NWQMC
NATIONAL WATER QUALITY MONITORING COUNCIL
Working Together for Clean Water

Water Quality Data Elements: A User Guide

National Water Quality Monitoring Council

Technical Report No. 3

Data Elements for Reporting Water Quality Monitoring Results for Chemical, Biological, Toxicological, and Microbiological Analytes

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of the
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Prepared For:
Advisory Committee on Water Information

NWQMC Technical Report No. 3
April, 2006

ACKNOWLEDGMENTS

The Water Quality Data Elements (WQDE) workgroup of the Methods and Data Comparability Board developed the Data Elements and the information in this introductory guidance. The WQDE workgroup began developing the set of water quality data elements for chemical and microbiological analytes in March 1999. The National Water Quality Monitoring Council and the Advisory Committee on Water Information approved these in 2001. Data elements described here extend that original work. The co-chairs of the WQDE workgroup that have generated the proposed lists and forged consensus on their content are Mr. Charles Job of the U.S. Environmental Protection Agency (EPA), Mr. Glenn Patterson of the U.S. Geological Survey (USGS), and Ms. LeAnne Astin of the Interstate Commission on the Potomac River Basin. The WQDE workgroup membership guided the development of each list and consisted of representatives from many federal, tribal, state, and local agencies, academia, and the private and public sector water industries as listed below:

Arizona Department of Environmental Quality
Association of Public Health Laboratories
Delaware River Basin Commission
Denver Metropolitan Water District
East Bay Municipal Utility District (California)
Florida Department of Environmental Protection
George Washington University
Hampton Roads Sanitation District (Virginia)
IDEXX Laboratories, Inc.
Interstate Commission on the Potomac River Basin
Merck and Co., Inc.
Michigan State University
National Institute for Standards and Technology
National Oceanic and Atmospheric Administration
National Water Research Institute
New Jersey State Geological Survey (or Department of Environmental Protection)
New York Department of Environmental Health
Ohio River Sanitation Commission
Orange County Water District (California)
Oregon Department of Environmental Quality
St. Johns River Water Management District
Tetra Tech, Inc.
Virginia Department of Environmental Quality
Washington State Department of Ecology
Wisconsin Department of Natural Resources
United States Environmental Protection Agency
United States Fish and Wildlife Service
United States Geological Survey

ABSTRACT

Many entities collect water quality monitoring data using different data reporting templates. However, drawing comparisons and discerning trends in water quality are difficult due not only to large natural variations in conditions but also to widely disparate assessment methodologies, data system incompatibilities, and inconsistent data documentation standards. These problems are found in both surface water and ground water studies. These barriers impede coordination of data collection efforts and the productive exchange of water quality data among monitoring entities. Recent reports by federal, state, and non-governmental organizations including the U.S. General Accounting Office, the Association of State and Interstate Water Pollution Control Administrators, and the Environmental Integrity Project, have highlighted these problems.

The Methods and Data Comparability Board (MDCB) with the National Water Quality Monitoring Council (NWQMC) developed sets of data elements which they believe are the minimum elements necessary to facilitate the exchange of chemical, microbiological, population/community (ecological and bioassessment) and (eco) toxicological assessment data. These elements were approved by the Advisory Committee on Water Information (ACWI). This Guide lists these data elements as modules in a framework that addresses who, where, when, why, and how data are collected. Several modules of elements are common to all types of water quality data (e.g., contact information, where samples are collected), while other modules contain somewhat different data elements depending on the type of analyte (e.g., how samples were collected, result type). Several tools are now available to help automate the implementation of these data elements and the Guide describes several programs and activities in which these elements are now being incorporated.

The data elements lists are not sets of required information; rather, they are recommended as a means to help data collectors more easily consider the most important WQDE needed to assess data comparability. These lists have been developed in conjunction with numerous Local, State, Federal, and private sector water-quality sampling entities to assure that the use of the data elements listed are compatible with the majority of existing databases. Use of these data elements will help ensure that information collected and reported by various organizations will increase in value to other agencies and the public. The Advisory Committee, its Monitoring Council and Methods Board believe that the use of these standard WQDE will enhance the evaluation and sharing of water quality monitoring data across levels of government and organizations and will improve water quality data collected in the future. The Advisory Committee recommends that organizations collecting and managing such data use these data elements to facilitate data sharing.

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ABBREVIATIONS

ACWI	Advisory Committee on Water Information
ASTM	American Society for Testing and Materials
BMP	Best Management Practice
CAS	Chemical Abstract Service
CRS	Chemical Registry System
CWA	Clean Water Act
DET	Data Exchange Templates
DRBC	Delaware River Basin Commission
EDR	Environmental Data Registry
EPA	U.S. Environmental Protection Agency
EDSC	Environmental Data Standards Council
FACA	Federal Advisory Committee Act
GIS	Geographic Information System
ICTVdB	International Committee on Taxonomy of Viruses Database
ITFM	Intergovernmental Task Force on Monitoring Water Quality
ITIS	Integrated Taxonomic Identification System
MDCB	Methods and Data Comparability Board
MMSD	Milwaukee Metropolitan Sewerage District
NWQMC	National Water Quality Monitoring Council
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OMB	Office of Management and Budget
PDA	Personal Digital Assistant
P.O.	Post Office

QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SD	Standard Deviation
SM	Standard Methods
SOP	Standard Operating Procedure
STORET	STOrage and RETrevial Database of the U.S. Environmental Protection Agency
USGS	United States Geological Survey
WDNR	Wisconsin Department of Natural Resources
WICP	Water Information Coordination Program of the U.S. Geological Survey
WQDE	Water Quality Data Elements
XML	Extensible Markup Language
ZIP	Zone Improvement Plan
E C	degrees Celsius
%RSD	Percent Relative Standard Deviation
Φg/L	micrograms per liter
pCi/L	pico-Curies per liter
CFU/ml	colony forming units per milliliter

1.0 Introduction

Widespread use of commonly accepted data elements will increase the comparability, sharing, and value of water quality data. Data elements provide the definition and structure of data and metadata used to describe the results of water quality investigations. These elements address the who, what, where, when, why, and how data are collected and analyzed, providing extremely useful information about the data to prospective users. When common data elements are used by data generator organizations, the information collected and reported increases its value to other agencies, to the public, and even to the agency that originally collected the data because the data continues to be understood. Such data can then be used in subsequent studies and shared with others, potentially increasing the geographic or temporal coverage of water quality characterizations and providing better information upon which to base management decisions.

What is NWQMC?

The NWQMC was formed in 1997 as the permanent successor to the Intergovernmental Task Force on Monitoring Water Quality (ITFM). The NWQMC reports to the Advisory Committee on Water Information (ACWI), convened by the Department of the Interior under the Federal Advisory Committee Act (FACA). The NWQMC was created by the ACWI under Office of Management and Budget (OMB) memorandum M-92-01, Coordination of Water Resources Information (OMB, 1991), establishing the Water Information Coordination Program (WICP) to ensure coordination of water information programs. NWQMC membership is comprised of a balanced cross-section of 35 representatives, from federal, tribal, interstate, state, local, and municipal governments, watershed groups, universities, and the private sector, including volunteer monitoring. NWQMC provides the major national forum for the coordination of consistent and scientifically defensible Federal and State water quality monitoring methods and strategies. The NWQMC's mission is to implement a strategy for improving and coordinating monitoring of water quality in the United States. The data elements in this Guide were developed through the Methods and Data Comparability Board (MDCB) of the NWQMC.

In the late 1990s, the National Water Quality Monitoring Council (NWQMC), and its member federal, tribal, state, and local agencies, and private sector organizations, identified the need for a technical and institutional framework for archiving data that described water quality with enough metadata that it could be assessed for comparability by secondary users. This need stemmed, in part, from earlier recommendations made by the National Research Council (NRC, 1995) and the Interagency Task Force on Monitoring (ITFM, 1995a, b), the latter having produced a data elements glossary to standardize terms. The Methods and Data Comparability Board (MDCB), a Workgroup under the NWQMC, formed a Water Quality Data Elements Workgroup in 1999 to address this need.

The water quality data elements effort was timely, in light of subsequent reports and recommendations made by several other prominent organizations including the National Academy Of Public Administration (NAPA, 2002), Heinz Center (2002), USEPA (2003), and the General Accounting Office (GAO, 2000 and 2004). Each of these reports emphasized the lack of sufficient metadata available to

data users, resulting in questions of data comparability, missed opportunities for data sharing, and inadequate regional and national water quality assessments.

The purpose of this Guide is to present and define the set of water quality data elements (WQDE) for common use by all organizations, agencies, corporations, and individuals that are monitoring water quality and describe the importance of those standard data elements and of standardizing data documentation. These elements were presented to the public at the National Water Quality Monitoring Conferences in May 2000, 2002, and 2004 and through additional public meetings and Federal Register notices.

The data elements are available from the MDCB website at: **http:// acwi.gov/methods/**

1.1 Benefits of Using WQDE

Most guidance on monitoring discusses the use of data quality objectives as the mechanism to plan for efficient sampling and analysis. Data collected using this process will meet its intended primary use. Increasingly, however, water quality data are proving valuable in secondary uses where precise needs cannot be foreseen. To serve secondary uses, data must be proven worthy by assessing their metadata. Data suitable for secondary uses are deemed "comparable" data. WQDE provide a common lexicon for water quality data and metadata, and represents a standard of good practice within the water industry.

The MDCB and the NWQMC identified several specific benefits from the development and use of standard WQDE:

- Data documented with common elements can be archived and shared, enhancing the potential for increased use of water quality monitoring data (both spatially and temporally) within and among organizations.

- Well-documented data become more valuable with time, whereas the value of undocumented data quickly erodes.

- Increased size of a data set through data sharing can provide greater statistical power, with a higher degree of confidence in the analyses using the data.

- Additional data, through better data sharing, increases the likelihood of more accurate or comprehensive environmental assessments because the meaning of each data set, and how they fit into a given context, is better understood.

- Any individual data set increases in value through use of common data elements because they increase the potential of using the data for purposes other than what was originally intended.

- A consensus view of standard WQDE provides a useful checklist including measurements, analytic results, and metadata to be gathered, serving as a guide for organizing data aspects of a monitoring program, and as a list of data fields to be included in a database.

The Advisory Committee believes that the use of standard WQDE will enhance the evaluation and sharing of water quality monitoring data across levels of government and organizations, and will likely improve water quality data collection in the future. For these reasons, ACWI recommended their use by all entities that collect such data (ACWI, 2001).

1.2 What is a Standard Data Elements Set?

Simply stated, a data element is a name for a category of information with the same attribute. A set of standard data elements is then the larger group of data elements common to describing the results and circumstances associated with a specific activity, which in this case is water quality monitoring. The standardization of use of the data elements among organizations reflects an agreement on representations, formats, and definitions of common data, metadata, and their definitions. The content of a given data element may be a data field in a database such as a laboratory name, or analyte identifier taken from an authoritative list, or the latitude/longitude coordinates using a standard system to locate a sampling station. Examples of metadata elements include quality assurance/quality control measures, and laboratory and sampling procedures.

The WQDE presented in this Guide are unique in that they were developed specifically to facilitate data sharing and to increase the longevity of any water quality monitoring data. A consensus process, involving many water quality experts from different organizations (see next section), determined that the WQDE lists in this Guide are what is minimally needed to serve most, if not all, secondary uses of the respective types of data and to make an informed assessment regarding data comparability.

Chemical and Microbiological WQDE Consensus and Review Process

- Public consensus and review process required over two years of effort by the committee, which consisted of 35 members from Federal, State, and Local governments and private sector firms and organizations.
- The annual NWQMC conference held a workshop in April 2000 for input about approach and proposed data elements.
- The MDCB held four public meetings in four regions April and May 2001, announced in the Federal Register.
- The NWQMC published the availability of the data elements for public review in *Federal Register* on March 16, 2001 (66 FR 15273).

The WQDE were defined from the perspective of a database record, but the list of elements is intended to be database independent. Indeed, databases should be designed to accommodate a wider range of data than are proposed

here. Organizations using this list of elements may extend them to include additional elements, define data formats for them, or associate Extensible Markup Language (XML) tags with them.

1.3 How were the Data Elements Developed?

The MDCB went through a consensus development and review process to develop the initial WQDE for chemical and microbiological analytes. After a two-year development and review process, a national workshop, and several public meetings, the MDCB recommended, and the NWQMC adopted, these data elements in 2001. The data elements addressing chemical and microbiological analytes were approved by the Advisory Committee on Water Information (ACWI), a federally chartered advisory committee (FACA) on May 15, 2001 (See Appendix A for the list of these data elements). ACWI then recommended that all agencies adopt these data elements and use them in reporting water-monitoring data.

What is the Methods and Data Comparability Board?

The MDCB was established in 1998 by the NWQMC to promote and coordinate voluntary participation of the monitoring community in the use of collection and analysis methods that produce water quality monitoring data of known and documented quality. The MDCB is a partnership of water-quality professionals from Federal, State, and Local agencies, tribes, and private sector firms and organizations.

Other types of analytes such as ecological or toxicological analytes were not addressed in this initial effort because it was realized that these types of analytes required some different approaches and more development time. However, it was recognized that many of the elements, as well as the framework of elements approved by the ACWI (i.e., a modular framework – see below), were directly transferable to most if not all other types of analytes.

Recognizing the increasing role of biological studies in water quality management, in 2002 the MDCB water quality data elements workgroup began developing data elements for population and community-level (ecological) analytes and toxicological analytes. The ACWI-approved data elements for chemical and microbiological analytes were incorporated as much as possible. Efforts were made to include only those additional elements considered necessary for evaluating comparability of these types of biological data. These additional data elements were developed over the course of several meetings, through comments from over 30 organizations, and a public workshop was held at the National Water Monitoring Conference in May 2004. The NWQMC reviewed several drafts of these elements and documented support for them. Appendix B contains the toxicological data elements and Appendix C contains the data elements for population and community analyses.

The intent of these standard WQDE, for all groups that monitor water quality, is to voluntarily adopt the data elements, and record them with their water quality results. This standardization, when combined with electronic data storage and Internet access, will greatly increase data access and facilitate its sharing.

The data elements are intended to promote both the use of universal definitions of the data elements and a common understanding of the extent of information needed to ensure the continued utility of data describing water resources. The chemical and microbiological data elements are now being used in an increasing number of water quality monitoring programs and projects (See Section 5). It is likely that the biological WQDE presented here will be implemented throughout the water quality monitoring community as well.

1.4 What is the Voluntary Nature of the WQDE?

Both the NWQMC and MDCB are technical advisory organizations of public and private sector interests and not regulatory bodies. Therefore, these lists of WQDE should not be construed as mandates. However, public agencies and private organizations that understand the value of consistent documentation have already voluntarily adopted the WQDE in its entirety, or in parts or phases, to extend the usefulness of their results. A data generator may desire to record more attributes than those addressing the current WQDE to satisfy particular monitoring or project needs.

The list of data elements for a given data type may appear lengthy to some; however, it should be understood that not all elements will necessarily apply to all monitoring programs or data collection activities. It is expected that the data generators will use the WQDE as a guide to include as many as are relevant to their programs. As will be explained in Section 2.0, many elements are likely to contain the same information for all samples collected in a given program (e.g., who collected the samples, other contact information, why they were collected) and their inclusion in a given database can be easily entered from information provided in the planning phase of monitoring studies. Furthermore, recent technological advancements (e.g., field data entry using personal digital assistant and scannable field sheets) have made recording of WQDE relatively easy and efficient so that implementation of WQDE is not so onerous (see Section 2.2 for further information concerning implementation of WQDE).

The NWQMC recommends that all data generators use the WQDE to the greatest extent possible for all new monitoring efforts. In addition, the usefulness of data already collected and reported by an organization could be greatly extended by retroactively including as many of the WQDE as are known and were documented at the time the data were collected. It is understood that there is a cost to providing such metadata for archived data if it is not easily accessible. However, as discussed previously, the potential benefits of including such metadata, in terms of the useful lifespan of those data, can justify the cost.

1.5 Who Should Use Standard WQDE?

All organizations that either collect or report water-monitoring data should use the WQDE recommended in this Guide. These include:

- Federal, State, and Local regulatory and non-regulatory agencies.
- State and Local monitoring councils.
- Public and privately owned drinking water and waste water utilities.
- Private sector firms and organizations.
- Academic research groups that routinely or often monitor water quality parameters.
- Volunteer monitoring organizations.

1.6 How Does One Use WQDE Now?

The NWQMC suggests several approaches that agencies and organizations may take to initiate using WQDE:

- Consider using all the data elements or as many as possible in your next water quality monitoring project.

- Use the WQDE to plan a new monitoring project, adopting its provisions into planning documentation, field collection templates, and in laboratory data flows.

- Plan to include these WQDE in database modernization or updating.

- In combination with other approaches, program field electronic devices for onsite entry of field data to down load directly to your database.

- Encourage the use of WQDE by others whose data you may some day value.

Several organizations have begun implementing WQDE in their programs as discussed in Section 5.0 of this report.

1.7 How will the WQDE list be kept current?

The NWQMC through the MDCB, plans to make periodic revisions or updates to the standard WQDE. Suggestions for changes and/or additions to the WQDE for chemical and microbiological analytes as well as the toxicological and biological population/community data elements can be sent to the NWQMC through its web site (see section 4.0 Communication). Additionally, the MDCB coordinates ongoing development and planning efforts for other data elements. For example, modules for physical habitat, biological markers, and sediment quality data are now in the planning stage.

2.0 Water Quality Data Element Format

This section of the Guide presents and defines the WQDE, followed by a discussion of their importance and how often they will likely be reported (many WQDE are not reported more than once per data set).

2.1 Modular System of Data Elements

The data elements were developed using a modular framework, in which each module represents a category of metadata information. The modules or categories are:

- Point of Contact Information - who collected and analyzed the sample.
- Results - what was analyzed and what was the resultant measurement.
- Reason for Sampling - why the sampling was undertaken and sampling design used.
- Date/Time - when the sample was collected.
- Sampling Station Location - where the sampling occurred.
- Sample Collection and Analysis - methods for sample collection and laboratory analysis.

Quality assurance/quality control elements associated with the data are included in the sample analysis module.

The modular system allows for relatively easy changes should the WQDE be updated, or for organizations to easily tailor the data elements to the various components of their monitoring programs. The modular system also provides an efficient organizational framework that helps a data generator integrate data elements for different types of analytes (e.g., chemistry, toxicity, ecological) (see Exhibit 1).

This flexibility was apparent when developing the population/community and toxicological WQDE: there was consensus that certain modules of the existing WQDE structure could remain untouched regardless of the type of analyte being measured. These are the Contact, Location, and Date/Time modules, and, to a large extent, the Reason for Sampling module as well. The two modules that needed to change with the type of analyte were the Results module and the Sample Collection/Analysis module.

As explained further in Section 3.0, these two new modules may contain several of the same data elements for different analyte types but differ with respect to other elements. In the toxicological and population/community WQDE lists appended to this report (Appendices B and C, respectively), data elements that are shared with the approved chemical and microbiological WQDE in Appendix A are so noted. All data elements have definitions to promote consistency of their use. Chemical and microbiological data elements that are not likely to be relevant to either ecological or toxicological analytes are also noted in the appended lists.

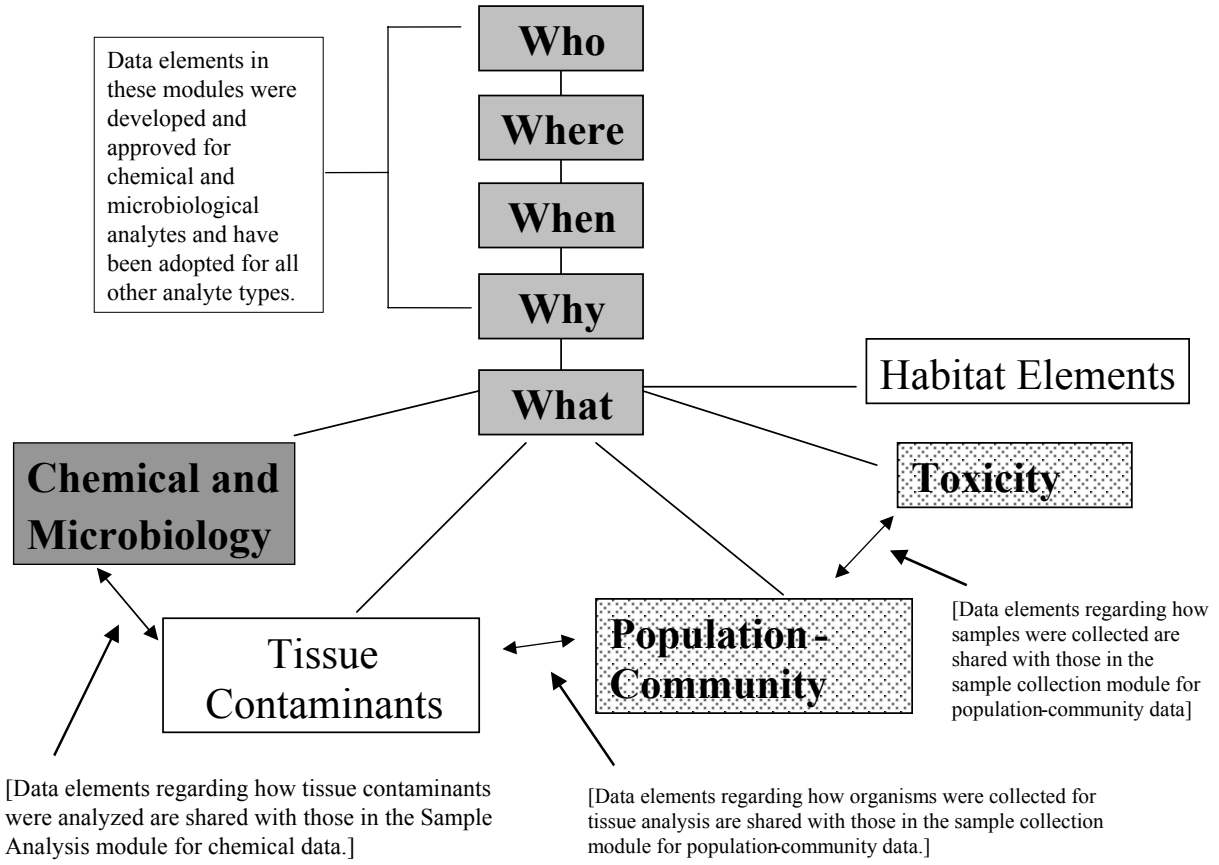

Exhibit 1. Schematic representation of the modular framework for Water Quality Data Elements discussed in this Guide. Who, where, when, why, and what correspond to the WQDE modules: Point of Contact, Sampling Location, Date/Time, Reason for Sampling, and Result, respectively. Some data elements in the Sample collection, processing, analysis, and QA/QC module ("how" for a given type of analyte) may be drawn from those developed for a different analyte as depicted in a few examples in the schematic. Toxicity and Population – Community WQDE are newly presented in this Guide. Chemical and Microbiological WQDE were previously approved by ACWI. Unique data elements pertaining to Habitat and Tissue Contaminant data are currently under development.

WQDE lists are intended to be checklists for describing the breadth of information needed to ensure the continuing utility of the information both within an organization and among organizations as information is stored and shared. Each list was developed so as to be comprehensive enough to handle most, if not all, monitoring efforts involving a particular type of analyte, but without being an exhaustive list of every possible data element that could be reported. Alternate names are also listed with some WQDE to accommodate various groups collecting data and the terminology commonly used within their discipline.

2.2 Implementing the Data Elements

The WQDE lists provide a useful tool to ensure complete and well-documented data for most aspects of monitoring. These aspects include planning field activities and data collection, establishing laboratory analysis and reporting requirements, quality assurance/quality control of data collected and incorporated in a database, and database development. In each of these activities, recent technological advancements are available that can help a data generator efficiently incorporate the use of recommended data elements. These advancements can, in some cases, help automate inclusion of certain data elements into a given activity and can also reduce certain error sources related to the collection, database storage, and reporting of water quality data.

Planning Field Activities. The WQDE lists should help resource managers plan field activities to ensure complete data collection and site categorization. As discussed under Section 3.0, certain data elements and even whole modules of elements are often constant for all samples collected in a given program, or known well before actual sampling occurs. As both a quality assurance and a project efficiency measure, these data elements can be completed for field sheets or laboratory analysis request forms prior to collecting the data. For example, elements in the Contact Information and the Reason for Sampling modules should be known prior to field work and could be incorporated into forms before taken into the field. Field and laboratory forms, themselves, should be evaluated to see whether recommended data elements in this Guide are relevant to a monitoring program and should be incorporated.

Several recent technological tools are available that can help reduce the planning effort and ensure completeness of field and laboratory information collected. Digital log "sheets", using a PDA or similar instrument, for example, can be pre-programmed to include certain basic information such as contact information, reason for data collection, types of analyses required or desired (Results module), and even perhaps certain key protocol steps (elements from the Sampling and Analysis Module). The field crew would only need to enter actual data or information obtained at the site; other key metadata would already be included and linked to the data for efficient uploading to a database. Furthermore, such pre-programmed "log sheets" can provide a check that all required data and information are in fact collected at a site as required by the project data quality objectives (DQOs). This helps to ensure data completeness. USGS has begun using PDAs in pilot projects and intends to expand this effort in several large-scale studies in the near future. Similarly, USEPA's EMAP program is using scannable field log sheets to

more efficiently and accurately upload field information into a database and to help ensure that required metadata are incorporated with the data.

Establishing Laboratory Analysis and Reporting Requirements. Just as WQDE can help in planning field activities, these data elements are also useful in ensuring that the proper analytes are measured, that the sample is treated in accordance with Data Quality Objectives (DQOs) (see for example USEPA, 1996) prior to analysis (e.g., preservation, filtering, sieving and other types of pre-analysis sample processing), and that the required QA/QC information is provided with the reported results. Forms detailing laboratory instructions and requirements can be automated to include certain information, as defined by some key data elements, to ensure that analyses are completely conducted in accordance with DQOs. Laboratory results reported on such forms would then be linked to the appropriate metadata ensuring more complete and useful data.

Quality Assurance/Quality Control of Data. The foregoing discussed some benefits of incorporating WQDE in automated or pre-programmed forms and field sheets. The end result of using WQDE in this manner is a greater likelihood of completed information for each site, better documented data, and fewer transcription errors. This approach is consistent with the Data Quality Act (US Congress, 2001), which requires that any results used are transparent and contain appropriate elements of objectivity, integrity, and utility.

Database Development. In developing a database, many WQDE can be programmed with "drop-down" menus or macros to define common or default choices, similar to the way that a PDA form can be pre-programmed, which reduces some of the apparent burden of the list. Not all of the WQDE are needed for every sample. Some of the WQDE are specific to a type of source water or type of contaminant. For example, some WQDE are used only for ground water, some only for surface water; taxon systematic context name would not be reported for chemical parameters. Certain WQDE for toxicological analysis will be specific to the matrix being tested (i.e., water, sediment, etc.); Population/Community WQDE may be specific for the sampling method or reason for sampling. As indicated in the next section, many data elements only need to be entered once and can be copied or transferred to other data sets recording the same analyte or within the same monitoring survey. Use of default menus or drop down boxes with choices can make such tasks easier to implement.

2.3 Reporting Frequency of Data Elements.

As mentioned in Section 2.2, many of the WQDE need only be reported once and can be copied or linked to other data as appropriate. Because studies or monitoring programs collect a variety of data using many different methods, there is no pre-determined frequency of recording the WQDE that holds true for all data sets. Possible scenarios for frequency of recording include:

- Report once and potentially serve many results in a data set. Either use as a template, link, or copy the information to the next data set.

  Example - contact information may not change among many samples over time, unless there is a change in staff.

- Report once in a data set. WQDE related to sampling point will most likely remain the same throughout the monitoring period.

  Example - depth of the monitoring well.

- Report for each analyte, sample site, or group of data.

  Example - the locational information for a monitoring program with 6 sites.

- Report with every sample.

  Example - date/time of collection.

3.0 WQDE Common to All Types of Data

Three WQDE modules are identical regardless of the analyte being reported. These are Point of Contact, Date/Time, and Sampling Station Location as discussed below. Data elements for these modules in Appendix A have been adopted for all analyte types.

3.1 Point of Contact

Contact information in the database should provide quick access to someone familiar with the data. Researchers also may need additional information about the laboratory analyses. Providing the name and contact information of the laboratory or program allows the user to contact them directly, if needed. This holds true whether communication is between organizations monitoring similar analytes or between data analysts and data providers.

3.2 Date/Time

This information is essential for combining data sets from specified time periods. They are also essential for relating information to other data and events (e.g., discharge, climatic changes), assessing range and outliers in a data set, and temporal trends. In general, both date and time data elements need to be recorded for every sample. Most existing monitoring programs already record this information (at least date).

3.3 Sampling Station Location

The specific location of sample collection is critical to relate results to other monitoring activities and other environmental features. Ground water results can be highly dependent on vertical as well as horizontal location as the type of aquifer and hydrogeologic characteristics change. Surface water quality also changes with vertical location; for example, when algae grows at the bottom of lakes, it consumes oxygen and causes a lower dissolved oxygen concentration at the bottom of the lake than at the top. The WQDE provide for recording three-dimensional locational data.

Latitude and longitude designations using a global positioning system (GPS) provide greater specificity and consistency than other descriptions of locations, and can be very helpful to differentiate closely spaced sites. Latitude and longitude measures also more readily allow use of the data in a geographic information system (GIS), and in turn, allow the merger with other spatial data, which can be a very powerful tool. The method used to measure latitude and longitude, as well as the datum and standards for locational accuracy should be documented as well.

The locational metadata elements are listed in the tables provided in Appendix A. Most of these are only recorded once per sample site. Several other locational data elements may be recorded more than once, depending on changes in the water level or depth during the sampling event.

4.0 WQDE Unique to Particular Types of Data

Some WQDE may differ among particular types of data according to the type of sample and result reported. These are contained in the Result, Reason for Sampling, and Sample Collection/Analysis modules as discussed below.

4.1 Results

The data elements contained in the Results module are intended to characterize the analyte and the analytical result value. Water quality monitors need to ensure the data represents their analyte of interest. The type of result value does vary with the type of analyte. For example, the result for chemical and microbiological analyses is typically a concentration or magnitude of an analyte (e.g., mg/L or pH units) or biological organism (e.g., numbers per milliliter). The result of toxicological analyses is often a toxicity endpoint that represents some organism effect level (e.g., LC_{50}, No Observed Effect Concentration, Inhibition Concentration). Therefore, Result data elements for toxicological analyses address the type of endpoint measured, the calculation method or citation used to obtain the endpoint, and confidence intervals calculated around the result value (Appendix B). In addition, this module has some specific data elements pertaining to the test species upon which the data are based (e.g., organism's age or life stage), which are unique to toxicological analyses. Similarly, the Result module for population and community analyses includes data elements addressing the type of result or endpoint reported (e.g., metric, index) and the methods used to obtain the endpoint (Appendix C).

Reporting the unit of measure is also important to ensure data comparability. The unit of measure is often obvious to the data collector; however, many groups often have their own "conventional" unit of measure, and do not record it in a database. This is a common source of errors, and an important, fundamental element to avoid misinterpretation of results. A study or monitoring program that measures several analytes should record the analyte name and chemical or biological identification number for each analyte and the unit of measure, along with the measured result.

4.2 Reason for Sampling

The reason for sampling should be recorded with each sample collected. For example, a study characterizing temporal variance may imply very different, unique conditions compared to permit compliance samples. For most studies, this information would be entered once. However, many routine monitoring programs will collect additional samples if special circumstances arise. The reason for collecting these additional samples should also be recorded. For example, a wastewater system routinely monitors residual chlorine in the discharge to the river and may conduct a two-week trial using a different dechlorination process. During these two weeks, the system may have collected four times the number of samples normally collected, and it may need to be noted that these samples were not related to normal operational monitoring.

In the case of population/community assessment data, particular sites may be reference sites to which other sites will be compared. While other sites may be visited on more than one occasion during the same sampling period, reference sites may be sampled only periodically in order to check the accuracy, precision, and reproducibility of results within a study protocol. For all types of data, it is desirable to include some indication of data quality objectives as part of this module, represented by "reason for sampling".

4.3 Sample Collection, Processing, Analysis, QA/QC

Data elements describing sample collection will differ most across analyte types. This is the case not only for the equipment and procedures used to obtain a sample but also that used to process the sample for analysis. For example, waterbody habitat features are often important considerations in terms of sampling populations and communities because fauna and flora distribution and abundance depends on habitat characteristics and equipment is typically designed to be efficient in certain habitats. Therefore, the equipment types used as well as the habitat sampled are critical factors in evaluating comparability of population and community-level data (Appendix C). For this reason, QA/QC data elements pertaining to field staff certifications, training, or accreditation are included in the WQDE.

Methods used to process samples for analysis can be a critical factor affecting comparability of all types of data but the types of processes typically used may vary with the type of analyte. For example, sediment toxicity analyses may require certain methods for sieving, compositing, and/or subsampling a sample prior to testing (Appendix B). For population and community data, some methods require animal sorting and perhaps taxonomic identification in the field, while others require varying degrees of laboratory sample processing and taxonomic analysis. Certain chemical measures can be greatly affected depending on whether the sample is filtered prior to analysis and the way in which it is filtered. Unfiltered surface water samples may include contaminants attached to suspended solids, while filtered samples provide a measure of the dissolved phase. The preservation method and container type may also affect the result when compared to data using different methods.

Sample analysis data elements are important to fully characterize the results and determine data compatibility based on sample analysis methods. Accuracy, precision, and other quality assurance/quality control (QA/QC) notes contribute to the confidence associated with the data and are critical factors affecting data comparability. Some of the sample analysis data elements used for chemical and microbiological data are unlikely to be relevant for most population and community or toxicological data. For example, data elements describing the "run batch" or "extraction process" (Appendix A) are typically specific to certain chemical analysis methods. Conversely, other data elements such as organism feeding method or number of organisms per replicate (Appendix B) tend to be specific to toxicological and certain microbiological analyses and are not often applicable to either chemical or population-community analyses (unless perhaps the latter is a controlled experiment as opposed to a field census study).

Quality assurance and quality control data elements contained in this module are generally applicable to most, if not all, types of analytes; however, there are some differences. For example, reference toxicant tests are one prominent tool toxicologists use to document the sensitivity of each batch of test organisms relative to other batches tested under identical conditions, as well as the correct conduct of the test method by the laboratory. Therefore, for toxicological analyses, data elements describing the reference toxicant test results are associated with the data being reported (Appendix B). Similarly, for population and community analyses, accurate taxonomic identification is critical to the quality of the data. Therefore, data elements specifically addressing the taxonomic source and citation are recommended as well as taxonomic verification procedures (Appendix C).

Most sample analysis data elements may need to be recorded with each sample or analyte, but quality assurance and quality control data elements may be recorded less frequently depending on the study design and the programs' data quality objectives. Much of this information is generally recorded by field personnel, laboratories, and sample analysts, and is transferred to a database.

5.0 Case Studies Incorporating WQDE

Since the adoption of the chemical and microbiological data elements by ACWI (see Appendix A), several state, interstate, and federal agencies have begun developing approaches to incorporating WQDE recommendations into their databases and monitoring programs. Federal agency applications include US EPA STORET database**,** USGS NWIS database, NOAA databases, and some USFWS monitoring programs. In addition, several interstate, state, and local groups have also begun evaluating the recommended WQDE in their monitoring programs as described below.

5.1 States and EPA Environmental Data Standards Council (EDSC)

States, Tribal representatives, and EPA formed a council in 1999 to develop and reach consensus on data standards for environmental information collection and exchange. The EDSC approved the standard WQDE (August 2001), subsequent to the adoption of the standard WQDE by the NWQMC and ACWI for use on future data exchanges between States and EPA for ambient water quality data. The EDSC has a Web site that provides information about environmental data standards and EDSC actions (**http://www.epa.gov/edsc/**). Future data exchanges between States or Tribes and EPA will begin to apply the WQDE.

5.2 Delaware River Basin Commission

The Delaware River Basin Commission (DRBC) is a regulatory commission including four States (Pennsylvania, Delaware, New York, and New Jersey) dealing with water allocation and quality of the Delaware River. DRBC member agencies are determining the extent of their use of the WQDE in their monitoring programs and databases and to identify which are currently in use and which are not. The agencies can also evaluate the cost for including the WQDE in monitoring programs and databases. Over time, member agencies will apply the WQDE to monitoring results submitted to the Commission.

5.3 New York Intensive Basin Studies Program

The intensive monitoring component of the State's *Comprehensive Assessment Strategy* begins with the Rotating Intensive Basins Studies (RIBS) Sampling Program. Traditionally, the RIBS effort has included chemical analyses of contaminants in water, bottom sediment, and whole organisms (macroinvertebrates) and fish flesh samples, as well as biological assessments and ambient toxicity evaluations. RIBS assessments have been expanded to accommodate other State monitoring programs and types of data. These may include lake assessment and classification, fishery habitat and community assessment, fish tissue contaminant sampling, toxicity screening and chemical sampling of facility effluents, groundwater quality evaluation, pollutant source efforts, and nonpoint source monitoring.

5.4 State of New York Mohawk River Basin Ground Water Quality Project

The state, in conjunction with the U.S. Geological Survey, is using WQDE in their well monitoring program, both to help make existing data more useful and to make future data collection efforts more comprehensive. The database is available to other program activities within the State Division of Water. The database was also installed on a laptop computer for use in the field with the longer-term goal of using personal digital assistants (PDAs) to facilitate the input of the water quality data elements while in the field.

5.5 Milwaukee Metropolitan Sewerage District - USGS WQDE Pilot Project

The USGS, Wisconsin District office, is involved in a cooperative project with the Milwaukee Metropolitan Sewerage District (MMSD) involving the monitoring and assessment of chemical and microbiological analytes of concern. There are three phases of this project: 1) develop an Oracle database to include all available physical, chemical, and biological data for the stream corridors in the MMSD area; 2) develop and implement a one-year baseline monitoring network in the MMSD area; and 3) develop a long-term monitoring network for the MMSD area. The database includes data previously collected by MMSD, USGS, EPA, Wisconsin Department of Natural Resources (WDNR), Southeast Wisconsin Regional Planning Commission, local colleges, and universities, and various volunteer and other organizations. The baseline-monitoring network was implemented beginning in the spring of 2003. The database was developed with the WQDE in mind, however, because much of the historical data did not include many of the data elements, only a portion of the WQDE list could be incorporated into the database at this time. The field forms being used include most of the recommended WQDE. An initial PDA application has been developed, which will be implemented during Phase 3 of this study.

5.6 Stroud Water Research Center - New York Project

The Stroud Water Research Center was contracted by the New York State Department of Environmental Conservation (NYSDEC) to conduct a three-year study to monitor the amount, movement, and control sources of contaminants into New York City's drinking water from the Hudson River watersheds. Principle objectives of the project are: 1) provide dependent variables for statistical analyses relating aquatic ecosystem structure and function to landuse, best management practice (BMP) implementation, and other watershed inputs or factors; 2) provide chemical, physical, and biological indicators for evaluating the occurrence and source of selected chemical and biological aquatic contaminants; and 3) provide a baseline data set of population, community, and ecosystem-level parameters and also chemical, physical, and biological indicators of contaminants in order to assess changes in water quality and aquatic ecosystem structure and function in response to on-going and/or future changes in landuse BMP implementation. This monitoring program is designed to provide WQDE information that is of use to existing programs of the NYSDEC, New York City Department of Environmental Protection (NYCDEP), EPA, and the New York State Department of Health (NYDOH) as well as programs under the direction and/or cooperation of the various counties in the study area.

5.7 Pacific Northwest Water Quality Data Exchange

The Pacific Northeast Water Quality Data Exchange is a coordinated effort between the states of Alaska, Idaho, Oregon, Washington and EPA Region 10 that includes voluntary monitoring groups, watershed councils, Tribes, academia, and other state and local agencies. The Exchange has developed regional data exchange templates (DET) for the exchange of water quality data, a data catalog to register and discover data, a host database capability for those entities unable to host their own data, and an application for discovering and downloading data from the Exchange **http://www.exchangenetwork.net/exchanges/water/pnwwqx.htm.** The DET was developed from the foundation provided by the Chemical and Microbiological WQDE. Now, rather than logging onto a variety of data sources and integrating datasets in different formats and documentation regimes, one application brings the data together.

5.8 Citizens Monitoring Program, California State Water Resources Control Board

Several Citizen monitoring groups in California are implementing a set of forms and instructions for documentation of field measurements in a way that captures essential information. These materials are the basis of a data quality management (DQM) system, developed to assure that all the core water quality data elements (WQDE) can be provided along with the data. The DQM system also features spreadsheets for electronic information-capture that can be used on a Personal Digital Assistant (PDA) in the field. These and other spreadsheets enable data processing at the monitoring project level, i.e., they are used by project personnel to document and validate the monitoring results, as well as for staging the results with the core WQDE in preparation for migration into a central database. All spreadsheets and worksheets pertaining to a single monitoring project are conveniently stored in one Excel workbook called the "Project File". To facilitate project planning and communication, the DQM system also provides a list of information Fields that may be needed for different types of monitoring activities, along with a preliminary "pick-list dictionary" for data values that are given as verbal categories. This list is organized by subject-matter as a Road Map that leads the user to the desired field, and – like the WQDE list - is totally separate from any database structure. It includes the information Fields required for Project operations and quality assurance, and it is updated periodically to include all the core data elements in the six modules developed by the WQDE workgroup (as presented in Section 2).

6.0 Using WQDE's Effectively

6.1 Integrating Data Elements For Certain Monitoring Needs

The modular framework of WQDE presented in Section 2.1 is intended to help organize and integrate the information needed for comparability assessments. As explained in the previous sections of this Guide, some data elements are associated with certain types of analyses and not others. Using a combination of the data elements included in the appended lists, a data generator can properly document many kinds of data and monitoring situations that are not necessarily explicitly addressed in this document. For example, if a program is reporting chemical measurements in fish tissue, it is desirable to include not only the relevant data elements addressing laboratory analysis methods and associated QA/QC elements (Appendix A), but also relevant data elements pertaining to the fish collection methods, habitat where sampled, fish processing methods, and associated QA/QC elements (Appendix C). In this case, there may be two or more entries for contact information data elements as well: one for the field collection organization and one for the laboratory conducting the analyses. Similarly, a program reporting sediment chemistry analyses should include relevant data elements pertaining to sediment sample collection and processing methods (Appendix B), as well as data elements pertaining to laboratory analysis (Appendix A).

6.2 Storing Data

The WQDE are independent of any particular database and can be applied in any information systems structure. With today's software standards, data recorded in spreadsheets using various databases can be easily copied, modified, and transferred among different applications. Use of consistently defined WQDE among different databases will afford easier transfer, sharing, and use of the data.

Electronic Reporting and Storage. The NWQMC and MDCB developed the WQDE to be independent of any data system and format. The common lexicon of the WQDE is intended to foster the use of similar terms and definitions, including those used in electronic reporting and storage. Some pilot projects implementing the WQDE developed XML tags for them. XML is the universal format for facilitating the exchange of data on the Internet. XML allows developers to easily describe and deliver rich, structured data from any application in a standard, consistent way.

The tables in these appendices do not include the XML tag for use in formatting the data for electronic management purposes. XML tags were not included in the original WQDE list, but they are being added by EPA and can be referenced there. These XML tags have been registered in the EPA Environmental Data Registry (EDR) as alternate for data element names and can be found on the data element detail page for most of the EPA data standards should they be needed. See **http://www.epa.gov/edr** .

6.3 Database Requirements

The data elements can be incorporated into the structure of any database. The data element names do not have to be identical to the standard WQDE names; however, definitions should be close to the WQDE definitions to facilitate comparability and data sharing.

6.4 Real-Time or Continuous Data

The standard data elements can represent "real-time" or "continuous data." Although such data are often termed as continuous (i.e., a running plot with time) they are actually recorded at discrete intervals. If all such data are to be recorded, then the actual time (every 15 minutes, etc.) must be recorded with every measurement result. Storing continuous data can be a data storage burden particularly if collected over relatively long periods of time. It is often more practical to store statistical summary values that describe the data for discrete time intervals, and functionally allow for re-creation of the important properties of the continuous observations.

6.5 Communication

The key to effective data sharing is communication. The NWQMC has a Web site to facilitate communication among monitoring organizations and to provide a forum for improving data exchange (**http://acwi.gov/monitoring**). The Web site will maintain the current list of the standard data elements available for download. The list of the standard WQDE, and the Web site for the NWQMC are maintained by the various Federal agencies that support the NWQMC. The various agencies involved with the NWQMC are working to communicate the use of the data elements, and as noted, various projects have begun to utilize them. Also, various States and regions have developed their own water quality monitoring councils to communicate these issues, coordinate monitoring activities, and facilitate data sharing. For example, the Pacific Northwest Water Quality Data Exchange Workgroup, described in Section 5.0, was formed and has developed plans and mechanisms to facilitate water quality data sharing among all the Pacific Northwest state and tribe monitoring organizations (Windsor Solutions, 2003). As part of this effort, this Workgroup has incorporated the approved chemical and microbiological data elements as a template for identifying and organizing metadata that should accompany all water quality data in their respective databases. The NWQMC periodically updates its Web site with any new information regarding the WQDE as well as other related activities.

7.0 Conclusions

Many different entities collect water quality monitoring data and many different kinds of data are collected. These data are useful to the data collectors and give us important information about water quality and aquatic ecological condition. These data could be even more useful to others by having sufficient information with the data to help answer other common questions such as "Do their conclusions support mine?" as well as unrelated questions for which their collection was not originally intended and future questions that have yet to be asked by others involved in water quality monitoring. Common concerns in using another's data are: Are the data of similar quality as my own? Were the data collected in a comparable way? Were the data based on the same type of samples? In other words, the monitoring community needs to know if water quality data sets are comparable, and can therefore be combined for a given use. The Water Quality Data Elements (WQDE) presented in this Guide were developed through a consensus process by the Methods and Data Comparability Board (MDCB) and the National Water Quality Monitoring Council (NWQMC), and are intended to address these concerns.

WQDE are lists of the minimum elements, or metadata, that give a data user information about the data so that they can make an informed decision as to the quality of those data, and the comparability of those data for their question or purpose. WQDE should be readily available to other interested parties, along with the data, to facilitate information sharing and data exchange. The broad metadata categories, which characterize all types of data, including who, what, when, where, why, and how data were collected, are used in a modular framework that can be tailored by a data generator to specific types of data and their program needs. Three lists of WQDE are presented, each of which addresses metadata specific to different types of water quality monitoring analyses (e.g., chemical and microbiological, toxicological, and population/community-level). These lists have been developed in conjunction with numerous Local, State, Federal, and private sector water-quality sampling entities to assure that the use of the data elements listed are compatible with the majority of existing databases.

Many types of analyses share common data elements and, for a given sampling program, many of the data elements recommended need only be entered once, decreasing implementation costs. Also, several new technological tools are available that can easily automate much of the entry and tracking of these data elements, further assisting implementation. Several case studies are described in which these data elements are being incorporated into their programs.

The proposed lists are not a set of required information. They are intended as a means to help data collectors and database managers more effectively characterize their data and thereby promote the use of those data by others. The WQDE in this Guide are intended to promote both the use of universal definitions of the data elements and a common understanding of the extent of information needed to ensure the continued utility of data describing water resources. The NWQMC encourages the widespread use of these data elements in both public and private sectors to increase the comparability, sharing, and value of the nation’s water quality monitoring results.

8.0 Literature Cited

ACWI. 2001. Resolution of the Advisory Committee on Water Information Adopting the Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes. Advisory Committee on Water Information, May 15, 2001 http://acwi.gov/acwi2001/resolution_wqde01.html

General Accounting Office (GAO). 2004. Watershed Management: Better Coordination of Data Collection Efforts. GAO-04-382, http://www.gao.gov/new.items/d04382.pdf.

General Accounting Office (GAO). 2000. Water Quality Key EPA And State Decisions Limited By Inconsistent And Incomplete Data. GAO/RCED-00-54, http://www.gao.gov/new.items/rc00054.pdf.

H. John Heinz III Center. 2002. The state of the nation's ecosystems: measuring the lands, waters, and living resources of the United States. The H. John Heinz III Center for Science, Economics, and the Environment, Washington, D.C., Cambridge University Press, http://www.heinzctr.org/ecosystems/index.htm

ITFM. 1995a. The Strategy for Improving Water Quality Monitoring in the U.S. Report #OFR95-742, U.S. Geological Survey, Reston, VA.

ITFM. 1995b. Performance-based approach to water quality monitoring. *In*: Strategy for Improving Water Quality Monitoring in the U.S., Appendix M, Report #OFR95-742, Interagency Task Force on Monitoring Water Quality, U.S. Geological Survey, Reston, VA.

National Academy Of Public Administration (NAPA). 2002. Understanding What States Need To Protect Water Quality. John J. Kirlin, *Chair,* Jesus Garza, Robert C. Shinn, Jr., Academy Project Number 2001-001, December 2002.

National Research Council (NRC). 1995. Finding the Forest in the Trees: The Challenge of Combining Diverse Environmental Data. National Academy Press, Washington, D.C. http://www.nap.edu/openbook/0309050820/html/1.html

National Research Council (NRC). 2001. Assessing the TMDL Approach to Water Quality Management. Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction, Water Science and Technology Board Division on Earth and Life Studies, National Academy Press, Washington, D.C., http://www.nap.edu/books/0309075793/html/

USEPA. 1996. Guidance for the Data Quality Objectives Process. EPA QA/G4. EPA-600-R-96-055. Office of Environmental Information, Washington, D.C.

U.S. Congress. 2001. Data Quality Act. PL 106-544, Sec. 515.

USEPA. 2003. Draft Report on the Environment. Office of Water, Washington, D.C.

Windsor Solutions, Inc. 2003. Pacific Northwest Water Quality Data Exchange: Data Exchange Templates and Directory Services Approach. Windsor Solutions, Inc., 4000 Kruse Way Place Building 2, Suite 160, Lake Oswego, OR 97035.

APPENDIX A: WATER QUALITY DATA ELEMENTS FOR CHEMICAL AND MICROBIOLOGICAL ANALYTES

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**

This version of the file, Final WQDE 20010622, last revised 20011024, shows the changes recommended and accepted by the National Water Quality Monitoring Council on June 06, 2001, based on its WQDE modification policy.

1.0 Contact	
1.1 Sources of Data (Alternate Names: Data Owner, Data Source, Sampling Entity, Laboratory Name and Address)	This element identifies the primary sources or providers of data to the system, whether within or outside the agency, including: name, address, telephone number including area code and e-mail address of the agency to direct questions about the sample analytical results.
1.1.1 Organization Formal Name	The legal, formal name of an organization that is the primary source of data.
1.1.2 Mailing Address	The exact address where a mail piece is intended to be delivered, including urban-style street address, rural route, and PO Box.
1.1.3 Mailing Address City Name	The name of the city, town, or village where the mail is delivered.
1.1.4 Mailing Address State Name	The name of the state where mail is delivered.
1.1.5 Mailing Address ZIP Code/ International Postal Code	The combination of the 5-digit Zone Improvement Plan (ZIP) code and the four-digit extension code (if available) that represents the geographic segment that is a subunit of the ZIP code, assigned by the U.S. Postal Service to a geographic location to facilitate mail delivery; or the postal zone specific to the country, other than the U.S., where the mail is delivered.
1.1.6 Telephone Number	The telephone number including area code of the person who is the point of contact for an establishment.
1.1.7 Electronic Mail Address Text	The text that describes an electronic mail address of a person located at an establishment.
1.2 Sampling Entity/Person	Name, address, telephone number including area code and e-mail address of the organization or person to direct questions about the sample collection.
1.2.1 Sampling Entity/Person Formal Name	The legal, formal name of an organization that is the sampling entity.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
1.2.2 Mailing Address	The exact address where a mail piece is intended to be delivered, including urban-style street address, rural route, and PO Box.
1.2.3 Mailing Address City Name	The name of the city, town, or village where the mail is delivered.
1.2.4 Mailing Address State Name	The name of the state where mail is delivered.
1.2.5 Mailing Address ZIP Code/ International Postal Code	The combination of the 5-digit Zone Improvement Plan (ZIP) code and the four-digit extension code (if available) that represents the geographic segment that is a subunit of the ZIP code, assigned by the U.S. Postal Service to a geographic location to facilitate mail delivery; or the postal zone specific to the country, other than the U.S., where the mail is delivered.
1.2.6 Telephone Number	The telephone number including area code of the person who is the point of contact for an establishment.
1.2.7 Electronic Mail Address Text	The text that describes an electronic mail address of a person located at an establishment.
1.3 Laboratory/Field (Alternate Names: Laboratory Name and Address)	Name, address, telephone number including area code and e-mail address of the organization to direct questions about the laboratory analysis. Field denotes measurements conducted in the field.
1.3.1 Laboratory Formal Name	The formal title of the laboratory facility.
1.3.2 Mailing Address	The exact address where a mail piece is intended to be delivered, including urban-style street address, rural route, and PO Box.
1.3.3 Mailing Address City Name	The name of the city, town, or village where the mail is delivered.
1.3.4 Mailing Address State Name	The name of the state where mail is delivered.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
1.3.5 Mailing Address ZIP Code/ International Postal Code	The combination of the 5-digit Zone Improvement Plan (ZIP) code and the four-digit extension code (if available) that represents the geographic segment that is a subunit of the ZIP code, assigned by the U.S. Postal Service to a geographic location to facilitate mail delivery; or the postal zone specific to the country, other than the U.S., where the mail is delivered.
1.3.6 Telephone Number	The telephone number including area code of the person who is the point of contact for an establishment.
1.3.7 Electronic Mail Address Text	The text that describes an electronic mail address of a person located at an establishment.
2.0 Results	
2.1 Result Value	Reportable numerical measure of the result for the chemical or microbiological analyte, or other characteristic, being analyzed.
2.1.1 Result Value Unit of Measure Name	The name of the determinate quantity for a standard of measurement used for measuring dimension, capacity, or amount of something (e.g., mg/L, pCi/L, CFU/mL, etc.).
2.2 Analyte Name (Alternate Names: Analyte, Analyte Name, Constituent, Contaminant, Parameter, Chemical, Taxon, Metric, Index)	The name assigned to a substance or feature that describes it in terms of its molecular composition, taxonomic nomenclature or other characteristic. This field is optional if the analyte is adequately described in one of the following subelements.
2.2.1 Chemical Identifier/Number (Chemicals only) (Alternate Names: EPA Preferred Number, Constituent Identification Number; Contaminant; Chemical)	Chemical Identifier/Number is the unique number assigned to all chemical substances in the Chemical Abstract Service's (CAS) Registry or, in the EPA Chemical Registry System, to chemical groupings for which CAS Registry Numbers do not exist and cannot be assigned.
2.2.2 Biological Identification Number (Alternate Names: ITIS Taxonomic Serial Number, ICTVdB Taxon Identifier, EPA Biological Registry System Number)	The unique identification number assigned by either the Integrated Taxonomic Information System, (ITIS) the International Committee on Taxonomy of Viruses, or the EPA Biological Registry System .

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
2.2.2.1 Biological Systematic Context Name (Alternate Names: Biological Context Name, Biological Group Context Name)	The name of the classification system used to assign a systematic name to a biological entity.
3.0 Reason for Sampling	
3.1 Reason for Sample Collection See also 6.1 Sample Type	A text field to include such reasons as: (a) Reconnaissance/Occurrence Survey (b) Trend analysis (c) Permit Compliance (d) Pollution Event (e) Storm Event (f) Research (g) Regulatory benchmark (h) Bioaccumulation (i) Deposition (j) Other entries as applicable
4.0 Date/Time	
4.1 Sample Collection Start Date (Alternate Names: Date; Sample Collection Date; Sampling Date; Year, Month and Day)	The calendar date when collection of the analyte was started, reported as 4-digit year, 2-digit month, and 2-digit day in YYYYMMDD format.
4.2 Sample Collection Start Time Measure (Alternate Names: Time; Sample Collection Time; Collected; Collected End; Hour and Minute; Hour, Minute and Second)	The measure of clock time and time zone when collection of the analyte was begun, reported as a 24-hour day with 2-digit hour, 2-digit minute, and 2-digit second.
4.3 Sample Collection End Date (Alternate Names: Date; Sample Collection Date; Sampling Date; Year, Month and Day)	The calendar date when collection of the analyte was finished, reported as 4-digit year, 2-digit month, and 2-digit day in YYYYMMDD format.
4.4 Sample Collection End Time Measure (Alternate Names: Sample Collection Time; Collected; Collected End; Hour and Minute; Hour, Minute and Second)	The measure of clock time and time zone when collection of the analyte was finished, reported as a 24-hour day with 2-digit hour, 2-digit minute, and 2-digit second.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
5.0 Location	
5.1 Water Body/Aquifer Name (Alternate Name: Receiving Water Name)	Name of the lake, stream, river, estuary, aquifer, reach name in the National Hydrography Dataset or other water feature related to the physical site.
5.2 Sample Station Identifier (Alternate Names: Sampling Station/Facility Identification Number; Site Number, Well Identifier)	The name or number that uniquely identifies the sample station.
5.3 Sampling Station Type Name (Alternate Names: Facility Type; Site Type)	The descriptive name for a type of sampling station. The valid sampling facility choices are: (a) Ambient (i) River/Stream (ii) Canal Drainage Irrigation Transport (iii) Lake (iv) Wetland Estuarine, emergent Estuarine, forested Estuarine, scrub-shrub Lacustrine, emergent Palustrine, emergent Palustrine, forested Palustrine, moss-lichen Palustrine, shrub-scrub Riverine, emergent Constructed (v) Reservoir (v) Riverine Impoundment (vi) Estuary (vii) Tidal Fresh (viii) Tidal Brackish (ix) Ocean (x) Great Lake (xi) Well (xii) Subsurface unsaturated/vadose zone (xiii) Spring
5.3 Sampling Station Type Name (cont'd)	

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
	(b) Water Supply/Source Influent (i) Raw/untreated water (drinking/com/ind) (ii) Finished/treated water for drinking (A) From treatment system (B) Entry Point to the distribution system after treatment (C) Within the distribution system (D) End of the distribution system with longest residence time (E) Point in distribution system with lowest disinfection residual (F) Household/drinking water tap (iii) Unknown (comment field) (c) Within treatment process (comment field) (d) Wastewater/Effluent (i) End of pipe (ii) Within mixing zone (iii) Downstream from mixing zone (iv) Upstream from mixing zone (e) Storm Sewer (f) Combined Sewer (g) Land Runoff
5.3 Sampling Station Type Name (continued) (Alternate Names: Facility Type; Site Type)	(h) Mine/Mine Drainage (i) Landfill (j) Waste Pit (k) Other entries as applicable
5.4 Latitude Measure (Alternate Names: Latitude; Latitude of Sampling Station)	The measure of the angular distance on a meridian north or south of the equator in degrees, and decimal degrees.
5.5 Longitude Measure (Alternate Names: Longitude; Longitude of Sampling Station)	The measure of the angular distance on a meridian east or west of the prime meridian in degrees, and decimal degrees.
5.6 Latitude/Longitude Accuracy	
5.6.1 Horizontal Accuracy Measure	The measure of the accuracy (in meters) of the latitude and longitude coordinates.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
5.6.2 Source Map Scale Number	The number that represents the proportional distance on the ground for one unit of measure on the map or photo.
5.6.3 Coordinate Data Source Name	The name of the party responsible for providing the latitude and longitude coordinates.
5.7 Latitude/Longitude Method	
5.7.1 Horizontal Collection Method	The method used to determine the latitude and longitude coordinates for a point on the earth.
5.7.2 Horizontal Reference Datum	The code that represents the reference datum used in determining latitude and longitude coordinates. Can include the NAD27 North American Datum of 1927, the NAD83 North American Datum of 1983, the World Geodetic System of 1984, or other entries as applicable
5.7.3 Reference Point (Alternate Names: Sample Point Identifier)	The place for which geographic coordinates were established. Entries may include: - Facility/Station Building Entrance or Street Address - Facility Center/Centroid - Boundary Point - Intake Point - Treatment/Storage Point - Release Point - Monitoring Point - Other entries as applicable
5.8 Altitude of the Sampling Station	
5.8.1 Vertical Measure (Alternate Name: Elevation, Altitude)	The measure of elevation above or the depth below a reference datum.
5.8.1.1 Vertical Collection Method	The method used to establish the elevation or depth of the sampling site

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
5.8.1.2 Vertical Reference Datum	The reference datum used to determine the vertical measure
5.8.1.3 Vertical Measure Unit of Measure	The unit for expressing the vertical measure
5.9 Altitude of Sampling Station Features	
5.9.1 Water Level (Alternate Names: Depth to Water)	(a) Surface Water: (i) Quantitative measurement of water level: The level of the water surface at the sampling point. (ii) Qualitative measurement of water level: (A) Tidal (1) High (2) Low (B) Stream Stage (1) Flood (over bank) (2) High (3) Medium (4) Low (b) Ground Water: The vertical distance from the land surface to the water surface level in a well
5.9.1.1 Water Level Unit of Measure	The unit for measuring the water level, where applicable.
5.9.2 Bottom Depth Measure (Surface Water)	The measure of the distance from the water surface to the channel or lake bottom.
5.9.3 Depth at Completion Measure (Ground Water)	The measure indicating the total depth of the well upon completion of construction.
5.9.3.1 Bottom Depth/Depth at Completion Unit of Measure	The unit for measuring the distance from the surface to the bottom..
5.9.4 Depth to Top of Well Open Interval (Alternate Name: Depth to Top)	The depth to the top of the open interval. Openings are permeable portions of the well casings or lining. Openings may be protected with screens, fractured rock, or other devices/materials.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
5.9.4.1 Depth to Top of Well Open Interval Unit of Measure	The unit for measuring the distance down to the top of the open interval
5.10 Altitude of Sample (Alternate Names: Sample Collection Water Depth)	The numerical measure of the vertical location of sample collection.
5.10.1 Sample Depth/Altitude Units Text (Alternate Names: Sample Collection Water Depth Unit of Measure)	The text that describes the units for sample Depth/Altitude.
5.11 Water Discharge Rate Value (Alternate Names: Flow, yield)	The numerical value of the discharge rate of the water being sampled
5.11.1 Water Discharge Rate Unit of Measure	The text that describes the units for the discharge rate of the water being sampled

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**

6.0 Sample Collection	
6.1 Sample Type (Alternate Names: Quality Control Sample Type)	The type of sample being described. Permitted values include: (1) Field Measurement/Observation (a) Routine Measurement/ Observation (b) Replicate Measurement/Observation (2) Sample (a) Routine Sample (b) Field Blank (c) Field Replicate (d) Depletion Replicate (d) Integrated Time Series (d) Integrate Flow Proportioned (g) Integrate Horizontal Profile (h) Integrated Vertical Profile (i) Composite Without Parents (j) Positive Control (Microbio.) (k) Negative Control (Microbio.) (l) Other entries as applicable (3) Sample Created from Sample (No subtypes recommended) (4) Composite Sample with Parents (No subtypes recommended) (5) Quality Control Sample (a) Trip blank (b) Reagent Blank (c) Equipment Blank (d) Pre-preservative Blank (e) Post-preservative Blank (f) Field Spike (g) Field Blank (h) Reference Sample (i) Measurement Precision Sample (j) Other entries as applicable

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
6.2 Media Sampled (Alternate Names: Sample Medium Code, Water Source Type, Water Body Type)	The environmental media sampled at a site. The environmental material about which results are reported from either direct observation or collected samples. Includes water, sediment, precipitation and other entries as applicable.
6.3 Sample Temperature	Temperature of the sample when collected
6.3.1 Temperature Unit Measure	Fahrenheit, or Centigrade
6.4 Sample Identification (Alternate Names: Sample Number, Sample Identification Number)	The unique name, number, or code assigned to identify the sample.
6.5 Sample Collection Method	The method used to collect the sample: (a) Surface Water (i) Grab (ii) Pump (iii) Collection filter – positive charge (iv) Collection filter - negative charge (v) Insitu monitor (probe) (vi) Composite (A) Flow weighted (B) Proportional (C) Cross sectional (D) Integrated Depth (vii) Other entries as applicable (b) Ground Water (i) High flow submersible pump (specify water flow rate) (ii) Low flow submersible pump (specify water flow rate) (iii) Bladder pump (iv) Bailer (v) Other entries as applicable

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
6.5 Sample Collection Method (cont'd)	(c) Precipitation/Atmospheric (i) Grab (ii) Pump (iii) Collection filter – positive charge (iv) Collection filter – negative charge (v) Continuous (specify water flow rate) (vi) Other entries as applicable
6.6 Sample Preservation / Treatment	
6.6.1 Container Type	Free text: Sample container type
6.6.2 Container Color	Free text: Sample container color
6.6.3 Container size	The container size used in sample collection
6.6.3.1 Container size unit of measure	The unit of measures used in specifying the container size
6.6.4 Sample collection filtering (Alternate Name: Sample Fraction)	Filtered, unfiltered, or the specific fraction
6.6.5 Chemical preservation method	The method used to preserve the sample in the field by the sampling entity. This entry is intended to include preservation techniques that are NOT specified as part of the Analytical Method, element 7.1: (a) Chemical added (1) Acidification (2) Antioxidant (3) Mercuric oxide (4) Other (comment field) (b) None (c) Other entries as applicable

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
6.6.6 Temperature preservation method	The method used to preserve the sample in the field by the sampling entity. This entry is intended to include preservation techniques that are NOT specified as part of the Analytical Method, element 7.1: Temperature Preservation Method. Suggested entries include: (a) Wet Ice (4 deg C) (b) Dry Ice (-78.5 deg C) (c) Cold Packs (4 deg C) (d) Refrigerated (4 deg C) (e) Frozen (0 deg C) (f) Frozen (-20 deg C) (g) Frozen (-50 deg C) (h) Freeze Dried (i) None (j) Other entries as applicable
6.10 Sample volume	The numerical value of the volume of the sample
6.10.1 Sample volume unit of measure	The unit of measures used in specifying the sample volume
6.11 Sample weight	The numerical value of the sample weight
6.11.1 Sample weight unit of measure	The unit of measures used in specifying the sample weight
7.0 Sample Analysis	
7.1 Extraction/Processing Date	The calendar date when an extract for a sample analysis was taken for sample analysis, reported as 4-digit year, 2-digit month, and 2-digit day.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
7.2 Extraction Process Time	The measure of clock time and time zone when the extraction of the sample was completed, reported as a 24-hour day with 2-digit hour, 2-digit minute, and 2-digit second.
7.3 Analysis Date (Alternate Names: Date; Year, Month, and Day)	The calendar date when analysis of the analyte was finished, reported as 4-digit year, 2-digit month, and 2-digit day in YYYYMMDD format.
7.4 Analysis Time	The measure of clock time and time zone when analysis of the analyte was completed, reported as a 24-hour day with 2-digit hour, 2-digit minute, and 2-digit second.
7.5 Analytical Method Number (Alternate Names: Analytical Method, Method References)	The method number of the analytical method used, represented as a reference number: (a) EPA (Specify number) (b) ASTM (Specify number) (c) SM (Specify number) (d) Other methods as applicable
7.6 Sample Size (Microbiologicals only)	The size of the sample used for analysis
7.6.1 Sample Size Unit of Measure (Microbiologicals only)	The unit of measure of the size of the sample, measured in Liters or milliliters.
7.7 Serial Dilution (Microbiologicals only)	The serial dilution is expressed as a numerical factor representing the number of equal volumes of dilute added to the sample and to be applied to the same units as the "Analytical Result Unit of Measure"

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
7.8 Composite Sample	Composite samples for microorganisms are: (a) Time (i) Flow weighted (ii) Proportional (iii) Cross sectional (iv) Integrated Depth (b) Flow (i) Flow weighted (ii) Proportional (iii) Cross sectional (iv) Integrated Depth (c) Spatial (i) Flow weighted (ii) Proportional (iii) Cross sectional (iv) Integrated Depth (d) Other entries as applicable
7.9 Run Batch (Alternate Names: Sample Batch Identification Number; Batch Number)	A lab-defined identifier for a batch of analyses done on one instrument that make up a sequence of analyses during which the instrument is continuously in control.
7.10 (Spiking) Amount or Dose Added (Alternate Names: Spiking Concentration)	For Chemicals: The amount (weight or volume) or final concentration of an analyte that has been spiked into an aliquot at any time during the analysis process.
	For Microorganisms: The dose of method organisms/cells added to a sample to be analyzed for calculating analytical precision and accuracy where the value reported use the same unit of measure reported for Analytical Results.

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
7.10.1 Spiking Amount or Dose Added Unit of Measure	The name of the determinate quantity for a standard of measurement used for measuring dimension, capacity, or amount of something (e.g., mg/L, pCi/L, CFU/mL, etc.)
7.11 Analytical Precision (Alternate Names: Precision of Value)	A measure of the agreement among individual measurements of the same property in duplicate laboratory samples (duplicate laboratory spiked samples) under prescribed similar conditions to estimate variability in the measurement method or procedures. Precision is expressed as: (a) Standard Deviation (SD) SD= [{ (x_i - avg x)2} / (n-1)] (b) % Relative Standard Deviation (RSD), % RSD = (SD / mean concentration) x 100 , or (c) Relative Percent Difference (RPD), RPD = [X_1 - X_2) / {(X_1 + X_2)/2}]x 100
7.12 Analytical Accuracy/Error (Alternate Names: Bias of Value; Analytical Accuracy Measure)	(a) Accuracy is a measure of confidence in a measurement and can be assessed by calculating: (i) % deviation % deviation = [(average x - true value) / true value] x 100; or (ii) % recovery (Rec) % Rec = [(amt. found in Spiked sample - amt. found in sample) / amt. in spiked sample] x 100 Accuracy describes how close a result is to the true value measured through the use of spikes, surrogates, standards, or performance evaluation samples. (b) Error (i) Type I error (False positive) - a numerical value indicating the magnitude of Type I error (ii) Type II error (False Negative) - a numerical value indicating the magnitude of Type II error

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
7.13 Controls	
7.13.1 Positive Control (Microbiologicals only)	Identification of organisms used for determining accuracy: Genus and species
7.13.2 Positive Control Result (Microbiologicals only)	The analytical result of measuring the positive control: Presence or Absence
7.13.3 Negative Control (Microbiologicals only)	Identification of organisms used for determining accuracy: Genus and species
7.13.4 Negative Control Result (Microbiologicals only)	The analytical result of measuring the negative control: Presence or absence
7.14 Detection / Quantitation Level Measure (Alternate Names: Detection Limit; Detection Level)	The measure that describes the quantity of analyte below which the sample analysis equipment will not detect the analyte accurately. If the lowest numerical value that a laboratory can report reliably for a test result based on the laboratory's experience with the method and equipment is different than the Detection Limit Measure and set by Statute or Regulation, then it should be reported as the Regulatory Reporting Level.
7.14.1 Detection / Quantitation Level Unit of Measure Name	The name of the determinate quantity for a standard of measurement used for measuring dimension, capacity, or amount of something (e.g., mg/L, pCi/L, CFU/mL, etc.).

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes	
Data Element	**Definition**
7.15 Detection / Quantitation Level Type (Alternate Names: Detection Limit Type)	The type of detection level used in the analysis of a chemical constituent: (a) Instrument detection level (b) Method detection level (c) Estimated detection level (d) Practical quantitation limit (e) Limit of detection (f) Long term method detection level (g) Regulatory reporting level . Drinking Water Maximum Contaminant Level . Water quality standard or criteria . Alternate concentration level (h) Other entries as applicable
7.16 QA/QC Exception Flags	Flags should allow for: Analyzed past holding time - Dual quantification difference> 40% RPD - Estimated value, quantification doesn't meet SOP criteria - Duplicate injection precision not met - Spike recovery outside of control limits - Spike out of calibration range
7.16.1 QA/QC Comment Field	Text noting other aspects of the quality assurance and control

APPENDIX B: WATER QUALITY DATA ELEMENTS FOR TOXICOLOGICAL ANALYTES

Water Quality Data Elements for Reporting Results of Toxicity Test Analyses
January 22, 2004 Version 2.5

Data Element	Definition
1.0 Contact Elements Module	**See Chemical/Microbiology Data Elements**
2.0 Result Module	
2.1 Result Value	
2.1.1 Result or Endpoint Value	Reportable numerical measure of the result for the biological organism, or other characteristic, being analyzed: e.g., LC50, NOEC
2.1.2 Unit of Measure	The name of the determinate quantity for a standard of measurement used for measuring dimension, capacity, or amount of something. e.g. count
2.1.3 Biological Response*	Type of organism response measured in the test: e.g., survival, reproduction, growth (e.g., dry weight), fertilization.
2.1.4 Result Type*	The statistically-derived endpoint that was calculated to express the test result in 2.1.1: e.g., NOEC, LOEC, LC_{50}, IC_{25}.
2.1.5 Confidence Intervals**	The values representing the lowest and highest confidence level
2.1.6 Confidence Level**	The percent confidence associated with the confidence levels; i.e., 95%, 99%
2.1.7 Method of Comparison**	The basis for comparison that yielded the sample result or endpoint. For example, compared to laboratory control, reference sample, upstream sample.
2.1.8 Statistical Analysis Used**	Statistical test(s) used to obtain result or endpoint value (e.g., t-test, Dunnett t, ANOVA, Probit)
2.1.9 Mean organism survival per replicate and treatment*	Table with mean survival values for each replicate and treatment in the test to which the result value applies. Note, if the response reported is survival, this element not necessary
2.1.10 Range of physicochemical parameters per replicate and treatment*	Table with numeric ranges of water quality parameters measured during the test in either replicates or treatments to which the result value (element 2.1.1) applies. Examples of parameters include dissolved oxygen, pH, temperature, salinity or conductivity.
2.2 Species Tested	
2.2.1 Analyte (Species) Name	The name assigned to a substance or feature that describes it in terms of its molecular composition, taxonomic nomenclature or other

Data Element	Definition
	characteristic.
2.2.2 Analyte (Species) Code	The unique identification number assigned by either the Integrated Taxonomic Information System, (ITIS) the International Committee on Taxonomy of Viruses, or the EPA Biological Registry System .
2.2.3 Taxonomic Identification Reference**	Text indicating taxonomic reference or source used to verify test species identity.
2.2.4 Test Organism Age*	Age of organisms at test initiation in either hours or days
2.2.5 Units of Organism Age*	Hours or days
3.0 Reason for Sampling Module	
3.1 Reason for Sample Collection	A text field e.g., Reconnaissance/Occurrence Survey, Permit Compliance, Pollution Event, Storm Event, Research
3.2 Sampling Design Used	Type of sampling design used to choose sites for sample collection. Includes: probabilistic, stratified-random, targeted, systematic
3.3 Data and/or Measurement Quality Objectives**	Brief summary of MQOs in relation to toxicity sampling and testing; for example, test precision, RSD ≤ 20%.
4.0 Date/Time Module	**See Chemical/Microbiology Data Elements**
5.0 Sample Location Module	**See Chemical/Microbiology Data Elements**
6.0 Sample Collection Module	
6.1 Sample Type	The type of sample being described e.g., Routine Sample, Field Replicate, Reference sample
6.2 Media Sampled	The environmental media sampled at a site. The environmental material about which results are reported from either direct observation or collected samples e.g., surface water, sediment, wastewater
6.3 Sample Collection Temperature	Temperature of the sample when collected
6.4 Sample Identification	The unique name, number, or code assigned to identify the sample.
6.5 Sample Collection Method	
6.5.1 Area or Volume Sampled**	Amount of area or volume of material sampled for toxicity testing. For example, 1 square meter of stream bottom was sampled or 2 liters of sediment were collected for testing.
6.5.2 Written Sampling Method Citation**	Reference citation (preferably published) for sampling method used.
6.5.3 Certification/Training Status Of Sampler Personnel**	Text providing any certification or experience level of personnel sampling. For example, agency-trained/certified personnel.
6.5.4 Sample Composite Method**	Method used to composite subsamples, if any

Data Element	Definition
6.5.5 Elapsed Time From Sample Collection To Delivery To Lab*	Time in hours between the end of sample collection and the receipt of the sample at the lab
6.6 Sample Preservation/Processing	
6.6.1 Container type	Free text: Sample container type
6.6.2 Container color	Free text: Sample container color
6.6.3 Container size	The container size used in sample collection
6.6.4 Sample collection filtering code	Filtered, unfiltered, or the specific fraction
6.6.5 Sample collection filtering comment text	Free text describing any comments
6.6.6 Chemical preservation method	The method used to preserve the sample in the field by the sampling entity. This entry is intended to include preservation techniques that are NOT specified as part of the *Analytical Method,* element 7.5
6.6.7 Chemical preservation method comment	Free text describing any comments
6.6.8 Temperature Preservation Method	The method used to preserve the sample in the field by the sampling entity. This entry is intended to include preservation techniques that are NOT specified as part of the *Analytical Method,* element 7.5
6.6.9 Chemical manipulation of the sample*	Text indicating chemical modification of the sample prior to testing, if any; e.g., pH adjustment, dechlorination.
6.6.10 Field Or Lab Processing**	Indicate whether samples were processed in the field or lab
6.6.11 Initial Device Used**	Indicate equipment used for initial processing such as screens, sieves, splitters.
6.6.12 Subsampling Method**	Text indicating method used to obtain subsamples for testing, if any: random aliquot
6.6.13 Homogenization Method**	Text indicating how sample was mixed prior to testing, if any: shaker, manual stirring,?
6.6.14 Compositing Method**	Text indicating the way in which samples were composited during processing, if any.
6.6.15 Written Protocol Citation**	Citation for method used in sample processing.
6.6.16 Sample Storage Time**	Time, in hours or days, over which sample was stored prior to testing hours or days.
6.7 Sample Volume	See Chemical/Microbiology Data Elements
6.8 Sample Weight Collected	See Chemical/Microbiology Data Elements
7.0 Sample Analysis and QC Module	
7.1 Extraction/processing Date	N/A - See Chemical/Microbiology Data Elements
7.2 Extraction/processing Time	N/A - See Chemical/Microbiology Data Elements

Data Element	Definition
7.3 Analysis (Test) Date (inclusive beginning and end dates)	The calendar date when analysis of the analyte was finished, reported as 4-digit year, 2-digit month, and 2-digit day in YYYYMMDD format.
7.3.1 Test Duration*	Time over which test performed
7.4 Analysis (Test) Time	At test initiation; See Chemical/Microbiology Data Elements
7.5 Method Number	The method number of the analytical method used, represented as a reference number: (a) EPA (Specify number) (b) ASTM (Specify number) (c) SM (Specify number) (d) Other methods as applicable
7.5.1 Modifications to method if any*	Text indicating any departures from the referenced method such as test temperature, sample holding time, or organism age
7.5.2 Organism feeding regime*	Text specifying type and rate of feeding and whether organisms were fed as per cited protocol
7.5.3 Test chamber material*	Text indicating type of material with which test chambers made: HDPE plastic, stainless steel, Teflon, glass, etc.
7.5.4 Chamber volume*	Number of mls of solution or sediment/soil that the test chamber can hold
7.5.5 Number of replicates*	Number of separate replicates tested for each test concentration or sample
7.5.6 Organisms per replicate*	Number of test organisms exposed to material in each test chamber
7.5.7 Mean response per replicate and treatment*	Table with numeric values of the mean response (as defined in element 2.1.3) for each replicate and treatment in the test to which the result value (element 2.1.1) applies.
7.5.8 Test Temperature*	Target temperature value and acceptable range
7.6 Sample Size	The size of the sample used for analysis
7.7 Serial Dilution*	Percentages of sample tested: e.g., 0, 10, 20, 50, 100% sample
7.8 Composite Sample	(a) Time, Flow, or (c) Spatial flow-weighted, proportional, cross-sectional, or integrated depth, or (d) Other entries as applicable
7.9 Run Batch	N/A - See Chemical/Microbiology Data Elements
7.10 (Spiking) amount or dose added	The amount (weight or volume) or final concentration of an analyte that has been spiked into an aliquot at any time during the

Data Element	Definition
	analysis process.
7.11 Analytical (Test) Precision	
7.11.1 Control Precision	A measure of the agreement among individual measurements of the same property in duplicate laboratory samples (or duplicate laboratory spiked samples) under prescribed similar conditions to estimate variability in the measurement method or procedures. Precision is expressed as: (a) standard Deviation, (b) % Relative Standard Deviation (RSD), (c) Relative Percent Difference (RPD), (d) coefficient of variation (C.V.)
7.11.2 Intra-test Precision*	Measure of test precision or statistical sensitivity (e.g., Minimum Significant Difference [MSD] or percent MSD [PMSD])
7.12 Analytical Accuracy/Error	N/A - See Chemical/Microbiology Data Elements
7.13 Bias Number	N/A - See Chemical/Microbiology Data Elements
7.14 Control and Reference Sample Information*	
7.14.1 Positive Control Name*	Analyte used as positive control in test
7.14.2 Positive Control Result*	The analytical result of measuring the positive control: Presence or Absence of negative control
7.14.3 Negative Control Name (Dilution Water or Control Sediment or Soil Used)*	Text indicating type of water or sediment used for test dilutions and as a negative control (e.g., tap water vs. RO water vs surface water and salinity, hardness, and/or organic carbon content)
7.14.4 Negative Control Result*	The analytical result of measuring the negative control: Presence or absence of control
7.14.5 Reference Sample Name*	Text indicating name (location) of water, soil, or sediment used as a reference measure for test, if any
7.14.6 Reference Sample Result*	Numeric entry indicating response of reference sample results, if any, associated with result or endpoint; e.g., upstream water survival = 100%
7.15 Detection/Quantitation Level	
7.15.1 Detection/Quantitation level measure	N/A - See Chemical/Microbiology Data Elements
7.15.2 Detection/Quantitation	N/A - See Chemical/Microbiology Data Elements
7.16 Detection/Quantitation Level Type	N/A

Data Element	Definition
7.17 QA/QC Exception Flags (Test Acceptability Criteria Met?)	Flags should allow for: Analyzed past holding time - Dual quantification difference> 40% RPD - Estimated value, quantification doesn't meet SOP criteria - Duplicate injection precision not met - Spike recovery outside of control limits - Spike out of calibration range
7.18 QA/QC Exception Comment (Test Acceptability Notes)	Text indicating any comments or clarifications concerning how the test met or didn't meet certain acceptability criteria
7.19 QA/QC Comment Field	
7.19.1 Potential Interferences Observed in Test*	Text indicating potential sources of interference observed by analysts such as low dissolved oxygen, high turbidity, presence of predators.
7.20 Reference Toxicant Results*	
7.20.1 Reference Toxicant Name*	Text indicating material used in reference toxicant testing
7.20.2 Reference Toxicant Results*	Endpoint or result for corresponding >reference toxicant test
7.20.3 Date of reference toxicant test*	Date when associated reference toxicant test was initiated.
7.20.4 Control Chart Limits*	95% C.I. for endpoint or result value given in 7.20.2
7.21 Laboratory Certifications/ Accreditation**	List applicable certifications or accreditations for the type of testing reported.

Elements marked with * denote ones that are unique to toxicological data. Elements marked with ** denote ones that are shared between toxicological and population-community data

APPENDIX C: WATER QUALITY DATA ELEMENTS FOR POPULATION AND COMMUNITY LEVEL ANALYTES

Water Quality Data Elements for Reporting Results of Population/Community Biological Assessments
May 2005

Data Elements	Definition
1.0 Contact Information Module	See Chemical/Microbiology Data Elements
2.0 Results Module	
2.1 Result/Endpoint Value	Reportable numerical measure of the result for the biological organism, or other characteristic, being analyzed.: index score, metric value, density, biomass, etc.
2.1.1 Measure Name**	(Alternate Names: Parameter, Taxon, Metric, Index) Metric = measure of biological attribute (e.g. EPT, % lithophils, % Sensitive Diatoms) index = aggregated number used to judge condition (e.g. IBI, RBP, RIVPACS)
2.1.2 Unit of Measure	The name of the determinate quantity for a standard of measurement used for measuring dimension, capacity, or amount of something. e.g. count, mg
2.1.3 Confidence Intervals**	The values representing the lowest and highest confidence level
2.1.4 Confidence Level**	The percent confidence associated with the confidence levels; i.e., 95%, 99%
2.1.5 Method of Comparison**	The basis for comparison that yielded the sample result or endpoint. For example, compared to reference condition, upstream sample.
2.1.6 Statistical Methods Used**	Statistical test(s) used to obtain result or endpoint value (e.g., t-test, ANOVA, ordination or other multivariate method)
2.1.7 Modifications to method if any**	Text describing alterations to published methods; metric substitution, etc.
2.1.8 Method citation**	Reference citation (preferably published) for assessment method or metric calculation (including formula) used
3.0 Reasons for Sampling Module	
3.1 Reason for Sample Collection	A text field to include such reasons as: (a) Reconnaissance/Occurrence Survey (b) Trend analysis (c) Permit Compliance (d) Pollution Event (e) Storm Event (f) Research (g) Regulatory benchmark (h) Bioaccumulation (i) Deposition (j) Other entries as applicable
3.2 Sampling Design Used	Type of sampling design used to identify sampling sites: probabilistic, stratified-random, targeted, systematic
3.3 Data and/or Measurement Quality	Brief summary of MQOs in relation to biological

Objectives**	analysis; for example, sample precision, RSD ≤ 20%.
4.0 Date/Time Module	
4.1 Sample Collection Start Date	See Chemical/Microbiology Data Elements
4.2 Sample Collection Start Time	See Chemical/Microbiology Data Elements
4.3 Sample Collection End Date	See Chemical/Microbiology Data Elements
4.4 Sample Collection End Time Measure	See Chemical/Microbiology Data Elements
5.0 Sample Location Module	
5.1 Water Body/Aquifer Name	See Chemical/Microbiology Data Elements
5.1.1 Water Body Use Classification	Designated use classification of the water body sampled, if applicable
5.2 Sample Station Identifier	See Chemical/Microbiology Data Elements
5.2.2 River Mile*	River mile where the station is located, if applicable.
5.2.3 Reach*	EPA Reach code for where the station is located, if applicable
5.3 Sampling Station Type Name	See Chemical/Microbiology Data Elements
5.4 Latitude Measure	See Chemical/Microbiology Data Elements
5.5 Longitude Measure	See Chemical/Microbiology Data Elements
5.6 Horizontal Reference Datum	See Chemical/Microbiology Data Elements
6.0 Sample Collection Module	
6.1 Sample Type	See Chemical/Microbiology Data Elements
6.1.1 Assemblage Sampled*	The type of biological assemblage sampled (e.g., fish, periphyton, macroinvertebrates, etc.)
6.2 Media Sampled	See Chemical/Microbiology Data Elements
6.3 Sample Ambient Condition(s)*	For physical and/or water quality characteristics measured *in situ* at the time of the survey, refer to the following elements in the Chem/Micro data Elements list: 2.1 Parameter Value 2.1.1 Unit of measure 2.2.2 Parameter name 3.0 Reason for sampling 6.0 sample type 6.2 Media sampled 6.5.2 Instrument used For samples collected for detailed chemical analysis, refer to the Chem/Micro Data Elements modules 6.0 and 7.0
6.4 Sample Identification	See Chemical/Microbiology Data Elements
6.5 Sample Collection Method	
6.5.1 Sample Collection Device*	Name of the field gear used for sampling e.g. D-frame net, artificial substrate, seine, electroshocker
6.5.2 Area or Volume Sampled**	Area of media sampled; e.g. 1 m^2 of stream bottom
6.5.3 Written Sampling Method Citation**	Reference citation (preferably published) for

	sampling method used.
6.5.4 Certification/Training Status Of Sampler Personnel**	Text providing any certification or experience level of personnel sampling: e.g. agency-trained/certified personnel.
6.5.5 Sample Composite Method**	Text indicating the way in which samples were composited in the field prior to processing, if any: e.g. Depth-integrated composite, time-integrated composite, area-integrated, habitat-integrated, none.
6.6 Sample Processing	
6.6.1 Field Or Lab Processing**	Indicate whether samples were processed in the field or lab. For samples preserved for transport to lab, begin at 6.6.2. For samples processed in situ, go to 6.6.9.
6.6.2 Container type	For microbiological/plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.3 Container color	For microbiological/phytoplankton/algal samples; See Chem/Micro Data Elements
6.6.4 Container size	For microbiological/plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.5 Sample collection filtering code	For microbiological /plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.6 Sample collection filtering comment text	For microbiological /plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.7 Sample Volume	For microbiological /plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.8 Sample Weight Collected	For microbiological /plankton/algal samples; See Chemical/Microbiology Data Elements
6.6.9 Preservation method	See Chemical/Microbiology Data Elements
6.6.10 Initial Device Used**	Indicate equipment used for initial processing such as screens, sieves, splitters.
6.6.11 Subsampling Method**	Text indicating method used to obtain subsamples for testing, if any: random aliquot
6.6.12 Homogenization Method**	Text indicating how sample was mixed prior to processing, if any: shaker, manual stirring?
6.6.13 Compositing Method**	Text indicating the way in which samples were composited during processing, if any.
6.6.14 Written Protocol Citation**	Citation for method used in sample processing.
6.6.15 Sample Storage Time**	Time, in days, over which sample was stored prior to processing.
6.6.16 Organism sorting efficiency	Measure of number of organisms isolated for taxonomic identification and enumeration versus organisms remaining in the sorted or picked sample

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7.0 Sample Analysis and QC Module

Note: Data elements 7.1 – 7.16 of the Chemical/Microbiological list may not be generally applicable to population – community data and are omitted here. Organizations should consult those elements to decide whether some are applicable to their program or study. Data element numbers in this module, therefore, do not correspond to element numbers in lists for other chemical/microbiological or toxicological data.

7.1 Organism Identification*	
7.1.1 Field or lab identification*	Indicate whether organisms were taxonomically identified in the field or lab
7.1.2 Device used*	Indicate equipment used for identification such as hand lens, dissecting scope
7.1.3 Organism Preparation*	Indicate how organisms were prepared prior to identification: dissection, slide-mounting, rose bengal staining, etc.
7.1.4 Organism Classification*	
7.1.4.1 Taxonomic resolution*	Indicate taxonomic level to which organisms are identified
7.1.4.2 Taxonomic Citations*	Taxonomic keys (preferably published) used as references in the identification process
7.1.4.3 Taxonomic Identifier	See Chemical/Microbiology Data Elements at 2.2
7.1.4.4 Taxonomic name	See Chemical/Microbiology Data Elements
7.1.4.5 Taxonomic verification procedures*	Text describing how taxonomic identifications are confirmed and cross-checked
7.1.4.6 Taxonomic precision*	e.g., % taxonomic agreement in QC samples; percent difference in enumeration in QC samples
7.1.4.7 Taxonomic accuracy*	e.g., use of reference or voucher specimens; qualitative evaluation of specimen condition (e.g., slide mounts) for identification
7.2 QA/QC Exception Flags (Test Acceptability Criteria Met?)	Flags should allow for (e.g.): Precision of field sampling method not met; high sorting or subsampling bias; reduced sorting efficiency; control limit for taxonomic identification exceeded; other deviations from established MQOs/DQOs.
7.3 QA/QC Exception Comment (Test Acceptability Notes)	Text indicating any comments or clarifications concerning how the data met or didn't meet certain acceptability criteria (e.g. inclement weather or dangerous conditions, sparseness of samples due to impairment, loss or damage of organisms, or samplers)

Elements marked with * denote ones that are unique to population-community data.
Elements marked with ** denote ones that are shared between toxicological and population-community data