BRITISH GEOLOGICAL SURVEY

TECHNICAL REPORT WA/89/20

Onshore Geology Series

TECHNICAL REPORT WA/89/20

Sheet SP28NW

MAXSTOKE

Part of one-inch sheets 168 (Birmingham) and 169 (Coventry)

R A Old

Geographical index
UK, C England, Warwickshire,

Subject index
Geology, Stratigraphy, Mineral resources

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 Keyworth, Nottingham British Geological Survey 1989

CONTENTS

SUMMARY

The geology of Sheet SP28NW (Maxstoke) is described, with special emphasis on important exposed sections and borehole logs.

The Cambrian, older Carboniferous formations and the Kidderminster and Bromsgrove Sandstone formations, are known either from boreholes or underground mine workings. Most of the Keele Formation, the lower part of the Coventry Sandstone, and most of the Mercia Mudstone Group, come to crop, but are only poorly exposed.

The boundary between the Warwickshire Coalfield in the east, and the major Triassic sedimentary Knowle Basin in the west, is formed by the Maxstoke and Meriden faults.

The lithologies of the glacial and post-glacial drift deposits are described.

Important coal reserves underlie the east of the area, and there are potential reserves of sand and gravel. The huge Little Packington Landfill Site is described. A schedule of boreholes is appended.

INTRODUCTION

This report describes the geology of 1:10 000 Sheet SP28NW (Maxstoke) (Figure 1), which lies within one-inch geological sheets 168 (Birmingham) and 169 (Coventry).The area was first geologically surveyed on the one-inch scale by A C Ramsay and H H Howell, and published as Old-Series One-Inch Sheet 62SE in 1855. An explanatory memoir for the Warwickshire Coalfield was published soon after (Howell, 1859). The primary six-inch survey was made by C H Cunnington in 1913-14, and some local details are given by Eastwood and others (1923; 1925).The whole area was surveyed at the 1:10 000 scale in 1988 by R A Old as part of a regional survey partly funded by the Department of the Environment (Old and others, 1989).

Palaeotological contributions to this report are by Drs. N J Riley and A W A Rushton, and the petrology of the igneous rocks has been examined by Messrs. R K Harrison and R J Merriman.

Thanks are due to British Coal, Packington Estate Enterprises Ltd. and Sir Owen Williams and Partners for providing borehole and other unpublished data.

Copies of this report and uncoloured dyeline copies of the 1;10 000 map may be purchased from the British Geological Survey, Keyworth.

Similar reports covering adjacent 1:10 000 sheets are:

SP28NE Fillongley (Rees, 1989)
SP28SW Meriden (Sumbler, 1989)

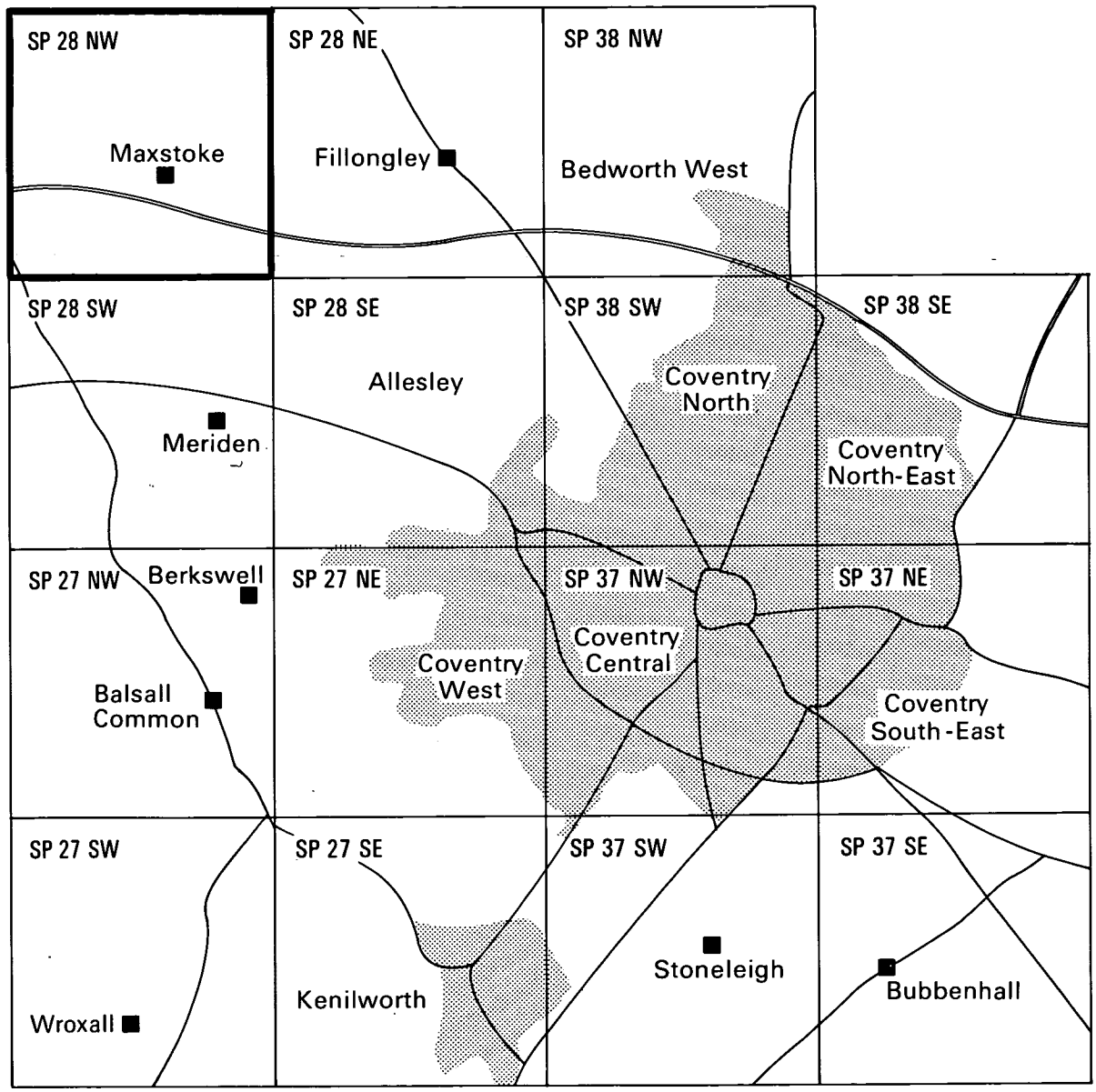

Figure 1. Area of this report relative to area of whole contract is shown with bold outline

GEOLOGICAL SEQUENCE

The Carboniferous sequence from about 90 m above the base of the Keele Formation, and the Triassic sequence from about 50 m above the base of the Mercia Mudstone, are present at outcrop. The remaining parts of the solid geological squence are known only from boreholes.

Drift		
Quaternary		
	Alluvium	
	River Terrace Deposits	
	Fluvio-Glacial Sand and Gravel	
	Glacial Sand and Gravel	
Solid		
Triassic		
	Mercia Mudstone Group	Undivided red mudstone
		Arden Sandstone Member
	Sherwood Sandstone Group	Bromsgrove Sandstone Formation
		Kidderminster Formation
Carboniferous		
Westphalian D	Enville Group	Coventry Sandstone Formation
		Keele Formation
		Halesowen Formation
Westphalian B (part) and C		Etruria Marl Formation
Westphalian A and B(part)		Productive Coal Measures with Vanderbeckei Marine Band
Cambrian		
Tremadoc		Merevale Shales
Merioneth		Monks Park Shales

CAMBRIAN

Cambrian rocks (here taken to include the Tremadoc) have been penetrated below Coal Measures in five British Coal boreholes.

Monks Park Shales

Monks Park Shales were penetrated for 9 m (including thin sills) in the Dove House Farm Borehole [2472 8912]. They were predominantly pale green siltstone with thin beds of black mudstone, and yielded a single specimen of *Orusia lenticularis* (Taylor and Rushton, 1971 p.36) indicative of an Upper Cambrian age.

Merevale Shales

The Merevale Shales proved in the other boreholes were medium to dark grey or grey-green fissile mudstones, with a few thin sandstone beds. In the Outwoods Borehole [2463 8529] ironstone and pyrites nodules were common, while in the Kimberley's Grove Borehole [2462 8764] calcareous nodules were common.

The Shales from the Kimberley's Grove and Woodcock Wood [2425 8681] boreholes did not yield any fossils, and probably represent the lowest part of the Formation, which is known to be sparsely fossiliferous (Old and others, 1987). The cores from the Outwoods Borehole yielded abundant *Rhabdinopora flabelliformis* (formerly *Dictyonema flabelliforme*), (with some specimens appearing to be the subspecies *belgicum*), *Eurytreta sabrinae*, sponge spicules, burrows (*Planolites*) and pellets. This assemblage indicates a low Tremadoc, *R. flabelliformis* Zone age. The cores from the Priory Wood Borehole [2821 8399] yielded sponge spicules, *Linarssonia belti*, *Eurytreta sabrinae*, *Broggeria salteri*, and *Oneotodus* sp., suggestive of a low-Tremadoc horizon.

PRE-CARBONIFEROUS INTRUSIONS

Thin lamprophyre sills intrude the Cambrian rocks of the Woodcock Wood Boehole. A 0.7 m sill below 665.6 m has irregular, lobate, crenulate and re-entrant contacts with the intruded sediments. There is a gradual coarsening of grain size, and the appearence of euhedral ferromagnesian phenocrysts, towards the centre of the sill. A second, 1.5 m, sill below 667.1 m consists of a complex of lamprophyre and sediment; the former occurs in discrete 'pillows' between 1 and 20 cm in diameter, and with lobate and crenulate, chilled margins. The pillows are not in contact with one another; a few have broken after solidifying and the broken surfaces are not chilled. The top 0.5 m of another sill occurs above the base of the borehole at 677.4 m, and has a concordant contact with the mudstone above. The mudstone between the sills is extensively hornfelsed with appreciable amounts of secondary pyrites, and is contorted in some places. The features described above suggests that these sills were intruded into poorly consolidated sediments, and that they are, therefore, of late-Cambrian or earliest-Ordovician age.

The Priory Wood Borehole encountered four lamprophyre sills between 541.4 m and 589.3 m, with only thin intervals of sedimentary rocks between; the thickest sill (31.7 m) lay between 548.9 m and 580.6 m. The highest sill was encountered only 11 m below the base of the Thick Coal, whereas there are usually at least 35 m of Westphalian rocks in this interval before the Cambrian is reached (Figure 2). Because it is uncertain either that the baked mudstones overlying the highest sill are of Cambrian age, or that they are faulted against the Carboniferous mudstones just below the Thick Coal, the possibility that the sills are of post-Westphalian age cannot be entirely discounted. Thin sections described by Mr. R K Harrison show that the sills consist of highly altered basic igneous rock, comparable to but not identical with the pre-Westphalian lamprophyres of the Nuneaton area (Taylor and Rushton, 1971). They are composed of a mesh of albite-oligoclase laths, with ferromagnesian minerals, entirely altered to chlorite, occurring as phenocrysts and interstitially. Pleochroic apatite is notable among the accessory minerals, together with quartz, biotite, leucoxene and iron oxide.

Mr.R J Merriman reports that the alteration of these rocks is much more intense, and of a different character, to that exhibited by a post-Westphalian sill in the Dale Wood Borehole in the area to the east (Rees, 1989),so that the balance of the evidence is in favour of the sills at Priory Wood being pre-Westphalian in age.

UPPER CARBONIFEROUS (Westphalian)

The Westphalian beds rest unconformably upon Cambrian strata; below the basal 90 m of the Keele Formation they do not come to crop, but are known only from boreholes (Figure 2). The sequence consists mainly of mudstones, siltstones and seatearths. The Productive Coal Measures and the Halesowen Formation are grey-coloured and coal-bearing; the intervening Etruria Marl is variegated grey, green and red-brown. The Keele Formation and the Enville Group consist almost entirely of red measures, predominantly argillaceous in the former and arenaceous in the latter. The only identifiable major Westphalian subdivision is that between Westphalian A and B, marked by the Vanderbeckei Marine Band, which occurs sporadically about 5 m below the Thick Coal. The Aegiranum Marine Band, which lies at the base of Westphalian C, has passed laterally in this area into a terrestrial facies within the Etruria Marl (Fulton and Williams, 1988).

Productive Coal Measures

The beds below the Vanderbeckei Marine Band (Westphlian A) are typically 30 to 50 m thick, although in the Priory Wood Borehole they are apparently faulted out, so that Cambrian rocks were entered only 4.5 m below the Thick Coal (Figure 2). They consist mainly of grey mudstone , siltstone and seatearth, but in the Outwoods Borehole sandstone formed a considerable proportion of the sequence. A few thin coals occur but have only been named at Dove House Farm (Figure 2), and even there the correlations are tentative.

The beds above the Vanderbeckei Marine Band (Westphalian B (part) are from 45 to 55 m thick, and while similar to those below,are somewhat more arenaceous with thicker, more persistent coal seams. The Vanderbeckei Marine Band has been recorded in three boreholes, where it overlies the Thin seam. At Woodcock Wood 0.5 m of dark grey, pyritous mudstone, yielding *Lingula mytilloides* (juv.), were overlain by an oolitic ironstone with *Anthracosia* sp. and *Spirorbis* sp. At Kimberley's Grove the Marine Band consisted 0.8 m of medium grey mudstone with fish debris and *Lingula* sp., while at Outwoods it was 0.6 m of black mudstone with *Lingula* sp. No specimens were retained from the latter boreholes.

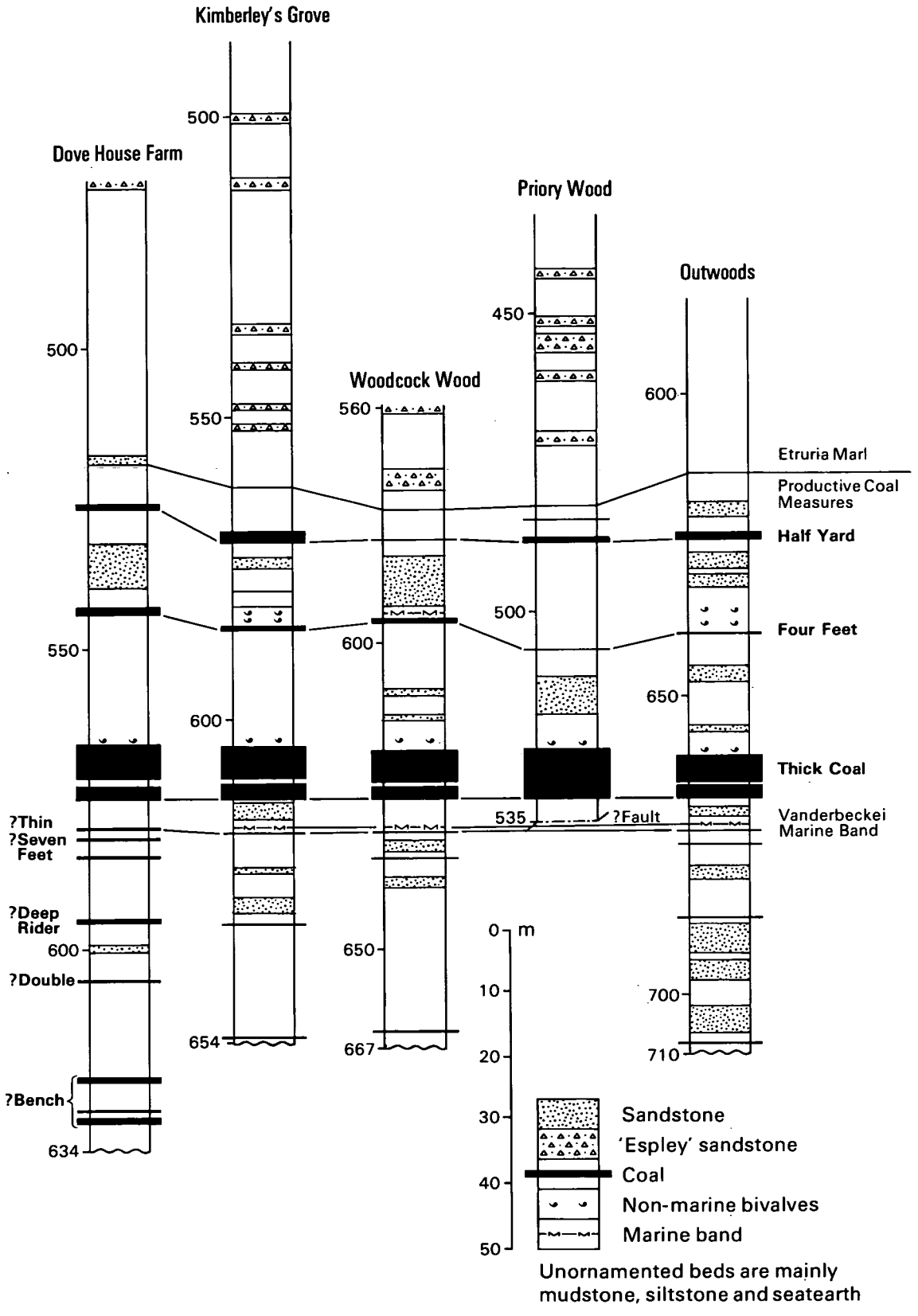

Figure 2. Comparative Westphalian successions in cored boreholes

The **Thick Coal** lies 3 to 4 m above the Vanderbeckei Marine Band. It is the only seam of economic importance (see Economic Geology), and is an amalgamation of eight seams, each of which is named separately in other parts of the Warwickshire Coalfield, where they are separated by intervals of other rocks (Cope and Jones,1970; Old and others, 1987). In ascending order the constituent seams are the Smithy, High Main, Nine Feet, Ell, Ryder, Bare, Two Yard and Thin Rider, although Fulton (1987) excludes the Smithy.

A published section of the Thick Coal from the Dove House Farm Borehole (Cope and Jones, 1970) shows that all the seams are present in this area, with the only significant "dirt" band occurring between the Nine Feet and Ell. Including partings of mudstone, the Thick Coal is 6 to 8 m thick.

The mudstones forming the roof of the Thick Coal usually contain non-marine bivalves, and at Woodcock Wood *Anthracosia* sp. and *Naiadites* sp. were obtained.

The **Four Feet** coal is persistent, and reaches a maximum thickness of 1.1 m at Dove House Farm. The mudstones forming its roof usually contain non-marine bivalves and fish scales, but at Woodcock Wood they also yielded *Lingula* sp. in a local development of a marine band, probably the Maltby Marine Band.

The **Half Yard** coal persists throughout the area reaching a maximum thickness at Kimberley's Grove, where it comprises upper and lower leaves of 0.67 m and 0.92 m respectively, separated by 0.3 m of mudstone.

Etruria Marl Formation

There is a gradual passage upwards, some 5 to 10 m above the Half Yard, from grey Productive Coal Measures into the 100 to 140 m of multicoloured beds which constitute the Etruria Marl. The boundary with the overlying Halesowen Formation has not been cored in this area, and is taken at the base of a thick sandstone, presumed to belong to the Halesowen Formation, identifiable in geophysical logs of boreholes.

The Etruria Marl consists of mudstone, siltstone and mudstone-flake breccia (Espley sandstone), which occur in shades of red, purple, ochre, grey and green. The mudstone-flake breccias are characterisitc of the Etruria Marl, and

consist of a mixture of intraclast and extraclast grey, brown and red mudstone flakes in a sandy matrix; the extraclasts were probably derived from outcrops of Cambrian rocks.

The sedimentary facies represented by the Etruria Marl inludes elements of the "alluvial plain" and "alluvial fan" facies described by Besly (1988,pp204-209). According to Besly's palaeogeographic models, the area to the west of the Warwickshire Coalfield was uplifted during Etruria Marl times, providing a source for the mudstone-flake breccias.

Halesowen Formation

The Halesowen Formation is known only from borehole chipping samples and geophysical logs, and as a result its limits are not clearly defined. It consists of 110 to 150 m of mainly pale grey mudstone,seatearth, siltstone and sandstone, with subordinate red-brown or chocolate-brown mudstone. Following British Coal practise the top of the Formation is placed at a distinctive, high gamma-ray value recorded in borehole geophysical logs, although by comparison with a control-borehole core near Coventry (Old,1989),the gamma-ray peak may lie about 50 m below the top of the Formation.

Keele Formation

All but the lowest 90 m of the 370 m-thick Keele Formation crop out east of the Meriden Fault. The Formation consists of barren red-brown mudstone, subordinate sandstones which vary rapidly in thickness, and thin beds of conglomerate and limestone. The top of the Formation is placed at the base of the lowest, thick, sandstone of the Coventry Sandstone.

Red, blocky mudstone,crowded with secondary calcareous concretions, was exposed in a pipeline trench at Hill Farm, Maxstoke [2365 8852 to 2398 8841]. At the western end of the exposure mudstones belonging to the Mercia Mudstone, juxtaposed by the Meriden Fault, were seen to be less silty and duller red-brown.

Hard, purple, pebbly sandstone and conglomerate crops out adjacent to the Meriden Fault at Dumble Farm [238 890]. The conglomerate contains pebbles mainly of quartzose sandstone and chert, with a few of grey limestone and

quartz, together with intraclasts of red mudstone. The beds above were formerly exposed in a stream section described as follows by Eastwood and others (1923, p82):

> "The lowest part of the sequence (in Dumble Wood) consists of red marl with sandstones, followed by a medium-grained even-bedded sandstone dipping eastward at 10°. A thin marl belt intervenes between this and the next sandstone, which is pellety near the base, coarse grained and massive. Opposite Dove House Farm the section shows a lenticle, about 1 ft (0.3 m) thick containing foreign pebbles, amongst which some of white friable chert are particularly abundant."

Part of the sandstone forming the prominent escarpment between Hill Farm, Shustoke [245 899] and Maxstoke [238 868], is exposed in a 6-m face in the quarry at Hill Farm, Maxstoke [241 880]. Here coarse red-brown sandstone exhibits channel cross-bedding indicating an east-west orientated drainage system. One sandstone unit is crowded with mudstone clasts, and another has an impersistent channel-lag breccia up to 0.5 m thick, with intraclasts of mudstone, and pebbles of chert and quartzitic sandstone. The breccia is thickest where it is channelled into the underlying 0.5 m thin-bedded, impersistent mudstone and siltstone. The base of the section is best exposed in the adjacent yard, where it shows up to 0.5 m of coarse well-cemented conglomerate, with pebbles up to 6 cm mainly of grey and purple sandstone and chert, together with vein-quartz, porphyry, grey limestone and Keele-type sandstone. The section is also described in Eastwood and others (1923,p82), and a pebble count is given by Shotton (1927).

The same sandstone is exposed at Hill Plantation [2415 8850] where the section is:

	m
Sandstone, flaggy, red-brown, cross-bedded in part; basal lag breccia up to 0.2 m with irregular load-casted base	1.5
Mudstone, brecciated by bed above	0 to 0.05
Sandstone, cross-laminated, pale-green and red-brown	0.2
Sandstone, red-brown, cross-bedded; a few green laminae	(seen) 2.0

A thin bed of *"Spirorbis"* limestone occurs close above the sandstone just described. It can be traced almost continuously between Hill Farm, Shustoke and Maxstoke, and was named the "Maxstoke Limestone" by Eastwood and others (1923). It is possible to trace the limestone by means of the numerous pits dug along its outcrop, because the soils in and around the pits yield numerous fragments of dark grey porcellanous limestone. An isolated outcrop, probably of the same bed, occurs in a stream 600 m ENE of Hermitage Farm [2381 8575]. A 15-cm limestone within red mudstone, and which yielded a few ostracods but no *Spirorbis*, was observed here by Cantrill (1909). The Maxstoke Limestone lies about 160 m below the top of the Keele Formation. Therefore, limestone fragments recorded by Cantrill (MS field map) 700 m southwest of Parsonage Farm [2428 8504] must be derived from a limestone outcrop higher in the sequence, just below the base of the Coventry Sandstone.

East of Hill Plantation a conglomerate, probably deposited in a point bar, can be traced for 700 m along strike, until it passes laterally into sandstone. Pebbles in scattered blocks of conglomerate and loose in the soil, are mainly of chert, sandstone and shelly Dinantian limestone. Up to 4.5 m of conglomerate, formerly exposed in a gravel pit [2432 8845], showed an upward decrease in limestone pebbles from 15% to 3% (Cantrill, MS notebook); Shotton (1927,p612, localities 2 & 3) also found variations in the proportion of limestone in this bed.

Enville Group

Coventry Sandstone Formation

The lowest 120 m of the Coventry Sandstone crop out along the southeastern margin of the area. The Formation consists of red-brown sandstone and mudstone in beds which show some impersistence along the strike. They are generally similar to those of the Keele Formation, but with a greater proportion of sandstone.

Sandstone debris occurs widely over the sandstone outcrops, and a small quarry southeast of Bentley's Farm [2473 8722] exposes 4 m of coarse, red-brown sandstone including numerous pockets of channel-lag breccia up to 30 cm thick; the pebbles are mainly of hard, fine-grained sandstone, together with chert,

and are up to 4 cm in diameter. Shotton (1927,p612, locality 4) gives a pebble count for a conglomerate at the same horizon, exposed in a quarry nearby [2498 8752].

A large 5m-deep quarry at Quarry Wood [245 861], now has only very small exposures of flaggy sandstone.

TRIASSIC

Sherwood Sandstone Group

Kidderminster Formation

Beds assigned to the Kidderminster Formation have been proved only in the Blythe Bridge Borehole [2119 8979], where the sequence was not bottomed. The absence of the Kidderminster Formation from the Dumble Farm Borehole, where Bromsgrove Sandstone rests unconformably on Coventry Sandstone (see below), suggests that the Maxstoke Fault is a major Triassic growth fault (see "Structure"). The 578 m of Kidderminster Formation, proved to a depth of 1059 m at Blythe Bridge, are known mainly from from chipping samples, and the boundary with the overlying Bromsgrove Sandstone has not been located accurately.

The Kidderminster Formation is distinguished from the Bromsgrove Sandstone by the presence of mainly red-brown (as opposed to mainly buff) sandstones, which contain a proportion of well-rounded "millet-seed" grains, and by thick beds of conglomerate.

The sandstones ecountered at Blythe Bridge occur in shades of red-brown, purple and, rarely, pale-grey. They are medium- to coarse-grained, and the few short lengths of core show cross bedding, mudstone clasts, micaceous bedding planes, concentrations of millet-seed grains and scattered pebbles; they vary from weakly- to strongly-cemented.

Conglomerates dominate the sequence from 1015 to 1048 m, 613 to 631 m and 561 to 573 m. The pebble chippings are of quartz and quartzite in a variety of colours, and the pebbles are presumably of the type known as "Bunter pebbles" in the literature.

Mudstone, together with some siltstone and sandstone, occurs in the chippings chiefly from 887 to 927 m and 749 to 771 m. It is usually red-brown, but below 921 m it is pale grey.

There are no beds at the top of the sequence at Blythe Bridge which can be correlated with the Wildmoor Sandstone (Upper Mottled Sandstone) known in the Birmingham area to the west (Eastwood and others,1925), and the Kidderminster Formation is overlain by the Bromsgrove Sandstone.

Bromsgrove Sandstone Formation

The Bromsgove Sandstone is known only from boreholes: its full thickness, proved in the Blythe Bridge and Dumble Farm boreholes, was 182 m and 79 m respectively. The greater thickness at Blythe Bridge is probably due to growth faulting on the Maxstoke Fault, although it is possible that part of the sequence is faulted out at Dumble Farm.

No cores were taken at Blythe Bridge and only short lengths at Dumble Farm,so the limits of the Formation are based on imprecise data from chipping samples. The gamma-log of the Dumble Farm Borehole (Figure 3) (digitised by the BGS Deep Geology Unit) indicates a rapid passage upwards from sandstone into the mudstone-dominated Mercia Mudstone; the base of the Formation is less clear on the gamma-log because the underlying Coventry Sandstone has a similar response.

The sandstones of the Bromsgrove Sandstone are buff, red-brown and grey-brown and commonly micaceous, with calcareous patches probably of pedogenic origin. Cross bedding was recorded only once in the short Dumble Farm cores, but is almost certainly widely developed throughout the Formation. In both boreholes the sandstones from the lower part of the Formation (c30 m at Dumble Farm and c100 m at Blythe Bridge) are darker red-brown , coarser and contain a few quartzite pebbles. At Dumble Farm this change corresponds to the decreased gamma values below 135 m.

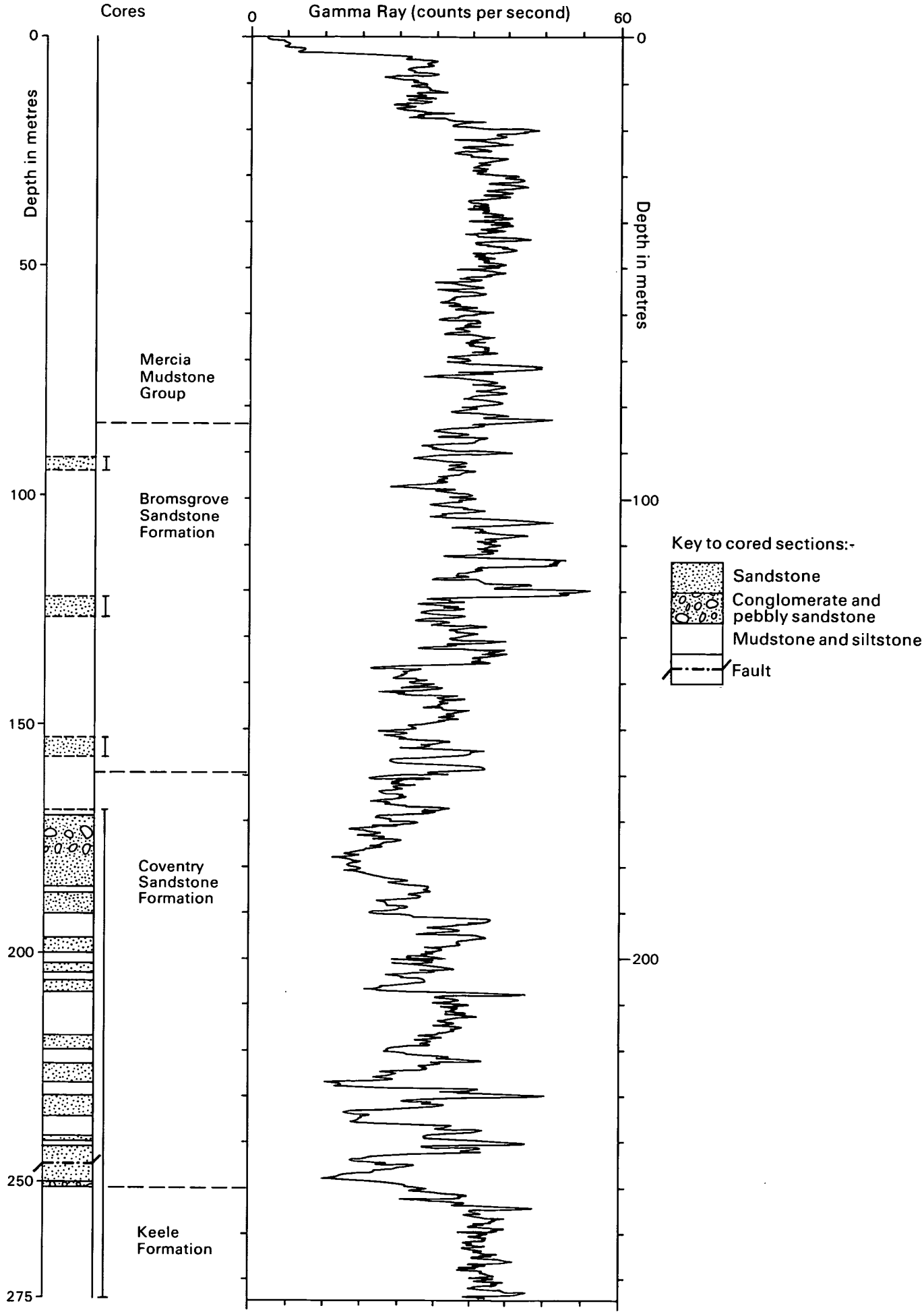

Figure 3. Lithological and Gamma Ray logs of Dumble Farm Borehole

Mercia Mudstone Group

Approximately 365 m of beds belonging to the Mercia Mudstone Group have been proved in this area, all but the lowest 60 m of which come to crop. However, the sequence is very poorly exposed, and apart from the Arden Sandstone there are no distinctive stratigraphic subdivisions.

The bulk of the Formation consists of red-brown mudstone with rare grey-green bands. Fibrous and nodular gypsum has been proved in boreholes at depths greater than 40 m, but is absent from exposures due to solution by groundwater.

Beds of hard grey-green slitstone (skerries), occur at several horizons, chiefly in the lowest beds at outcrop, between the Meriden and Maxstoke faults. They form mappable features,and are commonly encountered as fragments dug from ditches and marl pits. Pseudomorphs after halite occur on one outer surface (probably the base) of many of the fragments. A 1 to 2 cm micaceous skerry, exposed in a ditch at Spring Guns Plantation [2267 8952], had a rippled, cross-laminated top, and halite pseudomorphs at the base.

Arden Sandstone Member

The Arden Sandstone Member occurs about 320 m above the base of the Mercia Mudstone. It forms a mappable unit between Coleshill and Little Packington, due to its distinctive lithology which, in turn, gives rise to a prominent scarp. The Arden Sandstone consists of about 10 m of grey, grey-green and red-brown, thinly bedded sandstone, siltstone and mudstone. There are very few exposures, but a prominent feature about half way up the escarpment appears to be formed by a well-cemented, hard sandstone, yielding abundant fragments in ploughed fields. Blocks of this sandstone occur in the steep river bank 300 m west of Duke Bridge [2138 8818], while softer, cross-laminated, red sandstone crops out in the river bed below.

The following section was formerly exposed in a pit on Maxstoke Lane, 420 m west of the dismantled railway [2082 8860] (Cunnington, MS notebook; see also Eastwood and others, 1925 p89 for a different interpretation of Cunnington's notes):

"In the west of the pit the section reads:

Blue shale with rectangular cleavage	5 ft (1.5m)
Red shale	1 ft 6 in (0.46m)
Hard coarse sandstone	1 ft 6 in (0.46m)
Red shale	2 ft (0.61m)

The sandstone passes rapidly into sandy marl..."

At the top of the east side of the pit "a hard sandstone 4 ft (1.2m) thick appears, separated from the (blue) shale above by 1 ft (0.3m) of red marl. The incoming of this sandstone is extremely abrupt".

An old pit 250 m southeast of Hawkswell Farm [2147 8689] still exposes about 1 m of cross bedded, flaggy, hard, grey sandstone with mudstone partings. Here, Cunnington (MS notebook, and in Eastwood and others, 1925 p89) recorded sandstone with ripple marks, mudstone pellets, desiccation cracks and ?load casts.

STRUCTURE

Pre-Carboniferous Movements

The Cambrian rocks encountered in boreholes have dips ranging from 5 to 20°. No direct evidence of dip directions is available, but the faunal zones proved in boreholes decrease in age to the southwest, indicating a regional dip in that direction. This folding presumably dates from the Caledonian Orogeny.

Post-Caledonian - Pre-Triassic Movements

The Carboniferous rocks lie on the western flank of the Warwickshire Coalfield Syncline, and dip eastwards at up to 15°. The dip slackens eastwards and minor north-south folding occurs just south of Birchley Stump [248 864].In the fault-bounded outcrop of Keele Formation at Hermitage Farm [236 855] the dip is gently southwards.

An open NE-SW syncline, bisecting grid square 24 85, has been identified in the Two Yard seam from British Coal seismic records. The absence of this fold at the surface lends support to evidence from the east of the area for a period of pre-Halesowen Westphalian folding (Rees,1989).

Facies changes in the Westphalian (see above) suggest that the Meriden Fault may have been active during the Carboniferous, although most of the faults cutting the Carboniferous are probably post-Triassic in age.

Intra- and Post-Triassic Movements

The north-south Maxstoke and Meriden Faults, with westerly downthrows of 330 and 500 m respectively, probably acted as growth faults controlling Triassic sedimentation on the eastern margin of the Knowle Basin. The absence of the Kidderminster Formation between the two faults, proves that the Maxstoke Fault is the older.

QUATERNARY

Quaternary sediments of glacial and post-glacial age occur mainly in the western half of the area. Contours on the sub-drift (rockhead) surface are shown in Figure 4, and drift thickness is shown in Figure 5.

Glacial Sand and Gravel

Glacial sand and gravel caps the ridge between Coleshill and Little Packington, and forms a smaller outcrop at Twist's Wood [229 852]. Over the major outcrop it is mostly 3 to 5 m thick, but locally exceeds 10 m (Figure 5).

Although thee were formerly extensive workings in sand and gravel, no significant exposures occur now, and no recorded sections are known. Small diggings in various parts of the outcrop yield pebbles principally of "Bunter" quartzite. Grading for playing fields at Father Hudson's Homes [2034 8825] laid bare up to 2.5 m of clayey sand and gravel, which contained abundant angular grey flint; flint pebbles occur in the soil for 1 km to the south.

Over most of the area the sand and gravel was deposited on a gently sloping topopgraphy, but at Little Packington [216 855] drilling carried out for Packington Estate Enterprises Ltd., revealed a steep-sided, sub-drift valley sloping to the north (Figure 4).

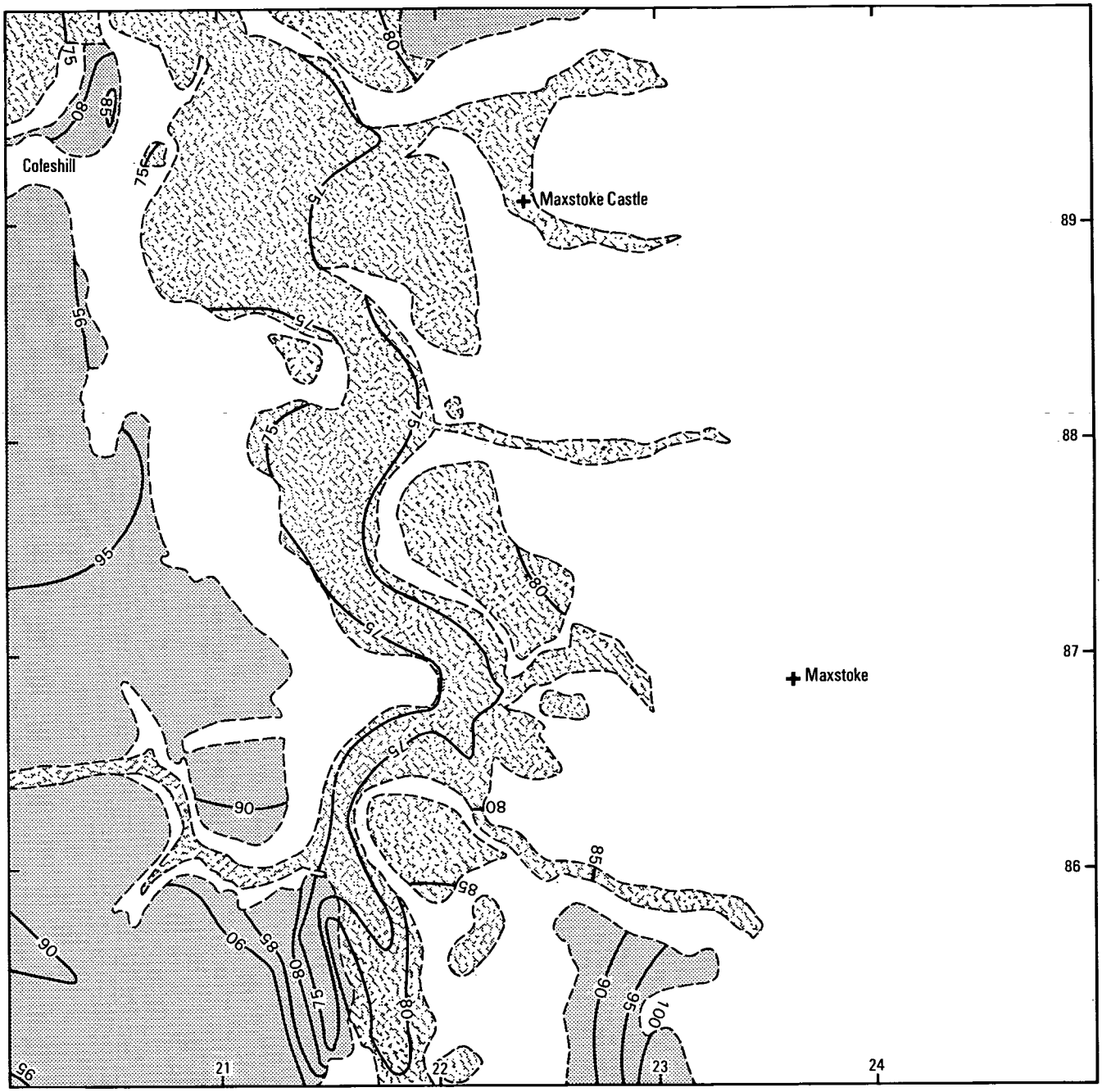

Figure 4. Rockhead elevation at the base of the drift

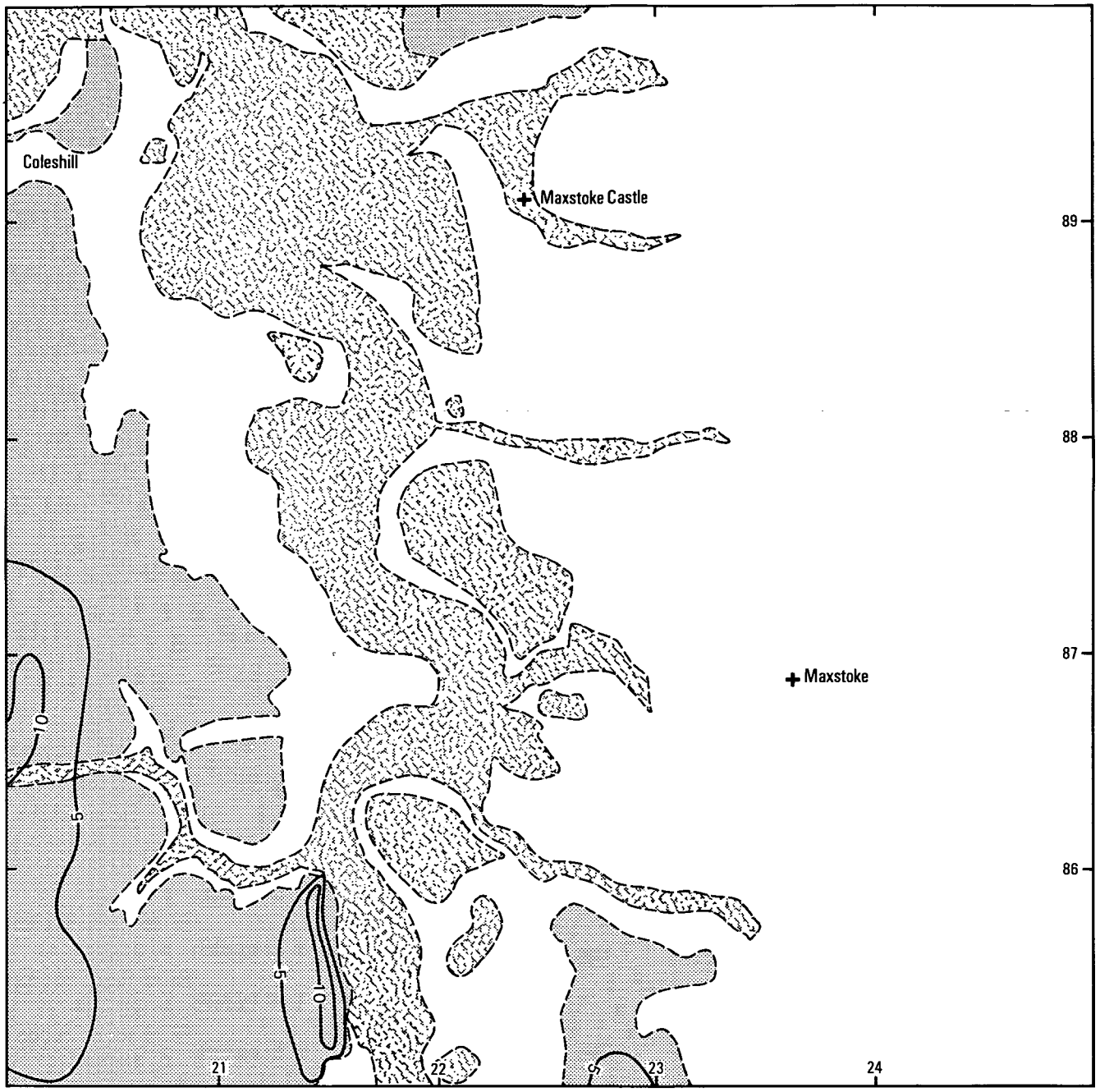

Figure 5. Thickness of drift

Fluvio-Glacial Sand and Gravel

A small outcrop of brown sandy clay containing Bunter quartzite pebbles, occurs 900 m north of Maxstoke Castle [224 899]. The deposit is similar to those described as fluvio-glacial sand and gravel in the area to the south, and which overlie the glacial sand and gravel (Sumbler,1989).

River Terrace Deposits

Extensive River Terrace Deposits occur along the Blythe Valley.They were formerly included mainly within glacial deposits referred to as "unbedded clayey gravel" by Eastwood and others (1925,p118).

The terraces occur at two levels; the Second Terrace has a surface 3 to 5 m above the flood plain, while the First Terrace surface lies at 1 to 3 m above the flood plain. Where the terraces are in contact their boundary is formed by a strong feature 1 to 1.5 m high, whereas the First Terrace and alluvium are commonly separated only by an indistinct low rise.

Both the terraces are composed of Bunter pebble gravel; the deposits of the Second Terrace tend to be rather clayey, while those of the First Terrace are mainly of coarse gravel, with cobbles reaching 20 cm in diameter. The deposits probably do not exceed 3 m in thickness.

Alluvium

The River Blythe, its larger tributaries, and the River Cole are flanked by alluvial flood plains up to 400 m wide. Typically the alluvium consists of an upper layer of grey or grey-brown clay, variably sandy or pebbly, and up to 1.5 m thick, overlying bedded sand and Bunter pebble gravel at least 0.5 m thick.

Made Ground (Landfill)

The former gravel workings at Little Packington, which were mostly about 3 m deep, have been completely restored, apart from the amenity area at Broadwater [226 854]. The smaller pits south of the M6 motorway [204 861; 210 864] have been restored with landfill which rises up to 3 m above the original land surface, but it is at Little Packington [205 853] that the greatest amount of

tipping has occurred. Although started in the void created by sand and gravel extraction, with subsequent extensions this site has been extended to cover 156 ha, and with recent planning permission to raise the original ground levels to 150 m AOD, it has become the largest overland landfill in the United Kingdom, and one of the largest waste disposal sites in Europe. It is claimed to accommodate 15% of all domestic, commercial, industrial and construction industry wastes arising from the West Midlands. The landfill operation is carefully controlled through the use of clay lined cells which serve to minimise leachate generation. The operator has also installed one of the largest and most innovative landfill gas recovery and control systems in the UK, the gas being used to generate electricity for the national grid. (Packington Estate Enterprises Ltd.,1987; Biddle, 1988).

ECONOMIC GEOLOGY

Building Stone

Numerous small quarries have in the past worked sandstone for building stone from the Keele and Coventry Sandstone formations, and the quarries on the outcrop of the Arden Sandstone may also have been worked for building stone.

Coal

The Thick Coal is currently mined beneath the area from shafts at Daw Mill Colliery just to the east. Isopachytes and nomenclature for the Thick Coal have been published by British Coal (National Coal Board, 1985). The presently known coalfield is bounded to the west by the Meriden Fault. The Thick Coal is a good quality seam which can be prepared to the requirements of domestic and industrial markets.

Limestone

The outcrop of the Maxstoke Limestone is marked by numerous shallow pits from which limestone was dug for agricultural use.

Sand and Gravel

Glacial sand and gravel has been worked extensively since the 1950's in the Packington area, although all the workings are now closed. Areas of potentially workable resources occur around Pool Farm [202 868], where in places they exceed 10 m in thickness, and around The Bogs Farm [204 858] they are 3 to 5 m thick.

The River Terrace deposits of the River Blythe, especially those of the First Terrace, are potentially workable; the the most promising areas being at Castle Farm [210 890] and Duke End [215 878].

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APPENDIX I. Schedule of boreholes on Sheet SP 28 NW.

BOREHOLE REF.NO SP28NW		BOREHOLE NAME	GRID.REF. EAST	NORTH	DEPTH (m)	DATE
1		DOVE HOUSE FARM BH FILLONGLEY	2472	8912	643.92	1957
2		PACKINGTON PARK NO.51 LITTLE	2173	8507	3.73	1961
3		PACKINGTON PARK NO.60 LITTLE	2196	8505	6.10	1961
4		PACKINGTON PARK NO.62 LITTLE	2211	8506	3.51	1961
5		PACKINGTON PARK NO.63 LITTLE	2207	8514	3.43	1961
6		DUMBLE FARM BORE MAXSTOKE	23057	88737	274.93	1969
7		N.C.B.KIMBERLEYS GROVE MAXSTOKE NO.511	2462	8763	671.65	1972
8		M42 SOLIHULL SECTBH323 LITTLE	2002	8651	16.00	1970
9		M42 SOLIHULL SECTBH324 LITTLE	2004	8652	17.96	1970
10	A	M42 SOLIHULL SECTBH325 LITTLE	2004	8648	20.00	1970
10	B	M42 SOLIHULL SECTBH325 LITTLE	2004	8648	30.00	1970
11	c	BLYTH BRIDGE NCB(1972) COLESHILL	2119	8979	154.53	1972
12		MIDLAND M/WAY BH1001 LITTLE PACKINGON	2037	8654	12.95	1965
13		MIDLAND M/WAY BH1002 LITTLE PACKINGON	2054	8655	3.05	1965
14	A	MIDLAND M/WAY BH1003 LITTLE PACKINGON	2063	8656	3.05	1965
14	B	MIDLAND M/WAY BH1003B LITTLE PACKINGON	2063	8656	6.17	1965
15		MIDLAND M/WAY BH1004 LITTLE PACKINGON	2070	8657	9.22	1965
16		MIDLAND M/WAY BH1005 LITTLE PACKINGON	2078	8658	4.57	1965
17		MIDLAND M/WAY BH1006 LITTLE PACKINGON	2085	8662	9.14	1965
18		MIDLAND M/WAY BH1007 LITTLE PACKINGON	2087	8661	10.67	1965
19		MIDLAND M/WAY BH1008 LITTLE PACKINGON	2087	8659	9.14	1965
20		MIDLAND M/WAY BH1009 LITTLE PACKINGON	2097	8662	9.14	1965
21		MIDLAND M/WAY BH1010 LITTLE PACKINGON	2117	8666	12.19	1965
22		MIDLAND M/WAY BH1011 LITTLE PACKINGON	2126	8669	12.19	1965
23		MIDLAND M/WAY BH1012 LITTLE PACKINGON	2126	8665	12.19	1965
24		MIDLAND M/WAY BH1013 LITTLE PACKINGON	2141	8667	4.57	1965
25		MIDLAND M/WAY BH1014 LITTLE PACKINGON	2147	8666	12.19	1965
26		MIDLAND M/WAY BH1015 LITTLE PACKINGON	2157	8665	7.62	1965
27		MIDLAND M/WAY BH1029 LITTLE PACKINGON	2323	8592	9.14	1966
28		MIDLAND M/WAY BH1029B LITTLE PACKINGON	2330	8591	12.19	1966
29		MIDLAND M/WAY BH1030 LITTLE PACKINGON	2338	8591	12.19	1965
30		MIDLAND M/WAY BH1030 LITTLE PACKINGON	2353	8588	3.05	1965
31		MIDLAND M/WAY BH1032 LITTLE PACKINGON	2360	8589	9.30	1965
32		MIDLAND M/WAY BH1033 LITTLE PACKINGON	2364	8586	16.76	1966
33		MIDLAND M/WAY BH1034 LITTLE PACKINGON	2372	8588	12.19	1966
34		MIDLAND M/WAY BH1035 LITTLE PACKINGON	2399	8582	9.14	1966
35		MIDLAND M/WAY BH1036 LITTLE PACKINGON	2401	8584	9.14	1966
36		MIDLAND M/WAY BH1037B LITTLE PACKINGON	2402	8581	4.57	1966
37		MIDLAND M/WAY BH1038 LITTLE PACKINGON	2414	8580	12.19	1966
38		MIDLAND M/WAY BH1039 LITTLE PACKINGON	2431	8578	9.14	1966
39		MIDLAND M/WAY BH1040 LITTLE PACKINGON	2443	8574	12.19	1965
40		MIDLAND M/WAY BH1041 LITTLE PACKINGON	2456	8581	18.29	1965
41		MIDLAND M/WAY BH1042 LITTLE PACKINGON	2456	8573	18.29	1965
42		MIDLAND M/WAY BH1043 LITTLE PACKINGON	2464	8574	18.29	1965
43		MIDLAND M/WAY BH1044 LITTLE PACKINGON	2469	8580	12.19	1965
44		MIDLAND M/WAY BH1045 LITTLE PACKINGON	2474	8570	12.19	1965
45		MIDLAND M/WAY BH1046 LITTLE PACKINGON	2483	8571	6.71	1965
46		MIDLAND M/WAY BH1047 LITTLE PACKINGON	2499	8573	3.05	1965
47		MIDLAND M/WAY BH1047B LITTLE PACKINGON	2492	8570	2.59	1966
48		BENTLEY LANE MAXSTOKE	2428	8748	45.72	1965
49		MAXSTOKE CASTLE LODGE BORING	2282	8909	91.44	1906
50		DOVEHOUSE FARM COLESHILL	2432	8930	45.72	1946
51		PACKINGTON LANE MERIDEN	2111	8584	60.96	1954
52	c	N.C.B.OUTWOODS	24462	82528	611.00	1981
53		CATTHORPE-CASTLE BROMWICH SPEC.ROAD1400	2449	8574	1808.00	1967
54		CATTHORPE-CASTLE BROMWICH SPEC.ROAD 1401	2472	8572	19.74	1967
55	c	PRIORY WOOD BH N.C.B.	24361	82577	406.00	1967
56	c	WOODCOCK WOOD NCB 1986	2427	8682	677.97	1986

BOREHOLE REF.NO SP28NW		BOREHOLE NAME	GRID.REF. EAST	NORTH	DEPTH (m)	DATE
57		MIDLAND MOTORWAY LINK BH1016	2165	8664	12.19	1965
58		MIDLAND MOTORWAY LINK BH1017	2165	8659	12.19	1965
59		MIDLAND MOTORWAY LINK BH1018	2172	8662	15.24	1965
60		MIDLAND MOTORWAY LINK BH1019	2173	8658	15.70	1966
61		MIDLAND MOTORWAY LINK BH1020	2188	8655	9.14	1965
62		MIDLAND MOTORWAY LINK BH1021	2204	8647	15.24	1966
63		MIDLAND MOTORWAY LINK BH1022	2220	8641	15.32	1966
64		MIDLAND MOTORWAY LINK BH1023	2217	8638	15.24	1966
65		MIDLAND MOTORWAY LINK BH H1024	2216	8620	4.57	1966
66		MIDLAND MOTORWAY LINK BH1025	2250	8617	6.10	1966
67		MIDLAND MOTORWAY LINK BH H1026	2274	8606	3.05	1966
68		MIDLAND MOTORWAY LINK BH1027	2286	6803	9.14	1966
69		MIDLAND MOTORWAY LINK BH H1028	2308	8594	4.57	1966
70		MIDLAND MOTORWAY LINK BH 148	2176	8662	9.14	1960
71		MIDLAND MOTORWAY LINK BH 149	2269	8611	9.14	1960
72		MIDLAND MOTORWAY LINK BH 144	2087	8661	9.14	1960
73		MIDLAND MOTORWAY LINK BH 146	2120	8671	13.72	1960
74		MIDLAND MOTORWAY LINK BH 152	2329	8592	9.14	1960
75		MIDLAND MOTORWAY LINK BH 153	2362	8588	9.14	1960
76		MIDLAND MOTORWAY LINK BH 155	2450	8576	16.76	1960
77	c	PACKINGTON ESTATE WATER SPORT AREA A6	21242	85029		1970
78	c	PACKINGTON ESTATE WATER SPORT AREA A22	21115	85082		1970
79	c	PACKINGTON ESTATE WATER SPORT AREA A26	21039	85259		1970
80	c	PACKINGTON ESTATE WATER SPORT AREA A27	21079	85170		1970
81	c	PACKINGTON ESTATE WATER SPORT AREA A28	21056	85110		1970
82	c	PACKINGTON ESTATE WATER SPORT AREA A29	21218	85114		1970
83	c	PACKINGTON ESTATE WATER SPORT AREA A30	21178	85061		1970
84	c	PACKINGTON ESTATE WATER SPORT AREA A31	41145	85146		1970
85	c	PACKINGTON ESTATE WATER SPORT AREA A32	21326	85051		1970
86	c	PACKINGTON ESTATE WATER SPORT AREA A33	21292	85138		1970
87	c	PACKINGTON ESTATE WATER SPORT AREA A34	21368	85177		1970
88	c	PACKINGTON ESTATE WATER SPORT AREA A35	21171	85214		1970
89	c	PACKINGTON ESTATE WATER SPORT AREA A36	21144	85299		1970
90	c	PACKINGTON ESTATE WATER SPORT AREA A37	21106	85229		1970
91	c	PACKINGTON ESTATE WATER SPORT AREA A38	21228	85331		1970
92	c	PACKINGTON ESTATE WATER SPORT AREA A39	21252	85246		1970
93	c	PACKINGTON ESTATE WATER SPORT AREA A40	21197	85264		1970
94	c	PACKINGTON ESTATE WATER SPORT AREA A41	21298	85353		1970
95	c	PACKINGTON ESTATE WATER SPORT AREA A42	21332	85272		1970
96	c	PACKINGTON ESTATE WATER SPORT AREA A43	21271	85298		1970
97	c	PACKINGTON ESTATE WATER SPORT AREA A48	21301	85003		1970
98	c	PACKINGTON ESTATE WATER SPORT AREA GB4	20877	85159		1970
99	c	PACKINGTON ESTATE WATER SPORT AREA GB10	20962	85032		1983
100	c	PACKINGTON ESTATE WATER SPORT AREA GB13	20930	85222		1983
101	c	PACKINGTON ESTATE WATER SPORT AREA GB14	20848	85032		1983
102	c	PACKINGTON ESTATE PE5	20852	85080		1983
103	c	PACKINGTON ESTATE PE7	21233	85124		1983
104	c	PACKINGTON ESTATE PE8	20220	85234		1983
105	c	PACKINGTON ESTATE PE12	21420	85723		1983
106	c	PACKINGTON ESTATE PE13	21480	85637		1983
107	c	PACKINGTON ESTATE PE20	21145	85256		1983
108	c	PACKINGTON ESTATE PE21	21139	85243		1983
109	c	PACKINGTON ESTATE PE23	20548	85690		1984
110	c	PACKINGTON ESTATE PE24	20560	85686		1984
111	c	PACKINGTON ESTATE PE25	20282	85512		1984
112	c	PACKINGTON ESTATE PE26	20251	85207		1984
113	c	PACKINGTON ESTATE PE27	20262	85211		1984
114	c	PACKINGTON ESTATE PM3	21061	85822		1954

BOREHOLE REF.NO SP28NW		BOREHOLE NAME	GRID.REF. EAST	NORTH	DEPTH (m)	DATE
115	c	PACKINGTON ESTATE PE29	21157	85243		1985
116	c	PACKINGTON ESTATE PE30	21212	85473		1985
117	c	PACKINGTON ESTATE PE31	21200	85420		1985
118	c	PACKINGTON ESTATE PE32	21208	85575		1985
119	c	PACKINGTON ESTATE PE33	21153	85652		1985
120	c	PACKINGTON ESTATE PE34	21000	85847		1985
121	c	PACKINGTON ESTATE PE35	20842	85846		1985
122	c	PACKINGTON ESTATE PE36	20949	85830		1985
123	c	PACKINGTON ESTATE PE37	21009	85809		1985
124	c	PACKINGTON ESTATE PM5	21030	85860		1976
125	c	PACKINGTON ESTATE PM9	20513	85680		1976
126	c	PACKINGTON ESTATE PM10	20719	85775		1976
127	c	PACKINGTON ESTATE PM11	20922	85567		1976
128	c	PACKINGTON ESTATE PM12	20528	85200		1976
129	c	PACKINGTON ESTATE PM13	20959	85058		1976
130	c	PACKINGTON ESTATE PM14	21159	85010		1976
131	c	PACKINGTON ESTATE PM18	21183	85748		1980
132	c	PACKINGTON ESTATE PM19	21281	85615		1980
133	c	PACKINGTON ESTATE PM20	21175	85468		1980
134	c	PACKINGTON ESTATE PM21	20740	85799		1983
135	c	PACKINGTON ESTATE PM22	20383	85610		1983
136	c	PACKINGTON ESTATE PM23	20213	85337		1983
137	c	PACKINGTON ESTATE PM26	21186	85896		1983
138	c	PACKINGTON ESTATE PM27	21188	85899		1983
139	c	PACKINGTON ESTATE PM28	21194	85900		1983
140	c	PACKINGTON ESTATE PM29	21344	85927		1983
141	c	PACKINGTON ESTATE PM30	21424	85952		1983
142	c	PACKINGTON ESTATE PM31	21452	85620		1983
143	c	PACKINGTON ESTATE PM35	2064	8578		1984
144	c	PACKINGTON ESTATE PM36	21180	85441		1985
145	c	PACKINGTON ESTATE PM37	21109	85659		1985
146	c	PACKINGTON ESTATE PM38	21081	85520		1985
147	c	PACKINGTON ESTATE PM39	21150	85605		1985
148	c	PACKINGTON ESTATE PM40	21142	85498		1985
149	c	PACKINGTON ESTATE PM41	21078	85603		1985
150	c	PACKINGTON ESTATE PM42	21066	85782		1985
151	c	PACKINGTON ESTATE PM43	20914	85869		1985
152	c	PACKINGTON ESTATE PM44	21514	85218		1985
153	c	PACKINGTON ESTATE PM46	21308	85201		1985
154	c	PACKINGTON ESTATE PM47	20344	85360		1987
155	c	PACKINGTON ESTATE PM48	20718	85687		1987
156	c	PACKINGTON ESTATE PM49	20958	85749		1987
157	c	PACKINGTON ESTATE PM50	20792	85285		1987
158	c	PACKINGTON ESTATE PM51	21051	85379		1987
159	c	PACKINGTON ESTATE PM52	20847	85073		1987
160	c	PACKINGTON ESTATE PM53	21175	85232		1987
161	c	PACKINGTON ESTATE PM54	21202	85078		1987
162	c	PACKINGTON ESTATE TILCON POOL TP1	2056	8537		1980
163	c	PACKINGTON ESTATE TILCON POOL TP2	2053	8537		1980
164	c	PACKINGTON ESTATE TILCON POOL TP4	2043	8517		1980
165	c	PACKINGTON ESTATE TILCON POOL TP5	2045	8515		1980
166	c	PACKINGTON ESTATE TILCON POOL TP6	2040	8539		1980
167	c	PACKINGTON ESTATE TILCON POOL TP7	2041	8532		1980
168	c	PACKINGTON ESTATE TILCON POOL TP8	2039	8525		1980
169	c	PACKINGTON ESTATE TILCON POOL TP9	2035	8529		1980
170	c	PACKINGTON ESTATE TILCON POOL TP10	2035	8523		1980
171	c	PACKINGTON ESTATE TILCON POOL TP11	2031	8526		1980
172	c	PACKINGTON ESTATE TILCON POOL TP12	2029	8530		1980

BOREHOLE REF.NO SP28NW		BOREHOLE NAME	GRID.REF. EAST	NORTH	DEPTH (m)	DATE
173	c	PACKINGTON ESTATE TILCON POOL TP13	2027	8529		1980
174	c	PACKINGTON ESTATE TILCON POOL TP14	2032	8514		1980
175	c	PACKINGTON ESTATE TILCON POOL TP15	2030	8513		1980
176	c	PACKINGTON ESTATE TILCON POOL TP16	2030	5810		1980
177	c	PACKINGTON ESTATE TILCON POOL TP17	2045	8506		1980
178	c	PACKINGTON ESTATE TILCON POOL TP18	2042	8500		1980
179	c	PACKINGTON ESTATE TILCON POOL TP19	2057	8501		1980
180	c	PACKINGTON ESTATE TILCON POOL TP20	2042	8506		1980
181	c	PACKINGTON ESTATE TILCON POOL TP21	2096	8569		1980
182	c	PACKINGTON ESTATE TILCON POOL TP22	2101	8569		1980
183	c	PACKINGTON ESTATE TILCON POOL TP23	2100	8571		1980
184	c	PACKINGTON ESTATE TILCON POOL TP24	2099	8572		1980
185	c	PACKINGTON ESTATE TILCON POOL TP25	2097	8571		1980
186	c	PACKINGTON ESTATE TILCON POOL TP26	2099	8567		1980
187	c	PACKINGTON ESTATE TILCON POOL TP27	2044	8546		1980
188	c	PACKINGTON ESTATE TILCON POOL TP28	2049	8516		1980
189	c	PACKINGTON ESTATE TILCON POOL TP29	2052	8521		1980
190	c	PACKINGTON ESTATE NORTHERN GULLY TP1	2062	8577		1984
191	c	PACKINGTON ESTATE NORTHERN GULLY TP2	2061	8575		1984
192	c	PACKINGTON ESTATE NORTHERN GULLY TP3	2061	8582		1984
193	c	PACKINGTON ESTATE NORTHERN GULLY TP4	2063	8576		1984
194	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP1	21287	85048		1984
195	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP2	21300	85037		1984
196	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP3	21330	85040		1984
197	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP4	21312	85044		1984
198	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP5	21322	85033		1984
199	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP6	21324	85048		1984
200	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP7	21348	85046		1984
201	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP8	21344	85005		1984
202	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP9	21328	85008		1984
203	c	PACKINGTON ESTATE SOUTH DUCK PONDS TP10	21308	85004		1984

Detailed logs of non-confidential boreholes may be examined at the BGS National Geosciences Data Centre, Keyworth, by prior appointment, and on payment of the current fee.

c Denotes confidential record, details of which may only be released by permission of the original source.