



Chapter A7. BIOLOGICAL INDICATORS

Third Edition

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ABSTRACT

The *National Field Manual for the Collection of Water-Quality Data* (*National Field Manual*) provides guidelines and standard procedures for U.S. Geological Survey (USGS) personnel who collect data used to assess the quality of the Nation's surface-water and ground-water resources. This chapter of the manual includes procedures for the (1) determination of biochemical oxygen demand using a 5-day bioassay test; (2) collection, identification, and enumeration of fecal indicator bacteria; (3) collection of samples and information on two laboratory methods for fecal indicator viruses (coliphages); and (4) collection of samples for protozoan pathogens.

Each chapter of the *National Field Manual* is published separately and revised periodically. Newly published and revised chapters are posted on the World Wide Web on the USGS page "National Field Manual for the Collection of Water-Quality Data." The URL for this page is <http://pubs.water.usgs.gov/twri9A/> (accessed November 25, 2003).

INTRODUCTION

As part of its mission, the U.S. Geological Survey (USGS) collects the data needed to determine the quality of our Nation's water resources. A high degree of reliability and standardization of these data are paramount to fulfilling this mission. Documentation of nationally accepted methods used by USGS personnel serves to maintain consistency and technical quality in data-collection activities. *The National Field Manual for the Collection of Water-Quality Data*

(*National Field Manual*) describes protocols (required and recommended procedures) and provides guidelines for USGS personnel who collect those data on surface-water and ground-water resources. Chapter A7 includes procedures for the (1) determination of biochemical oxygen demand using a 5-day bioassay test; (2) collection, identification, and enumeration of fecal indicator bacteria; (3) collection of samples and information on two laboratory methods for fecal indicator viruses (coliphages); and (4) collection of samples for protozoan pathogens. Many of the equipment-sterilization and sample-collection procedures are identical for fecal indicator bacteria, viruses, and protozoans; these nevertheless appear in each section for the convenience of the user.

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The *National Field Manual* is Section A of Book 9 of the USGS publication series "Techniques of Water-Resources Investigations" (TWRI) and consists of individually published chapters designed to be used in conjunction with each other. Chapter numbers are preceded by an "A" to indicate that the report is part of the *National Field Manual*. Other chapters of the *National Field Manual* are referred to in the text by the abbreviation "NFM" and the specific chapter number (or chapter and section number). For example, NFM 6 refers to chapter A6 entitled *Field Measurements*, and NFM 6.4 refers to the section in Chapter A6 on field measurement of pH.

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PURPOSE AND SCOPE

The *National Field Manual* is targeted specifically toward field personnel in order to (1) establish and communicate scientifically sound methods and procedures, (2) encourage consistency in the use of field methods for the purpose of producing nationally comparable data, (3) provide methods that minimize data bias and, when properly applied, result in data that are reproducible within acceptable limits of variability, and (4) provide citable documentation for USGS water-quality data-collection protocols.

Data collectors must have formal training and field apprenticeship in order to correctly implement the procedures described in this chapter. The *National Field Manual* is meant to complement such training. A description of the determination for ultimate carbonaceous biochemical oxygen demand is beyond the scope of Section 7.0 (Five-Day Biochemical Oxygen Demand), but is provided in Stamer and others (1979, 1983). The information

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+ provided in Section 7.1 (Fecal Indicator Bacteria) and in Section 7.2 (Fecal Indicator Viruses) is to be used in conjunction with *Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples* edited by L.J. Britton and P.E. Greeson (TWRI, Book 5, Chapter A4, 1989), the 20th edition of Standard Methods for the Examination of Water and Wastewater, and with the other chapters of this *National Field Manual* series.

It is impractical to provide guidance that would encompass the entire spectrum of data-collection objectives, site characteristics, environmental conditions, and technological advances related to water-quality studies. The fundamental responsibility of data collectors is to select methods that are compatible with the scientific objective for the field work and to use procedures that are consistent with USGS standard procedures to the extent possible. Whenever a standard procedure is modified or not used, a description of the procedure used and supporting quality-assurance information are to be reported with the data.

REQUIREMENTS AND RECOMMENDATIONS

+ As used in the *National Field Manual*, the terms **required** and **recommended** have the following USGS-specific meanings.

Required (require, required, or requirements) pertains to USGS protocols and indicates that USGS Office of Water Quality policy has been established on the basis of research and (or) consensus of the technical staff and has been reviewed by water-quality specialists and selected District¹ or other professional personnel, as appropriate. Technical memorandums or other documents that define the policy pertinent to such requirements are referenced in this manual. Personnel are instructed to use required equipment or procedures as described herein. Departure from or modifications to the stipulated requirements that might be necessary to accomplishing specific data-quality requirements or study objectives must be based on referenced research and good field judgment, and be quality assured and documented in permanent and readily accessible records.

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¹"District" refers to an organizational unit of the USGS in any of the States or Territories of the United States.

Recommended (recommend, recommended, recommendation) pertains to USGS protocols and indicates that USGS Office of Water Quality policy recognizes that one or several alternatives to a given procedure or equipment selection are acceptable on the basis of research and (or) consensus. References to technical memorandums and selected publications pertinent to such recommendations are cited in this chapter to the extent that such documents are available. Specific data-quality requirements, study objectives, or other constraints affect the choice of recommended equipment or procedures. Selection from among the recommended alternatives should be based on referenced research and good field judgment, and reasons for the selection must be documented. Departure from or modifications to recommended procedures must be quality assured and documented in permanent and readily accessible records.

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FIELD MANUAL REVIEW AND REVISION

This is the third edition of Chapter A7, "Biological Indicators," dated November 2003; this edition updates and expands upon the second edition dated March 2003. As chapters of the *National Field Manual* are reviewed and revised to correct any errors, incorporate technical advances, and address additional topics, dates of revisions appear in the footer of the report. Refer to "Comments and Errata" on the *National Field Manual's* Home page (<http://pubs.water.usgs.gov/twri9A/>) for each chapter's revision history.

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Comments on the *National Field Manual*, and suggestions for updates or revisions, should be sent to nfm-owq@usgs.gov. Newly revised and reissued chapters or chapter sections will be posted on the World Wide Web on the USGS page "National Field Manual for the Collection of Water-Quality Data." The URL for this page is <http://pubs.water.usgs.gov/twri9A/> (accessed November 25, 2003). This page also contains a link to the NFM "Comments and Errata" page that chronicles revisions to each chapter.

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