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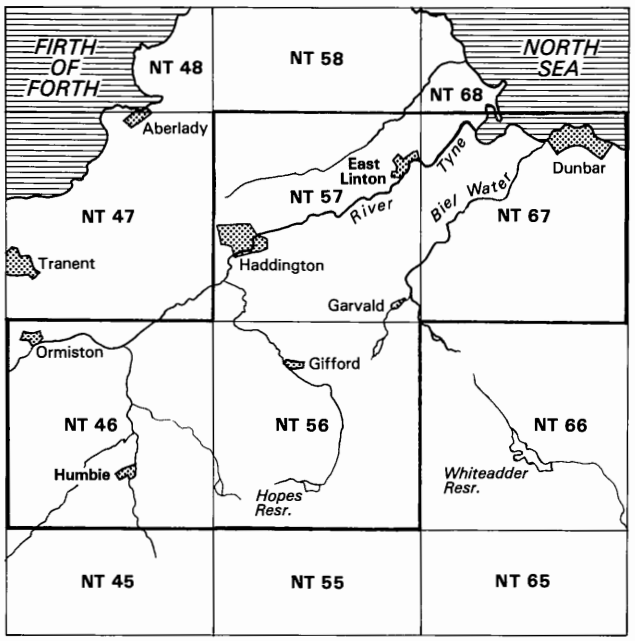

The sand and gravel resources of the country around Humbie and East Linton, Lothian Region

Description of 1:25000 sheets NT 46, 56, 57 and 67

A. M. Aitken and D. L. Ross

Contributors
A.D. McAdam and C.W. Thomas

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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 13 and subsequent reports up to number 139 appear as Mineral Assessment Reports of the Institute of Geological Sciences. Reports 140 to 144 were published as Mineral Assessment Reports of the British Geological Survey.

The reports up to number 144 are published through Her Majesty's Stationery Office and are available from Government Bookshops, other booksellers or directly from the British Geological Survey. They are listed in HMSO's Sectional List 45.

Reports subsequent to number 144 are published internally by the British Geological Survey. The style of these reports and their accompanying maps vary but all may be purchased from the Bookshops at the Keyworth and Edinburgh offices of the British Geological Survey, or from the Bookshop of the Geological Museum, Exhibition Road, London SW7 2DE.

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

Sand and gravel surveys have been commissioned recently by the Department of the Environment using universities and the private sector. These reports are broadly similar to Mineral Assessment Reports but are not listed here: details of their availability may be obtained from the Department of the Environment, (Mineral Planning Division), 2 Marsham Street, London, SW1P 3EB.

Any enquiries concerning this report may be addressed to the Programme Manager, Central Scotland Research Programme, British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA.

PREFACE

The demand for industrial minerals and for land for all purposes continues at a high level and it remains clear that a national assessment of mineral resources is necessary. As well as providing a stocktaking of resources, regional assessment gives the basis, along with other studies, for sound planning policies and decisions about the use of land.

Sand and gravel was selected in the 1960s as the bulk mineral most needing attention and systematic surveys were initiated under the then Ministry of Land and Natural Resources, beginning in south-east England. Some 146 full resource surveys have been carried out by BGS to a standardised model, providing an assessment to a consistent level of confidence.

East Lothian was selected as an area of priority planning interest by the Scottish Development Department. The work was commissioned and financed by the Department of the Environment.

This report describes the resources of sand and gravel of 395km^2 of country around Haddington, lying mainly in Lothian Region, and shown on the accompanying resource maps. The survey was conducted by A M Aitken, D L Ross, J W Merritt and C W Thomas, under the supervision of J I Chisholm, Programme Manager. The work is based on the published Haddington (33W) and Dunbar (33E) Drift sheets of the Geological Map of Scotland, but incorporates a partial resurvey of the sand and gravel deposits during 1982 and 1983 by A D McAdam. Palaeontological examination of clay samples was carried out by D K Graham.

J D Burnell, ISO, FRICS (Land Agent), has been responsible for negotiating access to land for drilling; the ready cooperation of land owners, tenants and sand and gravel operators is gratefully acknowledged.

The views expressed in this report are not necessarily those of the Department of the Environment or the Scottish Development Department.

G I Lumsden
Director

British Geological Survey
Keyworth, Nottingham
NG12 5GG

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SUMMARY

The assessment of sand and gravel resources around Humbie and East Linton, Lothian Region, is based on the published geological maps of the British Geological Survey, ninety-nine boreholes and seventy-one shallow pits commissioned for the assessment, data from working pits and natural sections, and pre-existing borehole information.

All known deposits in the area which might be potentially workable for sand and gravel have been investigated and a simple statistical method used to estimate their volume. Where possible the reliability of the volume estimates is given at the symmetrical 95 per cent probability level.

The sand and gravel resources are identified on two 1:25000-scale resource maps. These maps are divided into eight resource blocks, which contain between 3.5 and 11.6km^2 of potentially workable sand and gravel.

The geology of the deposits is described and the mineral-bearing area, the mean thickness of overburden and mineral, and the mean grading are stated. Detailed sample-point data are given. The geology, the outlines of the resource blocks and the position of sample points used in the assessment are shown on the two accompanying resource maps.

Bibliographic reference

Aitken, A.M., and Ross, D.L. 1986. The sand and gravel resources of the country around Humbie and East Linton, Lothian Region. Description of 1:25000 sheets NT 46,56,57 and 67. *Miner. Assess. Rep. Brit. Geol. Surv.*, No. 147.

Authors and contributors

A.M. Aitken, BSc., A.D. McAdam, BSc., MIGeol., D.L. Ross, BSc., and C.W. Thomas, MSc. British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA.

Note

National Grid references are given in the form *[455 656]* throughout. In this report all lie within the 100-km square NT.

INTRODUCTION

The survey is concerned with the estimation of *resources*, which include deposits that are not currently exploitable but have a foreseeable use. It is not concerned with *reserves*, which can only be assessed in the light of current, locally prevailing, economic considerations. Clearly, both the economic and the social factors used to decide whether a deposit may be workable in the future cannot be predicted; they are likely to change with time. Deposits not currently economically workable may be exploited as demand increases, as higher grade or alternative materials become scarce, or as improved processing techniques are applied to them. The improved knowledge of the main physical properties of the resource and their variability, which this survey seeks to provide, will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971, 1981; Harris and others, 1974).

The survey provides information at the *indicated* level for which "tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout" (Bureau of Mines and Geological Survey, 1948, p.15).

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

The following arbitrary physical criteria have been adopted:

a The deposit should average at least 1m 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 BS sieve, about $\frac{1}{16}$ (0.065)mm) should not exceed 40 per cent.
d The deposit must lie within 25m 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 18m if no sand and gravel has been proved.

A deposit of sand and gravel that broadly meets these criteria is regarded as *potentially workable* and is described and assessed as *mineral* in this report. As the assessment is at the 'indicated' level, parts of such a deposit may not satisfy all the criteria. For the particular needs of

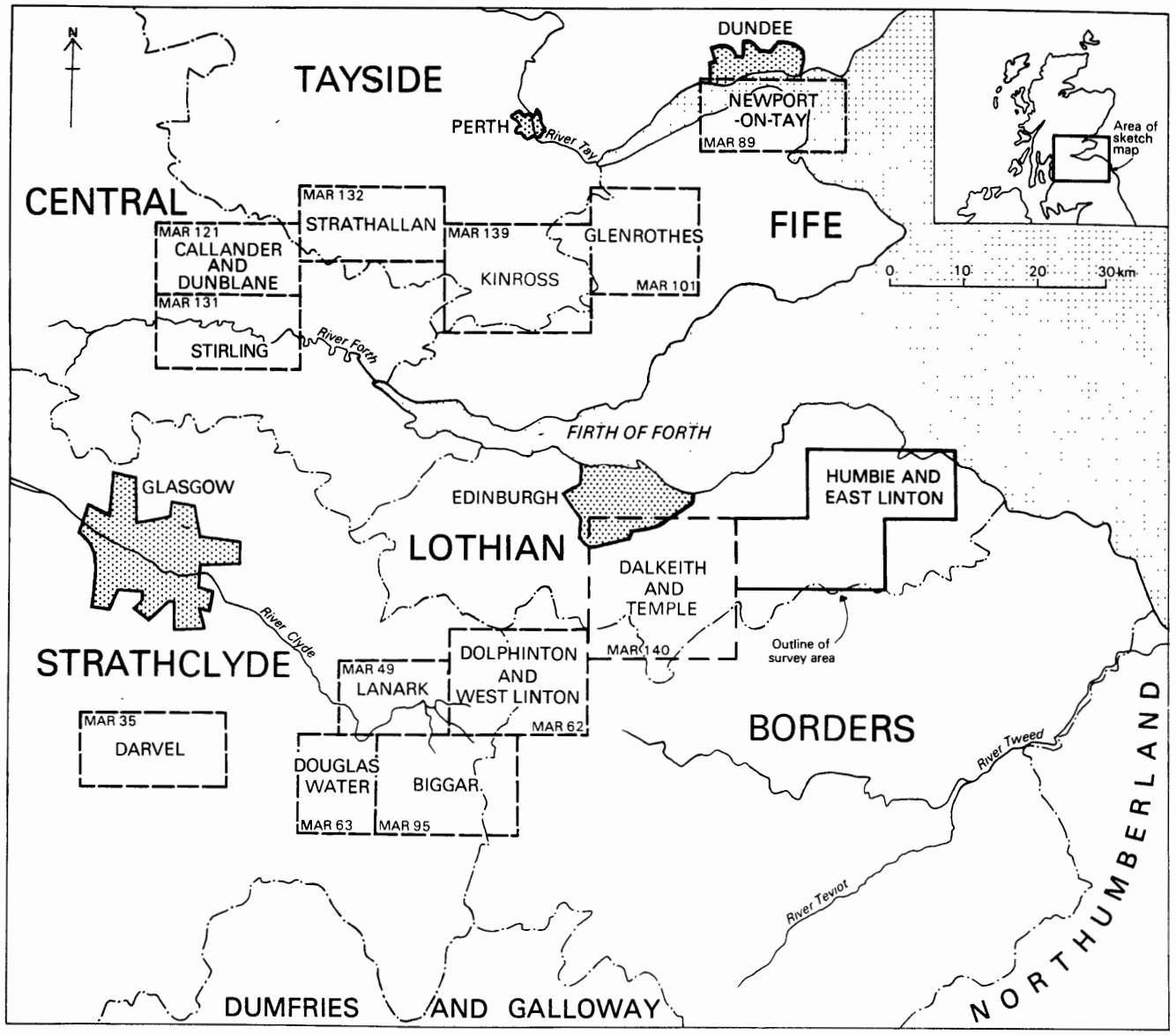


Figure 1 Sketch-map showing the location and limits of the published resource sheets in the south of Scotland

assessing sand and gravel resources, a grain-size classification based on the geometric scale $\frac{1}{16}$mm, $\frac{1}{4}$mm, 1mm, 4mm, 16mm 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 4mm respectively (see Appendix C).

The volume and other characteristics are assessed within *resource blocks*, each of which, ideally, contains approximately 10km^2 of sand and gravel. No account is taken of any factors, for example, roads, villages and high agricultural or landscape value, which might stand in the way of sand and gravel being exploited, although towns are excluded. The estimated total volume therefore bears no simple relationship to the amount that could be extracted in practice.

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

DESCRIPTION OF THE ASSESSMENT AREA

General

This report describes the resources of sand and gravel in 395km^2 of country in East Lothian, between the Lammermuir Hills in the south and the estuary of the River Tyne in the north (Figure 1). More than 98 per cent of the assessment area falls within Lothian Region. The resource sheet area includes the towns of Haddington *[51 74]* and Dunbar *[68 79]* and the villages of Ormiston *[413 692]*, Pencaitland *[440 690]*, East Saltoun *[476 677]*, Gifford *[535 681]*, Drem *[511 795]*, East Linton *[590 775]*, Garvald *[588 708]* and Stenton *[622 743]* (Figure 2).

Apart from the uplands which support grazing, and several scattered forestry plantations, most of the district is given over to arable farming, the area being renowned for its production of grain and potatoes. Coal was formerly mined around Ormiston and limestone has been quarried at a number of localities, notably at East Saltoun and currently east of Dunbar where it is used for portland cement manufacture. Igneous rock was worked until recently for aggregate at Traprain Law *[582 747]* and for a short period near Markle Mains *[563 774]*.

The sand and gravel resources account for 53km^2 or about 13 per cent of the survey area. They were first described systematically by Haldane (1948) and Goodlet (1970); McAdam (1978) has summarised published and unpublished data on the deposits in Lothian Region. Assessment of

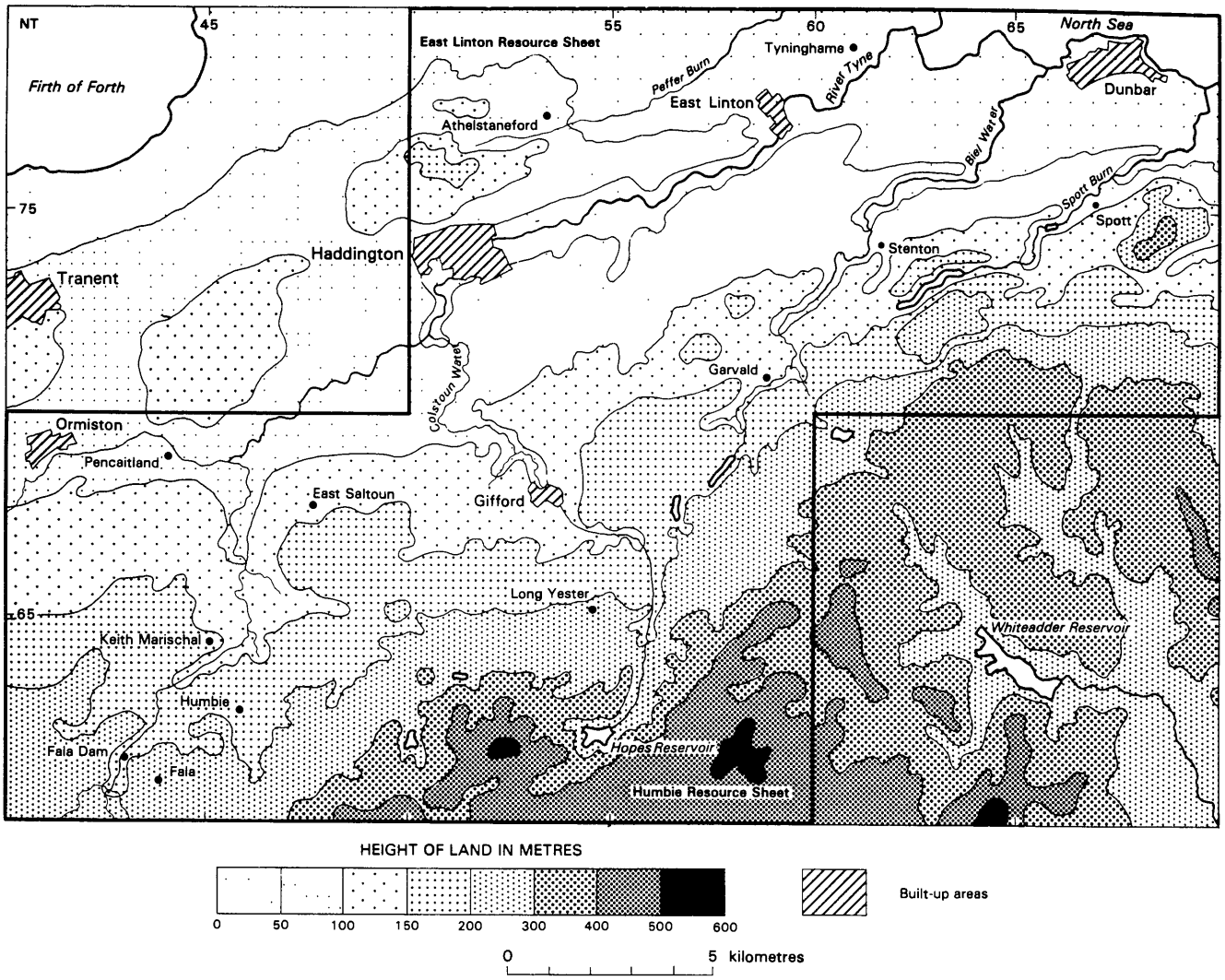


Figure 2 Sketch-map showing topography and localities

resources in the adjacent Dalkeith and Temple area is published in Mineral Assessment Report 140 (Aitken and others, 1984).

There are only two active sand and gravel pits in the area, near Long Yester at *[534 641]* and at Keith Marischal *[450 640]*.

Topography

The drainage system of the area is dominated by the River Tyne which flows parallel to the Lammermuir Hills in a north-easterly direction through Ormiston, Haddington and East Linton to the North Sea east of Tyninghame *[610 791]* (Figure 2). Major tributaries are the Birns (Keith) Water and the Colstoun (Gifford) Water which drain northwards from the scarp of the Lammermuir Hills, along with the Biel Water which reaches the sea near Dunbar. A former channel of the River Tyne north of East Linton is occupied by the misfit Peffer Burn.

North of the River Tyne, the topography is moderately subdued, the Garleton Hills and the ridge extending eastwards towards East Linton forming the most prominent features. South of the river the ground rises steadily, forming a broad bench-like area lying between 150 and 300m above Ordnance Datum (OD), and containing much of the sand and gravel resource in the district.

The prominent northern scarp of the Lammermuir Hills forms the effective southern boundary of the assessment area; sand and gravel are virtually absent on high ground over 400m above OD.

GEOLOGY

The assessment area falls within the Haddington (33W) and Dunbar (33E) sheets of the 1:50000 Geological Map of Scotland, for which there are explanatory memoirs (McAdam and Tulloch, 1985; Davies, McAdam and Cameron, 1986). The area was originally geologically surveyed at a scale of six inches to one mile by H H Howell, A Geikie and A C Ramsay between 1855 and 1860. Resurveys were conducted between 1902 and 1938 by E M Anderson, E B Bailey, G Barrow, C T Clough, C B Crampton, H B Maufe and J B Simpson. Drift boundary lines on the resource sheets for areas devoid of sand and gravel were taken from a resurvey between 1950 and 1970 by A Davies, M F Howells, A D McAdam and W Tulloch. The potential mineral-bearing areas were resurveyed by A D McAdam in 1982-83.

Solid geology

A sketch map of the solid geology is shown in Figure 3. The oldest rocks, which crop out to the south-east of the Lammermuir Fault, comprise greywacke-sandstone, siltstone, shale and chert of Ordovician and Silurian age (Table 1). These sediments suffered intense deformation during the Caledonian Orogeny which reached a climax towards the close of the Silurian period. As a result of this deformation, intensely folded and faulted Ordovician and Silurian rocks formed an uplifted massif. After a prolonged period of erosion, deposition resumed during Lower Devonian times, in the form of a poorly cemented, ill-sorted

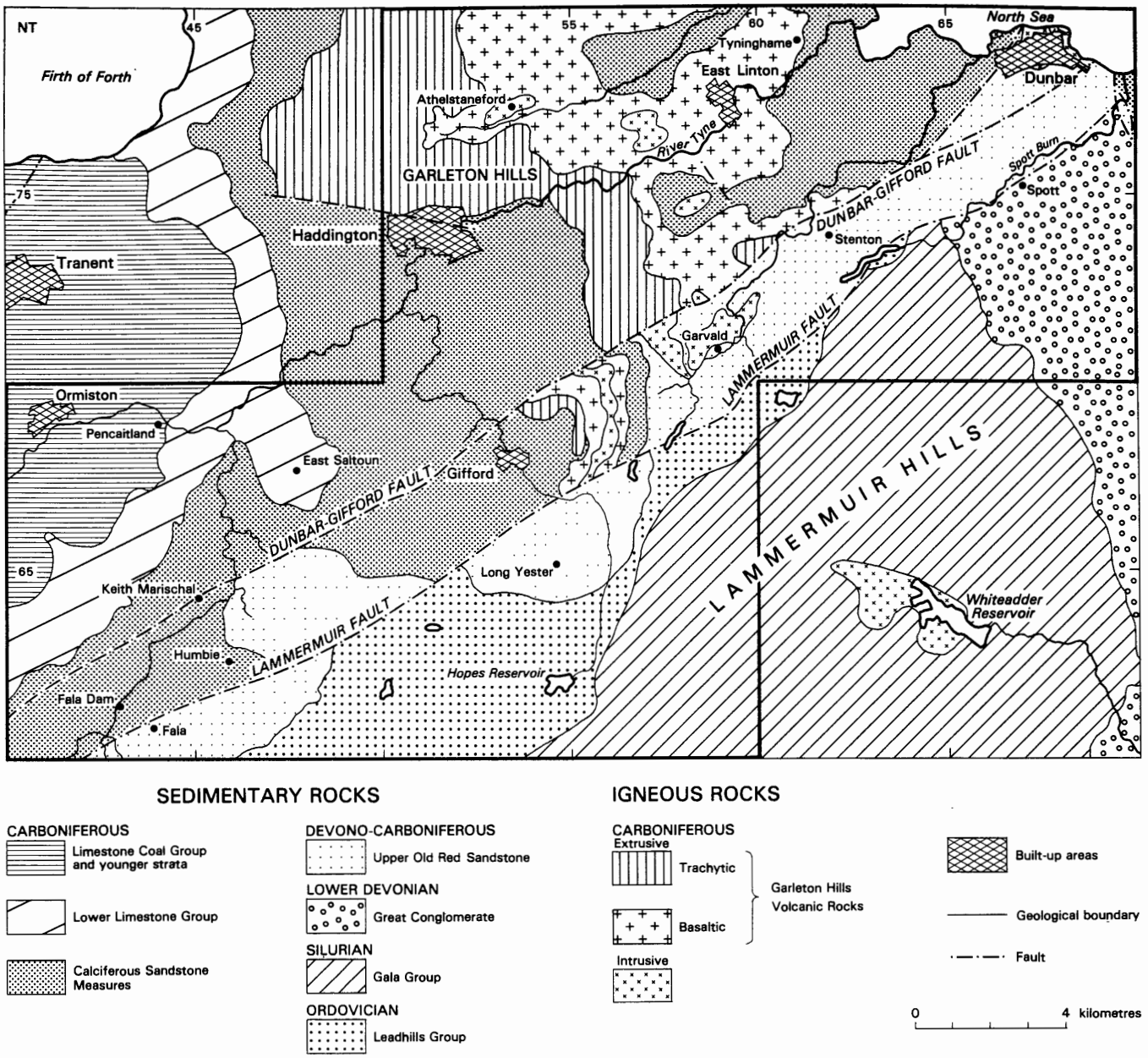


Figure 3 Sketch-map of the solid geology

greywacke-conglomerate, laid down by flash-floods in a semi-arid, mountainous environment. These rocks, which may constitute an additional resource of sand and gravel but have not been investigated during this survey, are preserved only in the south-east of the assessment area, south of Spott *[672 755]*.

The final phase of the Caledonian Orogeny took place in Middle Devonian times when the Lammermuir and Dunbar-Gifford faults were initiated or reactivated. Fluviatile sedimentation of red, mainly arenaceous beds resumed during late Devonian or early Carboniferous times. These strata, which locally exhibit a basal conglomerate, rest unconformably on Ordovician strata south of the Lammermuir Fault. Devono-Carboniferous rocks do not crop out north of the Dunbar-Gifford Fault, except in the vicinity of Dunbar. The oldest definitively Carboniferous sediments belong to the Calciferous Sandstone Measures and comprise mudstone, cementstone and sandstone, representing a shallow lagoonal, non-marine environment, with fluvial episodes resulting in sandstone deposition. There followed a prolonged period of volcanic activity, represented by the Garleton Hills Volcanic Rocks which crop out from between Drem and East Linton in the north, to Gifford in the south. The rocks comprise mainly basaltic and trachytic lava, tuff and agglomerate. Intrusive igneous activity also occurred at the time, indicated by several thick sills, plugs and the Traprain Law laccolith.

Following the volcanic episode, lagoonal or brackish water conditions returned with cyclical sedimentation of mudstone, siltstone, sandstone, seatearth and thin coal seams. Marine incursions gradually became more common, producing limestone beds which become thicker towards the top of the Calciferous Sandstone Measures and reach their greatest development in the Lower Limestone Group. Those now quarried for cement manufacture near Dunbar belong to this Group. Marine incursions decreased towards the end of Lower Limestone Group times and in the succeeding

Table 1 Geological classification of deposits

DRIFT	
Quaternary (Pleistocene and Recent)	Blown sand
	Peat
	Alluvium and lake deposits
	Alluvial fan (cone) deposits
	Present beach and salt marsh deposits
	Storm beach and bar deposits
	Post-Glacial marine deposits
	Late-Glacial marine deposits
	Head
	Glacial sand and gravel
	Glaciolacustrine deposits
	Till
SOLID	
Carboniferous	
Limestone Coal Group	Sandstone and mudstone, workable coal seams
Lower Limestone Group	Sandstone, mudstone limestone and rare coal seams
Calciferous Sandstone Measures	Mudstone, cementstone, sandstone, lava, tuff, and thin coal seams
Devono-Carboniferous	
Upper Old Red Sandstone	Sandstone, siltstone, mudstone and local basal conglomerate
Lower Devonian	
Great Conglomerate	Conglomerate with sandstone lenses
Silurian	
Gala Group	Greywacke-sandstone and -siltstone with mudstone
Ordovician	
Leadhills Group	Greywacke-sandstone and -siltstone, with conglomerate and chert

Limestone Coal Group coal seams are common. These crop out in the neighbourhood of Ormiston.

The Carboniferous strata suffered gentle folding and minor faulting during the Hercynian Orogeny at the end of the Carboniferous period, and the youngest solid rocks in the area, quartz-dolerite dykes, were intruded at about the same time.

Drift geology

No record exists of sedimentation in the area between the Carboniferous and the Quaternary; any strata laid down have been subsequently removed by erosion. However, during the Pleistocene, several glaciations are known to have occurred: most of the Quaternary superficial deposits derive from the last (late-Devensian) major ice-advance which probably reached its climax 17-18000 years ago (Sissons, 1974). The direction of the ice-advance was deduced from erosional features by 19th century workers to be slightly north of east in most of the area, but eastwards in the western part and in the vicinity of Dunbar. This ice-sheet emanated from the Southern Highlands via the Forth valley, with a probable component originating in the Southern Uplands and passing south of the Pentland Hills.

At its maximum, the ice-sheet extended well into the North Sea, at least 60km north-east of Dunbar (Thomson and Eden, 1977, figure 5) and reached elevations of up to 360m above OD against the northern scarp of the Lammermuir Hills (Sissons, 1958). Ice-marginal features at higher levels are considered to have originated during an earlier glaciation, on account of their more subdued morphology. At this time all the ground north of the Lammermuir scarp would have been covered by ice, the degree of erosion of the solid rocks depending on their durability. Crag-and-tail features such as Traprain Law were formed, and huge erratic blocks chiefly composed of limestone, and probably plucked from pre-existing minor scarp features, were transported and deposited, for example near Kidlaw *[510 642]*. Lodgement till deposited at the base of the ice-sheet forms a cover to the bedrock except on the higher ground where it is commonly thin or absent.

When the climate ameliorated the ice-front began to recede eastwards in the Forth valley and away from the Lammermuir scarp. Increasing volumes of spring and summer meltwaters were released, and these created a complex system of drainage channels, on successively lower levels as the ice receded. They were first systematically plotted by Kendall and Bailey (1908), although Young (Howell, Geikie and Young, 1866) had recognised their existence. The major channels were ice-marginal, with an overall north-eastward trend, because ice on lower ground still impeded the pre-glacial drainage system. Sissons (1958) has deduced that a number of the marginal channels were sub-glacial, at least in part. The earlier and more southerly channels are the largest, probably because the ice-sheet was still solid when they were formed, and most of the run-off was concentrated along the ice margin. The Rammer Cleugh near Deuchrie *[623 714]*, for example, is some 60m deep. The northward reduction in magnitude of these meltwater channels is well illustrated in Section D-D1 on the East Linton resource map.

Sediments deposited by the meltwaters are mainly located along the Lammermuir foothills, but important outwash deposits also occur around Dunbar, East Linton and in the valleys of the Birns and Biel waters. North of the Lammermuir Hills, the pattern of sedimentation appears to have been controlled by the line of the scarp, in that meltwater deposits tend to be concentrated in embayments and that the dominant sediment type can vary between adjacent areas. The prime depositional areas are around Humbie, Long Yester *[546 652]*, Garvald, Halls *[654 727]* and Woodhall *[686 727]*. The first two areas, separated by the ridge on which Leehouses *[498 651]* stands, demonstrate a contrast in sediment types: deposits are principally fine grained around Humbie but commonly gravelly in the neighbourhood of Long Yester.

The deposits occur as eskers (sinuous ridges of sand and gravel deposited subglacially), kame terraces (flat-topped ridges laid down at the margin of the ice-sheet, and often related to particular meltwater channels), kames (isolated mounds deposited within masses of dead ice) and outwash spreads of sand and gravel laid down beyond the ice-front. In existing valleys, these last take the form of fluvioglacial terraces.

Eskers are comparatively rare in this area; examples exist east of East Bearford *[556 746]* and west of Markle Mains. Kames and kame terraces contain the bulk of the resource in the southern half of the assessment area. Around Fala and Humbie the mainly fine grained sediments are indicative of deltaic deposition in ice-dammed lakes; the subsequent meltout of masses of dead ice accounts in large measure for the irregular surface expressions.

The occurrence of tills interbedded with sand, a phenomenon first noted by E M Anderson and illustrated in Kendall and Bailey (1908), has been shown by the drilling results of this survey to be widespread (see for example boreholes 46 NE 107 and 46 SW 29). Kendall and Bailey gave the cause as oscillations of the ice-front and Kirby (1968) proposed successive ice-advances from differing directions. Martin (1981) concluded that all the glacial deposits were the product of a single glaciation, but failed to provide a satisfactory explanation for the multiple till sequences. It is feasible to explain two tills separated by sand, in an ice-marginal context, as the product of a single glaciation (lodgement till overlain by outwash deposits overlain by flow till: Boulton, 1972). However, this explanation will not suffice where more than one lodgement till is present. Unfortunately good exposures in this area are scarce, and it would be unwise to attempt any systematic correlation of the tills proved in the boreholes until the disposition of the buried tills is more clearly understood; however, a simplistic representation is shown in section A-A^1 on the Humbie resource map. There is little doubt that the surface till deposit, which may be analogous to the Roslin till in Midlothian, is fairly widespread in the Humbie and Yester areas. It was also recorded near Ormiston and between Garvald and Whittingehame, but not in the coastal region, nor east of Deuchrie.

South of Gifford are to be found the most extensive gravel-bearing deposits in the assessment area, occurring as a mixture of kames and kame terraces at various elevations up to about 290m above OD. Kettle-holes, for example near Quarryford *[560 657]*, and the commonly irregular topography, testify to the ice-contact nature of the deposition. The identification of glaciolacustrine deposits in many of the boreholes hereabouts implies the creation and infilling of successive ice-dammed lakes during deglaciation (see section B-B^1 on the Humbie resource map).

Glacial sand and gravel occurring on lower ground was laid down when the ice-margin had receded towards the Forth Estuary. Deposits of this phase are seen around Ormiston, in the valleys of the Birns and Biel waters, and near Fortoun Bank *[567 790]*, East Linton and Tyninghame *[610 791]*. Some of this material represents pro-glacial outwash but moundy deposits occur around Kamehill *[579 797]* , while kames and kame terraces have been identified by Sissons (in Craig and Duff, 1975) between Tyninghame House *[619 798]* and West Barns, with surface levels about 18-20m above OD. These relate to the Main Perth Shoreline, considered by Cullingford (in Gray and Lowe, 1977) to have formed about 13500 years BP. Marine deposits associated with this high sea-level, and comprising silt, clay and fine sand, occur in the valleys of the Peffer Burn and the River Tyne. Although too fine-grained to constitute a resource these late-Glacial marine deposits locally mask glacial sand and gravel. Fine grained sediments proved quite widely at depth in boreholes in this area, and commonly underlying glacial sand and gravel, are unfossiliferous and may therefore be of glaciolacustrine rather than marine origin. In response to the wasting of the ice-sheet interactive glacio-isostatic and eustatic changes caused the sea level to fall below Ordnance Datum for the remainder of the late-Glacial period.

A marine transgression around 7000 years BP, in response to decay of the North American and European ice sheets, raised sea level to some 6-7m above OD in this area, and post-Glacial marine deposits, comprising sand, silt and clay, were laid down in the Tyne Estuary and bordering the coast. Since then sea level has gradually fallen to its present position and thin deposits of estuarine carse clay have formed in the Tyne Estuary. During the same period fluvial erosion has caused considerable redistribution of drift deposits, creating terraced deposits of alluvium in many of the river valleys. Lake deposits and peat have accumulated in many of the hollows left after the ice age.

COMPOSITION OF THE MINERAL DEPOSITS

Potentially workable sand and gravel within the survey area is found in deposits classified as glacial sand and gravel, alluvium, late-Glacial and post-Glacial marine deposits and blown sand. In addition, potential sources of aggregate are present in some occurrences of glaciolacustrine deposits, till and flow till. These groups are used as the basis for the description of the composition of the sand and gravel.

Details of the particle size distribution of the mineral-bearing deposits in the survey area are given in Table 2 and shown graphically in Figure 4. The curves represent the cumulative mean gradings of all the potentially workable sand and gravel sampled from each deposit, together with the envelopes within which the range of values from individual sample points fall. The graphs also show the mean gradings in histogram form.

Glacial sand and gravel Deposits of glacial sand and gravel occur throughout the assessment area. They take the form of mounds, ridges, terraces and flat spreads. Considerable deposits are to be found in the area drained by the Salters and Fala Dam burns and the Keith Water, along the flanks of the Lammermuir foothills from Marvingston *[509 660]* in the west to Elmscleugh *[697 719]* in the east. Deposits form low mounds and ridges in the East Fortune area, and underlie terraces on the flanks of the Tyne valley from East Linton towards the coast. Glacial sand and gravel also occurs as mounds and in thin spreads in many other parts of the assessment area.

The lithological composition of the glacial sand and gravel varies greatly throughout the area, depending on the original direction of sediment transport and bedrock geology. Deposits flanking the Lammermuir Hills tend to have many clasts of greywacke and sandstone, whereas those around East Fortune and East Linton contain higher proportions of igneous rocks.

Overall the deposit grades as *'clayey' sandy gravel* with a mean of fines 10 per cent, sand 57 per cent and gravel 33 per cent. There is a wide range of values among individual sample points as shown by the broad envelope in Figure 4, indicating considerable local variations in the grading of the deposit.

The deposit as a whole is only moderately well sorted, with a poorly developed mode in the fine and medium sand grades. Fine and coarse gravel (see Appendix C) appear in almost equal proportions (14 and 15 per cent) whereas cobbles

Table 2 Mean gradings of potentially workable deposits

	Number of data points	Number of samples	Mean grading percentage						
			Fines $-\frac{1}{16}$mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$mm	Medium sand $+\frac{1}{4}-1$mm	Coarse sand +1–4mm	Fine gravel +4–16mm	Coarse gravel +16–64mm	Cobbles and boulders +64mm
Glacial sand and gravel	99	407	10	26	20	11	14	15	4
Alluvium	14	36	10	17	18	11	15	24	5
Post-Glacial marine deposits	5	14	7	60	28	3	1	1	0
Late-Glacial marine deposits	3	6	11	33	18	11	15	12	0
Blown sand	1	4	6	75	16	1	1	1	0
Glaciolacustrine deposits	25	94	21	67	10	1	1	0	0
Till	8	8	17	23	14	10	14	16	6
Flow till	7	7	6	7	6	13	22	33	13

are generally scarce (4 per cent). Cobbles are more abundant locally, for example pit 46 SE 22, where they comprise 45 per cent of the deposit, and borehole 67 SE 15 where they comprise 14 per cent of the deposit. The proportion of cobbles may also be underestimated in borehole samples as a result of the drilling process.

The greatest recorded thicknesses of glacial sand and gravel are from sites on the flanks of the Lammermuirs south of Gifford *[535 681]*. Borehole 56 SW 3 near Latch recorded 19.1m of glacial sand and gravel. Near Long Yester 10.4m of glacial sand and gravel underlying flow till was recorded in a quarry face (section 56 SW 14).

Alluvium The most continuous spreads of alluvium within the survey area are found in the valley of the River Tyne around Ormiston *[413 692]*, downdownstream from Haddington, and between East Linton and the coast. Elsewhere alluvium is patchily developed, generally adjacent to streams. Samples of alluvium from around Ormiston contained Carboniferous sediments, including coal, many of the sandstones being soft and friable. Samples from the lower part of the Tyne, downstream from East Linton, contained a variety of rock types including weathered igneous clasts.

The alluvium has a mean grading of fines 10 per cent, sand 46 per cent and gravel 44 per cent; its overall grading is *'clayey' sandy gravel*. As with the glacial sand and gravel there is a wide range of values between sample points as shown by the broad envelope in Figure 4. The deposit is poorly sorted with a poorly developed mode in the coarse gravel range. The cobble content ranges from nil in several boreholes to 21 per cent in pit 57 NE 28.

The alluvium is generally thin with a maximum recorded thickness of 7.1m in borehole 67 NW 7.

Post-Glacial marine deposits Post-Glacial marine deposits were encountered in five boreholes and pits around the mouth of the River Tyne. Sample points demonstrated mean thicknesses of 3.3m for potentially workable material and 1.4m for overburden.

Overall the deposit grades as *sand* with a mean of fines 7 per cent, sand 91 per cent and gravel 2 per cent. The deposit is well sorted with a strongly developed mode in the fine sand grade and a relatively narrow grading envelope (Figure 4). The greatest recorded thickness of post-Glacial marine deposits was 5.8m, proved in borehole 67 NW 13.

Late-Glacial marine deposits Late-Glacial marine deposits which could be classified as mineral were encountered at two sites; at the surface in borehole 57 NW 3 near Drem at *[5168 7995]* and buried below post-Glacial deposits in borehole 67 NW 9 near Kirklandhill at *[6235 7875]*. They were also recorded, but not sampled, in an auger hole (57 NE X3) drilled outwith the present survey. A mean thickness of 2.2m of potentially workable mineral was recorded. The deposit has a mean grading of fines 11 per cent, sand 62 per cent and gravel 27 per cent. It is moderately well sorted with a mode developed in the fine sand grade. Fine and coarse gravel occur in similar proportions and no cobbles are present. There is however a wide range of values between the sample points as shown by the broad envelope in Figure 4.

Blown sand Blown sand is mapped as being present, at surface, both to the north and south of the mouth of the River Tyne. It was recorded in one borehole, 67 NW 13 at West Links *[6413 7891]* where 4.1m, largely composed of fine shelly sand, were encountered. The deposit grades as *sand*, with a mean grading of fines 6 per cent and sand 92 per cent, gravel 2 per cent. The deposit is very well sorted with a strongly developed mode in the fine sand grade. As can be seen from Figure 4 the envelope is very narrow, reflecting not only the homogeneity of the deposit, but also the lack of sample data.

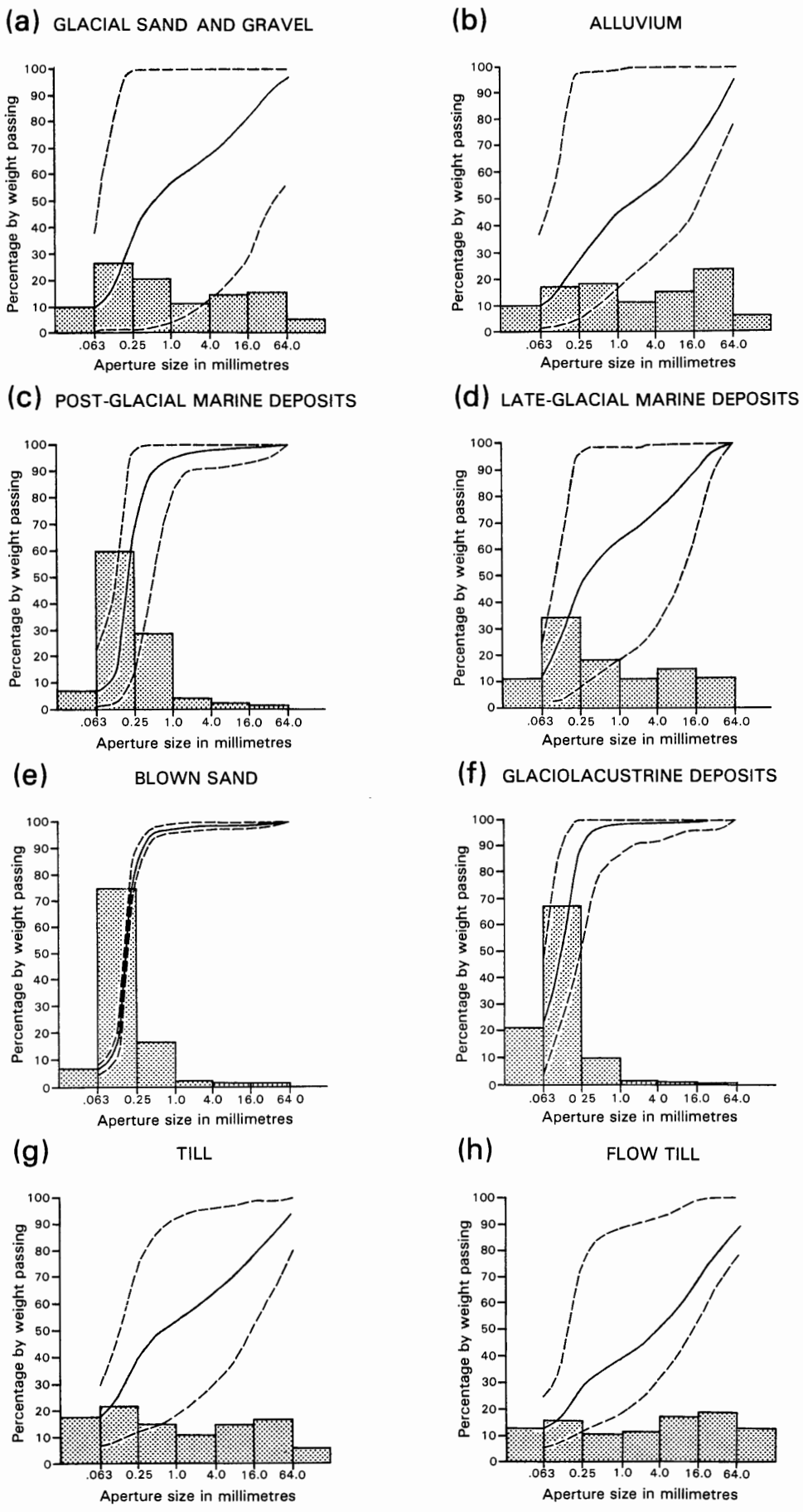


Figure 4 Mean grading characteristics of potentially workable sand and gravel in eight types of mineral deposit. The continuous line represents the mean grading for the mineral deposit; the broken lines denote the envelope within which the mean grading curves for individual data points fall. The mean grading for each deposit is also shown as a bar graph

Table 3 Source and geological classification of composite samples used in pebble counts and mechanical and physical tests

Source	Composite sample number	Geological classification of composite sample	Boreholes and pits from which samples were taken	Depth range (m)
River Tyne floodplain (Ormiston to Pencaitland)	1	Alluvium	46 NE 109	0.1-4.6
			46 NW 237	0.3-4.5
			46 NW 238	0.4-5.8
Latch area	2	Glacial sand and gravel	56 SW 3	0.4-20.2
			56 SW 4	0.2- 5.2
Yester area	3	Glacial sand and gravel	56 NE 3	0.5- 4.1
			56 NE 4	0.3- 4.2
			56 NE 12	0.3- 2.2
			56 NE 13	0.4- 2.7
			56 NW 6	0.5- 2.3
			56 NW 7	0.4- 4.5
			56 NW 9	3.5- 9.3
			56 NW 10	0.3- 4.0
			56 SE 1	0.3- 3.6
			56 SE 2	0.3- 3.1
			56 SW 2	5.8- 9.0
			56 SW 5	2.1- 5.0
			56 SW 7	0.3- 3.5
Newlands area	4	Glacial sand and gravel	56 NE 8	0.2- 2.6
			56 NE 9	0.3-11.0
			56 NE 15	0.1- 5.5
River Tyne floodplain and terraces (East Linton to Tyninghame)	5	Alluvium, glacial sand and gravel, late-Glacial marine deposits	57 NE 22	0.5- 7.7
			57 NE 23	0.0- 4.3
			57 NE 28	0.2- 3.5
			67 NW 3	0.3- 7.0
			67 NW 4	0.4- 4.5
			67 NW 7	0.3- 7.4
			67 NW 9	5.8- 8.7
Halls area	6	Glacial sand and gravel	67 SE 15	0.2-12.0
			67 SE 16	0.1- 3.1
			67 SE 17	0.7- 3.7
			67 SE 18	0.1-12.7
			67 SE 19	0.2- 6.8

Glaciolacustrine deposits A number of boreholes, particularly in the Humbie *[459 627]* and Yester *[520 660]* areas encountered deposits which were considered to have been formed in ice-dammed lakes. This classification was largely based on the high proportion of fine sand, silt and clay in the deposits, which are usually concealed under other materials including glacial sand and gravel. The deposit grades as *'very clayey' sand,* with a mean grading of fines 21 per cent, sand 78 per cent and gravel 1 per cent. The deposit shows a relatively small range of values between sample points and is well sorted, as shown by the well developed mode in the fine sand grade in Figure 4. The deposit is thickest on the valley sides of the Keith Water *[445 635],* borehole 46 SW 33 recording 10.9m, of which 10.0m proved potentially workable.

Till Till is present over much of the assessment area, being absent only in the river valleys where it has been removed by subsequent erosion and on hills where deposition possibly never occurred. The till is shown, from a restricted number of samples, to be a potential resource with a mean grading of fines 17 per cent, sand 47 per cent, gravel 36 per cent, of which 6 per cent are cobbles. The deposit generally has a clay or clayey sand matrix, clasts are generally subangular to subrounded and the lithological composition frequently reflects local bedrock geology. The deposit is very poorly sorted with a broad envelope, showing a wide variation in grading between data points (Figure 4).

Flow till Potentially workable flow till was recorded in seven boreholes, chiefly in the Humbie, Fala and Yester areas. The material grades as *'clayey' gravel,* with a mean grading of fines 13 per cent, sand 38 per cent and gravel 49 per cent. The deposits are poorly sorted and have a broad grading envelope similar to that for till (Figure 4).

PETROGRAPHY, MECHANICAL AND PHYSICAL PROPERTIES OF THE AGGREGATE

A series of mechanical and physical tests was conducted in accordance with BS 812 (British Standards Institution, 1975) in order to determine the aggregate impact value (AIV), aggregate crushing value (ACV), relative density (on both

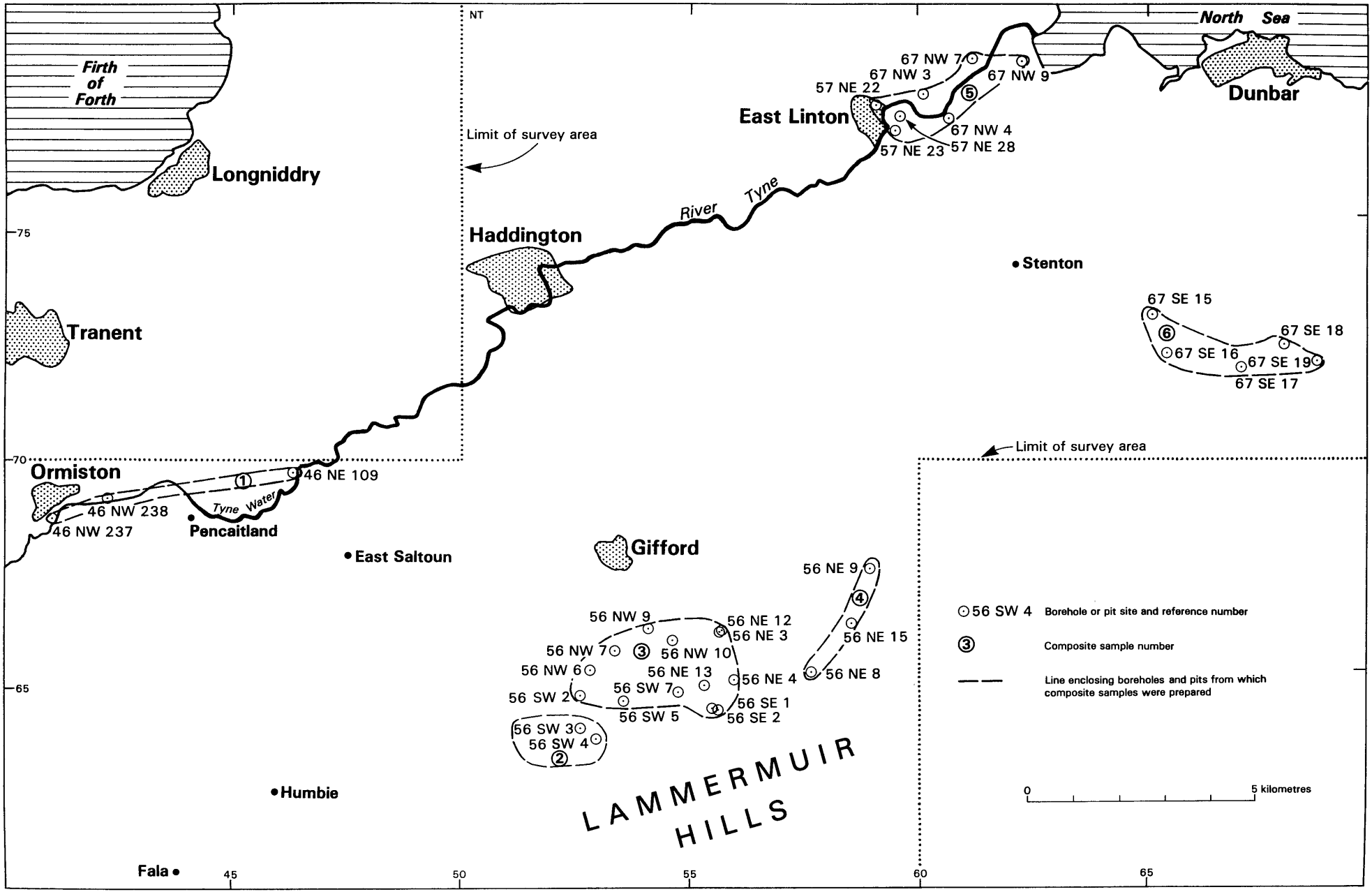


Figure 5 Location of boreholes from which aggregate was obtained for mechanical and physical testing

Table 4 Compositional analyses (pebble counts) of composite test samples (for origin of samples see Table 3)

Composite sample number		1	2	3	4	5	6
British Standard Trade Group	Rock Type						
Basalt (2)*	Andesite	6	4	6	1	15	1
	Basalt	1	-	4	-	7	3
	Dolerite	-	-	-	-	-	-
	Total, undivided	7	4	10	1	22	4
Flint (3)	Chert	2	2	2	-	3	1
Gabbro (4)	Diorite	1	-	-	**	-	-
	Gabbro	-	-	-	-	**	-
	Total, undivided	1	-	-	**	**	-
Granite (5)	Granite/Granodiorite	**	-	1	-	-	-
Gritstone (6)	Greywacke (arenaceous)	20	16	20	25	25	18
	Sandstone	39	54	48	30	29	35
	Total, undivided	59	70	68	55	54	53
Limestone (8)	Limestone	3	-	-	-	**	-
Porphyry (9)	Felsite	2	-	3	1	5	1
Quartzite (10)	Quartzite	2	1	2	**	5	2
	Vein-quartz	2	3	3	2	3	2
	Total, undivided	4	4	5	2	8	4
Schist (11)	Phyllite	-	-	-	-	-	-
	Schist	1	-	-	**	1	-
	Total, undivided	1	-	-	**	1	-
Others	Coal	4	-	-	-	-	-
	Greywacke (argillaceous)	12	19	9	33	3	31
	Ironstone	6	-	1	-	3	**
	Mudstone	**	1	**	6	1	5
	Total, undivided	22	20	10	39	7	36
Number of pebbles counted		410	379	410	396	372	431

Results are given in frequency per cent. Calculations of weight per cent show close correlation.

* The numbers in parenthesis correspond with those used in BS 812.1:1975. Petrological groups 1 and 7 are represented here.

** Trace amounts (less than 0.5 per cent)

oven-dried and surface-dried bases), apparent relative density and water absorption. In addition, the aggregate impact value residue (AIVR) and the aggregate crushing value residue (ACVR) as defined by Ramsey (1965) and Ramsey, Dhir and Spence (1973, 1974), were determined.

The tests were carried out on the 10- to 14-mm gravel fraction (BS 812.1:1975) of a selection of samples representing the major deposits of sand and gravel within the survey area. Approximately 15kg of material is required for a complete series of tests and the composite sample is obtained by sieving the residues of bulk samples taken for particle size analysis from trial pits and boreholes. In one case this was combined with material from a quarry section. The sources and geological classification of the composite samples are given in Table 3. Samples 2 and 4 had insufficient material for the full range of tests. All material was washed and oven-dried before testing in accordance with BS 812.3:1975. The geographical distribution of the sample points is shown in Figure 5. Pebble counts (compositional analyses) were also undertaken on the 10- to 14-mm samples, and a direct comparison can be made between the petrographic composition of the gravel and the mechanical and physical properties. The results of the pebble counts are given in Table 4.

The aggregate impact value (AIV) and aggregate crushing value (ACV) tests are both measures of the strength of an aggregate. AIV is an indicator of impact resistance and measures the relative amount of comminuted material passing a 2.36-mm sieve, after the sample has been subjected to fifteen blows of standard magnitude. ACV is an

Table 5 Results of mechanical and physical tests

Composite sample	AIV (%)	AIVR (%)	ACV (%)	ACVR (%)	Relative density (oven-dried basis)	Relative density (surface-dried basis)	Apparent relative density	Water absorption (%)	Inferred drying shrinkage* (%)
1	28	33	22	36	2.44	2.54	2.71	4.06	0.112
2	29	23	No test		2.40	2.51	2.68	4.29	0.117
3	28	35	21	39	2.40	2.50	2.68	4.41	0.120
4	28	23	No test		2.34	2.47	2.69	5.65	0.140+
5	26	38	21	38	2.44	2.53	2.68	3.72	0.102
6	22	34	21	33	2.41	2.51	2.69	4.35	0.118

* The derivation of these values is explained in the text

indicator of resistance of an aggregate to applied compressive load, and measures the relative amount of comminuted material passing a 2.36-mm sieve, after the sample has been subjected to a load, uniformly increased to 400KN in ten minutes. Although these tests give an indication of the strength of intergranular bonding it is usually the ability of a clast to withstand impact and loading relatively intact, rather than to fragment, that is the most important attribute. For this reason Ramsay (1965) introduced the concept of the aggregate impact value residue (AIVR) and aggregate crushing value residue (ACVR) which are calculated by measuring the amount of 10- to 14-mm material remaining intact after the AIV and ACV tests and expressing this as a percentage of the original mass.

Aggregate strength has been shown, by the work of Ramsay and Ramsay, Dhir and Spence, to be dependent on several petrographical features. In an aggregate composed of clasts of sedimentary rock types the main petrographical factor influencing the strength of the aggregate is the strength of the intergranular cement. In igneous rocks, strength is governed by the degree of crystal interlocking, which is inversely proportional to grain size. In coarse-grained igneous rocks the strength of individual crystals is important. This is influenced by twinning, cleavage and the presence of microfracture planes within the crystals.

The shape and degree of weathering of individual clasts also affect the strength of an aggregate. These factors are partly controlled by petrography, but are also dependent on the distance and mode of transportation and the environment of deposition.

The results of the mechanical and physical tests carried out on the composite samples are shown in Table 5. The AIV values range from 22 to 29 with an average of 27, which is well above the average of 19 quoted by Edwards (1970), for worked Scottish gravels. The range of values is less than that (14-27) recorded for the adjacent Dalkeith and Temple area (Aitken and others, 1984) and does not necessarily reflect any variations in the pebble counts shown in Table 4. The sample with the lowest AIV (22), sample 6, consisting of glacial sand and gravel from the Halls area, had a relatively high proportion of flaky greywacke. Sample 2 from the Latch area had the highest AIV (29), possibly due to a friable, weathered sandstone component. The results of the AIVR test do not altogether reflect those of the AIV, confirming that some aggregates have a better capacity to remain intact than is shown by the AIV results.

The ACV results show little variation between the samples, with an average of 21 which again is higher than that (17) recorded in the adjacent Dalkeith and Temple area.

The suitability of an aggregate for use in concrete manufacture depends not only on its impact and crushing strength, but also on its water absorption and drying shrinkage (Table 5). The water absorption value is a measure of the amount of water absorbed by the aggregate after 24 hours of immersion, expressed as a percentage of its oven-dried weight, and is thought to have a broadly linear relationship to the drying shrinkage, both of the aggregate itself and of any concrete manufactured from it (Edwards, 1970). The drying shrinkage, in turn, is a key factor affecting the stress-carrying ability and resistance to weathering of concrete. The water absorption values range from 3.72 to 5.65, all very much above the average of 1.48 per cent quoted by Edwards for various Scottish and English gravels. These high values of water absorption are possibly partly due to the presence of high proportions of highly porous clasts such as sandstone and weathered igneous rocks together with clayey rock types such as shale and mudstone which absorb water and swell when immersed. The presence of weathered clasts also increases the water absorption potential of the aggregate.

By using the graph published by Edwards (1970, Figure 1) a very broad estimate of the drying shrinkage properties of aggregate in this study can be obtained. The inferred drying shrinkages calculated in this way range from 0.102 for sample 5 to >0.14 for sample 4. Gravels yielding concrete drying shrinkage values greater than 0.085 per cent lie in the category defined by the Building Research Station Digest (1968) that

requires the greatest care to be exercised when they are used in concrete manufacture. It must be emphasised that inferred drying shrinkage values should be interpreted with caution. The figures given here are for guidance alone, and tests in accordance with standard procedures would have to be carried out to determine accurate drying shrinkage values for aggregate from the survey area. The quality of an aggregate may often be improved by crushing and washing after stockpiling, to remove deleterious weathered and friable components.

Values were obtained for the relative densities of the samples on both an oven-dried and a saturated, surface-dried basis. The apparent relative density was also calculated. Some comparison can be made between these values and the values for water absorption, in that there is in general an inverse relationship between the two. No obvious correlation can be made however between these values and the results of the impact and compression tests.

THE MAPS

The sand and gravel resource maps are folded into pockets at the end of this report. The base is the Ordnance Survey 1:25000 Outline Edition, which is printed in grey: the geological lines and symbols are in black. Mineral resource information, including areas of potentially workable sand and gravel, resource notes and block boundaries, is presented in shades of red.

Geological data The geological boundary lines are taken from geological maps surveyed at the scale of 1:10000 or 1:10560; these offer the best interpretation of the available data but, due to the highly variable nature of the deposits, the accuracy of the map will be improved as new evidence from boreholes and excavations becomes available.

Borehole data, which include the stratigraphical relations and mean particle-size analysis of the sand and gravel samples collected during the assessment, are also shown on the maps.

Mineral resource information The maps are divided into resource blocks (see Appendix A) within which the extent of mineral-bearing ground is shown in red. The dark shade indicates where mineral is exposed, that is, where the overburden averages less than 1.0m in thickness: a lighter tone is used to identify where it is present in relatively continuous spreads beneath overburden that averages more than 1.0m in thickness. Within these areas, however, there may be small patches where sand and gravel is absent or not potentially workable, as for example around borehole 57 NE X4. A further category, which is shown on the resource maps in the lightest tone of red, is that where mineral is considered to be discontinuous. The recognition of categories is subjective, depending on the proportion of boreholes which did not find potentially workable sand and gravel, and on the distribution of these barren boreholes within a block. Areas where sand and gravel is deemed to be not potentially workable, where superficial deposits do not contain mineral, or where bedrock crops out, are shown uncoloured. Sand and gravel within built-up areas, and patches too small or insufficently documented to be assessed, but which may nevertheless be potentially workable, are indicated by red stipple.

For the most part the distribution of resource categories is based on mapped geological boundaries. Where transitions between categories cannot be related to the geological map, inferred boundaries have been inserted. Such boundaries, drawn primarily for the purpose of volume estimation, are shown by a distinctive 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 cartographic considerations. For the purpose of measuring areas the centre-line of the symbol is used.

THE ASSESSMENT

The survey area is divided into eight blocks for assessment. The positioning of the block boundaries is a compromise to meet the aims of the survey: on the one hand to provide sufficient sample points on which to base an assessment and on the other to group together deposits of broadly similar origin, thickness, grade and composition.

The principal resources of sand and gravel occur as glacial meltwater deposits, which comprise glacial sand and gravel, and glaciolacustrine deposits. The last-named, commonly occurring in association with glacial sand and gravel, may contain potentially workable material, but the deposits have not been recognised at the surface and have been identified only in boreholes; hence their distribution is poorly known. Additionally, the deposits generally comprise very fine sand and silt which Merritt and others (1983) consider to have very few potentially commercial end-uses at present. Consequently the glaciolacustrine deposits have not been assessed. Till may be potentially workable across much of the area, as judged by the arbitrary criteria adopted for the survey, but because the lithology is variable and the distribution of that part which is regarded as mineral is not sufficiently well known, the resource is normally excluded from the assessment. Important resources of sand and gravel are also contained in the alluvium of the River Tyne and the Colstoun Water, together with post-Glacial marine deposits and blown sand adjacent to the estuary of the same river.

The statistical procedure adopted for the volumetric assessment of the mineral resources is outlined in Appendix B. Statistical assessments are offered for blocks A to G, but the potentially workable deposits of block H are too patchy and diverse to assess in such a manner. Consequently, inferred assessments are offered for the lithologically similar deposits in each of the sub-blocks (except sub-block H_3) based upon sample-point data and consideration of the geology and three-dimensional shape. For example, eskers have been assumed to approximate to the form of triangular prisms, the volumes of which have been calculated by simple arithmetic. Likewise mounds were often considered as hemispheres and terrace features as trapezoid prisms. Such computed volumes must be interpreted cautiously: the procedure tends to underestimate volume because no account has been taken of material that may lie below the general ground level, unless there is evidence to the contrary.

RESULTS

The mineral resources of the assessment area are discussed in the block descriptions. Data used in the assessment are given in Tables 8 to 15: a summary of these data is presented in Tables 6 and 7. Some conclusions are offered, at the end of the report, regarding the resources most likely to command attention in the future.

Table 6 The sand and gravel resources: summary of statistical assessments

Resource block and mineral-bearing deposits	Area		Mean thickness		Volume of sand and gravel			Yield of sand and gravel	Mean grading percentage		
	Block km^2	Mineral km^2	Over-burden m	Mineral m	$m^3 \times 10^6$	Limits at the 95% probability level ±%	±$m^3 \times 10^6$	m^3 per hectare	Fines $-\frac{1}{16}$mm	Sand $+\frac{1}{16}$ -4mm	Gravel +4mm
A Alluvium, blown sand, post- and late-Glacial marine deposits and glacial sand and gravel	13.2	11.6	0.6	4.0	46	37	17	40000	7	62	31
B Glacial sand and gravel	24.9	8.2	2.5	5.5	45	38	17	55000	9	78	13
C Glacial sand and gravel	21.5	5.7	1.2	5.3	30	36	11	53000	9	48	43
D Glacial sand and gravel	16.2	3.5	0.5	5.0	18	38	7	50000	8	42	50
E Glacial sand and gravel	29.6	3.6	0.5	7.1	26	45	12	71000	13	55	32
F Glacial sand and gravel	9.8	3.8	0.3	4.2	16	42	17	42000	10	57	33
G Glacial sand and gravel	17.4	4.4	0.5	4.9	22	51	11	49000	11	61	28
Total	132.6	40.8	-	-	203	-	-	-	-	-	-

Accuracy of results For the seven resource blocks assessed statistically, the accuracy of the results at the symmetrical 95 per cent probability level ranges from 36 to 51 per cent; that is, it is probable that on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral. However, the real values are more likely to be nearer the median than the limits. Moreover, it is probable that in each block roughly the same percentage limits would apply for the estimate of mineral volume within a very much smaller parcel of ground (for example, 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 reserves of part of a block, it can be expected that more than ten sample points would be required, even if the area is quite small.

However, 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, for no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of land for mineral working.

NOTES ON THE RESOURCE BLOCKS

Most of the block boundaries have been drawn arbitrarily or follow the limits of built-up areas such as Ormiston, Haddington and Dunbar. The

Table 7 The sand and gravel resources: summary of inferred assessments in Block H

Sub-block	Deposit	Area of mineral	Mean thickness		Inferred volume of sand and gravel	Mean grading percentage		
			Over-burden	Mineral		Fines	Sand $+\frac{1}{16}$	Gravel
		km^2	m	m	$m^3 \times 10^6$	$-\frac{1}{16}$mm	-4mm	+4mm
H_1	Glacial sand and gravel in the Ormiston area	1.5	1.0	1.7	3	9	52	39
H_1	Glacial sand and gravel in the Pencaitland area	1.0	0.5	4.2	4	12	67	21
H_2	Glacial sand and gravel in the Ewingston, Stobshiel and Blegbie areas	1.6	0.3	1.9	3	10	52	38
H_3	No assessment offered							
H_4	Glacial sand and gravel in the Abbey Mains and East Bearford areas	0.7	0.3	3.0	2	13	67	20
H_5	Glacial sand and gravel in the Stenton and Belton areas	3.0	1.1	2.6	8	7	40	53
H_6	Glacial sand and gravel and post-Glacial marine deposits in the Dunbar area	2.8	0.4	5.9	17	11	56	33
	Totals	10.6	-	-	37	-	-	-

major exception is block A, the boundaries of which delimit the alluvium of the River Tyne and the Colstoun Water, together with areas of blown sand and post-Glacial marine deposits bordering the estuary of the River Tyne.

Blocks B, C, D and E encompass the principal deposits of glacial sand and gravel occurring on the northern flanks of the Lammermuir Hills. Block B takes in the extensive spreads around Fala Dam *[430 616]* ,Costerton *[438 633]* and Humbie *[459 627];* those around Long Yester *[546 652]* are included in block C; mainly moundy deposits between Garvald *[588 708]* and Danskine *[569 673]* are incorporated in block D and similar deposits in the neighbourhood of Stoneypath *[616 711]*, Halls *[654 727]* and Elmscleugh *[697 719]* constitute the resource in block E.

Terraced and moundy spreads of glacial sand and gravel adjacent to the floodplain of the River Tyne east of East Linton are included in block F, and similar deposits between Drem and East Linton make up block G. The remainder of the assessment area, barring built-up areas, is included in block H which is sub-divided into six sub-blocks for descriptive purposes.

Block A

Valley-floor deposits of the River Tyne between Ormiston and the sea east of Tyninghame, together with those of the Colstoun Water north of Gifford constitute block A; however a three kilometre stretch of the River Tyne between Pencaitland and Haddington falls outwith the assessment area. The resource block boundary chiefly coincides with the back feature marking the limit of the alluvial plains of the above mentioned rivers, but where urban development (Ormiston, Haddington and East Linton) has encroached on to them the alluvium is not assessed. At the mouth of the River Tyne, owing to the merging of fluvial and marine deposits, and the difficulty in attempting to distinguish them lithologically, blown sand and post-Glacial marine deposits bordering the estuary are also included in block A.

The major resource is contained in the alluvium which forms a continuous strip from the western margin of the assessment area to the river's estuary. Alluvial terraces are well developed throughout the valleys of the River Tyne and the Colstoun Water, and height differences between adjacent terraces are usually in the range 2 to

Table 8 Block A: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	
ALLUVIUM											
NT 46 NW 237	2.9	1.6		20	16	11	12	19	20	2	VCG
NT 46 NW 238	1.6	0.4		22	19	9	9	12	15	14	VCG
NT 46 NE 109	4.5	0.1		8	17	27	12	11	16	9	SG
NT 56 NW 12	1.8+	0.3		8	90	1	1	0	0	0	S
NT 56 NW 14	1.3	0.3		15	18	15	11	15	26	0	CSG
NT 57 NW 12	1.0+	2.0		9	12	40	11	11	17	0	SG
NT 57 NE 26	3.0+	0.3		6	5	14	12	16	40	7	G
NT 57 NE 28	3.3+	0.2		3	6	14	12	17	27	21	G
NT 57 SW 20	3.9+	0.9		5	6	12	18	21	28	10	G
NT 57 SW 21	2.8	0.6		10	11	13	9	17	32	8	CG
NT 67 NW 7	7.1	0.3		7	15	27	13	17	21	0	SG
Mean	**3.0**	**0.6**		**9**	**16**	**18**	**12**	**15**	**23**	**7**	**SG**
GLACIAL SAND AND GRAVEL											
NT 46 NW 238	3.7	2.1		3	7	11	20	26	22	11	G
BLOWN SAND											
NT 67 NW 13	4.1	0.0		6	75	16	1	1	1	0	S
POST-GLACIAL MARINE DEPOSITS											
NT 67 NW 9	4.9	0.6		8	47	36	8	1	0	0	S
NT 67 NW 13	5.8+	4.1		7	68	24	1	0	0	0	S
NT 67 NW 16	2.6+	0.8		2	58	33	1	2	4	0	PS
NT 67 NE 24	2.2+	0.3		5	66	19	5	5	0	0	PS
Mean	**3.9**	**1.4**		**6**	**59**	**28**	**4**	**2**	**1**	**0**	**S**
LATE-GLACIAL MARINE DEPOSITS											
NT 67 NW 9	2.9	5.8		4	11	24	17	25	19	0	SG
TILL											
NT 67 NW 7	1.1	8.0		7	9	11	18	26	29	0	G

Statistical assessment of alluvium, blown sand, post- and late-Glacial marine deposits and glacial sand and gravel

Area of exposed mineral	10.1km^2
Area of continuous or almost continuous spreads of mineral beneath overburden	0.9km^2
Area of discontinuous spreads of mineral beneath overburden	1.2km^2
Total area of mineral	11.6km^2*
Mean thickness of overburden	0.6m
Mean thicknes of mineral	4.0m
Estimated volume of mineral	46 million m^3 ±37% or 17 million m^3
Estimated yield of sand and gravel per hectare	40 thousand m^3 ±37% or 15 thousand m^3

* In the calculation of this figure 50 per cent of the area of discontinuous spreads of mineral beneath overburden is assumed

3m. The alluvial plain of the River Tyne is commonly about 300m wide, as around Ormiston and east of Haddington, but achieves a width of 800m near Grants' Braes Bridge *[506 719]* and downstream from East Linton it widens steadily to over 1km. By contrast, between Monkmill Island *[560 751]* and East Linton the river occupies an incised valley where the alluvial plain is mostly less than 100m wide, except for a stretch west of Hailes Castle *[574 758]*.

At the estuary of the River Tyne post-Glacial marine deposits occur mainly as flattish spreads which coalesce locally with low mounds composed of blown sand, for example at West Barns Links *[643 792]*.

Where present, mineral is believed to occur within 1m of the surface throughout most of the block. Exceptions to this do occur however; around Ormiston for example the present floodplain of the River Tyne has a cover of mainly silty overbank deposits, this being confirmed by borehole 46 NW 237 which proved 1.6m of soil, sandy silt and silty clay above 2.6m of sand and gravel. An inferred boundary to this area of

silty overburden has been drawn near Winton House *[438 695]*. Between Tyninghame and West Barns *[655 781]*, several areas are shown on the resource map as discontinuous spreads of mineral beneath overburden because field mapping revealed silt and silty clay at surface, the deposits being classified as post-Glacial marine deposits. As there are no sample points thereabouts, the presence of any underlying mineral is conjectural. Inferred boundaries have been used on the resource sheet where the post-Glacial marine deposits grade laterally at surface from silt and clay to sand, classified as potentially workable, for example near East Links *[648 786]*.

Two sample points near Ormiston showed the alluvium to consist of *'very clayey' gravel*, with thicknesses of 2.9 and 1.6m. However, one of these, borehole 46 NW 238, proved a further 3.7m of *gravel*, which is classified as glacial sand and gravel owing to the presence above it of 0.1m of a diamicton interpreted as flow till. East of Pencaitland, borehole 46 NE 109 revealed 4.5m of *sandy gravel* on 1.2m of till on bedrock. In the valley of the Colstoun Water a pit at Eaglescarnie *[519 695]* proved *sand* more than 1.8m thick, whereas one near Gifford penetrated 1.3m of *'clayey' sandy gravel*, overlying silt and clay, indicating that the deposits thereabouts are variable in composition. Pits sunk in the lower reaches of the valley of the Colstoun Water near Bolton *[507 701]* and Colstoun Bridge *[515 714]* failed to prove any mineral, indicating that some of the terraces there are barren, particularly the higher ones.

From Grants' Braes Bridge to Tyninghame, six sample points in the alluvium of the River Tyne showed the deposits to be chiefly gravelly with thicknesses in the range 1.0 to 7.1m with a mean thickness of 3.5m, but it should be noted that at four sites the base of the mineral was not reached. With the exception of pit 57 NW 12, which proved 2.0m of soil and silty overburden, sand and gravel was shown to lie within 1m of the surface. Also, in borehole 67 NW 7 near Tyne Bridge *[613 785]*, the uppermost deposit graded as *'very clayey' pebbly sand* and resembles an overbank deposit. Downstream from Tyne Bridge, a surface deposit of carse clay is common, but on the basis of two sample points on the lower terraces it is a metre or less in thickness. Post-Glacial marine deposits found west of West Barns and also at higher levels, for example north of Tynefield *[629 779]*, are known from field mapping to be clayey at surface but the thickness is unknown and the presence of any mineral resource underlying these higher terraces is conjectural. Around West Barns the post-Glacial marine deposits are sandy at surface, as confirmed by pit 67 NE 24 which proved 2.2m of *'pebbly' sand* but failed to bottom the deposit.

Two boreholes were drilled in this area. Borehole 67 NW 9 proved 0.6m of soil and carse clay on 4.9m of shelly sand classified as post-Glacial marine deposits, overlying 0.3m clayey silt with rootlets, tentatively classified as late-Glacial in age. This in turn overlay 2.9m of *sandy gravel* on 8.3m of silt and clay, together classified as late-Glacial marine deposits. Borehole 67 NW 13, sited in a former sand pit at West Barns Links, proved 9.9m of sand classified as blown sand and post-Glacial mineral deposits but the base of the deposit was not reached owing to technical difficulties.

The majority of pits and boreholes in block A encountered groundwater, and in several cases was the cause of their termination. Exceptions were sample points sited on higher terraces, for example pits 57 NE 26 and 28, where water was not struck. Groundwater was proved at depths ranging from 1.1m in borehole 46 NE 109 to 4.6m in borehole 46 NW 238, with a mean depth of 2.5m, on the basis of ten sample points. Sand was formerly won from a pit at West Barns Links, but only from above the water table.

Based on 15 sample points, the mean thicknesses of mineral and overburden for all deposits in block A are 4.0 and 0.6m respectively (Table 8). The mean grading of potentially workable alluvium (the principal resource) is fines 9 per cent, sand 46 per cent and gravel 45 per cent.

Block B This block takes in extensive spreads of glacial sand and gravel occurring around Humbie, from Duncrahill *[453 656]* in the north-east to Saughland *[416 612]* in the south-west. The boundary of the block is drawn arbitrarily to include this major resource and is bounded to the north-west by sub-block H1 and to the south by sub-block H_2, both of which contain only scattered patches of glacial sand and gravel. This elevated area, lying between 150 and 250m above O.D. has an irregular surface, caused in part by numerous mounds of sand and gravel and in part by marked fluvial dissection. The block contains the Hamlets of Fala *[438 609]* and Humbie (un-named on the resource sheet) and is crossed by the A68 trunk road, but there are no built-up areas.

Glacial sand and gravel constitutes the major resource in block B, occurring as spreads and mounds deposits either at surface or as almost continuous deposits beneath till overburden. Potentially workable glaciolacustrine deposits commonly underlie the glacial sand and gravel but have not been mapped at surface, being identified only in boreholes on the basis of their grading characteristics. Except for two boreholes near Saughland which proved till on bedrock, and boreholes 46 SE 9 and 12 which demonstrated non-mineral glaciolacustrine deposits sandwiched between tills, all sample points in block B cut through potentially workable mineral. At the north-eastern and south-western extremities of the block glacial sand and gravel occurs as discrete mounds and ridges, separated by outcrops of till. Elsewhere sand and gravel forms a more or less continuous cover, except where dissected by streams. However, the sand and gravel is commonly concealed beneath sheets of superficial ablation or flow till which from sample-point data ranges in thickness from 0.3 to 3.7m (mean thickness 1.9m). This till is usually indistinguishable from the ubiquitous underlying lodgement till and is thus not shown separately on the geological map. Consequently the extent of concealed sand and gravel deposits is conjectural and extensive use is made of inferred boundaries on the resource map to show the limit of concealed mineral deposits.

The drilling investigation has confirmed observations by earlier workers, for example Kirby (1968), that the drift succession in this area contains multiple sequences, commonly with up to three distinct deposits of till separated by glacial meltwater deposits. This phenomenon was first observed in natural sections in the valley sides of the Keith Water; three tills or more were observed in five boreholes and two till horizons were recorded in a further nine boreholes within the block.

In block B, the mean grading of the glacial sand and gravel is fines 9 per cent, sand 78 per cent and gravel 13 per cent (Table 9), from which it is clear that gravel is not common. Thin gravelly deposits were found in the Saughland area

Table 9 Block B: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral	Depth of burial	Intervening waste	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel	Cobbles and boulders	
	m	m	m	$-\frac{1}{16}$ mm	$+\frac{1}{16}$ $-\frac{1}{4}$mm	$+\frac{1}{4}$ -1 mm	+1 -4 mm	+4 -16 mm	+16 -64 mm	+64 mm	
GLACIAL SAND AND GRAVEL											
NT 46 NE 108	2.0	0.1		9	62	20	4	3	2	0	PS
NT 46 SW 25	2.1	0.5	0.1	23	39	21	8	7	2	0	VCPS
NT 46 SW 26	1.2	0.5		8	11	27	10	25	19	0	SG
NT 46 SW 27	17.2	0.3	2.0	9	45	39	4	2	1	0	S
NT 46 SW 28	9.9	0.1	6.6*	7	30	26	9	14	13	1	SG
NT 46 SW 29	2.7	14.3		10	76	12	1	0	1	0	CS
NT 46 SW 30	5.5	2.6	8.8§	5	19	29	13	13	17	4	SG
NT 46 SW 31	5.5	5.8		9	78	13	0	0	0	0	S
NT 46 SW 32	4.9	8.6		9	45	43	2	1	0	0	S
NT 46 SW 33	7.3	0.5	12.0ϕ	9	42	30	5	8	5	1	PS
NT 46 SW 35	6.0	1.7		6	14	33	12	17	15	3	SG
NT 46 SW 36	4.7	1.4		12	37	38	5	6	2	0	CPS
NT 46 SW 37	2.0	1.5		9	6	10	16	29	30	0	G
NT 46 SW 38	3.0	0.4	0.4	5	3	9	11	31	38	3	G
NT 46 SW 41	11.1+	0.0		9	70	21	0	0	0	0	S
NT 46 SE 10	6.8	3.5		9	65	23	2	1	0	0	S
NT 46 SE 11	4.6	3.0		9	56	31	3	1	0	0	S
NT 46 SE 18	2.4	0.6		23	63	8	2	2	2	0	VCPS
Mean	**5.5**	**2.5**		**9**	**45**	**28**	**5**	**6**	**6**	**1**	**PS**
GLACIOLACUSTRINE DEPOSITS											
NT 46 NE 108	1.0	2.1		17	73	8	1	1	0	0	CS
NT 46 SW 25	4.2	3.3	1.0	29	66	4	1	0	0	0	VCS
NT 46 SW 28	5.0	3.4		20	70	10	0	0	0	0	VCS
NT 46 SW 29	4.4	3.0		18	65	12	3	2	0	0	CS
NT 46 SW 30	8.7	5.3		16	69	12	1	1	1	0	CS
NT 46 SW 31	5.5	0.3		15	83	1	1	0	0	0	CS
NT 46 SW 33	10.0	2.5		19	70	11	0	0	0	0	CS
NT 46 SW 34	7.1	12.0	1.8	20	63	13	3	1	0	0	VCS
NT 46 SW 35	1.8	7.7		17	65	10	1	4	3	0	CS
NT 46 SW 36	7.4	7.5		18	64	15	1	1	1	0	CS
NT 46 SE 11	5.4	1.0		20	76	3	1	0	0	0	VCS
Mean	**5.5**	**4.4**		**19**	**69**	**10**	**1**	**1**	**0**	**0**	**CS**

* Includes 5.0m of potentially workable glaciolacustrine deposits
§ Includes 8.7m of potentially workable glaciolacustrine deposits
ϕ Includes 10.0m of potentially workable glaciolacustrine deposits

Statistical assessment of glacial sand and gravel

Area of exposed mineral	5.3km^2
Area of continuous or almost continuous spreads of mineral beneath overburden	2.9km^2
Total area of mineral	8.2km^2
Area of worked ground	<0.1km^2
Mean thickness of overburden	2.5m
Mean thicknes of mineral	5.5m
Estimated volume of mineral	45 million m^3 ±38% or 17 million m^3
Estimated yield of sand and gravel per hectare	55 thousand m^3 ±38% or 21 thousand m^3

in borehole 46 SW 26 and in pits 46 SW 37 and 38, both of which failed to prove the base of the deposit, but other boreholes in the same district proved mainly sand. Boreholes 46 SW 28 and 30 near Costerton Mains *[434 626]* proved two horizons of *sandy gravel* separated by thick, predominantly sandy sequences, but the uppermost gravelly deposits were only 1.7 and 2.6m thick. Farther to the north-east borehole 46 SW 35 demonstrated 6.0m of *sandy gravel*, otherwise sandy deposits prevailed.

Although the history of deposition is complex, in general terms evidence suggests that much of the deposition occurred in a delta-fan environment in ice-dammed lakes containing large masses of dead ice, with a source of supply to the west or south-west, thus accounting for the broad fining in grade in a north-easterly direction. This hypothesis would appear to be borne out by sample-point data from Duncrahill, Nether Keith

Table 10 Block C: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	Descriptive category (see the diagram in Appendix C)
BLOCK C: GLACIAL SAND AND GRAVEL											
NT 56 NW 3	7.1	1.3		8	13	15	15	24	23	2	G
NT 56 NW 5	3.6	1.7		11	23	62	1	2	1	0	CS
NT 56 NW 6	1.8	0.5		11	14	15	13	23	21	3	CG
NT 56 NW 7	4.1	0.4		12	10	15	16	22	24	1	CG
NT 56 NW 9	6.1	3.5		10	11	11	13	20	33	2	CG
NT 56 NW 10	3.7	0.3		13	17	24	10	13	18	5	CSG
NT 56 NE 3	4.2	0.5		6	11	14	15	30	24	0	G
NT 56 NE 4	6.9	0.3		6	31	38	9	9	7	0	PS
NT 56 NE 13	2.3	0.4		4	5	13	14	16	22	26	G
NT 56 SW 1	6.0	0.5		9	8	11	19	22	23	8	G
NT 56 SW 2	3.2	5.8		11	10	14	15	20	21	9	CG
NT 56 SW 3	19.1	0.4	0.7	9	6	11	17	22	26	9	G
NT 56 SW 4	5.0	0.2		9	8	14	19	28	21	1	G
NT 56 SW 5	2.9	2.1		5	5	15	26	23	20	6	G
NT 56 SW 6	13.2	0.3	2.5*	9	44	33	4	6	4	0	PS
NT 56 SW 7	3.2	0.3		10	12	11	8	18	34	7	CG
NT 56 SW 11	3.2+	0.2		4	2	6	13	12	26	37	G
NT 56 SW 12	1.6	1.0		17	18	19	8	11	12	15	CSG
NT 56 SW 13	1.4	1.6		37	40	10	4	6	3	0	VCPS
NT 56 SW 14	10.4	2.6		4	14	17	13	18	27	7	G
NT 56 SE 1	3.3	0.3		8	9	21	16	17	20	9	G
Mean	**5.3**	**1.2**		**9**	**16**	**19**	**13**	**17**	**20**	**6**	**SG**
GLACIOLACUSTRINE DEPOSITS											
NT 56 NW 5	2.3	5.3		26	66	8	0	0	0	0	VCS
NT 56 NW 7	2.3	8.0		26	72	2	0	0	0	0	VCS
NT 56 NW 11	4.1	6.5		29	55	16	0	0	0	0	VCS
NT 56 NE 4	8.3	7.2		23	59	16	1	1	0	0	VCS
NT 56 SW 1	0.9	6.5		24	51	14	6	3	2	0	VCPS
NT 56 SW 2	0.8	9.0		27	52	16	1	2	2	0	VCPS
NT 56 SW 4	4.3	5.2		19	60	19	1	0	1	0	CS
NT 56 SW 6	2.5	8.3		19	68	12	1	0	0	0	CS
NT 56 SW 7	2.0	3.5		24	56	19	1	0	0	0	VCS
NT 56 SW 14	1.2+	13.0		21	75	4	0	0	0	0	VCS
Mean	**2.9**	**7.2**		**23**	**62**	**14**	**1**	**0**	**0**	**0**	**VCS**
FLOW TILL											
NT 56 NW 5	1.5	0.2		14	14	13	10	16	17	16	CG
NT 56 SW 2	1.0	4.8		13	8	13	10	15	24	17	CG
Mean	**1.2**	**2.5**		**13**	**11**	**13**	**10**	**15**	**21**	**17**	**CG**

* potentially workable glaciolacustrine deposits

Statistical assessment of glacial sand and gravel

Area of exposed mineral	5.1km^2
Area of continuous or almost continuous spreads of mineral beneath overburden	<0.1km^2
Area of discontinuous spreads of mineral beneath overburden	1.2km^2
Total area of mineral	5.7km^2*
Area of worked ground	<0.1km^2
Mean thickness of overburden	1.2m
Mean thicknes of mineral	5.3m
Estimated volume of mineral	30 million m^3 ±36% or 11 million m^3
Estimated yield of sand and gravel per hectare	53 thousand m^3 ±36% or 19 thousand m^3

* In the calculation of this figure 50 per cent of the area of discontinuous spreads of mineral beneath overburden is assumed

[453 647], Highlea *[465 644]* and Hattonhill *[471 637]*, which demonstrate predominantly very fine grained sediments. For example borehole 46 NE 108 proved 12.3m of glaciolacustrine deposits, only 1.0m of which is potentially workable.

On the basis of 19 sample points the mean thickness of all potentially workable glacial meltwater deposits is 8.5m. If, however, the potentially workable glaciolacustrine deposits are excluded on the grounds that they comprise chiefly fine sand and fines and are unlikely ever to be exploited, the mean thickness falls to 5.5m (Table 9).

Groundwater was proved within mineral in a number of boreholes in block B, but mainly at depths of 10m or more below surface. However in boreholes 46 SW 27, 29, 35 and 46 SE 11 groundwater was recorded at depths below surface of 9.1, 5.8, 8.0 and 7.5m, respectively. Sand is currently being won from a pit at *[450 640]* near Keith Marischal. The lithology is described in section 46 SW 41 (Appendix E).

Statistical assessments are offered for the glacial sand and gravel in block B; details are given in Table 9.

Block C

Glacial sand and gravel forming fairly extensive deposits around Long Newton *[515 648]*, Latch *[524 639]* and Long Yester, are included in block C which lies south of Gifford (sub-block H_3) and is bounded to the south by the Lammermuir Hills (sub-block H_2). Patchy deposits of glacial sand and gravel occur to the east in block D and more sparsely to the west in sub-block H_2; north of the block, sand and gravel is rare and to the south, virtually absent. The block boundary has no geological significance, being drawn arbirarily to enclose this area of fairly continuous spreads of sand and gravel. To the east in block D, the sand and gravel disposition is more patchy and mainly at higher elevations than in block C. The western boundary with sub-block H_2 is intended to demarcate thick deposits of glacial sand and gravel exemplified by boreholes 56 NW 3 and 56 SW 1 from the generally thin spreads characteristic of sub-block H_2. Block C is a rural area with one working sand and gravel pit near Long Yester at *[534 641]*.

The topography of the district is dominated by the morphology of the deposits of sand and gravel. A prominent series of kame terraces borders the northern flanks of the Lammermuir Hills around Latch, at elevations up to almost 300m above OD. On lower ground steep-sided ridges and elongate mounds trending approximately west-south-west to east-north-east are common, especially south of Yester Mains *[537 667]* as far as the road between Long Yester and West Latch *[522 647]*. In the eastern part of the block however, around Long Yester and Castle Mains *[556 663]*, the mounds are more subdued, producing rolling, undulating topography.

The sand and gravel deposits in block C are the product of multi-phase sedimentation, on the evidence of the different morphologies and lithologies present. What appear to be the oldest deposits make up the kame terraces around Latch, which were formed while static or waning glacial ice occupied the ground to the north, although sand and gravel may also have been laid down englacially or subglacially at lower elevations at the same time. With time, sand and gravel deposition took place at progressively lower levels, and was commonly preceded by a lacustrine phase, as demonstrated by the glaciolacustrine deposits recorded in 14 sample points. Melt-out of dead ice has contributed to the irregular topography now displayed in the district. Deposits of till are common within the meltwater sequences, and also as a surface drape; the latter disposition was shown in ten sample points in the block. This phenomenon, although not so widespread as in block B, has posed difficulties in predicting the distribution of concealed mineral deposits; the positioning of inferred boundaries shown on the resource map within block C should therefore be viewed with caution.

The mean grading of glacial sand and gravel in block C is fines 9 per cent, sand 48 per cent and gravel 43 per cent, equivalent to *sandy gravel*. If glaciolacustrine deposits are included, the overall mean grading becomes fines 12 per cent, sand 54 per cent and gravel 34 per cent. Where potentially workable glacial sand and gravel was proved in sample points, gravel was almost ubiquitous, in contrast to block B where it is rare. Exceptions were boreholes 56 NE 4 and 56 SW 6, in which thick sequences grading as *pebbly sand* were penetrated. It should be noted that a short distance west of borehole 56 SW 6, in the Long Yester gravel pit (see 56 SW 14) gravel is abundant in the faces exposed there. A predominantly arenaceous sequence was also recorded in borehole 56 NW 5 near Redshill *[525 661]*.

Potentially workable glaciolacustrine deposits, composed chiefly of fine sand and silt, were proved in ten sample points, usually beneath glacial sand and gravel, but beneath flow till in borehole 56 NW 11, at Long Yester. The extremely fine grained nature of this resource will almost certainly preclude it from exploitation; therefore it is not assessed.

Potentially workable flow till was proved at surface in a number of sample points, but was considered to be potentially workable in only two boreholes where it graded as *'clayey' gravel;* consequently flow till is not assessed.

The thickness of potentially workable glacial sand and gravel, based on 21 sample points all but one of which bottomed the deposit, ranges from 1.4 to 19.1m and the mean thickness is 5.3m; the greatest thicknesses are likely to underlie the kame terraces in the Latch area where borehole 56 SW 3 recorded the maximum thickness in block C.

On the evidence of assessment boreholes the majority of the resource lies above groundwater. Water was encountered within glacial sand and gravel in a number of boreholes, but in the majority it probably emanated from perched water tables occurring near the base of the permeable deposits. Groundwater was recorded at relatively shallow levels only in boreholes 56 NW 3 and 5 at depths of 4.3 and 2.5m respectively.

There is one working sand and gravel pit in this block: the succession at one locality in the pit is described in section 56 SW 14 (Appendix E). Details of the assessment of glacial sand and gravel are given in Table 10.

Block D

Deposits of glacial sand and gravel with a somewhat patchy distribution and varying modes of origin, are encompassed by block D. The block is situated on the flanks of the Lammermuir Hills between Garvald and Newlands *[569 665]*, being bounded on the west by block C, on the east by block E and elsewhere by block H. With the exception of the village of Garvald, the district is given over to farming.

The lower ground has an undulating, irregular topography dominated by several deeply incised glacial drainage channels, the most prominent of

Table 11 Block D: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	
GLACIAL SAND AND GRAVEL											
NT 56 NE 6	4.4	2.5	0.4	8	9	23	19	21	16	4	SG
NT 56 NE 8	2.4	0.2		10	5	6	14	24	33	8	CG
NT 56 NE 9	10.7	0.3		9	5	8	18	30	26	4	G
NT 56 NE 11	3.0+	0.2		9	27	8	5	9	25	17	G
NT 56 NE 14	2.6+	0.2		3	2	14	22	21	31	7	G
NT 56 NE 15	5.4	0.1		1	1	5	13	27	42	11	G
NT 57 SE 2	6.0	1.3		9	10	16	19	21	19	6	G
NT 57 SE 3	3.7	0.2		9	11	21	18	18	23	0	SG
NT 57 SE 4	4.7	0.3		17	19	28	12	9	8	7	CSG
NT 57 SE 5	7.0	0.2		7	13	36	11	17	11	5	SG
Mean	**5.0**	**0.5**		**8**	**10**	**17**	**15**	**21**	**23**	**6**	**G**
FLOW TILL											
NT 57 SE 2	1.0	0.3		16	12	12	15	21	20	4	CG
TILL											
NT 57 SE 5	3.9	10.3		22	42	23	5	4	4	0	VCPS

Statistical assessment of glacial sand and gravel

Area of exposed mineral	3.2km^2
Area of discontinuous spreads of mineral beneath overburden	0.5km^2
Total area of mineral	3.5km^2*
Area of worked ground	<0.1km^2
Mean thickness of overburden	0.5m
Mean thicknes of mineral	5.0m
Estimated volume of mineral	18 million m^3 ±38% or 7 million m^3
Estimated yield of sand and gravel per hectare	50 thousand m^3 ±38% or 19 thousand m^3

* In the calculation of this figure 50 per cent of the area of discontinuous spreads of mineral beneath overburden is assumed

which are now occupied by Danskine Loch, Snawdon Howe and the misfit Sounding Burn, a tributary of the Whittingehame Water. The highest ground occurs around Snawdon *[584 677]* and Darned House *[587 664]*, where mounds of sand and gravel form prominent hillocks.

Although all the potentially workable material in block D is classified as glacial sand and gravel, the variety of elevations at which the deposits occur, together with their morphology, indicate that their depositional history was episodic. The oldest sand and gravel was laid down as mounds and kame terraces on high ground between Dod Law *[568 646]* and Birset Hill *[591 683]* at elevations up to about 300m above OD. Fairly extensive kame terraces, composed of glacial sand and gravel, also occur at lower levels around Nunraw *[597 706]* and Garvald. Deposits at similar elevations in the neighbourhood of Carfrae *[575 692]* demonstrate a more moundy form, with the added complication that thin flow till thereabouts may conceal sand and gravel. The extent of such a flow till sheet is uncertain; hence the inferred boundary limiting a possible concealed resource south-west of Carfrae.

The mean grading of glacial sand and gravel in block D is fines 8 per cent, sand 42 per cent and gravel 50 per cent; corresponding to *gravel* (Table 11). The most gravelly material was recorded in sample points in the south-eastern part of the block, reaching 80 per cent in the section sampled near Darned House (56 NE 15). Elsewhere in the block glacial sand and gravel graded as *sandy gravel* or *gravel*, although horizons of *pebbly sand* were recorded in boreholes 57 SE 4 and 5 near Nunraw. For the most part the resource in block D is rather poorly graded and 'dirty', some of the material being classified as *'clayey'*. Flow till was recorded in boreholes 56 NE 6 and 57 SE 2, and although proving potentially workable at the latter site, it is not assessed. Glaciolacustrine deposits were not found in this block.

The mean thickness of glacial sand and gravel is 5.0m and the range is from 2.4 to 10.7m; only two pits failed to prove the base. Groundwater was not recorded within glacial sand and gravel in any sample point. A few small borrow pits have been worked intermittently for local use, for example section 56 NE 15.

Details of the assessment of glacial sand and gravel are given in Table 11.

Table 12 Block E: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	
GLACIAL SAND AND GRAVEL											
NT 67 SW 3	7.4	2.1		22	74	4	0	0	0	0	VCS
NT 67 SW 5	2.2	0.3		11	10	14	14	23	28	0	CG
NT 67 SE 15	11.8	0.2		7	4	6	15	27	27	14	G
NT 67 SE 16	3.0	0.1		5	5	12	17	26	35	0	G
NT 67 SE 17	3.0	0.7		8	7	10	16	34	25	0	G
NT 67 SE 18	11.4	0.1		15	29	21	12	14	8	1	CSG
NT 67 SE 19	6.6	0.2		9	12	15	20	18	18	8	SG
NT 67 SE 20	6.2	0.3		18	44	6	7	11	12	2	CSG
NT 67 SE 21	12.5	0.2		15	59	17	5	3	1	0	CS
Mean	**7.1**	**0.5**		**13**	**32**	**12**	**11**	**14**	**14**	**4**	**CSG**
TILL											
NT 67 SE 16	0.9	3.1		8	6	8	12	26	33	7	G

Statistical assessment of glacial sand and gravel

Area of exposed mineral	3.6km^2
Total area of mineral	3.6km^2
Mean thickness of overburden	0.5m
Mean thicknes of mineral	7.1m
Estimated volume of mineral	26 million m^3 ±45% or 12 million m^3
Estimated yield of sand and gravel per hectare	71 thousand m^3 ±45% or 32 thousand m^3

Block E

This block takes in a suite of kame terraces composed of glacial sand and gravel, and is situated on the northern flanks of the Lammermuir Hills to the east of block D. It is bounded arbitrarily to the north by sub-blocks H_5 and H_6. The district is entirely rural.

The high ground of the Lammermuir Hills is devoid of sand and gravel; the topography of the foothills immediately to the north is dominated by numerous steep-sided valleys which represent an impressive suite of glacial drainage channels formed at or near the margin of the ice-sheet. The dominant trend of these channels is west to east, parallel to the ice-sheet margin. The numerous misfit streams testify to the ephemeral nature of these glacial spillways.

Glacial sand and gravel was laid down as mounds, ridges and kame-terrace deposits by the same meltwaters as eroded the glacial drainage channels. Kame terraces are particularly well developed at several different elevations in the central part of the block around Halls *[654 727]*. The steep-sided valleys are incised into till and bedrock, sand and gravel being confined to the flatter surfaces forming the interfluves between channels.

The mean grading of potentially workable glacial sand and gravel in block E is fines 13 per cent, sand 55 per cent and gravel 32 per cent, equivalent to *'clayey' sandy gravel*. The grade of the resource, as demonstrated in assessment boreholes, is quite variable. In the neighbourhood of Halls, the deposits were shown to be consistently gravelly; elsewhere the material appears to be much more variable in grade. Borehole 67 SW 3, in the west of the block, proved 7.4m of *'very clayey' sand*, but gravel was recorded during field mapping higher up on the same ridge and in most of the outcrops in the Stoneypath area. It is therefore probable that coarsening-upward sequences, typical of deltaic depositional environments, are prevalent thereabouts. Borehole 67 SE 21 at Elmscleugh demonstrated a similar succession. The remaining boreholes in block E, around Woodhall *[686 727]*, proved a variety of deposits, ranging in grade from *gravel* to *'very clayey' sand*. The gravel was seen to be claybound quite commonly in block E, this feature being reflected to a degree in the mean grading of the resource. Potentially workable till was recovered from borehole 67 SE 16, but it is excluded from the assessment.

Based on nine sample points, potentially workable glacial sand and gravel has a mean thickness of 7.1m (range 2.2 to 12.5m), and overburden thickness is less than 1m except in borehole 67 SW 3 where 2.1m of soil and till overlay glacial sand and gravel. Superficial tills have not been recorded elsewhere in block E.

The majority of the resource in this block can be expected to lie above the water table; water was struck in some boreholes, but probably represented perched water tables. Sand and gravel is not worked except for local purposes. Details of the assessment of glacial sand and gravel are given in Table 12.

Table 13 Block F: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	
GLACIAL SAND AND GRAVEL											
NT 57 NE 22	7.2	0.5		8	31	19	9	14	16	3	SG
NT 57 NE 23	4.3	0.0		15	12	11	10	19	32	1	CG
NT 67 NW 3	7.3	0.3	1.4	11	22	24	12	14	14	3	CSG
NT 67 NW 4	4.1	0.4		7	8	14	14	22	33	2	G
NT 67 NW 5	2.0	0.3		6	7	35	14	21	17	0	SG
NT 67 NW 8	2.8	0.3		7	22	26	12	21	12	0	SG
NT 67 NW 11	4.0	0.4		13	57	24	4	2	0	0	CS
NT 67 NW 18	2.3	0.3		5	4	56	20	12	3	0	PS
Mean	**4.2**	**0.3**		**10**	**23**	**23**	**11**	**15**	**17**	**1**	**CSG**
GLACIOLACUSTRINE DEPOSITS											
NT 67 NW 11	5.6	4.4	0.2	30	68	2	0	0	0	0	VCS

Statistical assessment of glacial sand and gravel

Area of exposed mineral	3.8km^2
Total area of mineral	3.8km^2
Mean thickness of overburden	0.3m
Mean thicknes of mineral	4.2m
Estimated volume of mineral	16 million m^3 $\pm$42% or 7 million m^3
Estimated yield of sand and gravel per hectare	42 thousand m^3 $\pm$42% or 18 thousand m^3

Block F

Moundy and flattish spreads of glacial sand and gravel bordering the alluvial plain of the River Tyne east of East Linton are encompassed by block F, which is broadly horseshoe-shaped. The inner margin coincides with the geological boundary marking the extent of alluvium, blown sand and post-Glacial marine deposits around the estuary of the River Tyne. Elsewhere the block boundary is drawn arbitrarily to include the outcrops of glacial sand and gravel in this area. The burgh of East Linton and the hamlet of Tyninghame lie in block F; both are largely built on deposits of glacial sand and gravel, but the resource underlying the former community is not assessed.

Most of the block is low-lying with the majority of the resource occurring at elevations below 25m above OD; but around Lawhead *[601 793]* the ground rises to over 50m above OD. The glacial sand and gravel deposits underlie a series of low ridges superimposed on broadly terrace-like features flanking the alluvial plain of the River Tyne, and were probably laid down in the form of glacial outwash spreads which have been modified by post-depositional erosion. Several glacial drainage channels testify to this.

The drilling results demonstrate a progressive fining in grade eastwards, and also show upwards-coarsening sequences in all boreholes except 57 NE 23. These characteristics indicate a delta-fan depositional environment.

The mean grading of glacial sand and gravel in block F is fines 10 per cent, sand 57 per cent and gravel 33 per cent, equivalent to *'clayey' sandy gravel*. Four boreholes in the western part of the block all proved a gravel deposit at surface, some of which was *'clayey'*, particularly in the upper parts of the deposit. North of the River Tyne, where the resource is thicker, boreholes 57 NE 22 and 67 NW 3 proved underlying deposits of *pebbly sand*, with seams of flow till in the latter borehole. Farther east boreholes 67 NW 5 and 8 penetrated deposits of *sandy gravel*, 2.0 and 2.8m thick, respectively. Around Tynefield there is a barren area, but a little to the east at Hedderwick Hill *[639 781]* borehole 67 NW 11 proved an arenaceous and argillaceous sequence 14.7m thick, of which the upper 4.0m of *'clayey' sand* was classified as glacial sand and gravel, but the lower part, of which 5.6m is partially workable, was designated as glaciolacustrine deposits and is excluded from the assessment of resources. Shallow pit 67 NW 14, north-east of Lawhead, proved a deposit of mainly fine sand and silt to a depth of 3.6m, which failed marginally to meet the criteria for mineral thickness and fines content; nevertheless this area of glacial sand and gravel is shown to be potentially workable on the resource map.

The mean thicknesses of glacial sand and gravel and overburden are 4.2 and 0.3m respectively. Water was proved in the majority of boreholes in block F, but only in boreholes 57 NE 22 and 67 NW 3 was it not below or at the base of the glacial sand and gravel; consequently most of the resource could be worked dry. There is no record of sand and gravel workings in this block. Details of the assessment are given in Table 13.

Table 14 Block G: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							Descriptive category (see the diagram in Appendix C)
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	
GLACIAL SAND AND GRAVEL											
NT 57 NW 9	1.5	1.3		9	10	17	21	32	11	0	SG
NT 57 NW 11	2.6	0.9		9	42	23	9	12	5	0	PS
NT 57 NE 14	5.9	0.4		12	25	19	10	13	18	3	CSG
NT 57 NE 16	3.0	0.3		14	11	10	11	25	22	7	CG
NT 57 NE 17	3.4	0.4		8	21	30	13	17	11	0	SG
NT 57 NE 18	11.0+	0.1	13.9*	8	46	25	8	6	6	1	PS
NT 57 NE 19	5.6+	0.2		13	10	7	11	16	26	17	CG
NT 57 NE 27	3.0+	0.5		20	57	22	1	0	0	0	VCS
NT 57 NE X1	8.4+	0.0		**	**	**	**	**	**	**	
Mean	**4.9**	**0.5**		**11**	**32**	**20**	**9**	**12**	**12**	**4**	**CSG**
GLACIOLACUSTRINE DEPOSITS											
NT 57 NE 18	3.6	4.1	2.2	22	77	1	0	0	0	0	VCS
FLOW TILL											
NT 57 NE 20	1.3	3.1		6	7	6	13	22	33	13	G

* Includes 3.6m of potentially workable glaciolacustrine deposits

Statistical assessment of glacial sand and gravel

Area of exposed mineral	3.8km^2
Area of continuous or almost continuous spreads of mineral beneath overburden	0.6km^2
Total area of mineral	4.4km^2
Mean thickness of overburden	0.5m
Mean thicknes of mineral	4.9m
Estimated volume of mineral	22 million m^3 ±51% or 11 million m^3
Estimated yield of sand and gravel per hectare	49 thousand m^3 ±51% or 25 thousand m^3

Block G

Spreads of glacial sand and gravel in the neighbourhood of Drem *[511 795]* and the disused airfield of East Fortune *[552 789]*, and lying in a broad basin with a gentle undulating relief, constitute block G. The Peffer Burn, a misfit stream occupying a former channel of the River Tyne, flows through the eastern part of the block, which is largely devoted to agriculture.

The surface of the glacial sand and gravel deposits is for the most part irregular with low mounds and ridges, but in the vicinity of the airfield the ground is fairly flat. A low, flat-topped ridge, running parallel with the northern boundary of the resource sheet, is well developed 1km east and west of Kamehill *[579 797]*, and may be traced westwards through Betony Hill *[538 796]* to Drem where glacial sand and gravel forms a dozen small mounds. It is possible that this feature represents an esker, but the morphology, especially in cross-section, is much more subdued than the typical form. Near Markle Mains *[563 774]* a small but well marked esker, approximately 1km in length, is aligned south-west to north-east. Glaciolacustrine deposits were proved beneath glacial sand and gravel in all sample points within a radius of approximately 1km from Fortoun Bank *[567 790]*, and clay recorded at two localities in cuttings of the Edinburgh-London railway is similarly classified.

Late-Glacial marine deposits, comprising mainly silt, clay and fine sand, and representing deposits laid down during a period of high sea-level, crop out widely in the eastern half of the block. In places they overlie glacial sand and gravel which is considered to occur as almost continuous spreads of mineral beneath this overburden. Between Kamehill and Fortoun Bank, there is no evidence to delineate the concealed glacial sand and gravel; hence an inferred boundary is used on the resource map.

The mean grading of glacial sand and gravel in block G is fines 11 per cent, sand 61 per cent and gravel 28 per cent, equivalent to *'clayey' sandy gravel*. From the evidence of the drilling and sampling results the grading of the glacial sand and gravel varies widely, both laterally and vertically, and without any discernable pattern. On the ridge at Kamehill, for example, borehole 57 NE 19 proved 5.6m+ of *'clayey' gravel*, whereas borehole 57 NE 18, 750m away, recorded 3.0m of *'clayey' sand* on 13.9m of glaciolacustrine deposits on 8.0m of *sandy gravel* and *pebbly sand*. The lowest deposit probably represents a separate depositional phase, possibly from an earlier glaciation; the meltwater succession is also unusually thick here. Although 3.6m of the glaciolacustrine sequence graded as mineral in this borehole, the deposit contained excessive fines elsewhere and is not assessed. In the central part of the block boreholes 57 NE 14 and 17 both recorded deposits which became finer

grained with depth. Near Markle Mains, borehole 57 NE 16, on an esker, proved 3.0m of *'clayey' gravel*. In the vicinity of Crauchie *[563 784]* deposits of glacial sand and gravel proved to be too thin or fine grained to be potentially workable. In borehole 57 NE 20, late-Glacial marine deposits overlay 2.8m of flow till, of which 1.3m proved to be potentially workable. However flow till is not assessed for the reasons stated elsewhere in this report.

The thickness of potentially workable glacial sand and gravel, on the basis of nine sample points, ranged from 1.5 to 11.0m+, and although the base of the deposit was not reached in four cases, the mean thickness of 4.9m is considered to be representative of the block as a whole. The mean thickness of overburden is 0.5m.

Groundwater was proved in half of the assessment sample points in block G, at depths of between 2.0 and 8.3m below surface. Sand and gravel working has been confined to a few small borrow pits, for local consumption only. Details of the assessment of glacial sand and gravel are given in Table 14.

Block H

The block comprises all the resource sheet outwith blocks A to G, and includes part of the Lammermuir Hills and other areas of mainly barren ground such as the country around Athelstaneford *[535 774]*, East Saltoun *[476 677]*, Traprain Law *[582 747]* and Spott *[672 755]*. Potentially workable sand and gravel deposits are scattered across the block, but they are too small, patchy and diverse to be assessed statistically. Inferred assessments are offered for deposits in five sub-blocks. Details of mean thickness and estimated volume are given in Table 15.

Sub-block H_1 The western part of the survey area around Ormiston and Pencaitland, but excluding the alluvial plain of the River Tyne, is contained in the sub-block. The built-up area of Ormiston is not assessed. Much of the sub-block is rolling farmland in which till crops out widely. Bedrock is commonly exposed in the southern part and limestone was formerly quarried at East Saltoun. Isolated patches of glacial sand and gravel overlie till around Ormiston, West Saltoun *[461 674]*, Spilmersford Bridge *[460 690]*, Murrays *[413 661]* and Whitburgh Mains *[407 636]*. Pit 46 NW 241 north of Ormiston proved 2.5m of *'clayey' gravel* without bottoming the deposit, and south of the River Tyne near West Byres *[405 674]* borehole 46 NW 236 sampled 1.2m of *sandy gravel*. At Puddle Wood *[418 699]* pit 46 NW 239 penetrated 1.6m of flow till on 1.5 m of *'clayey' sandy gravel* without reaching the base of the deposit; this concealed resource is delimited by an inferred boundary. On the opposite side of the River Tyne near West Byres *[405 674]* borehole 46 NW 236 sampled 1.2m of *sandy gravel* and farther south at Murrays, pit 46 NW 242 demonstrated 1.5m+ of *sand*. A patch of glacial sand and gravel at Whitburgh Mains was not sampled but the field surveyor observed sand and fine gravel at the surface.

Borehole 46 NE 107 at Milton *[454 672]* proved 3.8m of *sandy gravel* and 2.7m of *'very clayey' pebbly sand*, separated by 1.4m of laminated silt and flow till, and 2km away at Saltoun Home Farm *[465 689]* pit 46 NE 110 sampled 1.9m of *pebbly sand*.

From sample-point data the mean thickness of mineral in the sub-block is 2.5m, and although half of the sample points did not bottom the deposits, this figure is considered to be representative of the sub-block as a whole. Owing to the paucity of sample points and the scattered nature of the glacial sand and gravel deposits, a statistical assessment of the resource is not possible, and separate inferred assessments are offered for the western and eastern parts of sub-block H_1 (Table 15). Further data on the sand and gravel deposits are presented in Table 15.

Sub-block H_2 The Lammermuir Hills together with the foothills around Stobshiel House *[494 634]* and Woodcote Park *[459 603]*, constitute sub-block H_2. Bedrock crops out over much of the higher ground and the few small patches of glacial sand and gravel there are not assessed. On lower ground till crops out widely, and is overlain locally by moundy deposits of glacial sand and gravel. Associated with the till are several large glacial erratics, usually consisting of massive limestone slabs, for example Meikle Law *[454 608]* and Little Law *[452 606]*. Several patches of sand and gravel occur between Fala, Woodcote Park and Johnstounburn *[461 617]*, but because the sole sample point in the area proved 0.7m of *gravel*, at the margin of a deposit, no assessment is possible. In the central part of the sub-block where there is a fairly extensive scattering of sand and gravel patches, sample-point data would suggest a progressive southward thickening of the material. Pits 46 NE 111, 46 SE 20 and borehole 46 SE 16 in the neighbourhood of Ewingston *[492 648]* each proved between 1.0 and 1.2m of mineral, ranging in grade from *'very clayey' sand* to *sandy gravel*. Farther south at Stobshiel *[496 635]*, pit 46 SE 22 sampled 2.9m of *gravel*, while at Leaston House, pit 46 SE 21 demonstrated 2.4m of *sandy gravel*, the uppermost 0.4m of which comprised superficial till. In consequence, till mapped at surface around this sample point may conceal a buried resource of sand and gravel which is depicted on the resource map with the appropriate ornament.

Borehole 46 SE 15 at Blegbie *[481 617]* penetrated 2.1m of *gravel* overlying glaciolacustrine deposits, 4.4m of which proved potentially workable, on 2.4m of flow till, also potentially workable. The lower part of the succession is a repeat of the upper part, but only the uppermost 1.0m is mineral.

At White Knowe *[499 621]* moundy deposits of glacial sand and gravel achieve thicknesses in the order of 10m. A temporary gravel pit there demonstrated coarse, greywacke gravel, but it was backfilled before it could be sampled.

In the vicinity of Hattonhill glacial sand and gravel comprises silty sand which proved to be non-mineral in borehole 46 SE 13, and is classified as barren ground.

On the basis of six sample points, an inferred assessment is offered for the area around Stobshiel; details are given in Table 15.

Sub-block H_3 The central part of the assessment area east of the River Tyne between Haddington and Gifford, but excluding the valley of the Colstoun Water, constitutes the sub-block. The area is notably devoid of mineral deposits, except for a few patches of glacial sand and gravel north of Bolton and around Bolton Muir Wood *[506 680]*. Till forms extensive spreads and the underlying bedrock crops out frequently.

Many former glacial drainage channels, particularly in the neighbourhood of Colstoun Mains *[527 716]*, contain alluvial deposits but these are considered to be too fine grained or too

Table 15 Block H: Data from sample points and the assessment of resources

Sample point	Recorded thickness			Mean grading percentage							
Borehole or pit	Total mineral m	Depth of burial m	Intervening waste m	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	Cobbles and boulders +64 mm	Descriptive category (see the diagram in Appendix C)
SUB-BLOCK H1: GLACIAL SAND AND GRAVEL											
NT 46 NW 236	1.2	0.3		8	13	15	22	19	18	5	SG
NT 46 NW 239	1.5+	2.0		15	11	31	14	15	14	0	CSG
NT 46 NW 241	2.5+	0.7		11	7	9	9	15	17	32	CG
NT 46 NW 242	1.5+	1.0		5	48	45	1	1	0	0	S
NT 46 NE 107	6.5	0.3	1.4	14	32	22	8	12	10	2	CSG
NT 46 NE 110	1.9	0.6		3	10	52	23	10	2	0	PS
Mean	**2.5**	**0.8**		**11**	**23**	**26**	**11**	**12**	**10**	**7**	**CSG**
SUB-BLOCK H2: GLACIAL SAND AND GRAVEL											
NT 46 NE 111	1.0	0.3		25	50	23	1	1	0	0	VCS
NT 46 SE 15	3.1	0.3	7.6§	9	12	31	14	15	17	2	SG
NT 46 SE 16	1.0	0.4		34	40	12	6	6	2	0	VCPS
NT 46 SE 20	1.2	0.3		0	10	26	17	20	18	9	SG
NT 46 SE 21	2.4	0.3		8	48	16	4	6	6	12	SG
NT 46 SE 22	2.9	0.3		4	3	6	11	14	17	45	G
Mean	**1.9**	**0.3**		**10**	**23**	**19**	**10**	**11**	**12**	**15**	**CSG**
SUB-BLOCK H4: GLACIAL SAND AND GRAVEL											
NT 57 NW 5	3.0	0.4		20	59	16	2	2	1	0	VCS
NT 57 SE 6	3.0+	0.3		6	24	22	10	21	17	0	SG
Mean	**3.0**	**0.3**		**13**	**42**	**19**	**6**	**11**	**9**	**0**	**CPS**
SUB-BLOCK H5: GLACIAL SAND AND GRAVEL											
NT 67 NW 12	2.8	0.7		14	17	13	9	16	20	11	CG
NT 67 NW 19	2.9	0.3		6	7	9	11	18	27	22	G
NT 67 SW 1	2.6	3.8		4	13	35	24	12	10	2	PS
NT 67 SW 6	2.4	0.3		2	6	17	19	25	26	5	G
NT 67 SW 7	2.4	0.3		7	6	7	9	16	25	30	G
Mean	**2.6**	**1.1**		**7**	**10**	**16**	**14**	**17**	**22**	**14**	**G**
SUB-BLOCK H6: GLACIAL SAND AND GRAVEL											
NT 67 NE 21	8.9	0.3		11	9	18	24	20	16	2	CSG
NT 67 NE 30	2.9+	0.6		12	43	25	5	7	8	0	CPS
Mean	**5.9**	**0.4**		**11**	**17**	**20**	**19**	**17**	**14**	**2**	**CSG**

Inferred assessement of glacial sand and gravel in the Pencaitland area (sub-block H_1)

Area of exposed mineral	1.0km^2
Mean thickness of overburden	0.5m
Mean thickness of mineral	4.2m
Estimated volume of mineral	**4 million m^3**

Inferred assessement of the glacial sand and gravel in the Ewingston, Stobshiel and Blegbie areas (sub-block H_2)

Area of exposed mineral	1.5km^2
Area of discontinuous spreads of mineral beneath overburden	0.3km^2
Total area of mineral	1.6km^2*
Mean thickness of overburden	0.3m
Mean thickness of mineral	1.9m
Estimated volume of mineral	**3 million m^3**

Inferred assessement of the glacial sand and gravel in the Stenton and Belton areas (sub-block H_5)

Area of exposed mineral	2.8km^2
Area of discontinuous spreads of mineral beneath overburden	0.4km2
Total area of mineral	3.0km^2*
Mean thickness of overburden	1.1m
Mean thickness of mineral	2.6m
Estimated volume of mineral	**8 million m^3**

Inferred assessement of the glacial sand and gravel in the Ormiston area (sub-block H_1)

Area of exposed mineral	1.4km^2
Area of continuous or almost continuous spreads of mineral beneath overburden	0.1km^2
Total area of mineral	1.5km^2
Mean thickness of overburden	1.0m
Mean thickness of mineral	1.7m
Estimated volume of mineral	**3 million m^3**

Inferred assessement of the glacial sand and gravel in the Abbey Mains and East Bearford areas (sub-block H_4)

Area of exposed mineral	0.7km^2
Mean thickness of overburden	0.3m
Mean thickness of mineral	3.0m
Estimated volume of mineral	**2 million m^3**

Inferred assessement of the glacial sand and gravel and post-Glacial marine deposits in the Dunbar area (sub-block H_6)

Area of exposed mineral	2.8km^2
Mean thickness of overburden	0.4m
Mean thickness of mineral	5.9m
Estimated volume of mineral	**17 million m^3**

* In the calculation of this figure, 50 per cent of the area of discontinuous spreads of mineral beneath overburden is assumed

thin to be potentially workable.

Near Bolton Muir Wood the field surveyor recorded gravel in the moundy deposits of glacial sand and gravel. North of Bolton the deposits comprise mainly fine gravel and sand. At both localities the mean thickness is not likely to exceed 2 m; however, without sample-point data no assessment can be made.

Sub-block H_4 With a total area of 47.6km^2, this sub-block occupies the predominantly barren tract of ground that stretches from Drem south-eastwards to Traprain Law, and includes the Garleton Hills north of the town of Haddington. The latter is not assessed. The valley-floor deposits of the River Tyne are contained in block A which splits sub-block H_4 into two parts. The River Tyne formerly flowed north-eastwards from Haddington into the valley now occupied by the Peffer Burn, but the route of the former channel has been filled with till and lies beneath the ridge on which Beanston *[548 763]* stands.

Till crops out widely in the sub-block, and bedrock is commonly exposed on the higher ground. Outcrops of sand and gravel are rare, being confined to several patches in the neighbourhood of Abbey Mains *[536 758]* and East Bearford *[556 746]*. Near the former, borehole 57 NW 5 proved 3.0m of *'very clayey' sand*, although gravel has been observed in other mounds in the vicinity. At East Bearford, pit 57 SE 6 sampled 3.0m of *gravel* and *pebbly sand* without bottoming the deposit. An inferred assessment is offered for the glacial sand and gravel in sub-block H_4 (Table 15).

Sub-block H_5 The valleys of the Biel Water and its tributary the Sauchet Water, are dominant topographic features in the sub-block. Both are large glacial drainage channels, as is the prominent valley occupied by Pressmennan Lake. Moundy and terraced deposits of glacial sand and gravel flank the Biel Water from Whittingehame House *[606 734]* to Beltonford *[642 776]*. Upstream from the site of Belton House *[645 767]*, where the valley of the Biel Water is deeply incised, the sand and gravel deposits occur as mounds and prominent kame terraces bordering the channels, and almost certainly relate to their active phase. Quarry Hill *[621 746]* near Stenton is a particularly good example. North of Belton House, meltwaters debouching on to flat and open ground created outwash spreads of coarse gravel, which are known to be 2m thick from natural sections adjacent to the Biel Water.

Five sample points in the sub-block proved glacial sand and gravel, and nearly all recorded gravelly deposits. The exception was borehole 67 SW 1 which sampled 2.6m of *pebbly sand* overlain by 3.4m of flow till, the surface distribution of which could not be established during field survey. It may be an isolated deposit. The mean grading of glacial sand and gravel is fines 7 per cent, sand 40 per cent and gravel 53 per cent and the recorded thicknesses were unusually consistent, in the range 2.4 to 2.9m. Thicker deposits do occur, for example at Quarry Hill, but no sample points were sited there.

Boreholes 67 SW 2 and 4 recorded potentially workable till at surface, on ground classified as glacial sand and gravel on the geological map. This anomaly could not be resolved during field survey; consequently the deposits in the vicinity of both sample points are shown as discontinuous spreads of potentially workable sand and gravel on the resource map. Till, although grading as mineral locally, displays marked variations in lithology and is not assessed.

An inferred assessment is offered for the glacial sand and gravel in sub-block H_5 (Table 15).

Sub-block H_6 Moundy and flattish spreads of glacial sand and gravel on the south side of Dunbar, together with outcrops of post-Glacial marine deposits east of the town, constitute the resource in sub-block H_6. The town itself is not assessed. The hilly southern half of the sub-block south of Spott, in which bedrock crops out extensively, is barren; however it is noteworthy that the bedrock hereabouts comprises conglomerate (lithified sand and gravel) of Lower Devonian age, which may itself constitute a resource, particularly if any poorly indurated or weakly cemented deposits can be located.

The sand and gravel deposits have been laid down by glacial meltwaters which emanated from the over-deepened valley of the Spott Burn and the channel adjacent to Bourhouse *[667 766]*. The irregular surface of the deposits, notably around Eweford *[666 777]* and Broxmouth *[696 776]*, testifies to the existence of masses of dead ice at the time of their formation. The till surface on which the sand and gravel rests is also uneven, so that rapid fluctuations in thickness will occur.

Six sample points in this sub-block were sited on barren ground, although in three of them glacial sand and gravel deposits less than 1m thick were recorded, and a further two demonstrated potentially workable till. This necessitated amendments to the geological map of the area. Borehole 67 NE 21 at Newtonlees sampled 8.9m of *'clayey' sandy gravel* resting on 3.0m of till, the upper 1.5m of which is potentially workable. This thickness is probably representative of the resource east of the railway line. Pit 67 NE 30, sited on a steep hillslope south-east of Little Pinkerton *[695 761]* proved 2.9m of *'clayey' pebbly sand* without reaching the base of the deposit. On lower ground adjacent to the farmhouse, where sand and gravel was formerly dug, the material is more gravelly. The ground surface is extremely stony hereabouts, owing to the conglomeratic nature of the bedrock and its influence upon the till lithology.

In the neighbourhood of Eweford where sample points failed to prove potentially workable glacial sand and gravel, field observations indicate that the resource is generally gravelly at surface. Several small mounds of sand and gravel occur around Spott, but were not investigated by borehole or pit.

Post-Glacial marine deposits adjacent to the shore in the north-east corner of the sub-block were not sampled during the assesssment, but probably comprise reworked glacial sand and gravel.

The inferred assessment offered for the glacial sand and gravel in sub-block H_6 is based on only two sample points and must be viewed with caution (Table 15).

NOTES ON THE SAND AND GRAVEL WORKINGS IN THE AREA

A brief description of former pits was made by Haldane (1948); more recent information was provided by Goodlet (1970) and by McAdam (1978). Material is not known to have been extracted from below the water table, the usual intention being to back fill pits and restore the ground to agriculture after mineral extraction. In 1985 only two sand and gravel pits, listed below, were operational. Sites of former working on a very small scale are fairly common; the only former pit worthy of mention on account of its size, is at West Barns Links.

Site	*Grid Ref*	*Operator*	*Mode of Operation*	*Deposit worked*	*Block*
Humbie	450 640	Baxter's (Bangley) Quarry Co Ltd	Inter-mittent	Glacial sand	B
Long Yester	534 641	Gifford Gravels Ltd	Contin-uous	Glacial sand and gravel	C

CONCLUSIONS

The sand and gravel resources of the district have been described systematically and the results of the assessment summarised in Tables 6 and 7. It must be emphasised that the survey concerns the estimation of resources rather than reserves and that the assessment of the deposits is judged solely in terms of the arbitrary physical criteria stated in the introduction to this report. No account is taken of prevailing environmental or economic considerations: the quoted volumetric estimates bear no simple relationship to the amount of sand and gravel that might be extracted in practice. The chief aim of the survey is to provide a factual, geologically based assessment of the sand and gravel, against which the economic, social and environmental costs of developing the resource can be weighed.

Bearing in mind that much more detailed exploration and evaluation of the deposits will be required to establish the whereabouts of reserves, it is possible, nonetheless, to indicate with some degree of certainty those resources that may first command attention.

The factors that govern the attractiveness of a sand and gravel deposit in relation to exploitation (leaving aside the factors which are outwith the remit of this report), include:- deposit grade, deposit thickness, overburden thickness, gravel quality and disposition of the deposit relative to water table. As the block boundaries have been drawn specifically to encompass deposits with similar properties, the resources can most conveniently be summarised block by block; however, certain categories of deposit do not warrant further mention. These are potentially workable glaciolacustrine deposits, till and flow till. More than 30 per cent of glaciolacustrine deposits which grade as mineral would pass a 0.125-mm sieve, and would therefore find very few markets. Potentially workable till grades overall as *'clayey' sandy gravel* on the basis of only eight samples. It may find an end use as bulk fill, but is usually too clayey and too consolidated to command attention as a source of sand and gravel. Likewise flow till, which grades as *gravel* on the basis of seven bulk samples, is inherently extremely variable in lithology, and although the deposit may prove to be readily workable locally, especially if extracted in conjunction with an underlying deposit of sand and gravel, is excluded from the assessment of resources. It is noteworthy that in the two working pits in the assessment area, where flow till overlies the sand and gravel it is treated as overburden.

Block A The bulk of the resource in Block A is contained in the alluvium, chiefly of the River Tyne, and grades as fines 9 per cent, sand 46 per cent and gravel 45 per cent (Table 8). The mean grading of mineral in the block as a whole is less gravelly (Table 6), mainly owing to the blown sand and post-Glacial marine deposits which contribute to the resource downstream from Tyninghame. This block contains the greatest volume of mineral of any in the assessment area; however, the mean depth to groundwater was 2.5m at the time of survey and consequently only about one third of the resource would be available for dry working. It has traditionally been the practice in Scotland to discourage wet working of sand and gravel. The communities of Ormiston and Haddington, which border block A locally, are partly built on alluvium of the River Tyne.

Block B Although thick sequences of glacial meltwater deposits were proved in this block, fine sandy material classified as glaciolacustrine deposits comprises a significant proportion of the resource. The mean thickness of glacial sand and gravel is 5.5m, and the deposit grades as fines 9 per cent, sand 78 per cent and gravel 13 per cent (Tables 6 and 9). Gravelly material does occur in places, but it is commonly overlain by thick sequences of sand, for example in borehole 46 SW 28. Flow till crops out widely and forms a patchy cover of overburden, the mean thickness of 2.5m being largely explained by this phenomenon. However, the resource is not all classified as concealed, because an attempt has been made to map out the extent of flow till during the survey. Groundwater is not likely to pose a problem in this block, having usually been encountered at depths of more than 10m.

Block C The prime resource in block C is glacial sand and gravel, which occurs as extensive kame-terraced deposits on the flanks of the Lammermuir Hills and as mounds and ridges on lower ground to the north. The mean thickness of the deposit is 5.3m and of overburden is 1.2m (Tables 6 and 10). The overburden thickness exceeded 1m in eight of the 21 sample points, mainly owing to the presence of a surface deposit of till which, as in block B, has been mapped out as far as possible. The possible existence of additional concealed resources of glacial sand and gravel, undiscovered during this survey, cannot be discounted. The mean grading is fines 9 per cent, sand 48 per cent and gravel 43 per cent. Taking the mineral-bearing area into account, this would indicate a volume of gravel for block C exceeded only by block A in this assessment. However much of the resource in the latter lies below groundwater level, unlike block C, where most of the sand and gravel is above the water table. Some sandy deposits occur in the block, chiefly in the south-eastern quadrant.

Block D Glacial sand and gravel occurs as kames and kame-terraced deposits which have a much more patchy distribution than in the adjacent block C. The resource has a mean thickness of 5.0m and overburden is negligible except in the neighbourhood of Carfrae. The glacial sand and gravel has a mean grading of fines 8 per cent, sand 42 per cent and gravel 50 per cent, this being the highest proportion of gravel of any block in the survey area, with the exception of sub-block H_5. Groundwater was not met in boreholes in this block.

Block E Mounds, ridges and kame-terraced deposits of glacial sand and gravel comprise the resource in block E, which is deeply dissected by many prominent glacial drainage channels. The sand and gravel has a mean thickness of 7.1m (Tables 6 and 12), the greatest mean thickness of any block, and amounts of overburden are slight,

except in one borehole which proved 2.1m. The mean grading of the deposit is fines 13 per cent, sand 55 per cent and gravel 32 per cent. Boreholes indicated quite a wide range in grade across the block, but no clear pattern to this variation emerged. Groundwater is not likely to pose a problem to potential exploitation in block E.

Block F The bulk of the resource in this block is contained in terraced spreads of glacial sand and gravel bordering the alluvial plain of the River Tyne, together with moundy deposits around Tyninghame. The mean thickness of the deposit is 4.2m and overburden is minimal (Tables 6 and 13). The glacial sand and gravel has a mean grading of fines 10 per cent, sand 57 per cent and gravel 33 per cent, and assessment boreholes generally demonstrated an eastward fining and an upward coarsening in grade. Most of the resource would be capable of dry working.

Block G Low mounds, ridges and rare eskers composed of glacial sand and gravel constitute the resource in block G. Sample-point data gave a mean thickness of sand and gravel of 4.9m, but the base of the deposit was not proved in four of them. The deepest borehole (57 NE 18) reached 25m, but only 11m of the sequence there comprised potentially workable glacial sand and gravel (Tables 6 and 14). Much of the low lying ground north of Fortoun Bank contains non-mineral deposits of alluvium and late-Glacial marine deposits which probably rest on glacial sand and gravel. However, as no assessment boreholes or pits were sited on such deposits, this phenomenon is not reflected in the figure of 0.5m for the mean thickness of overburden. The mean grading of glacial sand and gravel is fines 11 per cent, sand 61 per cent and gravel 28 per cent, but the grade varies widely across the block, and also between adjacent sample points. Groundwater was proved within glacial sand and gravel in four assessment boreholes at depths of between 2.0 and 8.3m below surface.

Block H The block is divided into six sub-blocks which contain deposits of sand and gravel which are either too small, or have too few sample points, to justify statistical assessments. Inferred assessments for six separate areas are offered in Table 7, from which it can be seen that the calculated volumes are of modest proportions except in sub-blocks H_5 and H_6.

The glacial sand and gravel in sub-block H_1 is generally thin, except at Milton where a borehole proved 6.5m of *'clayey' sandy gravel* in two seams separated by 1.4m of waste. Many scattered patches of glacial sand and gravel in sub-block H_2 are thin but at Blegbie and Stobshiel, thicker deposits occur. At White Knowe a gravel pit was opened temporarily in 1985. Sand and gravel deposits are virtually absent in sub-block H_3. Small patches of glacial sand and gravel in sub-block H_4 are likely to satisfy only small-scale, local requirements. In sub-block H_5 moundy and terraced deposits of glacial sand and gravel occur mainly along the valley sides of the Biel Water. Although the mean thickness of glacial sand and gravel, on the basis of five sample points, is only 2.6m, the deposits are quite extensive. In sub-block H_6, kettled, moundy deposits of glacial sand and gravel are well developed, especially around Eweford and Broxmouth. Although a large potential resource of sand and gravel exists hereabouts, the sample points are too sparse for a high level of confidence to be placed on the volumetric assessment given in Table 7.

Many of the resources identified on the accompanying maps will repay further investigation by the industry as reserves for future exploitation. It is recommended that these target resources should be considered in more detail in a future sub-regional study (encompassing also the assessment of the adjacent Dalkeith and Temple area).

REFERENCES

AITKEN, A.M., LOVELL, J.H., SHAW, A.J. and THOMAS, C.W. 1984. The sand and gravel resources of the country around Dalkeith and Temple, Lothian Region. Description of 1:25 000 sheets NT 25 and 35, and NT 26 and 36. *Miner. Assess. Rep. Br. Geol. Surv.*, No. 140.

ALLEN, V.T. 1936. Terminology of medium-grained sediments. *Rep. Natl. Res. Counc. Washington, 1935-36, App.1, Rep. Comm. Sediment.*, 18-47.

ARCHER, A.A. 1969. Background and problems of an assessment of sand and gravel resources in the United Kingdom. *Proc. 9th Commonw. Min. Metall. Congr., 1969*, Vol. 2: Mining and Petroleum Geology, 495-508.

_____ 1970a. Standardisation of the size classification of naturally occurring particles. *Geotechnique*, Vol. 20, 103-107.

_____ 1970b. Making the most of metrication. *Quarry Managers' J.*, Vol. 54, 223-227.

ATTERBERG, A. 1905. Die rationelle Klassifikation der Sande und Kiese. *Chem. Ztg.*, Vol. 29, 195-198.

BOULTON, G.S. 1972. Modern Arctic glaciers as depositional models for former ice sheets. *J. Geol. Soc. London*, Vol 128, 361-393.

BRITISH STANDARDS INSTITUTION. 1975. *BS 812: Methods of sampling and testing of mineral aggregates, sands and fillers.* 104pp. (London: British Standards Institution.)

_____ 1975. *BS 1377: Methods for testing soils for civil engineering purposes.* 143pp., (London: British Standards Institution.)

BUILDING RESEARCH ESTABLISHMENT. 1968. Shrinkage of natural aggregates in concrete. *Dig. Build. Res. Establ.* Ser. 2, No. 35, 7pp.

BUREAU OF MINES AND GEOLOGICAL SURVEY. 1948. *Mineral resources of the United States*, 14-17. (Washington D.C., Public Affairs Press.)

CLOUGH, C.T., BARROW, G., CRAMPTON, C.B., MAUFE, H.B., BAILEY, E.B. and ANDERSON, E.M. 1910. The geology of East Lothian. *Mem. Geol. Surv. G.B.*

CRAIG, G.Y. and DUFF, P.M.D. 1975. (Editors). *The geology of the Lothians and south east Scotland.* (Edinburgh: Edinburgh Geological Society, Scottish Academic Press.)

DAVIES, A., McADAM, A.D. and CAMERON, I.B. 1986. Geology of the Dunbar district. *Mem. Geol. Surv. G.B.*

DHIR, R.K., RAMSAY, D.M. and BALFOUR, N. 1971. A study of the aggregate impact and crushing value tests. *J. Inst. Highway Eng.* Vol. 18, No. 11, 17-27.

EDWARDS, A.G. 1970. Scottish aggregates: their suitability for concrete with regard to rock constituents. *Curr. Pap. Build. Res. Stn.* No. 28/70.

GOODLET, G.A. 1970. Sands and gravels of the southern counties of Scotland. *Rep. Inst. Geol. Sci.*, No. 70/4. 82 pp.

GRAY, J.M. and LOWE, J.J. (Editors). 1977. *Studies in the Scottish Lateglacial Environment.* Pergamon Press, Oxford.

HALDANE, D. 1948. Sands and gravels of Scotland. Quarter-inch Sheet 15: Fife-The Lothians-Berwickshire. *Wartime Pam. Geol. Surv. G.B.*, No 30.

HARRIS, P.M., THURRELL, R.G., HEALING, R.A., and ARCHER, A.A. 1974. Aggregates in Britain. *Proc. R. Soc. London*, Ser. A., Vol. 339, 329-353.

HOWELL, H.H., GEIKIE, A. and YOUNG, J. 1866. The geology of East Lothian. *Mem. Geol. Surv. G.B.*

HULL, J.H. 1981. Methods of calculating the volume of resources of sand and gravel. *Appendix* (pp.192-193) to THURRELL, R. G. 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. *Quarry Management*, for March 1981, 181-193.

KENDALL, P.F. and BAILEY, E.B. 1908. The glaciation of East Lothian south of the Garleton Hills. *Trans. R. Soc. Edinburgh*, Vol. 46, 1-31.

KIRBY, R.P. 1968. The ground moraines of Midlothian and East Lothian. *Scott. J. Geol.* Vol. 4, 209-220.

LANE, E.W., and others. 1947. Report of the sub-committee on sediment terminology. *Trans. Am. Geophys. Union*, Vol. 28, 936-938.

MARTIN, J.H. 1981. Quaternary glaciofluvial deposits in Central Scotland: sedimentology and economic geology. Unpublished PhD thesis, University of Edinburgh.

McADAM, A.D. 1978. Sand and gravel resources of the Lothian Region of Scotland. *Rep. Inst. Geol. Sci.*, No 78/1, 18pp.

_____ and TULLOCH, W. 1985. Geology of the Haddington district. *Mem. Geol. Surv. G.B.*

MERRITT, J.W., LAXTON, J.L., SMELLIE, J and THOMAS, C.W. 1983. Summary assesment of the sand and gravel resources of south-east Strathclyde, Scotland. *Open File Rep. Inst. Geol. Sci.*

PETTIJOHN, F.J. 1975. *Sedimentary rocks.* Third edition. (London: Harper and Row.)

RAMSAY, D.M. 1965. Factors influencing aggregate impact value in rock aggregate. *Quarry Managers' J.*, Vol. 49, 129-134.

RAMSAY, D.M., DHIR, R.K. and SPENCE, I.M. 1973. The reproducibility of results in the aggregate impact test: The influence of non-geological factors. *Quarry Managers' J.*, Vol 57, 179-181.

_____ 1974. The role of rock and clast fabric in the physical performance of crushed-rock aggregate. *Eng. Geol.*, Vol. 8, 267-285.

SISSONS, J.B. 1958. The deglaciation of part of East Lothian. *Trans. Inst. Br. Geogr.*, Vol. 25, 59-77.

_____ 1974. The Quaternary in Scotland: a review. *Scott. J. Geol.*, Vol 10, 311-337.

THOMSON, M.E. and EDEN, R.A. 1977. Quaternary deposits of the central North Sea, 3. The Quaternary sequence in the west-central North Sea. *Rep. Inst. Geol. Sci.*, No. 77/12, 18pp.

THURRELL, R.G. 1971. The assessment of mineral resources with particular reference to sand and gravel. *Quarry Managers' J.*, Vol. 55, 19-25.

_____ 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. *Quarry Management*, Vol. 8, No. 3, 181-192.

TWENHOFEL, W.H. 1937. Terminology of the fine-grained mechanical sediments. *Rep. Natl. Res. Counc. Washington 1936-37. App. 1, Rep. Comm. Sediment*, 81-104.

UDDEN, J.A. 1914. Mechanical composition of clastic sediments. *Bull. Geol. Soc. Am.*, Vol. 25, 655-744.

WENTWORTH, C.K. 1922. A scale of grade and class terms for clastic sediments. *J. Geol.*, Vol. 30, 377-392.

_____ 1935. The terminology of coarse sediments. *Bull. Natl. Res. Counc. Washington*, No. 98, 225-246.

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

APPENDIX A

FIELD AND LABORATORY PROCEDURES

Trial and error during initial studies of the complex and variable glacial deposits of East Anglia and Essex showed that an absolute minimum of five sample points evenly distributed across the sand and gravel are needed to provide a worthwhile statistical assessment, but that, where possible, there should not be 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 BGS and cannot be disclosed.

The mineral shown on each 1:25000 sheet is divided into resource blocks. The arbitrary size selected, 10km^2, is a compromise to meet the aims of the survey by providing sufficient sample points in each block. Where possible the block boundaries are determined by geological boundaries, but for this resource sheet area many have been drawn arbitrarily and may bear no relationship to the geology.

A reconnaissance of the ground is carried out to record any exposures, and inquiries are made to ascertain what borehole information is available. Borehole and trial pit 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 30m at a diameter of about 200mm, beneath different types of overburden. It should be reliable, quiet, mobile and relatively small (so that it can be moved to sites of difficult access). Shell and auger rigs have proved to be almost ideal.

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

A continuous series of bulk samples is taken throughout the sand and gravel. Ideally samples are composed exclusively of the whole of the material encountered in the borehole or pit, between stated depths. However, care is taken to discard, as far as possible, material which has caved or has been pumped from the bottom of the hole. A new sample is commenced whenever there is an appreciable lithological change within the sand and gravel, or at every 1m depth. The samples, each weighing between 25 and 45kg, 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.

All sampling data, including grading analysis figures are coded up for processing by computer. Abbreviated logs together with gradings data are reproduced in Appendix E.

Detailed records may be consulted at the appropriate offices of BGS: 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 2km^2, 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 ($\bar{d}_m$) calculated from the individual thicknesses at the sample points. The standard deviations for these variables are related such that

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

4 The above relationship may be transposed such that

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

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

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 d_{m_1}, d_{m_2} ... d_{m_n}, the the best estimate of mean thickness, $\bar{d}_m$, is given by

$$\sum (d_{m_1} + d_{m_2} \ldots d_{m_n})/n.$$

For groups of closely spaced boreholes a discretionary weighting factor may be applied to avoid bias (see note on weighting below). The

Block calculation

Scale: 1:25000
Block: Fictitious

Area
Block: 11.08km^2
Mineral: 8.32km^2

Mean thickness
Overburden: 2.5m
Mineral: 6.5m

Volume
Overburden: 21 million m^3
Mineral: 54 million m^3

Confidence limits of the estimate of mineral volume at the 95 per cent probability level: ±20 per cent. That is, the volume of mineral (with 95 per cent probability): 54 ± 11 million m^3

Thickness estimate (measurements in metres)
d_o = overburden thickness d_m = mineral thickness

Sample point	Weighting ω	Overburden d_m	Overburden ωd_o	Mineral d_m	Mineral ωd_m	Remarks
SE 14	1	1.5	1.5	9.4	9.4	
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	BGS
SE 23	1	6.2	6.2	4.1	4.1	boreholes
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	½	1.2		9.8		
123/45	½	2.0	1.6	4.6	7.2	Hydro-geology Unit record
1	¼	2.7		7.3		Close
2	¼	4.5		3.2		group of
3	¼	0.4	2.6	6.8	5.8	four
4	¼	2.8		5.9		boreholes (commer-cial)
Totals	$\Sigma\omega = 8$	$\Sigma\omega d_o = 20.2$		$\Sigma\omega d_m = 52.0$		
Means		$\overline{\omega d_o} = 2.5$		$\overline{\omega d_m} = 6.5$		

Calculation of confidence limits

ωd_m	$(\omega d_m - \overline{\omega d_m})$	$(\omega d_m - \overline{\omega d_m})^2$
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

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

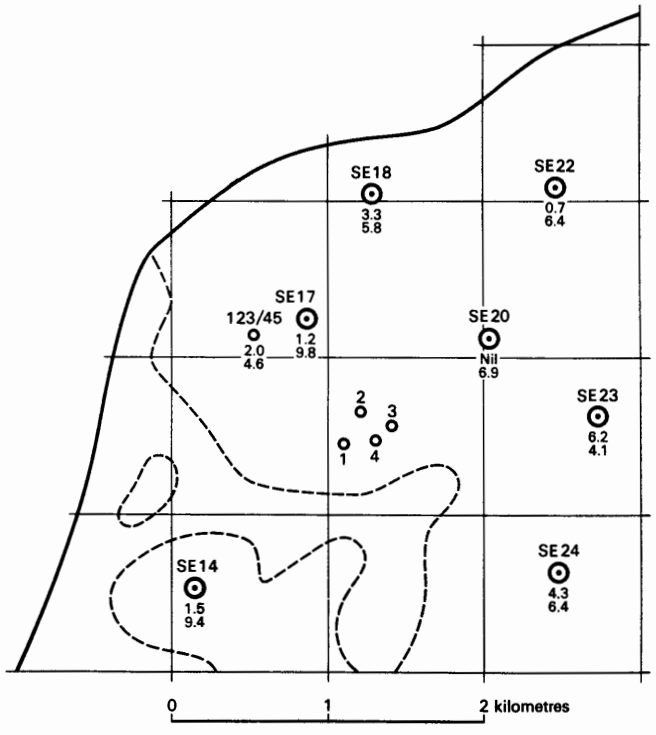
$n = 8$
$t = 2.365$
L_v is calculated as

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

$$= 1.05 \times (2.365/6.5)\sqrt{[15.82/(8\times7)]} \times 100$$

$$= 20.3$$

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



SE24 IMAU borehole
4.3 / 6.4 Overburden / Mineral } Thickness in metres
Other boreholes
Boundary of resource block
Boundary of sand and gravel deposit

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

standard deviation for mean thickness $S_{\bar{d}_m}$ expressed as a proportion of the mean thickness, is given by

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

where d_m is any value in the series d_{m_1} to d_{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 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 $S_A/S_{\bar{d}_m} \leq 1/3$ is assumed in all cases. It follows from equation [2] that $S_{\bar{d}_m} \leq S_v \leq 1.05S_{\bar{d}_m}$.

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

$\pm(t/\sqrt{n})\times S_{\bar{d}_m}$ or as a percentage

$\pm(t/\sqrt{n})S_{\bar{d}_m}(100/\bar{d}_m)$ 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_V, the following inequality corresponding to equation [3] is applied: $L_{\bar{d}_m} \leq L_V \leq 1.05L_{\bar{d}_m}$.

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

$$[(1.05t)/\bar{d}_m]\times[\sqrt{\sum(d_m - \bar{d}_m)^2/n(n-1)}]\times 100 \text{ per cent,}$$

and when n is greater than 20, as

$$[(1.05\times 1.96)/\bar{d}_m]\times[\sqrt{\sum(d_m - \bar{d}_m)^2/n(n-1)}]\times 100 \text{ per cent}$$

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

11 The application of this procedure to a fictitious area is illustrated.

Inferred assessment

12 If the sampled area of mineral in a resource block is between 0.25km^2 and 2km^2 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 0.25km^2.

15 **Note on weighting** The thickness of a deposit at any point may be governed solely by the position of the point in relation to a broad trend. However, most sand and gravel deposits also exhibit a random pattern of local, and sometimes considerable, variation in thickness. Thus the distribution of sample points 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 deposits, 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 64mm 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 (see the figure 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 Note 11, 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, 1974). 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. It appears 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

Classification of gravel, sand and fines

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

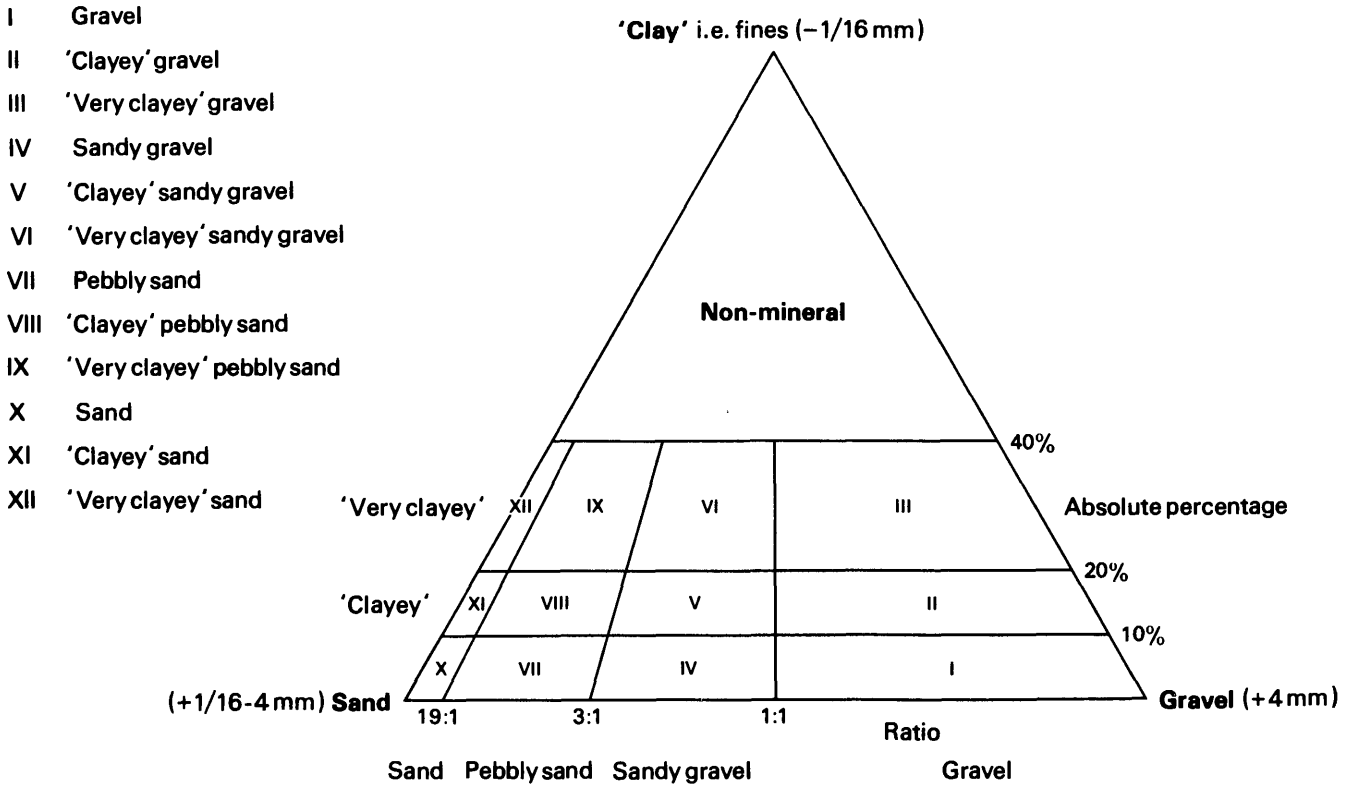


Diagram showing the descriptive categories used in the classification of sand and gravel

blocks. Three sizes of sand are recognised, fine (+$\frac{1}{16}$-$\frac{1}{4}$mm), medium (+$\frac{1}{4}$-1mm) and coarse (+1-4mm). The boundary at 16mm distinguishes a range of finer gravel (+4-16mm), often characterised by abundance of worn tough pebbles of vein-quartz, from larger pebbles often of notably different materials. The boundary at 64mm 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, 1mm, 4mm, 16mm and so on as required. Original sample grading curves are available for reference at the appropriate office of BGS.

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

The relative proportions of the rock types present in the gravel fraction are indicated by the use of the words 'and' or 'with'. For example, 'sandstone and greywacke' indicates very approximate equal proportions with neither constituent accounting for less than about 25 per cent of the whole; 'sandstone with greywacke' indicates that sandstone is dominant and greywacke, 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 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.

APPENDIX D
EXPLANATION OF THE ASSESSMENT RECORDS

Annotated example

NT 46 NW 238[1] **4214 6913**[2] **Ormiston**[3] **Block A**

Surface level +79.81m (261.8ft)[4]
Groundwater level +75.2m[5]
250mm percussion[6]
May 1985

Overburden[7]	0.4m
Mineral	1.6m
Waste	0.1m
Mineral	3.7m
Waste	0.2m
Bedrock	0.6m+[9]

LOG

Geological classification[10]	Lithology[11]	Thickness m	Depth[8] m
	Soil: silty sandy loam, dark brown	0.4	0.4
Alluvium	a 'Very clayey' gravel, claybound below 0.9m Gravel: coarse, fine and cobble, subangular to rounded, mainly sandstone and greywacke Sand: fine with medium and coarse, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate yellowish brown (10 YR 5/4) then moderate brown (5 YR 4/4)	1.6	2.0
Flow till	Diamicton: pebbly sandy clay, moderately firm, with clasts mainly of sandstone, moderate brown (5 YR 3/4)	0.1	2.1
Glacial sand and gravel	b Gravel; fines artificially lost Gravel: fine and coarse with cobbles, mainly subangular to rounded, sandstone, greywacke, seatearth, coal, dolerite and limestone Sand: coarse with medium and some fine, angular to subrounded, quartz with lithic fragments and coal Fines: disseminated silt and clay, deposit possibly claybound throughout, moderate brown (5 YR 4/4)	3.7	5.8
Till	Diamicton: trace only recovered of silty clay with pebbles, pale brown (5 YR 5/2)	0.2	6.0
Limestone Coal Group	Sandstone, friable, poorly bedded, medium to coarse grained, composed mainly of subangular to subrounded quartz with some coal, feldspar and rare rose and amethyst quartz; light grey (N7) to light olive grey (5 Y 6/1)	0.6+	6.6

Grading

	Mean for Deposit[15] percentages			Depth below[12] surface (m)	percentages[13]							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm	
a	22	37	41	0.4– 0.9	26	27	12	7	11	17	0	
				0.9– 2.0	20	15	7	10	13	14	21	
				Mean	22	19	9	9	12	15	14	
b	3	37	60	2.1– 3.2	5	8	11	16	25	21	14	
				3.2– 4.2	3	6	9	20	26	22	14	
				4.2– 5.2	2	5	11	23	25	25	9	§[14]
				5.2– 5.8	1	7	16	24	29	19	4	§
				Mean	3	6	11	20	27	22	11	
a&b	9	37	54	Mean	9	10	10	17	22	20	12	

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

1 Borehole registration number
Each British Geological Survey (BGS) borehole, shallow pit or logged section is identified by a registration number. This consists of two statements.

1 The number of the 1:25000 sheet on which the borehole lies, for example NT 46
2 The quarter of the 1:25000 sheet on which the borehole lies and its number in a series for that quarter for example NW 238

Thus the full registration number is NT 46 NW 238. Usually this is abbreviated to 46 NW 238.

2 The National Grid reference
All National Grid references in this publication lie within the 100-km square NT. Grid references are given to eight figures, accurate to within 10m for borehole locations. (In the text, six-figure grid references are used for more approximate locations, for example, for quarries and farms.)

3 Location
The position of the borehole is referred to the nearest named locality on the 1:25000 base map, usually followed by the name of the parish or nearest community. The resource block in which it lies is also stated.

4 Surface level
The surface level at the sample point is given in metres above Ordnance Datum. Measurements were made in metres, approximate conversions to feet are given in brackets. Sites of most boreholes and pits were levelled from either spot heights or bench marks, the precision of the figure reflecting the nature of the point of origin. The surface levels of the remaining sites were estimated from contours on 1:10000 and 1:10560 sheets and are probably accurate to plus or minus two metres; such elevations are prefixed by the letter 'c'.

5 Groundwater conditions
If groundwater was present the level at which it was either encountered or statically measured is normally given (in metres above Ordnance Datum).

6 Method and date of sampling
Modified shell and auger rigs were used for the drilling of boreholes in this survey. The drilling method, the external diameter of the casing used, and the month and year of completion of the borehole are given. Where appropriate other methods of sampling are stated (for example, sections sampled by hand).

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

8 Thickness and depth
All measurements were made in metres.

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

10 Geological classification
The geological classification is given whenever possible.

11 Lithological description
When sand and gravel is recorded a general description based on the mean grading characteristics (for details see Appendix C) is followed by more detailed particulars. The description of other rocks is based on visual examination, in the field. Details of colour are based on the Rock-color Chart distributed by the Geological Society of America: the colour is followed by the relevant colour code.

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

13 Grading results
The results are expressed as per cent by weight retained on British Standard sieves whose aperture sizes are given in millimetres or fractions thereof.

14 Bailed samples
Fully representative sampling of sand and gravel is difficult to achieve, particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures suggests that in borehole samples the proportion of sand may be higher and the proportion of fines and coarse gravel (+16mm) may be lower. Samples obtained by the bailing technique (that is, from deposits below the water table) are indicated thus: §.

15 Mean grading
The grading of the full thickness of the mineral deposit identified in the log is the mean of the individual sample gradings weighted by the thickness represented. The classification used is shown in the Table in Appendix C. Where two or more mineral units are distinguished, the mean grading for each is given in addition to the combined calculation for all the deposits. Trace amounts are indicated thus: **. For multiple mineral units, each is designated by a letter, for example, a, b etc.

APPENDIX E

BRITISH GEOLOGICAL SURVEY BOREHOLE, SECTION AND SHALLOW PIT RECORDS

NT 46 NW 236 4020 6706 **West Byres, Ormiston** **Block H_1**

Surface level +111.7m (+366.5ft)
Water not struck
250mm percussion
May 1985

Overburden 0.3m
Mineral 1.2m
Waste 1.7m
Bedrock 0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy clayey loam, brown	0.3	0.3
Glacial sand and gravel	Sandy gravel Gravel: fine and coarse with some cobbles, subanguler to subrounded, predominantly sandstone with siltstone, andesite, felsite and some greywacke Sand: coarse, medium and fine, subangular with subrounded, quartz with lithic fragments and coal Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	1.2	1.5
Till	Diamicton: sandy stony clay, moderately stiff with clasts up to 10 cm diameter, of sandstone, siltstone, coal, limestone and volcanic rocks, but sandstone dominant below 2.7m, greyish brown (5 YR 3/2) to light brown (5 YR 5/6), locally mottled	1.7	3.2
Limestone Coal Group	Sandstone, bedded, fine to medium grained with some coarser seams, weathered and broken at top, dusky yellow (5 Y 6/4)	0.7+	3.9

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
8	50	42	0.3- 1.5	8	13	15	22	19	18	5

NT 46 NW 237 4112 6874 **Wolfstar, Ormiston** **Block A**

Surface level +82.29m (+270.0ft)
Groundwater level +78.4m
250mm percussion
May 1985

Overburden 1.6m
Mineral 2.9m
Waste 1.2m
Bedrock 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty sandy loam, dark yellowish brown (10 YR 4/2)	0.3	0.3
Alluvium	Silt with 5cm thick seams of medium grained sand near base, dark yellowish brown (10 YR 4/2)	0.8	1.1
	Silty clay, plastic, mottled, pale yellowish brown (10 YR 6/2)	0.5	1.6
	'Very clayey' gravel, claybound Gravel: coarse and fine, with cobbles and boulders below 3.0m, subrounded to well rounded, greywacke, sandstones, dolerite, basic volcanic rocks and seatearth Sand: fine, medium and coarse, subangular to well rounded, quartz with lithic fragments and coal Fines: disseminated clay and silt, deposit very 'dirty', colour variable, light brown (5 YR 5/6), pale yellowish brown (10 YR 6/2) and greyish orange (10 YR 7/4)	2.9	4.5
Till	Diamicton: stony silty clay, firm, with clasts mainly of coarse and cobble gravel grade, comprising sandstones with greywacke, seatearth, vein-quartz, coal and rare boulders of basic lava; mudstone abundant from 5.4m; brownish grey (5 YR 3/1)	1.2	5.7
Limestone Coal Group	Seatearth, rooty, micaceous, brownish grey (5 YR 5/1)	0.3+	6.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
20	38	42	1.6- 3.0	21	21	12	9	13	19	5	
			3.0- 4.5	19	12	9	14	25	21	0	§
			Mean	20	16	10	12	19	21	2	

NT 46 NW 238 4214 6913 **Ormiston** **Block A**

Surface level +79.81m (261.8ft)
Groundwater level +75.2m
250mm percussion
May 1985

Overburden	0.4m
Mineral	1.6m
Waste	0.1m
Mineral	3.7m
Waste	0.2m
Bedrock	0.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty sandy loam, dark brown	0.4	0.4
Alluvium	a 'Very clayey' gravel, claybound below 0.9m Gravel: coarse, fine and cobble, subangular to rounded, mainly sandstone and greywacke Sand: fine with medium and coarse, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate yellowish brown (10 YR 5/4) then moderate brown (5 YR 4/4)	1.6	2.0
Flow till	Diamicton: pebbly sandy clay, moderately firm, with clasts mainly of sandstone, moderate brown (5 YR 3/4)	0.1	2.1
Glacial sand and gravel	b Gravel; fines artificially lost Gravel: fine and coarse with cobbles, mainly subangular to rounded, sandstone, greywacke, seatearth, coal, dolerite and limestone Sand: coarse with medium and some fine, angular to subrounded, quartz with lithic fragments and coal Fines: disseminated silt and clay, deposit possibly claybound throughout, moderate brown (5 YR 4/4)	3.7	5.8
Till	Diamicton: trace only recovered of silty clay with pebbles, pale brown (5 YR 5/2)	0.2	6.0
Limestone Coal Group	Sandstone, friable, poorly bedded, medium to coarse grained, composed mainly of subangular to subrounded quartz with some coal, feldspar and rare rose and amethyst quartz; light grey (N7) to light olive grey (5 Y 6/1)	0.6+	6.6

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm	
a	22	37	41	0.4– 0.9	26	27	12	7	11	17	0	
				0.9– 2.0	20	15	7	10	13	14	21	
				Mean	22	19	9	9	12	15	14	
b	3	37	60	2.1– 3.2	5	8	11	16	25	21	14	
				3.2– 4.2	3	6	9	20	26	22	14	
				4.2– 5.2	2	5	11	23	25	25	9	§
				5.2– 5.8	1	7	16	24	29	19	4	§
				Mean	3	6	11	20	27	22	11	
a&b	9	37	54	Mean	9	10	10	17	22	20	12	

NT 46 NW 239 4179 6987 **Puddle Wood, Ormiston** **Block H_1**

Surface level +85.22m (+279.6ft)
Water struck (perched?) at +81.8m
Pit
November 1984

Overburden 2.0m
Mineral 1.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, dark yellowish brown (10 YR 4/2)	0.4	0.4
Flow till	Clay, stony, silty, soft, clasts up to boulder size, mainly of Carboniferous sediments, brownish grey (5 YR 4/1) to dark yellowish brown (10 YR 4/2)	1.6	2.0
Glacial sand and gravel	'Clayey'sandy gravel, sand to 3.1m, then gravel to base Gravel: fine and coarse with cobbles, subangular to rounded, mainly sandstone, some siltstone, shale, coal and vein-quartz Sand: medium with coarse and fine, angular to rounded, quartz with lithic fragments and feldspar Fines: disseminated silt with clay, light brown (5 YR 5/4) to 3.1m, then greyish yellowish brown (10 YR 5/2)	1.5+	3.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
15	56	29	2.0- 3.5	15	11	31	14	15	14	0

NT 46 NW 241 4107 6974 **Bellyford Burn, Ormiston** **Block H_1**

Surface level c +83m (c +272ft)
Water not struck
Pit
November 1984

Overburden 0.7m
Mineral 2.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.7	0.7
Glacial sand and gravel	'Clayey' gravel Gravel: cobble, coarse and fine, with boulders up to 50cm diameter, subrounded to rounded, mainly sandstone with coal, siltstone, ironstone and rare dolerite Sand: coarse, medium and fine, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, deposit 'dirty', greyish brown (5 YR 3/2)	2.5+	3.2

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
11	25	64	0.7- 3.2	11	7	9	9	15	17	32

NT 46 NW 242 **4162 6573** **Murrays, Ormiston** **Block H_1**

Surface level +138m (+453ft)
Water struck (perched) at +136m
Pit
November 1984

Overburden 1.0m
Mineral 1.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy silt loam, dusky brown (5 YR 2/2)	1.0	1.0
Glacial sand and gravel	Sand with rare pebbles Gravel: fine, angular to subrounded, sandstone, siltstone, ironstone, igneous rocks and coal Sand: fine and medium with rare coarse, subangular to rounded with angular, mainly quartz with some feldspar, ferromagnesian minerals and coal Fines: some disseminated silt, moderate yellowish brown (10 YR 5/4)	1.5+	2.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
5	94	1	1.0- 2.5	5	48	45	1	1	0	0

NT 46 NE 107 **4534 6690** **Milton, Pencaitland** **Block H_1**

Surface level +112.9m (+370.4ft)
Groundwater level +94.4m
250 and 200mm percussion
November 1985

Overburden	0.3m
Mineral	3.8m
Waste	1.4m
Mineral	2.7m
Waste	13.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam	0.3	0.3
Glacial sand and gravel	a Sandy gravel, including sand seam from 0.8 to 1.5m Gravel: fine and coarse with rare cobbles, subangular to rounded, mainly sandstones with vein-quartz, coal, limestone and andesite siltstone, ironstone, igneous rocks and coal Sand: medium and fine with coarse, angular to rounded, quartz with lithic fragments and coal Fines: mainly disseminated silt, deposit claybound locally, greyish orange (10 YR 6/4) between 0.8 and 1.5m, otherwise dark yellowish brown (10 YR 4/2)	3.8	4.1
	Silt, laminated with very fine sand and clay laminae; several 1cm thick diamict seams, more common towards base; some pebbles of fine and coarse gravel, including vein-quartz and sandstone; greyish orange (10 YR 6/4) in upper part, greyish yellowish brown (10 YR 5/2) in lower part	0.5	4.6
Flow till	Diamicton: stony sandy clay, with clasts, mostly small, of Carboniferous sediments; colour variable, from moderate yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 3/2)	0.9	5.5
Glacial sand and gravel	b 'Very clayey' pebbly sand, with gravelly stringers Gravel: fine with coarse and some cobbles, subangular to rounded, sandstone, limestone, vein-quartz and igneous rocks Sand: fine with medium and some coarse, angular to rounded, quartz with lithic fragments and coal Fines: disseminated silt with clay, greyish yellowish brown (10 YR 5/2) to moderate yellowish brown (10 YR 5/3)	2.7	8.2
Till	Diamicton: very sandy pebbly silt, moderately firm; clasts include sandstones, vein-quartz, ironstone; moderate yellowish brown (10 YR 5/3)	0.4	8.6
	Diamicton: stony clay, stiff but softer below 14.0m as sand content increases, with clasts up to cobble grade, composed of limestone, dolomitic limestone, sandstone and seatearth with vein-quartz, dolerite and rare greywacke; colour variable, greyish brown (5 YR 3/2) at top and around 11.0m, light brown (5 YR 5/4) at 9.5m, moderate brown (5 YR 4/4) to moderate reddish brown (10 R 4/6) at 10.0m, and moderate brown (5 YR 3/4) from 12.0m	6.4	15.0
Glacial sand and gravel	'Clayey' sand with some pebbles Gravel: fine Sand: fine with medium and rare coarse, angular to rounded, quartz with lithic fragments and coal Fines: silt, disseminated and in seams, dark yellowish brown (10 YR 4/4)	1.2	16.2
	Very fine sand and silt with clay laminae; also diamict seams 1 to 2cm thick; moderate brown (5 YR 4/4)	0.4	16.6

NT 46 NE 107 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Till	Diamicton: sandy stony clay, stiff, with clasts of dolerite, sandstone, limestone, vein-quartz and rare greywacke, greyish brown (5 YR 3/2) to 17.3m, then sandier and dark yellowish brown (10 YR 4/2)	1.4	18.0
	Diamicton: silt and fine sand, with some medium sand and rare pebbles, thinly bedded but contorted and brecciated, derived from glacio-lacustrine deposits which have been probably deformed by ice action; dark yellowish brown (10 YR 4/2)	2.2	20.2
	Diamicton: sandy stony clay, moderately plastic, firm to stiff; pods of laminated fine sand and silt; larger clasts are of sandstone and greywacke, but smaller fragments comprise mainly Carboniferous sediments; greyish brown (5 YR 3/2)	1.8+	22.0
	Borehole terminated owing to excessive overburden		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	9	54	37	0.3- 0.8	13	13	25	12	21	16	0
				0.8- 1.5	6	45	39	5	4	1	0
				1.5- 2.4	8	15	14	8	14	27	14
				2.4- 3.6	8	15	23	15	24	15	0
				3.6- 4.1	14	9	20	9	28	20	0
				Mean	9	19	25	10	18	16	3
b	22	73	5	5.5- 6.5	28	48	14	5	4	1	0
				6.5- 7.5	23	55	13	4	4	1	0
				7.5- 8.2	12	42	36	5	3	2	0
				Mean	22	49	19	5	4	1	0
a&b	14	62	24	Mean	14	32	22	8	12	10	2

NT 46 NE 108 **4556 6582** **Old Duncrahill, Humbie** **Block B**

Surface level +117.91m (+386.8ft)
Water seepage from +115.8m
250 and 200mm percussion
May 1985

Overburden 0.1m
Mineral 3.0m
Waste 13.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy brown	0.1	0.1
Glacial sand and gravel	a Pebbly sand Gravel: fine and coarse, subrounded, sandstone and andesite Sand: fine with medium and some coarse, subangular with subrounded, quartz and lithic fragments with some coal Fines: silt, disseminated, moderate brown (5 YR 4/4)	2.0	2.1
Glaciolacustrine deposits	b 'Clayey' sand Gravel: rare fine, as above Sand: fine with some medium and rare coarse, otherwise as above Fines: as above	1.0	3.1
	Silt, sandy, laminated, with sandy clay seams, increasing in frequency with depth, moderate brown (5 YR 4/4)	11.3	14.4
Till	Diamicton: sandy silty stony clay, moderately stiff, containing subangular clasts up to 15cm diameter, of sandstone, siltstone, coal, some greywacke and volcanic rocks, dusky brown (5 YR 2/2)	2.1+	6.5
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	9	86	5	0.1- 1.1	10	59	22	4	3	2	0
				1.1- 2.1	9	66	18	3	2	2	0
				Mean	9	62	20	4	3	2	0
b	17	82	1	2.1- 3.1	17	73	8	1	1	0	0
a&b	12	85	3	Mean	12	66	16	3	2	1	0

NT 46 NE 109 **4639 6972** **Nisbet, Pencaitland** **Block A**

Surface level +66.8m (+219.2ft)
Groundwater level +65.7m
250mm percussion
May 1985

Overburden 0.1m
Mineral 4.5m
Waste 1.2m
Bedrock 0.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam	0.1	0.1
Alluvium	Sandy gravel, mainly sand to 1.0m. Gravel: coarse, fine and cobble, subangular to well rounded, sandstone with greywacke, limestone, dolerite, basic fine grained igneous rocks and vein-quartz Sand: medium with fine and coarse, sharp below 3.7m, angular to rounded, quartz with lithic fragments and coal Fines: disseminated silt and clay, but fines largely washed out, light brown (5 YR 5/6) then yellowish brown (10 YR 5/2)	4.5	4.6
Till	Diamicton: stony silty clay, stiff with clasts commonly of limestone with sandstone, seatearth, coal and carbonaceous siltstone, pinkish grey (5 YR 7/1)	1.2	5.8
Lower Limestone Group	Seatclay on fine grained sandstone with some mica and rare organic traces, cross-bedded and ripple laminated, very light grey (N8)	0.5+	6.3

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
7	57	36	0.1- 1.0	20	40	18	8	9	5	0	
			1.0- 2.0	6	10	9	11	17	42	5	§
			2.0- 3.0	3	20	32	18	11	5	11	§
			3.0- 4.0	3	7	30	12	12	22	14	§
			4.0- 4.6	6	7	55	11	5	1	15	§
			Mean	7	17	28	12	11	16	9	

NT 46 NE 110 **4643 6884** **Saltoun Home Farm, Saltoun** **Block H_1**

Surface level +93.1m (+305.5ft)
Water not struck
Pit
November 1984

Overburden 0.6m
Mineral 1.9m
Waste 0.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy with some pebbles, dusky brown (5 YR 2/2)	0.6	0.6
Glacial sand and gravel	Pebbly sand Gravel: fine with coarse, subangular to rounded, sandstone, vein-quartz, greywacke and felsite Sand: medium with coarse and fine, angular to rounded, quartz with lithic fragments and coal Fines: some disseminated silt and silty seams from 2.3 to 2.5m, moderate yellowish brown (10 YR 5/4)	1.9	2.5
Till	Diamicton: stony sandy clay, very stiff, clasts up to boulder size, commonly of Carboniferous sandstone, greyish brown (5 YR 3/2)	0.4+	2.9
	Floor of pit is very stony: possible sandstone bedrock		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
3	85	12	0.6- 2.5	3	10	52	23	10	2	0

NT 46 NE 111 **4965 6524** **Leehouses, Yester** **Block H_2**

Surface level +208.58m (+684.3ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 1.0m
Waste 2.1m
Bedrock 0.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam	0.3	0.3
Glacial sand and gravel	'Very clayey' sand Gravel: fine, angular to subrounded, greywacke with sandstone and rare felsite Sand: fine with medium and rare coarse, subangular to rounded, mainly quartz Fines: mainly silt, light brown (5 YR 5/6)	1.0	1.3
	Silt, unbedded, moderate reddish brown (10 R 4/6)	0.5	1.8
Till	Diamicton: sandy, silty, stony clay, stoneless at base, clasts up to cobble size, mainly of sandstone with greywacke and coal, moderate reddish brown (10 R 4/6)	1.6	3.4
Upper Old Red Sandstone	Sandstone, unbedded, fine grained, speckled with haematite, moderate red (5 R 5/4)	0.2+	3.6

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
25	74	1	0.3- 1.3	25	50	23	1	1	0	0

NT 46 SW 23 4097 6114 **Saughland, Fala** **Block B**

Surface level +245.72m (+806.2ft)
Water not struck
250mm percussion
May 1985

Waste 5.8m
Bedrock 0.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Made ground		0.6	0.6
Till	Diamicton: gravelly sandy clay, with seam of pebbly sand (c 5cm thick) at 2.1m, increase in sand content with depth, firm to stiff, but quite 'soft' by 3.0m. Clasts up to cobble size, mainly fine grained basic igneous rock, sandstone, quartzite and coal. Matrix is dark yellowish brown (10 YR 4/3)	4.2	4.8
	Diamicton: stiff stony clay (lodgement till), dusky yellowish brown	1.0	5.8
Carboniferous	Basalt, porphyritic, fresh, very hard, dark grey to black	0.2+	6.0

NT 46 SW 24 4164 6189 **Crichton Dean, Fala** **Block B**

Surface level +214.71m (+704.4ft)
Water struck (perched) at +213.5m
250mm percussion
May 1985

Waste 4.5m
Bedrock 0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Diamicton: silty sandy stony clay, soft to firm, clasts up to boulder size, mostly limestone and sandstone, with mudstone increasingly common towards base, light olive brown (5 Y 5/4)	4.3	4.5
Calciferous Sandstone Measures	Mudstone, calcareous, bituminous, dark grey (5 Y 4/1), unbedded	0.7+	5.2

NT 46 SW 25 **4154 6131** **Saughland, Fala** **Block B**

Surface level +235.95m (+774.1ft)
Groundwater level (perched) at +213.5m
250 and 200mm percussion
October 1985

Overburden	0.5m
Mineral	1.0m
Waste	0.1m
Mineral	1.1m
Waste	0.6m
Mineral	3.0m
Waste	1.0m
Mineral	1.2m
Waste	9.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam	0.5	0.5
Glacial sand and gravel	a 'Very clayey' pebbly sand Gravel: fine with coarse, Sand: fine with some medium and rare coarse, quartz with lithic fragments Fines: disseminated silt and clay, moderate yellowish brown (10 YR 5/4)	1.0	1.5
Flow till	Pebbly clay, very sandy, firm, crude bedding, chiefly dark yellowish brown (10 YR 4/4) with coaly streaks and patches of dark yellowish orange (10 YR 6/6)	0.1	1.6
Glacial sand and gravel	b 'Clayey' pebbly sand Gravel: fine with coarse, subangular to rounded, vein-quartz and sandstone Sand: fine and medium with coarse, quartz and lithic fragments Fines: silt, disseminated and as seams, and diamict seams of sandy clay, moderate yellowish brown (10 YR 5/4)	1.1	2.7
Glaciolacustrine deposits	Interbedded fine sandy silt, silty fine sand and clayey fine sand, colour as above. Rare clay films, moderate reddish brown (10 R 4/6) and clayey diamict seams	0.6	3.3
	c 'Very clayey' sand Sand: fine with some medium and rare coarse, quartz with some lithic fragments and coal Fines: mainly silt, disseminated and as seams, moderate yellowish brown (10 YR 5/4)	3.0	6.3
	Very silty sand, with some signs of cross-lamination, composition as for deposit above	1.0	7.3
	d 'Very clayey' sand, composition as deposit (c)	1.2	8.5
Flow till	Diamicton: very sandy stony clay, firm, with angular to subangular clasts up to cobble grade, of dolerite, yellow and greenish grey sandstones with limestone, dark yellowish brown (10 YR 4/4)	0.4	8.9
Glaciolacustrine deposits	Silt and clay with rare fine sand partings and rare scattered clasts, generally coarsening upwards, laminae of tenacious clay, pale brown (5 YR 5/2), increase in number downwards; dark yellowish brown (10 YR 4/2)	3.3	12.2
Flow till	Diamicton: very sandy clay, firm with scattered angular to subrounded clasts of basalt and sandstone, moderate brown (5 YR 4/4)	1.8	14.0
Glacial sand and gravel	'Clayey' pebbly sand, gravelly from 14.9 to 15.0m Gravel: fine with coarse, subrounded mainly sandstone Sand: fine and medium with coarse, subangular, quartz and lithic fragments Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	1.5	15.0

NT 46 SW 25 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Till	Diamicton: silty sandy stony clay, firm to stiff, with clasts of red and buff sandstones and siltstone with coal, some igneous rocks and vein-quartz; colour progressively darkens from dark reddish brown (10 R 3/4) to dusky yellowish brown (10 YR 2/2) by 11.9m, and dusky brown (5 YR 2/2) by 18.0m	2.8+	18.3
	Borehole terminated for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	29	66	5	0.5- 1.5	29	49	13	4	4	1	0
b	17	70	13	1.6- 2.7	17	30	29	11	10	3	0
c	31	69	0	3.3- 4.3	23	65	11	1	0	0	0
				4.3- 5.3	31	67	2	0	0	0	0
				5.3- 6.3	40	59	1	0	0	0	0
				Mean	31	64	5	**	0	0	0
d	25	74	1	7.3- 8.5	25	72	1	1	1	0	0
a&b	23	68	9	Mean	23	39	21	8	7	2	0
c&d	30	70	0	Mean	30	65	4	1	**	0	0
a-d	27	69	4	Mean	27	56	10	3	3	1	0

NT 46 SW 26 **4126 6017** **Saughland, Fala** **Block B**

Surface level +230.6m (+756.6 ft)
Water struck at +218.9m
250 and 200mm percussion
October 1985

Overburden 0.5m
Mineral 1.2m
Waste 17.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: clayey loam, brown	0.5	0.5
Glacial sand and gravel	Sandy gravel, compact, slightly 'claybound' Gravel: fine and coarse with rare cobbles, subangular to subrounded, sandstone with vein-quartz and some igneous rocks Sand: medium with coarse and fine, subangular, quartz and lithic fragments, also coal Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	1.2	1.7
Glaciolacustrine deposits	Silt, clay and very fine sand, interbedded, seams up to 5cm thick, moderate brown (5 YR 3/4) and olive-grey (5 Y 5/2)	2.3	4.0
Flow till	Diamicton: very stony, very sandy clay, clast supported, clasts up to cobble size, of sandstone, limestone, basalt, greywacke and vein-quartz, moderate reddish brown (10 R 4/6)	1.2	5.2
Till	Diamicton: silty, sandy, stony clay, very firm, clasts chiefly of sandstone with coal, siltstone, limestone and basalt, rare seams of sandy silt, dusky yellowish brown (10 YR 2/2)	6.5	11.7
Glacial sand and gravel	'Clayey' sand Sand: medium with coarse and fine, subangular, quartz and lithic fragments Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	0.4	12.1
Till	Diamicton: sandy stony clay, with numerous seams up to 10cm thick of clayey sand and silt mainly in upper part, soft, becoming moderately firm below 13.0m, clasts mainly of Carboniferous sediments, dark reddish brown (10 R 3/4)	3.7	15.8
Glaciolacustrine deposits	Silt, sandy with sand lenses, laminated, very soft, moderate reddish brown (10 R 3/4)	0.8	16.6
Till	Diamicton: very sandy stony clay, clasts up to cobble size, mainly of Carboniferous sediments with vein-quartz. Sandy silt seams present from 17.5m	2.6+	19.2
	Borehole terminated owing to excessive overburden		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
8	48	44	0.5- 1.7	8	11	27	10	25	19	0

NT 46 SW 27 **4273 6295** **Whitburgh House, Pathhead** **Block B**

Surface level +189.4m (+621.5ft)
Groundwater level +180.3m
250 and 200mm percussion
October 1985

Overburden 0.3m
Mineral 11.7m
Waste 2.0m
Mineral 5.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy with pebbles	0.3	0.3
Glacial sand and gravel	a Pebbly sand Gravel: coarse and fine, subangular to well rounded, sandstone, greywacke and various igneous rocks (some rotten and friable) Sand: medium with fine and coarse, mainly subangular to rounded, quartz with feldspar and lithic fragments Fines: silt, mainly in seams, moderate yellowish brown (10 YR 5/4)	3.2	3.5
	b 'Clayey' sand with pebbles, rare above 11.5m Gravel: fine with trace of coarse, mainly at base, subrounded to rounded, sandstone, greywacke, andesite, vein-quartz, limestone and coal Sand: fine and medium with rare coarse, (mainly as coal), angular to rounded, quartz with lithic fragments, feldspar and coal Fines: silt, disseminated and as rare seams, greyish yellowish brown (10 YR 5/2) to water table, then dark yellowish brown (10 YR 4/2)	8.5	12.0
Glaciolacustrine deposits	Silt, slightly clayey, and very fine sand, laminated, with scattered pebbles of fine gravel and several diamict pods, dark yellowish brown (10 YR 4/2)	2.0	14.0
Glacial sand and gravel	c Sand with rare pebbles of coal Sand: fine with medium and some coarse, angular to rounded, quartz with lithic fragments, feldspar and coal (concentrated in films), dark yellowish brown (10 YR 4/2)	5.5+	19.5
	Borehole abandoned for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm	
a	8	79	13	0.3- 1.3	10	27	50	6	4	3	0	
				1.3- 2.2	7	17	51	9	6	10	0	
				2.2- 3.5	7	10	56	11	8	8	0	
				Mean	8	17	53	9	6	7	0	
b	10	89	1	3.5- 4.4	8	36	54	1	1	0	0	
				4.4- 5.5	9	53	38	0	0	0	0	
				5.5- 6.6	14	67	19	0	0	0	0	
				6.6- 7.8	10	54	35	1	0	0	0	
				7.8- 8.8	20	56	23	1	0	0	0	§
				8.8-10.0	7	42	49	1	1	0	0	§
				10.0-11.5	6	41	51	1	1	0	0	§
				11.5-12.0	8	37	26	7	15	7	0	§
				Mean	10	50	38	1	1	**	0	
c	9	90	1	14.0-15.6	7	35	53	4	1	0	0	§
				15.6-16.9	9	77	13	1	0	0	0	§
				16.9-18.2	8	55	28	5	4	0	0	§
				18.2-19.5	11	52	29	7	1	0	0	§
				Mean	9	54	32	4	1	0	0	
a&b	10	85	5	Mean	10	40	42	3	3	2	0	
a–c	9	87	4	Mean	9	44	39	4	2	2	0	

NT 46 SW 28 **4255 6240** **Salters' Road, Fala Dam** **Block B**

Surface level +203.34m (+667.1ft)
Water struck at +187.0m
250 and 200mm percussion
October 1985

Overburden	0.1m
Mineral	1.7m
Waste	1.6m
Mineral	13.2m
Waste	0.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam	0.1	0.1
Glacial sand and gravel	a Sandy gravel Gravel: coarse and fine, subrounded with subangular and well rounded, sandstone with siltstone, some limestone, vein-quartz and rare igneous rocks Sand: medium with fine and coarse, subangular, quartz and lithic fragments, including some coal Fines: silt and clay, disseminated moderate brown (5 YR 4/4)	1.7	1.8
Flow till	Diamicton: sandy silty stony clay, moderately soft, with subrounded clasts up to cobble grade, chiefly of sandstone and siltstone; many thin sand seams; moderate brown (5 YR 4/4)	0.6	2.4
	Silt, very fine sand and clayey seams, laminated, light brown (5 YR 5/6)	1.0	3.4
Glaciolacustrine deposits	b 'Very clayey' sand Sand: fine with some medium and trace of coarse, subrounded, quartz with lithic fragments and coal Fines: silt and clay, disseminated and as seams, light brown (5 YR 5/6)	5.0	8.4
Glacial sand and gravel	c Sand Sand: fine with medium, otherwise as above Fines: disseminated silt, light brown (5 YR 5/6)	2.0	10.4
	d Sandy gravel, transitional top Gravel: fine and coarse with rare cobble, subangular to well rounded, buff and red sandstones, sil stone and limestone with vein-quartz, rare igneous rocks and coal Sand: medium with fine and coarse, subangular, quartz with lithic fragments Fines: disseminated silt and clay, diamict seam from 16.1 to 16.2m	6.2	16.6
Till	Diamicton: silty stony clay with boulders at top and angular to subangular clasts of buff and red sandstones, siltstone, grit, vein-quartz and limestone with greywacke and some igneous rocks, dusky brown (5 YR 2/2)	0.6+	17.2
	Borehole terminated for operational reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	5	60	35	0.1- 1.1	5	13	39	10	17	16	0
				1.1- 1.8	6	17	29	10	16	22	0
				Mean	5	15	35	10	17	18	0
b	20	80	0	3.4- 4.4	20	78	2	0	0	0	0
				4.4- 5.4	23	74	3	0	0	0	0
				5.4- 6.4	18	60	21	1	0	0	0
				6.4- 7.4	28	71	1	0	0	0	0
				7.4- 8.4	11	69	20	0	0	0	0
				Mean	20	71	9	**	0	0	0
c	6	94	0	8.4- 9.4	6	79	15	0	0	0	0
				9.4-10.4	5	80	15	0	0	0	0
				Mean	6	79	15	0	0	0	0
d	7	58	35	10.4-11.4	13	50	32	2	2	1	0
				11.4-12.4	7	25	38	8	13	9	0
				12.4-13.4	6	10	18	13	25	28	0
				13.4-14.4	7	11	32	12	23	15	0
				14.4-15.4	6	7	25	23	19	20	0
				15.4-16.6	6	9	19	14	25	21	6
				Mean	7	18	28	12	18	16	1
a&d	7	58	35	Mean	7	18	28	12	18	16	1
b&c	16	84	0	Mean	16	73	11	**	0	0	0
b-d	12	72	16	Mean	12	47	19	6	8	7	1
a-d	11	71	18	Mean	11	45	20	6	9	9	**

NT 46 SW 29 4223 6104 **Bleak Law, Fala** **Block B**

Surface level +216.92m (+711.7ft)
Groundwater level +211.1m
250 and 200mm percussion
May 1985

Overburden	0.3m
Mineral till	1.4m
Waste	1.3m
Mineral	4.4m
Waste	6.9m
Mineral	2.7m
Waste	4.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam, greyish brown (5 YR 3/2)	0.3	0.3
Flow till or solifluction deposit (head)	a 'Very clayey' pebbly sand Gravel: fine with coarse, subangular to rounded, mainly sandstone and greywacke Sand: fine with some medium and rare coarse, angular to rounded, quartz and lithic fragments Fines: silt with some clay, disseminated and as seams, mottled moderate brown (5 YR 4/4)	1.4	1.7
	Diamicton: silty pebbly clay, rather soft with local evidence of bedding, dusky yellowish brown (10 YR 3/2)	1.3	3.0
Glaciolacustrine deposits	b 'Clayey' sand Gravel: fine with trace of coarse, absent below 5.0m, subangular to well rounded, greywacke, fine grained igneous rocks, sandstone and some coal Sand: fine with some medium and rare coarse, angular to rounded, quartz with lithic fragments and coal Fines: silt with clay, disseminated and as seams, greyish yellowish brown (10 YR 5/2)	4.4	7.4
	Silty clay, laminated, with some seams of fine sand at top, light brown (5 YR 5/4) to 8.4m, then greyish yellowish brown (10 YR 5/2)	2.5	9.9
Till	Diamicton: stony, very sandy clay, quite soft, with clasts of sandstones, greywacke and andesite, greyish yellowish brown (10 YR 5/2)	4.4	14.3
Glacial sand and gravel	c 'Clayey' sand Gravel: trace of coarse, coal and vein-quartz Sand: fine with some medium and trace of coarse, angular to well rounded, quartz with feldspar, coal and rock fragments Fines: silt, disseminated and as seams, greyish yellowish brown (10 YR 5/2)	2.7	17.0
Glaciolacustrine deposits	Very fine sand and silt with clay films, laminated, coarsening upwards, dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 3/2) at base	2.1	19.1
Glacial sand and gravel	Sandy gravel Gravel: fine and coarse, subangular to rounded, sandstone and greywacke with basalt, quartzite, tuff and vein-quartz Sand: fine and medium with coarse, angular to rounded, quartz and lithic fragments with rare coal Fines: silt, disseminated and as seams, dusky yellowish brown (10 YR 3/2)	0.9	20.0
Till	Diamicton: sandy stony clay, firm to stiff, with clasts of sandstone, greywacke, basalt and vein-quartz with coal and quartz-dolerite; dusky yellowish brown (10 YR 3/2)	1.1+	21.1
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	25	67	8	0.3- 1.7	25	49	14	4	7	1	0	
b	18	80	2	3.0- 4.0	21	40	25	8	5	1	0	
				4.0- 5.0	21	56	17	4	2	0	0	
				5.0- 6.2	15	81	4	0	0	0	0	§
				6.2- 7.4	16	79	5	0	0	0	0	§
				Mean	18	65	12	3	2	**	0	
c	10	89	1	14.3-16.3	9	77	12	1	0	1	0	§
				16.3-17.0	13	74	12	1	0	0	0	§
				Mean	10	76	12	1	0	1	0	
b&c	15	84	1	Mean	15	70	12	2	1	**	0	
a-c	17	80	3	Mean	17	66	12	2	2	1	0	

NT 46 SW 30 **4325 6300** **Costerton, Humbie** **Block B**

Surface level +182.67m (+599.3ft)
Groundwater level +170.7m
250 and 200mm percussion
October 1985

Overburden 2.6m
Mineral 2.6m
Waste 0.1m
Mineral 11.6m
Waste 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till	Diamicton: Silty stony clay with rare signs of crude bedding, firm, locally stiff, with clasts composed mainly of buff and red sandstones, various igneous rocks and greywacke; colour viariable, mainly moderate yellowish brown (10 YR 5/4) to moderate brown (5 YR 4/4)	2.4	2.6
Glacial sand and gravel	a Sandy gravel, more gravelly below 4.7m Gravel: coarse and fine, mainly subrounded to rounded, chiefly cream and yellow sandstones with greywacke, limestone and rare dolerite or basalt Sand: medium with coarse and fine, subangular to rounded, quartz with lithic fragments, feldspar and coaly seams less than 1cm thick Fines: some disseminated silt, dark yellowish brown (5 YR 4/4)	2.6	5.2
Flow till	Diamicton: pebbly silty clay, quite firm, slightly plastic, clasts mainly of sandstones and greywacke with coal, moderate brown	0.1	5.3

NT 46 SW 30 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Glaciolacustrine deposits	b 'Clayey' sand, pebbly to 7.3m Gravel: fine and coarse, as above Sand: fine with some medium and rare coarse, subangular to rounded, mainly quartz Fines: silt, disseminated and in seams associated with coal and mica, moderate yellowish brown (10 YR 5/4 then 10 YR 5/3)	8.7	14.0
Glacial sand and gravel	c Sandy gravel Gravel: coarse and fine with some cobbles of sandstone, subangular to well rounded, sandstones, greywacke, limestone, various igneous rocks and vein-quartz Sand: fine and medium with coarse, angular to rounded, sharp, quartz with lithic fragments, feldspar and coal Fines: some silt, mostly washed out by drilling process, greyish yellowish brown (10 YR 5/2)	2.9	16.9
Till	Diamicton: gritty sandy clay, moderately firm, clasts mostly granule to coarse gravel grade and composed chiefly of greywacke and sandstone with andesite, basalt and vein-quartz, moderate yellowish brown (10 YR 5/3)	0.3+	17.2
	Borehole terminated for operational reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	6	66	28	2.6- 3.6	7	10	39	14	6	24	0	
				3.6- 4.6	6	14	46	21	12	1	0	
				4.6- 5.2	5	15	22	9	21	28	0	
				Mean	6	13	37	16	12	16	0	
b	16	82	2	5.3- 6.3	13	60	18	1	5	3	0	
				6.3- 7.3	16	65	10	2	4	3	0	
				7.3- 8.3	20	70	10	0	0	0	0	
				8.3- 9.6	25	69	6	0	0	0	0	
				9.6-10.6	18	70	11	1	0	0	0	
				10.6-11.6	13	81	6	0	0	0	0	
				11.6-12.6	14	73	13	0	0	0	0	
				12.6-14.0	12	65	21	1	1	0	0	
				Mean	16	69	12	1	1	1	0	
c	4	56	40	14.0-15.0	8	39	24	8	9	12	0	§
				15.0-16.0	1	6	19	13	25	32	4	§
				16.0-16.9	4	27	21	11	10	9	18	§
				Mean	4	24	21	11	15	18	7	
a&c	5	61	34	Mean	5	19	29	13	13	17	4	
a-c	12	74	14	Mean	12	50	19	5	6	7	1	

NT 46 SW 31 **4329 6218** **Costerton, Humbie** **Block B**

Surface level +200.64m (+658.3ft)
Groundwater level +188.3m
250 and 200mm percussion
May 1985

Overburden 0.3m
Mineral 11.0m
Waste 5.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Sandy soil	0.3	0.3
Glaciolacustrine deposits	a 'Clayey' sand with 5cm thick diamict sandy pebbly clay at 1.0m Sand: fine with trace of medium and coarse, mainly quartz with some coal debris Fines: silt, disseminated and as crude seams, moderate yellowish brown (10 YR 5/4)	5.5	5.8
Glacial sand and gravel	b Sand with thin diamict seam near base Sand: fine with some medium and trace of coarse, as above Fines: silt, disseminated and as seams associated with coal debris locally, moderate yellowish brown (10 YR 5/4), but greyish brown (5 YR 3/2) at base	5.5	11.3
Flow till	Diamicton: sandy silty stony clay, firm to stiff, clasts up to 5cm diameter, mainly of limestone and calcareous siltstone with sandstones and coal, moderate brown (5 YR 4/4)	0.5	11.8
Glaciolacustrine deposits	Sand, fine, clean, buff coloured	0.6	12.4
	Silty clay, firm to stiff, plastic, generally massive but locally poorly laminated, dark yellowish brown (10 YR 4/2)	1.6	14.0
Till	Diamicton: sandy silty stony clay, very stiff, with angular to subrounded clasts of sandstones with quartzite, vein-quartz, coal and basalt or dolerite, dusky yellowish brown (10 YR 3/2)	3.0+	17.0
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	15	85	0	0.3- 1.3	26	69	3	1	1	0	0
				1.3- 2.5	20	78	1	1	0	0	0
				2.5- 3.5	12	88	0	0	0	0	0
				3.5- 4.8	10	88	2	0	0	0	0
				4.8- 5.8	9	90	0	1	0	0	0
				Mean	15	83	1	1	**	0	0
b	9	91	0	5.8- 7.0	8	83	9	0	0	0	0
				7.0- 8.2	9	82	9	0	0	0	0
				8.2- 9.4	6	81	13	0	0	0	0
				9.4-10.4	8	68	23	1	0	0	0
				10.4-11.3	18	71	10	0	1	0	0
				Mean	9	78	13	**	**	0	0
a&b	12	88	0	Mean	12	81	7	**	**	0	0

NT 46 SW 32 **4327 6120** **Blackshiels, Fala** **Block B**

Surface level +229.5m (+753.0ft)
Groundwater level +216.7m
250 and 200mm percussion
June 1985

Overburden 8.6m
Mineral 4.9m
Waste 7.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till sequence	Diamicton: very sandy silty clay, firm, with scattered clasts mainly of fine gravel grade but including cobbles and boulders especially towards base, composed mainly of sandstone with some mudstone, limestone and coal, moderate brown (5 YR 4/4)	3.7	3.9
	'Clayey' sand Gravel: rare, fine Sand: fine with medium and rare coarse, chiefly quartz Fines: disseminated silt, dark yellowish brown (10 YR 4/2)	1.2	5.1
	Diamicton: sandy silty pebbly clay, stiff, with clasts mainly of sandstones and coal, mottled moderate brown (5 YR 4/4)	0.3	5.4
	Diamicton: very sandy silty clay, firm to soft, with rare coarse sand and gravel-size clasts of sandstone and coal, bedded locally with sand laminae, dark yellowish brown (10 YR 4/3)	0.6	6.0

NT 46 SW 32 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
	Diamicton: sandy silty stony clay, stiff, with clasts up to boulder size, mainly of white sandstone with some dolerite and many fine gravel and coarse sand grade coal fragments, colour as above	2.6	8.6
Glacial sand and gravel	Sand Gravel: trace of fine and coarse Sand: fine and medium with rare coarse, mainly quartz with coal fragments, in local concentrations Fines: disseminated silt, moderate yellowish brown (10 YR 5/4)	4.9	13.5
Glacialacustrine deposits	Silt, clayey, with very fine grained sand, also rare diamict seams, in part crudely bedded, in part massive, rarely finely laminated, with some coaly streaks and micaceous partings; dark yellowish brown (10 YR 4/2) to 18.5m then dusky yellowish brown (10 YR 3/2) with diamict characteristics	5.5	19.0
Till	Diamicton: sandy silty stony clay, stiff to very stiff, with clasts up to cobble grade, chiefly of sandstone	1.0	20.0
	Sand and gravel Gravel: coarse and fine, some cobbles, angular to rounded, white, grey and brown sandstones with basalt and some vein-quartz Sand: coarse to fine, angular to subangular, lithic fragments and quartz Fines: silt, disseminated	0.2	20.2
	Diamicton: sandy silty stony clay, stiff to very stiff, with clasts up to boulder size, of sandstones, basalt, much black mudstone and some vein-quartz, dusky yellowish brown (10 YR 2/2)	1.2+	21.4
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
9	91	0	8.6- 9.9	10	37	51	2	0	0	0	
			9.9-11.5	7	42	48	2	0	1	0	
			11.5-13.5	10	53	33	3	1	0	0	§
			Mean	9	46	43	2	**	**	0	

NT 46 SW 33 **4459 6399** **Old Windy Mains, Humbie** **Block B**

Surface level +176.55m (+579.2ft)
Water struck at +156.3m
250 and 200mm percussion
May 1985

Overburden	0.5m
Mineral	12.0m
Waste	2.0m
Mineral	5.3m
Waste	2.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, brown	0.5	0.5
Glacial sand and gravel	a 'Clayey' sand Gravel: rare fine, subangular to rounded, greywacke and buff and pink sandstones with vein-quartz, igneous rocks, limestone and coal Sand: fine and medium with rare coarse, subangular, quartz and lithic fragments Fines: disseminated silt and clay, pale brown (5 YR 5/6) and moderate brown (5 YR 4/4)	2.0	2.5
Glaciolacustrine deposits	b 'Clayey' sand Gravel: trace of fine at base Sand: fine with some medium, mainly subangular, quartz and lithic fragments Fines: silt, disseminated and as seams which become more common with depth, moderate brown (5 YR 4/4) then light brown (5 YR 5/6), finally moderate brown (5 YR 4/4)	10.0	12.5
	Silt, laminated, with seams of very fine sand, coaly, micaceous, some clay laminae, light brown (5 YR 5/6) then brownish grey (5 YR 4/1)	0.9	13.4
Flow till	Diamicton: stony, silty clay, firm, with clasts mainly of sandstones and greywacke, dusky red (5 R 3/2) to 14.1m, dusky brown (5 YR 2/2) to 14.3, then moderate brown (5 YR 4/3)	1.1	14.5
Glacial sand and gravel	c Pebbly sand Gravel: fine with coarse and rare cobble, subangular to rounded, sandstones, greywacke and vein-quartz Sand: fine and medium with some coarse, angular to subangular, quartz with lithic fragments and some coal and shale Fines: some disseminated silt, greyish yellowish brown (10 YR 5/2)	3.1	17.6
	d 'Clayey' pebbly sand Gravel: coarse and fine, otherwise as above Sand: fine with medium and some coarse, as above Fines: disseminated silt, colour as above	2.2	17.8
Till	Diamicton: very sandy gravelly clay, perhaps with sand and gravel lenses, angular sandstone debris common	0.7	20.5
	Diamicton: very silty sandy clay with scattered clasts, stiff to very stiff, clasts up to cobble grade, chiefly of red and white sandstone, dark yellowish brown (10 YR 4/2) to greyish brown (5 YR 3/2)	2.0+	22.5
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	10	89	1	0.5- 1.5	15	40	42	2	1	0	0
				1.5- 2.5	5	57	37	1	0	0	0
				Mean	10	47	40	2	1	0	0
b	19	81	0	2.5- 3.5	22	58	19	0	1	0	0
				3.5- 4.5	24	56	20	0	0	0	0
				4.5- 5.5	10	75	15	0	0	0	0
				5.5- 6.5	17	73	10	0	0	0	0
				6.5- 7.5	24	65	11	0	0	0	0
				7.5- 8.5	27	70	3	0	0	0	0
				8.5- 9.5	11	79	10	0	0	0	0
				9.5-10.5	15	77	8	0	0	0	0
				10.5-11.5	17	77	6	0	0	0	0
				11.5-12.5	26	68	5	0	1	0	0
				Mean	19	70	11	0	**	0	0
c	6	75	19	14.5-15.6	4	24	28	9	28	7	0
				15.6-16.6	7	49	33	6	3	2	0
				16.6-17.6	6	37	38	3	3	7	6
				Mean	6	36	33	6	12	5	2
d	13	70	17	17.6-18.6	13	53	19	3	5	7	0
				18.6-19.8	13	35	20	10	11	11	0
				Mean	13	43	20	7	8	9	0
a&b	18	82	0	Mean	18	67	15	**	**	0	0
c&d	9	73	18	Mean	9	40	27	6	10	7	1
a&c&d	9	77	14	Mean	9	41	31	5	8	5	1
a-d	15	80	5	Mean	15	59	19	2	3	2	**

NT 46 SW 34 **4484 6334** **Knox's Wood, Humbie** **Block B**

Surface level +169m (+555ft)
Groundwater level (perched?) at +153.9m
250 and 200mm percussion
October 1985

Overburden	12.0m
Mineral	2.2m
Waste	1.8m
Mineral	4.9m
Waste	2.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam	0.3	0.3
Glaciolacustrine deposits	Silt and fine sand with clay films, laminated, light brown (5 YR 5/4) to 1.5m, then variable (locally colour laminated), moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2)	8.9	9.2

NT 46 SW 34 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Flow till	Diamicton: very sandy pebbly silt, incorporating seams of laminated fine sand and silt with scattered pebbles, dark yellowish brown (10 YR 4/2)	0.3	9.5
Till	Diamicton: silty stony clay, firm to stiff, with clasts up to 14cm, commonly of limestone with red and cream mudstone, greywacke, vein-quartz and coal, dusky yellowish brown (10 YR 3/2) then moderate yellowish brown (10 YR 5/3)	1.6	11.1
Flow till	Diamicton: very sandy pebbly silt, bedded locally, with sandy laminae, moderate yellowish brown (10 YR 5/4)	0.9	12.0
Glaciolacustrine deposits	a 'Very clayey' sand with rare pebbles Gravel: trace of fine, subangular to rounded, sandstone, greywacke, various igneous rocks and coal Sand: fine with some medium and rare coarse, angular to subrounded, mainly quartz with lithic fragments and coal Fines: much silt, disseminated and in seams, moderate yellowish brown (10 YR 5/3) then greyish orange (10 YR 6/4)	2.2	14.2
	Silt and very fine sand, greyish orange (10 YR 6/4)	1.8	16.0
	b 'Clayey' sand with scattered pebbles Gravel: rare fine, trace of coarse and rare cobbles below 19.1m, subangular to rounded, sandstone, greywacke, various igneous rocks and coal Sand: fine with some medium and rare coarse, angular to rounded, quartz, lithic fragments and coal Fines: silt, disseminated and in seams, moderate yellowish brown (10 YR 5/3)	4.9	20.9
Till	Diamicton: pebbly sandy silt, moderately firm, clasts mainly of Carboniferous sediments, dusky yellowish brown (10 YR 3/2)	0.3	21.2
	Diamicton: pebbly sandy clay, stiff, with clasts of buff sandstone, limestone, mudstone, coal, seatearth and some red sandstone, dusky yellowish brown (10 YR 2/2 to 3/2)	1.7+	22.9
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	30	70	0	12.0-13.1	26	56	15	2	1	0	0	
				13.1-14.2	34	57	8	1	0	0	0	
				Mean	30	58	11	1	**	0	0	
b	16	83	1	16.0-17.1	15	51	25	7	1	1	0	§
				17.1-18.1	14	72	12	1	1	0	0	§
				18.1-19.1	15	75	8	1	1	0	0	§
				19.1-20.1	15	68	14	2	1	0	0	§
				20.1-20.9	23	62	9	4	2	0	0	§
				Mean	16	66	14	3	1	**	0	
a&b	20	79	1	Mean	20	63	13	3	1	**	0	

NT 46 SW 35 **4413 6288** **Haugh Wood, Keith, Humbie** **Block B**

Surface level +183.5m (+602.0ft)
Water struck at +175.5m
250mm percussion
May 1985

Overburden 1.7m
Mineral 7.8m
Waste 0.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, brown	0.1	0.1
Head	'Clayey' pebbly sand Gravel: fine and coarse, subrounded, mainly sandstone with rare greywacke, vein-quartz, quartzite and igneous rocks Sand: fine with medium and some coarse, subangular, quartz and lithic fragments Fines: disseminated silt, moderate brown (5 YR 4/4)	0.9	1.0
Flow till	Diamicton: sandy silty stony clay, firm, with clasts up to 5cm diameter of sandstone with siltstone, coal and andesite, mottled moderate brown (5 YR 4/4) with light brown (5 YR 5/1)	0.7	1.7
Glacial sand and gravel	a Sandy gravel Gravel: fine and coarse with cobbles, subrounded with subangular, sandstone with siltstone, vein-quartz, andesite, basalt, felsite and some coal Sand: medium with fine and coarse, subangular with subrounded, quartz and lithic fragments with some coal Fines: silt, mainly disseminated but also as seams, moderate brown (5 YR 4/4)	6.0	7.7

NT 46 SW 35 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Glaciolacustrine deposits	b 'Clayey' pebbly sand Gravel: fine and coarse, subangular to subrounded, greywacke sandstone and siltstone with cream and red sandstones, ironstone and vein-quartz Sand: fine with some medium and rare coarse, subrounded, mainly quartz Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	1.8	9.5
Till	Diamicton: stony silty clay, moderately stiff with clasts up to 15cm diameter of sandstone, siltstone, coal, andesite, basalt and greywacke	0.8+	10.3
	Borehole terminated prematurely owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	6	59	35	1.7- 2.7	6	22	43	14	10	5	0	
				2.7- 3.7	6	8	41	13	16	16	0	
				3.7- 4.7	12	5	31	13	21	18	0	
				4.7- 5.7	5	10	41	11	21	12	0	
				5.7- 6.7	3	8	22	10	21	18	18	
				6.7- 7.7	4	32	22	7	12	23	0	
				Mean	6	14	34	11	17	15	3	
b	18	75	7	7.7- 8.7	14	65	13	1	4	3	0	§
				8.7- 9.5	22	65	7	1	3	2	0	§
				Mean	18	64	10	1	4	3	0	
a&b	9	63	28	Mean	9	26	28	9	14	12	2	

NT 46 SW 36 **4473 6209** **Kippit Hill, Humbie** **Block B**

Surface level +207.49m (+680.7ft)
Groundwater level +188.0m
250 and 200mm percussion
May 1985

Overburden	1.4m
Mineral	4.7m
Waste	1.4m
Mineral	7.4m
Waste	6.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly sandy loam	0.2	0.2
Flow till or head	Diamicton: silty sandy pebbly clay, structureless, with clasts mainly of sandstone and greywacke, slightly mottled, mostly greyish brown (5 YR 4/2)	1.2	1.4
Glacial sand and gravel	a 'Clayey' pebbly sand with rare diamict seams to 2.0m and from 3.1 to 4.8m Gravel: fine with coarse, subangular to rounded, sandstones and greywacke with andesite lava and tuff, vein-quartz and felsite Sand: medium and fine with some coarse, angular to subrounded, quartz with lithic fragments, feldspar and coaly partings Fines: silt with clay, disseminated and as seams, moderate brown (5 YR 4/4) to 2.0m, greyish yellowish brown (10 YR 5/2) to 3.1m and then moderate yellowish brown (10 YR 5/4)	4.7	6.1
Glaciolacustrine deposits	Very silty fine sand, moderate yellowish brown (10 YR 5/4)	1.4	7.5
	b 'Clayey' sand with pebbles Gravel: fine and coarse, sandstone and greywacke with various igneous rocks and vein-quartz Sand: fine with medium and rare coarse, angular to rounded Fines: silt, disseminated and in seams, moderate yellowish brown (10 YR 5/4 then 5/3)	7.4	14.9
	Silt and fine sand with rare clay films, fining with depth, greyish yellowish brown (10 YR 5/2)	6.1+	21.0
	Borehole terminated for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	12	80	8	1.4- 2.0	18	39	14	7	12	10	0
				2.0- 3.1	10	19	54	9	7	1	0
				3.1- 4.8	8	33	48	5	5	1	0
				4.8- 6.1	16	57	23	2	2	0	0
				Mean	12	37	38	5	6	2	0
b	18	80	2	7.5- 8.9	15	81	4	0	0	0	0
				8.9-10.4	23	66	5	1	1	4	0
				10.4-11.7	38	44	13	2	3	0	0
				11.7-13.3	8	68	22	1	1	0	0
				13.3-14.9	12	58	28	1	1	0	0
				Mean	18	64	15	1	1	1	0
a&b	16	80	4	Mean	16	53	24	3	3	1	0

NT 46 SW 37 4118 6229 **Crichton Dean, Fala** **Block B**

Surface level +203.23m (+666.8ft)
Water not struck
Pit
October 1984

Overburden 1.5m
Mineral 2.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy, silty, pebbly loam, greyish brown (5 YR 3/2)	0.4	0.4
Glacial sand and gravel	Gravel	0.7	1.1
	Gravel: fine and coarse, some cobbles, subangular to rounded, mainly greywacke and sandstone		
	Sand: fine to coarse, angular to rounded, quartz and lithic fragments		
	Fines: disseminated silt and clay, deposit quite 'dirty', moderate brown (5 YR 4/4)		
Flow till	Diamicton: stony, silty clay, with clasts mostly of sandstone with coal and greywacke, dark yellowish brown (10 YR 4/2)	0.4	1.5
Glacial sand and gravel	Gravel, poorly bedded, 'dirty'	2.0+	3.5
	Gravel: coarse and fine with cobble and some boulders, subangular to rounded, mainly cream and red sandstone, with siltstone, mudstone, greywacke and vein-quartz		
	Sand: coarse and medium with fine, angular to rounded, quartz and lithic fragments		
	Fines: disseminated silt and clay, dark yellowish brown (10 YR 4/2)		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
9	32	59	1.5- 3.5	9	6	10	16	29	30	0

NT 46 SW 38 4222 6056 **West Mains of Blackshiels, Fala** **Block B**

Surface level +215 (+705ft)
Water struck at +211m
Pit
October 1984

Overburden	0.4m
Mineral	1.9m
Waste	0.4m
Mineral	1.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy, pebbly loam, greyish brown (5 YR 3/2)	0.4	0.4
Glacial sand and gravel	Gravel Gravel: coarse and fine with cobbles, subrounded to subangular, greywacke with red and cream sandstone, vein-quartz and some dolerite Sand: coarse and medium with some fine, subangular to subrounded, quartz with lithic fragments and feldspar Fines: silt and clay, disseminated and in pockets below 2.0m	1.9	2.3
	Silt, laminated, with some clay films, olive grey (5 Y 4/2)	0.4	2.7
	Gravel, composition as above, except grade is coarser and cobbles are common	1.1+	3.8

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	5	23	72	0.4- 2.3	5	3	9	11	31	38	3
b	No grading data available for this deposit										

NT 46 SW 40 **4445 6069** **Fala Mains** **Block H_2**

Surface level c +231m (c +758ft)
Water not struck
Pit
October 1984

Waste 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty pebbly loam, dusky brown (5 YR 2/2)	0.6	0.6
Glacial sand and gravel	Gravel, slightly dirty Gravel: coarse and fine with cobbles, subangular to rounded, mainly cream sandstone, greywacke sandstone and siltstone Sand: coarse to fine, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate yellowish brown (10 YR 5/4)	0.7	1.3
Till	Diamicton: stony clay, firm to stiff, clasts up to cobble size, include sandstone, greywacke, mudstone and coal. Colour is variable from moderate brown (5 YR 3/4) to mottled brownish grey (5 YR 4/1)	1.7+	3.0

NT 46 SW 41 **4496 6403** **Sand Pit, Keith Marischal, Humbie** **Block B**

Surface level c +165m (c +541ft)
Water not struck
Section sampled by hand
November 1985

Mineral 11.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Flow till	Soil and flow till of unknown thickness removed by stripping	0.0	0.0
Glacial sand and gravel	Sand Gravel: trace of fine, subangular, including andesite and coal Sand: fine with medium and trace of coarse, mainly angular to subrounded, quartz with some feldspar, lithic fragments and coal which is commonly concentrated in seams, mainly light brown Fines: seams of moderate brown silt and rare clay films between 5.7 and 7.4m	11.1+	11.1

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	91	0	0.0- 1.6	5	44	51	0	0	0	0
			1.6- 3.4	11	84	5	0	0	0	0
			3.4- 5.7	5	85	10	0	0	0	0
			5.7- 7.4	22	48	29	1	0	0	0
			7.4- 9.2	6	78	16	0	0	0	0
			9.2-11.1	7	70	22	1	0	0	0
			Mean	9	70	21	**	0	0	0

NT 46 SE 9 **4541 6465** **Nether Keith, Humbie** **Block B**

Surface level +138m (+453ft)
Groundwater level +135m
250mm percussion
October 1985

Waste 8.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.3	0.3
	Fossil soil	0.1	0.4
Flow till	Gravelly lag deposit	0.1	0.5
	Diamicton: stony, silty clay, stiff to 2.0m then firm, clasts up to cobble size of red, rust and cream coloured sandstones plus coal, but almost stoneless from 2.5m, mottled mainly light brown (5 YR 5/6) to moderate brown (5 YR 4/4) to 2.0m, then moderate brown (5 YR 4/3). Pale grey sand-filled fissure from 0.5 to 2.0m	2.5	3.0
Glaciolacustrine deposits	Silt and fine sand with coal fragments and rare pebbles, mostly of sandstone, moderate yellowish brown (10 YR 5/4) to 3.5m, then greyish orange (10 YR 6/4)	2.0	5.0
Till	Diamicton: sandy pebbly silt, firm, with seams or pockets of sand at about 6.0m, clasts mainly of grey and red sandstones with seatearth, dark yellowish brown (10 YR 4/2)	1.7	6.7
	Diamicton: stony clay, very stiff, clasts up to cobble size, mainly of Carboniferous sediments including sandstone, mudstone, coal, ironstone and limestone, olive black (5 Y 2/1)	2.1+	8.8
	Borehole terminated owing to slow progress		

NT 46 SE 10 **4572 6384** **New Mains, Humbie** **Block B**

Surface level +155m (+509ft)
Water struck (perched) at +149m
250 and 200mm percussion
May 1985

Overburden 3.5m
Mineral 6.8m
Waste 6.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Made ground		0.5	0.5
Flow till	Diamicton: sandy silty clay, pebbly below 1.5m, mainly stiff, clasts up to 5cm of sandstone, siltstone, coal, andesite, felsite and coal; sandy silt intercalations; moderate brown (5 YR 4/4)	3.0	3.5
Glacial sand and gravel	Sand with rare pebbles Gravel: rare fine and trace of coarse, subrounded, mainly sandstone with andesite, basalt, siltstone and coal Sand: fine with medium and rare coarse, subangular with subrounded, quartz and lithic fragments with coal, in discrete seams; especially between 6.5 and 8.5m where deposit is oily and coloured brownish black (5 YR 2/1) Fines: disseminated silt and clay with rare seams of sandy silt, mainly light brown (5 YR 5/6) to moderate brown (5 YR 4/4)	6.8	10.3
Till	Diamicton: sandy silty stony clay, stiff, locally very stiff, rare sandy seams, clasts up to 10cm diameter, chiefly of sandstone, moderate brown (5 YR 4/4)	6.1+	16.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	90	1	3.5- 4.5	6	83	11	0	0	0	0
			4.5- 5.5	6	76	17	1	0	0	0
			5.5- 6.5	10	47	36	4	2	1	0
			6.5- 7.5	10	59	23	5	3	0	0
			7.5- 8.5	6	52	37	3	1	1	0
			8.5- 9.5	12	62	24	1	1	0	0
			9.5-10.3	10	76	14	0	0	0	0
			Mean	9	65	23	2	1	**	0

NT 46 SE 11 **4540 6308** **Hazyhill, Humbie** **Block B**

Surface level +180.06m (+590.8ft)
Groundwater level +172.6m
250 and 200mm percussion
October 1985

Overburden	1.0m
Mineral	10.0m
Waste	11.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: clayey loam	0.3	0.3
Flow till	Diamicton: silty sandy clay with scattered rounded pebbles including vein-quartz and ironstone; firm; crudely laminated towards base and increasingly sandy; light brown (5 YR 5/4)	0.7	1.0
Glaciolacustrine deposits	a Very clayey sand Gravel: rare fine and coarse, angular to rounded, mainly sandstone with vein-quartz, greywacke and rare coal Sand: fine with some medium and rare coarse, angular to subangular, mainly quartz Fines: seams of silt and rare clay, light brown (5 YR 5/4)	2.0	3.0
Glacial sand and gravel	b Sand with scattered pebbles, fining downwards Gravel: rare, fine and coarse, subrounded, sandstone, vein-quartz, greywacke and coal Sand: fine with medium and rare coarse, angular to rounded, quartz with lithic fragments, coal and feldspar Fines: disseminated silt, moderate yellowish brown (10 YR 5/4)	4.6	7.6
Glaciolacustrine deposits	c 'Clayey' sand Sand: fine with rare medium, angular to rounded, mainly quartz Fines: disseminated silt, partly lost by drilling process, moderate yellowish brown (10 YR 5/4)	3.4	11.0
	Laminated silt and very fine sand with clay films, light brownish grey (5 YR 5/1)	3.5	14.5
Flow till	Diamicton: sandy pebbly silt, quite firm at top, softer towards base where material is sandier and has signs of bedding, brownish grey (5 YR 4/1)	2.5	17.0
Till	Diamicton: sandy stony clay, very stiff and overconsolidated, with clasts of red and cream sandstones, greywacke, coal and various igneous rocks, moderate reddish brown (10 R 4/6) but slightly darker from 18.4m	2.0	19.0
	Diamicton: sandy stony clay, stiff with clasts mainly less than cobble grade, including sandstones, greywacke, coal and igneous rocks, mainly moderate brown (5 YR 3/4) but greyish brown (5 YR 3/2) from 20.2 to 20.5m	3.4+	22.4
	Borehole terminated owing to excessive overburden		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64	mm
a	35	62	3	1.0– 2.0	35	54	6	2	2	1	0	
				2.0– 3.0	No grading data available							
				Mean	35	54	6	2	2	1	0	
b	9	89	2	3.0– 4.0	10	52	28	4	3	3	0	
				4.0– 5.2	10	35	47	6	2	0	0	
				5.2– 6.5	6	71	22	1	0	0	0	
				6.5– 7.6	10	64	26	0	0	0	0	
				Mean	9	55	31	3	1	1	0	
c	16	84	0	7.6– 9.3	16	82	2	0	0	0	0	§
				9.3–10.2	12	85	3	0	0	0	0	§
				10.2–11.0	21	78	1	0	0	0	0	§
				Mean	16	82	2	0	0	0	0	
a&c	23	76	1	Mean	23	72	3	1	1	**	0	
a–c	17	82	1	Mean	17	64	16	2	1	**	0	

NT 46 SE 12 **4566 6244** **Upper Keith, Humbie** **Block B**

Surface level +188.31m (+617.8ft)
Groundwater level +185.6m
250mm percussion
October 1985

Waste 12.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, dark brown	0.5	0.5
Head	Silt, sandy, fluvial	0.5	1.0
Ablation till	Diamicton: silty pebbly clay, soft to firm, some local lamination, mottled light brown (5 YR 5/6) to dark yellowish brown (10 YR 4/2). Wood fragments recovered at approximately 2.2m	1.4	2.4
	Diamicton: sandy stony clay, firm, with clasts mainly of Carboniferous sediments, greyish brown (5 YR 3/2) to dusky brown (5 YR 2/2)	0.8	3.2
Glaciolacustrine deposits	Silt with some fine sand and a 5mm thick peaty seam at 3.5m, poorly bedded, moderate brown (5 YR 4/4)	0.8	4.0
	Silt, dark yellowish brown (10 YR 4/2) to greyish yellowish brown (10 YR 5/2)	1.0	5.0
	Silt and clay, increasing plasticity with depth, light olive grey (5 Y 5/1)	1.0	6.0
Till	Diamicton: pebbly sandy silt, dusky yellowish brown (10 YR 3/2)	0.7	6.7
	Diamicton: stony sandy clay with sand pockets, greywacke clasts common, greyish brown (5 YR 4/2)	1.0	7.7
	Diamicton: stony sandy clay, very stony around 8.5m, stiff, clasts mainly of Carboniferous sediments and volcanics, dusky yellowish brown (10 YR 2/2 and 3/2)	4.4+	12.1
	Borehole terminated owing to slow progress		

NT 46 SE 13 **4710 6368** **Hattonhill, Humbie** **Block H_2**

Surface level +185.8m (+609.6ft)
Water struck at +175.0m
250 and 200mm percussion
May 1985

Waste 16.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.2	0.2
Glaciolacustrine deposits	Clay, silty, moderately stiff, moderate brown (5 YR 4/4)	0.6	0.8
	Silt, sandy, clayey, with many coal-rich laminae and rare pebbles of greywacke, sandstone, basalt, andesite and coal, mainly in upper part, moderate yellowish brown (10 YR 5/4) to 2.8m, then strong brown (5 YR 4/6)	7.7	8.5
Till	Diamicton: sandy silty stony clay, firm to stiff, ultimately very stiff, with numerous clasts up to cobble size of greywacke, sandstone, basalt and dolerite with quartzite and vein-quartz; moderate brown (5 YR 3/5) then (5 YR 3/4); from 11.5m is dusky yellowish brown (10 YR 3/2)	7.9+	16.4
	Borehole terminated owing to slow progress in till		

NT 46 SE 14 **4784 6175** **Blegbie, Humbie** **Block H_2**

Surface level +229.8m (+753.9ft)
Water not struck
250mm percussion
May 1985

Overburden	0.2m
Mineral till	1.6m
Waste	6.6m
Bedrock	0.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till	Diamicton, grades as gravel Gravel: fine to cobble with boulder, subangular to rounded, sandstone, greywacke, basalt, dolerite and vein-quartz Sand: coarse with medium and some fine, angular to subangular, quartz and lithic fragments Fines: disseminated silt and clay, pale reddish brown, mottled yellowish brown and grey	1.6	1.8
Glaciolacustrine deposits	Sand and silty clay, interbedded with rare fine gravel. Sand is moderate orange brown, silty clay is tenacious and medium grey in colour. Below 2.2m interbeds of diamicton up to 10mm thick are present	0.8	2.6
Till	Diamicton: very sandy silty stony clay, firm to stiff, clasts up to cobble size, plus rare boulders, composed mainly of greywacke in upper part, mainly sandstone with coal below 5.6m, purplish reddish brown to grey at top, reddish brown at base	3.7	6.3
	Diamicton: silty clay, firm to stiff, sheared locally, with clasts of sandstone and siltstone which are abundant in lower part, moderate red (5 R 4/4)	2.1	8.4
Upper Old Red Sandstone	Sandstone, silty, slightly friable, soft, thinly bedded, mainly fine-grained, composed of quartz with mica and clay minerals, moderate reddish brown (10 R 4/4)	0.4+	8.8

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
6	28	66	0.2- 1.8	6	6	7	15	25	23	18

NT 46 SE 15 **4790 6210** **Blegbie, Humbie** **Block H_2**

Surface level +231.5m (+759.5ft)
Groundwater level +221.2m
250 and 200mm percussion
November 1985

Overburden	0.3m
Mineral	6.5m
Waste	0.8m
Mineral till	2.4m
Mineral	1.0m
Waste	6.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: clayey gravelly loam, brown	0.3	0.3
Glacial sand and gravel	a Gravel, locally claybound Gravel: coarse and fine with cobbles, subangular to subrounded, red and buff sandstones with vein-quartz, greywacke, basalt and trace of coal Sand: medium with coarse and fine, subangular, lithic fragments and quartz Fines: disseminated silt and clay, with 5cm silt seam at base, moderate brown (5 YR 4/4)	2.1	2.4
Glaciolacustrine deposits	b 'Clayey' sand, fining downwards Gravel: rare fine, subrounded, sandstone Sand: fine with some medium and trace of coarse, subangular, quartz and lithic fragments Fines: disseminated silt and clay, light brown (5 YR 5/6) to moderate brown (5 YR 4/4) but moderate reddish brown (10 R 4/6) at base	4.4	6.8
	Silt, sandy with clay films and sandy laminae, moderate reddish brown (10 R 4/6)	0.8	7.6
Flow till	c Diamicton, grading as 'clayey' gravel Gravel: cobble, coarse and fine, but cobbles confined to upper 20cm, subangular to subrounded, red and yellow sandstones, greywacke and vein-quartz Sand: coarse, medium and fine, angular, quartz and lithic fragments Fines: silt and clay but much lost in drilling process, moderate reddish brown (10 R 4/6)	2.4	10.0
Glacial sand and gravel	d Pebbly sand Gravel: fine with coarse, subrounded to subangular, sandstone, greywacke and vein-quartz Sand: medium with coarse and fine, subangular, quartz and lithic fragments, with coal Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	1.0	11.0
Glaciolacustrine deposits	Silt and clay, interbedded with frequent fine sand laminae and rare pebbles of sandstone and greywacke, moderate reddish brown (10 R 4/6)	1.3	12.3
Till	Diamicton: very sandy stony clay, largely disaggregated by drilling process, abundant clasts up to cobble grade, of red and buff sandstones, greywacke, vein-quartz and rare coal; moderate reddish brown (10 R 4/6)	1.3	13.6

NT 46 SE 15 Cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
	Diamicton: sandy silty stony clay, firm becoming stiff, with mainly subangular clasts up to cobble grade, of red sandstone and greywacke with some mudstone and vein-quartz; sandstone increasingly common towards base; dusky brown (5 YR 2/2) grading to moderate reddish brown (10 R 4/6) by 17.3m, then moderate red (5 R 4/4) to moderate reddish brown (10 R 4/6)	4.1+	17.7
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	9	45	46	0.3- 1.3	10	14	19	12	19	26	0	
				1.3- 2.4	9	10	21	14	17	24	5	
				Mean	9	12	20	13	18	25	3	
b	17	82	1	2.4- 3.4	17	74	5	1	3	0	0	
				3.4- 4.4	20	77	3	0	0	0	0	
				4.4- 5.6	10	82	8	0	0	0	0	§
				5.6- 6.8	21	76	3	0	0	0	0	§
				Mean	17	77	5	**	1	0	0	
c	10	36	54	7.6- 9.0	No grading data available							
				9.0-10.0	10	10	14	12	14	16	24	§
				Mean	10	10	14	12	14	16	24	
d	7	84	9	10.0-11.0	7	12	54	18	8	1	0	§
a&d	9	57	34	Mean	9	12	30	15	15	17	2	
a&c&d	9	49	42	Mean	9	11	25	13	14	17	11	
a-d	13	64	23	Mean	13	41	15	8	8	9	6	

NT 46 SE 16 **4979 6454** **Ewingston, Humbie** **Block H_2**

Surface level +208m (+682ft)
Water not struck
250mm percussion
May 1985

Overburden	0.4m
Mineral	1.0m
Waste	6.4m
Bedrock	0.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy pebbly loam, light brown	0.4	0.4
Glacial sand and gravel	Very clayey pebbly sand, fining downwards Gravel: fine with coarse, angular to subrounded, sandstone, vein-quartz and rare coal Sand: fine with medium and some coarse, angular to subrounded, mainly quartz Fines: silt with clay, disseminated at top, then as thinly bedded seams, light reddish brown	1.0	1.4
	Silt, sandy, thinly bedded, soft, rare pebbles of sandstone and vein-quartz	1.1	2.5
Till	Diamicton: sandy, silty, stony clay, moderately stiff, with clasts up to 20cm, of sandstone with greywacke, vein-quartz and dolerite, but chiefly sandstone below 6.5m, moderate reddish-brown (10 R 4/6)	5.3	7.8
Upper Old Red Sandstone	Sandstone, fine grained with rare well rounded medium grains, silty, bedded, friable, mainly greyish pink (5 R 8/2) with pale red (5 R 6/2) and greyish red (5 R 4/2) with specks of blackish red (5 R 2/2) haematite. Also seams of soft silty micaceous mudstone, mottled pale green (10 G 7/2) and pale red (10 R 6/2)	0.9+	8.7

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
34	58	8	0.4- 1.4	34	40	12	6	6	2	0

NT 46 SE 18 **4656 6447** **Highlea, Humbie** **Block B**

Surface level +159.1m (+522.0ft)
Water not struck
Pit
October 1984

Overburden 0.6m
Mineral 2.4m
Bedrock 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty sandy loam, moderate brown (5 YR 3/4)	0.3	0.3
Flow till	Diamicton: pebbly sandy silty clay, with rare cobbles of sandstone and fine grained basic igneous rock. Mainly moderate reddish brown (10 R 4/4)	0.3	0.6
Glacial sand and gravel	'Very clayey' pebbly sand with diamict seams, increasing in number with depth Gravel: fine and coarse Sand: fine with some medium and trace of coarse, angular to subangular, quartz with some coal fragments Fines: silt, as seams, pale yellowish brown (10 R 6/2)	2.4	3.0
Upper Old Red Sandstone	Sandstone, fine grained, dark reddish brown (10 R 3/4)	0.3+	3.3

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
23	73	4	0.6- 3.0	23	63	8	2	2	2	0

NT 46 SE 19 **4706 6279** **Humbie Mains** **Block H_2**

Surface level +204.5m (+670.9ft)
Water not struck
Pit
October 1984

Waste 1.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, stony silty loam, greyish brown (5 YR 3/2)	0.3	0.3
Till	Diamicton: stony silty clay, firm, clasts mainly of sandstone and fine grained igneous rocks with rare greywacke	1.5+	1.8

NT 46 SE 20 **4858 6442** **Bughtknowe, Humbie** **Block H_2**

Surface level +171m (+561ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 1.2m
Waste 1.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly sandy loam	0.3	0.3
Glacial sand and gravel	Sandy gravel Gravel: fine and coarse with cobbles, subangular to rounded, mainly sandstone with igneous rock, vein-quartz and coal Sand: medium with coarse and some fine, sharp, angular to rounded, mainly quartz with some lithic fragments Fines: rare silt, light brown (5 YR 5/4)	1.2	1.5
	Clay, silty, moderate brown (5 YR 4/4)	0.2	1.7
Till	Diamicton: stony, silty clay, firm, with many sandstone clasts, greyish brown (5 YR 3/2)	1.0+	2.7

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
0	53	47	0.3- 1.5	0	10	26	17	20	18	9

NT 46 SE 21 **4808 6353** **Leaston House, Humbie** **Block H_2**

Surface level +194.3m (+637.5ft)
Water not struck
Pit
October 1984

Overburden	0.3m
Mineral	2.4m
Waste	0.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy silty gravelly loam	0.3	0.3
Glacial sand and gravel	Sandy gravel; sand with diamict seams from 0.3 to 0.7m and from 0.8 to 1.4m Gravel: (confined to diamict seams) fine to cobble with boulders, mainly subangular to rounded Sand: mainly fine with medium and some coarse, angular to rounded, mainly quartz with some feldspar and ferromagnesian fragments Fines: disseminated silt and clay, chiefly in diamicton which is moderate reddish brown (10 R 4/4); sand is moderate brown (5 YR 4/4)	2.4	2.7
Till	Diamicton: stony clay, stiff, clasts mainly of greywacke and sandstone, moderate reddish brown (10 R 4/4)	0.5+	3.2

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
8	68	24	0.3- 1.4	10	20	12	8	11	13	26
			1.4- 2.7	6	71	20	1	2	0	0
			Mean	8	48	16	4	6	6	12

NT 46 SE 22 **4964 6362** **Stobshiel, Humbie** **Block H_2**

Surface level +218.6m (+717.2ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 2.9m
Waste 0.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: gravelly sandy loam, greyish brown (5 YR 3/2)	0.3	0.3
Glacial sand and gravel	Gravel, dirty and slightly claybound Gravel: cobble, coarse and fine with rare boulders, mainly subangular to subrounded, greywacke, sandstone and siltstone, with vein-quartz Sand: coarse with medium and rare fine, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate reddish brown (10 R 4/4)	2.9	3.2
Till	Diamicton: stony silty clay, firm, clasts mainly of greywacke and sandstone with some chert and coal, moderate reddish brown (10 R 4/4)	0.2+	3.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
4	20	76	0.3- 3.2	4	3	6	11	14	17	45

NT 56 NW 3 **5091 6561** **Skedsbush, Yester** **Block C**

Surface level +186.33m (+611.3ft)
Groundwater level +182.0m
250mm percussion
June 1985

Overburden	1.3m
Mineral	7.1m
Waste	0.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, brown	0.1	0.1
Glacial sand and gravel	'Very clayey' pebbly sand Gravel: fine and coarse, subrounded, chiefly sandstone, soft and weathered Sand: fine with medium and coarse, subangular to subrounded, quartz and lithic fragments Fines: silt and clay, disseminated, reddish brown	0.9	1.0
Flow till	Diamicton: silty sandy stony clay, soft, with clasts mainly of fine gravel grade, chiefly sandstone, moderate reddish brown	0.3	1.3
Glacial sand and gravel	Gravel Gravel: fine and coarse with rare cobbles, angular to subrounded, sandstones (white, yellow, dark greenish grey) and basalt with siltstone, coal and rare dolerite and vein-quartz Sand: fine, medium and coarse, angular to subrounded, quartz with lithic fragments Fines: silt and clay, mainly disseminated but also as seams, brown then dusky yellowish brown (10 YR 3/2), finally moderate brown (5 YR 4/4)	7.1	8.4
Till	Diamicton: sandy clay with scattered fine gravel grade clasts, moderate brown (5 YR 4/4)	0.1	8.5
Glacial erratic	Limestone, coarse grained, very hard, fossiliferous (corals and crinoid ossicles), dark grey (N 3)	0.3+	8.8
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
8	43	49	1.3- 2.3	19	28	16	11	15	11	0	
			2.3- 3.3	10	11	10	13	22	28	6	
			3.3- 4.3	9	6	15	25	29	16	0	
			4.3- 5.3	6	7	9	12	28	34	4	§
			5.3- 6.3	3	8	15	12	28	34	0	§
			6.3- 7.3	3	10	17	14	26	27	3	§
			7.3- 8.4	5	22	25	16	19	13	0	§
			Mean	8	13	15	15	24	23	2	

NT 56 NW 4 **5148 6529** **Kidlaw Burn, Yester** **Block C**

Surface level +201.9m (+662.4ft)
Water not struck
250 and 200mm percussion
June 1985

Waste 11.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam with pebbles, brown	0.4	0.4
Glacial sand and gravel	'Clayey' sandy gravel Gravel: fine and coarse, subrounded, sandstone with siltstone, limestone, greywacke and dolerite Sand: medium and coarse with fine, subangular, quartz and lithic fragments Fines: disseminated silt, brown	0.5	0.9
Till	Diamicton: stony clay, sandy to 1.5m, then firm to very stiff, with subrounded clasts of sandstone, siltstone and coal with limestone and dolerite, moderate reddish brown (10 R 4/6) at top, then greyish brown (5 YR 3/2), but locally dusky blue (5 PB 3/2) at 2.5m	3.5	4.4
	Diamicton: sandy clay, stiff, with some subangular to subrounded clasts of sandstone, siltstone and coal, with dolerite and greywacke; thin silty sand lenses occur between 4.5 and 4.8m and between 6.5 and 7.1m; moderate reddish brown (10 R 4/6)	3.4	7.8
	Diamicton: stony clay, stiff to very stiff, with many clasts of sandstone, siltstone, mudstone and coal with some quartz, dolerite and greywacke, medium dark grey (N4)	3.2+	11.0
	Borehole terminated owing to slow progress		

NT 56 NW 5 **5266 6626** **Redshill, Gifford** **Block C**

Surface level c +163m (c +535ft)
Groundwater levels c +160m and c +155m
250 and 200mm percussion
June 1985

Overburden	0.2m
Mineral till	1.5m
Mineral	5.9m
Waste	10.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till	a Diamicton grading as 'clayey' gravel Gravel: cobble, coarse and fine, angular to rounded, mainly sandstone and dolerite Sand: fine, medium and coarse, angular to rounded, quartz and lithic fragments Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	1.5	1.7
Glacial sand and gravel	a 'Clayey' sand Gravel: rare, fine and coarse, angular to subrounded, mainly buff and cream sandstones with greywacke, red sandstone and some vein-quartz and igneous rocks Sand: medium with fine and trace of coarse, angular to subrounded, mainly quartz with lithic and coal fragments Fines: silt with clay as seams, also disseminated, light brown (5 YR 5/6)	3.6	5.3
Glaciolacustrine deposits	b 'Very clayey' sand Sand: fine with medium, angular to subrounded, quartz with coal fragments Fines: silt, disseminated and as seams, moderate brown (5 YR 4/4)	2.3	7.6
	Silt, sandy with clay laminae present from 10.0m, brownish grey (5 YR 4/4) then (5 YR 4/3)	4.6	12.2
Till	Diamicton: sandy stony clay, firm to stiff, matrix supported, with numerous clasts up to cobble grade, of sandstone, coal, quartzite, basaltic and rare andesitic igneous rocks, dusky reddish brown (10 R 3/2)	2.3	14.5
Glacial sand and gravel	Sandy gravel Gravel: fine and coarse with cobbles, subangular to rounded, mainly red sandstone, vein-quartz and basaltic igneous rocks with mudstone Sand: coarse and medium with fine, subangular to rounded, quartz and lithic fragments Fines: silt, dark reddish brown (10 R 3/5)	1.0	15.5
Till	Diamicton: sandy stony silty clay, stiff, with clasts of red and buff sandstones, vein-quartz and coal, dusky yellowish brown (10 YR 3/2). Seam of gravelly sand, 0.2m thick at base	1.2	16.7
	Diamicton: sandy stony clay, firm to stiff, with clasts of buff and carbonaceous sandstones and basaltic igneous rock with coal and mudstone, moderate brown (5 YR 3/4) to 17.2m, then dusky yellowish brown (10 YR 2/2)	1.7+	18.4
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	14	37	49	0.2- 0.9	No grading data available							
				0.9- 1.7	14	14	13	10	16	17	16	
				Mean	14	14	13	10	16	17	16	
b	10	87	3	1.7- 2.7	17	20	52	3	4	4	0	
				2.7- 4.0	8	24	66	1	1	0	0	§
				4.0- 5.3	8	25	66	0	1	0	0	§
				Mean	10	23	63	1	2	1	0	
c	26	74	0	5.3- 6.5	15	71	14	0	0	0	0	§
				6.5- 7.6	37	61	2	0	0	0	0	§
				Mean	26	66	8	0	0	0	0	
b&c	16	82	2	Mean	16	40	41	1	1	1	0	
a-c	16	73	11	Mean	16	35	35	3	4	4	3	

NT 56 NW 6 **5282 6536** **Dumbadam Burn, Yester** **Block C**

Surface level +196m (+643ft)
Water struck at +193m
250mm percussion
June 1985

Overburden 0.5m
Mineral 1.8m
Waste 7.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, slightly sandy loam	0.5	0.5
Glacial sand and gravel	'Clayey' gravel, very silty at top Gravel: fine and coarse with many cobbles, angular to subangular, orange, red, buff and carbonaceous sandstones (some friable) and basalt with coal, vein-quartz and rare red mudstone and quartzite Sand: fine to coarse, subangular to subrounded, quartz and sandstone fragments with some coal Fines: silt and clay, disseminated and rarely as seams, light reddish brown	1.8	2.3
Flow till	Diamicton: very sandy stony clay, soft to firm, stiffer with depth, with clasts generally coarsening in grade with depth, chiefly sandstones (some red and friable) with conglomerate, coal and mudstone, moderate brown (5 YR 4/4)	3.5	5.8
Till	Diamicton: sandy stony clay, stiff to very stiff, with many clasts up to boulder grade, mainly of sandstones with dolerite, basalt, and coal in finer fractions, dark yellowish brown (10 YR 4/2), mottled dusky yellowish brown (10 YR 2/2) with depth	4.1+	9.9
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
11	41	48	0.5- 1.2	11	14	14	12	20	21	8
			1.2- 2.3	11	13	16	14	25	21	0
			Mean	11	13	15	13	24	21	3

NT 56 NW 7 **5336 6578** **Scarhill Wood, Redshill, Gifford** **Block C**

Surface level +183.9m (+603.4ft)
Groundwater level +173.9m
250 and 200mm percussion
October 1985

Overburden	0.4m
Mineral	4.1m
Waste	3.5m
Mineral	2.3m
Waste	4.5m
Bedrock	0.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: clayey gravelly loam	0.4	0.4
Glacial sand and gravel	a 'Clayey' gravel, commonly claybound Gravel: coarse and fine with rare cobbles, subangular with subrounded, greywacke with sandstone, limestone, vein-quartz and igneous rocks Sand: coarse and medium with fine, subangular, quartz, lithic fragments and coal Fines: silt and clay, disseminated, moderate brown (5 YR 4/4) at top, moderate reddish brown (10 R 4/6) at base	4.1	4.5
	Silt, sandy, with sandy and coal-rich laminae, moderately soft, moderate reddish brown (10 R 4/6)	1.3	5.8
Till	Diamicton: very sandy stony clay, firm, clasts up to cobble grade, composed of red and buff sandstones, greywacke and basalt with vein-quartz, moderate yellowish brown (10 YR 5/4)	1.2	7.0
	Diamicton: silty stony clay, cohesive, rare clayey sandy silt seams, clasts mainly of red sandstone with greywacke, dark reddish brown (10 R 3/4)	0.8	7.8
Glaciolacustrine deposits	Clay, silty, poorly laminated, sandier at base, moderate reddish brown	0.2	8.0
	b 'Very clayey' sand Sand: fine with rare medium, subangular to subrounded, mainly quartz with some greywacke and sandstone grains Fines: silt and clay, disseminated and as seams, moderate reddish brown (10 R 4/6)	2.3	10.3
	Clay, silty, laminated, moderate reddish brown (10 R 4/6)	1.0	11.3
Till	Diamicton: silty stony clay, firm to stiff, bedding recognisable to 11.7m, with clasts mainly of sandstones with basalt, moderate reddish brown (10 R 4/6)	1.2	12.5
	Diamicton: sandy stony clay, soft to firm, poorly banded, clasts up to coarse gravel grade, dark reddish brown (10 R 3/4)	1.0	13.5
	Diamicton: silty sandy stony clay, firm to stiff, becomes sandier and stonier below 14.2m, clasts mainly of sandstone, mottled dark reddish brown (10 R 3/4) and very dusky red (10 R 2/2)	1.3	14.8
Upper Old Red Sandstone	Sandstone, very fine grained, silicified, light brownish grey (5 YR 5/1) to greyish red (5 R 4/2)	0.5+	15.3

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	12	42	46	0.4- 1.4	11	12	17	14	22	24	0
				1.4- 2.4	10	9	19	17	24	21	0
				2.4- 3.4	13	10	17	14	19	23	4
				3.4- 4.5	12	11	9	19	23	26	0
				Mean	12	11	15	16	22	23	1
b	26	74	0	8.0- 9.3	26	71	3	0	0	0	0
				9.3-10.3	25	74	1	0	0	0	0
				Mean	26	72	2	0	0	0	0
a&b	17	53	30	Mean	17	32	11	10	14	15	1

NT 56 NW 8 **5359 6559** **South Port, Yester Mains, Gifford** **Block C**

Surface level +197.7m (+648.6ft)
Water struck (perched) at +190.0m
250 and 200mm percussion
June 1985

Waste 16.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Flow till	Diamicton: pebbly sandy clay, firm then soft, some lamination, clasts mainly of sandstone with coal and some vein-quartz, dark yellowish brown (10 YR 4/2) then moderate brown (5 YR 5/6)	1.9	2.2
Till	Diamicton: sandy stony clay, firm becoming stiff, with clasts up to cobble grade, of sandstone, greywacke and basaltic igneous rocks, mainly dark yellowish brown (10 YR 4/2)	5.5	7.7
Glaciolacustrine deposits	Sand, very silty with some pebbles, up to cobble grade commonly of coal with sandstone and basalt, coal-rich laminae, moderate yellowish brown (10 YR 5/4) with brownish black (5 YR 2/1) laminae	0.6	8.3
Till	Diamicton: silty stony clay, firm to stiff, with clasts up to cobble grade, matrix supported, colour variable, moderate brown (5 YR 4/4 then 5 YR 3/4), then light brown (5 YR 5/6) to 13.0m, then moderate reddish brown (10 R 4/6) to 16.5m and finally dark yellowish brown (10 YR 4/3)	8.5+	16.8
	Borehole terminated owing to slow progress		

NT 56 NW 9 5408 6632 **Saugh Wood, Yester Mains, Gifford** **Block C**

Surface level +170.1m (+558.1ft)
Water not struck
250 and 200mm percussion
June 1985

Overburden 3.5m
Mineral 6.1m
Waste 10.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Flow till or head	Diamicton: silty pebbly clay, soft, structureless, with clasts up to cobble grade, mainly of sandstone and vein-quartz, moderate brown (5 YR 3/5 then 4/4) and moderate yellowish brown (10 YR 5/4 at base)	2.5	3.5
Glacial sand and gravel	'Clayey' gravel, claybound at top Gravel: coarse and fine with cobbles, subangular to subrounded, red and buff sandstones, basaltic and doleritic igneous rocks with vein-quartz, coal and greywacke Sand: coarse, medium and fine, subangular to subrounded, quartz with coal and lithic fragments Fines: silt, disseminated, moderate yellowish brown (10 YR 5/4) then light brown (5 YR 5/6) and moderate brown (5 YR 4/4) towards base	6.1	9.6
Till	Diamicton: silty stony clay, firm, matrix supported, with clasts of sandstone, basalt, greywacke and coal, dusky brown (5 YR 2/2) but dusky blue (5 PB 3/2) at top	3.4	13.0
Flow till	Diamicton: silty clay with some clasts, soft, poorly laminated, dusky yellowish brown (10 YR 2/2)	0.5	13.5
Till	Diamicton: silty stony clay with seam of clayey pebbly sand from 16.9 to 17.1m, stiff, with clasts up to cobble grade of greywacke, sandstone, vein-quartz, basalt, andesite and coal, dark yellowish brown (10 YR 4/2) to 17.6m, then moderate reddish brown (10 R 4/6). From 19.8m clasts are mainly of basalt with some sandstone and vein-quartz	6.7+	20.2
	Borehole terminated owing to slow progress in till		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
10	35	55	3.5- 4.5	17	22	22	10	13	16	0
			4.5- 5.7	9	10	10	10	23	36	2
			5.7- 6.9	7	6	4	12	24	44	3
			6.9- 8.3	8	8	6	10	20	43	5
			8.3- 9.3	12	10	17	23	17	21	0
			9.3- 9.6	No grading data available						
			Mean	10	11	11	13	20	33	2

NT 56 NW 10 **5462 6601** **Little Todlaw Wood, Long Yester** **Block C**

Surface level +181.5m (+595.5ft)
Water struck at +175.7m
250mm percussion
October 1985

Overburden	0.3m
Mineral	3.7m
Waste	7.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: clayey loam	0.3	0.3
Glacial sand and gravel	'Clayey' sandy gravel; more gravelly at top and bottom Gravel: coarse and fine with cobbles, subangular to subrounded, red and yellow sandstones and greywacke with vein-quartz, siltstone, limestone and igneous rocks Sand: medium and fine with coarse, subangular, quartz and lithic fragments with coal Fines: silt and clay, disseminated, deposit locally claybound, moderate brown (5 YR 4/4)	3.7	4.0
Till	Diamicton: stony silty clay, firm to stiff, with clasts up to cobble grade, of red and yellow sandstones, siltstone, greywacke and basalt with some coal, dusky brown (5 YR 2/2). Seam of 'very clayey' sand from 6.2 to 6.5m	7.8+	11.8
	Borehole terminated for technical reasons		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
13	51	36	0.3- 1.4	18	14	9	8	14	22	15
			1.4- 2.4	13	27	43	7	6	4	0
			2.4- 3.0	12	25	27	8	12	16	0
			3.0- 4.0	7	7	18	16	19	30	3
			Mean	13	17	24	10	13	18	5

NT 56 NW 11 **5452 6536** **Long Yester, Gifford** **Block C**

Surface level +210.00m (+689.0ft)
Water struck (perched) at +200.5m
250 and 200mm percussion
June 1985

Overburden	6.5m
Mineral	4.1m
Waste	5.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till	Diamicton: stony clay, moderately firm, with clasts up to cobble grade, mainly of greywacke with buff and red sandstones and vein-quartz, mottled moderate brown (5 YR 4/4) and dark yellowish brown (10 YR 6/6), then moderate brown (5 YR 3/5), then greyish brown (5 YR 3/2) and moderate brown (5 YR 4/5) at base	6.3	6.5
Glaciolacustrine deposits	'Very clayey' sand Gravel: trace of fine Sand: fine with medium and trace of coarse, angular to subrounded, quartz with rare lithic fragments and coal Fines: silt, disseminated and as seams containing clay laminae below 7.7m, light brown (5 YR 5/5) then moderate brown (5 YR 4/5)	4.1	10.6
Till	Diamicton: gritty silty stony clay, firm, with clasts up to cobble grade, mainly of cream sandstone, mudstone, fine grained basic igneous rock and coal, dusky yellowish brown (10 YR 3/2) but brownish grey (5 YR 3/1) at base	5.4+	16.0
	Borehole terminated owing to slow progress in till		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
29	71	0	6.5- 7.7	31	58	10	0	1	0	0	
			7.7- 9.0	25	53	21	1	0	0	0	
			9.0-10.3	31	54	15	0	0	0	0	§
			10.3-10.6	No grading data available							
			Mean	29	56	15	**	**	0	0	

NT 56 NW 12 **5186 6950** **Eaglescarnie, Bolton** **Block A**

Surface level +85m (+279ft)
Water struck at +83m
Pit
October 1984

Overburden 0.3m
Mineral 1.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, forest, dusky brown (5 YR 2/2)	0.3	0.3
Alluvium	Sand Sand: fine with rare medium and coarse, soft, mainly quartz with coal fragments Fines: silt, disseminated, dark yellowish brown (10 YR 4/2)	1.8+	2.1

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
8	92	0	0.3- 2.1	8	90	1	1	0	0	0

NT 56 NW 13 **5160 6621** **Dean Wood, Woodhead, Gifford** **Block C**

Surface level +172.8m (+566.9ft)
Water not struck
Pit
October 1984

Waste 2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, greyish brown (5 YR 3/2)	0.3	0.3
Glacial sand and gravel	Silt, sandy, bedded, mottled moderate yellowish brown (10 YR 5/4)	0.3	0.6
Till	Diamicton: sandy stony clay, firm, with clasts of sandstone and greywacke with fine grained igneous rock and vein-quartz, moderate reddish brown (10 R 4/6)	1.6+	2.2

NT 56 NW 14 **5320 6844** **Gifford Vale, Gifford** **Block A**

Surface level +98.5m (+323.2ft)
Water struck at +96.1m
Pit
October 1984

Overburden 0.3m
Mineral 1.3m
Waste 1.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, moderate brown (5 YR 3/4)	0.3	0.3
Alluvium	'Clayey' sandy gravel, coarser grade below 1.0m Gravel: coarse with cobble and fine, subangular to rounded, mainly white and red sandstones with basic igneous rocks and greywacke Sand: fine, medium and coarse, angular to rounded, mainly quartz with feldspar and some coal Fines: silt, disseminated, moderate reddish orange (10 R 5/6)	1.3	1.6
	Silt and clay, laminated, soft, olive grey (5 Y 4/1)	1.4+	4.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
15	44	41	0.3- 1.6	15	18	15	11	15	26	0

NT 56 NE 2 **5529 6679** **Castle Wood, Castle Mains, Gifford** **Block C**

Surface level +167.19m (+548.5ft)
Slight water seepage
250 and 200mm percussion
August 1985

Waste 18.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, brown	0.3	0.3
Flow till	Diamicton: sandy silty clay with some stones, frequent silty sand lenses below 3.1m, moderately soft at top, firm by 2.0m, subangular clasts of sandstone, greywacke and coal, moderate reddish brown (10 R 4/6) at top, then gradual change to dark reddish brown (10 R 3/4)	4.3	4.6
Glaciolacustrine deposits	Clay, silty, with seams of silty sand, rare sandstone pebbles below 7.6m, firm, dark reddish brown (10 R 3/4) to 6.5m then dusky yellowish brown (10 YR 2/2)	5.5	10.1
	Silt, sandy, soft, silty sand seams common, moderate reddish brown (10 R 4/6)	0.6	10.7
	Clay, silty, firm, rare sandy laminae and rare pebbles of sandstone and coal, dark reddish brown (10 R 3/4)	3.7	14.4
Till	Diamicton: sandy silty stony clay, firm to stiff, clasts rarely up to cobble grade, comprise greywacke, sandstone, siltstone, limestone and some coal, moderate reddish brown (10 R 4/6)	4.1+	18.5
	Borehole terminated owing to excessive overburden		

NT 56 NE 3 **5570 6626** **Castle Mains, Gifford** **Block C**

Surface level +178.05m (+584.2ft)
Groundwater level +169.5m
250 and 200mm percussion
June 1985

Overburden	0.5m
Mineral	4.2m
Waste	12.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty sandy loam with pebbles	0.3	0.3
Flow till	Diamicton: pebbly silty clay, moderately firm, moderate reddish brown (10 R 4/4)	0.2	0.5
Glacial sand and gravel	Gravel Gravel: fine and coarse with rare cobbles near base, subangular to rounded, red with cream sandstones, greywacke, vein-quartz and coal Sand: coarse, medium and fine, angular to rounded, quartz with lithic fragments and coal Fines: silt, disseminated, deposit locally 'dirty', moderate reddish brown (10 R 4/5) at top then moderate yellowish brown (10 YR 5/4)	4.2	4.7
Flow till	Diamicton: stony silty sandy clay, firm, with clasts up to cobble grade, sandy silt laminae in top 10cm, otherwise structureless, mainly dark yellowish brown (10 YR 4/2)	0.6	5.3
Glaciolacustrine deposits	Clay, silty with some sand and rare pebbles, dusky yellowish brown (10 YR 3/2)	1.2	6.5
	Sand: medium with fine and coarse, angular to subrounded, vein-quartz and lithic fragments; also rare pebbles of fine gravel; dusky yellowish brown (10 YR 2/2)	0.6	7.1
	Silt, clayey, laminated, with seams of fine sand with rare pebbles to 8.0m, seams of very fine sand from 9.0 to 10.0m, locally colour laminated in upper part, greyish yellowish brown (10 YR 5/2) with moderate reddish brown (10 R 4/5)	4.7	11.8
Till	Diamicton: stony sandy clay, firm, slightly plastic, clasts mainly of light brown sandstone and greywacke, with some fine grained igneous rock, basalt and coal; by 15.0m greywacke is dominant; locally bedded, indicated by colour banding; mainly greyish brown (5 YR 4/2), but also dusky brown (5 YR 2/2) and reddish brown	4.2	16.0
	Diamicton: sandy stony silt, stiff (non-plastic), clasts mainly of red, micaceous, fine grained sandstone with some greywacke, moderate reddish brown (10 R 4/6)	1.5+	17.5
	Borehole terminated owing to slow progress in till		

Grading

Mean for Deposit percentages			Depth below surface (m)								
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
6	40	54	0.5- 1.8	6	14	18	12	34	16	0	
			1.8- 2.8	5	6	11	23	24	31	0	
			2.8- 4.1	8	11	12	13	30	26	0	§
			4.1- 4.7	No grading data available							
			Mean	6	11	14	15	30	24	0	

NT 56 NE 4 **5599 6518** **Quarryford, Gifford** **Block C**

Surface level +205.38m (+673.8ft)
Water struck at +191.0m
250 and 200mm percussion
October 1985

Overburden 0.3m
Mineral 15.2m
Waste 6.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam	0.3	0.3
Glacial sand and gravel	a Pebbly sand Gravel: fine and coarse, subangular to subrounded, sandstone, greywacke, vein-quartz and igneous rocks Sand: medium with fine and coarse, subangular, quartz and lithic fragments Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	3.9	4.2
	b Pebbly sand Gravel: coarse and fine, subrounded, sandstone and greywacke Sand: fine and medium with rare coarse, subangular, lithic fragments, coal and quartz Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	3.0	7.2
Glaciolacustrine deposits	c 'Very clayey' sand Gravel: fine with trace of coarse, subrounded, sandstone and greywacke Sand: fine with medium and rare coarse, subangular, quartz, lithic fragments and coal Fines: disseminated silt and seams of sandy clayey silt, moderate brown (5 YR 4/4)	8.3	15.5
	Silt, sandy, with many seams of fine and medium sand, soft, moderate brown (5 YR 4/4)	3.8	19.3
	Clay, silty, sandy laminae, rare pebbles of fine gravel, firm, unbedded, moderate brown (5 YR 4/4)	0.7	20.0

NT 56 NE 4 Cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Till	Diamicton: silty stony clay, locally sandy, stiff, with scattered clasts of sandstone, greywacke, limestone and some basalt, dark yellowish brown (10 YR 4/2) to 20.9m, then dark reddish brown (10 R 3/4) with clast composition dominantly of red sandstone	2.0+	22.0
	Borehole terminated for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	6	71	23	0.3- 1.2	7	4	16	29	30	14	0
				1.2- 2.2	5	8	48	18	12	9	0
				2.2- 3.2	8	33	54	3	1	1	0
				3.2- 4.2	4	19	42	10	14	11	0
				Mean	6	16	40	15	14	9	0
b	6	87	7	4.2- 5.2	6	62	30	1	1	0	0
				5.2- 6.2	6	63	30	1	0	0	0
				6.2- 7.2	7	26	42	5	8	12	0
				Mean	6	51	34	2	3	4	0
c	23	76	1	7.2- 8.2	11	50	34	3	1	1	0
				8.2- 9.2	18	75	7	0	0	0	0
				9.2-10.2	27	66	7	0	0	0	0
				10.2-11.2	22	70	8	0	0	0	0
				11.2-12.2	28	67	4	0	1	0	0
				12.2-13.2	34	63	3	0	0	0	0
				13.2-14.2	2	46	49	2	1	0	0
				14.2-15.5	39	41	18	1	1	0	0
				Mean	23	59	16	1	1	**	0
a&b	6	78	16	Mean	6	31	38	9	9	7	0
a-c	15	78	7	Mean	15	47	26	5	4	3	0

NT 56 NE 5 **5622 6960** **Bara, Gifford** **Block H_3**

Surface level +180m (+590ft)
Groundwater level (perched?) +176.4m
250mm percussion
June 1985

Waste 6.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: dark brown loam	0.4	0.4
Till	Diamicton: sandy silty stony clay, very stiff but plastic, clasts up to cobble size, angular to subrounded, comprise mainly yellow, brown, white, red and dark grey sandstones with indurated laminated siltstone and rare vein-quartz, mainly moderate brown (5 YR 4/4) but mottled yellowish brown and pale grey	1.2	1.6
	Sand and gravel: very silty, passing down into diamicton, cohesive, matrix is a clayey sand (medium with fine and some coarse), also scattered fine and coarse gravel, moderate brown (5 YR 4/4)	0.2	1.8
	Diamicton: very sandy stony clay with some thin seams of sand and gravel as above, firm, plastic, fissile and stiffer by 2.1m, clasts up to boulder size, chiefly sandstones with rare very hard black basalt and coal, moderate reddish brown (10 R 4/6)	2.5	4.3
	Diamicton: sandy stony clay, soft and very sandy to 4.8m, then stiff to very stiff, very gravelly by 5.2m, clasts up to boulder size, composed of yellow sandstone with andesitic vesicular lava and tuff, porphyry, some felsite and rare coal, dusky yellowish brown (10 YR 3/2 then 2/2)	1.9+	6.2
	Borehole terminated owing to slow progress in till		

NT 56 NE 6 **5769 6935** **Carfrae, by Garvald** **Block D**

Surface level +191.00m (+626.6ft)
Groundwater level +183.4m
250 and 200mm percussion
June 1985

Overburden	2.5m
Mineral	2.4m
Waste	0.4m
Mineral	2.0m
Waste	6.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly loam, light reddish brown	0.3	0.3
Flow till	Clay, extremely sandy and silty with seams of clayey sand, moderate reddish brown (10 R 4/6)	0.4	0.7
	Diamicton: sandy stony clay, crudely bedded, angular to well rounded clasts of greywacke, siltstone and yellow sandstone with rare vein-quartz, colour as above	0.2	0.9
	'Very clayey' sandy gravel, compact but not cohesive Gravel: fine and coarse, subangular to well rounded, greywacke siltstone and yellow sandstone with rare vein-quartz Sand: fine and medium with coarse, angular to subrounded, quartz and lithic fragments Fines: much silt, disseminated, moderate reddish brown (10 R 4/6)	0.6	1.5
	Diamicton: composition as above with seams of silty clayey fine sand, fine sandy clay and fine sand, crudely interbedded	1.0	2.5
Glacial sand and gravel	a Gravel, diamict (claybound) below 3.9m Gravel: coarse and fine with cobbles, angular to well-rounded, mainly red, yellow, white and grey sandstones, red and yellow mudstones, greywacke siltstone and basalt with some felsite and vein-quartz Sand: medium with coarse and fine, angular to subrounded, quartz and lithic fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	2.4	4.9
Flow till	Fine sand and laminated silty sand with scattered pebbles of fine gravel, moderate yellowish brown (10 YR 5/4)	0.2	5.1
	Diamicton: claybound gravel and sand	0.2	5.3
Glacial sand and gravel	Sandy gravel Gravel: fine with coarse, subangular to subrounded, composition as gravel above Sand: coarse and medium with fine, angular to subangular, chiefly lithic fragments Fines: some silt and clay, deposit slightly bound, greyish red (10 R 4/2)	2.0	7.0
Till	Diamicton: sandy stony clay, soft at top but mainly stiff, with angular to well rounded clasts composed mainly of sandstones (commonly pale grey and fine grained) with some basalt, moderate yellowish brown (10 YR 5/4), becoming dusky yellowish brown (10 YR 3/2) by 8.5m and moderate brown (5 R 3/4) by 10.8m	6.4+	13.7
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	7	45	48	2.5- 3.9	10	10	35	12	12	21	0
				3.9- 4.9	3	9	9	10	23	27	19
				Mean	7	10	24	11	17	23	8
b	9	58	33	5.3- 6.3	8	8	16	27	34	7	0
				6.3- 7.3	9	9	26	31	18	7	0
				Mean	9	9	21	28	26	7	0
a&b	8	51	41	Mean	8	9	23	19	21	16	4

NT 56 NE 7 **5730 6862** **Carfrae, by Garvald** **Block D**

Surface level +217m (+712ft) Waste 10.1m+
Groundwater level (perched?) +211m
250mm percussion
June 1985

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, stony, reddish brown	0.3	0.3
Glacial sand and gravel	Very clayey pebbly sand, compact, gritty, with angular to subangular coarse sand and fine gravel with scattered larger clasts, moderate brown (5 YR 3/4)	0.4	0.7
Till	Diamicton: sandy stony clay, generally stiff to very stiff, but softer and sandier to 2.0m and also between 5.8 and 6.2m and below 8.3m, where distorted laminae of silt, fine sand and clay are present; clasts up to boulder size, composed of white, red, brown and yellow sandstones, mudstone, black shale, basalt, tuff, diorite, porphyry, coal and rare vein-quartz; moderate reddish brown (10 R 4/6) at top, thereafter varies between moderate yellowish brown (10 YR 5/4), dusky yellowish brown (10 YR 3/2 and 2/2) and dark yellowish brown (10 YR 4/2 and 4/4)	8.2	8.9
	Very silty, clayey, fine sand, dark yellowish brown (10 YR 4/2)	0.3	9.2
	Silty clay with scattered coarse sand, pebbles of fine gravel and coaly streaks, locally clayey silt, stiff, moderate brown (5 YR 4/4)	0.3	9.5
	Diamicton: composition as above, stiff, quite sandy and gravelly, with boulder of dark greenish grey tuff at base	0.6+	10.1
	Borehole abandoned for technical reasons		

NT 56 NE 8 **5763 6529** **Park Burn, Newlands, Gifford** **Block D**

Surface level +298m (+978ft)
Water not struck
250mm percussion
September 1985

Overburden	0.2m
Mineral	2.4m
Waste	4.3m
Bedrock	0.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: stony sandy loam, moderate brown (5 YR 3/4)	0.2	0.2
Glacial sand and gravel	'Clayey' gravel, claybound locally Gravel: coarse and fine with cobble, angular to rounded, mainly greywacke (including siltstone) with some purple sandstone Sand: coarse with medium and fine, angular to rounded, lithic fragments and quartz Fines: disseminated silt and clay, colour mottled, mainly moderate brown (5 YR 4/4)	2.4	2.6
Till	Diamicton: stony sandy clay, moderately firm, clast supported, fragments entirely of greywacke (mainly siltstone), pale yellowish brown (10 YR 6/2) to dark yellowish brown (10 YR 6/6)	4.3	6.9
Silurian (Gala Group)	Greywacke: mudstone and siltstone with fine grained sandstone laminae, thinly bedded, well jointed, mainly olive grey (5 Y 4/1)	0.6+	7.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
10	25	65	0.2- 1.2	7	4	4	12	21	37	15
			1.2- 2.1	13	6	8	17	27	29	0
			2.1- 2.6	12	6	6	12	22	32	10
			Mean	10	5	6	14	23	34	8

NT 56 NE 9 **5894 6758** **Snawdon, by Gifford** **Block D**

Surface level +258m (+846ft)
Groundwater level +247m
250mm percussion
June 1985

Overburden 0.3m
Mineral 10.7m
Waste 2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam	0.3	0.3
Glacial sand and gravel	Gravel, locally 'clayey' and with rare sand seams Gravel: fine and coarse with cobbles (more common below 2.3m), subangular to rounded, chiefly greywacke with some cream sandstone, pale reddish brown acidic tuff and rare coal Sand: coarse with medium and fine, angular to rounded, lithic fragments and quartz Fines: silt and clay, disseminated, deposit 'dirty' throughout and claybound below 4.0m, pale yellowish brown (10 YR 5/2)	10.7	11.0
Till	Diamicton: very stony sandy clay, firm, clasts predominantly of greywacke siltstone with some sandstone and igneous rocks, greyish orange (10 YR 6/4) to 12.5m, mixture of greyish orange (10 YR 6/4) and moderate reddish orange (10 R 5/6) to 13.1m, then moderate reddish brown (10 R 3/6)	2.2+	13.2
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	31	60	0.3- 1.3	15	9	10	17	29	20	0
			1.3- 2.3	8	6	13	23	28	22	0
			2.3- 4.0	6	4	9	21	31	18	11
			4.0- 5.2	23	4	6	15	30	22	0
			5.2- 6.2	6	4	5	10	23	37	15
			6.2- 7.2	9	5	7	20	33	26	0
			7.2- 8.2	6	6	6	11	31	40	0
			8.2-10.0	6	5	8	19	32	30	0
			10.0-11.0	6	3	7	22	32	23	7
			Mean	9	5	8	18	30	26	4

NT 56 NE 10 **5576 6894** **Bara Wood, Gifford** **Block D**

Surface level +179m (+587ft)
Water not struck
Pit
October 1984

Waste 2.2m
Bedrock 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, rare pebbles, moderate yellowish brown (5 YR 5/3)	0.3	0.3
Till	Diamicton: sandy stony clay, soft to moderately firm, clasts up to cobble grade, mainly of locally derived basic igneous rocks in a sandy silty matrix, moderate brown (5 YR 4/4)	1.9	2.2
Carboniferous	Basaltic tuff, fine to medium grained, yellow and black	0.3+	2.5

NT 56 NE 11 **5596 6818** **Walden Roundall, Gifford** **Block D**

Surface level +213m (+699ft)
Water struck (perched) at +210m
Pit
October 1984

Overburden 0.2m
Mineral 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly sandy loam, moderate brown (5 YR 3/4)	0.2	0.2
Glacial sand and gravel	Gravel, poorly graded Gravel: coarse and cobble with fine, angular to subrounded, mainly white sandstone, some red sandstone, greywacke, basic lava and dolerite Sand: fine with medium and coarse, angular to subrounded, mainly quartz with lithic fragments Fines: disseminated silt with clay, strong yellowish orange (10 YR 4/6)	3.0+	3.2

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
9	40	51	0.2- 3.2	9	27	8	5	9	25	17

NT 56 NE 13 **5531 6505** **Long Yester, Gifford** **Block C**

Surface level +207m (+679ft)
Water not struck
Pit
October 1984

Overburden	0.4m
Mineral	2.3m
Waste	0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly sandy loam, moderate brown (5 YR 3/3)	0.4	0.4
Glacial sand and gravel	Gravel, sandy to 1.3m Gravel: cobble, coarse and fine, subangular to rounded, mainly red and white sandstones with greywacke and some felsite Sand: coarse and medium with fine, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, light brown (5 YR 5/6) then moderate brown (5 YR 3/4)	2.3	2.7
Till	Diamicton: stony silty clay, firm to stiff, moderate reddish brown (10 R 4/5)	0.3+	3.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
4	32	64	0.4- 2.7	4	5	13	14	16	22	26

NT 56 NE 14 **5893 6959** **Garvald Mains** **Block D**

Surface level +195m (+640ft)
Water not struck
Pit
October 1984

Overburden 0.2m
Mineral 2.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly, greyish reddish brown (10 YR 3/3)	0.2	0.2
Glacial sand and gravel	Gravel Gravel: coarse and fine with cobbles, subangular to rounded, mainly white and red sandstones with greywacke, some igneous rocks and quartzite Sand: coarse with medium and rare fine, angular to well rounded, mainly quartz with lithic fragments Fines: disseminated silt and clay, deposit quite 'dirty', dark reddish brown (10 R 3/4)	2.6+	2.8

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
3	38	59	0.2- 2.8	3	2	14	22	21	31	7

NT 56 NE 15 **5853 6637** **Darned House, by Gifford** **Block D**

Surface level +277m (+909ft)
Water not struck
Sampled by hand
June 1985

Overburden	0.1m
Mineral	5.4m
Waste	0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial sand and gravel	Gravel, imbricated and displaying large-scale foresets Gravel: coarse and fine with cobbles and boulders, mainly subangular to well rounded but fine gravel is angular to rounded, greywacke-sandstone and tabular to platy greywacke-siltstone, fine grained red sandstone, some friable red mudstone, cream and red siltstone, rare vein-quartz and pink porphyry Sand: coarse with medium and rare fine, angular to subrounded, quartz and lithic fragments (the latter mainly platy greywacke siltstone) Fines: silt and clay, as cuticles, moderate yellowish brown (10 YR 5/4)	5.4	5.5
Till	Diamicton: silty stony clay, stiff, with fine and coarse gravel grade clasts composed mainly of greywacke siltstone, moderate reddish brown	0.1+	5.6

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
1	20	79	0.1- 1.0	2	1	8	22	21	42	4
			1.0- 2.0	2	1	4	7	14	49	23
			2.0- 3.0	2	1	4	17	40	28	8
			3.0- 4.0	1	1	5	16	27	39	11
			4.0- 5.5	0	1	3	9	30	49	8
			Mean	1	1	5	14	27	41	11

NT 56 SW 1 **5059 6422** **Kidlaw, Yester** **Block C**

Surface level +222m (+728ft)
Water struck at +212m
250 and 200mm percussion
May 1985

Overburden	0.5m
Mineral	6.9m
Waste	4.2m
Bedrock	0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, brown	0.5	0.5
Glacial sand and gravel	a Gravel, claybound in places Gravel: coarse and fine with cobble, subangular to subrounded, sandstone and siltstone with vein-quartz, greywacke and dolerite Sand: coarse with medium and fine, subangular, lithic fragments and quartz Fines: disseminated silt and clay-rich seams, brown	6.0	6.5
Glaciolacustrine deposits	b 'Very clayey' pebbly sand Gravel: fine and coarse, sandstone, siltstone, some greywacke and dolerite Sand: fine with medium and some coarse, subangular, quartz and lithic fragments Fines: silt and clay, disseminated and as rare seams	0.9	7.4
	Silt, sandy, clayey, soft, moderate reddish brown (10 R 4/6)	0.5	7.9
Till	Diamicton: stony sandy silty clay, firm to stiff, clasts subangular to subrounded, mainly of sandstone with siltstone, limestone and dolerite, moderate reddish brown (10 R 4/6)	3.7	11.6
Upper Old Red Sandstone	Sandstone, fine to medium grained, rare bedding traces, medium grey (N5) to greyish red (5 R 4/2)	0.3+	11.9

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	9	37	54	0.5- 1.5	9	8	9	15	24	29	6	
				1.5- 2.5	13	10	8	12	23	32	2	
				2.5- 3.5	6	9	9	29	29	18	0	
				3.5- 4.5	7	6	7	14	18	24	24	
				4.5- 5.5	9	7	8	13	22	24	17	
				5.5- 6.5	10	7	21	33	18	11	0	§
				Mean	9	8	10	19	22	24	8	
b	24	71	5	6.5- 7.4	24	51	14	6	3	2	0	§
a&b	11	42	47	Mean	11	13	11	18	20	20	7	

NT 56 SW 2 **5259 6482** **West Latch, Yester** **Block C**

Surface level +215m (+705ft)
Water not struck
250mm percussion
June 1985

Overburden	4.8m
Mineral till	1.0m
Mineral	4.0m
Waste	2.5m
Bedrock	0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Flow till	Diamicton: silty sandy stony clay, firm to stiff, angular to subrounded, clasts composed mainly of sandstone, moderate brown (5 YR 4/4) mottled with pale greyish white and black streaks. At 13.2m, colour change to greyish brown (5 YR 3/2); coal particles and carbonaceous mudstone common	4.6	4.8
	a 'Clayey' gravel; diamicton, possibly waterlain Gravel: coarse, cobble and fine, subangular to subrounded, sandstone, siltstone, some coal and mudstone Sand: medium and coarse with fine Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	1.0	5.8
Glacial sand and gravel	b 'Clayey' gravel with diamicton from 6.5 to 6.7m Gravel: coarse and fine with cobble, mainly subrounded to rounded, sandstone with andesite, basalt and greywacke Sand: coarse, medium and fine, angular to subangular, quartz and lithic fragments Fines: silt and clay, disseminated, also concentrated in more 'clayey' horizons, moderate brown (5 YR 4/4)	3.2	9.0
Glaciolacustrine deposits	c 'Very clayey' pebbly sand Gravel: fine and coarse Sand: fine with medium and rare coarse, angular to subrounded, quartz with mica and coaly flecks Fines: silt with some clay, disseminated and as seams associated with very fine sand, moderate reddish brown (5 YR 4/4)	0.8	9.8
	Silt, laminated, grading to clayey silt with clay films, moderate reddish brown (10 R 4/6) then moderate brown (5 YR 4/4)	0.4	10.2
Till	Diamicton: stony silty clay, firm to 12.0m, then more sandy and less firm, clasts comprise sandstones with andesite, basalt and greywacke, mottled moderate reddish brown (10 R 4/4) and dark yellowish orange (10 R 6/6) to 12.0m, then moderate reddish brown (10 R 4/6)	2.1	12.3
Upper Old Red Sandstone	Sandstone, gritty, fine to coarse grained, with pebbles of yellowish grey (5 Y 7/2) mudstone. Sandstone is composed mainly of subangular to subrounded quartz and is mottled moderate red (5 YR 4/4) and pale red (10 R 6/2)	0.3+	12.6

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	13	31	56	4.8- 5.8	13	8	13	10	15	24	17
b	11	39	50	5.8- 7.0	11	10	12	17	16	24	10
				7.0- 8.0	12	9	16	16	21	20	6
				8.0- 9.0	10	11	13	13	23	20	10
				Mean	11	10	14	15	20	21	9
c	27	69	4	9.0- 9.8	27	52	16	1	2	2	0
a&b	11	37	52	Mean	11	10	13	14	19	22	11
a-c	14	42	44	Mean	14	16	14	12	16	19	9

NT 56 SW 3 **5265 6410** **Whinny Knowe, West Latch, Yester** **Block C**

Surface level +263m (+863ft)
Water struck at +242m
250 and 200mm percussion
June 1985

Overburden	0.4m
Mineral	14.0m
Waste	0.7m
Mineral	5.1m
Waste	1.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly, brown	0.4	0.4
Glacial sand and gravel	a Gravel, poorly bedded Gravel: coarse and fine with cobbles, subangular with subrounded, coarse and fine grained sandstone (commonly friable) with greywacke, dolerite and vein-quartz Sand: coarse with medium and fine, subangular, quartz and rock fragments, moderate reddish brown Fines: silt and clay, disseminated	11.0	11.4
	b 'Clayey' gravel Gravel: as above Sand: coarse and medium with fine, otherwise as above Fines: silt and clay, disseminated	3.0	14.4
Flow till	Diamicton: sandy, silty, stony clay, clasts mainly less than cobble grade, include sandstone, siltsone, greywacke and dolerite, moderate brown (5 YR 4/4)	0.7	15.1
Glacial sand and gravel	c 'Clayey' gravel with diamict seam from 18.5 to 18.6m Gravel: coarse and fine with cobble, subangular to subrounded, chiefly sandstone with dolerite and greywacke	5.1	20.1

LOG

Geological classification	Lithology	Thickness m	Depth m
	Sand: coarse, medium and fine, subangular, lithic fragments and quartz Fines: disseminated silt and clay, deposit claybound locally, brown		
Till	Diamicton: very sandy silty stony clay, moderately soft, subangulr to subrounded clasts composed mainly of sandstone with some dolerite and greywacke, moderate reddish brown (10 R 4/6)	1.8+	22.0
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	7	32	61	0.4- 1.4	10	7	14	23	26	20	0
				1.4- 2.4	10	5	12	23	21	19	10
				2.4- 3.4	6	4	9	21	20	30	10
				3.4- 4.4	5	4	9	24	24	34	0
				4.4- 5.4	6	6	10	23	33	22	0
				5.4- 6.4	9	6	9	16	28	27	5
				6.4- 7.4	8	4	5	11	21	30	21
				7.4- 8.4	6	5	7	13	21	32	16
				8.4- 9.4	5	4	6	11	18	40	16
				9.4-10.4	7	6	7	12	20	22	26
				10.4-11.4	9	6	8	17	24	25	11
				Mean	7	5	9	18	23	28	10
b	13	41	46	11.4-12.3	11	6	13	14	21	35	0
				12.3-13.4	15	8	14	16	17	20	10
				13.4-14.4	12	9	20	22	19	18	0
				Mean	13	8	16	17	19	23	4
c	10	34	56	15.1-16.1	9	8	9	12	17	31	14
				16.1-17.1	9	9	10	12	19	24	17
				17.1-18.1	9	9	16	18	23	15	10
				18.1-19.1	10	8	11	17	23	20	11
				19.1-20.2	11	8	11	17	23	30	0
				Mean	10	8	11	15	21	25	10
a&b	9	34	57	Mean	9	6	10	18	22	26	9
a-c	9	34	57	Mean	9	6	11	17	22	26	9

NT 56 SW 4 **5298 6387** **Latch, Yester** **Block C**

Surface level +266m (+873ft)
Water struck at +258m
250 and 200mm percussion
June 1985

Overburden 0.2m
Mineral 9.3m
Waste 8.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, brown	0.2	0.2
Glacial sand and gravel	a Gravel, poorly bedded Gravel: fine and coarse with rare cobbles, subrounded to subangular, sandstone with siltstone, mudstone, greywacke and dolerite Sand: coarse with medium and fine, subangular to subrounded, quartz and lithic fragments Fines: disseminated silt, brown	5.0	5.2
Glaciolacustrine deposits	b 'Clayey' sand Gravel: rare fine and coarse between 5.2 and 7.2m, subrounded, sandstone Sand: fine with medium and trace of coarse, subangular to subrounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate reddish brown (10 R 4/6)	4.3	9.5
	Silt, sandy, clayey with rare silty clay seams, moderate reddish brown (10 R 4/6)	2.8	12.3
Till	Diamicton: sandy silty stony clay, soft to firm, clasts up to cobble grade, comprise sandstone with dolerite, vein-quartz and greywacke, moderate reddish brown	5.4+	17.7
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	9	41	50	0.2- 1.2	7	5	9	17	33	29	0
				1.2- 2.2	10	6	13	19	29	19	4
				2.2- 3.2	10	6	16	20	27	21	0
				3.2- 4.2	9	5	17	19	27	20	3
				4.2- 5.2	8	20	14	21	23	14	0
				Mean	9	8	14	19	28	21	1
b	19	80	1	5.2- 6.2	18	71	6	1	1	3	0
				6.2- 7.2	13	44	42	1	0	0	0
				7.2- 8.2	18	51	29	2	0	0	0
				8.2- 9.5	25	72	3	0	0	0	0 §
				Mean	19	60	19	1	**	1	0
a&b	13	60	27	Mean	13	33	16	11	15	11	1

NT 56 SW 5 **5355 6469** **Pishwanton Wood, Long Yester** **Block C**

Surface level +217m (+712ft)
Water struck at +212m
250mm percussion
August 1985

Overburden	2.1m
Mineral	2.9m
Waste	2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: gravelly loam, brown	0.4	0.4
Flow till sequence	Sandy pebbly silt, becoming more sandy, gravelly and clayey downwards, crudely bedded with lenses of clayey pebbly sand, light brown (5 YR 5/6)	0.7	1.1
	Pebbly sand, very silty Gravel: fine and coarse, angular to subangular, sandstone and greywacke siltstone Sand: mainly coarse, chiefly angular to subrounded, lithic fragments, dark yellowish brown (10 YR 4/4)	0.2	1.3
	Naturally disturbed sequence of sandy silty clay with rare fine gravel, dark yellowish orange (10 YR 6/6) mottled with pale yellowish brown (10 YR 6/2); stiff, diamict, sandy pebbly clay, dark yellowish brown (10 YR 4/4); clayey sandy gravel, composition as above	0.8	2.1
Glacial sand and gravel	Gravel Gravel: fine and coarse with rare cobbles, subangular to subrounded, grey, red and white sandstones, greywacke siltstone with red mudstone, diorite and yellow siltstone Sand: coarse with medium and some fine, angular to subangular, lithic fragments and quartz Fines: some disseminated silt, moderate reddish brown (10 R 4/6)	2.9	5.0
Till	Diamicton: sandy silty stony clay, stiff to very stiff, with angular to subrounded clasts up to boulder size, including white, grey and red sandstones, felsite, shale, mudstone and coal, dusky yellowish brown (10 YR 2/2)	2.1	7.1
Glacial erratic	Limestone, very fine grained, crystalline, hard, with scattered crinoid debris, medium grey (N5)	0.2+	7.3
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
5	46	49	2.1- 3.3	6	4	16	29	24	21	0
			3.3- 4.2	4	5	15	28	28	20	0
			4.2- 5.0	5	5	12	20	16	19	23
			Mean	5	5	15	26	23	20	6

NT 56 SW 6 5377 6373 **Brown Rig, Long Yester** **Block C**

Surface level +283m (+928ft)
Groundwater level +267m
250 and 200mm percussion
November 1985

Overburden 0.3m
Mineral 15.7m
Waste 2.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam	0.3	0.3
Glacial sand and gravel	a 'Clayey' pebbly sand, sand with gravel stringers Gravel: fine and corse, with rare cobbles, subangular to rounded, red and grey sandstones and greywacke, with andesitic lava and rare felsite Sand: fine with medium and some coarse, generally in well sorted seams, angular to rounded, quartz with some feldspar, lithic fragments and coal Fines: silt, some disseminated but mainly in seams less than 5cm thick, mainly light brown (5 YR 5/4), but light brown (5 YR 5/4) and moderate reddish orange (10 R 6/6) at top	8.0	8.3
Glaciolacustrine deposits	b 'Clayey' sand Gravel: trace of fine, composition as above Sand: fine with some medium and rare coarse, otherwise as above Fines: silt, mainly in seams up to 10cm thick, light brown (5 YR 5/4)	2.5	10.8
Glacial sand and gravel	c Sand, pebbly towards base Gravel: fine with some coarse, composition as above Sand: fine and medium with rare coarse, otherwise as above Fines: silt, disseminated and as seams up to 10cm thick, also 1 to 2cm thick diamict seams between 14.8 and 15.4m, light brown (5 YR 5/4) but greyish yellow brown (10 YR 5/2) at base	5.2	16.0
Till	Diamicton: stony silty clay, firm, with clasts up to cobble grade, mainly of red sandstone and greywacke with vein-quartz and some micaceous siltstone, mainly moderate reddish orange (10 R 5/6) but locally pale brown (5 YR 5/4)	1.6	17.6
	Diamicton: stony clay, stiff, but sandy and moderately stiff at top, with clasts composed of sandstones and greywacke with siltstone, limestone and various igneous rocks, olive black (5 Y 2/1)	0.5+	18.1
	Borehole terminated owing to slow progress in till		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
a	10	76	14	0.3- 1.6	28	48	15	3	4	2	0	
				1.6- 2.6	7	22	28	8	18	17	0	
				2.6- 3.6	9	48	29	3	6	5	0	
				3.6- 4.6	7	65	24	2	0	2	0	
				4.6- 5.6	7	41	27	7	12	6	0	
				5.6- 7.1	5	28	39	10	11	7	0	
				7.1- 8.3	5	52	37	3	2	1	0	
				Mean	10	42	29	5	8	6	0	
b	19	81	0	8.3- 9.5	24	67	7	1	1	0	0	
				9.5-10.8	14	68	17	1	0	0	0	
				Mean	19	68	12	1	**	0	0	
c	7	89	4	10.8-12.6	5	50	43	1	1	0	0	
				12.6-13.7	6	42	48	2	2	0	0	
				13.7-14.8	6	50	43	1	0	0	0	
				14.8-15.4	16	44	29	4	5	2	0	
				15.4-16.0	9	42	26	9	10	4	0	§
				Mean	7	47	40	2	3	1	0	
a&c	9	81	10	Mean	9	44	33	4	6	4	0	
a-c	10	82	8	Mean	10	48	30	4	5	3	0	

NT 56 SW 7 **5473 6489** **Smiddy Wood, Long Yester** **Block C**

Surface level +216m (+709ft)
Groundwater level (perched?) +200m
250 and 200mm percussion
November 1985

Overburden 0.3m
Mineral 5.2m
Waste 15.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly loam	0.3	0.3
Glacial sand and gravel	a Gravel Gravel: coarse and fine with cobbles, subangular to rounded, greywacke and sandstones with vein-quartz Sand: coarse, medium and fine, angular to rounded, quartz with lithic fragments Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	1.4	1.7
	b 'Clayey' gravel, claybound to 2.2m, possibly mud flow or flow till Gravel: composition as above Sand: fine, medium and coarse, otherwise as above	1.8	3.5

NT 56 SW 7 Cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fines: silt and clay, disseminated especially in upper part, moderate brown (5 YR 4/4) to light brown (5 YR 5/6)		
Glaciolacustrine deposits	c 'Very clayey' sand Sand: fine with medium and rare coarse, angular to rounded, quartz with lithic fragments, feldspar and coal Fines: silt with clay, disseminated and as seams which increase downwards, moderate brown (5 YR 4/4)	2.0	5.5
	Silt and very fine sand with clay films, firm from 7.2 to 8.0m where clay is absent, otherwise soft, mainly light brown (5 YR 5/4) but dark yellowish brown (10 YR 4/3) towards base	3.8	9.3
Till	Diamicton: stony, gritty clay, stiff to very stiff, with clasts up to cobble grade, composed of sandstone and greywacke with limestone, dolerite, quartzite and granodiorite, mainly dusky yellowish brown (10 YR 3/2) but dark yellowish brown (10 YR 4/2) between 10.3 and 10.9m where deposit comprises contorted, laminated silty clay, and dusky brown (5 YR 2/2) around 15.0m	11.5+	20.8
	Borehole terminated owing to excessive overburden		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	5	26	69	0.3- 1.2	5	5	8	10	19	40	13	
				1.2- 1.7	4	7	12	12	27	38	0	
				Mean	5	6	9	11	22	39	8	
b	14	35	51	1.7- 2.9	14	16	11	7	18	34	0	
				2.9- 3.5	14	20	13	4	8	21	20	
				Mean	14	17	12	6	15	29	7	
c	24	76	0	3.5- 4.5	21	53	25	1	0	0	0	§
				4.5- 5.5	27	59	14	0	0	0	0	§
				Mean	24	55	20	1	0	0	0	
a&b	10	31	59	Mean	10	12	11	8	18	34	7	
a-c	15	48	37	Mean	15	29	14	5	11	21	5	

NT 56 SW 8 **5167 6485** **Long Newton, Yester** **Block C**

Surface level +212m (+696ft)
Water not struck
Pit
October 1984

Waste 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: stony silty loam, greyish brown (5 YR 3/2)	0.4	0.4
Glacial sand and gravel	Gravel, claybound Gravel: coarse and fine with cobbles, subangular to rounded, mainly sandstone with greywacke Sand: medium with coarse and fine, angular to rounded, quartz and rock fragments Fines: disseminated silt and clay, light brown (5 YR 5/6)	0.4	0.8
Till	Diamicton: stony sandy clay, firm, with clasts composed mainly of sandstone, greywacke and igneous rocks, moderate reddish brown (10 R 4/6)	2.2+	3.0

NT 56 SW 9 **5259 6434** **Dumbadam Strip, West Latch** **Block C**

Surface level +244m (+801ft)
Water not struck
Pit
October 1984

Waste 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, greyish brown (5 YR 3/2)	0.2	0.2
Till	Diamicton: sandy stony clay with angular to subrounded clasts up to cobble grade, composed of sandstone and greywacke with igneous rocks, moderate reddish brown (10 R 4/4)	2.8+	3.0

NT 56 SW 10 **5229 6377** **Fawn Knowes, Latch** **Block C**

Surface level +276m (+906ft)
Water not struck
Pit
October 1984

Waste 0.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, greyish brown (5 YR 3/2)	0.2	0.2
Till	Diamicton: sandy silty pebbly clay, moderate reddish brown (10 R 4/6)	0.7+	0.9

NT 56 SW 11 **5363 6460** **Blinkbonny Wood, Long Yester** **Block C**

Surface level +212m (+696ft)
Water not struck
Pit
October 1984

Overburden 0.2m
Mineral 3.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, moderate brown (5 YR 3/4)	0.2	0.2
Glacial sand and gravel	Gravel Gravel: cobble and coarse with fine and boulders, mainly red and white sandstones with greywacke and some igneous rock Sand: coarse with medium and some fine, angular to rounded, quartz and lithic fragments Fines: disseminated silt and clay, moderate reddish brown (10 R 4/4)	3.2+	3.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
4	21	75	0.2- 3.4	4	2	6	13	12	26	37

NT 56 SW 12 **5398 6432** **Blinkbonny Wood, Long Yester** **Block C**

Surface level +238m (+781ft)
Water not struck
Pit
October 1984

Overburden	1.0m
Mineral	1.6m
Waste	0.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Forest soil, peaty	0.2	0.2
Flow till	Diamicton: sandy silty clay with pebbles, mottled greyish red (10 R 4/2)	0.8	1.0
Glacial sand and gravel	'Clayey' sandy gravel Gravel: cobble, coarse and fine, subangular to rounded, mainly white and red sandstones with greywacke Sand: medium and fine with coarse, angular to rounded, mainly quartz with some lithic fragments Fines: disseminated silt, light brown (5 YR 6/4)	1.6	2.6
	Clay, silty, laminated, micaceous, moderate reddish orange (10 R 5/6)	0.4	3.0
Till	Diamicton: sandy pebbly clay, firm, moderate reddish brown (10 R 3/6)	0.4+	3.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
17	45	38	1.0- 2.6	17	18	19	8	11	12	15

NT 56 SW 13 **5442 6429** **Fawn's Wood, Long Yester** **Block C**

Surface level +239m (+784ft)
Water not struck
Pit
October 1984

Overburden 1.6m
Mineral 1.4m
Waste 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, clayey loam, greyish yellowish brown (10 YR 5/2)	0.3	0.3
Flow till	Diamicton: silty pebbly clay, firm, mottled greyish red (10 R 4/2) and moderate brown (5 YR 4/4)	1.3	1.6
Glacial sand and gravel	'Very clayey' pebbly sand Gravel: fine with coarse, subangular to subrounded, buff and red sandstones and greywacke with vein-quartz, igneous rocks, siltstone and rare coal Sand: fine with medium and some coarse, mainly as stringers Fines: silt, disseminated and as seams, moderate brown (5 YR 4/4)	1.4	3.0
Till	Diamicton: sandy silty pebbly clay, very firm, dusky brown (5 YR 2/2)	0.3+	3.3

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
37	54	9	1.6- 3.0	37	40	10	4	6	3	0

NT 56 SW 14 **5350 6377** **Gravel Pit, Long Yester** **Block C**

Surface level c +272m (c +892ft)
Water not struck
Sampled by hand
November 1985

Overburden 2.6m
Mineral 11.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Flow till	Diamicton: sandy clay with numerous randomly located clasts up to cobble grade, composed mainly of red sandstone, with some fine grained basic igneous rocks, vein-quartz and coal; the deposit is structureless and matrix supported	0.6	0.6
Glaciolacustrine deposits	Pebbly sandy silt, bedded with reddish brown lamination, with randomly scattered pebbles up to cobble grade, comprising mainly sandstone with some basaltic igneous rock and greywacke	2.0	2.6
Glacial sand and gravel	a Gravel; loosely bound, with 0.5m thick sand seam from 3.0 to 3.5m Gravel: coarse and fine with cobbles and some boulders, subangular to rounded, sandstones, greywacke, fine grained basic igneous rock, vein-quartz and felsite Sand: coarse, medium and fine, angular to rounded, quartz with lithic fragments, feldspar and rare coal Fines: some disseminated silt	6.9	9.5
	b Sandy gravel; mainly sand but gravelly from 11.4m Gravel: coarse and fine with cobbles and rare boulders, otherwise as above Sand: medium and fine with coarse, composition as above but coal quite common Fines: silt, disseminated and also as seams	3.5	13.0
Glaciolacustrine deposits	c 'Very clayey' sand Sand: fine with some medium, angular to subrounded, mainly quartz with mica, feldspar, lithic fragments and some coal Fines: silt in seams	1.2+	14.2

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	2	33	65	2.6- 4.0	3	27	10	10	13	25	12
				4.0- 5.2	1	2	9	11	20	43	14
				5.2- 6.4	2	2	8	15	23	41	9
				6.4- 7.5	2	2	10	16	26	40	4
				7.5- 8.5	1	3	18	25	31	22	0
				8.5- 9.5	1	4	12	10	22	33	18
				Mean	2	8	11	14	22	33	10
b	9	66	25	9.5-10.2	3	20	71	3	0	3	0
				10.2-11.4	22	57	4	5	6	6	0
				11.4-13.0	2	7	31	17	19	24	0
				Mean	9	27	29	10	11	14	0
c	21	79	0	13.0-14.2	21	75	4	0	0	0	0
a&b	4	44	52	Mean	4	14	17	13	18	28	6
a-c	6	47	47	Mean	6	20	16	11	16	25	6

NT 56 SE 1 **5558 6450** **Harelaw Burn, East Hopes** **Block C**

Surface level c +209m (c +686ft)
Groundwater level c +199m
250 and 200mm percussion
June 1985

Overburden 0.3m
Mineral 3.3m
Waste 12.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly loam, dark brown	0.3	0.3
Glacial sand and gravel	Sandy gravel, coarsening upwards, 'dirty' to 2.3m Gravel: coarse and fine with cobbles and rare boulders, subangular to well-rounded, cream and red sandstones with greywacke, some fine grained igneous rocks and vein-quartz Sand: medium and coarse with fine, angular to rounded, quartz and lithic fragments Fines: silt and clay, disseminated, with claybound seams 10cm thick near top, moderate brown (5 YR 4/4) to 2.3m, then light brown (5 YR 5/4)	3.3	3.6
Glaciolacustrine deposits	Clayey silt, colour laminated, greyish yellowish brown (10 YR 5/2) and moderate reddish brown (10 YR 4/4)	1.1	4.7
	Silty sand Sand: fine with rare medium and coarse, angular to subrounded, quartz with lithic fragments Fines: silt, disseminated, moderate reddish orange (10 R 5/4)	0.6	5.3

NT 56 SE 1 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
	Very silty sand, as above with seams of silt and films of clay, light brown (5 YR 5/6) and moderate reddish brown (10 R 4/6)	1.4	6.7
	Silt, very fine grained sand and clay, colour laminated, greyish red (10 R 5/2), light brown (5 YR 5/6) and deep yellowish brown (10 YR 3/5)	1.1	7.8
Till	Diamicton: stony, 'gritty' clay, firm, dusky yellowish brown (10 YR 3/2); quite sandy and soft by 10.0m where pale brown (5 YR 5/2). Clasts chiefly of sandstones and greywacke, becoming mostly greywacke downwards to 14.4m; also rare medium grained pink igneous rock (?granodiorite); from 10.8m, very stiff, clasts almost entirely of greywacke siltstone, and dark yellowish brown (10 YR 4/2); sharp colour change at 14.4m to greyish red (5 R 4/2), abundant clasts of reddish, fine grained sandstone	8.0+	15.8
	Borehole terminated owing to slow progress in till		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm	
8	46	46	0.3– 1.1	7	6	6	10	16	32	23	
			1.1– 2.3	6	6	18	20	21	19	10	
			2.3– 2.8	5	9	28	19	23	16	0	
			2.8– 3.6	12	16	34	15	10	13	0	§
			Mean	8	9	21	16	17	20	9	

NT 57 NW 3 **5168 7995** **Drem (Muirton Farm)** **Block H_4**

Surface level +16m (+52.5ft)
Water struck at +15.5m
250mm percussion
September 1985

Overburden	0.3m
Mineral	2.1m
Waste	2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.3	0.3
Late-Glacial marine deposits	'Very clayey' sand; sand becomes fine with depth Gravel: coarse with trace fine, subrounded, sandstone, basalt and tuff Sand: fine with medium and trace coarse, subangular, quartz and rock fragments including some coal Fines: silt and clay, disseminated with silty clay bands appearing at 2.0m and becoming more abundant with depth, moderate yellowish brown (10 YR 5/4)	2.1	2.4
Till	Diamicton: clay, sandy, plastic, with clasts becoming more abundant with depth, chiefly sandstone, siltstone, basalt, and tuff. Deposit becomes very silty at base. Greyish brown (5 YR 3/2)	2.2+	4.6
	Borehole terminated at 4.6m owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
21	78	1	0.3- 1.3	19	59	17	2	1	2	0	§
			1.3- 2.4	23	73	3	1	0	0	0	§
			Mean	21	67	10	1	**	1	0	

NT 57 NW 4 **5423 7997** **Betony Bridge, East Fortune** **Block H_4**

Surface level +16.57m (+54.36ft)
Water not struck
250mm percussion
September 1985

Waste 1.0m
Bedrock 1.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam, brown	0.3	0.3
Head	Clay, sandy, moderate brown (5 YR 4/4), containing many angular clasts of basalt, some of which are soft and weathered	0.7	1.0
Carboniferous	Mugearite, broken and weathered at top, many large phenocrysts, some weathered clay horizons	1.4+	2.4

NT 57 NW 5 **5402 7513** **Abbey Mains, Haddington** **Block H_4**

Surface level +47.5m (+155.8ft)
Water struck at +44.0m
250mm percussion
September 1985

Overburden 0.4m
Mineral 3.0m
Waste 8.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam, brown	0.4	0.4
Glacial sand and gravel	a 'Clayey' sand; sand becoming finer with depth, with gravel in top metre. Fines increasing with depth with clay bands and silt lenses near base Gravel: fine with some coarse, subrounded, sandstone Sand: fine with medium and some coarse, subangular, quartz and rock fragments, moderate brown (5 YR 4/4) Fines: silt and clay, disseminated and as clay seams and silt lenses	2.0	2.4
	b 'Very clayey' sand; some rare coarse gravel Gravel: coarse, subrounded, sandstone Sand: fine with some medium, subangular, quartz and rock fragments including coal Fines: silt and clay, as clay seams and silty lenses, disseminated	1.0	3.4
Glaciolacustrine deposits	Silt; clayey, soft, abundant fine-sand lenses, moderate brown (5 YR 4/4) at top becoming grey (N5) below 6m	3.8	7.2
Till	Diamicton: clay, very sandy, soft to 8.0m with many silty and sandy lenses, clasts up to coarse-gravel size, angular to subrounded, sandstone and siltstone with basalt and some greywacke. Becomes firmer with few sand lenses below 8m. Dark yellowish brown (10 YR 2/2)	4.6+	11.8
	Borehole terminated at 11.8m in till owing to drilling difficulties		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm
a	12	84	4	0.4– 1.4	8	44	37	6	4	1	0
				1.4– 2.4	16	72	10	1	1	0	0
				Mean	12	56	24	4	3	1	0
b	35	62	3	2.4– 3.4	35	60	2	0	0	3	0
a&b	20	77	3	Mean	20	59	16	2	2	1	0

NT 57 NW 6 **5049 7997** **Drem Farm** **Block H_4**

Surface level +10.8m (+35.4ft)
Water struck (perched) at +7.8m
Pit
October 1984

Waste 3.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, greyish brown (5 YR 3/2)	0.3	0.3
Late-Glacial marine deposits	Silt, dusky yellowish brown (10 YR 3/2) with bands of fine sand, moderate yellowish brown (10 YR 5/4) and coaly seams to 2.0m then brownish grey (5 YR 4/1) with clay seams	3.2+	3.5

NT 57 NW 7 **5067 7951** **Drem Farm** **Block H_4**

Surface level +25.2m (+82.7ft)
Water not struck
Pit
October 1984

Waste 1.6m
Bedrock 0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, clayey loam with gravel, moderate brown (5 YR 3/4)	0.4	0.4
Late-Glacial marine deposits	'Clayey' sandy gravel Gravel: coarse and fine with some cobbles, subangular to rounded, sandstone and igneous, angular to subangular trachyte Sand: fine to coarse, angular to subrounded, quartz and rock fragments Fines: silt, disseminated	0.6	1.0
Till	Clay, silty, stony, mottled, moderate brown (5 YR 4/4), sandstone and igneous clasts	0.6	1.6
Carboniferous	Lava, dark, fine grained, basaltic, non-porphyritic but with some amygdales	0.1+	1.7

NT 57 NW 9 **5258 7945** **Prora, Drem** **Block G**

Surface level +28.66m (+94.02ft)
Water not struck
Pit
October 1984

Overburden 1.3m
Mineral 1.5m
Waste 0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, pebbly, sandy, moderate brown	0.3	0.3
Late-Glacial marine deposits	'Clayey' gravel Gravel: coarse and fine with some cobbles, subangular to rounded, sandstone, igneous rocks, coal and siltstone Sand: medium with fine and rare coarse, angular to rounded, quartz and rock fragments Fines: silt, disseminated	0.4	0.7
Flow till	Clay, stony, silty, mottled, brown, containing small clasts, subangular to subrounded, of coal, sandstone, and other rock fragments	0.1	0.8
Glacial sand and gravel	Silt, sandy, ill-sorted, poorly bedded, scattered fine gravel clasts, moderate brown (5 YR 4/4)	0.5	1.3
	Sandy gravel Gravel: fine and coarse with cobbles, angular to subrounded, igneous including basalt and felsite, white and brown sandstone Sand: coarse and medium with fine, angular to rounded, quartz and rock fragments with coal Fines: silt and clay, disseminated, dark yellowish brown (10 YR 4/2)	1.5	2.8
Till	Silt, clayey, stony, containing subangular to subrounded clasts, mainly igneous, brownish grey (5 YR 4/1)	0.7+	3.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	48	43	1.3- 2.8	9	10	17	21	32	11	0

NT 57 NW 10 **5317 7968** **West Fortune, Drem** **Block G**

Surface level +18.49m (+60.66ft)
Water not struck
Pit
October 1984

Waste 2.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, loam, sandy, moderate brown	0.6	0.6
Late-Glacial marine deposits	Sand Sand: fine to medium, angular to rounded, quartz with ferromagnesian minerals, feldspar and mica Fines: silt, disseminated, moderate yellowish brown (10 YR 5/4)	0.5	1.1
Till	Clay, stony, silty, firm, with clasts mainly cobble size, but some boulders, chiefly igneous rocks and sandstone	1.8+	2.9

NT 57 NW 11 **5425 7943** **Merryhatton** **Block G**

Surface level +27.86m (+91.4ft)
Water not struck
Pit
October 1984

Overburden 0.9m
Mineral 2.6m
Waste 0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy, gravelly loam, moderate brown (5 YR 3/4)	0.4	0.4
	Subsoil, pebbly, sandy clayey with rootlets, moderate brown (5 YR 3/4)	0.5	0.9
Glacial sand and gravel	a 'Clayey' sand Gravel: fine with some coarse Sand: fine with medium and some coarse, angular to rounded, quartz with some coal, ferromagnesians and mica, coal in coarse fractions Fines: silt, disseminated, moderate yellowish brown (10 YR 5/4)	1.4	2.3
	b 'Sandy' gravel Gravel: fine with coarse and rare cobbles subrounded to rounded, chiefly red and white sandstones, various igneous rocks, some vein-quartz and coal Sand: fine with medium and some coarse, angular to rounded, quartz with some coal, ferromagnesians and mica Fines: silt, disseminated, pale yellowish brown (10 YR 6/2)	1.2	3.5
	Silt, laminated with clay bands, moderate yellowish brown (10 YR 5/4)	0.1+	3.6

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	11	86	3	0.9- 2.3	11	56	24	6	2	1	0
b	6	61	33	2.3- 3.5	6	26	23	12	23	10	0
a&b	9	74	17	Mean	9	41	24	9	12	5	0

NT 57 NW 12 **5485 7512** **Sandy's Mill, Haddington** **Block A**

Surface level +35.2m (+115.5ft)
Water struck at +32.2m
Pit
October 1984

Overburden 2.0m
Mineral 1.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, silty, moderate brown (5 YR 3/4)	0.3	0.3
Alluvium	Silt, with fine sand and rare pebbles, light brown (5 YR 5/6), becoming pale yellowish brown (10 YR 6/2) below 1.6m	1.7	2.0
	Sandy gravel Gravel: coarse with fine, subangular to well rounded, chiefly sandstone with various fine grained igneous rocks and vein-quartz Sand: medium with coarse and some fine, subangular to rounded, quartz with feldspar and rock fragments Fines: silt, disseminated and in seams, mottled orange with light brown (5 YR 5/6)	1.0+	3.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	63	28	2.0- 3.0	9	12	40	11	11	17	0

NT 57 NE 14 **5581 7954** **East Fortune Hospital, Athelstaneford** **Block G**

Surface level +26.23m (+86.1ft)
Groundwater level +23.2m
250 and 200mm percussion
July 1985

Overburden 0.4m
Mineral 5.9m
Waste 12.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly	0.4	0.4
Glacial sand and gravel	a Gravel; pebbly sand to 1.0m, becoming more gravel-rich and clayey from 1.4m. Cohesive at 3.4m Gravel: coarse and fine with some cobbles, subrounded, basalt with sandstone and siltstone Sand: fine and medium with coarse, subangular to subrounded, quartz and rock fragments including coal Fines: disseminated silt and clay, moderate reddish brown (10 R 4/6)	4.0	4.4
	b 'Very clayey' pebbly sand; gravel fraction decreases with depth, sand becomes finer with depth Gravel: fine and coarse, subrounded, basalt with sandstone and siltstone Sand: fine with medium and some coarse, subangular to subrounded, quartz and rock fragments including coal Fine: silt, disseminated and in laminae	1.9	6.3
Glaciolacustrine deposits	Silt, sandy, light grey, unconsolidated	0.7	7.0
	Clay, stiff, plastic, contains frequent silt seams and silty sand between 7.5 and 8.5m and from 11.0m. Several fine and coarse gravel clasts from 14.1m, with clay becoming very firm	7.2	14.2
Till	Diamicton: sandy stony clay, moderate reddish brown (10 R 4/6), very stiff, with subangular to subrounded clasts up to cobble size, of basalt with some sandstone	4.8+	19.0
	Borehole termined owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
a	8	44	48	0.4- 1.4	10	17	13	8	13	29	10	
				1.4- 2.4	9	13	13	10	17	34	4	
				2.4- 3.4	9	14	19	14	20	24	0	§
				3.4- 4.4	6	13	28	17	21	15	0	§
				Mean	8	14	18	12	18	27	3	
b	20	73	7	4.4- 5.4	28	35	23	5	5	4	0	§
				5.4- 6.3	12	62	20	3	2	1	0	§
				Mean	20	47	22	4	4	3	0	
a&b	12	55	33	Mean	12	26	19	10	13	18	2	

NT 57 NE 15 **5588 7828** **Sunnyside Strip, East Linton** **Block G**

Surface level +23.40m (76.77ft)
Water struck at +23.0m
250mm percussion
August 1985

Waste 5.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, clayey, dark yellowish brown (10 YR 4/2)	0.3	0.3
Alluvium	Sand, fine with disseminated silt and clay, clay content increasing with depth, moderate yellowish brown (10 YR 5/4)	0.4	0.7
Glaciolacustrine deposits	Clay, silty in part, soft to firm, moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2) with dusky yellowish brown (10 YR 2/2) flecks and rare thin, grey silty sand laminae	2.9	3.6
Till	Clay, stony, dark yellowish brown (10 YR 4/2), stiff, becoming very stiff below 4.5m, containing angular to subrounded clasts, fine to coarse gravel size, of basic and intermediate igneous rocks, vein-quartz, sandstone and siltstone	1.5+	5.1
	Borehole abandoned owing to slow progress		

NT 57 NE 16 **5545 7713** **Beanston Mains, East Linton** **Block G**

Surface level +28.2m (92.5ft)
Water struck at +26.2m
250mm percussion
September 1985

Overburden 0.3m
Mineral 3.0m
Waste 5.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly loam	0.3	0.3
Glacial sand and gravel	'Clayey' gravel, generally claybound, the deposit has a tilloid appearance below 3.0m Gravel: coarse and fine with some cobble, subangular to subrounded, red and yellow sandstones, basalt and tuff Sand: fine, medium and coarse, subangular, quartz and rock fragments Fines: disseminated silt and clay, moderate brown (5 YR 4/4)	3.0	3.3
Till	Diamicton: sandy silty stony clay, firm to stiff becoming very stiff below 7.0m. Fine and coarse gravel-size clasts with some cobbles, subangular to subrounded, red and yellow sandstones with basalt tuff. Dusky yellowish brown (10 YR 2/2)	5.1+	8.4
	Borehole terminated due to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
13	32	55	0.3- 1.3	13	10	8	10	24	26	9
			1.3- 2.3	12	11	10	11	26	26	4
			2.3- 3.3	15	13	11	13	26	15	7 §
			Mean	13	11	10	11	26	22	7

NT 57 NE 17 5603 7888 **East Fortune Airfield** **Block G**

Surface level +27.31m (89.6ft)
Water struck at +24.3m
250mm percussion
August 1985

Overburden 0.4m
Mineral 3.4m
Waste 1.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Made ground	Fill: coarse tarmac and whinstone rubble	0.4	0.4
Glacial sand and gravel	a Sandy gravel, clayey in part, sandy laminae present in places, possibly disturbed at top Gravel: fine with coarse, rounded to subangular, sandstone, siltstone, vein-quartz and igneous rocks Sand: medium with fine and coarse, subangular and subrounded, quartz and rock fragments including coal Fines: disseminated silt and clay, also as matrix in places, moderate to dark yellowish brown (10 YR 5/4 to 4/2)	2.6	3.0
	b Pebbly sand, becomes finer overall with depth Gravel: fine, subangular to rounded, clasts of sandstone, siltstone, vein-quartz and igneous rocks Sand: medium and fine with coarse, subangular to subrounded, quartz and rock fragments including coal Fines: disseminated silt and clay, increasing with depth, moderate to dark yellowish brown (10 YR 5/4 to 4/2)	0.8	3.8
Glaciolacustrine deposits	Clay, smooth, slightly silty, containing abundant clasts from 4.4m. Dark yellowish brown (10 YR 4/2) in top few centimetres, rapidly becomes dusky yellowish brown (10 YR 2/2). Till-like from 4.4m	1.0	4.8
Till	Diamicton: extremely hard clay with cobbles and boulders, dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 2/2)	0.6+	5.4
	Borehole terminated due to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	8	57	35	0.4- 1.4	9	12	19	13	24	23	0	
				1.4- 3.0	7	19	32	14	18	10	0	
				Mean	8	16	27	14	20	15	0	
b	8	86	6	3.0- 3.8	8	37	38	11	6	0	0	§
a&b	8	64	28	Mean	8	21	30	13	17	11	0	

NT 57 NE 18 **5753 7975** **Kamehill, East Linton** **Block G**

Surface level +18.8m (61.7ft)
Groundwater level +10.5m
250 and 200mm percussion
July 1985

Overburden	0.1m
Mineral	3.0m
Waste	1.0m
Mineral	1.1m
Waste	2.2m
Mineral	2.5m
Waste	7.1m
Mineral	8.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy silty loam	0.1	0.1
Glacial sand and gravel	a 'Clayey' sand; silty and coal-rich laminae, becomes more silty with depth Sand: fine with some medium and trace coarse, subangular to subrounded, quartz and rock fragments Fines: disseminated and laminated silt and clay, moderate yellowish brown (10 YR 5/4)	3.0	3.1
	Silt, sandy and clayey, moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2)	1.0	4.1
Glaciolacustrine deposits	b 'Very clayey' sand Sand: fine with trace medium, quartz, rock fragments and medium and coarse coal fragments Fines: disseminated silt, dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 3/2)	1.1	5.2
	Clay, smooth, slightly silty, plastic and firm, dusky yellowish brown (10 YR 3/2)	2.2	7.4
	c 'Clayey' sand Sand: fine with trace medium, quartz and rock fragments including coal Fines: disseminated silt, dusky yellowish brown (10 YR 3/2)	2.5	9.9
	Silt, sandy, laminated with abundant coal fragments, dusky yellowish brown (10 YR 3/2)	0.5	10.4
	Clay, smooth, slightly silty, dusky yellowish brown (10 YR 3/2)	6.6	17.0

LOG

Geological classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	d Sandy gravel; becomes less gravel-rich between 20.0 and 21.0m Gravel: coarse and fine with some cobble, subangular and subrounded, clasts of sandstone, greywackes, volcanics (andesite and felsite), some limestone and Highland metamorphic rocks Sand: fine and medium with some coarse, subangular to subrounded, quartz and rock fragments including fairly abundant coal Fines: some disseminated silt, dark yellowish brown (10 YR 4/2)	4.0	21.0
	e Pebbly sand; becomes slightly less pebbly with depth. Sand is coarser in places, but finer generally from 24.0m Gravel: fine with coarse, subangular to subrounded, clasts of sandstone, greywackes, andesite, felsite, some limestone and Highland metamorphic rocks Sand: fine and medium with some coarse, subangular to subrounded, quartz and rock fragments Fines: disseminated silt with rare thin clayey silt seams from 22.0 to 25.0m, dark yellowish brown (10 YR 4/2)	4.0+	25.0

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64	mm
a	17	83	0	0.1- 1.1	9	68	21	1	1	0	0	
				1.1- 2.1	14	78	7	1	0	0	0	
				2.1- 3.1	28	70	2	0	0	0	0	§
				Mean	17	72	10	1	**	0	0	
b	30	70	0	4.1- 5.2	30	69	1	0	0	0	0	§
c	19	81	0	7.4- 8.9	18	81	1	0	0	0	0	§
				8.9- 9.9	20	79	1	0	0	0	0	§
				Mean	19	80	1	0	0	0	0	
d	4	67	29	17.0-18.0	4	25	26	9	9	18	9	§
				18.0-19.0	5	37	30	9	8	11	0	§
				19.0-20.1	3	23	26	13	18	11	6	§
				20.1-21.0	2	30	34	11	11	12	0	§
				Mean	4	29	27	11	12	13	4	
e	7	86	7	21.0-22.0	5	45	34	10	6	0	0	§
				22.0-23.0	4	40	36	13	5	2	0	§
				23.0-24.0	6	46	34	9	3	2	0	§
				24.0-25.0	11	44	29	8	4	4	0	§
				Mean	7	43	33	10	5	2	0	
b&c	22	78	0	Mean	22	77	1	0	0	0	0	
d&e	5	78	17	Mean	5	37	31	10	8	7	2	
a-c	20	80	0	Mean	20	75	5	**	**	0	0	
a-e	12	79	9	Mean	12	54	19	6	4	4	1	

NT 57 NE 19 **5829 7987** **Howden Burn, East Linton** **Block G**

Surface level +17.0m (+55.8ft)
Water not struck
250mm percussion
September 1985

Overburden 0.2m
Mineral 5.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey with gravel clasts up to cobble size	0.2	0.2
Glacial sand and gravel	'Clayey' gravel; consolidated, damp and iron-stained below 1.2m. Boulders in top metre and below 3.2m Gravel: coarse with fine and cobbles and some boulders, subangular to subrounded, red and yellow sandstones, basalt and tuff with some vein-quartz, siltstone and limestone Sand: fine, medium and coarse, subangular, quartz and rock fragments, including a little coal Fines: disseminated silt and clay binding the deposit	5.6+	5.8
	Borehole terminated at 5.8m owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
13	29	58	0.2- 1.2	15	13	11	10	18	25	8
			1.2- 2.2	20	10	9	20	25	16	0
			2.2- 3.2	14	3	5	13	18	31	16
			3.2- 4.2	7	6	3	9	12	23	40
			4.2- 5.8	10	17	7	6	9	31	20
			Mean	13	11	7	11	16	25	17

NT 57 NE 20 **5833 7910** **Janefield, East Linton** **Block G**

Surface level +12.8m (+42.0ft)
Water struck at +9.9m
250mm percussion
September 1985

Overburden	3.1m
Mineral till	1.3m
Waste	2.1m
Bedrock	0.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Late-Glacial marine deposits	Clay, firm, plastic, fissured, flecks of coal, dark yellowish brown (10 YR 4/2) and light brown (5 YR 5/6), mottled. Below 0.5m clay becomes very stiff with scattered coarse sand and fine gravel-size clasts of white and grey sandstones, dark grey mudstone, and coal; moderate brown (5 YR 4/4) becoming moderate yellowish brown (10 YR 4/4) by 1.5m with light bluish grey (5 B 7/1) mottling	2.5	2.6
Flow till	Clay, sandy, gravelly, firm, plastic, dark yellowish brown (10 YR 4/2). Clasts mainly fine, but up to cobble gravel-size, with boulders of red and grey sandstones and basalt from 2.9 to 3.1m; sand mainly fine and medium	0.5	3.1
	Gravel, claybound Gravel: coarse and fine with some cobbles, angular to subrounded, dolerite and basalt, some trachyte lavas and red porphyry, white and grey sandstones, grey siltstone Sand: fine to coarse, angular to subangular, rock fragments Fines: disseminated silt and clay, binding the deposit in places, clay increasing with depth, dusky yellowish brown (10 YR 3/2)	1.3	4.4
Till	Clay, sandy, stiff becoming very stiff, dusky yellowish brown (10 YR 3/2) with moderate reddish brown (10 R 4/6) patches containing red mudstone fragments, increasing with depth	2.1	6.5
Calciferous Sandstone Measures	Mudstone, sheared, fissile, moderate reddish brown (10 R 4/4), with harder greyish red (10 R 4/2) seams, green reduction spots	0.6+	7.1

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
6	26	68	3.1- 4.4	6	7	6	13	22	33	13 §

NT 57 NE 21 **5940 7993** **Binning Wood, Tyninghame** **Block G**

Surface level +11.10m (+36.1ft)
Water struck (perched) at +8.3m
250 and 200mm percussion
October 1985

Waste 15.6m
Bedrock 0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Made ground	Fill; crushed rock and soil	0.4	0.4
Late-Glacial marine deposits	Clay, silty in places, plastic, moderately firm with rare fine gravel size clasts, moderate yellowish brown (10 YR 5/4)	0.6	1.0
	Clay, silty with some sandy lenses, firm to stiff, mottled moderate yellowish brown (10 YR 5/4) to moderate reddish brown (10 R 4/6), the latter colour predominant below 2.0m	1.8	2.8
	Silt, soft, sandy, clayey, unconsolidated, with many sandy and clayey laminae, dark yellowish brown (10 YR 4/2)	1.9	4.7
	Clay, silty with a few sandy and silty laminae, silty laminae more abundant from 10.4 to 12.0m, dark yellowish brown (10 YR 4/2)	9.3	14.0
Till	Diamicton: silty sandy clay, firm from 14.4m, fine and coarse gravel size clasts with some cobbles, of subangular to subrounded, red and yellow sandstones, andesite, basalt limestone and vein-quartz. From 14.4m clasts predominantly angular to subangular, red silty mudstone. Dark yellowish brown (10 YR 4/4) becoming mottled dusky yellowish brown (10 YR 2/2) and dusky purple (5 P 2/2) below 14.4m	1.6	15.6
Calciferous Sandstone Measures	Mudstone, silty, sheared, broken, calcite on joints, some clay matrix between fragments, moderate reddish brown (10 R 4/4)	0.7+	16.3

NT 57 NE 22 **5907 7783** **Drylaw Hill Farm, East Linton** **Block F**

Surface level +19.99m (+65.6ft)
Water struck at +13.5m
250mm percussion
September 1985

Overburden 0.5m
Mineral 7.2m
Waste 1.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial sand and gravel	a Gravel, sandy in places, with numerous cobbles at 2.8m, becoming more sandy and silty towards base Gravel: coarse and fine with some cobble, sandstone and greywacke Sand: medium with coarse and fine, quartz with coal fragments Fines: silt and clay, disseminated, with silty bands, moderate brown (5 YR 4/4) to dark yellowish orange (10 YR 6/6)	4.7	5.2
	b Pebbly sand, becoming less pebbly with depth Gravel: coarse and medium with some cobble, quartz and some greywacke Sand: fine with some medium and coarse, quartz and rock fragments with some coal Fines: silt and clay, disseminated, moderate yellowish brown (10 YR 5/4)	2.5	7.7
Till	Diamicton: stony clay, firm becoming stiffer with depth, clasts angular, of basalt and white sandstone, moderate yellowish brown (5 YR 4/3), lighter (5 YR 4/4) at 8.2m	1.3+	9.0
	Borehole terminated at 9.0m owing to drilling difficulties		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	7	46	47	0.5- 1.8	6	11	33	12	22	16	0	
				1.8- 2.8	7	7	23	8	18	33	4	
				2.8- 3.9	8	4	23	11	18	23	13	
				3.9- 5.2	8	18	16	15	20	23	0	
				Mean	7	10	24	12	20	23	4	
b	9	85	6	5.2- 6.0	10	48	20	8	9	5	0	
				6.0- 7.7	9	82	5	2	1	1	0	§
				Mean	9	71	10	4	4	2	0	
a&b	8	59	33	Mean	8	31	19	9	14	16	3	

NT 57 NE 23 **5952 7722** **Phantassie Farm, East Linton** **Block F**

Surface level +13.59m (+44.6ft)
Water not struck
250mm percussion
July 1985

Mineral 4.3m
Waste 2.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	'Clayey' gravel, claybound and till-like at top Gravel: coarse with fine and trace cobble, subangular to subrounded, basalt with sandstone, siltstone, limestone and a little coal Sand: fine, medium and coarse, subangular to subrounded, quartz, rock fragments and coal Fines: silt and clay, disseminated and binding deposit in places, moderate reddish brown (10 YR 4/6)	4.3	4.3
Till	Diamicton: clay, sandy and gravel-rich in places, firm, clasts up to cobble size, of basalt with some sandstone, siltstone, limestone, vein-quartz and a little coal; boulder at 6.1m; moderate reddish brown (10 R 4/6)	2.6+	6.9
	Borehole terminated owing to an obstruction, possibly bedrock		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
15	33	52	0.0- 1.0	28	13	9	7	13	24	6
			1.0- 2.0	17	16	10	8	18	31	0
			2.0- 3.0	11	13	12	11	22	31	0
			3.0- 4.3	8	8	12	12	22	38	0
			Mean	15	12	11	10	19	32	1

NT 57 NE 24 **5679 7843** **Crauchie** **Block G**

Surface level +16.36m (+53.7ft)
Water struck at 14.7m
Pit
October 1984

Waste 3.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy loam, dark yellowish brown (10 YR 4/2)	0.4	0.4
Late-Glacial marine deposits	Silt, sandy, bedded, dark yellowish orange (10 YR 6/6) to 1.2m then light olive green (5 Y 5/1)	1.4	1.8
	Clay, silty, laminated, firm, with laminated silt and films of fine coal-rich sand, clay is brownish grey (5 YR 4/1), silt is light olive grey (5 Y 5/1)	1.4+	3.2

NT 57 NE 25 **5650 7831** **Crauchie** **Block G**

Surface level +20.13m (+66.0ft)
Water struck at 18.1m
Pit
October 1984

Waste 3.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy loam, greyish brown (5 YR 3/2)	0.5	0.5
Glacial sand and gravel	Sand, with silt seams Sand: fine with medium, angular to well rounded, quartz with some feldspar and coal Fines: silt, disseminated and in seams, mottled light brown (5 YR 5/6)	0.7	1.2
	Silt, sandy; sand is fine, with medium and coarse coal fragments, moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2)	1.4	2.6
Glaciolacustrine deposits	Clay, silty, firm, laminated and micaceous, brownish grey (5 YR 3/1)	1.0+	3.6

NT 57 NE 26 **5710 7579** **Hailes Castle, East Linton** **Block A**

Surface level +32.6m (+107.0ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil; gravelly, silty loam, medium brown (5 YR 3/4)	0.3	0.3
Alluvium	Gravel, becoming less coarse with depth, some iron pan bands Gravel: coarse with fine and some cobble, subrounded to rounded, chiefly sandstone with some igneous rocks, greywacke, limestone, coal and siltstone Sand: medium and coarse with fine, angular to rounded, quartz with coal, rock fragments and feldspar Fines: silt and clay, disseminated, moderate yellowish brown (10 YR 5/4) becoming dusky brown (5 YR 2/2) with depth	3.0+	3.3

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64 mm
6	32	62	0.3- 2.0	5	6	11	10	14	41	13
			2.0- 3.3	8	5	17	14	18	38	0
			Mean	6	6	14	12	16	39	7

NT 57 NE 27 **5862 7998** **Howden Burn** **Block G**

Surface level +15.0m (+49.2ft)
Water not struck
Pit
October 1984

Overburden 0.5m
Mineral 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, moderate brown (5 YR 3/4)	0.5	0.5
Glacial sand and gravel	'Very clayey' sand; some rare coarse and fine gravel pebbles Sand: fine with medium and trace coarse, angular to rounded, quartz with ferromagnesians, coal, some feldspar and mica Fines: silt, disseminated and as rare laminae and seams, moderate brown (5 YR 4/4)	3.0+	3.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
20	80	0	0.5- 3.5	20	57	22	1	0	0	0

NT 57 NE 28 **5962 7750** **Dovecot, Phantassie, East Linton** **Block A**

Surface level +13.59m (+44.6ft)
Water not struck
Pit
October 1984

Overburden 0.2m
Mineral 3.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam with pebbles	0.2	0.2
Alluvium	Gravel; sand seam from 2.3 to 2.5m with gravel becoming coarser from 0.8m Gravel: coarse with cobble and fine and some boulders, subangular to rounded, chiefly sandstones, dolerite and basalt Sand: medium and coarse with fine, well rounded, quartz with rock fragments and feldspar Fines: silt and clay, disseminated and as rare thin clayey seams, moderate brown (5 YR 4/4)	3.3+	3.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
3	32	65	0.2- 2.0	3	6	18	12	18	22	21
			2.0- 3.5	4	5	10	11	15	33	22
			Mean	3	6	14	12	17	27	21

NT 57 SW 20 5005 7132 **Parkend (Westfield), Haddington** **Block A**

Surface level +55m (+180ft)
Groundwater level +53m
250mm percussion
August 1985

Overburden 0.9m
Mineral 3.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, clayey, brown	0.3	0.3
Head	Diamicton: clay, sandy, silty, soft, with a few fine gravel size clasts of sandstone, greywacke and igneous rocks, some sandy seams	0.6	0.9
Alluvium	Gravel; fines bind the deposit in places above 2.5m, cobbles alone recovered at 3.4m, cobbles up to 230mm Gravel: coarse with fine and cobble, chiefly subrounded with subangular, sandstone, siltstone, vein-quartz, greywacke, igneous rocks and limestone, with some coal Sand: coarse with medium and some fine, subangular to subrounded, quartz and rock fragments including some coal Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	3.9+	4.8
	Borehole terminated at 4.8m owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
5	36	59	0.9- 1.9	11	10	10	16	13	24	16
			1.9- 2.9	7	7	8	12	18	48	0
			2.9- 4.0	1	3	12	18	25	21	20
			4.0- 4.8	1	4	18	28	30	19	0
			Mean	5	6	12	18	21	28	10

NT 57 SW 21 **5296 7453** **Abbey Bridge, Haddington** **Block A**

Surface level +44m (+144ft)
Groundwater level +41m
250mm percussion
August 1985

Overburden 0.6m
Mineral 2.8m
Bedrock 0.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, dark yellowish brown (10 YR 4/2)	0.6	0.6
Alluvium	'Clayey' gravel; claybound in part, somewhat sandy, cobbles abundant from 2.8 to 3.4m Gravel: coarse with fine and some cobble, subangular to rounded, sandstone, siltstone, greywacke and some vein-quartz with trace of limestone and felsite Sand: medium and fine with coarse, subangular, quartz and rock fragments Fines: clay and silt, disseminated	2.8	3.4
Till	Diamicton: clay, silty, stony, firm to hard, angular to subangular clasts of sandstones and siltstones with basic to intermediate igneous rocks, up to cobble and boulder size. Dark yellowish brown (10 YR 3/2), becoming dusky yellowish brown (10 YR 2/2) by 4.0m	2.1	5.5
Calciferous Sandstone Measures	Sandstone, medium grained, buff, with some grit and ?tuffaceous bands, soft	0.9+	6.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
10	33	57	0.6- 1.7	12	12	14	8	20	25	9	
			1.7- 2.8	9	10	13	10	16	35	7	
			2.8- 3.4	9	10	10	9	15	40	7	§
			Mean	10	11	13	9	17	32	8	

NT 57 SW 23 **5045 7098** **Parkend, Westfield** **Block H_3**

Surface level +60m (+197ft)
Water not struck
Pit
October 1984

Waste 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, pebbly loam, moderate brown (5 YR 3/4)	0.3	0.3
Till	Diamicton: clay, silty, firm, clasts chiefly of sandstone, greywacke, siltstone and fine grained igneous rocks, becomes more stony with depth, moderate reddish brown (10 R 4/4) but variable	2.0+	2.3

NT 57 SW 24 **5005 7003** **Begbie Wood** **Block H_3**

Surface level +72m (+236ft)
Water not struck
Pit
October 1984

Waste 2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Diamicton: clay, stony, stiff, with clasts up to cobble size chiefly of sandstone and limestone with some greywacke, weathered orange brown to 0.7m then brownish grey (5 YR 3/1)	1.9+	2.2

NT 57 SW 26 **5094 7011** **Bolton** **Block A**

Surface level +68m (+223ft)
Water not struck
Pit
October 1984

Waste 0.9m
Bedrock 0.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, gravelly loam, moderate brown (5 YR 3/3)	0.3	0.3
Alluvium	Gravel Gravel: fine to cobble with boulders, angular to rounded, sandstone and greywacke with vein-quartz and igneous rocks Sand: fine to coarse, angular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	0.6	0.9
Calciferous Sandstone Measures	Marl, red, soft	0.2	1.1
	Mudstone, silty, light olive grey (5 Y 6/1)	0.4+	1.5

NT 57 SW 27 **5163 7152** **Colstoun Bridge, Lennoxlove** **Block A**

Surface level +58m (+190ft)
Water not struck
Pit
October 1984

Waste 2.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, moderate brown (10 YR 4/4)	0.3	0.3
Alluvium	Clay, silty, unbedded, mottled moderate reddish orange (10 R 5/6)	0.5	0.8
	Gravel, clayey, clasts coarse and fine, subrounded to rounded, of sandstone; matrix is silty clay, moderate brown (5 YR 4/4)	0.6	1.4
	Silt, unbedded, moderate reddish orange (10 R 5/6)	0.1	1.5
Till	Diamicton: clayey silt, soft, pebbly, mottled reddish brown (10 R 4/6)	0.5+	2.0

NT 57 SW 29 **5421 7497** **Stevenson House, Haddington** **Block H_4**

Surface level +43m (+141ft)
Water not struck
Pit
October 1984

Waste 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, moderate yellowish brown (10 YR 4/4)	0.4	0.4
Till	Diamicton: clay, stony, sandy, silty, hard, with fine to cobble size clasts, chiefly white, brown and red sandstones and igneous rocks, boulder at base, soft from 2.1m, mottled medium grey (N5) to moderate brown (5 YR 4/4)	1.9+	2.3

NT 57 SE 1 **5767 7006** **Sled Hill, Garvald** **Block D**

Surface level +185m (+607ft)
Water not struck
250mm percussion
November 1985

Waste 6.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, brown	0.2	0.2
Till	Diamicton: clay, sandy, locally very sandy (1.5 to 1.8m), very stiff to stiff, clasts up to cobble size, but generally fine with coarse below 3.5m, basalt with red and buff sandstones, vein-quartz, greywacke and some coal, moderate reddish brown (10 R 4/6) to 2.5m then dark reddish brown (10 R 3/6 to 3/4)	5.6	5.8
	Diamicton: clay, silty, very sandy, rare subangular, fine gravel-size clasts, chiefly of sandstone, coal and vein-quartz. Frequent thin fine sandy silty seams; moderate reddish brown (10 R 4/6), mottled dark yellowish orange (10 YR 6/6) at base	1.1+	6.9
	Borehole terminated at 6.9m owing to drilling difficulties		

NT 57 SE 2 **5857 7132** **Garvald Grange** **Block D**

Surface level +149.09m (+489.1ft)
Water struck at +141.8m
250mm percussion
June 1985

Overburden	0.3m
Mineral till	1.0m
Mineral	6.0m
Waste	0.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly loam, compacted	0.3	0.3
Flow till	a 'Clayey' gravel; deposit claybound, firm in places but generally soft Gravel: fine and coarse with some cobble, mainly subangular, sandstone, siltstone, greywacke and fine grained igneous rocks with some vein-quartz and quartzite. Cobbles chiefly comprise basaltic rocks Sand: coarse with medium and fine, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, light brown (5 YR 5/6)	1.0	1.3
Glacial sand and gravel	b 'Clayey' sandy gravel, containing seams of poorly sorted sand, pebbly sand and silty sand Gravel: fine with coarse, subangular to well rounded, sandstone, siltstone and fine grained igneous rocks with some vein-quartz and quartzite Sand: medium with coarse and fine, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	2.0	3.3
	c Gravel, clayey to 4.4m Gravel: coarse with fine and some cobble, subangular to rounded, cream sandstone, various igneous rocks of basic to intermediate composition Sand: coarse with medium and some fine, angular to rounded, quartz and rock fragments Fines: silt, disseminated, greyish red (10 R 4/3)	4.0	7.3
Till	Diamicton: clay, sandy, stony, clasts of andesite and limestone, matrix pale reddish brown (10 R 5/5)	0.5+	7.8
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	16	39	45	0.3- 1.3	16	12	12	15	21	20	4
b	14	63	23	1.3- 2.2	12	19	31	20	13	5	0
				2.2- 3.3	15	15	19	24	21	6	0
				Mean	14	17	24	22	17	6	0
c	7	35	58	3.3- 4.4	7	7	13	16	21	15	21
				4.4- 5.5	7	5	14	16	23	24	11
				5.5- 6.5	8	6	9	16	22	39	0
				6.5- 7.3	7	7	11	21	29	25	0
				Mean	7	6	12	17	23	26	9
b&c	9	45	46	Mean	9	10	16	19	21	19	6
a-c	10	43	47	Mean	10	10	15	18	22	19	6

NT 57 SE 3 **5864 7055** **Nunraw Barns, Garvald** **Block D**

Surface level +162.79m (+534.1ft)
Water not struck
250mm percussion
June 1985

Overburden 0.2m
Mineral 3.7m
Waste 2.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: gravelly loam	0.2	0.2
Glacial sand and gravel	Sandy gravel; rare seams of fine sand and silt from 1.3 to 2.4m, gravel from 3.6 to 3.9m Gravel: coarse with fine, subangular to rounded, red and cream sandstones, fine grained basic to intermediate igneous rocks and greywacke with some conglomerate and quartz Sand: coarse with fine and medium, angular to subrounded, quartz and rock fragments Fines: silt, disseminated and in seams to 2.4m, greyish red (10 R 4/2)	3.7	3.9
Till	Diamicton: stony, sandy, silty clay, angular to well rounded clasts of red and grey sandstone, basaltic lava, porphyry, felsite and dolerite, moderate reddish brown (10 R 4/6)	2.6+	6.5
	Borehole terminated owing to slow progress in till		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
9	50	41	0.2- 1.3	8	7	11	15	19	40	0
			1.3- 2.4	12	18	31	18	12	9	0
			2.4- 3.6	8	9	21	21	21	20	0
			3.6- 3.9	No grading data available						
			Mean	9	11	21	18	17	24	0

NT 57 SE 4 **5996 7108** **Stoneypath Tower, Garvald** **Block D**

Surface level +168.3m (+552.2ft)
Water not struck
250mm percussion
July 1985

Overburden 0.3m
Mineral 4.7m
Waste 5.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly loam	0.3	0.3
Glacial sand and gravel	a Sandy gravel; claybound to 0.9m with seams of silt below 1.9m. Gravel becomes finer with depth Gravel: cobble with fine and coarse, subangular to rounded, red and cream sandstones with coarse grained greywacke, basic fine grained igneous rocks and vein-quartz Sand: medium with coarse and fine, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	2.0	2.3
	b 'Very clayey' pebbly sand; with 20cm and 5cm diamict seams from 3.0 to 3.2m and at 4.1m respectively, composed of small gravel clasts in a mottled yellowish brown (10 YR 4/2) and moderate reddish brown (10 R 4/2), silty clayey matrix Gravel: fine and coarse, subangular to rounded, red and cream sandstones with coarse grained greywacke, basic fine grained igneous rocks and vein-quartz Sand: medium with fine and coarse, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated and in clayey bands described above, rare thin coal-rich silty seams, moderate reddish brown (10 R 4/4)	2.7	5.0
Till	Diamicton: silt, sandy, stony, moderately firm, clasts almost entirely composed of fine grained micaceous sandstone, moderate reddish brown (10 R 4/6), becoming sandstone rubble towards base	5.1+	10.1
	Borehole terminated owing to slow progress, probably near to rockhead		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
a	8	52	40	0.3- 1.3	7	7	13	12	17	13	31
				1.3- 2.3	10	11	43	14	10	12	0
				Mean	8	9	30	13	13	12	15
b	23	66	11	2.3- 3.2	18	19	32	15	9	7	0
				3.2- 4.3	20	25	38	12	4	1	0
				4.3- 5.0	35	39	10	4	5	7	0
				Mean	23	27	28	11	6	5	0
a&b	17	59	24	Mean	17	19	28	12	9	8	7

NT 57 SE 5 5973 7004 **Nunraw Abbey, Garvald** **Block D**

Surface level +194.8m (+639.1ft)
Water struck at +184.3m
250 and 200mm percussion
July 1985

Overburden	0.2m
Mineral	7.0m
Waste	3.1m
Mineral till	3.9m
Waste	1.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly	0.2	0.2
Glacial sand and gravel	a Gravel; fining downwards, some small boulders at top Gravel: fine and coarse with cobble, subrounded to well rounded, chiefly yellow, red and grey sandstones, tuff, basalt, quartzite, softish red mudstone, cream ?cornstone and rare vein-quartz Sand: coarse with medium and fine, angular to subrounded, quartz and rock fragments Fines: silt, disseminated, moderate reddish brown (10 R 3/6)	2.0	2.2
	b Sandy gravel; coal debris in sand from 2.2 to 2.5m Gravel: fine with coarse and some cobble, subrounded to well rounded, composition as above Sand: medium with fine and coarse, angular to subrounded, composition as above Fines: silt, disseminated and also as seams of fine sandy silt, moderate yellowish brown (10 YR 5/4)	2.4	4.6
	c Pebbly sand; including 20cm silty sand seam from 5.8 to 6.0m Gravel: fine with some coarse, composition as above Sand: medium with some fine and coarse, angular to subrounded, mainly quartz Fines: silt, disseminated and in seams, moderate yellowish brown (10 YR 5/4)	1.8	6.4

NT 57 SE 5 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
	d Sandy gravel; with cobbles in a sandy matrix from 7.1 to 7.2m Gravel: fine with some coarse, subangular to subrounded, composition as above Sand: medium with coarse and fine, angular to subrounded, quartz and rock fragments Fines: silt, disseminated and some clay as cuticles, moderate reddish brown (10 R 3/6)	0.8	7.2
Till	Diamicton: sand matrix, clayey, silty, firm but crumbling, dispersed clasts up to cobble size, angular to subrounded, chiefly reddish brown sandstone, siltstone, porphyry. Locally more stony with sandy clay matrix. Moderate reddish brown (10 R 4/6)	3.1	10.3
	e 'Very clayey' pebbly sand; crumbly above water, probably diamicton Gravel: coarse and fine, angular to subrounded, black shale and rotted white ?feldspar, with some sandstone Sand: fine with medium and some coarse, moderate yellowish brown (10 YR 5/4)	3.9	14.2
	Diamicton: very sandy clay, silty in part, firm to very stiff, with clasts up to coarse gravel size, angular to rounded, of sandstone, shale and rare coal, moderate yellowish brown (10 YR 5/4) to 14.8m, then moderate brown (5 YR 3/4)	1.0+	15.2
	Borehole terminated for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	4	30	66	0.2- 1.2	2	5	10	12	22	19	30	
				1.2- 2.2	6	7	13	15	29	30	0	
				Mean	4	6	11	13	26	25	15	
b	8	61	31	2.2- 3.2	10	31	29	8	15	7	0	
				3.2- 4.6	6	6	37	13	19	15	4	
				Mean	8	16	34	11	17	12	2	
c	7	88	5	4.6- 5.6	6	13	71	5	4	1	0	
				5.6- 6.4	9	18	65	5	3	0	0	
				Mean	7	15	68	5	4	1	0	
d	8	63	29	6.4- 7.2	8	12	32	19	26	3	0	
e	22	70	8	10.3-14.2	22	42	23	5	4	4	0	§
a&b&d	6	50	44	Mean	6	12	25	13	22	15	7	
a-d	7	60	33	Mean	7	13	36	11	17	11	5	
a-e	12	64	24	Mean	12	23	32	9	12	9	3	

NT 57 SE 6 **5561 7741** **East Bearford** **Block H_4**

Surface level +52.07m (+170.8ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: light, sandy, gravelly loam, moderate brown (5 YR 3/4)	0.3	0.3
Glacial sand and gravel	a Gravel Gravel: fine and coarse with rare cobbles and boulders, subrounded to rounded, sandstone, basalt, felsite and other igneous rocks, with vein-quartz Sand: fine and medium with coarse, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated and clay from rotted igneous clasts, greyish brown (5 YR 4/2)	1.7	2.0
	b Pebbly sand; rare pebbles, possibly fallen in from above Gravel: fine with coarse Sand: fine and medium with some coarse, angular to rounded, chiefly quartz with ferromagnesians, feldspar and rock fragments Fines: silt, disseminated, moderate yellowish brown (10 YR 5/4)	1.3+	3.3

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	6	32	62	0.3- 2.0	6	7	9	16	33	29	0
b	5	89	6	2.0- 3.3	5	47	39	3	4	2	0
a&b	6	57	37	Mean	6	25	22	10	20	17	0

NT 57 SE 7 **5793 7035** **Sled Hill, Garvald** **Block H_4**

Surface level +173.49m (+569.2ft)
Water not struck
Pit
October 1984

Waste 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy loam with pebbles, moderate brown (5 YR 3/3)	0.3	0.3
Till	Diamicton: silty, stony clay, moderately firm, with boulders and cobbles of basic igneous rocks, sandstones, vein-quartz and greywacke, moderate reddish brown (10 R 4/6)	2.0+	2.3

NT 67 NW 3 **6012 7806** **Preston Mains, East Linton** **Block F**

Surface level +20.7m (+67.9 ft)
Water struck at +12.7m
250mm percussion
August 1985

Overburden 0.3m
Mineral 5.8m
Waste 1.4m
Mineral 1.5m
Waste 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravel-rich	0.3	0.3
Glacial sand and gravel	a Gravel; claybound to 2.0m Gravel: coarse with fine and some cobble, subangular to subrounded, sandstone, siltstone, greywacke, basalt, vein-quartz and some coal Sand: medium with coarse and fine, subangular quartz and rock fragments including some coal Fines: disseminated silt and clay with some silty clay laminae, moderate, reddish brown (10 R 4/6)	2.9	3.2
	b Pebbly sand Gravel: fine with coarse, composition as above Sand: medium with fine and coarse, fine grained light brown (5 YR 5/6) seam from 4.2m to 4.6m, composition as above Fines: disseminated silt and clay	2.9	6.1
?Flow till	Diamicton: clay, sandy and silty, stiff, moderate reddish brown (10 R 4/6). Fine gravel-size subangular clasts of sandstone with some coal	0.5	6.6
Glacial sand and gravel	Silty sand, fine with medium and coarse, subangular, quartz and rock fragments. Some rare subrounded fine gravel-size clasts of sandstone and igneous rocks. Silt and clay disseminated, also as coal-rich silty clay laminae. Moderate reddish brown (10 R 4/6)	0.4	7.0

NT 67 NW 3 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
?Flow till	Diamicton: clay, sandy, silty, stiff, with clasts up to cobble size, of sandstone with some basalt. Moderate reddish brown (10 R 4/6)	0.5	7.5
Glacial sand and gravel	c 'Very clayey' pebbly sand; gravel in top 0.5m Gravel: fine with trace coarse, subrounded, sandstone Sand: fine with some medium and coarse, subangular, quartz and rock fragments including coal Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	1.5	9.0
Till	Diamicton: clay, sandy, hard, structureless. Fine gravel- and some cobble-size clasts, subangular, of sandstone, siltstone, coal, rare igneous rocks and greywacke	2.3+	11.3
	Borehole terminated for technical reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	5	42	53	0.3- 1.3	6	9	14	9	16	28	18	
				1.3- 2.2	6	8	16	11	19	40	0	
				2.2- 3.2	4	7	35	15	17	22	0	
				Mean	5	8	22	12	17	30	6	
b	9	71	20	3.2- 4.2	6	7	47	14	16	10	0	
				4.2- 5.2	12	43	19	10	11	5	0	
				5.2- 6.1	9	16	37	21	15	2	0	
				Mean	9	22	34	15	14	6	0	
c	28	62	10	7.5- 9.0	28	46	9	7	9	1	0	§
a&b	7	56	37	Mean	7	15	28	13	16	18	3	
a-c	11	59	30	Mean	11	21	26	12	14	14	2	

NT 67 NW 4 **6069 7749** **Knowes, East Linton** **Block F**

Surface level +14.9m (+48.9 ft)
Water struck at +10.4m
250mm percussion
July 1985

Overburden 0.4m
Mineral 4.1m
Waste 2.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy silty cohesive loam, stony, with fine and coarse, subangular to subrounded gravel clasts, dark yellowish brown (10 YR 4/2) to moderate yellowish brown (5 YR 3/4)	0.4	0.4
Glacial sand and gravel	Gravel; clayey and sandy in places, cohesive Gravel: coarse with fine and trace cobble, subangular to subrounded, indurated siltstone, sandstone, coarse grit, some vein-quartz, basic igneous rocks and rare coal. Sand: coarse and medium with fine, angular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate yellowish brown (10 YR 5/4) to moderate brown (5 YR 3/4)	4.1	4.5
Till	Diamicton: sandy, silty, stony clay with common fine to cobble-size gravel clasts, stiff, dark reddish brown (10 R 3/4) to greyish brown (5 YR 3/2)	2.9+	7.4
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
7	36	57	0.4- 1.4	10	12	9	11	28	30	0
			1.4- 2.4	8	7	10	12	23	40	0
			2.4- 3.0	6	6	10	11	24	35	8
			3.0- 4.0	4	7	20	19	18	32	0
			4.0- 4.5	4	4	28	17	13	28	6
			Mean	7	8	14	14	22	33	2

NT 67 NW 5 **6150 7975** **Tyninghame House** **Block F**

Surface level +22.85m (+75.0ft)
Water not struck
250mm percussion
July 1985

Overburden 0.3m
Mineral 2.0m
Waste 3.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy light loam, greyish brown (5 YR 3/2) to dusky brown (5 YR 2/2)	0.3	0.3
Glacial sand and gravel	Sandy gravel Gravel: fine with coarse and rare cobbles, subangular to rounded, mainly indurated siltstone and sandstone with some basic igneous rocks, vein-quartz, carbonaceous shale and rare agate Sand: medium with some coarse and fine, angular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate brown (5 YR 4/4 to 3/4)	2.0	2.3
Till	Diamicton: silty, sandy, stony clay, soft. Angular to rounded clasts including rotten yellow sandstone, red sandstone, siltstone and some igneous rocks	3.0+	5.3
	Borehole terminated in till owing to very slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
6	56	38	0.3- 1.3	4	7	30	14	23	22	0
			1.3- 2.3	8	7	39	13	20	13	0
			Mean	6	7	36	13	21	17	0

NT 67 NW 6 **6113 7930** **Tyninghame Mains** **Block F**

Surface level +8.9m (+29.2ft)
Water not struck
250mm percussion
July 1985

Waste	3.3m
Bedrock	0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy silty clayey loam, moderate brown (5 YR 3/4)	0.4	0.4
Till	Diamicton: sandy, silty clay, hard, weathered, clasts angular to subangular, of yellow, red and grey sandstones; moderate brown (5 YR 3/4)	1.7	2.1
	Clay, silty, slightly sandy, friable, some pale pink and red sandstone clasts up to cobble size, naturally disturbed appearance, greyish red (10 R 5/2) and flecked grey and red	1.2	3.3
Calciferous Sandstone Measures	Sandstone, fine grained with micaceous partings, laminated, red and white	0.3+	3.6

NT 67 NW 7 **6122 7881** **Dam Bridge, Tyninghame** **Block A**

Surface level +4.45m (+14.6ft)
Groundwater level +3.1m
250mm percussion
October 1985

Overburden	0.3m
Mineral	7.1m
Waste	0.6m
Mineral till	1.1m
Waste	1.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty loam, dark brown	0.3	0.3
Alluvium	a 'Very clayey' pebbly sand Gravel: fine with coarse, subrounded to rounded, vesicular basalt, greywacke and sandstone Sand: fine with medium and some coarse, angular to subrounded, quartz and rock fragments, including coal Fines: silt and clay, disseminated, moderate brown (5 YR 4/3)	1.0	1.3
	b Sandy gravel Gravel: coarse with fine with rare cobbles, subangular to well rounded, cream and buff sandstones, vesicular basalt, greywacke and vein-quartz Sand: medium with coarse and fine, angular to subangular, quartz and rock fragments including coal Fines: silt and clay, disseminated, dark yellowish brown (10 YR 4/2)	6.1	7.4

NT 67 NW 7 cont'd

LOG

Geological classification	Lithology	Thickness m	Depth m
Till	Diamicton: sandy, silty clay, firm, with fine gravel-size clasts, subangular to subrounded, of red and yellow sandstones, siltstone and basalt with vein-quartz and some greywacke	0.6	8.0
	c Gravel; washed till Gravel: coarse and fine with rare cobbles, subangular to subrounded, sandstone, basalt, tuff and vein-quartz Sand: coarse with medium and fine, subangular, quartz and rock fragments Fines: silt and clay, disseminated and as silty clay seams	1.1	9.1
	Diamicton: silty, stony clay, stiff to very stiff, abundant clasts up to cobble size, of sandstone, vesicular basalt, greywacke and vein-quartz, moderate brown (5 YR 3/4)	1.5+	10.6
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	30	66	4	0.3- 1.3	30	42	20	4	3	1	0	
b	3	52	45	1.3- 2.3	6	19	51	8	8	8	0	§
				2.3- 3.4	3	5	18	15	27	32	0	§
				3.4- 4.6	2	8	14	15	26	35	0	§
				4.6- 5.6	2	10	39	20	13	16	0	§
				5.6- 6.6	2	12	24	14	16	32	0	§
				6.6- 7.4	2	7	26	13	29	23	0	§
				Mean	3	10	28	14	20	25	0	
c	7	38	55	8.0- 9.1	7	9	11	18	26	29	0	§
a&b	7	55	38	Mean	7	15	27	13	17	21	0	
a-c	7	52	41	Mean	7	14	25	13	19	22	0	

NT 67 NW 8 **6168 7783** **Kirklandhill, Tyninghame** **Block F**

Surface level +18.75m (+61.5ft)
Water struck at +15.6m
250mm percussion
August 1985

Overburden 0.3m
Mineral 2.8m
Waste 1.3m
Bedrock 0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam	0.3	0.3
Glacial sand and gravel	Sandy gravel; deposit becomes slightly bound towards 3.1m Gravel: fine with coarse, subrounded, sandstone, siltstone, intermediate and basic igneous rocks, some greywacke Sand: medium and fine with coarse, subangular to subrounded, quartz and rock fragments including coal. Five centimetre layer of very coal-rich clayey sand from 2.95 to 3.0m Fines: silt and clay, disseminated, moderate brown (5 YR 3/4)	2.8	3.1
Till	Diamicton: stony clay, very sandy and firm to 3.3m then moderately stiff, with fine gravel-size subangular clasts, of sandstone, coal and igneous rocks; moderate reddish brown (10 R 4/6)	1.3	4.4
Carboniferous	Dolerite, extremely hard	0.1+	4.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
7	60	33	0.3- 1.3	7	31	17	10	21	14	0
			1.3- 2.3	6	16	28	13	23	14	0
			2.3- 3.1	9	18	36	12	19	6	0
			Mean	7	22	26	12	21	12	0

NT 67 NW 9 **6235 7875** **Firth Plantation, Kirklandhill** **Block A**

Surface level +2.9m (+9.5ft)
Groundwater level +1.7m
250 and 200mm percussion
October 1985

Overburden	0.6m
Mineral	4.9m
Waste	0.3m
Mineral	2.9m
Waste	11.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, light brown	0.2	0.2
Post-Glacial marine deposits	Silt, with some fine sand and many rootlets, mottled pale yellowish brown (10 YR 6/2) and moderate yellowish brown (10 YR 5/4)	0.2	0.4
	Sand, fine, very silty, with rootlets, pale yellowish brown (10 YR 6/2) to moderate yellowish brown (10 YR 5/4)	0.2	0.6
	a Sand, with rare gravel. Shell debris below 3.3m Gravel: fine with trace coarse, subangular to rounded, including sandstone, lavas and vein-quartz Sand: fine with medium and some coarse, angular to subrounded, quartz with rock fragments, feldspar and coal Fines: silt and clay as seams below 3.3m, also disseminated, moderate brown (5 YR 4/4) becoming brownish grey (5 YR 4/1)	4.9	5.5
Late-Glacial marine deposits	Silt, clayey, unbedded, rootlets common, with coal fragments in upper part, greyish brown (5 YR 4/2)	0.3	5.8
	b Sandy gravel Gravel: fine with coarse and rare cobbles, subrounded to rounded, commonly flaky, mainly sandstones with vein-quartz, fine and coarse grained igneous rocks and greywacke Sand: medium and coarse with fine, angular to well rounded, quartz and rock fragments with some feldspar and coal Fines: most washed out, light brownish grey (5 YR 5/1)	2.9	8.7
	Silt, laminated, with clay laminae and seams of very fine sand, micaceous, brownish grey (5 YR 4/1)	3.8	12.5
	Clay, silty, becoming more plastic with depth to 15.5m, then stiff, brownish grey (5 YR 4/1)	4.5	17.0
Till	Diamicton: sandy stony clay, stiff, cobbles rare, clasts mainly of sandstone and various igneous rocks, with greywacke, limestone and coal, greyish brown (5 YR 3/2) at top, becoming moderate brown (5 YR 3/4) by 19.0m	3.3+	20.3
	Borehole terminated for operational reasons		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	8	91	1	0.6- 2.0	16	36	38	8	2	0	0	§
				2.0- 3.3	4	10	66	16	3	1	0	§
				3.3- 4.5	4	91	3	2	0	0	0	§
				4.5- 5.5	5	59	34	2	0	0	0	§
				Mean	8	48	36	7	1	**	0	
b	4	52	44	5.8- 6.6	3	6	27	20	24	20	0	§
				6.6- 7.8	3	8	33	20	24	12	0	§
				7.8- 8.4	2	6	10	13	33	36	0	§
				8.4- 8.7	10	50	8	7	13	12	0	§
				Mean	4	11	24	17	25	19	0	
a&b	6	77	17	Mean	6	34	32	11	10	7	0	

NT 67 NW 10 **6284 7807** **Tynefield, East Linton** **Block F**

Surface level +13.7m (+44.9ft)
Water struck at +9.9m
250mm percussion
September 1985

Waste 5.5m
Bedrock 0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Diamicton: silty, sandy, pebbly clay, stiff, becoming softer at 1.2m, very stiff from 1.6m, clasts generally fine gravel size with some up to cobble size above 1.6m, up to boulder size below 1.6m, composed of angular to subangular basalt, dolerite and sandstone with some dark grey mudstone. Mottled dark yellowish brown (10 YR 4/2) and light brown (5 YR 5/6) above 1.6m, becoming moderate brown (5 YR 3/4) by 3.0m	5.2	5.5
Calciferous Sandstone Measures	Siltstone, fine grained, soft, poorly bedded, micaceous, composed of quartz and mica with carbonaceous fragments and some feldspar, medium dark grey (N4)	0.7m+	6.2

NT 67 NW 11 **6384 7800** **Hedderwick Hill, West Barns** **Block F**

Surface level +18.5m (+60.7ft)
Water struck at +8.0m
250 and 200mm percussion
July 1985

Overburden	0.4m
Mineral	7.4m
Waste	0.2m
Mineral	2.2m
Waste	7.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, brown	0.4	0.4
Glacial sand and gravel	a 'Clayey' sand; some rare gravel clasts Gravel: fine with trace coarse, subangular to subrounded, sandstone, siltstone, basalt and some coal Sand: fine with medium and some coarse, subangular to subrounded, quartz and rock fragments including coal. Coal abundant from 1.7m to 3.5m Fines: silt and clay, disseminated and as sandy silt seams, more abundant with depth, moderate brown (5 YR 4/4), black between 1.7 and 3.5m	4.0	4.4
Glaciolacustrine deposits	b 'Very clayey' sand; silt and clay laminae and seams becoming more abundant with depth, up to 10cm thick near the base of deposit Sand: fine with some medium, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated and as laminae and seams, moderate brown (5 YR 3/4)	3.4	7.8
	Clay, plastic, moderately stiff, moderate reddish brown (10 R 4/6)	0.2	8.0
	c 'Very clayey' sand; rare coarse gravel Sand: fine with trace medium, subangular and subrounded, quartz, rock fragments and rare coal Fines: silt and clay, disseminated and as thin silty clay laminae, light brown (5 YR 5/6)	2.2	10.2
	Clay, plastic, moderately stiff, with some thin sand lenses, moderate brown (5 YR 3/4)	0.3	10.5
	Silt, sandy, clayey, soft to very soft, frequent sandy and silty clay seams up to 10cm thick, increasingly abundant with depth, moderate reddish brown (10 R 4/6)	4.6	15.1
Till	Diamicton: sandy, silty, stony clay, stiff to very stiff, clasts up to cobble size, subangular to subrounded, of basalt with sandstone, siltstone, coal and limestone	2.1+	17.2
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	13	85	2	0.4- 1.4	7	29	42	12	8	2	0
				1.4- 2.4	20	53	23	3	1	0	0
				2.4- 3.4	15	71	13	1	0	0	0
				3.4- 4.4	9	75	16	0	0	0	0
				Mean	13	57	24	4	2	**	0
b	27	73	0	4.4- 5.4	36	59	5	0	0	0	0
				5.4- 6.4	20	79	1	0	0	0	0
				6.4- 7.8	25	73	2	0	0	0	0
				Mean	27	70	3	0	0	0	0
c	34	65	1	8.0- 9.0	40	58	2	0	0	0	0
				9.0-10.2	29	70	0	0	0	1	0
				Mean	34	64	1	0	0	1	0
b&c	30	70	0	Mean	30	68	2	0	0	**	0
a-c	23	76	1	Mean	23	63	11	2	1	**	0

NT 67 NW 12 **6373 7531** **Pitcox** **Block H_5**

Surface level +82.4m (+270ft)
Water not struck
250mm percussion
July 1985

Overburden 0.7m
Mineral 2.8m
Waste 2.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, silty, sandy, with rootlets, moderate brown (5 YR 3/4)	0.5	0.5
Flow Till	Diamicton: clay, stony, with subangular to subrounded cobbles and boulders of purple sandstone and andesite; generally moderate reddish brown (10 R 4/6) flecked with yellow limonite and black manganese oxide patches	0.2	0.7
Glacial sand and gravel	'Clayey' gravel; some silty sandy lenses between 1.7m and 2.7m, boulder at 2.7m Gravel: coarse and fine with cobbles, chiefly purple-red and white sandstones, intermediate and basic igneous rocks and rare limestone Sand: fine and medium with coarse, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated and as infrequent lenses and thin seams, and dark reddish brown (10 R 3/4)	2.8	3.5
Till	Diamicton: clay, stony, very hard, clasts of sandstone, shale and weathered igneous rocks, with some coal fragments, moderate brown (5 YR 3/4) to greyish brown (5 YR 3/2) and dark reddish brown (10 R 3/4)	2.8+	6.3
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
14	40	46	0.7- 1.7	10	16	12	8	17	20	17
			1.7- 2.7	15	18	15	10	14	22	6
			2.7- 3.5	17	16	14	10	16	18	9
			Mean	14	17	14	9	16	19	11

NT 67 NW 13 **6413 7891** **West Links, Dunbar** **Block A**

Surface level +3.4m (+11ft) Mineral 9.9m+
Groundwater level +0.8m
250mm percussion
July 1985

LOG

Geological classification	Lithology	Thickness m	Depth m
Blown sand	a Sand Gravel: rare fine and coarse, subrounded, sandstone and shell fragments Sand: fine with some medium and trace coarse, subangular, quartz, rock and shell fragments Fines: silt and clay, disseminated with a few sandy silt lenses near base of deposit, light brown (5 YR 6/4 to 5/6)	4.1	4.1
?Post-Glacial marine deposits	b 'Clayey' sand Gravel: trace of sandstone, shell, coal and wood Sand: fine with rare medium, subangular, quartz, rock fragments, shell debris and coal Fines: silt and clay, disseminated and as silt lenses, medium grey (N5)	2.0	6.1
	c Sand Gravel: rare clasts as above Sand: fine with medium and rare coarse, as above Fines: disseminated silt and clay, medium grey (N5) to 8.0m then brownish grey (5 YR 4/1)	3.8+	9.9
	Borehole terminated owing to rising sand		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
a	6	92	2	0.0- 1.0	4	74	19	1	1	1	0	
				1.0- 2.0	6	77	15	1	1	0	0	
				2.0- 3.0	7	82	10	1	0	0	0	
				3.0- 4.1	8	67	21	1	1	2	0	§
				Mean	6	75	16	1	1	1	0	
b	16	84	0	4.1- 5.1	22	75	3	0	0	0	0	§
				5.1- 6.1	10	86	4	0	0	0	0	§
				Mean	16	80	4	0	0	0	0	
c	2	98	0	6.1- 7.1	5	82	13	0	0	0	0	§
				7.1- 8.1	2	61	36	1	0	0	0	§
				8.1- 9.1	1	52	46	1	0	0	0	§
				9.1- 9.9	1	49	43	5	2	0	0	§
				Mean	2	62	34	2	**	0	0	
b&c	7	93	0	Mean	7	68	24	1	**	0	0	
a-c	7	93	0	Mean	7	71	21	1	**	**	0	

NT 67 NW 14 **6077 7994** **St Baldred's Cottage, Tyninghame** **Block F**

Surface level +19.7m (+64.6ft)
Water struck at +16.2m
Pit
October 1984

Waste 3.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam	0.3	0.3
Glacial sand and gravel	'Clayey' sand; coal-rich seams from 0.6m to 0.7m Sand: fine and medium with some coarse, subangular to subrounded, quartz with some feldspar, ferromagnesian minerals, mica and coal Fines: silt and clay, disseminated and as seams	0.7	1.0
	Silt, sandy, moderate yellowish brown (10 YR 5/4)	0.2	1.2
	Sand, extremely silty, non-mineral, some rare fine gravel. Sand is fine with some medium and trace coarse, subangular to subrounded quartz, with some feldspar, ferromagnesian minerals, mica and coal. Fines as disseminated silt and clay and as silt seams from 1.3 to 1.4m and 2.1 to 2.3m. Moderate yellowish brown (10 YR 5/4)	1.6	2.8
	'Very clayey' sand; rare fine gravel Sand: fine, angular to rounded, mainly quartz with coal and mica Fines: disseminated silt and clay, and silt seams, brownish grey (5 YR 5/1)	0.8+	3.6

NT 67 NW 16 **6257 7968** **Fir Links Wood, Tyninghame House** **Block A**

Surface level +6.64m (+21.8ft)
Water not struck
Pit
October 1984

Overburden 0.8m
Mineral 2.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and subsoil: sandy loam, moderate brown (5 YR 3/4)	0.8	0.8
Post-Glacial marine deposits	Pebbly sand Gravel: coarse with fine are rare cobbles, rounded, igneous rocks Sand: fine with medium and trace coarse, angular to subrounded, quartz, shell fragments, feldspar, some rock fragments and ferromagnesian minerals Fines: silt, disseminated, moderate reddish brown (10 R 4/6) then greyish orange (10 YR 7/4)	2.6+	3.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
2	92	6	0.8- 2.0	3	67	29	0	1	0	0
			2.0- 3.4	2	51	37	1	2	7	0
			Mean	2	58	33	1	2	4	0

NT 67 NW 18 6305 7759 **Tynefield** **Block F**

Surface level +16.8m (+55.1ft)
Water struck at +14.1m
Pit
October 1984

Overburden 0.3m
Mineral 2.3m
Waste 0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, greyish brown (5 YR 3/2)	0.3	0.3
Glacial sand and gravel	Pebbly sand Gravel: fine with some coarse, rounded to well rounded clasts Sand: medium with coarse and some fine, angular to rounded, quartz, rock fragments, feldspar, ferromagnesian minerals and coal, Fines: silt, disseminated, light brown (5 YR 4/4)	2.3	2.6
Till	Diamicton: silty stony clay, firm, moderate brown (5 YR 3/4)	0.1+	2.7

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
5	80	15	0.3- 2.6	5	4	56	20	12	3	0

NT 67 NW 19 6248 7560 **Bielmill, Stenton** **Block H_5**

Surface level +54.67m (+179.4ft)
Water struck (perched) at +151.3m
Pit
October 1984

Overburden 0.3m
Mineral 2.9m
Waste 0.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty pebbly loam, moderate brown (5 YR 3/4)	0.3	0.3
Glacial sand and gravel	Gravel; claybound, with boulders Gravel: coarse, cobble and fine, subrounded to rounded, red and white sandstones, limestone greywacke and igneous rocks Sand: coarse, medium and fine, angular to rounded, chiefly quartz and rock fragments Fines: silt and clay, disseminated, dark reddish brown (10 R 3/4)	2.9	3.2
Till	Diamicton: silty, stony clay, fine gravel-size clasts including coal, dark yellowish brown (10 YR 4/2)	0.2+	3.4

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
6	27	67	0.3- 2.3	6	9	8	8	15	24	30
			2.3- 3.2	7	4	10	19	24	33	3
			Mean	6	7	9	11	18	27	22

NT 67 NW 20 6425 7606 **Biel (East Lodge), Pitcox** **Block H_5**

Surface level +48.6m (+159.4 ft)
Water not struck
Pit
October 1984

Waste 2.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, pebbly, moderate brown (5 YR 4/4)	0.3	0.3
Till	Diamicton: clay, stony, firm, clasts of red and white sandstones, siltstone, igneous rocks and coal fragments, moderate reddish brown (10 R 4/4), mottled from 0.3 to 0.7m	2.3+	2.6

NT 67 NE 21 **6905 7768** **Newtonlees, Dunbar** **Block H_6**

Surface level +20m (+66ft)
Water not struck
250mm percussion
October 1985

Overburden	0.3m
Mineral	8.9m
Mineral till	1.5m
Waste	1.5m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, pebbly, clayey	0.3	0.3
Glacial sand and gravel	a 'Clayey' sandy gravel; claybound with diamict seams to 2.0m, cobbles rare or absent from 5.0 to 8.8m Gravel: fine and coarse with some cobble, subangular to rounded, sandstones and greywacke with limestone, dolerite, ironstone and, below 3.9m, vein-quartz and basalt Sand: coarse with medium and some fine, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/5)	8.9	9.2
Till	b 'Very clayey' gravel; very sandy stony silt (diamicton), clast supported Gravel: coarse and fine with cobble, angular to rounded, chiefly sandstone and some siltstone with basic lava Sand: coarse, medium and fine, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	1.5	10.7
	Diamicton: clay, silty, stony, with silty and sandy laminae around 11.0m, fine to cobble size clasts, chiefly of sandstone, limestone, lavas and coal. Reddish brown (10 R 4/6) to dusky yellowish brown (10 YR 3/2) and then greyish brown (5 YR 3/2)	1.5+	12.2
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	11	51	38	0.3- 1.5	15	14	16	19	19	17	0
				1.5- 2.7	13	12	15	17	16	27	0
				2.7- 3.9	8	7	9	13	22	29	12
				3.9- 5.0	10	8	17	27	28	10	0
				5.0- 6.2	10	9	24	32	18	7	0
				6.2- 7.3	12	9	19	29	23	8	0
				7.3- 8.8	8	6	26	29	19	12	0
				8.8- 9.2	11	8	13	16	15	26	11
				Mean	11	9	18	24	20	16	2
b	21	25	54	9.2-10.7	21	8	8	9	20	23	11
a&b	12	48	40	Mean	12	9	17	22	20	17	3

NT 67 NE 22 **6960 7718** **West Lodge, Broxmouth, Dunbar** **Block H_6**

Surface level +19m (+62ft)
Water not struck
250mm percussion
June 1985

Waste 5.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, some pebbles, brown	0.3	0.3
Till	Diamicton: clay, silty in part with thin sandy lenses near base, soft to moderately stiff, fine gravel-size clasts, subangular to subrounded, of red and yellow sandstones, siltstone, coal, some limestone and greywacke; some clasts soft and friable, moderate brown (5 YR 4/4)	1.2	1.5
Glacial sand and gravel	'Very clayey' pebbly sand Gravel: fine, subrounded, sandstone Sand: fine with medium and some coarse, subangular to subrounded, quartz and rock fragments Fines: disseminated silt and clay, deposit cohesive, moderate brown (5 YR 4/4)	0.5	2.0
Till	Diamicton: clay, silty, sandy, stiff to very stiff, clasts up to cobble size, chiefly fine grained red sandstone and siltstone with coal, greywacke and limestone, moderate reddish brown to 2.5m, moderate red (5 R 4/6) to 4.8m, then moderate brown (5 YR 4/4)	3.9+	5.9
	Borehole terminated owing to slow progress		

NT 67 NE 23 **6944 7629** **Little Pinkerton, Dunbar** **Block H_6**

Surface level +57m (+187ft)
Water not struck
250mm percussion
October 1985

Overburden 0.4m
Mineral till 1.3m
Waste 4.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty pebbly loam, moderate brown (5 YR 3/4)	0.4	0.4
Till	Gravel; claybound in part, till-like deposit Gravel: coarse with fine and cobble, subangular to rounded, chiefly purple to red sandstone and greywacke, with some limestone, vein-quartz and rare igneous rocks Sand: fine with some medium and coarse, angular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	1.3	1.7
	Diamicton: poor recovery to 4m, then clay, sandy, stony, firm, clasts of buff, cream, red and purple sandstones, greywacke, igneous rocks and coal, becoming clast rich with depth; moderate brown (5 YR 3/3) then moderate reddish brown (10 R 4/6) from 4.9m	4.8+	6.5
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- 1/16	+ 1/16 - 1/4	+ 1/4 -1	+1-4	+4-16	+16-64	+64 mm
7	23	70	0.4- 1.7	7	5	6	12	20	30	20

NT 67 NE 24 **6519 7862** **East Links, West Barns** **Block A**

Surface level +4m (+13ft)
Groundwater level +2m
Pit
November 1984

Overburden 0.3m
Mineral 2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: sandy loam, greyish brown (5 YR 3/2)	0.3	0.3
Post-Glacial marine deposits	Pebbly sand, well bedded Gravel: fine, including shell fragments Sand: fine with some medium and coarse, angular to rounded, quartz and rock fragments with ferromagnesian minerals and shell fragments Fines: silt, mainly in thin seams, greyish orange (10 YR 7/4) through pale brown (5 YR 5/2) to dark grey (N3)	2.2+	2.5
	Pit abandoned due to collapse		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- 1/16	+ 1/16 - 1/4	+ 1/4 -1	+1-4	+4-16	+16-64	+64 mm
5	90	5	0.3- 2.5	5	66	19	5	5	0	0 §

NT 67 NE 25 6598 7784 **West Barns, Dunbar** **Block H_6**

Surface level +18m (+59ft)
Water not struck
Pit
October 1984

Waste 2.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, greyish brown (5 YR 3/2)	0.4	0.4
Glacial sand and gravel	'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded, chiefly red and cream sandstones with various fine-grained igneous rocks and vein-quartz Sand: fine and medium with coarse, angular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, deposit quite claybound, greyish red (10 R 4/2)	0.6	1.0
Till	Diamicton: clay, silty, gravel-rich, soft to moderately firm, clasts up to cobble size, composition as above, moderate reddish brown (10 R 4/4)	1.2+	2.2

NT 67 NE 26 6591 7740 **West Barns Mains, Dunbar** **Block H_6**

Surface level +27m (+89ft)
Water not struck
Pit
October 1984

Waste 1.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: pebbly silty loam, greyish brown (5 YR 3/2)	0.6	0.6
Till	Diamicton; clay, silty, stony, moderately firm, clasts up to cobble size, also rare boulders, chiefly cream and red sandstones with various igneous rocks; greyish yellowish brown (10 YR 5/2) at top, then moderate reddish brown (10 R 4/6)	1.0+	1.6

NT 67 NE 27 **6683 7744** **Eweford, Dunbar** **Block H_6**

Surface level +25m (+82ft)
Water not struck
Pit
November 1984

Overburden 0.7m
Mineral till 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.7	0.7
Till	'Clayey' gravel; diamicton, very stony, sandy, dense Gravel: coarse and fine with some cobbles and boulders, angular to rounded, chiefly sandstone with greywacke, red siltstone and fine grained igneous rocks Sand: coarse with medium and fine, angular to rounded, quartz and rock fragments Fines: clay and silt, disseminated, moderate reddish brown (10 R 4/4)	2.3+	3.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
13	31	56	0.7- 3.0	13	7	8	16	22	25	9

NT 67 NE 28 6811 7733 **Easter Broomhouse, Dunbar** **Block H_6**

Surface level +24m (+79ft)
Water not struck
Pit
November 1984

Waste 3.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.8	0.8
Glacial sand and gravel	Sandy gravel; poorly sorted, slightly claybound Gravel: fine and coarse, subangular to rounded, chiefly sandstone with greywacke Sand: fine and medium, angular to subrounded, chiefly quartz Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	0.7	1.5
Till	Diamicton: clay, silty, very stony, clasts less than boulder size, angular to well rounded, chiefly sandstone and greywacke with dolerite and cornstone, moderate reddish brown (10 R 4/4)	1.6+	3.1

NT 67 NE 29 6825 7645 **Easter Broomhouse, Dunbar** **Block H_6**

Surface level +55m (+180ft)
Water not struck
Pit
October 1984

Waste 3.2m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, pebbly loam, moderate brown (5 YR 4/4)	0.4	0.4
Till	Diamicton: clay, silty, stony, clasts up to cobble size, chiefly sandstone and basalt with greywacke mudstone fragments becoming more abundant with depth, moderate reddish brown (10 R 4/6)	2.8+	3.2

NT 67 NE 30 **6977 7591** **Little Pinkerton, Dunbar** **Block H_6**

Surface level +68m (+223ft)
Water struck (perched) at +64.5m
Pit
November 1984

Overburden 0.6m
Mineral 2.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy, pebbly loam, greyish brown (5 YR 3/2)	0.6	0.6
Glacial sand and gravel	'Clayey' pebbly sand; silty sand with pebbly seams, rare diamict seams in lower part Gravel: coarse and fine with rare cobbles, subangular to subrounded, sandstone, greywacke and fine grained igneous rocks Sand: fine with medium and some coarse, angular to rounded, chiefly quartz Fines: silt, disseminated and in seams, moderate reddish brown (10 R 4/4)	2.9+	3.5

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
12	73	15	0.6- 3.5	12	43	25	5	7	8	0

NT 67 NE 31 **6844 7668** **Easter Broomhouse, Dunbar** **Block H_6**

Surface level +51m (+167ft)
Water not struck
Pit
October 1984

Waste	0.4m
Bedrock	0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy, pebbly loam, greyish red (10 R 4/3)	0.4	0.4
Upper Old Red Sandstone	Sandstone; broken, fine to medium grained with scattered subrounded to rounded pebbles of fine gravel size; sand is subangular to rounded, chiefly quartz; moderate red (5 R 4/4)	0.7+	1.1

NT 67 SW 1 **6020 7347** **Whittinghame House** **Block H_5**

Surface level +103m (+338ft)
Water struck at +101m
250mm percussion
July 1985

Overburden	3.8m
Mineral	2.6m
Waste	1.4m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, dark brown	0.4	0.4
Flow till	Diamicton: clay, very sandy, gravelly, firm to crumbly, cohesive but barely plastic, becomes sandy silty clay with depth, then sandy near base; clasts up to cobble size chiefly of red sandstone; moderate reddish brown (10 R 4/6) mottled with yellow and orange-brown; some manganese staining on fissures	3.4	3.8
Glacial sand and gravel	Pebbly sand; less gravel-rich below 4.8m Gravel: fine and coarse with some cobbles, subangular to subrounded, sandstone, siltstone, lava, felsite and basalt Sand: medium with coarse and some fine, subangular, quartz and rock fragments Fines: silt and clay, disseminated	2.6	6.4
	Diamicton: clay, silty, sandy, stiff to very stiff, clasts up to cobble and boulder size, but generally fine and coarse, chiefly yellow and white sandstones, basalt, greywacke, siltstone, black shale and coal with rare vein-quartz, moderate reddish brown (10 R 4/6)	1.4+	7.8
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
4	72	24	3.8- 4.8	4	6	18	32	20	20	0	§
			4.8- 5.8	3	8	51	23	8	2	5	§
			5.8- 6.4	6	34	36	13	5	6	0	§
			Mean	4	13	35	24	12	10	2	

NT 67 SW 2 **6185 7299** **Ruchlaw West Mains, Stenton** **Block H_5**

Surface level +130m (+427ft)
Water not struck
250mm percussion
July 1985

Overburden 0.3m
Mineral till 1.1m
Waste 1.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly, reddish brown	0.3	0.3
Till	'Clayey' sandy gravel; diamicton, very sandy with seams of clayey pebbly sand Gravel: fine and coarse with some cobble, angular to rounded, chiefly red, yellow and white sandstones with red mudstone, basalt, felsite/porphyry and some coal Sand: medium, coarse and fine Fines: silt and clay matrix, moderate reddish brown (10 R 4/6)	1.1	1.4
	Diamicton as above, but more clayey and stiff	1.3+	2.7
	Borehole terminated owing to rock obstruction		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
18	50	32	0.3- 1.4	18	15	18	17	14	13	5	

NT 67 SW 3 **6195 7145** **Deuchrie, Stenton** **Block E**

Surface level +194m (+636ft)
Water not struck
250mm percussion
July 1985

Overburden 2.1m
Mineral 7.4m
Waste 2.9m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey, brown	0.2	0.2
Flow till	Diamicton: clay, silty, locally sandy, stony, moderately stiff, clasts up to cobble size, red and cream sandstones, siltstone, basalt, felsite, greywacke, agglomerate and some coal, moderate reddish brown (10 R 4/6)	1.9	2.1
Glacial sand and gravel	'Very clayey' sand becoming finer grained with depth; fine, subrounded sandstone clasts Sand: fine with some medium and trace coarse, subangular to subrounded, quartz and rock fragments Fines: silt, disseminated and thin sandy silt seams above 3.6m and more commonly below 5.2m, some coal flecks, moderate brown (5 YR 4/4)	7.4	9.5
	Silt, clayey, sandy, with many thin sand and stiff clayey seams, and rare fine gravel, chiefly of sandstone, becoming till-like at base, moderate brown (5 YR 4/4)	0.9	10.4
Till	Diamicton: clay, silty, sandy, stony, stiff, with clasts up to boulder size, chiefly sandstone with some siltstone, coal and greywacke, much tuff at base, moderate reddish brown (10 R 4/6)	2.0+	12.4
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm	
22	78	0	2.1- 3.1	34	64	2	0	0	0	0	
			3.1- 4.1	23	74	3	0	0	0	0	
			4.1- 5.2	11	80	9	0	0	0	0	
			5.2- 6.2	28	69	3	0	0	0	0	
			6.2- 7.2	22	74	4	0	0	0	0	
			7.2- 8.2	28	68	4	0	0	0	0	
			8.2- 9.5	12	85	2	1	0	0	0	§
			Mean	22	74	4	**	0	0	0	

NT 67 SW 4 **6253 7488** **Newbarns, Stenton** **Block H_5**

Surface level +87m (+285ft)
Water struck at +85.5m
250mm percussion
July 1985

Overburden 0.2m
Mineral till 1.5m
Waste 4.0m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly, reddish brown	0.2	0.2
Till	'Very clayey' pebbly sand; diamicton, becoming more clayey with depth Gravel: fine with coarse and rare cobbles and boulders, angular to well rounded, red, yellow and white sandstones, greywacke, basalt and rare vein-quartz Sand: fine with medium and some coarse Fines: silt and clay, moderate reddish brown (10 R 4/6)	1.5	1.7
	Diamicton; as above, but more clayey and stiff with irregular seams of very silty fine sand, gravel-rich in places	1.2	2.9
	Diamicton: clay, silty, sandy, with abundant cobbles and boulders, clast supported, clasts chiefly of red sandstone, dolerite, grey gritstone	2.8+	5.7
	Borehole terminated owing to slow progres		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
30	66	4	0.2- 1.7	30	42	20	4	3	1	0

NT 67 SW 5 **6482 7257** **Halls, Stenton** **Block E**

Surface level +181m (+594ft)
Water not struck
250mm percussion
July 1985

Overburden 0.3m
Mineral 2.2m
Waste 1.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground; cobbles and boulders in sandy clay matrix	0.3	0.3
Glacial sand and gravel	'Clayey' gravel; till-like band from 1.7 to 2.0m, cohesive Gravel: coarse with fine, subangular to subrounded, grey, yellow and red sandstones, with greywacke and indurated siltstone Sand: coarse and medium with fine, subangular, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	2.2	2.5
Till	Diamicton: clay, silty, sandy, stiff to very stiff, with clasts up to cobble size, but generally fine with coarse, subangular, of indurated sandstone and siltstone, greywacke and some igneous rocks, moderate reddish brown (10 R 4/6)	1.3+	3.8
	Borehole terminated owing to lack of progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
11	38	51	0.3- 1.3	7	7	11	15	24	36	0
			1.3- 2.5	15	13	16	13	22	21	0
			Mean	11	10	14	14	23	28	0

NT 67 SW 6 6075 7411 **Eastfield, Stenton** **Block H_5**

Surface level +87m (+285ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 2.4m
Waste 0.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, greyish red (5 R 4/2)	0.3	0.3
Glacial sand and gravel	Gravel, locally claybound Gravel: coarse and fine with some cobble and boulder, subrounded to rounded, chiefly red sandstone, some white sandstone, greywacke and igneous rocks Sand: coarse and medium with fine, angular to well rounded, chiefly quartz with rock fragments Fines: silt, disseminated, greyish red (10 R 4/2)	2.4	2.7
Till	Diamicton: clay, silty, stony, micaceous, clasts of fine and coarse gravel size with some cobbles, moderate reddish brown (10 R 4/4)	0.3+	3.0

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
2	40	58	0.3- 1.5	3	3	13	15	22	34	10
			1.5- 2.7	1	9	20	22	29	19	0
			Mean	2	6	16	18	25	28	5

NT 67 SW 7 6169 7453 **Ruchlaw Mains, Stenton** **Block H_5**

Surface level +86m (+282ft)
Water not struck
Pit
October 1984

Overburden 0.3m
Mineral 2.4m
Waste 0.1m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, pebbly, sandy loam, greyish brown (5 YR 4/2)	0.3	0.3
Glacial sand and gravel	Gravel Gravel: cobble with coarse, fine and some boulders, subangular to well rounded, chiefly red and white sandstones, greywacke and igneous rocks Sand: coarse with medium and fine, angular to rounded, quartz with rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	2.4	2.7
Till	Diamicton: clay, silty, pebbly, soft, dark reddish brown (10 R 3/4)	0.1+	2.8

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
7	22	71	0.3- 2.7	7	6	7	9	16	25	30

NT 67 SE 15 **6515 7321** **Pathhead, Stenton** **Block E**

Surface level +165m (+541ft)
Water struck at +147m
250 and 200mm percussion
July 1985

Overburden 0.2m
Mineral 11.8m
Waste 8.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly, brown	0.2	0.2
Glacial sand and gravel	Gravel, poorly bedded and locally claybound with till-like seams in places, some boulders below 5.2m Gravel: fine and coarse with cobble, subangular to subrounded, greywacke, indurated sandstone, siltstone and some volcanic rocks; some clasts weathered Sand: coarse with medium and fine, subangular, quartz and rock fragments Fines: silt and clay, disseminated	11.8	12.0
Till	Diamicton: clay, sandy, firm, locally clast supported, abundant clasts, up to cobble size, subangular to subrounded, of indurated red sandstone, shale and greywacke, moderate reddish brown	6.0	18.0
	Diamicton: clay, stiff to very stiff, locally slightly sandy, with fine and coarse gravel-size clasts, subangular to subrounded, greywacke and sandstone, with basalt, felsite and greywacke siltstone, dark reddish brown (10 R 3/4) to 19.0m, then moderate red (5 R 4/6)	2.6+	20.6
	Borehole terminated owing to slow progress		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
7	25	68	0.2- 1.2	5	4	4	10	20	40	17
			1.2- 2.2	7	4	8	16	25	33	7
			2.2- 3.2	7	4	8	17	21	29	14
			3.2- 4.2	8	3	7	16	20	22	24
			4.2- 5.2	7	7	8	18	30	22	8
			5.2- 6.2	9	5	7	18	25	17	19
			6.2- 7.2	6	4	5	19	32	34	0
			7.2- 8.2	7	4	5	17	37	30	0
			8.2- 9.2	7	3	4	14	32	24	16
			9.2-10.2	7	3	4	10	22	23	31
			10.2-11.2	8	4	5	14	28	29	12
			11.2-12.0	6	4	3	11	28	24	24
			Mean	7	4	6	15	27	27	14

NT 67 SE 16 **6546 7234** **Hartside, Halls, Stenton** **Block E**

Surface level +194m (+636ft)
Water not struck
250mm percussion
July 1985

Overburden	0.1m
Mineral	3.0m
Mineral till	0.9m
Waste	0.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, gravelly	0.1	0.1
Glacial sand and gravel	a Gravel Gravel: coarse and fine with rare cobbles, subangular to subrounded, greywacke sandstone and siltstone, platy siltstones, some basalt, felsite and vein-quartz Sand: coarse with medium and some fine, subangular to subrounded, rock fragments and quartz Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	3.0	3.1
Till	b Gravel; diamicton, gravel rich Gravel: coarse and fine with some cobbles and boulders, angular to subangular with some subrounded, indurated sandstone, siltstone and greywacke with basalt, some felsite and vein-quartz Sand: coarse and medium with some fine Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/6)	0.9	4.0
	Diamicton; as above, but more clayey and very stiff	0.7+	4.7
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	5	34	61	0.1- 1.1	5	5	13	17	23	37	0
				1.1- 2.1	5	4	10	19	29	33	0
				2.1- 3.1	5	6	12	16	27	34	0
				Mean	5	5	12	17	26	35	0
b	8	26	66	3.1- 4.0	8	6	8	12	26	33	7
a&b	6	32	62	Mean	6	5	11	16	26	34	2

NT 67 SE 17 6710 7205 **Black Law, Stenton** **Block E**

Surface level +216m (+709ft)
Water struck at +212m
250mm percussion
July 1985

Overburden 0.7m
Mineral 3.0m
Waste 6.7m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey loam, dark brown	0.5	0.5
Flow till	Diamicton: silt, sandy, abundant clasts of fine gravel size with rare cobbles, chiefly greywacke, moderate brown	0.2	0.7
Glacial sand and gravel	Gravel, claybound to 1.7m, then claybound in places from 1.7 to 3.7m Gravel: fine with coarse, subangular to subrounded, indurated fine grained sandstone and siltstone, some greywacke Sand: coarse with medium and fine, subangular, quartz and rock fragments Fines: silt and clay, disseminated, moderate brown (5 YR 4/4)	3.0	3.7
Till	Diamicton: clay, silty, stiff to very stiff, clasts generally fine gravel size, but some cobbles, subangular to subrounded, of greywacke with indurated red sandstone, siltstone and grit, some basalt, dolerite and vein-quartz, moderate red (5 R 4/6) to moderate reddish brown (10 R 4/6)	3.8	7.5
	Diamicton: clay, siltier than above, clasts of greywacke with some sandstone and siltstone, very dark moderate red (5 R 4/6), becomes very stony from 9.0m with red sandy silty matrix, possibly bedrock (Devonian conglomerate)	2.9+	10.4
	Borehole terminated owing to technical difficulties		

Grading

Mean for Deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
			from to	- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
8	34	58	0.7- 1.7	7	9	11	14	30	29	0
			1.7- 2.7	10	6	8	16	33	27	0
			2.7- 3.7	8	8	10	17	38	19	0
			Mean	8	8	10	16	33	25	0

NT 67 SE 18 **6806 7258** **Bradeley Hill** **Block E**

Surface level +203m (+666ft)
Water not struck
250 and 200mm percussion
July 1985

Overburden 0.1m
Mineral 11.4m
Waste 1.6m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: silty, sandy loam, moderate reddish brown (10 R 4/6 to 3/4)	0.1	0.1
Glacial sand and gravel	a 'Clayey' pebbly sand; silty lenses in places Gravel: fine with coarse and rare cobbles, subangular to subrounded, indurated sandstone and siltstone with some igneous rocks Sand: fine with medium and some coarse, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated and in lenses, moderate reddish brown (10 R 3/4)	4.4	4.5
	b 'Clayey' sandy gravel Gravel: fine with coarse and some cobble, subangular to subrounded, indurated sandstone and siltstone with some igneous clasts Sand: medium, fine and coarse, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, moderate reddish brown (10 R 3/4)	6.0	10.5
	c 'Very clayey' sand Gravel: rare, coarse and fine, subangular to subrounded, sandstone and siltstone Sand: fine with some medium and coarse, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated and in laminae, moderate reddish brown (10 R 3/4)	1.0	11.5
Till	Diamicton: clay, silty and sandy, with clasts up to cobble size, subangular to subrounded, of sandstone and siltstone, moderate reddish brown (10 R 3/4)	1.6+	13.1
	Borehole terminated owing to rock obstruction		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	17	69	14	0.1- 1.3	16	35	15	8	13	13	0
				1.3- 2.3	25	29	14	12	11	9	0
				2.3- 3.3	11	22	52	7	6	2	0
				3.3- 4.5	16	67	14	2	1	0	0
				Mean	17	39	23	7	8	6	0
b	10	57	33	4.5- 5.5	9	13	18	19	21	13	7
				5.5- 6.5	7	17	14	13	18	23	8
				6.5- 7.5	10	18	22	19	22	9	0
				7.5- 8.5	9	19	28	17	22	5	0
				8.5- 9.5	11	16	23	21	23	6	0
				9.5-10.5	16	23	24	12	15	10	0
				Mean	10	18	22	17	20	11	2
c	37	61	2	10.5-11.5	37	47	12	2	1	1	0
a&b	13	62	25	Mean	13	27	22	13	15	9	1
a-c	15	62	23	Mean	15	29	21	12	14	8	1

NT 67 SE 19 **6877 7219** **Woodhall** **Block E**

Surface level +225m (+738ft)
Water not struck
250mm percussion
July 1985

Overburden 0.2m
Mineral 6.6m
Waste 1.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy, moderate brown (5 YR 3/4)	0.2	0.2
Glacial sand and gravel	a Sandy gravel; claybound in places, cobbles present below 2.2m Gravel: coarse and fine with cobbles, subangular to subrounded with some angular, greywacke, siltstone, limestone and igneous rocks with vein-quartz Sand: coarse with medium and some fine, subangular to rounded, quartz and rock fragments Fines: silt and clay, disseminated, dark reddish brown (10 R 3/4) to moderate reddish brown (5 YR 3/4)	4.6	4.8
	b 'Clayey' sandy gravel: becoming more gravel-rich around 5.6m and from about 6.5m Gravel: fine with coarse and some cobble, red and grey sandstones and siltstones, coarse grained greywacke and some intermediate igneous rocks Sand: fine with coarse and medium, subangular to subrounded, quartz and rock fragments with some mica Fines: silt and clay, disseminated and as lenses and laminae, moderate reddish brown (10 R 4/6)	2.0	6.8
Till	Diamicton: clay, stony, very hard, reddish brown (10 R 3/4)	1.3+	8.1
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64 mm
a	6	47	47	0.2- 1.2	4	7	11	22	23	33	0
				1.2- 2.2	7	7	23	33	18	12	0
				2.2- 3.3	5	6	21	27	16	14	11
				3.3- 4.2	8	8	12	13	15	23	21
				4.2- 4.8	6	12	11	15	20	20	16
				Mean	6	8	16	23	18	20	9
b	16	47	37	4.8- 5.8	16	26	14	15	18	11	0
				5.8- 6.8	15	17	11	13	18	17	9
				Mean	16	20	13	14	18	14	5
a&b	9	47	44	Mean	9	12	15	20	18	18	8

NT 67 SE 20 **6927 7288** **Whittly Strip, Woodhall** **Block E**

Surface level +166m (+545ft)
Water not struck
250mm percussion
October 1985

Overburden 0.3m
Mineral 6.2m
Waste 4.8m
Bedrock 0.8m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: gravelly, sandy loam	0.3	0.3
Glacial sand and gravel	a Gravel Gravel: fine with coarse and cobble, subangular to rounded, brick-red, purple and buff fine grained sandstones and greywacke with mudstone Sand: coarse with medium and fine, angular to subrounded, rock fragments and quartz Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/4)	1.0	1.3
	b 'Clayey' gravel; claybound deposit Gravel: coarse with fine with rare cobble, subangular to rounded, composition as above, but lacking brick red sandstone and with rare coarse acid igneous rock Sand: as above Fines: silt and clay, disseminated, moderate reddish brown (10 R 4/5)	1.7	3.0
	c 'Very clayey' pebbly sand; silty seams common locally, especially below 5.0m, and rare gravel stringers, more gravel-rich between 5.2 and 6.0m Gravel: coarse and fine with some cobble, chiefly subrounded, sandstone, greywacke, basalt and vein-quartz Sand: coarse with medium and fine, angular to subrounded, chiefly quartz Fines: silt, in seams with very fine sand, light brown (5 YR 5/4)	3.5	6.5
Till	Diamicton: clay, silty, stony, sandy, firm to stiff, clasts chiefly of sandstone and greywacke, with rare igneous rocks, cobbles rare, becoming slightly sandier below 10.5m, moderate reddish brown (10 R 4/6)	4.8	11.3
Lower Devonian	Conglomerate: abundant pebbles up to coarse gravel size, of sandstone (hard, fine to medium grained, greyish purple), greywacke and dolerite; with sand matrix adhering to some pebbles, moderate red (5 R 4/4)	0.8+	12.1

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
				from to	- 1/16	+ 1/16 - 1/4	+ 1/4 -1	+1-4	+4-16	+16-64	+64 mm
a	7	34	59	0.3- 1.3	7	6	9	19	27	20	12
b	10	36	54	1.3- 2.2	10	9	10	17	24	30	0
				2.2- 3.0	No grading data available						
				Mean	10	9	10	17	24	30	0
c	22	70	8	3.0- 4.2	10	81	6	1	2	0	0
				4.2- 5.2	35	53	2	1	1	8	0
				5.2- 6.0	23	68	4	1	3	1	0
				6.0- 6.5	26	36	7	6	10	15	0
				Mean	22	63	5	2	3	5	0
a&b	9	36	55	Mean	9	8	10	18	25	26	4
a-c	17	54	29	Mean	17	38	7	9	13	14	2

NT 67 SE 21 **6980 7195** **Elmscleugh, Innerwick** **Block E**

Surface level +186m (+610ft)
Water struck at +178m
250 and 200mm percussion
June 1985

Overburden 0.2m
Mineral 12.5m
Waste 2.3m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil: loam, silty, sandy with small pebbles, moderate brown (10 YR 3/4)	0.2	0.2
Glacial sand and gravel	a Sandy gravel Gravel: fine with coarse and rare cobbles, indurated siltstone and sandstone with some felsite, clayey coating on some clasts Sand: medium with fine and coarse, subangular to subrounded, quartz and rock fragments Fines: silt and clay, disseminated, with silty lenses from 2.2m, moderate reddish brown (10 YR 3/4)	2.0	2.2
	b 'Clayey' sand; sand mainly fine to 7.3m, then somewhat coarser, with rare subangular to subrounded pebbles Sand: fine with some medium and rare coarse, subangular to subrounded, quartz and some rock fragments Fines: silt and clay, disseminated and in lenses and laminae, moderate reddish brown (10 R 4/6)	10.5	12.7
Till	Diamicton: clay, silty, sandy, with angular to subangular, fine and coarse pebbles, moderate reddish brown	2.3+	15.0
	Borehole terminated owing to slow progress		

Grading

	Mean for Deposit percentages			Depth below surface (m)	percentages							
	Fines	Sand	Gravel		Fines	Sand			Gravel			
				from to	$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16-64	+64	mm
a	8	69	23	0.2- 1.2	6	7	30	30	14	13	0	
				1.2- 2.2	9	18	30	23	16	4	0	
				Mean	8	12	30	27	15	8	0	
b	16	83	1	2.2- 3.2	12	50	25	6	6	1	0	
				3.2- 4.3	11	75	13	1	0	0	0	
				4.3- 5.3	24	75	1	0	0	0	0	
				5.3- 6.3	12	80	8	0	0	0	0	
				6.3- 7.3	24	74	2	0	0	0	0	
				7.3- 8.0	15	60	23	1	1	0	0	
				8.0- 9.0	22	60	17	1	0	0	0	§
				9.0-10.0	15	66	18	1	0	0	0	§
				10.0-11.0	15	63	22	0	0	0	0	§
				11.0-12.0	16	66	18	0	0	0	0	§
				12.0-12.7	14	68	17	1	0	0	0	§
				Mean	16	67	15	1	1	**	0	
a&b	15	81	4	Mean	15	59	17	5	3	1	0	

The following reports relate particularly to bulk mineral resources

Reports of the Institute of Geological Sciences

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R. Allender and S. E.Hollyer.
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Mineral Assessment Reports (Institute of Geological Sciences)

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J. R. Gozzard and D. Price.
ISBN 0 11 884033 9 £4.50

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36 The sand and gravel resources of the country around Southend-on-Sea, Essex: Resource sheets comprising parts of TQ 88, 89, 98, 99, TR 08, 09; and TQ 78, 79 and parts of 88, 89. S. E. Hollyer and M. B. Simmons.
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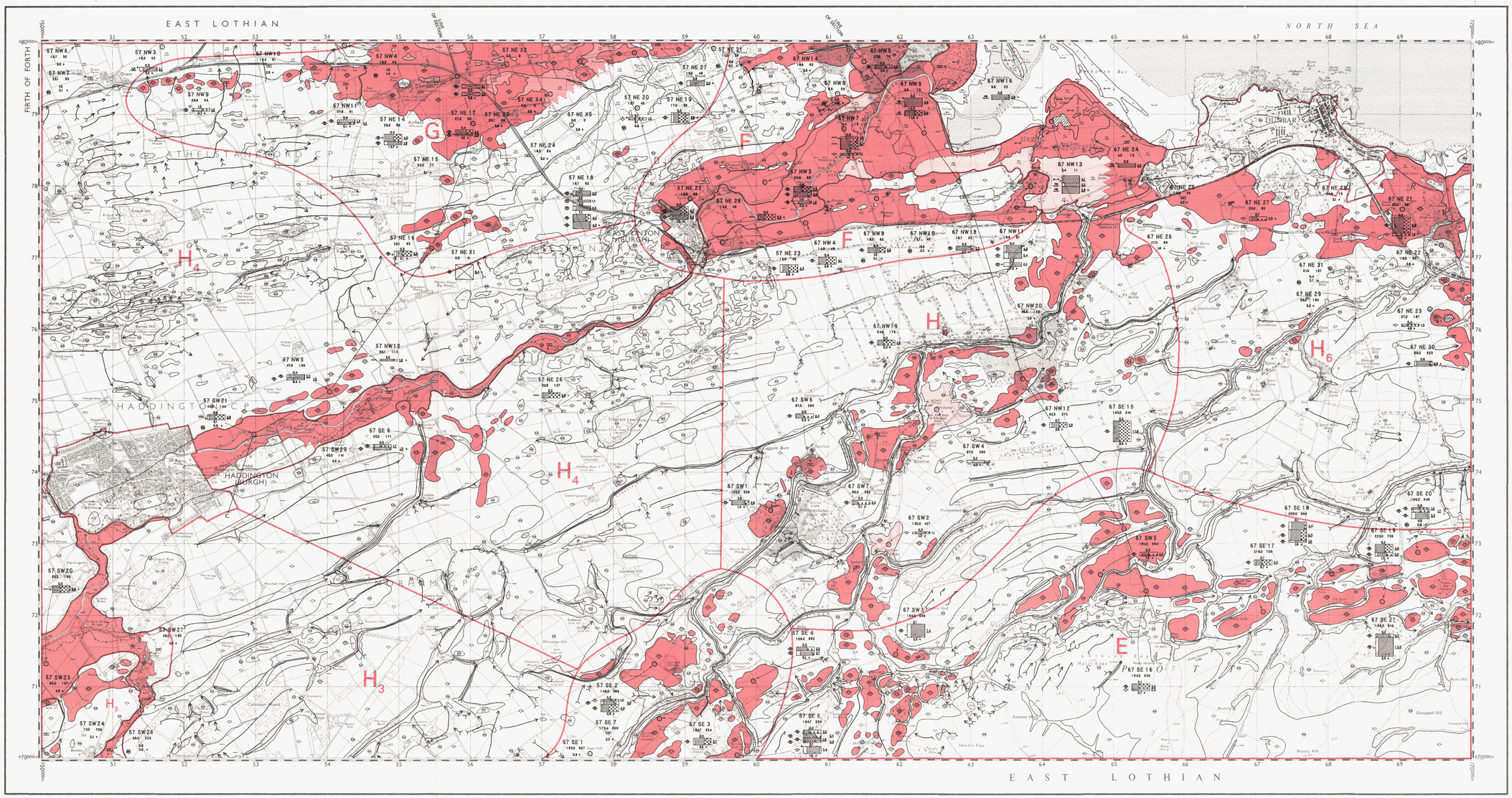
BRITISH GEOLOGICAL SURVEY (SCOTLAND)

THE SAND AND GRAVEL RESOURCES OF THE COUNTRY AROUND EAST LINTON, LOTHIAN REGION

SHEET NT 57/67

Scale 1:25 000

Ordnance Survey



THE SAND AND GRAVEL RESOURCES OF THE COUNTRY AROUND EAST LINTON, LOTHIAN REGION

(NORTHERN SHEET)

147 (NORTH)

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

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

- **Made ground**—waste and/or natural earth materials deposited on the original ground surface MG-3
- **Made ground**—waste and/or natural earth materials deposited in opencast workings MG-8
- **Landslip** L-1

DRIFT
Recent and Pleistocene

- **Blown sand**—fine sand BS-7
- **Peat** P-1
- **Alluvium**—floodplain and valley-floor deposits generally comprising sand and gravel and/or silt and clay A-83
- **Lake deposits**—fine sand, silt and clay LK-3
- **Alluvial fan deposits**—composed of sand, gravel and clay AF-10
- **Present beach deposits**—mainly fine sand and silt PB-5
- **Salt marsh deposits** SMD-1
- **Storm beach and bar deposits** ST-4
- **Raised marine deposits, post-Glacial**—mainly fine with medium sand; otherwise silty clay RS-13
- **Raised marine deposits, late-Glacial**—mainly fine sand, silt and clay; rare gravel RS-12
- **Head**—stony sandy clay H-57
- **Glacial sand and gravel**—moundy and terraced spreads of sand and gravel, ranging in composition from cobble gravel to fine sand GS-95
- **Glaciolacustrine deposits**—fine sand, silt and clay with rare pebbles, commonly laminated (identified only in boreholes) G-10
- **Flow till**—generally firm to stiff stony clay, found locally (*not* distinguished from till on the face of the map but identified in boreholes) FT-3
- **Till**—typically stiff silty, sandy clay with gravel clasts up to boulder size, in a variety of hues, mainly shades of brown, red and grey TL-27

SOLID

- **Bedrock at or near surface**—The south-east part of the sheet comprises greywacke-sandstone and -mudstone overlain by Devonian conglomerate. North of the Lammermuir Fault, bedrock consists of Devonian and Carboniferous sediments (mainly sandstone, mudstone and siltstone with seatearth, limestone and ironstone), together with basaltic and trachytic lavas, tuffs and intrusions which crop out extensively in the north-west of the area
- **Worked ground (sand and gravel)**—boundaries as at October 1986 WG-10

BOUNDARY LINES

- Geological boundary
- Geological boundary following back-feature of terrace, downward slope in direction of arrowhead
- Line marking back-feature of terrace, downward slope in direction of arrowhead
- Glacial drainage channel, arrow shows direction of water flow
- Glacial drainage channel, one side only preserved
- Inferred boundary between categories of deposit at surface
- Inferred boundary between categories of deposit at depth
- Resource block boundary

BOREHOLE AND OTHER DATA

SITE LOCATIONS

- British Geological Survey (BGS) mineral assessment borehole
- Other borehole
- BGS shallow pit

BGS BOREHOLES

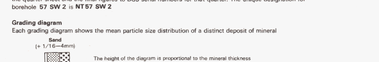
Note:
(i) Figures underlined denote thicknesses used in the assessment of resources
(ii) The + sign denotes that the base of the deposit was not reached
(iii) The Geological Classification is given only for mineral and bedrock
(iv) The water level is given only if groundwater or perched groundwater was first struck: the symbol placed at the top of a box may denote that water was encountered in the overlying overburden or waste

Registration Number

Each BGS borehole is identified by a registration number, e.g. **57 SW 2** The first numbers and letters refer to the quarter sheet and the final figures to BGS serial numbers for that quarter. The unique designation for borehole **57 SW 2** is **NT 57 SW 2**

Grading diagram

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



Note: When grading data are not sufficiently detailed or are absent the grading diagram is crossed through and shown without ornament

OTHER BOREHOLES

Boreholes providing ancillary assessment data are located on the map where space permits. These boreholes are identified by serial numbers prefixed by the letter **X**, and indexed by the numbers and letters of the relevant standard quarter sheet, e.g. **57 NE X2**

SHALLOW PITS

Where space permits the locations of shallow pits providing ancillary assessment data are shown by a distinctive symbol, thus ⊠ . Each pit is identified by a serial registration number e.g.**67 NW 16**

CATEGORIES OF DEPOSITS

- **Exposed, potentially workable sand and gravel** CAT-E7
- **Continuous or almost continuous spreads of potentially workable sand and gravel beneath overburden** CAT-C4
- **Discontinuous spreads of potentially workable sand and gravel exposed or beneath overburden** CAT-D2
- **Sand and gravel not assessed (usually in built-up areas)** CAT-N1
- **Sand and gravel absent or not potentially workable** CAT-A4

RESOURCE BLOCKS

For the purposes of assessment, the mineral-bearing land is divided into Resource Blocks (see Report). Each is designated by a letter

KEY TO SECTIONS

- Potentially workable sand and gravel, exposed or beneath overburden
- Bedrock and wastes, including overburden, are uncoloured
- Geological boundary (broken line denotes uncertainty)
- Inferred boundary limiting the extent of potentially workable material

Otherwise symbols and abbreviations as map legend

Original geological survey by A. C. Ramsay, H. H. Howell and A. Geikie, 1855-60.
Resurveys by E. B. Bailey, G. Barrow, C. T. Clough and H. B. Maufe, 1902-4; A. Davies, M. F. Howells and A. D. McAdam, 1961-8.
Drift revision by A. D. McAdam, 1982-3; D. H. Land, District Geologist.
Minor amendments by A. M. Aitken in 1985

Sand and gravel survey by A. M. Aitken, A. D. McAdam, K. A. T. MacPherson, J. W. Merritt, D. L. Ross and C. W. Thomas in 1984-5; J. I. Chisholm, Programme Manager
G. I. Lumsden, B.Sc., F.R.S.E., Director, British Geological Survey

Borehole graphics drawn by computer using programs written by J.L. McInnes and modified by J.L. Lexton

Produced for the British Geological Survey by Reyerfield Carto-Graphics (Edinburgh) 1986

Printed by John Bartholomew & Son Ltd. Edinburgh 1986

Based on 1:25 000 1st & 2nd Series Mapping, 1974 & 1981

Made and compiled by Ordnance Survey Southampton.

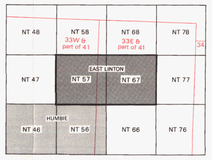
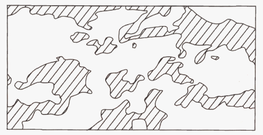


Diagram showing the relation of this resource sheet to the southern (Humbie) resource sheet, to the National Grid Squares and to the One-inch Geological sheets.

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

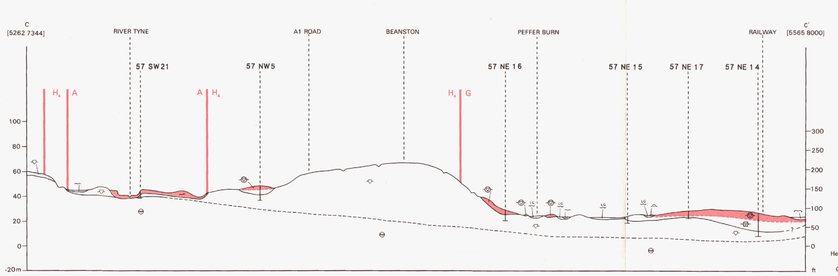


The area shown hatched was resurveyed at the Six-Inch scale by A. D. McAdam in 1982-3, and amended locally by A. M. Aitken in 1985. The remainder of the sheet was compiled from older surveys

This map gives an interpretation of data available at the date of survey. Detailed records may be consulted on application to the Programme Manager (Central Scotland), British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA

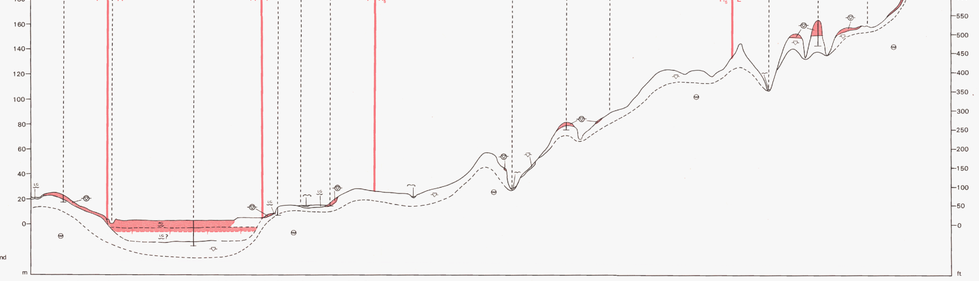
The British Geological Survey welcomes any additional geological information known to the user

SCHEMATIC HORIZONTAL SECTIONS SHOWING RELATIONSHIPS BETWEEN THE DRIFT DEPOSITS
HORIZONTAL SCALE 1:25 000 VERTICAL EXAGGERATION 12.5 x



Heights in metres and feet relative to Ordnance Datum

The line of section between the A1 road and the Peffer Burn coincides with a former channel of the River Tyne, now infilled by drift (probably mainly till) which is at its thickest in the neighbourhood of Beanston: geophysical investigations here gave a thickness of ca. 50m



Evidence for the succession and stratigraphical relationships depicted beneath the estuary of the River Tyne is confined to borehole 67 NW 9; consequently the interpretation shown is conjectural at best. Clayey deposits, too thin to be shown on the section, were proved in this borehole at surface and at the base of the post-Glacial marine deposits

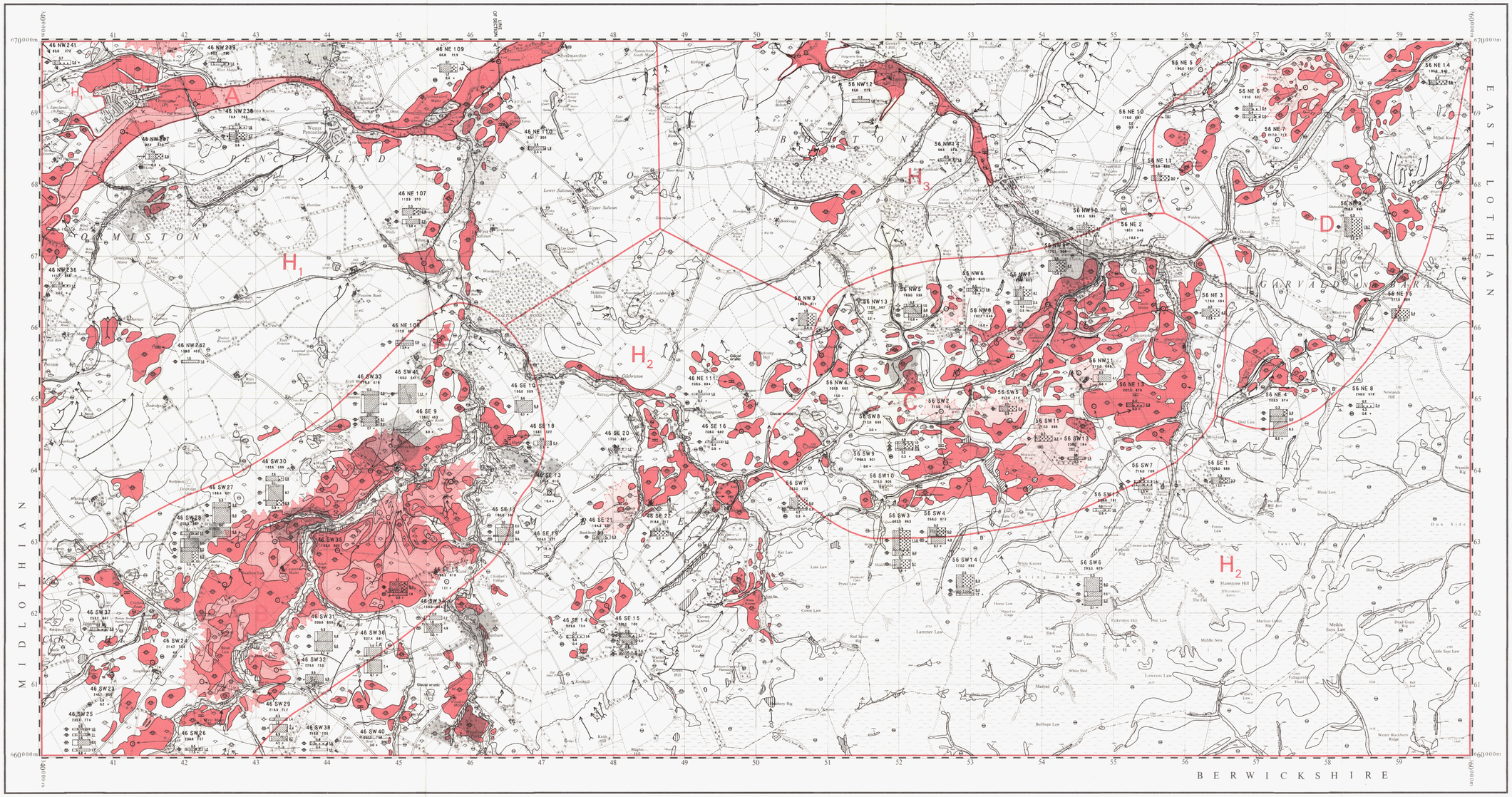
BRITISH GEOLOGICAL SURVEY (SCOTLAND)

THE SAND AND GRAVEL RESOURCES OF THE COUNTRY AROUND HUMBIE, LOTHIAN REGION

SHEET NT 46/56

Scale 1:25 000

Ordnance Survey OS



Original geological survey by H. H. Howell and A. Geikie, 1855-60.
Resurveys by E. M. Anderson, E. B. Bailey and C. B. Crampton, 1902-4;
J. B. Simpson, 1936; M. F. Howells and W. Tulloch, 1962-69.
Drift revision by A. D. McAdam, 1982-3; D. H. Lend, District Geologist.
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Borehole graphics drawn by computer using programs written by J. L. McInnes and modified by J. L. Leaton

Produced for the British Geological Survey by Baynefield Carto-Graphics (Edinburgh) 1986

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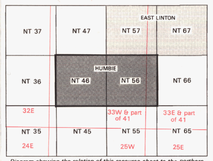


Diagram showing the relation of this resource sheet to the northern (East Linton) resource sheet, to the National Grid Squares and to the One-Inch Geological sheets.

Data quoted for an individual sample point refer strictly to that site: reliable conclusions cannot be drawn about the resource in the surrounding area, which is variable, particularly in material as variable as sand and gravel. However, estimates of volume and mean grading of the mineral as a whole in each Resource Block are given in the Report.

SURVEY DIAGRAM

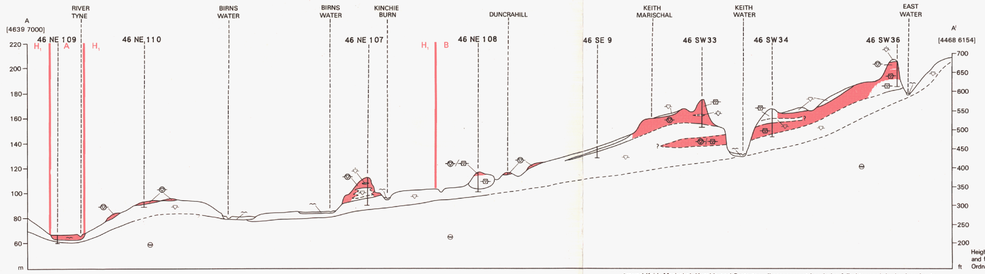
The area shown hatched was resurveyed at the Six-Inch scale by A. D. McAdam in 1982-3, and amended locally by K. A. T. MacPherson in 1985. The remainder of the sheet was compiled from older surveys

This map gives an interpretation of data available at the date of survey. Detailed records may be consulted on application to the Programme Manager (Central Scotland), British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA.

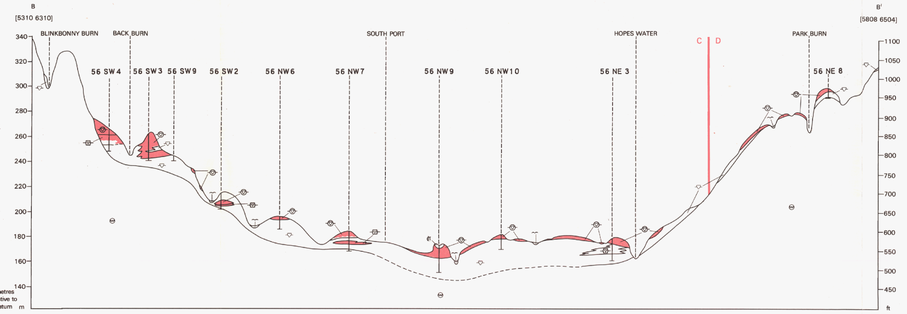
The British Geological Survey welcomes any additional geological information known to the user

Made and compiled by Ordnance Survey Southampton

SCHEMATIC HORIZONTAL SECTIONS SHOWING RELATIONSHIPS BETWEEN THE DRIFT DEPOSITS
HORIZONTAL SCALE 1:25 000 VERTICAL EXAGGERATION 12.5 x



Around Keith Marischal, Humbie and Costerton all assessment boreholes failed to reach bedrock owing to the thick drift sequence. Glacial meltwater deposits, largely gravel-free, are commonly concealed beneath a drape of till, 2 to 3m thick. An intermediate till is also present, in addition to the basal till, as proved in borehole 46 SW 34 and recorded in sections along the Keith Water



Deposits of glacial sand and gravel in the Yester area have a patchy distribution in places. This is partly due to the occurrence of a surface deposit of till (as proved in borehole 56 SW 2), the extent of which is not fully known: consequently the distribution of buried sand and gravel may be wider than shown on the resource map

THE SAND AND GRAVEL RESOURCES OF THE COUNTRY AROUND HUMBIE, LOTHIAN REGION
(SOUTHERN SHEET)

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

147 (SOUTH)

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

Made ground—waste and/or natural earth materials deposited on the original ground surface MG-3

Made ground—waste and/or natural earth materials deposited in opencast workings MG-8

Landslip L-1

DRIFT
Recent and Pleistocene

Peat P-1

Alluvium—floodplain and valley-floor deposits generally comprising sand and gravel and/or silt and clay A-83

Lake deposits—fine sand, silt and clay LK-3

Alluvial fan deposits—composed of sand, gravel and clay AF-10

Head—stony sandy clay H-57

Glacial sand and gravel—moundy and terraced spreads of sand and gravel, ranging in composition from cobble gravel to fine sand GS-35

Glaciolacustrine deposits—fine sand, silt and clay with rare pebbles, commonly laminated (identified only in boreholes) G-10

Flow till—generally firm to stiff stony clay, found in spreads up to 2m thick and occurring widely at the surface in the Fala, Humbie, Yester and Carfrae areas (not distinguished from till on the face of the map but identified in boreholes) FT-4

Till—typically stiff, silty, sandy clay with gravel clasts up to boulder size, in a variety of hues, mainly shades of brown, red and grey. Several distinct till units have been recognised in boreholes and sections TL-27

SOLID

Bedrock (undifferentiated)—The Lammermuir Hills are underlain mainly by greywacke-sandstone and -siltstone with minor amounts of bedded chert and intrusive felsite. The remainder of the area comprises mainly Carboniferous with some Devonian sediments, principally sandstone, siltstone and mudstone, with limestone, seatearth and coal. Some basaltic igneous rocks also occur locally

Worked ground (sand and gravel)—boundaries as at October 1985 WG-10

BOUNDARY LINES

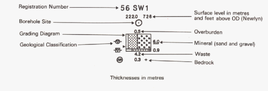
- Geological boundary
- Geological boundary following back-feature of terrace, downward slope in direction of arrowhead
- Line marking back-feature of terrace, downward slope in direction of arrowhead
- Glacial drainage channel, arrow shows direction of water flow
- Glacial drainage channel, one side only preserved
- Inferred boundary between categories of deposit at surface
- Inferred boundary between categories of deposit at depth
- Resource block boundary

BOREHOLE AND OTHER DATA

SITE LOCATIONS

- British Geological Survey (BGS) mineral assessment borehole
- Recorded exposure
- BGS shallow pit

BGS BOREHOLES



Note:
(i) Figures underlined denote thicknesses used in the assessment of resources
(ii) The 0.4m denotes that the base of the deposit was not reached
(iii) No geological Classification is given only for mineral and bedrock
(iv) A triangle on the right of the grading diagram indicates water first struck: the symbol placed at the top of a box may denote that water was encountered in the overlying overburden or waste

Registration Number

Each BGS borehole is identified by a registration number, e.g. **56 SW 1**. The first numbers and letters refer to the quarter sheet and the final figures to BGS serial numbers for that quarter. The unique designation for borehole **56 SW 1** is **NT 56 SW 1**

Grading diagram

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

The height of the diagram is proportional to the mineral thickness

The widths of the divisions show the proportions of **Fines, Sand** and **Gravel**

Note: When grading data are not sufficiently detailed or are absent the grading diagram is crossed through and shown without ornament

EXPOSURE RECORDS

Information from the inspection of exposures is shown in the same way as for BGS boreholes but they are located by an asterisk thus ✱. The exposures are registered in the same series as the boreholes, for example, **56 SW 14**

SHALLOW PITS

Where space permits the locations of shallow pits providing ancillary assessment data are shown by a distinctive symbol, thus ⧦. Each pit is identified by a serial registration number e.g. **46 NW 239**

CATEGORIES OF DEPOSITS

Exposed, potentially workable sand and gravel CAT-E7

Continuous or almost continuous spreads of potentially workable sand and gravel beneath overburden CAT-C4

Discontinuous spreads of potentially workable sand and gravel exposed or beneath overburden CAT-D2

Sand and gravel not assessed (usually in built-up areas) CAT-N1

Sand and gravel absent or not potentially workable CAT-A4

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