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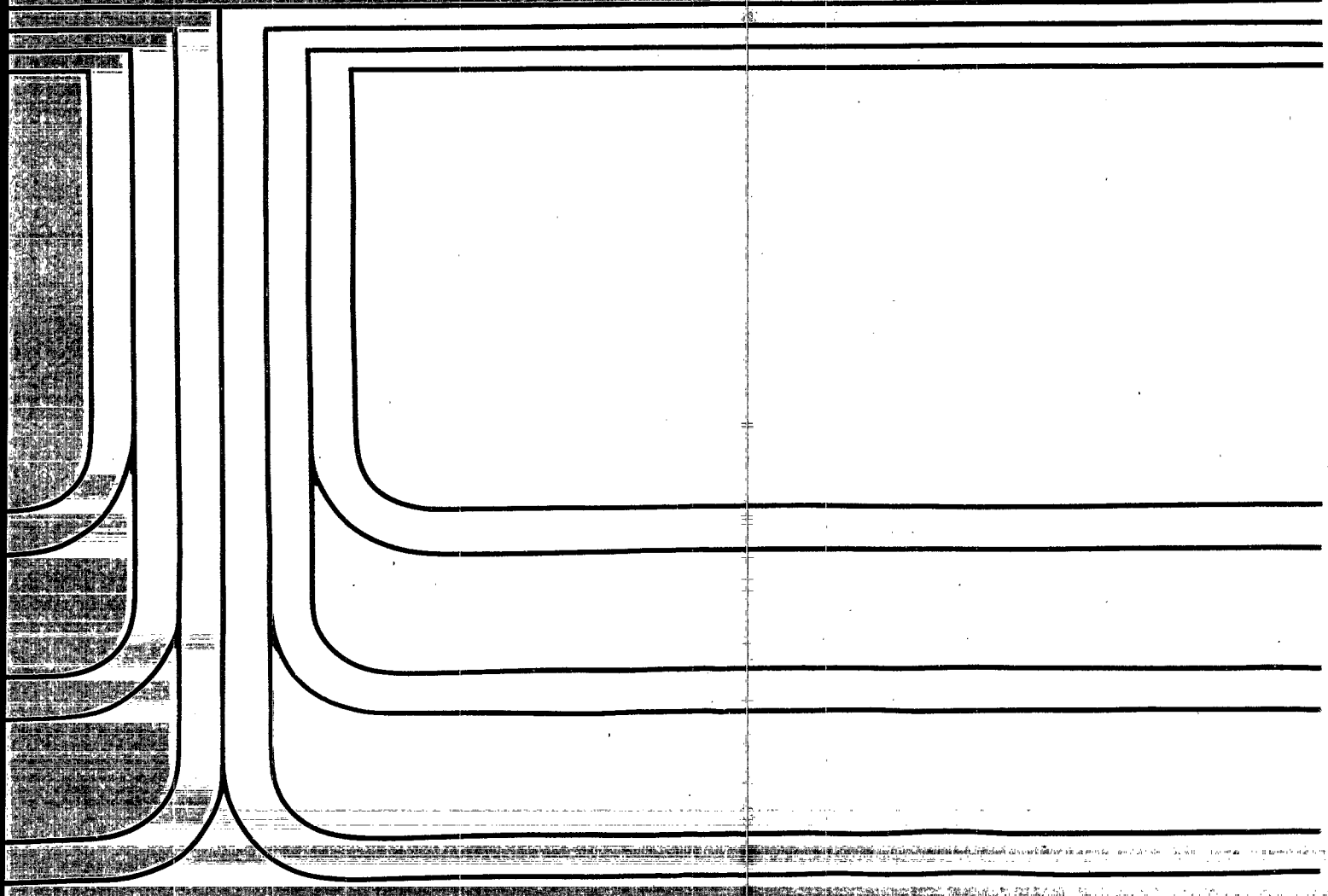
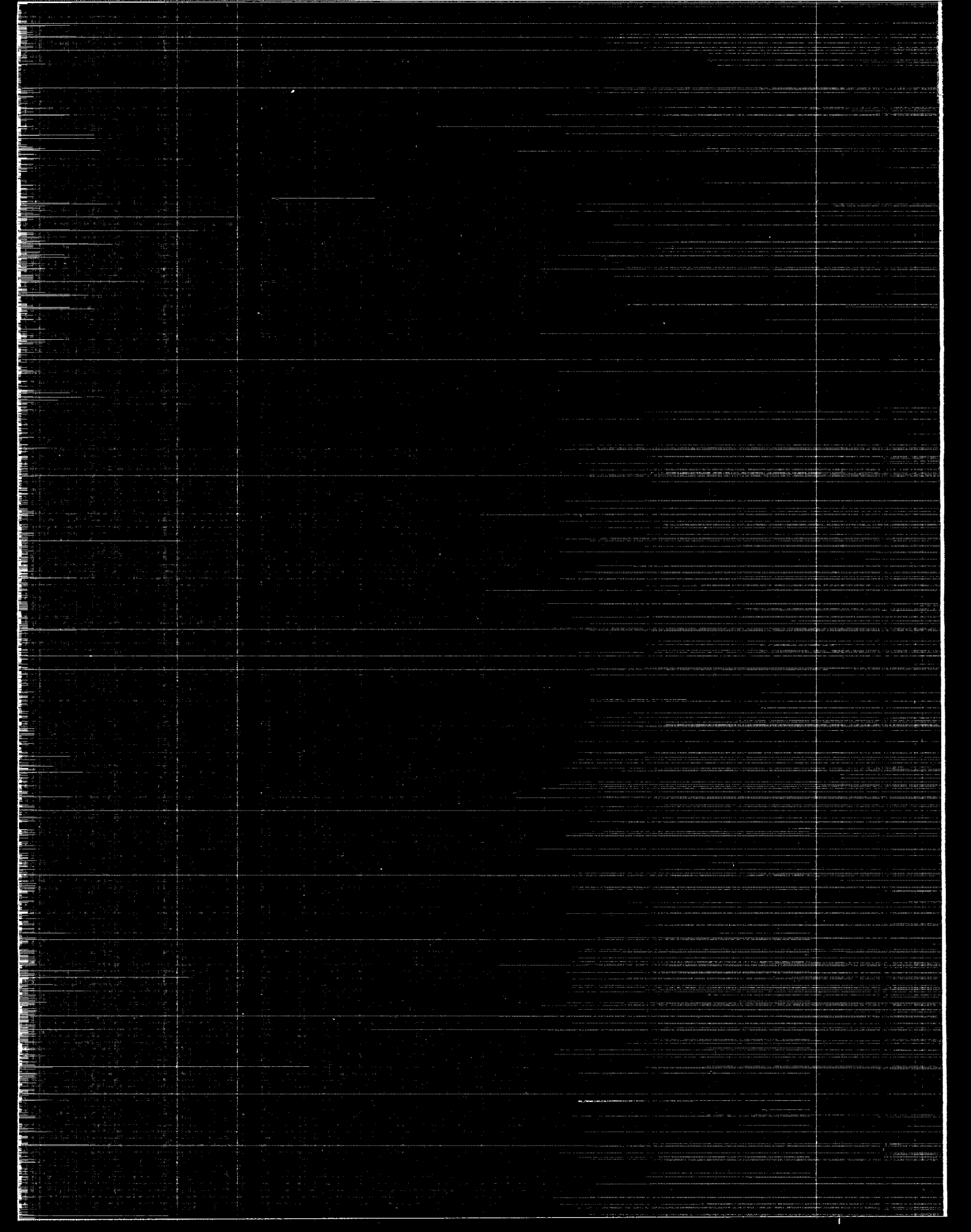
Minimum Set Of Data Elements For Ground Water Quality

Brochure





U.S. Environmental Protection Agency
Minimum Set of Data Elements for Ground Water Quality – Brochure

INTRODUCTION

The protection of our nation's ground water resources is receiving widespread attention at all levels of government as the need to protect this vital resource becomes increasingly clear. As a part of the Environmental Protection Agency's (EPA) continuing commitment to protect the Nation's ground water resources, through implementing EPA's Ground Water Strategy[1], the Agency has identified a critical need to improve the management of ground water information. EPA's Ground Water Strategy recommends standardizing the type and quality of ground water data collected to improve the accessibility, accuracy and consistency of these data. To facilitate this effort, EPA's Office of Ground Water and Drinking Water, with the help of numerous State and Federal officials, has established a Minimum Set of Data Elements for Ground Water Quality (MSDE). The MSDE is comprised of two parts: (a) EPA Policy Order 7500.1A, October 1992 and (b) the guidance document, *Definitions for the Minimum Set of Data Elements for Ground Water Quality*, EPA 813/B-92-002, July 1992.

The MSDE is "the minimum number of elements necessary to use ground water quality data . . . across related programs." It is a set of 21 ground water quality-related data elements that contain geographic, well and sample descriptors. These data elements form a standard data set that EPA and States can use to support better environmental decision-making and promote the integration of related environmental programs. The following pages list the elements and their definitions that comprise the MSDE.

PURPOSE

The purpose of the MSDE is to help standardize the collection and storage of ground water quality data to allow the efficient management and sharing of these data. By standardizing the type and quality of ground water data that are collected, the MSDE supports the EPA's goal to improve the access, accuracy and consistency of ground water data. It also supports the use and transfer of ground water data between EPA, the States, municipalities and other Federal agencies. The MSDE will help achieve the data management goals of programs such as the Wellhead Protection (WHP) Program as included in the Safe

[1] U.S. EPA, *Protecting the Nation's Ground Water: EPA's Strategy For the 1990s*, EPA/21Z-1020, July 1991.

The Minimum Set of Data Elements for Ground Water Quality

The MSDE is comprised of 21 data elements that are divided into the following four categories or descriptors: **the general descriptor** — describes where the well information is maintained; **the geographic descriptors** — describe a well or spring in relation to the earth's surface; **the well descriptors** — describe various features of a well or spring; and **the sample descriptors** — describe different aspects of collecting, analyzing and recording the results of a ground water sample.

General Descriptor

1. **Data Sources** - The names of the organizations to direct questions regarding the following data: (1) latitude and longitude coordinates, (2) altitude, (3) well log information, (4) sample collection and (5) laboratory sample analyses.

Geographic Descriptors

2. **Latitude** - A coordinate representation that indicates a location on the surface of the earth using the earth's equator as the latitude origin, reported in degrees (D), minutes (M), seconds (S) and fractions of a second in decimal format (if fractions of a second are available). A "+" (plus) symbol represents latitudes north of the equator. A "-" (minus) symbol represents latitudes south of the equator.

3. **Longitude** - A coordinate representation that indicates a location on the surface of the earth using the prime meridian (Greenwich, England) as the longitude origin, reported in degrees (D), minutes (M), seconds (S) and fractions of a second in decimal format (if fractions of a second are available). A "+" (plus) symbol represents longitudes east of the prime meridian. A "-" (minus) symbol represents longitudes west of the prime meridian.

4. **Method Used to Determine Latitude and Longitude** - The procedure used to determine the latitude and longitude coordinates (Technology of Method Used), the standard used for three dimensional and horizontal positioning (Reference Datum), the method used for map interpolation (Scale of Map) and the date on which the coordinates were determined (Date). Latitude always precedes longitude.

5. **Description of Entity** - A textual description of the entity to which the latitude and longitude coordinate refers.

6. **Accuracy of Latitude and Longitude Measurement** - The quantitative measurement of the amount of deviation from true value present in a measurement (estimate of error). It describes the correctness of a measurement.

7. **Altitude** - The vertical distance from the National Reference Datum for Altitude to the land surface or other measuring point in feet or meters. If the measuring point is above the National Reference Datum for Altitude, a "+" (plus) sign shall precede the reported altitude value. If the measuring point is below the National Reference Datum for Altitude, a "-" (minus) sign shall precede the reported altitude value.

8. **Method Used to Determine Altitude** - The method used to determine the altitude value (Altitude Method), the National Reference Datum on which the altitude measurement is based (National Reference Datum for Altitude) and the date the measurement was taken (Altitude Date).

The Minimum Set of Data Elements for Ground Water Quality (continued)

Geographic Descriptors (continued)

9. **State FIPS Code** - A Federal Information Processing Standard (FIPS) alphabetic or numeric code to indicate the location of the State (or its equivalent such as territory or province) in which the well is located.

10. **County FIPS Code** - A Federal Information Processing Standard (FIPS) numeric code to indicate the location of the county (or county equivalent) in which the well is located.

Well Descriptors

11. **Well Identifier** - A unique well identifier assigned by the responsible organization.

12. **Well Use** - The principal current use of the well, or if the well is not currently in use, then the original or principal purpose for its construction.

13. **Type of Log** - The type of record-keeping log(s) available for a well.

14. **Depth of Well at Completion** - The depth of the completed well below the land surface or other measuring point, in feet or meters.

15. **Screened/Open Interval** - The depth below the measuring point to the top and bottom of the open section in a well reported as an interval in feet of meters. The open section may be a well screen, perforated casing or open hole.

Sample Descriptors

16. **Sample Identifier** - A unique number for each water quality sample collected at a well (Sample Control Number) which references the date (Sample Date), the depth at which each sample is taken reported in feet or meters (Sample Depth) and the time the sample is taken (Sample Time).

17. **Depth to Water** - The vertical distance between the measuring point and the water surface level at a well, corrected to land surface, where the measuring point is not the land surface. This distance should be reported in feet or meters (Measurement Depth), along with the date and time the measurement was taken (Measurement Date and Measurement Time).

18. **Constituent or Parameter Measured** - Measurement of a physical, chemical or biological component. The physical, chemical or biological components are referred to as constituents or parameters.

19. **Concentration/Value** - The analytical results value, the units of measure used (Analytical Concentration/Value) and the analytical method applied (Analytical Method) to the samples collected.

20. **Analytical Results Qualifier** - Qualifying information that will assist in the interpretation of the concentration/value, such as whether the value is below the detectable limit or if the constituents (parameters) of interest are present but cannot be quantified.

21. **Quality Assurance Indicator** - The quality assurance of the field protocol plan and laboratory quality assurance/quality control (QA/QC) procedures.

Drinking Water Act. The purpose of the WHP Program is to prevent contamination of underground sources of drinking water. The MSDE will also support Comprehensive State Ground Water Protection Programs[2] (CSGWPPs) as written in the EPA Ground Water Strategy. Through the CSGWPP initiative, EPA is working with States to establish common ground water protection priorities and better integrate and coordinate ground water protection activities.

DEVELOPMENT OF THE MSDE

EPA began developing the MSDE as a result of a Ground Water Data Requirements Analysis conducted in 1987. An issue consistently identified during this analysis was the need to improve access to ground water data and the need to standardize data elements to increase information sharing capabilities. In response to this need, EPA conducted a workshop in 1988 to discuss the development of a minimum set of data elements for ground water quality.

The goals of the workshop were to achieve consensus on a minimum set of data elements that would facilitate the collection and sharing of ground water data across agencies and to identify implementation issues that must be resolved to encourage collection of a MSDE throughout the ground water community.

Workshop participants used the following criteria to identify minimum elements:

- The elements that are needed to communicate ground water data across related programs;
- The elements that are common to all programs and completely adequate for some programs;
- The elements that provide a path to other ground water data; and
- Those elements that provide a link between ground water quality and well location information.

EPA established an interim Policy Order in 1989 that made the use of the MSDE a requirement for EPA and its contractors. EPA issued the final Policy Order (number 7500.1A) in October, 1992.

The development of the policy order and its accompanying guidance document (that includes definitions, discussions and examples of use for each element in the MSDE) involved an iterative process of drafting and peer review by a MSDE work group of over 100 representatives from EPA, other Federal agencies and the States. The 21 elements that comprise the MSDE represent the *minimum* data elements officials should consider when collecting ground water quality data. They form the core upon which data managers can build data bases by adding additional elements.

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[2] U.S. EPA, *Final Comprehensive State Ground Water Protection Program Guidance*, EPA 100-R-93-001, December 1992.

BENEFITS OF THE MSDE

There are a number of benefits to adopting and using the MSDE. The MSDE ensures consistency in the type and quality of data collected by all users of this data set. By collecting the same set of data elements that have established definitions, members of the ground water community can easily share important ground water quality data. Such sharing facilitates effective and efficient information exchange within and between Federal, State and local programs.

As an example, one scenario follows: A State water management agency is planning to track trends in ground water quality in order to prioritize its ground water management activities. Historically, only limited data have been collected from only a portion of the State. Recently, however, the agency and other members of the ground water community in the State have incorporated the MSDE into their current data management systems in an effort to develop a solid base of information for a comprehensive information management system.

To collect the additional data that the State needs to complete its work, the agency turned to others who collect ground water quality data (e.g., EPA RCRA and CERCLA site managers, U.S. Geological Survey (USGS) personnel conducting site-specific hydrogeologic assessments and local health and environmental departments). Since these other agencies collect the same MSDE elements and define these elements in the same way, the State can add these fundamental data to its now rapidly growing data base. Use of the MSDE across the State or nationally will help this State agency to access data bases to find information before spending often scarce resources to implement an expensive monitoring program.

Another benefit of the MSDE is to help States achieve formal endorsements of their Comprehensive State Ground Water Protection Programs (CSGWPPs) from EPA. A MSDE is specifically referenced in the following adequacy criteria for CSGWPP endorsement:

> *A minimum set of data elements is defined and used by all ground water-related programs within the State to facilitate data sharing and cross media analyses and provide users with consistent and comparable data.*

Implementation of the MSDE will help EPA and States to efficiently measure progress in and document the success of CSGWPPs and help States identify ground water priorities, which is an important component of a CSGWPP.

WHO SHOULD USE THE MSDE?

EPA Order 7500.1A requires that all EPA staff and EPA contractors use the MSDE for all ground water data collection activities, including research and development and enforcement. In addition, EPA strongly encourages all organizations that collect ground water quality data to adopt and use the MSDE. Such organizations include State and local governments, EPA grantees, other Federal agencies, the regulated community, associations and other members of the ground water community.

POLICY ISSUES RELATED TO THE MSDE

Implementation of the MSDE is most important under the following conditions:

(1) When States, Federal agencies or other officials are creating a new ground water quality data base; or

(2) When officials want to modernize an existing data base because they have a significant amount of new data or because they want to achieve consistency with other data bases.

When implementing the MSDE there are a number of policy issues to consider. First, formal recognition of the MSDE as an integral part of programs should be considered during the reauthorization of related programs; however, the MSDE policy does not require the modification of existing regulations.

Second, officials should consider the personnel and other resources needed to implement the MSDE. In many cases, most of the data elements in the MSDE are part of existing ground water data bases and therefore implementing the MSDE will likely require limited effort. In other cases, data management systems may need some modification and staff may also need limited training. The resources necessary to implement the MSDE will depend on the specifics of each existing data management system and the technical expertise of those in the field who collect the data.

TECHNICAL ISSUES RELATED TO THE MSDE

There are several key technical issues to consider when implementing the MSDE. First, data should be expressed consistently. For example, data formats need to be uniform. Also, data need to be expressed in the same units of measurement (e.g., feet or meters), for all relevant data elements. EPA is prescribing data formats in the MSDE for a limited number of elements to ensure conformance with EPA and Federal government policies. For most of the elements in the MSDE, however, EPA does not prescribe but rather suggests data storage conventions. In the guidance document, EPA presents the preferred data storage format for each element as the first data convention example.

Secondly, related data should be linked together. Similar data elements can be grouped into what are called "entity" files. Entity files related to the MSDE are wells and other ground water locations, samples and analytical results. Each element in the MSDE fits into one of these three entity files. Organizing data by entity files improves the efficiency of a data base's storage capabilities.

Lastly, data fields should be stored separately. Data elements that contain two or more values representing distinct pieces of information can be stored in different fields to increase the flexibility of a data base. For example, the Sample Identifier element is comprised of the date, time and depth the sample was taken in addition to a unique sample control number. Storing each component separately makes it easy to correct data errors and will help minimize difficulties in tracking the sample and linking data should corrections be necessary.

WHAT IS EPA DOING TO IMPLEMENT THE MSDE?

EPA amended the 1989 MSDE Policy Order to reflect the definitions for each data element and to clarify when EPA and EPA contractors must implement the MSDE. EPA has also met with various State and Federal groups to explain the benefits of using the MSDE. If you are interested in discussing implementing the MSDE in your data system, call the EPA Ground Water Protection Division, MSDE Coordinator, at (202) 260-7077.

In response to the Order, EPA is including the MSDE in its Federal Reporting Data System (FRDS) and its STOrage and RETrieval System (STORET)[3]. Currently undergoing major redevelopment, FRDS is an automated data base supporting the Public Water Systems Supervision Program operated by EPA's Office of Ground Water and Drinking Water. This data base is a repository for data on public water supplies and compliance monitoring requirements and regulations of the Safe Drinking Water Act Amendments of 1986.

STORET, one of the oldest and largest water information systems, is also undergoing a major modernization that is expected to continue for the next five years. STORET forms the basis for many other water information systems and has served as a standard for the design of many State water information systems. STORET contains information on ambient, intensive survey, effluent and biological water quality monitoring information. As part of the FRDS redevelopment, ground water data from FRDS will be linked to ground water data in STORET. Designed to reside on EPA's mainframe computer, the modernized STORET will provide enhanced capabilities to describe the more than 150 million parametric observations currently residing within the system. STORET is jointly maintained by EPA's Office of Information Resources Management and the Office of Wetlands, Oceans and Watersheds.

The inclusion of the MSDE in FRDS and STORET is expected to greatly increase the utilization of ground water data between EPA programs and Federal, State and local agencies. For instance, locating public water supplies and linking them to STORET ambient and source-specific monitoring data may assist in setting priorities for ground water programs and in characterizing source-contaminants for the development of drinking water standards.

In addition to this brochure, EPA has also developed an internal fact sheet (for EPA and EPA contractors) and an external fact sheet (for States, EPA grantees, other Federal Agencies) to promote the implementation of the MSDE. The internal fact sheet focuses on how the MSDE can help standardize and improve the sharing of ground water information within the Agency. The external fact sheet discusses how the MSDE can help (1) States meet one of the adequacy criteria for a CSGWPP, (2) States achieve approval of their WHP Program and (3) Federal agencies share information more effectively.

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[3] For more information on FRDS, contact Jeff Sexton at (202) 260-7276. For more information on STORET, contact Bob King at (202) 260-7028.

CASE STUDIES OF DATA BASES ADOPTING THE MSDE

Minnesota and the MSDE[4]

Historically, ground water data collected by the Minnesota Pollution Control Agency (MPCA) programs were stored in a variety of data bases and formats that made accessing and sharing these data difficult. More than seven years ago, program development personnel at MPCA recognized the advantages of a central repository for ground water quality data collected by a variety of MPCA programs. The MPCA envisioned its central data repository as a model for other ground water information systems developed within Minnesota and elsewhere. This comprehensive system would enhance MPCA's ability to collect, access, share and utilize ground water information among multiple program areas. This system, the Integrated Ground Water Information System (IGWIS), became operational in August 1990.

The MPCA had already established standards for the collection of ground water data, but as the MSDE developed, the Agency adopted MSDE elements not already included in IGWIS. The MPCA recognized the benefits of including these critical elements in any comprehensive data base. Establishing data collection standards and centralizing data has helped MPCA integrate data from various programs and resulted in the following cross-program benefits:

- Minnesota's Ground Water Monitoring and Assessment Program (GWMAP) can use other MPCA programs' upgradient wells to evaluate regional ambient water quality conditions;
- The GWMAP can also use other programs' data to track low level contamination in areas of widespread contamination;
- Regulators can compare site data to data on nearby wells monitored by other MPCA programs to determine if action is necessary; and
- Access to a collective data base enables MPCA programs to better understand the geology, ground water flow and contamination levels within a given area and should reduce the need to install additional sampling stations or perform additional sampling events.

IGWIS consists of the following three components that parallel the descriptor categories of the MSDE:

- The Facility component stores general descriptive information about each facility including name, location, owner, type of facility, the requirements for ground water monitoring and effective dates, and facility remarks.
- The Station component contains detailed information about specific sampling stations including location, construction and installation information, geologic characteristics and station remarks.

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[4] For more information on IGWIS, contact either Susan Schreifels at (612) 296-8581 or Shelly Street at (612) 296-7318.

- The Sample component contains detailed information about each sampling event, the samples taken and the results of analyses on those samples.

IGWIS is a mainframe system and was designed as a user-friendly, menu-driven, multi-user, relational data base that has a number of capabilities. These capabilities include on-line validation of data, journaling of critical fields, electronic conversion of locational coordinate systems, automatic calculation of data, standard and user formatted queries and security and data confidentiality provisions. Data are entered manually from data collection forms and in the future IGWIS will also allow electronic transfer of data. Outputs include standard reports and electronic data sets that can be interfaced with other software applications.

Data stored in IGWIS can be used for ground water modeling, hydrogeologic mapping, geologic cross-sections, fence diagrams, contaminant distribution mapping, three-dimensional plotting, statistical analysis, trend analysis and Geographical Information Systems.

Idaho and the MSDE[5]

The Idaho Department of Health and Welfare, Division of Environmental Quality is in the final stages of completing a major modification of their water quality data information system. Scheduled for completion in Spring 1994, the Drinking Water Information Management System (DWIMS) will serve as a comprehensive data base system for drinking water, surface water and ground water data. This personal computer-based system is designed to serve the needs for specific water resource data and reporting requirements needs of regional and field offices. It also supports other State programs.

The DWIMS is designed to incorporate the MSDE. It includes multiple modules that will enhance Idaho's ability to interact with other State and Federal data systems. In addition to the generation of standard data reports, the inclusion of the MSDE into DWIMS will help Idaho to report public water supply data to the EPA. Data in DWIMS resides in dBase, and the system software is written in Clipper.

The USGS and the MSDE[6]

The USGS is in the process of redesigning its hydrologic data management system and has included the MSDE as one of its features. The new data management system, named the National Water Information System II (NWIS-II), will integrate the current distributed data processing functions of NWIS-I, the central data base and archival functions of the national Water Data Storage and Retrieval System (WATSTORE) and the water data index functions of the National Water Data Exchange (NAWDEX).

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[5] For more information about DWIMS, contact either Steve Dempsey at (208) 334-0414 or Derek Thomas at (208) 334-0484.

[6] For more information about NWIS-II, contact Tom Yorke at (703) 648-5659.

NWIS-II integrates more than 13 major data files including water quality, ground water site characteristics, water uses, stream and sediment discharge and basin characteristics. NWIS-II will also have an expanded capability for processing and storing additional sediment, biological and spatial data. The comprehensive and integrated architecture of NWIS-II provided the capability to incorporate the MSDE and to facilitate the exchange of data between the USGS and EPA and other agencies.

The objectives of NWIS-II are to develop an integrated, multidisciplinary data base that will:

- Provide a comprehensive data management system to support the USGS's Water Resources Division's mission to appraise the nation's water resources;
- Serve as an archive for all data used in completed and published products of the USGS; and
- Provide a national index for water data.

NWIS-I is maintained on PRIME minicomputers at 54 locations nationwide; WATSTORE and NAWDEX are maintained on an Amdahl mainframe computer in Reston, Virginia. The data processing, storage and management functions of NWIS-II will be fully distributed on a network of 32-bit workstations with UNIX operating systems.

NWIS-II will be released in two stages. The first release, which will include data processing and management of water quality, ground water and biological data, will occur in April 1993. The streamflow, sediment and water use components of the system will be released in October 1993.

WHERE CAN I GET MORE INFORMATION ON THE MSDE?

More information on the MSDE can be found in the following documents:

Guidance Document

Definitions for The Minimum Set of Data Elements for Ground Water Quality, EPA 813/B-92-002, July 1992.

Policy

EPA Policy Order No. 7500.1A, October 1992.

Fact Sheets

Minimum Set of Data Elements for Ground Water Quality / Fact Sheet on Implementation for EPA and EPA Contractors

Minimum Set of Data Elements for Ground Water Quality / Fact Sheet on Implementation for States, Local Governments, Tribes, Federal Agencies, Grantees, Associations and the Regulated Community

Copies of these MSDE documents may be obtained by *calling*:

U.S. Environmental Protection Agency
Safe Drinking Water Hotline
1-800-426-4791

or by *writing*:

U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water Resource Center
401 M Street, SW, Mail Code RC-4100
Washington, DC 20460

Additional References

Codes for the Identification of the States, the District of Columbia and the Outlying Areas of the United States and Associated Areas, Federal Information Processing Standards (FIPS) Publication 5-2, May 1987.

Counties and Equivalent Entities of the United States, its Possessions and Associated Areas, Federal Information Processing Standards (FIPS) Publication 6-4, August 1990.

Information Resources Management Policy Manual — Locational Data Policy, U.S. EPA Office of Information Resources Management, April 8, 1991.

Locational Data Policy Implementation Guidance — Guide to The Policy, EPA/220/B-92/008, March 1992.

Locational Data Policy Implementation Guidance — Guide To Selecting Latitude/ Longitude Collection Methods, EPA/220/B-92/009, March 1992.

Locational Data Policy Implementation Guidance — Global Positioning Systems Technology and Its Application in Environmental Programs, EPA/600/R-92/036, February 1992.

EPA Order 2180.3 — Facility Identification Data Standard, U.S. EPA Office of Information Resources Management, April 9, 1990.

Facility Identification Data Standard Implementation Plan, U.S. EPA Office of Administration and Resources Management, February 1992.

Further information on the additional references may be obtained by *calling* or *writing*:

U.S. Environmental Protection Agency
Headquarters Library
401 M Street, SW
Washington, DC 20460
(202) 260-5922