INSTITUTE of
HYDROLOGY

RBB

# COLCHESTER CAR AUCTIONS, ESSEX PRELIMINARY HYDROLOGICAL SURVEY

## INTRODUCTION

The tarmac car park area on the northern side of the new Colchester Car Auction Hall near Frating in Essex has shown evidence of differential movement. This has led on occasion to the ponding of water on the tarmac surface.

The cause of the tarmac instability is uncertain. Cores have been taken of the tarmac surface and base material to check whether the surface has been constructed according to specification. It has been reported that the tarmac sub-base was laid when surface water was present on the stripped ground surface.

However, local information suggests that this particular site suffers from poor drainage. It has therefore been suggested that shallow groundwater could be a contributing factor to the instabilty of the tarmac surface.

At the request of Douglas Construction a hydrogeologist from the Institute of Hydrology visited the site on 22 September 1989 accompanied by Mr B. Graham of Douglas Construction and Mr K. Williamson from Geoffrey Collett Associates. This site visit was undertaken to:

indicate whether shallow groundwater might be a factor to be considered in any remedial measures

- outline any further field investigations required to define the depth and fluctuations of the water table.

This preliminary note is based on existing information obtained mainly from ground engineering investigations undertaken for the design of the site.

## 2. SITE DESCRIPTION

The new car auction hall is located near the junction of the A130 and A133 about 1 km east of Frating crossroads. The site covers an area of about 5 ha and includes a covered auction hall, tarmac car parks on the northern and southern sides of the hall and gravel parking areas on the northern and eastern boundaries of the site. The surrounding area consists of arable fields.

The area is generally flat with an elevation of about 29.5m with a shallow slope towards the south or south east.

A drainage ditch extends from north of the site along the western perimeter and drains to the ditch system alongside the A133. The tarmac areas are drained by a shallow stormwater system which drains to the roadside ditch. The drift deposits occurring in the area are described in IMAU Report number 14 on the sand and gravel resources of Sheet TM 02, East of Colchester. The geological sequence is as follows:

1. Loam: brown clays with variable amounts of sand, silt and gravel about 1m thick

2. Glacial Sands and Gravels: sandy gravel up to 7m thick

3. London Clay: dark grey clays (weathering brown).

The loams and the sand and gravel deposits are of Recent and Pleistocene age and were deposited on an eroded surface of London Clay which is of Eocene age. The London Clay is exposed in the Frating Brook valley less than about 1km north of the site.

The hydrogeological map for the area (Sheet 5, South Anglia, 1:125000 scale) indicates springs near the site at the boundary of the loam and gravel deposits. Springs also occur at the boundary of the gravels and London Clay in this general area.

## 3. SITE INFORMATION

Site investigations were made by Jetwell Ltd in September 1986 and by Douglas Technical Services in July 1988. These included the following works:

- four boreholes into the underlying London Clay at each corner of the auction hall

- six trial pits to depths of about 3m to investigate the near surface deposits beneath the auction hall

- eleven boreholes drilled at locations across the site into the underlying London Clay

Six cores of the tarmac area to depths of up to about 0.4m were also taken in July 1989.

Unfortunately, the site investigations did not include any trial pits or boreholes within the tarmac area on the northern side of the auction hall.

Simplified logs are shown in Figure 1.

## 4. SITE CONDITIONS

### 4.1 Surface deposits

The surface deposits overlying the sands and gravels range from about 0.25m to about 1.2m in thickness. Over most of the site there is a thin surface soil layer having a thickness of about 0.3m. However, at the following locations the soil layer overlies a silty sandy clay layer of about 1m in thickness (layer B in Figure 1):

- JW8 and JW9 in the southern part of the commercial vehicle parking area

- BH 10 at the northeastern corner of the auction hall

- BH 1, TP2, BH 3, JW2 in the southern tarmac area.

This clay layer is also present beneath the northwestern part of the auction hall and at TP5 where it is about 0.5 to 0.7m thick.

Cored sites C2, C5, and C6 suggest that most of the northern tarmac area is underlain by only the thin soil layer, which was stripped for laying the sub-base.

The available lithological information has been used to indicate the possible extent of the clay layer as shown in Figure 2.

### 4.2 Water levels

The only available water level information is that collected during the borehole and trial pit investigations, which were carried out during times of the year when low water levels would normally occur.

The sand and gravel deposits form an aquifer with a saturated thickness of up to 5 to 6m. This aquifer is are used for water supplies from shallow wells in the general area.

There are no reports of water being encountered in the clay layer. Water levels are reported at depths generally of 2 to 3m, although water levels of 1.2 to about 1.7 were reported at BH10, BH1, BH3, and JW1 in the area of the auction hall and in the south east corner of the site. There is no particular evidence from the lithological data to indicate perched aquifers within the sands and gravels, although the water level at BH10 occurs in a sand layer within the clay layer.

It is likely that the shallower water levels are more representative of the true water table position. If so then it is possible that the water table might rise fairly close to the surface during the spring or wet periods. The direction of groundwater flow is probably from north to south in the same direction as the land surface.

There is no information on the hydraulic characteristics of the surface deposits or the sands and gravels at the site. The clays would tend to impede infiltration. The sands and gravels usually have a high permeability and in this area would have a high transmissivity since the saturated thickness is fairly large. The water level gradient however is low.

The thin soil cover over most of the site would allow rapid direct infiltration of rainfall to the water table. The tarmac areas would not have any significant effect on the amount of recharge from rainfall.

The ditch on the western boundary, which is about 0.5m in depth, would also provide a source of recharge into the site. This may have been increased by the sewage treatment plant located about 40m north of the northern tarmac area and which has an outfall to this ditch. The bed of the ditch is silted up to some extent, at least in the southern part of the site, which would restrict the amount of recharge. There are no records of the volume of flow in this ditch.

## 5. DISCUSSION

At this stage it is not possible to draw any firm conclusions as to whether shallow groundwater could be the cause of the instability of the tarmac area north of the auction hall. This can only be resolved by a programme of further investigation and a period of water level monitoring.

Given the thin and rather silty nature of the soils, a thick sequence of permeable sands and gravels, and the limited depth of the ditch it seems surprising that the site is reported as being poorly drained, unless the water table rises close to the surface or infiltration is impeded where the clay layer is present.

The available information suggests that the clay layer does not underlie the tarmac area north of the auction hall, except perhaps along the western part of this area. However, if this is the case then there may be some difference in the supporting strength at the boundary of the clay layer and the thin soils on sands and gravels when the clay layer is subject to wetting. This is an engineering aspect beyond our particular expertise.

The drains are installed beneath the sub-base and tests have indicated that these are water tight. It is therefore unlikely that these are contributing water into the sub-base.

The soil layer was stripped from the tarmac area and it would appear that the sub-base is laid on the surface of the sands and gravels, except perhaps on the western side of the tarmac area where the clay layer may be present.

It is understood that the sub-base was laid in February 1989 when water was standing on the surface. This might suggest that either the deposits immediately underlying the sub-base were compacted or that the water table was actually at the surface. Given the dry winter conditions of 1988/89 it would be surprising that water levels would be so high at that time, which suggests that the layer beneath the sub-base is compacted. However, the water that may have accumulated on this layer should have drained away after a relatively short time. Even so, this may not have been the case if the clay layer, which may have been compacted by the sub-base preparation activities, is present over the western part of the tarmac area.

## 6. FURTHER INVESTIGATIONS

There are a number of uncertainties remaining to fully understand the hydrological conditions of the site. These include:

- the type and thickness of the surface deposits underlying the tarmac area
- whether the clay layer impedes the drainage of the site
- whether the western ditch and the sewage treatment works are a source of additional recharge to the site
- the depth to water table and the maximum water table position.

The following programme of further investigation is proposed to obtain information on these aspects. The suggested locations are shown in Figure 2. As far as possible these have been chosen to reduce the amount of drilling on the tarmac area.

(a) Optimum Programme:

- construct seven piezometers (sites A to G in Figure 2) to depths of 3m to obtain lithological information on the surface deposits and for water level measurements
- install a gauging site on the ditch
- install a raingauge at the site.

(b) Minimum Programme

- construct three piezometers in the immediate area of the tarmac car park (sites A or D plus E and F in Figure 2) for lithological information and water level measurements
- undertake a surface geophysical survey using electromagnetic techniques (EM) to define the distribution of the surface clay layer
- visual records of flow in the western ditch
- use the daily rainfall records of the nearest meteorological station.

The boreholes could be drilled by the Marlow jack hammer technique with flow through cores, although it may be necessary to mobilise a Pilcon cable tool rig or auger rig to penetrate to the depths required in the gravels. These drilling facilities can be provided by IH. Several sites could be installed in trial pits instead of drilling (sites A, B, and G) if these can be located outside the perimeter fence. The final site locations would depend on the local conditions taking into account buried pipes, overhead power lines (along the western boundary) and to minimize disturbance.

Water levels will need to be measured regularly until the seasonal high, which normally occurs in about March or April. It may be impractical to measure the piezometer network manually at frequent intervals (say, once per week) but it would also be necessary to show how the water table responds to short term high rainfall events, particularly with high water level conditions. It is therefore recommended that transducers are fitted to one or two piezometers to provide a continuous record without the need for frequent site visits. Less frequent water level measurements (say, monthly) in the remaining piezometers could then be used to supplement the transducer records.

Institute of Hydrology
4 October 1989

LOGS SHOWING MAIN LITHOLOGICAL UNITS AND WATER LEVELS

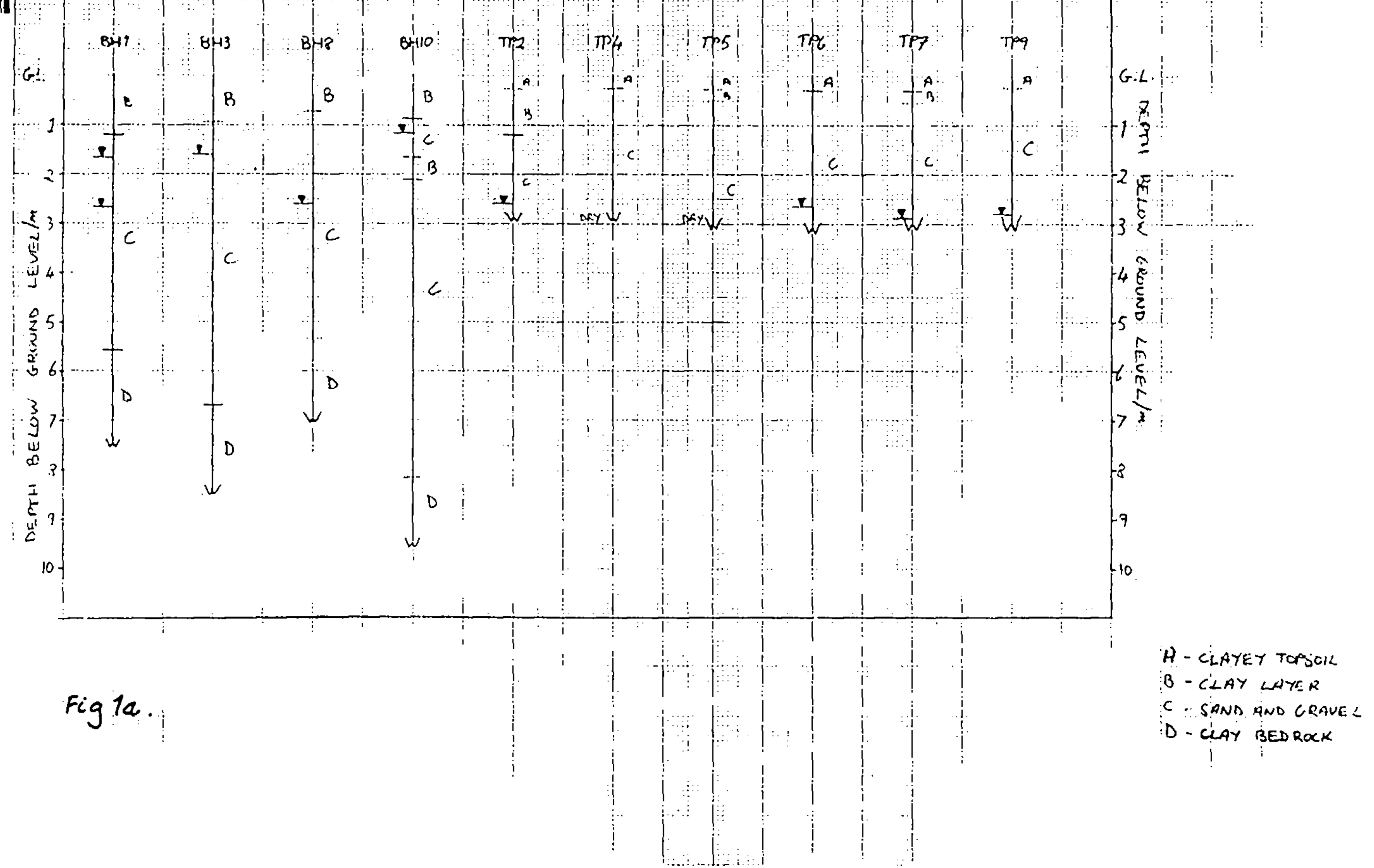


Fig 1a.

LOGS SHOWING MAIN LITHOLOGICAL UNITS AND WATER LEVELS

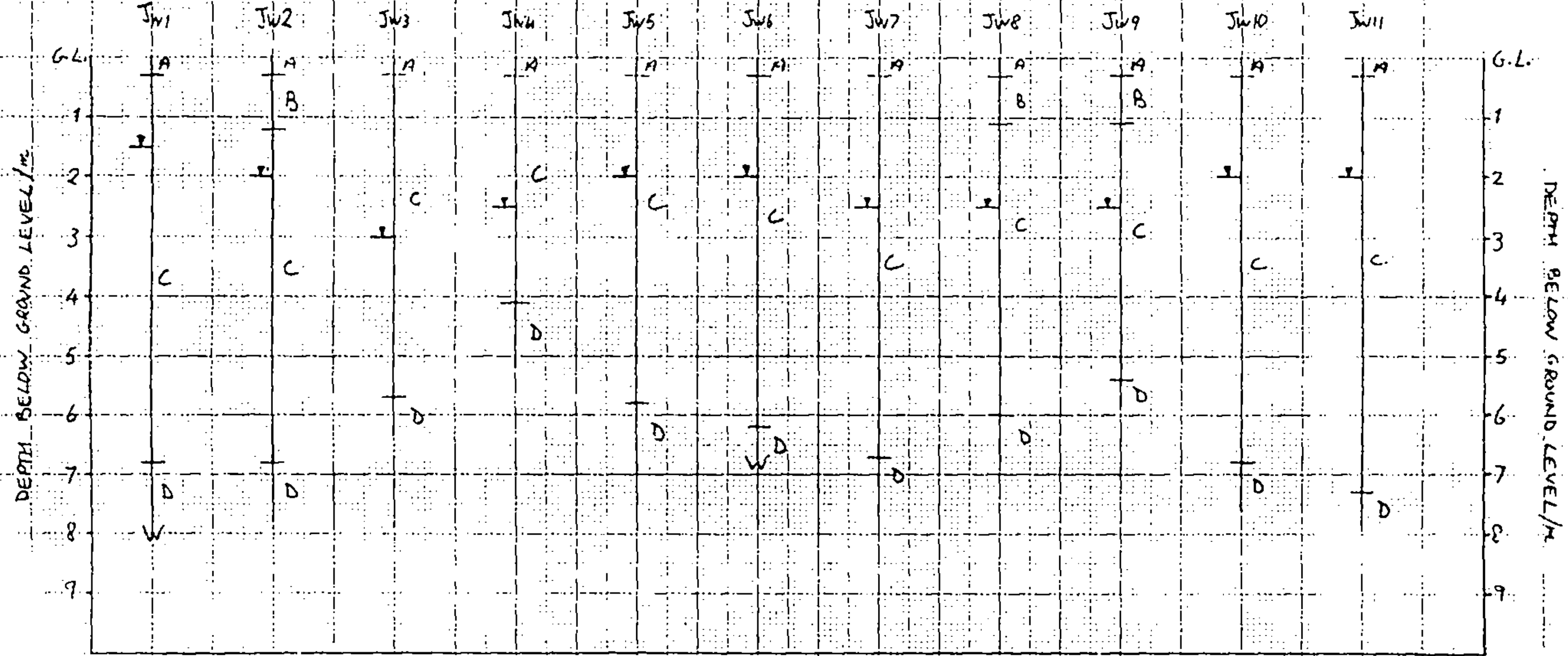


Fig 1b.

A - CLAYEY TOPSOIL
B - CLAY LAYER
C - SAND AND GRAVEL
D - CLAY BEDROCK

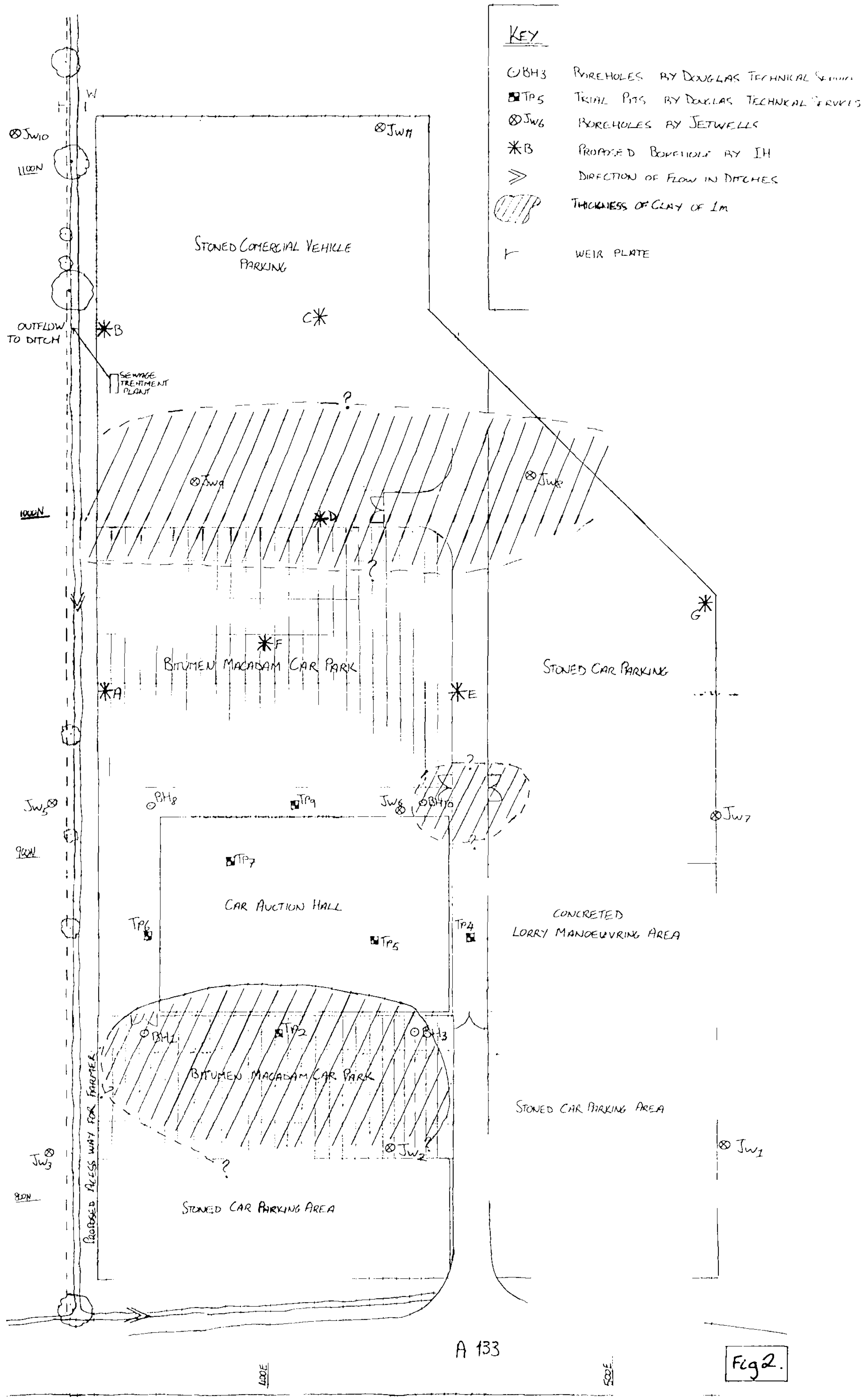
KEY
BH3 BOREHOLES BY DOUGLAS TECHNICAL SERVICES
TP5 TRIAL PITS BY DOUGLAS TECHNICAL SERVICES
JW6 BOREHOLES BY JETWELLS
B PROPOSED BOREHOLE BY IH
DIRECTION OF FLOW IN DITCHES
THICKNESS OF CLAY OF 1m
WEIR PLATE
STONED COMERCIAL VEHICLE PARKING
OUTFLOW TO DITCH
SEWAGE TREATMENT PLANT
BITUMEN MACADAM CAR PARK
STONED CAR PARKING
CAR AUCTION HALL
CONCRETED LORRY MANOEUVRING AREA
STONED CAR PARKING AREA
PROPOSED ACCESS WAY FOR FARMER
A 133
1100N
1000N
900N
800N
400E
500E

Fig 2.

The demand for long-term scientific capabilities concerning the resources of the land and its freshwaters is rising sharply as the power of man to change his environment is growing, and with it the scale of his impact. Comprehensive research facilities (laboratories, field studies, computer modelling, instrumentation, remote sensing) are needed to provide solutions to the challenging problems of the modern world in its concern for appropriate and sympathetic management of the fragile systems of the land's surface.

The **Terrestrial and Freshwater Sciences** Directorate of the Natural Environment Research Council brings together an exceptionally wide range of appropriate disciplines (chemistry, biology, engineering, physics, geology, geography, mathematics and computer sciences) comprising one of the world's largest bodies of established environmental expertise. A staff of 550, largely graduate and professional, from four Institutes at eleven laboratories and field stations and two University units provide the specialised knowledge and experience to meet national and international needs in three major areas:

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Land Use and Natural Resources

★

Environmental Quality and Pollution

★

Ecology and Conservation

INSTITUTE of HYDROLOGY

The **Institute of Hydrology** is a component establishment of the UK Natural Environment Research Council, grant-aided from Government by the Department of Education and Science. For over 20 years the Institute has been at the forefront of research exploration of hydrological systems within complete catchment areas and into the physical processes by which rain or snow is transformed into flow in rivers. Applied studies, undertaken both in the UK and overseas, ensures that research activities are closely related to practical needs and that newly developed methods and instruments are tested for a wide range of environmental conditions.

The Institute, based at Wallingford, employs 140 staff, some 100 of whom are graduates. Staff structure is multidisciplinary involving physicists, geographers, geologists, computer scientists, mathematicians, chemists, environmental scientists, soil scientists and botanists. Research departments include catchment research, remote sensing, instrumentation, data processing, mathematical modelling, hydrogeology, hydrochemistry, soil hydrology, evaporation flux studies, vegetation-atmospheric interactions, flood and low-flow predictions, catchment response and engineering hydrology.

The budget of the Institute comprises £4.5 million per year. About 50 percent relates to research programmes funded directly by the Natural Environment Research Council. Extensive commissioned research is also carried out on behalf of government departments (both UK and overseas), various international agencies, environmental organisations and private sector clients. The Institute is also responsible for nationally archived hydrological data and for publishing annually HYDROLOGICAL DATA: UNITED KINGDOM.