

Writing Design Reports

Fritz R. Fiedler
Department of Civil Engineering
University of Idaho
Moscow, Idaho

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SUMMARY

This document provides a description and an example of engineering design reports. Engineers must routinely communicate the results of analysis and design work to both technical and non-technical audiences, thus it is vital that engineers become proficient in written communication. Design reports are commonly organized into the following sections, in order: letter of submittal, title page, summary, table of contents, introduction, discussion, conclusion, references, and appendices. Sections may be omitted as appropriate. In addition to report organization and content, this document addresses formatting tables and figures, writing style, and editing procedures. While there are many details of writing design reports that are not considered herein, this document provides a basic foundation for successful written communication of technical analyses and designs.

TABLE OF CONTENTS

Summary	ii
Introduction	1
Discussion	2
General Organization	2
Smaller Scale Organization	3
Tables and Figures	4
Writing Style	5
Editing	6
Conclusion	7

INTRODUCTION

Writing design reports is one of the most basic, yet often troublesome tasks a young engineer faces. This skill is primarily developed by practice and hard work. The more you write, the easier it will become. Do not underestimate the importance of a well-written and nicely formatted report. I am personally aware of one instance in which a consultants proposal was removed from consideration because it was not well written; the worth of the project was approximately \$1,000,000.00.

The first thing to do in writing a report is to asses your audience: is it primarily technical, or is it managerial. Technical audiences are interested in the quantitative details, thus these must be emphasized. Managers are more interested in effectiveness and costs, information that is used to make decisions. Often, your audience will be a mix of technical and managerial, which forces the writer to provide, in clearly marked sections, both the technical details and, for example, cost information.

In this document, report organization is first discussed, with a brief description of each typical section (including the Introduction). Examples of tables and figures are then presented. Following these are brief sections on writing style and the editing/revision process.

DISCUSSION

The discussion section of any report presents the “meat” of the analysis and/or design. It may be broken into several subsections, which neatly merge with the rest of the text; there may not actually be a section titled “Discussion” but there will be one or more sections that are discussion in every report. An expanded discussion on the Discussion section is provided subsequently. This section is broken into the following subsections: General Organization, Smaller Scale Organization, Tables and Figures, Writing Style, and Editing.

General Organization

Design reports may contain any or all of the following sections, and each of these may have sub-sections as appropriate for the topic:

- Letter of Submittal
- Title Page
- Summary
- Table of Contents
- Introduction
- Discussion
- Conclusion
- References
- Appendices

Each of these sections is addressed in turn.

Letter of Submittal. This section is not formally part of the report, but often accompanies the report to provide information not included in the report itself. Think of it as a “cover letter.” For example, the letter of submittal may describe the work chronology (initiation, interim goals, due dates), identify related reports (possibly previously submitted for the same project), contract information, and project contacts.

Title Page. This includes the name of the report, the names of authors and companies, addresses, and dates.

Summary. There are two types of summaries relative to engineering design reports: abstracts and executive summaries. Abstracts are usually written towards a technical audience, and may contain a few details of the analysis/design as well as select quantitative aspects of the results. Executive summaries are geared towards a managerial audience, thus contain few technical details, and focus on more general descriptions of the work performed, including effectiveness and costs.

Introduction. The introduction, in general describes the problem. It provides the background necessary to put the report in context, details the objectives of the work (defines the scope of work), and lists the *major* assumptions. It may also present alternatives, identify the preferred alternative, and present gross costs. It almost always ends with an outline of the rest of the report. In summary, the introduction provides information necessary for the reader to understand the discussion.

Discussion. This is essentially the body of the report. The design and supporting analyses are presented here. It usually is composed of several subheadings, depending on the project. For example, a discussion section may be composed of three distinct sections:

- Methodology
- Results
- Discussion

The methodology section would describe the analysis and/or testing methods, the results section would provide the results of those analyses and/or tests, and the discussion section would contain your interpretation of the results. The discussion section may present theory, analyze and interpret data, summarize results (using figures and tables), and identify problems, solutions, and limitations.

Conclusion. This may be a simple summary, or provide conclusions that provide insight into the problem as a whole. It, most importantly, contains an assessment of the results and design, including comments on costs. If multiple alternatives were considered, the preferred alternative is selected, with the reasons for the selection. If the design was implemented, the conclusion will describe how well it worked, and suggestions for improvement. The conclusion section may end with suggestions for future work, if appropriate.

References. All information derived from outside the report must be referenced. If the reference style is not specified, choose a major style and be consistent in its use. Note that in engineering, quotes are typically not appropriate; they should only be used if the original text would lose its meaning if paraphrased (think: poem).

Appendices. These contain raw data, detailed calculations, and other information that would “bog down” the discussion. There may be one for each of several topics.

Smaller Scale Organization

All reports have essentially the same structure: introduction, body (discussion), and conclusion. Each of these sections (and their subsections, if

any) also follows the introduction-body-conclusion structure. In fact, each paragraph tends to follow this structure as well: topic sentence (introduction), paragraph body, and transition sentence (conclusion). If these three “scales” of structure are followed when writing and editing a report, it is usually easy to follow.

Tables and Figures

Tables and figures are used to summarize large amounts of data and to give the reader an opportunity to visualize the results. Often, readers will concentrate on the “pictures,” thus each table and figure should stand alone to the extent possible.

Tables. Each table must have a descriptive, stand alone title, which is typically located *above* the table. Each table is numbered, and the table number is referred to in the text where it is fully described. Each table should appear in the text as soon as possible after its reference in the text. If notes are required to qualify the fields of the table, they appear beneath the table. The word “table” is capitalized; an example is provided in Table 1. Note that the table’s font should match the font of the text.

Table 1. Station weights for sub-basin GRUV2, located within the Big Sandy forecast group of the Ohio River Forecast Center.

Station	A_i (km²)	T_i	P_i (cm)	MAP_i (cm)	S_i	W_i
WV4408	21.05	0.034	112.47	119.83	1.07	0.036
WV3353	17.85	0.029	103.99	120.14	1.16	0.033
VA7997	15.91	0.026	111.02	121.01	1.09	0.028
VA4180	30.49	0.049	113.54	117.73	1.04	0.051
VA4078	26.60	0.043	108.56	119.71	1.10	0.047
VA3640	398.47	0.642	113.72	114.53	1.01	0.647
VA2269	110.28	0.178	109.14	115.60	1.06	0.188
		$\Sigma T_i P_i =$	112.29		$\Sigma W_i P_i =$	115.62

Figures. These may take on many forms, including pictures, maps, charts, graphs, and other images or visualization tools. Each figure must have a descriptive title, typically located *below* the figure (don’t have a title above, as Excel tends to do, and one below). Each figure is numbered, and the figure number is referred to in the text where it is fully described. Each figure should appear in the text as soon as possible after its reference in the text. Axes of graphs must be labeled, legends provided if necessary, and fonts should match the text. The word “figure” is capitalized in referring to it and in the title. An example is provided in Figure 1.

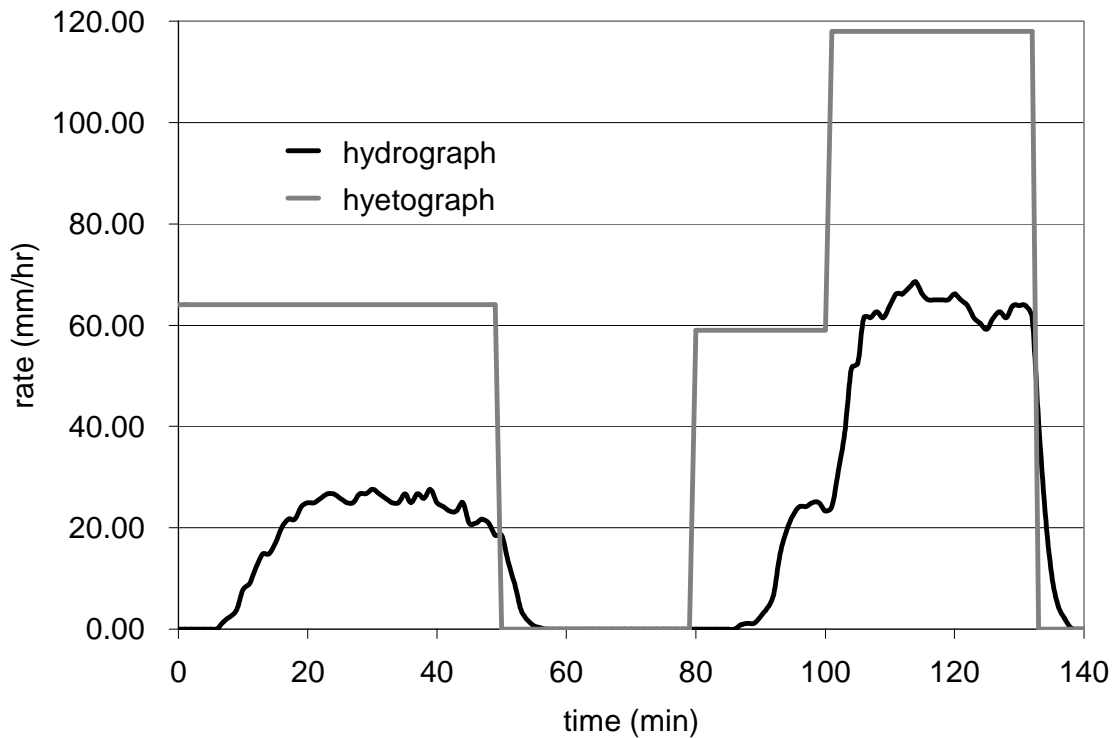


Figure 1. Rainfall hyetograph and corresponding runoff hydrograph for plot 23EP4, representative of heavy grazing pressure.

Writing Style

This sub-section presents a list of technical report writing considerations. Overall, you should strive to write simple, clear, and direct text. Never try to “pad” in an attempt to make it seem more impressive. Aim to be concise, clearly saying what needs to be said with a minimum number of words. The following should be viewed as suggestions rather than rules.

- Avoid the use of first person (I, we, us) – use third person instead.
- Use present tense only for things that will be true *now* and in the future.
- Avoid use of the passive voice, which is sometimes difficult in technical writing. Active: Jane wrote a report. Passive: A report was written by Jane.
- Omit needless words. For example, use “because...” rather than “because of the fact that...”
- Put statements in a positive form. “None of the integers were non-negative” versus “All of the integers were negative.”
- Avoid dangling comparatives and superlatives. “Mr. Sparkle gets your clothes cleaner.” Cleaner than what?

- Hyphenate compound adjectives (two or more words that modify a noun), except when the first ends in “ly.” For example, “steady-state discharge,” “10-m wide,” “that is a poorly designed building.”
- Equations should be numbered and offset from the text.
- Symbols and acronyms should be defined on first use; once defined, use the symbol or acronym rather than the full name.
- The word “affect” is a verb, and the word “effect” is a noun.
- The word “data” is plural. “These data show that the creek has been adversely affected by contaminants.”

Editing

Editing is hard work. In fact, you will usually spend more time editing substantial reports than writing the first draft. Editing takes practice and concentration. Read each sentence literally to determine what it really says, as (possibly) opposed to what you intended it to say. It helps to put the report away for a few days before editing. You should plan to perform at least three separate reviews (each of these may be repeated):

- Content and reasoning. Is there sufficient background? Is there adequate supporting information? Is the relevant theory included? Do the results make sense? Are the conclusions valid, and do they follow the results?
- Mechanics and organization. Are all of the necessary parts included, and are they appropriately structured? Are the objectives clearly stated? Does the report flow smoothly? Are all of the tables and figures referred to in the text, and are they correctly numbered?
- Spelling and grammar. Are all the correctly spelled words used correctly (check the spelling check)? Is each section, paragraph, and sentence effective? Do sentences vary in length (avoid monotony)?

CONCLUSION

There are many aspects to a good report. Once the audience and the stated requirements are identified, the general organization of the report can be created. An outline is helpful in this initial stage. As writing progresses, the writer should pay attention to the content and structure of each section, as well as each paragraph and sentence. Tables and figures are used to summarize and present results in a manner that is easy for the reader to ingest. It is important to consider the editing process to be as important as the initial writing. By following widely accepted report structure and writing styles, design reports can concisely present involved designs in a manner that is easily understandable to the designated audience. Remember that it is simple to make something simple seem complex; but it is both desirable and challenging to make something complex seem simple. A well-written report does the latter.