EVALUATION OF THREE ELECTRONIC REPORT PROCESSING SYSTEMS FOR PREPARING HYDROLOGIC REPORTS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

Gloria J. Stiltner, Editor

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MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

Office of Scientific Information Management
U.S. Geological Survey
Water Resources Division
445 National Center
Reston, Virginia 22092

Copies of this report can be
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Box 25425
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PREFACE

In 1987, the Water Resources Division of the U.S. Geological Survey undertook three pilot projects to evaluate electronic report processing systems as a means to improve the quality and timeliness of reports pertaining to water-resources investigations. The primary function of an electronic report processing system is to provide for page layout, which requires the user to specify page parameters and type specifications for all of the textual and graphics components that will appear in a report. Proposals were solicited from the Water Resources Division offices that prepare reports resulting from water-resources investigations and that were interested in participating in pilot projects.

The three projects selected for study included the use of the following configuration of software and hardware: Ventura Publisher[1] software on an IBM model AT personal computer, PageMaker software on a Macintosh computer, and FrameMaker software on a Sun Microsystems workstation. The following assessment criteria were to be addressed in the pilot studies: The combined use of text, tables, and graphics; analysis of time; ease of learning; compatibility with the existing minicomputer system; and technical limitations. It was considered essential that the camera-ready copy produced be in a format suitable for publication. Visual improvement alone was not a consideration.

Because the largest report workload in the offices conducting water-resources investigations is preparation of Water-Resources Investigations Reports, Open-File Reports, and annual State Data Reports, the pilot studies only involved these kinds of products. Ten U.S. Geological Survey Water-Resources Investigation Reports, 2 Open-File Reports, and an annual State Data Report were prepared using these electronic report processing systems during these pilot studies. This report consolidates and summarizes the findings of the electronic report processing pilot projects.

Gloria J. Stiltner

[1]The use of trade or firm names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

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87-4058 Geohydrology and Numerical Model Analysis of Ground-Water Flow in the Goose Lake Basin, Oregon and California, by David S. Morgan

87-4166 Hydrogeology of the Citrus Park Quadrangle, Hillsborough County, Florida, by Miguel A. Corral, Jr. and T.H. Thompson

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FL-87-4 Water Resources Data for Florida, Water Year 1987, Volume 4, Northwest Florida

CHAPTER A.--USE OF AN ELECTRONIC PAGE-COMPOSITION SYSTEM TO PREPARE CAMERA-READY COPY OF SCIENTIFIC REPORTS

By

Linda H. Geiger, Patsy R. Mixson, and Sherron D. Flagg

ABSTRACT

U.S. Geological Survey offices conducting water-resources investigations prepare camera-ready copy for about 1,500 abstracts and reports each year, which requires time-consuming collaboration among authors, cartographers, illustrators, typographers, and editors. Currently (1989), camera-ready copy for about 550 abstracts and reports is prepared using various word-processing software packages and desktop printers.

Three evaluations were conducted to assess the use of electronic page-composition systems to prepare camera-ready copy of reports pertaining to water-resources investigations. Electronic page composition was expected to result in reports that: (1) were less expensive to produce, and (2) were similar in typography and layout to typeset reports. The evaluations were conducted in the Florida (Tallahassee), Ohio (Columbus), and Oregon (Portland) offices of the U.S. Geological Survey, Water Resources Division. Each evaluation tested a different configuration of hardware and software.

In the Florida evaluation, the configuration used consisted of a personal computer with a full-page monitor, laser printer, word-processing software, and page-composition software. The scope of the Florida evaluation included comparing the preparation of camera-ready copy for a volume of the annual State Data Report and an Open-File Report using conventional methods and an electronic page-composition system.

Improvements in the preparation of camera-ready copy resulting from the Florida evaluation are:

- *Reusable templates that decrease the time spent on subsequent reports.*
- *Automatic preparation of table of contents, indexes, and page numbers that decrease the time spent on an individual report.*
- *Proportional-spaced printer fonts that decrease the number of pages per report, thereby decreasing printing costs. The greatest percentage decrease of pages in a report is realized in those reports having a large ratio of text to tables or graphics.*
- *Importing graphics decreases the coordination with an illustrator when preparing final copy of the report. Sizing and positioning of graphics and text on graphics can be changed without redrafting.*

INTRODUCTION

U.S. Geological Survey (USGS) offices conducting water-resources investigations prepare camera-ready copy for about 1,500 abstracts and reports each year, which requires time-consuming collaboration among authors, cartographers, illustrators, typographers, and editors. Currently (1989), camera-ready copy for about 550 abstracts and reports is prepared using various word-processing software packages and desktop printers.

Three evaluations were conducted to assess the use of electronic page-composition systems to prepare camera-ready copy. Electronic page-composition was expected to result in reports that: (1) were less expensive to produce, and (2) were similar in typography and layout to typeset reports. The evaluations were conducted in the Florida (Tallahassee), Ohio (Columbus), and Oregon (Portland) offices of the USGS, Water Resources Division. Each evaluation tested a different configuration of hardware and software. The configuration used in Florida consisted of Xerox Ventura Publisher (VP) software, WordMARC

Composer (WMC) word-processing software, an IBM PC/AT with Enhanced Color Display and 640 MB (megabytes) of system memory, an IMSI Opti Mouse, a Moniterm Viking I video display system, and a Hewlett-Packard LaserJet Series II desktop printer.

There were three participants in the Florida evaluation. Patsy Mixson represented the data-collection group and prepared Volume 4 of the annual State Data Report for Florida (U.S. Geological Survey, 1988) using the VP software. Sherron Flagg represented the reports-preparation group and prepared the sample Open-File Report using the VP software. Linda Geiger of the data-collection group served as evaluation coordinator and computer specialist.

The objectives of this evaluation were:

- Acquire and install hardware and software necessary for testing.
- Transfer files from the Prime minicomputer to the IBM PC/AT for Volume 4 of the annual State Data Report.
- Monitor time and costs required in producing each sample report using the WMC word-processing software.
- Monitor time and costs required in producing each sample report using the VP software.
- Compare costs and time required for each sample report.
- Compare the processing of reports using the two methods.
- Document results of the evaluation.

Purpose and Scope

The purpose of this chapter is to document the potential usefulness of preparing camera-ready copy of sample USGS reports using the VP software on an IBM PC/AT. Specifically, this chapter describes the hardware and software used, the training needed, a comparison of the time required to produce camera-ready copy of sample reports by conventional word-processing methods and the VP software, the estimated cost of producing each version of each sample report, and the technical issues associated with using the VP software.

Acknowledgment

Special thanks are extended to Eva Baker, USGS, Nashville, Tennessee, who provided scanned images graphics for testing. The scanned images were produced with a Princeton Graphics System LS-300 scanner using the PC Paintbrush option.

CONVENTIONAL METHODS AND COSTS

Currently the WMC word-processing software, revision 5.0, version 86.09.08C2, is used for producing text and tables on the IBM PC/AT. It is an easy-to-use, full-featured word-processing system. There are advanced report-preparation features such as a spelling checker, automatic hyphenation, and storage of the history of the report. The software will process a long report; assemble sections of the report into the final report; automatically number pages, tables, and graphics; automatically create the table of contents and the index; and add footnotes and cross references. The software also will reproduce complex mathematical equations.

Communication between the WMC word-processing software and the Prime minicomputer is provided by LincMARC, revision 3.1. LincMARC provides error-free file transfer to and from the Prime minicomputer and the IBM PC/AT. There are several options for file transfer. The -RAW option supports the transfer of Computer Graphics Metafile (CGM) and Hewlett-Packard Graphics Language (HPGL) file formats. Text files usually are transferred with no special LincMARC options. The current procedure for preparing camera-ready copy using the WMC word-processing software is to:

- Change from double-spaced to single-spaced text.
- Remove current page-end designations.
- Insert tables where they are introduced.
- Measure the size of graphics.
- Provide space for and insert graphics, and readjust for proper spacing.
- Type captions for graphics.

- Add new page-end designations.
- Add page numbers to table of contents, list of graphics, and list of tables.
- Print out camera-ready copy of each page in the report.

This procedure is based on the assumption that all text and tables have been typed using WMC, all corrections have been made, and the size and number of graphics are known.

For an average report of 80 pages, 7 tables, and 24 graphics, this procedure would take about 8 hours. About 4 hours of the 8 hours would be expended in placing and adjusting graphics in the text.

The cost of printing a page of text only is about $0.03 per page, and 300 copies of most reports are printed. The printing cost of an average report of 80 pages is about $720. Salary cost for this report would be about $58 on the basis of a basic hourly rate of $7.24 for 8 hours.

ELECTRONIC PAGE-COMPOSITION SYSTEM

Description

The following hardware was purchased for the evaluation:

1. BOCARAM/AT 128 K (kilobytes) expanded-memory board
2. IMSI Opti Mouse (serial mouse)
3. Moniterm Viking I video display system

The above items were added to a monochrome-display IBM PC/AT with 512 K of conventional memory to complete the hardware needed to test the VP software. Revision 3.0 of the disk operating system was used.

The Moniterm Viking I display system includes the Viking Portrait Monitor with 960 x 1,280-pixel resolution, paper-white phosphor, and an IBM PC/AT video controller with 2 MB of memory. This system served two purposes: (1) it provided a graphics screen, and (2) it provided a full-page layout screen to speed work with a report. (A full-page layout screen is not a mandatory item, but is extremely useful.)

The following software was purchased for this evaluation:

1. VP software
2. Desktop Publisher's Graphics (included in purchase of mouse) including EGA/CGA drivers, a Ventura driver, and a Moniterm Viking driver
3. Family of fixed-spaced fonts (Prestige)

The following additional software was used in testing the VP software:

- SUPERIMAGE, version 1.0, a PC/AT-based graphics software package, was used to produce CGM files for transfer to the VP software.
- TELLAGRAF, version 6.0, was used to produce HPGL files for transfer to the VP software. TELLAGRAF is installed on the Prime minicomputer.
- TELLAGRAF, Beta version 6.1, was used to produce CGM files for transfer into the VP software.
- WordMARC Composer Plus (WMC+), a word-processing software package that includes a program that converts page-composition commands in the WMC word-processing software into the corresponding page-composition commands of the VP software.

The VP software is an easy-to-use and powerful electronic page-composition package. This software currently accepts several word-processing formats. These include: WordStar US, WordStar UK, MultiMate, MS-Word, Writer US, WordPerfect, Writer G-1, and DCA. The VP software also accepts files in the American Standard Code for Information Interchange (ASCII) format. The format for the WMC word-processing software is not currently supported, therefore, WMC word-processing files were converted to the ASCII format and then were transferred to the VP software. (See "Other Testing.")

The user interface of the VP software includes pull-down menus, a mouse, keyboard shortcuts, and dialog boxes typical of other graphics software packages. The VP software, however, has an additional feature called the sidebar. The sidebar is a textual description of the user's purpose and location within the VP software and includes the function selector (purpose for being in the report), the addition selector (allows the user to add various items depending on the function selected), the assignment list (lists of files, tags, or other items depending on the function selected), and the current selection box. There are four function selections; frame setting, paragraph tagging, text editing, and graphic drawing.

The frame-setting function is used for manipulating frames that are the containers for text, tables, and graphics. Margin and column widths are frame attributes. The paragraph-tagging function is used for specifying paragraph attributes. There are many paragraph tags that are automatically available in the VP software, for instance–heading, footer, and body text, but the user can build his or her own according to need. The text-editing function is used to create and alter text and tables. The graphics-drawing function is used to create or modify graphics.

The VP software uses templates, (called style sheets) that are separate files containing the formatting rules for paragraph tags. This is a powerful feature. These formatting rules can apply to the overall page, such as margins and column specifications, or to some text on the page. For instance, all paragraphs tagged as body text will appear on the screen or be printed out using a specific screen or printer font.

A separate template can be set up for specific reports, and can be re-used. The templates can automatically reformat reports. For example, a template can be set up for a Water-Resources Investigations Report, and can be re-used for subsequent Water-Resources Investigations Reports, or a report with single-column text can be automatically converted to a multicolumn, serpentine text by loading a different template that specifies that format.

The VP software uses chapter files in building reports. A chapter file stores file names, locations and placements, frame information, starting page, chapter, table or graphic number, headers, footers, and footnote settings. The chapter file saves time because manual reloading of files, style sheets, and graphics is avoided.

Two types of fonts are used in the VP software: screen fonts and printer fonts. Because only a printer font was purchased for preparation of the annual State Data Report, there were times when tables were misaligned on the screen but printed correctly. This is somewhat annoying, but for this evaluation was not important enough to pursue the purchase of a matching screen font. Screen fonts are available through several companies.

The VP software provides an additional feature for tables consisting mostly of text. By use of a paragraph tag for each column and setting proper attributes for spacing and breaks, the software will recognize each column as a paragraph. This is valuable when modifying the text in the table. The text is automatically adjusted to the new changes and each column maintains left justification and alignment.

Installation

The VP software was installed on two separate IBM PC/AT's. The VP software installation consisted of reading in 13 or fewer diskettes (depending on hardware and software configuration) and took about 1 1/2 hours to install the first time. Some minor problems were encountered in discerning appropriate responses to the menu selections. Subsequent installations took 30 minutes or less.

The first attempt at the installation of the Viking Portrait Monitor took about 6 hours. The Viking Portrait Monitor was installed as a second display, in addition to the Enhanced Color Display of the IBM PC/AT. The IBM PC/AT system unit was inside a stand that had to be removed to install the control board of the monitor. Time also was allotted for labeling all cables and connections. The control board has four jumpers that needed to be adjusted. After the control board was installed, the monitor would not work. Moniterm technical personnel provided several alternatives that included replacing the first control board with a second (spare) board, testing the monitor, and using a "fine-tuning" adjustment on each control board. After several additional unsuccessful efforts, it was discovered that the installation instructions were written for the landscape monitor, not the portrait monitor.

Working less than full time on this installation, the monitor and the VP software were installed in about 10 working days. The installation of the second monitor took about 4 hours.

User Training

The VP software is a complex software package, but each individual task is easy to learn. Learning the fundamentals about the software can be completed in less than 2 days, but, because of its complexity, it takes about 6 weeks to become familiar with the software and to make selections using the mouse. The most difficult concept to master was paragraph tagging. There was not an adequate explanation about this topic in any reference.

Training materials provided or purchased were:

1. Xerox Desktop Publishing Series: VP Edition–Reference Guide

The reference guide contains setup and installation instructions for VP software as well as detailed information about the pull-down menus, the dialog boxes, and the four functions. The guide also contains a chapter of hints and tips. The appendixes include installation details, common problems, character sets and codes, printer information, and application notes. This informative book is more useful for the knowledgeable user than for a novice user.

2. Xerox Desktop Publishing Series: VP Edition–Training Guide with Publication Planning Workbook

The training guide contains a brief introduction to the VP software and includes various sections with exercises. It takes about 16 hours to complete all the exercises, but it isn't necessary to finish each exercise to know how to do specific tasks. About 8 hours, using the training guide, are needed to become familiar with the software, including use of the mouse. The publication-planning workbook was not used because most USGS reports have a standard format.

3. Xerox Desktop Publishing Series: VP Edition–Quick Reference

This booklet was used as a reference for the tables of alternate characters and keyboard shortcuts.

4. Inside Xerox Ventura Publisher, A guide to professional-quality desktop publishing on the IBM PC/AT, by James Cavuoto and Jesse Berst.

This book is very useful because it is written for the novice user. This book includes sections on traditional methods of publishing, an introduction to the VP software, creating text and graphics, templates, report design and layout, and producing camera-ready copy. There also are sections on advanced functions and special tips and techniques.

In addition to the training materials provided, Patsy Mixson, Sherron Flagg, and Linda Geiger attended the Long Documents Workshop offered by the Xerox Corp. This training consisted of 16 hours of instruction in the use of the VP software to manage and produce long reports.

The Xerox Corp. in Dallas, Tex., maintains a 24-hour telephone service to provide quick answers to problems encountered. All contacts with the technical-support staff resulted in helpful information. The contacts also were knowledgeable concerning other vendors' hardware and software used in conjunction with the VP software. The Xerox Corp. offers 60 days free support for new users; additional support can be purchased. The technical contact at the Xerox Corp. in Tallahassee, Fla., also was helpful as well as the technical contacts at the Moniterm Corp.

Interaction with the Prime Minicomputer

Word-Processing Software

The VP software contains a limited text editor. All of the word processing, therefore, is accomplished using the WMC software. Resulting files reside on the IBM PC/AT and are read into the VP software. The files are either created using the WMC word-processing software and are converted to ASCII format on the IBM PC/AT or are transferred from the Prime minicomputer using LincMARC. There is little change in this procedure between the current way of producing camera-ready copy and using the VP software.

Graphics Software

The VP software allows the integration of two types of graphics--line-art and images. Line-art refers to graphics created using object-oriented graphics programs and an image refers to those graphics created with bit-map graphics programs. The VP software (1988) supports eight object-oriented graphics programs: GEM Draw, Lotus 1-2-3, AutoCAD, Mentor Graphics, Macintosh PICT, VideoShow, and CGM- and HPGL-file formats. The VP software also currently supports 4 bit-map graphics programs: GEM Paint, PC Paintbrush, Macintosh MacPaint, and Desktop Publisher's Graphics.

Xerox also has added support for the Encapsulated Postscript (EPS) file. The EPS file provides a useful method for incorporating detailed images into the VP software. These images only can be printed on a postscript printer; they cannot be displayed on the screen. A large "X" appears on the screen where the image is located. Use of the EPS file was not tested in this evaluation. It was decided that the inability to manipulate the image, while using the VP software, precluded any serious testing at this time.

The integration of graphics and text using the VP software was successful with the following four graphics software:

- SUPERIMAGE, version 1.0--Use the "meta" option when invoking SUPERIMAGE. Create a graphic and print it using the "camera" option. This procedure creates a file that can be transferred to the VP software as a CGM file. SUPERIMAGE also can be used to create a GEM file that can be transferred to the VP software.

- TELLAGRAF, version 6.0--Produces a HPGL file that can be transferred to the VP software using a plotter as the primary device.

- TELLAGRAF, Beta Version 6.1--This version will produce a binary CGM file. That CGM file needs to be transferred to a utility called CGM2SI provided by SUPERIMAGE. The resulting CGM file can be transferred to SUPERIMAGE. Again, SUPERIMAGE needs to be invoked with the "meta" option, and the file printed out using the "camera" option. It can then be transferred to the VP software.

- Desktop Publisher's Graphics--Create a graphic; use the utility, CUTTOIMG, to produce an image file that can be transferred to the VP software.

Scanned images were needed for testing because the many drainage-basin maps showing locations of sites were not available in a format that could be transferred to the VP software. Scanned images were written to a diskette as a PC Paintbrush PCX file. When scanned images are brought into the VP software, an image file is created. When working with a large file, an entire 1.2-MB (megabyte) diskette may be needed for each scanned image. Scanned images were only tested for the annual State Data Report. Care needs to be taken when scanning the image, because the image cannot be manipulated after it is transferred to the VP software with the exception of adjusting size and position. By creating a separate frame, text can be added to the scanned image (fig. A-1).

Two files containing scanned images as PC Paintbrush PCX files were transferred using the File Transfer Service on the Prime minicomputer. There were no problems encountered in transferring the files and loading them into the VP software. Transferring files of 110,000 and 230,000 characters from the Prime minicomputer to the IBM PC/AT took about 35 minutes. Transfer times from the Prime node in Reston, Va., to the Prime node in Tallahassee ranged from 4 to 8 minutes. Transferring the files to the VP software took about 6 minutes. Printing the 230,000-character file took about 10 minutes.

TELLAGRAF files were transferred from the Prime minicomputer to the IBM PC/AT using LincMARC. They need to be transferred using the -RAW option of LincMARC to prevent translation from Primos to disk-operating-system format.

TELLAGRAF 6.0, produces an HPGL file that can be transferred to the VP software. The VP software, however, will not print the rotated (side-title) text from HPGL files. Because of this, all graphics for the annual State Data Report were scanned for transfer to the VP software. Rotated text can be printed using TELLAGRAF 6.1 CGM files.

The VP software supports four screen-capture programs; Frieze, HotShot, Snapshot, and Sidekick. These programs will produce files that can be transferred to the VP software. None of these programs

SPECIAL NETWORKS AND PROGRAMS

Hydrologic Bench-Mark Network is a network of 57 sites in small drainage basins around the country whose purpose is to provide consistent data on the hydrology, including water quality, and related factors in representative undeveloped watersheds nationwide, and to provide analyses on a continuing basis to compare and contrast conditions observed in basins more obviously affected by the activities of man.

National Stream Quality Accounting Network (NASQAN) is a nationwide data-collection network designed by the U.S. Geological Survey to meet many of the information needs of government agencies and other groups involved in natural or regional water-quality planning and management. The 500 or so sites in NASQAN are generally located at the downstream ends of hydrologic accounting units designated by the U.S. Geological Survey Office of Water Data Coordination in consultation with the Water Resources Council. The objectives of NASQAN are (1) to obtain information on the quality and quantity of water moving within and from the United States through a systematic and uniform process of data collection, summarization, analysis, and reporting such that the data may be used for, (2) description of the areal variability of water quality in the Nation's rivers through analysis of data from this and other programs, (3) detection of changes or trends with time in the pattern of occurrence of water-quality characteristics, and (4) providing a nationally consistent data base useful for water-quality assessment and hydrologic research. The NASQAN stations are shown in Figure 15.

The National Trends Network (NTN) is a 150-station network for sampling atmospheric deposition in the United States. The purpose of the network is to determine the variability, both in location and in time, of the composition of atmospheric deposition, which includes snow, rain, dust particles, aerosols, and gases. The core from which the NTN was built was the already-existing deposition-monitoring network of the National Atmospheric Deposition Program (NADP).

Radiochemical Program is a network of regularly sampled water-quality stations where samples are collected to be analyzed for radioisotopes. The streams that are sampled represent major drainage basins in the conterminous United States.

Tritium Network is a network of stations that has been established to provide baseline information on the occurrence of tritium in the Nation's surface waters. In addition to the surface-water stations in the network, tritium data are also obtained at a number of precipitation stations. The purpose of the precipitation stations is to provide an estimate sufficient for hydrologic studies of the tritium input to the United States.

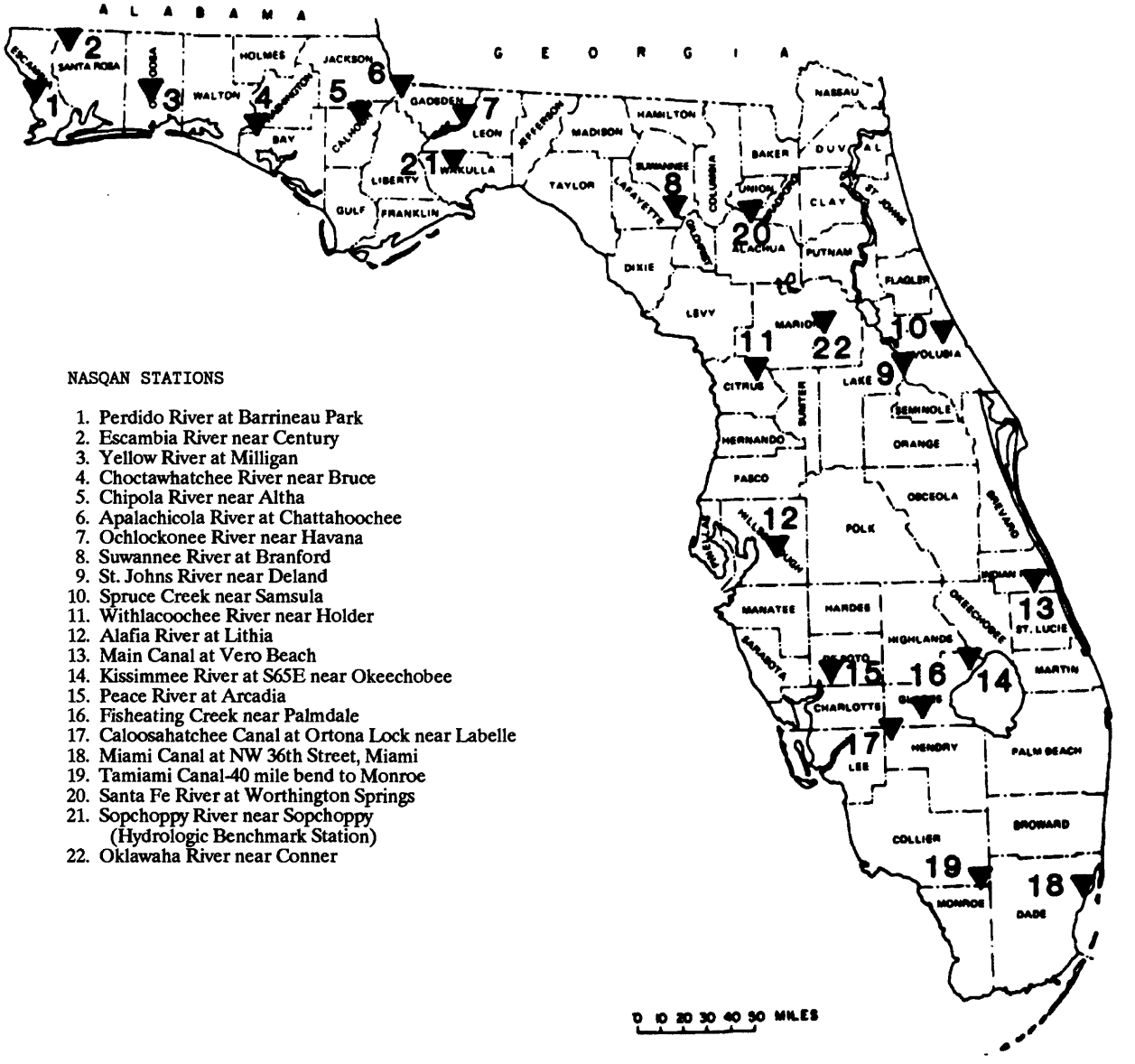

Figure 16.--NASQAN stations in the State of Florida.

Figure A-1.--Page 18 of the annual State Data Report showing a map that was scanned and transferred into the Ventura Publisher software; after the transfer, the list of stations was typed on a frame overlay.

were tested. Typically, resolution for screen-captured graphics is not adequate to meet publication standards of the USGS.

SAMPLE SCIENTIFIC REPORTS

Selection

Volume 4 of the annual State Data Report (U. S. Geological Survey, 1988), and an Open-File Report (Hathaway and McNellis, 1989) were selected for comparisons of processing time and cost. Each report was prepared from draft to camera-ready copy using the WMC word-processing software and also the VP software. Volume 4 of the annual State Data Report is a complex, 265-page report. It contains a table of contents, a listing of graphics with page references, a downstream order listing of sites with page references, a well listing by counties with page references, an introduction, definition of terms, a list of references, maps with site locations, station text and data tables, partial-record site data, miscellaneous well measurements, and an index. The annual State Data Report also contains 10 pages of hydrographs and 4 pages of scatter plots. The Open-File Report consists of text, 25 tables, 1 map, 85 flow charts, and 7 sets of supplementary data.

Comparison of Processing the Sample Reports Using Conventional Methods and the Ventura Publisher Software

For this evaluation, many of the steps for producing camera-ready copy were the same for the WMC and VP software. Text files were either created using the WMC word-processing software or already existed in the same format. The VP software was designed to be used with a word processor, and, therefore, the text-editing functions of the VP software are limited. This is a disadvantage of the software because it takes considerable time to leave the VP software, enter WMC software, make changes, and return to the VP software. There are shortcuts for this procedure, but a better text editor in the VP software would be beneficial.

The conventional procedure for preparing camera-ready copy using the VP software is to:

- Copy in tables where they are introduced.
- Tag paragraphs for tables.
- Measure the size of graphics.
- Provide space for graphics. A ruler is provided so no adjustment is necessary. If the graphic is computer generated by a graphics software package supported by the VP software, then space adjustment is automatic.
- Type captions for graphics.
- Add page numbers to table of contents, list of graphics, and list of tables. This step is based on the assumption that the table of contents and lists have already been typed using the WMC word-processing software and were not automatically produced using the VP software.
- Print out camera-ready copy of each page in the report.

The most time-consuming task is tagging the paragraphs for tables, which requires setting tabs for each column of the table. This takes about 5 minutes per table. Tagging is not necessary if a fixed-spaced printer font is used for the table. This procedure for an average report, defined previously, would take about 2 1/2 hours.

A comparison of the cost effectiveness of selected functions available in the WMC software and in the VP software for all report formats tested is summarized in table A-1. Cost effectiveness is defined as: (1) saving time by being quicker or less operator intensive, or (2) decreasing printing costs by decreasing the number of pages in the report. Further quantification of time saved would be misleading because of the variability of the typing skills of the user involved.

For a comparison of the keystrokes and time required using the WMC and VP software, see table A- 2. Testing determined that once templates were defined, subsequent reports similar to the first report were produced with fewer keystrokes and in a much shorter time.

For Volume 4 of the annual State Data Report, considerable time was saved in indexing and page numbering with the VP software. Although the WMC word-processing software has an indexing feature, it had never been used. Indexing using the WMC software is accomplished on a file-by-file basis. This is not practical with a report that consists of many files,

Table A-1.--*Cost effectiveness of selected functions in the WordMARC Composer and Ventura Publisher software*

[WMC = WordMARC Composer software, VP = Ventura Publisher software. Availability: Yes = minimal operator intervention; No = intensive operator intervention or not available; Lim. = limited, can be done within certain limitations, or it requires more than minimal operator intervention]

Function	Availability WMC	Availability VP	Comments
WMC more cost effective			
Search and replace text string	Yes	No	
Little or no difference between WMC and VP			
Underline selected text	Yes	Yes	
Deunderline text	Yes	Yes	
Print selected text in bold lettering	Yes	Yes	
Center text	Yes	Yes	
Indent first line	Yes	Yes	
Outdent first line (hanging indent)	Yes	Yes	
Nonbreaking spaces (keep two words together)	Yes	Yes	
Nonbreaking hypens	Yes	Yes	
Automatic hyphenation	Yes	Yes	
User controlled hyphenation	Yes	Yes	
Lift and right justified, and centered tabs	Yes	Yes	
Ruling line below text	Yes	Yes	
Release screen while printing (can work on other file while printing)	No	No	VP--Releases screen a few seconds (5-7) before printing is complete.
User controlled, automatic page numbering	Yes	Yes	
Footnotes stay with text	Yes	Yes	
Headers and footers	Yes	Yes	
VP more cost effective[1]			
Print selected text in capital letters	No	Yes	
Print selected text in italics	No	Yes	
Superscript a character	Yes	Yes	WMC--Type character by character.
Subscript a character	Yes	Yes	VP--Can do block of characters.
Keep paragraphs together	No	Yes	WMC--Requires manual page adjustment.
Enlarged view (screen is magnified)	No	Yes	Makes working with graphics easier.
Greek or symbol characters	Lim.	Yes	WMC--Type each character. VP--Can do block of characters.
Overstrike (cross out text with diagonal)	Lim.	Yes	WMC--Type character, depress auxilliary key, type o then diagonal, repeat. VP--Can do block of characters.
Overscore selected text (Opposite of underline, ruling line above text)	No	Yes	VP--Can do block of characters.

Table A-1.--*Cost effectiveness of selected functions in the WordMARC Composer and Ventura Publisher software--Continued*

Function	Availability WMC	Availability VP	Comments
Ruling line above text	Lim.	Yes	WMC--Actually an underline on line above paragraph.
Decimal tabs	Lim.	Yes	WMC--Doesn't have true reproduction of information shown on screen, decimal tabs aren't aligned on screen and must be printed out to see how they align.
VP is considerably more cost effective			
Simultaneous processing:			
Print out page currently shown on screen without exiting file	No	Yes	
Print out selected page(s) without exiting file	No	Yes	Being able to perform these functions from within a file saves considerable time
Print out entire report without exiting file	No	Yes	
Perform selected operations of the disk operating system within file	No	Yes	
Save (refile) report without exiting file	No	Yes	
Layout:			
True reproduction of information shown on screen	No	Yes	VP--99 percent true.
Reduced view (to see whole page)	No	Yes	This is invaluable for page layout if working on a screen that shows less than a full page.
Facing-pages view (to see layout of facing pages)	No	Yes	Extremely helpful for doing final layout.
Printing control:			
Print out alternating pages	No	Yes	Use these two VP functions to print out double-sided pages that are ready to bind if the report will not be sent to a commercial printer.
Print out from last page to first page	No	Yes	
Print out more than one file at a time	No	Yes	VP--Allows grouping several files together and will automatically number the pages.
Change printer font size within a page or a line	No	Yes	Smaller printer font results in in less space being needed for the information, extremely cost effective for large tables.

Table A-1.--*Cost effectiveness of selected functions in the WordMARC Composer and Ventura Publisher software--Continued*

Function	Availability WMC	Availability VP	Comments
Graphics:			
Insert space on page for graphic(s)	Lim.	Yes	WMC--Space for graphics can only be made by inserting carriage returns, breaking the page, or changing the format at least twice. Any changes are done manually. The page usually needs to be printed out to ensure that the space is adequate because it difficult to judge the size of the space on screen. After sizing of the space and text, the graphics are manually 'cut and pasted' on the page. VP--Create a frame (box) into which the text, table or graphic will be placed. There are rulers on screen to determine size and location of frame. Rulers can be shown in inches, centimeters, or picas. The frame can be moved easily. The frame can be 'anchored' to specific block of text (frame will always stay with the specified text, even if the text is moved.)
Insert space on page for small graphic, have text placed around the graphic	Lim.	Yes	
Move space assigned for a graphic around on page or to another page	Lim.	Yes	
Insert electronic-produced graphic on page with text	No	Yes	
Space control:			
Control size of graphic to fit available space on page	No	Yes	Frame can be enlarged or reduced to fit available space.
Eliminate single lines at bottom or top of page	Lim.	Yes	WMC--Limited by software default.
Proportional spacing	Lim.	Yes	VP--User controlled; allows more text on page, which means fewer pages.
Kerning	No	Yes	
Adjust space between paragraphs	Lim.	Yes	WMC--Can only be adjusted by adding or deleting carriage returns.

Table A-1.--*Cost effectiveness of selected functions in the WordMARC Composer and Ventura Publisher software--Continued*

Function	Availability WMC	Availability VP	Comments
Adjust space between words and characters	No	Yes	VP--Allows adjustment of space
Adjust space between lines within a paragraph	No	Yes	in fractional points, points and picas, centimeters, or inches. Being able to adjust space means being able to put more text on the page or being able to place the text on the page better and easier.
Editing:			
Make same paragraph characteristics change simultaneously more than once on a page	No	Yes	
Make same paragraph characteristics change simultaneously, more than once in a report	No	Yes	
Change characteristics of all similar paragraphs within a file (indent, outdent, spacing, type-face, printer font size)	Lim.	Yes	WMC--Each paragraph needs to be done manually and separately. VP--Change to one paragraph changes all.
Change from bold lettering to normal lettering	Lim.	Yes	WMC--Need to retype to return to normal lettering.
Tabs with leaders (such as table of contents with dots or dashes from entry, across page to page number	No	Yes	WMC--Leaders need to be typed manually. VP--Menu item, user can specify type of leader, spacing between leaders, and beginning and end of leaders. Changes are easy to make.
Bullets (paragraph is indented and has bullet at left margin)	Lim.	Yes	WMC--Needs to be done manually. VP--Menu item.
Mouse rather than keystrokes	No	Yes	Mouse is faster than keystrokes and less prone to error. VP allows user to program keys for many mouse movements if user prefers keystrokes.
Save file characteristics for use in subsequent files[2]	No	Yes	VP--Once the specifications of a of a report (such as an Open-File Report are established, all specifications are stored in a style sheet (template). Future reports with the same style can be easily produced.

Table A-1.--*Cost effectiveness of selected functions in the WordMARC Composer and Ventura Publisher software--Continued*

Function	Availability WMC	Availability VP	Comments
Function is esthetic rather than cost effective			
Change font size within a page	No	Yes	
Change font size within a line	No	Yes	
Ruling box around text	No	Yes	
Right-hand justification	Lim.	Yes	WMC does not accurately show what is shown on the screen.
Proportional spacing and right-hand justification	No	Yes	
Variable text alternating headers and footers	No	Yes	

[1]Some functions may be considerably more cost effective but rarely are used; therefore, cost effectiveness is not considered important.

[2]Probably the most cost-effective feature of the VP software. Processing of similar, subsequent reports should be four times faster.

Table A-2.--*Results of time trials comparing selected functions of the WordMARC Composer and Ventura Publisher Software*

[WMC = WordMARC Composer, VP = Ventura Publisher. Time: s = seconds, m = minutes]

WMC functions performed on IBM PC/AT screen (one-half page), VP functions performed on a Moniterm Viking screen (full page). The selected Open-File Report was prepared as camera-ready copy using both types of software. The selected report contained 1 map and 85 flow charts. These charts were prepared using the WMC software by using alternate characters to form horizontal and vertical lines and corners. The charts were prepared using the VP software by using the graphic function. The report was 54 pages long when prepared using the WMC software and 28 pages long when prepared using the VP software. The version of the report prepared using the VP software had fewer pages because: (1) proportional spacing allowed more text per page, and (2) flow charts could be reduced in size. Also, the text could be placed around the flow charts. After the time trials, the map and flow charts were removed from the report and a few functions were timed again. After removal of the map and flow charts, the number of pages in the two versions of the report were: WMC software, 39 pages; VP software, 22 1/2 pages. Both versions of the report had superscripts, subscripts, bold lettering, underlines, footnotes, footer files, and alternate (Greek) characters.

Function	Action required		Time required	
	WMC	VP	WMC	VP
	Version of report with map and flow charts			
(1) Load software from disk operating system	Type WMC, enter	Type VP, enter	11s	19s
(2) Open (load) report, if unsure of report name (search for name[1]	Cursor is on EDIT, enter, depress FILE key, move cursor to selection, enter	Move cursor to FILE, menu appears on screen, move cursor to OPEN CHAPTER, click mouse for list of chapters, move cursor to list, scroll down, move cursor to selection, click mouse	18s	1m 18s
(3) Open report, if name is known[1]	Cursor is on EDIT, enter, type file name, enter	Move cursor to FILE, menu appears on screen, move cursor to OPEN CHAPTER click mouse, type chapter name, enter	7s	1m 10s
(4) Go to end of report	Depress GOTO key, depress END key	Depress END key	21s	12s
(5) Go to beginning of report	Depress GOTO key, depress HOME key	Depress HOME key	19s	4s

Table A-2.--*Results of time trials comparing selected functions of the WordMARC Composer and Ventura Publisher Software--Continued*

Function	Action required		Time required	
	WMC	VP	WMC	VP
(6) Go to page within report (from beginning of report)	(Used page 25)--Depress GOTO key, type 25, enter	(Used page 20)--Depress CTRL and G keys, backspace twice, type 20, enter	11s	10s
(7) Go to page within report (from end of report)	(Used page 25)--Depress GOTO key, type 25, enter	(Used page 20)--Depress CTRL and G keys, backspace twice, type 20, enter	11s	3s
(8) File report (save), with no changes made[1]	Depress FILE key, type R, enter	Depress CTRL and S keys	26s	22s
(9) File report (save), new name save old[1]	Depress FILE key, type S, enter	Move cursor to FILE, menu appears on screen, move cursor to SAVE AS.., enter	26s	19s
(10) Print out entire report	Type P, enter, type P, enter enter	Move cursor to FILE, menu appears on screen, move cursor to TO PRINT, click on selection, enter	10m	12m 15s
(11) Print out one page within report	(Used page 25)--Type P, enter (will be on OPTIONS), enter, move cursor down three lines, type 25, move cursor down one line, type 25, enter, type P, enter	(Used page 20)--Move cursor to FILE, menu appears on screen, move cursor to TO PRINT, click on selected pages, enter, backspace twice, type 20, enter move cursor down one line, backspace twice, type 20, enter	50s	55s
(12) Unload software (go back to disk operating system	Type Q, enter	Move cursor to FILE, menu appears on screen, move cursor to QUIT, enter	2s	4s

Table A-2.--*Results of time trials comparing selected functions of the WordMARC Composer and Ventura Publisher Software--Continued*

Function	Action required		Time required	
	WMC	VP	WMC	VP
	Version of report with no map and flow charts			
(3) Open (load) report[1]	See function (3) above	See function (3) above	4s	5s
(4) Go to end of report	See function (4) above	See function (4) above	11s	8s
(5) Go to beginning of report	See function (5) above	See function (5) above	13s	3s
(6) Go to page within report (from beginning of report)	See function (6) above (used page 20)	See function (6) above (used page 11)	7s	7s
(7) Go to page within report (from end of report)	See function (7) above (used page 20)	See function (7) above (used page 11)	7s	4s
(8) File (save), no changes[1]	See function (8) above	See function (8) above	12s	10s
(13) File (save) after deleting graphics	Depress FILE key, type R, enter	Depress CTRL and S keys	13s	10s

[1]A report is filed in the WMC software as a "document", which is a simple text file. A report is filed in the VP software as a "chapter" and includes: one or more text files, a style-sheet file, a file with information about frames and graphics, the files containing the data for the frames and graphics, and a file with "pointers" to each file within the chapter. Opening a report using the VP software includes loading and opening all associated files; consequently, loading and saving take longer because there are more files and the files are more complex. Note the differences in the time required for function (3) for the two versions of the report. The version of the report without the graphics was loaded faster than the one with the graphics because there were fewer associated files and the files were less complex. Also note that even though the initial loading of a report takes longer using the VP software than it does using the WMC software, it is possible, using the VP software, to save changes to the report without unloading the file. A conscientious user will save the changes often (every 20 to 30 minutes). When using the WMC software, the user has to exit the file, save the changes, reload the file, then go to the correct page. When using the VP software, the user just saves the changes; the report and current page remain loaded and on the screen.

such as Volume 4 of the annual State Data Report. Initially, the index (fig. A-2) took 2 days to produce manually and 2 hours to produce using the VP software. All sites within a drainage basin composed a chapter and all the chapters were included to make a publication. The publication feature of the VP software consolidated the smaller files making automated indexing possible. Subsequent indexing using the VP software took as little as 45 minutes for the annual State Data Report. In previous years, page numbers were manually added to the pages of Volume 4 of the annual State Data Report. The VP software automatically added page numbers to the report, which saved several days work.

The ability of the VP software to automatically produce a table of contents also saved time. When using the VP software, items to be listed in the table of contents are identified through the use of paragraph tags. Several listings similar to the table of contents also can be made for one report. For Volume 4 of the annual State Data Report, the table of contents feature (fig. A-3) was used to create a table of contents, a downstream-order listing of stream-gaging stations, and a listing of wells published in the report. Producing multiple listings for a report is not a function available in the WMC word-processing software; such listings were produced manually in previous years. To produce the table of contents or other listings took about 45 minutes each. To produce them manually took 2 or more days for each listing.

The sample Open-File Report contained superscripts, subscripts, bold lettering, underlines, footnotes, footer files, hanging indents, and alternate (Greek) characters. The graphic in the report other than the 85 flow charts was a full-page, manually drawn map, and was manually added to both versions of the report. The version produced using the WMC software consisted of 297 pages. That produced using the VP software consisted of 180 pages. The version produced using the VP software had fewer pages because: (1) proportional spacing allowed more text per page, (2) flow charts could be reduced, and (3) text is automatically placed around flow charts. The number of pages that comprise the text and supplementary data sections in both versions of the sample Open-File Report are listed in table A-3.

Testing determined that use of the VP software resulted in an average decrease of 25 percent in the number of text pages for reports containing 20 to 30 pages of text. The percentage decrease per report was variable, dependent on the number of pages of text versus number of pages of tables or graphics, whether the tables or graphics were reduced, and if text was placed around the tables or graphics. In general, reports having a large percentage of text to tables or graphics will have the greatest percentage decrease in the number of pages. The decrease in printing costs would be about $45 per report of this size. This decrease in printing costs would increase as the number of text pages per report increased.

ADDITIONAL APPLICATIONS OF THE VENTURA PUBLISHER SOFTWARE

Other materials, such as text and tables for map reports; slides (figs. A-4 and A-5); graphics (figs. A- 6, A-7, and A-8); and other Water-Resources Investigations Reports, such as that by Irwin and McKenzie (1988), have been produced using the VP software. The current procedure for map reports is to have some text and tables typeset by a contractor. This procedure, which includes re-keying the text, typesetting, and proofing, takes about 1 1/2 weeks at a cost of $400 to $500. By using the VP software, the text and tables were produced in about 1 1/2 hours. Traditional methods take from 1 1/2 to 3 1/2 hours for a typical job of 14 slides. By using the VP software and changing typestyles took about 1/2 hour. A typical Water-Resources Investigations Report (64 pages, 18 graphics, and 4 tables) took about 2 1/2 days to produce using the VP software. This included setting up the style sheet. Subsequent water-resources investigations reports took less time, as few as 2 hours for one such report.

TECHNICAL ISSUES

In working with Volume 4 of the annual State Data Report, about 2 months were spent in various attempts at producing the variety of data tables using proportional-spaced printer fonts provided in the VP software and paragraph tagging. Although this was accomplished, it was deemed too time consuming. A fixed-spaced printer font was purchased for preparing the data-report tables because it maintained proper column alignment. It was decided only the textual material in the report would use the proportional-spaced fonts. The annual State Data Report consists of many types of data tables with formats that change from year to year, as is the case with water-quality data tables. Because of the current format of one data table per page for hundreds of pages, proportional-spaced fonts would not decrease the number of pages per report.

Figure A-2.--Page 264 of the annual State Data Report created by indexing feature of Ventura Publisher software.

[Letters after station names designate type of data: (d) discharge, (c) chemical, (b) biological, (m) microbiological, (s) sediment, (t) temperature, (e) elevation, gage heights, or contents]

Figure A-3.--Page X of the annual State Data Report created by the table of contents feature of the Ventura Publisher software.

CONCEPTUAL MODEL FOR THE PARTITIONING OF EDB IN THE SUBSURFACE

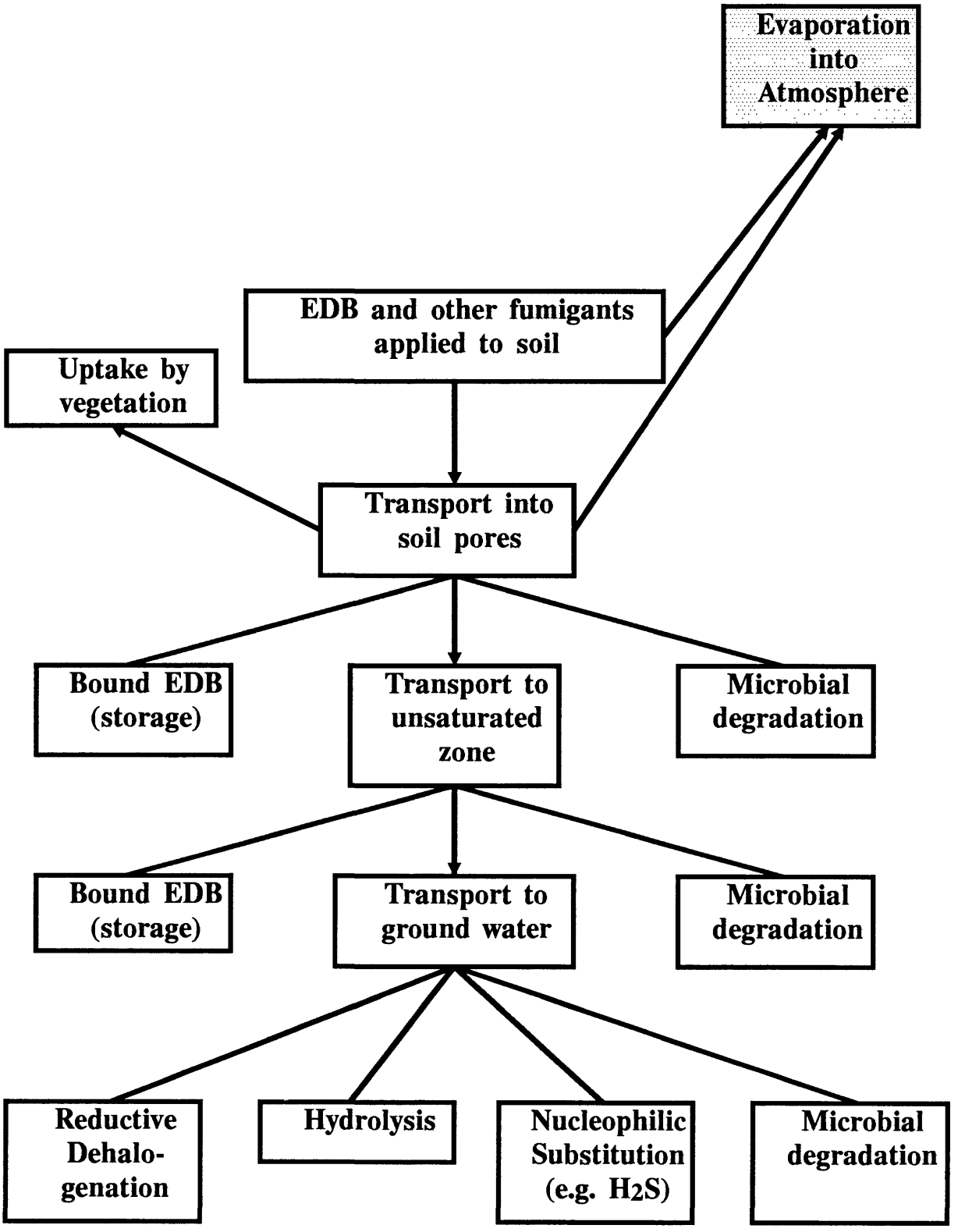

Figure A-4.--Sample of a word and line slide made using the Ventura Publisher software.

SCOPE OF STUDY

ALL PRINCIPAL AQUIFERS IN FLORIDA ARE INCLUDED:

FLORIDAN AQUIFER SYSTEM

SAND-AND-GRAVEL AQUIFER

BISCAYNE AQUIFER

SURFICIAL AQUIFER SYSTEM

INTERMEDIATE AQUIFER SYSTEM

WATER-QUALITY DATA USED IN HYDROGEOCHEMICAL CHARACTERIZATION:

DER AMBIENT MONITORING NETWORK

HEALTH AND REHABILITATIVE SERVICES (HRS) PRIVATE DOMESTIC WELL SURVEY

HISTORICAL DATA COLLECTED BY U.S. GEOLOGICAL SURVEY

Figure A-5.--Sample of a word slide made using the Ventura Publisher software.

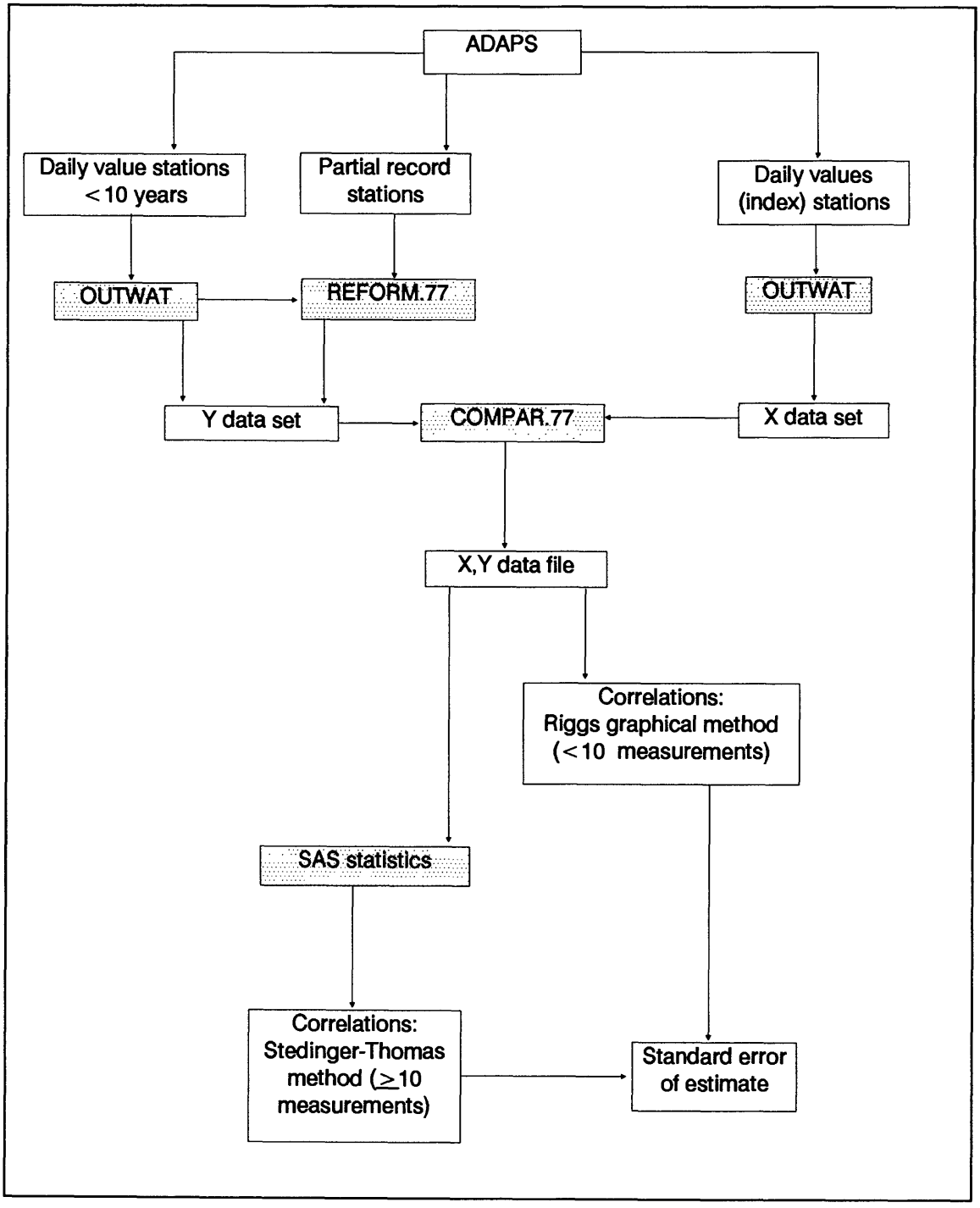

Figure A-6.--Sample of a flow chart made using the Ventura Publisher software.

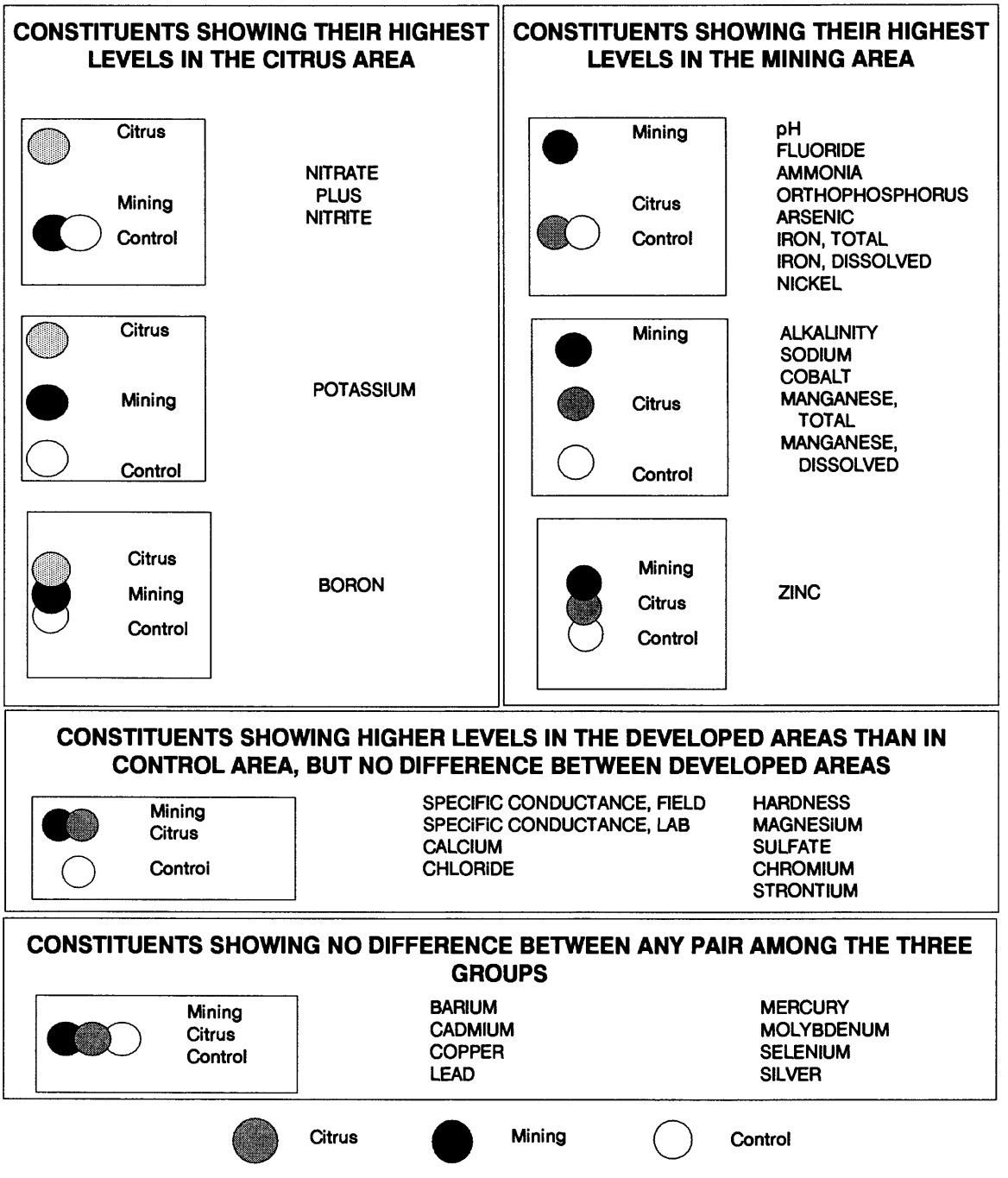

Figure A-7.--Sample of a moderately complex graphic made using the Ventura Publisher software.

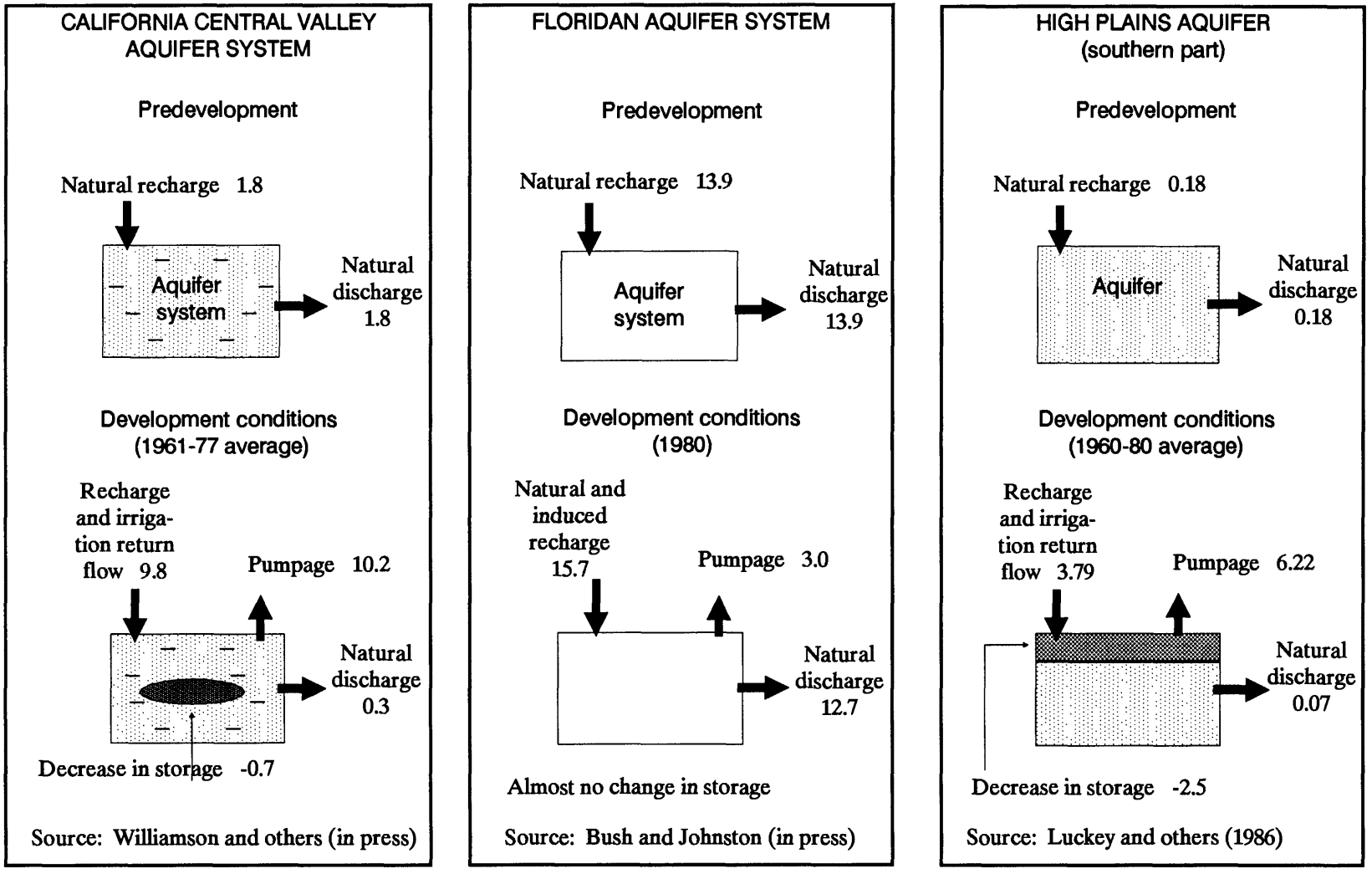

Figure A-8.--Sample of a complex graphic made using the Venture Publisher software.

Table A-3.--*Number of pages comprising the sample Open-File Report produced using the WordMARC Composer and Ventura Publisher software*

[WMC, Wordmarc Composer software; VP, Ventura Publisher software; SD, supplementary data section]

Part of report	Total number of pages		Number of flow charts	Number of tables	Number of table pages	
	WMC	VP			WMC	VP
Text	29	23	0 (1 map)	7	9	9
SDI	1	1	0	0	0	0
SDII	45	25	7	9	4 1/2	4 1/2
SDIII	40	26	9	3	11/2	1 1/2
SDIV	64	38	18	6	9	6
SDV	59	35	11	0	0	0
SDVI	54	28	40	0	0	0
SDVII	5	4	0	0	0	0

The VP software does not produce fractions easily, requiring a manual three-step process. Fractions are most efficiently handled by preformatting the file using the WMC software. This consists of entering paragraph tags, fonts, or text attributes directly into the file using the WMC software before the file is converted to ASCII file format, and transferred to the VP software.

When working with any type of tables other than those in an annual State Data Report, it is best to use soft instead of hard carriage returns to delineate the end of a line. A hard carriage return signals a paragraph end, and as such, stores paragraph information. A soft carriage return does not. This decreases the complexity of a page and requires less paragraph tagging.

The memory requirements for the VP software can be divided into three categories: system, frame, and page memory. For system memory, 640 K is required. This total is decreased by:

- The disk operating system; disk operating system, version 3.0, uses about 60 K.
- Any drivers present in the CONFIG.SYS file.
- Any RAM-resident utilities and desk accessories.
- The hyphenation-exception dictionary.
- Font descriptions in the currently active width table; this can be as much as 35 K.
- The VP software.

The VP software places a limit on the memory that is available for formatting one frame. As this limit is approached, the message "This frame is too complex to completely format" will be displayed. This memory limitation was attained when formatting the data tables for the annual State Data Report using one frame for a page and a proportional-spaced font. The use of many tab settings, columns, leaders, or lines of text rapidly increases the memory necessary for the frame. In this instance, further testing proved that a fixed-spaced font needs to be used for the data tables. Another solution is to split a page-size frame into smaller frames. The allowable memory for any given page can be doubled (two frames) or tripled (three frames).

The VP software places a limit on the number of lines on a page. This limit may be exceeded when using multicolumn text and a small point size for the typeface. This limit was not exceeded during the preparation of either sample report. The smallest point size tested was 7.

The discretionary use of tabs, carriage returns, tags, and leaders will help avoid exceeding memory restrictions. There is an informational dialog

box containing a number indicating the remaining external memory available and a number indicating the remaining number of line elements available. Monitoring of these numbers will warn a user when a memory limit is about to be exceeded.

OTHER TESTING

The "Ventura filter" option in the Beta version of WMC+ also was tested. This option converts many of the codes used in WMC+ to those recognized by the VP software. This filter is a valuable addition to WMC+ for those using the VP software. The VP software will not accept the WMC+ code for centering or those codes that overprint a character, such as overscore, but the option converts all other codes, including superscripts and subscripts.

SUMMARY AND CONCLUSIONS

The Florida evaluation assessed the use of Xerox Ventura Publisher software on an IBM PC-AT, which included installation of hardware and software, use of training guides provided, and the monitoring and comparison of time and costs required in producing two sample reports (a volume of the annual State Data Report and an Open-File Report) using conventional methods and the Ventura Publisher software. In addition the Ventura Publisher software was used to prepare text and tables for map reports, slides, graphics, and Water-Resources Investigations Reports.

The Ventura Publisher software is completely compatible with existing hardware and software, faster, and more cost effective than the conventional methods of preparation of camera-ready copy for scientific reports. Formats can be re-used; this results in a production time for subsequent, similar reports that is four times faster than that for the initial report. The number of features provided in the VP software minimizes manual intervention and outside involvement. This is especially true for graphic production. The availability of proportional-spaced fonts decreased the number of text pages by about 25 percent for a typical report except for the volume of the annual State Data Report. This percentage increases linearly with the size of the report to as much as about 50 percent.

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CHAPTER B.--EVALUATION OF A USER-FRIENDLY ELECTRONIC REPORT PROCESSING SYSTEM FOR PREPARATION OF SELECTED REPORTS

By

Michael Eberle

ABSTRACT

An evaluation of a user-friendly electronic report processing (ERP) system showed that the system is easy to install and learn, readily transfers text data files to and from a minicomputer located in the same office, and adequately performs most of the text-processing and page-layout functions needed to prepare camera-ready copy for selected reports of the U.S. Geological Survey, Water Resources Division. The preparation of camera-ready copy of text and tables for two sample reports by use of the ERP system, however, took about four times longer than preparation of the same text and tables by use of a conventional word-processing system.

The evaluation, which was conducted by the Ohio (Columbus) office of the U.S. Geological Survey, was one of three evaluations that addressed basic questions of cost effectiveness and technical feasibility of introducing ERP systems for applications where use of conventional word-processing techniques has been the norm. The ERP system tested in the Ohio office consisted of a Macintosh SE computer equipped with a 20-megabyte internal hard disk; an Apple LaserWriter printer; PageMaker page-layout software (version 2.0a; version 3.0 was not available during most of the evaluation); and ancillary terminal-emulation, word-processing, and graphics software. The conventional word-processing system consisted of IBM-compatible microcomputer (also with a 20-megabyte internal hard disk), a 55-character-per-second strike-on printer, and WordMARC word-processing software.

An important assumption in the evaluation was that the ERP system should readily transfer text files to and from the network of minicomputers already in place. To test for transferability, all text and table files for the sample reports were transferred from the minicomputer colocated in the Ohio office to the ERP system in American Standard Code for Information Interchange format. Selected files also were transferred from the ERP system to the minicomputer.

For both sample reports prepared with the ERP system, text and table processing time was about equally divided between formatting of American Standard Code for Information Interchange format files for transfer to the PageMaker software and on-screen page layout; however, the shorter of the sample reports (which was entirely in a two-column format) took twice as long per page to complete as the longer report (which contained about 50 pages of data tables in a fixed-space font in single columns).

Evaluation of graphics was restricted to how well PageMaker imported files in MacPaint format, PICT format, and Tag Image File Format could be transferred to the PageMaker software. Time and cost comparisons of ERP and conventional illustration-preparation techniques were not feasible. In general, graphics generated with the Macintosh-based software in all of the above-mentioned formats were transferred satisfactorially. Attempts to use images saved from the Macintosh screen in MacPaint and PICT formats, however, resulted in graphics characterized by garbled text and insufficient resolution for publication.

INTRODUCTION

A Macintosh-based, user-friendly electronic report processing (ERP) system was evaluated in the Ohio (Columbus) office of the U.S. Geological Survey (USGS), Water Resources Division, to determine its usefulness for preparing camera-ready copy of selected reports that are published by USGS offices conducting water-resources investigations. The evaluation was one of three evaluations of ERP systems conducted in similar USGS offices; the other evaluations were conducted in the Florida (Tallahassee) and Oregon (Portland) offices of the USGS.

Different combinations of hardware and software were assigned to the study teams for evaluation. The Macintosh-based system, which was evaluated by the Ohio office, was of interest because of the importance of Macintosh computers in the development of

electronic report processing, and the large number of these computers that are being used throughout the country.

Considerable latitude was given to each of the study teams in the design of their respective evaluations. The intent was to compare a variety of approaches to ERP, not necessarily to strive for complete uniformity between evaluations.

Purpose and Scope

The purpose of this chapter is to present the results of the Ohio evaluation of the Macintosh-based ERP system and discuss its potential usefulness for preparing camera-ready copy of selected reports of the USGS, taking into account other computer hardware and software common to USGS offices conducting water-resources investigations, prevailing specifications for locally produced reports, and assumptions for the evaluation as described herein. Specifically, this chapter describes the hardware and software used in the Ohio evaluation, the approach of the evaluation, ERP system and conventional word-processing methods, estimates of printing costs for each version of two sample reports, and technical limitations encountered with the ERP system.

Acknowledgments

Thanks are due to Carl Best of Micro Center, Columbus, Ohio, for advice on selecting and purchasing the hardware and software, and to Andrea Ardito, now with Foremost Computer Systems, Columbus, Ohio, for tutorial assistance.

APPROACH TO THE EVALUATION

The Ohio evaluation was designed to test the viability of a ERP system having minimal computing power in a small-office environment. Reports produced by the USGS Ohio office are typified by short reports in the Water-Resources Investigations Reports (WRIR) series.

I (the evaluator) was the only person substantially involved in the design or implementation of the Ohio evaluation. Although knowledgeable about the functions of several word processors and comfortable with doing simple file transfers between computer systems, I had little additional experience with computers, no experience with Macintosh hardware, and limited knowledge of ERP systems. The evaluation, therefore, also was an effective test of how well the documentation accompanying the hardware and software could lead a novice user to a working knowledge of the applications of interest.

Major offices of the USGS that conduct water-resources investigations are linked by means of a network of Prime minicomputers in a nationwide distributed information system. Because this network is the principal means for interoffice data-file transfers and because local Prime minicomputers serve as important text-, table- and graphic-processing tools for many authors, the ease of communications and the compatibility of software between the ERP system and a local Prime minicomputer was a foremost consideration in the technical evaluation. Thus, it was planned that the original text and tables for the sample reports, and at least some of the graphics, should originate on the Prime minicomputer in the Ohio office and be transferred to the ERP system. Transfer of text files from the ERP system to the Prime minicomputer also was to be demonstrated.

Because the intent of the evaluations was to compare the costs of producing comparable book reports using conventional word-processing equipment and the costs of using the ERP system, several measures were taken to minimize the human factor and to avoid giving either system an unfair advantage. First, only one person (the evaluator) was involved in hands-on production of the sample reports. Second, the conventional word processing, as well as the ERP work, was done on an IBM-compatible microcomputer with its own printer, even though considerable word processing in the Ohio office is done directly on the Prime minicomputer. Third, the files transferred to the conventional word processor were in American Standard Code for Information Interchange (ASCII) format, even though it would have been possible to transfer the files in such a way as to preserve all of the word-processor's document-formatting codes.

The conventionally produced report was done in a single-column, single-spaced format that conforms to standards of the USGS. A two-column format similar to that used in USGS Water-Supply Papers was designed for the ERP versions of the sample reports.

Description of the Electronic Report Processing System

Hardware

The hardware for the ERP system consisted of a Macintosh SE and extended keyboard with a 3.5 inch floppy-disk drive, a 20-MB (megabyte) internal hard disk, an Apple LaserWriter printer, and cable kits. An additional RS-232 modem cable was needed to connect the Macintosh to the Prime minicomputer through the Macintosh modem port. Connection of all components was a simple matter of connecting the cables to the components. No modification of cables was necessary.

Specifications for the Macintosh SE purchased for the Ohio evaluation (as configured in late 1987) are presented in table B-1. The Macintosh SE was chosen over the newer and more powerful Macintosh II, partly because I was interested in testing a smaller, less expensive system and partly because of reported software-compatibility problems at that time.

An excellent overview of the Macintosh computers is provided by Lu and Chu (1988). Bove and others (1987) discuss the role of Macintosh computers in providing affordable hardware and making possible the desktop level of ERP. The Macintosh computer, which was introduced in 1984, is characterized by a pictorial approach to manipulation of data and liberal use of a mouse as an alternative to typed commands. The hierarchical file-management system of the computer is controlled by the "Finder" systems program. Files typically are created by means of applications programs, although files can be copied, renamed, moved, and deleted at the systems program level. Once an application program has been used to create files, that program can be activated by selecting any file it has created. Thus, it is unnecessary to first load the application program and then specify the file to work on. The application works within the folder of the file of origin, but switching to another folder is easy.

System backups from the hard disk to the 3.5- inch disks are possible by use of the HD (hard drive) backup utility, which comes with the computer. HD backup enables global backup, incremental backup since last global backup, or backup of large single files to multiple 3.5-inch disks.

The Apple LaserWriter printer, (the basic LaserWriter is no longer manufactured) used in combination with the Macintosh, supported PostScript page-description language and came with four resident font families (Helvetica, Times, Courier, and Symbol). Specifications for the LaserWriter are presented in table B-1.

Software

Word Processor

Microsoft Word (for Macintosh), version 3.01, was selected as the word processor. Many format features of Microsoft Word can be transferred into the PageMaker software.

Microsoft Word operates primarily from menus, but many (not all) of the menu commands have keyboard equivalents, which are mnemonic only for the most commonly used functions. For commands involving choices, such as the Print command, a dialog box showing the various options appears on the screen (fig. B-1).

The position and size of the image area on the page is controlled by the Page Setup command (fig. B-2). Page formatting within the image area is controlled by a ruler line that can either be hidden or displayed. The ruler line (displayed in fig. B-3) is used to set position and types of tabs, indentions, and margins within the image area; the ruler line also is used for paragraph alignment, line spacing, and paragraph spacing. Size and style of type can be set not only from the Format and Font menus, but also by use of the Character command (fig. B-4; most appropriate for single characters or short character strings) and the Styles command (fig. B-5; most appropriate for headings or other text elements common to numerous reports of the same predefined format).

Documentation.–Consisted of two parts: *Learning Microsoft Word* (Microsoft Corp., 1987a), a 151-page volume that contained a tutorial and general beginner's information, and the encyclopedia-style *Reference to Microsoft Word* (Microsoft Corp., 1987b), a 458-page volume that discussed individual features in detail. There was little redundancy between volumes.

Default settings.–Preset defaults (listed in detail in the *Reference to Microsoft Word*) produce a report with the text in 12-point type within a 6- by 9-inch image area. Defaults are easily changed by modifying the image area with the Page Setup command, redefining the Normal type style with the Define Styles command, and setting ruler-line options before entering text.

Table B-1.- *-Specifications for Macintosh-based electronic report processing system*

[MHz, megahertz; MB, megabytes; RAM, random-access memory; K, kilobytes; ROM, read-only memory]

HARDWARE
Macintosh SE and extended keyboard
Processor: 7.8336-MHz MC68000 with 16 input/output bits and 32-bit internal processing.
Memory: 1 MB RAM (expandable to 4 MB), 256 K ROM, and 256 bytes of user-settable parameter memory.
Disk drives: 800-K, double-sided, 3.5-inch floppy disk and 20-MB internal hard disk.
Apple LaserWriter
Marking engine: Canon LBP-CX.
Controller: 12-MHz MC68000 processor with 1.5 MB RAM and 0.5 MB ROM.
Duty cycle: As many as 4,000 pages per month.
Print quality: All text and graphics at 300 dots per inch.
Speed: Eight pages per minute maximum throughout.
SOFTWARE
Word processing
Microsoft Word (for Macintosh), version 3.01; Microsoft Corp.
Page layout
PageMaker, version 2.0a; Aldus Corp.
Terminal emulation
VersaTerm-PRO, version 2.1; Abelbeck Software
Graphics
Cricket Draw, version 1.1; Cricket Software
SuperPaint, version 1.0p; Silicon Beach Software

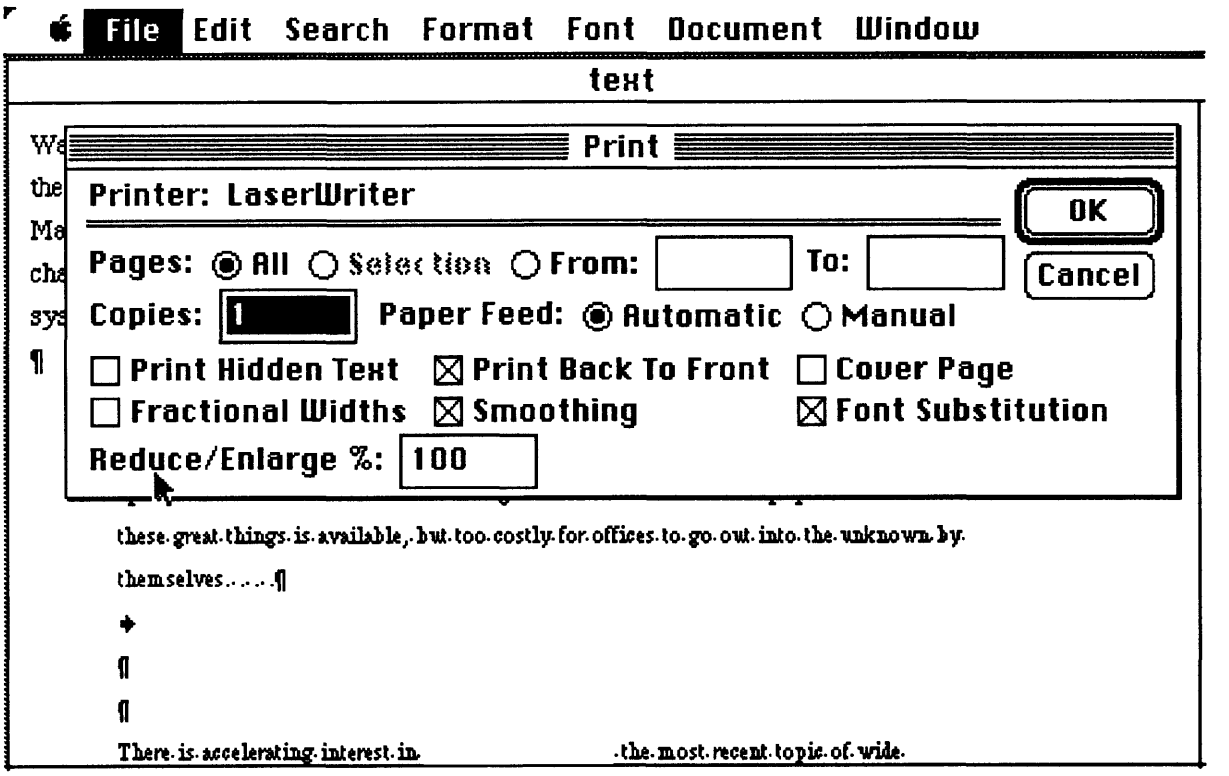

Figure B-1.--Example of dialog box for Print command in Microsoft Word.

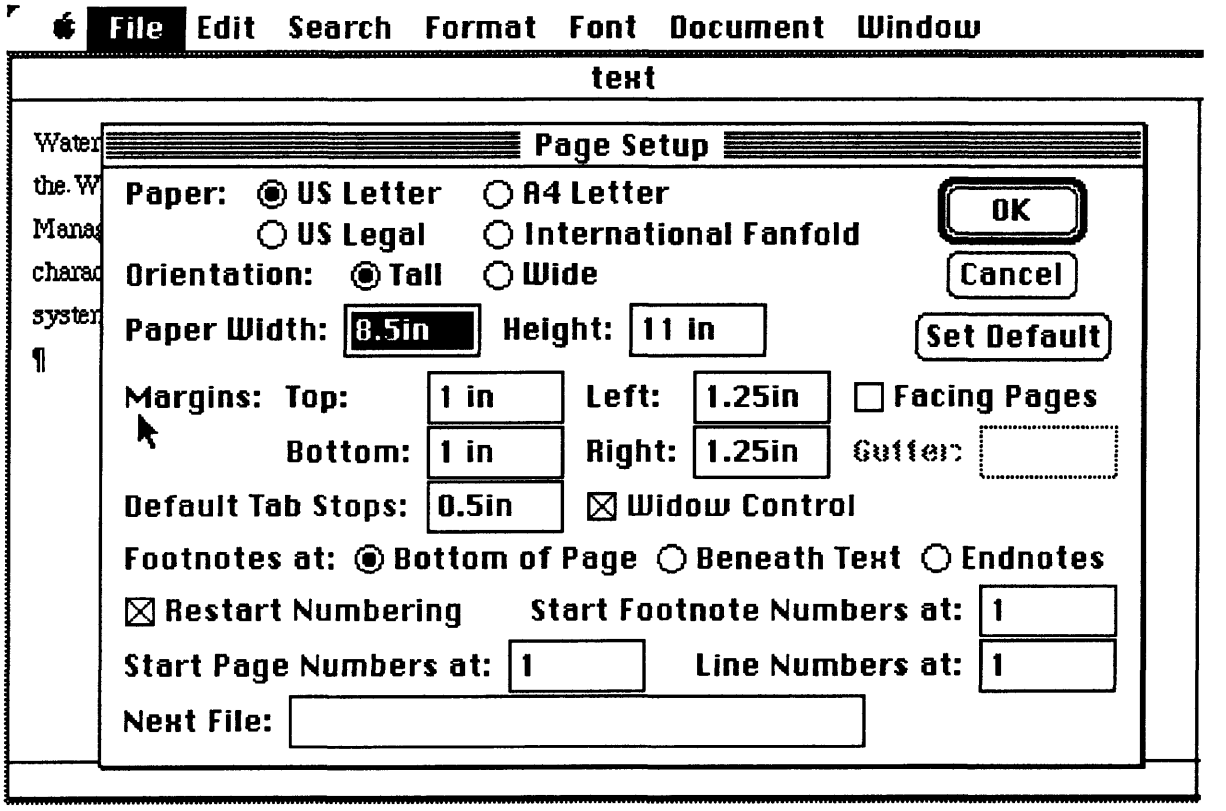

Figure B-2.--Example of dialog box for Page Setup command in Microsoft Word.

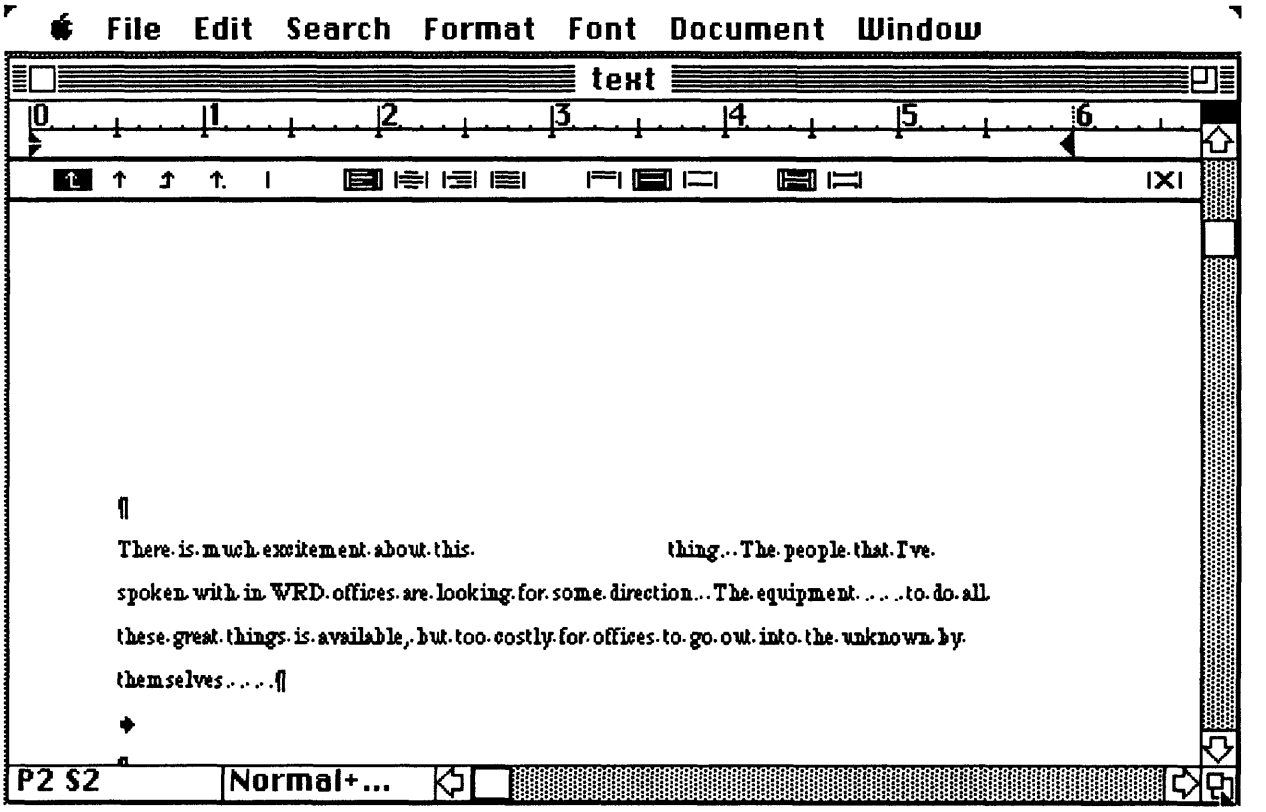

Figure B-3.--Example of displayed ruler line in Microsoft Word.

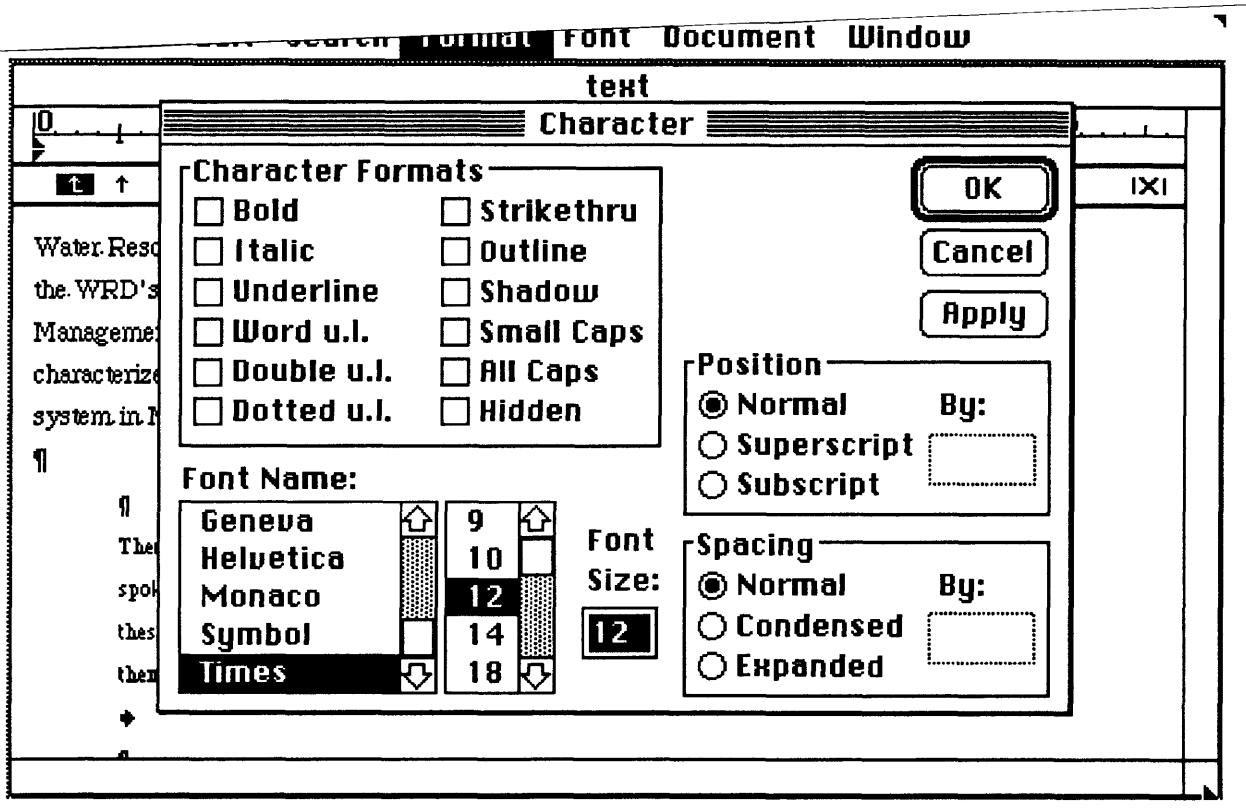

Figure B-4.--Example of dialog box for Character command in Microsoft Word.

Search and replace.–Activated and monitored from a dialog box for the Change command. This function can be used to find and replace standard, printable characters and a number of special characters (such as carriage returns, tabs, nonbreaking spaces, and optional hyphens), but not superscripts and subscripts.

Copy, cut, and paste.–Activated either from the Edit menu or by keyboard commands. Cut or copied selections are placed in the Clipboard area of the memory until the contents of the Clipboard area are replaced or the Macintosh is turned off. Thus, a text (or graphic) item can be repeatedly copied into a report or reports without reselecting the original.

Spelling and hyphenation.–The spelling function is activated either from the Document menu or by keyboard command; the hyphenation function is activated only from the Document menu. Spelling is checked against a predefined, change-protected Main Dictionary and optional user- defined dictionaries. Hyphenation, which is monitored through a dialog box, can be applied to either an entire report or a selected block of text, and can be either fully automated or conditional on the user's acceptance of each suggestion.

Undo command.–Reverses the last editing or formatting command in most cases. A "warning" dialog box appears on the screen if a change to a document is massive enough that insufficient computer memory prohibits undoing.

Symbols.–The Greek alphabet and many other scientific symbols are easily accessed by use of the Symbol font in the Character command or in the Font menu.

Superscripts and subscripts.–Activated by the Character command. This command works for single characters or strings of alphabetical or numerical characters, including symbols.

Use of superscripts and subscripts caused vertical spreading of single-spaced text in Microsoft Word if the size of the superscripted or subscripted character was not reduced. In columnar work, use of superscripts caused slight horizontal spreading and misalignment, even in columns of numbers that center on a decimal tab stop.

Table of contents.–Can be generated automatically. Style is almost identical to that for locally produced USGS reports, and can be modified for better compliance with USGS guidelines.

Page Layout

PageMaker, version 2.0a (Aldus Corp.) was selected for page layout. PageMaker operates from the concept of pages of a report laid out on a "pasteboard" (fig. B-6). Text and graphics are, for the most part, imported from other applications. Text or graphics or both placed on a page can be adjusted for size, overlain with other text or graphic elements, moved, or deleted after the initial placement. The image area is governed by Page Setup and Column Guide commands (figs. B-7 and B-8), which define the outside margins and columnar layout; by master pages, which control pagination and design elements common to every page; and by rulers and tools that can be used on any given page to modify or enhance format elements common to the report.

Placement of text on a page, or from page to page, is called threading. A starting point for the text is indicated within a column, and the text flows until the end of the text or the bottom margin of a column is reached. (Later versions of PageMaker allow the user to place an entire text file without stopping at the bottom of each column or page.) If the stopping point is the bottom margin, the text can be picked up and continued in the next column, on the next page, or on any point later in the report. Column length is adjusted during placement by use of "handles" at the top and bottom of each text block. Once a column is placed, the top or bottom "handle" can be "grabbed" with the pointer tool and the text lengthened or shortened. The text remains moveable within the placed columns; that is, if any column in the middle of a report is lengthened or shortened, the text is automatically adjusted in the remainder of the report. Although column guides initially constrain the placed text, they can easily be overridden in order to place text around graphics, to span more that one column with a headline, or to create similar special effects.

PageMaker provides some editing capability. New text can be added, and placed text can be deleted, copied, or moved. Access to fonts and special characters for text originating in PageMaker is similar to that in Microsoft Word. However, editing features such as search and replace are lacking. Because PageMaker preserves so many of the format features of imported documents, it is advisable–and recommended in the PageMaker documentation–to do all major editing in a compatible word processor and save PageMakerUs editing features only for minor cleanup tasks.

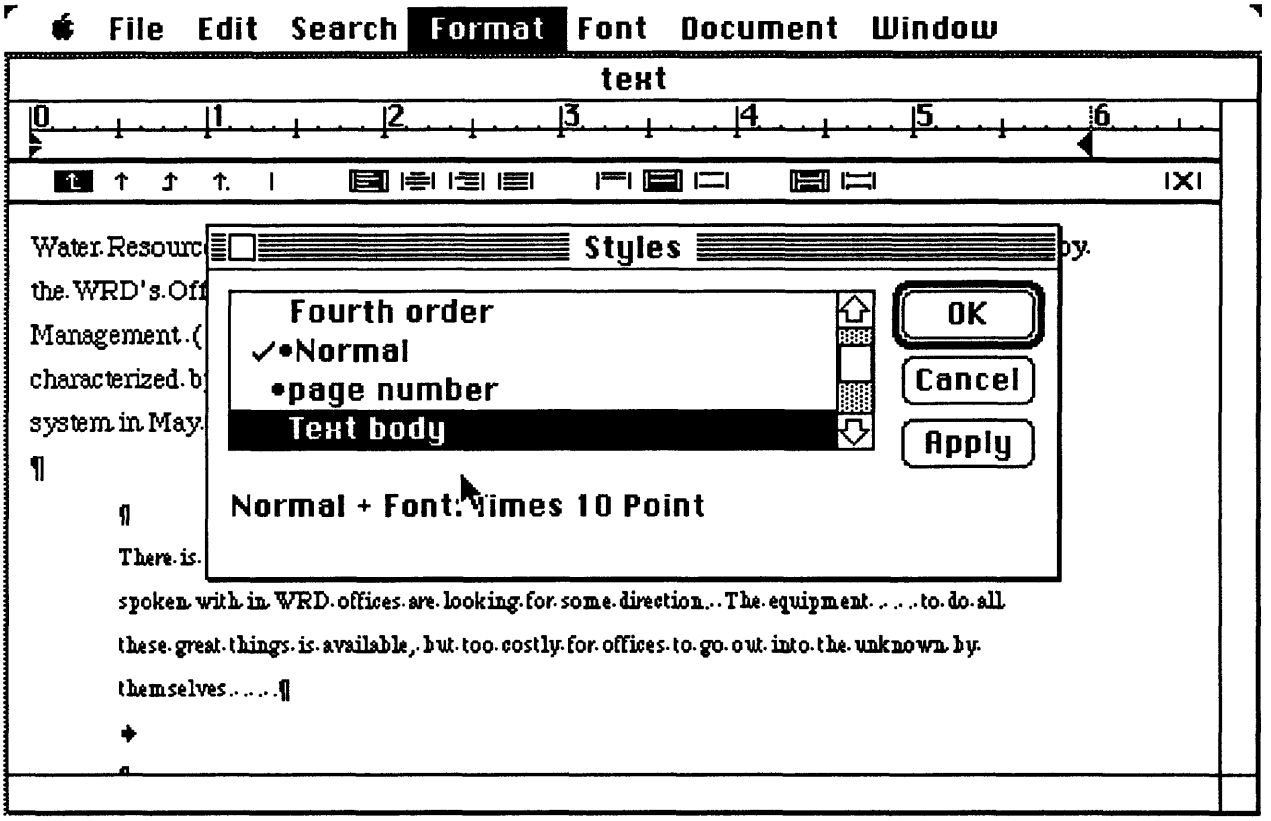

Figure B-5.--Example of dialog box for Styles command in Microsoft Word.

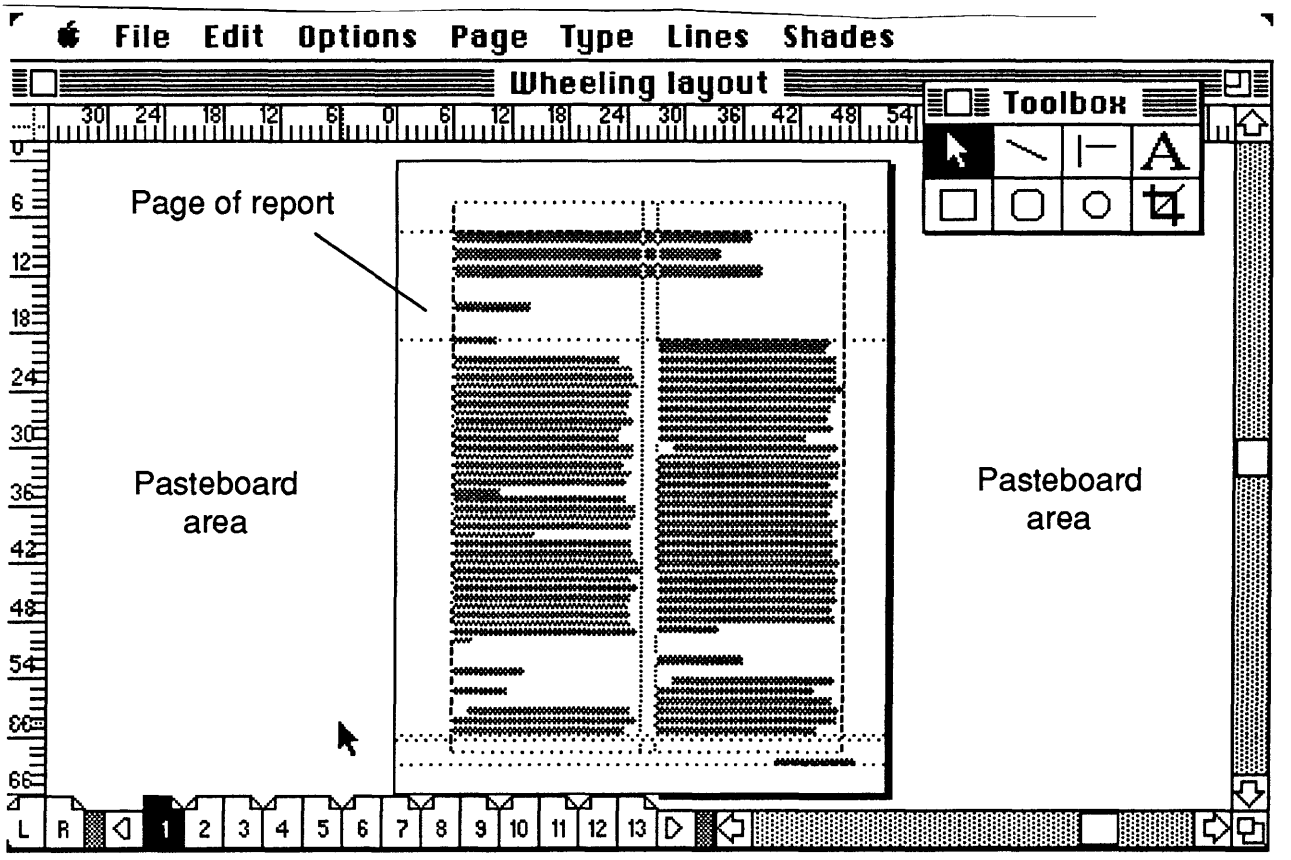

Figure B-6.--Example representation of publication window in PageMaker.

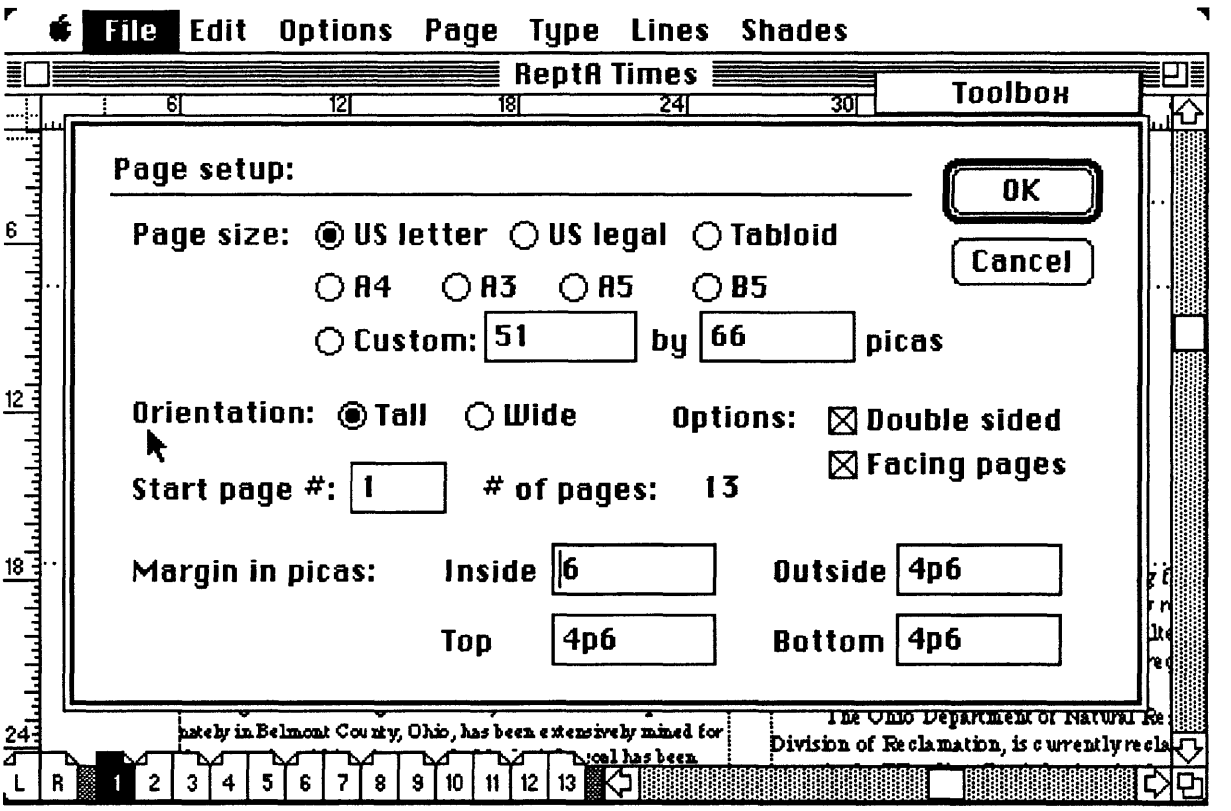

Figure B-7.--Example of dialog box for Page Setup command in PageMaker.

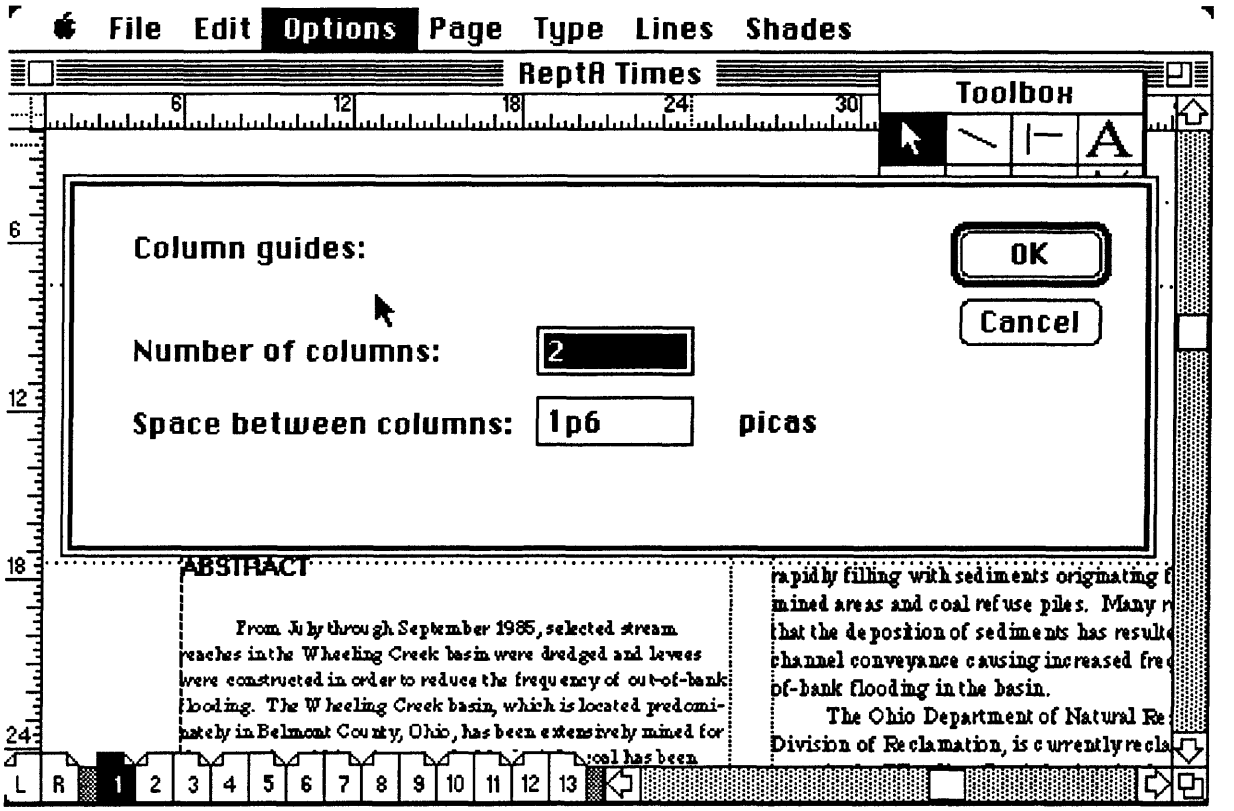

Figure B-8.--Example of dialog box for Column Guide command in PageMaker.

Graphics that can be transferred into PageMaker consist of graphics in MacPaint format, PICT (draw type) format, Encapsulated PostScript Format (EPSF), and Tag Image File Format (TIFF), which is a scanned format. Transferred graphics can be resized and cropped, but not rotated. Original graphics that can be done in PageMaker are confined to simple combinations of straight lines, regular shapes, and shading.

Documentation.–Consisted of two parts: *User Manual* (Aldus Corp., 1987a), a 314-page textbook that contained a tutorial, and *Reference Manual* (Aldus Corp., 1987b), a 131-page volume that provided summary listings of commands, short explanations of features, and a troubleshooting guide. There was considerable redundancy between volumes.

Default settings.–Preset defaults (listed in detail in the *User Manual*) produce a single-column, double-sided, facing-page report with the text in 12-point type within a 6.25- by 9.5-inch image area. Defaults are easily changed by modifying the image area with the Page Setup command, redefining the type style with the Type Specs command, and resetting column guides before entering text.

Hyphenation.–Activated from Paragraph Specs command; can be set to fully automatic or prompted depending on the preferences of the user.

Undo.–Reverses the most recent action in many cases. PageMaker actions that cannot be undone usually have a counteraction available within the command menus.

Importation of Microsoft Word-format features.–As mentioned above, most of the important format features from Microsoft Word can be transferred into PageMaker. In working with the two sample reports, only two transfer problems were encountered. First, some columns of numbers that had been set with decimal tab stops in tables done in Microsoft Word were misaligned after being transferred; the tab stops had to be reset from within PageMaker. Second, PageMaker occasionally did not recognize Microsoft Word fonts, and the PageMaker default font was substituted. The sections of text in question were easily reset to the original fonts from within PageMaker.

Terminal Emulation

VersaTerm-PRO, version 2.1 (Abelbeck Software) was selected as the terminal emulation and communications package. VersaTerm-PRO has a variety of features for communication with and transfer of files to and from other computers. Some of the more important features are summarized in table B-2. The performance of VersaTerm-PRO in this evaluation is discussed in the sections on the interaction between the minicomputer and the ERP system.

Graphics

Cricket Draw, version 1.1 (Cricket Software) and SuperPaint, version 1.0p (Silicon Beach Software) were selected for experimentation with PageMaker. It became obvious early on in the evaluation that considerable expertise with either software package would be necessary to produce graphics of publication quality. I had too little time available to develop such expertise; therefore, these graphic software packages were little used. The documentation for Cricket Draw includes tutorial material. The documentation for SuperPaint has no tutorial material, which could prove to be a drawback for users who have difficulty learning by experimentation.

Word-Processing System Used for Comparison

Hardware

An enhanced Compaq Deskpro Model 2 computer and a NEC Spinwriter Model 8810 printer composed the conventional word-processing system hardware. The Deskpro Model 2, an IBM-PC compatible, had performed reliably in the Ohio office in terms of being able to use standard IBM software and the Spinwriter printer. At the time the study began, the Ohio office owned three Deskpros, all enhanced with extra memory and 20-MB hard-disk drives. Two Deskpros in the office's reports processing unit were connected to Spinwriter printers. Specifications for these pieces of equipment are presented in table B-3.

Table B-2.- *-Summary of principal features of VersaTerm-PRO*

Type of operation	Remarks
	TEXT
Emulation	DEC VT100, Data General D200.
On-screen text	Selected text can be edited or printed. Text is selected in much the same way as in Microsoft Word. Available editing commands include cut, copy, paste, copy-paste, and copy table (which replaces strings of two or more spaces with tab characters when copying to the Clipboard memory area).
Data streams	Prints, saves, or sends data. Data can be saved in MacWrite, Microsoft Word, Edit, and QUED formats. Data sent under the "send stream" option is sent line by line without checking for errors.
Other file operations	Sends and receives files by use of Mac XModem, Text XModem, MacBinary XModem, or Kermit error-detection protocols. Multiple (batch) file transfers possible (send and receive) in Mac XModem and Kermit.
	GRAPHICS
Emulation	Tektronix 4014 and 4105.
Screen images	Can be scaled for printing and printed from terminal. Also can be saved and loaded into or out of MacDraw, MacPaint, or TekPrint formats.

Table B-3.- *-Specifications for conventional-system hardware*

[MHz, megahertz; K, kilobytes; RAM, random-access memory; MB, megabytes]

COMPAQ DESKPRO MODEL 2
Processor: 8086, 16-bit internal architecture, 7.14 MHz clock speed (switchable to 4.7 MHz).
Memory: 256 K RAM (expanded to 640 K).
Disk drives: Two 312-K, double-sided 5-inch floppy-disk drives with 20-MB Mountain DriveCard internal hard disk added on.
NEC SPINWRITER 8810
Type: Formed character (thimble)
Print speed: As many as 55 characters per second (50+ characters on average English text)
Resolution: Horizontal, 120 increments per inch; vertical, 48 increments per inch.
Serial interface: ASCII, full duplex; error detection, even/odd parity, framing/overrun; protocol, End-of-text/Acknowledge or X-on/X-off reverse channel, receive buffer, 2,048 characters.

Software

WordMARC Composer for the IBM PC and compatibles (Marc Software International), was in use in the Ohio office when the evaluation began, and was selected as the "conventional" word-processing software for comparison of systems. WordMARC Composer was, at the time of the evaluation, also commonly installed on Prime minicomputers at USGS offices conducting water-resources investigations. The PC and Prime versions are virtually the same in terms of appearance of menus and availability of functions. WordMARC composer, which has macro functions, automatic document formatting, profiling, automatic table of contents and indexing, document recovery, and other advanced features, makes full use of the capacities (that is, memory and hard disk) of an IBM-PC compatible, such as the enhanced Deskpros in the Ohio office.

Reports Selected as Samples

Two WRIR reports typical of those published by the Ohio office were selected for comparisons of text-processing time and printing cost. Each report was processed from double-spaced draft to camera-ready copy on the ERP and the conventional word-processing systems. Blank pages were left in the documents in place of full-page graphics. For a variety of reasons, among which were the limited experience of the evaluator and the short duration for the evaluation, extensive work with graphics was not feasible in this evaluation. Conventionally produced graphics were used in both versions of the sample reports, and no attempt was made to estimate the cost effectiveness of electronic-produced graphics compared to conventional-produced graphics. Some experimentation was done with scanned and screen-captured graphics, and the results are presented in the section on interchange of text and graphics.

Report A consisted of 25 pages of double-spaced text, 2 short tables that could potentially be set in a proportional-space type font by the ERP system, 1 outline map, and 7 graph stream-channel cross sections and channel profiles.

Report B consisted of 45 pages of double-spaced text, 10 tables (9 of which were extensive data tables that were placed at the back of the report), and 12 maps and graphs.

INSTALLATION OF ELECTRONIC REPORT PROCESSING SYSTEM

Installation was surprisingly easy. Despite my lack of experience with microcomputer and printer hardware, I was able to completely install the system by consulting manuals supplied by the Apple Corp. and the software vendors. No significant problems were encountered.

Approximate times for each of the principal installation tasks were:

- Unpack Macintosh, keyboard, and mouse; connect; start up--1/2 hour.
- Unpack LaserWriter; connect cables; install type fonts--2 hours.
- Install software packages, excluding PageMaker--5 minutes each.
- Install PageMaker--1/2 hour.

TRAINING REQUIRED

Total time required to reach a working knowledge of the pertinent features of the Macintosh, LaserWriter, and software packages was about 50 hours. Except for a 2-hour tutorial session with a trainer, which was valuable but not essential, I learned everything I needed to know from the manuals supplied with the hardware and software.

This 50 hours represents only time spent at the keyboard; breaks and interruptions were not counted. The time I spent in training, of course, reflects my previous experience with other computers, word processors, and terminal-emulation/communications packages. Potential users of this system who are not at least as experienced as this, or who have had difficulty

learning to use software without extensive personal coaching, could have a radically different learning experience.

COMPARISONS OF SAMPLE REPORTS PREPARED BY USE OF THE TEST SYSTEMS

Time Required for Processing

Both sample reports were transferred in ASCII format from the colocated Prime minicomputer to the ERP system and to the conventional system. Timekeeping began with the formatting of the transferred files for their respective applications and ended with completion of the versions of each report that would be suitable for printing with the addition of the final graphics.

For each sample report done on the ERP system, the processing time was about equally divided between formatting of ASCII files for transfer to PageMaker and on-screen page layout. The shorter of the sample reports (which was almost entirely in two-column format) however, took twice as long per page to complete than did the longer report (which contained about 50 pages of data tables in a fixed-space type font in single columns). Overall, the ERP versions of the sample reports took about four times as long to complete as the conventionally processed versions (table B-4).

The choice of a two-column format for the ERP versions of the sample reports definitely seems to have been a factor in the processing time required. A subsequent test of time required to process single- and two-column versions of a sample report on the ERP system indicates that, for some reports, use of the two-column format would have taken nearly twice as long. Much of the extra time required for two-column work was a function of the effort necessary to ensure that four columns aligned on two facing pages. In addition, part of the extra time needed probably was due to the small computer screen. The Macintosh SE screen displays less than one-half of a typical 8-1/2- by 11-inch page in actual-size mode, and much repositioning of the on-screen image was needed while checking alignment of columns at the tops and bottoms of pages and across facing pages.

The learning process also may have been responsible for some of the extra time required for the ERP versions. Although I was comfortable with all common PageMaker functions while working on the sample reports and my expertise was about the same as that at the end of the training phase, it is uncertain how much additional practice may have improved my speed.

Estimated Costs of Printing

Differences in printing costs for both versions of the sample reports were estimated by first assigning a reasonable cost to the conventionally processed report, computing the ratio of the number of pages in the ERP version and the conventional version, and then multiplying that ratio and the cost of the conventionally processed version to obtain the estimated cost for the ERP version. These estimated printing costs are summarized in table B-5.

The decrease in the number of printed pages possible by use of ERP methods will differ from report to report depending on the relative proportions of text, tables, and graphics. Note the differences in the page-number ratio for the two reports for the Ohio evaluation (table B-5).

TECHNICAL ISSUES

Limitations of Electronic Report Processing System

Speed

In comparison with the conventional word-processing systems the ERP system was about the same in terms of system response. Time required to load programs, open files, and save files on the disk varied in both systems with the size of file, the volume of material in memory, fragmentation of hard-disk space, and so forth. Overall, differences in speed for the two systems were not readily apparent to me as a user.

Screen and Printer Resolution

The Macintosh SE screen is a 9-inch diagonal, high-resolution, 512- by 342-pixel bit-mapped display. In terms of workability in "actual-size" mode in both Microsoft Word and PageMaker, I had no problems reading type fonts that were 12 points or greater in size; 10-point fonts were more difficult to read on the screen, and 9- and 8-point fonts were nearly impossible

Table B-4.--*Time required to produce both versions of the sample reports*

[ERP, electronic report processing]

Sample report and file	Time required for each version, in hours	
	ERP	Conventional
REPORT A		
Contents	0.98	0.23
Text	2.7	.58
Table 1	1.4	.22
Table 2	1.5	.12
Miscellaneous preparation	—	.25
Total	6.6	1.4
REPORT B		
Contents	1.0	.25
Text	3.9	.78
Table 1	.70	.08
Table 2	1.7	.28
Table 3	2.4	.10
Table 4	1.6	1.1
Table 5	.62	.08
Tables 6-10	2.7	2.0
Total	16	4.6

Table B-5.- -*Estimated printing costs for the sample reports*

[ERP, electronic report processing]

Sample report	Page-number ratio (ERP/Conventional)	Estimated cost, by version	
		Conventional	ERP
Report A	0.82	$300	$246
Report B	0.90	$500	$450

to read. Fortunately, PageMaker has a 200-percent viewing option so that even 8-point text can be magnified to a legible size.

Printer resolution was 300 dots per inch. This level of resolution was common among laser printers at the time of the evaluation and produces text of acceptable quality for many reports produced by the USGS.

Length and Complexity of Reports

Report A was assembled from three text files originally stored on the Prime minicomputer. The final ERP version consisted of two PageMaker files (one for front matter and one for the main body of the report). The printed copy consisted of 18 pages, including 9 blank pages as spacers for graphics. Report B was assembled from eight text files originally stored on the Prime minicomputer. The final ERP version consisted of six PageMaker files (one for front matter, one for the main body of the report, one for a single-page table within the main body of the report, and three for data tables at the back of the report). The printed copy consisted of 77 pages, including 12 blank pages as spacers for graphics.

Report A posed no problems for either system. Report B, the longer of the two documents selected, slowed the ERP system. While using Microsoft Word, massive format changes in the largest set of data tables completely filled the available memory and stopped the system; thus, I was forced to format the report a few pages at a time. While using PageMaker, the Macintosh repeatedly "lost contact" with the printer when printing of more than about seven pages of any large file was attempted; thus, I was forced to print such files in 3- to 5-page increments.

Report B also posed the problem of side-title (landscape) tables. In all, 30 pages of tables had to be oriented side title. Rotation of text and graphics is not possible in PageMaker, version 2.0a, so the problem was solved by setting up blank-page spacers for tables in the PageMaker file for the main body of the report (to preserve page numbering and footers) and overprinting the table files onto the spacers. This technique, although time consuming, resulted in output of acceptable quality for printing.

Interaction Between the Minicomputer and the Electronic Report ProcessingSystem

Interchange of Text

VersaTerm-PRO was used to emulate a DEC VT100 terminal to initially contact the Prime minicomputer. ASCII files were then listed individually and saved on the ERP system by use of the Save Stream option of VersaTerm-PRO. Once the files were saved by the ERP system, Microsoft Word was used to remove all unnecessary carriage returns and format the report to the style chosen for the ERP versions of the reports. No significant problems were encountered with this procedure.

Although transfer of files from the ERP system to the Prime minicomputer was not necessary for processing the sample reports, the feasibility of such a transfer was tested as part of the evaluation. Transfer of text files was accomplished by first saving Microsoft Word files as text only with line breaks, then using the version of Kermit in VersaTerm-PRO to transfer the files to the Prime minicomputer. Transfer of files both individually and in batch was successful.

Interchange of Graphics

One of the features of greatest interest in ERP systems is the ability to integrate text and graphics easily. As mentioned previously, graphics in MacPaint format, PICT (draw-type) format, EPSF, and scanned formats, notably TIFF can be transferred to the PageMaker.

Of particular interest were the possibilities of: (1) scanning base maps so that simple enhancements could be added directly in PageMaker (for example, adding an explanation or symbols for an observation-well or stream-gaging network); and (2) transferring graphics that had been generated on the Prime minicomputer, displayed on the Macintosh screen, and saved from the screen image in MacPaint or PICT formats (VersaTerm-PRO has this capability). A simple county base map and a fairly complicated line chart that had been produced by use of a Hewlett-Packard

7550A flat-bed plotter were selected to experiment with scanning. The same line chart produced on the flat-bed plotter was displayed on the Macintosh screen to experiment with screen-saved images.

Bilevel TIFF scans of the base map and line chart plot were done with an Abatron scanner by an outside contractor. The images were transferred into PageMaker quickly and easily. Distortion was minimal (-0.7 percent vertical, and +0.5 percent horizontal). Quality of the base-map image was unacceptable, primarily because the original was too light to scan well. (All line work on this base map had been done in a dot pattern). Had a darker base been scanned, more satisfactory results might have been obtained. In contrast, the scanned image of the line chart was nearly indistinguishable from the original.

It should be mentioned that images such as the sample base map can be scanned as bit maps, transferred into graphics packages, and used as templates for tracing. Lack of time and lack of experience on my part prohibited such experimentation, but such techniques are now commonly in use in ERP systems.

Experiments with the screen-saved images were less successful. The MacPaint- and PICT-format files were transferred properly and could be moved and resized easily. However, the MacPaint-format graphics were characterized by generally unacceptable resolution, notably, jaggedness of diagonal and curved lines. Diagonal lines were less jagged in the PICT-format graphics, but curved lines were jagged and extraneous connecting lines were added, particularly to letters and numbers. Neither type of screen-saved image was suitable for printing.

CONCLUSIONS

1. In terms of availability of necessary functions, ease of use, and satisfactory appearance of the final product, the Macintosh-based ERP system adequately produced text and tables for the two sample reports. Problems were few. The greatest difficulties involved handling large files, which had to be processed and printed in parts. Transfers of ASCII files between the ERP system and the colocated Prime minicomputer were attempted and no significant problems were encountered.

2. The sample reports processed with the ERP system took about four times as long to complete as did the corresponding versions processed with the conventional system. The extra time required for the ERP versions, however, was largely dependent in part on the assumptions used in the evaluations. If, for example, the bulk a given report destined for PageMaker had been originally typed on the ERP system in Microsoft Word, then perhaps only about one-half the time would be involved in the preparation from approved draft to two-column final copy as compared with a report downloaded in ASCII format. Even less time would be required if a single-column format had been used in lieu of the two-column format that was used.

3. The ERP system tested has the capability of incorporating transferred graphics in MacPaint format, PICT (draw type) format, EPSF, and TIFF. A simple county base map and a fairly complex line chart were scanned in TIFF to experiment with scanning. A line chart generated on the Prime minicomputer and displayed on the Macintosh screen was saved from the screen image in MacPaint and PICT formats to experiment with the transfer of graphics originating on another computer. The scanned images were transferred into the ERP system quickly and easily with minimal distortion. The quality of the base-map image was unacceptable, primarily because the original (which was screened) was too light. In contrast, the scanned image of the line chart was nearly indistinguishable from the original. Although the screen-saved images in MacPaint and PICT formats were transferred properly, they were characterized by unacceptable resolution; jaggedness of curved lines was a problem common to images in both formats. Neither type of screen-saved image was suitable for printing.

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CHAPTER C.--EVALUATION OF AN ELECTRONIC REPORT PROCESSING SYSTEM FOR PRODUCING EARTH-SCIENCE TECHNICAL REPORTS

By

Richard A. Hollway and Denise A. Wiltshire

ABSTRACT

An evaluation of effectiveness of electronic report processing (ERP) systems for widespread application in U.S. Geological Survey, Water Resources Division offices conducting water-resources investigations was made in the Oregon (Portland) office of the U.S. Geological Survey from November 1987 through June 1988 in conjunction with two other such evaluations. For the Oregon evaluation, the hardware of the system consisted of a 32-bit multiuser workstation (model 3/160) manufactured by Sun Microsystems, Inc. FrameMaker (version 1.11) software, manufactured by Frame Technology, Inc., was selected for the evaluation because this software is an integrated text-processing and page-composition package that operates on a Sun workstation.

The evaluation process required producing a 92-page technical report with 13 tables and 41 graphics using integrated ERP techniques and comparing procedures to those for preparing the same report using manual and conventional word-processing methods. The ERP system was evaluated by testing procedures of text processing, graphics integration, page composition, page report management, and the user interface. Compared to presently (1989) used word-processing software, the FrameMaker software has more extensive text-processing and page-composition capabilities. Advantages of the FrameMaker software include: (1) versatile page-report structuring; (2) report-format templates; (3) use of the SunView windowing interface; (4) consistently fast and accurate global changes of text and page composition; (5) easy-to-use menus for selecting typeface, column layout, and headers and footers; and (6) a very complete and fast spell checker.

The Sun workstation enhanced the performance of the software throughout the text-processing procedures used during the evaluation. The virtual-memory operating system of the Sun workstation offers broad functionality, such as multitasking capabilities. These capabilities allow FrameMaker to operate with the SunView windowing environment in which multiple pages of a report can be viewed on the workstation screen and then easily copied into FrameMaker windows. In addition, facing pages of a report also can be viewed on the screen simultaneously, thus facilitating page layout. The virtual memory of the operating system allows the production of reports with essentially a limitless number of pages. The power of the microcomputer is sufficient to ensure rapid loading, saving, and global changing of text and page composition in reports with more than 100 pages.

Comparisons of ERP methods to conventional report-processing methods using personal computers and Prime minicomputers operating WordMARC Composer software indicate additional advantages of a fully integrated software package, such as FrameMaker. The use of proportional typefaces, single-line control, and condensed tables composed using tab-construction techniques resulted in decreasing the total number of pages in the final version of a report when compared to conventional report-processing methods. As a result, a 21-percent decrease in printing costs was achieved with the ERP system version of the report prepared during the evaluation. Although additional time is required for preparing structural templates for page composition during the initial typing stage, the ability to store templates allows rapid production of subsequent reports with a similar format. Hence, substantial time can be saved if an office produces many reports requiring the same format specifications.

INTRODUCTION

Electronic report processing (ERP) systems have become increasingly widespread throughout the scientific and business communities since 1973 when the concept was first implemented at Xerox's Palo Alto Research Laboratory using an experimental workstation known as Alto (Seybold, 1987, p. 149). During the past 3 years, advances in laser printing, computer-graphics interfaces, and word processing have promoted the integration of microcomputers into the

reports preparation process. The ability to create and integrate text and graphics using a microcomputer and to prepare a camera-ready copy by use of laser technology have distributed powerful tools to the desktop that were available previously only to the typesetting industry.

Although there is some ambiguity associated with ERP systems, its history may be traced to the Apple Macintosh promotional campaigns in 1985 (Seybold, 1987, p. 149). As noted above, ERP systems have evolved into the ability to compose typeset-quality text electronically; merge text with graphics; and print reports using a high-resolution laser printer (Burns and Venit, 1987, p. 94).

A variety of ERP systems are currently recognized as production enhancements in major publishing firms in addition to scientific and business firms (Burns and Venit, 1987, p. 94). Documented benefits of the technology include substantially decreased page-composition, typesetting, and printing costs; greater internal control of the publication process; and shorter production schedules (Antonoff, 1988, p. 6).

Although the effectiveness of page-composition software for microcomputers is documented throughout the literature, most of the evaluations are based on production of newsletters, brochures, and nontechnical documents. In other instances, no indication is given about the length or complexity or both of the publications used as the basis of the evaluation. For example, evaluations of popular page-composition software, such as PageMaker, Quark Xpress, and Ventura Publisher are published annually in *Software Digest*. Although these evaluations were extensive, performance texts were conducted using one 8 1/2- by 11-inch page, and quality was measured by creating eight pages of text (National Software Testing Laboratories, 1987, p. 49).

Although valuable data may be obtained from such evaluations, the characteristics of U.S. Geological Survey (USGS) hydrologic reports require special consideration. The complexity and length of reports authored by USGS personnel need to be considered in determining the suitability of ERP systems. As a result of this need, the USGS, Water Resources Division, conducted evaluations of three ERP systems in the Florida (Tallahassee), Ohio (Columbus), and Oregon (Portland) offices where most reports resulting from water-resources investigations conducted by the offices are prepared for printing within the offices.

Purpose and Scope

This chapter presents the results of the evaluation of an ERP system conducted in the Oregon (Portland) office from November 1987 through June 1988. The results are based on the production of one technical report using an integrated ERP system consisting of a 32-bit, multiuser workstation hardware and associated software. Information about the ease of learning, performance, versatility, interconnectivity with other computing environments, and potential cost benefits of the system is presented. Several comparisons between the system and conventional word-processing methods are made.

Acknowledgment

Special thanks are extended to Thelma D. Parks of the USGS (Portland, Oregon) for assistance in testing including the layout of the Water-Resources Investigations Report (WRIR) published using the ERP system. Also, she assisted in the comparisons of the ERP system to the conventional word-processing system.

APPROACH

For this evaluation, FrameMaker, which operates on a 32-bit workstation, was one of the three software packages selected for evaluation purposes on the basis of price and limited product reviews (Schindler, 1986, p. 28).

Hardware Used for the Evaluation

The system unit is a Sun workstation (model 3/160) manufactured by Sun Microsystems, Inc., with 4 MB (megabytes) of random access memory; 140 MB of magnetic-disk storage; 60 MB magnetic-tape drive; and a 19-inch monochrome monitor with 1152 by 900 resolution, keyboard, and optical mouse. A bit-mapped monitor, such as the monitor supplied with the Sun workstation is required to operate FrameMaker. Although additional character or graphics-oriented terminals can be connected to a multitasking Sun workstation, only one bit-mapped monitor can be configured per workstation. Thus, only one user per workstation can operate FrameMaker at any given time.

FrameMaker supports all PostScript compatible printing devices. The Sun LaserWriter and AST TurboLaser were used for this study. In addition, FrameMaker supports Imagen printers.

The performance of the workstation also has a significant effect on automating the page-composition process, particularly for long, complex reports. The better performance of a 32-bit workstation when compared to a 16-bit microcomputer is based on several elements, including (1) a multitasking operating system, (2) better price to performance ratio, (3) faster data processing, and (4) better monitor management for graphics applications.

Software Used for the Evaluation

FrameMaker (version 1.1), manufactured by Frame Technology, Inc., was selected for this evaluation because it operates on a Sun workstation and it was priced within the budget of this project. Only limited ERP software was available for a Sun workstation when the evaluation began. FrameMaker is a full-featured, integrated text and graphics processing system (Sun Microsystems, Inc., 1988, p. 528). Unlike most commonly used ERP software, FrameMaker incorporates text processing, graphics integration, and page composition. Hence, text can be created within FrameMaker using the text-processing component of the software or a text file can be transferred into FrameMaker from other word-processing software. Because FrameMaker is a "what you see is what you get" (WYSIWYG) report processing system based on a bit-mapped technology, the screen accurately portrays the final printed appearance of a page. In addition, FrameMaker is designed to operate on a Sun workstation with a 19-inch monitor, thus allowing the contents of a full page to be displayed on the screen. Furthermore, FrameMaker operates under SunView, the windowing system developed by Sun Microsystems, Inc., thus providing the capability to view either multiple pages or facing pages at the same time.

Installation of Software

Installing FrameMaker is performed by copying the software from a 0.25-inch magnetic-tape cartridge (distributed by Frame Technology, Inc.) onto the magnetic disk of the Sun workstations in a directory accessible for general use. A procedure provided by Frame Technology, Inc. is followed to customize the software for the particular environment, thus eliminating redundant files from the distribution set, such as those required to support different revisions of the operating system and different printer. The entire procedure, including copying the files from a magnetic-tape cartridge, takes less than 20 minutes. After the procedure is completed, the software resides in a directory called */user/frame* with executable access allowed for all users on the system.

A copy-protection system (provided by Frame Technology, Inc.) utilizes a host identification number, unique to each Sun workstation, that is available by the software query. The unique host identification number is accessible only by querying the UNIX operating system resident on the Sun workstation. This copy protection system ensures better software-copy protection than a system that uses a factory-stamped serial number located on the exterior of the processor. An associated password is obtained by contacting Frame Technology, Inc., and informing their customer service of the host identification number. The newly assigned password along with the host identification number are placed into a control file using a standard text editor. If the password file is not accessible or improperly formatted, FrameMaker will indicate a warning at start time and will function correctly except that the option to save a file on the magnetic disk has been disabled. Utilizing this copy-protection system, Frame Technology, Inc., allows licensed owners of the software to copy the FrameMaker software to other workstations; in fact, the company encourages it. The advantage of this copy-protection system is all other nonregistered workstations access the same software package and have the ability to view, modify, and print pages of a report. Modifications made to a page or pages of a report using a non-licensed workstation cannot be stored for later retrieval from the magnetic disk.

The installation procedure also alters the search path, known as a *shell*, on a user's workstation to include the location of the directory containing the FrameMaker software. To avoid the added step of changing directories to begin using FrameMaker, all other users need to make a one-time change to their search path. This is accomplished by editing a script file in their home directory named *.login*, which is invoked automatically whenever the user logs into the system. This capability eliminated confusion on the part of the user if path names to initiate FrameMaker are forgotten. The capability both facilitates and accelerates initiating FrameMaker.

A user initiates the FrameMaker software package as a background process within the SunView windowing system. A FrameMaker selection window appears when loading is complete. Loading the entire software package, including screen fonts, takes less than 30 seconds. By use of the script file *.login* mentioned above and a similar script file named *.suntools* for activating the SunView windowing environment, the start-up procedure can automatically initiate SunView and load FrameMaker. Both software packages are ready for use within 40 seconds after logging into the system.

The FrameMaker software requires 6 MB of magnetic-disk storage for installation. Only 2 MB of disk storage are required for executable files and screen fonts.

Training Materials and Documentation

The FrameMaker-software documentation includes a reference guide and a user's manual. The user's guide is a tutorial on all aspects of FrameMaker. Topics described in tutorial include getting started, text editing, text formatting, graphics page layout, and customizing page-composition. As part of the evaluation, the authors completed the tutorial prior to attending a 1-day seminar at Frame Technology, Inc., located at San Jose, Calif. The tutorial was the sole instructional material for the editorial assistant who participated in the evaluation. The 1-day seminar conducted by Frame Technology, Inc., supplied little supplementary information beyond what is contained in the user's manual. The user's manual can be read, and suggested exercises can be completed within 8 to 40 hours depending on experience with word-processing systems and knowledge of page-composition, USGS report specifications, related publishing techniques and terminology, and operations of a mouse.

Similar to other software packages, mastering FrameMaker is achieved with experience. Users with little or no experience in operating a mouse have the option of using FrameMaker's keyboard equivalents of commands and most menu options. Generally, command keystrokes are based on the mnemonic equivalent of the commands shown on the menus. For example, to select the *catalog* option, which is included in the *Format* menu, the keystroke command is activated by depressing the *escape* key, followed by typing the letters *f* to represent the *Format* menu and *c* to indicate the *catalog* option.

The authors and editorial assistant determined that mastering the techniques required for operating FrameMaker did not require any additional skills beyond those needed for operating conventional word-processing software. The powerful page-composition functionality in FrameMaker, however, requires a different approach and methods for completing the final camera-ready copy than those used in conventional word-processing software. For example, the substituting of italic lettering for underlined lettering within a draft manuscript is no longer required because an italic-lettering typeface can be specified and viewed on the screen. Additionally, because text processing and page composition are integrated processes within FrameMaker, additional time and skills are needed to assign page properties for components such as the report title, section headings, paragraphs, and so forth, during the original typing of the report. In contrast, less time is spent on manually preparing page layouts.

FEATURES OF THE SUN WORKSTATION

The virtual-memory operating system and windowing environment of the Sun workstation provides functionality for an integrated word-processing and page-composition package. SunView windows can appear on the same monitor simultaneously with FrameMaker's windows. Information, text, or graphics, can be copied between SunView windows and from SunView windows to FrameMaker windows.

Because the Sun workstation is designed for scientific applications, functions other than word processing can be operated simultaneously, such as simulation modeling, spreadsheets, data-base queries, electronic mail, and communications with other computers. Both scientists and publications-production staff can use the same workstation, thus ensuring efficient use of computing resources and smooth connection for file transfers.

The virtual-memory operating system allows the production of reports with essentially a limitless number of pages. The power of the workstation is sufficient to ensure that loading, saving, and global changing of text and page composition can be accomplished in seconds even in reports with more than 100 pages. Similar performance is obtained in diskless Sun workstations. Additional time is required for initial loading of the FrameMaker software and large

documents, but generally the increase in time is less than 20 percent of the time for initial loading using an active local-area network.

FEATURES OF THE FRAMEMAKER SOFTWARE

Relation to the SunView Windowing System

FrameMaker not only runs within the SunView windowing system but the appearance of windows, types of menus, choices on the menus, and the results of those choices are the same using FrameMaker as with SunView (fig. C-1). Incorporating the SunView windowing capability into FrameMaker is an asset because it provides users operating FrameMaker with the same multitasking capability of the Sun workstation. Users familiar with SunView window options and the three-button mouse conventions are ensured consistency while operating the FrameMaker software.

FrameMaker takes advantage of the multiple-windowing capability for spell checking, search, search with replace, special symbols, and drawing tools. Many different pages of a report can be viewed on the workstation screen simultaneously. For example, facing pages in the same report can be viewed side by side to facilitate final page-composition (fig. C-2). In addition, FrameMaker uses the UNIX multiprocessing features to eliminate access delays caused by printing pages. FrameMaker sends a printable version of the page to the background print queue of the workstation.

Report Files

Reports can be divided into as many files as desired by the user; however, FrameMaker is designed for reports to be contained in two files. One file contains the text, tables, and graphics or space for the graphics. The other file is the automatically generated table of contents. FrameMaker uses the UNIX file system of the microcomputer to store, copy, and delete files. The use of single or paired files for each report simplifies storage, locating, and retrieval of files.

Page Properties and Structured Templates

The initial pages created for any particular report requires defining the properties of the components of the report, such as the title, section headings, and paragraphs. These properties include margins, indentions, line spacing, columns, hyphenation, and typeface (fig. C-3). The advantage of the structured page-property approach is that properties of a component can be changed throughout an entire report within seconds. For example, all first-order headings throughout the report can be altered to a bold typeface by selecting the *global-change* option from the appropriate *Component-Property* menu. All of the formatting information can be saved for later use by changing the name of the report file, deleting all the visible contents, and storing the formatting information on the magnetic disk. As a result of this evaluation, a template for future WRIR's was produced. To use the template, a copy is made to a new file representing the new report. At this point, text for the new report can either be entered within FrameMaker or transferred from a file. The template is a valuable tool because it eliminates the need to repeat time-consuming steps for composing each page in the new report. Hours and possibly days can be saved by using a well-planned template system (Burns and Venit, 1988, p. 28). Stored templates may be accessed by multiple users of a single workstation or by users in a network of workstations to promote consistency of report format.

Typeface Selection

Typeface selection is accomplished through either the *Paragraph-Component* menu or the *Font* menu (fig. C-4). Typeface attributes, such as boldface type, italics, or point size are chosen from the same menu (table C-1). The resultant choice can affect single character, word, line, sentence, paragraph, all paragraphs of the same component name, or in all the text in the entire report.

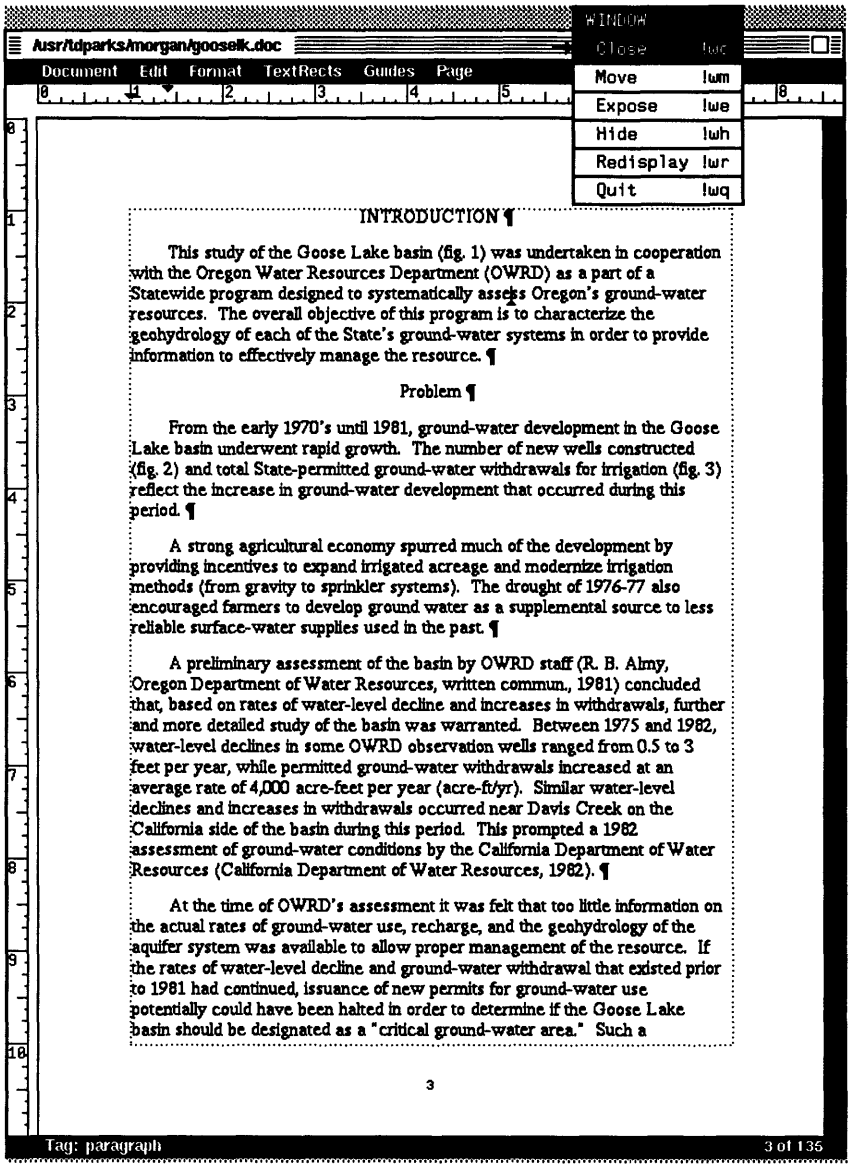

Figure C-1.--Example of menu for the window-feature options.

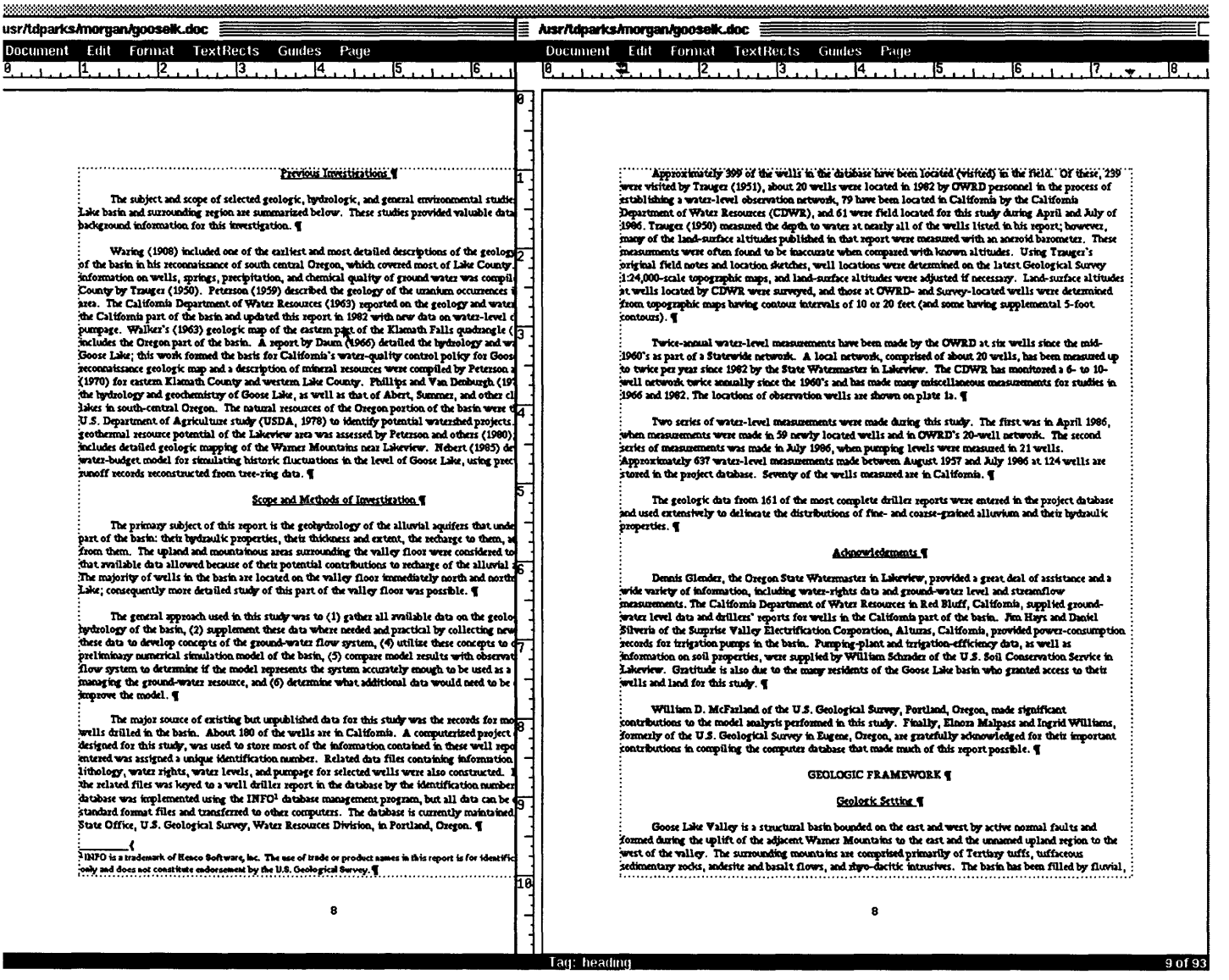

Figure C-2.--Reduced screen image showing facing pages of a report.

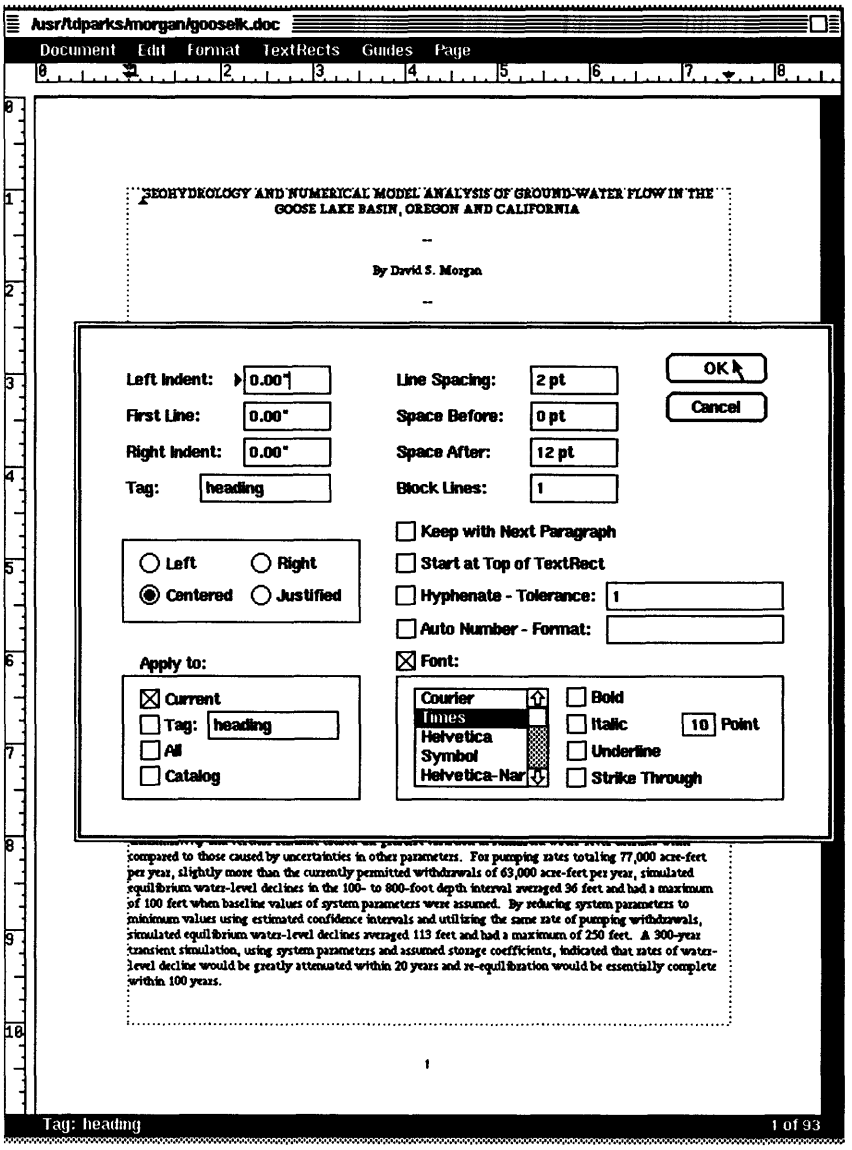

Figure C-3.--Example of menu for the paragraph-component options.

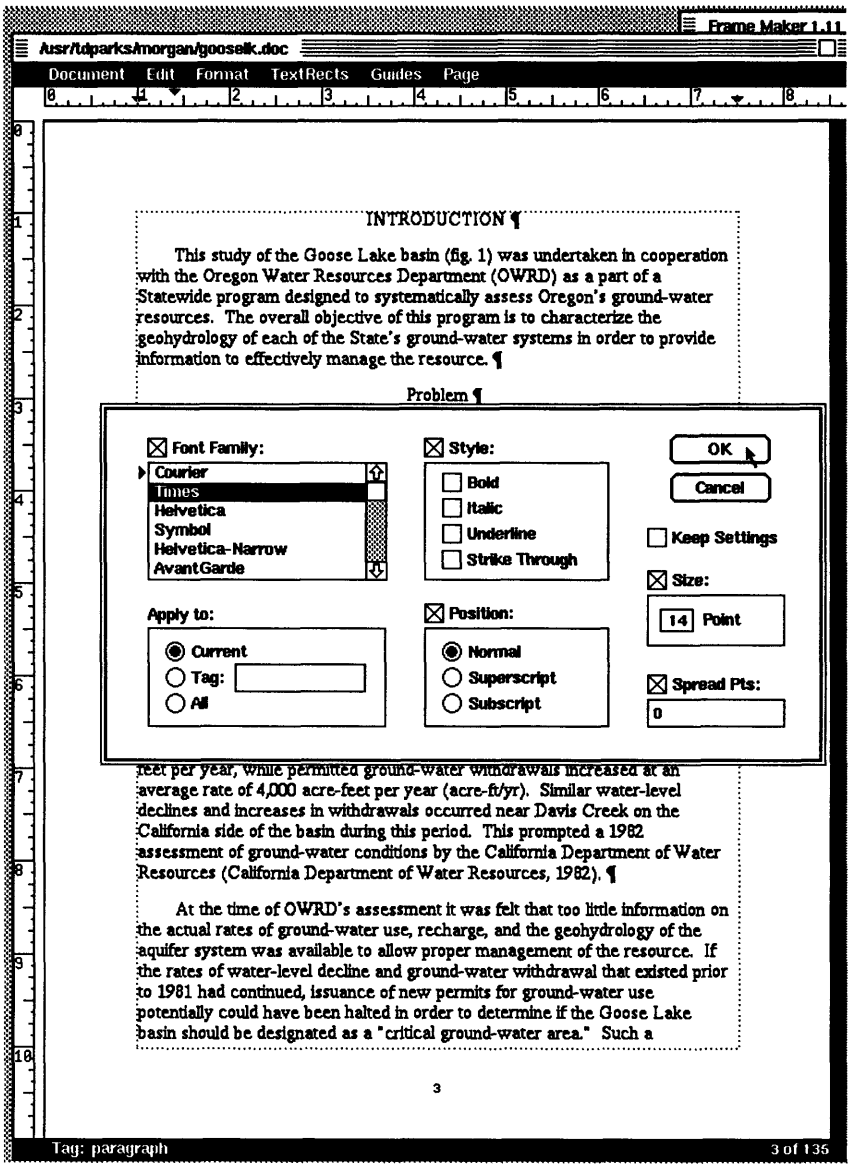

Figure C-4.--Example of menu for the typeface options.

Table C-1.--*Typeface options*

Typeface	Bold	Italics	Under-line	Strike-through	Point Size 7	8	9	10	12	14	18	24
Courier	●	●	●	●				●	●			
Times	●	●	●	●	●	●	●	●	●	●	●	●
Helvetica	●	●	●	●	●	●	●	●	●	●	●	●
Symbol			●	●				●	●	●	●	●
Helvetica-Narrow	●	●	●	●				●	●	●	●	●
Avant Garde	●	●	●	●				●	●	●	●	●
Bookman	●	●	●	●				●	●	●	●	●
New Century Schoolbook	●	●	●	●				●	●	●	●	●
Palatino	●	●	●	●				●	●	●	●	●
Zapf Chancery		●						●	●	●	●	●
Zapf Dingbats			●	●				●	●	●	●	●

Column Layout

Column layout is selected by using a menu. The choice can affect either a single page or the entire report. The location and dimensions (height or width or both) of columns can be further modified using the mouse. Modification using the mouse simplifies any differences in column layout needed for section headings, tables, or graphics that extend across multiple columns. The maximum number of columns per page is 10, which is much more than the maximum of 2 columns used in USGS reports.

Because specifications for the WRIR series include a single-column format, the report used for the evaluation was not formatted into double columns. The authors, however, conducted limited experiments formatting the sample report in various double-column formats. The conversion from single- to double-column format required no differences in time to do either format. No major adjustments in headings were needed to align tops and bottoms of adjacent columns.

Formatting Symbols

FrameMaker allows the display of formatting symbols within a report. The choice enables the symbols to be displayed either on a single page or throughout the entire report. Formatting symbols include active cursor position, tabs, soft carriage returns, end of paragraph, and end of page or report. Similarly, the simulated borders of each column or graphic frame can be visible for easy manipulation or removed to present a final appearance. Although the authors of this report preferred displaying formatting symbols while creating pages, the editorial assistant participating in the evaluation thought the display of the formatting symbols was disconcerting even though the appearance of the formatting symbols can be easily activated or deactivated.

Headers and Footers

Headers and footers can be added by use of a menu (fig. C-5). Choices include left justified, right justified, or centered. Page numbering can be done by using the *header and footer* option. Numbers can appear as either Arabic, upper or lower case Roman, or their alphabetic equivalent. The same typefaces are available for headers and footers as those for the body of the report.

In addition to the menu for headers and footers, any text or graphics appearing on the *master page* of the report will appear on every page. Special symbols or logos that are designated to appear on all pages of the report can be added to the *master page*, which is a template for formats that apply to an entire report. The final version of the WRIR prepared using the ERP system included page numbers as footers but no headers were used. Some experimentation with running headers, however, was conducted to test the functionality of the *header* option.

Undo

The *undo* feature allows the experimental use of nearly all options by providing a means to reverse the last option chosen. If an option that cannot be reversed using *undo* is selected, FrameMaker software will warn the user that the option can not be undone. At this point, the user has the opportunity to cancel the option.

Spelling Checker

FrameMaker's spelling checker is easy to operate and it provides a full range of options (fig. C-6). The speed of the spelling checker is rapid and the performance is accurate. A separate window, entirely for the spell-checking operation, is opened by selecting *Spelling Checker* from the *Edit* menu. The active cursor position needs to be set within the column frame and the checking proceeds in a forward manner. Options include (1) checking the current page or the entire report, (2) checking unusual capitalization and hyphenation, and (3) repeated words.

If a questionable spelling is located in the text, the software highlights the word on the page and displays it in a rectangle within the *Spelling Checker* window. The optimum correction is displayed in another rectangle along with a sample list of the next seven best choices. If more that seven choices exist, the remainder can be displayed by moving the slide bar on the right side of the *suggested corrections* list with the mouse. If the optimum choice is not desired, any of the options from the list may be selected by moving the mouse to the appropriate word. The new selection is automatically entered into the *correction rectangle* (fig. C-6). If none of the choices in the list is correct, the appropriate replacement may be entered either directly into the page window or into the *correction rectangle* of the *Spelling Checker* window. Selecting *correct*

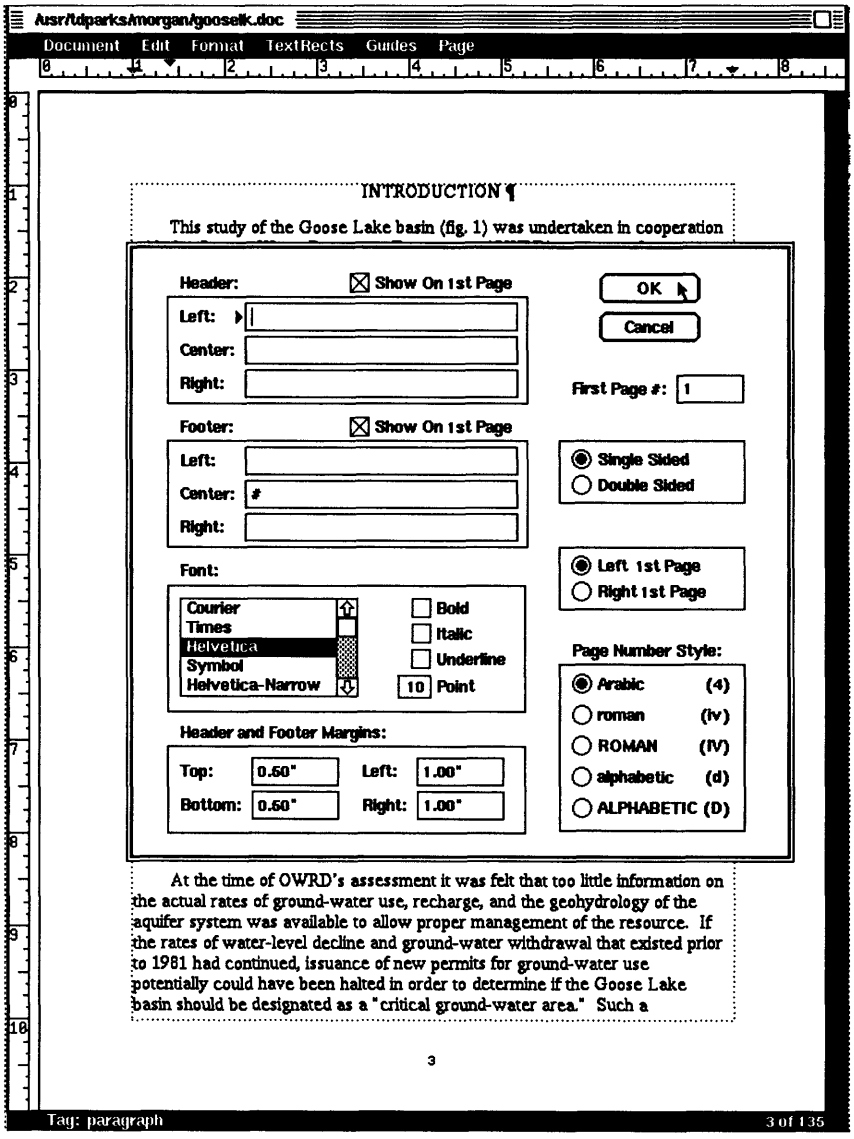

Figure C-5.--Example of menu for the headers and footers options.

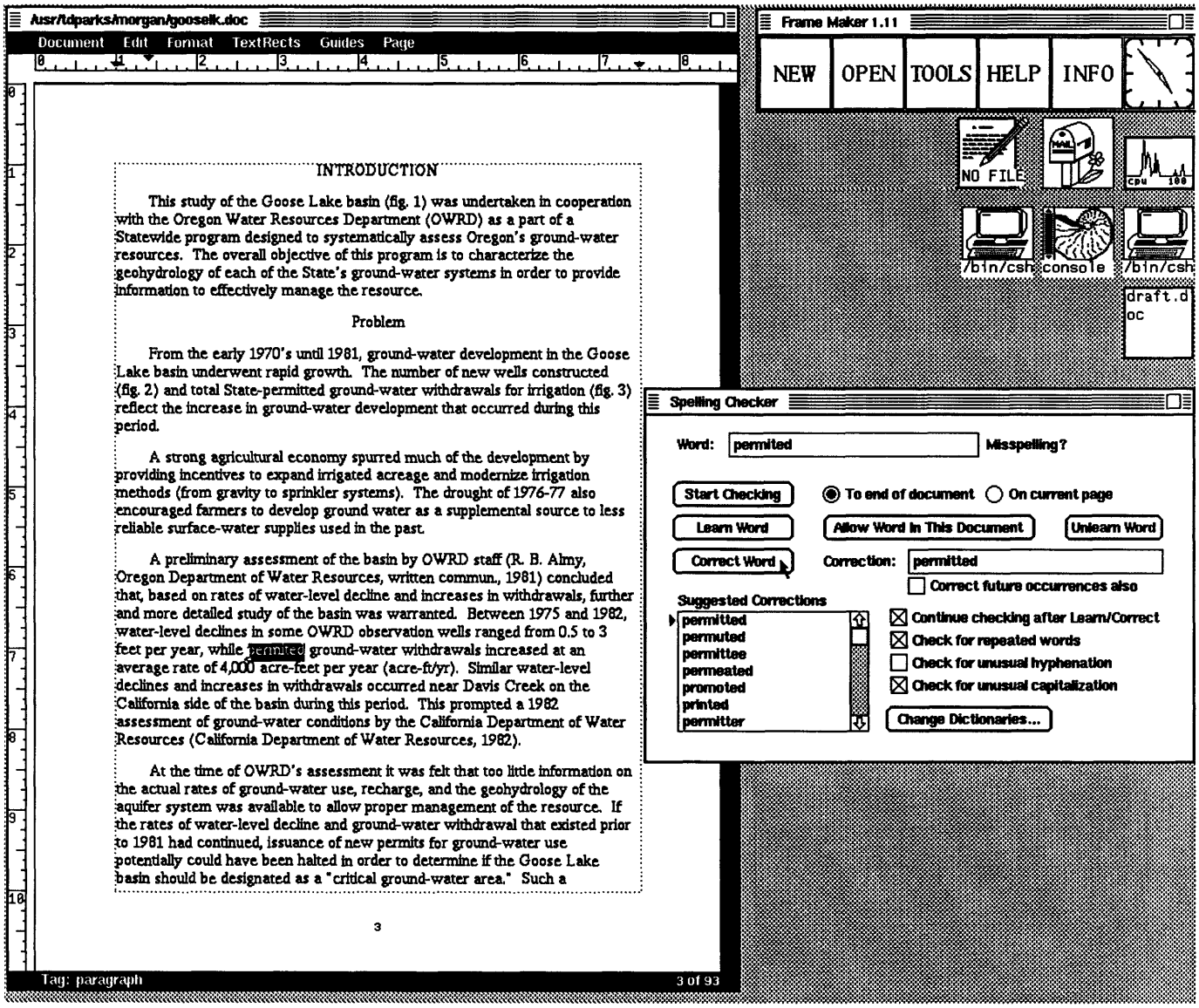

Figure C-6.--Example of menu for spelling-checker options, and display of misspelled word in text.

word from the *Spelling Checker* window replaces the highlighted word in the text with the contents of the *correction rectangle.*

The *Spelling Checker* also allows users to enter words into a customized dictionary. This is extremely useful for scientific and geologic terms that are not commonly in dictionaries provided by most word-processing software packages. Users also may accept words not in the *Spelling Checker* dictionary without permanently storing the word in the user's customized dictionary. Instead, these words are tagged as acceptable for the current editing session only.

Conversions to and from American Standard Code for Information Interchange to FrameMaker Document Format

FrameMaker provides an American Standard Code for Information Interchange (ASCII) translation program, or filter, that attempts to format text into paragraphs without using hard carriage returns as an end-of-line marker. Hence, hard carriage returns are only used to end a paragraph. This feature eliminates the need for considerable reformatting of transferred ASCII documents. The filter works well for text, but not for reformatting tables. Tables, however, can be transferred separately without using the filter to ensure correct page layout.

FrameMaker provides three format options for saving a document. First, the document format provides the most efficient use of storage for all formatting, text, and graphics for later retrieval. This format can only be viewed from within FrameMaker. Because of this *binary* file format, transfer to other computer systems can only be accomplished by network software that supports the protocols necessary for copying *binary* files. The UNIX file-transfer program, *ftp*, allows the transfer of *binary* files between computers that support this utility, such as Prime minicomputers (Revision 21 or greater of Primos) and Sun.

The second format called Maker Markup Language (MML) creates a readable ASCII text file with all the formatting information included in MML (table C-2). For each paragraph component, MML describes the margins, type styles, tabs, and so forth, then tags the appropriate text of the paragraph with the component name. The MML is a Frame Technology, Inc. proprietary language. FrameMaker provides a filter for transfer of MML files. MML has two advantages: (1) files can be transferred over networks that support only ASCII formatted files, and (2) it is possible to write output filters for conventional word-processing systems, such as WordMARC, so that files can be transferred from WordMARC into FrameMaker with minimal loss of formatting.

The third format is ASCII text. Most formatting features such as boldface type and centering are removed; however, tabs are not removed. The text is formatted flush left with no extra lines between paragraphs. Users of many other ERP systems find this format the easiest to transfer as no additional spacing is entered that must be manually removed.

Drawing Features

Similar to the *Spelling Checker*, drawing tools in FrameMaker are available through a separate window (fig. C-7). The procedure for opening the *TOOLS* window, however, is different than that for the *Spelling Checker*. The drawing window is opened by selecting *TOOLS* from the main FrameMaker window.

The types of drawing features include lines, arcs, circles, ovals, squares, rectangles, open and closed polygons, arrows, and curves. There are 16 fill patterns including opaque and transparent.

Graphics can be drawn on pages or in anchored frames. Anchored frames are tied to a location on a page or within the text. This allows the graphic to be moved when text is moved if the report is altered. Text can be added to the graphic using the *drawing* option and then modified by the *paragraph-component* option similar to regular text. Once drawn, graphics can be moved, copied, stretched, deleted, aligned, distributed, and grouped.

Frame Technology, Inc. markets another software package at a reduced price called Writer. Writer differs from FrameMaker only in its lack of a *TOOLS* window. All other features are equivalent. Graphics created by FrameMaker can be viewed, but not altered by a author or user. Writer is sold with FrameMaker so that their compatibility can be easily examined.

Table C-2.--*Sample of Maker Markup Language*

```
<MIFFile 1.01> # Generated by FrameMaker 1.1
include(mif_read.m4)
#
# /usr/rah/csin/workbookTOC.MML
# Options:
#   Paragraph Text
#   Paragraph Tags
#   Paragraph Formats
#   Font Information
#   Master Page Items
#   Headers and Footers
#   Paragraph Catalog
#
<Units Uin >
<Catalog
 <Pgf
  <PgfTag 'TOC Title'>
  <PgfAlignment Center >
  <PgfAutoNum No >
  <PgfHyphenate No >
  <PgfColumnTop No >
  <PgfWithNext Yes >
  <PgfForceFont Yes >
  <Font
   <FFamily 'NewCenturySchlbk'>
   <FSize 18>
   <FBold Yes >
   <FItalic No >
   <FUnderline No >
   <FStrike No >
   <FDX 0>
   <FDY 0>
   <FDAX 0>
   <FNoAdvance No >
  > # end of Font
  <PgfTolerance 4>
  <PgfBlockSize 1>
  <PgfLIndent 0.50">
  <PgfFIndent 0.50">
  <PgfRIndent 0.00">
  <PgfLeading 0 pt>
  <PgfSpBefore 0 pt>
  <PgfSpAfter 12 pt>
  <PgfNumTabs 0>
 > # end of Pgf
> # end of Catalog
<Document
 <DPageSize 8.50" 11.00">
 <DMargins 1.00" 1.00" 1.00" 1.00">
 <DColumns 1>
 <DHeadOnFirst Yes >
 <DFootOnFirst Yes >
 <DStartPage 1>
 <DTwoSides No >
 <DParity FirstLeft >
 <DFrozenPages No >
> # end of Document
<Page
 <PageType MasterPage >
 <PageNum '-1'>
 <PageSize 8.50" 11.00">
 <TextMargins 1.00" 1.00" 1.00" 1.00">
 <Columns 1>
 <HeaderL ''>
 <HeaderC ''>
 <HeaderR ''>
 <FooterL ''>
 <FooterC '#'>
 <FooterR ''>
 <HFMargins 1.00" 0.50" 1.00" 0.50">
 <HFFont
  <Font
   <FFamily 'NewCenturySchlbk'>
   <FSize 14>
  > # end of Font
 > # end of HFFont
 <NumStyle LCRoman >
> # end of Page
<Page
 <PageType BodyPage >
 <PageNum '1'>
 <PageSize 8.50" 11.00">
 <TextRect
  <ID 3>
  <Pen 15>
  <PenWidth '0.500 '>
  <Fill 7>
  <Inverted No >
  <BRect 1.00" 1.00" 6.50" 9.00">
  <TRNext 0>
  <TRAutoConnect Yes >
 > # end of TextRect
> # end of Page
<TextFlow
 <TextRectID 3>
 <Para
  <PgfTag 'TOC Title'>
  <ParaLine
   <TextRectID 3>
   <String 'Table of Contents'>
  >
 > # end of Para
> # end of TextFlow
# End of MIFFile
```

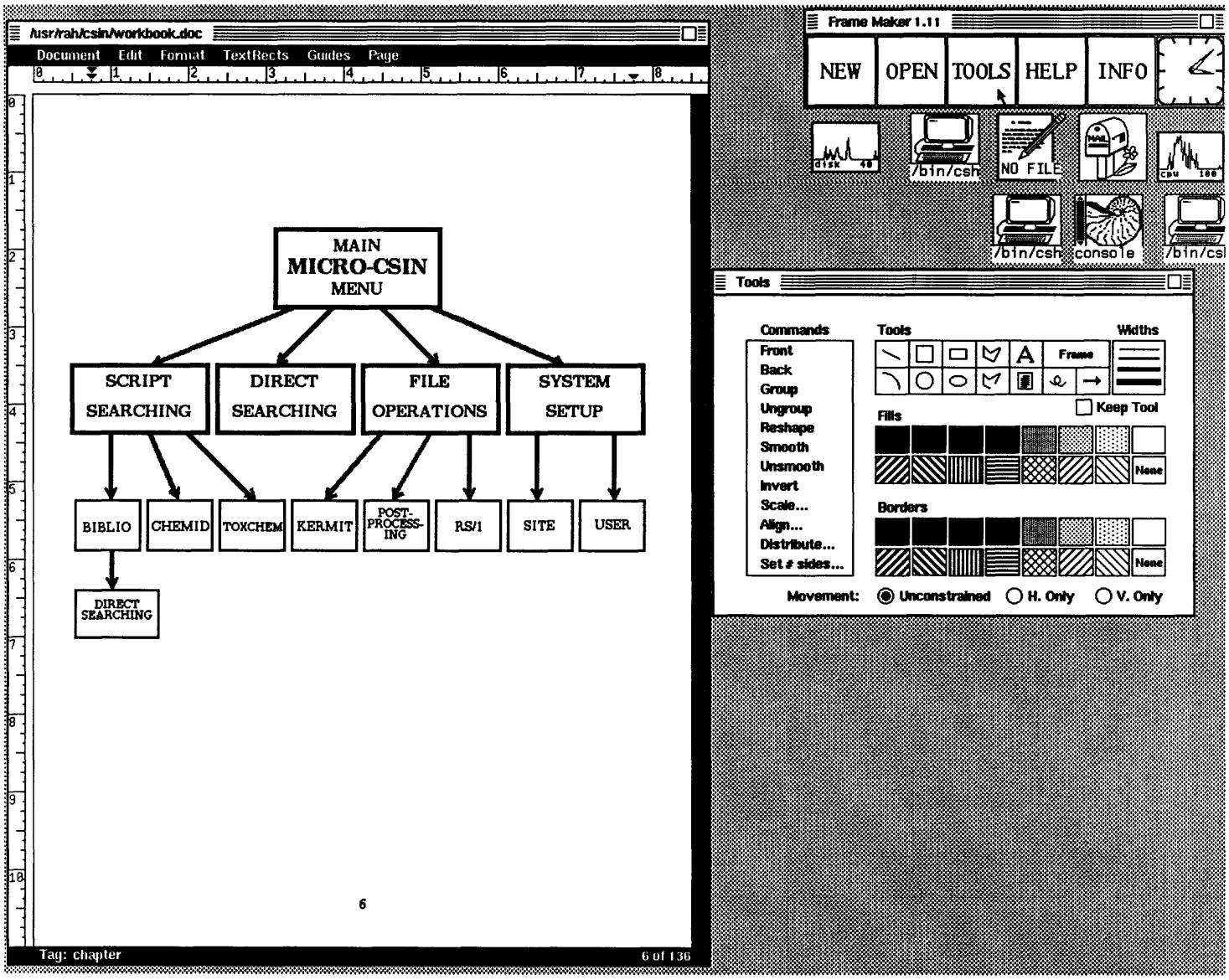

Figure C-7.--Example of TOOLS window showing drawing options.

Equations

Equations are constructed by entering the text and then leading or kerning the characters manually to the desired position. In addition, superscripts or subscripts can be added or modified by selecting options from the *Font* menu. A useful document of special symbols and clip-art, *HelpSymbols.doc*, is provided with FrameMaker specifically for constructing equations. Included in this document are commonly used mathematical symbols in a variety of sizes, such as integral sign and large braces.

Table of Contents

A table of contents can be generated automatically by FrameMaker by executing a program called *fmbook* from a separate window. The option selects section headings to be entered in the table of contents by their paragraph-component name. The selection of paragraph-component names are system definable and are placed in a file. The format of the table of contents can be customized by the user; features, such as page size, number of columns, margins, headers and footers, can be defined and are placed in a file. This flexibility allows users to format the table of contents to meet USGS specifications; for example, fourth-order section headings can be included. The output from *fmbook* is a new table of contents with a file name that is identical to that of the file name for the report except for the addition of the suffix *TOC*.

Rotating Text and Anchoring Graphics Frames

The drawing feature in FrameMaker does not have the capability to rotate text. This is a limitation because USGS publication specifications commonly require vertical text on the ordinate axis of a graphic. Frame Technology, Inc., plans to add the capability to rotate text in 90-degree increments with their next release of FrameMaker. Rotation of text in 90-degree increments should be sufficient for most graphic applications.

Although FrameMaker allows the anchoring of graphic frames to a mark on a page, a graphic on a following page can not be anchored to a previous page. Reports commonly contain full-page graphics. When properly placed in a report, full-page graphics are located on the page following the first reference to the graphic in the text. Ideally, if the reference is moved to a different page when the report is edited, the page containing the graphic should follow the page containing the reference to that graphic. FrameMaker has this capability only for graphics on the same page as the anchor. The ability to anchor a graphic on a following page will be added in the next release of FrameMaker.

Superscripts and Subscripts

The insertion of superscripts and subscripts within lines of text is a simple choice selected from the *Font* menu. However, the present method that is incorporated in FrameMaker to calculate line spacing is affected by the insertion of superscripted or subscripted text. Adding a superscript or subscript appears to increase the line spacing. In FrameMaker, line spacing is the white space between the bottommost character of a given line and the topmost character of the following line. The line-spacing algorithm will be modified with the next release of FrameMaker.

An acceptable method of entering superscripts and subscripts is being used in the interim. Instead of selecting *superscript* or *subscript* from the *Font* menu, a smaller point size is chosen for them. After entering the *superscript* or *subscript*, it is leaded upwards or downwards until it begins to affect the line spacing.

Scanning Images

Raster images can be transferred directly into FrameMaker. FrameMaker has the capability to scan images projected on the screen, saving the raster image to a file for transfer into a report. The resolution of the screen, however, is only about 72 dots per inch; this resolution is unacceptable for publication.

A scanner with a resolution of 300 dots per inch was not evaluated as part of this project. The means to transfer raster images with a resolution of 300 dots per inch, however, is available within FrameMaker. The addition of a scanner would allow the combination of text with graphics generated outside of FrameMaker, thus avoiding manual page composition. Raster images can not be edited directly within the FrameMaker software, but all the drawing tools may be used to enhance the images. Unwanted areas can be masked and new features added.

Interoperability with Other Word-Processing and Graphics Software

FrameMaker provides filters for transferring text or graphics or both created with the following software packages: troff, Interleaf, Document Content Architecture (DCA), MacPaint, and MacDraw. Frame Technology, Inc. also supplies samples of filters to allow users to create their own filters using MML. Raster images from scanners and screen-captured images can be transferred into FrameMaker.

Filters for transferring reports from FrameMaker to other word-processing or ERP systems are not included. Such filters can be written using MML, but considering that most word-processing software are an extremely small functional subset of an ERP system, the filtering program would remove page-composition format. Because FrameMaker provides full-featured word-processing capabilities in addition to page-composition capabilities, downloading and uploading the contents of a report for text-editing purposes is not required.

EVALUATION METHOD AND SYSTEM FUNCTIONS EVALUATED

The method for evaluating the software entailed producing camera-ready copy for a typical report to be published in the USGS's WRIR series. The report was produced by both conventional report-processing methods and the FrameMaker ERP software.

The final ERP version of the WRIR consisted of 92 pages including text, 13 tables, and 41 graphics. Many of the complex graphics were created manually by illustrators. Manual and computer-generated methods for creating graphics were compared. Page-composition procedures and transferring of computer-generated graphics into FrameMaker were evaluated.

PERFORMANCE EVALUATION

Evaluation of the ERP system was undertaken by testing text processing, graphics integration, page composition, report management, and the user interface. The evaluation was based on the required functions to produce camera-ready copy of complex, technical reports. Selection of the functions to be evaluated also was based on related studies, such as those conducted by the National Software Laboratories (National Software Testing Laboratories, 1987, p. 7). The evaluation was limited to testing the functions needed to create, edit, and prepare camera-ready copy of a WRIR. The following system functions were tested by the editorial assistant preparing the camera-ready copy and the authors of this report:

1. Formatting text
2. Inserting additional text
3. Deleting text
4. Movement within text
5. Cutting and pasting
6. Selecting typeface
7. Setting tabs
8. Headers and footers
9. Anchoring graphic frames
10. Column layout
11. Spelling checker
12. Formatting symbols
13. Graphics
14. Editing multiple pages

Although a semiquantitative method was used to determine ratings, some element of subjectivity also was involved. System functions were tested and subjective ratings were made by the editorial assistant and the authors of this report based on prior experience producing WRIS's using conventional word-processing software and 16-bit personal computers. The primary conventional word-processing software used for this evaluation was WordMARC Composer. WordMARC Composer was used by the office conducting this evaluation for all report preparation prior to obtaining FrameMaker for this evaluation.

On the basis of the evaluation, FrameMaker software provides excellent text-processing capabilities and good to excellent page-composition capabilities (table C-3). Results of the evaluation also indicate that anchoring graphics frames and constructing equations are rated as fair.

Table C-3.--*Definition of evaluation ratings*

- Excellent--The completion of the function using the FrameMaker software was: (1) substantially faster or substantially easier compared to the WordMARC Composer software and associated graphics software; or (2) there was no comparable function available in the other software packages, and the function in the FrameMaker software was rapid, east to use, and consistently resulted in an acceptable product.

- Good--The completion of the function using the FrameMaker software was: (1) moderately faster or moderately easier compared to the WordMARC Composer software and associated graphics software; or (2) there was no comparable function available in the other software packages, and the function in the FrameMaker software produced an acceptable product with moderate effort or minor limitations.

- Fair-- The completion of the function using the FrameMaker software was: (1) virtually the same with respect to time and ease of completion compared to the WordMARC Composer software and associated graphics software; or (2) there was no comparable function available in the other software packages, and the function in the FrameMaker software produced an acceptable product with substantial effort or major limitations.

COMPARISON OF CONVENTIONAL REPORT PROCESSING METHODS WITH ELECTRONIC REPORT PROCESSING METHODS

Conventional report processing methods in USGS offices conducting water-resources investigations commonly are a mix of manual and automated processes. In the Oregon office that conducted this evaluation, report drafts are delivered to an editorial assistant in either handwritten form or as a computerized ASCII text file. Tables are provided to the editorial assistant using formats similar to text drafts.

In the Oregon office, a software package known as WordMARC Composer is used with an IBM PC/AT for preparing camera-ready copy of a report. A laser printer, manufactured by Hewlett Packard (LaserJet II), is used with the IBM system. A limited number of typefaces and point sizes are used with the LaserJet II printer; these include Prestige Elite, Line Printer, and Times Roman. Although some graphics are computer generated, no method exists for integrating text and graphics using the conventional methods. The conventional method used in the Oregon office entails manually cutting and pasting graphics onto the camera-ready copy.

The results of the evaluation showed that from the point of receiving a draft, initial loading of the report by either typing or direct upload of an ASCII file takes nearly the same time whether using WordMARC Composer, the word-processing system used in the Oregon office, or FrameMaker. The first WRIR transferred into FrameMaker took additional time due to two factors: (1) the editorial assistant was not familiar with FrameMaker's capabilities, and (2) the paragraph and heading components had not been defined. Once the paragraph and heading components have been stored in a template, they can be used again without alteration for future WRIS's.

In both WordMARC Composer and FrameMaker, the majority of the final page composition is spent constructing tables. Because of difficulties with mixing typefaces, proportional spacing, and superscripts when printing on a Hewlett-Packard LaserJet printer from WordMARC Composer, all tables are constructed using a fixed-spaced typeface (Prestige Elite). Spaces instead of tabs are used in constructing tables. FrameMaker has no difficulty mixing fixed and proportionally spaced typefaces. FrameMaker provides four types of tab styles; left, right, centered, and decimal. Use of tabs for constructing tables markedly decreases the number of keystrokes. In addition, the tabs in FrameMaker can be modified dynamically by repositioning tab markers with the mouse on a visible ruler at the top of the document (fig. C-8). Modifying the tab positions allows for quick balancing of table layout and simple editing to accommodate modified data or an additional column.

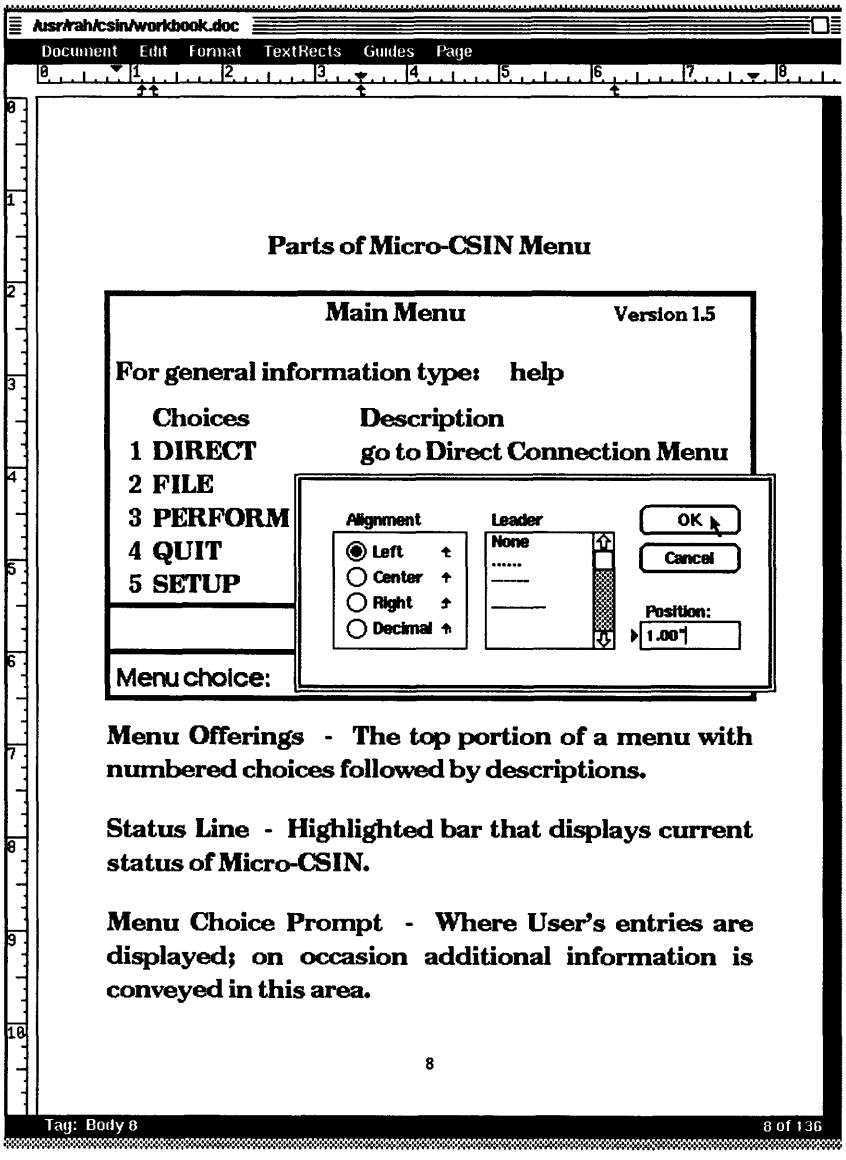

Figure C-8.--Example of menu for the tab options.

Graphics are not presently integrated within WordMARC Composer for printing. The advantage of FrameMaker is the ability to anchor frames or areas, except in this case, to reference points, such as the initial text reference to a graphic. This decreases the time required for final page composition using the initial draft when incorporating modifications because the area set aside for a graphic will be moved from page to page when the size of the text increases or decreases.

By using proportional typefaces, continuing paragraphs onto the following page with single-line control, and condensing tables with tabs all decrease the total number of pages required for the final report when compared to conventional methods. The report prepared for the evaluation was reduced to 92 pages from 116 pages, a 21-percent decrease. For the publication of the report produced during this evaluation, a savings of $130 was incurred.

The page composition of the final report incorporates techniques that are not available for conventional word-processing systems. Authors commonly require final page composition in specific formats that differ from USGS publication standards, such as those required by technical journals. Time delays result when formats, such as double-column formats, are needed and have to be produced manually by USGS publications staff or sent to a contractor. Production costs are usually increased in these situations as well. The ability to produce a variety of page-composition formats as simple as entering text was not considered a possibility as recently as 2 years ago.

CONCLUSIONS

On the basis of the evaluation in the Oregon (Portland) office of the USGS FrameMaker software provides easy to use and rapid text-processing and page-composition capabilities as compared to conventional word-processing methods for the preparation of WRIR's. Results of the evaluation also indicate fair ratings for anchoring graphics frames within text with some additional performance limitations for full-page graphics. Additional software limitations are described below.

Strengths of the FrameMaker software include versatile page and report structuring, report format templates, and the SunView windowing interface. As a result of the evaluation, a template for WRIR's was designed and stored for subsequent production. The software also offers menu selections for selecting typefaces, column layout, and headers and footers. The *undo* feature that is incorporated into the software lends further versatility to document preparation. Among the best of FrameMaker's features is the *Spelling Checker*. Both menu and text displays of the *Spelling Checker* along with the customized dictionary feature are superior to commonly used word-processing software for microcomputers. Alternate spelling options are extensive; the *Spelling Checker* performs both faster and more accurately than WordMARC Composer.

Additional strengths of the software noted throughout the evaluation include document formats or filters provided by way of the ASCII translation program and the MML. Reports created using FrameMaker are contained in *binary* files that are easily transferred through other computer system that support UNIX file transfer program, *ftp*. Drawing features and preparation of mathematical equations are additional strengths of the software because of ease of use and system-supplied symbols and clip art. Another useful feature of the software is the Table of Contents utility. The Table of Contents utility eliminates the need for manually labeling section headings and page references in the table of contents of the report. FrameMaker's customized formatting features also meet USGS report specifications for producing a table of contents.

Limitations of the software include the inability to rotate text because USGS publications specifications commonly require vertical text on the ordinate axis of a graphic. The inability to anchor a full-page graphic frame to the text contained on a page preceding the graphic is another software limitation.

Constructing superscripts and subscripts also present minor problems in report preparation using FrameMaker. Because line spacing is increased when a superscript or subscript is added within a paragraph, a smaller point size must be used for the superscript or subscript.

The virtual-memory operating system of the Sun workstation offers broad functionality for an integrated word-processing and page-composition package, such as FrameMaker. Because FrameMaker operates within the SunView windowing environment, multiple pages may be viewed on the workstation screen and are easily copied into FrameMaker windows. Facing pages of reports also can be viewed on the screen simultaneously because of this capability, thus facilitating page layout. The virtual-memory operating system of the Sun workstation allows the production of

reports with an essentially limitless number of pages, and the power of the processing unit is sufficient to ensure rapid leading, saving, and global changing of text or page composition in reports exceeding 100 pages.

Interoperability of FrameMaker with other word-processing and graphics packages is accomplished by way of system-supplied and customized filters. Integrated word-processing, graphics, and page composition utilities eliminate the need to transfer the contents of reports to and from separate software packages, thus decreasing the learning curve and incompatibility problems.

Comparisons of ERP methods to conventional report-processing methods indicate additional advantages of a fully integrated software package, such as FrameMaker. Complex report and graphics transfers and manual cut and paste procedures are eliminated. The use of proportional typefaces, widow and orphan control, and condensed tables composed using tab construction results in decreasing the total number of pages of the final version of the report when compared to conventional report-processing methods. As a result, a 21-percent decrease in printing costs was achieved with the ERP version of the report prepared during the evaluation. Although additional time is required for preparing a structured template for page composition during the initial typing stage, the ability to store templates allows rapid production of subsequent reports with a similar format. Hence, although more time was invested in creating original page composition for a WRIR using ERP methods as opposed to conventional report-processing methods, substantial time can be saved in producing subsequent reports because the format was saved as a template. Additional options for page composition, such as double-column format, provide enhancements to reports that formerly required substantial time for manual layout.

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