CHAPTER 5
SITE DESCRIPTIONS

5.1. Introduction

This chapter offers a brief description of each site and the samples investigated during this study. Particle size distribution data and results of lithological and macrofabric analyses where applicable are included, together with relevant information supplied by borehole data held by the BGS.

Previous work on glacial deposits of the Stevenage and Hitchin Channels is reviewed in Chapter 3, where the main till units have been assigned names. The latter are referred to throughout the site reports.

Tills from within the Hitchin Gap are closely associated with gravel deposits, some of which have been the subject of research by the University of Hertfordshire. Gravels examined at Sites 3, 4, 8 and 11 have been shown to represent part of a sequence of glaciofluvial deposits on the basis of the presence of fragile and calcareous exotic lithologies that would be destroyed by long distance fluvial transport. These gravels extend down the Hitchin Channel from Holwell (Site 11) in the north and in the Stevenage Channel to Frogmore (TL285205) in the south. Lithological studies suggest that these gravels have lost some calcareous clasts by attrition whilst being transported down the Hitchin Channel and were diluted with extra-glacial clasts in drainage and outwash derived from the North Hertfordshire Chalklands entering the system via the Stevenage Channel above Langley (Cheshire pers. comm.). The following borehole descriptions make mention of these deposits where appropriate.

A sample from Site 13, west of Broom Quarry, was initially investigated but later interpreted as a clay-enriched lag deposit (see Section 5.3 for details). An alternative sample was obtained nearby at Site 14 and Site 13 is therefore omitted from the following site descriptions**.**

Where appropriate, borehole references assigned by the drilling companies and shown in the BGS borehole database, are given.

Particle size distribution graphs are shown for all samples. These show three distributions, i.e. all lithologies present within the till (all liths), acid-soluble lithologies (sol) and acid-insoluble lithologies (insol). The percentage of total dry weight (%TDW) is shown against phi size (see Chapter 4).

Figure 5.1 is a key to the lithostratigraphic units used in this chapter.

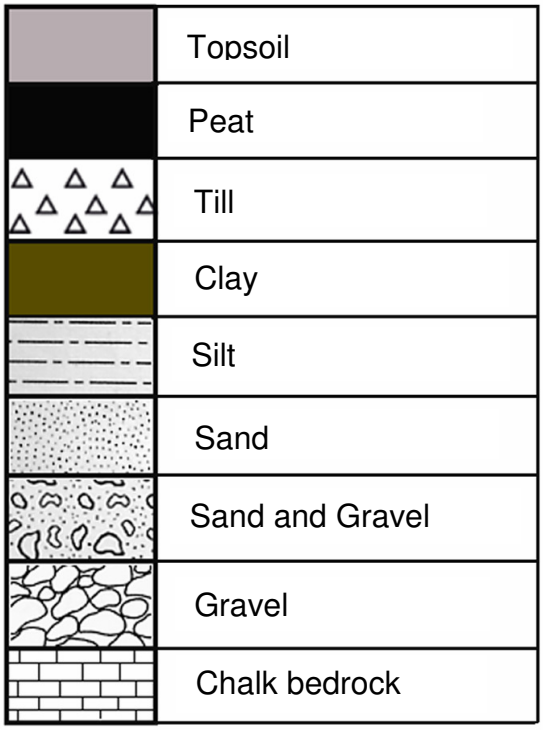


Figure 5.1. Key to lithostratigraphic units shown in borehole logs.

5.2. Sites within and adjacent to the Hitchin Gap (Sites 1-11)

Sites 1 to 9 lie in or near the buried channels south of Hitchin. Site 10 is situated north of Baldock and the Chalk scarp, being approximately 9 km northwest of Hitchin. The BGS Sheet 221 (Hitchin) shows Site 11 to lie on the western margin of the Hitchin Channel, approximately 2 km north of Hitchin.

Sites 1 to 8 are boreholes drilled by the Three Valleys Water Company in relation to an investigation it was conducting in 2000 into the groundwater hydrology of an area lying to the west of Stevenage. The boreholes were drilled on their behalf by Messrs. George W. Lack & Sons using the cable percussion method. The core samples, together with a number of bulk samples, were made available for this study.

Samples comprise 25 U100 samples, 22 of which were oriented on site, and 6 bulk samples.

SITE 1

Location	Knebworth Country Park
Grid Ref:	TL2289 2150
Ground level	106 m O.D.
Borehole Ref.	K1

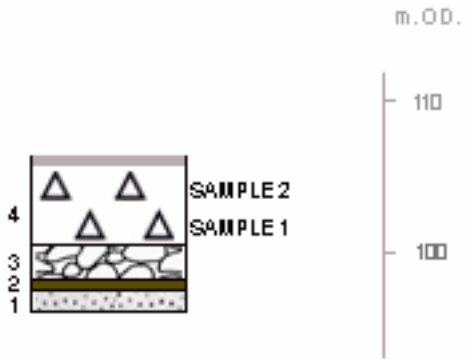


Figure 5.2. Borehole log for Site 1.

This site is situated south of the Hitchin Channel. This borehole did not penetrate the bedrock, which is shown to lie at approximately 90 m O.D. on the BGS 1:50,000 221 sheet (Hitchin).

Unit 1 Orange brown chalky sand

The lowest unit here comprises an orange/brown chalky sand. The driller's report of 'chalky sand with chalk fragments' probably relates to its close proximity to the bedrock, the borehole terminating at ~97 m O.D.

Unit 2 Layered chalky clay

Above the sand, at 97.8 m O.D. is a layer, less than 0.5 m thick, of layered chalky clay.

Unit 3 Gravel

Between 97.4 m and 100.5 m O.D. is a brown, medium to coarse, angular flint and chalk gravel.

Unit 4 Till

The lower part of this unit comprises a stiff grey/blue till. Above this, at 103.5 m O.D. and described separately on the driller's log as a 'firm brown boulder clay', is probably a slightly weathered upper portion of the same till unit.

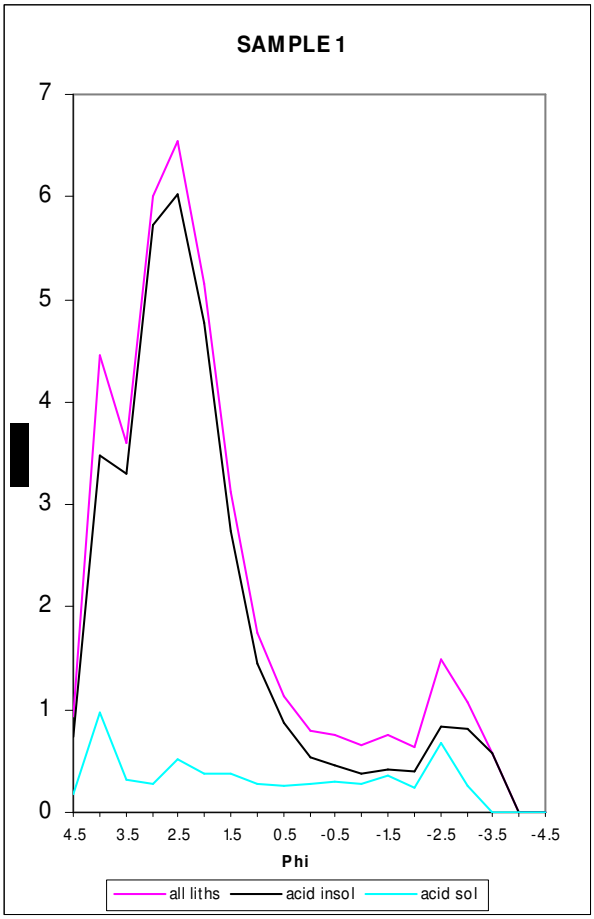
This till was sampled at 102.3 m O.D. (sample 1) and 104.2 m (sample 2). The lower sample was a brown (10YR 5/3) stiff clay. Rotted ironstone clasts were evident and black shale particles tended to disintegrate whilst conducting fabric analysis. Where large clasts were removed, the surrounding till appeared greyer, probably a result of iron reduction. The upper sample was of a soft dark yellowish brown (10YR 4/6) till with pockets of grey slightly stiffer material.

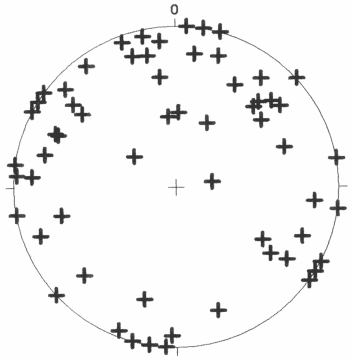
The two samples possess very similar particle size distributions (Figures 5.3 & 5.4), with a mode in the fine sand fraction at +2.0 phi. Figure 5.5 shows they also possess similar assemblages of small clast lithologies.

A very weak macrofabric is found in the lower sample (sample 1) which does not yield a statistically significant clast orientation. In contrast, a highly significant fabric from the upper sample (sample 2) indicates ice advance across the site from north to south. Dips are variable in both samples, most being below 60^{o} with averages of 19^{o} (sample 1) and 26^{o} (sample 2).

SAMPLE DETAILS

Sample 1 (Site 1, Unit 4)	
Height	102.3 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 5/3 Brown

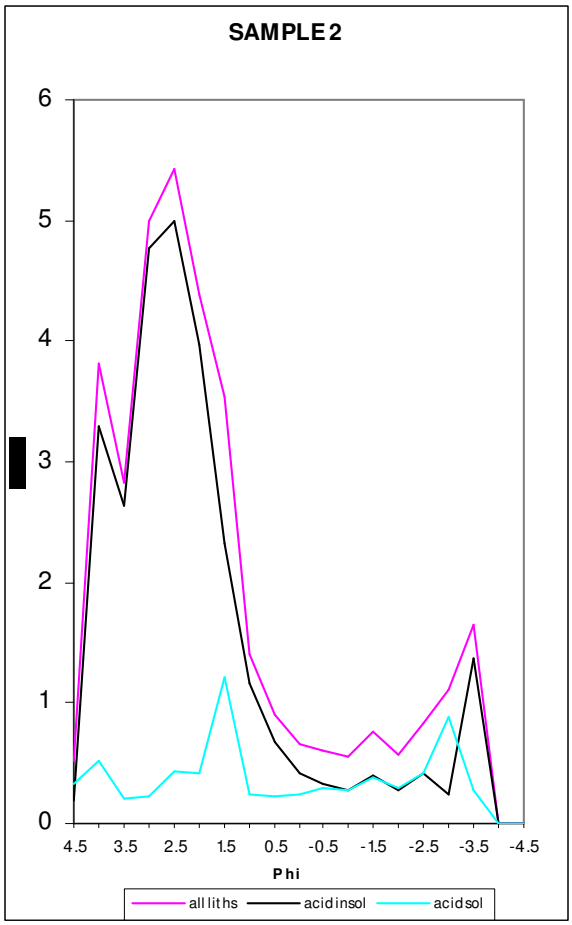


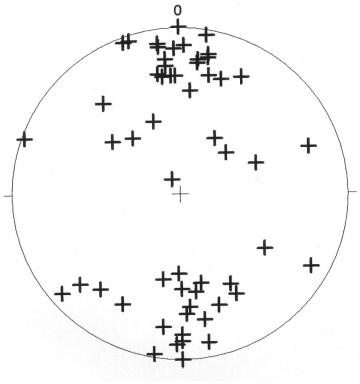


Macrofabric data for Sample 1	
Number in sample	51
Resultant vector	157°/337°
Vector magnitude	5.0%
Significance	(Not Significant)
Mean dip	19°

Figure 5.3. Particle size & macrofabric data for Sample 1.

Sample 2 (Site 1, Unit 4)	
Height	104.2 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/6 Dark yellowish brown





Macrofabric data for Sample 2	
Number in sample	55
Resultant vector	179°/359°
Vector magnitude	63.2%
Significance	>99.9% (Highly significant)
Mean dip	26°

Figure 5.4. Particle size & macrofabric data for Sample 2.

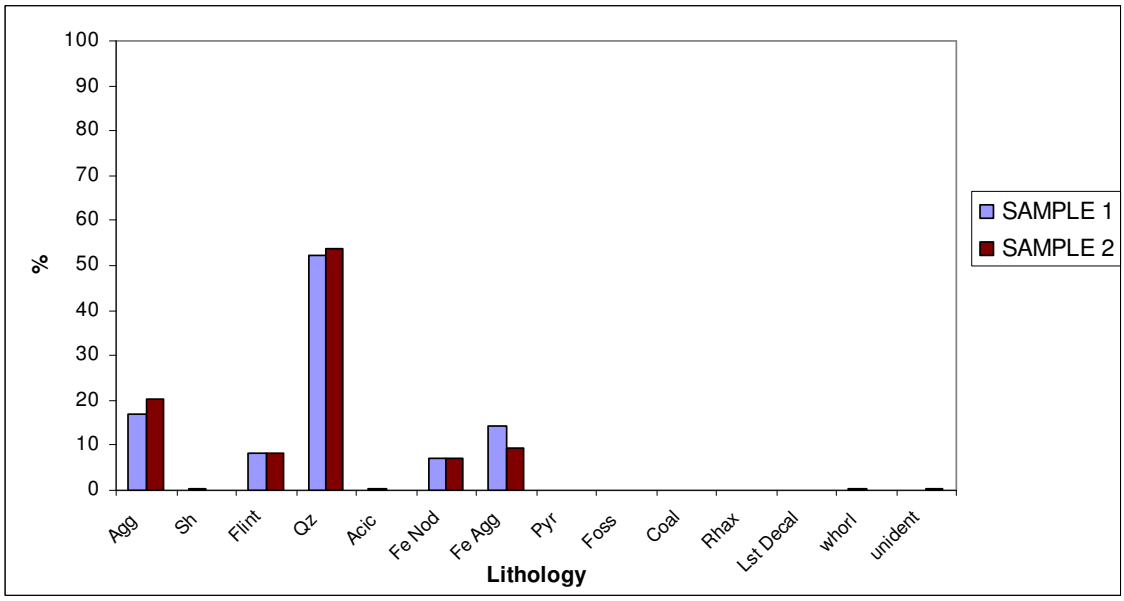


Figure 5.5. Small clast lithology data for Unit 4 at Site 1, Knebworth Country Park.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 2

Location	Norton Green
Grid Ref:	TL2288 2276
Ground level	100 m O.D
Borehole Ref.	K3

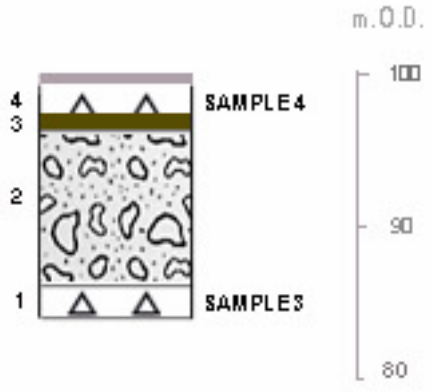


Figure 5.6. Borehole log for Site 2.

This borehole was sunk in woodland at Watery Grove, near Norton Green, and lies at the southern end of the Hitchin Channel, close to the junction with the Stevenage Channel.

Unit 1 Stiff till (lower till)

At the base of this borehole is 2.2 m of firm to stiff dark grey (10YR 4/1) till. A small sample (Sample 3) was retrieved from 85.9 m O.D. A macrofabric measurement was not possible.

Unit 2 Sand and gravel

A fine to coarse sand with occasional gravel occurs between 86.7 m and 97.0 m O.D. Near the base, at 87.0 m, a flint and sand concretion was noted. A layer of flint gravel with sand matrix exists at 89.7 m and further sandy gravel with flint pebbles is found between 93.0 m and 93.5 m O.D.

Unit 3 Sandy clay

Above the sand and gravel a band (1 m thick) of sandy clay is noted to be chalky in places. This probably represents the basal layers of the overlying till.

Unit 4 Chalky till (Upper Till)

Below 0.9 m of stony topsoil, a yellowish brown (10YR 5/4) stiff chalky till extends to 98.0 m O.D. This unit was sampled at a depth of 1.2 m (Sample 4) and was found to possess numerous crumbling chalk clasts. This sample, being rather close to the surface, contained a large root and organic matter which was subsequently removed. Rotten limestone was also present. The colour reflects its position within the weathered zone. A macrofabric of moderate strength (Figure 5.8) indicates ice moving across the site in a roughly NNE-SSW direction.

The particle size distributions for these two samples are shown in Figures 5.7 and 5.8. The lower till unit has an unusual distribution compared to other samples investigated in this study. Only 6.5% of the acid-insoluble fraction is composed of particles between +2.0 and +4.5 phi, whereas the corresponding figure for unit 4 is 17.7%. The primary mode of the lower till lies within the fine sand fraction at +4.0 phi, this being one of only a few samples in this study not to possess a primary mode between +2.0 to +3.0 phi. It is also apparent that the vein quartz content of the upper till is approximately twice that of the lower till (Figure 5.9). This is discussed further in Chapter 7.

The lack of iron pyrite clasts in the upper till (Figure 5.9) may be attributed to weathering. The lower till possesses a rather high proportion of these clasts, with an average of 11.5% across the size fractions -1.0 to +1.0 phi.

SAMPLE DETAILS

Sample 3 (Site 2, Unit 1 – Lower Till)	
Height	85.9 m O.D.
Sample Type	U100
Colour	10YR 4/1 Dark grey

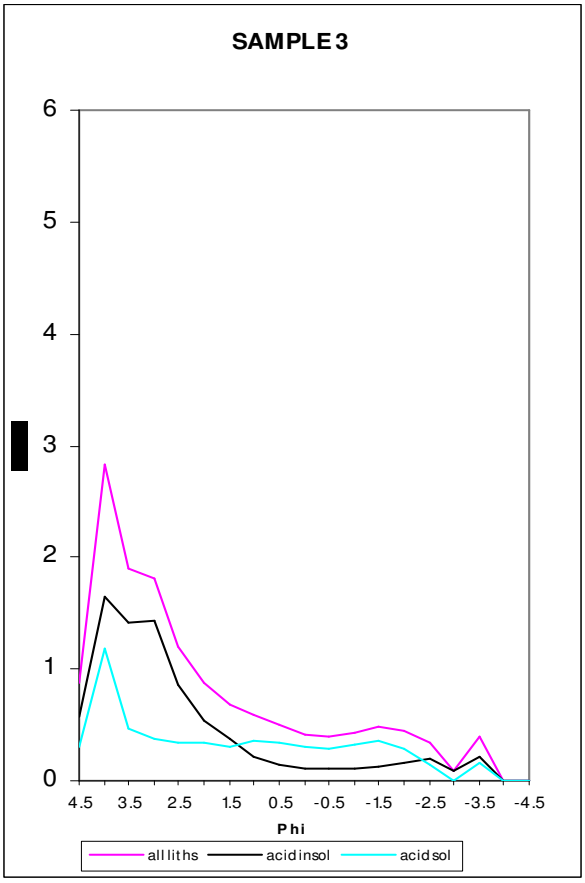
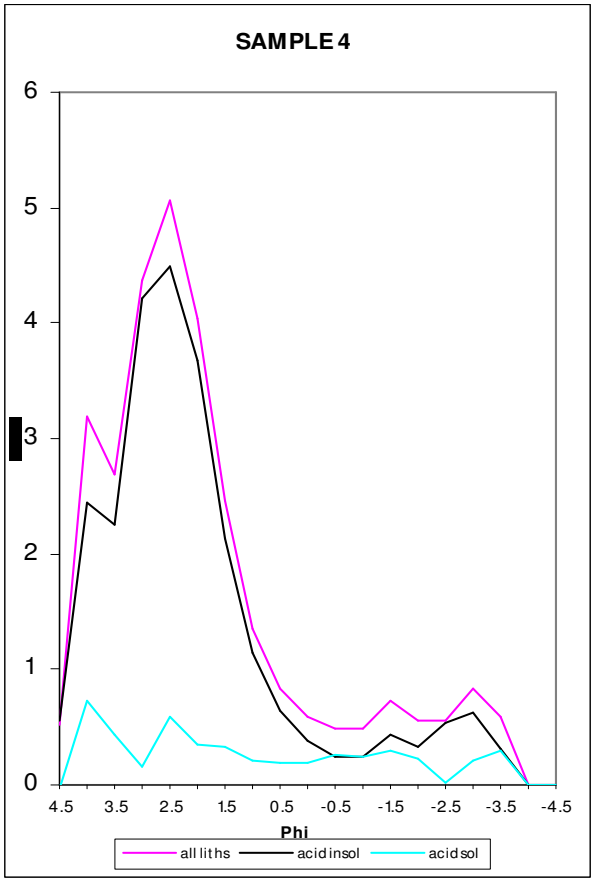
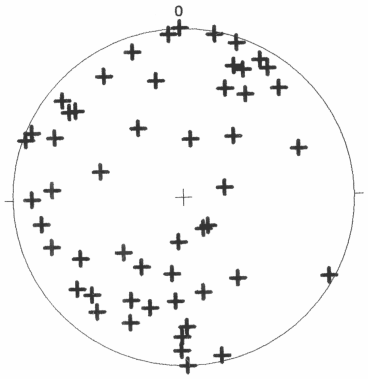


Figure 5.7. Particle size data for Sample 3.

Sample 4 (Site 2, Unit 4 – Upper Till)	
Height	98.8 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 5/4 Yellowish brown





Macrofabric data for Sample 4	
Number in sample	54
Resultant vector	14°/194°
Vector magnitude	30%
Significance	> 99.0% (Highly significant)
Mean dip	24 °

Figure 5.8. Particle size & macrofabric data for Sample 4.

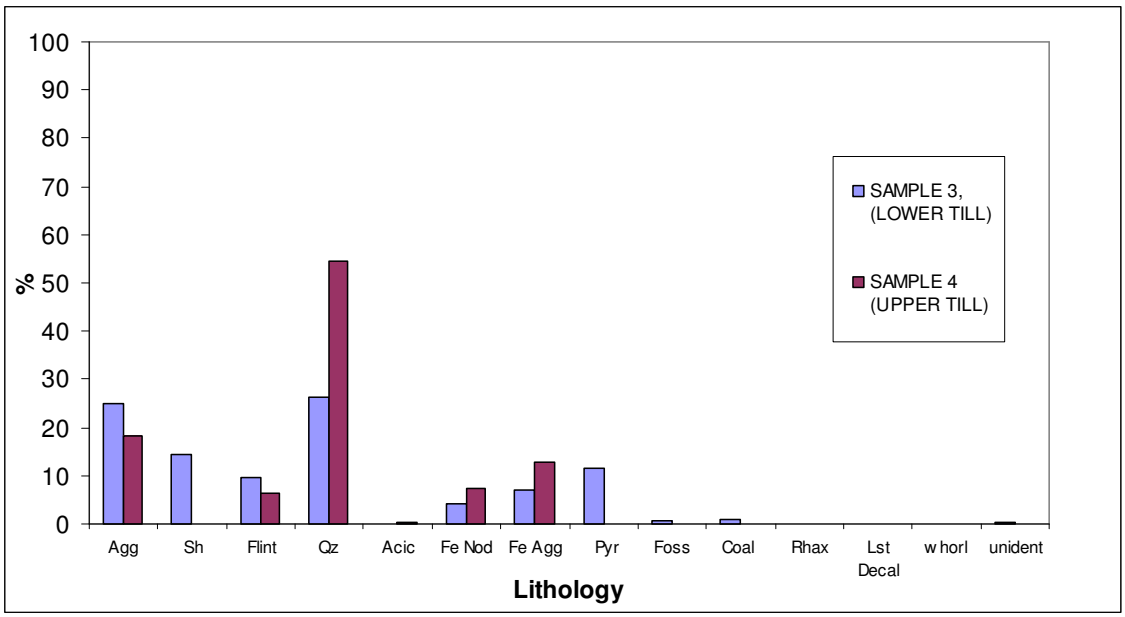


Figure 5.9. Small clast lithology data for Unit 1 (Lower), & Unit 4 (Upper) tills at Site 2, Norton Green.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 3

Location	Pigeonswick Cottage, Cannocks Wood, Knebworth
Grid Ref:	TL2240 2252
Ground level	98 m O.D.
Borehole Ref.	DB1

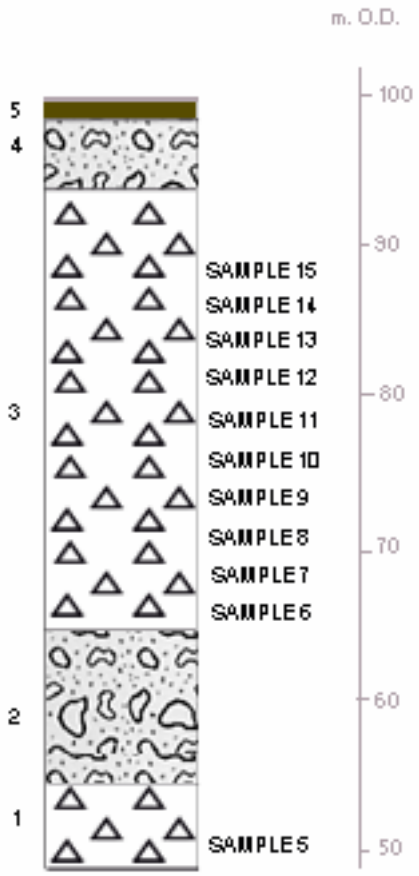


Figure 5.10. Borehole log for Site 3.

This is one of four deep boreholes investigated within the Hitchin Gap and lies close to the southern boundary of the Hitchin Channel. Eight U100 samples were retrieved together with three bulk samples from the till units.

Unit 1 Till (lower till)

The base of this borehole lies at 47.5 m O.D and is believed to lie close to the bedrock surface (see Chapter 8). The lowermost till unit was sampled from between 51 m and 52 m O.D. (Sample 5) and is here named the Langley Till. This dark grey (10YR 4/1) stiff till has a higher proportion of very fine sand than most samples from the upper till at this site. The two tills can be distinguished

by their particle size distributions (Figure 5.11 - 5.20). Although a primary mode between +2.0 and +3.0 phi is found in both till units, a secondary mode at +4.0 phi is much larger in this unit, accounting for over 2% of the total acid-insoluble distribution. The average quartz content is very similar to that of the upper till at 44.1% (Figure 5.21). However, the flint content at 20.9%, is much higher.

Unit 2 Sand and Gravel

This unit comprises a fine silty sand with gravel, lying between 53.4 m and 63.4 m O.D., being chalkier below 56.0 m O.D. A sample of these gravels extracted at 62.0 m O.D. has been analysed and is shown to be of glaciofluvial origin (Section 5.1), with approximately 37% chalk and 45% flint.

Unit 3 Till (Upper Till)

This massive upper till was noted in the driller's log to alternate between a brown and dark grey colour. This is confirmed by the ten borehole samples (Samples 6 - 15). Near the base of this unit, at a height of 64.1 m O.D., the till was dark greyish brown (10YR 4/2) and iron staining was noticeable around the clasts. At 70.4 m O.D. the core sample was mottled with a strong brown colour (7.5YR 4/6) (see Plate 5.1a). Occasional small clast-free silt pockets were also noted. The matrix of the till here contained a great deal of disseminated chalk and many broken and shattered chalk clasts were seen. Chalk 'stringers' were also in evidence. At 3 m higher the till again becomes a dark greyish brown, changing progressively upward through very dark greyish brown (10YR 3/2) and very dark grey (10YR 3/1) to dark grey (10YR 4/1) between 83.6 m and 87.7 m O.D. Further brown mottling was seen in the core above 81.5 m O.D. The top of the uppermost core sample contained a small layer (3 cm) of silt. The remaining till in the topmost sample contained large chalk and flint clasts as shown in Plate 5.1b. A high proportion of iron pyrite clasts were noted throughout this till (Figure 5.21), reaching a maximum at a depth of 18 m. The presence of Red Chalk was noted in Samples 12 and 13. Remarkably similar particle size distributions are shown for these samples, all with principal mode in the fine sand fraction between +2.0 and +3.0 phi and a more variable secondary mode between +3.5 and +4.0 phi in the very fine sand fraction (Figures 5.12 to 5.20). A further mode exists at approximately -3.5 phi in all the samples,

although in some this is composed almost entirely of acid-soluble lithologies. The average quartz and flint contents range from 42.1% to 49.2% and 4.6% to 13.8% respectively (Figure 5.21). The acid-soluble contents in the -1.0 to +4.0 phi fraction varies between 2.5% to 3.6%.

Eight macrofabrics were taken from this unit, only three of which proved to be statistically significant (Samples 9, 10 and 12). Strong fabrics are recorded in Samples 9 and 12 where highly significant vectors indicate clast 'a'-axes aligned in a northeast-southwest and northwest-southeast directions respectively. Sample 10 also records a northeast-southwest resultant vector, although the mean dip is very high at 44°. Remaining fabrics at this site also possess rather high average dip values at between 21° and 42°. They are discussed in detail in Chapter 6.

Unit 4 Sand and gravel

This deposit lying between 92.4 m and 97.3 m O.D. comprises a medium sand and gravel.

Unit 5 Stony brown clay

The highest unit consists of 70 cm of stiff, stony brown clay grading into 30 cm of topsoil.

SAMPLE DETAILS

Sample 5 (Site 3, Unit 1- Lower Till)	
Height	52 m O.D.
Sample Type	Bulk
Colour	10YR 4/1 Dark grey

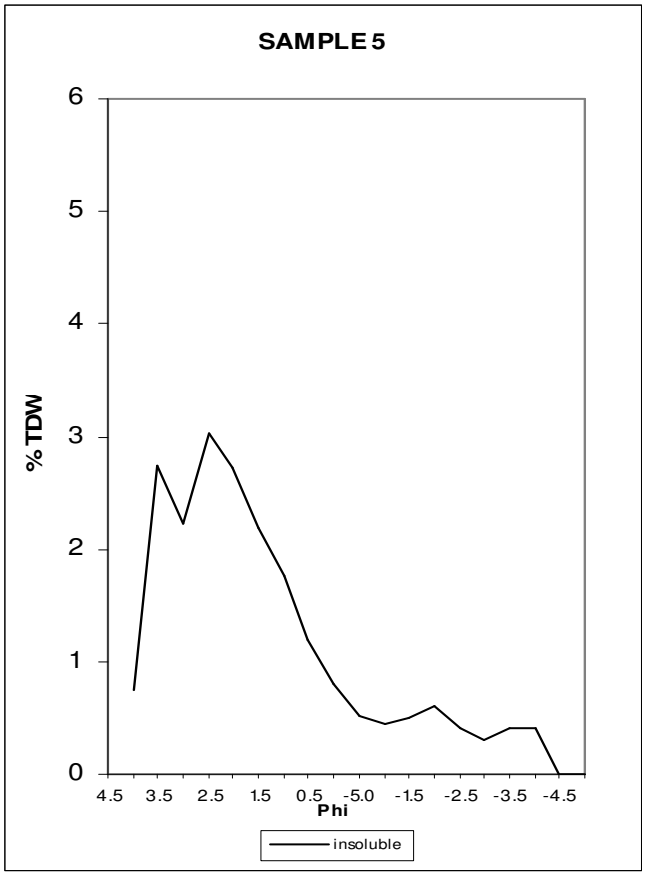


Figure 5.11. Particle size data for Sample 5.

Note: Data is available for the insoluble fraction only for this sample

	Sample 6 (Site 3, Unit 3 - Upper Till)	Sample 7 (Site 3, Unit 3 – Upper Till)
Height	64.1 m O.D.	67.3 m O.D.
Sample Type	Bulk	Bulk
Colour	10YR 4/2 Dark greyish brown	10YR 4/2 Dark greyish brown

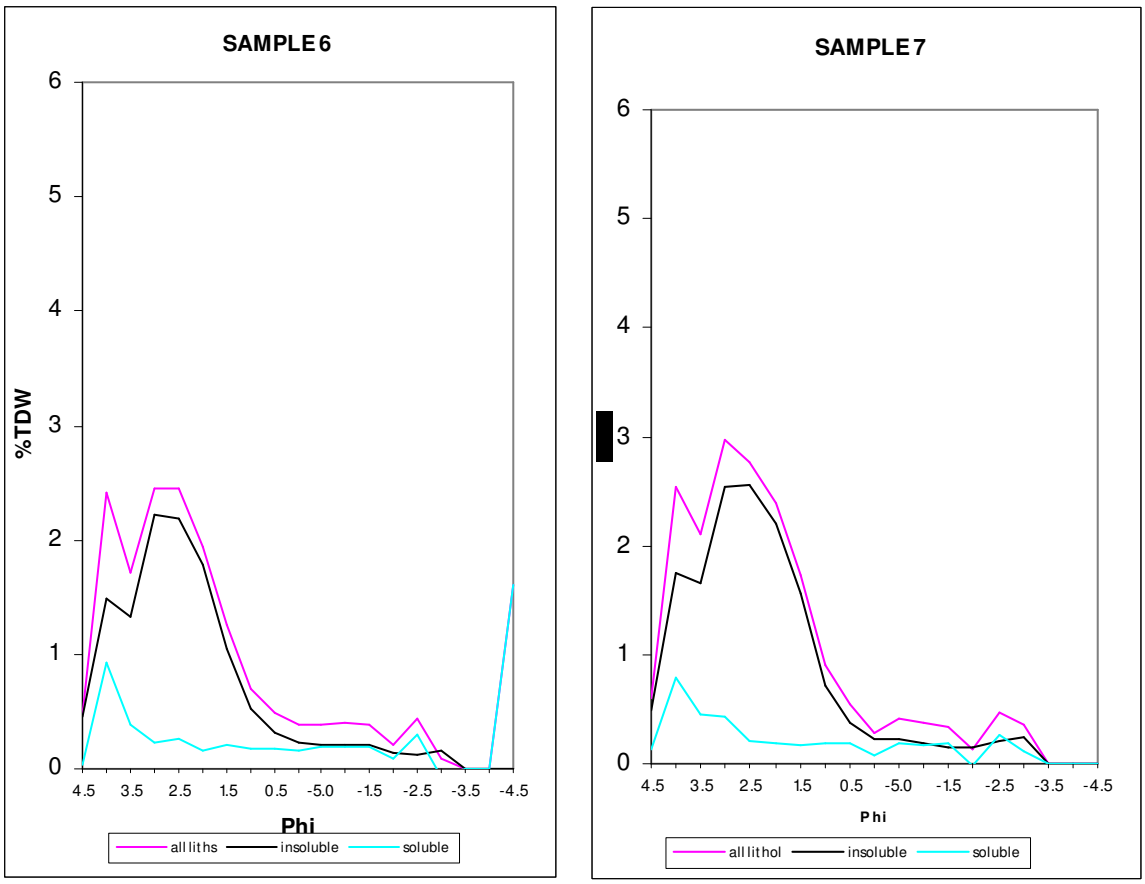
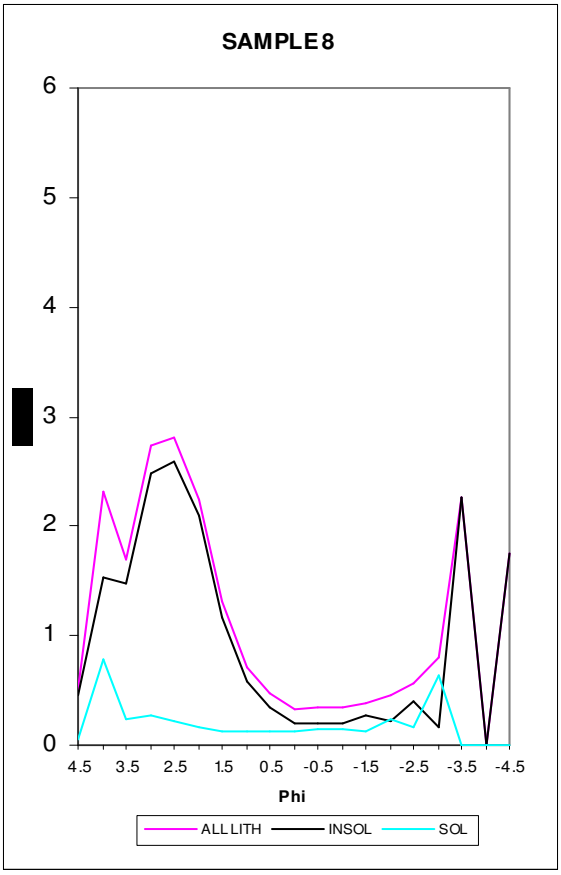
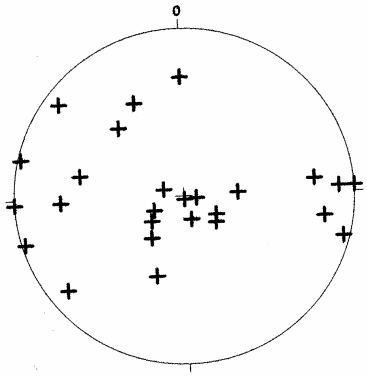


Figure 5.12. Particle size data for Samples 6 and 7.

Sample 8 (Site 3, Unit 3 – Upper Till)	
Height	70.4 m O.D.
Sample Type	U100 (not oriented)
Colour	7.5YR 4/6 Strong brown to 10 YR 3/1 Very dark grey

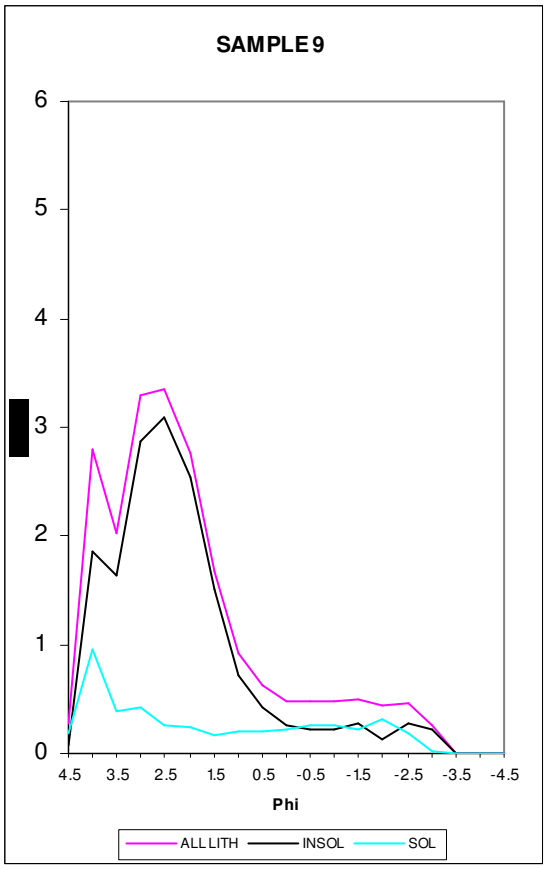


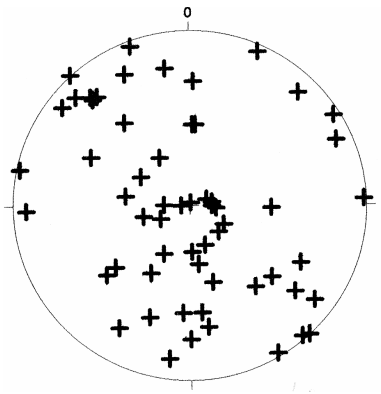


Macrofabric data for Sample 8	
Number in sample	25
Resultant vector	-
Vector magnitude	14.0%
Significance	(Not Significant)
Mean dip	42°

Figure 5.13. Particle size & macrofabric data for Sample 8.

Sample 9 (Site 3, Unit 3 – Upper Till)	
Height	73.4 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/2 Dark greyish brown

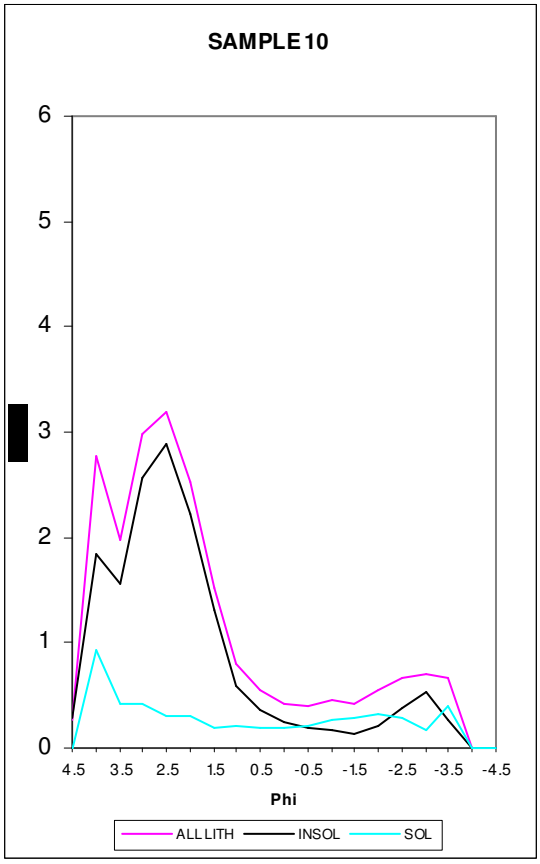


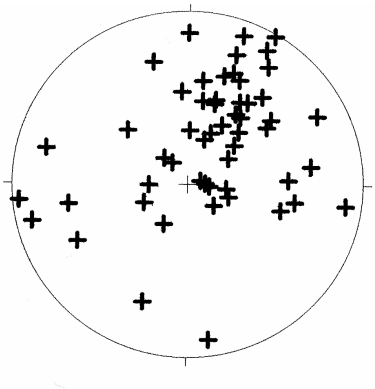


Macrofabric data for Sample 9	
Number in sample	56
Resultant vector	144°/324°
Vector magnitude	41.3%
Significance	>99.9% (Highly significant)
Mean dip	21°

Figure 5.14. Particle size & macrofabric data for Sample 9.

Sample 10 (Site 3, Unit 3 - Upper Till)	
Height	76.6 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 3/2 Very dark greyish brown

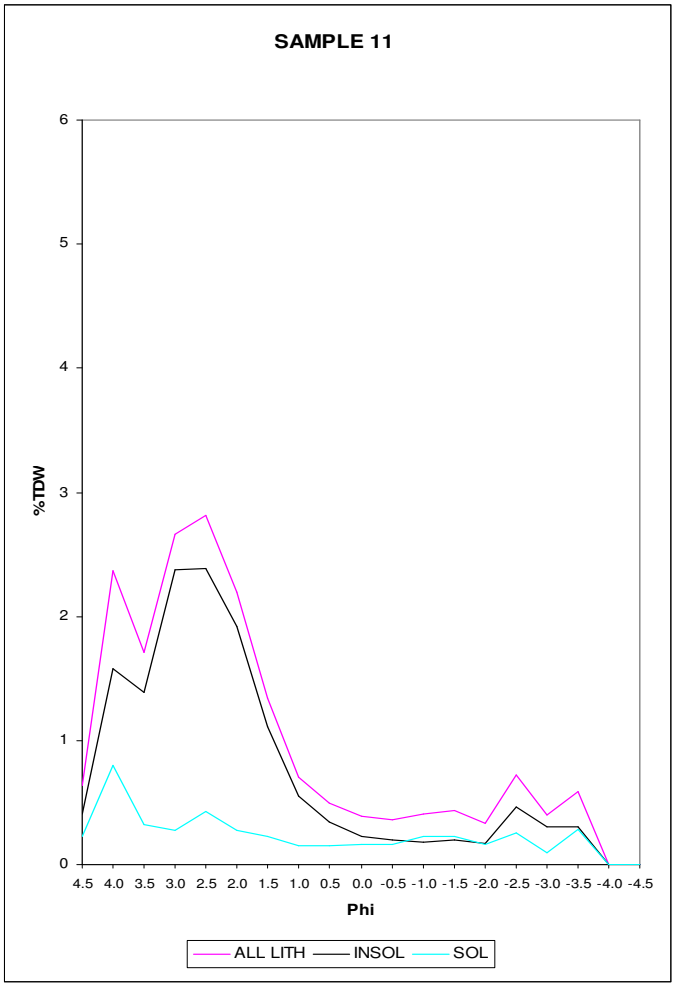


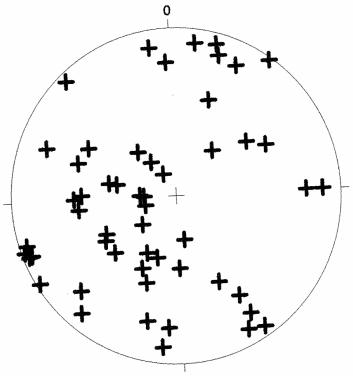


Macrofabric data for Sample 10	
Number in sample	55
Resultant vector	42/222°
Vector magnitude	33.7%
Significance	> 99.0% (Highly significant)
Mean dip	44 °

Figure 5.15. Particle size & macrofabric data for Sample 10.

Sample 11 (Site 3, Unit 3 - Upper Till)	
Height	79.7 m O.D.
Sample Type	U100 oriented
Colour	10YR 3/2 Very dark greyish brown

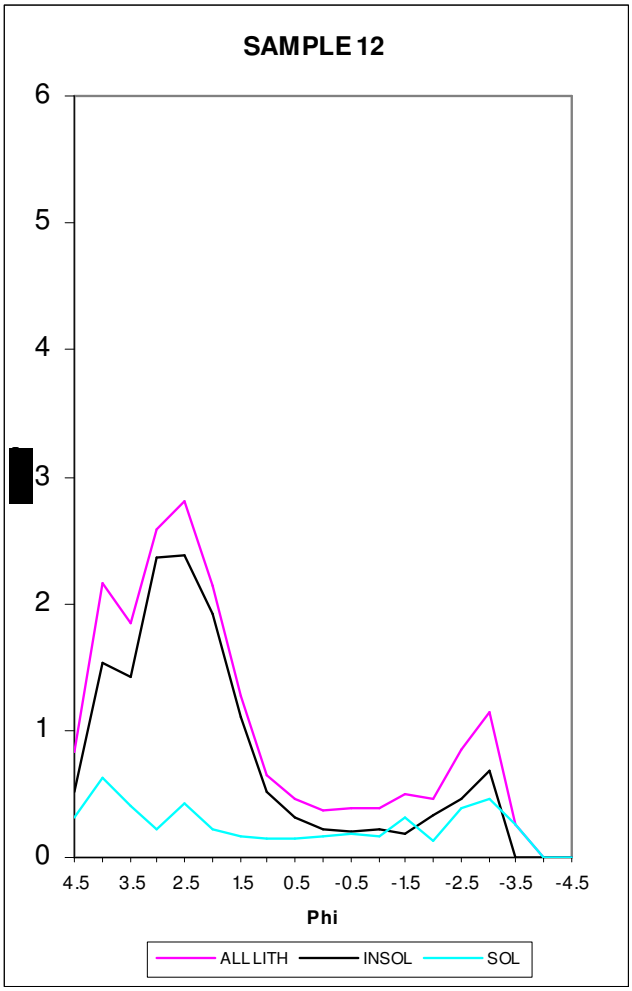


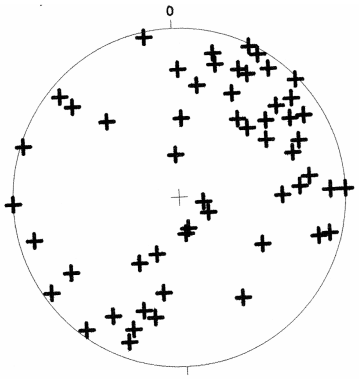


Macrofabric data for Sample 11	
Number in sample	53
Resultant vector	47°/227°
Vector magnitude	16.4%
Significance	(Not Significant)
Mean dip	34°

Figure 5.16. Particle size & macrofabric data for Sample 11.

Sample 12 (Site 3, Unit 3, Upper Till)	
Height	81.5 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 3/2 Very dark greyish brown

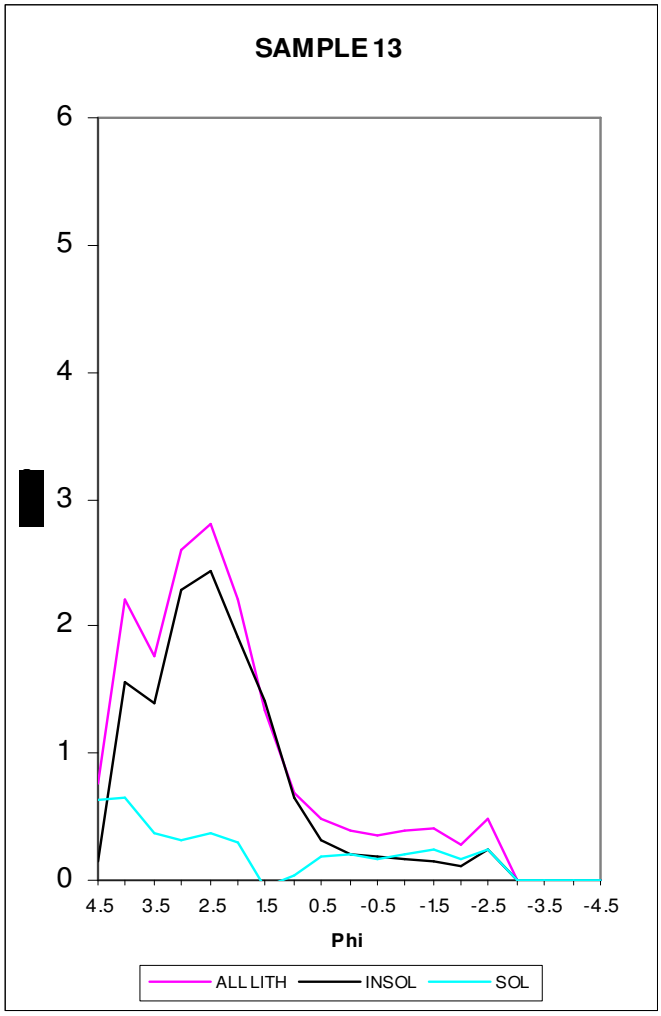


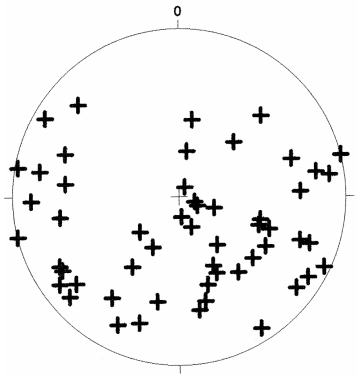


Macrofabric data for Sample 12	
Number in sample	55
Resultant vector	41°/221°
Vector magnitude	33.7%
Significance	>99.9% (Highly significant)
Mean dip	25°

Figure 5.17. Particle size & macrofabric data for Sample 12.

Sample 13 (Site 3, Unit 3 - Upper Till)	
Height	83.6 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 3/1 Very dark grey

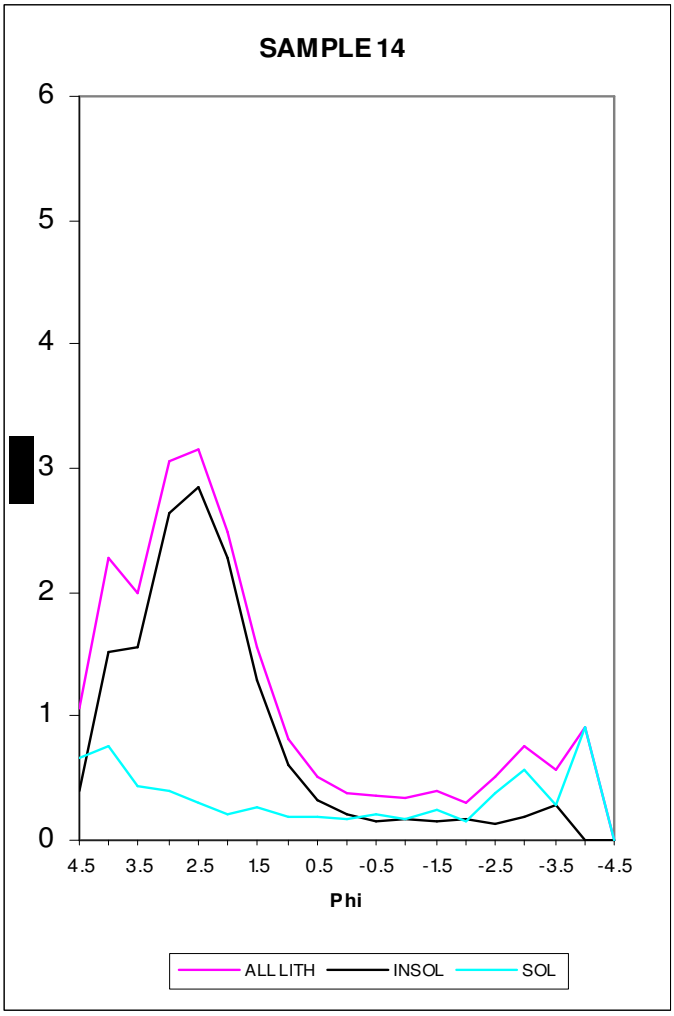


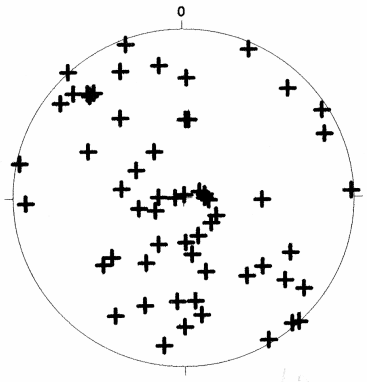


Macrofabric data for Sample 13	
Number in sample	53
Resultant vector	103°/283°
Vector magnitude	16.8%
Significance	(Not Significant)
Mean dip	34°

Figure 5.18. Particle size & macrofabric data for Sample 13.

Sample 14 (Site 3, Unit 3 – Upper Till).	
Height	85.6 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/1 Dark grey

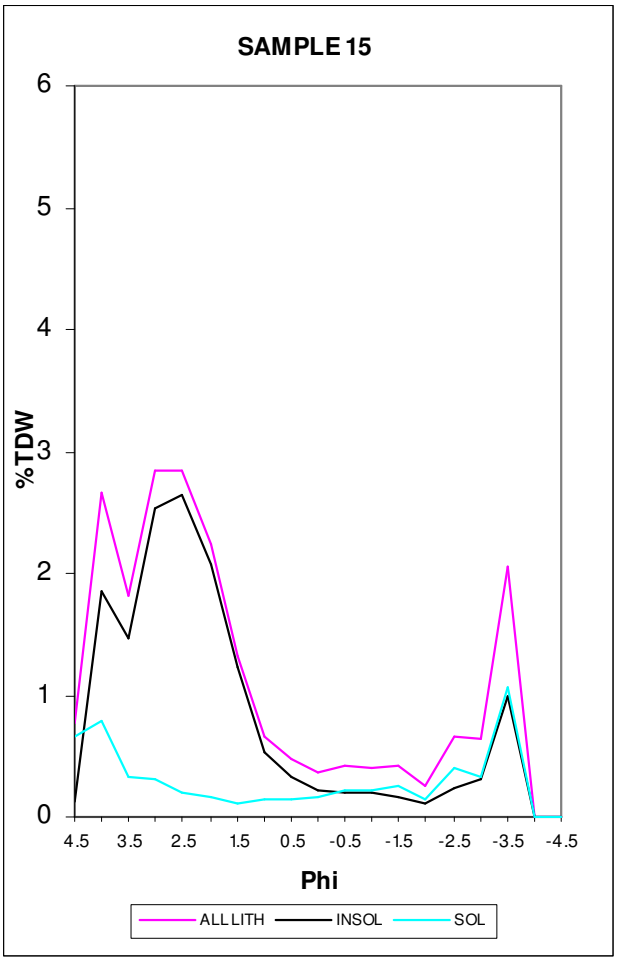


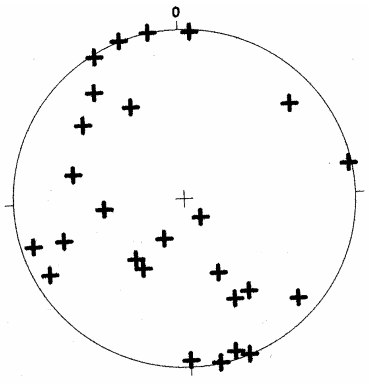


Macrofabric data for Sample 14	
Number in sample	58
Resultant vector	143°/323°
Vector magnitude	18.8%
Significance	(Not Significant)
Mean dip	38°

Figure 5.19. Particle size & macrofabric data for Sample 13.

Sample 15 (Site 3, Unit 3 - Upper Till)	
Height	87.7 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/1 Dark grey





Macrofabric data for Sample 15	
Number in sample	24
Resultant vector	158°/338°
Vector magnitude	21.0%
Significance	(Not Significant)
Mean dip	24°

Figure 5.20. Particle size & macrofabric data for Sample 15.

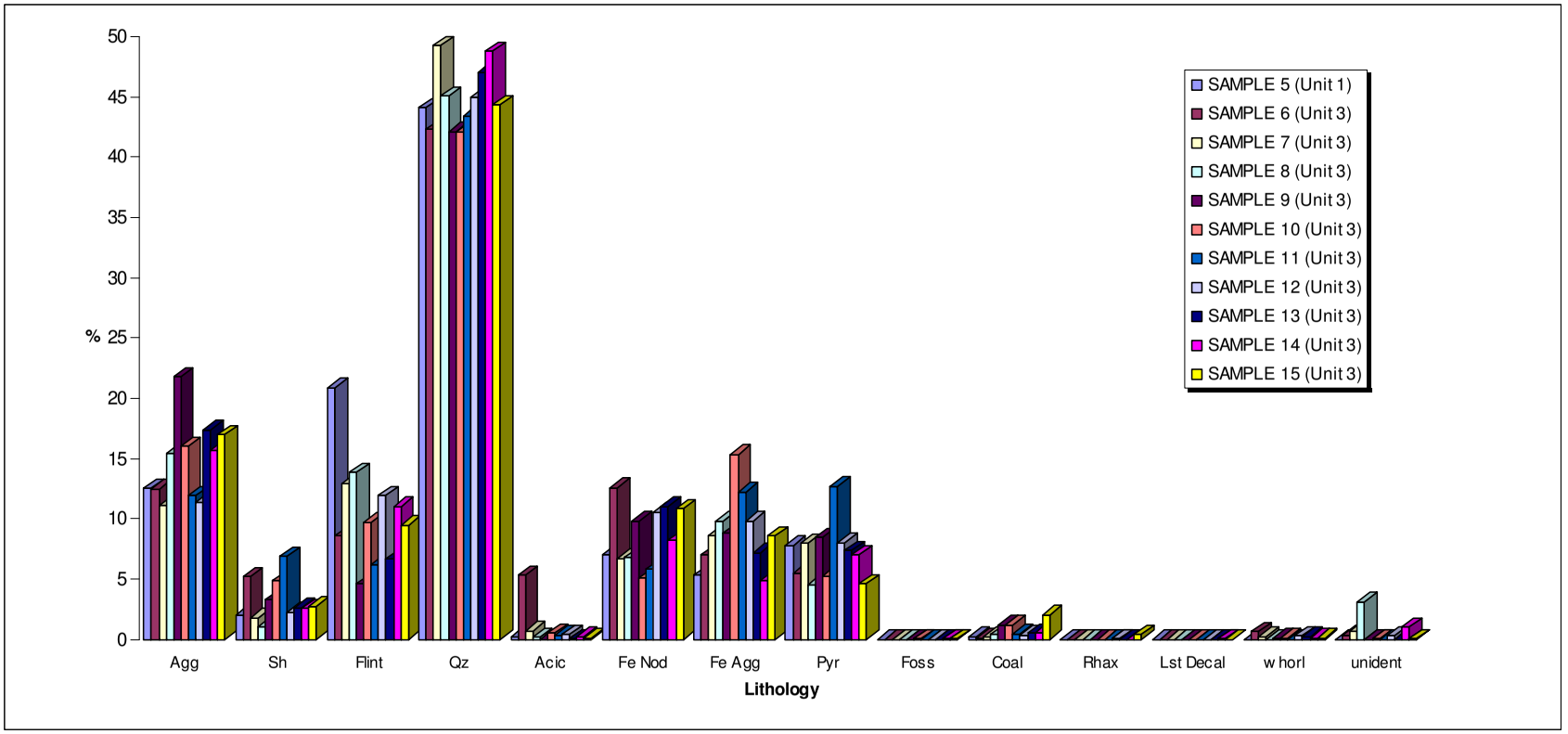


Figure 5.21. Small clast lithology data for Unit 1 (Lower Till) & Unit 3 (Upper Till) at Site 3, Cannocks Wood.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

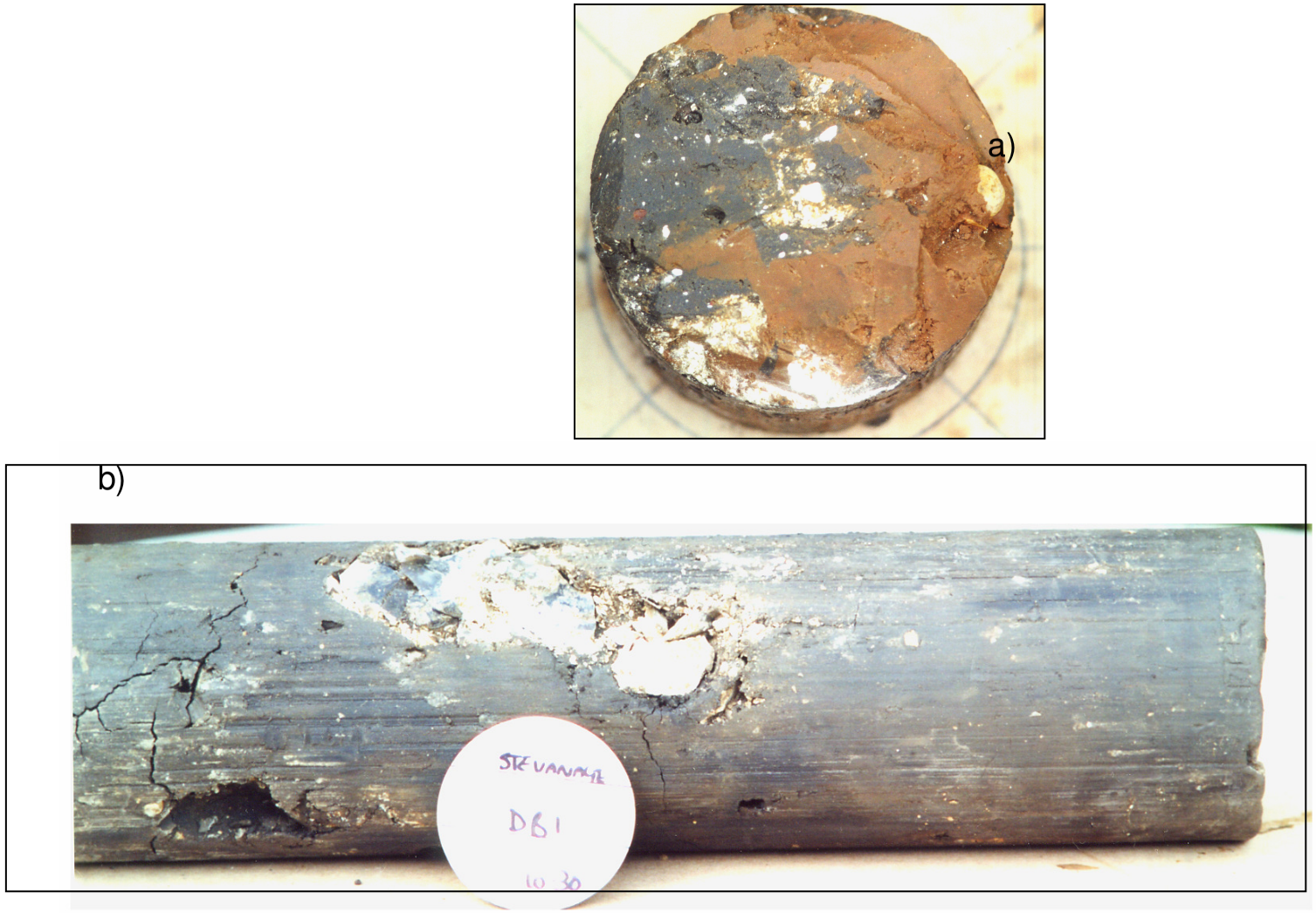


Plate 5.1 Site 3 – Cannocks Wood Unit 3 (Upper Till).
a) Core Sample 8 showing mottling .
b) Core Sample 15 showing large chalk & flint clasts.

SITE 4

Location	Letchmore Farm
Grid Ref:	TL2167 2430
Ground level	120 m O.D.
Borehole Ref.	DB2 and A1

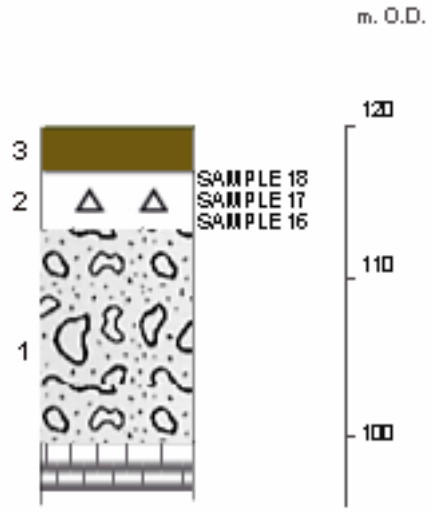


Figure 5.22. Borehole log of Site 4.

This site lies on the high ground between the Stevenage and Hitchin Channels.

Unit 1 Flinty clay/gravel

This unit is described on the driller's log as a firm, brown, flinty clay, but this deposit is shown to be very variable. It is markedly sandy in places and flint bands were noted at around 104.0 m and 100.0 m O.D. Samples obtained from between 106.0 m and 108.0 m O.D are sands and gravels of glaciofluvial origin (Section 5.1) with a 50% flint content in the -3.0 to -5.0 phi range (Cheshire pers. comm).

Unit 2 Till

Samples obtained from 2.0 m and 4.4 m depth revealed a yellowish to dark yellowish brown till, although the driller's log notes blue/brown till. Two bulk samples (Samples 16 and 18) and one oriented U100 sample (Sample 17) , were analysed. The uppermost sample (sample 18) comprised a stiff, chalky till with some orange staining and grey patches, giving a mottled effect.

The lower two samples were of similar composition and also mottled, predominantly yellowish brown (10YR 5/4) with light brownish grey (2.5Y6/2) patches.

A single macrofabric shows clasts to be aligned in a northwest – southeast direction (Figure 5.23). The particle size distributions (Figures 5.23 & 5.24) are very similar for all three samples, the greatest similarity being exhibited between the two lower samples (Samples 16 and 17). This similarity is reflected in the small clast lithology, the lower samples having flint/quartz ratios for total clasts in the -1.0 to +1.0 phi fraction of 0.076 and 0.064 respectively, whilst for sample 18, a ratio of 0.041 is explained by a lower flint content (Figure 5.25). A higher iron aggregate content is also evident in this sample.

Unit 3 Flinty clay

A thickness of 3.6 m of flinty clay is recorded overlying layers of blue/brown clay, overlain in turn by topsoil. This probably represents a continuation of Unit 2 that has become weathered and incorporated into the topsoil.

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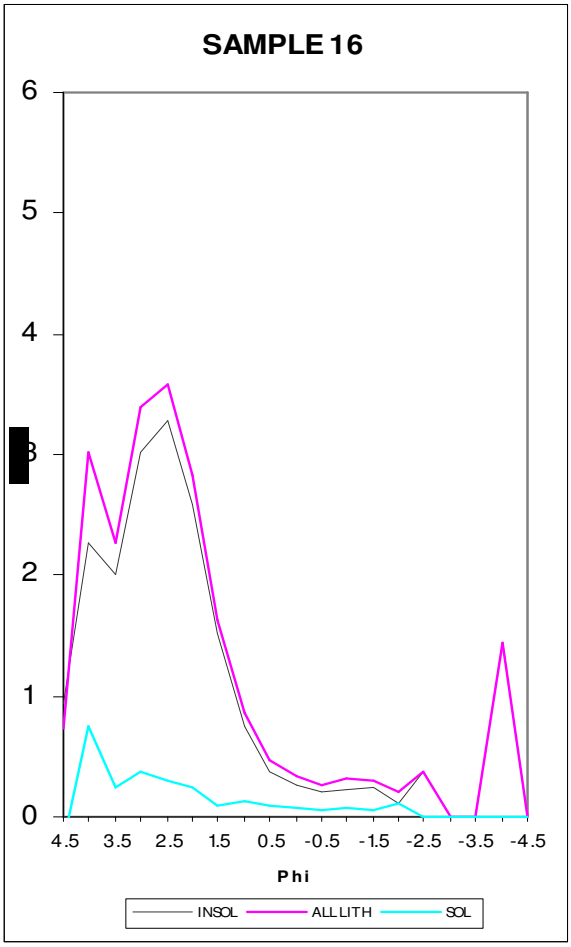
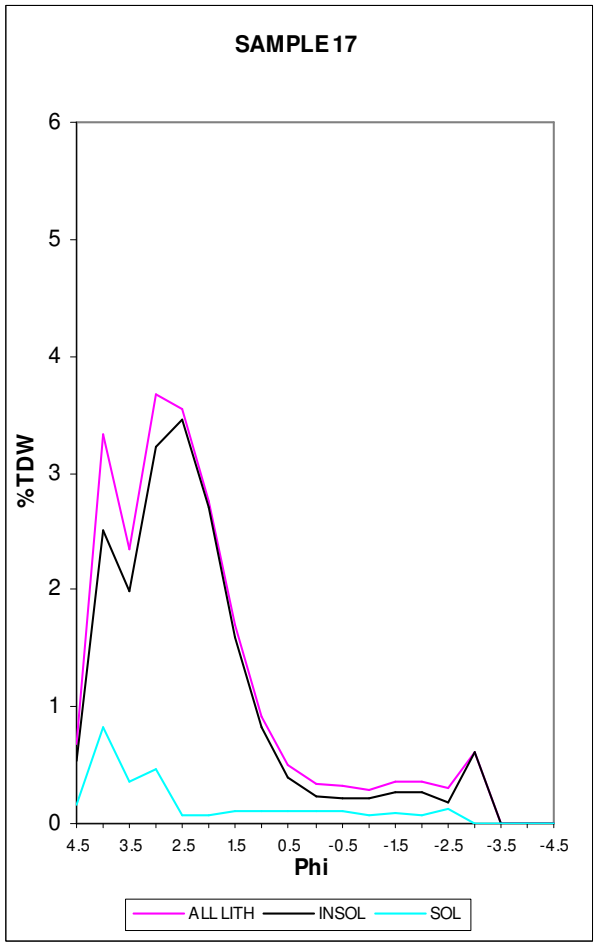
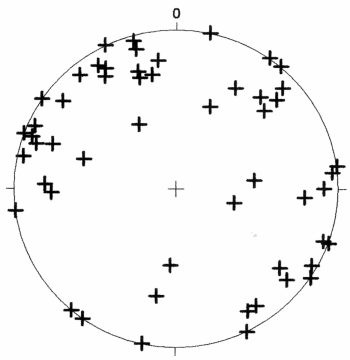
SAMPLE DETAILS

Sample 16 (Site 4, Unit 2)		Sample 17 (Site 4, Unit 2)
Height	115.5 m O.D.	116.0 m O.D.
Sample Type	Bulk	U100 (oriented)
Colour	10YR 5/4 Yellowish brown (2.5YR 6/2 light brownish grey patches).	10YR 4/4 Dark yellowish brown







Macrofabric data for Sample 17	
Number in sample	46
Resultant vector	129°/309°
Vector magnitude	24.8%
Significance	> 95% (Significant)
Mean Dip	17 °

Figure 5.23. Particle size data for Samples 16 & 17 & macrofabric data for Sample 17

Sample 18 (Site 4, Unit 2)	
Height	117.5 m O.D.
Sample Type	Bulk
Colour	10YR 4/4 Dark yellowish brown

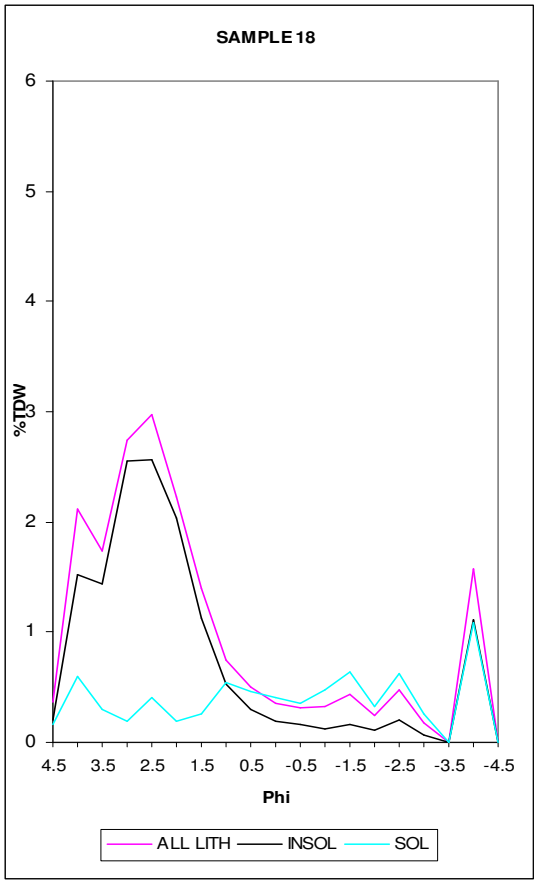


Figure 5.24. Particle size data for Sample 18.

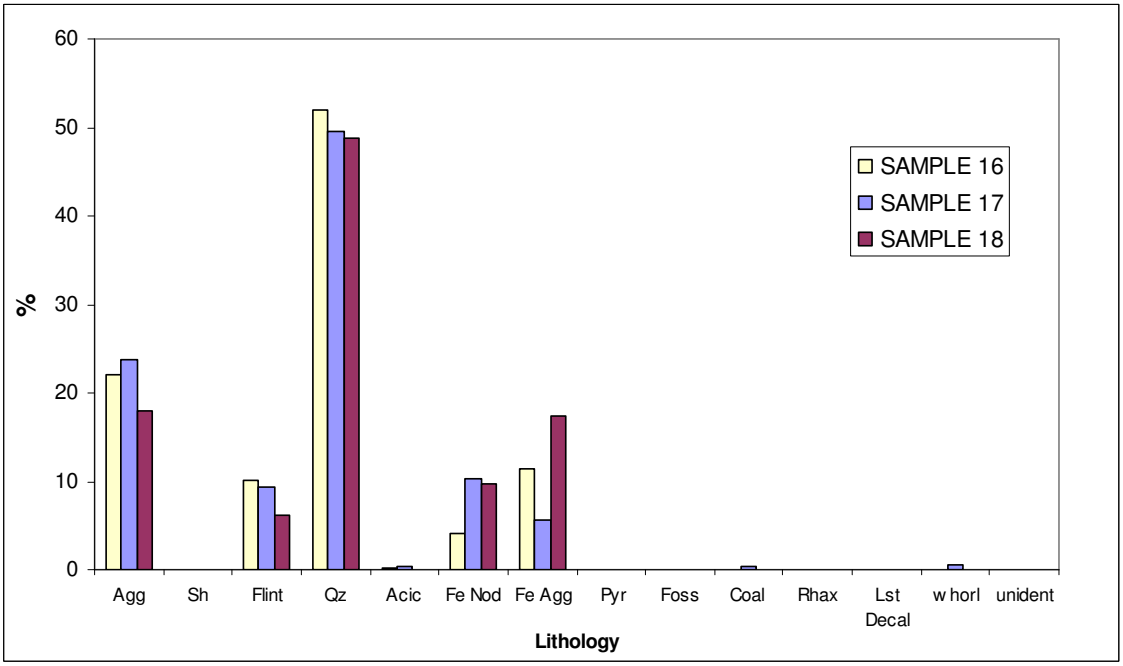


Figure 5.25. Small clast lithology data for Unit 2 at Site 4, Letchmore.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 5

Location	St Ibbs
Grid Ref:	TL1962 2662
Ground level	73.0 m O.D.
Borehole No.	IP2

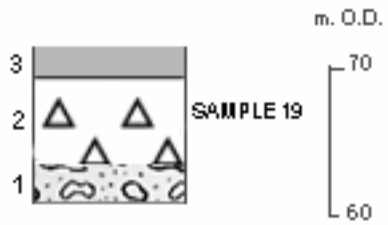


Figure 5.26. Borehole log for Site 5.

This site lies on the margin of the Hitchin Channel. The borehole penetrated to a depth of 10.7 m (62.3 m O.D.), close to the bedrock surface, believed to lie at approximately 60.0 m O.D.

Unit 1 Chalky sand

At the base was a fine, blue/grey very chalky, silty sand with occasional large cobbles. In places it was noted to be very gravelly.

Unit 2 Till

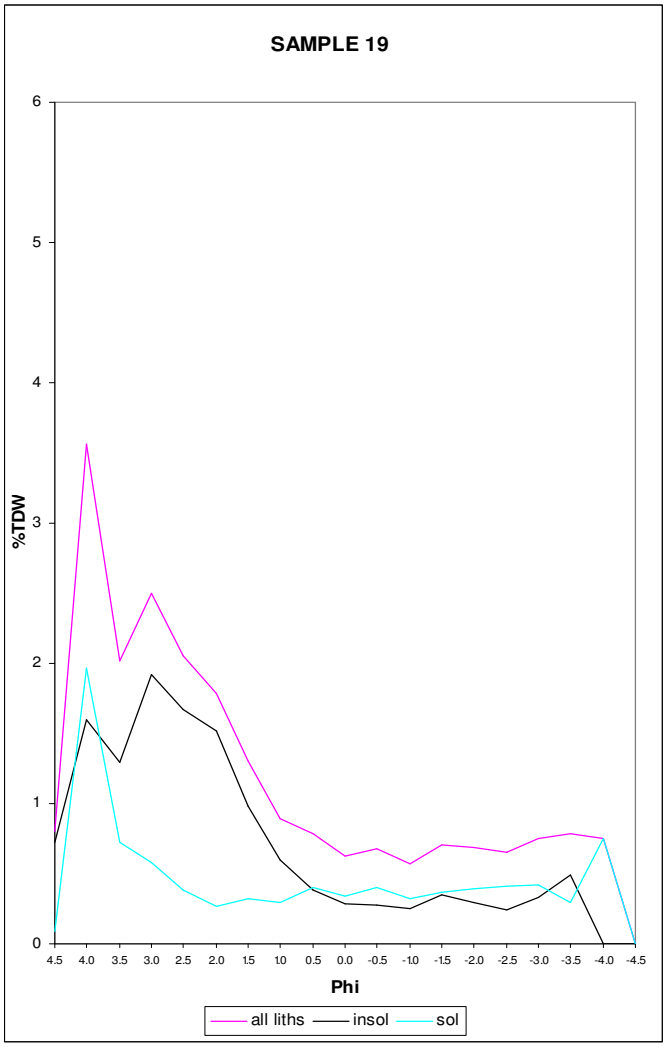
A stiff to firm, dark greyish brown (10YR 4/2) chalky, silty till, with large (up to 4.5 cm) clasts lies between 65.6 m and 69.3 m O.D**.** This till lies at a comparable height to that found at Site 8, lying approximately 550 m to the north. This unit was sampled at a height of 68.8 m O.D (Sample 19). Numerous clasts of pyrites were noted, including many pyritised fossils. A further borehole core removed from a height of 66.7 m O.D. proved to contain mostly silt. A highly significant macrofabric for Sample 19 shows clasts to be aligned in a NNE/SSW direction with consistently low dip values, averaging 14^{o}. Particle size analysis reveals a pronounced mode in the very fine sand fraction which is mainly accounted for by acid-soluble lithologies (Figure 5.27).

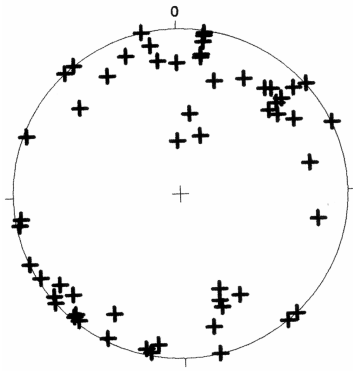
Unit 3 Sandy clay

Above the till is a brown sandy clay. Reported to contain stones and occasional fresh white 2 cm chalk clasts, this may represent a continuation of unit 2.

SAMPLE DETAILS

Sample 19 (Site 5, Unit 2)	
Height	68.8 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/2 Dark greyish brown





Macrofabric data for Sample 19	
Number in sample	53
Resultant vector	23°/203°
Vector magnitude	41.4%
Significance	> 99.9% (Highly significant)
Mean dip	14 °

Figure 5.27. Particle size & macrofabric data for Sample 19.

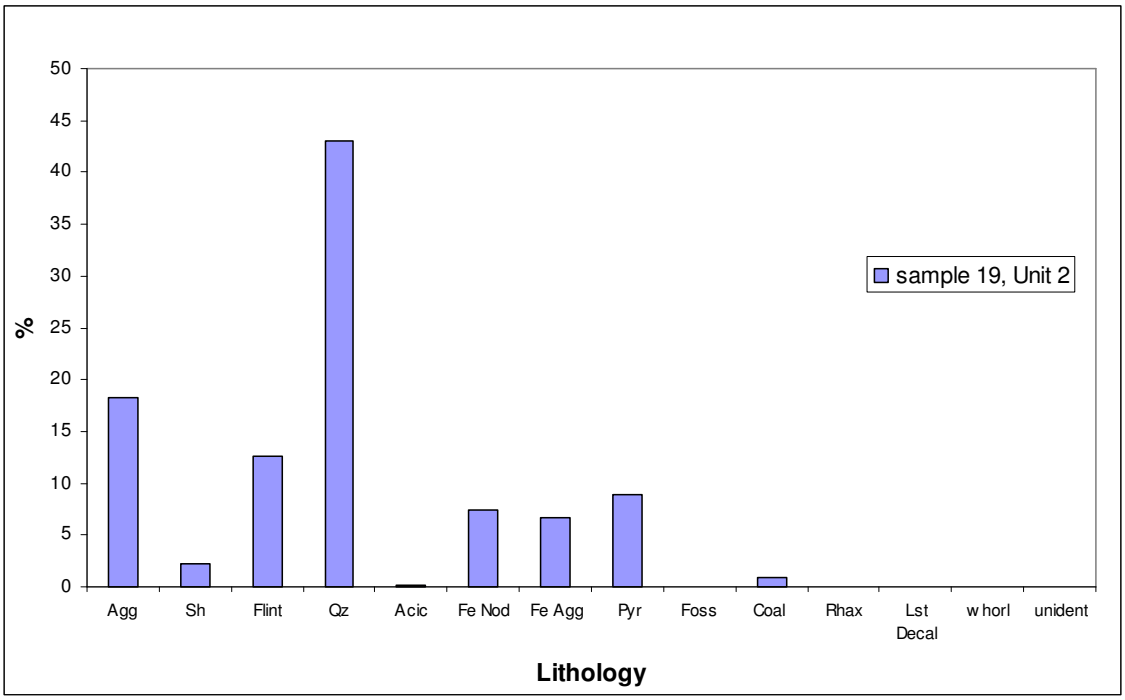


Figure 5.28. Small clast lithology data for Unit 2 at Site 5, St Ibbs

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 6

Location	Little Wymondley
Grid Ref:	TL2107 2753
Ground level	74 m O.D.
Borehole Ref.	W1

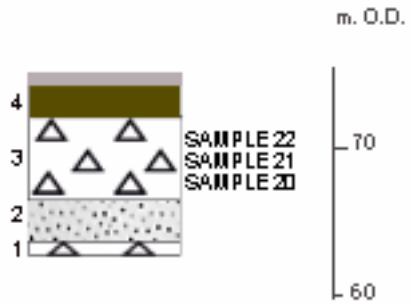


Figure 5.29. Borehole log for Site 6.

This borehole was drilled in communal ground, within a housing estate. The site lies just within the margins of the Stevenage Channel close to outcrops of the Charlton Till (Charlton Member) to the north and south (Aldiss, 1992b). The borehole penetrated almost 6.4 m of till, interrupted by a 2.4 m thick layer of sand.

Unit 1 Till

0.7 m of firm blue/grey till is reported at the base of this borehole, although no sample was retrieved for analysis.

Unit 2 Sand

Unit 2 comprises a fine brown, chalky sand, approximately 2.5 m thick.

Unit 3 Till

Unit 3 comprises 5.7 m of till - sampled at 66.5 m O.D. (sample 20), 68.5 m (sample 21) and 70.5 m (sample 22). The colour is dark greyish brown (10YR 3/2) becoming progressively darker grey with depth, to reach a very dark grey (7.5YR 3/0) in the lowest sample. Fragile Red Chalk clasts are found throughout together with many rotted clasts and fine chalk dispersed in the matrix. The small clast lithology (Figure 5.33) shows this till to have much less flint than other tills in this study. This is discussed in Chapter 7. Three macrofabrics were obtained from this unit (Figures 5.30 to 5.32), the lowest two samples having highly significant orientations, although these are separated by 74^{o}, clasts at 66.5 m O.D. aligned in a northeast – southwest direction and those at 68.5 m O.D. in a

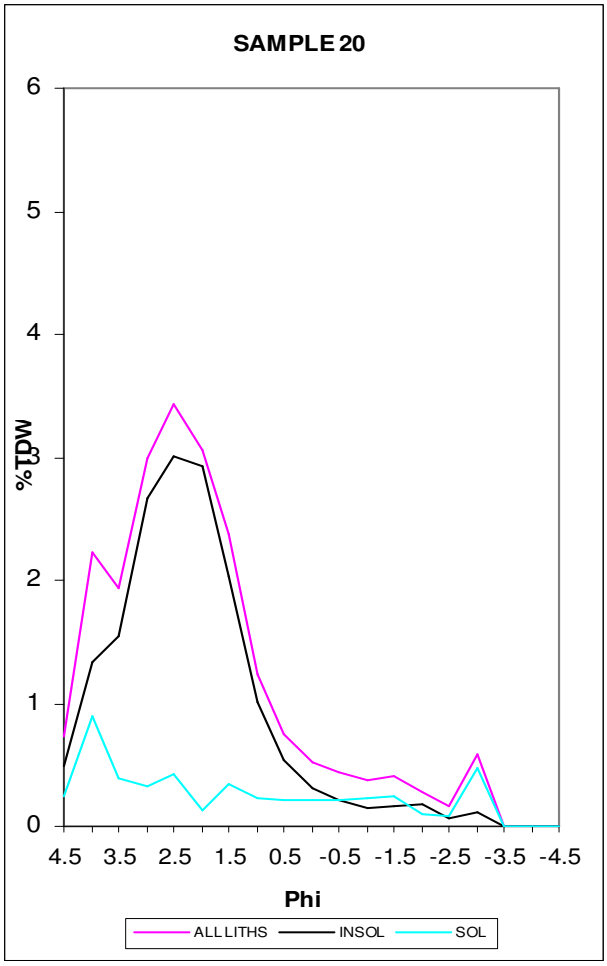
ESE-WNW direction. The uppermost sample (22) exhibits a weak fabric with no significant alignment of clasts. Dip values are consistent in all three macrofabrics, averaging between 23° and 25°. Comparison of the particle size distributions show a pronounced secondary mode in the uppermost sample at +4.0 phi (very fine sand), which declines in the middle sample and is not present in the lowest. The uppermost sample comprises a relatively soft chalky till.

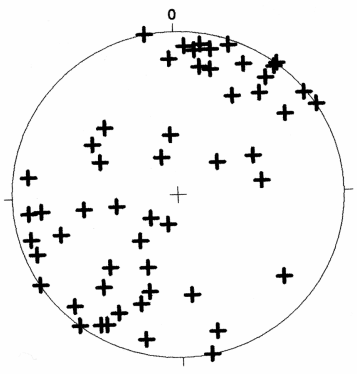
Unit 4 Stony sandy clay (?till)

The upper unit at this site consists of 2.3 m of brown stony, sandy clay, lying beneath 0.3 m of topsoil. This could represent weathered till.

SAMPLE DETAILS

Sample 20 (Site 6, Unit 3)	
Height	66.5 m O.D.
Sample Type	U100
Colour	7.5YR 3/0 Very dark grey

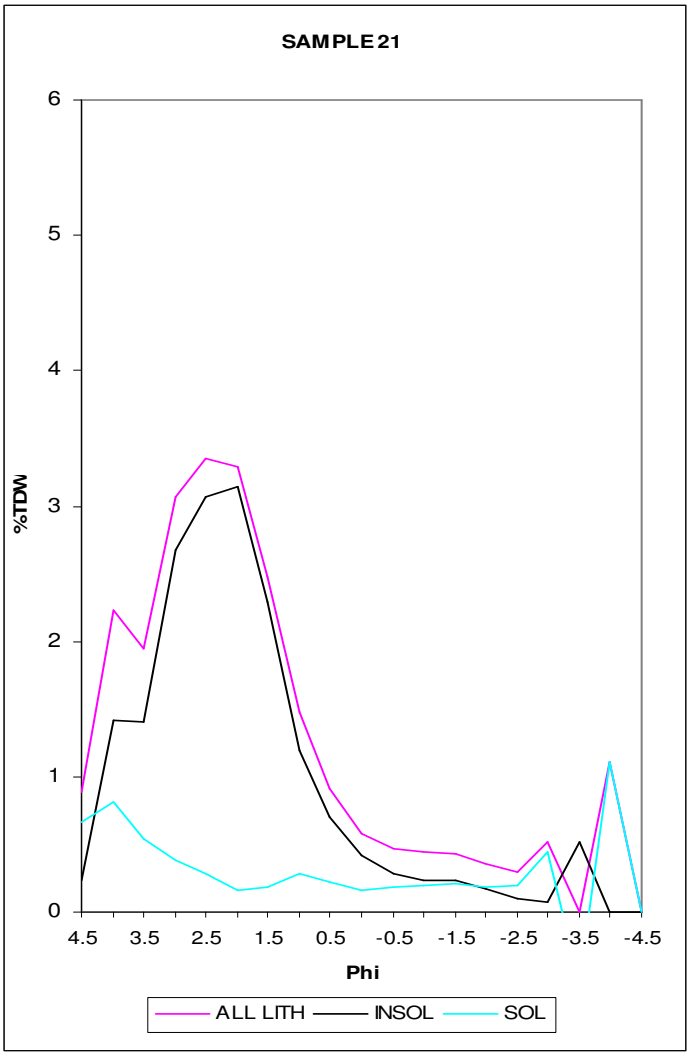


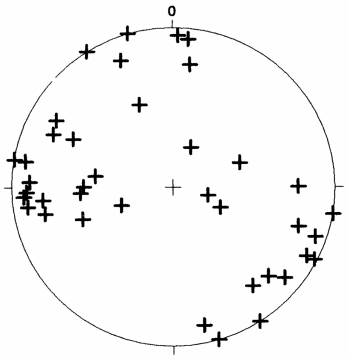


Macrofabric data for Sample 20	
Number in sample	51
Resultant vector	34°/214°
Vector magnitude	45.6%
Significance	>99.9% (Highly Significant)
Mean dip	25°

Figure 5.30. Particle size & macrofabric data for Sample 20.

Sample 21 (Site 6, Unit 3)	
Height	68.5 m O.D.
Sample Type	U100
Colour	5 YR 4/1 to 2.5YR 4/0 Dark grey



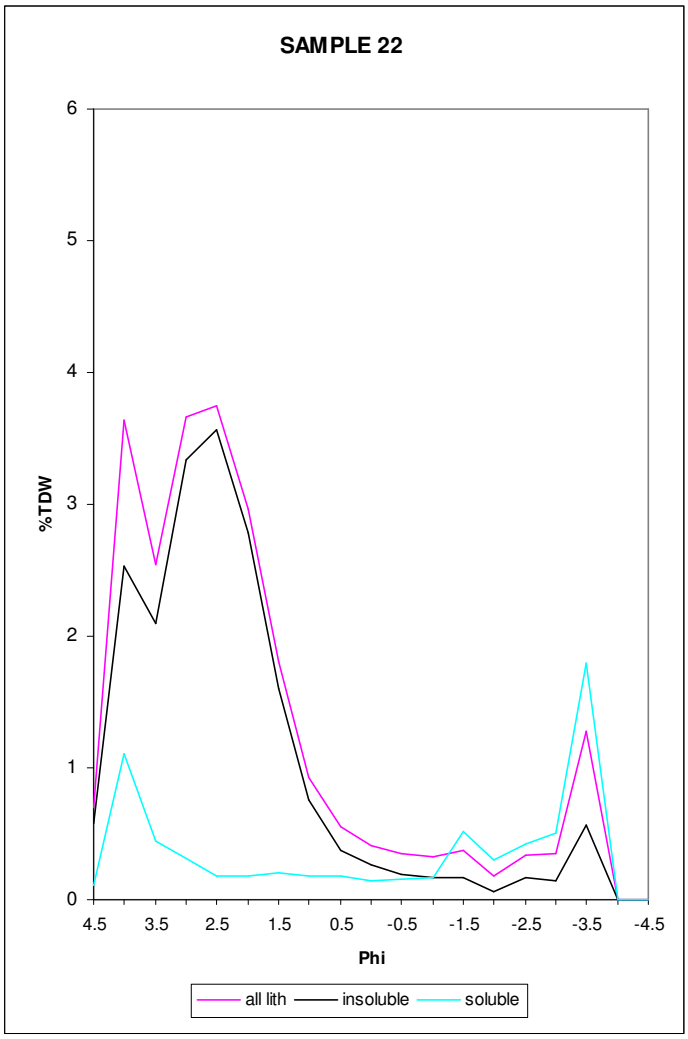


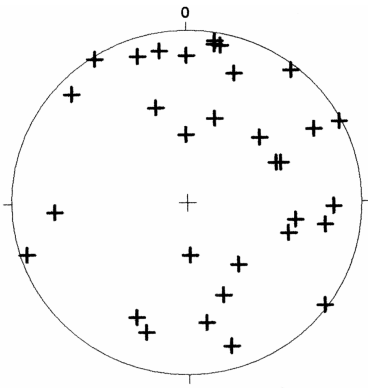
Macrofabric data for Sample 21	
Number in sample	36
Resultant vector	108°/288°
Vector magnitude	44.0%
Significance	>99.9% (Highly significant)
Mean Dip	23°

Figure 5.31. Particle size & macrofabric data for Sample 21

SAMPLE DETAILS

Sample 22 (Site 6, Unit 3)	
Height	70.5 m O.D.
Sample Type	U100
Colour	10YR 3/2 Very dark greyish brown (upper). 10YR 4/1 dark grey (lower)





Macrofabric data for Sample 22	
Number in sample	32
Resultant vector	5°/185°
Vector magnitude	21.0%
Significance	(Not Significant)
Mean dip	24°

Figure 5.32. Particle size & macrofabric data for Sample 22

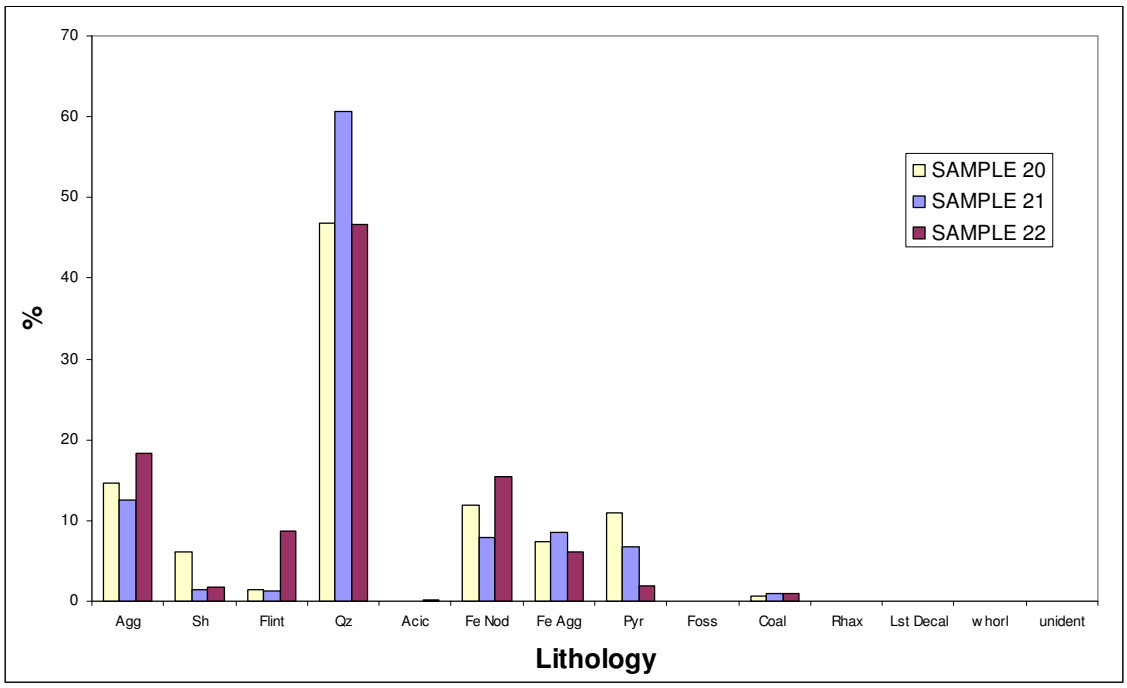


Figure 5.33. Small clast lithology data for Unit 3 at Site 6, Little Wymondley

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 7

Location	Graveley Lane, Great Wymondley
Grid Ref:	TL2176 2846
Ground level	88 m O.D.
Borehole No.	W2

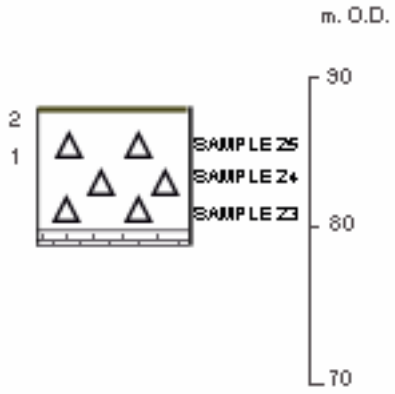


Figure 5.34. Borehole log for Site 7.

This borehole was sunk in a meadow, off Graveley Lane, Great Wymondley and lies just inside the Stevenage Channel. The Chalk bedrock is encountered at a depth of 8.0 m (~80 m O.D.).

Unit 1 Till

At the base of this unit was a very thin layer of black silt. Overlying this, is a firm till from which three samples were obtained (samples 23, 24 and 25). The till was dark greyish brown (10YR 4/2) at the base, becoming less firm and darker grey with pockets of orange sand at 83.0 m O.D. and pale brown (10YR 6/3) towards the top. The core sample 2.5 m from the surface (sample 25) contained many rotted chalk clasts. Lithological analysis shows the flint content to be highest at the top of this unit, declining from 11.47% to 6.77% at 81.5 m O.D. (Figure 5.38). Particle size distributions show all three samples have pronounced modes at +3.0 and +4.0 phi (Figures 5.35 to 5.37). Two weak macrofabrics showed no significant orientation of clasts (Figures 5.35 & 5.37).

Unit 2 Stony Clay (?Till)

1.3 m of stony brown clay, probably weathered till, extends from 86.7 m O.D. passing into topsoil.

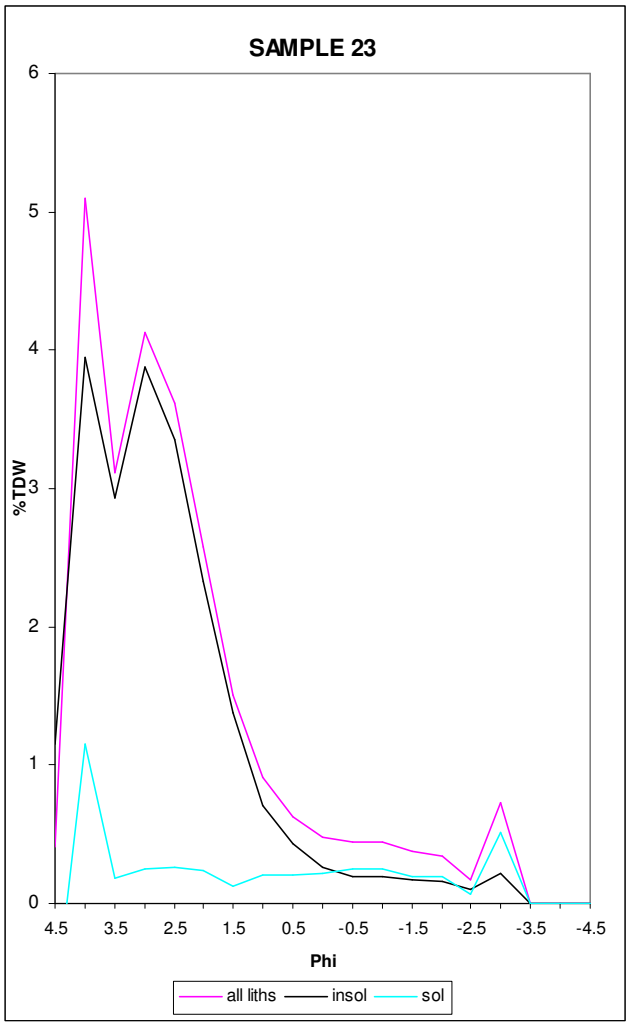
According to Aldiss (1992a) this site lies on an outcrop of the Maydencroft Member (Maydencroft Till). Site 9 is also believed to lie on the same till, close to the typesite at Maydencroft Manor (Aldiss 1992b). However, there are some distinct differences between the tills at these two sites, as described below.

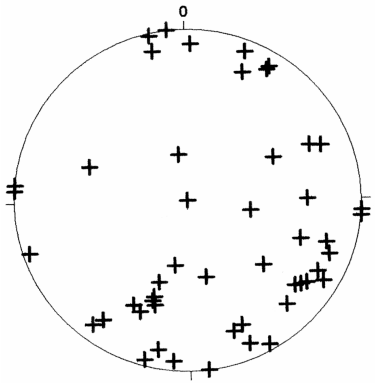
The percentage of acid-insoluble particles found in the size range +1 to +4 phi in till from Site 7 ranges from 18.5% to 22.5% (Figures 5.35 to 5.37). This is approximately twice that found in the till at Site 9 (Figure 5.43), whilst the acid-soluble fractions are very similar at an average of 4.5% for Site 7 and 6.8% at Site 9 (Figure 5.43). The acid insoluble distributions of tills at these two sites also differ considerably – the distribution at this site shown in Figures 5.35 to 5.37 is polymodal including modes at +3 and +4 phi, whilst till at Site 9 has a single mode between +2 and +2.5 phi (Figure 5.43).

The average flint/quartz ratio for total clasts in the -1.0 to +1.0 phi fraction at Site 7 is 0.076 whereas at Site 9 it is lower at 0.049. Samples at this site contain small amounts of shale, pyrites and coal, none of which occur at Site 9 (Figure 5.44).

SAMPLE DETAILS

Sample 23 (Site 7, Unit 1)	
Height	81.5 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 4/2 Dark greyish brown





Macrofabric data for Sample 23	
Number in sample	47
Resultant vector	3°/183°
Vector magnitude	14.0%
Significance	(Not Significant)
Mean dip	23°

Figure 5.35. Particle size & macrofabric data for Sample 23.

Sample 24 (Site 7, Unit 1)	
Height	83.5 m O.D.
Sample Type	U100
Colour	5YR 4/1 Dark grey

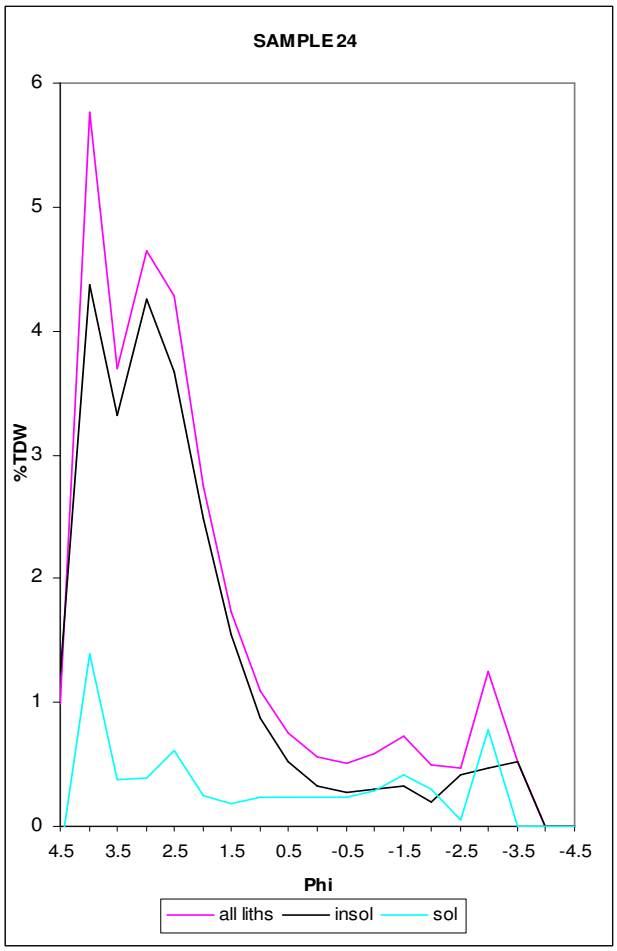
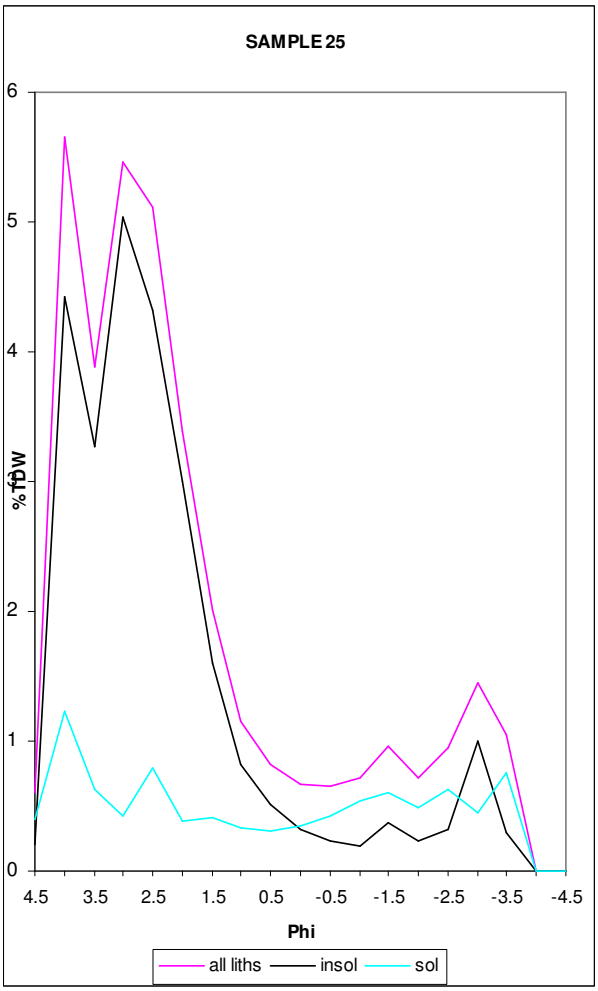
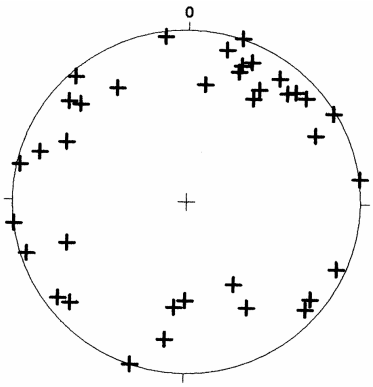


Figure 5.36. Particle size data for Sample 24.

Sample 25 (Site 7, Unit 1)	
Height	85.5 m O.D.
Sample Type	U100
Colour	10YR 6/3 Pale brown





Macrofabric data for Sample 25	
Number in sample	35
Resultant vector	24°/204°
Vector magnitude	17.0%
Significance	(Not Significant)
Mean dip	16°

Figure 5.37. Particle size and macrofabric data for Sample 25.

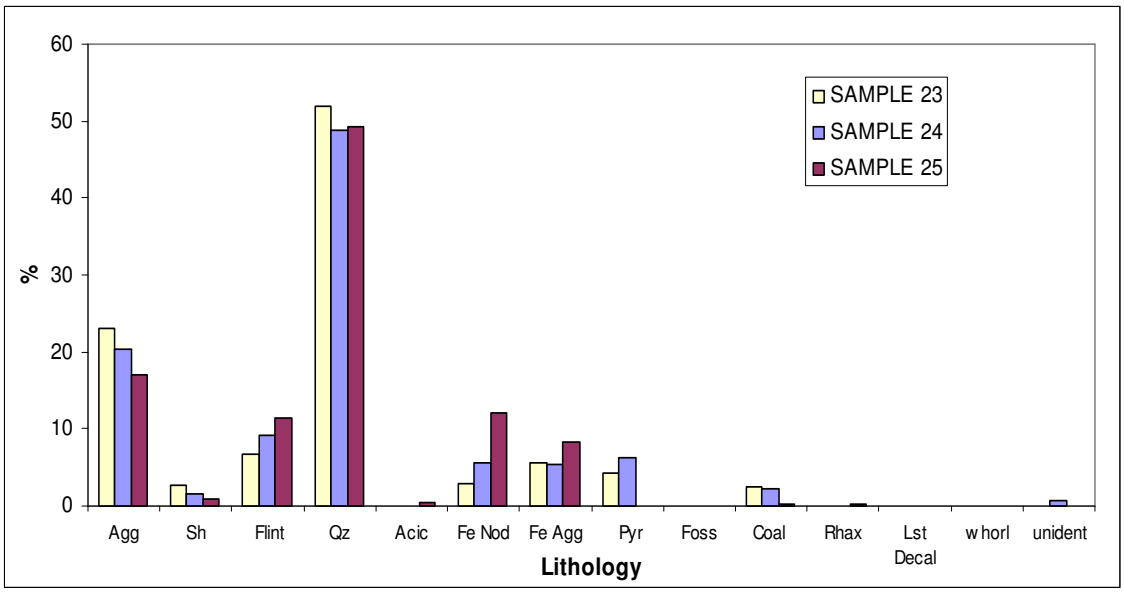


Figure 5.38. Small clast lithology data for Unit 1 at Site 7, Great Wymondley.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 8

Location	St Ippollitts
Grid Ref:	TL1960 2720
Ground level	65 m O.D.
Borehole No.	DB3/IP3

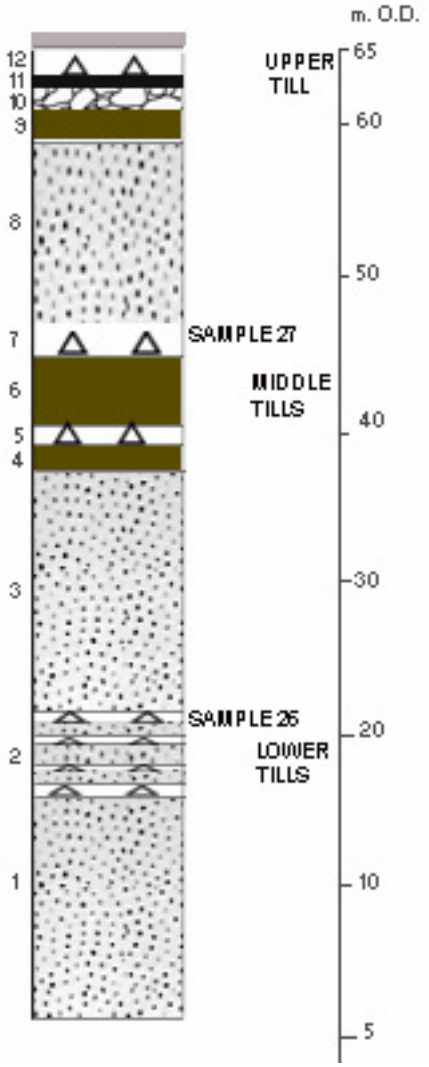


Figure 5.39. Borehole log for Site 8.

This is the site of a deep borehole sunk in a meadow close to Ippollitts Brook, immediately to the south of Hitchin. The borehole penetrated 59.9 m to 5.5 m O.D. Contours on the sub-Anglian surface shown on BGS 1:50,000 Sheet 221 (Hitchin) show its position is on the margin of the Hitchin channel. However, it is clear that this is one of the deepest boreholes in the area.

Unit 1 Dense silty sand

At the base of this sequence lies dense blue/grey silty sand. The Chalk bedrock was not penetrated and there is no mention of this being a particularly chalky deposit. It seems likely therefore that the Chalk surface lies below 5.0 m O.D. at this point.

Unit 2 Till (Lower Till)

Above the sand is a series of thin bands of till, often less than 0.5 m thick, interleaved with dense blue/grey silty sand. A bulk sample of till was extracted at 43.8 m depth (sample 26) comprising a chalky, dark greyish brown stiff clay. This sequence gives way to sand at 24 m O.D. Lithological analysis shows this lower till has more quartz but less flint than Unit 5 (upper till), and Figure 5.42 shows other differences in the small clasts of the two units.

Unit 3 Dense silty sand

Lying between 24 m O.D. and 38 m O.D., Unit 3 comprises a further layer of dense dark grey/blue silty sand, becoming denser with depth.

Unit 4 Silty Clay.

Unit 4 consists of 1.6 m thick layer of fine blue/grey silty clay.

Unit 5 Till (Middle Tills)

A core sample (sample 27) was extracted from this layer of till of less than 1.5 m thickness. It consists of dark grey, relatively soft clay, containing much black shale and pockets of sand and silt. At the top of this core was 5 cm of silty sand. This core was not oriented so, although a weak macrofabric was evident (Figure 5.41**),** a resultant vector could not be ascertained.

Unit 6 Soft grey silty clay

Over 4 m of soft grey silty clay is very sandy in places.

Unit 7 Till (Middle Tills)

This comprises another layer of till approximately 2 m thick. Although separated by 4 m of sand, Units 5 and 7 are both believed to be part of a sequence of tills and clays deposited in a single ice advance (see Chapter 8).

Unit 8 Silty Sand

A dense fine grey/brown silty sand with layers of stone and flint, passing up into a similar deposit but with more gravel. This unit has been shown by Cheshire (pers. comm.) to represent glaciofluvial gravel with a flint content varying between 32 and 37% (see Section 5.1).

Unit 9 Silty Clay

This unit comprises a 2 m thick layer of firm blue grey silty clay.

Unit 10 Gravel

This is a medium to coarse gravel with flints.

Unit 11 Silt

Unit 12, at a height of 62.6 m O.D. consists of approximately 1.8m of silt with a thin layer of black organic peat at the top. Unfortunately, this was contaminated with a good deal of wax used to seal the top of the core and it was not possible to subject this to further investigation.

Unit 12 Upper Till

A firm grey/brown till lies between 63.4 m and 64.8 m O.D.

Approximately 0.2 m of topsoil is present at the top of this borehole.

SAMPLE DETAILS

Sample 26	(Site 8, Unit 2 - Lower Till)
Height	21.2 m O.D.
Sample Type	Bulk
Colour	10 YR 4/2 Dark greyish brown

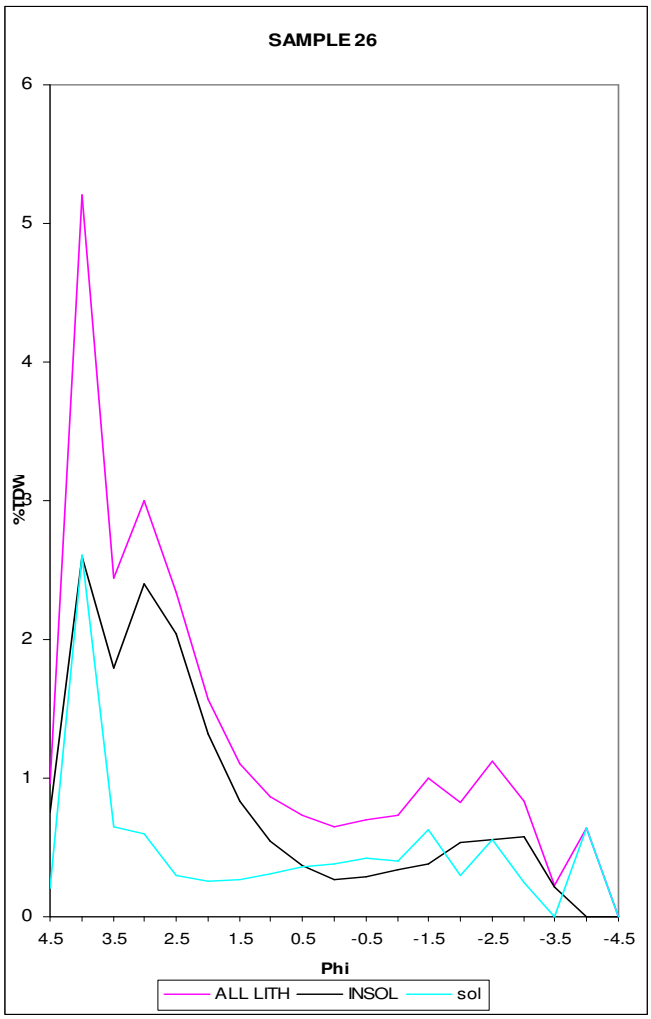
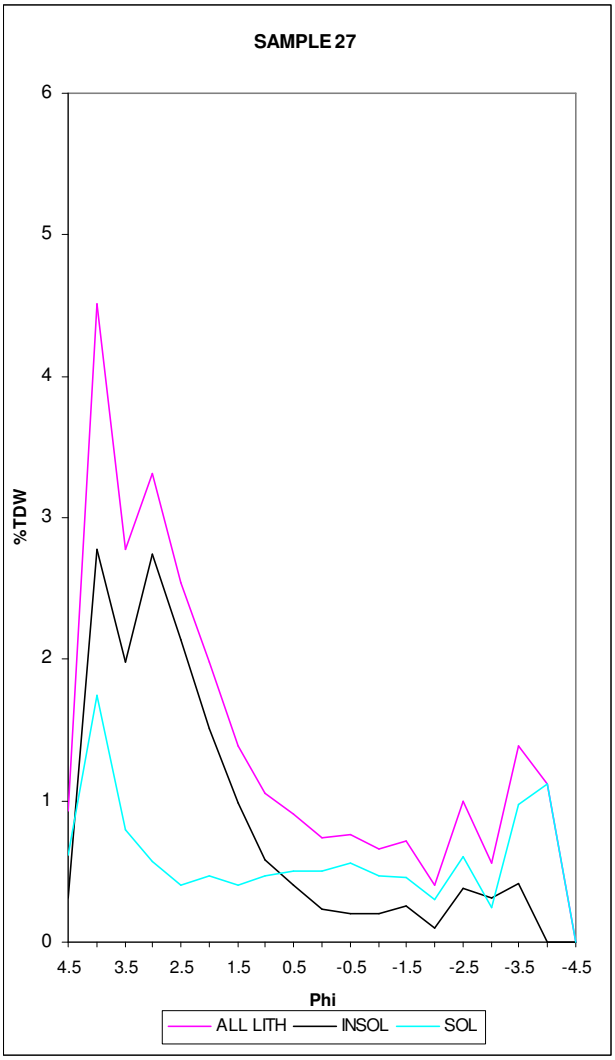
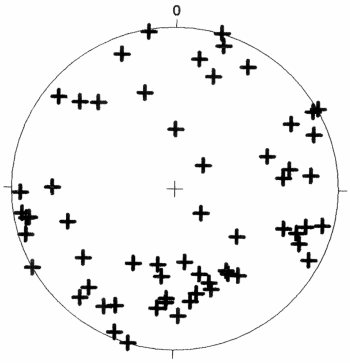


Figure 5.40. Particle size data for Sample 26.

SAMPLE DETAILS

Sample 27 (Unit 5, Middle Till)	
Height	39 m O.D.
Sample Type	U100 (not oriented)
Colour	10YR 3/1 Very dark grey





Macrofabric data for DB3 26.0	
Number in sample	58
Resultant vector	-
Vector magnitude	8.9%
Significance	(Not Significant)
Mean dip	25 ^{o}

Figure 5.41. Particle size and macrofabric data for Sample 27.

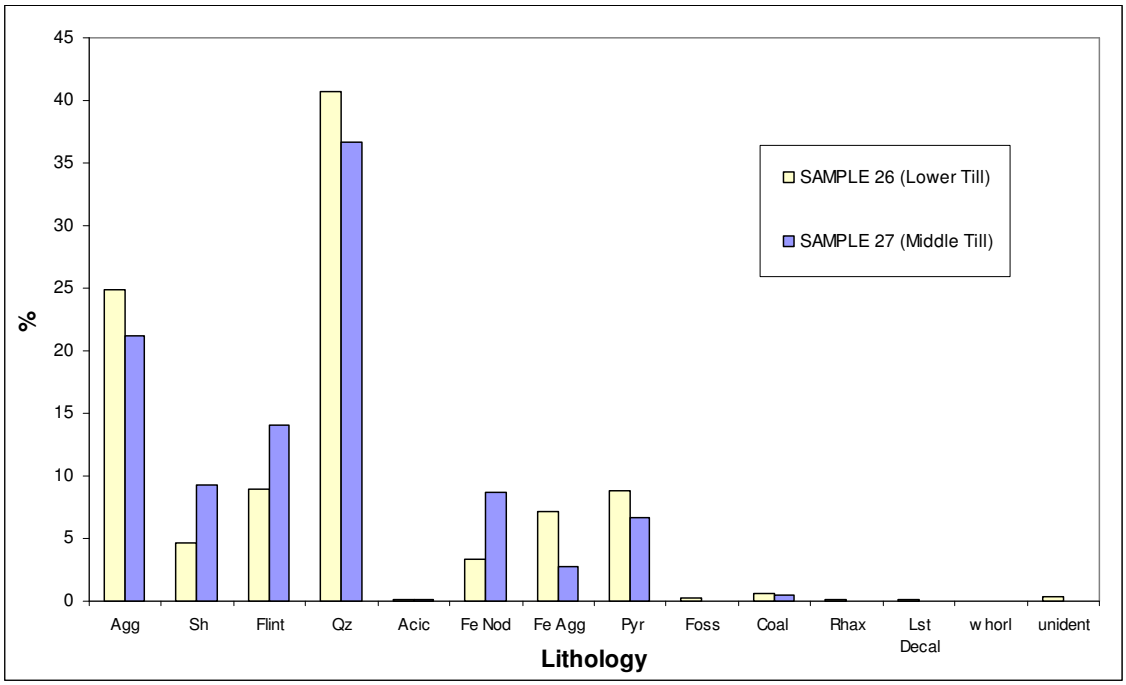


Figure 5.42. Small clast lithology data for Unit 2 (Lower) and Unit 5 (Middle) tills at Site 8, St Ippollitts.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 9

Location	Close to Maydencroft Manor, Hitchin
Grid Ref	TL1800 2765
Ground level	80 m O.D.

This site is located beside a woodland/field boundary close to the typesite for the Maydencroft Till (Maydencroft Member) at Maydencroft Manor (TL1829 2760). The Maydencroft Till is known to lie at a depth of 4.8 m at the typesite, but the land slopes down to the west towards Site 9, where it outcrops at the surface. The till lies beneath 0.6 m of topsoil. A single sample (sample 28) was extracted from a depth of 1.4m. The particle size distribution seen in Figure 5.43 shows this till to have a modal value between +2.0 and + 2.5 phi. Average quartz and flint contents are 48% and 9% respectively (Figure 5.44).

Till at Site 7, lying approximately 3.8 km WSW of Site 9, has also been correlated with the Maydencroft Member (Aldiss, 1992a). However, the tills at these sites exhibit different particle size and lithological characteristics. In particular, the acid-insoluble fraction at Site 9 (Figure 5.43) is half that seen at Site 7 (Figure 5.35). Also, Figure 5.43 shows this till to have a unimodal particle size distribution, whilst that at Site 7 is bimodal. Further details are given in the section relating to Site 7.

SAMPLE DETAILS

Sample 28	
Height	78.5 m O.D.
Sample Type	Auger
Colour	2.5Y 4/4 Olive brown

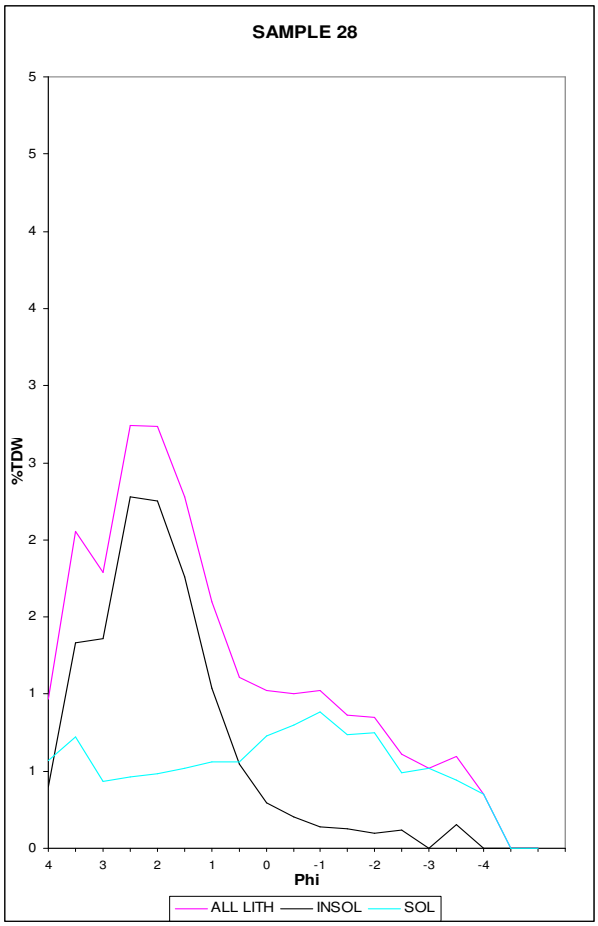


Figure 5.43 Particle size data for Sample 28.

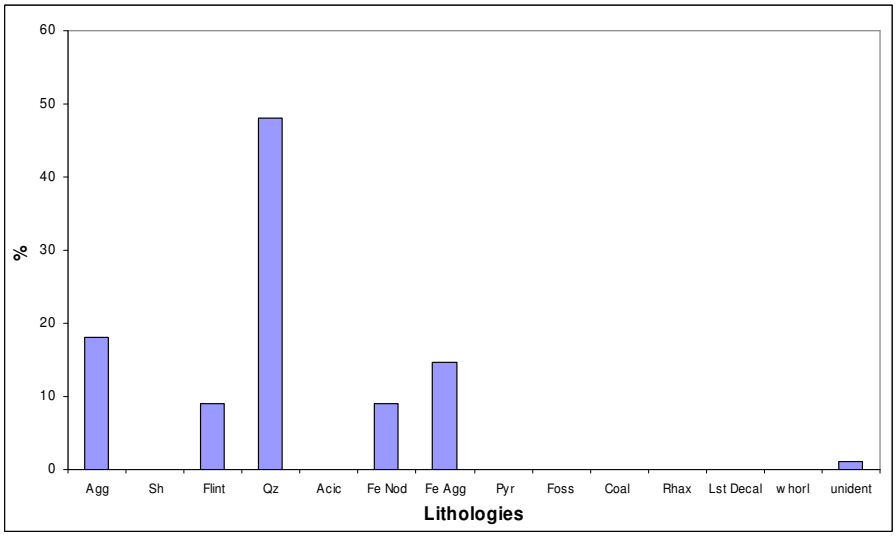


Figure 5.44 Small Clast lithology data for Site 9, Maydencroft.

(Average percentage of clasts from the five half-phi size fractions -1.0 to + 1.0 phi)

SITE 10

Location	Site of new service area beside A1(M) north of Baldock
Grid Ref	TL2346 3657
Ground level	73 m O.D.

Site 10 comprised exposures situated on a small outcrop of till on an interfluve between the River Ivel and Cat Ditch. Overlying the Lower Chalk, this outcrop lies mainly above the 75 m O.D. contour, but descends to 50 m west of the A1(M) in the Ivel Valley. The outcrop continues ESE of this site where it caps a plateau rising to 96 m O.D. The till becomes thicker in this direction and is over 14 m thick in borehole TL23NE17 at TL255365.

This site lies adjacent to the A1(M) immediately to the north of the Chalk scarp, northwest of the Hitchin Gap. Excavations for a new service area provided access to over 6.5 m of massive chalky till. It comprises stiff brown to dark greyish brown chalky clay with silt pockets near the base and occasional orange-brown mottling. The till is believed to rest directly on the Chalk bedrock and to the southwest of the sampled face (Figure 5.45), large pockets of fine chalk, numerous chalk boulders and chalk stringers were found at the base of the cutting. Red Chalk was noted in all samples at this site.

Lithological analysis shows the sample retrieved from 66.8 m O.D.(Sample 29) to have a very high shale content (average across size fractions -1.0 to +1.0 phi of 28.4%). Corresponding figures for the other three samples lie between 2.7% and 3.6% (Figure 5.50). Flint/quartz ratios for total clasts in the -1.0 to +1.0 phi fraction for all samples at this site are between 0.096 and 0.162. The particle size distribution curves are similar for all four samples with primary modes at around +4.0 phi in the very fine sand fraction. A secondary mode at –3.5 to -4.0 phi is also present in all samples. Macrofabric analysis of all four samples revealed very low vector magnitudes with no statistically significant alignment of clasts and dip values of between 9^{o} and 24^{o} (Figures 5.46 to 5.49).

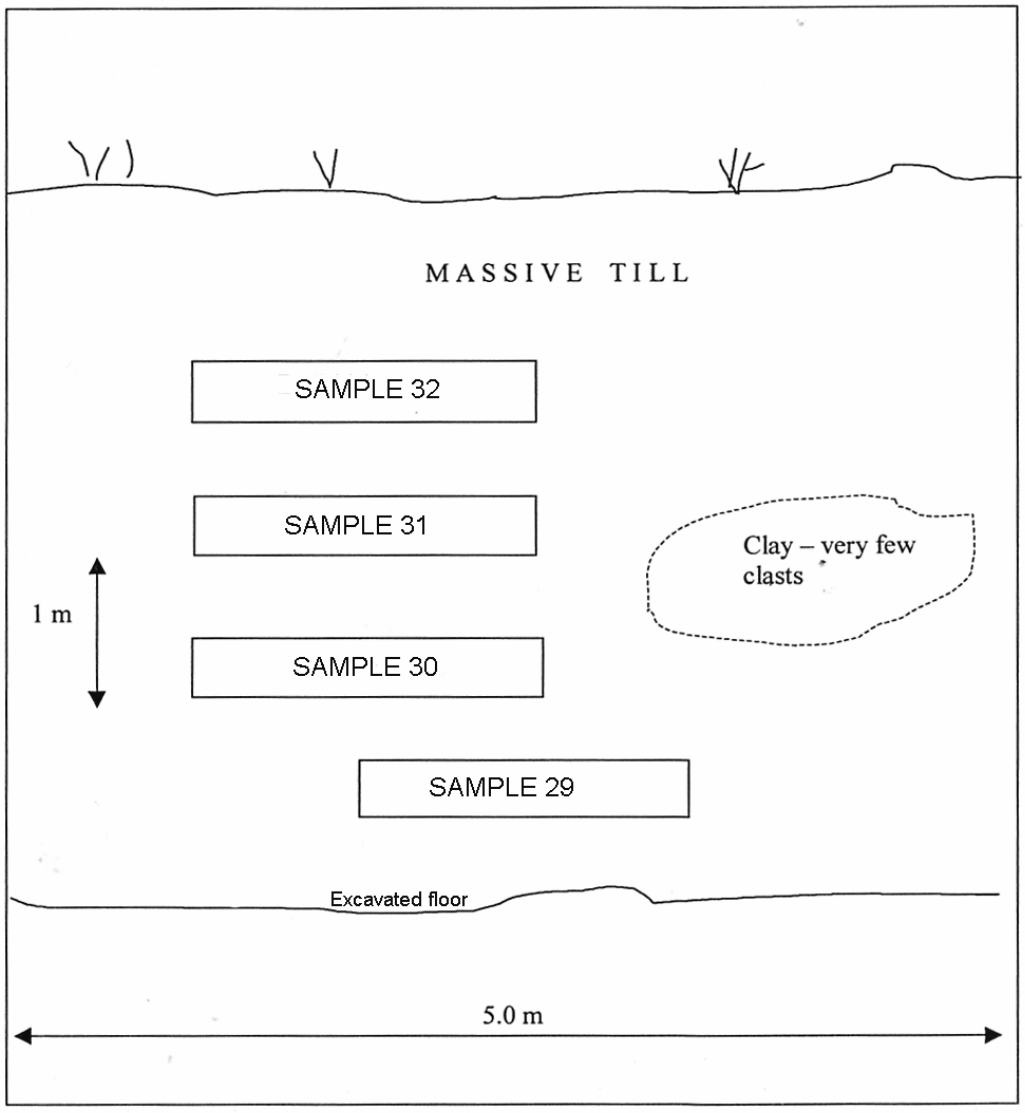
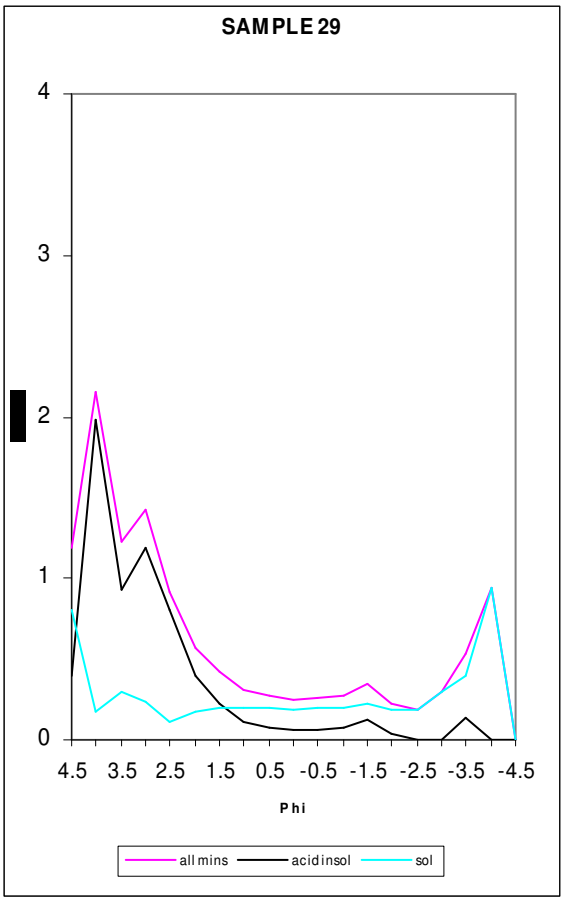
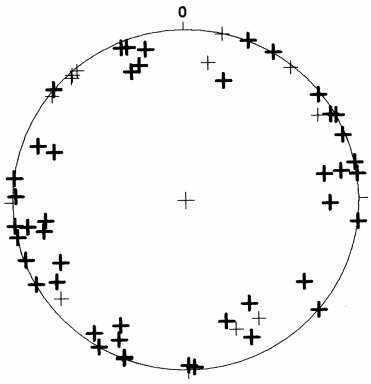


Figure 5.45. Schematic diagram of exposed face at Site 10 (Baldock) with location of samples.

SAMPLE DETAILS

Sample 29	
Height	66.8 m O.D.
Sample Type	Bulk
Colour	10YR 5/3 Brown

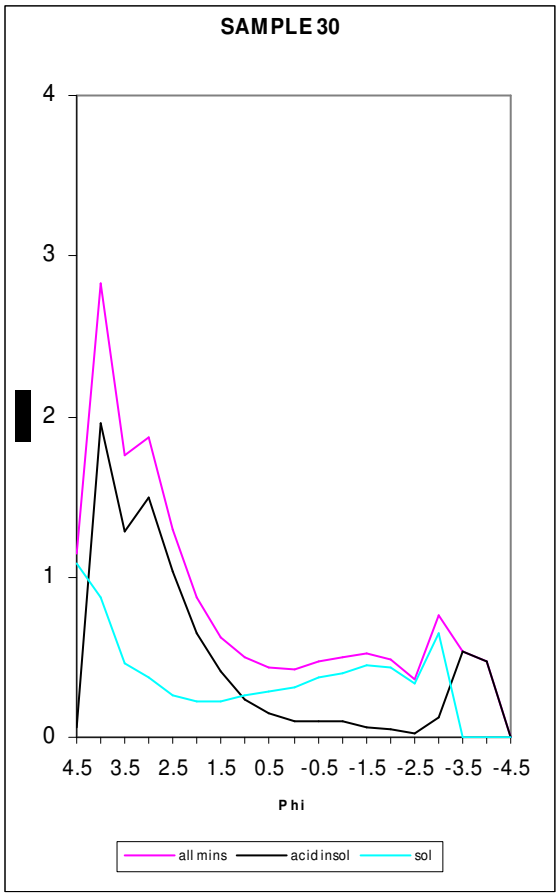


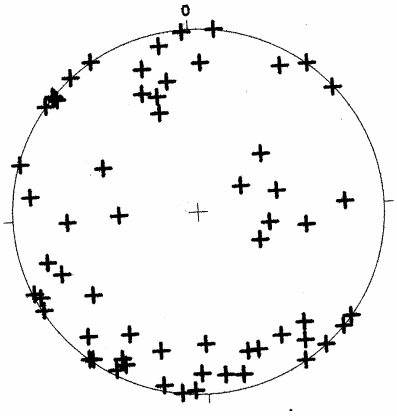


Macrofabric data for Sample 29	
Number in sample	51
Resultant vector	49°/229°
Vector magnitude	7.0%
Significance	(Not Significant)
Mean dip	9.5°

Figure 5.46. Particle size and macrofabric data for sample Sample 29.

Sample 30	
Height	68.1 m O.D.
Sample Type	Bulk
Colour	10YR 4/2 Dark greyish brown

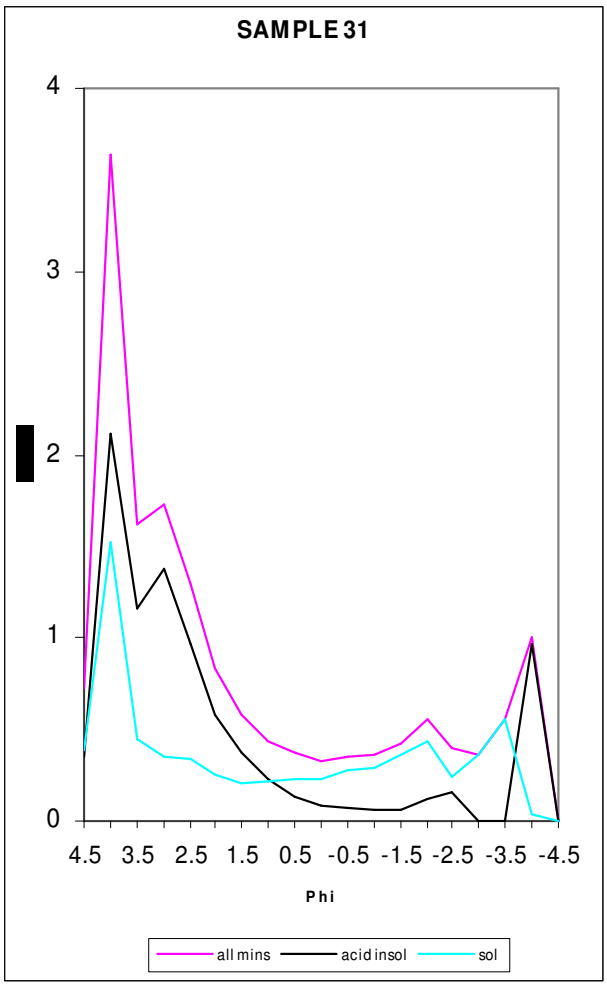


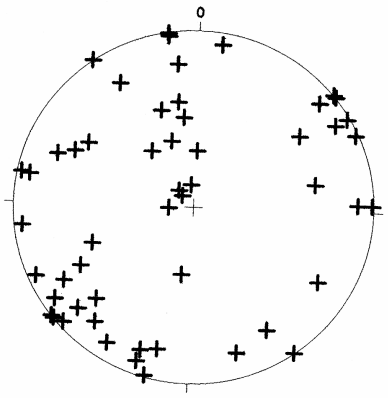


Macrofabric data for Sample 30	
Number in sample	54
Resultant vector	1°/181°
Vector magnitude	13.0%
Significance	(Not Significant)
Mean dip	17°

Figure 5.47. Particle size and macrofabric data for Sample 30.

Sample 31	
Height	69.4 m O.D.
Sample Type	Bulk
Colour	10YR 4/2 Dark greyish brown

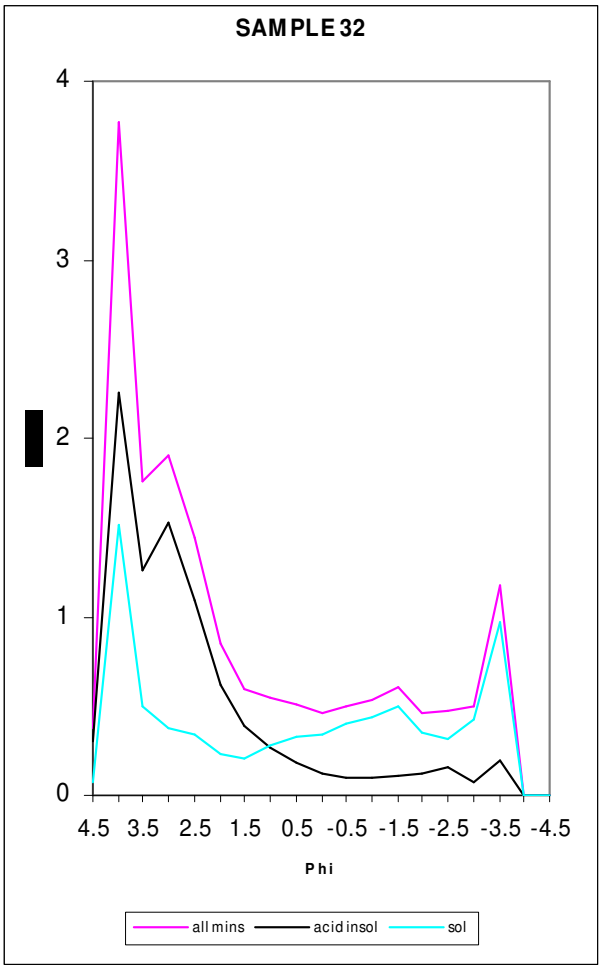


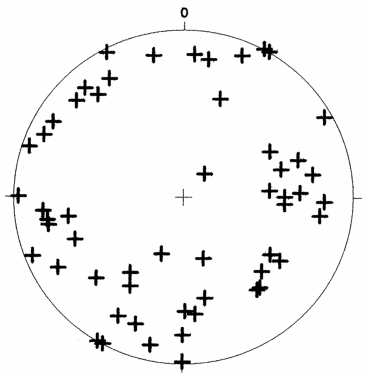


Macrofabric Data	Sample 31
Number in sample	51
Resultant vector	30°/210°
Vector magnitude	11.3%
Significance	(Not Significant)
Mean dip	20°

Figure 5.48. Particle size and macrofabric data for Sample 31.

Sample 32	
Height	70.7 m O.D.
Sample Type	Bulk
Colour	10YR 5/3 Brown





Macrofabric data for Sample 32.	
Number in sample	53
Resultant vector	65°/245°
Vector magnitude	7.2%
Significance	(Not Significant)
Mean dip	24°

Figure 5.49. Particle size and macrofabric data for Sample 32.

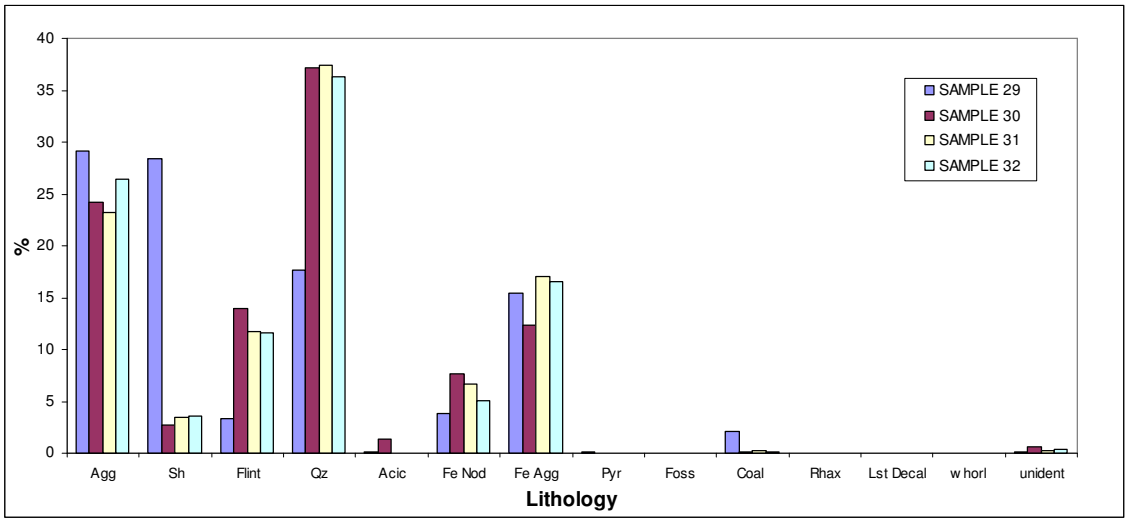


Figure 5.50 Small clast lithology data for Site 10, Baldock.

(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 11

Location	Primrose Hill Quarry, Holwell, Hitchin
Grid Ref	TL1676 3200
Ground level	48.9 m O.D.

This is the only site that lies within the buried channel north of Hitchin. The quarry, once designated the status of a Regionally Important Geological Site (RIGS), is now a landfill site. In 2001, borehole samples were obtained on behalf of the landfill operators, Messrs. Biffa Waste Service Ltd. Drilling was carried out by Direct Drilling using an 'A' frame cable percussion drilling rig.

The quarry consists of two pits. The samples obtained for this study originated from the northernmost of these but previously the writer worked in the pit to the south (Brownsell, 1996). This quarry was also the subject of a paper by Etienne (2001) who investigated the surface till and gravels. He considered these deposits to be characteristic of a fluctuating ice margin. His interpretation of the stratigraphy is discussed in Chapter 3.

Stratigraphy below the quarry floor in Figure 5.51 is taken from logs of the borehole described above. Descriptions of the deposits from exposures above the quarry floor are taken from Etienne (2001) and Brownsell (1996). Unit 16 (sand and gravels) is seen only in the southern of the two pits and is therefore not shown in Figure 5.51.

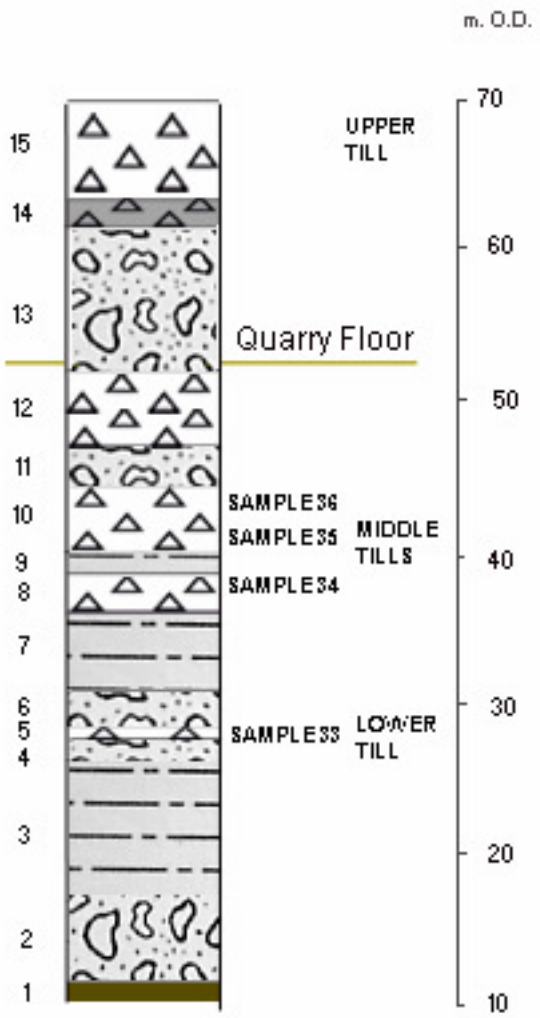


Figure 5.51 Stratigraphy of Site 11.

(derived from borehole data and site visit)

Unit 1 Silty Clay

The borehole penetrated a depth of 38.5 m to approximately 10.4 m O.D. At the base, 1.1 m of stiff to hard, dark grey silty clay is recorded.

Unit 2 Sand and gravel

A variable sand and gravel deposit, reported to be coarser at the base, lies between 11.5 m and 16.9 m O.D. These gravels include calcareous clasts and are considered to be glaciofluvial in origin (Cheshire, pers. comm., see Section 5.1). At the top of this unit is a grey fine to medium sand, with fine to large semi-rounded gravels containing chalk stones.

Unit 3 Silt

Over 8 m of dense dark grey silt, with very fine chalk stones is found between the two sand and gravel units 2 and 4.

Unit 4 Sand and gravel

Unit 4 is a 2 m layer of grey fine to medium sand with fine, medium and large gravels.

Unit 5 Till (Lower Till)

Unit 5 is a very silty, firm dark grey/brown till, sampled at 27 m O.D. (Sample 33). This unit is less than 1.5 m thick and is referred to as the Lower Till. The 'all lithologies' size distribution of this till displays a primary mode in the very fine sand fraction at +4.0 phi (Figure 5.52). However, over 54% of this is composed of acid-soluble lithologies. As a result the 'acid-insoluble lithologies' distribution displays a primary mode at +3.0 phi. The average acid-soluble content of the -1.0 to +4.0 phi fraction is 3.94%, considerably less than that of the Middle Till (Units 8 and 10).

Unit 6 Sand and gravel

This is a further unit of glaciofluvial sands and gravels, the top of which lies at 30.4 m O.D.

Unit 7 Sandy silt

Lying above the sands and gravels are approximately 5.5 m of firm dark grey fine sandy silt.

Unit 8 Till (Middle Tills)

Unit 8 is a firm dark grey to brown, very silty till with occasional bands of sandy silt. It was sampled at a height of 38 m O.D. (Sample 34). The particle size distribution of this till (Figure 5.53) is similar to that of Unit 10 (Figure 5.54). It is therefore considered that Units 8 and 10 were laid down during the same ice advance, or represent separate advances from the same direction under similar conditions. A macrofabric shows a significant alignment of clasts in an ESE-WNW direction (Figure 5.53).

Unit 9 Sandy silt

A thin band of firm grey fine, sandy silt with very fine chalk stones.

Unit 10 Till (Middle Tills)

This unit has a similar appearance to Unit 8. It lies between 39.9 m O.D. and 44.5 m O.D and was sampled at heights of 41.0 m O.D. (Sample 35) and 43.6 m O.D. (Sample 36). The latter sample contained a 4 cm layer of gritty sand. The two samples from this unit possess very similar particle size distributions to the sample from Unit 8 (Figures 5.53 and 5.55). The macrofabric at 41.0 m O.D. (sample 35) is non-significant but the upper sample revealed a strong fabric showing a northwest-southeast orientation (Figure 5.55). The average acid-soluble content of the -1.0 to +4.0 phi fraction of Units 8 and 10 are similar, lying within the range of 11.2 – 11.5% (Figures 5.53 - 5.55) although ratios of total flint/quartz clasts in the -1.0 to + 1.0 phi fraction vary somewhat (Figure 5.56), averaging 0.132 in Unit 8 and 0.090 in Unit 10.

Unit 11 Sands and gravels

Unit 11 consists of 2.3 m of glaciofluvial sands and gravels, described as light grey, fine to medium sand and fine, medium and coarse gravels with abundant chalk.

Unit 12 Till (? Middle Tills)

Unit 12 is represented by a till found at the top of the borehole, above 46.8 m O.D. In the southern pit to extends to ~ 53 m O.D. Previous work on this unit by the writer (Brownsell, 1996) has shown it to comprise a stiff olive grey, pebbly, sandy and silty till. Macrofabric analysis has shown clasts are oriented in northeast-southwesterly direction. This may represent a till deposited by a late part of the advance responsible for the Middle Till.

The following units are seen above ground level in the southern pit :

Unit 13 Sands

The Lower Holwell Sands (Etienne, 2001) can be separated into three units. The lowest unit comprises glaciofluvial sands and gravelly sands with large scale low

angle planar cross-bedding. It ranges from 6.5 m to 14.0 m in thickness and faulting is described by Etienne (2001).

The middle unit comprises between 0.8 and 1.2 m of clayey coarse gravel, also faulted. These deposits were considered by Hopson (1992) to result from a flash flood or mudflow.

The upper medium sand and gravel unit exhibits planar and low-angle bedding, with an erosional base. This unit ranges from 1.5 to 2.5 m in thickness.

Unit 14 Clay

At the base of Unit 15 is a thin clay, partly laminated. It is 10 cm - 40 cm thick with a sharp erosive planar base.

Unit 15 (Upper Till)

This is the main till unit seen in this quarry (Plate 5.2). Termed the Holwell Diamicton by Etienne (2001), the 3 to 4 m of massive blue-grey till is in places weathered to brown. Fabric analysis by Etienne (2001) suggested ice flow from the north. Previous investigations by the writer have shown this till to possess similar textural and lithological properties to Cheshire's Ware Member (see Chapter 3).

Unit 16 Sand and gravels

The Upper Holwell Sands are described by Etienne (2001) as graded, horizontally interbedded sands, gravels and gravelly sands. This unit is seen only in the southern of the two pits at this site and is therefore not shown on Figure 5.51.

The middle till units at this site can be distinguished from the lower till (Unit 5) by its anomalously high acid-soluble content (averaging 11.2%). The particle size characteristics of tills at this site (Figures 5.52 to 5.55) reveal fewer particles in the +1.0 phi to +4.0 phi fraction in the lower till. The total percentage of 'all lithologies' in this range is 9.33% for the lower till (Sample 33) and between 27.7% and 38.0% in the middle till (samples 34, 35 and 36).

Sample 33 (Unit 5, Lower Till)	
Height	27.0 m O.D.
Sample Type	U100
Colour	10YR 4/2 Dark greyish brown

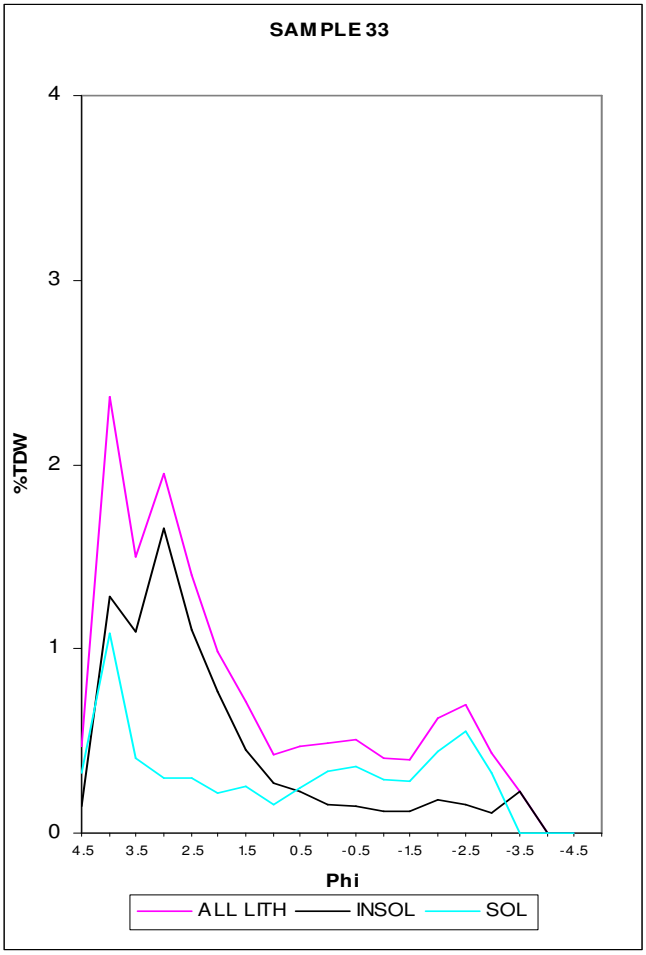
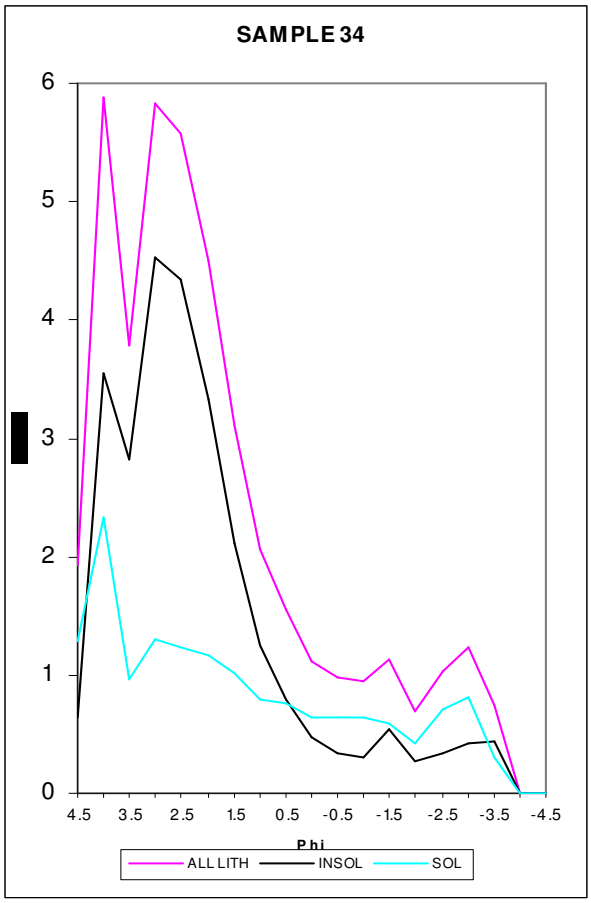
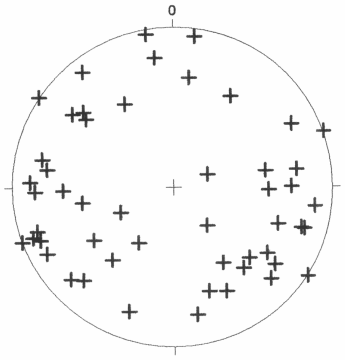


Figure 5.52. Particle size distribution for Sample 33.

Sample 34 (Unit 8, Middle till)	
Height	38.4 m O.D
Sample Type	U100 (oriented)
Colour	10YR 3/3 Dark Brown

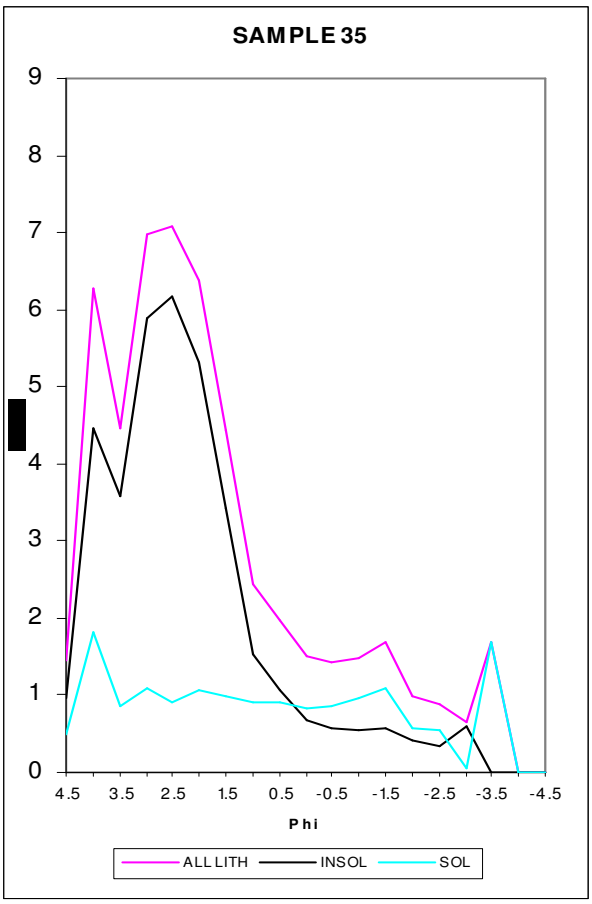


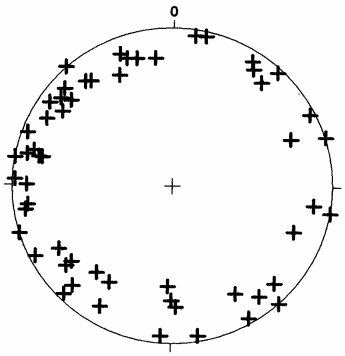


Macrofabric data for Sample 34.	
Number in sample	50
Resultant vector	98°/278°
Vector magnitude	25.1%
Significance	> 95.0% (Significant)
Mean dip	24°

Figure 5.53. Particle size and macrofabric data for Sample 34.

Sample 35 (Unit 10, Middle Till)	
Height	41.0 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 3/2 Very dark greyish brown

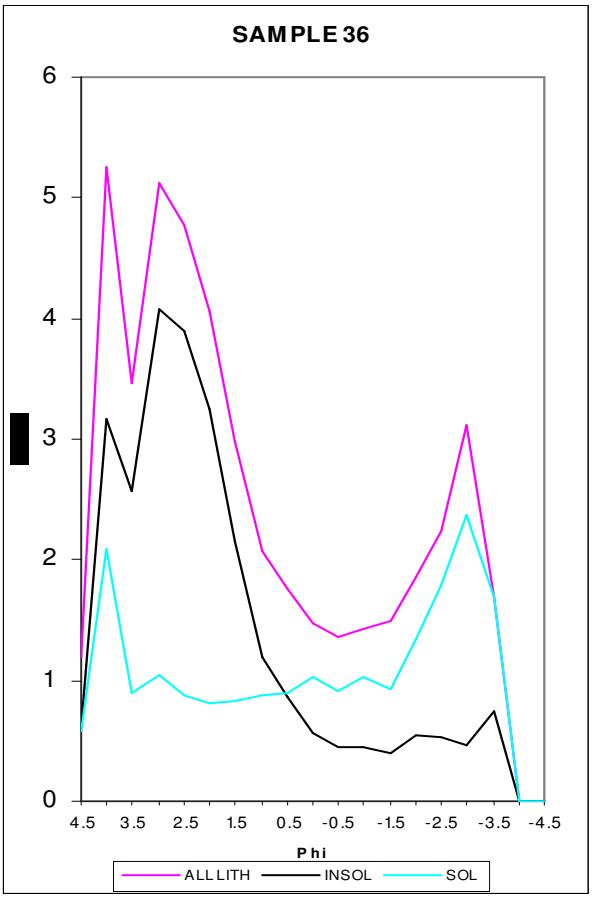


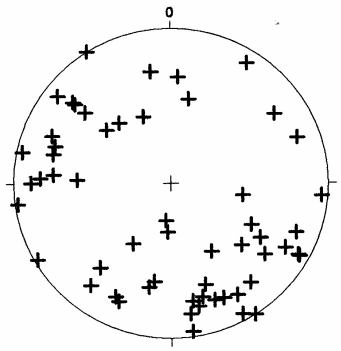


Macrofabric data for Sample 35	
Number in sample	53
Resultant vector	122°/302°
Vector magnitude	7.3%
Significance	(Not Significant)
Mean dip	13°

Figure 5.54. Particle size and macrofabric data for sample Sample 35.

Sample 36 (Unit 10, Middle Till)	
Height	44.0 m O.D.
Sample Type	U100 (oriented)
Colour	10YR 3/3 Dark greyish brown





Macrofabric data for Sample 36.	
Number in sample	55
Resultant vector	140°/320°
Vector magnitude	28.4%
Significance	>99.0% (Highly significant)
Mean dip	25°

Figure 5.55. Particle size and macrofabric data for Sample 36.

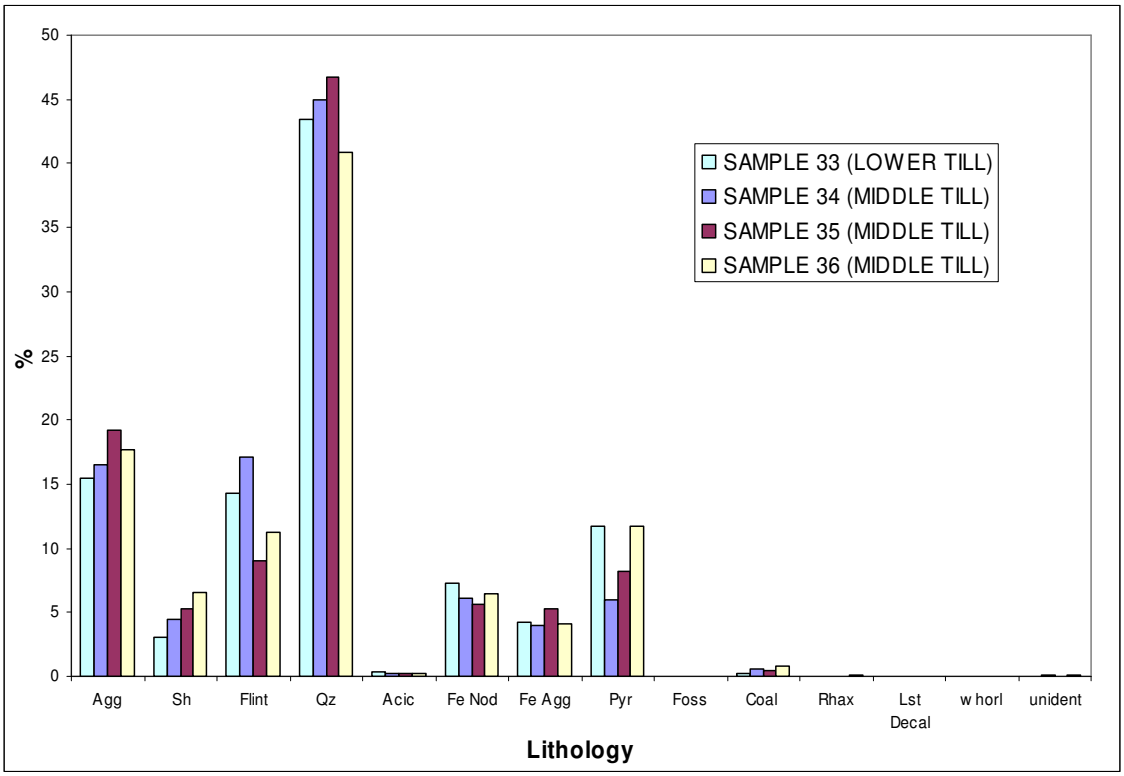


Figure 5.56. Small clast lithology data for Units 5 & 10 at Site 11, Primrose Hill Quarry.
(Average percentage of clasts from the five half- phi size fractions -1.0 to + 1.0 ph

Plate 5.2. South pit, Primrose Hill Quarry, Holwell (Site 11), 1996.

5.3. Sites lying to the west of the River Ivel (Sites 12 – 18).

Sites 12 to 18 are represented by a series of shallow samples obtained by auger or, in the case of Site 17, from a shallow trench. None of these sites exposed bedrock. They lie on irregular patches of till within or to the west of the Ivel Valley (Figure 5.57). The underlying bedrock varies from Oxford Clay in the north, through Woburn Sands to Gault Clay to the south.

Table 5.1 provides details of the borehole data referenced in this section.

Borehole name	BGS Number	Grid Ref
Pollards Nurseries, Lower Stondon	TL13NE9	TL1616 3506
Conway Nurseries	TL13NE8	TL1566 3525
500 yds SW of Hoo Farm, Meppershall Pumping Station	TL13NE13	TL1504 3705
Biggleswade By-Pass 61	TL14SE2	TL1930 4347
Biggleswade By-Pass 63	TL14SE3	TL1896 4358
Biggleswade By-Pass 64	TL14SE4	TL1885 4385
Biggleswade By-Pass 68	TL14SE7	TL1872 4366
Southill	TL14SW3	TL1410 4054
Mr Milton's Farm, Ickwell Bury, Northill	TL14NW4	TL1466 4594
A1 Tempsford Grade Separation 20	TL15 SE41	TL1625 5241
A1 Tempsford Grade Separation 40	TL15 SE43	TL1627 5245
A1 Tempsford Grade Separation 50	TL15SE44	TL1628 5244
A1 Tempsford Grade Separation 60	TL15SE45	TL1629 5249
A1 Tempsford Grade Separation 80	TL15SE47	TL1635 5292

Table 5.1. Details of BGS boreholes referred to in text.

Site 12 (Upper Stondon) (TL1454 3569) is situated next to the water tower on the Meppershall to Upper Stondon Road. At 78 m O.D., this site lies approximately 2 km west of the buried channel in which at Lower Stondon a borehole (TL13NE9) has proved 60 m of drift. However, a further borehole (TL13NE8) 1.3 km east of Site 12 records only 10 m of sands and gravels above the Gault. The till apparently thins northwards to Meppershall pumping station (TL13NE13) where only 0.5 m of drift was recorded above the bedrock. The particle size distribution of till at Site 12 shows a broad primary mode between +2.0 and +3.0 phi, but the large secondary mode at -4.0 phi is probably due to

the presence of one or two large clasts (Figure 5.58). Figure 5.59 shows relatively low quantities of iron lithologies within this till.

The land descends to approximately 40 m O.D. in the Ivel Valley, where a sample was obtained close to Broom Quarry. However this sample (from **Site 13**) was later found to be unrepresentative of the till in this area. It was extracted from a drainage ditch below gravels immediately to the west of the quarry and was interpreted as a lag deposit, much of the finer sediment having been removed. No further analysis was made of this sample and Site 13 is therefore omitted from this chapter. A further sample from **Site 14 (Broom)** (TL1605 4345) was obtained from the margin of a ploughed field west of Broom Quarry. The till outcrop terminates 450 m to the east of this site and a large outcrop of gravels stretches for almost 10 km alongside the River Ivel. These gravels overlie extensive lacustrine deposits, as evidenced from numerous boreholes along the route of the A1 Biggleswade By-Pass where up to 14 m of clays and organic silts are found beneath approximately 4 m of sands and gravels (e.g. TL14SE2, TL14SE3, TL14SE4 and TL14SE7).

The particle size characteristics of till at Sites 12 and 14 show that most clasts larger than -0.5 phi are acid-soluble (Figures 5.58 and 5.60). Small clast lithologies of these samples are of very similar compositions, with ratios of flint/ quartz in the -1.0 to +1.0 phi fraction of 0.105 (sample 37, Site 12) and 0.118 (sample 38, Site 14) and average amounts of iron lithologies (combined aggregates and nodules) of 15.2% and 18.9% respectively (Figures 5.59 & 5.61).

Site 15 (Southill) (TL1437 4130) lies just south of the boundary between the Woburn Sands and Gault bedrock. On higher ground, approximately 700 m to the south, over 10 m of till is found above the Gault at 67 m O.D. (TL14SW3). The samples were obtained from a field margin on the southern edge of the village of Southill. The two samples (39 & 40) from this site have very different particle size distributions from other samples in the study (Figure 5.62), discussed in Chapter 7, with a very pronounced mode in the medium to fine sand range, very little of which is accounted for by acid-soluble lithologies. This

could be due to incorporation of Woburn Sands (see below). Flint/quartz ratios are 0.097 in the lower sample and 0.116 in the upper.

Woodward & Thompson (1909) noted over 27 m of till in wells in Moggerhanger. However, during this study, 700 m northeast of **Site 16 (Moggerhanger)** (TL1350 4805), the till is seen to be no more than 0.9 m thick overlying the Oxford Clay. The sample (41) here was sited near to the radio transmitter, south of the village. The quartz content of this till, averaging 29.3% (Figure 5.65) is at the lower end of the range found in this study. High values of iron lithologies are seen at this site however, as are shown in counts of both iron nodules and aggregates. The acid-soluble content of the -1.0 to +4.0 phi fraction (Figure 5.64) is one of the highest, similar to that found in the tills at Site 11 (Primrose Hill Quarry) and Site 20 (Millowbury Farm). A highly significant macrofabric from this site indicates ice movement in a southwesterly direction (Figure 5.64). A fairly even spread of dip values exists with an average of 35^{o}.

A small outcrop of glacial deposits exists to the north of Ickwell Bury (TL146459) approx 2.5 km southeast of Site 16. The till here continues beneath the outcrop of adjacent sand and gravel and records have shown that approximately 2 m of gravels overlie more than 14 m of till at the borehole TL14NW4. The Oxford Clay bedrock lies at approx 13 m O.D. Edmonds & Dinham (1965) suggested that the thickness of glacial deposits here represents a continuation of the infilled buried Hitchin Channel system.

Although till is not mapped at **Site 17 (Sandy)** (TL1653 5051), this site lies on a southern extension of the small outcrop shown on BGS 1:50,000 Sheet 204 capping the hill rising to 35 m above the Oxford Clay plain east of Tempsford. The sample was obtained from a freshly dug trench on the edge of a building site beside the entrance to a track leading to Dane Hill Farm, north of Sandy. The stiff olive brown chalky till lay beneath approximately 5 cm of sand and gravel. North of this site, 24.5 m of till has been recorded at Tempsford Bridge, with bedrock reached at approximately 0.5 m O.D. (TL15SE41). However, adjacent boreholes TL15SE43, TL15SE47 shown in Figure 5.57 and at TL15SE44, TL15SE45 indicate between 13 m and 15 m of 'glacial drift' above Oxford Clay at roughly 12.76 m O.D. The ratio of flint/quartz in the -1.0 to + 1.0

phi fraction of this till is 0.147, the quartz content being higher than that in sample 41 at Site 16 (Figure 5.65).

Two samples were obtained from **Site 18 (Warden Street)** (TL1120 4445) close to the edge of the till outcrop. Augered from a position adjacent to the Greensand Ridge Walk, west of Warden Street, Figure 5.76 shows that the two samples from this unit display very different particle size distribution curves. The upper sample with a strong primary mode at 2.0 phi, is one of the few tills in this study that does not have a mode between +2.0 and +3.0 phi. This mode is not present in the lower sample from this site, which has modes at ~ +4.0 phi and +3.0 phi in the fine sand fraction.

The particle size distributions of the two till samples from Site 15 at Southill (Figure 5.62) and the upper sample from Site 18 at Warden Street, all display a narrow mode at +2.0 phi. Quantities of iron lithologies (combined aggregates and nodules) are high at these sites, averaging 28.5% at Site 15 (Figure 5.63) and 38% at Site 18 (Figure 5.69). These characteristics are probably due to incorporation of Lower Greensand, which outcrops approximately 0.5 km to the north of Site 15 and 2 km to the east of Site 18.

Summary details of these sites are given in Table 5.2 and particle size distributions, lithology data and where applicable macrofabric data, are shown in Figures 5.58 to 5.69.

Site No.	Location	Grid Ref	Ground Level	Sample Numbers
12	**Upper Stondon**	TL1454 3569	78 m O.D.	37
14	**Broom**	TL1605 4345	40 m O.D.	38
15	**Southill**	TL1437 4130	63 m O.D.	39 & 40
16	**Moggerhanger**	TL1320 4805	55 m O.D.	41
17	**Sandy**	TL1653 5051	24 m O.D.	42
18	**Warden Street**	TL1120 4445	80 m O.D.	43 & 44

Table 5.2. Summary details for Sites 12 – 18.

1 Site Locations (Site Number).

TL14SW3

10 Location of BGS registered boreholes. Depth of drift deposits given in metres below ground level.

(50 m contour shown).

Key to Figure 5.57.

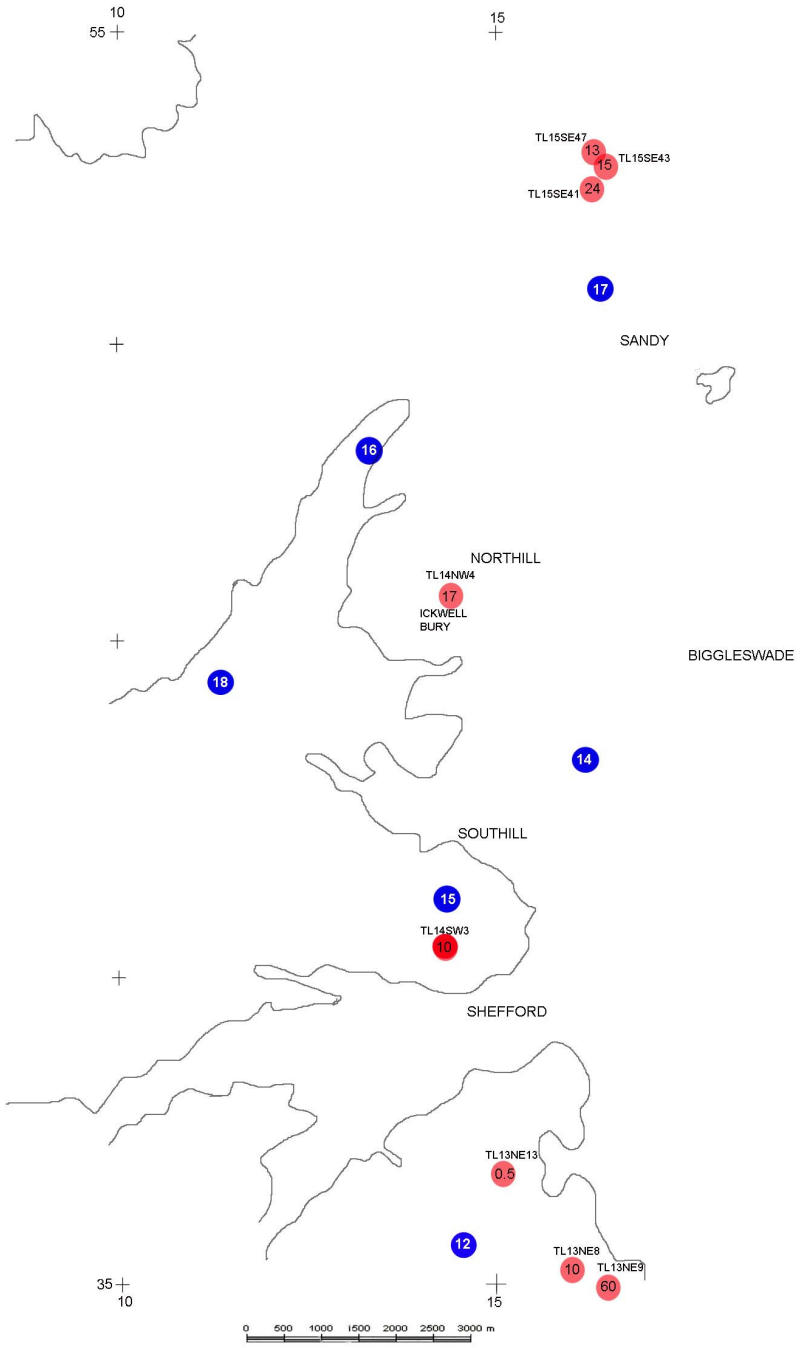


Figure 5.57.

Locations of Sites 12 to 18 and boreholes mentioned in the text.

SITE 12

UPPER STONDON	
Sample Number	**37**
Height	76.4 m O.D.
Sample Type	Auger
Colour	10YR 3/6 Dark yellowish brown

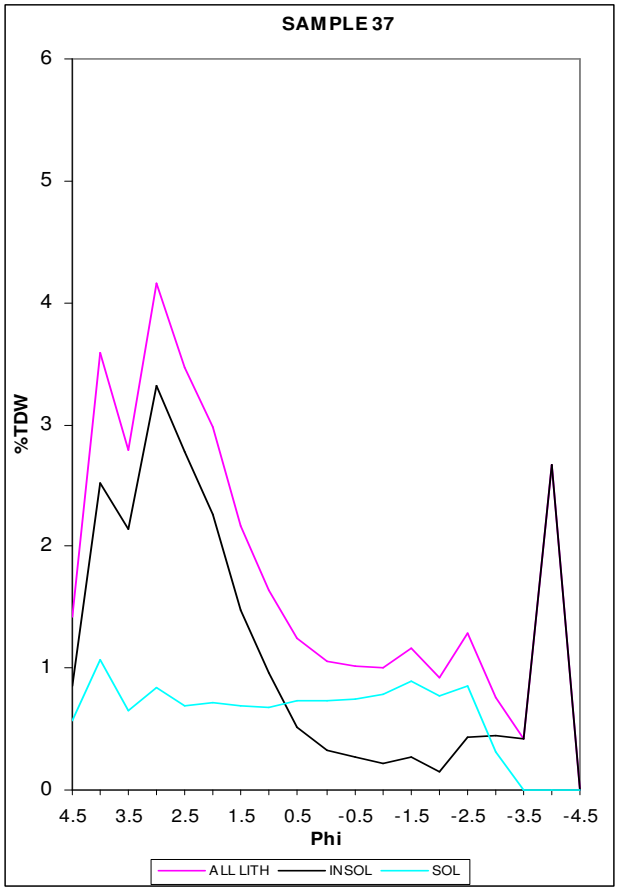


Figure 5.58 Particle Size data for Sample 37.

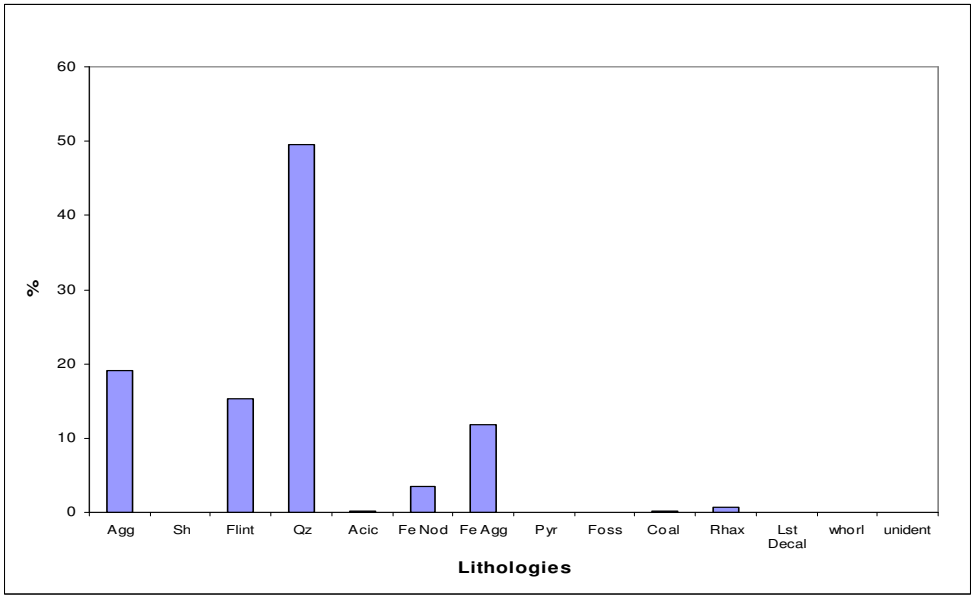


Figure 5.59. Small clast lithology for Site 12, Upper Stondon.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 14

BROOM	
Sample Number	**38**
Height	38.5 m O.D.
Sample Type	Auger
Colour	10YR 4/1 Dark grey

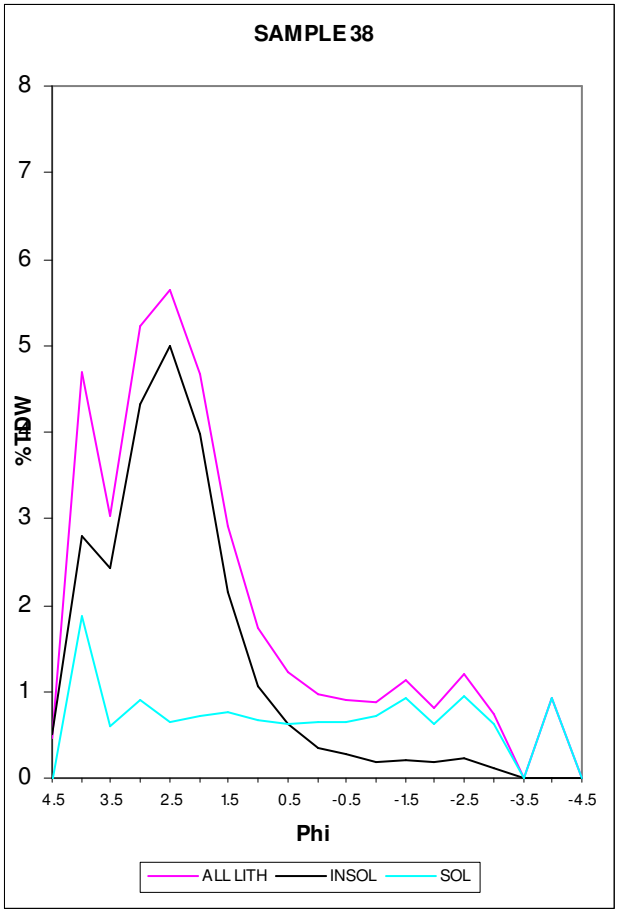


Figure 5.60. Particle size data for Sample 38.

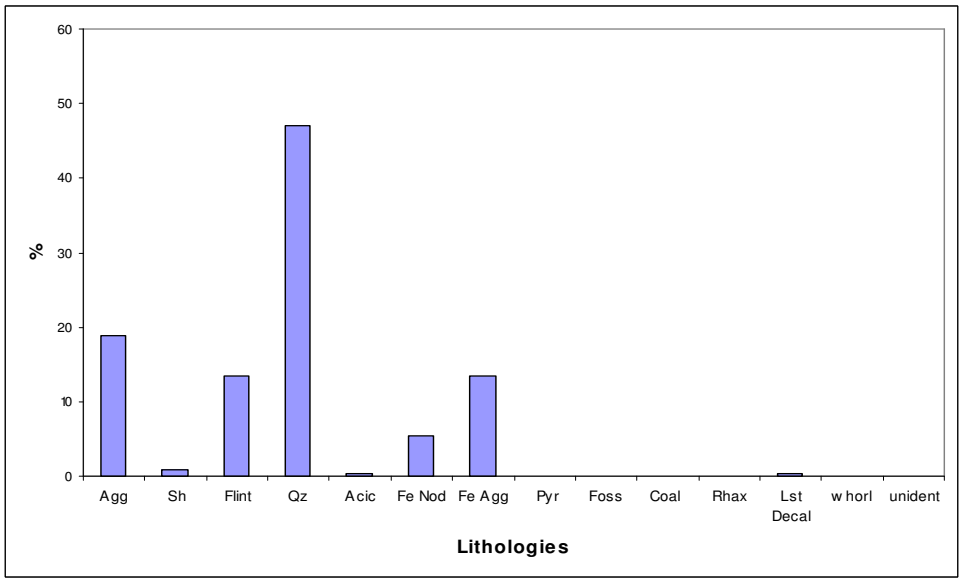


Figure 5.61. Small clast lithology data for Site 14, Broom.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 15

SOUTHILL		
Sample Number	**39**	**40**
Height	61.0 m O.D.	61.5 m O.D.
Sample Type	Auger	Auger
Colour	10YR 5/6 Yellowish Brown	10YR 5/6 Yellowish Brown

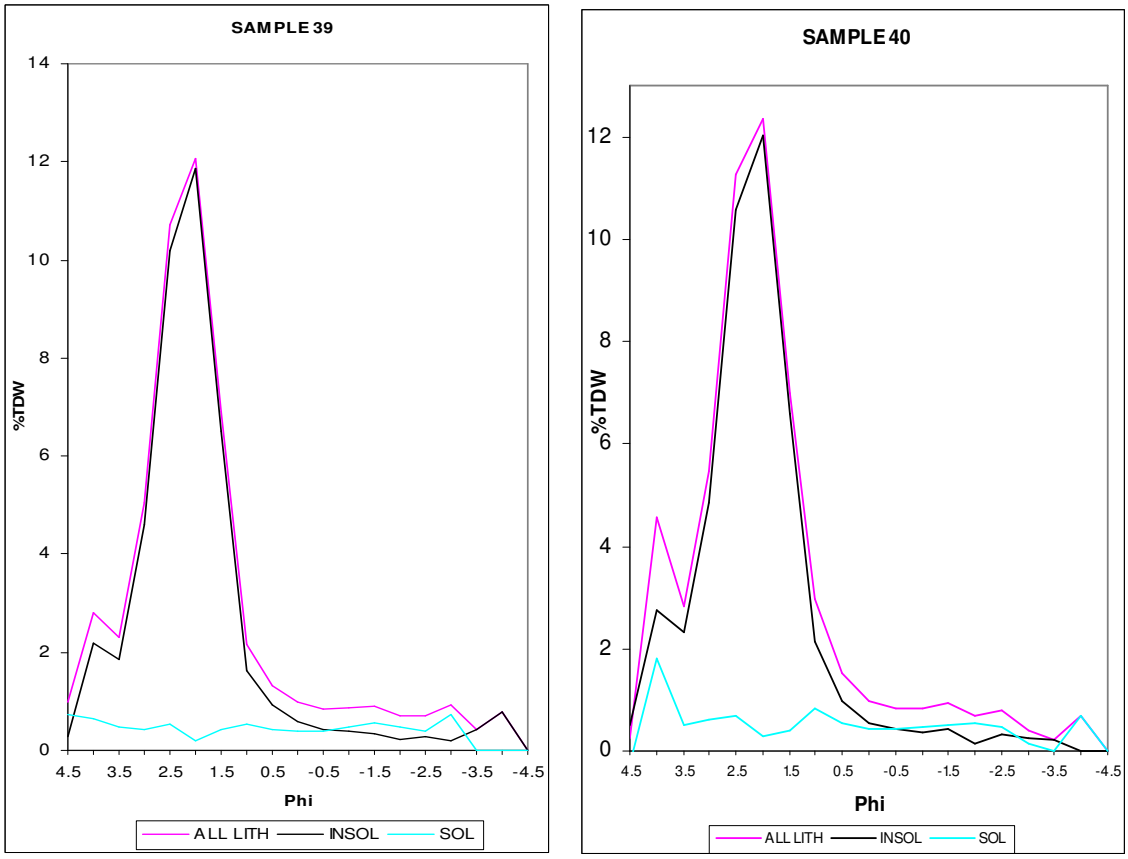


Figure 5.62. Particle size data for Samples 39 & 40.

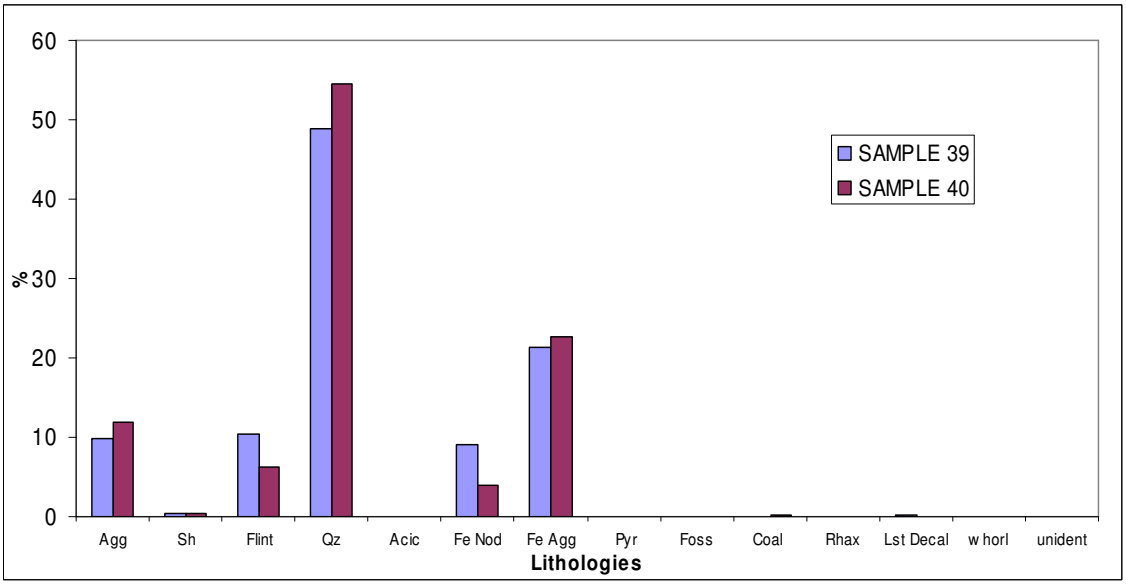
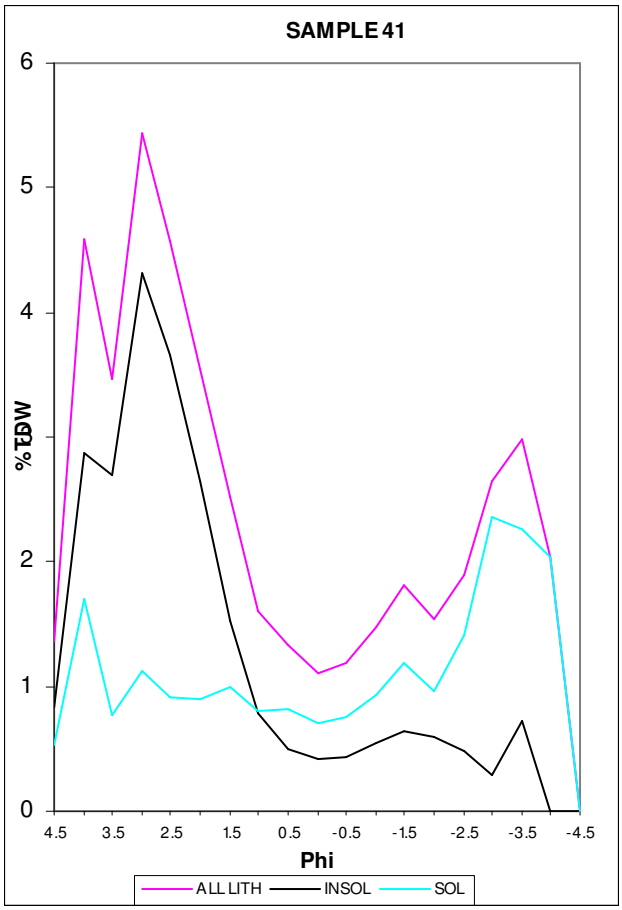
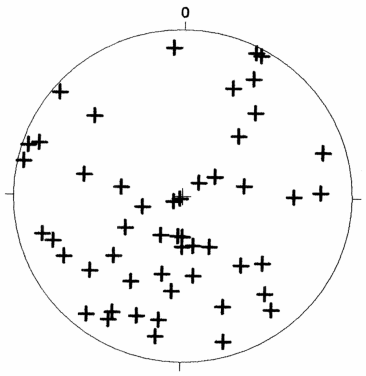


Figure 5.63. Small clast lithology data for Site 15, Southill.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 16

MOGGERHANGER	
Sample Number	**41**
Height	53.4 m O.D.
Sample Type	Auger
Colour	10YR 4/2 Dark greyish brown





Macrofabric data for Sample 41.	
Number in sample	51
Resultant vector	34°/214°
Vector magnitude	22.0%
Significance	>99.9% (Highly significant)
Mean dip	35°

Figure 5.64. Particle size & macrofabric data for Sample 41.

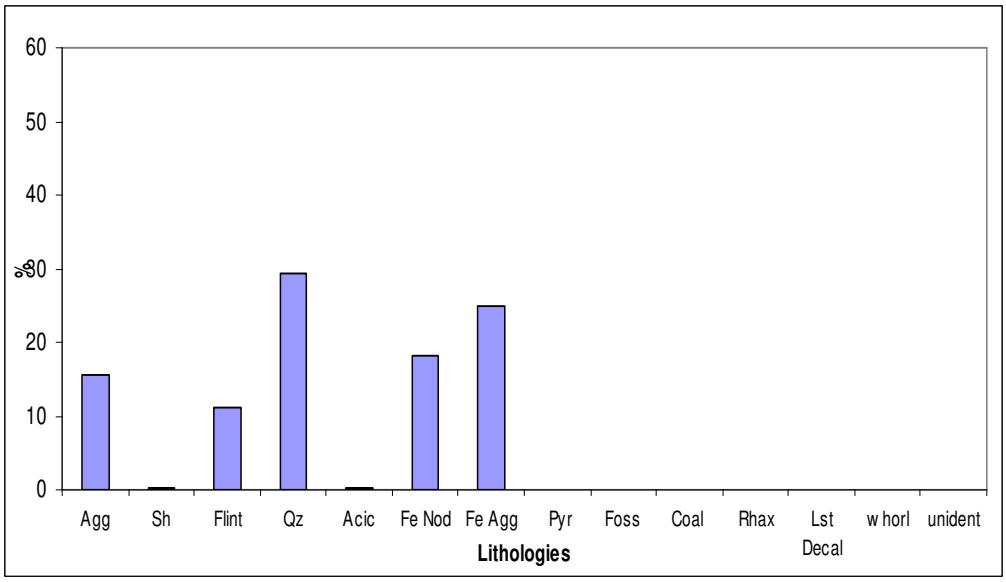


Figure 5.65. Small clast lithology data for Site 16, Moggerhanger.

(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 17

SANDY	
Sample Number	**42**
Height	23 m O.D.
Sample Type	Bulk
Colour	2.5 Y 4/4 Olive brown

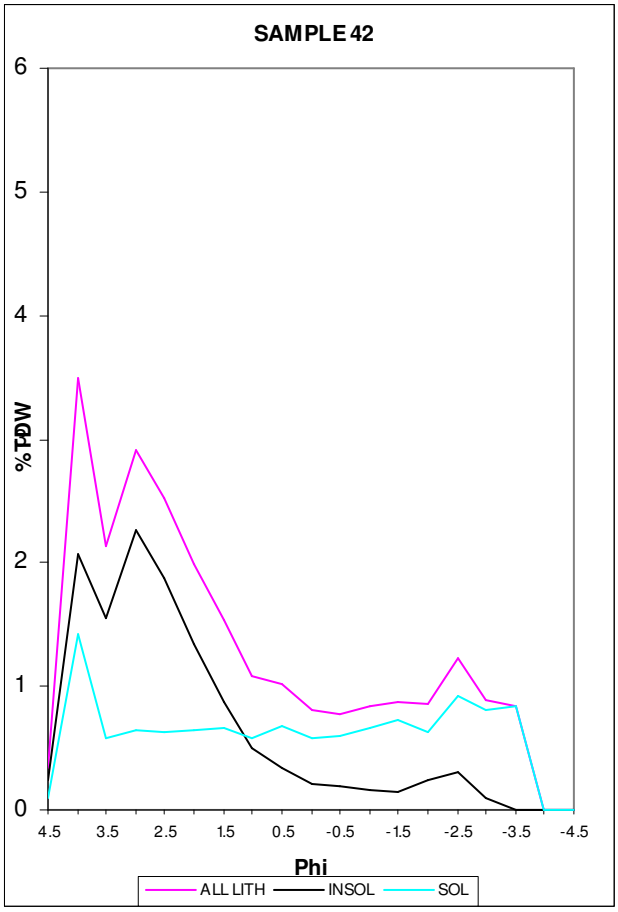


Figure 5.66. Particle size data for Sample 42

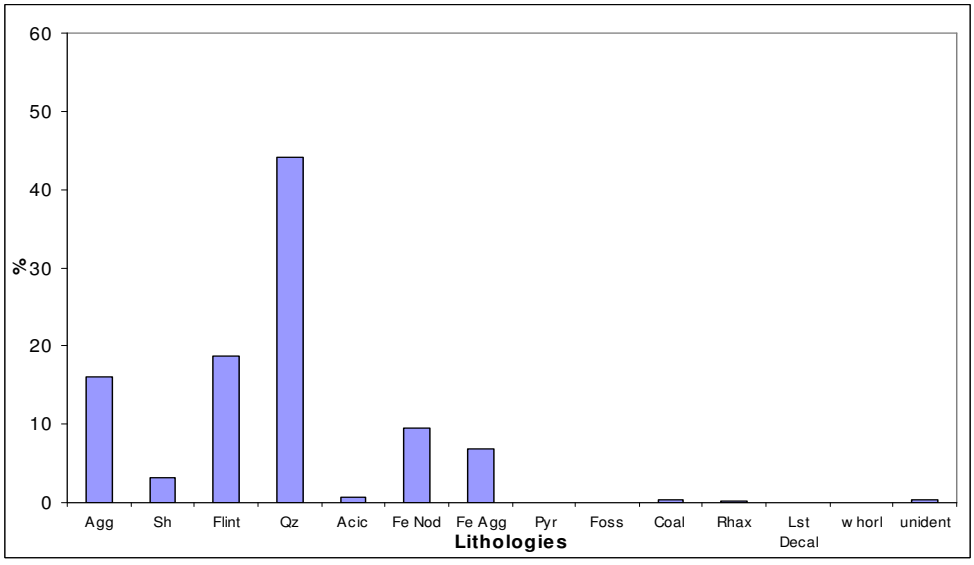


Figure 5.67. Small clast lithology data for Site 17, Sandy.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 18

WARDEN STREET		
Sample Number	**43**	**44**
Height	78.0 m O.D.	78.5 m O.D.
Sample Type	Auger	Auger
Colour	10YR 5/6 Yellowish brown	10YR 5/6 Yellowish brown

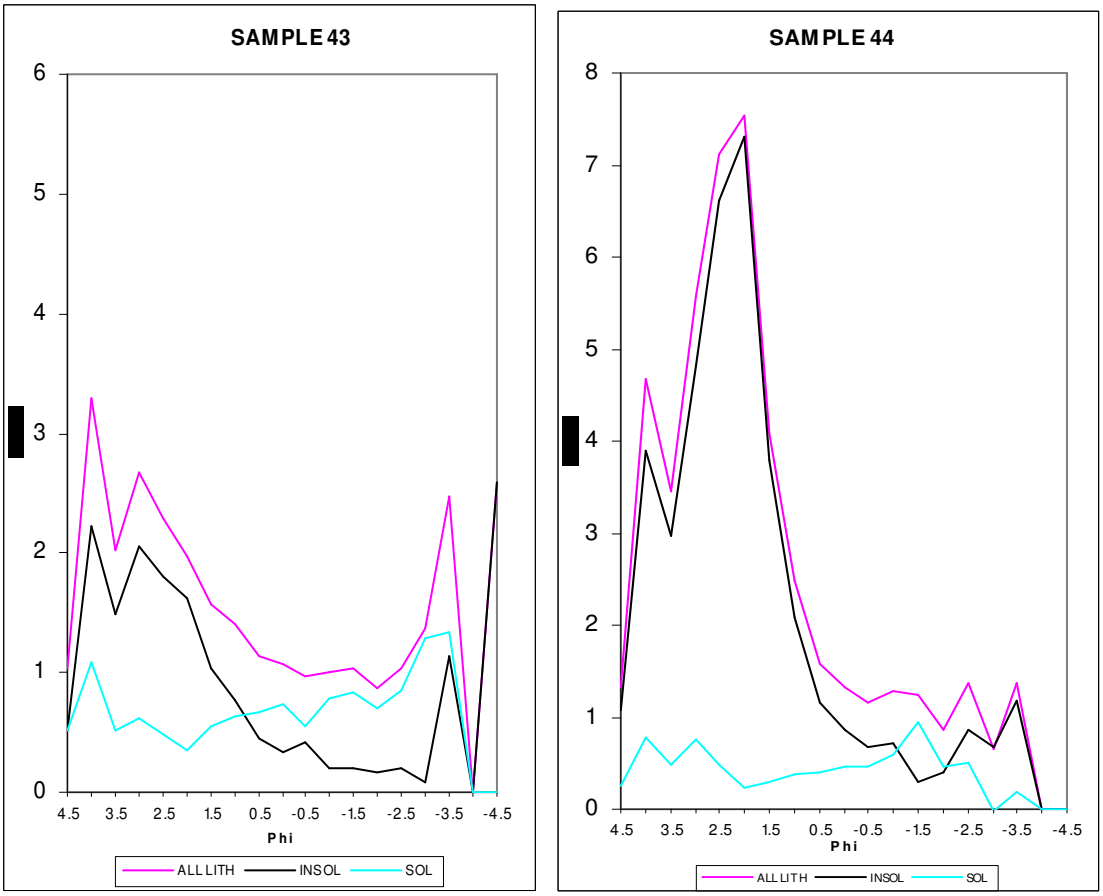


Figure 5.68. Particle size data for Samples 43 & 44.

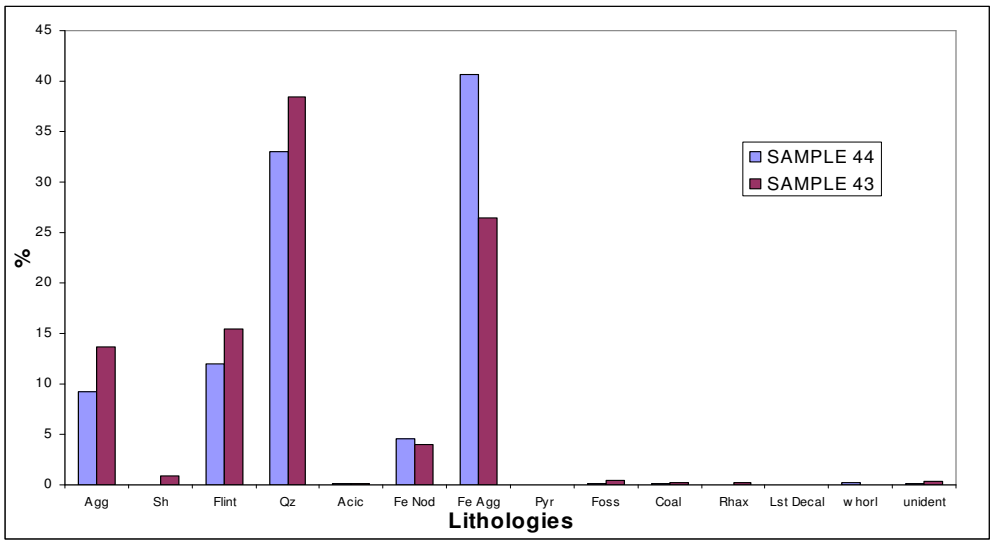


Figure 5.69. Small clast lithology data for Site 18, Warden Street.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

5.4. Sites 19 & 20

These sites are situated on low ground to the southeast of Biggleswade where the till plateau descends into the Ivel Valley. Table 5.3 gives details of BGS boreholes referred to in the following text and summary details of these sites are shown in Table 5.4.

Till in this area is reported to be of considerable depth, reaching almost 30 m in borehole TL24SW28 a kilometre to the southeast of Site 19. A series of boreholes at Dunton pumping station (TL241447) recorded till 10 - 16 m thick above the Gault bedrock. The log of the northernmost of these boreholes (TL24SW24) records almost 30 m of till, but an anonymous annotation on the log held by the BGS casts doubt on its reliability, although there is mention of the Gault dropping away here into a buried channel, the Hatley Channel of Edmonds & Dinham (1965) (see Section 3.8.5).

The drift thins rapidly to the east and a public well at Hinxworth (TL24SW32) penetrated only 2.7 m of drift overlying the Gault.

Site 19 (Edworth) (TL2217 4178) is located at the margin of a field, approximately 210 m from the Edworth to Dunton Road and lying approximately 1.7 km south of **Site 20 (Millowbury Farm)** (TL2277 4300). The latter is situated at the top of a hill beside the road and opposite the entrance to Millowbury Farm. The farm itself is approximately 0.5 km east of the road at the bottom of a steep incline, where Chalk bedrock lay within 0.5 m of the surface.

Borehole data shows till in the Edworth area to be approximately 30 m thick and there is evidence of at least one glacially transported mass incorporated into the till at Edworth (TL222412), described in Chapter 3.

Tills at both of these sites have high small clast flint contents, at 21.6% at Site 19 and 20.3% to 24.5% at Site 20 (Figures 5.71 & 5.73). Large quantities of acid-soluble lithologies are also present - amounts measured in the -1.0 to +4.0 phi fraction being 9.8% at Site 19 and 10.7% - 11.5% at Site 20 (Figures 5.70 & 5.72). At Edworth (Site 19) these lithologies appear to be concentrated in the

larger size fractions (above +1.0 phi), whereas at Site 20 they form a prominent mode at approximately +3.7 phi in the fine sand fraction.

Borehole name	BGS Number	Grid Ref
Pumping Station, Dunton	TL24SW24	TL2416 4481
Pumping Station,. Dunton Water Board	TL24SW28	TL2100 4100
Hinxworth, Hitchin	TL24SW32	TL2350 4020

Table 5.3. Details of BGS Boreholes referred to in text.

Site Nbr	Location	Grid Ref	Ground Level	Sample Number
19	**Edworth**	TL2217 4178	45 m O.D.	45
20	**Millowbury Farm**	TL2277 4300	55 m O..D.	46 & 47

Table 5.4. Summary details of Sites 19 & 20.

SITE 19 - SAMPLE DETAILS

EDWORTH	
Sample Number	**45**
Height	43.5 m O.D.
Sample Type	Auger
Colour	2.5Y 5/4 Light olive brown

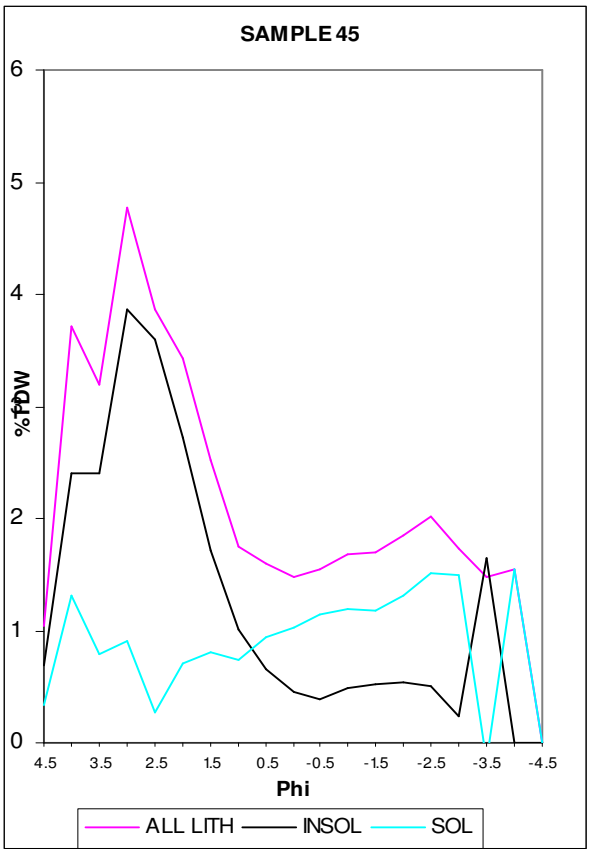


Figure 5.70. Particle size data for Sample 45.

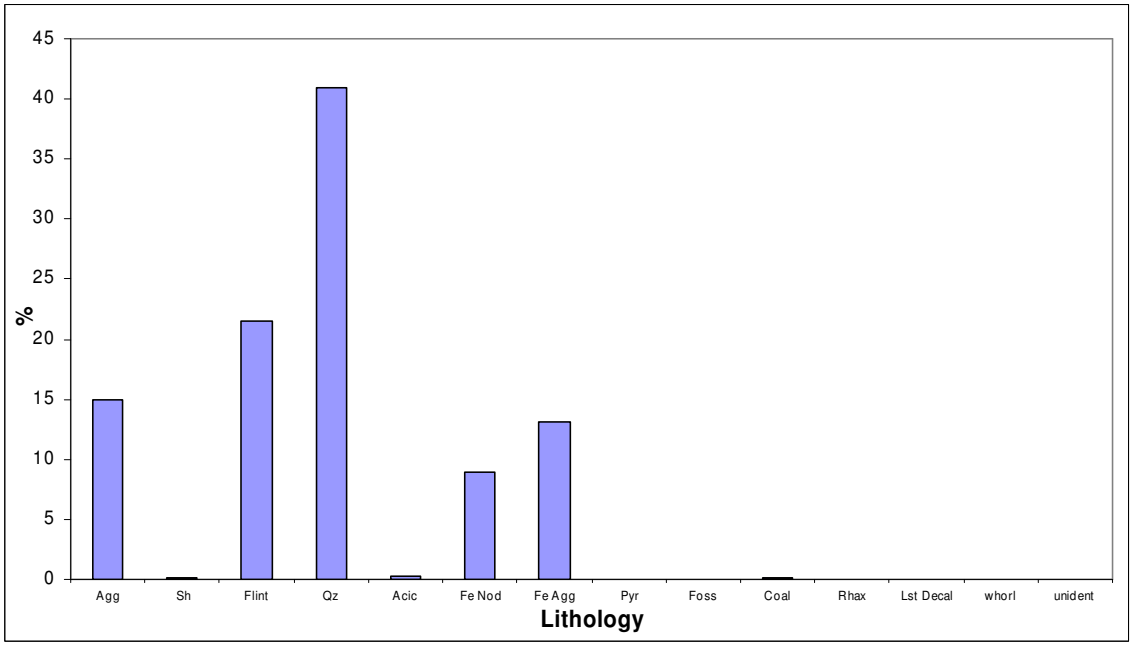


Figure 5.71. Small clast lithology data for Site 19, Edworth.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 20 - SAMPLE DETAILS

MILLOWBURY FARM		
Sample Number	**46**	**47**
Height	53.5 m O.D.	53.0 m O.D.
Sample Type	Auger	Auger
Colour	10YR 6/6 Brownish yellow	10YR 6/6 Brownish yellow

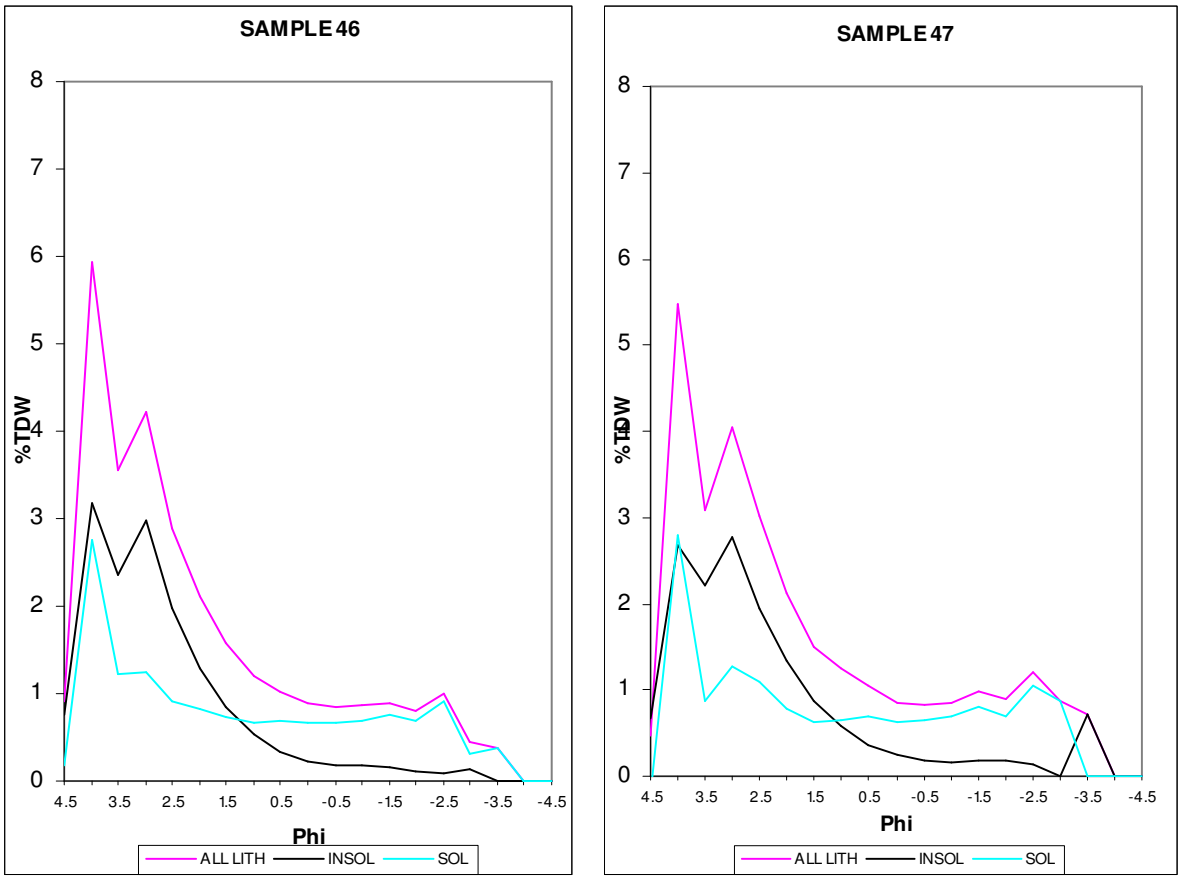


Figure 5.72. Particle size data for Samples 46 & 47.

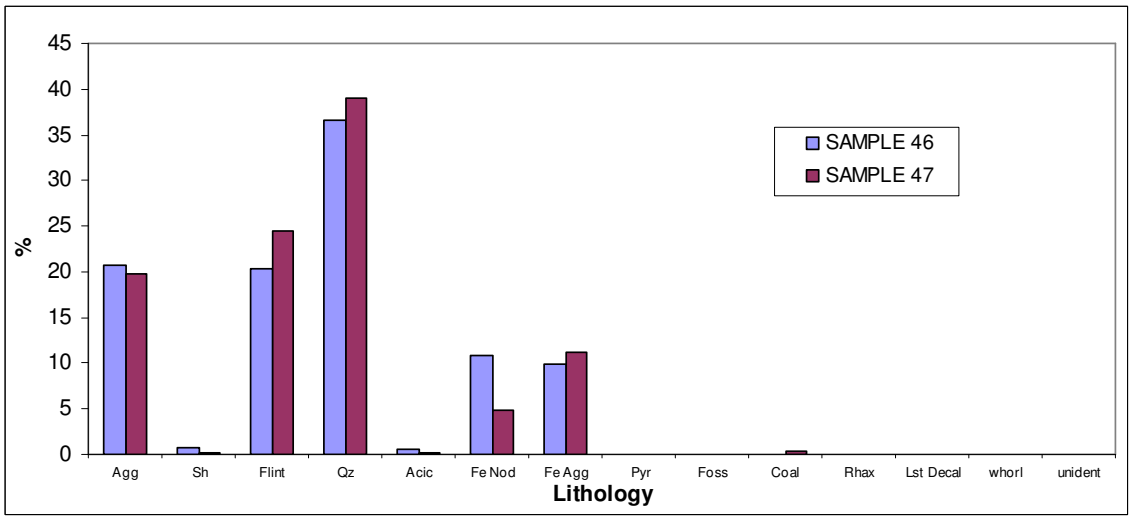


Figure 5.73. Small clast lithology data for Site 20, Millowbury Farm.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

5.5. Sites on & adjacent to the Northeastern Plateau (Sites 21 -26)

Sites 21 to 24 lie close to 75 m O.D. within the largest continuous spread of till present within the study area (Figure 5.74). However, the flat character of the surface topography is not reflected in the bedrock surface (Section 2.3). Site 25 lies at a lower elevation where the land surface descends into the Bourn Brook. Site 26 also lies at a lower elevation in the extreme south of the plateau where there is a sharp descent from 75 to 50 m O.D. The edge of the till outcrop is within 2 km of this site, where it meets the Gault at approximately 35 m O.D.

Table 5.5 gives details of BGS boreholes referred to in the following text and summary details of the sample Sites 21 to 26 are given in Table 5.6.

Site 21 (Potton) (TL2463 4950) lies on the western edge of the plateau, 1.8 km east of the village of Potton, which lies directly on Woburn Sands at less than 49 m O.D. Till thickness on this side of the plateau is uncertain but a borehole adjacent to Site 21 (TL24NW5) shows it reaches at least 6 m. The sample here was obtained at the edge of a field beside Potton water tower.

A further kilometre to the east at Cockayne Hatley, two boreholes (TL24NE1 and TL24NE2) record 25.3 m and 24.0 m of till respectively, overlying the Gault bedrock at *c.*40 m O.D. **Site 22 (Cockayne Hatley)** (TL2558 4969) is located next to the church. The macrofabric from this site (Figure 5.77) is the only fabric obtained from the Northeast Plateau. A fabric of moderate strength indicated a clast preferred orientation in a northwest-southeasterly direction. Clast dips are extremely variable ranging between 0^{o} and 70^{o} with an average of 24^{o}. The prominent mode at -3.5 phi in the particle size distribution of this till is probably due to the inclusion of a few large clasts of chalk.

The bedrock surface slopes eastwards - at Hatley Park (TL25SE3) 41 m of till extends down to 32 m O.D. and at Hatley St George (TL25SE7) Gault occurs at 27 m O.D. At the site of a former public well at East Hatley (TL25SE6) records dating to 1934 note 67 m of till, which is probably one of the deepest sections of till on this plateau. No detailed descriptions of these deposits are given and it is possible that confusion may have arisen due to the similar appearance of the till and Gault. However, to the northeast, a borehole near Longstowe (TL35SW5)

records drift to a depth of 57 m. Edmonds & Dinham (1965) believe this considerable depth of drift to relate to a buried channel (the Hatley Channel) (Chapter 3).

Site 23 (Hatley) (TL3058 4932) lies close to one of the highest points on this plateau - Croydon Hill Farm at 82 m O.D. The site, in a field approximately 350 m north of the High Street, is situated less than 1 km from the edge of the plateau where till continues to just below 70 m O.D., giving way to a small outcrop of the West Melbury Marly Chalk Member before the Gault plain is reached at approximately 21 m O.D. This sample contained a high percentage of flint clasts (24.4%) in the -1.0 to +1.0 phi fraction.

At **Site 24 (Longstowe)** (TL2975 5380) a sample of stiff, mid to dark grey till was obtained from a drainage ditch on the B1046 road, approximately 300 m east of the water tower at Longstowe.

The particle size distributions from Sites 21 to 24, shown in Figures 5.75, 5.77, 5.79 and 5.81 show these tills possess a primary mode in the very fine sand range at +4.0 phi. A smaller mode lies between +2.5 and +3.0 phi. The acid-soluble contents of these samples all lie within the range 5.9 to 7.3% and the ratios of total flint/quartz in the -1.0 to + 1.0 phi fraction vary between 0.105 and 0.201. Quantities of iron lithologies (combined nodules and aggregates) are similar for Site 21 (Figure 5.76), Site 22 (Figure 5.78) and Site 24 (Figure 5.82) at approximately 23%, but are only 12.2% at Site 23 (Hatley).

In the extreme northeast of the study area, the land descends into the Bourn Brook. At **Site 25 (Caxton**) (TL3073 5806) on the Caxton by-pass five samples were taken at half metre intervals from the homogeneous chalky till. Engineering reports prepared by Geotechnics record approximately 10 m of till resting on Lower Greensand at ~41 m O.D. This is confirmed by a borehole record 700 m to the southeast at Caxton Kennels (TL35NW12), where the Lower Greensand occurs at 38.4 m O.D. The till thins to approximately 7 m to the west at TL35NW2 where the bedrock rises to 42.5 m O.D.

Particle size distributions of all the samples from Site 25 are remarkably consistent, with primary modes at +3.0 phi and a further strong mode at +4.0 phi (Figures 5.83 to 5.85). Ratios of total flint/quartz in the -1.0 to +1.0 phi fraction from this site vary from 0.059 to 0.112 and quantities of iron lithologies (combined nodules and aggregates) are higher in the lower two samples (Figure 5.86). Values of acid-soluble lithologies in the -1.0 to +4.0 phi fraction are between 5.5 and 6.5%.

Site 26 (Wrestlingworth) (TL2568 4838) is located at the edge of a small stream at a field margin approximately 50 m from the Wrestlingworth to Hatley road. This lies on the southern edge of the Northeastern Plateau, at a height of 51 m O.D. The particle size distribution is quite different from others in this region, having larger amounts of fine sand (Figure 5.87). This may be attributed to the inclusion of alluvium from the adjacent stream when sampling. Figure 5.88 shows this sample possesses a high concentration of iron aggregates.

Borehole name	BGS Number	Grid Ref
Biggleswade Water Board	TL24NW5	TL2474 4945
Cockayne Hatley	TL24NE1	TL2565 4975
Cockayne Hatley House	TL24NE2	TL2544 4976
Hatley Park, Hatley St George	TL24SE3	TL2749 5096
Public well, East Hatley	TL25SE6	TL2873 5060
Hall Farm, Great Gransden	TL25NE6	TL2663 5590
Pumping station Hatley St George	TL25SE7	TL2783 5113
Caxton by-pass 302, Caxton	TL35NW2	TL3023 5790
Caxton kennels, Caxton	TL35NW12	TL3050 5740
New wind pump, Longstowe	TL35SW5	TL3069 5318

Table 5.5 Details of BGS boreholes referred to in text.

Site Nbr	Location	Grid Ref	Ground Level	Sample Number
21	**Potton**	TL 2463 4950	77.5 m O.D	48
22	**Cockayne Hatley**	TL 2558 4969	75.0 m O.D.	49
23	**Hatley**	TL 3058 4932	78.0 m O.D	50
24	**Longstowe**	TL 2975 5370	77.0 m O.D.	51
25	**Caxton by-pass**	TL 3073 5806	54.1 m O.D.	52-56
26	**Wrestlingworth**	TL 2568 4838	51.0 m O.D.	57

Table 5.6. Summary details of Sites 21 to 26

1 Site Locations (Site Number).

TL14SW3

10 Location of BGS registered boreholes. Depth of drift deposits given in metres below ground level.

(50 m contour shown)

Key to Figure 5.74.

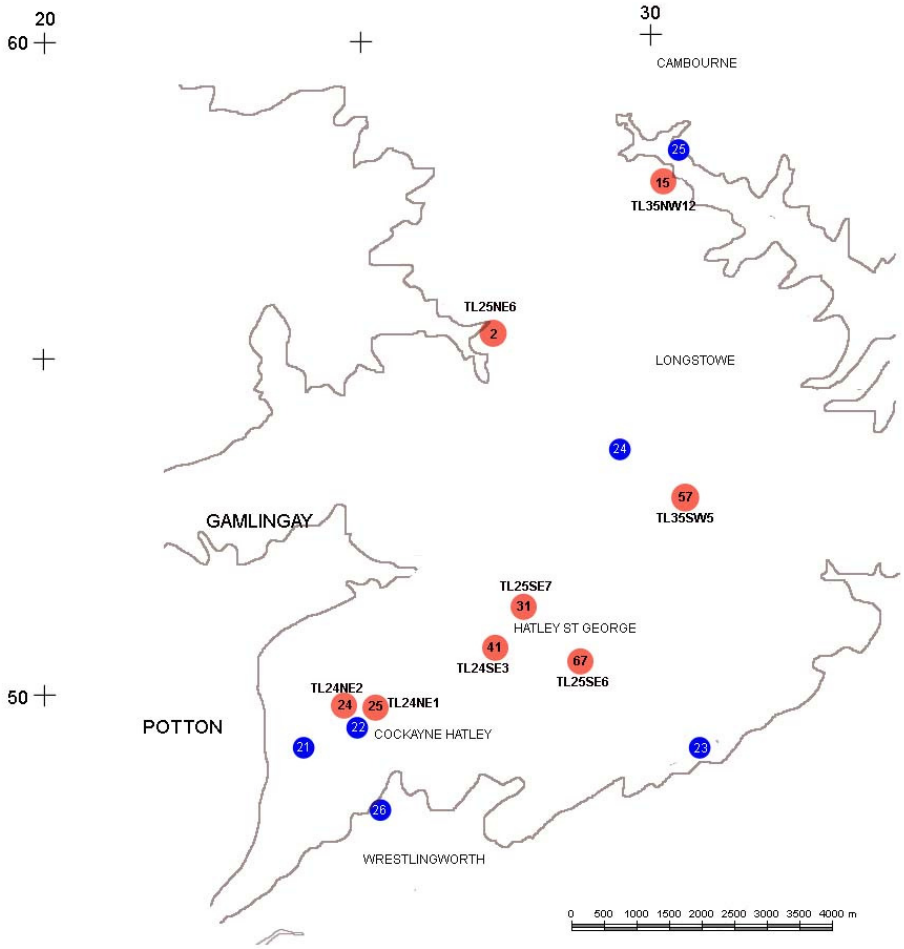


Figure 5.74. Locations of Sites 21 to 26 & boreholes mentioned in the text.

SITE 21 - SAMPLE DETAILS

POTTON	
Sample Number	**48**
Height	76.0 m O.D.
Sample Type	Auger
Colour	10YR 4/3 Dark brown

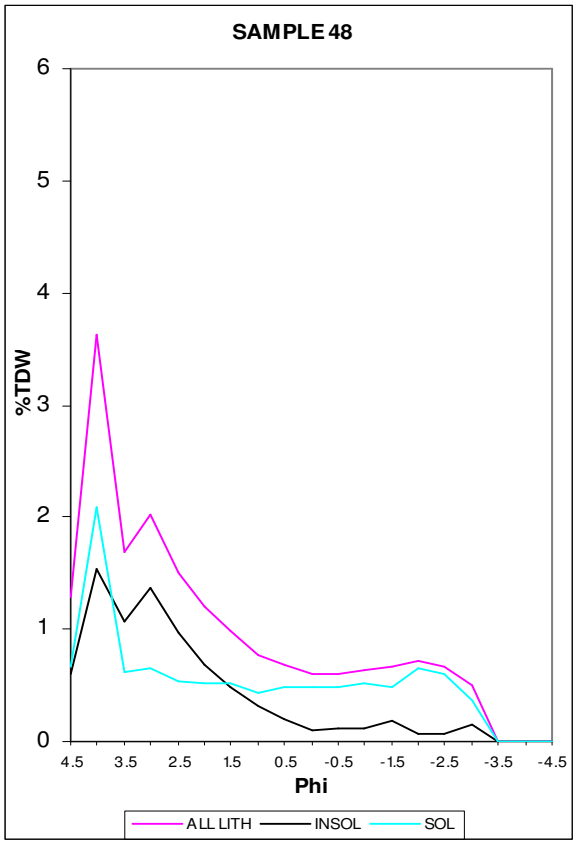


Figure 5.75. Particle size data for Sample 48.

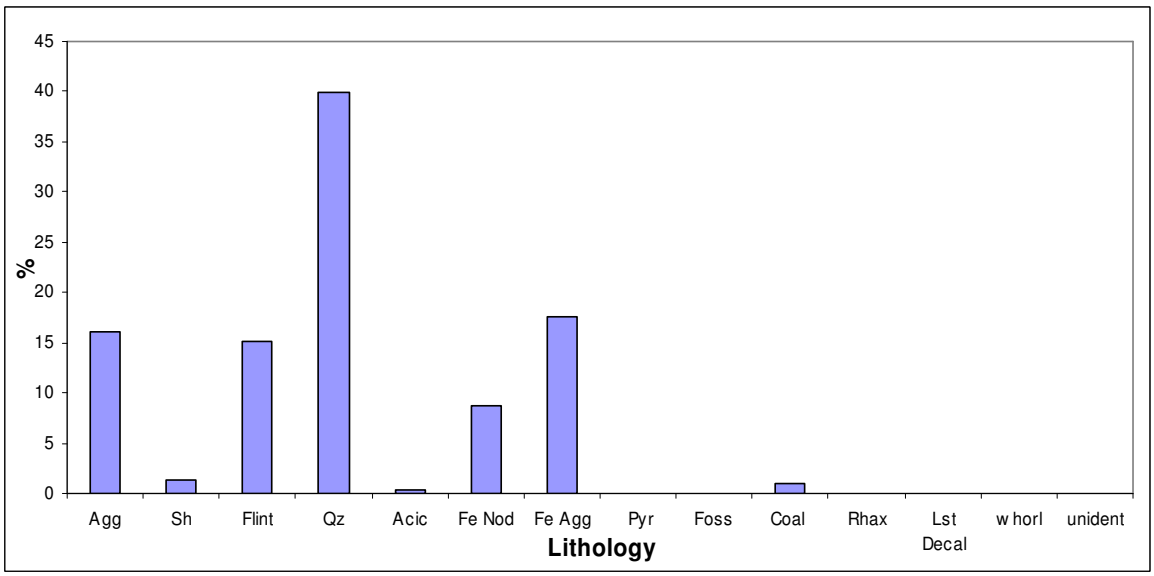
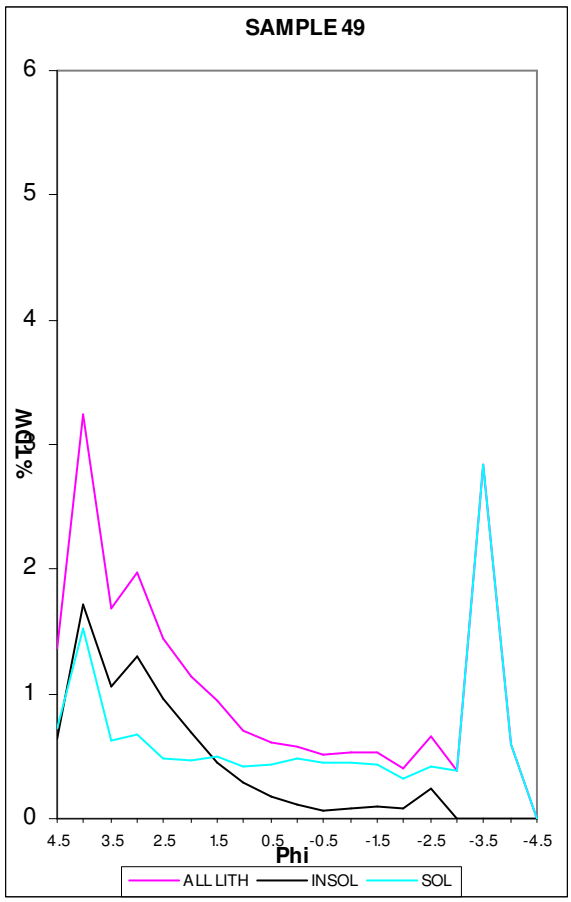
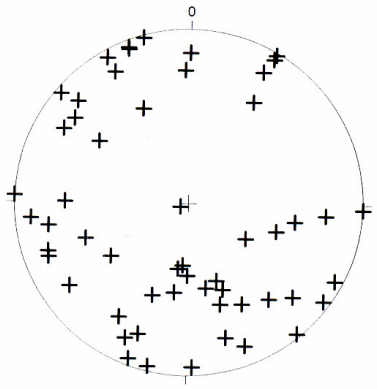


Figure 5.76. Small clast lithology data for Site 21, Potton.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 22 - SAMPLE DETAILS

COCKAYNE HATLEY	
Sample Number	**49**
Height	73.5 m O.D.
Sample Type	Auger
Colour	2.5Y 5/4 Light olive brown





Macrofabric data for Sample 49.	
Number in sample	55
Resultant vector	162/342°
Vector magnitude	24.0%
Significance	>95% (Significant)
Mean dip	24°

Figure 5.77. Particle size and macrofabric data for Sample 49.

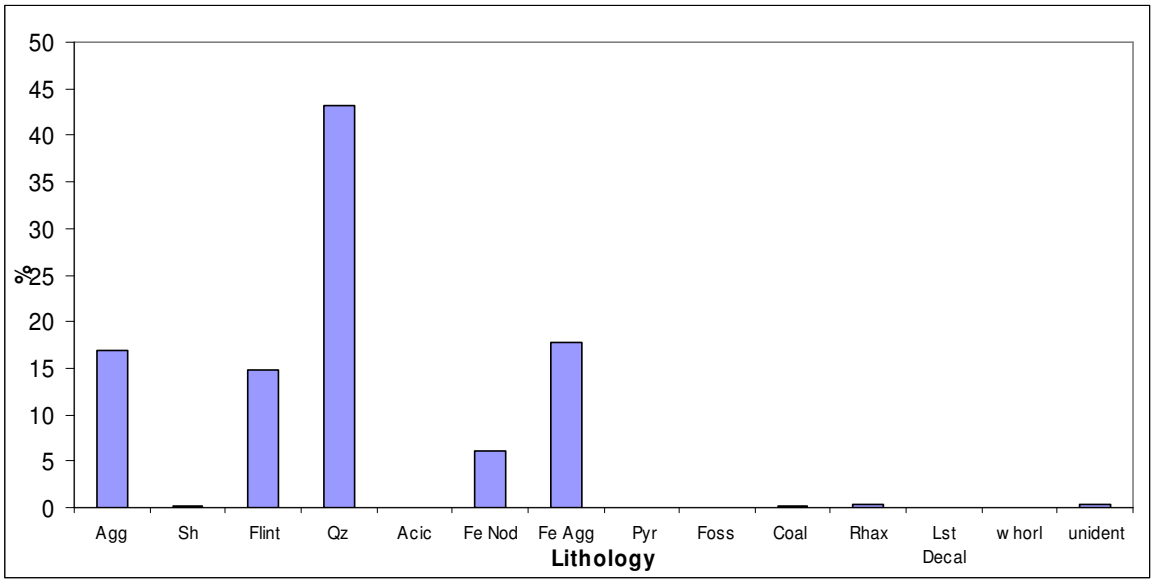


Figure 5.78. Small clast lithology data for Site 22, Cockayne Hatley.

(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 23 – SAMPLE DETAILS

HATLEY	
Sample Number	**50**
Height	76.5 m O.D.
Sample Type	Auger
Colour	10YR 6/6 Brownish yellow

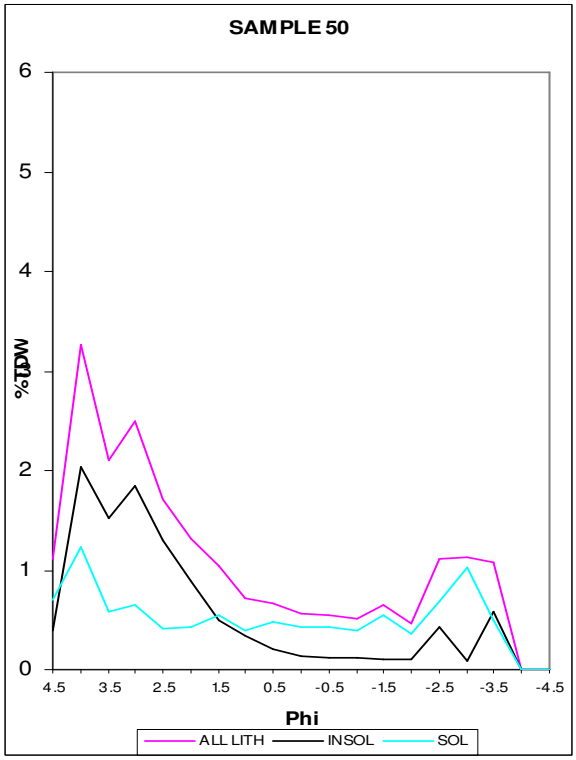


Figure 5.79. Particle size data for Sample 50.

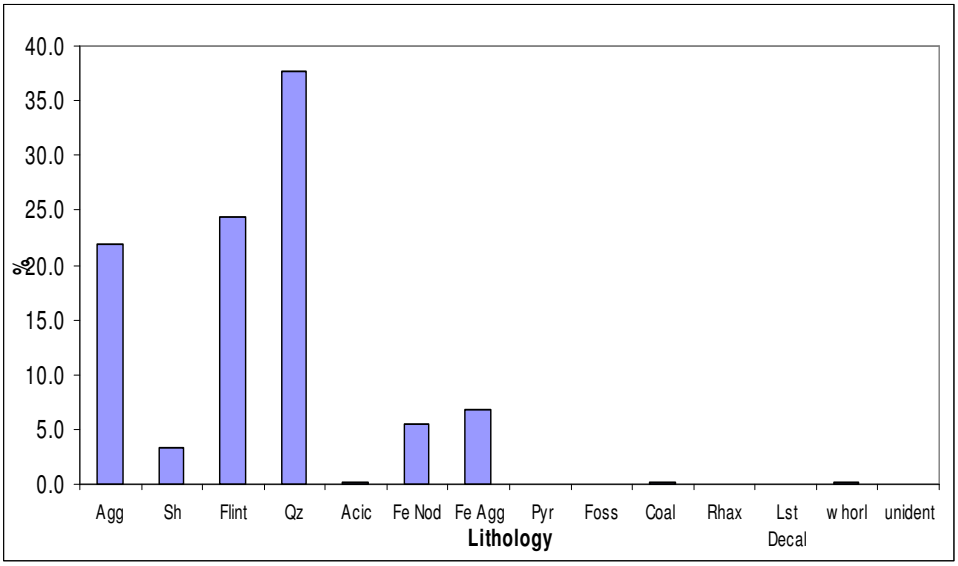


Figure 5.80. Small clast lithology data for Site 23, Hatley.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 24 - SAMPLE DETAILS

LONGSTOWE	
Sample Number	**51**
Height	75.3 m O.D.
Sample Type	Auger
Colour	2.5YR5/4 Dark grey to 10YR5/1 Grey.

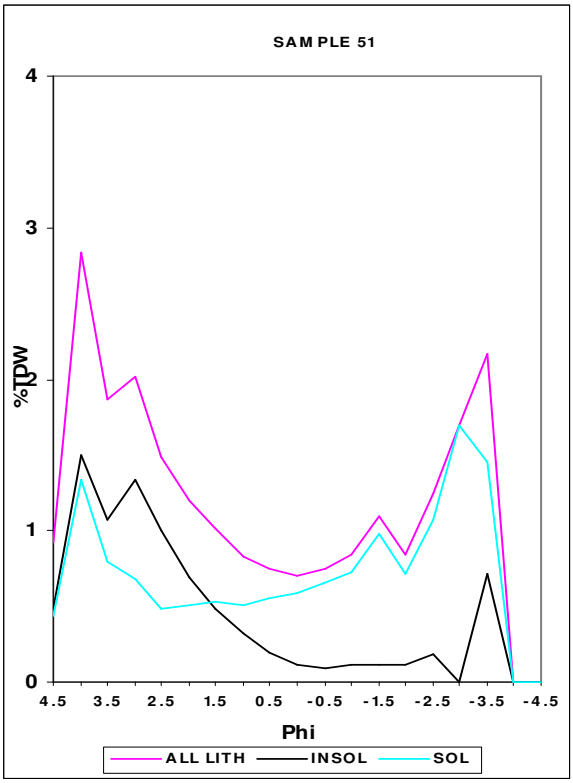


Figure 5.81. Particle size data for Sample 51.

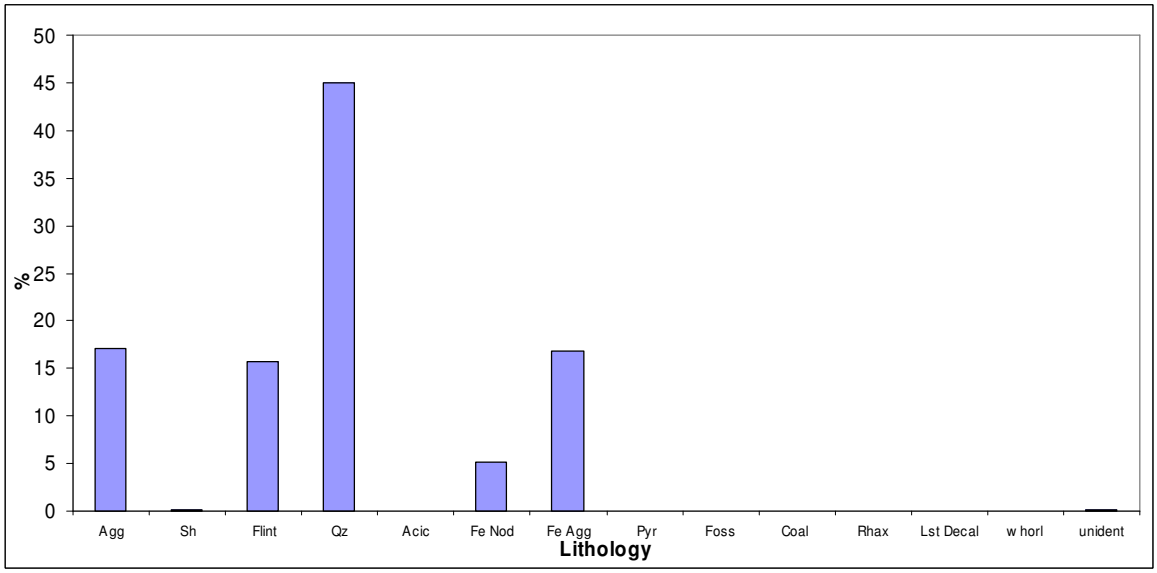


Figure 5.82. Small clast lithology data for Site 24, Longstowe.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

CAXTON		
Sample Number	**52**	**53**
Height	51.4 m O.D.	51.9 m O.D.
Sample Type	Bulk	Bulk
Colour	10YR 3/2 Very dark greyish brown	10YR 5/1 Grey to 10YR 5/6 Yellowish brown

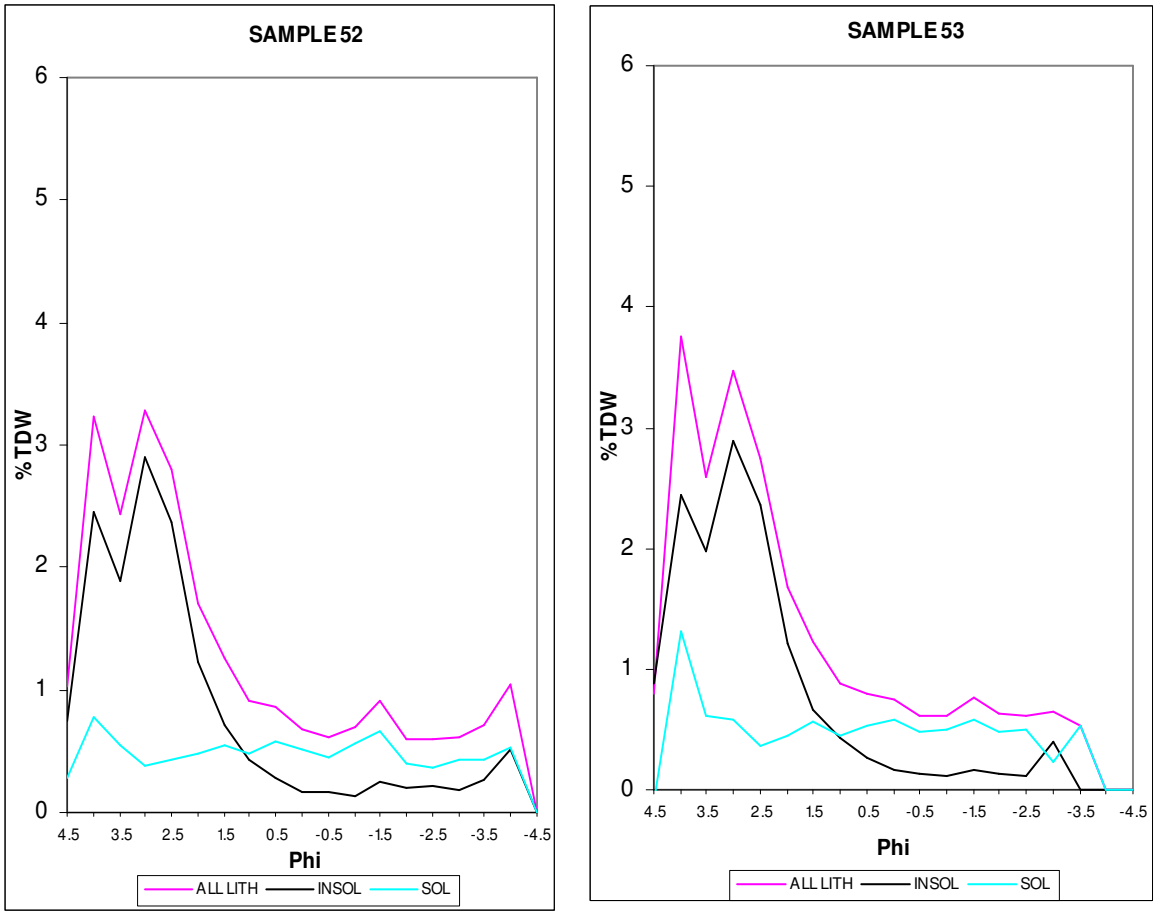


Figure 5.83. Particle size data for Samples 52 & 53.

SITE 25 - SAMPLE DETAILS

CAXTON		
Sample Number	**54**	**55**
Height	52.4 m O.D	52.9 m O.D.
Sample Type	Bulk	Bulk
Colour	10YR 4/2 Dark greyish brown	10YR5/1 Grey to 10YR4/2 Dark greyish brown

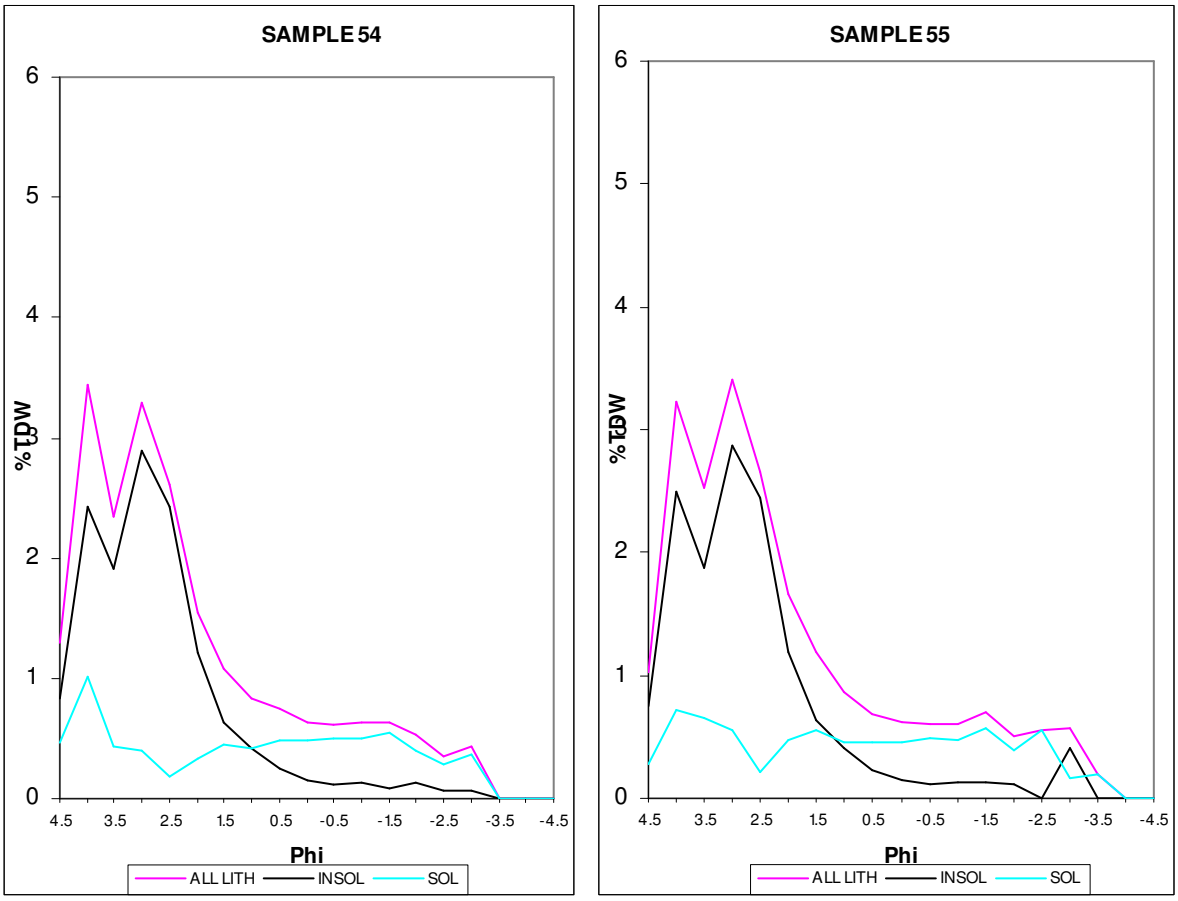


Figure 5.84. Particle size data for Samples 54 & 55.

CAXTON	
Sample Number	**56**
Height	53.4 m O.D.
Sample Type	Bulk
Colour	10YR 4/2 Dark greyish brown

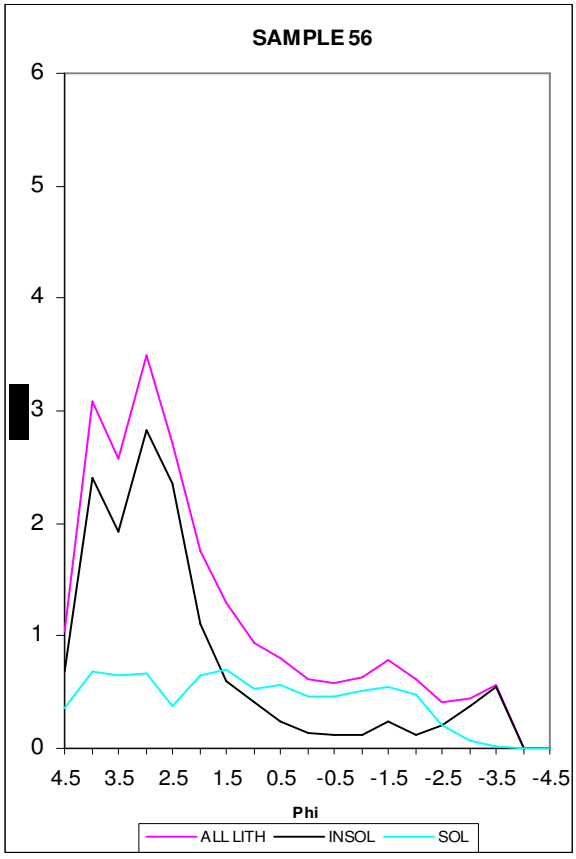


Figure 5.85. Particle size data for Sample 56.

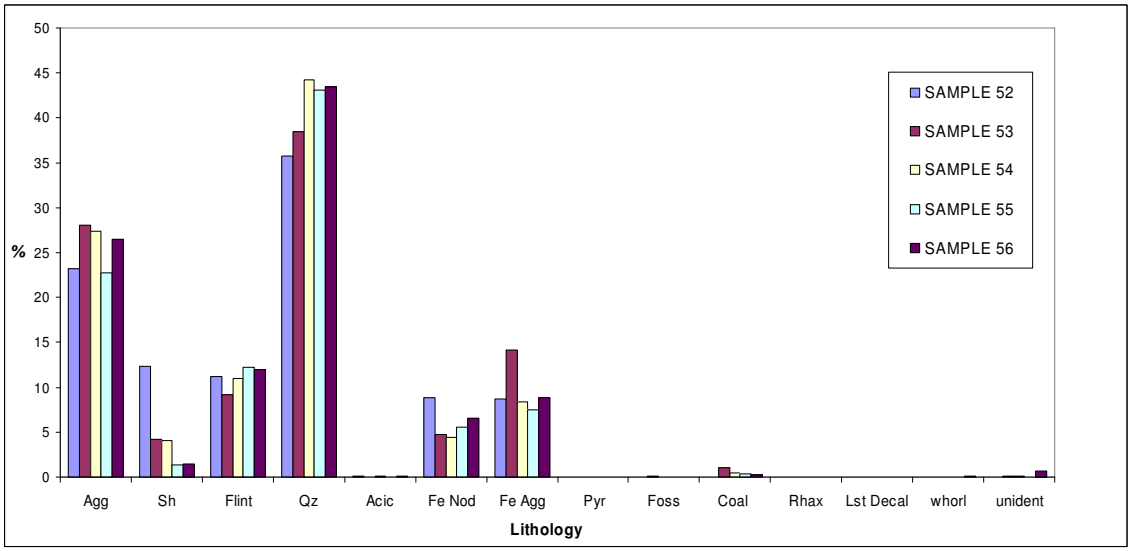


Figure 5.86 Small clast lithology data for Site 25, Caxton.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 26 - SAMPLE DETAILS

WRESTLINGWORTH	
Sample Number	**57**
Height	49.4 m O.D.
Sample Type	Bulk
Colour	10YR 5/6 Yellowish brown

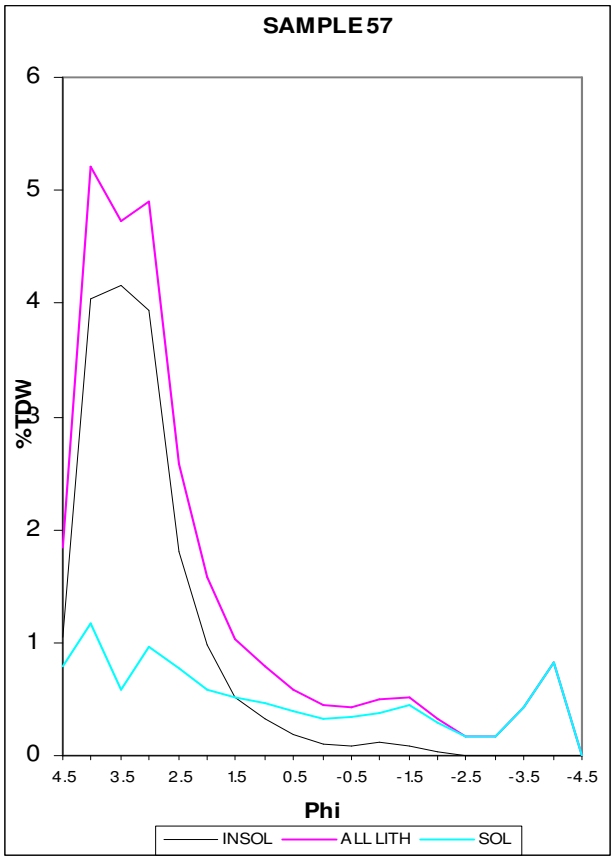


Figure 5.87. Particle Size data for Sample 57.

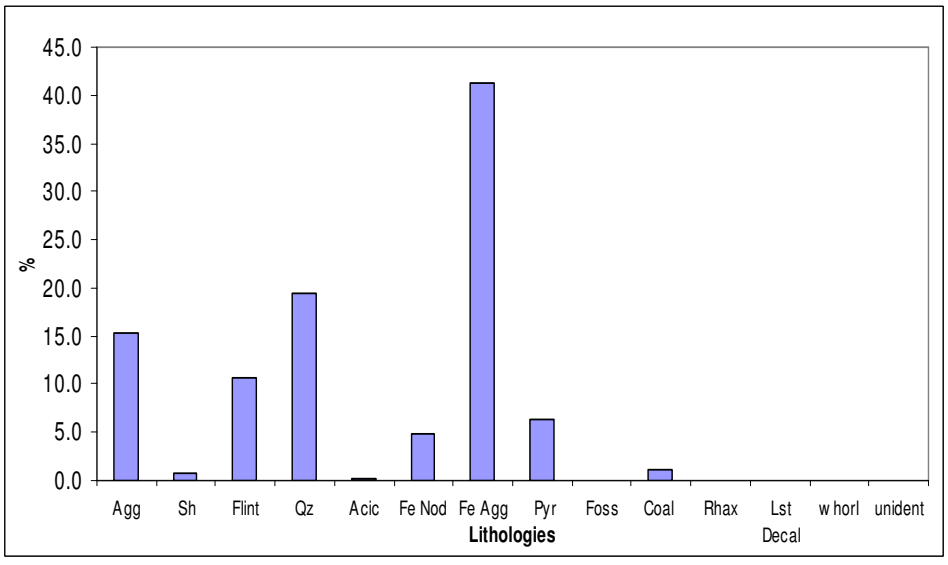


Figure 5.88. Small clast lithology data for Site 26, Wrestlingworth.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

5.6. Sites in the west of the study area (Sites 27 - 30).

Sites 27 to 30 lie on an outcrop of till on high ground stretching from Toddington in the east to Great Brickhill in the west. Summary details are given in Table 5.7.

Milton Bryan (Site 27) (SP9770 3045) occupies a central position in this outcrop, lying at 137 m O.D. Here, two samples were augered from heights of 132.9 m O.D. (sample 58) and 133.6 m (sample 59). Particle size distributions show primary modes in the fine sand fraction, between +2.0 and +2.5 phi, with a much smaller mode at +4.0 phi (Figure 5.89). Both of these tills also possess modes in the -3.0 phi medium/fine gravel fraction, although a good deal of sediment here is made up of acid-soluble lithologies. The small clast lithology is very similar for the two samples (Figure 5.90), with ratios of total flint/quartz in the -1.0 to + 1.0 phi fraction of between 0.041 and 0.048. A very weak macrofabric is evident at this site, with no statistically significant alignment of clasts. Dips range from 5 ^{o} to 80 ^{o} but include a high number between 5 ^{o} and 10 ^{o} giving an average of 24^{o}.

Lenticular bodies of gravelly sand are reported within the till in the vicinity of Sites 27 and 28 (Shephard-Thorn *et. al.,* 1994). Adjacent to **Site 28 (Potsgrove)** (SP9410 3069**)**, a BGS borehole log (SP93SW256 at SP941307) provides a detailed description of 4 m of till underlain by 2.6 m of gravel. Below this is a 5.8 m thick layer of silty clay and several thin bands (<1 m thick) of sand, gravel and clay; Lower Cretaceous deposits reached at approximately 15 m depth. However, a water well at Woburn Park (SP965313) approximately 2.5 km ENE of Site 28, proved over 32 m of drift.

The two samples, augered from heights of 123.4 and 123.0 m O.D. at Site 28 possess distinctive particle size characteristics, with sharply defined primary modes at +2.5 phi and secondary modes at +4.0 phi. Figures 5.90 and 5.92 show similar ratios between small clast lithologies for samples at Sites 27 and 28.

At **Mundays Hill (Site 29**) (SP9362 2800) 6 m of till was proved in borehole SP92NW167 (at SP940280). However, at the time of writing only a small outcrop (less than 1.5 m thick) was seen. The sample was extracted from the northwest facing section above the worked-out quarry. This again shows a primary mode at between + 2.0 and +2.5 phi (Figure 5.93). Also evident are large quantities of iron nodules and iron aggregates, probably incorporated from the Lower Greensand (Figure 5.94).

Figure 5.95 is a schematic representation of sample locations at **Heath and Reach (Site 30)** (SP9314 2916). A stony layer (Plate 5.3c) can be seen above the lowest sample. Iron staining is apparent to the upper layers of the till – as shown in Plate 5.3b. A small drift-filled channel was once present in the Woburn Sands in this quarry (Chapter 3), apparently infilled with 10 m of till overlying 6 m of sand and gravel (Shephard-Thorn *et al.,* 1994). At the time of writing no evidence remains of this channel. However, almost 14 m of till is present on the northeastern face of this quarry directly overlying the Gault. This would appear to represent the maximum thickness of till reported in surrounding gravel pits, a similar depth being found at Reach Lane Pit at SP933284.

Lithologies found within the till at this site include Red Chalk, a metamorphic (chloritic) rock considered to have originated in the Charnwood area and Triassic sandstone (Perkins, pers. comm.), together with examples of *Gryphaea dilatata* (J. Sowerby) from the Upper Jurassic and *Gryphaea arcuata* (Lamarck) from Lower Jurassic (Plate 5.4) and numerous belemnites.

Figures 5.99 to 5.101 show well defined peaks at +2.5 phi in the particle size distributions of the top three samples (66, 67 and 68). Much broader modes are seen in the lower samples (63 - 65), however, with decreasing amounts in the +1.5 to +4.5 phi fraction (Figures 5.96 - 5.98). Ratios of total flint/quartz in the -1.0 to + 1.0 phi fraction vary, lying between 0.034 and 0.44. Amounts of flint are small in these samples, the maximum being 4.69% in Sample 68. This sample also exhibits the highest content (21%) of iron lithologies (nodules and aggregates combined).

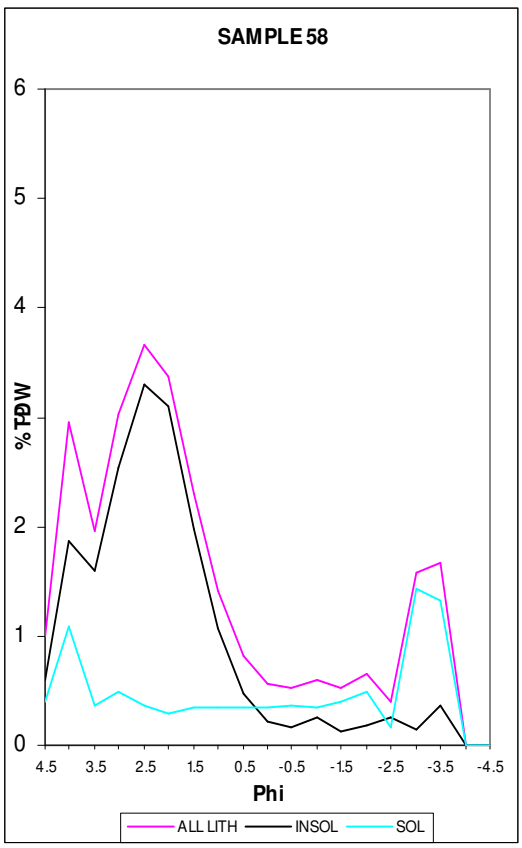
A strong macrofabric is present in the upper five samples in this sequence (Figures 5.97 – 5.101), clast 'a'- axes being consistently aligned in an ENE/WSW direction. Clasts are arranged more randomly in the lowest sample with no statistically significant orientation.

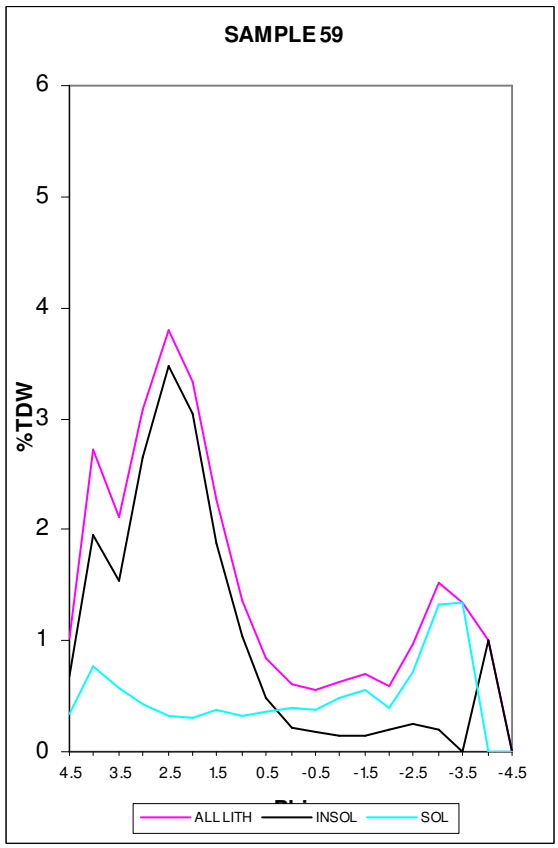
Site Nbr	Location	Grid Ref	Ground Level	Sample I.D.
27	**Milton Bryan**	SP9770 3045	135 m O.D.	58 & 59
28	**Potsgrove**	SP9410 3069	125 m O.D.	60 & 61
29	**Mundays Hill Quarry**, Eastern Way, Heath & Reach.	SP9362 2800	135 m O.D.	62
30	**Stone Lane Quarry,** Heath & Reach.	SP9314 2916	143 m O.D.	63-68

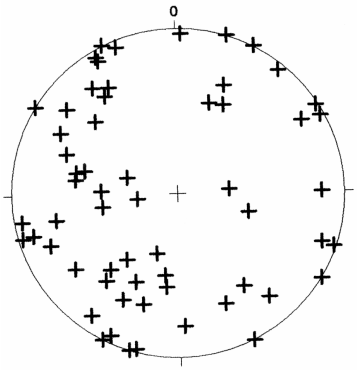
Table 5.7. Summary details for Sites 27 – 30.

SITE 27 SAMPLE DETAILS

MILTON BRYAN		
Sample Sample	**58**	**59**
Height	132.9 m O.D.	133.6 m O.D.
Sample Type	Auger	Auger
Colour	2.5Y 4/4 Olive brown	2.5Y 4/2 Dark greyish brown







Macrofabric data for Sample 58	
Number in sample	57
Resultant vector	061°/241°
Vector magnitude	9.0%
Significance	Not Significant
Mean dip	24°

Figure 5.89. Particle size data for Samples 58 & 59 and macrofabric data for Sample 58.

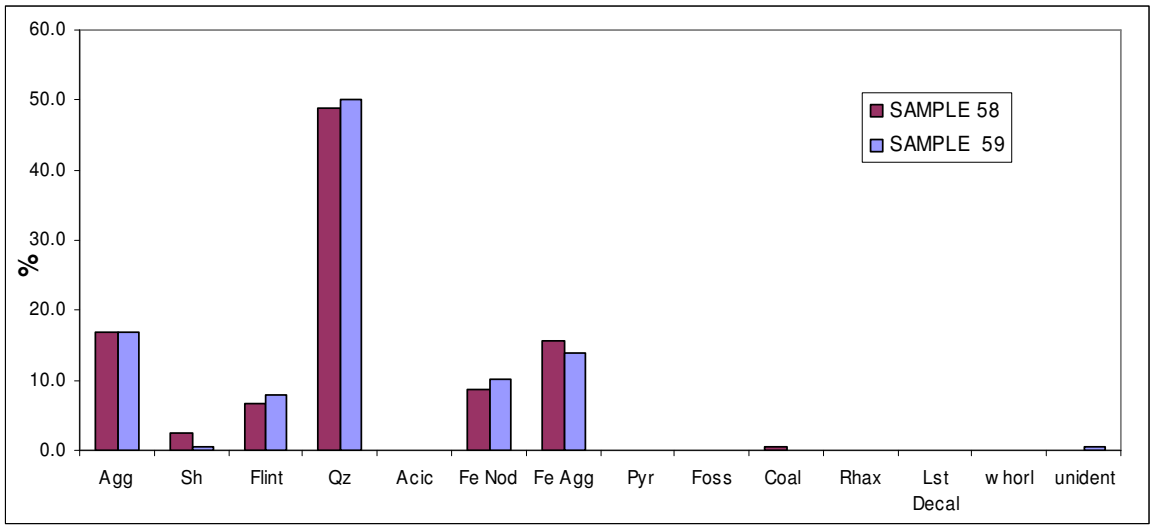


Figure 5.90. Small clast lithology data for Site 27, Milton Bryan.

(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 28 - SAMPLE DETAILS

POTSGROVE		
Sample Number	**60**	**61**
Height	123.0 m O.D.	123.4 m O.D.
Sample Type	Auger	Auger
Colour	10YR 3/2 Very dark greyish brown	10YR 3/3 Dark brown

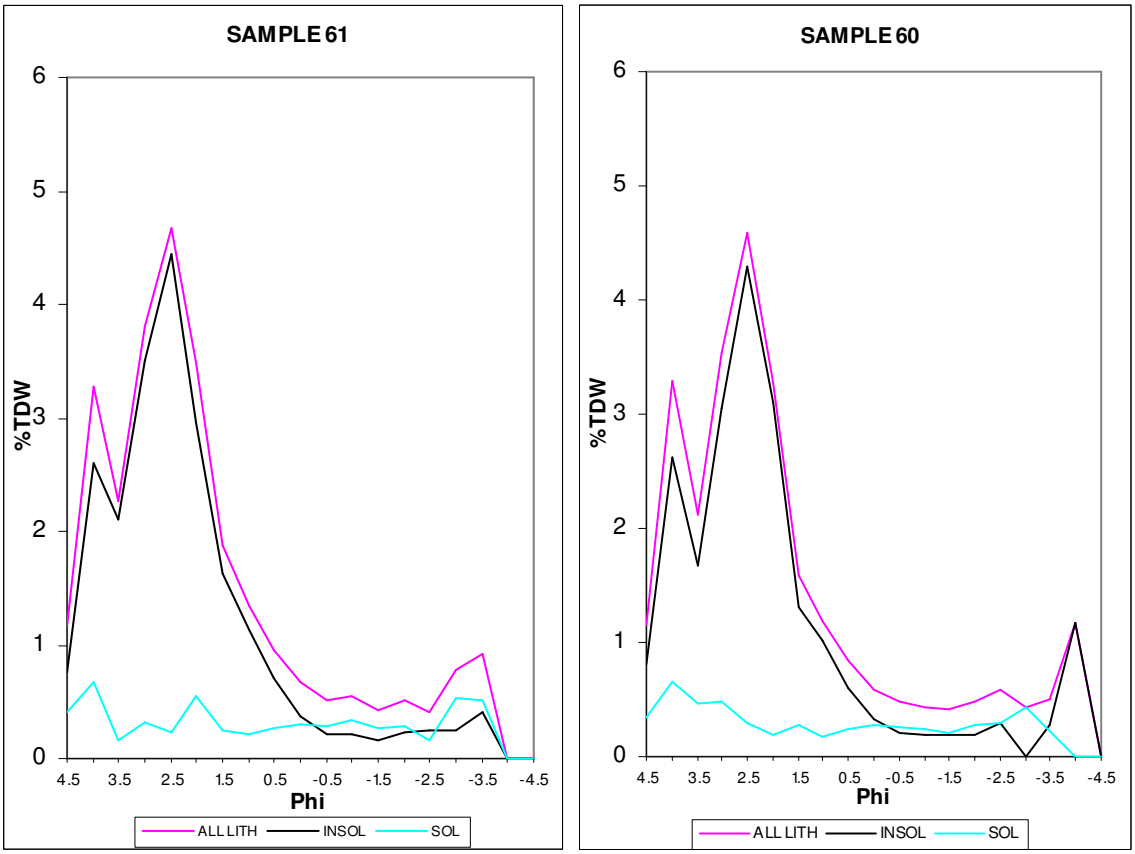


Figure 5.91. Particle size data for Samples 60 & 61.

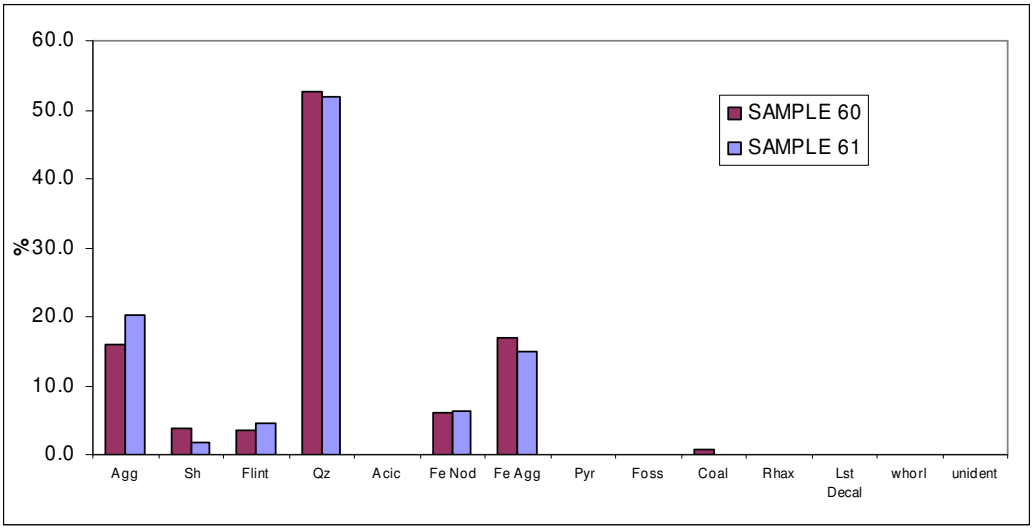


Figure 5.92. Small clast lithology data for Site 28, Potsgrove.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 29 - SAMPLE DETAILS

MUNDAY'S HILL	
Sample Number	62
Height	134.0 m O.D.
Sample Type	Bulk
Colour	10YR 3/2 Very dark greyish brown

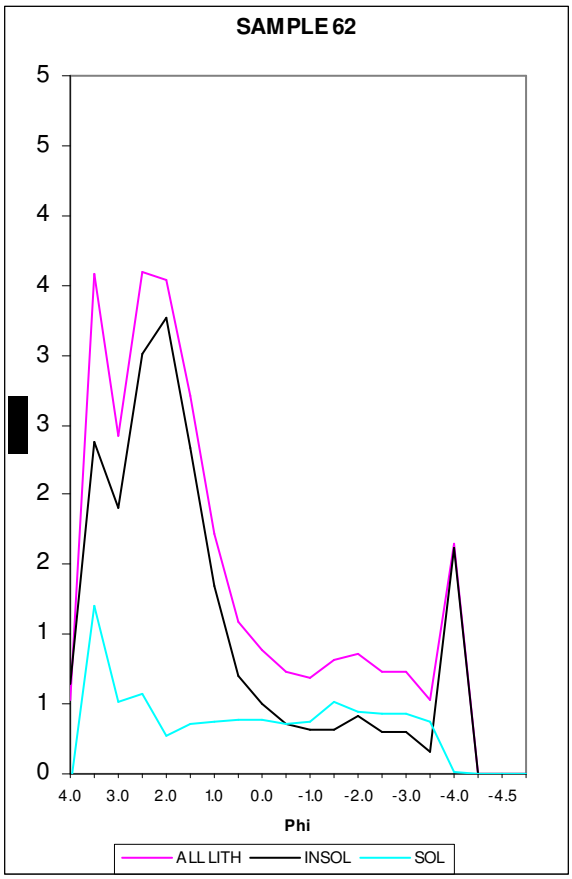


Figure 5.93. Particle size data for Sample 62.

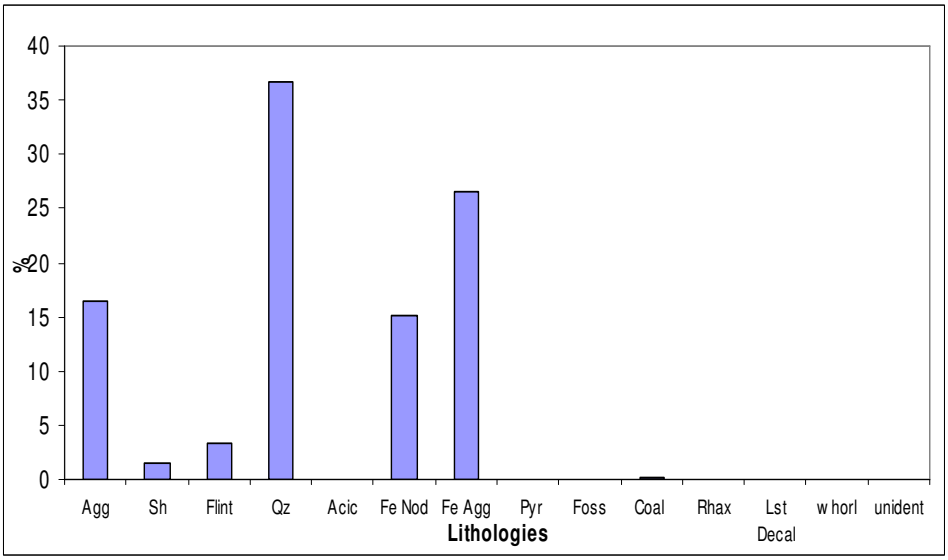


Figure 5.94. Small clast lithology data for Site 29, Munday's Hill.
(Average percentage of clasts for the five half-phi size fractions -1.0 to +1.0 phi)

SITE 30

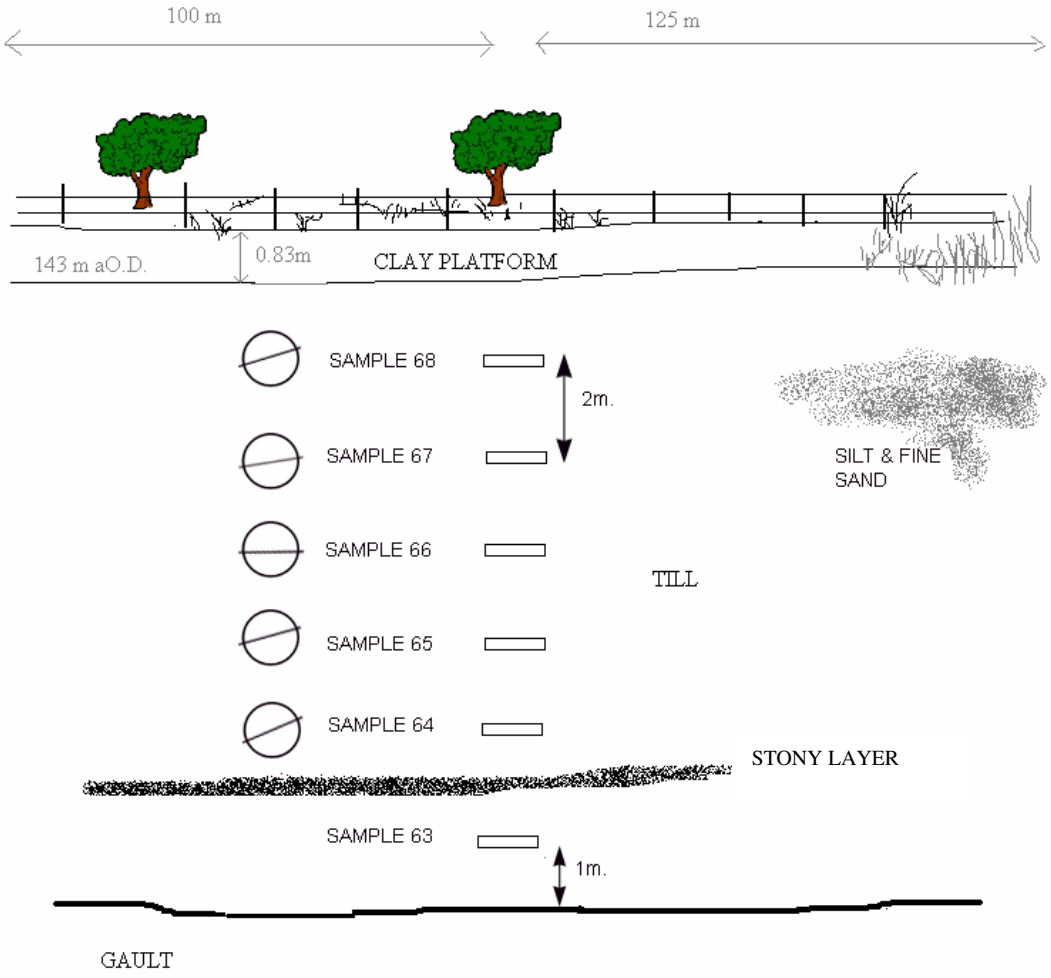


Figure 5.95. Schematic diagram of till section and macrofabrics at Heath & Reach (Site 30).

a.
Approx. 7m above the base of the sequence, near to sample site of Sample 66. Till here is relatively depleted in large clasts.

b.
Till, at the top of the sequence (Sample 68) showing iron staining

c.
Stony layer above sample site Sample 63.

Plate 5.3. Examples of till exposure at Heath & Reach (Site 30). See Figure 5.95 for location.

Plate 5.4
Erratic rock from Charnwood Forest.

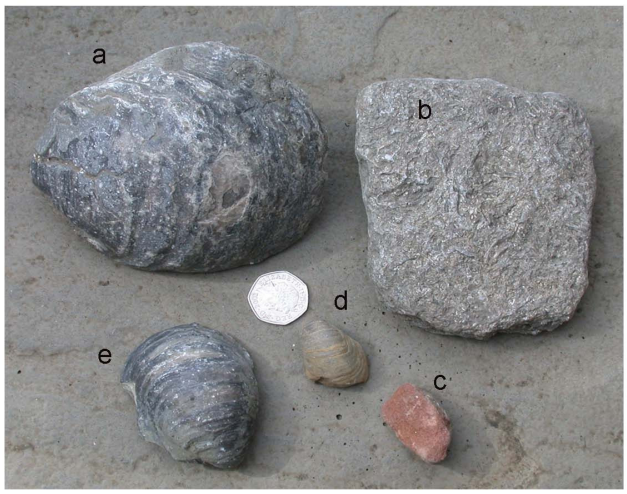
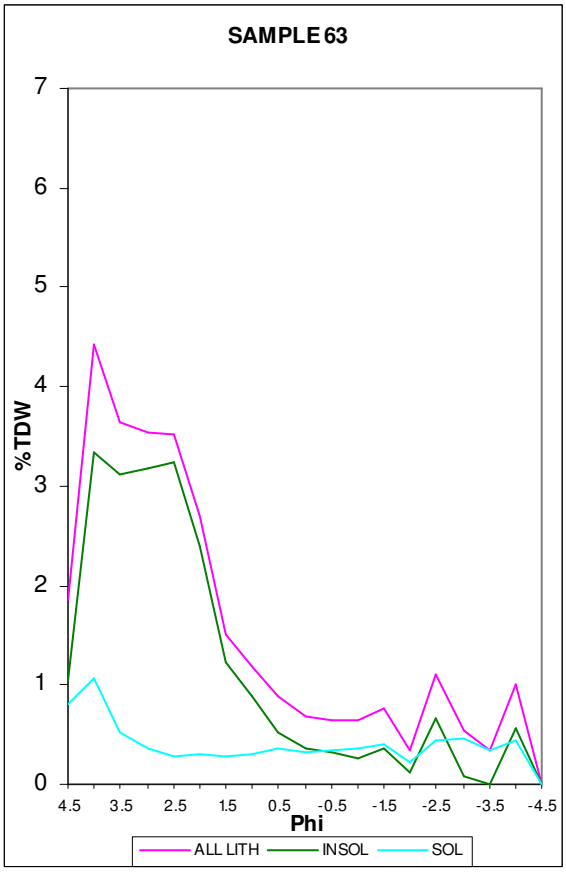


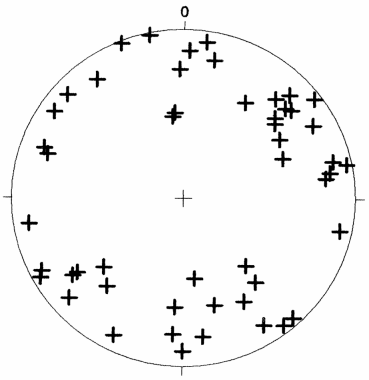
Plate 5.5
a. & *e* *Gryphaea dilatata* (J. Sowerby)
b Jurassic fossiliferous limestone
c Triassic Red Sandstone
d *Gryphaea arcuata* (Lamarck)

Plates 5.4 & 5.5. Examples of erratic lithologies and fossils found in the till at Heath & Reach (Site 30).

SITE 30 - SAMPLE DETAILS

Sample Number	**63**
Height	130.2 m O.D.
Sample Type	Bulk
Colour	10YR 3/2 Very dark greyish brown

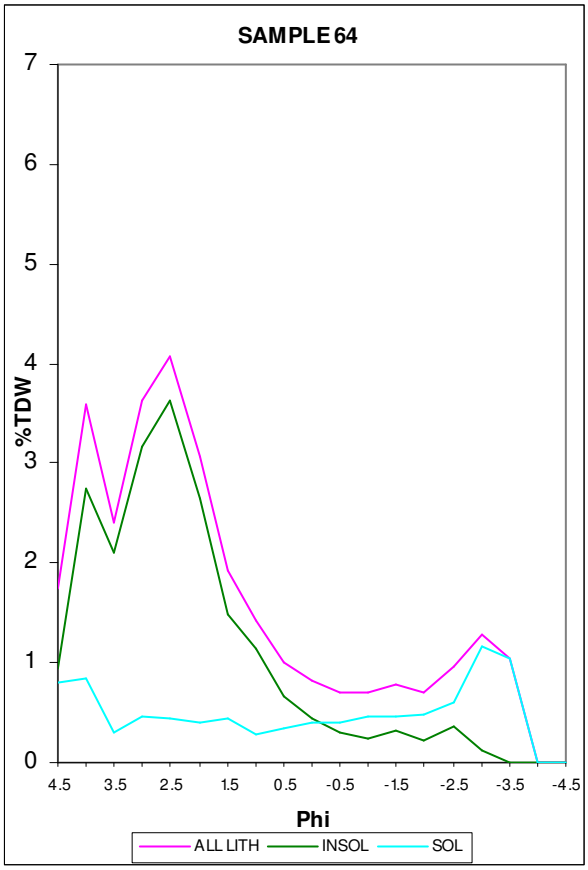


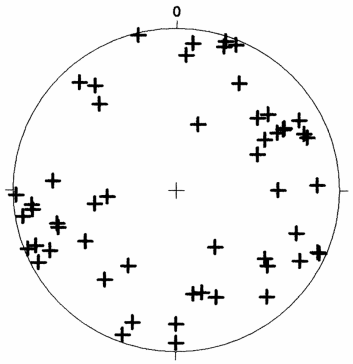


Macrofabric data for Sample 63	
Number in sample	50
Resultant vector	30°/210°
Vector magnitude	17.5%
Significance	Not Significant
Mean dip	20°

Figure 5.96. Particle size and macrofabric data for Sample 63.

Sample Number	64
Height	132.2 m O.D.
Sample Type	Bulk
Colour	10YR 3/6 Dark yellowish brown

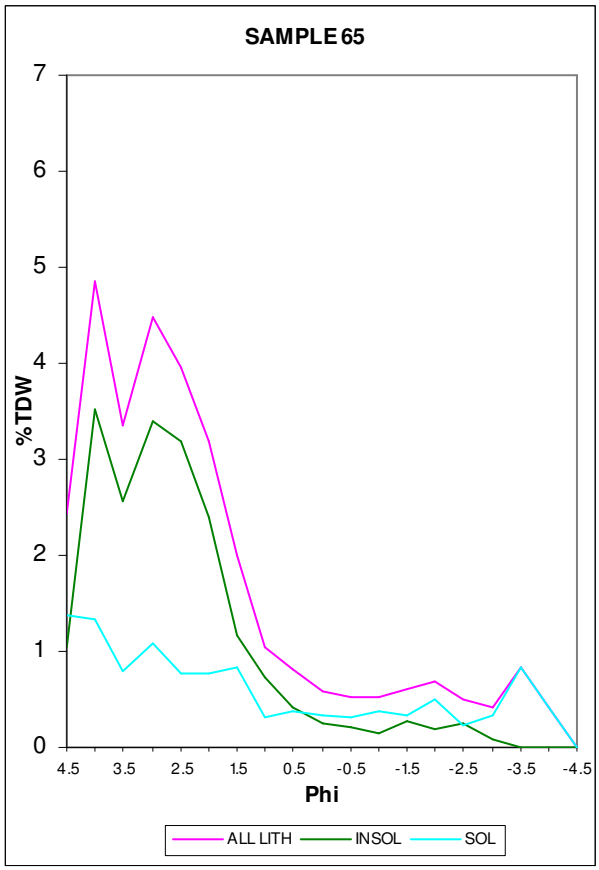


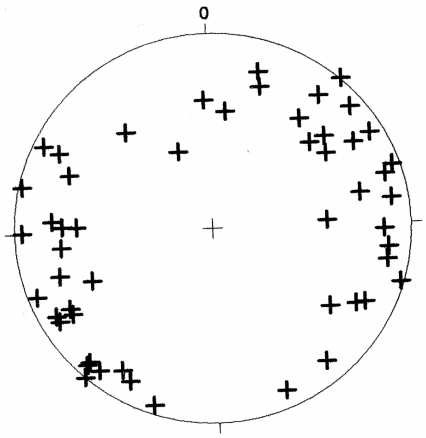


Macrofabric data for Sample 64	
Number in sample	55
Resultant vector	63°/243°
Vector magnitude	23.9%
Significance	>95% (Significant)
Mean dip	21°

Figure 5.97. Particle size and macrofabric data for Sample 64.

Sample Number	65
Height	134.2 m O.D.
Sample Type	Bulk
Colour	10YR 4/2 Dark greyish brown

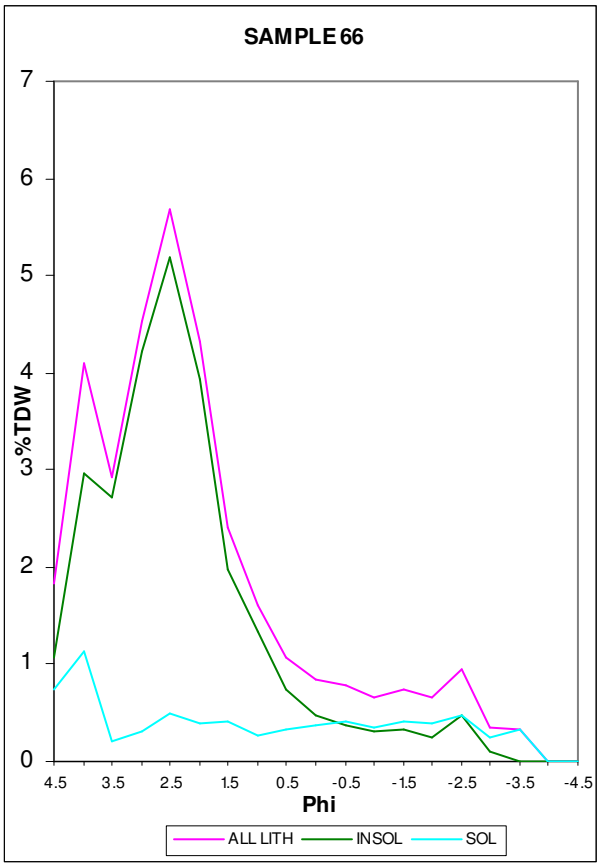


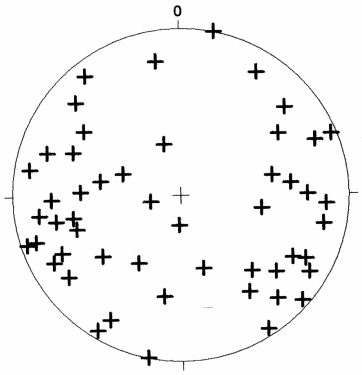


Macrofabric data for Sample 65	
Number in sample	51
Resultant vector	72°/252°
Vector magnitude	39.6%
Significance	>99.9% (Highly Significant)
Mean dip	18°

Figure 5.98. Particle size and macrofabric data for Sample 65.

Sample Number	66
Height	136.2 m O.D.
Sample Type	Bulk
Colour	10YR 3/2 Very dark greyish brown



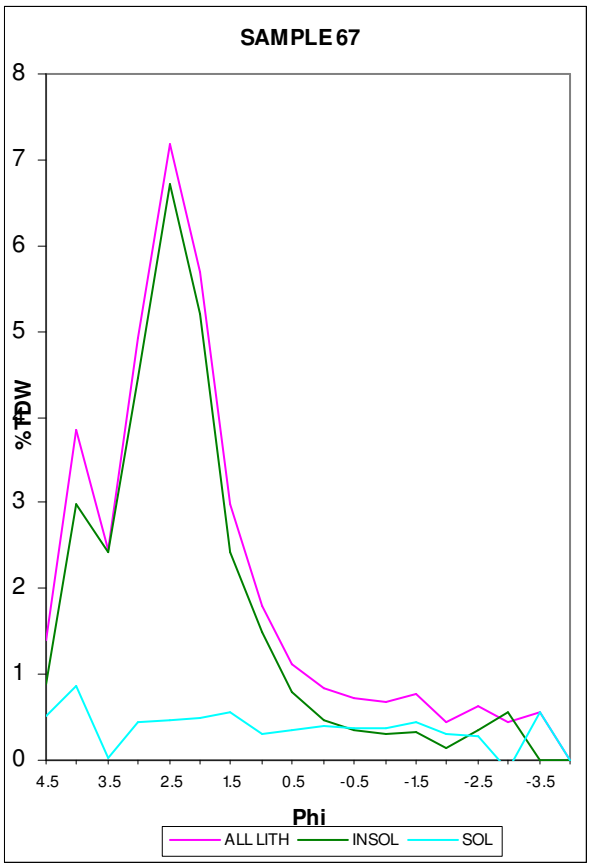


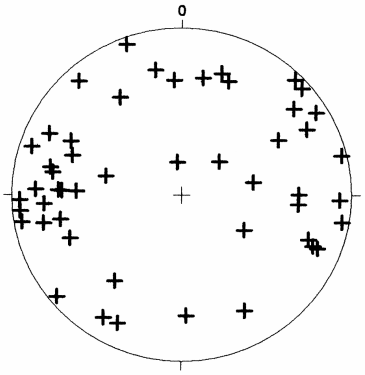
Macrofabric data for Sample 66.	
Number in sample	50
Resultant vector	091°/271°
Vector magnitude	29.5%
Significance	>99.0% (Highly significant)
Mean dip	26°

Figure 5.99. Particle size and macrofabric data for Sample 66.

Sample Number	67
Height	138.2 m O.D.

Sample Type	Bulk
Colour	10YR 3/2 Very dark greyish brown

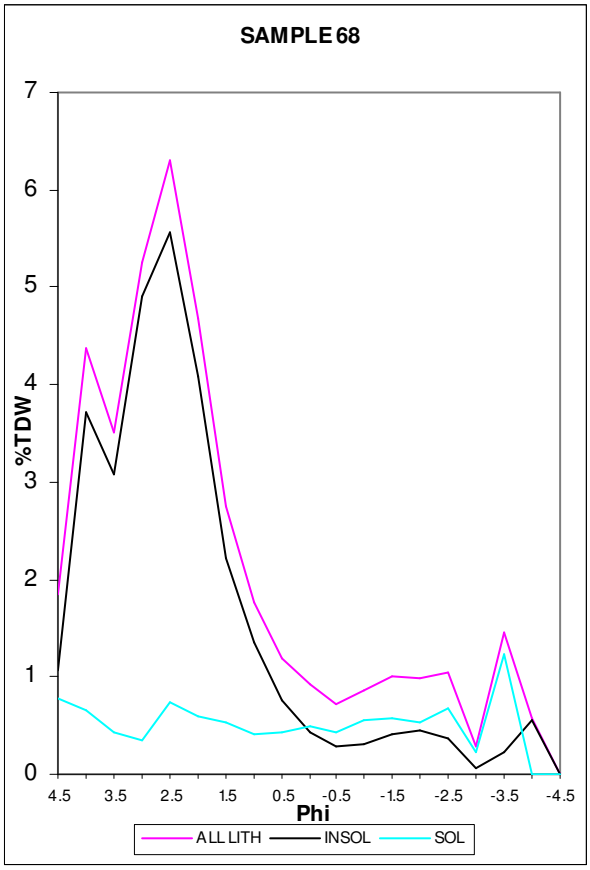


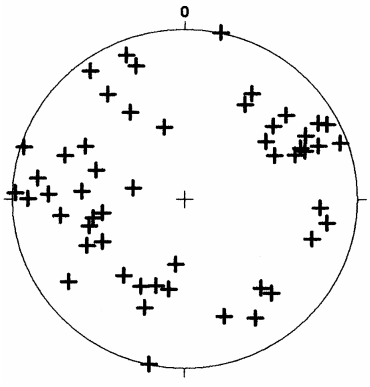


Macrofabric data for Sample 67	
Number in sample	50
Resultant vector	085°/265°
Vector magnitude	34.5%
Significance	>99.0% (Highly significant)
Mean dip	23°

Figure 5.100. Particle size and macrofabric data for Sample 67.

Sample Number	**68**
Height	140.2 m O.D.
Sample Type	Bulk
Colour	10YR 4/2 Dark greyish brown to 10YR 5/4 Yellowish brown (plus iron staining)





Macrofabric data for Sample 68.	
Number in sample	51
Resultant vector	075/255^{O}
Vector magnitude	27.2%
Significance	>95.0% (Significant)
Mean dip	29^{o}

Figure 5.101. Particle size and macrofabric data for Sample 68.

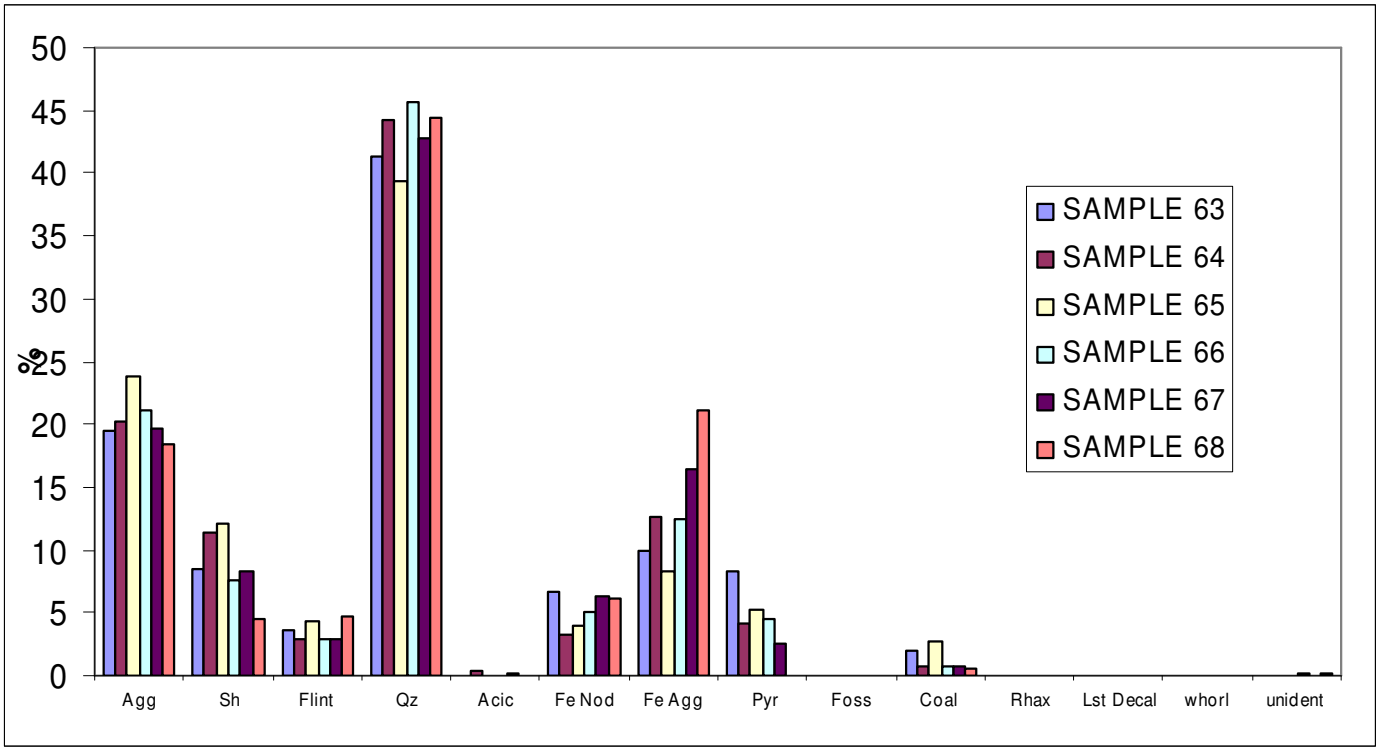


Figure 5.102. Small clast lithology data for Site 30, Heath and Reach.

(Average percentage of clasts for the five half-phi-size fractions -1.0 to +1.0 phi)