Management of environmental information

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"Because the amount of data collected . . . is voluminous . . . , it is extremely important for the technical reviewer to make sure that the owner/operators specify in their . . . plans the evaluation procedures for the data. Represented below are specific evaluation and reporting procedures that should be followed by the owner/operator when recording and evaluating assessment monitoring data. These procedures are used to structure, analyze, simplify, and present the groundwater monitoring data to help the technical reviewer evaluate the extent and concentration of groundwater contamination. The four evaluation or reporting procedures that should be described in the . . . plan used to record data . . . are:

- listing of data;
- summary statistics tables;
- data simplification; and
- plotting of data."

These words on management of environmental chemical information from "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" September 1986, characterize the U.S. EPA's approach to the growing volumes of regulatory chemistry data. The regulated community is expected to use computer tools to demonstrate compliance with environmental regulations, and to assist in planning remediation when regulations are violated. However, there are many obstacles which must be overcome to allow coherent use of these tools. This article will outline design criteria for a successful environmental database, describe several pitfalls which can prevent timely and successful use of computer tools, and discuss several orders of business for the successfully implemented system.

Why Use Computer Tools

In the early days of environmental concern the prevailing industry feelings were that the cost of environmental management was too high to implement. In the ensuing 20 years the viewpoint has changed as the public and industry have been educated to the difficulties that a mismanaged environment can cause. Happily, the prevailing attitude in industry today is to use appropriate technology applied as rationally as possible to clean up and maintain problem sites in the best way possible. The remaining arguments frequently involve rational decision making, how to apply technology, and proper use of environmental information.

At the present time the majority of information involved with management of environmental concerns is chemical in nature. In Resource Conservation and Recovery Act (RCRA) assessment monitoring, for instance, data on 300-400 different chemical species become part of the assessment information base for every sample analyzed (using Appendix VIII methodology). Even the older priority pollutant 600 series methodologies return data on over 100 chemical species per sample. At this rate a single sampling round involving ten wells or soil samples can produce 1000-4000 pieces of chemical data. It is not uncommon to see tens of thousands of chemical results involved in decision making on a RCRA site (or even more on a Superfund site during the remedial investigation alone).

The state of the art in environmental decision making at the present is to use these data arranged suitably for human pattern analysis. This means that the data are used over and over again arranged in ways which allow humans to evaluate questions about:

- whether contamination exists
- where contamination exists
- what is the source of the contamination
- is the contamination moving
- is the sampling plan adequate to detail problems
- is the sampling network adequate to provide spatial information

Without the use of computer tools and databases the rearrangement of this much data becomes a tremendously expensive paper task. As a result of the manpower cost of rearranging and correlating data fewer questions are asked of the data, and the conclusions which are drawn by environmental experts are allowed to stand unchecked. The ability to hide behind the lack of suitable data management systems is becoming increasingly untenable as the regulatory agencies become increasingly sophisticated in requests for information.

In a business sense management of environmental information can be characterized as control of liability. Each piece of regulation invoked codifies penalties for improper management of the environment. These penalties can range from fines to imprisonment to inability to execute favorable business decisions. In addition, the courts are open to redress individual and collective damages with additional penalties. These liabilities should be controlled by use of the best technology available, including technology for data management.

Most importantly of all, the environment affects those who live in it. Intelligent management of chemical and engineering information can make the environment safer for everyone.

What to Look for in Computerized Environmental Management

A well-designed computer environmental management system should allow several key benefits. In addition to the four evaluation procedures mentioned in the "RCRA Groundwater Monitoring Technical Enforcement Guidance Document," the system should:

1. Help to control quality of laboratory data by displaying data in historical trend order for each sampling point;
2. Allow management of data by exception by dis-

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playing only data which meets criteria (e.g., show only data which is above detection limits);
3. Flexibly provide answers to regulatory inquiries;
4. Allow better community relations;
5. Allow central management of outboard sites; and
6. Uniformly manage soil, water, and air data, allowing use of common tools for selection and presentation of data.

In the event of contamination it should help to quickly and inexpensively:

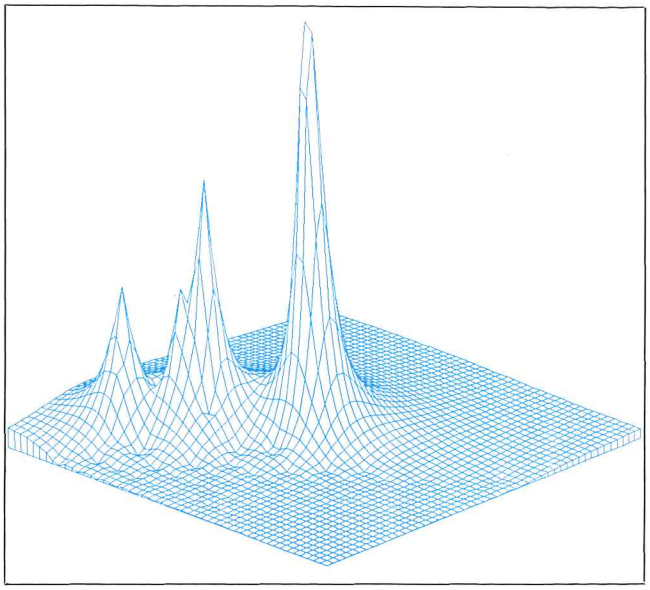
1. Identify and characterize contamination plumes by ranking contamination;
2. Determine plume migration by mapping contamination at different times;
3. Isolate and characterize contamination sources by plotting multiple contaminants versus time;
4. Determine effect on receptors by reporting data which exceed predetermined values;
5. Determine appropriate engineering alternatives by using more data in evaluating those alternatives;
6. Reduce management anxiety during negotiations by showing command of the data;
7. Enhance community relations by presenting data in a more favorable light;
8. Save time in preparing for sale of property by making quick analysis of the data possible; and
9. Avoid travel costs associated with hot spots by making data available at all times by telephone modem and terminal.

In addition to these requirements, the system should be capable of responding flexibly to changing needs for information. Regulations are changing at a tremendous rate. As remediation technology develops, the character and form of information needed to support that technology changes.

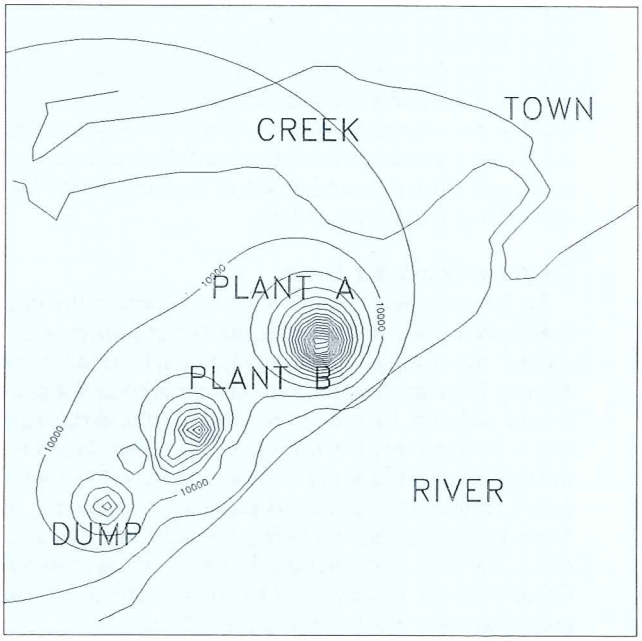
What Can Go Wrong

Two chief causes exist for the failure of new environmental information systems. The foremost problem lies in the lack of regulatory and chemical expertise in the central Management Information Systems (MIS) staffs which typically design large implementations of environmental databases. The other (often insurmountable) problem lies with the lack of organizational support for what is inherently a very difficult "garbage in/garbage out" problem.

The central MIS approach to designing and developing environmental databases has many difficulties, some of which are inherent to the nature of these groups, and some of which lie in the transfer of necessary technical information from environmental personnel. Central MIS groups typically have an unmanageable backlog which extends two or more years into the future. This means that the competition for their time becomes a political/funny money driven affair, often



Benzene identified in multi-contaminant stream.



Plume migration of contaminants.

unapproachable for the decentralized environmental manager. In addition, central MIS groups traditionally have their strengths in financial, sales, and other business related areas. It is extremely unusual to find expertise in chemistry based, regulatory driven systems development. Very often the MIS department may be committed (by their expertise and past triumphs) to hardware and software approaches that are not satisfactory for the environmental manager as end user. For these reasons a project to provide management of environmental information can become a costly, long term investment which is inadequate, inflexible, improperly designed, and does not function for the user.

The outright purchase of environmental data management software can lead to problems of different nature. There are several software packages available for purchase and use on personal computers, minicomputers, or on mainframe class systems. These packages vary widely in completeness, level of support, and in price. In the long run the success with which the packages can be applied hinges on two criteria, support by the software vendor and support by the organization using the software. Software systems which are purchased outright are supported by collecting a maintenance fee (typically 10-15 percent annually). The fee usually entitles one to software bug fixes and to any enhancements which are developed. The business of selling software is a very risky one at best. The sale of software is a very competitive business. If the software company is inadequately funded, moves on to more profitable business, or fails outright, the maintenance contract may become meaningless.

On a deeper level software, which is either purchased or commissioned from a corporate resource, must be supported by an organization. In the environmental arena the magnitude of data is so large, there traditionally have been no paper systems which could support the level of inquiry necessary to properly manage liabilities. Therefore the staff necessary to support data entry, discipline, review, and inquiry on a computer-based system may be new positions. Most companies are not prepared to staff at the levels required by implementation of large computer software systems. In addition, most traditional systems are designed to disallow transactions which do not pass data entry requirements (e.g., do not have appropriate well or sample point designators or valid chemical parameter codes). If the problems of data entry are not solved in an organizational sense, the data contained within the database can be incomplete or outdated when inquiries are made. In many cases data which appear incorrect at data entry time are not incorrect. An example might be when a new well has been commissioned but the new designator has not yet been entered. Very frequently the level of staff support necessary to ensure that the appropriate data is available is grossly underestimated. When these difficulties are complicated by the necessity to manage data at a corporate level a new set of problems arises. A central environmental staff may be charged with overseeing corporate liability by providing technical expertise and by reviewing environmental decisions. This task in an active company may become a near impossibility as divisions are bought and sold, multiple laboratories provide chemical analysis data, several engineering firms manage different site tasks, and regulators are involved in dialogs at multiple levels. Further complications arise when staff changes are made and responsibilities for new staff are not clearly delineated.

A Workable Alternative

A viable solution to these software and organizational problems is to turn to an environmental data services company. This type of company provides services which can reduce concerns about developing environmental database software and the organization to support it. Such a company can enter data, verify sample point and other designators, provide tools for quality review and management by exception, and eliminate the need for development costs, computer staff, and an environmental data management support organization. As well, the data management needs of a company can be addressed as a whole, eliminating political and funding problems.

When searching for such a firm several things should be kept in mind. An environmental data management service company must be built around a core of first-rate professionals. It should count among its ranks experts in regulatory affairs, environmental law, environmental management, computer sciences, chemistry, and engineering technology. These people should provide services which range from database organization to development of risk management strategy in order to augment your own staff at any level of your corporation. The computer system behind the data management service should be flexible, provide management tools which serve all corporate management levels, and should be backed up by a competent systems staff. The system should be demonstrably secure (in both a data protection and data backup sense), yet available to you for problem solving inquiries. The service should be cost effective in a direct comparison with real costs to emulate the capabilities.

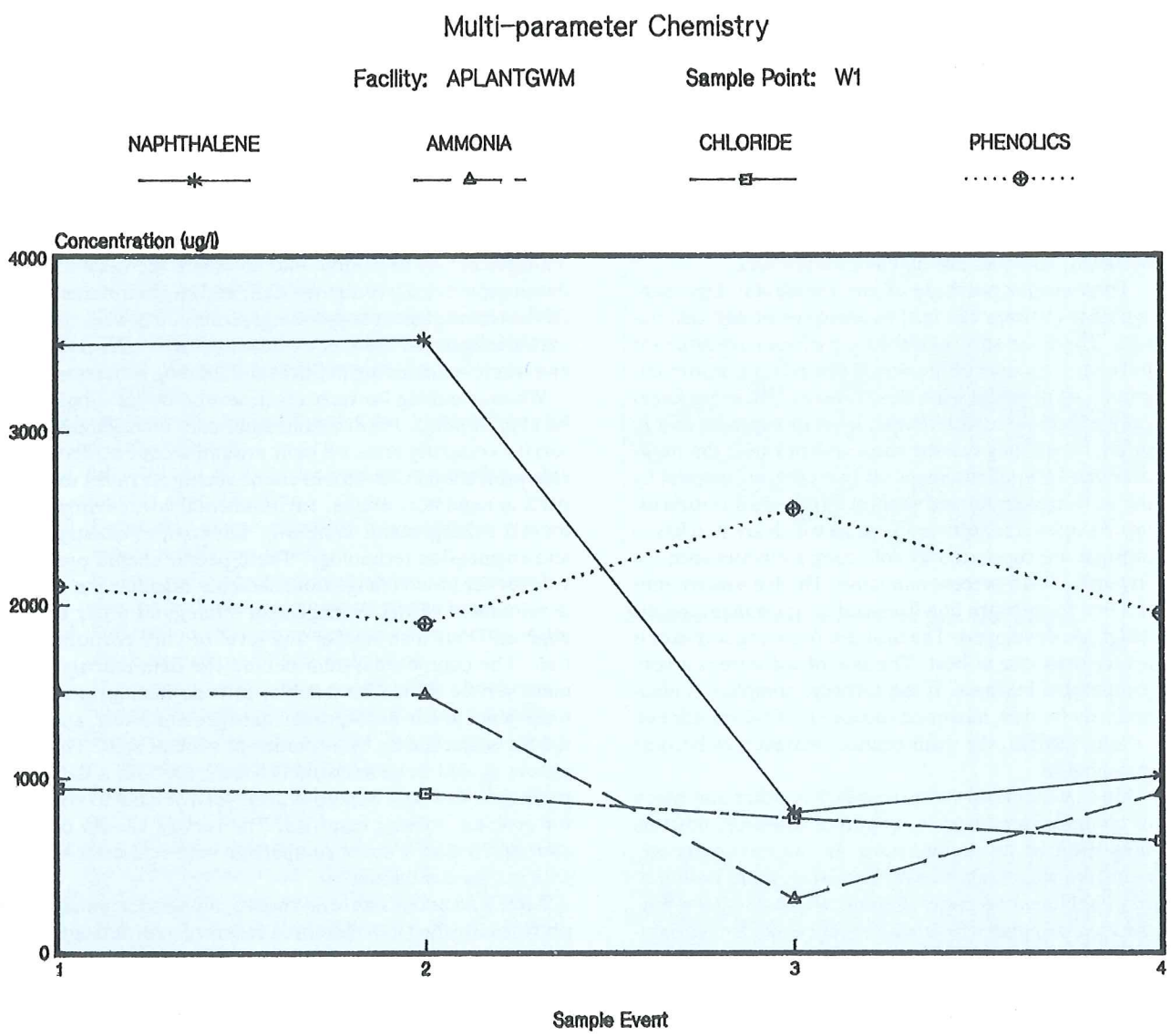
After a company has been chosen, the service should provide reporting tools for three orders of data management business:

1. routine collection/review of environmental data
2. environmental decision support
3. influence of the regulatory process.

The first order tools (for routine collection and review of data) are those which are involved with the daily business of gathering data from a variety of sources and ensuring its quality and completeness. The reports used in this phase of data management should include sample point ledgers, historical trend reports, exception reports, and simple graphical depictions of data. In addition, an interactive system should be available for routine inquiries. The first order tools should provide a bridge to personal computer software, which can be used for local manipulation of data.

Once the quality and completeness of data has been ensured, the business of decision support can be started. The type and format of information used in decision support is somewhat different from that in the data collection phase. Here the emphasis is on pattern recognition and engineering decision support. The reporting formats necessary for this phase are often graphical in nature. The data should be available in contour or surface map form for use in identifying contamination sources. Data should also be available in graphical form. Multiple parameter versus time graphs and parameter versus parameter correlation graphs can also

Isolation and characterization of multi-parameter waste stream.



be used in this phase to attribute contamination to particular processes or business units on a complex site.

A third phase of environmental database management is the use of large masses of chemical information to evaluate regulatory impact, and to suggest alternate strategies. Such an approach has been used to evaluate RCRA indicator parameters 2 and to review use of low level volatile organic data for site decision making.

The difficulties of system and organization development necessary to establish environmental data management systems are often underestimated. The use of an environmental data management company can often provide service which is cost effective and complete, without the organizational overhead. The choice of such a company might be justified financially in direct comparison with a software development or purchase plan when organizational costs are included. In the process of choosing an environmental data management company a large emphasis should be placed on suitability of the services, quality of consultory staff, level of support, and your long term environmental management goals. **PE**

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