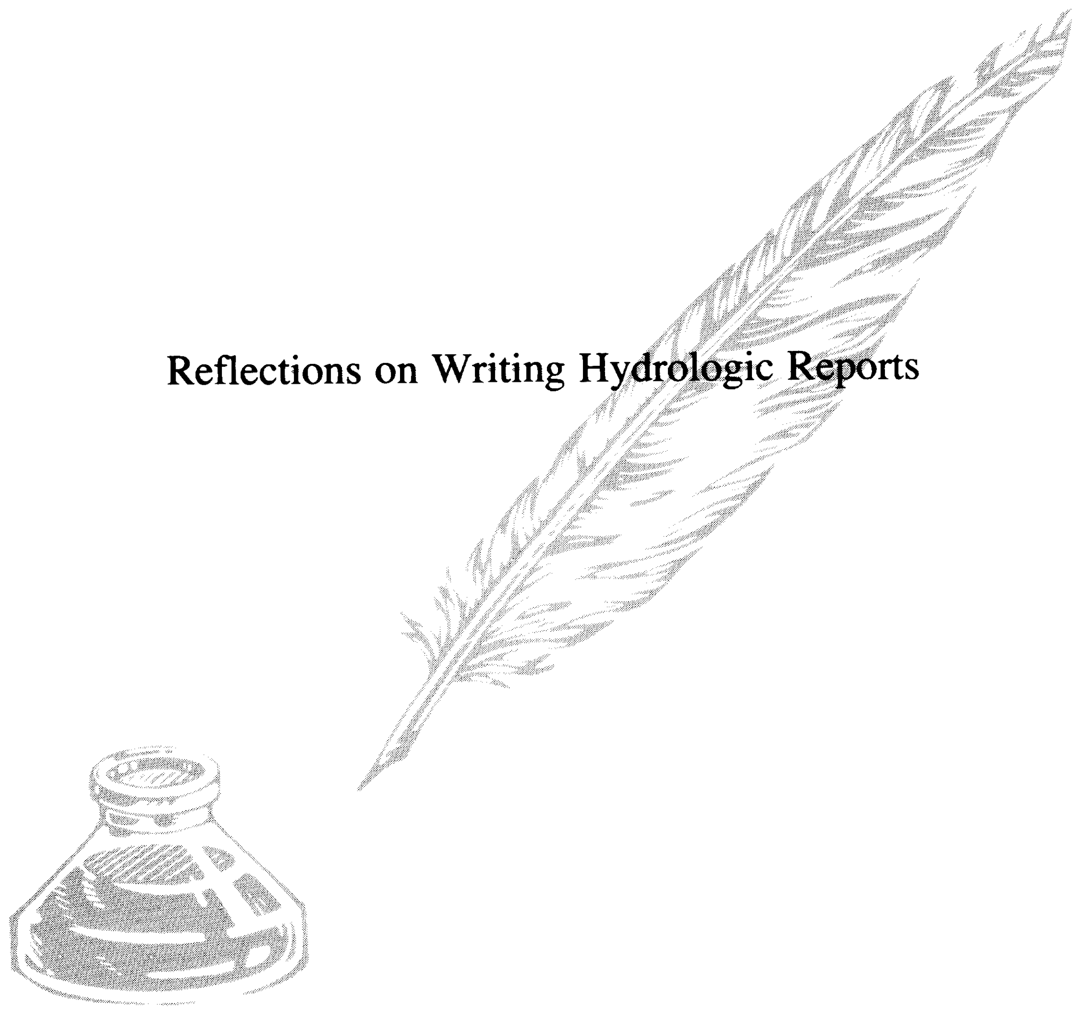
Reflections on Writing Hydrologic Reports



Perry G. Olcott

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by Perry G. Olcott

INTRODUCTION

The principal product of the Water Resources Division, U.S. Geological Survey is reports published in formal and informal series and in scientific journals, symposium proceedings, and by cooperating agencies. Authors, as well as the Survey, are judged by the scientific community on the clarity, accuracy, and technical competence of their reports. These qualities are also measures of the usefulness of our reports to water managers and to the public. Clarity and technical accuracy of Survey reports are continuing concerns. This paper reiterates some of the philosophy of scientific writing, and describes the functions of the various parts of a report and their relation to report organization. It is intended as an aid in the continuing process of improving report writing by Water Resources Division authors.

Research work of the Survey, as in most scientific endeavors, follows the scientific method: the systematic pursuit of knowledge involving the recognition of a problem, the formulation of hypotheses, and testing of the hypotheses through observation and experiment to finally answer the problem. *Reporting* of scientific work should be organized along similar lines. A *logical argument* is developed through presentation of the problem, development of a conceptual model, tabulation and display of the data pertinent to the model, and testing and interpretation of data to prove the model or hypotheses that address (or answer) the problem. Reporting of all scientific work should be *characterized* by this *logical argument* that dominates the report and focuses on the solution to the problem in question. Organization of the report is a vital mechanism in developing that logical argument.

Organization serves as the skeleton of the report, the integral, connecting framework that provides underlying support and continuity to the whole. Organization provides structure, continuity, logic, and emphasis through the proper use and linking of the parts of the report, each of which serves a specific function. The following discussion expands on these themes to explain and further emphasize the importance of report organization.

REPORT ORGANIZATION: THE PARTS OF A REPORT, THEIR FUNCTION, AND CONNECTING LOGIC

Scientific reports normally have a title, table of contents, abstract, introduction, body, summary and (or) conclusions, and references. Each part serves a specific function and, except for the references, each part is linked by a connecting logic, the logical argument of the report. Other optional parts of reports, such as foreword or preface, appendix, or additional data section, are supplemental to the main report. Each principal part is discussed below with emphasis on the function and connecting logic of the part.

THE TITLE

The title of a scientific report uniquely identifies it from all others. The title primarily conveys to the reader the principal subjects(s) of the report and, if pertinent, the general location of the study area and the dates when data used in the analyses were collected. It should be, however, as short and concise as possible. The title and the abstract are the initial and often only contacts that readers may have with a report. A good title attracts the reader's attention and helps him or her to decide if the report should be read in total. A poor title may discourage a potential reader.

The title uniquely establishes the content of the report. For example, the title ''Potentiometric Surface of the Plentywater Aquifer in January, 1981, Southwestern Mississippi'' establishes the *specific subject:* the potentiometric surface of an identified aquifer at a specific time and place. The reader knows that the report will *not* deal, for example, with surface-water discharge, ground-water quality, or projected effects of pumping. He assumes that it *will* include a presentation of the potentiometric surface of the Plentywater aquifer in January 1981 and *may* include a discussion of ground-water movement, recharge and discharge to the aquifer, water-level fluctuation, water use from the aquifer, and (or) other subjects pertinent only to the potentiometric surface of the Plentywater aquifer in January 1981.

The title should also emphasize the intended message of the report. For example, a report that describes a hydrologic investigation of an area where a digital model was used should be entitled "Hydrology of the study area" rather than "Digital model of the study area." Hydrology is the *subject* of the study. The digital model was a *method* used in the study and does not belong in the title.

THE TABLE OF CONTENTS

Scientific reports generally have a table of contents that presents a summary of report content in the form of an outline of section and subsection titles. This outline is a presentation of the organization and therefore conveys to the reader, at least in general terms, the logical argument that is developed in the report. A lack of logical organization in the table of contents conveys to the reader that the logical argument is flawed, which weakens the validity and the impact of the conclusions of the report. Supervisors and (or) reviewers, first and foremost, should focus on the table of contents to assure that organization of the report is *logical.* Similarly, authors should not attempt to start writing a report before this organization (report outline) is well thought out, reviewed, and committed to paper.

Contents of multisubject reports are divided into sections dealing with individual topics that all bear on the overall theme of the discussion. The sections help the reader to absorb the information piecemeal in an orderly fashion, and provide a ready reference to individual sections or subjects. Section titles, as with the title of the report, should reflect the principal subject of the section.

On the other hand, short, single-subject papers such as journal articles may be organized differently. Such articles discuss, for example, the results of scientific experiment, or a new method of data interpretation, and generally deal with *only one subject.* In effect, they are presenting an argument to prove the validity of the results of the experiment or interpretation. Therefore, documentation of the experiment (methods) is important as is the rationale or presentation of the results and interpretation. Organization of these short articles, therefore, takes a form similar to the following:

ABSTRACT
INTRODUCTION
METHODS
RESULTS
DISCUSSION
REFERENCES
ACKNOWLEDGMENTS

The abstract is a quantitative synopsis of the principal findings of the study; the introduction presents the problem, purpose, and any background information; and the methods section details equipment and procedures used for the study, similar to longer multisubject papers. The results section, which is unique to the short paper, is a presentation and interpretation of the data that takes the form of tables, graphs, maps, and discussions. The discussion section, also unique to the short paper, is used to further interpret data and relate these interpretations to the problem that is presented in the introduction. The significance to science of the conclusions of the study may also be discussed, as well as suggestions for further study.

Although this specialized organization is applicable to the short, single-subject article, it *cannot be used effectively,* and *should not be attempted,* on long, multisubject reports.

The following discussion is aimed at the organization of multisubject reports.

The *first order headings* in the table of contents and the body of a report separate the discussion into logical subjects and should reflect and give emphasis to the *key concepts* and (or) *keywords* in the *title* of the report. For example, if the report title is "Geohydrology of the Plentywater Aquifer, Southwestern Mississippi," first order headings in the body of the report (and in the table of contents) should include "Geology" and "Hydrology" or "Geohydrology." "Water quality" also may be a first order heading because water quality is implicit in the word hydrology. Thus, the first order headings *emphasize* and *carry forward* the *principal concepts* of the report *as defined in the title.*

The following title and table of contents from Hickey (1982) share this correlation of key concepts between title and table of contents.

"Hydrogeology and Results of Injection Tests at Waste-Injection Sites in Pinellas County, Florida"

Abstract
Introduction
- Purpose and scope
- Acknowledgments

Geologic framework
Definitions and methods of study
Hydrogeology of the test injection sites
- Surficial aquifer
- Floridan aquifer
  - Permeable zone A
  - Permeable zone B
  - Permeable zone C (injection zone)
  - Permeable zone D
  - Semiconfining beds
- Upper confining bed
- Lower confining bed

Ground-water-level fluctuations
    Ground-water flow in permeable
        zone C (injection zone)
    Water quality
Injection tests
    McKay Creek
    South Cross Bayou
        Pressure buildup
    Southwest St. Petersburg
        Use of dye tracer
        Water-quality changes
        Water-level and pressure
            buildup
Summary
References

The key concepts in the title are *hydrogeology, results of injection tests,* and *waste-injection test sites.* These concepts are carried forward in the first order headings of the contents by "Geologic framework," "Hydrogeology of the test injection sites," and "Injection tests."

Second and third order headings further subdivide the discussion of principal subjects into contributing units. Concepts and (or) words in these subheadings must also fit logically under the first order heading. For example, under the first order heading "Geology," second order headings of "Lithology" and (or) "Thickness of formations" are logical subheadings. "Yield of bedrock wells," for example, is not a logical subheading and would not appear under "Geology".

In the example above (Hickey, 1982), "Aquifers," "Permeable zones," "Confining beds," and "Ground-water flow, quality, etc.," all fit logically under "Hydrogeology." Similarly, tests designated by location (for example, McKay Creek) and test results (for example, pressure buildup) are pertinent subheadings for "Injection tests."

THE ABSTRACT

The report abstract is a summary or synopsis of the report content and especially of the principal findings of the report. The abstract should explain the purpose of the report and touch on all of the principal *conclusions* or *findings* of the report. It *must* reiterate and should expand on *all* of the *subjects* presented by the *title* and *purpose* of the report, which also are the subjects presented in the conclusions of the report. The abstract also should be quantitative; that is, principal numerical findings in the conclusions should be repeated in the abstract.

The abstract by Trujillo (1982) on page 24, presented as an example under "The summary and conclusions" section, is well written and provides an example of an abstract. Note the correlation of key concepts in the abstract to the purpose and the summary.

The abstract and the title are often published separately from the report by abstracting services and in announcements of new publications, and must, therefore, accurately summarize conclusions of the report and be written to stimulate the interest of potential readers.

THE INTRODUCTION

The introduction, as the name implies, introduces the reader to the discussion. First and foremost, it *presents the problem to be addressed in the report.* It also tells the reader the *purpose* and the *scope* of the work. It may present other technical or background information to set the stage for the discussion and (or) to describe the methods of study. Work of others that contributed to the report or study may also be acknowledged.

PRESENTATION OF THE PROBLEM

The introduction should start with a brief statement of the problem to be addressed in the report. It should be to the point of, and *must* match, the subject(s) described in the title.

The following paragraph is an excellent example from the introduction to an article by Barker (1984), entitled "Organochlorine Pesticide and Polychlorinated Biphenols Residues at Four Trophic Levels in the Schuylkill River, Pennsylvania."

> INTRODUCTION
>
> The presence of toxic substances in fish of the Schuylkill River has become a major concern of local and State officials in recent years. Studies by Brezina and Arnold (1976) have indicated the presence of high concentrations of some pesticides and polychlorinated biphenols (PCB's) in components of the Schuylkill River ecosystem, particularly fish. Subsequent studies of the water and bed sediments by the U.S. Geological Survey Schuylkill River Quality Assessment Project from 1978 to 1980 (Stamer and others, 1984) also have shown high concentrations of pesticides and PCB's in the bed material but relatively low concentrations (usually below detection limits) in the water. Several questions are raised: are the pesticides and PCB's being bioaccumulated by the fish? If there is evidence of bioaccumulation, at what trophic level(s) is it occurring? And do any of the fish harvested for consumption contain concentrations in their edible flesh that exceed current Food and Drug Administration guidelines?

The problem is stated in the first sentence: the presence of toxic substances in fish in the Schuylkill

River. Note the correlation with the title of the paper. The paragraph proceeds by expanding on the problem with pertinent results of previous studies. It then refines and encapsulates the problem in the form of several questions: are pesticides and PCB's bioaccumulating in the fish; is there evidence of bioaccumulation and at what trophic levels; and do concentrations of pesticides and PCB's in edible fish exceed Food and Drug Administration standards. Note that "Pesticides," Polychlorinated biphenols," and "Trophic levels" of the title are repeated in this statement of the problem. This introductory statement of the problem leads into statements of the purpose and scope of the report.

PURPOSE AND SCOPE

The purpose of a report should state why the specific report was written, not the reason for doing the study or for an overall study of which this study is a part, although this information may be given as background or introductory material. The purpose should directly relate to the *subject(s)* announced in the *title* and presented in the table of contents and in the statement of the *problem.* The scope sets limits on the purpose by telling the reader how far the purpose was carried out or what was done to carry out the purpose.

In the preceeding example (Barker, 1984), the statement of purpose and scope is:

> This paper evaluates the potential for organochlorine pesticide and PCB residues to bioaccumulate in periphyton, algae, macrophytes, snails, and nine species of fish. Four trophic levels are represented: primary producers, primary consumers, secondary consumers, and tertiary consumers.

The purpose is described in the first sentence, the scope in the second. Note that "Pesticide," "PCB," and "Four trophic levels" of the title and statement of the problem are repeated.

OTHER TECHNICAL INFORMATION

Other technical information in the introduction helps to orient the reader on various physical or mechanical aspects of the project. Examples are climate, physiography, topography, drainage, previous investigations, and (or) methods of study. By placing this information in the introduction, it is *deemphasized* and indicates to the reader that it is background information, not necessarily vital to understanding the report. Any such information that is important to developing the *logical argument* of the report should be presented under a first order heading in the body of the paper.

Other technical information should be pertinent to the subject of the report and should be brief and to the point. A discussion of climate of the project area, for example, is pertinent information to hydrologic studies. The discussion should be confined to several paragraphs or less, however, and present general information, such as average annual precipitation and temperature, coldest, warmest, wettest, and dryest months, and climatic conditions during the project. It should *not* summarize National Weather Service data for the past 30 years in a 3-page discussion.

The following example, "Previous investigations," from Lewis and Young (1982), is typical background information in Survey reports. It briefly explains the principal work done to date of the same nature as the present study or in the same area as the present study.

> PREVIOUS INVESTIGATIONS
>
> The occurrence of thermal water in the Banbury Hot Springs area was first mentioned in the literature by Stearns, Stearns, and Waring (1937). Ross (1971) summarized existing data that included several chemical analyses for the area. On the basis of similar water chemistry, Schoen (1972) concluded that Granitic rocks similar in composition to the Idaho batholith underlie the Banbury Hot Springs area. Young and Mitchell (1973) included chemical analyses from one thermal well and one thermal spring in their assessment of Idaho's geothermal potential. Using chemical geothermometers, Young and Mitchell estimated reservoir temperatures in the study area to range from 85 degrees to 135 degrees centigrade. Malde, Powers, and Marshall (1963) included the Banbury Hot Springs area in their reconnaissance geologic mapping of the west-central Snake River Plain. More detailed geologic mapping was done by Malde and Powers (1972) in their study of the Glenns Ferry-Hagerman area.

ACKNOWLEDGMENTS

Acknowledgments are a courtesy to individuals or organizations that have contributed substantially to the report (or project). They also are a form of scientific honesty since they give credit (assign blame?) and acknowledge the work of others. Acknowledgments should be confined to individuals both within and outside the Survey who made substantial contributions to the report (or project). Significant colleague reviews as well as contributions of data, equipment, property, or expertise may all qualify as a substantial contribution. An example of a serviceable acknowledgments section from Lewis and Young (1982) follows:

> ACKNOWLEDGMENTS
>
> Many landowners in the Banbury Hot Springs and nearby areas cooperated fully in this

study by allowing access to their property, supplying information about their wells and springs, and permitting water-level and discharge measurements to be made. Special thanks are due to Messrs. Leo Ray and Dick Kaster, who permitted the installation of continuous-recording equipment on their wells. The following Geological Survey employees contributed significantly to this investigation: A. H. Truesdell and N. L. Nehring provided sulfate-water isotope analyses, R. H. Mariner aided in interpretation of geochemical data, and T. A. Wyerman provided tritium isotope analyses. To all the above, the authors are grateful.

Because acknowledgments represent a break in the flow of the scientific discussion, they should be short, concise, and to the point. Journal articles often place acknowledgments at the end of the article, probably to avoid interruption of the logical argument that carries through the discussion.

THE BODY OF THE REPORT

The body of a report is the technical discussion and the vehicle for information transfer. It is the part wherein the subject(s) of the paper (from the title and purpose) is developed. Data are presented and interpreted to make specific points (conclusions) in the logical argument to prove the hypothesis and answer the problem (and purposes) presented in the introduction.

There are as many variations in content, style of writing, and use of technical methods in WRD reports as there are Survey authors. Each report, however, shares a similiar organization and development of argument required for effective scientific writing.

The body of a report is divided by first order headings into specific subject areas. The subject areas are those identified by the key concepts in the title and in the purposes of the report: *Each identified subject should appear as a first order heading in the body of the report.* Conversely, the *subject* of all *first order headings* in the body of the report need to be *reflected* in the *title* and the *purposes* of the paper. The easiest and most direct method of conveying these concepts is through the use of similar terminology in the title, purpose, and first order headings.

ORGANIZATION AND TITLE OF PRINCIPAL SECTIONS

Principal sections in the body of the report subdivide the discussion into broad subject categories. For example, ''hydrology'' is a broad subject area frequently found in WRD reports. These broad subject categories are further subdivided by second and third order headings, each more specific than the preceding heading. A first order heading, ''Hydrology,'' logically subdivides into more specific second order subject headings of ''Ground water,'' ''Surface water,'' and ''Quality of water.'' The Ground-water section, in turn, may subdivide into third order headings of ''Location and extent of aquifer,'' ''Potentiometric surface,'' and ''Recharge, discharge, and movement.'' The successive subheadings present a *logical* argument or chain of thought: for example, (1) Hydrology, (2) Ground water, (3) Potentiometric surface, or (1) Hydrology, (2) Surface water, (3) Streamflow.

Organization of the discussion within each section is a function of the subject material, available data, and how the subject fits into the overall paper. However, it should be explicit and to the point. The discussion should lead the reader through the logical argument by developing specific points both verbally and with illustrations and tables. Sections should finish with a conclusion or conclusions.

The subject material within long sections should start with an introductory or topic paragraph, develop a logical argument with supporting data for each step, and end with a paragraph that reiterates the conclusions arrived at in the discussion.

The mechanism of a topic sentence in each paragraph helps to organize the discussion. A section, ''Fluctuation of the Potentiometric Surface,'' from H. H. Tanaka (1972), is reproduced below as a good example of the use of topic sentences (in italics).

FLUCTUATION OF THE POTENTIOMETRIC SURFACE

Water levels in most wells fluctuate continuously, primarily as a result of changes in the amount of water in storage in the aquifer. Changes in storage are caused by differences in the rates of ground-water recharge and discharge.

Water-level fluctuations in the Verdigris Valley can be separated into short-term, seasonal, and long-term. Short-term fluctuations occur within a few hours or days after a change in the recharge or discharge relationship, or they occur in response to changes in pressure or load on the aquifer. Fluctuations of water levels in response to temporary changes in river stage or changes in atmospheric pressure are examples of short-term fluctuations.

Seasonal fluctuations of water levels are caused by variations in recharge or discharge during different seasons of the year. Water levels generally rise during the winter and are highest in the early spring, when recharge by spring rains is greater than discharge by evapotranspiration and seepage. Conversely, water levels decline rapidly during summer, when discharge by evapotranspiration and seepage is greater than recharge by rainfall. Typical seasonal water-level fluctuations in alluvium, ranging from 1 to 5 feet, for the period 1959–67 are shown by the

> hydrographs of wells 18N-16E-13ccl and 19N-16E-20aaal (fig. 3).
>
> *Long-term fluctuations in water-levels reflect cumulative differences in recharge and discharge during a longer period of time.* Water levels rise in years of above-normal precipitation and decline in years of below-normal precipitation. According to U.S. Weather Bureau records, the cumulative deficiency of precipitation from normal during the 3-year period 1962–64 at Muskogee was 29.39 inches. The deficiency in precipitation, and therefore the diminution of recharge to the aquifer, is reflected by consistent declines in water levels for the same period of time, as indicated by the hydrograph of well 17B-17E-35aabl (fig. 3). Long-term fluctuations of water levels in the alluvium typically are about 10 feet for the period of record (fig. 3). In the terrace deposits, typical water-level fluctuations generally are less than 5 feet, as shown by the hydrograph of a representative well 18N-17E-29cbcl (fig. 3).

Note that each topic sentence describes the subject (or topic) of the paragraph and each repeats the subject of the section title (Fluctuation of water level). Also note that the first paragraph defines fluctuations and the reason that they occur. It sets the subject or topic of the section which is clearly followed in each paragraph. The section is short enough that a summary paragraph is not needed.

Section titles announce the subject(s) of the sections that relate in turn to the report title.

THE SUMMARY OR CONCLUSION

The summary and (or) conclusion draws together and briefly reiterates the *principal conclusions* of the study developed in the discussion in the body of the report. Because this discussion is *directed* to answering the *purposes* of the *study,* the summary or conclusions logically must also address the *purposes.* The summary and (or) conclusions, then, *culminates* the *logical argument* of the report that started with the purpose, and should provide solutions or answers to the *problem* proposed in the introduction.

Long and (or) complex reports should be summarized with brief reiteration of the problem, methods used (if important), and the conclusions arrived at. Short simple reports can be adequately summarized by drawing together the conclusions. In either case, conclusions should be as quantitative as possible by using numbers mentioned in the body of the report.

The summary and conclusions section provides source material for the abstract and should be strongly reflected in that discussion.

The following example from the report "Trap Efficiency Study, Highland Creek Flood-Retarding Reservoir near Kelseyville, California, Water Years 1966–67" by Trujillo (1982), demonstrates this relationship between purpose, summary, and abstract. The summary section also is an example of a succinct and quantitative concluding statement.

> SUMMARY
>
> The Highland Creek drainage basin receives most of its rainfall, averaging 29 inches per year, during the winter months. Total runoff for the 11.8-year study period was 202,000 acre-ft (17,000 acre-ft/yr). This runoff carried an estimated 126,000 tons (10,700 ton/yr) of suspended sediment into Highland Creek Reservoir. Total reservoir outlow for the study period was 188,700 acre-ft (15,900 acre-ft/yr), which carried 15,230 tons (1,290 ton/yr) of sediment. Particle size for both inflow and outflow sediment ranged from <0.002 mm to 1.000 mm. Approximately 96 percent of the sediment released from the reservoir consisted of particles smaller than 0.062 mm. Estimated trap efficiency for the study period was 88 percent, based on the estimated sediment inflow and recorded sediment outflow.
>
> Reservoir surveys made in December 1965 and April 1972 revealed a capacity loss of 35.8 acre-ft. Based on an estimated specific weight of 70 lb/ft^3, 54,600 tons of sediment were deposited in the reservoir during the same 6.3-year period. The amount of sediment outflow from the reservoir during the same period was 8,890 tons. On the basis of the survey results and the recorded sediment outflow, the computed trap efficiency for the survey period was 86 percent.
>
> PURPOSE
>
> The ojectives of this study were (a) to determine the effectiveness for retaining sediment inflow of a typical flood retarding reservoir in a northern California environment, (b) to define streamflow and sediment-discharge characteristics of the Highland Creek drainage basin, and (c) to provide planning data for the design of future detention reservoirs.
>
> ABSTRACT
>
> This investigation is part of a nationwide study of trap efficiency of detention reservoirs. In this report, trap efficiency was computed from reservoir survey and outflow data.
>
> Highland Creek Reservoir is a flood-retarding reservoir located in Lake County, near Kelseyville, California. This reservoir has a maximum storage capacity of 3,199 acre-feet and permanent pool storage of 921 acre-feet. Mean annual rainfall for the 14.1 square-mile drainage area above Highland Creek Dam was 29 inches during the December 1965 to September 1977 study period. Resultant mean annual runoff was 17,100 acre-feet. Total reservoir inflow for the 11.8-year study period was 202,000 acre-feet, transporting an estimated 126,000 tons (10,700 tons per year) of suspended sediment. Total reservoir outflow for the same period was 188,700 acre-feet, including 15,230 tons (1,290 tons per year) of

sediment. Estimated trap efficiency for the study period was 88 percent, based on estimated sediment inflow and measured sediment outflow. Reservoir surveys made in December 1965 and April 1972 revealed a storage capacity loss of 35.8 acre-feet during the 6.3-year period. Computed by using an estimated specific weight, this loss represents 54,600 tons of deposited sediment. Sediment outflow during the same period was 8,890 tons. Trap effeciency for the survey period was 86 percent.

The title, table of contents, abstract, introduction, body, references, and conclusions sections are the "line items" of a scientific paper that present subject, problem, development of the scientific argument, and conclusions. Supplemental to these line items are the foreword, the preface, the appendixes, lists of tables and illustrations, the glossary, and other items that provide further data or information on report content, background, and (or) other information of interest to the reader which embellishes the report.

FOREWORD OR PREFACE

A foreword is an introductory statement, written and signed by someone other than the author(s), that describes the circumstances and significance of the report. A preface, which is written by the author and may or may not be signed, provides a prominent place for essential background information such as the relation of the report to earlier editions. Survey reports rarely need a foreword or preface but, when used, the subject of these items should be confined to the subject of the report as defined by the title.

The foreword from Water-Supply Paper 2262, "Selected Papers in the Hydrologic Sciences, 1984" (Meyer, 1984), is reprinted below.

FOREWORD

This Water-Supply Paper is the first in a periodic series that will present short papers in the hydrologic sciences. The emphasis of this series will be on new methods, techniques, and ideas of innovative applications of known techniques to solve hydrologic problems. Reviews and syntheses of recent work, available only in scattered publications, also will be included. Publication will be twice a year or more frequently as the number of contributions warrants.

The series is intended to be a forum for new ideas in hydrology. Dialogue between readers and authors is encouraged, and a discussion section for readers' comments and authors' replies will be included in each issue after the first.

Philip Cohen
Chief Hydrologist

Note that the foreword, signed by the Chief Hydrologist, announces the new series, explains its emphasis and content, mentions the frequency of publication, and states that comments on published papers will be accepted and published. It is short, succinct, and directly to the point of the title, "Selected Papers in the Hydrologic Sciences."

The unsigned preface from Water-Supply Paper 2185 A-D, "Water Quality of North Carolina Streams" (Wilder and others, 1982), reprinted below, presents background material on this report series that is published under one cover.

PREFACE

In 1972, the U.S. Geological Survey and North Carolina Department of Natural Resources and Community Development jointly designed and implemented a statewide monitoring program to help identify current and emerging water-quality problems. As part of this program the U.S. Geological Survey devised a study to make a detailed accounting of water quality in the large rivers of North Carolina at key locations. The three major goals of the Large Rivers Study are:

1. Definition of variation in water quality,
2. Determination of pollution loads in streams, and
3. Determination of trends in water quality.

Data collected since the 1940's have been used in this study to define water-quality variation and trends. Data recently collected from unpolluted streams were compared to data collected from large rivers to estimate pollution loads of the large rivers.

This Water-Supply Paper series includes all of the reports produced in the Large Rivers Study in the sequence that they were written. Methodologies presented in the reports have changed with time, and the emphasis of individual reports differ somewhat because of the data used and the individuality of the authors. However, each of the reports devoted to a large river follows a similar format to allow comparison between streams.

Chapter A describes in detail the initial design and philosophy of the U.S. Geological Survey water-quality program in North Carolina. Specific methodologies for the estimation of baseline water quality, pollution, and the evaluation of trends in water quality discussed in Chapter A are applied and refined in subsequent chapters that present water-quality-assessments of individual large rivers. Chapter B elaborates on the methodology used in estimating baseline water quality, and presents the results of a statewide baseline survey. Chapters C and D present water quality assessments of the French Broad and Neuse Rivers, respectively. Assessments of the water quality of other large rivers in North Carolina will be published in this series as the information becomes available.

This preface presents to the reader the main goals of the study, other background information, and the content of each of the reports in the series. It is succinct, informative, and does not stray from water quality, the subject of the report series.

SUPPLEMENTAL INFORMATION IN REPORTS

Supplemental information in the form of data tables, methods of analysis, mathematical derivations, and so forth, may be included as appendixes in reports to provide detailed additional information to the reader that was not essential to the report in developing the logical argument. Such material tends to be bulky and repetitive, and often is of interest only to readers who wish an exhaustive examination of the subject at hand. Printing this information at the back of the report provides ready access to interested readers, and preservation of the information without interfering with the readability of the paper.

Information presented in appendixes must relate to the discussion in the report and should be referenced in the report. Appendixes should be kept to a minimum, however, especially data tables for which other outlets are available.

SUMMARY

Reporting of scientific work should be characterized by a logical argument that is developed through presentation of the problem, tabulation and display of data pertinent to the problem, and testing and interpretation of the data to prove hypotheses that address the problem. Organization of the report is vital to developing this logical argument: it provides structure, continuity, logic, and emphasis to the presentation. Each part of the report serves a specific function and each is linked by a connecting logic, the logical argument of the report.

Each scientific report normally has a title, table of contents, abstract, introduction, body (of the report), and summary and (or) conclusions. The title uniquely identifies the report and conveys to the reader the principal subject(s) or concepts presented in the report. The table of contents summarizes report content as well as organization, and the first order headings should reflect and give emphasis to the principal concepts presented in the title of the report. The abstract presents a synopsis of the principal findings of the report. It should be quantitative, and it should address all of the principal concepts presented in the title, purpose, and first order headings of the report body. The introduction presents the problem to be addressed in the report, tells the reader the purpose and scope, and may present background information to set the stage for the discussion. The statements of problem and purpose must match the principal concepts described in the title and first order headings of the body of the report. The body of the report is a technical discussion and vehicle for information transfer. Data are presented and interpreted to make specific points (conclusions) in the logical argument to answer the purposes presented in the introduction.

Organization of sections within the body of the report is exactly parallel to overall organization; subjects presented in the section title are developed by logical subdivisions and pertinent discussion. The summary and (or) conclusions section culminates the logical argument of the report by drawing together and quantitatively reiterating the principal conclusions developed in the discussion. These conclusions logically should address the purpose(s) of the paper and, therefore, should provide a solution to the problem presented in the introduction.

Supplemental information on report content, background of the study, additional data or details on procedures, and other information of interest to the reader is presented in the foreword or preface, list of illustrations or tables, glossaries, and appendixes. This information is not an integral part of the logical argument of the report.

REFERENCES CITED

Barker, J. L., 1984, Organochlorine pesticide and polychlorinated biphenol residues at four trophic levels in the Schuylkill River, Pennsylvania, *in* Meyer, E. L. ed., Selected papers in the hydrologic sciences, 1984: U.S. Geological Survey Water-Supply Paper 2262, p. 25–31.

Hickey, J. J., 1982, Hydrogeology and results of injection tests at waste-injection test sites in Pinellas County, Florida: U.S. Geological Survey Water-Supply Paper 2183, 42 p.

Lewis, R. E., and Young, H. W., 1982, Geothermal reservoirs in the Banbury Hot Springs area, Twin Falls County, Idaho: U.S. Geological Survey Water-Supply Paper 2186, 27 p.

Meyer, E. L., ed., 1984, Selected papers in the hydrologic sciences, 1984: U.S. Geological Survey Water-Supply Paper 2262, 66 p.

Tanaka, H. H., 1972, Geohydrology of the Lower Verdigris River Valley between Muskogee and Catoosa, Oklahoma: U.S. Geological Survey Water-Supply Paper 1999-A, 23 p.

Trujillo, L. F., 1982, Trap-efficiency study, Highland Creek flood-retarding reservoir near Kelseyville, California, water years 1966–77: U.S. Geological Survey Water-Supply Paper 2182, 15 p.

Wilder, H. B., and others, 1982, Water quality of North Carolina streams, 1982: U.S. Geological Survey Water-Supply Paper 2185 A–D, 124 p.