

Depth below surface (m) *Percentage by weight in 8 – 16 mm fraction*

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta- morphic	Others	
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indi- genous	Derived		Calcareous			
7.3 – 11.2	52	trace	3	1	1	trace	6	2	2	24	1	8	trace	trace

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 – 16	7.3 – 11.2	24	31	45

**TF 21 NW 29 2344 1620 Near Greenland's Farm, Spalding South Fen**

**Block E**

Surface level + 1.96 m (+ 6.5 ft)  
Water struck at – 4.34 m  
152 mm percussion  
October 1979

Waste 11.3 m  
Bedrock 1.0 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
Barroway Drove Beds (?Roddon)	Soil, silty to clayey loam, dark brown, mottled orange, micaceous below 0.4 m	1.1	1.1
	Silt, firm becoming soft, glutinous and thixotropic below 2.0 m; predominantly dark brown mottled yellowish brown and orange in upper 0.9 m, becoming grey to dark grey; micaceous, with much black, carbonaceous fragmentary material below 2.0 m	4.2	5.3
Lower Peat	Peat, friable, becoming glutinous near base, dark brown to black with much woody material	0.6	5.9
River Terrace Deposits (Crowland Bed)	Sandy clay, soft in upper 0.2 m becoming firm; pale grey mottled slightly with pale orange-brown, with much sand of oolitic limestone, quartz and flint, with traces of fine to coarse gravel of subangular to subrounded flint, limestone and sandstone; calcareous throughout	0.9	6.8
Boulder Clay	Clay, indurated, dark grey to very dark grey [5 Y 4/1 – 3/1], mottled orange-brown in places, with many chalk clasts and traces of angular to subangular flint gravel, rare oyster lumachelle with ? <i>Modiolus imbricatus</i>	4.5	11.3
Oxford Clay	Clay, indurated, grey, calcareous, with abundant selenite crystals giving a 'gritty' texture, with traces of belemnites (? <i>Hibolites</i> ), serpulids and <i>Pentacrinus</i> ossicles	1.0+	12.3

Surface level +1.26 m (+ 4.5 ft)  
 Water struck at c -4.34 m  
 152 mm percussion  
 October 1979

Waste 9.1 m  
 Bedrock 0.6m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Barroway Drove Beds (Roddon)	Soil, firm, dark greyish brown, silty loam, layered in part, micaceous, with fragments of brick and wheat chaff	0.4	0.4
(Roddon)	Silt, firm, mottled grey and orange-brown, micaceous, with fine sand-grade pockets, occasional root fragments	1.2	1.6
('Buttery Clay')	Clay, soft, glutinous, thixotropic, dark grey [5 Y 4/1], with many black carbonaceous wood fragments, micaceous; near base with pockets of reed fragments commonly associated with 'rank' odour	1.8	3.4
Lower Peat ('upper leaf')	Peat, friable, dark grey to black; many root and plant fragments	0.1	3.5
Barroway Drove Beds (Buttery Clay')	Clay, as above, with traces of white thin-shelled lamellibranchs including <i>Scrobicularia plana</i>	1.6	5.1
Lower Peat ('lower leaf')	Peat, friable, dark grey to black; mixed with clay below 5.3 m	0.4	5.5
River Terrace Deposits (Crowland Bed)	Sandy clay, highly mottled pale greenish yellow with grey, calcareous, with fine to medium-grade quartz sand and traces of coarse-grade angular flint gravel	0.1	5.6
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded tabular oolitic and shelly limestone, with angular to subangular, brown and white flint and subrounded ironstone, with some subrounded to rounded quartzite and sandstone, with traces of belemnite guards and <i>Gryphaea</i> fragments; rare igneous clasts Sand: medium with coarse and fine; mostly rounded to subrounded shelly and oolitic limestone with ironstone, with some angular to subangular brown and white flint; below 2mm fraction, mostly subrounded to rounded quartz with some ironstone and oolitic limestone Fines: silty, greyish brown	1.4	7.0
Boulder Clay	Clay, stiff to indurated, khaki-brown in upper 0.1 m, becoming dark greyish brown, with abundant subrounded to rounded chalk clasts, with some gravel of black flint, siltstone and sandstone	2.1	9.1
Oxford Clay	Clay, stiff to indurated, greenish grey, calcareous, with traces of shell fragments	0.6+	9.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
9	53	38	5.6 - 7.0	9	7	31	15	34	4	0

Surface level +2.79 m (+9.0 ft)  
 Water not struck  
 152 mm percussion  
 November 1979

Waste 11.3 m +

### LOG

Geological classification	Lithology	Thickness m	Depth m
Terrington Beds (Roddon)	Soil, brown to greyish brown silty loam, calcareous, with many gastropod fragments in near-surface layers	0.6	0.6
(Roddon)	Silt, friable, layered, yellowish brown [10 YR 5/6] with pale grey to buff, calcareous	0.9	1.5
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, very dark grey [2.5 Y N3/], slightly micaceous; traces of thin-shelled lamellibranchs in upper layers with abundant ?indigenous molluscs between c 5.6 and 5.7 m mainly of ? <i>Cerastoderma edule</i> with some ‘turretted’ gastropods; with black peaty root intercalations often associated with a ‘rank’ odour	5.9	7.4
Lower Peat	Peat, friable, fibrous, dark brown to black, with some root and bark fragments	0.6	8.0
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, bluish-grey, silty, with much intercalated peaty material, with traces of shell fragments	0.1	8.1
Boulder Clay	Clay, firm to stiff, reddish brown [5 YR 5/3] in upper c 1.7 m becoming dark greyish brown [2.5 Y 4/2]; with traces of subrounded indurated chalk clasts in upper c 1.7 m, becoming abundant below c 9.8 m; with sandy gravel ?lens between c 9.6 and 9.8 m, mainly of subangular to subrounded, brown and white flint gravel with quartz sand; with vertical dendritic root traces in upper part—roots often with a pale grey halo	3.2+	11.3

Surface level + 2.31 m (+ 7.5 ft)  
 Water struck at - 4.89 m  
 152 mm percussion  
 November 1979

Waste 14.7 m  
 Bedrock 0.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
(?)Nordelph Peat	Soil, friable, dark brown to black, silty loam, peaty towards base	0.6	0.6
Barroway Drove Beds (Roddon)	Silt, soft, friable in parts, greyish brown [2.5 Y 5/2], mottled in part with orange-brown; slightly micaceous	1.1	1.7
(Roddon)	Clayey silt, soft, glutinous, brown [10 YR 5/3] in upper 0.3 m becoming dark grey to very dark grey [10 YR 4/1 - 3/1]; thixotropic below 2.0 m with traces of pale yellow-brown 'raffia-like' reed stems, often associated with a 'rank' odour, clayey matrix, with peaty intercalations at c 5.5 m	5.2	6.9
Lower Peat	Peat, friable, fibrous, mainly greyish brown to black, with some dark reddish brown patches, with some pockets of fine to medium-grade quartz sand	0.2	7.1
River Terrace Deposits (?Crowland Bed)	Pebbly clay to clay, firm in upper 1.6 m, becoming soft and glutinous between 8.7 and 9.4 m, soft to firm from 9.4 - 9.8 m; pale greenish grey in upper 1.6 m becoming khaki-brown below 8.7 m, predominantly pale grey in lower 0.4 m, mottled orange-brown throughout, with much fine-grade gravel between 7.1 and 8.7 m, with sandy gravel between 8.7 and 9.4 m—gravel mainly of subangular to subrounded flint and limestone; sand and gravel absent below 9.4 m	2.7	9.8
(First Terrace)	Sandy gravel, with ?indigenous shell fragments Gravel: fine with coarse with traces of cobble; mainly angular to subangular grey and brown patinated flint with subrounded chalk and shelly limestone, with some subrounded quartzite sandstone and ironstone, with abundant ?indigenous molluscs including lamellibranchs — <i>Astarte sp</i> , <i>Cerastoderma edule</i> , <i>Macoma balthica</i> , <i>Mytilus edulis</i> and <i>Ostrea edulis</i> , 'turretted' gastropod fragments and extensively bored pebbles, with traces of well-worn, bored, Oxford Clay; <i>Gryphaea</i> shells Sand: medium with coarse and fine; mostly subangular to angular brown flint, with subrounded shelly limestone and white shell fragments; below 2 mm fraction mainly subrounded to rounded quartz with shell fragments, ironstone traces throughout Fines: silty, greyish brown	0.8	10.6
Boulder Clay	Clay, stiff, grey to dark grey, with abundant subrounded to rounded, medium to fine-gravel grade indurated chalk, with traces of brown subangular flint gravel, rare cobbles, with traces of pyrite nodules	4.1	14.7
Oxford Clay	Clay, firm to stiff, grey to greenish grey, calcareous, with traces of selenite crystals in upper 0.1 m and traces of belemnite guard fragments throughout	0.3+	15.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand	Gravel				
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	68	28	9.8 - 10.6	4	12	40	16	21	7	0

Surface level +1.96 m (+6.5 ft)  
 Water struck at c +0.8 m  
 152 mm percussion  
 November 1979

Waste 13.6 m  
 Bedrock 0.4 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, dark greyish brown silty loam, slightly mottled orange towards base	0.7	0.7
Barroway Drove Beds (Roddon)	Silt, firm to stiff in upper 0.1 m becoming soft, glutinous, and thixotropic, layered in parts, generally greyish brown to fawnish brown, highly mottled orange-brown in upper parts, micaceous throughout; near base with black carbonaceous patches and traces of thin-shelled ?lamellibranch fragments; between c 5.8 and 6.2 m with peaty intercalations, traces of wood fragments	5.9	6.6
Lower Peat	Peat, friable, dark brown to black, with some micaceous silty pockets	0.2	6.8
River Terrace Deposits (Crowland Bed)	Sandy pebbly clay, soft to glutinous; predominantly khaki-brown with grey mottles, with much fine to medium-grade quartz sand, with some gravel of subangular to subrounded flint and limestone	1.5	8.3
Boulder Clay	Clay, firm to stiff, mottled khaki-grey with grey in upper 0.7 m, becoming predominantly grey to very dark grey, with abundant subrounded to rounded, indurated chalk clasts, with traces of flint, limestone and sandstone gravel—rare cobbles; between 12.6 and 13.1 m with chalk and gravel-free clay (with cream-coloured shell impressions)—?Oxford Clay 'raft'	5.3	13.6
Oxford Clay	Clay, stiff, grey to greenish grey, traces of selenite crystals near base	0.4+	14.0

Surface level + 2.14 m (+ 7.0 ft)  
 Water struck at - 3.76 m  
 152 mm percussion  
 October 1979

Waste 12.8 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Made ground, mixture of dark brown, loamy soil with brick rubble and gravel	1.4	1.4
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft to glutinous, dark greyish brown becoming grey to dark grey below c 1.9 m; slightly silty in parts, with some black carbonaceous wood material; peaty ?layer at c 1.8 m	3.1	4.5
Lower Peat (?‘upper leaf’)	Peat, dark grey to black, with bark fragments	0.2	4.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, essentially as above	c 0.8	c 5.5
Lower Peat (?‘lower leaf’)	Peat, dark grey to black, with bark fragments, with clay intercalations	c 0.4	5.9
River Terrace Deposits (Crowland Bed)	Sandy clay, stiff, grey mottled khaki-brown, with abundant medium-grade angular to subangular sand, ?chalk, ?patinated flint or limestone; calcareous throughout	1.4	7.3
(First Terrace)	‘Very clayey’ sandy gravel Gravel: fine with coarse; mainly angular to subangular brown with white and black flint with subrounded tabular, crystalline, oolitic and shelly limestone, with some subrounded sandstone (mostly calcareous), quartzite and ironstone, with traces of chalk Sand: coarse and medium with fine; mainly shelly and oolitic limestone with flint and ironstone; below 2 mm fraction, mainly quartz and ironstone Fines: ‘very clayey’, greyish brown, occasional clay nodules	0.6	7.9
Boulder Clay	Clay, stiff, mottled khaki-olive with grey in upper 0.4 m becoming grey to dark greyish brown; abundant subrounded, indurated chalk clasts with some subangular to subrounded sandstone, flint and quartzite gravel especially below 8.3 m	4.9	12.8
Oxford Clay	Clay, stiff to very stiff, grey, calcareous	0.5 +	13.3

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
24	41	35	7.3 - 7.9	24	7	16	18	30	5	0

**COMPOSITION**

Depth below surface (m) *Percentage by weight in 8 - 16 mm fraction*

Depth below surface (m)	Flint		Limestone		Ironstone	Quartzite	Fossil debris	Chalk	Sandstone	Igneous/ Meta- morphic	Others			
	Angular	Rounded	Crystalline	Oolitic								Shelly		
						Indi- genous	Derived	Calcareous						
7.3 - 7.9	56	nil	12	6	4	1	5	nil	1	trace	4	11	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8 - 16	7.3 - 7.9	9	59	32

Surface level + 1.23 m (+ 4.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 October 1979

Overburden 7.5 m  
 Mineral 3.3 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown clayey loam, with wheat chaff fragments	0.4	0.4
Barroway Drove Beds (Roddon)	Silt, firm, pale grey mottled brown to orange-brown, micaceous, calcareous	c 1.1	c 1.5
('Buttery Clay')	Clay, soft, glutinous, thixotropic, predominantly pale grey, silty	c 2.0	c 3.5
Lower Peat ('upper leaf')	Peat, dark grey	c 0.1	c 3.6
Barroway Drove Beds (Buttery Clay')	Clay, essentially as above, micaceous, calcareous, with dark reddish brown root traces	c 3.7	7.3
River Terrace Deposits (Crowland Bed)	Sandy clay, firm, predominantly brown to khaki-brown, mottled grey, with much fine-grade quartz sand; traces of gravel	0.2	7.5
(First Terrace)	Sandy gravel; with ?indigenous shell fragments Gravel: fine with coarse, with traces of cobbles—the latter mostly black flint; mainly rounded to subrounded tabular, crystalline, oolitic and shelly limestone with angular to subangular brown with white and black flint—rarely patinated, with some sandstone (mostly calcareous), quartzite and ironstone, with some subrounded chalk in + 4 – 8 mm fraction, with some well-worn Oxford Clay belemnite guards and <i>Gryphaea</i> shell fragments, with ?indigenous gastropods— <i>Nucella lapillus</i> , <i>Turritella sp</i> lamellibranchs— <i>Cerastoderma edule</i> , <i>Macoma balthica</i> and <i>Ostrea edulis</i> and with rare bored pebbles Sand: medium with coarse and fine; mostly oolitic and shelly limestone with flint and ironstone; many white shell fragments towards base; below 2 mm fraction mainly quartz Fines: silty, orange-brown in upper 1.5 m becoming predominantly grey below 9.0 m, with occasional clay nodules	3.3	10.8
Oxford Clay	Clay, stiff to indurated, bluish-grey, calcareous, with traces of shell fragments	0.5 +	11.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	52	42	7.5 - 8.5	7	10	44	12	24	3	0
			8.5 - 9.5	4	6	37	14	35	4	0
			9.5 - 10.8	8	2	17	18	44	11	0
			Mean	6	6	31	15	36	6	0

## COMPOSITION

Gravel fraction (mm)	Depth below surface (m)	Percentage by weight													
		Flint		Limestone		Ironstone		Quartzite	Fossil debris		Chalk	Sandstone		Igneous/ Meta-morphic	Others
		Angular	Rounded	Crystal-line	Oolitic	Shelly		Indi-genous	Derived		Cal-careous				
4-8	7.5-10.8	46	nil	18	5	8	trace	6	nil	2	3	4	7	1	nil
8-16	7.5-10.8	29	nil	15	17	12	2	8	trace	1	1	4	11	nil	nil
Mean	7.5-10.8	32	nil	16	15	11	2	8	trace	1	1	4	10	trace	nil

### Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
4-8	7.5-10.8	4	61	35
8-16	7.5-10.8	7	64	29
Mean	7.5-10.8	6	63	31



Surface level +2.65 m (+9.0 ft)  
 Water struck at -1.05 m  
 152 mm percussion  
 October 1979

Overburden 5.0 m  
 Mineral 1.8 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, dark brown loam, with brick and stone fragments	1.1	1.1
Terrington Beds (Roddon)	Silt, friable, ?layered; pale yellow with pale fawn, becoming predominantly brown with dark orange mottles below c 1.8 m, becomes bluish-grey to dark grey below 2.3 m; micaceous, slightly calcareous, with small fragments of black, carbonaceous wood, with traces of thin-shelled lamellibranchs including <i>Scrobicularia plana</i> and <i>Macoma balthica</i> ; with some coarse sand towards base	3.9	5.0
River Terrace Deposits (First Terrace)	Gravel, with ?indigenous shell fragments, occasional pebble concretions, silt layer between c 5.9 and c 6.0 m Gravel: fine with coarse; mainly subrounded, tabular, oolitic, crystalline and shelly limestone with angular to subangular brown with white and black flint—some patinated, with subrounded, irregular ironstone, quartzite and sandstone (some calcareous); with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments; rare subrounded chalk clasts, with fragments of ?indigenous gastropods ( <i>Buccinum undatum</i> ) and lamellibranchs ( <i>Cerastoderma edule</i> , <i>Macoma balthica</i> and <i>Mytilus edulis</i> ) and with decapod chelae Sand: coarse with fine and medium; mostly subrounded to rounded oolitic and shelly limestone with ironstone, with some flint and shell fragments Fines: silty, especially between c 5.9 and c 6.0 m with a laminated shelly (abundant comminuted shells) silty layer—with alternating laminae of dark grey with fawn; whole micaceous and greyish blue in upper 1.0 m, becoming brown to base	1.8	6.8
Oxford Clay	Clay, stiff to indurated, brown to khaki-brown in upper 0.5 m becoming pale bluish-grey to grey, calcareous, with traces of belemnite guards and other pyrite-coated shell fragments	1.2 +	8.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16	+ 64 mm
7	44	49	5.0 - 6.0	9	25	12	18	34	2	0
			6.0 - 6.8	6	5	8	18	52	11	0
			Mean	7	16	10	18	43	6	0

## COMPOSITION

Depth below surface (m) *Percentage by weight in 8–16 mm fraction*

Depth below surface (m)	Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone		Igneous/ Meta- morphitic	Others
	Angular	Rounded	Crystalline	Oolitic	Shelly			Indi- genous	Derived		Calcareous			
5.0–6.8	23	nil	17	18	12	10	9	trace	1	nil	5	5	nil	nil

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
8–16	5.0–6.8	6	61	33

**TF 21 SW 17 2045 1372 Near South Drove Drain, Deeping St Nicholas**

**Sub-block E<sub>1</sub>**

Surface level +0.95 m (+3.5 ft)  
Water struck at –1.85 m and –3.15 m  
152 mm percussion  
October 1979

Overburden 2.9 m  
Mineral 2.0 m  
Bedrock 0.6 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, dark greyish brown loam, with brick rubble and root fragments	1.2	1.2
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, dark greyish blue, with some intercalated peaty material, with black, carbonaceous wood fragments throughout and occasional root traces; with traces of mica	1.3	2.5
Lower Peat	Peat, friable, dark grey to black, with some clay	0.2	2.7
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, dark greyish blue, sandy towards base	0.2	2.9
(First Terrace)	Sandy gravel, 'clayey' in upper 1.0 m, sandy towards base, with a sandy ?layer between 3.9 and 4.1 m Gravel: fine with some coarse; mainly subrounded to rounded, tabular, oolitic and shelly limestone with angular to subangular brown flint—with some patination, with some subrounded to rounded irregular ironstone, quartzite and sandstone, with traces of well-worn belemnite guards Sand: medium and coarse with fine; mostly subrounded to rounded oolitic limestone with ironstone, with some angular to subangular flint and traces of ?derived-Oxford Clay shell fragments; below 2 mm fraction, quartz common Fines: 'clayey' to silty, generally dark greyish brown [2.5 Y 4/2], becoming olive brown [2.5 Y 4/4] in sandy clay ?layer	2.0	4.9
Oxford clay	Clay, stiff to indurated, mottled khaki-grey with bluish-grey in upper 0.2 m, becoming dark grey [5 Y 4/1] to base; traces of shell fragments, some partially veneered with pyrite	0.6+	5.5

## GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				– 1/16	+ 1/16 – 1/4	+ 1/4 – 1	+ 1 – 4	+ 4 – 16	+ 16 – 64	+ 64 mm
7	68	25	2.9–3.9	13	9	22	15	34	7	0
			3.9–4.9	1	11	42	36	8	2	0
			Mean	7	10	33	25	21	4	0

Surface level + 1.25 m (4.5 ft)  
 Water struck at - 1.65 m and - 2.85 m  
 152 mm percussion  
 September 1979

Waste 4.3 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark peaty loam	1.1	1.1
Barroway Drove Beds (‘Buttery Clay’)	Silty clay, soft, glutinous, thixotropic, grey mottled pale orange-brown in upper 0.9m becoming bluish-grey to base, with much carbonaceous (wood) and peat matter throughout; slightly micaceous, root traces	1.8	2.9
River Terrace Deposits (First Terrace)	Sandy gravel, ‘clayey’ in upper part Gravel: fine with some coarse; mainly subrounded to rounded, tabular, shelly and oolitic limestone, with some subrounded to rounded irregular ironstone and angular to subangular brown and white flint, with traces of indurated ?chalk, vein-quartz, quartzite and sandstone Sand: medium and coarse with fine, mostly subrounded to rounded oolitic limestone with ironstone with some angular to subangular brown and white flint, quartz common below 1 mm fraction Fines: ‘clayey’ in upper part becoming silty, greyish brown	0.9	3.8
	Clay, indurated, khaki-green mottled pale orange to orange-brown, with some limestone and flint gravel, calcareous	0.3	4.1
	Sandy gravel, essentially as above	0.2	4.3
Oxford Clay	Clay, indurated, pale grey mottled orange in association with vertical root traces in upper c 1.0m, becomes predominantly pale greenish grey to bluish-grey; calcareous	1.4+	5.7

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	63	32	2.9 - 3.8	5	7	36	20	28	4	0

Surface level + 1.25 m (+ 4.5 ft)  
 Water struck at - 0.65 m  
 152 mm percussion  
 September 1979

Overburden 1.9 m  
 Mineral 1.0 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, friable, dark brown, peaty loam, with many chaff fragments	0.9	0.9
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, predominantly dark grey with pale khaki mottles, with black, carbonaceous material, slightly micaceous, with pockets of plant material often with ‘rank’ odour	0.9	1.8
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, khaki-green mottled with dark bluish-grey in areas of ?carbonaceous matter, calcareous, with fine to medium-grade quartz sand and traces of flint and limestone gravel	0.1	1.9
(First Terrace)	Sandy gravel, with many pebbly concretions up to cobble-grade Gravel: fine with some coarse, with traces of cobbles; mainly subrounded to rounded, tabular, oolitic and shelly limestone with angular to subangular brown and white flint—rare black varieties, usually patinated, with some rounded to subrounded ironstone, quartzite and sandstone with traces of well-worn belemnite guards and ? <i>Gryphaea</i> shell fragments, rare ?igneous fragments and pyrite concretions Sand: medium with coarse and fine; mostly subrounded to rounded oolitic and shelly limestone with ironstone, with some subangular flint; quartz and ironstone predominate below 2 mm fraction Fines: slightly silty, pale greyish brown	1.0	2.9
Oxford Clay	Clay, indurated, mottled grey with khaki-brown in upper 0.2 m, becoming predominantly greyish green to base; calcareous, slightly silty; rare pebbles in upper 0.1 m, occasional root fragments throughout	1.1 +	4.0

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	56	42	1.9 - 2.9	2	7	27	22	39	3	0

Surface level +1.55 m (+5.0 ft)  
 Water struck at -0.85 m  
 152 mm percussion  
 September 1979

Overburden 2.4 m  
 Mineral 3.4 m  
 Bedrock 2.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, friable, dark brown, peaty	0.7	0.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, dark grey to black, silty to sandy in places, micaceous in parts, with black, carbonaceous patches and traces of wood fragments	1.4	2.1
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, mottled khaki-green with grey, calcareous, with fine to medium-grade quartz sand and traces of fine-grade gravel	0.3	2.4
(First Terrace)	Sandy gravel, gravel fraction ‘stained’ with iron-oxide Gravel: fine with coarse; mainly rounded to subrounded, tabular, oolitic and shelly limestone with angular to subangular, brown and white with some black flint—some patinated; with traces of ironstone, and well-worn belemnite guards and <i>Gryphaea</i> fragments, rare siltstone nodules with ?worm casts Sand: medium with coarse and some fine; mostly subrounded to rounded ironstone with oolitic and crystalline limestone, with some brown flint Fines: silty, pale orange-brown	3.4	5.8
Oxford Clay	Clay, soft to indurated, grey mottled orange-brown becoming grey near base, with traces of belemnite guards	2.5 +	8.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	50	47	2.4 - 3.4	2	5	39	17	34	3	0
			3.4 - 4.4	3	5	32	15	37	8	0
			4.4 - 5.8	3	2	17	22	51	5	0
			Mean	3	4	28	18	42	5	0

Surface level + 1.26 m (+ 4.5 ft)  
 Water struck at - 3.34 m  
 152 mm percussion  
 October 1979

Waste 6.4 m  
 Bedrock 1.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, dark greyish brown, with stone, brick and chaff fragments	0.9	0.9
Barroway Drove Beds (?Roddon)	Silt, firm to soft, grey to dark grey mottled with dark orange-brown and black, carbonaceous material	0.1	1.0
('Buttery Clay')	Clay, soft, glutinous, thixotropic, dark grey with some black carbonaceous mottling, with peaty intercalations between 2.0 and 2.5 m—layered in part with alternations of iron-oxide impregnated clay and fine, calcareous sand	2.4	3.4
Lower Peat (?‘upper leaf’)	Peat, friable, dark grey to black	0.2	3.6
Barroway Drove Beds (‘Buttery Clay’)	Clay, as above	0.2	3.8
Lower Peat (?‘lower leaf’)	Peat, dark grey to black, many bark fragments, ‘rank’ odour	0.2	4.0
River Terrace Deposits (?Crowland Bed)	Sandy clay, soft, glutinous, thixotropic in parts, grey highly mottled with black, carbonaceous material and khaki-brown; calcareous, mostly sand-free in upper 0.6 m; below c 4.6 m with fine to medium sand of quartz and oolitic limestone, with traces of fine to coarse gravel	1.2	5.2
(First Terrace)	Sandy gravel, with traces of ?indigenous shell fragments Gravel: fine with coarse, mainly subrounded to rounded, shelly and oolitic limestone with subrounded irregular ironstone (‘boxstones’ common), with some angular to subangular brown and white flint, quartzite and sandstone, with traces of well-worn Oxford Clay belemnite guards and <i>Gryphaea</i> shells, with ?indigenous molluscan fragments including ? <i>Cerastoderma edule</i> and <i>Mytilus edulis</i> with rare worn encrusted and bored pebbles Sand: medium with coarse and fine; mostly subrounded to rounded oolitic limestone with ironstone and flint, with many white shell fragments throughout, especially below 2 mm fraction, with quartz common in fine-grades Fines: silty, with occasional sandy clay nodules and shell fragments, greyish brown	1.2	6.4
Oxford Clay	Clay, firm to indurated, mottled khaki-brown with yellowish brown in upper 0.2 m becomes predominantly greenish grey to base; calcareous, slightly silty, with traces of black, carbonaceous material, with finely comminuted shell fragments	1.4 +	7.8

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
8	55	37	5.2 - 6.4	8	8	28	19	32	5	0

Surface level + 1.66 m (+ 5.5 ft)  
 Water struck at - 2.44 m  
 152 mm percussion  
 September 1979

Overburden 4.1 m  
 Mineral 1.5 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, brown, silty, with brick and chaff fragments	0.7	0.7
Barroway Drove Beds (?Roddon) (‘Buttery Clay’)	Silt, firm; (?)layered; orange and dark greyish buff; laminae mottled buff-brown  Clay, soft, glutinous, thixotropic, predominantly bluish grey mottled orange-brown associated with root traces, slightly calcareous and micaceous, with black carbonaceous patches	0.9 2.1	1.6 3.7
Lower Peat	Peat, dark grey to black, wood fragments throughout	0.3	4.0
River Terrace Deposits (Crowland Bed)  (First Terrace)	Sandy clay, soft, predominantly khaki-green mottled dark greyish blue to black with some orange patches, with fine to coarse-grade ? quartz sand and traces of coarse gravel  Sandy gravel, with pebbly concretions and clay layer between 4.7 and 5.1 m Gravel: fine with coarse; mainly subrounded to rounded, oolitic, shelly and crystalline limestone with angular to subangular brown and white flint, with some subrounded to rounded ironstone, quartzite, sandstone and vein-quartz Sand: medium with fine and coarse; mostly rounded to subrounded limestone and ironstone with some flint in coarse-grade; below 2 mm fraction, quartz common Fines: silty, with sandy clay layer; greyish brown in upper 1.0m, becoming brown	0.1 1.5	4.1 5.6
Oxford Clay	Clay, stiff to indurated, mottled grey with khaki-brown in upper 0.2m, becoming bluish-grey to base; silty, with traces of shell fragments throughout, with pyrite-veneered ammonites and <i>Gryphaea</i> fragments; stony in upper part	0.6+	6.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	53	42	4.1 - 5.1	6	19	30	11	29	5	0
			5.1 - 5.6	4	8	15	18	48	7	0
			Mean	5	15	25	13	37	5	0

Surface level + 1.16 m (+ 4.0 ft)  
 Water struck at - 2.04 m  
 152 mm percussion  
 September 1979

Overburden 3.2 m  
 Mineral 2.1 m  
 Waste 0.6 m  
 Mineral 0.5 m  
 Bedrock 0.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
?Nordelph Peat	Soil, friable, dark brown peaty	1.0	1.0
Barroway Drove Beds (‘Buttery Clay’)	Clay, firm, soft below 1.2 m, grey to pale grey with ?layers of orange-brown; with many black carbonaceous wood fragments	2.0	3.0
River Terrace Deposits (Crowland Bed)	Clay, soft, glutinous, pale grey mottled with khaki and black, sandy towards base	0.2	3.2
(First Terrace)	Sandy gravel Gravel: fine with coarse; mostly subrounded to rounded, tabular, oolitic and shelly limestone with ironstone, with some angular to subangular, mostly brown flint, with some subrounded quartzite and indurated ? chalk Sand: medium and coarse with fine; mostly subrounded to rounded oolitic limestone and ironstone, with some angular to subangular flint; below 2 mm fraction, quartz common Fines: silty, pale greyish brown	2.1	5.3
	Clay, firm to stiff, brown to khaki mottled grey, with much gravel	0.6	5.9
	Gravel, essentially as sandy gravel above	0.5	6.4
Oxford Clay	Clay, firm to indurated, brown to khaki mottled grey in upper 0.1 m, becoming greyish blue; gravelly in upper 0.1 m; fossiliferous below 6.5 m; calcareous	0.2+	6.6

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	56	41	3.2 - 4.2	3	5	25	23	37	7	0
			4.2 - 5.3	1	7	32	22	34	4	0
			5.3 - 5.9	Waste						
			5.9 - 6.4	8	4	23	18	41	6	0
			Mean	3	6	28	22	36	5	0



Surface level + 1.74 m (+ 5.5 ft)  
 Water struck at - 1.46 m  
 152 mm percussion  
 September 1979

Overburden 3.2 m  
 Mineral 1.7 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to indurated in upper 0.3 m—?hardpan becoming firm to friable, clayey becoming silty towards base, greyish brown	1.1	1.1
Barroway Drove Beds ('Buttery Clay')	Silty clay, firm becoming soft, glutinous and thixotropic towards base, dark greyish brown to grey, with many black carbonaceous patches, slightly calcareous	1.5	2.6
Lower Peat	Peat, friable, dark grey to black, with traces of wood fragments, with some clay intercalations	0.3	2.9
River Terrace Deposits (Crowland Bed)	Sandy clay, predominantly khaki with grey mottles, with much sand and traces of fine-grade gravel	0.3	3.2
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly rounded to subrounded oolitic and shelly limestone with ironstone and angular to subangular brown and white flint, with some subrounded to rounded quartzite and sandstone, with traces of chalk and well-worn belemnite guard fragments Sand: coarse and medium with some fine; mostly subrounded to rounded, oolitic limestone with ironstone, with some angular to subangular brown and white flint Fines: slightly silty, greyish brown becoming pale brown below 4.2 m	1.7	4.9
Oxford Clay	Clay, firm to indurated, grey; pebbles in upper 0.2 m	1.1 +	6.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	50	48	3.2 - 4.2	3	3	23	26	39	6	0
			4.2 - 4.9	3	4	23	20	44	6	0
			Mean	2	3	23	24	42	6	0

Surface level + 2.27 m (+ 7.5 ft)  
 Water struck at - 1.33 m  
 152 mm percussion  
 September 1979

Overburden 3.6 m  
 Mineral 3.2 m  
 Bedrock 0.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Nordelph Peat	Soil, friable, brown to dark brown, peaty	1.1	1.1
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic, very dark greyish brown [2.5 Y 3/2] becoming dark grey [5 Y 4/1] below 2.0 m, with peaty intercalations, sandy below 3.4 m	2.5	3.6
River Terrace Deposits (?Crowland Bed with First Terrace)	Gravel, with sandy clay layer in upper 0.2 m Gravel: fine with coarse; mainly subrounded to rounded, tabular, oolitic and shelly limestone with subrounded to rounded ironstone with some angular to subangular, brown and white flint, with some subrounded quartzite and sandstone, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with some fine; mostly subrounded to rounded oolitic and shelly limestone with ironstone with some brown flint; quartz common below 1 mm fraction Fines: silty, greyish brown in upper 1.0 m, becoming pale brown to brown	3.2	6.8
Oxford Clay	Clay, indurated, pale grey to greyish blue, calcareous, traces of fossil fragments	0.2+	7.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
3	47	50	3.6 - 4.6	8	4	18	16	43	11	0
			4.6 - 5.6	1	3	27	21	42	6	0
			5.6 - 6.8	2	4	31	15	41	7	0
			Mean	3	4	26	17	42	8	0

Surface level + 1.70 m (+ 5.5 ft)  
 Water struck at - 2.2 m  
 152 mm percussion  
 October 1979

Waste 6.0 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm greyish brown loam, calcareous, with brick and stone fragments; traces of chaff	1.2	1.2
Barroway Drove Beds (?Roddon) (‘Buttery Clay’)	Silty clay, poor recovery, firm to soft, extremely mottled grey, dark reddish-brown and bright yellow; with peaty intercalations  Clay, soft, glutinous, thixotropic, predominantly dark grey, micaceous, occasional peaty intercalations especially near base, with many small thin-shelled lamellibranch fragments including <i>Cerastoderma edule</i> ; sandy towards base	c 1.2  c 2.6	c 2.4  5.0
River Terrace Deposits (First Terrace)	‘Clayey’ sandy gravel, with ?indigenous shells—complete specimens in upper 0.2 m; ‘very clayey’ in upper 0.2 m Gravel: fine with coarse with traces of cobbles—the latter mainly flint; mostly subrounded to rounded tabular, oolitic and shelly limestone with angular to subangular brown and black with some white flint, with ironstone, with some subrounded to rounded quartzite and sandstone, with traces of well-worn belemnite guards, with ?indigenous molluscan shells (mostly fragments below 5.2 m) including lamellibranchs— <i>Cerastoderma edule</i> , <i>Macoma balthica</i> and <i>Mytilus edulis</i> Sand: medium with coarse and fine; mainly subrounded to rounded shelly and oolitic limestone with ironstone and flint, below 2 mm fraction; mainly quartz with shell fragments Fines: ‘clayey’, greyish brown	1.0	6.0
Oxford Clay	Clay, stiff to indurated, khaki-brown in upper 0.1 m becoming bluish grey, calcareous, slightly silty, fossiliferous	0.7+	6.7

**GRADING**

Mean for deposit <i>percentages</i>			Depth below surface (m)	<i>percentages</i>						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
12	61	27	5.0 - 6.0	12	11	31	19	22	5	0

Surface level + 1.37 m (+ 4.5 ft)  
 Water struck at - 2.53 m  
 152 mm percussion  
 October 1979

Waste 6.1 m  
 Bedrock 0.4 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm to stiff, dark greyish brown loam, with root and chaff fragments	1.2	1.2
Barroway Drove Beds (?Roddon)	Silt, firm to stiff, fawn mottled orange-brown	0.3	1.5
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, very dark grey [2.5 Y N3/], with some intercalated peaty material in upper 0.5 m, with some siltstone pellets	1.9	3.4
Lower Peat (?‘upper leaf’)	Peat, with some silt; ‘rank’ smell associated with organic material	0.3	3.7
Barroway Drove Beds (‘Buttery Clay’)	Clay as above	0.2	3.9
Lower Peat (?‘lower leaf’)	Peat, dark reddish brown with clay intercalations	0.6	4.5
River Terrace Deposits (Crowland Bed)	Sandy clay, soft to firm, predominantly very dark grey mottled with pale yellowish green, abundant sand, trace gravel	0.1	4.6
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly subrounded to rounded oolitic and shelly limestone with ironstone, with some angular to subangular white and brown flint—traces of patination, with some subrounded to rounded quartzite and sandstone, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments; rare extensively bored (? <i>Polydora</i> ) pebbles Sand: medium with coarse and fine; mostly subrounded to rounded oolitic and shelly limestone with ironstone, with some angular to subangular brown and white flint; below 1 mm fraction mostly quartz with ironstone Fines: silty, pale greyish brown	1.5	6.1
Oxford Clay	Clay, indurated, greenish grey, slightly silty, calcareous, traces of fossil fragments	0.4+	6.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
4	55	41	4.6 - 6.1	4	6	35	14	37	4	0	

Surface level + 1.55 m (+ 5.0 ft)  
 Water struck at - 2.55 m  
 152 mm percussion  
 October 1979

Overburden 4.8 m  
 Mineral 2.0 m  
 Bedrock 0.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, dark brown clayey loam, slightly peaty	0.6	0.6
Barroway Drove Beds (?Roddon)	Silt, firm to soft, layered, pale greyish fawn with orange-brown laminae to 1.7 m, becoming predominantly grey mottled pale orange to base, with peaty intercalations and some wood fragments	1.4	2.0
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, predominantly grey with black carbonaceous fragments, slightly calcareous and silty	1.5	3.5
Lower Peat	Peat, dark brown to black, with wood fragments	0.2	3.7
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, glutinous; predominantly grey mottled with khaki-olive and black carbonaceous patches; sand-free in upper 0.4 m; below 4.1 m with fine to medium-grade sand of quartz and oolitic limestone with traces of fine to coarse-grade flint, quartzite and limestone gravel	1.1	4.8
(First Terrace)	Sandy gravel, with some pebble concretions Gravel: fine with coarse; mainly subrounded to rounded, tabular, oolitic and shelly limestone with angular to subangular brown and white flint, with some subrounded irregular ironstone particularly in + 4 – 8 mm fraction, with some subrounded to rounded quartzite, vein-quartz and sandstone, with traces of well-worn belemnite guards and bored <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mostly subrounded to rounded oolitic and shelly limestone with ironstone, with traces of flint; below 2 mm fraction, quartz common Fines: silty, rare clay nodules; pale orange-brown to brown	2.0	6.8
Oxford Clay	Clay, stiff, dark grey to olive grey [5 Y 4/1 – 4/2] calcareous; with traces of shell fragments	0.3 +	7.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	52	46	4.8 – 5.8	2	5	25	20	40	8	0
			5.8 – 6.8	3	5	28	21	39	4	0
			Mean	2	5	27	20	40	6	0

Surface level +2.01 m (+6.5 ft)  
 Water struck at -3.09 m  
 152 mm percussion  
 September 1979

Overburden 5.1 m  
 Mineral 3.1 m  
 Bedrock 0.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, friable, dark greyish brown, peaty	0.7	0.7
Barroway Drove Beds (?Roddon)	Silt, soft, becoming glutinous below 2.4 m; mottled brownish yellow with black in upper c 1.7 m becoming greyish brown; upper part with thin seams of fine-grained quartz sand; at 3.7 m a large fragment of carbonised wood recovered; becomes progressively more sandy below 4.3 m	4.0	4.7
River Terrace Deposits (Crowland Bed)	Clay, firm, mottled dark olive-grey with olive; with abundant black organic matter, with traces of flint and sandstone gravel; sandy in parts	0.4	5.1
(First Terrace)	Sandy gravel Gravel: fine with coarse; mainly rounded to subrounded, oolitic and shelly limestone with angular to subangular grey white and brown flint—some patinated, with subrounded irregular ironstone, with some subrounded to rounded quartzite, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mostly subrounded to rounded shelly and oolitic limestone with ironstone, with some flint; below 1 mm fraction, quartz common Fines: silty, pale greyish brown; micaceous clayey silt nodules recovered between 5.6 and 6.2 m	3.1	8.2
Oxford Clay	Clay, very stiff to indurated, mottled pale greenish grey with orange-brown in upper 0.1 m becoming pale grey to greenish grey; calcareous, traces of shell fragments; traces of gravel in upper 0.1 m	0.3+	8.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
5	51	44	5.1 - 6.1	4	7	29	16	39	5	0
			6.1 - 7.1	2	7	30	23	33	5	0
			7.1 - 8.2	7	7	10	24	45	7	0
			Mean	5	7	23	21	38	6	0

Surface level + 2.99 m (+ 10.0 ft)  
 Water not struck  
 152 mm percussion  
 September 1979

Waste 4.0 m  
 Bedrock 3.0 m +

## LOG

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, firm, silty clay, pale greyish brown; abundant thin-shelled, molluscan fragments; with black carbonaceous patches; with traces of brick fragments in upper 0.2 m	1.1	1.1
	Clay, pale greyish brown mottled dark orange-red in association with root traces, abundant thin-shelled lamellibranch and gastropod fragments, with traces of rounded to subrounded coarse sand towards base	0.3	1.4
Nordelph Peat	Peat, friable, dark grey to black, fragments of wood throughout	0.9	2.3
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic; bluish-grey with some black carbonaceous patches, mottled dark orange-red in association with root traces, especially in upper 0.5 m	0.9	3.2
Lower Peat (?‘upper leaf’)	Peat, friable, black, with wood fragments; ‘rank’ odour	0.1	3.3
Barroway Drove Beds (‘Buttery Clay’)	Clay, essentially as above, with traces of subrounded vein-quartz and sandstone pebbles	0.6	3.9
Lower Peat (?‘lower leaf’)	Peat, soft, glutinous, dark grey to black, with clay intercalations	0.1	4.0
Oxford Clay	Clay, soft to indurated, pale bluish grey mottled khaki-yellow to olive brown in upper 2.6 m becoming pale greenish-grey to bluish-grey below 6.6 m; with pockets of selenite crystals from c 5.0 m to base; calcareous, rare shell fragments, slightly silty, many dark reddish brown root fragments from 4.0–6.6 m	3.0+	7.0

Surface level +1.73 m (+ 5.5 ft)  
 Water strikes at -4.17 m and -4.97 m  
 152 mm percussion  
 October 1979

Waste 9.6 m  
 Bedrock 0.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, greyish brown to pale brown, slightly mottled pale yellowish grey, slightly silty and calcareous, with chaff fragments	0.7	0.7
Barroway Drove Beds (Roddon)	Silt, firm, friable in parts, mottled pale yellowish brown with pale grey and orange, with some very fine-grained quartz sand; traces of dark brown to grey peat in upper 0.1 m	1.0	1.7
('Buttery Clay')	Clay, soft, glutinous; mottled pale grey with orange in upper 0.3 m becoming grey to dark grey to base, with many black carbonaceous wood fragments; slightly micaceous and silty, root fragments throughout often with associated orange mottles	2.4	4.1
Lower Peat (? 'upper leaf')	Peat, friable, black	0.1	4.2
Barroway Drove Beds ('Buttery Clay')	Clay, essentially as above, with occasional peaty intercalations, with abundant seed fragments (? <i>Phragmites sp</i> )	0.4	4.6
Lower Peat (? 'lower leaf')	Peat, friable, brown, with many wood fragments	c0.2	c4.8
River Terrace Deposits (Crowland Bed)	Sandy clay, soft, grey, calcareous, with much fine to medium-grade sand of quartz with some flint and ?oolitic limestone	c1.1	5.9
(First Terrace)	Sandy gravel, with pebbly concretions Gravel: fine with some coarse; subrounded, tabular, oolitic and shelly limestone and angular to subangular, mainly brown flint—rarely patinated, with ironstone and quartzite, with traces of well-worn belemnite guards and subrounded, indurated chalk Sand: medium with fine and coarse; mostly subrounded to rounded oolitic limestone with ironstone and flint; below 2 mm fraction, quartz fairly common Fines: silty, greyish brown	0.7	6.6
Boulder Clay	Clay, stiff, pale brown to brownish grey in upper 0.1 m becoming grey, with abundant chalk clasts and gravel of flint and sandstone with rare pyrite-rich nodules; with pebbly sand ?lens between c 6.7 and 6.9 m—poor recovery	3.0	9.6
Oxford Clay	Clay, stiff, dark grey to grey, calcareous	0.7+	10.3

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	55	39	5.9 - 6.6	6	16	26	13	35	4	0



Surface level +2.05 m (+7.0 ft)  
 Water strikes at -0.75 m and -2.95 m  
 152 mm percussion  
 October 1979

Overburden 5.7 m  
 Mineral 2.2 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, dark brown loam, peaty towards base, with traces of stone and brick fragments	0.7	0.7
Barroway Drove Beds (Roddon)	Silt, predominantly greyish fawn with alternating laminae of yellowish brown and dark brown to grey, micaceous, sandy in places, with black, carbonaceous fragments throughout; with traces of thin-shelled molluscs	3.9	4.6
Lower Peat	Peat, organic material mixed with soft clay	0.1	4.7
River Terrace Deposits (Crowland Bed)	Sandy clay, glutinous, grey to dark grey, micaceous, with much intercalated organic material	1.0	5.7
(First Terrace)	Sandy gravel Gravel: fine to coarse, rare cobbles—the latter mainly of angular to subangular flint and crystalline limestone; mostly subrounded to rounded, tabular, oolitic and shelly limestone with angular to subangular brown and white flint—rarely patinated, with subrounded to rounded ironstone, with some quartzite and sandstone, with traces of subrounded indurated chalk, well-worn belemnite guards and <i>Gryphaea</i> shell fragments; rare green crystalline ?igneous clasts Sand: medium and coarse with fine; mainly subrounded to rounded, oolitic limestone and ironstone, with some angular to subangular flint; below 2 mm fraction, mainly oolitic limestone and quartz Fines: silty, greyish brown, with occasional clay nodules	2.2	7.9
Oxford Clay	Clay, indurated, grey to pale greenish grey, calcareous, slightly silty	1.2 +	9.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	58	40	5.7 - 6.7	2	13	30	20	31	4	0
			6.7 - 7.9	2	5	23	26	40	4	0
			Mean	2	8	27	23	36	4	0

Surface level +2.40 m (+ 8.0 ft)  
 Water struck at c - 3.5 m  
 152 mm percussion  
 September 1979

Overburden 6.0 m  
 Mineral 2.0 m  
 Bedrock 0.5 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, indurated, greyish brown loam, becoming silty and peaty towards base; with some pebbles	0.5	0.5
Nordelph Peat	Peat, extremely silty, firm, friable in places, dark grey to black	0.6	1.1
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic, mottled dark greyish brown with orange-brown, calcareous in parts, with occasional peaty pockets, with some root fragments with associated iron-oxide haloes	3.6	4.7
Lower Peat (?‘upper leaf’)	Peat, friable, fibrous, dark greyish brown, many seed pods and rootlets	0.1	4.8
Barroway Drove Beds (‘Buttery Clay’)	Clay, essentially as above, with much organic matter and associated ‘rank’ odour	0.7	5.5
Lower Peat (?‘lower leaf’)	Peat as above	c 0.4	c 5.9
River Terrace Deposits (Crowland Bed)	Sandy clay, with intercalations of peat, mottled khaki with black and grey, with fine to medium-grade quartz sand	c 0.1	6.0
(First Terrace)	Sandy gravel, ‘clayey’ in upper 0.9 m Gravel: fine with coarse; mostly rounded to subrounded, tabular oolitic and shelly with some crystalline limestone, with rounded to subrounded irregular ironstone, with some angular to subangular brown and white flint—some patinated, with traces of subrounded to rounded chalk, well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: coarse and medium with some fine; mainly subrounded quartz and ironstone Fines: silty, greyish brown	2.0	8.0
Oxford Clay	Clay, indurated, bluish grey, calcareous, with traces of ammonites including <i>Cardioceras ex gr Scarburgeuse</i>	0.5 +	8.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	49	44	6.0 - 6.9	13	3	20	19	41	4	0
			6.9 - 8.0	3	3	22	30	37	5	0
			Mean	7	3	21	25	39	5	0

Surface level + 2.67 m (+ 9.0 ft)  
 Water struck at - 2.33 m  
 152 mm percussion  
 September 1979

Overburden 5.0 m  
 Mineral 2.9 m  
 Waste 0.1 m  
 Bedrock 0.6 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil	0.6	0.6
Nordelph Peat	Peat, fibrous, dark brown to black	0.5	1.1
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic; dark bluish grey, silty, slightly micaceous and calcareous; with peaty intercalations between 1.1 and 1.8 m and at c 4.5 m—the latter associated with a sandy ?layer	3.8	4.9
River Terrace Deposits (Crowland Bed)	‘Clayey’ sand, soft, glutinous, pale khaki with occasional black, carbonaceous patches, with fine to medium-grade quartz sand	0.1	5.0
(First Terrace)	Sandy gravel Gravel: fine with some coarse; mainly rounded to subrounded, tabular, shelly and oolitic limestone with angular to subangular, brown and white flint—some patinated, with some subrounded to rounded irregular ironstone, with traces of quartzite, well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine; mostly oolitic limestone and ironstone with some quartz and flint Fines: silty, pale brown	2.9	7.9
Boulder Clay	Clay, with chalk clasts	0.1	8.0
Oxford Clay	Clay	0.6+	8.6

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
2	61	37	5.0 - 5.9	4	11	27	24	32	2	0
			5.9 - 6.9	1	6	31	28	30	4	0
			6.9 - 7.9	2	5	29	22	35	7	0
			Mean	2	7	29	25	33	4	0

Surface level +2.83 m (+ 9.0 ft)  
 Water strike not recorded  
 152 mm percussion  
 September 1979

Waste 5.7 m  
 Bedrock 2.3 m +

**LOG**

Geological-classification	Lithology	Thickness m	Depth m
Alluvium	Soil, indurated (?hardpan), greyish brown loam, becoming clayey towards base; many chaff fragments	0.6	0.6
Nordelph Peat	Peat, friable, dark brown to black	1.0	1.6
Barroway Drove Beds (‘Buttery Clay’)	Clay, glutinous, thixotropic, below 3.6 m becomes firm; pale grey with black carbonaceous patches, silty, with much organic matter	2.3	3.9
Lower Peat	Peat, friable in parts, dark brown, many wood fragments, ‘rank’ odour	0.5	4.4
River Terrace Deposits (Crowland Bed)	Sandy clay, sand-free to 4.8 m; firm to very firm, highly mottled khaki-brown to orange-yellow with iron-oxide haloes associated with root traces, with fine to medium-grade sand, with traces of peaty ?intercalations, especially near base	1.3	5.7
Boulder Clay or weathered Oxford Clay	Clay, firm to indurated, pale grey mottled khaki brown, with traces of subrounded limestone and sandstone gravel, many pockets of selenite crystals, calcareous in places, with traces of shells including <i>Gryphaea</i>	2.0	7.7
Oxford Clay	Clay, essentially as above, bluish grey	0.3+	8.0

Surface level + 3.17 m (+ 10.5 ft)  
 Water struck at + 0.97 m  
 152 mm percussion  
 September 1979

Waste 4.1 m  
 Bedrock 1.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, greyish brown, silty clay, mottled orange-brown in association with root traces, calcareous, with traces of thin-shelled lamellibranchs	0.9	0.9
Nordelph Peat	Peat, friable, dark brown to black, with many root and bark fragments; 'rank' odour	1.1	2.0
River Terrace Deposits (First Terrace)	Sandy gravel, 'clayey' in upper 0.1 m; with clay ?layer at c 2.5 m; with ?indigenous shell fragments Gravel: fine with coarse; mainly angular to subangular black and brown patinated flint with rounded to subrounded oolitic and shelly limestone, with some subrounded, irregular ironstone, sandstone and indurated ?chalk, with traces of well-worn Oxford Clay shells and ?indigenous shell fragments including ? <i>Mytilus edulis</i> ; rare worm-tubes and worm-bored pebbles Sand: medium and coarse with fine; mainly subangular to subrounded flint and oolitic limestone in coarse-grade; below 2 mm fraction mainly subrounded quartz with ironstone; shell fragments occur throughout Fines: silty, light olive brown [2.5 Y 5/4], with some clay nodules at c 2.5 m	0.7	2.7
Boulder Clay	Clay, indurated to firm, grey to pale grey, mottled throughout by orange-brown, with rounded to subrounded chalk clasts, with some patches of sandy gravel; rare well-worn <i>Gryphaea</i> shells; with traces of dark reddish brown roots	1.4	4.1
Oxford Clay	Clay, indurated, khaki-grey slightly mottled orange-brown becoming bluish grey towards base, calcareous, slightly silty, with traces of shell fragments including ?scaphopod fragments	1.1 +	5.2

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
7	50	43	2.0 - 2.7	7	7	24	19	37	6	0

Surface level +2.33 m (+ 7.5 ft)  
 Water strike not recorded  
 152 mm percussion  
 September 1979

Waste 10.9 m  
 Bedrock c0.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, firm to stiff, brown, calcareous	0.3	0.3
	Silt, firm, yellowish brown to brown mottled orange-brown in association with root traces, calcareous, with traces of shell fragments	0.4	0.7
Nordelph Peat	Peat, friable, dark brown to black, with silt intercalations	0.6	1.3
Barroway Drove Beds ('Buttery Clay')	Clay, soft, glutinous, thixotropic, dark greyish brown [2.5 Y 4/2], with many black carbonaceous fragments, with traces of mica; becomes increasingly silty to sandy below 7.1 m to base	7.0	8.3
River Terrace Deposits (First Terrace)	Sandy gravel, with an abundance of ?indigenous shell fragments Gravel: fine with some coarse; mainly subangular to subrounded oolitic shelly and crystalline limestone, subrounded sandstone (some calcareous) and angular to subangular, brown and black with white flint, with ironstone and quartzite, with traces of well-worn Oxford Clay shell fragments; with abundant ?indigenous molluscan shells (many complete specimens) including gastropods— <i>Buccinum undatum</i> and <i>Buccinum sp</i> and lamellibranchs – <i>Cerastoderma edule</i> , <i>Macoma balthica</i> , <i>Mytilus edulis</i> , <i>Ostrea edulis</i> and some pholadacean fragments, with traces of <i>Balanus sp</i> and bored (? <i>Polydora</i> ) pebbles, some bored lamellibranch shells, epifanual bryozoa and decapod chelae Sand: fine with coarse and medium; mainly quartz with some flint; abundant shell fragments Fines: silty, dark grey	0.7	9.0
Boulder Clay	Clay, firm to stiff, predominantly with yellowish brown mottles in upper 0.3 m; with subrounded chalk clasts; traces of angular flint gravel	1.9	10.9
Oxford Clay	Clay, very poor recovery	c0.1+	c 11.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	70	24	8.3 - 9.0	6	43	13	14	21	3	0

## COMPOSITION

Gravel fraction (mm)	Depth below surface (m)	<i>Percentage by weight</i>													
		Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone		Igneous/Meta-morphic	Others
		Angular	Rounded	Crystal-line	Oolitic	Shelly		Indigenous	Derived		Calcareous				
4-8	8.3-9.0	14	nil	10	15	12	12	5	9	1	nil	17	5	nil	nil
8-16	8.3-9.0	32	nil	10	15	6	5	7	5	1	trace		18	1	nil
Mean	8.3-9.0	17	nil	10	15	11	11	6	8	1	trace		21	trace	nil

### Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
4-8	8.3-9.0	33	45	22
8-16	8.3-9.0	36	48	16
Mean	8.3-9.0	33	46	21

Surface level +2.16 m (+7.0 ft)  
 Water struck at -4.84 m  
 152mm percussion  
 September 1979

Waste 8.1 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Soil, firm to indurated (? hardpan), greyish brown silty loam, mottled brownish yellow with dark orange-red (especially associated with root traces) towards base; calcareous, with pockets of black carbonaceous matter	0.5	0.5
Nordelph Peat	Peat, friable, black	0.2	0.7
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, thixotropic; predominantly dark greyish brown [2.5 Y 4/2], mottled dark orange-red in association with root traces; calcareous; below 4.5 m with many mollusc fragments including gastropods— <i>Hydrobia ulvae</i> and <i>Hydrobia ventrosa</i> and lamellibranchs— <i>Cerastoderma edule</i> and <i>Macoma balthica</i> ; with many black carbonaceous fragments; with traces of coarse sand	6.1	6.8
Lower Peat	Peat, mixture of root material with clay; dark reddish brown; many wood fragments; ‘rank’ odour	0.2	7.0
River Terrace Deposits (?Crowland Bed)	Sandy clay, soft; mottled khaki-green with black, with peaty intercalations, ‘rank’ odour; with some shell fragments, with fine to medium-grade sand, with traces of coarse angular to subangular flint gravel	0.2	7.2
(First Terrace)	Sandy gravel, with traces of ?indigenous shell fragments Gravel: fine with some coarse; mainly subrounded to rounded tabular oolitic and shelly limestone with subrounded to rounded ironstone and angular to subangular brown with black flint, with traces of well-worn belemnite guards; with traces of ?indigenous molluscan shells including gastropods and thin-shelled lamellibranchs Sand: medium with coarse and fine; mostly subrounded to rounded oolitic limestone with ironstone with some angular to subangular flint and shell fragments; below 1 mm fraction mostly ooids, ironstone and quartz Fines: silty, dark greyish brown [2.5 Y 4/2], with occasional very dark grey [10 YR 3/1], ?organic, pebbly clay nodules Borehole abandoned at 8.1 m due to ?gravel obstruction	0.9+	8.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
4	68	28	7.2 - 8.1	4	15	34	19	27	1	0



Surface level + 1.64 m (+ 5.0 ft)  
 Water struck at c - 4.46 m  
 152 mm percussion  
 September 1979

Waste 8.7 m  
 Bedrock 1.3 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, firm, dark brown to brownish grey loam with many pale fawn mottled patches; calcareous; with traces of brick fragments	0.5	0.5
Barroway Drove Beds (Roddon)	Silt, firm, mottled pale yellowish brown with dark brown and black, calcareous	1.3	1.8
('Buttery Clay')	Clay, soft, glutinous, thixotropic, dark greyish brown [2.5 Y 4/2]; slightly micaceous and calcareous, very silty in parts, becomes very sandy towards base; with abundant fragments of black, carbonaceous material; with many thin-shelled lamellibranch fragments including <i>Cerastoderma edule</i> and <i>Macoma balthica</i>	4.3	6.1
River Terrace Deposits (First Terrace)	Sandy gravel, with traces of ?indigenous shell fragments in upper 0.1 m Gravel: fine with some coarse; mainly subrounded tabular oolitic and shelly with some crystalline limestone, with subrounded irregular ironstone and angular to subangular brown and white flint, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments; rare dark green, crystalline ?igneous clasts and indurated chalk Sand: medium and coarse with fine; mostly subrounded quartz with oolitic limestone and ironstone, with some subangular flint Fines: slightly silty, pale grey to grey	1.6	7.7
Boulder Clay	Clay, stiff to indurated, khaki in upper 0.1 m becoming bluish-grey to base, with chalk clasts and some limestone gravel	1.0	8.7
Oxford Clay	Clay, stiff to indurated, dark bluish-grey to grey; silty in parts, calcareous, with traces of shell fragments	1.3 +	10.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16	+ 64 mm
2	62	36	6.1 - 7.7	2	8	30	24	32	4	0

Surface level + 1.31 m (+ 4.5 ft)  
 Water struck at c - 0.69 m  
 152 mm percussion  
 September 1979

Waste 7.1 m  
 Bedrock 1.0 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark grey, peaty silt	0.2	0.2
Barroway Drove Beds (‘Buttery Clay’)	Clay, soft, glutinous, below 2.0 m becomes thixotropic; predominantly pale greyish fawn mottled grey and orange-brown, between 0.6 and 2.0 m ?layered greyish brown with brown, below 5.0 m becomes predominantly dark-grey; silty and sandy in parts especially below 2.0 m; with traces of black, carbonaceous fragments throughout; below 5.0 m with white thin-shelled lamellibranch fragments; with peaty ?layer at c 5.7 m with complete ? <i>Cerastoderma edule</i> and rare bark fragments	5.5	5.7
(?Lower Peat at c 5.7 m)			
River Rerrace Deposits (First Terrace)	‘Very clayey’ sandy gravel, with ?indigenous shell fragments; whole deposit shows a high degree of ‘rounding’; particularly sandy towards base Gravel: fine with coarse; mainly rounded to subrounded, crystalline, oolitic and shelly limestone, subangular brown and white with black, flint and subrounded sandstone (some calcareous), with subrounded to rounded ironstone and quartzite, with some subrounded to rounded chalk, with traces of well-worn belemnite guards; from c 6.0 m with abundant ?indigenous molluscan fragments including ? <i>Cerastoderma edule</i> , with some bored pebbles Sand: fine with coarse and medium; mostly subrounded to rounded quartz Fines: ‘very clayey’, dark grey	0.7	6.4
Boulder Clay	Clay, stiff, dark grey mottled with khaki and olive, with subrounded chalk clasts	0.7	7.1
Oxford Clay	Clay, indurated, bluish grey	1.0+	8.1

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				- 1/6	+ 1/6 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
20	39	41	5.7 - 6.4	20	27	4	8	35	6	0	

**COMPOSITION**

Gravel fraction (mm)	Depth below surface (m)	Percentage by weight												
		Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others
		Angular	Rounded	Crystalline	Oolitic	Shelly		Indigenous	Derived		Calcareous			
4 - 8	5.7 - 6.4	26	nil	16	12	10	10	7	1	2	3	11	trace	2
8 - 16	5.7 - 6.4	41	nil	9	8	12	1	9	2	1	3	14	nil	nil
Mean	5.7 - 6.4	30	nil	15	11	10	8	7	1	2	3	12	trace	1

**Flint colour variation** (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
4 - 8	5.7 - 6.4	15	53	32
8 - 16	5.7 - 6.4	15	49	36
Mean	5.7 - 6.4	15	52	33

Surface level + 1.69 m (+ 5.5 ft)  
 Water struck at - 4.61 m  
 152 mm percussion  
 September 1979

Waste 7.2 m  
 Bedrock 0.8 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark greyish brown, slightly peaty	0.7	0.7
Barroway Drove Beds (Roddon)	Silt, firm, soft below 1.6 m, thixotropic below 2.2 m; variegated buff with orange-yellow to orange-red, becoming dark greyish brown [2.5 Y 4/2], with traces of roots and associated orange-red iron-oxide mottles in upper c 1.0 m; slightly calcareous and micaceous; becomes sandy towards base with many black carbonaceous fragments; with rare fragments of thin-shelled lamellibranchs; 'rank' odour in parts	5.6	6.3
River Terrace Deposits (First Terrace)	Sandy gravel, with abundant ?indigenous molluscan shells in upper 0.2 m; much of the deposit 'stained' black Gravel: fine with coarse; subrounded to rounded, tabular, oolitic and shelly limestone and angular to subangular, mainly brown and white flint, with ironstone, vein-quartz and sandstone, with some subrounded, soft to indurated chalk, with traces of well-worn belemnite guards; with abundant ?indigenous molluscan fragments including gastropods— <i>Buccinum undatum</i> and <i>Turritella communis</i> and lamellibranchs— <i>Cerastoderma edule</i> , <i>Macoma balthica</i> , <i>Mytilus edulis</i> and <i>Scrobicularia plana</i> with traces of decapod chelae and rare bored (? <i>Polydora</i> ) pebbles, with some bored lamellibranch shells Sand: medium with fine and coarse; mainly ironstone, oolitic limestone, chalk and shell fragments in coarse-grade; below 2 mm fraction, mostly subrounded to rounded quartz Fines: silty, dark grey	0.8	7.1
Boulder Clay	Clay, stiff, brownish grey to greyish blue, many chalk clasts, with some flint gravel	0.1	7.2
Oxford Clay	Clay, indurated, pale grey to greyish blue, slightly silty, calcareous, traces of shell fragments—usually veneered with pyrite, with some pyrite-rich ?layers	0.8+	8.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
6	59	35	6.3 - 7.1	6	13	33	13	27	8	0

Surface level +1.57 m (+ 5.0 ft)  
 Water struck at -0.33 m  
 152 mm percussion  
 September 1979

Overburden 1.1 m  
 Mineral 3.7 m  
 Waste 0.5 m  
 Bedrock 1.2m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark reddish brown [5 YR 2.5/2]	0.5	0.5
River Terrace Deposits (First Terrace)	Silt, predominantly pale brown [10 YR 6/3] slightly mottled dark orange-brown; with some sand	0.6	1.1
	'Clayey' sandy gravel, 'very clayey' and sandy in upper 1.0 m Gravel: fine with coarse, rare mainly quartzite cobbles; mainly subrounded tabular oolitic and shelly limestone with angular to subangular brown and white flint, with some subrounded irregular ironstone, with some subrounded to rounded quartzite and sandstone, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium with coarse and fine; mostly subrounded quartz with ironstone and flint Fines: 'very clayey' to silty, strong brown [7.5 YR 5/8]	3.7	4.8
Boulder Clay	Clay, firm in upper 0.2m becoming stiff; pale brown mottled grey becoming dark grey below 5.0m; with subrounded to rounded chalk clasts throughout	0.5	5.3
Oxford Clay	Clay, indurated, dark bluish-grey, slightly calcareous, traces of shell fragments including <i>Gryphaea</i>	1.2+	6.5

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
13	51	36	1.1 - 2.1	33	19	36	6	6	0	0
			2.1 - 3.1	6	9	34	19	25	7	0
			3.1 - 4.1	5	4	14	24	44	9	0
			4.1 - 4.8	7	3	14	18	49	9	0
			Mean	13	9	25	17	30	6	0

Surface level +2.05 m (+7.0 ft)  
 Water struck at c +0.15 m  
 152 mm percussion  
 September 1979

Overburden 3.0 m  
 Mineral 1.8 m  
 Bedrock 1.2 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, greyish brown, peaty loam	0.5	0.5
River Terrace Deposits (First Terrace)	Silt, firm, laminae of alternate pale cream to buff with dark greyish brown	0.5	1.0
	<b>a</b> Very clayey pebbly sand; mainly fine with medium and coarse sand of subrounded to rounded quartz and ironstone with some flint and shell fragments; with some fine gravel, mostly subrounded tabular shelly limestone with some angular to subangular flint; with very clayey matrix—brownish yellow [10 YR 6/8] with nodules of shelly, silty clay at c 1.8 m—shells mainly lamellibranchs—?indigenous	2.0	3.0
	<b>b</b> Sandy gravel, with some iron-oxide 'staining' Gravel: fine with coarse; mainly subrounded to rounded, tabular, shelly with some oolitic and crystalline limestone, and angular to subangular brown with some white and black flint, with some subrounded to rounded quartzite, ironstone, sandstone (some calcareous) and chalk, with traces of well-worn belemnite guards and <i>Gryphaea</i> fragments Sand: medium and coarse with fine, mostly subrounded quartz Fines: silty, strong brown [7.5 YR 5/8]	1.8	4.8
Oxford Clay	Clay, soft to firm in upper 0.2 m, becoming indurated below 5.0 m; mottled pale khaki with fawn and grey, becoming predominantly bluish-grey below 5.0 m; calcareous, silty in places, with traces of disseminated pyrite; rare belemnite guards	1.2+	6.0

**GRADING**

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel								
					Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm	
<b>a</b>	43	43	14	1.0 - 1.4	Unsampled						
				1.4 - 2.4	40	27	16	5	10	2	0
				2.4 - 3.0	48	19	11	6	13	3	0
				Mean	43	24	14	5	12	2	0
<b>b</b>	9	48	43	3.0 - 4.0	9	17	17	14	32	11	0
				4.0 - 4.8	9	8	20	21	35	7	0
				Mean	9	13	18	17	33	10	0
<b>a + b</b>	26	45	29	Mean	26	18	16	11	23	6	0

## COMPOSITION

Gravel fraction (mm)	Depth below surface (m)	Percentage by weight												
		Flint		Limestone			Ironstone	Quartzite	Fossil debris		Chalk	Sandstone	Igneous/ Meta-morphic	Others
		Angular	Rounded	Crystal-line	Oolitic	Shelly		Indi-genous	Derived		Cal-careous			
4-8	1.4-4.8	27	trace	nil	8	44	5	5	trace	4	4	3	nil	nil
8-16	1.4-4.8	45	nil	nil	3	37	1	7	trace	1	1	5	trace	nil
16-31.5	1.4-4.8	48	1	12	4	10	2	9	nil	nil	nil	14	trace	nil
31.5	1.4-4.8	46	9	nil	nil	3	nil	23	nil	nil	nil	19	nil	nil
Mean	1.4*-4.8*	31	trace	1	7	41	4	6	trace	3	3	4	trace	nil

### Flint colour variation (see Roeder, 1977)

Gravel fraction (mm)	Depth below surface (m)	Colour variation (percentages by weight)		
		Black	Brown	White
4-8	1.4-4.8	2	89	9
8-16	1.4-4.8	4	37	59
16-31.5	1.4-4.8	trace	38	62
31.5	1.4-4.8	nil	34	66
Mean	1.4*-4.8*	2	79	19

\*Composition analysis shown here includes an upper non-mineral layer between 1.4-3.0m.

Surface level + 1.60 m (+ 5.0 ft)  
 Water struck at + 0.1 m  
 152 mm percussion  
 September 1979

Overburden 0.6 m  
 Mineral 2.7 m  
 Waste 2.0 m  
 Bedrock 1.7 m +

**LOG**

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown to brown, sandy and clayey towards base	0.6	0.6
River Terrace Deposits (First Terrace)	'Clayey' sandy gravel, 'very clayey' in upper 1.0 m Gravel: fine with coarse; mainly angular to subangular brown and white flint with subrounded to rounded oolitic, crystalline and shelly limestone, with some subrounded, irregular ironstone, with some subrounded quartzite and sandstone Sand: medium with fine and coarse; mainly angular to subangular white flint in coarse-grade; below 2 mm fraction, mostly rounded to subrounded quartz and ironstone Fines: 'very clayey' to silty, yellowish brown [10 YR 5/8]	2.7	3.3
Boulder Clay	Clay, firm to stiff in upper 0.1 m, becoming indurated; variegated pale greyish brown to reddish brown becoming bluish-grey below 3.4 m; with many subrounded to rounded chalk clasts	2.0	5.3
Oxford Clay	Clay, indurated, pale grey to grey, slightly silty, calcareous, with traces of ammonite and belemnite fragments	1.7 +	7.0

**GRADING**

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- 1/16	+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16 - 64	+ 64 mm
15	52	33	0.6 - 1.6	29	22	30	5	10	4	0
			1.6 - 2.6	8	7	34	13	33	5	0
			2.6 - 3.3	5	5	22	18	41	9	0
			Mean	15	12	29	11	27	6	0

The following IGS registered (non-confidential) were used in the assessment of resources. Only those data points used the calculations are listed.

Borehole* No.	Grid reference	Block/sub block
TF 01 NE 58 <sup>‡</sup>	069 161	A <sub>2</sub>
TF 01 SE 44 <sup>‡</sup>	0804 1172	A <sub>1</sub>
50 <sup>‡</sup>	0889 1190	F <sub>1</sub>
55	0855 1194	F <sub>1</sub>
56	0832 1170	A <sub>1</sub>
58	0818 1174	A <sub>1</sub>
61	0809 1174	A <sub>1</sub>
68	0952 1356	A <sub>1</sub>
69	0941 1339	A <sub>1</sub>
70	0944 1349	A <sub>1</sub>
78 <sup>‡</sup>	0953 1354	A <sub>1</sub>
TF 11 NW 2 <sup>‡</sup>	1053 1688	F <sub>1</sub>
4c <sup>‡</sup>	c1478 1799	D <sub>1</sub>
6	1486 1911	E <sub>1</sub>
7a	c1403 1642	F <sub>1</sub>
8	1447 1756	D <sub>1</sub>
9 <sup>‡</sup>	1235 1698	D <sub>1</sub>
10 <sup>‡</sup>	1402 1769	D <sub>1</sub>
12 <sup>‡</sup>	1394 1601	F <sub>1</sub>
13 <sup>‡</sup>	1391 1597	F <sub>1</sub>
33 <sup>‡</sup>	1145 1823	D <sub>1</sub>
36	1045 1700	F <sub>1</sub>
43 <sup>‡</sup>	1098 1693	F <sub>1</sub>
45 <sup>‡</sup>	1047 1657	F <sub>1</sub>
46 <sup>‡</sup>	1150 1643	F <sub>1</sub>
52b	1073 1503	A <sub>1</sub>
53 <sup>‡</sup>	1191 1546	F <sub>1</sub>
TF 11 NE 1 <sup>‡</sup>	1576 1506	F <sub>1</sub>
2 <sup>‡</sup>	1610 1510	E <sub>1</sub>
3 <sup>‡</sup>	1608 1517	E <sub>1</sub>
12 <sup>‡</sup>	1527 1646	E <sub>1</sub>
13 <sup>‡</sup>	1504 1618	E <sub>1</sub>
TF 11 SW 7 <sup>‡</sup>	1272 1425	F <sub>1</sub>
8 <sup>‡</sup>	1251 1276	F <sub>1</sub>
9	1374 1012	F <sub>1</sub>
10 <sup>‡</sup>	1313 1018	A <sub>1</sub>
11 <sup>‡</sup>	1195 1285	F <sub>1</sub>
12 <sup>‡</sup>	1093 1120	F <sub>1</sub>
13	1108 1491	F <sub>1</sub>
14	1110 1492	F <sub>1</sub>
15	1175 1414	F <sub>1</sub>
16	1093 1380	F <sub>1</sub>
17 <sup>‡</sup>	1127 1379	F <sub>1</sub>
18 <sup>‡</sup>	1186 1203	F <sub>1</sub>

Borehole* No.	Grid reference	Block/sub block
TF 11 SE 1b <sup>‡</sup>	c1741 1295	F <sub>1</sub>
2 <sup>‡</sup>	1541 1463	F <sub>1</sub>
3 <sup>‡</sup>	1660 1407	F <sub>1</sub>
4 <sup>‡</sup>	1527 1292	F <sub>1</sub>
6 <sup>‡</sup>	1898 1399	E <sub>1</sub>
7 <sup>‡</sup>	1931 1384	E <sub>1</sub>
8 <sup>‡</sup>	1926 1080	D <sub>1</sub>
9 <sup>‡</sup>	1871 1039	D <sub>1</sub>
10 <sup>‡</sup>	1826 1125	D <sub>1</sub>
12 <sup>‡</sup>	1630 1158	F <sub>1</sub>
13	5170 1032	A <sub>1</sub>
14 <sup>‡</sup>	1687 1282	E <sub>1</sub>
TF 21 NW 3 <sup>‡</sup>	2413 1967	C <sub>1</sub>
5 <sup>‡</sup>	2427 1914	C <sub>1</sub>
6 <sup>‡</sup>	2401 1902	C <sub>1</sub>
7	2416 1914	C <sub>1</sub>
8	2414 1954	C <sub>1</sub>
TF 21 SW 1	2405 1039	F <sub>2</sub>
4	243 103	F <sub>2</sub>
12 <sup>‡</sup>	2385 1384	E <sub>1</sub>
45	2437 1026	F <sub>2</sub>

\* By sheet quadrant.

† All fall within 100 km squares TF 01, TF 11 or TF 21.

‡ Boreholes shown on the map.

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A. D. McAdam.  
ISBN 0 11 884042 8 £1.00

78/8 Sand and gravel resources of the Highland Region.  
W. Mykura, D. L. Ross and F. May.  
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INSTITUTE OF GEOLOGICAL SCIENCES  
INDUSTRIAL MINERALS ASSESSMENT UNIT  
**THE SAND AND GRAVEL RESOURCES OF THE COUNTRY BETWEEN BOURNE AND CROWLAND, LINCOLNSHIRE**  
Scale 1:25 000 or about 2 1/4 Inches to 1 Mile

ORDNANCE SURVEY  
SHEET TF 11 & PARTS OF TF 01 AND TF 21  
PROFESSIONAL EDITION

THE SAND AND GRAVEL RESOURCES OF THE COUNTRY BETWEEN BOURNE AND CROWLAND, LINCOLNSHIRE

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

**EXPLANATION OF SYMBOLS AND ABBREVIATIONS**

DRIFT	Allevium - clays and silts	A-21	RECENT QUATERNARY	
Tb1	Terrington Beds - silts of former tidal creeks	Tb-3		
N	Nordalgh Peat - black peat, often incorporated into the soil horizons	NP-3		
BDM	Barroway Drive Beds - mainly soft clays with carbonaceous roots, including silty sands with channels or Roddons (R) often poorly defined and rarely terminated	BD-3		
LW	Lower Peat - peat only in borcoliths	LW-1		
FT	First Terrace - includes the Crowland Bed - occasional interbedded clay lenses and sand filled scour channels	FT-42		
GD	Glacial Drift, undifferentiated - heterogeneous clays green and pebbly clay	GD-2		PLEISTOCENE UPPER
H	Heed - loams, stony clays and unsorted rock debris	H-31		
BC	Blowworth Clay - soft blue clay with pebbles of chalk and flint	BC-4		UPPER MIDDLE JURASSIC
GS	Glacial Sand and Gravel - poorly sorted sand and gravel	GS-64		

**SOLID**

OC	Oxford Clay - grayish blue, fossiliferous clays and mudstones	UPPER MIDDLE JURASSIC
KS	Kilwasey Sand - fine-grained, pale grey silty sand	
KC	Kilwasey Clay - dark grey mudstone	
CL	Carborough - indurated, shell-dental limestone	
BC	Blowworth Clay - grey to green, with ironstone and purple-coloured mudstone	
BL	Blowworth Limestone - massive, blue-banded shaly limestone	
UT	Upper Estuarine 'Series' - interbedded grey and green mudstones, with sands and silts	
UL	Upper Lincolnshire Limestone - oolitic and shaly limestone - proved only in non-IMAU boreholes	

**BOUNDARY LINES**

- Geological boundary
- Western limit of the Barroway Drive Beds beneath the Nordalgh Peat
- Roddons - mapped boundaries
- Roddons - median line (found only in north-eastern part of map)
- Geological boundary, Solid
- Fault at surface, crossmark indicates downthrow side
- Resource block and sub-block boundary
- Inferred boundary between recognized categories of deposits

**BOREHOLE DATA**

**SITE LOCATIONS**

- Industrial Minerals Assessment Unit (I.M.A.U.) boreholes
- Other boreholes - see Report 38

**I.M.A.U. BOREHOLES**

Borehole Registration Number - 11 SE 29

Surface level in metres (OD) and feet (above O.D.)

Overburden - 2.79 m (9.15 ft)

Borehole Size - 150 mm (6 in)

Geological Classification - 11 SE 29 - 11 SE 29 - Mineral (sand and gravel)

Geological Classification - 11 SE 29 - 11 SE 29 - Mineral (sand and gravel)

Grading diagram

**OTHER BOREHOLES**

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

**CATEGORIES OF DEPOSITS**

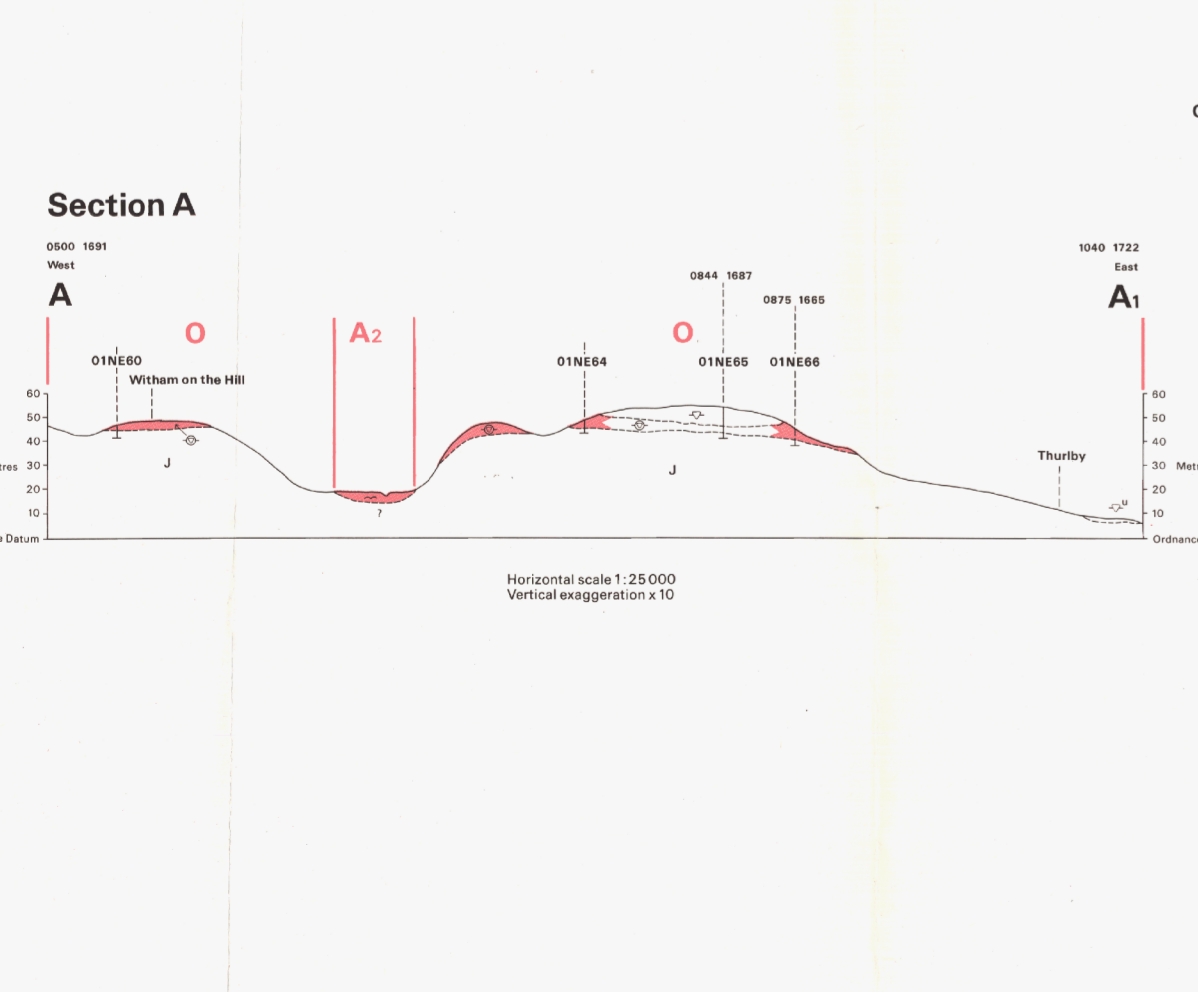
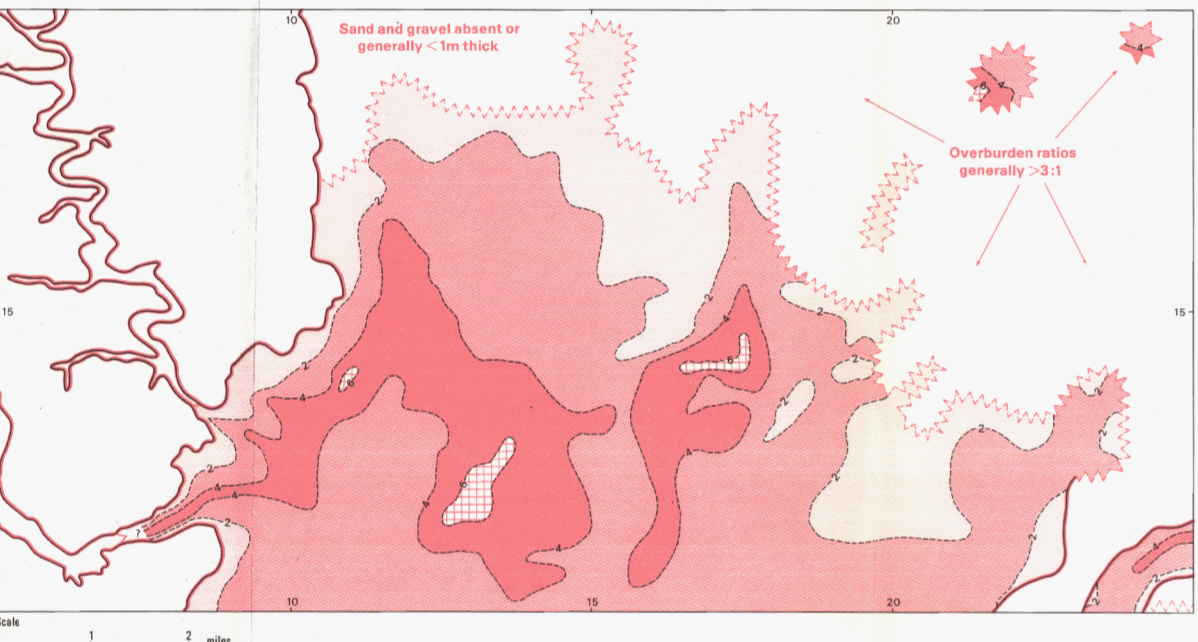
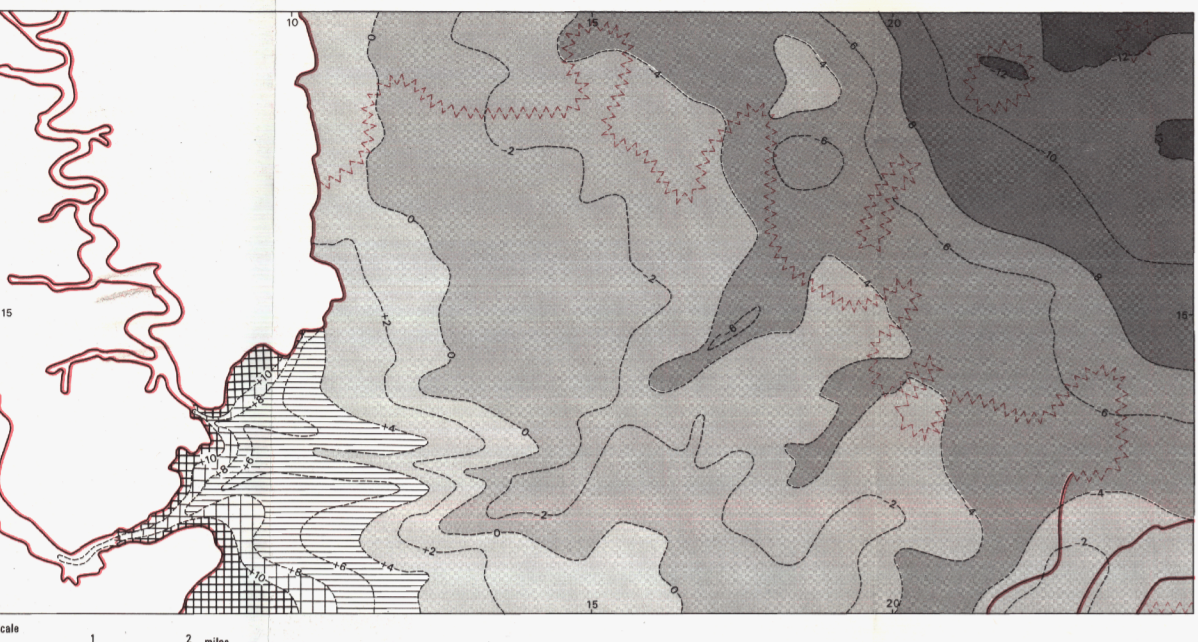
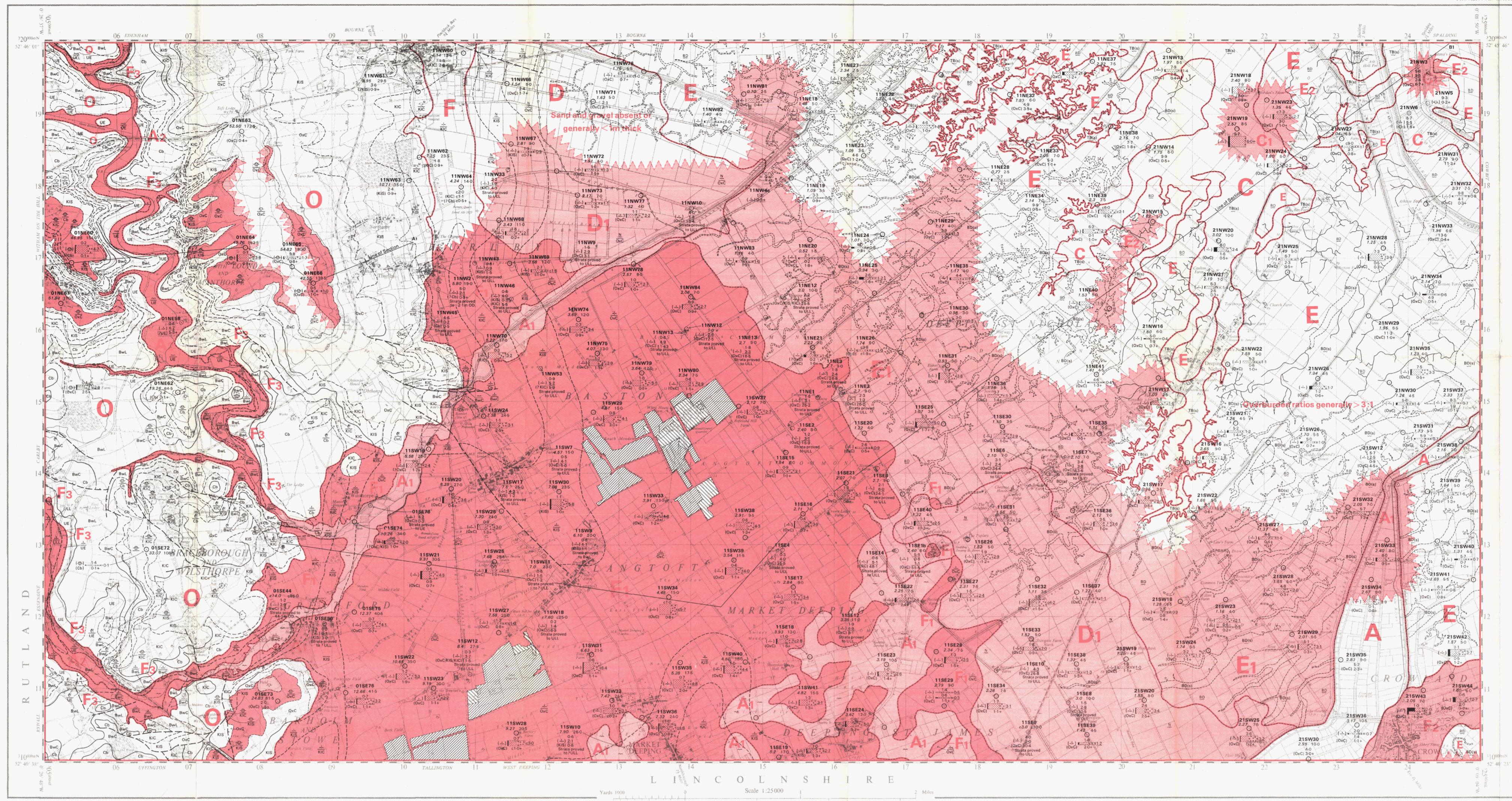
- Exposed mineral - CAT-E6
- Continuous or almost continuous spreads of mineral beneath overburden - CAT-C1
- Sand and gravel either not potentially workable or absent - CAT-A2

**RESOURCE BLOCKS/SUB-BLOCKS**

For the purposes of assessment, the map is divided into Resource Blocks within which sand and gravel classified as mineral is distinguished by sub-blocks (see Report 2). Each block is designated a letter and sub-blocks by a letter and a subscript number (see Report Table 4).

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

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**KEY**

- Boundary of Block O (the islands) and mineral limits (lower right)
- Inferred boundary of assessed mineral

**A. Heights in metres relative to OD**

> +50
+48 - +50
+44 - +48
0 - +44
-4 - 0
-8 - -4
-12 - -8
< -12

**B. Thickness in metres**

0-2
2-4
4-6
6+

**ORNAMENT KEY**

- Redden - Terrington Beds
- Redden - Barroway Drive Beds
- Peat including intermediate beds of the Lower Peat
- Upper clayey facies - laterally equivalent to the Crowland Bed
- Sand and gravel
- Sandy facies, including indigenous shells and some gravel
- Jurassic undivided

**Generalised sections**

Section A: 0500 1891 West to 1040 1722 East. Boreholes: 01NE60, 01NE64, 01NE65, 01NE66.

Section B: 0820 1300 West to 2480 2000 North-west. Boreholes: 11SW21, 11SW34, 11SE16, 11SE21, 11SE3, 11SE25, 11SE36, 11NE40, 21NW4, 21NW27, 21SW4, 21SW27, 21SW42, 21SW43.