Institute of Hydrology

Overseas Development Report

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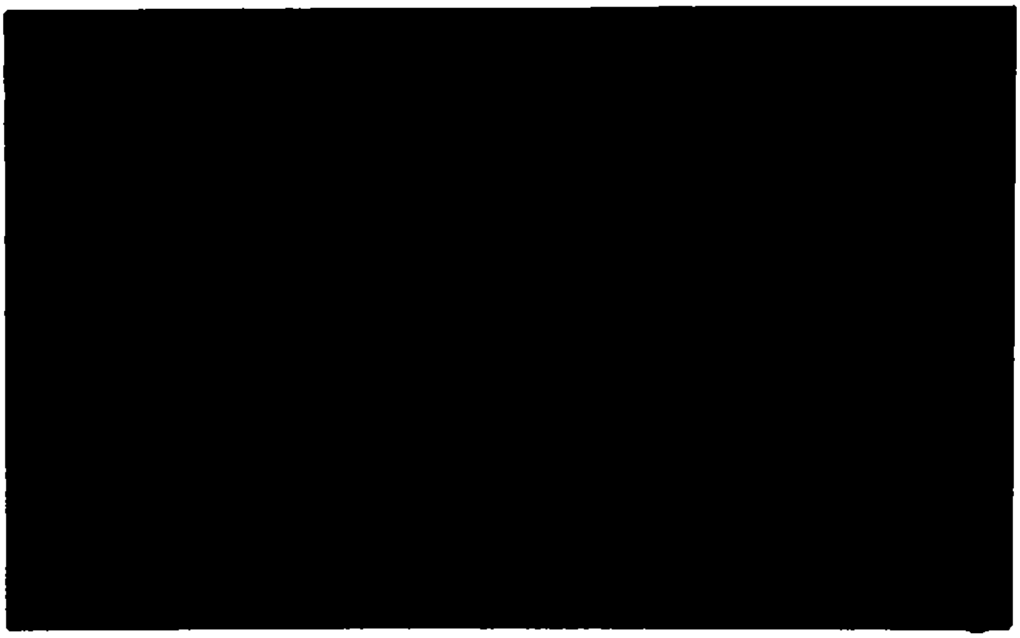
Natural Environment Research Council



HYDATA Advanced Training Workshop

Institute for Meteorological Training and Research

Report to the Overseas Development Administration and the World Meteorological Organisation

14-25 February 1994

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Institute of Hydrology
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
UK

Tel: 0491 838800
Fax: 0491 832256
Telex: 849365 Hydrol G

ODA 94/3

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1 Introduction

HYDATA is a hydrological database system for personal computers which was developed at the Institute of Hydrology in the United Kingdom. HYDATA has been used in more than 50 countries worldwide including more than 20 African countries (see Figure 1).

In November 1990, a 1 week HYDATA workshop (ref.1) was held in Nairobi, Kenya at the Institute for Meteorological Training and Research (IMTR) which is part of the Kenyan Meteorological Department. The workshop was attended by 12 working hydrologists from 10 African countries and aimed to give the participants practical experience in using personal computers and databases for the analysis of hydrological data, together with an in-depth knowledge of the HYDATA system. The workshop was jointly funded by ODA (through IH) and WMO, and was envisaged as a first step in developing a homogeneous hydrological database system throughout the SADCC and IGADD countries of Africa. As a direct result of this workshop, HYDATA was adopted as the national database system for Uganda (ref.2) and several of the other countries represented have since obtained funding for the system and the associated computer hardware.

Following the success of this first workshop, it was decided to hold the course annually to give African hydrologists from other organisations a chance to see and use the system. WMO recommended that the workshop should in future be timed to coincide with the WMO sponsored Regional Postgraduate Diploma course in Operational Hydrology at IMTR. This nine month course aims to bring working hydrologists and hydrometeorologists from African countries up to date in the latest hydrological measurement and analysis techniques. The participants can come from any African country but must be educated to at least BSc standard and must be working in an operational hydrology or meteorology deparment. Two such workshops were organised on this basis and were held in 1992 (13 participants from 8 African countries - ref.3) and 1993 (12 participants from 9 African countries - ref 4).

Following the 1993 workshop, IMTR and IH jointly proposed that IMTR should be established as a regional training centre for HYDATA and that an advanced training course should be organised to provide IMTR staff with the expertise to run HYDATA workshops in future with only limited support from IH. This report describes the outcome of this advanced training. Funding for the Institute of Hydrology contribution was again provided by ODA through the project "HYDATA dissemination" (ODA Research Scheme no. D120) and funding for the IMTR contribution was provided by WMO.

2 The workshop

2.1 ADVANCED TRAINING

The advanced training was held from 14-18 February 1994 at the Institute for Meteorological Training and Research in Nairobi and also continued as a background activity during the main HYDATA workshop which was held in the following week 21-25 February 1994 (Appendix A). The advanced training was given by two staff members of the Institute of Hydrology. Three computers were loaned by IMTR and the WMO Drought Monitoring Center (DMC) for the duration of the course:

HYDATA USERS in Africa

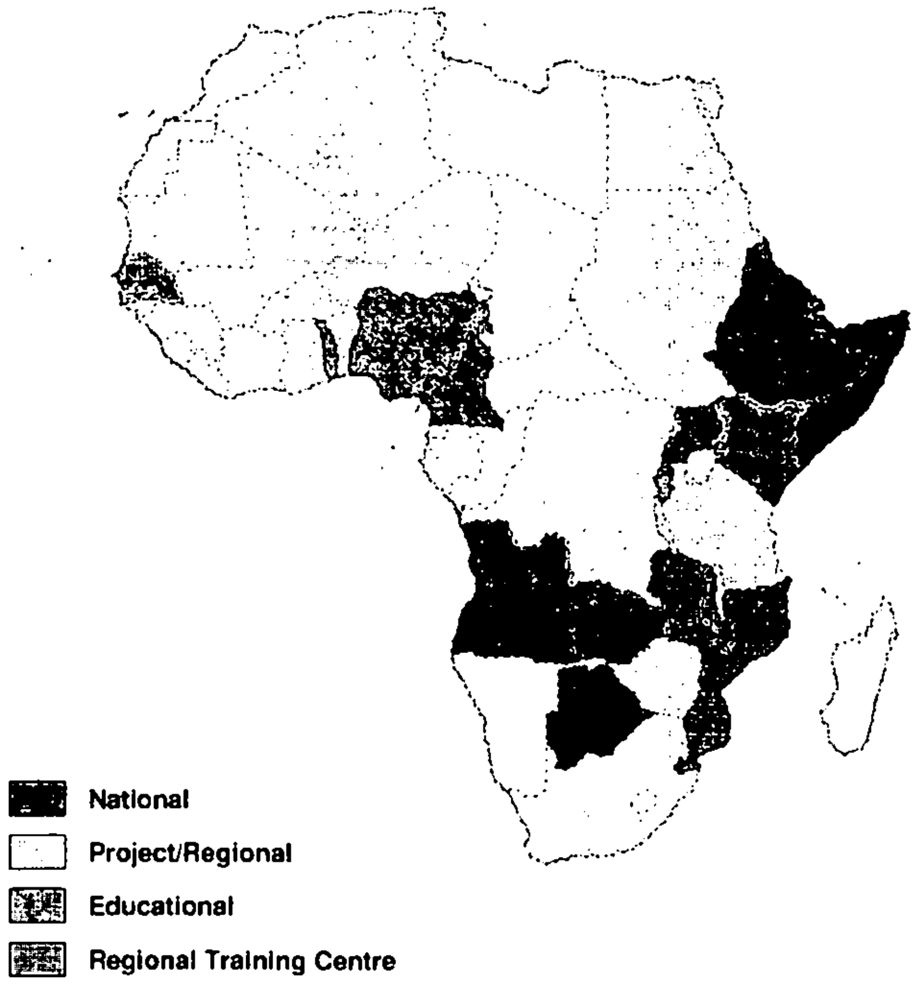


Figure 1

Type	Processor	Memory		Screen	Disk drive
BULL MICRAL 600	80386	640K RAM	VGA	3.5 inch	1.44 Mb
DEC STATION 300	80386	640K RAM	VGA	3.5 inch	1.44 Mb
BULL MICRAL 200	80286	640K RAM + extended	VGA	3.5 inch	1.44 Mb

DMC also lent an IBM proprinter and an Epson dot matrix printer. Several other computers owned by IMTR or DMC and used in the previous workshops were either in use on other projects or were too outdated to run the latest and most powerful version of HYDATA (Version 3.10A) used for the workshop. An additional laptop computer and 2 Canon portable printers were also lent by the Institute of Hydrology for use on the course. The computing equipment was installed in a lecture room which was reserved for the duration of the course. All of the details of course administration and registration were dealt with efficiently by IMTR.

IMTR nominated six staff to attend the advanced training course (Appendix B). The nominees all had previous teaching experience and together encompassed a wide range of research interests:

Organsiation	Postion	Research and teaching interests
IMTR	Deputy Director	Low flow and flood frequency analysis
IMTR	Meteorologist	Rainfall runoff modelling
DMC	Systems Manager	Drought forecasting/computer systems management
DMC	Hydrometeorologist	Regional evaporation estimation and water balances
MWD	Hydrologist	Operational hydrology
UNMD	Lecturer	Flood frequency analysis

IMTR = Institute for Meteorological Training and Research
DMC = WMO Drought Monitoring Centre
UNMD = Head Office of Ministry of Land Reclamation, Regional and Water Development, Nairobi
MWD = Meteorology Department, University of Nairobi

As the main aim of the HYDATA training courses is to give the participants practical 'hands on' experience of using a hydrological database system, the main part of the advanced training was centred around the set of practical exercises which the participants were to attempt during the main workshop in the following week. These include 18 prepared exercises and a post-flood assessment project. The background to these exercises and the 'model' answers to the questions were covered in detail together with revision of the underlying theory. Once the full course material had been covered, individual lecturers were allocated specific topics to cover in more depth, and further training was given on a 'one to one' basis in each of the topics chosen. In general, the nominated lecturers were already familiar with much of the theory and quickly picked up the skills needed to operate the HYDATA system.

One further aspect of the advanced training was to simulate some of the hardware and software related problems which, in our experience, often occur during software training courses. For these exercises, two of the lecturers were nominated as 'System Managers' and, during the main workshop, were presented without warning with a range of simulated hardware and software failures to fix. These included problems like accidentally deleting or corrupting key program files, accidentally introducing computer viruses to the course computers, incorrectly modifying the computer's configuration files and various problems with setting up and operating printers and plotters. The ability to 'troubleshoot' problems of this type is vital when running software training courses for users with only limited computing experience.

2.2 MAIN WORKSHOP

The main workshop followed on immediately from the advanced training. Eight participants from four African countries attended the workshop (Appendix B). Apart from the introductory lecture, all of the lectures and individual tuition were given by IMTR's nominated lecturers. Overall, the workshop ran smoothly with little assistance from the two Institute of Hydrology staff, other than to provide additional advanced training.

As in previous courses, the participants were supplied with copies of the teaching material used during the course and with various technical papers giving more background information on the software. Copies of the HYDATA manual and the UK Low Flow Study report, which were donated to the IMTR library in 1992, were also made available for reference. The participants worked mainly in pairs but also had the opportunity to work alone during lunch and coffee breaks.

Appendix A lists the program of the workshop and the subjects which were covered. The first two days were spent on the basic operations of entering, plotting and editing data and developing rating curves. The third day was spent on aspects of data transfer and system management. The discussion included a description of the responsibilities of the System Manager in setting up and maintaining a database system ready for operational use. The main analysis options in HYDATA, and the underlying theory, were covered on the fourth day and the final day was given over to revision and demonstrations of other software. Also, a revised week-long project was included which is designed to demonstrate the way HYDATA is actually used operationally in many hydrological departments. The project consisted of entering a backlog of historic river level and discharge data for a site, developing a rating equation for the site, converting the levels to flows and then deriving various flow statistics for use in a hypothetical post-flood assessment study.

Several related topics were also covered during the course. For example, a half day was spent on a general introduction to personal computers and the DOS operating system. This was useful preparation for the data transfer exercises and is essential knowledge for anyone who uses personal computers on a regular basis. The following related hydrological software packages were also used or demonstrated:

- HDBINS   Installation and customisation program for HYDATA
- HYTRAN   A program for loading data directly onto a HYDATA database
- HYFAP   A flood frequency analysis package

More information on these packages is given in the technical leaflets at the back of this report. Together, these components provide an integrated system for the capture, routine analysis and storage of hydrological data.

3 Recommendations and conclusions

IMTR's nominated lecturers generally coped well with mastering and delivering the course material. The course was kept on schedule and the project - which was more difficult than in previous years - was completed by the end of the week. Initial feedback from the eight participants was that it had been a useful although intensive week and many expressed the intention to use HYDATA on their main course project, due to start in the second semester of the Operational Hydrology course. Also, this year, most of the participants thought it likely that they will use HYDATA when they return to their normal duties at the end of the course since, with only two exceptions, HYDATA is already used in the Head Office of all the departments represented.

For use on future courses, IMTR were presented with copies of all the overhead transparancies used on the course and with a set of briefing notes for the lecturers (Appendix C). IMTR was also given a 20 user educational licence for the full HYDATA system. This will allow IMTR to keep HYDATA permanently loaded on several machines for use both in teaching and in project work by the participants. IMTR and DMC staff will also be able to use HYDATA in their own research work if they wish (and IH would encourage this as a way of becoming more familiar with the system).

Several discussions were also held about future workshops. On the evidence of this first IMTR-managed course, IMTR will have little difficulty organising HYDATA training courses in future. However, some continuing annual support will be required from the Institute of Hydrology in the form of updated lecture notes, participant training packs, updates to software and, possibly, additional advanced training. In particular, for the next course, we strongly recommend that IMTR are provided with the following items:

1. The HYFAP flood frequency analysis package
2. The HYRROM rainfall runoff model
3. A laptop computer and computer screen projection panel

The HYFAP and HYRROM packages link into HYDATA and would be a useful complement to existing modules in the Operational Hydrology course while the laptop computer and projection panel would make demonstrating the exercises on the computers much easier.

For the future, we anticipate that the IMTR-managed HYDATA courses will continue to provide working hydrologists with useful direct experience of the advantages of using computers for processing hydrological data and will further encourage adoption of the HYDATA database system in many African countries. Indeed, experience from past courses does suggest that several countries have subsequently submitted requests for HYDATA systems after seeing the system in use either at IMTR or in other African countries. IMTR may also wish to provide direct regional support of existing HYDATA users possibly through organising advanced regional HYDATA training workshops themselves. The Institute of Hydrology would strongly support this approach if adopted. It is worth noting that, of the

SADCC and IGADD countries, most now have at least one organisation using the HYDATA package and, in many of these countries, HYDATA is used as the national database system for archiving hydrological data.

References

1. The HYDATA Workshop, Institute for Meteorological Training and Research, 19-23 November, 1990. IH report to the Overseas Development Administration and the World Meteorological Organisation, December 1990.

2. A hydrological database system for Uganda; installation and training. IH report to the British Development Division in East Africa, Nairobi, Kenya, May 1992.

3. HYDATA workshop, Institute for Meteorological Training and Research, 7-11 April, 1992. IH report to the Overseas Development Administration and the World Meteorological Organisation, May 1993.

4. HYDATA workshop, Institute for Meteorological Training and Research, 21-26 March, 1993. IH report to the Overseas Development Administration and the World Meteorological Organisation, ODA 93/4.

Appendix A Programme of the workshop

IMTR, FEBRUARY 21-25, 1994

<u>Monday February 21</u>

Introduction and Welcome
General principles of operation
Plotting and printing
Entering and editing river level data

<u>Tuesday February 22</u>

Entering and editing river level data (continued)
Introduction to DOS and hardware
Entering and editing discharge measurements
Rating curve development
Introduction to project

<u>Wednesday February 23</u>

Introduction to system management
Data backup and restore options
Monthly data and other data types
Project work (continued)

<u>Thursday February 24</u>

Comparison plot options
Double mass curves
Flow Duration curves
Low Flow analysis routines
Project work (continued)

<u>Friday February 25</u>

Data transfer methods
Demonstrations of other software
General discussion of project work
Closing speeches and presentation of certificates

Course exercises

The course was based around a set of 18 prepared exercises covering the following topics:

1. General principles of operation, plotting data

2. Examining contents of database

3. Stage data editor, printing and plotting stage data

4. Gauging data editor. Plotted and printed output for gaugings

5. Fitting rating curves

6. Conversion of stage to discharge or storage

7. Conversion of daily to monthly values

8. Allocating space and setting up stations

9. Loading data from a file

10. Backing up data to floppy disc

11. Installing and customising a HYDATA database

12. Revision of edit, print and plot options for daily data

13. Comparison plots

14. Double mass plots

15. Flow duration curves

16. Low flow statistics (base flow index, annual minima)

17. Transferring data using HYTRAN and HYDATA macro files

18. Introduction to DOS

Appendix B The course participants

Advanced training course

1. Philip D. Munah
   Deputy Director
   Institute for Meteorological Training and Research
   Kenya Meteorological Department
   PO Box 30259
   Nairobi
   Kenya

2. Julius N. Kabubi
   Meteorologist I
   Institute for Meteorological Training and Research
   Kenya Meteorological Department
   PO Box 30259
   Nairobi
   Kenya

3. Joseph M. Kimani
   Senior Meteorologist: Systems
   WMO Drought Monitoring Centre
   Kenya Meteorological Department
   PO Box 30259
   Nairobi
   Kenya

4. Johnson Maina
   Hydrometeorologist I
   WMO Drought Monitoring Centre
   Kenya Meteorological Department
   PO Box 30259
   Nairobi
   Kenya

5. Mr E.M.Mnyamwezi
   Senior Hydrologist
   Ministry of Land Reclamation, Regional and Water Development
   PO Box 30521
   Nairobi
   Kenya

6. Mr Alfred O. Opere
   Lecturer (Hydrometeorology)
   Department of Meteorology
   University of Nairobi
   Nairobi
   Kenya

Main workshop

1. Hamis G.K. Mbaruku
   Senior Assistant Geologist
   Water Research Section
   Ministry of Water, Energy and Minerals
   P.O.Box 35066
   Dar es Salaam
   Tanzania

2. Projestus Magezi Rwiza
   Executive Engineer
   Operations and Maintenance
   Ministry of Water, Energy and Minerals
   P.O.Box 35066
   Dar es Salaam
   Tanzania

3. Atakelte Teferi
   Geoscientist II
   Ethiopian Valleys Development Authority
   PO Box 1086
   Addis Ababa
   Ethiopia

4. Muchai Shaban Mugwika
   Hydrologist II
   Ministry of Land Reclamation, Regional and Water Development
   PO Box 30521
   Nairobi
   Kenya

5. Stanley Nyaga Mbae
   District Hydrologist
   Ministry of Land Reclamation, Regional and Water Development
   District Water Office
   PO Box 4571
   Kisumu
   Kenya

6. Aaron Bundi Aduna
Hydrologist
Hydrology Division
Architectural and Engineering Services Corporation
PO Box 3969
Accra
Ghana

7. Namusasi Edward Masibaye
Meteorologist II
Kenya Meteorological Department
PO Box 30259
Nairobi
Kenya

8. Gerald Muhara
Meteorologist-Climatologist
Kenya Meteorological Department
PO Box 30259
Nairobi
Kenya

Appendix C Lecture material provided to IMTR

IMTR were provided with the following material for use on future courses:

C.1 A full set of all the overhead transparancies used on the course. These comprise some 120 colour transparancies divided into ten 1 hour (approx.) lectures on the following themes:

Introduction
General principles of operation
Editing data
DOS and hardware
Gaugings and rating curves
System Management
Analysis 1
Analysis 2
Data Transfer
Project

C.2 Lecturer's briefing notes. These comprise some 40 pages of notes on various aspects of the HYDATA package. These notes are designed to supplement the information provided in the HYDATA manual and on the overhead transparancies, and are grouped into the following themes:

Introduction to HYDATA
General principles of operation
Editing data
Rating curves
System Management
Data analysis
Data Transfer
DOS and hardware

C.3 HYDATA tutorial notes. A set of 18 prepared exercises which test participants on various aspects of the HYDATA system, together with 'model' answers to the questions at the end of each exercise (not included here).

C.4 Notes for the course project. The project is designed to run over several days and simulates a miniature 'crisis' in a hydrological department. In a short space of time, participants are required to enter a backlog of historical data and to derive various statistics relating to an imaginary flood event. The answers are required for use in justifying or rejecting possible compensation claims following failure of a flood protection embankment. The project material consists of a set of notes and some 80 observer record cards containing the project data (not included here).

INSTITUTE OF HYDROLOGY

HYDATA TRAINING COURSE

Institute for Meteorological Training and Research

Nairobi

HYDATA

AIMS OF COURSE

- Working knowledge of HYDATA
  - hydrological database system for personal computers
- Introduction to PC's
- Introduction to DATABASES
- Revision - Hydrological data/ analysis
- Demonstration of other software

HYDATA

HISTORY OF COURSE

FUNDED BY WORLD METEOROLOGICAL ORGANISATION (WMO) AND THE BRITISH OVERSEAS DEVELOPMENT ADMINISTRATION (ODA)

1990	First Workshop (12 Hyrologists from 10 African countries)
1992	Second Workshop (13 hydrologists from 8 African countries)
1993	Third Workshop (12 Hydrologists from 8 African countries)
1994	First course organised by IMTR staff

* REGIONAL HYDATA COURSES FOR AFRICAN HYDROLOGISTS

TANZANIA 1995 - SOUTHERN AFRICA FREND PROJECT

HYDATA

PLAN OF COURSE

DAY 1	Introduction to HYDATA Editing data
DAY 2	Gaugings and Ratings
DAY 3	System management
DAY 4	Analysis options
DAY 5	Revision Project work

HYDATA

COURSE MATERIAL

PARTICIPANTS

- Lecture notes
- Copies of transparencies
- Exercise notes
- Notes on Course Project

MATERIAL FROM IMTR LIBRARY

- UK Flood Studies Report
- UK Low Flow Studies Report
- HYDATA Manual

HYDATA

COURSE CONTENT

- Lectures
- Demonstrations
- Course exercises
- Course Project
- Tutorials and advanced options

HYDATA

WHY USE A HYDROLOGICAL DATABASE SYSTEM

Gives rapid access to data

Provides high quality output;
- graphical
- tabular
- yearbook output

Allows data to be analysed e.g
- rating curves
- flow duration curves
- low flow analysis

Improves data quality control

Improves data security

Improves staff motivation and efficiency

HYDATA

WHAT IS HYDATA

- Hydrological database system for personal computers
- Allows for storage of data types most commonly encountered in water resources studies
- Used by more than 50 countries worldwide
- Used as national database system in more than 20 countries

HYDATA

FEATURES OF HYDATA

- Full editing facilities for data
- Rating curve editor
- Conversion options
  - Levels → Flows
  - → Storage
  - Daily → Monthly
- System Summary
- Installation program
- Analysis options
  - Flow Duration
  - Comparison Plots
  - Low Flows
- Menu driven (+ mouse)
- Graphical/ tables output
- Hydrological year

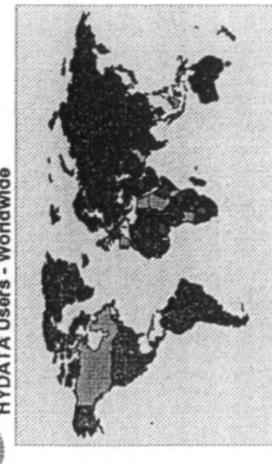
HISTORY OF HYDATA

- Developed by the Institute of Hydrology, UK
- Based on mainframe database system used until recently for UK hydrological data
- Specially adapted for personal computers with user friendly input and output
- Dissemination supported by;
  - national governments
  - World Meteorological Organisation
  - Overseas Development Administration and others
- 1995 New version for WINDOWS to be released with mapping and network facilities

HYDATA SUPPORT AND DEVELOPMENT

- Regional workshops in Africa and elsewhere
- On-site training courses
- Permanently staffed helpline at Institute of Hydrology
- 12 months free advice on installation and use (extensions for nominal charge)
- New versions of Hydata released every 1 - 2 years
- I.H.Software Newsletter issued twice a year (including HYDATA news and ideas)

HYDATA Users - Worldwide



HYDATA USERS in Africa

BACKGROUND TO INSTITUTE OF HYDROLOGY

- Established 1967
- Main research centre for hydrology in UK
- Site of UK national surface water database
- 150 professional staff
- Funded by :
  - government
  - international agencies
  - consultancy work
- Research interests include:
  - water resources
  - flood estimation
  - low flows
  - water quality
  - hydrometeorological instrumentation
  - hydrological software
  - training

Location of the Institute of Hydrology

GENERAL PRINCIPLES OF OPERATION FOR HYDATA

HYDATA MENUS

- HYDATA is operated by a screen menu system
- A menu is a list of options and data entry forms
- Special keys for using HYDATA

↑ ↓

PGUP
PGDN
ESC
HOME
END

EXAMPLE OF A HYDATA MENU

NAME

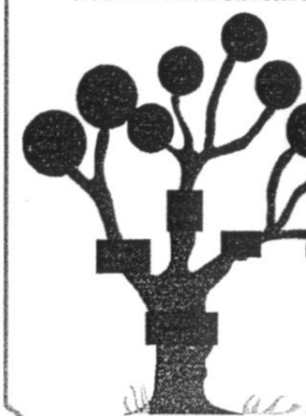
DATA SELECTION - EVC1

TO PREVIOUS MENU

[1] Quit
[2] Station No. : [10123]
[3] Year [1991]
[4] Find data

OPTION — TO NEXT MENU — DATA ENTRY BOX

HYDATA menu structure



SPECIAL KEYS IN HYDATA

GENERAL

F1	HELP MESSAGES
F3	QUIT HYDATA
F4	READ FILE
ESC	GO BACK 1 LEVEL

MENUS

PGUP
PGDN
HOME
END

DATA ENTRY BOXES

DEL HOME END BKSP

TYPES OF DATA STORED IN HYDATA

RIVER LEVEL
+ FLOW
RESERVOIR/LAKE STORAGE
GAUGINGS and RATING CURVES
LEVEL/STORAGE CURVES
RAINFALL
GENERAL e.g. MET DATA
WATER QUALITY DATA

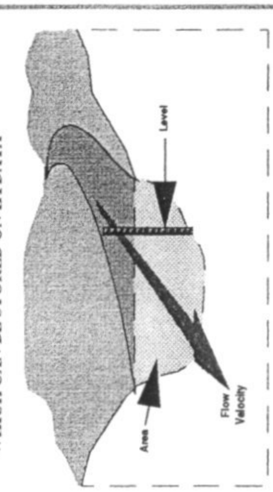
DATA STORAGE INTERVALS IN HYDATA

UP TO 100 READINGS /DAY
-RIVER LEVELS/RAINFALL

DAILY - ALL DATA TYPES

MONTHLY - ALL DATA TYPES

EXAMPLE OF THE TYPE OF DATA WHICH CAN BE STORED ON HYDATA



STATIONS - GENERAL PRINCIPLES

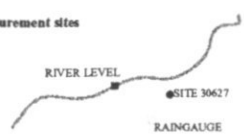
- All data in HYDATA are stored in stations
- A station is any site where data are collected
- Station identities are numerical only 1- 99999999 (But 32 character name)
- Space for station must be allocated in advance

Station types on HYDATA

- EVENT (LEVEL/RAINFALL) 100/DAY
- GAUGING + RATING
- DAILY FLOW
- DAILY GENERAL
- DAILY RAINFALL
- DAILY STORAGE
- MONTHLY

EXAMPLE OF STATION NUMBERING SYSTEM

Measurement sites



Stations required on HYDATA

RIVER
30627 EVENT (LEVELS) 2/DAY
30627 GAUGINGS + RATINGS
30627 DAILY FLOW (AVERAGE)
30627 MONTHLY FLOW

RAINFALL
30627 DAILY RAINFALL (TOTAL)
30627 MONTHLY RAINFALL (TOTAL)

HYDATA

PRACTICAL SESSION 1

- All practical sessions are based on the set of exercises provided with the course notes
- The exercises are based on a demonstration database of data from several different countries
- The demonstration database is described in the HYDATA manual

HYDATA

EXERCISES

(based on the demonstration database)

- **Using MENUS and SPECIAL KEYS**
- **DATABASE summary** **Exercises 1 and 2**
- **Editing data**
- **Gaugings and ratings**
- **Converting levels to flows**
- **Monthly data**
- **COMPARISON PLOTS**
- **DOUBLE MASS PLOTS**
- **FLOW DURATION CURVES**
- **BASE FLOW ANALYSIS**
- **Loading data**
- **Setting up a database**

HYDATA

INTRODUCTORY EXERCISE + EXERCISES 1/2

TOPICS COVERED

- **Using menus**
- **Using special keys**
- **Producing plots**
- **Producing database summary**

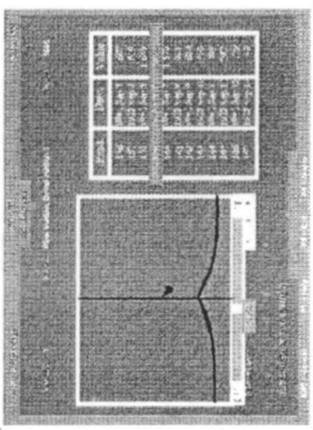
i.e. General priciples of operation

HYDATA

EDITING DATA

- **Every station has an editor**
- **The editors are used for entering data from the keyboard or from file**
- **Many options are available**
  e.g. Apply correction factors (unit conversion)
  Interpolate for missing data
  Enter data flags
- **Use with or without a mouse**

EXAMPLE OF A HYDATA EDIT SCREEN



HYDATA

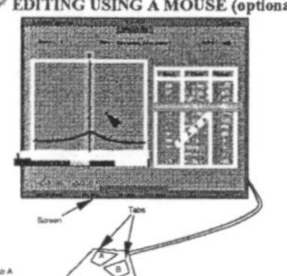
MOVING AROUND THE EDITORS

[HOME]	- Move to top
[END]	- Move to end
[PGUP]	- Move up a page
[PGDN]	- Move down a page
ARROWS	- Move up/down a line
MOVE 12	- Move to line 12
JAN 15	- Move to January 15
[ESC]	- Display Menu TS1

Sets data limits and editor default parameters (e.g. default flag, limits on interpolation)

HYDATA

EDITING USING A MOUSE (optional)



Using Tab A

Area 1 Denote data span

< << >> > Moves through data in large or small increments
Place arrow along shaded area to centre data from that part of the hydrological year on the screen display

Views into smaller span or out to larger span
Shows data value at that point in the file

Area 2

Select date from data file and edit value with screen arrow

Tab B Goes to TS1 - Options
(On screen help is available in this menu by pressing the [F1] button)

HYDATA

EDITING DATA VALUES

Data value formats

e.g.

12.7	Flag 1
12.7,1	Flag 1
12.7,2	Flag 2
m	missing

Default flags

Original	Chart
Estimate	Model
Ratio	Observer
Logger	Missing

ALWAYS USE DATA FLAGS WHEN ENTERING DATA

HYDATA

EDITOR COMMANDS

- **SET/COR** Apply a constant and/or multiplier to the data
- **BLOCK** Defines block of data
- **SET** Used to set block of data to same value
- **LIN/INT** Used to interpolate data (Linear / Logarithmic)
- **TIME** Changes times displayed (EVENT data only)

See HYDATA manual for details

HYDATA

GAUGINGS

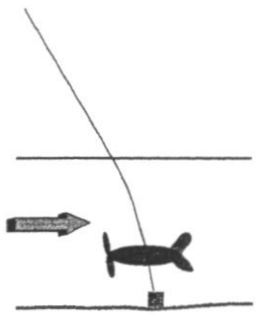
- **Simultaneous measurements of level and flow**
- **Also called discharge measurements**
- **Usually made using current meters (from cableway/by wading/by boat/from a bridge)**
- **Also floats/theoretical methods**
- **In HYDATA, also applies to simultaneous measurements of lake or reservoir levels and storage**
- **Date required consists of**

DATE

and LEVEL/AREA/VELOCITY/FLOW or STORAGE

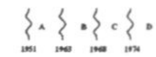
optional optional
(set to 1.0 if missing)

TYPICAL SETUP FOR DISCHARGE MEASUREMENTS



BASIC CONCEPTS - GAUGING DATA

SPLIT BY DATE



EXCLUDE ?

APPLY WEIGHTING

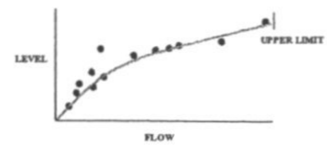
Q* 2

or +

DELETE (Doubtful reading)

IGNORE (Enter rating manually)

RATING CURVES IN HYDATA



$$Q = a(h + c)^b$$

FLOW LEVEL

$$\text{Log } Q = \log a + b \log (h + c)$$

RATING CURVE CALCULATIONS IN HYDATA

LEAST SQUARES FIT LOG/LOG

(Reduces to linear)

FIX C, FIND BEST a AND b

REPEAT TO FIND BEST C

UP TO 6 PARTS

UP TO 26 SHIFTS IN TIME

e.g. BED MOVEMENT

CHANNEL MODIFICATION

(LETTERS A - Z)

PROBLEMS IN RATING CURVE DEVELOPMENT

SEASONAL EFFECTS

e.g. Weeds

BACKWATER EFFECTS

e.g. Sluices, Tributaries

LOOPED RATING CURVE

Rising /Falling limb - slope effect

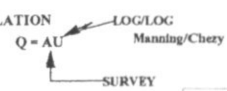
CHANNEL/FLOOD PLAIN CHANGES

e.g. Scouring

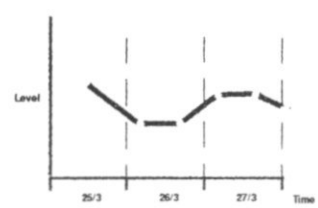
Deposition

Engineering works

EXTRAPOLATION

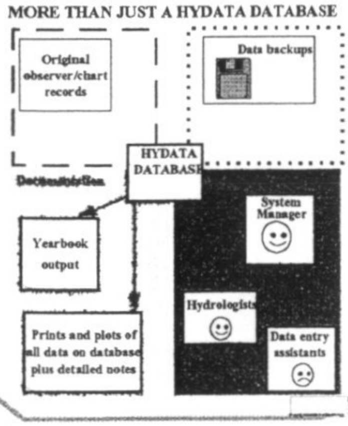


CONVERSION



SYSTEM MANAGEMENT

A WELL MANAGED SYSTEM CONSISTS OF MORE THAN JUST A HYDATA DATABASE



ROLE OF THE SYSTEM MANAGER

- Ensure all documentation is kept up to date
- Supervise data entry and validation work
- Ensure HYDATA backups are performed regularly
- Add/delete stations
- Customise HYDATA using the installation program
  e.g. defining passwords
  setting titles for output
- Training junior staff
- Publishing the data and supervising data transfers to other organisations

HINTS ON PERFORMING DATA BACKUPS

- Data backups are essential
  (for example, your computer might break, be stolen, be damaged in a fire or storm)
- It is advisable to perform backups every week
- The floppy discs should be kept in a separate room or building to the computer
- A copy of the database should be kept on a second computer (if available)
- For extra security, the Institute of Hydrology operates a Data Disaster Recovery Service - you send copies of your database to the UK for safe storage in case of problems

HYDATA

DATA BACKUPS

YOU CANNOT MAKE TOO MANY DATA BACKUPS

Floppy discs are cheap but the time spent entering and checking data is irreplaceable

HYDATA

HINTS ON ADDING A NEW STATION

1 Backup the Database before starting

2 Allocate enough space for all future requirements

a) Stage stations - Check No. readings /day
- Data format
- Type

b) Flags

- Missing	Chart
Original	Logger
Estimate	Radio
Observer	Lockage

c) Monthly stations

1900 - 2000 Automatically

HYDATA

HDBINS
THE HYDATA INSTALLATION PROGRAM

- Allows many aspects of HYDATA to be changed

  e.g. Passwords (3 levels of protection)

  Appearance of graphs

  Hydrological year

  Printers/plotters used

- The program can be run at any time

BUT there is one exception

NEVER CHANGE THE HYDROLOGICAL YEAR AFTER STARTING TO LOAD DATA ON A DATABASE

HYDATA

DOCUMENTATION

- A database is NO use without detailed records on the data loaded and the analyses performed
- There are two main types of documentation

  System documentation

  Station files

HYDATA

SYSTEM DOCUMENTATION

As a minimum this should consist of :

- Record of backups performed
- Record of problems encountered with hardware/software

  e.g. computer breakdowns

  mistakes made in operating the database

- An up to date SYSTEM SUMMARY from HYDATA
- Record of data entry and validation work
- Copies of all yearbooks produced

HYDATA

STATION FILES

These should contain:

- All documentation relevant to a station

  e.g. observer names

  repair work done

  post flood survey data

  maps

- Plots and print out of all validated data

  e.g. flow hydrographs

  rating curve plots and discharge tables

  data tables

- Detailed notes on validation and analysis work performed for the station

  e.g. Infilling performed

  data deleted due to errors in original records

  Notes on rating curve development

HYDATA

ANALYSIS ROUTINES IN HYDATA

- HYDATA provides some basic analysis routines

  COMPARISON PLOTS

  DOUBLE MASS PLOTS

  FLOW DURATION CURVES

  LOW FLOW ANALYSIS

  Baseflow index

  Annual minimum frequency plots

- More complex analyses can be performed outside HYDATA using related software:

  e.g. HYFAP Flood frequency analysis

  HYRROM Rainfall runoff analysis

HYDATA

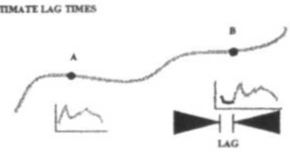
COMPARISON PLOTS

- The comparison plot options allow 2 time series to be plotted on the same graph
- Also allows more than 1 year of daily data to be plotted on a graph

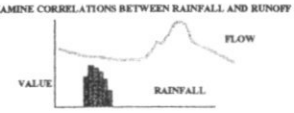
HYDATA

SOME TYPICAL USES OF COMPARISON PLOTS

ESTIMATE LAG TIMES



EXAMINE CORRELATIONS BETWEEN RAINFALL AND RUNOFF



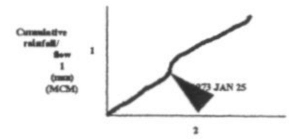
COMPARISON PLOTS - OPTIONS IN HYDATA

- **Plot data as lines or histograms**
  (e.g. use histogram for rainfall)
- **Invert one series**
  (e.g. to examine the timing of flood peaks)
- **Lag one series with respect to the other**
  (e.g. to estimate the lag between two stations)
- **Plot the logarithms of the data**
  (e.g. to examine low flow behavior)

DOUBLE MASS PLOTS

- In HYDATA, double mass plots are based on daily data
- Compare cumulative flows or rainfall at 2 stations
  - Quality checks on data
  - Examining correlations between stations
- Typical uses
- A 'break' in the curve indicates a positive problem with the data

IDENTIFYING ERRORS WITH DOUBLE MASS PLOTS



Shows possible data error starting from Jan 1973

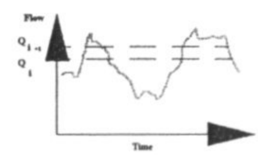
SOME POSSIBLE CAUSES OF 'BREAKS' IN DOUBLE MASS PLOTS

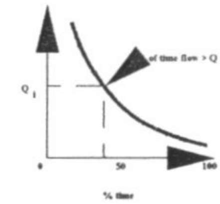
- FLOW DATA (2 nearby stations on the same river)
  - Shift in rating
  - Abstractions between the 2 stations
  - Tributary inflow between the 2 stations
- RAINFALL DATA (2 nearby raingauges)
  - Raingauge moved
  - Exposure of raingauge changed (e.g. tree cut down, building constructed near gauge)
- GENERAL
  - Change in observer
  - Change in measurement units
  - Change in recording equipment

FLOW DURATION CURVES IN HYDATA

- Show percentage of time a given flow exceeded
- Based on daily data (up to 5 stations)
- Output as plots or tables
- Typical uses
  - Measurement of flow reliability
  - Guide to catchment characteristics
  - Validation of output for hydrological models

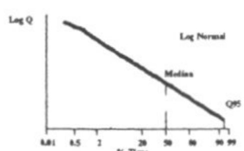
METHODS USED TO CALCULATE FLOW DURATION CURVES IN HYDATA



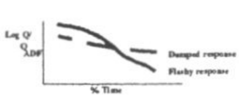


EXAMPLES OF USES OF FLOW DURATION CURVES

Calculating the median flow and Q95



Comparing catchment response



FLOW DURATION CURVES - OPTIONS IN HYDATA

- D - Day option
  Specify the flow averaging period e.g. 1 Day
  5 Days
- Divide by ADF option
  Normalise all values by the Average Daily Flow
  (e.g. for comparison between catchments)
- Use linear or logarithmic axes
- Specify season
  e.g. Summer or winter curves
- Divide by catchment area option
  (e.g. for comparison between catchments)

LOW FLOW ANALYSIS ROUTINES IN HYDATA

- BASE FLOW INDEX
- LOGARITHMIC PLOTS OF HYDROGRAPHS
- RECESSION PLOTS
- ANNUAL MINIMA PLOTS

Only possible to present a brief introduction here.
For further information, refer to the HYDATA manual.

HYDATA

LOW FLOW ROUTINES

- The methods are based of those recommended in the UK 'Low Flow Studies Report, 1980'
- Although developed for the UK, the methods are suitable for many countries
- The most common uses of the low flow routines are:

  Deriving catchment characteristics
  Estimating flow reliability
  Developing models for infilling data
- Particularly useful for regional/international studies of catchment response e.g. FREND projects in West Africa Southern Africa (9 countries)

HYDATA

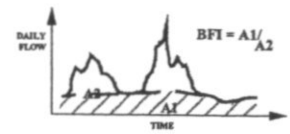
BASE FLOW INDEX

- Gives a measure of the proportion of flow originating from groundwater sources
- A high BFI implies a large groundwater contribution
- A low BFI implies a high surface runoff contribution
- Maps of BFI give a useful guide to catchment response on a regional scale
- BFI can also be used in regression equations for predicting other low flow statistics

e.g. $Q_{95} = aBFI + b$

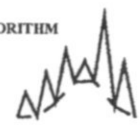
HYDATA

CALCULATION METHOD FOR BASE FLOW INDEX



The Base Flow Index is defined as Area1 /Area 2

ALGORITHM



The HYDATA annual gives full details of the algorithm used

HYDATA

BASE FLOW INDEX OUTPUT

- Output can be provided on the screen or as a printed table
- The hydrograph separation can also be plotted
- The Average Daily Flow (ADF) is also computed

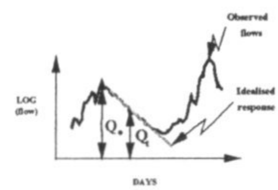
HYDATA

LOGARITHMIC PLOT OPTION

- Plot daily flows on a logarithmic basis
- Used to examine recession/low flow response
- For example, can be used to estimate an average recession constant for use in infilling/low flow forecasting

HYDATA

ESTIMATING THE RECESSION CONSTANT FROM A LOGARITHMIC PLOT



THEORY

If $Q = Q_0 e^{-at}$

Then $a = -\frac{1}{t}\log\left[Q_t/Q_0\right]$

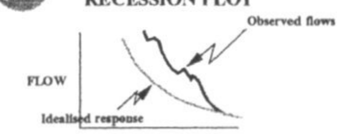
HYDATA

RECESSION PLOT OPTION

- An alternative method for estimating the recession constant
- Works well on some UK data
- Not widely used - so presented for general interest only
- However, may be useful in some situations

HYDATA

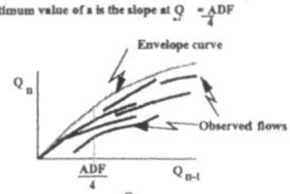
RECESSION PLOT



THEORY

Assumes observed values bounded by an envelope curve

Optimum value of a is the slope at $Q_{n-t} = \frac{ADF}{4}$



$$\text{Slope} = \frac{Q_n}{Q_{n-t}} = e^{-at}$$

HYDATA

LOW FLOW FREQUENCY PLOTS

- Produces plots of annual minimum flows against return period
- Assumes Weibull Distribution/ Gringorten Plotting position
- Used to estimate flow reliability

  e.g. Annual minimum flows for the 100 year return period

HYDATA

EXAMPLE OF FORTRAN SUBROUTINE LIBRARY

```
C-----------------------------------------------------------
C
C Example of program using the HYDATA subroutine library
C
C Extracts 10 years of daily flow data for Station 102301 (1974 to 1983)
C and writes values to file TEMP.DAT
C
C-----------------------------------------------------------
C
   REAL VAL(366)
   INTEGER IFLAG(366)
C
   CALL HYLIB(40)
C
   OPEN(61,FILE='TEMP.DAT',STATUS='UNKNOWN')
C
   IST=102301
   IYS=1974
   IYF=1983
C
   DO 100 IY=IYS,IYF
C
    CALL HYGY(IST,IYS,IYF,VAL,IFLAG,NDAYS,IERR)
C
    IF (IERR.NE.0) THEN
     WRITE(6,9991)
     GOTO 9999
    ENDIF
C
    WRITE(6,*) IY
    WRITE(61,9992) IY,VAL
C
100 CONTINUE
C
9991 FORMAT(25(/),
  &' *** PROGRAM STOPPED - ERROR READING DATABASE ***')
9992 FORMAT(I4,/,36(10F8.1,/))
C
9999 STOP
   END
```

HYDATA

LOW FLOW FREQUENCY OPTIONS IN HYDATA

- **D-Day option**
  Defines averaging period for flows e.g.1 Day
  5 Days
- **Missing days option**
  Defines maximum number of missing days allowed per year
- **ADF divide option**
  Standardises results by the average daily flow
- **MAM**
  Standardises results by the mean annual minimum
- **Plotted or tabular output**

HYDATA

OTHER OPTIONS FOR ANALYSIS OF DATA

- **For simplicity, HYDATA only provides a limited range of analysis options**
- **Other options for data analysis include:**
  - Export the data to a spreadsheet or statistical package (Using 'Write file' or HYDOUT)
  - Write FORTRAN routines using the HYDATA FORTRAN Subroutine Library
  - Use software packages which link directly to HYDATA
    e.g. HYFAP flood frequency analysis
    HYRROM rainfall runoff modelling

HYDATA

DATA INPUT AND OUTPUT

(EXERCISES 9 and 17)

HYDATA

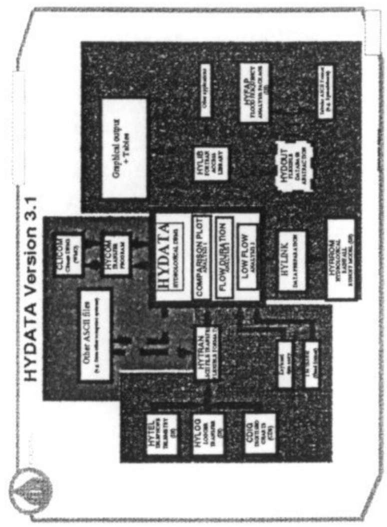
OPTIONS FOR DATA TRANSFER

INTO HYDATA

1. Keyboard
2. F4 + Datafile
3. F4 + Macro file
4. HYTRAN
5. HYCOM (from CLICOM)

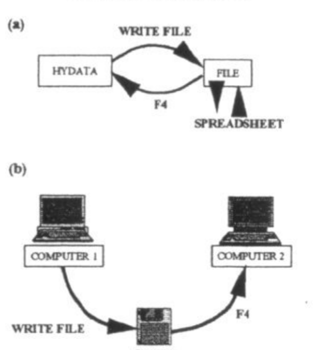
OUT OF HYDATA

1. Graphs/ Tables
2. Write File option
3. HYDOUT
4. FORTRAN Subroutine Library
5. HYCOM (to CLICOM)



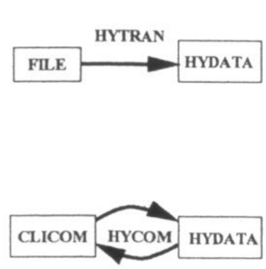
HYDATA

EXAMPLES OF METHODS FOR DATA TRANSFERS



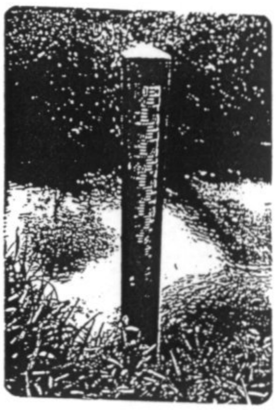
HYDATA

EXAMPLES OF METHODS FOR DATA TRANSFERS



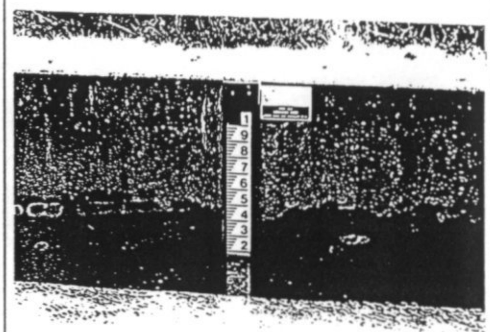
HYDATA

EXERCISE 3 EDIT SOME EVENT DATA



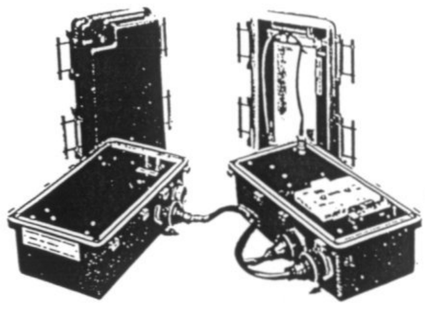
HYDATA

EXAMPLE OF STAFF GAUGE



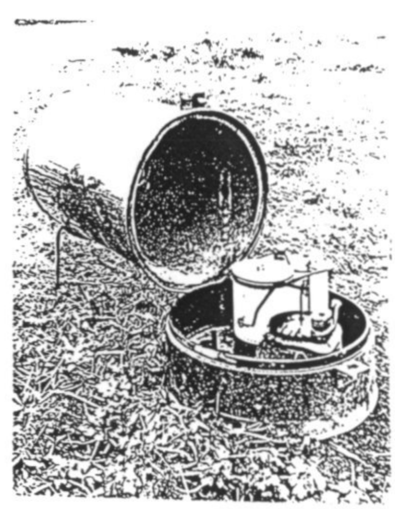
HYDATA

EXAMPLE OF AUTOMATIC DATA LOGGER



HYDATA

EXAMPLE OF RAINGAUGE



HYDATA

EXAMPLE OF SUMMARY INFORMATION (EXERCISE 2)

File allocation usage for ... stations

Daily data

Key

- = outside project period
= inside project period
x = space allocated - no data
# = space allocated - data on

Table 3.1 Example of System Summary Print List - page 4

HYDATA

LIST OF HYDATA EDIT COMMANDS

COMMAND	DESCRIPTION
BLOCK r1 - r2	Define a block from reading number 'r1' to 'r2'. The block will be shown on the screen by flags of filled squares. The numbers r1 and r2 in the command can be separated by minus, comma or space.
BLOCK ALL	Defines the whole data set as a block, with Event data the whole year would be set as a block.
BLOCK OFF	Removes the current BLOCK setting.
COMM	The 'COMM' command allows a comment to be entered or amended. Comments may optionally be stored for Event data on a monthly basis. Each comment may be up to 32 characters in length and is displayed in the bottom right hand corner of the screen. File space has to be allocated for comments when the station year space is allocated.
COR	The 'COR' command (Correct) applies the currently set multiplying factor and constant to the currently active block of data. The multiplying factor is applied before the addition of a constant. The form of the command is COR which applies the correction to the block assigned. If no block is assigned COR will have no effect. The correction is only applied within the stage limits set in menu TS1. Section 4.2 explains these limits and describes how the constant and multiplying factor may be changed.
COR X	Will apply the correction as COR, but will also change the 'source' of the data. Source 1 will become Source 2 and vice versa.
DATE	Move to the current date. The format depends on the type of data: for event and daily use mmm dd (eg apr 5 to move to April 5th) (note "dd" is optional), for monthly use mmm yyyy (eg mar 1990 to move to

cont...

HYDATA

LIST OF HYDATA EDIT COMMANDS

	March 1990)
[End]	Pressing this key (or entering E) sets the current reading to the last reading in the year.
[→]	Pressing this key advances the current position by one reading.
[Esc]	The [Esc] command transfers the user from the edit screen to the TS1 options menu, and vice versa.
[Home]	Pressing this key (or entering T) sets the current reading to the first reading in the year.
INT	Fill all missing values within the current block, and where the gap in data does not exceed the limit defined in menu TS1 option [10], by logarithmic interpolation. (Note that it is not possible to interpolate to or from zero or -ve readings)
LIN	Fill all missing values within the current block, and where the gap in data does not exceed the limit defined in menu TS1 option [10], by linear interpolation.
M	Entering m or M sets the current value missing.
SET vvv,vv,s	Set all the source 's' values within the current block and within the current limits defined in menu TS1 to value 'vvv,vv'. 'vvv,vv' can be set missing using m. To change all missing values set 's' to 0. Examples: SET m,2 (set all source 2 values to missing), SET 0.0,0 (set all missing values to 0.0).
MOVE r	Move to reading 'r' eg MOVE 30000.
BAR	Plot data as bars in the graph.
LINE	Plot data as lines in the graph.

cont...

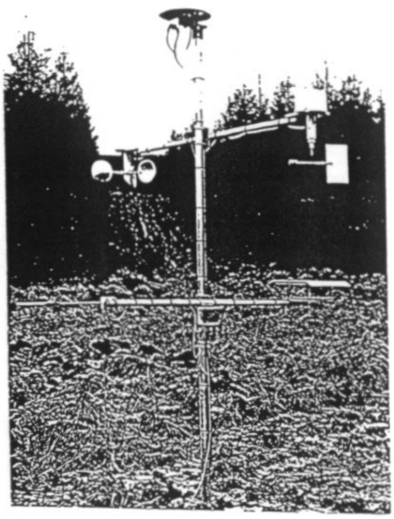
HYDATA

LIST OF HYDATA EDIT COMMANDS

FILE ON	Plot 'file' data as well as 'edit' data.
FILE OFF	Only plot 'edit' data.
POINTS n	Plot 'n' points before the current reading and 'n' points after. The default is set with the 'points' option of menu TS1, and the update of display is made faster by reducing the number of points plotted.
S	The 'S' command stops the screen updating as the current position moves through the data. The main use of this command is to speed up the entry of data from file. For example if a whole year of data was to be read in using the F4 [Macro] key (Section 2.10), the time taken would be considerable since the screen would require much updating. However, if the 'S' command was given prior to [Macro], the process would be many times faster. The screen update may be returned to its normal 'on' state by a second 'S' command.
TIME	The 'TIME' command changes the time of the current reading and is therefore only available for EVENT data. The format of the command is TIME hh:mm:ss where hh, mm, ss are the new hours, minutes and seconds respectively of the new time. The new time applies only to the 'Edit' data until edits are saved using option [8] of Menu EVD1. The new time will then be saved on file. The 'TIME' command is effective for the whole year of data. For example if the second reading of the day were originally set to 6:00:00 hours and it was changed to 8:30:00 hours by the command TIME 08:30:00, the second reading of the day for all days within the year would then be changed to 8:30 am. TIME must be used in sequence so that a time set is not later than a following data time or previous to an earlier data point.
[>]	Pressing this key has the same effect as the [→] key.

HYDATA

EXAMPLE OF AUTOMATIC WEATHER STATION



HYDATA

EXERCISE 4,5 AND 6 - GAUGINGS AND RATINGS

HYDATA

EXAMPLE OF GAUGING EDITOR PRINTOUT

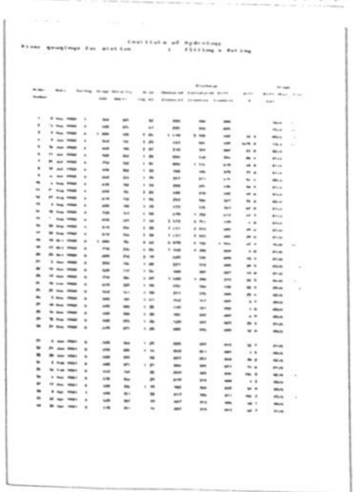
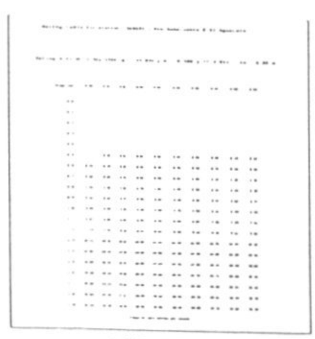
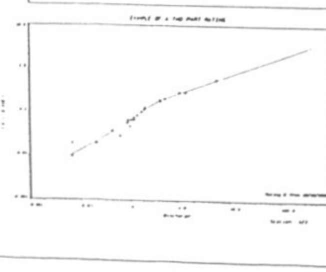


Table 6.3 Example printout of river gaugings

HYDATA

EXAMPLES OF RATING CURVE EDITOR OUTPUT





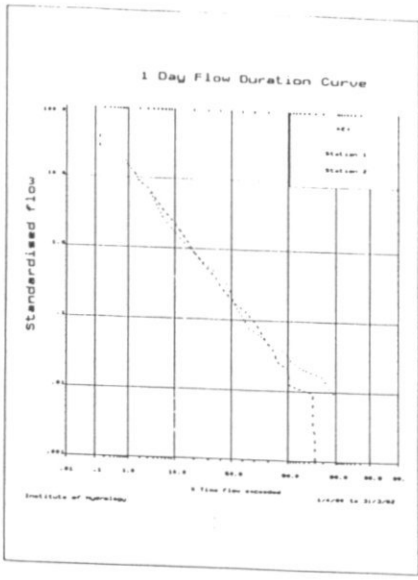


Figure 9.3 Example of flow duration curve plot

EXAMPLE OF FLOW DURATION ANALYSIS SHORT PRINTOUT

Institute of Hydrology

FLOW DURATION TABLE

Period of analysis from 1 Apr 1976 to 31 Mar 1982

Time interval (days) = 1 Intervals in period = 2191

Station number : 1 Name : Flow station. Demo station 1
Station number : 2 Name : Flow station. Demo station 2

	Station 1	Station 2	Station
Intervals with data	2161	2191	
Intervals missing	30	0	
Average daily flow	.456	.460	
95 percentile (Q95)	.005	.021	
90 percentile (Q90)	.008	.030	
75 percentile (Q75)	.022	.065	
50 percentile (Q50)	.057	.083	
25 percentile (Q25)	.192	.329	
10 percentile (Q10)	.834	.925	
5 percentile (Q 5)	2.159	1.703	

Average daily flow and percentiles cubic metres per second

Average daily flow from 1 Apr 1976 to 31 Mar 1982

Table 9.1 Example of flow duration analysis short printout

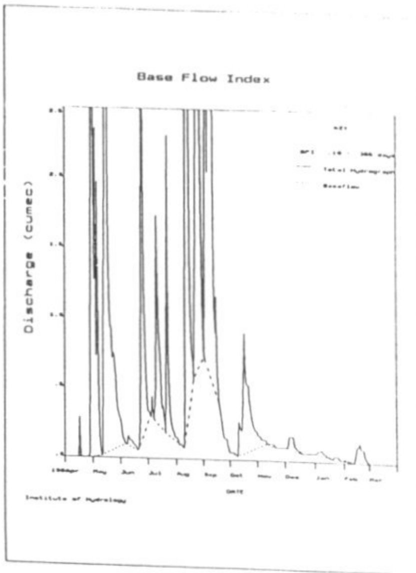


Figure 9.4 Example of baseflow index plot

Institute of Hydrology
BASEFLOW INDEX CALCULATION

Station number : 1 Name Flow station. Demo station 1

Period of analysis from 1 Apr 1980 to 31 Mar 1982

BFI calculated over whole period

Number of days in period = 730
Number of days with data = 693
Number of days for BFI = 584

Total volume (mm / year) = 1782.17
Baseflow volume (mm / year) = 307.16

BFI = .172

BFI in each hydrological year

Year start	Days	Data days	BFI days	Total (mm)	Baseflow (mm)	BFI
Apr 1980	365	330	275	1759.95	264.10	.150
Apr 1981	365	363	309	1089.50	226.92	.208

Table 9.4 Example of printout of BFI

9

HYDATA

EXAMPLE OF HYDATA YEARBOOK OUTPUT WITH NOTES ON VALIDATION WORK

CHAPTER 7 DAILY DATA

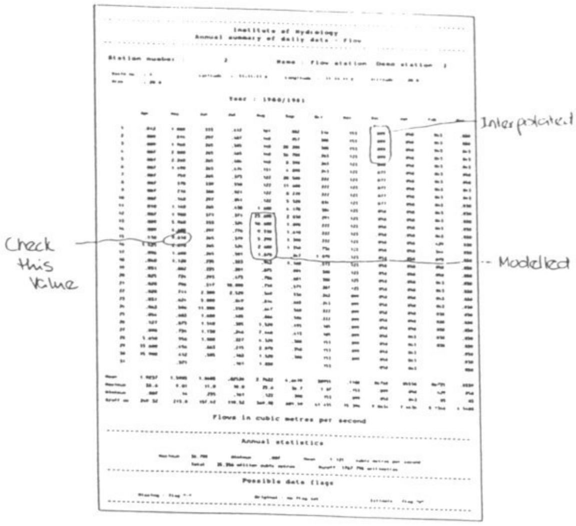


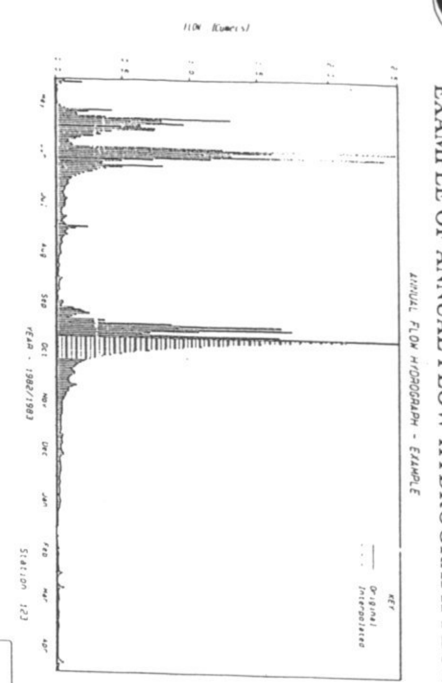
Table 7.1 Example printout of daily flow data

Converted using Lamg A (22/7/93)

7.4

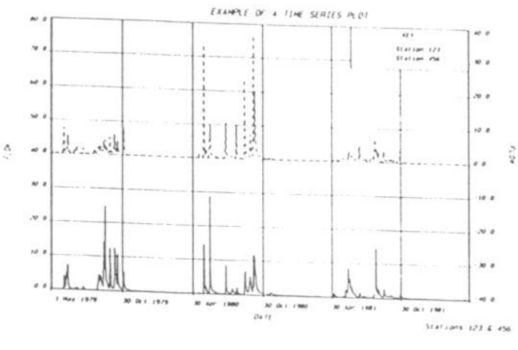
HYDATA

EXAMPLE OF ANNUAL FLOW HYDROGRAPH PLOT



HYDATA

EXAMPLE OF COMPARISON PLOT OUTPUT (NOTE Y AXES SHIFTED TO SEPARATE THE LINES)



HYDATA

EXAMPLE OF DOUBLE MASS PLOT OUTPUT

9.2 Comparison plot

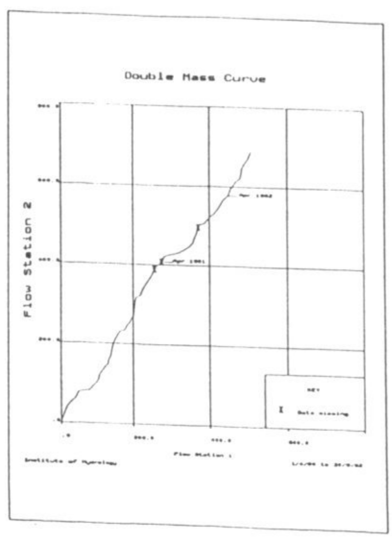


Figure 9.1 Example of double mass curve plot

9.3

HYDATA

THE HYDATA MANUAL GIVES A FULL LIST OF THE SPECIAL HYDATA KEYS

Meaning	Function key (IBM PS/2)	Character	Descriptor in this manual
Proceed	↵	blank line	[↵]
Help information	F1	not available	[HELP]
Leave database	F3	!	[Exit]
Read from file	F4	@	[Macro]
Top (of menu or data)	Home	T	[Home]
End (of menu or data)	End	E	[End]
Move up	↑	U	[↑]
Move down	↓	D	[↓]
Page Up	Page Up	P	[Page Up]
Page Down	Page Down	Q	[Page Down]
Abort current action	Esc	*	[Esc]

For example the last item on a menu list may be selected by pressing the [End] key if available, by typing E followed by [↵], or by using the mouse to move the cursor on the screen to the appropriate item and clicking on the left hand button of the mouse.

[↵] is used throughout this manual to represent the carriage return key on the IBM PS/2 keyboard. On other keyboards this may be replaced by a [Return] or [Enter] Key.

2.3 Selecting menu options

HYDATA is controlled by selecting options from 'menus' or numbered lists of commands. Having entered your password the first or main menu is displayed:

HYDATA

EXAMPLES OF PRINTED OUTPUT FROM HYDATA

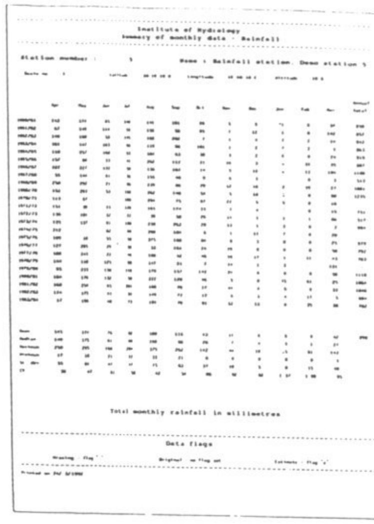
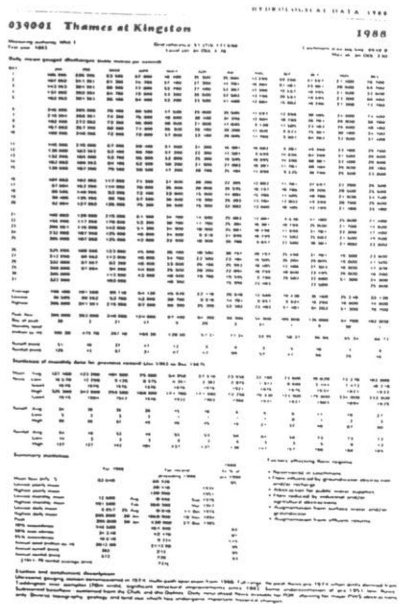


Table 8.1 Example of monthly rainfall printout

HYDATA

EXAMPLE OF A DATA TABLE FROM THE UK HYDROLOGICAL YEARBOOK



HYDATA

CONTENTS OF THE DEMONSTRATION DATABASE (FROM HYDATA MANUAL)

Type	Station Number	Description	Period of Record or Number of readings
Event (Stage)	1	River level (6 readings/day)	1980 & 1982
Event (Stage)	3	Reservoir level (2/day)	1980 to 1983
Rating	1	River gaugings & Rating equations	115 4
Rating	3	Stage/storage points & Stage /storage equation	14 1
Rating	4	River gaugings	63
Flow	1	Daily mean flows	1970 to 1984
Flow	2	Daily mean flows	1971 to 1984
General	8	Pan Evaporation (daily)	1985 to 1986
General	9	Pan Evaporation (daily)	1985 to 1985
General	10	Maximum daily temperature	1986
General	11	Minimum daily temperature	1986
Rainfall	5	Daily rainfall	1950 to 1985
Rainfall	6	Daily rainfall	1953 to 1985
Rainfall	7	Daily rainfall	1961 to 1975
Storage	3	Daily reservoir storage	1980 to 1983

Table 11.1 The demonstration data set

HYDATA

EXAMPLE OF FLOW DURATION CURVE PLOT

CHAPTER 9 ANALYSIS PROGRAMS

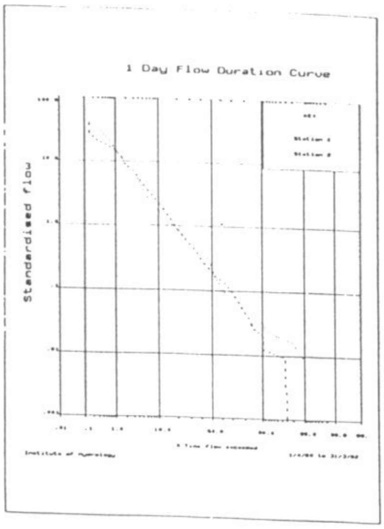


Figure 9.3 Example of flow duration curve plot

HYDATA

CHAPTER 9 ANALYSIS PROGRAMS

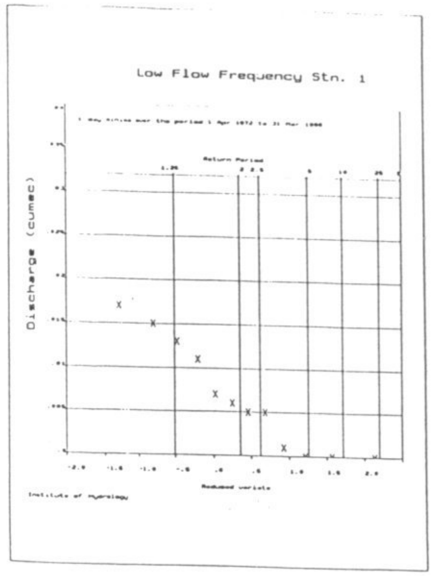


Figure 9.7 Example of flow frequency plot

HYDATA

HYFAP

Hydrological Frequency Analysis Package
Software from the Institute of Hydrology

HYFAP estimates the parameters of a number of probability distributions from a sample of ANNUAL MAXIMUM event magnitudes.

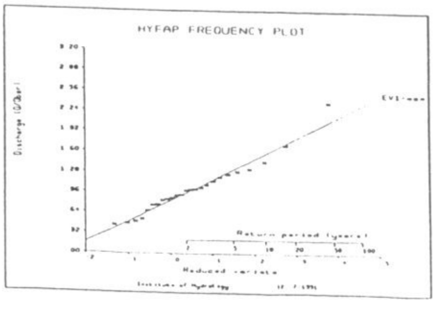
HYFAP can perform a frequency analysis with standardised data.

HYFAP can be used to estimate magnitudes of particular return period events or the return periods of specified magnitudes.

HYFAP can apply an externally produced dimensionless regional frequency curve.

KEY FEATURES :

* Menu and mouse operated
* Tabular, hard copy and screen Graphical representation of results
* Choice of 12 distribution and fitting methods



HYDATA

HYDATA FORTRAN SUBROUTINE LIBRARY

10.3 List of subroutines and functions

Number	Name	Purpose
(i)	HYLIB	Initialising before calling any other 'HY. . . .' subroutine
(ii)	HYWS	Finds what station numbers are on HYDATA
(iii)	HYFS	Finds if a specified station is on HYDATA
(iv)	HYDT	Gets station details such as name, latitude and longitude
(v)	HYDT2	Gets additional station details such as maximum and minimum
(vi)	HYGY	Gets a year of daily data
(vii)	HYGD	Gets one day of daily data
(viii)	HYGS	Gets one event value
(ix)	HYGG	Gets a river gauging
(x)	HYGR	Gets a rating equation
(xi)	HYGM	Gets monthly data
(xii)	HYGA	Gets annual data
(xiii)	HYCV	Converts event to flow
(xiv)	HYDF	Estimates daily flow
(xv)	DATEY	Useful routine for date handling

A detailed description of all the subroutines follows, but first there are some general notes.

The parameters of the subroutine or function call are defined as follows:

INT	Normal 4 byte INTEGER
REAL	Normal 4 byte REAL
LOGIC	Normal 4 byte LOGICAL
CHAR*n	Character string length 'n' bytes of type CHARACTER

Where parameters are arrays, the dimensions of the array are given in brackets. For example INT(100) would mean an integer array of dimension 100, each element being 4 bytes long.

HYDATA

HYDATA version 3.1 ON DOS based PC's

DOS Filenames

The DOS filename is madeup of two parts separated by a (.). The first part should be topic related and the second part should indicate the file type.

for example

MYDATA.DAT

Name Extension

The DOS Path

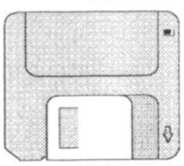
A typical DOS path would consist of one or more directories and a filename. It may also have a drive name.

C:\HYDATA\DEMO\MYDATA.DAT

Each item is separated from the adjacent items by the backslash (\)

5.25" floppy disk

3.5" floppy disk



Special files

. Indicates current directory

.. Indicates parent directory

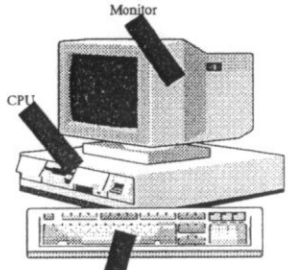
.EXE

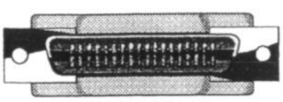
.COM Are both programs

.SYS System files

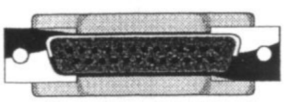
.BAT Batch files

The Personal Computer (PC)

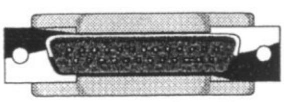




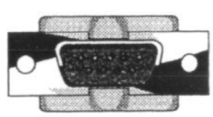
Centronic parallel socket



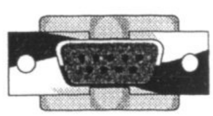
Standard 25 pin D plug (female)



Standard 25 pin D plug (male)



9 pin D plug (male)



9 pin D plug (female)

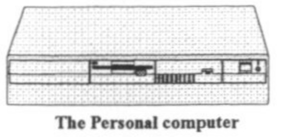
Hard disk - also known as a Winchester

CGI.CFG

```
DEVCE=C:\HYDATA\PROGS\IBMVGA12.SYS /G:DISPLAY
DEVICE=C:\HYDATA\PROGS\LASERJET.SYS /G:OUTDEV
DEVICE=C:\HYDATA\PROGS\MSMIOUSE.SYS /G:POINT
DEVICE=C:\HYDATA\PROGS\GSSCGI.SYS /T
;
;
DISPLAY=IBMVGA12
MOUSE=MSMOUSE;
PRINTER=LASERJET
FONTS=C:\HYDATA\PROGS
PAPER=ISOA4
```

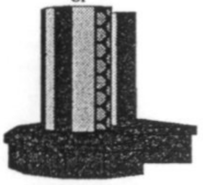
Basic DOS commands

Command	What it does
DIR	List files in a directory
MD [directory]	Creates a directory
CD [path]	Changes directory
RD [directory]	Removes directory
DEL [file]	Deletes a file
ERASE	Same as DEL
COPY [file1][file2]	Copies a file
RENAME [] []	Renames a file
FORMAT A:	Format a disk



The Personal computer

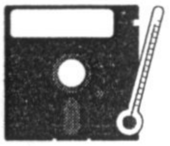
or



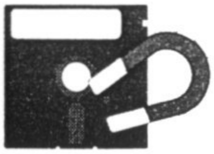
The main frame

CONFIG.SYS

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\EMM386.EXE NOEMS
DOS=UMB,HIGH
DEVICE=C:\DOS\ANSI.SYS
COUNTRY=044
BUFFERS=10
FILES=50
BREAK=0N
```



Do not expose to excess heat



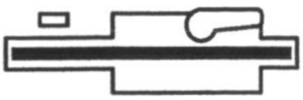
Do not place magnets near disks
NB. Monitors contain powerfull magnets

Directories and Subdirectories

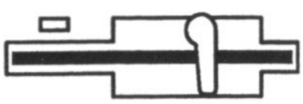
```
C:\ ─ DOS
    ├ WINDOWS
    ├ 123
    └ HYDATA ─ PROGS
               ├ DEMO
               └ DATA
```

Do not bend floppy disks

Always keep your disks safe



Open



Closed

What is HYDATA ?

HYDATA is a hydrological database system for personal computers which is used in more than 50 countries worldwide. The system is designed to store the types of data most commonly required in water resources studies, including river, reservoir and lake levels, river flows, rainfall data and reservoir and lake storage values. Output is provided in the form of 'yearbook' style tabulations of data, graphs and powerful data transfer facilities. HYDATA also includes facilities for developing rating equations relating river levels to flows and reservoir and lake levels to storage. Options are also provided for routine hydrological analyses such as the calculation of flow duration curves and low flow statistics. Several related software packages are also available from the Institute of Hydrology for more sophisticated tasks such as flood frequency analyses and rainfall runoff modelling. HYDATA is operated using on-screen menus which can optionally also be operated using a computer 'mouse'. Both English and other language versions are available, including a full French version and partial Spanish and Portugese versions. Other language versions can be supplied on request.

HYDATA has been in use for more than 10 years and was developed by the Institute of Hydrology, which is the United Kingdom's main research centre for hydrology. The Institute provides technical support through newsletters, by organising training courses, through a permanently staffed helpline and by offering a 'disaster recovery' service to retrieve accidentally lost data. HYDATA was initially developed from the Institute of Hydrology's mainframe data storage system for UK hydrological data; since then it has been developed to meet the needs of users world-wide and in particular the needs of users with only a limited experience of personal computers. HYDATA is constantly under development and improved versions are released every 1-2 years.

What types of data can be stored ?

HYDATA stores the types of data most commonly required in water resources studies. Several categories of data are defined in HYDATA. These include storage locations for river levels, lake levels and reservoir level data, river flow data, reservoir and lake storage data, river discharge measurements and rating curves and rainfall data. A general storage category is also defined, suitable for storing any type of daily or monthly time series data, such as measurements of water conductivity, sediment content or meteorological data such as wind speed, evaporation or temperature. Data can be stored at intervals of up to 100 readings per day, corresponding to a minimum data storage interval of about 15 minutes. This allows data from automatic data loggers or chart digitisers to be stored on the system. Within the system, several facilities are provided for conversion between data types; for example, for conversion between river levels and flows, or between daily flows and monthly flows or between daily rainfall and monthly rainfall.

There are few limitations on the amount of data which can be stored. HYDATA uses efficient data compression techniques to ensure that the data occupy as little space as possible. Data storage requirements vary widely from country to country so it is difficult to give general guidelines on the storage space required; however, of those countries using HYDATA as the national database system, many have found that the entire national database can be accommodated in a few megabytes of disk space, equivalent to a few floppy discs. HYDATA applications for specific water resources projects typically require considerably less storage space.

How are data values entered and retrieved ?

HYDATA accepts data from a wide range of sources. Manual observations by observers and watchmen can be entered directly at the keyboard. In-built quality control routines check all values entered against minimum and maximum permitted values defined by the user. Digitised records from charts and loggers are usually entered automatically, using either the data input facilities built into the package or additional software provided as part of the standard package. These facilities can also be used to transfer data automatically from other personal computer or mainframe database systems, including the CLICOM database system developed by the World Meteorological Organisation for storing meteorological data. Repeated operations can be automated using a macro facility available within HYDATA.

Data stored on HYDATA can be retrieved (exported) automatically either from within or outside the system. Within HYDATA, facilities are provided to export data in yearbook style or in a form suitable for input to many other software packages, such as spreadsheets and various other commercially available database and analysis packages. From outside HYDATA, standard software supplied with the system allows data to be retrieved in a wider range of formats, including formats compatible with CLICOM and with various software packages developed by the Institute of Hydrology, including a flood frequency analysis package (HYFAP) and a rainfall runoff model (HYRROM). For users with FORTRAN programming skills, a subroutine library of data access routines is also provided to allow data stored on HYDATA to be used by their own software. Using these routines, quite sophisticated packages can be written; for example, these routines have been used within the Institute of Hydrology to write a real time flow forecasting system and a GIS based rainfall analysis package.

How is HYDATA operated ?

HYDATA is operated using a series of on-screen menus. A menu is a list of options each of which causes HYDATA to perform an operation or receive information provided by the user. Each menu has a unique name and code number. The HYDATA manual gives full details on the operations which can be performed by every menu. Also, a display chart at the back of the manual shows all the main menus and how they are related.

The menus have two types of option. The first type causes HYDATA to perform certain types of operation, such as saving data, displaying a graph or moving to the next menu. The second type allows data to be entered such as the station identifier or the years for which data are required. The usual way of moving between menu options is to use the up and down arrow keys on the keyboard. Alternatively, the option number may also be typed in directly. Options are selected by pressing the [ENTER] key. There are also several special keyboard commands defined in HYDATA. These are described in Section 2 of the HYDATA manual and include:

[HOME] Move to top of menu
[END] Move to bottom of menu
[ESC] Abandon an operation
[PGUP] Move up several lines
[PGDN] Move down several lines

The [DEL] and [BKSP] keys may also be used to edit data that has been wrongly entered. Three other keys also have special meanings:

[F1] Display help menu
[F3] Quit HYDATA
[F4] Read data input or macro file

The [F1] key may be used at any time to display a help message relevant to the type of operation currently being performed in HYDATA. Shorter messages also appear at the bottom of the screen describing the type of operation expected or the cause of any errors which may occur. The HYDATA menus can also be operated using a mouse if this is available. To use the mouse, the user simply points at the option or data entry box required and then 'clicks' on the option using the mouse. HYDATA then performs the operation selected.

Keys to avoid when using HYDATA

HYDATA is extremely robust and will rarely cause problems in normal operation. However, there are two sets of keys which must never be used when operating HYDATA since using them risks damaging the database or loosing data entirely. Firstly, HYDATA must never be interrupted by using the [CTRL] [ALT] and [DEL] keys together to reboot the computer. If HYDATA appears to be taking a long time to perform an operation, simply be patient and wait ! Secondly, the on/off power switch must never be used to interrupt HYDATA for similar reasons. Normally, if HYDATA is interrupted using either of these methods, it will be necessary to reload the database from the most recent data backup available - an operation which should be avoided if possible since any data entered since the backup was performed will be permanently lost.

How does HYDATA store data ?

HYDATA stores data for a location using the concept of stations. Stations are described by the type of data they hold and their identifier. Identifiers in HYDATA are numerical and can have numbers up to 8 digits long i.e. in the range 1 to 99,999,999. Once a station has been set up on HYDATA, data can be entered for any year defined for that station provided that storage space has already been allocated for that year. There are many optional entries which can be given to describe the characteristics of a station, including the latitude and longitude of the station, its altitude, the maximum and minimum values permitted for the station and the name of the station. The 'name' entry can be up to 32 characters long and appears on all graphical and tabulated output for that station - this allows countries which use alphanumerical station identifiers to link the local station identifiers to the numbering system defined on HYDATA.

For a given location, stations are required for each of the data types recorded at that station. The main data types are EVENT, GAUGING AND RATING, DAILY FLOW, DAILY GENERAL, DAILY RAINFALL, DAILY STORAGE and MONTHLY. Event stations are used for any data type with more than 1 reading per day e.g. river levels, digitised rainfall records. The DAILY GENERAL category can be used for any type of data defined by the user and stored on a daily basis e.g. electrical conductivity, wind speed, sediment load. The MONTHLY category is used for any type of data (e.g. flow, rainfall, general) stored on a monthly interval.

As an example, consider a flow gauging station where river levels are monitored by a chart recorder and discharge measurements are made using a cableway. For this site, four stations with the same identifier could be defined to accept (1) the river level data (2) the discharge measurements/rating curves (3) the daily river flows calculated from the river levels and rating curves and (4) the monthly river flows calculated from the daily values.

Data editors

Perhaps the simplest and most widely used method to enter data is by typing values in from the keyboard. In HYDATA, this is done from the station editors. Every station defined on HYDATA has an editor associated with it and all editors (except for gauging station editors) are operated using the same general principles.

When an editor is selected, a table appears on the screen giving the current values stored on the database for the dates shown. New values are entered simply by typing in the new number. A data flag may be added by typing a comma and the flag number (1 or 2) after the value e.g. 12.7,2 assigns flag 2 to the value 12.7. The flag is assumed to be flag 1 if no flag is specified. Values can be set missing simply by typing the letter m. When a new value is entered, it is plotted on the graph displayed alongside the data table. If a mouse is available, the amount of data displayed in this graph can be changed by 'clicking' on the control symbols marked beneath the graph. Alternatively, the POINT command may be used if no mouse is available (see the HYDATA manual).

The editors have many features to help speed up data entry. These are described in full in the HYDATA manual and can be summarised by pressing the [F1] key whilst using the editors. Examples include the facility to define blocks of data so that the same operations can be performed on all values within the block e.g. set values to missing, apply a multiplying factor, change the data flag. The parameters used in BLOCK operations can be defined in the editor menu (Menu TS1) which is reached by pressing the [ESC] key whilst using the editor. For example, the permitted maximum and minimum values can be changed temporarily to allow an unusually large or small data value to be entered.

Once the data values have been entered, the data values should then be saved. Before saving data, it is a good idea to plot the values first to check that they are sensible. For example, typographical errors when entering level or flow data can often be spotted immediately from a graph. When plotting edited data, it is important to note the distinction between 'file' values and 'edit' values. 'File' values are the values stored on the hard disc of the computer while 'edit' values are those which have been entered using the data editor but not yet saved. The plot menus in HYDATA contain a 'Plot edits' option which allows the 'file' and 'edit' values to be compared on the same plot. The 'edit' values should only be saved if they seem to be correct.

EVENT data editors

For EVENT data, the station editors include some additional features. The most usual types of data stored in these editors are observer readings of river levels, digitised chart or logger records of river levels, or digitised pluviograph or logger records of rainfall. Up to 100 readings per day can be stored, allowing for a minimum data storage interval slightly less than 15 minutes.

Within each EVENT station editor, the times of the readings are given as well as the day. The default is to give the times at equal intervals; for example, for an EVENT station with 3 reading per day, the default times might be 0800, 1600 and 2400. Note that the installation program HDBINS includes an option 'Water Day Start time' which defines the way HYDATA displays the time for midnight e.g. 0000 or 2400. A water day starting at 0900 can also be defined (as used in some UK studies).

It is important to note that the times displayed in the editor can be changed and need not be at equal intervals. For example, if an observer takes river level readings at times of 0900, 1200 and 1600 each day, these values can be used instead of the defaults suggested by HYDATA. To change the values, the TIM command should be used. The only restriction is that, within each hydrological year, all days have the same set of times. Between years, the times used and the number of readings per day may be altered. To change the times for all years for a station, the editor for each year must be entered and the required times set. This can be tedious so it is usual to automate this process by writing a HYDATA macro procedure which will allow the changes to be performed in a single operation (see HYDATA manual).

Data flags

Data flags allow the source of a data value to be stored on the database. Flags can indicate the method used to make the measurement (e.g. observer, logger), whether the value is measured or estimated by modelling, or whether the value is thought to be reliable. Flags are a valuable feature of HYDATA and should be used whenever possible.

Within HYDATA, flags are entered by adding a ,1 or ,2 after the data value. For example, entering 12.7,2 indicates a value 12.7 with data flag 2. If no flag is entered, the flag is assumed to be 1. The meaning of the flags is defined by the user within the 'Station details' menu for the station. The default values are 'Original' for flag 1 and 'Estimate' for flag 2. However, for each database, eight possible flags are defined and any two of these can be chosen. The choice of flags is defined by using the 'Data sources and flags' option in the installation program HDBINS (see Appendix B of the HYDATA manual). The default set of flags is Missing, Original, Estimate, Observer, Chart, Logger, Radio, Model. In the case of the flag for missing data, the default value is 'm' when typing in data and '-' on any tabulated printout of the data. For the 'Original' flag, the default is to print no flag on data tables. For the 'Estimate' flag, the default is to print the letter 'e' after each value with this flag e.g. 12.7e. On graphical output, the flag names will appear in the keys to the lines and the lines will be coloured according to the flags used.

It is strongly recommended that data flags are used for all data values entered onto a database. This is particularly important when a mixture of observed and estimated values is entered; for example, when infilling missing periods in a record. This then allows estimated values to be easily identified if the infilling method is later changed. Also, the estimated values will be indicated on any printed output giving an indication of the accuracy of the modelling method and the amount of original data available.

Hints on infilling missing data

River level and flow records often contain many gaps. Gaps can arise for many reasons; for example, an automatic logger breaking, an observer falling sick, or the recording equipment being damaged in a flood. It is often desirable to infill missing periods in a record in order to improve estimates of the long term statistics of the record, such as the annual total flows or the long term mean annual runoff.

There are many methods which can be used for infilling data. For example, it may be possible to estimate flows at a station by regression with flows at a nearby upstream or downstream station. Alternatively, flows can often be estimated from catchment rainfall records by regression techniques or using a rainfall runoff model. The choice of method is the responsibility of the hydrologist and requires considerable experience and a knowledge of the behaviour of the catchment under consideration. However, for <u>short</u> periods of missing data, HYDATA provides two basic methods for infilling missing values. These are linear and logarithmic interpolation. Both methods are available within the station editors. The procedure used to infill a missing period is to first define a block which covers all the missing values AND the data values immediately before and after the first and last missing values. The LIN command is then used for linear interpolation and the LOG command for logarithmic interpolation. The values are then infilled automatically for the whole block.

It is good practice to first set the default data flag to flag 2 in Menu TS1 before doing any interpolation. The interpolated values will then be indicated on all output. Also, before the values are saved, they should first be plotted against the observed values using the 'Plot Edit' option in the plot menu. This will immediately show if the values are reasonable and blend smoothly with the existing values. If possible, checks should also be made against flow records for other stations on the same river and against rainfall records for the catchment to ensure that no flood peaks have been missed when performing the interpolations. Only when all these checks have been made should the interpolated values be saved on the database.

Normally, interpolation is only suitable for missing periods of a few readings. For longer periods, regression techniques, rainfall runoff modelling or flow routing models are normally more appropriate.

Rating curves in HYDATA

Water levels are easy to measure but flows and storages are not. This is why rating curves are used to relate observations of levels to the flow/storage values required for water resources studies. HYDATA uses the following form for a flow rating curve:

$$Q=a(h+c)^b$$

where Q is flow, h is the water level and a, b and c are constants. A similar form is used to relate volumes to levels:

$$V=a(h+c)^b$$

where V is the reservoir or lake volume. Some countries may use a different form of equation, particularly for man-made sections such as weirs and for level-storage equations. However, experience shows that the above form often provides just as good a fit in many cases. Users with FORTRAN programming skills may also use the HYDATA FORTRAN subroutine library to apply any specified rating curve to level data and then re-load the resulting flows back onto HYDATA.

For many gauging stations, multi-part ratings are required to represent the form of the rating curve over the full flow range. In HYDATA, rating curves can have up to 6 parts. Often it is possible to relate the levels over which the curves apply to levels at which real changes ocur in the channel cross section. This is particularly true for man-made sections and for level/storage rating curves.

HYDATA provides comprehensive graphical facilities for fitting rating curves (i.e. estimating the parameters a, b and c). The procedure used is to guess successive values for c and then to estimate a and b by a least squares procedure in logarithmic co-ordinates. The user can specify maximum and minimum allowed values for each parameter and, for multi-part ratings, can specify the range of levels over which each rating applies. HYDATA also provides the option to weight curves towards the high flow measurements. This is done using the Q*2 option (see HYDATA manual). When fitting multi-part ratings, HYDATA checks that the individual curves cross close to the specified upper and lower limits of each curve. An error message occurs if this does not happen, in which case the rating should be re-fitted using a slightly different set of control parameters (e.g. upper/lower limits, ranges for a, b and c). Rating curves may also change over time due, for example, to changes in channel cross section following flood events. In HYDATA, each single or multi-part rating is identified by a code letter e.g. A, B, C. Each code applies over a specified period e.g. 1978 to 1985. Up to 20 letters can be used at any station to identify shifts in ratings.

Advice on fitting rating curves in HYDATA

NOTE: Fitting rating curves is a job only for experienced hydrologists and rating curves should not be altered without the permission of the System Manager.

The normal procedure is to begin by typing in the raw data on which the curve(s) are to be based. For flow data, this consists of the date of the measurement, the level (stage) and the estimated discharge. If available, the mean velocity and cross-sectional area should also be entered; if these are not known, dummy values of 1.0 can be entered. For level/storage curves, levels and storages should be entered with values of 1.0 for the 'velocity' and 'area' entries.

Once the measurements are on HYDATA, they should be plotted to see if they all fall near the same line. If not, then attempts should be made to see whether the rating may have shifted over time. One way to do this is to fit a single rating curve over all time and then to see from the gauging editor whether, in certain periods, all measurements lie above or below the line. The < < and > > symbols shown in the editor and printouts help to identify such periods (see HYDATA manual). Local knowledge of flood events etc may also help to identify hydrological reasons for shifts in a curve.

Once the shifts have been identified, the measurements should be grouped using the letters A, B, C etc. Single or multi-part rating curves can then be fitted to each group separately. Data points which seem to lie well away from the lines (outliers) can be excluded using the ? code in the editor. Alternatively, particularly valuable high flow measurements can be included in all groups using the + code in the editor. Also, the Q*2 option may be used if required to help force the curves through the high flow measurements. Great care should be taken not to extrapolate the curves to unrealistically high or low flows. An upper limit of applicability may be imposed if it is not clear how to extrapolate the curve.

Once a satisfactory fit has been obtained, the curves can be used to convert levels to flows (or storage) using the 'Conversion' option in HYDATA. To do this, it is necessary to first save the new curves. To make sure poor curves are not saved accidentally, HYDATA deliberately makes this a two stage process. The curve must first be saved in computer memory from the rating curve editor before it can be plotted on a 'Gauging Plot' and then must be saved again from the Menu GDD1 to save it to hard disc. Only curves saved on disc are used in conversions. Needless to say, good documentation must be kept stating the parameters of the new curves and the reasons why the old curve was changed. Note that the converted values may differ slightly from those obtained by hand or from other systems since, to obtain the best possible estimates, HYDATA uses an interpolation procedure to estimate the variation in flows over each day, and then integrates the resulting instantaneous flows to estimate the daily mean flow (see HYDATA manual).

Advice on system management

In a busy hydrological department, several people may need access to the department's HYDATA database. Typically, this will include data entry assistants and hydrologists who require access to the data for modelling and data validation work. In this situation, it is vital to appoint a System Manager who takes overall responsibility for maintaining the system. The manager should be the only person allowed to create or delete stations on the database and should also determine who has access to the database and the schedule for entering historical and current data onto the database. The manager should also be responsible for ensuring that data backups are performed regularly. To help the System Manager, HYDATA has a password protection system to restrict access to the system. Passwords are set up using the HDBINS program and have 3 possible levels. At the lowest level, users can only look at the data. At the second level, users can also save data but cannot create or delete stations. At the highest level, which is normally used only by the System Manager, the user has access to all the facilities in HYDATA. For extra security, the HDBINS program can be kept only on floppy disc so that only the System Manager can change the passwords.

The information stored on a database is only of value if the users of the database understand the sources of the data and the quality of the data. For this reason, it is vital to keep good notes on how the database has been set up and where the data have been obtained from. Typically, the System Manager will keep an up to date 'System summary' printout from the database and a series of files containing up to date plots and tables of all values stored on the database together with notes describing the rating curves used to generate these values. The System Manager should also keep detailed notes on any checking, editing or infilling of the data which has been performed, and on the methods used to develop the rating curves stored on the system. The original observer, chart or logger records should also be kept in case it is necessary to check back against these in the future. In a well maintained system, it should be possible at all times to provide up to date and reliable printouts or plots of any of the data on the system. Typically, a busy hydrological department will receive a steady stream of such requests from other ministries, consulting engineers and development agencies working in the country. In some cases, large amounts of information may be required in a short time, particularly during flood and drought events. These requests will normally be accompanied by additional questions regarding the sources of the data and any validation or infilling work performed to improve the quality of the data. Detailed notes are essential in order to meet these requests satisfactorily.

Advice on creating stations

Stations are created in HYDATA by following a simple set of menu operations starting from the 'Increase data storage' option. However, some care is needed so normally stations should only be created by the person nominated as the System Manager. The first consideration is that the new station will increase the size of the database. The System Manager should therefore always check that there is sufficient space on the hard disc of the computer to accept the new station. Also, particularly on old or poorly maintained computers, there is always a slight risk of a hardware failure which could corrupt (damage) the database. The existing database should therefore always be backed up before creating space for a new station or stations.

Another factor to consider is that the database will operate more efficiently if all the storage space for the station is allocated in a single operation. For this reason, space should be created in a single operation for every current and anticipated need for that station. For example, if a station opened in 1950, say, and is still in operation, space should be allocated from 1950 to several years in the future, even if only a few years of data are to be entered initially. The numbering system used should also be consistent with the numbers used for the stations already stored on the database.

When a station is created, some descriptive information can also be entered for that station, such as its latitude and longitude or its altitude. These entries are optional and can be entered or changed later at any time from the station editor. Normally, though, it is advisable to enter at least the correct station name and quality control limits (max/min/max change) when the station is created. For EVENT stations, it is also advisable to define the numbers of the corresponding rating equation and flow/storage stations at the outset to avoid mistakes being made later when the data are converted. The default is to use the same station number for the rating and flow/storage stations. Also, the data format entry should be correct, since this will determine the decimal place accuracy and data flag system for all data subsequently entered for that station (see HYDATA manual for details).

Data backups

Although modern personal computers are mostly very reliable, failures do occur occasionally, particularly under hot, dusty or humid conditions, or when the electrical power supply is unreliable. Computers may also be stolen, vandalised or damaged in disasters such as floods, fire or earthquakes. For these reasons, it is ESSENTIAL to make regular backups of your database and all other essential data files on your department's computers. Remember - the floppy discs used for backups only cost a small amount but the time and effort spent entering and validating data is irreplacable.

The following system is recommended and is used by several countries. Under this system, two sets of backup floppy discs are used and backups are made every week on the same day. The sets of discs are used alternately. This way there are always two recent backups, with the most recent backup made within the past week. Every 1 to 2 months, one of the sets is taken out of use and replaced by a new set of blank discs. The set taken out of use is stored with the other older sets which are no longer used, preferably in a different building to the computer containing the HYDATA database.

In addition to floppy discs, some users also maintain a recent copy of their main HYDATA database on a separate computer. Users with tape backup facilities may also make regular backups of the whole hard disc onto tape. Also, for a small annual fee, HYDATA users can make use of the 'Disaster Recovery Service' operated by the Institute of Hydrology. Under this system, backup discs are sent periodically to the UK for safe storage. Before storage, the integrity of each database is checked. The data then remains strictly confidential to the user and is not accessed without a specific request from the user.

As a final point, it may be of interest to know some of the most common reasons for HYDATA files and other data files being lost. In our experience, these are:

Data losses caused by computer viruses
Computer hard disc failures
Hardware failures due to fluctuating electrical supplies

Advice on starting a new database

A user can create as many HYDATA databases as required on a single machine. For example, a single computer might contain the national flow database, a smaller personal database for analysis work and a third database for rainfall data. Of course, great care must be taken to keep the databases separate. It is often helpful to set up several DOS batch files containing the commands required to access each database.

Each HYDATA database must be contained in a separate directory. A database consists of 11 files with the name HDB**, where ** is a number in the range 01 to 11, a file called HDBIN and two index files called INDEX1 and INDEX2. In a new, empty database the HDB** files all ocupy 128 bytes of disk space. As stations are created, these files gradually fill up, and may reach several Mb in size on a large database. Since all databases use the same 14 filenames, great care must be taken not to over-write one database with another. Each new empty database is generated from the HYDATA installation discs using the HYINA program. Before setting up a new database, enough free space must be made on the hard disc to accept the new data.

Once the database has been created, it can be customised as required using the HDBINS program from within the directory containing the database e.g. passwords, titles on output. This will then modify the HDBIN file. If you already have a HDBIN file set up on another database, you could instead copy this to the new directory to get an identical configuration to the existing database (although note that you CANNOT copy individual INDEX or HDB** files; these must always be kept together for a given database). Whichever method is used, the hydrological year MUST be defined correctly using HDBINS since this cannot be changed after starting to create space for stations on the database.

In summary then, there are only a few serious mistakes which can be made when starting a new database. As described above, these are:

(a) Accidentally over-writing an existing database

(b) Not allowing enough disk space for the new database

(c) Forgetting to define the hydrological year before starting to add space for stations to the database

(d) Accidentally using the wrong database when loading data

With care, all these mistakes can be avoided.

Data analysis routines in HYDATA

Comparison plots

The comparison plot option allows the hydrographs or time series for 2 daily stations to be plotted on the same graph. This is useful for comparing records at nearby stations, data validation work and modelling work. Typical uses might be to estimate the lag time between two locations on the same river or to compare rainfall records and runoff response. This option is also useful for plotting more than 1 year of daily data for a single station. Options provided by HYDATA include the facility to plot the records as histograms, to invert one of the series on the plots, to lag one series with respect to the other and to plot the data in logarithmic coordinates. The two y-axes may also be scaled independently, allowing the two lines to be separated vertically.

Double mass plots

Double mass plots compare the daily records for 2 stations on a cumulative basis. Typical uses might be to examine the correlations between stations or to check for data errors. For 2 identical records, the double mass plot will be a perfect straight line. More generally, if the stations are close to one another and experience similar hydrological regimes, then the double mass plot will be close to a straight line, but with a slope greater than or less than 1. This might be the case for rainfall records for the same catchment, or flow records for nearby stations on the same river. Sudden changes in slope ('breaks') indicate a possible problem with the data. For example, when considering 2 nearby raingauges, the break may correspond to one of the raingauges being moved or the exposure of one of the gauges changing. For flow stations, abstractions or inflows between stations are possible causes of changes in slope. More generally, breaks may be caused by a change in observer, measurement units or recording equipment.

Flow duration curves

Flow duration curves show the percentage of time that a given flow is exceeded. For example, the Q95 flow is normally the daily flow exceeded 95% of the time and is a useful measure of low flow reliability. Flow duration statistics also give a guide to catchment response and can be useful in validating the output from hydrological models. HYDATA provides options to specify the flow averaging period used in calculating a flow duration curve. The minimum period is daily, called the 1-DAY flow. Other periods (e.g. 5-DAY) can also be used. Up to five curves can be plotted on a single graph. For comparing the curves from different stations, the values may be divided (standardised) by either the average daily flow (ADF) or the flow per unit catchment area. The curves may be for the whole year or just for specified seasons. Plots may be on linear or logarithmic axes.

Low flow analysis routines in HYDATA - 1

HYDATA provides a range of routines which can be used to characterise the low flow behaviour of a catchment. The methods are based on those developed from a major research study on the low flow response of catchments in the UK (NERC Low Flow Studies Report, 1980). These methods have since been applied widely throughout the world.

Base Flow Index

The Base Flow Index option allows the base flow component to be estimated for a given hydrograph. The BFI is a measure of the contribution to the total flow from groundwater sources. It also provides a useful indicator of catchment response. HYDATA estimates the BFI using an algorithm set out in the "Low Flow Studies report" and summarised in the HYDATA manual. The calculations are based on daily flows, and attempt to identify the turning points in a hydrograph automatically so that the baseflow separation may be performed. The results of this separation can be plotted and tabulated as required.

Logarithmic plots

This option allows the daily flows for a station to be plotted in logarithmic coordinates. This is useful for examining the low flow part of a hydrograph. In particular, during recession periods, the flow may decrease in an approximately exponential manner. The recession constant can then be estimated from the average of the slopes over several typical recessions. This is useful for developing models of recession behaviour; for example for infilling missing flow data or predicting future flows during a period of drought. The recession constant is also another useful indicator of catchment response.

Recession plots

The 'Recession Plot' option provides a more objective, although less widely used, method for estimating the recession constant. The basis of the method is to plot the daily flows for each day against the daily flows for the day N days before, where N is specified by the user. During recession periods, the resulting lines will all tend to be bounded by a single 'envelope' curve, whose slope can be related theoretically to the recession constant. Under UK conditions, it was found that, for many catchments, the best estimate of the recession constant was given by the slope of the envelope curve at a flow equal to 0.25 of the average daily flow (ADF).

Low flow analysis routines in HYDATA - 2

Low flow frequency plots

This option extracts the minimum flow in each year in a record and plots the values on a single graph with the exceedance probability on the x-axis. The flows may be the minimum daily values or may be averaged over longer periods e.g. 5-DAY average flows. To allow the flows to be related to return periods, the values are plotted using the Gringorten plotting position assuming a Weibull distribution. For many catchments, the annual minima plot close to straight line when plotted on this basis, although this is not assumed in the analysis. Low flow frequency plots provide an alternative to flow duration plots for estimating flow reliability, and are particularly useful for describing rare events with return periods of 10 years or more. Within HYDATA, several options are provided to customise the output. For example, the number of missing days allowed per year can be defined and the results can be divided by the average daily flow (ADF) or mean annual minimum (MAM). Both graphical and tabulated output is provided.

Input of data to HYDATA

The simplest way to enter data into HYDATA is using the keyboard. This is the best way to enter handwritten or typewritten data, such as observer records or yearbook data. However, if the data are already on computer disc, it should almost certainly be possible to transfer the values into HYDATA automatically without re-typing the numbers.

Several possible methods are provided in the HYDATA system for automatic input of data, provided that the data are in normal text (i.e. ASCII) data files. The simplest method is designed for when the data values appear in the file as one value per line, and the period of data is the same or less than that covered by the station editor (e.g. 1 year for daily flow data). This type of file can be entered simply by pressing the [F4] key and specifying the name of the file whilst in the appropriate station editor. The values will then be loaded into the editor one per line and can be saved to the database after checking that the correct values are present using plots or printouts of the data. Some tips for using this method are that, before pressing the [F4] key, the cursor must be on the date/time corresponding to the first data value in the file. Also, before pressing the [F4] key, the S key can be pressed to 'lock' the screen temporarily. On slow computers, this will greatly speed up the data entry. Once the file has been read, the screen can then be 'unlocked' by pressing the S key again.

The [F4] method of data input can also be used in conjunction with HYDATA macro commands. This allows several files with one value per line to be entered in a single operation. The method used here is to add the appropriate HYDATA macro commands needed to 'chain' the files to the start and end of the data in each file. The final lines in each file should be the macro commands which call the name of the next file. Alternatively, the data and macros for all years may be merged into a single large file.

The most sophisticated method of data entry is to use the HYTRAN program. This allows for a wide range of file formats, and allows many years of data to be entered in a single operation. HYTRAN is also be used in conjunction with several other software packages from the Institute of Hydrology, allowing data from telemetry, logger and other database packages to be entered onto HYDATA

Data input using HYTRAN

The program HYTRAN allows many years of data to be entered into HYDATA in a single operation. Full instructions for using HYTRAN are given in the HYTRAN manual and a simple example of using HYTRAN is given in the tutorial notes.

The only main restrictions when using HYTRAN are that the data values must be contained in a normal text (i.e. ASCII) data file and must be organised into blocks of throughout the file. There are also limits on the maximum width of each line and the total number of lines in the file (see the HYTRAN manual). The basic principles when using HYTRAN are to define the structure of the file (i.e. the blocks), the dates of the values, the type of data and the HYDATA station in which the data are to be loaded. There are many ways in which the file structure can be defined and full details are given in the HYTRAN manual.

After defining the file structure, the file is then scanned to check that the values are assigned the correct dates and fall within the limits defined for the HYDATA station. If the scan is successful, the values can then be loaded onto HYDATA. During the loading operation, the same general guidelines apply as when saving data from within HYDATA i.e. never interrupt the transfer using the [CTRL] [ALT] and [DEL] keys together or the power switch as this may corrupt (i.e damage) the database. Also, it is good practice to make a backup of the database onto floppy disc before using HYTRAN.

Once a file's structure has been defined successfully, the HYTRAN commands can be saved into a format file for use with other files with the same format. Also, a batch facility is available for loading many files of the same format in a single operation. This is useful, for example, when transferring data from another database system to HYDATA.

Exporting data from HYDATA

HYDATA has comprehensive facilities for obtaining plots and printouts of data. However, it is often useful to obtain copies of the data on computer disc for transfer to other database systems or analysis packages. The standard HYDATA package includes several methods for exporting data to disc.

The simplest method is to use the 'Write File' option available for every station in HYDATA. This produces a file containing all the data values for the editor being used (e.g. 1 year of daily data for a daily flow editor). Values are written one per line with the data flag following the data value. This form of output is simple to obtain and can be read directly into many commercial spreadsheet and statistical packages for further analysis. An alternative method is to 'Print' the data but to type the letter F when prompted to press the [ENTER] key. HYDATA then prompts for a file name and the output which would have been directed to the printer is written to the file instead. This facility s useful, for example, if a user wishes to make changes to the standard HYDATA yearbook style printouts, or simply requires the data values in a file in yearbook style for further analysis. Note that, when using this option, several printer control codes will appear in the file. These can be edited out using a screen editor if required. Also,, the file can be printed out at a later date using the REPRINT program supplies with HYDATA.

A second method of obtaining data on disc is to use the utility program HYDOUT supplied with HYDATA. This allows data to be obtained in a wide range of formats and for several years, or several stations, at a time. Examples of the types of output are annual maximum flows, daily flows and monthly flows. HYDOUT is menu operated and is supplied with a comprehensive user manual. This method is widely used by many users.

For users with FORTRAN programming skills, the final and most flexible method to read data from HYDATA is to use the library of FORTRAN sub-routines (HYLIB) supplied with HYDATA. The data can then be accessed from within the users own programs and used or written out as required. Sophisticated packages can be produced using this method; for example, within the Institute of Hydrology, these routines have been used in conjunction with a GIS rainfall analysis package and a real time flow forecasting package.

As a final point, several other software packages produced by the Institute of Hydrology include facilities for accessing data from HYDATA. These include the program HYCOM for accessing data in a form suitable for input to the WMO's meteorological database system CLICOM, and the package HYRROM, which is a rainfall runoff modelling system for personal computers.

Prior to the early 1980's the term personal computer did not exist, although it is true that there were a variety of microcomputers available, including the Apple and Commodore range of desk top micros. In 1980 IBM launched its Intel 8088 based microcomputer and marketed it as a Personal Computer, thus coining the term PC. During the 80's Intel developed further the CPU. The 8086 was not far behind the 8088, then came the 80286. By this time IBM had lost its monopoly and hundreds of new companies were set up, producing PC clones. Companies like Compaq, Dell, NEC, and Bull are now as well established as IBM in the PC market place.

With the increase in consumer choice, came massive reductions in the price. Consequently, the PC really did become an affordable tool for the individual. The leading processor in the Intel range is now the 80486 with the Pentium (often referred to as the 80586) close on its heels. With each improvement in the processor, Intel increased its capability and performance, enabling it to carry out tasks that were traditionally done by much bigger mainframes or minis. Not only did the processors improve, the memory expanded also, the original PC had only 64K of ram. Now it is not uncommon to find '486' machines with 16M or more, although the most common memory size seems to be 4M on most 386 and 486 PCs.

Most PCs have three distinct components, the CPU, the monitor and the keyboard. The desktop CPU is probably the most common. However, over the past four or five years users have tried to reclaim their desks, consequently tower and mini towers are now becoming very popular. Also, advances in technology have led to the down sizing of the major components enabling manufacturers to produce smaller and more portable 'notebook' and even 'palm-top' PCs..

The processor is the hardware brain of the system, but until the user tells it do something it will just sit there. On all computers the user communicates with the CPU via a program. A program is a series of commands that the CPU understands. Each command does very little, however when they are executed according to the program order, the processor can be made to perform. The language of this program is call machine code. Machine code is both hard and slow to write. It is, however fast to run. To make life easier for the user, a special program (or series of programs) were developed and became the operating system. Using this system, programs written in more structured languages such as **BASIC, FORTRAN** and **C** could be executed. The operating system used on the IBM range of PCs and its clones is Microsofts DOS (Disk Operating System). Like the processor it too has developed, the most recent version of **MSDOS** being version 6.2. The operating systems primary function is to allow the user to use the CPU constructively. Commands are issued to a command interpreter, this is also a program, without which the PC will not work. The command interpreter on the PC is **COMMAND.COM** and can be found on all startup disks. The interpreter receives its commands from the user via the keyboard. As each command received it is interpreted and acted upon. If the command is a valid internal DOS function the command is executed. External dos commands are really just programs and are loaded and executed by the interpreter. The DOS manual indicates those commands that are internal and those that are external. The following commands are internal commands: **DIR, MKDIR (MD), CHDIR (CD), RMDIR (RD), DEL, ERASE** and **COPY**. Examples of external commands are: **FORMAT, FDISK, CHLDSK, EDLIN, LABEL, KEYB** and **MODE**. See the **MSDOS** reference guide for a full list and description each command and what it does.

There are two types of file found on PCs, programs and data, they are store together on either floppy or hard disks. Each program or data file must have a unique name. These names are made-up of two parts, the filename and the extension separated by a dot (.). The filename should ideally be subject related and the extension should be type specific. For example, executable program files will have an extension of either **COM** or **EXE**, SYSTEM files will have the extension SYS, and batch files will have the extension **BAT**. What remains, by definition, must be a data file (**BAT** are really data files **COMMAND.COM**). Data file can have many different extensions or even none, though the latter is not advised. Typically the extension: **WP5** (wordperfect), **DAT** or **DTA** for numeric data, **FOR, PAS, BAS, C and ASM** for program source code which are just data files for programs known as compilers.

The filename part of the name can contain up-to eight characters and the extension can have up-to three characters. Both the filename part and the extension can include any alpha-numeric character on the keyboard. Although others characters can be used, it is best to avoid them, especially punctuation characters. Some commonly used non alpha numeric characters are the _, -, ~, {, and the &. The *, ? and \ should be **not** be used in the file name. The * and ? are used by DOS as wild card search characters in commands like **DIR, COPY** and **RENAME**.

Two special files which are used to set-up the computer when it starts-up are **CONFIG.SYS** and **AUTOEXEC.BAT**. **CONFIG.SYS** is used to load special device drivers such as **ANSI.SYS**, **HIMEM.SYS** and **EMM386.EXE**. **AUTOEXEC.BAT** is used to set-up environment programs and variables (see **PATH** later).

To help the user organise the files on the disks, the operating system allows the disk to be arranged into a **DIRECTORY**. This directory can then be subdivided into **SUBDIRECTORIES**. The directory structure can be look on as an inverted tree, with its branches spreading out downwards. Keeping to this analogy, the top most directory is known as the **ROOT** directory. If your computer was started from its internal hardisk then the prompt that you would see would be the name of the root directory that contained COMMAND.COM and should be **C:**.

Subdirectories can be used to keep similar files, such as **.WP5** files in a subdirectory called **DOCUMENTS**, or all DOS related files in a subdirectory called **DOS**. Packages will create their own directory structure when they are installed, consequently a hard disk might have subdirectory names such as **123**, **WINDOWS**, **QUATTRO**, and **NORTON**. Each of these subdirectories may have additional subdirectories below them.

The contents of a given directory can be viewed by using the internal DOS command **DIR**. DIR has two useful options, **DIR /W** and **/P**. The **/W** option or switch is used to display the file names in rows. The **/P** switch tells the DIR command to pause after a screenful has been displayed. More recent versions of DOS allow the user to sort the files in a variety of different orders, including date and time.

In order to find these files it is necessary to know their address. This address is known as their **PATH**. For example, there is a file called **MYDATA.DAT** in the subdirectory **DATA** on the hard disk known as **D:**. The path of this file is **D:\DATA\MYDATA.DAT**. If the subdirectory **DATA** contained another subdirectory called **MYDATA** and the file was in there, its path would be **D:\DATA\MYDATA\MYDATA.DAT** . Each subdirectory is separated from the one above by a \, and this is one reason why you can not use the \ in the file name.

To move from one subdirectory to another the internal DOS command **CD** is used.. For example if the current directory is the root directory of **D:** then, to get to the subdirectory **D:\DATA\MYDATA**, the command **CD \DATA\MYDATA** [rtn] would be issued. In order to move up the tree to **DATA**, **CD\DATA** command can be issued. However DOS provides a shortcut. Each subdirectory has a parent directory, the parent of **DATA** is **D:** and the parent of **MYDATA** is **DATA**. The parent directory is listed in a **DIR** of the disk as .. , therefore by issuing the command **CD ..** the parent directory becomes the current directory.

The word **PATH** is also used to describe the search path that DOS uses to look for programs. The search path is set up by the user in a special file called **AUTOEXEC.BAT**. The line **PATH=C:\DOS;C:\WP5;C:\123** tells the command interpreter to search each of paths separated by the ; for the request program before failing.

At the heart of the file system is the hardware and media that allow the data and program code stored in the files to be maintained safe. The floppy disk is the most common storage medium that the user will have actual contact with. Few will encounter a hard disk directly. Many megabytes of data are stored on floppies, often in a very haphazard way. Most people tend to take the continued integrety of the data on those disks for granted. However, floppy disks are not infallible, they can be all to easily damaged. Disks are vulnarable to high temperatures and humidity, which can cause media damage. Another cause of data loss from floppies arises from data corruption. Currupted data is most often caused by inadvertent exposure to magnetic fluxes. The user of floppy disks must remember that many pieces of equipment have strong magnetics associated with their use. The most obvious are monitors and loud speakers. Less obvious sources of magnetic fluxes are power cables, the more convoluted they are the greater the flux.

If a large number of floppy disks are used to store data for long periods of time, then these disks should be stored in a dry cool place well away from adverse magnetic fluxes; in properly design disk boxes; more than one copy should be made with both copies be stored in different locations.

In addition to the above those users who use large hard disks have to deal with disk management problems. In the days of room sized mainframes there would be a large team of computer operators to backup the disks, sort out file structures and maintain the software. Now the PC users must do all that themselves. Again in all probability, these tasks are all to often neglected. The PCs of today have the computing power and data storage facillities of the mainframes of the 70's, which would be unavailable to users for up to half a day a week for disk and file maintenance, PC users should allow the same period for their maintenance. Time spent thus could save many hours of work from being lost through disk crashes. Most disk crashes are preceded by tell-tale signs: slow data access, the odd corrupted character, they are not all typographic errors and intermitant read and write errors.

Floppy disks come in two forms, the 5.25" and the 3.5". Both types have two sizes, 360K and 1.2M for the 5.25", and 720K and 1.44M for the 3.5" disks. Many read and write errors from floppies are caused by the disk not being inserted properly. Always make sure the disk is fully in and the door shut and always wait for the drive active light to go out before you open the drive and extract the disk. Never remove the disk while it is being written to or read from. Though the disk read/write heads are not touching the disk, they are extremely close, less than the thickness of a human hair.

When using hard disks, especially those that are cached (buffered) the user must wait until the drive becomes inactive before power down. This may not be immediate, so a few seconds should be allowed. If a power down occurs while processing an application, then there is a strong likelihood that data could be lost. Many applications use temporary files, if there is a power loss in mid-use then these become unassociated, DOS knows very little about them, they have no name and no owner. All it does know is that there is data present. These files are totaly hidden and known as **LOST CLUSTERS**. Each cluster typically takes up a minimum of 2048 bytes of disk space. They are invisable to the user unless the progrm **CHKDSK** is used. **CHKDSK** can also be used to recover these lost files. Another less common result from premature power down is **CROSS LINKED FILES,** this is where two files share the same cluster on a disk. This is potentially the more serious, as one of the files will lose data. Again **CHKDSK** can be used to find and recover the one intact file. **CHKDSK** is not the only program that can be used for disk repair. There are a number of packages available for total disk maintenance, such as **NORTON** utilities.

The back of the PC can often be a nightmare of cables. Aside from the power, keyboard and monitor cable, there maybe cables to printers, a mouse, plotters and modem links. The 'sockets' for these cables come in many forms, they are though easily identified. The printer port will be a 25 pin D-socket (female) or a centronics edge. The serial mouse and plotter ports are serial devices and use either a 9 pin or 25 pin D-plug (male). The monitor socket has more pins than the serial 9 pin.

Serial cable come in two forms. One form is used as an extension and the other can be used on its own. The latter differs from the former in that pin 2 goes to pin 3 and *vice versa*. The parallel printer cable usually has a centronics socket on one end, the printer will have the oposite gender. Many communication problems come from poor wiring due to lack of maintenance and abuse. Pulling a cable out by the flex will ultimately lead to broken wires. A few seconds extra spent unplugging properly can save hours of work and fewer burnt fingers (from the soldering iron).

As mentioned earlier, the backup duties and general file maintenance were performed by system operators on the mainframes. Now these tasks are down to the individual user of the PC. Regular backups of the data should be made. These should be done on a weekly basis using either the DOS backup system or for HYDATA's datasets, the HYDATA backup system (see the System Managment Options).

Another aspect of machine security is anti-virus protection. In an ideal world, this should not be necessary, however, because of a variety of reasons from pure malice to practicle jokes there are now many thousands of computer viruses lurking on disks all over the world. These viruses are just waiting for the unsuspecting to inadvertently load them on to their machines, where they wreak havoc. The appearance of such entities has spurned a whole new family of software call anti-virus software. A few hundred dollars spent on a good AV package **WILL** save many many hours of work.

The HYDATA installation program HYINA creates on the PCs hard disk a directory structure that spreads out from a subdirectory called HYDATA. The subdirectories are: **PROGS**, **DEMO**, and **DATA**. The **PROGS** subdirectory contains all the HYDATA run time programs and support files, the **DEMO** subdirectory contains all the data files for the demonstration dataset, and the **DATA** subdirectory contains an empty but initiallized database for future use.

To run **HYINA** the user should make drive A the current drive by typing **A:** [rtn]. At the A:\ prompt the user must type **HYINA.** The initial screen display is the **HYINA** imenu. This menu should be read carefuly. **Option 2** installs **HYDATA, option 3** installs a new empty database, **option 4** will upgrade an existing **HYDATA 3.01** database and **option 5** installs the demonstration database. Select **option 2** and follow the instructions, reading each subsequent menu carefully. Full details of **HYINA** are given in the **HYDATA** user guide. NB. Do not change any of the default values if you want the structure describe in the previous paragraph.

In the **PROGS** subdirectory, there is a file call **CGI.CFG**. This file tells HYDATA how to set up for graphics, it contains information about the PCs graphics capabilities. Only the drivers selected during the installation process will be present on the hard dsik. The others can be found on the distribution disks Graphics1 through to 4. If they are required they can simply be copied to the **PROGS** subdirectory.

Another important control file is **HDBIN,** this tells HYDATA about the database associated with it. **HDBIN** can be found in each of the **DEMO** and **DATA** subdirectories. The parameters that are contained in this file can be changed using the program **HDBINS.EXE**. This program has 24 main options. Each of these options are describerd in detail in the **HYDATA** user guide. Many database features are set using this program and care should be taken when using it.

HYDATA

Insufficient disk space: HYDATA requires in excess of 7 megabyes of free disk space to install. HYDATA will require additional space as the database increases in size. **To rcover more disk space, check for LOST CLUSTERS and temporary files. Try removing old unused files and packages.**

Insufficient memory: HYDATA requires about 490 Kbytes of conventional ram. It does not use extended or expanded memory. **If DOS 5 or above is the current operating system then extra conventional memory can be recovered by putting TSR's and drivers in high memory (memory above 640K).**

HYDATA loads OK but does not display graphs or the editor: HYDATA requires that the program DRIVERS is run prior to running HYDATA. Either the program has not been run or there is insuficient memory to load the transient drivers. **Exit HYDATA and if necessary run DRIVERS, or free more conventional memory (see above), also prior to running DRIVERS, ensure that the environment variable CGIPATH is set in AUTOEXEC.BAT (See installation guide). If neither of the previous solutions work then try changing the screen driver. More drivers can be found on the distribution disks. (See notes on CGI.CFG))**

HYDATA fails to load and returns a protection error: HYDATA is a copy protected package. The protection system has to be transfered from the installation floppy disk to the hard disk. Only one copy per licence (except for site licences) is allowed per installlation. **Run the transfer program on the distribution disk labelled PROGRAM 3. (See additional notes on copy protection).**

Parts of HYDATA do not work or cause the program to crash: HYDATA is a collection of programs. The programs are loaded when required by a shell program. HYDATA needs to know where all its component programs are. This information is contained in the HDBIN file for each dataset. **Check to see if the program nanes are set correctly in HDBIN. (Use the HDBINS program).**

Cont....

Make sure that the program resource directory is set for the directory that contains the programs. Ensure that the environment variable PATH in AUTOEXEC.BAT is set (See installation guide).

General

Accessing the hard disks is slow or with many read/write errors: This is a clear indication that the hard disk needs to be checked. There may be **LOST CLUSTERs** and fragmented files which need to be fixed. There may also be bad media which would need to be flagged to prevent future use. **To recover LOST CLUSTERS run the DOS program CHKDSK /F. If the access remains slow then use a disk maintenance tool and defrag program such as the one supplied with DOS 6 or Norton Utilities.**

HYDATA Versions 3.10 and 3.10A

MANUAL CONFIGURATION FOR GRAPHICS SETUP

The graphics drivers used by HYDATA are usually installed and set up automatically through the HYDATA installation program (HYINA). HYDATA will not work properly if incorrect printer (or plotter), screen and mouse drivers are selected. If any of the graphics devices are changed the HYDATA configuation can be altered by running HYINA again. The graphics configuration can be set up manually if necessary and the method is described below.

The configuration information for HYDATA graphics drivers is contained in a file named CGI.CFG in the HYDATA program directory. This file describes the name and location of the graphics drivers riiiequired by HYDATA. All of the graphics drivers called by CGI.CFG must also be present in the HYDATA program directory. Two examples of the CGI.CFG file are given below. The required drivers should be substituted for those given in the examples. The lines beginning with semi-colons are remarks and can be omitted. For the purpose of the examples the HYDATA program files are assumed to in a directory \HYDATA\PROGS on disk drive C. The correct drive and path should be substituted.

```
;CGI.CFG configured for a VGA monitor type, Microsoft
;compatible mouse and a Hewlett Packard plotter
;
;Drivers
;
driver = C:\HYDATA\PROGS\HPPLOT.SYS /G:OUTDEV
driver = C:\HYDATA\PROGS\IBMVGA12.SYS /G:CRT
driver = C:\HYDATA\PROGS\MSMOUSE.SYS /G:POINT
driver = C:\HYDATA\PROGS\GSSCGI.SYS /t
;
display = IBMVGA12
mouse = MSMOUSE
plotter = HPPLOT
;
;Plotter settings
;
FLAGGING = XONXOFF
LOGICALBUF = 128
HP_TYPE = 7475,A,6,N,N
COM1 = 96,E,7,1
HPLOT = COM1
;
;Fonts
;
fonts = d:\HYDATA\PROGS\
;
;End of example
```

```
;CGI.CFG configured for an IBM PS2 with VGA monitor, HP laser printer and an IBM PS2
mouse
;
; Declare GSS*CGI drivers to be loaded
;
driver = C:\HYDATA\PROGS\IBMVGA12.SYS  /G:CRT
driver = C:\HYDATA\PROGS\PS2MOUSE.SYS  /G:INPUT
driver = C:\HYDATA\PROGS\LASERJET.SYS  /G:OUTPUT
driver = C:\HYDATA\PROGS\GSSCGI.SYS /t
;
; Declare environmental defaults
;
display = IBMVGA12
printer = LASERJET
mouse = PS2MOUSE
;
;End of example
```

Institute of Hydrology

Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire OX10 8BB
Telephone: (0491) 838800
Facsimile: (0491) 832256
Telex: 849365 HYDROL G

HYDROLOGICAL SOFTWARE COPY PROTECTION NOTES

Software from the Institute of Hydrology is protected from illegal copying to safeguard your rights as a user. The installation procedure should be described in your user manual. If the copy protection system fails to work properly, please study these notes carefully. Some of our software installation routines automatically try to perform the transfer of the copy protection system but it is always possible to perform this operation manually if necessary.

Copy protection is manually transferred from a floppy disk to a hard disk using a batch file called TRANSFER.BAT that is supplied on one of the program disks. To run this file you must type the following command, substituting the correct drive and path names for your system:

TRANSFER *s: d:\path*

where *s:* is the source drive, *d:* the destination drive and *path* the directory where the software programs will be stored. As an example, if you had your floppy disk with TRANSFER.BAT in drive A and wanted to transfer the copy protection system to a subdirectory called \HYDATA\PROGS on hard disk drive C, you would type **TRANSFER A: C:\HYDATA\PROGS**. Please note that if you want to place the protection in the root directory you should indicate this by use of the backslash (e.g. TRANSFER A: C:\).

It is not absolutely essential that the copy protection system be transferred into the same directory as the program (as long as the path to its location is added to the AUTOEXEC.BAT file) but it is highly recommended that both protection system and program files are placed in the same directory. Problems can occasionally arise when this advice is ignored.

If the copy protection needs to be moved to a different computer, hard disk drive or subdirectory, it must first be moved back to the original floppy disk and then to the new destination. The command for transferring the protection back to the floppy disk is:

TRANSFER *s:\path d:*

where *s:* is the source drive, *path* the subdirectory containing the protection and *d:* the destination drive. Using the installation example above, the command to transfer the protection back to a floppy disk in drive A would be:

TRANSFER C:\HYDATA\PROGS A: (or from the root directory TRANSFER C:\ A:)

The copy protection may then be installed into its new location.

WARNING ! *Remember to transfer all copy protections back to the appropriate floppy disks for every installed software package before reformatting a hard disk. We recommend that you place a warning label on any machine containing copy protection.*

HYDATA macro files

A macro file is a file containing a sequence of HYDATA commands and, possibly, data. Macro files allow repetitive operations in HYDATA to be automated saving time and effort by the user. Some typical uses are:

(a) to automate data entry using the [F4] command
(b) to infill many missing periods of data
(c) to change the storage times in several years for an EVENT station

Macro files can be created manually using a screen editor, or can be generated as output from computer programs written by the user.

The usual way to set up a macro file is to first perform the set of HYDATA commands manually, and to note down the commands in the order in which they are typed in. Note that there are special macro symbols to represent certain HYDATA commands; for example, the * symbol has the same effect as pressing the [ESC] key. A full list is given in Section 2 of the HYDATA manual. Once the appropriate commands have been noted, they can be typed one per line into the macro file or the user's program can be modified to output the commands to a normal text (ASCII) file. The macro is then read into HYDATA by pressing the [F4] key and then giving the name of the macro file. It is important here that the [F4] key is only pressed when the cursor is placed on the HYDATA menu corresponding to the first command in the macro file. If the file has been set up correctly, HYDATA will then perform all of the commands in the file automatically.

For macro files which save data to the database, a useful tip is to first try out the files without the 'Save Edits' commands present. Then, if there any errors in the files, this will avoid saving values wrongly to the database. It is also good practice to make a backup of the database before using any macro files which save data to the database. Data entry can also be made faster by inserting the screen lock command S into the macro to freeze the editor screen as data values are entered.

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