

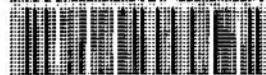
HYDRODAT

Groundwater Monitoring Database System

Guidelines

File No. 681 / 7 / 11

ENVIRONMENT AGENCY



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HYDRODAT
GROUNDWATER MONITORING DATABASE SYSTEM
GUIDELINES

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The Environment Agency - Central Area, Anglian Region
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PREFACE

The HYDRODAT database has been used since 1992 to record the groundwater levels for the observation sites of the Central Area, Anglian Region monitoring network. Since then various other components of HYDRODAT have been updated and utilised, however this was mostly done on an ad hoc basis. This prompted the recognition for the need of a thorough database update, in order so that members of the Water Resources Department could fully benefit from the HYDRODAT package.

A complete update commenced in July 1996 which continued on through to March 1997. About 1200 observation sites, both used and disused, were updated. The database now provides reliable, standardised information on; location, aquifer type, licensing details, monitoring status, report references, borehole/well construction, geology, source testing, water levels and water level statistics for each of the observation network sites. The previously updated water level database has been thoroughly checked and it is hoped that most of the erroneous records have been removed.

This manual is aimed at providing the user with the necessary information needed to use HYDRODAT to its full potential. It is anticipated that HYDRODAT will be used for various functions within the Water Resources Department, and perhaps other departments, by both the employees of the Environment Agency and their respective customers.

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1. INTRODUCTION

The current version of HYDRODAT used in the Central Area of the Anglian Region comprises 4 main databases:

- | | |
|-----------------------|--|
| 1. Archive | Contains basic information about the site, including location, construction details, licensing information, aquifer testing and water level statistics. This database was updated in 1996. |
| 2. Groundwater Levels | Contains time dependant water level data for all the observation network sites in Central Area. This database was updated from hardcopy files in 1992, and since then has been updated on a monthly basis for the majority of the sites. |
| 3. Hydrochemistry | Contains details of chemical analyses. This data has not been kept up to date. |
| 4. Geology | Holds the Agency geological code, strata depth and thickness, and lithological log details. This database was updated in 1996. |

The layout of this manual is divided into two parts. The first section, **Using Hydrodat**, is a user guide for most of the functions available on HYDRODAT. The second section, **Updating Archive / Geology Databases**, describes most of the fields that appear in the data entry portion of the archive and geology databases, and outlines the guidelines used to interpret, code and enter information gathered from a variety of sources onto these particular databases.

2. USING HYDRODAT

Upon opening up the package, the following screen appears:

MAIN MENU
Set Up Sitelist
View Data
Data Entry / Update
Inquiry Report
Graphics
Utilities
Quit Database

Each of the above options are described in order below.

2.1 SET-UP SITELIST

A site list comprises a number of sites grouped together according to certain criteria specified by the user to be subsequently used for viewing or printing out reports. To create a new sitelist, the *Create Another List* option is selected. Choosing the criteria used to set up a site list is achieved by selecting **a)** the appropriate *fields* required to filter out the desired records (eg. aquifer, number of water levels, last water level date) and **b)** the appropriate *conditions* (eg. chalk, > 12, < 01/01/1975).

Once the fields and conditions have been set, the "end" command should be chosen. A box will appear stating the radius of search required. This option is needed only when the sites around a particular grid reference are required. In this case the radius of search and the grid reference should be entered, and the "yes" option selected on the third line. Otherwise the first two lines may be left blank and the "no" option selected.

In the next box to appear an arbitrary name used to identify the list should be entered. It is this list which will appear on the list of site lists.

To view a site list that has already been set up, the *Review an existing List* option is selected, from which an existing site list may be chosen for viewing.

In some instances a red box will appear after attempting to create a site list, stating that zero records were searched. This problem is solved by running the *Index* option in the *Utilities* screen for the archive database (see section 2.7.1) and retrying the site list creation.

2.2 VIEW DATA

To view either archive or groundwater level data, the *View Data* option under the main menu is selected. Information in the geology database cannot be viewed using this option. The following options available on this screen are described below.

Station Archive Either all records or those from a site list may be viewed. Creation of site lists is described in the *Set-Up Sitelist* option (section 2.1).

GW Levels Either all records or those from a site list may be viewed. Creation of site lists is described in the *Set-Up Sitelist* option.

To search for a certain site while in the *View Data* option, press the "F7" key. This will bring up a blue box. Next use the down arrow key to highlight the *Seek* option. Press enter. Now type in the site ID which will automatically come up beside the *Goto* option. Press enter twice. This will take you to the entered site on the *View* screen.

Records can be updated whilst in this screen. Depressing the "F10" key activates the edit mode. Information on the screen may be edited when in this mode. This is quite useful for correcting an incorrect water level, or to delete it altogether (delete key). However records can only be edited one at a time.

It is easier to change the datum using the PSION programme which is

described in section 2.8. This programme changes the datum for a number of the records all at once.

Note: Any water level or datum changes must be entered into the "HYDRODAT ALTERATIONS" file under the *GW level alterations* section.

Define View Using this option allows the user to select the data presented in the *View Data* window.

2.3 DATA ENTRY / UPDATE - Station Archive

The procedures described in the **Updating Archive / Geology Databases** part of the manual (section 3.) can be used as guidelines for adding new information or altering existing details on the archive database.

To add a new site to the database, enter in the new siteID and press return. A green box will appear asking if a new site should be accepted. Type in "Y" for yes.

Note: New sites added to the HYDRODAT database are to be entered into the "HYDRODAT ALTERATIONS" file.

To temporarily delete a site from the database, type in the siteID and press return. A blue box will appear with various options available within it. Select "D" to delete the site. The site will be temporarily deleted. To permanently delete the site see section 2.7.1. To recall the temporarily deleted site, type in the siteID and bring up the blue box once more. Then from the blue box select the "R" option.

Note: Site deletions from the HYDRODAT database are to be entered into the "HYDRODAT ALTERATIONS" file.

2.4 DATA ENTRY - GW Levels

To enter a new groundwater level into the groundwater level database, this option is used. Upon selecting *Data Entry/Update* from the main menu followed by *GW Levels*, a box appears at the top of the screen. The siteID is entered into the first line, followed by the date of the measurement into the second line. The time of the measurement on the third line is usually ignored.

Once the first box is completed, an option is given to create a new measurement. By selecting "yes" a second box appears on the screen. Upon entering in the water level dip on the first line, the elevation is automatically calculated using the current datum. The reverse holds true if the elevation is entered.

If the well was pumped at the time of the measurement, the discharge rate may be entered, however this option has usually been ignored in the past and has not been updated. If it is known it should be entered.

Beside *condition* the site status at the time of measurement is entered. The various options are listed in the help box (F1). It is especially important to enter these when the level has influenced by pumping, or is somewhat dubious.

The *measurement type* (routine or special project) may also be entered, however it has usually been ignored in the past and has not been updated. It is not necessary to update this option..

In order to add water levels to a new site, it is necessary to set up the site through the archive database first (see section 2:3).

Note: Water level additions are to be entered into the "HYDRODAT ALTERATIONS" file.

2.5 INQUIRY / REPORT

To report a site list in the form of a print out, screen display, data file, etc., the *Inquiry / Report* option from the main menu is selected.

From the database option only the first two databases (Well Archive, GW Levels) are available. The appropriate fields to be included in the report are to be chosen from the *Fields* option. Conditions may be set using the *Conditions* option, in much the same manner as setting up conditions for creating a site list. However if the desired conditions have already been used to set up a site list, it is not necessary to do so again in this screen. In fact if this is attempted this may create an unwanted error while reporting. The same principle applies when using the *Near* option to select wells surrounding a particular grid reference. The desired list is selected from the *List* option.

In the *Output* option the type of output for the site list report is selected. To generate the report the *Run* option is selected. The various output types are described below.

2.5.1 Screen

This option will generate a screen output, displaying one site at a time, once the report has been run. By using the continue option each site may be viewed one at a time by scrolling through each record..

2.5.2 Printer

To print out a report on a printer that is directly connected to the PC on which the report has been generated (ie. not networked). The choice of printer depends on which printer is connected to the PC.

2.5.3 Lotus File

To convert the report to a file which may be subsequently incorporated into a spreadsheet

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2.5.3 Lotus File

To convert the report to a file which may be subsequently incorporated into a spreadsheet

package. To run this option a file name must be entered. The file is retrieved from the appropriate directory as a ".prn" file in the c: drive (eg. c:\proglib\hydrodat).

2.5.4 Text File

To convert the report to a file which may be subsequently incorporated into a word processing package. To run this option a file name must be entered. The file is retrieved from the appropriate directory as a ".txt" file in the c: drive (eg. c:\proglib\hydrodat)

2.6 GRAPHICS

Using this option generates hydrographs from the groundwater level database. Hydrographs can be viewed on screen, plotted, or printed out. These options are described below:

2.6.1 Viewing hydrograph on screen

To select the borehole(s) / well(s) to be graphed, the *plot list* option is chosen. Undesired sites are deleted using the "delete" key. Sites to be graphed are entered into the plot list using the "insert" key. Up to five hydrographs may be viewed at once on the display screen.

To generate the hydrograph(s) for the site(s) on the plot list, the *G Water Level* option is selected. A box appears from which the *Normal Graphics Mode* is selected. Ignore the *Batch Graphics Mode* option. In the next box to appear the start and end dates are to be inserted. The default is 01/01/1950 to the current day. The next box asks whether only validated records are to be used. Enter "no" for this option (default). The records are read and then another box appears stating the number of records retrieved. To plot the graph press the "enter" key. A screen with a site list in the top left hand corner appears. By using the F1-F5 keys and the up/down arrow keys, up to five hydrographs from the sitelist may be displayed at once. The F6 key switches the water level axis between m bdat and m AOD. The F7 key allows to graphics of the hydrograph (lines, symbols) to be altered. Water level and date ranges on the hydrograph are adjusted using the F8 key. To display the graph in full screen mode, use the F9 key.

2.6.2 Plotting hydrograph

Set up the hydrograph on the screen as described above. To plot a hydrograph on the plotter the **F10** key is depressed. Once a title name has been entered, "COM 1" should be selected from the *PORT* options by entering in "3". From the *DEVICE* options "Plotter" is then selected. Be sure that the plotter paper is properly inserted before carrying out the last instruction as plotting begins as soon enter is pressed after "Plotter" is selected.

It is important that no other devices are used on COM 1, such as a mouse. All drivers should be removed from COM 1, otherwise the plotter will not respond.

Refer to Appendix I for a cable connection diagram for a HP 7475A plotter.

2.6.3 Printing hydrograph

Set up the hydrograph on screen as described above. Hydrographs may be printed on a laser printer that is connected to the network, in which case it is necessary to save the hydrograph on a file which is subsequently used to generate the hydrograph. Once again select **F10** and enter the title name. Under the *PORT* options select "File" by entering in "1", and under *DEVICE* select "Laser". At this point a filename will need to be entered. Be sure that no decimal points, full stops, or slashes are entered into the file name as this will generate an error. At this point the hydrograph is saved in a ".plt" file on the c: drive (eg. filename.plt).

To print the hydrograph it is necessary to be in DOS. Once in DOS type in "pconsole". From the *Available Options* box choose "Print Queues". A box entitled *Print Queues* will appear. From this box choose the desired printer, which will most probably be "HYD_LASER". From the next box entitled *Print Queue Information* select "Print Jobs". Once in the next screen depress the "insert" key, use the backspace to clear the line, then type in the directory in which the ".plt" file is found (eg. c:\proglib\hydrodat). At this point a box will appear with a list of files and from it the desired hydrograph (plt) files are chosen using the **F5** key. Once chosen, press enter, and then press enter once more at *job configurations*. A screen will appear which allows you to set up printer conditions. Everything may be left as it is here,

however it is wise to set the *Print Banner* to "no" if a number of hydrographs are being printed out. Finally by pressing the F10 key the file is sent to the printer and the hydrograph is generated. Use the "esc" key to escape back to DOS.

2.7 UTILITIES

2.7.1 Indexing

Indexing through the *Index* option updates the index files for the chosen database. Upon selecting *Index*, the database options are displayed. Only the *Archive* and *Water Level* database options are relevant. Once one of these two options are chosen, indexing begins and may take up to 30 minutes to complete for the *Water Level* database. The *Archive* database usually takes about half a minute to index.

Indexing through the *Delete* option is required when sites and/or water levels have been temporarily deleted from the databases and it is desired to permanently remove them from the system. Temporarily deleting record is described above in sections 2.2-2.3.

Both these options should be carried out after water level changes or deletions have been made. The *Delete* option must be run first, followed by the *Index* option when indexing the ARCHIVE database. If the index option is not run this may prevent the creation of new site lists (see section 2.1).

Note: Indexing is to be carried out at least once a month and recorded in the "HYDRODAT ALTERATIONS" file.

2.7.2 Changing SiteID

The siteID of a borehole / well may be changed using the *Change* option. Using this option changes the siteID on both the archive and water level databases.

Note: SiteID changes are to be entered into the "HYDRODAT ALTERATIONS" file.

2.7.3 Deleting Site Lists

Site lists may be deleted from the system using the *Lists* option. Once this option is chosen, a list of site lists appears. To highlight the list to be deleted, use the arrow keys. Once the list is highlighted, press the return key and the highlighted list will be deleted. If deleting a list is undesired once in the *List* screen, use the "esc" key to exit, which avoids deletion of any of the site lists.

2.7.4 System Statistics

The following water level details are available for view in the *Data Entry/Update-Station Archive* option:

No. of water level records	
First water level record	(date & level)
Last water level record	(date & level)
Min water level record	(date & level)
Max water level record	(date & level)
Mean water level record	

When changes are made to the groundwater level database it is important to upgrade these statistics. Upon selecting the *Stats* option, a box with a number of options appears. The first option allows you to upgrade statistics for a specified site list. If this option is bypassed, all the sites on the system will be upgraded, which may take some time. To upgrade the statistics listed above choose the *Make Summary Level Statistics* option.

It is important to upgrade the statistics after any change in the water level database because:

When new water level records are added, all of the statistics listed above except for *mean water level record* are automatically updated.

When changes are made to existing water levels (ie. same date kept), only the *first &*

last water level records are automatically updated.

When deletions are made to the water level records, none of the statistics are automatically updated. In this case it is necessary to index the water level database, followed by the *Stats* procedure described above.

A monthly statistics package has been incorporated into HYDRODAT, however at the time of writing it was not functioning properly. Upgrading the monthly statistics is assumed to be achieved by choosing the *Make Monthly Level Statistics* option under the *Stats* option. However when viewing this data (*View Level Statistics* under *Stats*) the data seems incorrect.

Note: System statistics are to be upgraded at least once a month and recorded in the "HYDRODAT ALTERATIONS" file.

2.7.5 Creating Data for SURFER

HYDRODAT is able to create files of groundwater levels for use by the contouring package SURFER. To create a file which SURFER can use, first create a site list as described in section 2.1. From the *Utilities* menu the *XYZ SURFER* option is chosen. The instructions are fairly explanatory. For groundwater levels the *GW Levels* database and *GW Elevation* field are selected. A time range option is available. Once the filename is entered, HYDRODAT will then read the water level database to find the water level elevation for each site on the site list. Once the search is completed press "esc" to leave HYDRODAT. **Do not press enter when the search is completed** or SURFER will not be able to read the file. SURFER is then executed using the created file which will contain a Northing and Easting for each point plus a water elevation. Contouring can then proceed as normal (see SURFER manual).

2.7.6 Water Level Validation

By using the *Validate* option water levels in the water level database are checked against the specified water level validation range entered into *Water Level Validation* (see section 3.8). This enables erroneous records to be located. Records are checked one at a time, and when

any record falls outside the validation range options are given to correct or ignore suspect data.

2.8 CHANGING DATUM LEVEL

Even though it is possible to change the datum level through the *View Data* option under the main menu for the groundwater level database, this can only be done one record at a time and can be very time consuming if there are many records. Thus an application has been set up to change all or part of the records at once.

To execute this programme it is necessary to quit HYDRODAT and exit from Windows (if necessary) to the *Environment Agency Main Menu*. Using the "Page Down" key brings up the second page of the menu, from which the *Transfer PSION dippings to HYDRODAT* option is selected. Next highlight the *Back Up Completed* option and press enter. Then highlight the *Datum correction* option and press enter. Once the *Accept* command is highlighted press enter once again.

A new screen will appear. Enter in the full siteID, followed by the desired date range for the datum change (eg. 01/01/76). The new datum level in mAOD is entered in under *Datum level*, then press enter. *Elevation* will be highlighted, press enter once more. At this stage two options appear, *Elevation* and *Dip Level*. Care must be taken as to which one should be selected. If water levels were originally entered as a water level dips, then *Elevation* should be selected (ie. dips are correct and are used in conjunction with the datum level to produce new elevation levels). If the water level records were entered in as elevations (sometimes the case with data loggers or chart recorders), the *Dip Level* should be selected. At this point the cursor will move to the second line. If no data is to be entered here press enter. The *accept* command will be highlighted - press enter. It may take a minute or two for the programme to run. Once completed a message appears in the top right hand corner stating so (eg. completed 26 out of 26 records). The programme is terminated by selecting *Quit*.

Note: Datum changes are to be entered into the "HYDRODAT ALTERATIONS" file under the *GW level alterations* section.

3. UPDATING ARCHIVE / GEOLOGY DATABASES

The following information outlines the procedure used to update the archive and geology databases during the major update in 1996. Guidelines are more detailed where on screen instructions are unclear. Certain items may pertain to the Central Area - Anglian Region only, but can be easily adapted to any of the eight regions of the Environment Agency.

Note: Alterations to existing station archive / geology databases are to be entered into the "HYDRODAT ALTERATIONS" file.

To add site details or make changes to any of the HYDRODAT databases, the *Data Entry / Update* option under the Main Menu is chosen. This will bring up the following menu:

Station Archive	GW Levels	Hydrochemistry	Quit
-----------------	-----------	----------------	------

The *Station Archive* option allows the user to update both the archive and geology databases. The water level database is updated using the *GW Levels* option, and the hydrochemistry database using the *Hydrochemistry* option. This section focuses on using the *Station Archive* option to update the archive and geology databases.

Once the *Station Archive* option has been selected, a *Site ID* box appears. Each borehole or well is represented by a site identification number, which is the 10 km grid reference used in the National Grid Reference System, followed by a well number. The following example illustrates this system of identification:

TL44/007 NGR TL 4120 4560 Well no. 7

Central Area - Anglian Region comprises the TL, TF, TG, TM and SP grid letter areas.

Once the siteID has been entered, the following screen appears:

1. Basic Well Information
2. Licence Details
3. Construction Details
4. *Lithology*
5. Ownership Details
6. Source Testing
7. Water Level Details
8. Water Level Validation

The archive database is updated by using all of the above options, except for the *Lithology* option, which is used to update the geology database.

In addition to the above station archive sections, a *memo* option is also available (see section 3.9). This option is activated by depressing the "F10" key, but only once you are in one of the above options.

3.1 BASIC WELL INFORMATION

GRID REF The National Grid Reference. Two letters and eight digits (eg. TL 1803 2473).

AREA Automatically entered from the title string. In this area it is almost always Central. In some cases a site located very close to the Central Area border is monitored, thus the appropriate area has been entered here (eg. Eastern, Thames).

AQUIFER The producing aquifer. The major producing aquifers in this area are:

1. Chalk 2. Woburn Sands 3. Norfolk Greensand 4. Great Oolite

In addition to the four main aquifers given above, minor aquifers may be tapped by some boreholes or wells. The various aquifer types are listed in Appendix II and may be viewed on screen by depressing the "F1" key whilst in the *aquifer* option.

AQUIFER UNIT The major aquifers are divided into areal units as follows:

Chalk	14 units	CH01, CH2 - CH14
Woburn Sands	3 units	GS1 - GS3
Norfolk Greensand	1 unit	GS4
Great Oolite	1 unit	GO

By using the grid reference of a site, the aquifer unit was identified from the "Great Ouse River Authority" Aquifer Map. Thus a two letter code followed by the unit number has been entered here. In the case of the Great Oolite, no number is necessary.

In a case where the borehole abstracts from a minor aquifer (eg. alluvium, glaciofluvial sands and gravel) the appropriate aquifer has been entered in the *aquifer* field, and in the *aquifer unit* field the major aquifer unit followed by the minor aquifer code has been entered. For example, an alluvial aquifer in the CH9 area has been entered into the *aquifer unit* field as "CH9 AL". If the site is a gaugeboard, the major aquifer code has been entered into the *aquifer* field, and the appropriate *aquifer unit* followed by "GB" in the aquifer unit field (eg. CH9 GB).

The first chalk unit is represented by CH01 and not CH1 as the latter will be confused with units 10-14 when creating sitelists using the *aquifer unit* option as a field (see section 2.1). For instance, if *Aquifer unit* = CH1 is chosen to create a site list, a list with all the sites from CH1, CH10, CH11, CH12, CH13 and CH4 will be created.

HYDROMETRIC AREA Central Area - Anglian Region is subdivided into 66 hydrometric surface water catchments. The grid reference of a site was used to locate the appropriate sub-catchment on the "Great Ouse River Authority" Map 2 - Subcatchments and River Gauging Stations. The code entered here is the Central Area catchment number (always 33), followed by the subcatchment number (eg. 33/42).

LICENCE NUMBER

The full licence number has been entered here:

6 / 33 / subcatchment number (2 digits) / licence number (3 digits)

eg. 6/33/42/021

If the Agency has received a licence application that is in the process of being determined, "P/A" has been entered into this field. This is to be noted in the "HYDRODAT ALTERATIONS" file, which should be checked periodically to ensure that the "P/A" is changed appropriate.

SITE STATUS

Site status shows whether a site is currently being observed. The two options available are "I" (inuse) and "D" (disused). If a borehole is currently being observed (ie. water levels being measured on a frequent basis), "I" has been entered into this field. Any borehole that is not currently being monitored for observation purposes is denoted with "D". The latter includes boreholes that may be currently used for other purposes such as domestic, agricultural or industrial purposes (these are specified under *Site Use*). By checking *GW Levels* (*View Data* option), the monitoring state of a site was ascertained.

SITE USE

Where a borehole/well is currently being used for any purposes other than observation, the appropriate code has been entered here. The various uses are displayed by depressing the "F1" key. A single letter code is used to represent each type of use. Note that there is not an

"observation" use, as this is revealed in the *Site Status* field.

In cases where a site is used for more than one purpose, that use which is of more importance was entered. For instance, a well used for domestic and agricultural uses has been entered as domestic as this purpose has particular licensing and health implications. A domestic well with a licence number usually indicates that the borehole/well is multipurpose.

If a borehole is not currently being used for any purposes other than observation, this field is left blank.

**DATUM
LOCATION**

Usually the datum location is shown on the well details sketch on the back of the well survey sheets. The "F1" key reveals the various datum locations and the corresponding single letter codes that have been entered in this field. In cases where the datum location is not shown, the field technicians should be contacted and the location obtained, so that the records can be amended.

DATUM LEVEL

Usually on well survey sheets. Levels may be surveyed (z) or approximate (c). Always check that the datum level in the *Station Archive* is the same as the datum level in the *GW Levels* section. They may differ due to changes in the datum over the course of the site history. Reported to two decimal places.

GROUND LEVEL

Sometimes on well survey sheets, however often it is wrong. Check the sketch of the well head, and ensure that it is current as the well head may have been altered. Ground level may have been approximated from photographs of the well head that usually accompany the well survey sheets, or from Ordnance Survey Maps. Ground level can be above, a or below the datum level. Reported to two decimal places.

REPORT

Any reports or references in addition to well survey sheets and BGS well records that are available about the site have been entered into this field. The following codes cover the various reference types:

CF	Customer File
PT	Pump Test Report (not always a pump test)
GL	Geophysical Log
CP	Capital Project
WQ	Water Quality Report
GWDS	Groundwater Development Scheme
GSS	Greensand Scheme
MW	Mineral Workings Report
GWPS	Groundwater Pilot Scheme
LGS	Lodes-Granta Scheme
NVZ	Nitrate Vulnerability Study
WFS	Water Features Survey
BGS/EEC	National Network

3.2 LICENCE DETAILS

Licence details were obtained from the orange customer files, which are stored in the licensing department. The customer file number (prefixed with 3000/ or 503/) should be in the *Report References* window (see section 3.1).

LICENCE NUMBER

This is carried over from *Basic Well Information* section.

PURPOSE

This is a free field, so more than one purpose may have been entered here. The one letter codes as used in the *Site Use* field have been used here as well (eg. Domestic/agricultural entered as "D/A"). Purposes are given in order of importance.

**DATE OF
EXPIRY**

If no expiry date exists for a licence, the field has been left blank. Dates of revocation have been entered into this field, as have been the dates when licences ceased to have effect. A Licence of Right has no expiry date, spray irrigation licences usually do.

**DETAILS OF
ABSTRACTION**

Annual and daily rates are in thousand cubic metres per annum/day. Hourly rates are in m³/hour. Many figures may seem without rounding as they have been converted from imperial to metric units.

**MEANS OF
ABSTRACTION**

This is usually listed under "conditions and requirements" of the licence. If the borehole is metered to measure quantity, "M" has been entered into this field. If the abstraction is being monitored by running time, then the abstraction is assessed based on the capacity of the pump (stated on licence), hence "A" has been entered into the field.

3.3 CONSTRUCTION DETAILS

Various sources were used to obtain well construction details. Well survey sheets, customer licence files, BGS records/reports, driller's logs, geophysical logs and water quality reports were the main sources.

CONSTRUCTION This level is taken as the top of the borehole casing or well brick lining.

DATUM LEVEL This value is nearly always the same as the datum used for water level measurements.

DETAILS

Depths are reported as metres below casing top (mbCT), not metres below ground level. If the casing extends above ground level, the top of the casing has been used as the "0" reference point. This means that the final depth of the well may differ from other sources which refer to the borehole/well depth as metres below ground level.

Often the depth of the lining has been left blank as it is unknown. This

is almost always the case with wells, as the depth of the brick lining is seldom known. If the borehole casing depths are unknown, this should be stated in the memo.

In cases where a well/borehole has been extended, both the original and new depths of the well are conveyed in this section. For instance an open borehole may be reported as occurring from 0-50 mbCT, followed once again by an open borehole from 50-100 mbCT. Thus the original borehole, being 50 m in depth, was deepened to 100 m at a later date.

3.4 LITHOLOGY.

Information found in this section form the geology database. The information may only be reported out of the database using the FOXPPO or dBASEIV programmes.

Sources of geological and lithological information included:

- 1) well survey sheets
- 2) customer files
- 3) BGS well catalogues
- 4) geological / hydrogeological / drift maps
- 5) additional reports (water quality, mineral workings)

DEPTH

Depths are reported as metres below datum (as in section 3.1), not metres below ground level. Thus an interval of "air space" has been entered where the datum is above ground level.

Where the datum is located below ground level, an initial depth of "0" has been entered, and depths thereafter are reported as metres below datum. Thus the depth from ground level to the datum will not show on the screen, but can be deduced by subtracting the datum level from the ground level reported in the *Basic Well Information* screen.

CODES

Codes have been entered according to the geological scheme outlined in the help option (F1 key) and in Appendix III. Driller's logs have been interpreted according to this scheme. A **zero** denotes that the geology of a particular unit or sub-unit is not known, or that there is no further description of a particular unit/sub-unit.

LITHOLOGY

The lithological description is described according to the driller's log, with interpretations made where necessary by a qualified geologist / hydrogeologist. Where the lithology does not provide any more information than that conveyed in the code, the lithology has usually not been entered (eg. topsoil 840, boulder clay 820).

Where the letter "m" has been entered in beside the elevation and the thickness, this denotes that the memo (F10) should be referred to. It usually means that a depth or thickness has been estimated from ~~many~~ sites or from contour maps. Thus these values are approximate.

3.5 OWNERSHIP DETAILS

This section is self explanatory. Note that the occupier may be different than the owner.

3.6 SOURCE TESTING

The main sources of information were the technical files (pump test files), which are located in the same room as the well survey sheet catalogues. Most of these files contain pump test data, however the data has not always been analysed. Licence determination reports found in these technical files proved quite useful. Geophysical information may also be found in these files.

3.6.1 Pump Test

If a monitoring site has been used as an observation borehole for a nearby abstraction

borehole, this is stated in the memo along with details of the pumped borehole. Otherwise it may be assumed that aquifer parameters were determined from pump testing of the monitoring network borehole.

TEST TYPE If a test type other than those listed in the help screen (F1) has been used to determine the aquifer parameters, this field has been left blank and the test type entered into the memo (eg. slug tests).

TRANSMISSIVITY If simple calculations have been used to estimate these parameters, the
STORATIVITY calculations have been entered into the memo (eg. Logan's Approximation where $\text{Transmissivity} = 1.22 \times \text{discharge} / \text{drawdown}$).

When "01" has been entered into the day and/or month category, this usually indicates that the exact date of the test is unknown. Thus "01" has been entered only to complete the field. A date of 01/01/1968 usually indicates that the pump test was carried out under the Groundwater Pilot Scheme (GWPS) which commenced in 1968.

T & S values calculated from a step test has only been entered where no constant rate test results are available. Otherwise values represent constant rate figures, even when step test values are available.

3.6.2 Geophysical Logging

Where a reference number or code exists for a geophysical log, this has been entered in the *Basic Well Information* screen under the *Report References* field. A reference list of geophysical logs is found in Appendix IV.

TYPE In most cases a number of log types are available, hence this field has been left blank in most instances. Where one or two types have been used, the appropriate log types have been entered according to the options listed in the help screen.

LOCATION

The location of logs at the Brampton Agency office is either in the storage shed or in the technical files.

A separate file of geophysical log interpretations is found at the Brampton office - Water Resources Department (Hydrogeology), covering logs that are located at Anglian Water Services Ltd (AWS Ltd). The interpretations are updated up until 1989. The log locations have been entered as Anglian Water Services Ltd for these records.

If an observation borehole is known to have been constructed and/or logged under the supervision of AWS and no records are available at Brampton, it has been assumed that AWS have the geophysical ~~work~~

DATE

Where the date is unknown, the borehole construction date has been entered instead.

3.7 WATER LEVEL DETAILS

MONITORING FREQUENCY

For the chalk aquifer, the monitoring frequency of most boreholes is monthly. For the Woburn Sands and Norfolk Greensand aquifers the monitoring frequency of most sites is quarterly, although monthly readings are common for a small number of sites. The frequency has been obtained from the water level database.

The three monitoring types are:

- 1) chart (C) Munro Chart Recorder
- 2) logger (L) Data Logger
- 3) manual (M)

A site which does not appear in the chart or logger lists in Appendix V is assumed to be manually monitored.

INFLUENCES

An observation borehole/well located close to a large scale licensed groundwater abstraction (eg. public water supply, large scale spray irrigation) that is, has been or has the potential of being influenced by pumping has been allocated one of three varying types of pumping "P" influence:

definite observation borehole is significantly affected by the nearby abstraction, the influence showing up quite clearly on the borehole hydrograph. The borehole is usually located <100m away from the abstraction borehole.

probable observation borehole is located close to a large scale abstraction (<500m), was significantly influenced from pump testing of the abstraction source. An influence may not be clearly seen on the hydrograph, especially if the abstraction is more or less continuously pumped. Drought conditions may obscure pumping effects.

possible observation borehole located close to a groundwater abstraction (<500m), however pump test results are absent or unreliable. May indicate that future increases in abstraction rates at a nearby borehole could have a pumping effect on the observation site, even though it does not seem to have an effect at the present rate.

A pumping influence has only been entered where the effect is not solely attributable to pump tests (eg. pump test of a purpose built observation borehole).

Observation network sites that are also used for abstraction are considered as being potentially affected by pumping, unless it is

absolutely certain that water level measurements were always taken under static conditions (ie. pump off / water level fully recovered).

**PUMPING
EFFECTS**

Pumped boreholes only. Data is usually obtained from yield tests, often given in the BGS well catalogues. Full scale pump test results are not entered into this field.

3.8 WATER LEVEL VALIDATION

**ELEVATION OF
MAXIMUM W.L.** This value is the maximum water level as given in the *Water Level Details Screen*, plus 0.1 m. The depth below ground surface is automatically calculated.

**ELEVATION OF
MINIMUM W.L.** This value is the maximum water level as given in the *Water Level Details Screen*, minus 0.1 m. The depth below ground surface is automatically calculated.

3.9 MEMO

The memo is used to provide any additional information that may be useful. This may include information that elaborates on details in any of the previous sections that require further explanation (eg. estimates in the lithology section).

**PRIMARY
PURPOSE**

Every effort has been made to state the primary purpose of the borehole/well with respect to monitoring or licensing schemes / investigations.

DEPTH

Borehole/well depths have been entered as metres below ground level, unless stated otherwise.

4. INTEGRITY OF THE DATABASE

In order to preserve the integrity and reliability of the HYDRODAT database, the following procedures should be adhered to:

4.1 Periodic Updates

All databases should be indexed at least once a month (section 2.7.1).

System statistics should be updated at least once a month (section 2.7.4).

In addition a record should be kept of these periodic updates so that the user is always aware of the last time these functions were carried out. This is discussed in section 4.2.

In addition to the above the *Licence status* field should be checked periodically to ensure that outstanding pending applications "P/A" are appropriately changed (section 3.2).

4.2 Hydrodat Alterations File

Any changes made to the HYDRODAT database should be recorded in the "HYDRODAT ALTERATIONS" file, kept next to PC 95513 (Hydrogeology Room), which has the master copy of HYDRODAT. Any changes to HYDRODAT should be made on PC 95513 only. The file is subdivided into the following sections:

- 1) Indexing and System Statistics
- 2) Site Additions / Deletions
- 3) Water Level Additions
- 4) Water Level Alterations (changes and deletions)
- 5) Station Archive / Geology Alterations

The date and reasons for change should be entered. Each change should be initialled by the person who has made the change.

4.3 Authorised Persons

As of March 1997 the only persons authorised to make changes to the master copy of HYDRODAT (PC 95513) are listed below:

Chris Taylor	Hydrogeology	Water Resources
Tony Reynolds	Hydrogeology	Water Resources
Eileen Young	Hydrogeology	Water Resources
Michael Hutchinson	Hydrogeology	Water Resources
Richard Maxey	Hydrometry	Water Resources

Any other persons who are authorised (by the Senior Hydrogeologist) to make changes to HYDRODAT should be entered below. This may include new persons replacing those listed above, persons from other departments, or persons seconded or hired on a temporary basis to the Environment Agency.

Name	Position	Department	Date	Authorisation

APPENDIX I

Plotter Set-Up Instructions

Fax Message

To : T. Reynolds / S. Wallace

@ E.A. 01480 413381

From : T R Haggrenes

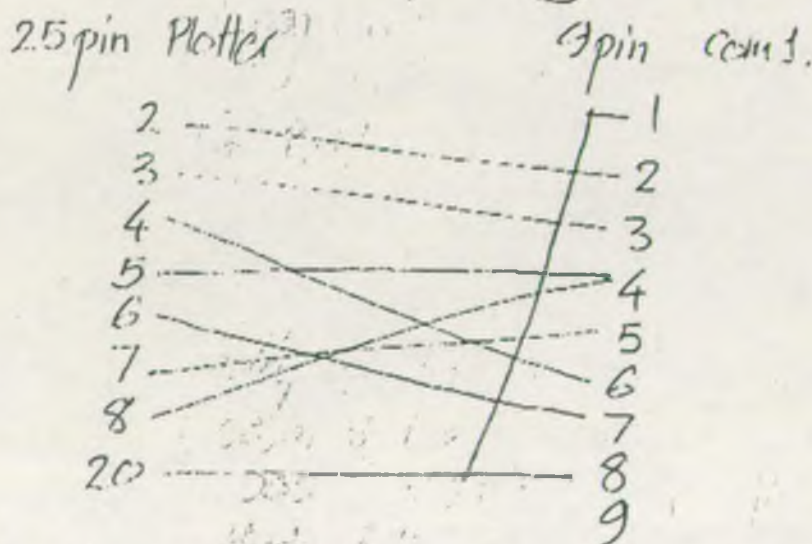
@ H.S.I. 01483 35759

Date : 16 Jan 1997

Re : Plotting

I have successfully plotted to a HP 7475 with a
mode of com1, 8, 1, p.
both through DOS with copy <file> com1:
and through Hydrat.

The plotter cable has the following connections.



Dip Switches on Plotter

81 84
000001010

APPENDIX II

Central Area Aquifer Codes

CENTRAL AREA AQUIFER CODES

AL	Alluvium
CB	Cornbrash
CR	Crag
CS	Carstone
CH	Chalk
UC	Upper Chalk
MC	Middle Chalk
LC	Lower Chalk
BL	Blisworth Limestone
FG	Fluvioglacial Sand and Gravels
FD	Fen Deposits
GO	Great Oolite
GU	Upper Greensand
KB	Kellaway Beds
LL	Lincolnshire Limestone
LT	London Tertiaries
NG	Norfolk Greensand
NS	Northampton Sands
RC	Red Chalk
SA	Sandringham Sands
SS	Spilsby Sandstone
UE	Upper Estuarine Series
UK	Unknown
UM	Multiple
UN	Non Aquifer
UO	Other

APPENDIX III

Central Area Lithological Codes

CENTRAL AREA LITHOLOGICAL CODES

000	NOT KNOWN		
900	MAN MADE	920	ABOVE GROUND
		910	MAN MADE
800	DRIFT	890	CLAY
		893	NAR VALLEY CLAY
		892	ALLUVIAL
		891	CLAYEY TILL
		880	CLAYEY SILT
		883	LACUSTRINE
		882	ALLUVIAL
		881	TILL (GLACIAL)
		870	SILTY SAND
		873	CRAG
		872	ALLUVIAL
		871	GLACIOFLUVIAL
800	DRIFT	860	CLEAN SAND
		861	WINDBLOWN
		850	SAND AND GRAVEL
		855	BEACH DEPOSITS
		854	RIVER TERRACE
		853	CRAG
		852	ALLUVIAL
		851	GLACIOFLUVIAL
		840	TOPSOIL
		830	PEAT
		831	WETLAND FEN
800	DRIFT	820	BOULDER CLAY
		810	CRAG
		802	ALLUVIAL DEPOSITS
		801	GLACIAL DEPOSITS (BURIED CHANNEL)
700	CHALK	730	UPPER CHALK
		732	TOP ROCK
		731	CHALK ROCK
		720	MIDDLE CHALK
		721	MELBOURN ROCK
		710	LOWER CHALK
700	CHALK	715	PLENUS MARLS
		714	GREY CHALK
		713	TOTTERNHOE STONE
		712	CHALK MARL
		711	CAMBRIDGE GREENSAND

600	GAULT	630	UPPER GREENSAND	
		620	RED-CHALK	
		610	GAULT CLAY	
500	WOBURN SANDS	530	FULLERS EARTH	
		520	SANDSTONE	
		510	SAND	
400	NORFOLK GREENSAND	430	CARSTONE	415 DERSINGHAM BEDS
		420	SNETTISHAM CLAY	414 LEZIATE BEDS
		410	SANDRINGHAM SANDS	413 MINTLYN BEDS
				412 RUNCTON BEDS
				411 ROXHAM BEDS
300	UPPER JURASSIC CLAY FORMATIONS	330	KIMMERIDGE CLAY	
		320	AMPTHILL CLAY	322 CLAY
				321 WEST WALTON FORMATION
		310	OXFORD CLAY	
200	MIDDLE JURASSIC	230	KELLAWAY FORMATION	234 ROCK
				233 SAND
				232 SILT
				231 CLAY
		220	GREAT OOLITE GROUP	224 CORNBRASH
				223 BLISWORTH CLAY
				222 BLISWORTH L/S
				221 U. ESTUARINE SER
		210	INFERIOR OOLITE GROUP	213 L. ESTUARINE SER
				212 NORTHHAMPTON IRONSTONE
				211 NORTHMPTN SAND
100	LOWER JURASSIC	130	UPPER LIAS	
		120	MIDDLE LIAS	
		110	LOWER LIAS	121 MARLSTONE ROCK

APPENDIX IV

Geophysical Logging Reference List

CENTRAL AREA GEOPHYSICAL LOGS

WHITE

GWDS Thetford Area

1. 71 TL88/66
2. 73 TL98/145
3. 74 TL98/148
4. 75 TL98/147

5. TL98/154
6. TM08/109
7. TM09/138
8. TM08/103

Others

9. TF70/70
10. TL43/61
11. TL33/93
12. TL65/42
13. TL44/289
14. TL77/1,2,7,20
15. TF80/171
16. TL44/289
17. TL34/18
18. TL66/78
19. TL02/126
20. TL02/127
21. TL53/21
22. TL44/289
23. CWC Ob, Duxford
24. TL55/133
25. TL87/128
26. TL77/85
27. TL77/93
28. TL77/83
29. TL77/84
30. TL87/130
31. TL34/165
32. TL34/169

33. TL34/170
34. TL34/167
35. TL34/175,171
36. TL34/171
37. TL34/175
38. TL44/46,43,44
39. TL44/45
40. TL44/46
41. TL77/51
42. TF90/127
43. TL12/108
44. TL12/109
45. TL22/15
46. TL44/249
47. TL77/18
48. TL55/9
49. TL55/99
50. TL55/118,119
51. TL55/117
52. TL22/15
53. TL44/239?
54. TL55/154
55. TF72/46
64. TL44/301

Greensand

56. SP92 Heath & Reach
57. SP92/16
58. SP92/5
59. SP93/21, SP92/129

60. SP92/72
61. TL14/117
62. TL 3985 5135
63. TL44/45

BLUE

Granta Basin

- | | | | |
|----|-------------------|-----|--------------------|
| 1. | TL64/41 (to 115m) | 8. | TL54/113 |
| 2. | TL64/41 (to 140m) | 9. | TL54/101 |
| 3. | TL54/101 | 10. | TL54/119 |
| 4. | TL54/121 | 11. | TL54/119 (caliper) |
| 5. | TL54/116 | 12. | TL54/122 |
| 6. | TL54/112 | 13. | TL54/114 |
| 7. | TL54/101 | 14. | TL54/119,120? |

Swaffham

- | | | | |
|-----|----------|-----|-----------|
| 15. | TF80/16 | 20. | TF80/153 |
| 16. | TF80/170 | 21. | TF80/55 |
| 17. | TF80/61 | 22. | TF80/152 |
| 18. | TF80/59 | 23. | TF80/58 |
| 19. | TF80/151 | 24. | TF80/58,5 |

PURPLE

GWDS Cam / Rhee

1.	35	TL34/163	28.	140	TL23/41
2.	37	TL34/48	29.	141	TL23/42
3.	38	TL44/230	30.	144	TL33/40
4.	39	TL43/30	31.	144	TL33/40
5.	39	TL43/30	32.	145	TL33/41
6.	39	TL43/30	33.	146	TL33/42
7.	41	TL44/245	34.	146	TL33/42
8.	42	TL44/231	35.	147	TL33/43
9.	43	TL44/267	36.	147	TL33/43
10.	44	TL23/149	37.	148	TL34/105
11.	46	TL33/70	38.	148	TL34/105
12.	48	TL33/39	39.	148	TL34/105
13.	48,51	TL33/39,46	40.	149	TL33/44
14.	121	TL34/48	41.	150	TL33/45
15.	124	TL44/235	42.	150	TL33/45
16.	125	TL43/31	43.	151	TL33/46
17.	127	TL43/32	44.	152	TL33/47
18.	127	TL43/32	45.	153	TL33/48
19.	129	TL44/238	46.	153	TL33/48
20.	133	TL44/23	47.	154	TL33/60
21.	134	TL44/24	48.	154	TL33/60
22.	135	TL44/240	49.	155	TL43/54
23.	135	TL44/240	50.	156	TL44/288
24.	136	TL44/307	51.	158	TL43/58
25.	137	TL45/14	52.	159	TL44/287
26.	138	TL44/286	53.	49	TL43/53
27.	139	TL23/40			

APPENDIX V

Chart Recorder / Data Logger Site Lists

GROUNDWATER LOGGER ARCHIVING (AS OF MAR 1997)

Sites having data loggers with record on HYDROLOG database.
Details of the record can be found in the black file kept in Hydrology.

Site ID	Site Name	NCR
TL 77/177	Tuddenham Heath (deep)	TL 7467 7326
TL 77/178	Cavenham Heath	TL 766 727
TL 77/192	Icklingham Plains	TL 7644 7340
TL 77/193	Cavenham Heath	TL 766 193
TL 79/10	Cerne No 2, Mundford	TL 7935 9088
TL 79/109	Wellington Wellfield	TL 762 901
TL 79/140	Cranwich Layby	TL 7774 9502
TL 79/145	Wellington Wellfield	TL 7497 9252
TL 88/85	Baxter Healthcare	TL 8525 8281
TM 08/11	Hay Fen, Quidenham	TM 0400 8835
TM 09/180	Banham Poultry	TM 0617 9377
TF 70/126	Cockley Cley, car park	TF 7949 0406
TF 70/127	Cockley Cley, edge of copse	TF 7968 0388
TF 70/128	Gooderstone, Plantation entrance	TF 7649 0158
TF 70/129	Furze Hill	TF 7424 0352
TF 70/130	Furze Hill	TF 7480 0345
TF 70/131	Near Stringsides Drove	TF 7149 0095
TF 80/211	North Pickenham, road verge	TF 8668 0656
TF 80/212	North Pickenham, field boundary	TF 8706 0642
TF 80/213	Water End Farm	TF 8441 0192
TF 80/214	Dairy Cottages, Brandon Road	TF 8934 0008
TF 80/215	New Field Barn	TF 8922 0023
TF 80/216	New Field Barn	TF 8922 0023
TF 80/217	Little Cressingham	TF 8666 0025
TF 80/218	Little Cressingham	TF 8657 0039
TL 80/118	Bodney Bridge	TL 8276 9877
TL 89/119	Near Bodney Bridge	TL 8264 9864

(AS OF MARCH 97)

Details of the record can be found in the black file kept in Hydrology.

[illegible]

CONTINUOUSLY MONITORED BOREHOLES (AS OF MAR 197)

Sites having Munro chart recorders.
Charts are kept in the red files in Hydrology.
One reading each month has been entered onto HYDRODAT.

Site ID	Site Name	NGR
TL 14/125	Warren Villas	TL 1750 4807
TL 23/5	Odsey	TL 2926 3804
TL 23/40	Ashwell, Silver Leys	TL 2695 3952
TL 23/41	Ashwell, Slip End	TL 2745 3806
TL 23/42	Ashwell, The Cinques	TL 2862 3912
TL 34/165	Royston, Shell Oil Depot	TL 3475 4105
TL 34/167	Royston, Mackerel Hall	TL 3500 4082
TL 35/1	Wimpole Park	TL 3279 5054
TL 43/7	Parsonage Farm, Chrishall	TL 4457 3890
TL 44/11	Fowlmere Cress Beds	TL 4043 4566
TL 44/208	Thriplow Meadows No.1	TL 4375 4683
TL 44/289	Ciba Ceigy, Duxford	TL 4815 4528
TL 44/335	Thriplow Meadows No.2	TL 4375 4685
TL 55/144	Six Mile Bottom, Lower Farm	TL 5930 5606
TL 75/68	Park Farm, Ousden	TL 7285 5964
TL 77/103	How Hill, Elveden	TL 7633 7634
TL 77/46	Cavenham	TL 7708 7169
TL 79/7	Spring Lodge, Methwold	TL 7519 9464
TL 79/21	Wellington Plantation	TL 7642 9136
TL 86/171	Bury St Edmunds Parkway	TL 8520 6385
TL 87/133	North Stow Farm	TL 8124 7585
TL 89/2	Buckenham Tofts	TL 8323 9475
TL 98/29	Ringmere	TL 9100 8780
TF 71/7	Narborough	TF 7474 125
TF 80/170	Swaffham, Kings Lynn Road	TF 8114 0923
TF 81/10	Washpit Farm	TF 8135 1959