

# **Data Elements for Reporting of Water Quality Results**

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## **Biographical Sketch of Author**

Chuck Job serves as Chief of the Infrastructure Branch, Office of Ground Water and Drinking Water, U.S. Environmental Protection Agency, with responsibilities for information systems, drinking water state revolving fund, data analysis, training, communications and outreach. In this capacity, he is responsible for designing and implementing information systems, providing guidance on data reporting, and receiving and analyzing data on drinking water quality and standards compliance.

**ABSTRACT:** The National Water Quality Monitoring Council (Council), created under the Federal Advisory Council on Water Information (ACWI), a Federal Advisory Committee Act (FACA) organization, determined that water quality data could be more easily shared if all entities conducting monitoring used the same “core set” of water quality data elements (WQDE) for reporting results. The Council members represent local, State, Federal and private sector organizations and agencies. Greater sharing of monitoring data among different agencies, levels of governments and the private sector could reduce the overall cost of monitoring and improve the overall efficiency of monitoring programs. As a result, the Council developed a “core set” of data elements for water quality monitoring reporting for chemical and microbiological analytes, addressing the questions of “who, what, why, where, when and how” associated with sample collection and analysis. Implementation of these data elements would be voluntary. Council members will be reviewing their programs for implementation opportunities and report back to the Council on their progress in using them in their programs. The Council also encourages other organizations - public and private - to use the set of data elements to promote more efficient monitoring and sharing of results. Monitoring organizations could report on more data elements than those identified, at their discretion, but are encouraged to at least report the core set to encourage data sharing and more efficient use of water quality monitoring data. The NWQMC will review the WQDE at least every 2 years and has adopted a process for its future revision, as necessary, to keep them current.

## **Introduction**

Recognizing the need to use monitoring resources at all levels more efficiently and effectively, the National Water Quality Monitoring Council (NWQMC) developed a “core set” of water quality data elements to promote consistency in reporting results. While millions of dollars are spent annually for monitoring, it is still difficult to share these results across agencies. (ITFM, 1995a) Earlier recommendations for consistency in water quality reporting (ITFM, 1995b) needed a broader basis for support and to obtain a consensus on the specifics of the data elements. Based on the recognized need, the NWQMC through its parent organization, the Advisory Committee on Water Data (ACWI) (OMB, 1991), completed a two-year public process culminating in the “Data Elements for Reporting Water Quality Results for Chemical and Microbiological Analytes” in 2001.

## **Development Process**

The NWQMC set up a process to obtain a consensus for the scope and specificity of the water quality data elements. This process had both technical and public process components:

Technical Components. The NWQMC’s Methods and Data Comparability Board’s Data Elements Committee:

- (1) Reviewed other lists of data elements;
- (2) Considered data elements in use in other databases, such as STORET (Storage and Retrieval System), Chesapeake Bay Information System, Great Lakes Information System and the Texas Natural Resources and Conservation Commission database;
- (3) Established criteria for the data elements (see Exhibit 1); and
- (4) Organized a data model (see Exhibit 2).

## **Exhibit 1**

### **Data Element Criteria**

- a. Who conducted the monitoring?
- b. What was measured?
- c. At what concentration was it found?
- d. Where was the analyte found?
- e. When was the analyte found?
- f. What was the type of water source?
- g. Was there co-occurrence with other chemical, physical or microbiological parameters?
- h. Why was the sample collected?
- i. How was the sample collected and analyzed?
- j. What was the level of confidence in the reported results?

## **Exhibit 2**

### **Data Model**

- 1 - Contacts
- 2 - Analyte Sampled
- 3 - Reason for Sampling
- 4 - Date/Time
- 5 - Location
- 6 - Sample Collection
- 7 - Sample Analysis

Public Process Components. Since consensus was an important consideration in establishing the Water Quality Data Elements (WQDE), the NWQMC provided several means to obtain input to its public processes:

- (1) The Data Elements Committee was set up to mirror the diverse representation of the NWQMC, including local, State, Federal and private sector organizations;
- (2) The committee held a workshop at the annual NWQMC monitoring conference in April 2000 (Austin TX) to obtain input on and confirmation of the approach and proposed data elements;
- (3) NWQMC published the proposed WQDE in the Federal Register in April 2001 for public comment; and
- (4) NWQMC held four public meetings (Chicago, Denver, San Francisco and Washington DC) on the proposed WQDE during April and May 2001.

The results of the public process confirmed the approach and need for the WQDE. While some commenters indicated concern for the burden of including all the metadata (information about the primary data), many commenters stated that they already collected the data, but just did not report them to a central information system. Many of these same commenters indicated that they agreed that the NWQMC should allow the data element list to be implemented voluntarily. All commenters agreed that reporting a “core set” of data elements would improve the quality and usability of water quality data, facilitating the sharing of the data for other purposes.

On June 5, 2001, the Advisory Committee on Water Information approved the WQDE, recommended by the NWQMC, for use in water quality data reporting by its member organizations and other individuals and groups conducting monitoring.

### **Benefits of the WQDE**

The NWQMC saw several benefits from development and application of the WQDE:

- 1 - improved consistency of water quality results reporting, since the WQDE use by members and others would facilitate employment of common terms and definitions;
- 2 - increased sharing of data because of common terms and definitions for data elements; and
- 3 - enriched use of resources for monitoring through data sharing.

Furthermore, because of the voluntary nature of the WQDE implementation, organizations using them could report additional information for their projects in their own databases, if necessary, to address other needs unique to their monitoring efforts.

### **Implementation**

The NWQMC decided that the WQDE should be tested to demonstrate their usefulness and provide for any near-term modifications needed. Several pilot projects have been implemented:

#### 1 - Delaware River Basin Commission WQDE Pilot Project

- Still in the initial stages - planning to canvass Commission member states on use of data elements in water-quality data reporting

#### 2 - Oklahoma WQDE Pilot Project

- Directing contractor to include the WQDE in database structure
- Will report on the cost of making this modification
- Data include water-quality data collected by the USGS, EPA, public water supplies, and Oklahoma Water Resources Board
- Some new fields currently empty of data, but will be examining current data to enter into these fields

#### 3 - New York WQDE Pilot Project

- Prototype study of the ground water quality within the Mohawk River Basin in cooperation with USGS
- Part of the Clean Water Act Sect. 305b reporting for NY
- WQDE to be used as core elements of database to manage data obtained from the study
- Drafted tables in Microsoft Access format

#### 4 - Milwaukee Metropolitan Sanitation District and US Geological Survey

- Developing long-term monitoring network and database for MMSD using WQDE
- To minimize the effort to capture data and limit data transfer errors, field forms developed using personal digital assistants (PDAs) in the field with macros for WQDEs

#### 5 - USGS National Water Information System (NWIS)

- Incorporates many of WQDEs currently
- Reviewing the recommended data elements for future inclusion
- Remaining data elements to be added to NWIS through long-range database planning in phased approach

#### 6 - EPA Storage and Retrieval System (STORET)

- Review indicates that the WQDE can be accommodated
- Based on pilot project evaluation, EPA intends to build on these data elements to create an EPA Data Standard that will be consistent with EPA's STORET database. EPA has added data formats and field lengths for this purpose.

Once EPA has adopted the data elements as its Data Standard for water quality results, the WQDE will form

the structure essential to the National Environmental Information Exchange Network. This structure, or template, will allow the exchange of the information needed to describe the actions EPA and the states take to manage the environment. The next step in this process is to have the data elements reviewed and adopted by the State-EPA Environmental Data Standards Council (EDSC). The EDSC will publish the WQDE in the *Federal Register* (in the spring of 2002) for comment by states and the public for the specific purpose of water quality data exchange between states and EPA. Previously, EPA has implemented such a process through large centralized data systems and software. This process is less useful to states that have developed their own information systems. New and dissimilar systems present data sharing challenges that can be overcome by the approach of the data elements such as the ACWI WQDE. The National Water Quality Monitoring Council is now working to develop water quality data elements for biological constituents.

Council members will be reviewing their programs for implementation opportunities and report back to the Council on their progress in using them in their programs. The Council also encourages other organizations - public and private - to use the data elements to promote more efficient monitoring and sharing of results. Monitoring agencies and organizations could report on more data elements than those identified, at their discretion, but are encouraged to at least report the core set to encourage data sharing and more efficient use of water quality monitoring data. If not able to apply the entire core set of data elements in the near term, the Council has indicated that agencies and organizations should consider phasing in its use, focusing on those aspects of it that are of most immediate interest or concern, to improve data quality and enhance data exchange over time. The NWQMC will review the WQDE and its use at least every 2 years and has adopted a process for its future revision, as necessary, to keep them current.

The “Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes” are listed in Exhibit 3. The complete text, including definitions, is available at:  
<http://wi.water.usgs.gov/pmethods/elements/elements.html>

## **Conclusion**

The use of the WQDE by monitoring agencies and organizations holds the prospect of greatly improving the exchange of water quality data with confidence. Consistent documentation of water quality data across organizations and purposes will enhance the value of the data now and in the future. The resources devoted to water quality monitoring at all levels and in all sectors will then be more effectively used.

## **EXHIBIT 3**

### **WQDE Categorical Hierarchy and Data Elements**

#### **1.0 Contacts**

##### **1.1 Sources of Data**

- 1.1.1 Organization Formal Name
- 1.1.2 Mailing Address
- 1.1.3 Mailing Address City Name

- 1.1.4 Mailing Address State Name
- 1.1.5 Mailing Address ZIP Code/ International Postal Code
- 1.1.6 Telephone Number
- 1.1.7 Electronic Mail Address Text

## **1.2 Sampling Entity**

- 1.2.1 Organization Formal Name
- 1.2.2 Mailing Address
- 1.2.3 Mailing Address City Name
- 1.2.4 Mailing Address State Name
- 1.2.5 Mailing Address ZIP Code/ International Postal Code
- 1.2.6 Telephone Number
- 1.2.7 Electronic Mail Address Text

## **1.3 Laboratory**

- 1.3.1 Name
- 1.3.2 Mailing Address
- 1.3.3 Mailing Address City Name
- 1.3.4 Mailing Address State Name
- 1.3.5 Mailing Address ZIP Code/ International Postal Code
- 1.3.6 Telephone Number
- 1.3.7 Electronic Mail Address Text

## **2.0 Analyte Sampled**

### **2.1 Result Value**

#### **2.1.1 Result Value Unit of Measure Name**

### **2.2 Analyte Name**

#### **2.2.1 Chemical Identifier/Number** (*Chemicals only*)

#### **2.2.2 Biological Identification Number** (*Microbiologicals only*)

##### **2.2.2.1 Biological Systematic Context Name** (*Microbiologicals only*)

## **3.0 Reason for Sampling**

### **3.1 Reason for Sample Collection**

## **4.0 Date/Time**

### **4.1 Sample Collection Start Date**

### **4.2 Sample Collection Start Time Measure**

### **4.3 Sample Collection End Date**

### **4.4 Sample Collection End Time Measure**

## **5.0 Location**

### **5.1 Water Body/Aquifer Name**

### **5.2 Sample Station Identifier**

### **5.3 Sampling Station Type Name**

### **5.4 Latitude Measure**

### **5.5 Longitude Measure**

### **5.6 Latitude/Longitude Accuracy**

5.6.1 Horizontal Accuracy Measure

5.6.2 Source Map Scale Number

5.6.3 Coordinate Data Source Name

### **5.7 Latitude/Longitude Method**

5.7.1 Horizontal Collection Method

5.7.2 Horizontal Reference Datum

5.7.3 Reference Point

### **5.8 Altitude of the Sampling Station**

5.8.1 Vertical Measure

5.8.1.1 Vertical Collection Method

5.8.1.2 Vertical Reference Datum

5.8.1.3 Vertical Measure Unit of Measure

### **5.9 Altitude of Sampling Station Features**

5.9.1 Water Level

5.9.1.1 Water Level Unit of Measure

5.9.2 Bottom Depth Measure (Surface Water)

5.9.3 Depth at Completion Measure (Ground Water)

5.9.3.1 Bottom Depth/Depth at Completion Unit of Measure

5.9.4 Depth to Top of Well Open Interval

5.9.4.1 Depth to Top of Well Open Interval Unit of Measure

### **5.10 Altitude of Sample**

5.10.1 Sample Depth/Altitude Units Text

5.11 Water Discharge Rate Value

5.11.1 Water Discharge Rate Unit of Measure

## **6.0 Sample Collection**

### **6.1 Sample Type**

### **6.2 Media Sampled**

### **6.3 Sample Temperature**

6.3.1 Temperature Unit Measure

### **6.4 Sample Identification**

### **6.5 Sample Collection Method**

### **6.6 Sample Preservation / Treatment**

- 6.6.1 Container Type
- 6.6.2 Container Color
- 6.6.3 Container size
  - 6.6.3.1 Container size unit of measure
- 6.6.4 Sample collection filtering
- 6.6.5 Chemical preservation method
- 6.6.6 Temperature preservation method

## **6.7 Sample volume**

- 6.7.1 Sample volume unit of measure

## **6.8 Sample weight**

- 6.8.1 Sample weight unit of measure

## **7.0 Sample Analysis**

### **7.1 Extraction/Processing Date**

### **7.2 Extraction Process Time**

### **7.3 Analysis Date**

### **7.4 Analysis Time**

### **7.5 Analytical Method Number**

### **7.6 Sample Size**

- 7.6.1 Sample Size Unit of Measure (*Microbiologicals only*)

### **7.7 Serial Dilution** (*Microbiologicals only*)

### **7.8 Composite Sample**

### **7.9 Run Batch**

### **7.10 (Spiking) Amount or Dose Added**

- 7.10.1 Spiking Amount or Dose Added Unit of Measure

### **7.11 Analytical Precision**

### **7.12 Analytical Accuracy/Error**

### **7.13 Controls**

#### **7.13.1 Positive Control** (*Microbiologicals only*)

#### **7.13.2 Positive Control Result** (*Microbiologicals only*)

#### **7.13.3 Negative Control** (*Microbiologicals only*)

#### **7.13.4 Negative Control Result** (*Microbiologicals only*)

### **7.14 Detection / Quantitation Level Measure**

- 7.14.1 Detection / Quantitation Level Unit of Measure Name

### **7.15 Detection / Quantitation Level Type**

### **7.16 QA/QC Exception Flags**

- 7.16.1 QA/QC Comment Field

## References

Intergovernmental Task Force on Monitoring Water Quality (ITFM). 1995a. Final Report.

Intergovernmental Task Force on Monitoring Water Quality (ITFM). 1995b. Technical Appendices.

Office of Management and Budget. 1991. Memorandum M-92-01, Coordination of Water Resources Information