Proceedings of the 13th Annual British Columbia Mine Reclamation Symposium in Vernon, BC, 1989.
The Technical and Research Committee on Reclamation

AN OVERVIEW OF AVAILABLE SOFTWARE AND HARDWARE FOR MANAGING ENVIRONMENTAL DATA

Calvin J. Price
Environmental Coordinator
Afton Operating Corporation
Kamloops, B.C.

Jim Robertson
Environmental Coordinator
Teck Corporation
Vancouver, B.C.

Proceedings of the 13th Annual British Columbia Mine Reclamation Symposium in Vernon, BC, 1989.
The Technical and Research Committee on Reclamation

AN OVERVIEW OF AVAILABLE SOFTWARE AND HARDWARE FOR MANAGING ENVIRONMENTAL, DATA

I. INTRODUCTION

Many companies have ambitious water and air quality sampling programs which are intended to monitor compliance with an assortment of government standards and objectives. These sampling programs can generate large amounts of data which require an organized system to prevent the data from becoming unmanageable.

The decrease in prices of personal computers has resulted in powerful computers being available to most people in the industry. The ability of computers to manage data is well known but there are many different methods available to accomplish the objective of managing environmental data. Choosing the most appropriate and cost effective equipment (hardware) and programs (software) can be confusing in an area where there is such rapid and continual change.

The objective of this paper is to give an overview of the various LBM compatible computer hardware and software options available for handling environmental data and to outline key factors to consider when developing a system.

First to consider the objectives of an environmental data handling system:

1. Ensure quality control of input data to maintain an error free data set.
2. Allow statistical analysis such as means, standard deviations, t test, etc.
3. Produce hard copy tables of data in a complete and summary format suitable for submission to management and to government agencies.
4. Provide an automated method of comparing all data to prescribed objectives and standards such as drinking water standards and Waste Management Objectives.
5. Produce graphs in bar and line format that represent the interval scale in real time.
6. Provide a method of integrating tables and graphs into final documents.

II. HARDWARE

A Desktop Computers

There is considerable variation in throughput and cost between IBM compatible desktop computers. Many extra features are available. Two hardware features which are essential to run current software are at least 64OK of memory and a hard disk with 20 megabytes capacity. Faster processing chips and hard disks result in little difference for programs such as word processing, whereas significant productivity gains can be realized when running CPU and disk intensive programs such as

database, modelling, compiling and CAD (Computer Aided Drafting) applications. For example a modelling program that would take over an hour with a 4.77 MHz PC with no math co-processor would take only a few minutes with a 20 MHz 386 with a math co-processor.

COMPUTER	CLOCK SPEED(MHz)	NORTONS TEST	APPROXIMATE COST
IBM PC - 8088	4.77	1.0	Not Available
Laser - 8088 -20 meg disk,640K -mono screen	10.0	1.9	$1700
Amdek - 286 -20 meg disk,1000k -mono screen	12.0	8.6	$3000
Compaq - 386S -40 meg disk, 2000k -VGA Colour	16.0	11.0	$7700
HP Vectra -100 meg disk, 2000k -387 math chip -VGA Colour	20.0	15.9	$10,000

The above table gives a example of a few computers available illustrating the range of computer speeds and prices in early 1989. The Nortons test gives as approximate comparison of throughput as compared to the original 4.77 MHz IBM PC.

B. Laptops

Laptop technology has improved dramatically in the past year. All the options available for the desktop computer such as 386 chip and large hard disks have become available for the laptop computer. The price of laptop is usually about 40% more than a comparable desktop. The displays have improved with backlit displays and EGA (640x350) and VGA (640x450) resolution but are stUl less readable than a regular monitor.

The battery operation and weight under 15 pounds allows laptops to be used in collecting and evaluating information from data loggers in the field. They are also invaluable for use when travelling. Current batteries only allow a few hours of operation without recharging, but improved battery technology like the Molicell manufactured in B.C. may increase the usefulness of battery powered computers in the near future.

III. SOFTWARE

The best computer hardware available is worth nothing without quality software. As there is no popular commercial program that is specific for environmental data available, the general purpose spreadsheet and database programs are commonly used. When more extensive features are required, programming languages are used for developing in-house application programs.

A. SPREADSHEETS

Spreadsheet programs were one of the first applications developed for desktop computers and are still a valuable tool for managing numerical data. With their straight forward format of data in rows and columns spreadsheets are relatively easy to learn to use. Data can be tabulated, simple statistics like mean and standard deviation can tie calculated, and presentable graphs can be produced. Spreadsheets are a particulary good choice when a table or graph is required for only one occasion.

There are number of choices in spreadsheet software with Lotus 1-2-3 dominating the market. Excel and Supercalc 5, which have newer releases than Lotus 1-2-3, have many additional features which allow production of impressive quality tallies and graphs.

However all spreadsheets suffer from some limitations when managing environmental data. Spreadsheets do not make good database managers as the amount of data in a spreadsheet is limited by the memory of the computer, rather than the storage available on the hard disk. The database manipulation commands are also limited. Some tasks can be automated in a spreadsheet through the use of macros which will play back key strokes, but these spreadsheet options are generally not as reliable and or as automated as other options available for handling environmental data,

B. PROGRAMMABLE DATABASES

Programmable relational databases are designed to allow database development and management and are appropriate for managing environmental data. They provide the tools to develop a workable database management system with a minimal amount of programming. However in order to get the maximum benefit from a database program, considerable programming skills are required. Programmable databases provide good networking capabilities with database security if a multi-user environment is required.

Relational databases by design have a high input to output leverage, ie. information placed in the system once will be typically used many times. All common information such as parameter descriptions and government agency information is present in only one file location. For example, a description of a sampling location is entered into the system only once, but appears on every report that is prepared for this site.

Like other PC products there are a number of data bases vendors. Ashton Tate with their dBase products have the largest market share of data base managers, although other companies such as Microrim with R:Base for DOS have generally been a step ahead of dBase in functionality. Both R:base and the recent release of dBase IV have sophisticated interfaces that allow the user to easily query the database for specific information. For example with database products it is relatively simple matter to extract all the concentrations of selected parameters over a specific value for a time period.

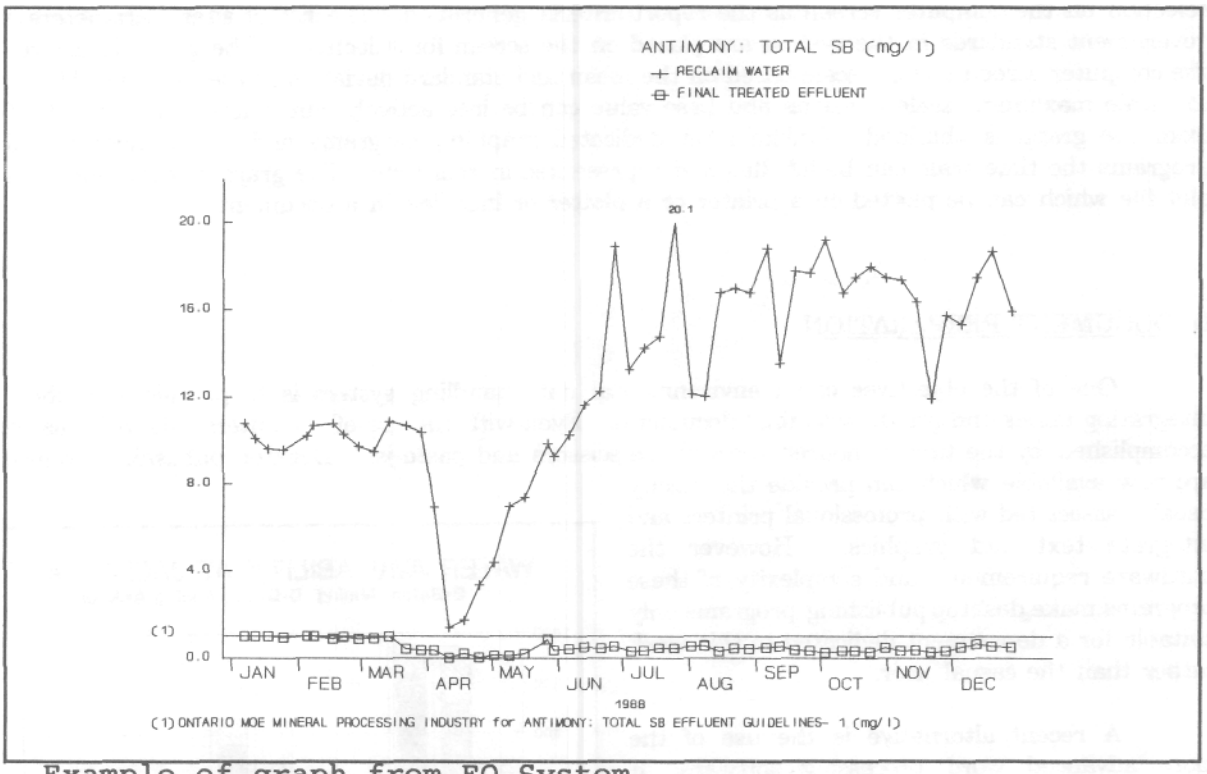
Most database programs do not have graphing capabilities although specific data can be exported to a spreadsheet or dedicated graph program for production of graphs.

C. PROGRAMMING LANGUAGES (EQ SYSTEM)

Packaged commercial programs such as spreadsheets and relational databases are very powerful and will satisfy most environmental data needs. However it always seems there is one more thing to do or one more way to do it. This is where programming languages such a C, Pascal or Basic can be valuable.

Afton has had a programmed environmental computer data system for the past eight years that has evolved through several computers and languages. The system, called the EQ System, is written in compiled Microsoft Quickbasic and is used for handling the environmental data from most of the Teck properties. Although many of the features of the EQ system can be duplicated by a spreadsheet or a database, the ease of use and the special features programmed into the system make it much more productive than the commercial programs.

The EQ system, like the commercial database programs, is designed as a relational data base, where all common site, parameter and government agency information is present in only one file location.



Example of graph from EQ System

The transfer of data to the EQ system can be accomplished from any spreadsheet or from its own data entry program. The spreadsheet option allows data from a commercial lab to transferred from the lab's computer system without re-entering the data. The EQ system provides an extensive quality control check on the input data, which helps to maintain the accuracy of the main data base. Site and parameter codes , detection levels, calculations, total-dissolved ratios etc, are checked. The quality control program also compares the current sampling set with previous data and reports any values outside historic statistical ranges. This can provide an alert for values that are incorrect or provide an early identification of anomalous trends.

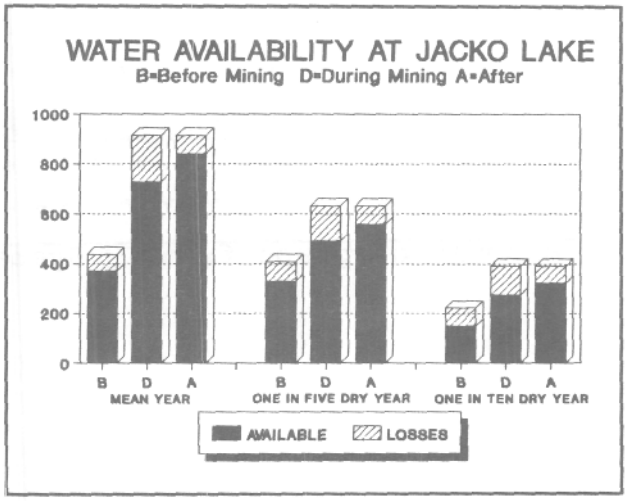
One of the most important parts of any information storage system is the ability to easily retrieve selective information in a organized report table. The EQ system accomplishes this by providing interactive selection on the computer screen of a number of optional items, such as statistics and comparison to government standards, to be included in the report table. Once the criteria for a report is chosen it is automatically saved so a particular report can be printed as many times as desired or modifications can be made to the report criteria. For example a report table with mean and student's t included can be generated for an annual report for one year and it would only be necessary to change the time frame to generate a report table for the next year's annual report.

The generation of graphs of environmental data with the EQ system uses the same interactive data selection on the computer screen as the report (criteria generation. The list of sites, parameters and government standards in the system are placed on the screen for selection. The graph is drawn on the computer screen using a scale based on the mean and standard deviation of the data set. However the scale maximum, scale divisions and base value can be interactively edited until the desired effect from the graph is obtained. Unlike most dedicated graphing programs and spreadsheet graphing programs the time scale can be labelled and represented in real time. The graph is then output, to a plot file which can be plotted on a printer or a plotter or included in a document.

D. DOCUMENT PREPARATION

One of the objectives of an environmental data handling system is to provide a method of integrating tables and graphs into final documents. Even with the use of computers this task has been accomplished by the time honoured tools of the scissors and paste jar. Desktop publishing programs are now available which can provide the quality usually associated with professional printers and integrate text and graphics. However the hardware requirements and complexity of these programs make desktop publishing programs only suitable for a department dedicated to this work rather than the casual user.

A recent alternative is the use of the more advanced word processing software, in particular the popular program WordPerfect 5.0 which allows the integration of graphics, tables and text. The adjacent graph imported into WP 5.0 from Harvard graphics and printed on a laser printer illustrates this ability.



IV. COMPUTER APPLICATION CONSIDERATIONS

Computers are an effective tool in managing environmental data, but like most things there are traps which must be avoided. There is always the danger of being overwhelmed with the "bells and whistles" or the "nifty factor" and losing sight of productivity and accuracy.

The following key points should be considered when using either custom or packaged applications:

1. Adequate resources of people and equipment must be allocated in order to obtain an overall quality job. A computer system will be of little assistance to an approach to environmental affairs where persons involved are poorly trained or not motivated. A computer application will also not help a poorly designed sampling program which has improper sampling and laboratory procedures.

2. The role of the user must be emphasized. A person who is familiar with all aspects of the program from sample sites, to lab, to final reporting must be involved at each step. The time savings possible with a computer often makes it practical for one person to accomplish the complete program.

3. The data input portion of the program is crucial, and until data quality assurance programs are proven to be goof proof (which is unlikely), a human logic spot check is needed. Once again the computer is only a tool. Too much reliance on the computer can be disastrous.

4. Although many applications are becoming simpler and easier to use, personnel must start with the basics. Attempting to accomplish too much at first will result in frustration and probably mistakes. Personnel skills should increase with the increased use of more sophisticated software and hardware.

5. Be wary of the promises made by computer salesman and software developers. There is often some caveat that is not very well explained where one needs specialized hardware, or where the feature only works under one special condition. Be especially wary of new programs where the software developer uses the public to discover all the bugs and idiosyncrasies of a recently released program.

V. SUMMARY

Computers are a powerful tool when used for handling environmental data. The computer industry is going through a period of rapid growth and keeping current is difficult, even for computer specialists. However it is becoming increasingly important that persons handling environmental data keep somewhat familiar with the hardware and software options available in order to remain as productive as possible when manipulating environmental data.

The recent strategy of various provincial regulatory authorities to require electronic transfer of compliance monitoring data in the near future indicates the universality of this mechanism of environmental data handling. This development will undoubtedly cause growth pains by all parties. Consequently, all operations will be affected directly or indirectly by the application of computers to their environmental commitments. However these difficulties are more than offset by the significant benefits which allow quick response to a wide range of complex questions presented by regulatory agencies and internal company management.