U.S. GEOLOGICAL SURVEY
NATIONAL COMPUTER TECHNOLOGY MEETING:
PROGRAMS AND ABSTRACTS
RANCHO MIRAGE, CALIFORNIA
MAY 19-23, 1996

Compiled by Kim L. Shank

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FOREWORD

The U.S. Geological Survey's (USGS) Eighth National Computer Technology Meeting (NCTM) focused on World Wide Web activities and advancements in the use of Geographic Information Systems to disseminate hydrologic information to our customers and the public. Many presentations during the meeting included on-line demonstrations of the accessibility of hydrologic data on the World Wide Web. The 16th Annual Environmental Systems Research Institute (ESRI) User Conference was held the same week at the Palm Springs Convention Center. Attendees from both conferences were able to participate in presentations and training at both conferences.

This report contains abstracts presented at the NCTM `96 meeting in Rancho Mirage, California. The abstracts are of technical papers and demonstrations on the use of the World Wide Web, Geographic Informations Systems, system administrations techniques, and application development for storage and retrieval of hydrologic and business data.

Extensive training continues to be a major part of the National Computer Technology Meeting. Six topic tracks for training were conducted at this meeting, including Applications, Geographic Information Systems, Local and Wide area networking, Programming, System Administration, and the World Wide Web. Training courses ranged from introductory courses to detailed, advanced courses.

Colleen A. Babcock
Technical Coordinator

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AGENDA

Sunday, May 19, 1996

3:00 pm - 8:00 pm	Registration	Grand Ballroom Foyer
5:30 pm - 7:30 pm	Welcome Hospitality	Sunset Suite
8:00 pm - 9:00 pm	Mike Hathaway Memorial	Salon D

Monday, May 20, 1996

7:00 am - 5:30 pm	Registration and Information Services		Grand Ballroom Foyer
8:00 am - 8:15 am	GIS Orientation		Desert Suites 2 & 3
	Training Sessions		
8:00 am - 4:30 pm	PGM	Introduction to the Python Programming Language	Salon A
8:00 am -10:00 am	SA	Installing Microsoft Windows NT Server	Salon C
8:00 am -11:30 am	WWW	WWW Server Administration	Salon D
8:00 am -10:00 am	SA	MacIntosh System Administration	Salon E
8:15 am -10:00 am	GIS	ArcView for the Uninitiated	Salon F
8:00 am -10:00 am	APP	AIS Future Happenings	Salon G & H
8:15 am -10:00 am	GIS	Printing and Plotting in ARC/INFO	Desert Suites 2 & 3
10:00 am -10:30 am	**BREAK**		
10:30 am -11:30 am	NET	Remote Access Using ISDN BRI	Salon C
10:30 am -11:30 am	SA	Legal Responsibilities and Liabilities of System Administration	Salon E
10:30 am -11:30 am	GIS	New Horizons in Digital Data Acquisition	Salon F
10:30 am -11:30 am	APP	Synchronize: Calendaring and Task Management	Salon G & H

10:30 am -12:00 pm — Presentations on GIS — Desert Suites 2 & 3

Moderator - *Robert Pierce*

Updating GIS Coverages

Revising Feature Data from Merged Multiple Map and Image Sources, *Thomas A. Connolly Jr., NMD, Reston, VA*

Scanned Map Graphics as Tools for Thematic Data Collection, *Laurence R. Moore, NMD, Rolla, MO*

Surface Water Applications

Analysis of Changes in Channel Geometry, Lower Virgin River, Arizona and Nevada, *Timothy D. Liebermann and Marsha M. Hilmes, WRD, Las Vegas, NV*

Description of Basinsoft, A Computer Program to Quantify Drainage-Basin Characters, *David A. Eash and Craig A. Harvey, WRD, Iowa City, IA*

Thinning Reach File 3 to Enhance the Nationwide Rivers Inventory Geographic Information System, *Peter H. Murtaugh and Stephen E. Suitt, NMD, Reston, VA*

Creating a Gaging Station Database for Minnesota, and Parts of North Dakota, Iowa, and Wisconsin Using a GIS, *Chris A. Sanocki, WRD, Mounds View, MN*

AGENDA—CONTINUED

11:30 am - 1:00 pm	**LUNCH**		
	Training Sessions		
1:00 pm - 5:30 pm	SA	PARTS - An Intro to Quick and Dirty System Administration	Salon C
1:00 pm - 5:30 pm	APP	Ingres Administration	Salon D
1:00 pm - 3:00 pm	NET	Introduction to Wide-Area Network Monitoring and Troubleshooting on the WRD DIS-II Cisco Routers	Salon E
1:30 pm - 3:00 pm	GIS	Use of the ARC Regions Data Model in WRD	Salon F
1:00 pm - 3:00 pm	SA	Integrating Software Applications in a Mixed Unix and Windows Environment	Salon G & H
1:00 pm - 3:00 pm	Spider SIG Meeting, Ken Lanfear		Los Ranchitos Rooms - Mojave
1:00 pm - 1:30 pm	Presentation on GIS Moderator - *Robert Pierce*		Desert Suites 2 & 3
	The National Spatial Data Infrastructure, *Billy R. Tolar, Jr., NMD, Reston, VA*		
1:30 pm - 2:00 pm	Training (GIS) - Metadata in ArcView-II		Desert Suites 2 & 3
2:00 pm - 3:00 pm	Presentations on GIS Moderator - *Robert Pierce*		Desert Suites 2 & 3
	Landuse/Landcover		
	A Comparison of GIRAS Agricultural Land-Use Data with 1994 Large Scale Agricultural Land-Use Data, *Douglas J. Newcomb, WRD, Raleigh, NC*		
	Using a Geographic Information System to Integrate National Wetlands Inventory Data with Digital Line Graphs, *Daniel R. Sechrist and Russell D. Berry, NMD, Reston, VA*		
	Programming		
	Graphic Display of Spatial Database Query Results, *Jeffery D. Wendel, NMD, Rolla, MO*		
3:00 pm - 3:30 pm	**BREAK**		
	Training Sessions		
3:30 pm - 5:30 pm	WWW	Introduction to HTML	Salon E
3:30 pm - 5:30 pm	APP	Options for Converting Documents Between FrameMaker and Another Format	Salon G & H
3:30 pm - 5:30 pm	GIS	Standards Dissemination, Sharing of Coverages, DSDL NWIS-II Connection	Desert Suites 2 & 3
3:30 pm - 5:30 pm	SA	Installing Microsoft Windows NT Server	Salon F
7:00 pm -10:30 pm	ESRI Conference Hospitality and Poster Session (Transportation by buses)		

AGENDA—CONTINUED

Tuesday, May 21, 1996

7:00 am - 5:30 pm	Registration and Information Services		Grand Ballroom Foyer
	Training Sessions		
8:00 am -11:30 am	WWW	Enhancing Web Documents with Graphics	Salon A
8:00 am - 9:00 am	SA	SA Corner	Salon C
8:00 am - 9:00 am	NET	Using and Setting Up SLIP on a DG	Salon E
8:00 am - 9:00 am	APP	Cartographic Design and Production, Part 1—Preliminary vs. Final Copy Requirements	Salon F
8:00 am -10:00 am	APP	AIS Email and DBA Issues for System Administrators	Salon G & H
9:00 am -11:30 am	NET	10BaseT LAN	Salon C
9:00 am -10:00 am	SA	Introduction to Automated System Management by dwm	Salon E
9:00 am -10:00 am	APP	Cartographic Design and Production, Part 2—Hardware Graphic Capabilities Proofing Devices	Salon F
10:00 am -10:30 am	**BREAK**		
	Training Sessions		
10:30 am -11:30 am	PGM	Fortran Futures—F90 & F95	Salon D
10:30 am -11:30 am	SA	Making dwm, an Automated Unix System Manager, Work Harder for You	Salon E
10:30 am -11:30 am	APP	Cartographic Design and Production, Part 3—Fact Sheet Process Maps-on-Demand: It's NOT WYSIWYG Future of Publishing and Printing	Salon F
10:30 am -11:30 am	APP	ZMail, the Geomail User Agent	Salon G & H
11:30 am - 1:00 pm	**LUNCH**		
	General Session - Salon D & E		
1:00 pm - 1:10 pm	Welcome - *Gloria J. Stiltner* ..... Chief, Distributed Information System Program Office		
	Introduction - *Verne R. Schneider* ..... Assistant Chief Hydrologist for Technical Support		
1:15 pm - 2:15 pm	Guest Speaker - *Graciela Perez, ScD, CPE* ..... Occupational Safety and Health Act (OSHA), Speaker and Ergonomist		
2:15 pm - 3:00 pm	Keynote Speaker - *Jack Dangermond* ..... President, Environmental Systems Research Institute (ESRI)		
3:00 pm - 3:30 pm	**BREAK**		
3:30 pm - 5:30 pm	All System Administrators Town Meeting Moderator - *Gloria Stiltner* Status of AIS, DIS, and NWIS Questions and Answers		Salon D & E

AGENDA—CONTINUED

4:30 pm - 5:30 pm	Presentations on Programming Techniques Moderator - *Linda K. Peng*	Salon G & H
	Object-Oriented Concepts Used in a Data-Import Program, *Todd W. Augenstein, WRD, Richmond, VA*	
	Development of a Toolkit for SDTS Applications, *Phyllis S. Altheide, NMD, Reston, VA*	
	Development of a Platform-Independent Paperless Time and Attendance System, *Greg Huttman, OPS, Reston, VA*	
5:45 pm - 7:45 pm	NCTM '96 T-Shirt Hospitality	Sunset Suite
8:00 pm -10:00 pm	Regional Computer Specialists Meeting	Los Ranchitos Rooms
	Northeast Region - *Merritt Blalock*	Mojave
	Southeast Region - *Jim Bettandorff*	Anza
	Central Region - *Scott McEwen*	Navajo
	Western Region - *Graig McHendrie*	Caliente

Wednesday, May 22, 1996

7:00 am - 5:00 pm	Registration and Information Services	Grand Ballroom Foyer
8:00 am -10:00 am	Presentations on the World Wide Web Moderator - *Lewis Wade*	Salon D & E
	Overview of the WWW Activities in WRD, *Kenneth J. Lanfear, WRD, Reston, VA*	
	Real-Time Streamflow Data on WWW, *David W. Briar, WRD, Helena, MT*	
	National Geospatial Data Clearinghouse, *David L. Govoni, NMD, Reston, VA*	
10:00 am -10:30 am	**BREAK**	
10:30 am -11:30 am	Presentations on the World Wide Web *(Continued)* Moderator - *Lewis Wade*	Salon D & E
	Texas District Experience, *James A. Bisese, WRD, Austin, TX*	
	South Platte NAWQA on WWW, *Sharon L. Qi, WRD, Denver, CO*	
11:30 am -12:30 pm	**LUNCH**	
	Training Sessions	
12:30 pm - 2:30 pm	WWW Map-Based WWW Interactive Inline Images	Salon A
12:30 pm - 2:30 pm	APP Customized AIS Reports	Salon C
12:30 pm - 2:30 pm	Presentations on Applications for Data Activities Moderator - *Scott McEwen*	Salon D
	Use of Geographic Information Systems and Other Computer Resources for Evaluating Chloride Distribution in the Coastal Plan Aquifers of Virginia, *Willet D. Wilson, WRD, Richmond, VA*	
	Customized Software for Model Calibration and Visualization of Reservoir Water-Quality Model Results, *Wendi S. Young, WRD, Raleigh, NC, Brian R. Schachte, OPS, Reston, VA, and Jerad D. Bales, WRD, Raleigh, NC*	

AGENDA—CONTINUED

A Procedure to Generate Slope-Area Plots and Compute Estimated Discharge of Peak Flows in the Field Using a Portable Computer, *Charles Berenbrock, WRD, Boise, ID*

Development of a Computer Program to Graphically Present Well-Log Data, *Eric W. Strom, WRD, Pearl, MS*

The GIS Weasel - An Interface for the Development of Parameter Inputs for Watershed Modeling, *Roland J. Viger, Steven L. Markstrom, and George H. Leavesley, WRD, Denver, CO*

An Electronic Exhibit of the National Atlas, *Wayne Vickers, NMD, Reston, VA*

12:30 pm - 2:30 pm	Presentations on Partnerships Moderator - *Greg Snyder*		Salon E

Implications for Information Technology in The USGS Strategic Plan, *Douglas R. Posson, OPS, Denver, CO*

Future Plans for the Telecommunications Network of the Department of the Interior, *James L. Hott, OPS, Reston, VA*

A Collaborative Approach to Telecommunications Infrastructural Design and Development, *Rodney W. Payne, Jr, OPS, Reston, VA*

Hydrography Framework Partnership, *Keven Roth, NMD, Reston, VA*

Methods and Results of a Committee to Study Hardware/Software Compatibility in the Colorado District, *Theresa J. Lane, WRD, Denver, CO*

A Real-Time Data-Acquisition Network, *Scott L. Daugherty, WRD, Indianapolis, IN*

Training Sessions

12:30 pm - 2:30 pm	PGM	Data and Text Processing with AWK	Salon F
12:30 pm - 2:30 pm	SA	Cookbook Approach to Data General Security	Salon G & H
2:30 pm - 3:00 pm	**BREAK**		
3:00 pm - 5:00 pm	Information Systems Council (ISC) Meeting		Los Ranchitos Rooms - Caliente

Training Sessions

3:00 pm - 5:00 pm	WWW	Enhancing Web Documents with Graphics	Salon A
3:00 pm - 5:00 pm	PGM	Introduction to Korn Shell Programming	Salon C
3:00 pm - 5:00 pm	SA	Cookbook Approach to Data General Security	Salon D
3:00 pm - 5:00 pm	WWW	World Wide Web Authoring	Salon E
3:00 pm - 5:00 pm	APP	Preprocessing Geomail	Salon F
3:00 pm - 5:00 pm	NET	Introduction to Network Analysis Tools	Salon G & H

5:30 pm - 7:30 pm	Hospitality	Sunset Suite
8:00 pm -10:00 pm	Demos and Birds of a Feather Gatherings Video Conferencing Demo Scientific Computing During and After DIS-II, *Lee DeCola* Computer Associates on Ingres The "Best" Way to Configure the HP650C!!	

AGENDA—CONTINUED

Thursday, May 23, 1996

7:00 am - 3:30 pm	Information Services		Grand Ballroom Foyer
	Training Sessions		
8:00 am - 9:00 am	APP	LABEL - A Database Program to Manage Addresses	Salon A
8:00 am - 10:00 am	PGM	RDB Futures	Salon C

8:00 am -11:30 am — Presentations on New Approaches in Presenting Data — Salon D

Moderator - *Jim Bettandorff*

Use of a Web-based Virtual Poster Presentation Style as a Complement to Standard U.S. Geological Survey Paper Reports, *Jennifer B. Sharpe and John M. Kilpatrick, WRD, Lincoln, NE*

The Learning Web, *Maura J. Hogan, GD, Reston, VA*

Case Study on Evaluating Educational Hypermedia Systems for Teaching Earth Science to Middle School Students, *Denise A. Wiltshire and Carmelo F. Ferrigno, OPS, Reston, VA, and Payson R. Stevens, InterNetwork Media, Inc., Del Mar, CA*

The Inter-American Geospatial Data Network: A Multi-lingual WWW Geospatial Data Distribution System, *Michelle Anthony, EROS Data Center, Sioux Falls, SD*

Examination of the Internet as a Venue for Conducting Administrative Business, *Fred Travnicek and Gerry Lebing, OPS, Reston, VA*

The Access USGS Regional Web Server, San Francisco Bay Ecosystem, *Leonard J. Gaydos, NMD, Richard E. Smith, WRD, Rex Sanders, GD, and Laura Zink, Contractor, USGS, Menlo Park, CA*

National Park Visualization Using Surveyor and U.S. Geological Survey Data, *Robert L. Stevens, Tony Herr, Robert G. Clark and Brian R. Schachte, OPS, Reston, VA*

Using the World Wide Web to Interrogate Ingres Databases, *John P. Crisci and William S. Sockriter, III, WRD, Denver, CO*

8:00 am -11:30 am — Presentations on System Administrative Techniques — Salon E

Moderator - *Susan Trapanese*

Supporting DOS and Window Applications in a Unix Environment, *M. Roland Bryant, WRD, Little Rock, AR*

Parallel Execution of System Administration Commands, *Patrick M. Rael, WRD, Little Rock, AR*

Beyond Workstations: A Possible Future Computing Environment for the U.S. Geological Survey's Water Resources Division, *David Boldt, WRD, Reston, VA*

Managing Tape Backups on Ever-Changing Computer Systems over a Local-Area Network, *David K. Yancey, WRD, Sacramento, CA*

A Multithreaded Backup System for Distributed Networks, *G. Peter Harrigan, Jr., NMD, Rolla, MO*

Releasing Software on Compact Disc-Read Only Memory (CD-ROM), *Mark G. Negri, WRD, Reston, VA*

AGENDA—CONTINUED

Visualizing the Computer Environment, *Patrick M. Rael, WRD, Little Rock, AR*

Implementing UNIX Electronic Mail Group Aliases Through the Use of Relational Databases, *Thomas W. Cutter, WRD, Sacramento, CA*

Training Sessions

8:00 am -11:30 am	NET	Geomail System Administration	Salon G & H
9:00 am - 2:30 pm	PGM	CGI-BIN Programming	Salon A
9:00 am -11:30 am	SA	Microsoft Windows NT Server Administration	Salon F

10:00 am -10:30 am **BREAK**

11:30 am -12:30 pm **LUNCH**

Training Sessions

12:30 pm - 2:30 pm	PGM	Advanced Korn Shell Programming	Salon F
12:30 am - 2:30 am	WWW	JAVA	Salon E
12:30 pm - 2:30 pm	SA	LINUX System Administration	Salon C
12:30 pm - 2:30 pm	SA	Integrating Software Applications in a Mixed Unix and Windows Environment	Salon G & H

2:30 pm - 3:00 pm **BREAK - Pick up soft drinks and head for ESRI Exhibits**

3:00 pm - 5:00 pm ESRI Conference Vendor Exhibit
8:00 pm -12:00 am NCTM '96 "Unplugged" Party

Training Tracks are identified with the following codes:

APP	Applications Programs
GIS	Geographic Information System
NET	Local and Wide Area Networking
PGM	Programming Languages
SA	System Administration
WWW	World Wide Web

INGRES BATCH-FILE PROCESSING TOOLS

ALLEN, *Bruce M., USGS, WRD, National Water Quality Laboratory, Box 25046, MS 407, Denver Federal Center, Lakewood, Colorado, 80225-0046*

Batch processing of flat files is required in almost any Management Information System (MIS) department. Flat files may originate as spreadsheets, disk deliverables, or time-series data from an instrument. Moving flat files into Ingres can be tedious since they usually require reformatting for the Ingres copy facility. Reformatting may include inserting parse tokens or tabs, or creating a file with a uniform record length. Manual intervention by MIS personnel is required to process each flat file. Time lost processing flat files manually could be spent doing more productive work.

Two tools have been created to process flat files and to speed their movement to an Ingres table structure. They are **bsql** and **ingfix**. **bsql**, or batch structured query language (SQL), was created to allow MIS personnel to automate the movement of flat files into Ingres. This C language program will process any group of flat files in a specified directory using SQL script written by the user. **bsql** can send mail to a user-specified Unix account if processing errors occur. The user needs only to check the mail to discover processing errors. **ingfix**, or Ingres fix, will process any column-oriented flat file and create a new flat file that now has the user-requested record length. Furthermore, **ingfix** allows the user to exclude data from the final reformatted flat file and to reformat date columns so they can be copied into Ingres table date columns. **ingfix** can send mail to a user-specified Unix account if processing errors occur. The reformatted flat file can be processed directly by Ingres or by the **bsql** facility described above.

DEVELOPMENT OF A TOOLKIT FOR SPATIAL DATA TRANSFER STANDARD APPLICATIONS (SOFTWARE APPLICATIONS: GIS AND OBJECT-ORIENTED APPLICATIONS)

ALTHEIDE, *Phyllis, USGS, NMD, 1400 Independence Road, MS 821, Rolla, Missouri 65401*

The Spatial Data Transfer Standard (SDTS) enables the exchange of geospatial data between different environments without the loss of information, regardless of the hardware and software. One aspect of implementing SDTS requires data producers and GIS software vendors to develop SDTS import and export capabilities. An object-oriented toolkit, the SDTS Common Software Platform (SDTS-CSP), is being developed by the National Mapping Division (NMD) of the U.S. Geological Survey to aid in the implementation of SDTS encoders and decoders. The architecture of the C++ class library of the SDTS-CSP follows the conceptual, logical, and format levels of SDTS. The SDTS-CSP offers an application programming interface that supports interaction with SDTS modules and transfers. The SDTS-CSP has been used by the NMD and some vendors. The development of the SDTS-CSP is continuing as enhancements and improvements are being made.

OBJECT-ORIENTED CONCEPTS USED IN A DATA-IMPORT PROGRAM

AUGENSTEIN, *Todd W., USGS, WRD, 3600 West Broad Street, Room 606, Richmond, Virginia 23230*

Object-oriented concepts are being used in the design of a data-import program for the U.S. Geological Survey's National Water Information System-II (NWIS-II). The import program consists of a class database, a user interface, and a batch/edit processor.

The class database contains a master list of possible classes and attributes. A class is a model of a real-world entity that consists of data and functions. The details of how a class are implemented are hidden from the user and programmer. The user views a class as a real-world entity. Example entities are wells, diversions, reservoirs, and water-treatment plants. An entity is described by a list of attributes, such as a latitude and longitude of a well. The programmer views a class as a data structure and a set of functions for reading, writing, and processing data.

The user interface is used to describe the content and format of an input file. The content is described by identifying which classes and attributes the file contains. An object-oriented approach allows the use of familiar hydrologic concepts when describing an input data file. The format is described by providing information required to read the data. The interface writes the information to an import control file, which is used by the batch/edit processor.

The batch/edit processor is an independent program used to perform batch updates of NWIS-II. The processor uses a control file to determine how and what data to read from the input file (class of data and attributes to process). Data are read and mapped to a class (or several classes). Data are then validated by data type, format, and database integrity. Data not passing validation checks are written to a text error file, otherwise, data are updated, inserted, or deleted.

Object-oriented concepts allow for familiar presentation of hydrologic concepts in the user interface and provide for reusable and modular code. Because classes inherit data and functions from other classes, code can be written once and shared among classes. The class library developed also can be used in other programs requiring the retrieval or update of data from NWIS-II.

WATER-RELATED SCIENTIFIC ACTIVITIES OF THE SPATIAL APPLICATIONS SECTION, NEVADA DISTRICT, U.S. GEOLOGICAL SURVEY, 1995

AUGUST, *Marianne, USGS, WRD, 333 West Nye Lane, Room 203, Carson City, Nevada 89706*

The U.S. Geological Survey (USGS) cooperates with Federal, State, and local water-management agencies to collect hydrologic data and make scientific studies that improve the knowledge and understanding of Nevada's water resources. The Spatial Applications Section of the USGS, Nevada District, is involved in the creation, analysis, and display of digital data to support such activities and studies. The section routinely incorporates state-of-the-art technologies such as geographic information systems (GIS), remote sensing, near-real-time data transmission, comprehensive relational databases, and multidimensional digital models. Some of the activities and studies the Spatial Applications Section of the Nevada District was involved with in 1995 are:

- Ash Meadows Ground-Water Discharge
- Data Synthesis of Irrigation Drainage Areas
- GIS for Lake Tahoe Basin
- Ground Water Budget for Dayton Valley
- Ground-Water Conditions In and Near Newlands Irrigation Project, Carson Desert
- Ground-Water Conditions, Desert Valley
- Humboldt Basin Mining Effects
- Intermittent Recharge in Eagle Valley
- Nevada Basin and Range National Water-Quality Assessment
- Railroad Valley Evapotranspiration
- Truckee-Carson Program, River Basin Modeling and Monitoring
- Upper Carson GIS: Spatial Data Base for Water Rights Information
- Virgin River Geomorphic Study
- Walker River Assessment
- Water Resources Data Report, Water Year 1994
- Water Resources Evaluation of Spanish Springs Valley

A Procedure to Generate Slope-Area Plots and Compute Estimated Discharge for Peak Flows in the Field Using a Portable Computer

BERENBROCK, *Charles, USGS, WRD, 230 Collins Road, Boise, Idaho 83702-4520*

The U.S. Geological Survey has made indirect measurements to estimate peak discharge in streams for many decades. The slope-area method is the most commonly used indirect discharge measurement procedure. A new icon-driven procedure was developed to produce slope-area plots and slope-area computation (SAC) program input files using a portable computer in the field. The procedure requires a total station for surveying and recording field data, a 386 or higher portable computer with 4 or more megabytes of random access memory, the Quattro Pro 6 for Windows spreadsheet program, and the SAC computer program.

The slope-area method requires location and elevation of high-water marks and channel cross sections and identification and selection of roughness coefficients within a stream reach. Traditionally, high-water marks and cross sections have been surveyed using an automatic level, and the data have been recorded manually on field notesheets. These data subsequently were plotted on-site using a portable drafting table. If evaluation of the plots indicated a need to improve the definition of the geometry in the reach, additional high-water marks and (or) cross sections were surveyed and plots modified. These data were used to compute the discharge estimate in the office using a mainframe computer. These procedures were cumbersome and time consuming. Frequently, the important step of plotting the data in the field was not done because of insufficient time. Neglecting this step often resulted in poorly chosen locations for cross sections, which adversely affected the overall quality of the discharge estimate.

A new procedure permits automated data plotting and field computation of the discharge estimate. An electronic total station is used to survey and record data in the field. Each surveyed point is labeled with a specific prefix. For example, the label "X2-10" describes the tenth surveyed point of the second cross section. Data can be downloaded into a Quattro Pro 6 for Windows spreadsheet at any time as the survey progresses. Plan-view and cross-section plots can be created and viewed on the computer monitor at any time by selecting predefined icons on the menu bar. Once the field crew is satisfied that the geometry is adequately defined, selection of another icon generates a SAC input file that can be saved in ASCII format. The input file is used with the SAC computer program to calculate the discharge estimate in the DOS environment. Total time required to download data from the total station to the spreadsheet, create plots, and compute discharge is much less than traditionally required to plot data and compute discharge estimates. Because high-water marks and cross sections can be readily incorporated at any time, this procedure can improve the overall quality of the discharge estimate. The procedure would benefit from the use of a portable printer, but such a printer is not essential.

BEYOND WORKSTATIONS: A POSSIBLE FUTURE COMPUTING ENVIRONMENT FOR THE U.S. GEOLOGICAL SURVEY'S WATER RESOURCES DIVISION

BOLDT, *David, USGS, WRD, 12201 Sunrise Valley Drive, MS 445, Reston, Virginia 22092*

A combined hardware and software contract, Distributed Information Systems II (DIS-II), which has supplied the U.S. Geological Survey's Water's Resources Division's computing environment since 1992, will end on September 30, 1996. Decisions on a computer system architecture for future computation need to be made as soon as possible so that hardware and software purchases can be planned.

One of the original goals of DIS-II was to distribute computing capacity to each individual while sharing home directories and software so as to provide a flexible and easily scaled environment with all the advantages of both the PC and mini-computer paradigms. In a large part, this has been achieved. However, this computer system architecture did not anticipate the significant system administration effort of supporting a network of workstations, the rate at which performance enhancements have been required, and the increasing scarcity of commercial software for our hardware platform.

Experience is showing that there are many advantages to X-terminals over workstations. A computing environment of Unix servers and X-terminals is much easier to administer than multiple workstations. In addition, it is proving more cost effective to upgrade servers than to replace aging workstations.

The degree to which the software community has concentrated its efforts on MicroSoft Windows, to the exclusion of all other operating systems, is unprecedented and unexpected. As a result, it is increasingly important to be able to access software that runs only under MicroSoft Windows, and many sites have begun buying PC's for individual use. This is likely to result in a system that will be even more difficult to administer than that of Unix workstations. In an environment of desktop PC's, each user is a system administrator, software cannot be updated easily for all PC's, and there are many incompatible hardware and software combinations. In addition, PC hardware becomes obsolete and needs to be replaced even more frequently than Unix hardware.

A promising solution for providing access to MicroSoft Windows applications is software that runs on the MicroSoft NT operating system, which can provide access to a MicroSoft Windows session to any computer capable of running X-Windows, such as a Unix workstation or an X-Terminal. The multi-user capabilities of MicroSoft NT permits a single PC to serve software applications to multiple X-terminals.

In a mixed Unix and MicroSoft NT environment, software and home directories can be shared among all systems using Network File System (NFS), just as they are now in DIS-II. Users will be

able to keep both Unix and MicroSoft Windows files in a single home directory. This centralization of these resources will make backups and operating system and software upgrades easier than an environment in which users have their own PC's. It also will be easier to maintain security and control the spread of computer viruses if software coming into the system passes through just a few checkpoints. In an X-Terminal and Unix/NT servers environment, we can maintain all of our current software and systems knowledge while adding access to MicroSoft Windows applications in a controlled, maintainable system where software and hardware upgrade costs are minimized, and backups can be assured.

DESCRIPTION OF THE STORAGE AND RELATION OF WATER-QUALITY AND QUALITY-ASSURANCE DATA IN THE NATIONAL WATER INFORMATION SYSTEM

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The U.S. Geological Survey (USGS) has designed a new National Water Information System (NWIS). NWIS is an interdisciplinary system that integrates all hydrologic data and data processing that is currently represented in the National Water Information System I, the National Water Data Exchange, the National Water Data Storage and Retrieval System, and the National Water-Use Information System of the USGS. The NWIS data model incorporates a new approach to data processing that requires users to change the way they conceptually view their data. One of the new concepts is the establishment of activities. Activities are the record of hydrologic work done in the field or in the laboratory. To demonstrate how the activity portion of NWIS functions, this paper describes the activities a field person performs to collect environmental and quality-control samples for a water-quality analysis and the associated data model structures used to store this information. In particular, emphasis is placed on the approach that should be taken to store quality-assurance information in the NWIS database in conjunction with data from environmental measurements and samples collected using standard procedures, such as the "equal-width-increment" method. Associated quality-control samples include split replicates, concurrent replicates, source solution blanks, sampler blanks, splitter blanks, pump blanks, and equipment blanks. This paper demonstrates a portion of the activity subsystem illustrating the relationship between the collection of water-quality and quality-assurance data in the field to the storage of these data in NWIS. The NWIS design ensures that these data remain accessible for subsequent review and approval, thereby assuring our users of quality information.

U.S. GEOLOGICAL SURVEY FEDERAL FINANCIAL SYSTEM REMOTE DATA ENTRY PILOT

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The U.S. Geological Survey, Water Resources Division (WRD), in cooperation with the Office of Program Support, Office of Financial Management, began implementing a remote data entry program for accounts payable documents into the Federal Financial System (FFS) during fiscal year 1995. The WRD is geographically dispersed across the United States with a field office (cost center) in almost every state.

The new pilot program allows the field to enter accounts payable documents into the FFS and process them to complete the transaction and update the general ledger. The results of the data entry session are transmitted back to the field activity the following day to update their local Administrative Information System (AIS) from which they are able to produce management reports. The duplication of effort and reconciliation of the two systems is eliminated.

A pilot program involving nine sites was implemented in January 1995. The pilot was evaluated in May 1995. The sites indicated that remote data entry was streamlining processes and saving time previously spent processing and reconciling documents. As a result of this feedback, the pilot was expanded in June 1995 to include nine additional sites, bringing the total to 18 sites. WRD hopes to have all sites using remote data entry by June 1996.

The pilot program is to be expanded in December 1995 to include usage of travel manager software to process employee travel. A program has been written to electronically transmit the travel information into the FFS. This electronic transmission will post the expenditure to the general ledger and generate payment to the traveler. The data will then update the local AIS the following day. The program has allowed a more expeditious recognition of expenses. It has resulted in cost savings related to the elimination of duplicate data entry.

SUPPORTING DOS AND WINDOW APPLICATIONS IN A UNIX ENVIRONMENT

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The Arkansas District of the U.S. Geological Survey has experimented with Merge, a proprietary software technology that allows DOS or Windows software to be run on Intel-based Unix systems, such as SCO Unix or UnixWare. Because Merge runs in a Unix environment, multiple DOS or Windows sessions can be run concurrently. Merge also takes advantage of the X-Window system's capability to export a display to a remote computer or X-terminal. Users at the remote computer or X-terminal can connect to the Intel-based Unix system and run a DOS or Windows session with this capability. Users have access to all features of Unix, DOS, and Windows with this arrangement.

USE OF MULTIMEDIA AS AN AID FOR OUTREACH

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Results of 1995 congressional hearings for the U.S. Geological Survey (USGS) showed that the agency needs to find new and innovative ways to promote and publicize its programs and improve its ability to provide timely products to its current and potential customers. Increasing competition is making it necessary for managers to seek and use the new technology that is available for disseminating information about USGS activities to the public. The Maryland-Delaware-D.C. District of the USGS has been successful in producing some of its products and presentations by use of new multimedia technologies available on the market. Several new computer-based tools for preparing nontraditional products, such as colored fact sheets, data on disks, on-line publications (World Wide Web), interactive multimedia, video, and full-color publications are presented. An overview of what is available to the multimedia publisher, including graphics, audio, video, animation, three-dimensional modeling, as well as cost considerations, also are presented.

REVISING FEATURE DATA FROM MERGED MULTIPLE MAP AND IMAGE SOURCES

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The U.S. Geological Survey (USGS) collects and revises digital line graphs (DLG) by extracting data from topographic maps and image sources. The DLG's are revised primarily by using digital orthophoto quadrangle (DOQ) images. The DOQ's are produced by scanning and differentially rectifying photographs from the National Aerial Photography Program or from other sources. A digital raster graphic (DRG), which is produced by scanning and georeferencing an existing topographic map, can be used by itself for collecting feature data or with a DOQ for revising feature data. The USGS is currently combining DRG's and DOQ's and using this merged product to collect up-to-date DLG's in one step, rather than using the more traditional method of digitizing from map sources and then revising from images. Partnerships also are being developed with other agencies, State and local organizations, and commercial companies to obtain attribute information unobtainable from images, such as names and unique reference ID's. Taken together, these actions will ensure that current feature data are available through the National Spatial Data Infrastructure in a more timely manner.

USING THE WORLD WIDE WEB TO INTERROGATE INGRES DATABASES

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The Webintool software is a generic building tool to provide a link between Structured Query Language (SQL) databases and the World Wide Web (WWW). Webintool allows an Ingres database to be queried using the WWW graphical user interface. With Webintool, users can view pre-defined reports or develop ad hoc requests for data.

Webintool provides additional flexibility not found in the existing WWW server software that will allow the Computer Services Unit at the National Water Quality Laboratory (NWQL) to create more powerful WWW applications. It also gives NWQL personnel the ability to access real-time data with a familiar graphical user interface - the World Wide Web.

A Database Program to Manage Addresses

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In an effort to minimize the work required to maintain an office's address list, a program named "label" was developed by the Virginia District office of the U.S. Geological Survey. By use of a graphical user interface, an individual can organize and categorize address data quickly and easily, making retrievals adhere to individual needs. Entries retrieved can be output in a format that can be read by FrameMaker to create mailing labels.

The program uses a relational database management system for storing the data. An office can define a master database that is accessed by everyone but which restricts updating to only those with permission. In addition, an individual can create and set up independent databases with little effort.

This program was written in an object-oriented language, tcl/tk, and requires less than 5 megabytes of disk space for an 800-address installation. The program requires little training, and its simplicity and portability provide users with a flexible system.

IMPLEMENTING UNIX ELECTRONIC MAIL GROUP ALIASES THROUGH THE USE OF RELATIONAL DATABASES

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Unix Mail groups are created to simplify sending electronic mail to large lists of users. They short cut the task of typing multiple electronic mail addresses through the use of pre-created aliases.

These aliases exist for personal and system-wide usage. System-wide aliases are created to be used by many individuals, are of general interest in nature, and are designed to be shared. The lists of mail addresses are stored in individual files that are included in a system-wide default file.

Managing the many individual files is difficult. Names for aliases may not describe the contents well enough to indicate who would be the recipient, and having many aliases makes it difficult to find the right one and requires editing many files to maintain.

A simplified method of organizing and maintaining system-wide aliases is needed. Mail groups based on organizational structure and geographic location have values determined for all users. They are hierarchical and can be easily organized and maintained in a relational database. Using an organized approach to alias creation, updating, deletion, and mailing through the use of relational databases would benefit U.S. Geological Survey Electronic Mail users.

A REAL-TIME DATA-ACQUISITION NETWORK

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The U.S. Geological Survey, Indiana District, in cooperation with the U.S. Army Corps of Engineers, currently is developing a real-time data-acquisition system for early detection of rising stream stage and precipitation events. The first generation of this system has been delivered and installed for the Army Corps and is currently in operation in the Chicago and northwestern Indiana areas.

The system is designed around a personal computer that is used as a base station to receive and process data from remote monitoring stations. These remote stations are equipped with data loggers that collect river and precipitation data by means of sensors. The data loggers use cellular modems to transmit data to the base station. The base-station computer uses a conventional modem attached to a serial port and captures any data sent through this port. Once data have been received, processing begins. Depending on the type of data received, various types of processing are performed.

Three different types of calls can be generated by the data-acquisition system: a daily status call, a real-time call, and an outcall. A status call occurs once each day and transmits a single sensor value; therefore, each data logger must generate a status call for each sensor it is monitoring. A real-time call occurs when a specific threshold level on a sensor being monitored is exceeded. The data logger then immediately calls the base station and transmits this data. The base station also is equipped to call any of the data loggers and obtain all of the current sensor readings. All sensor values are reported when this type of call is initiated.

When a daily status call is received, the data are captured, reformatted, and written to a storage file. This same processing is used if the base station generates the call to the data-acquisition device to obtain its current data values. When a real-time call is generated in the field, processing is slightly different. Once the data have been received by the base station, data are reformatted and written to a storage file, and a window appears on the screen informing the user of the data transmission. This window displays the station name from which the call was received, the date and time of the call, and the current type and value of the sensor. This window also displays the previous reading received for comparison purposes. The station data also are printed at this time, providing a hard-copy record of the real-time call. No matter what type of call is received, the data are always reformatted and written to a storage file. These storage files are then used to generate daily reports and are inserted into a database for backup and storage.

BIRDS-OF-A-FEATHER SESSION: SCIENTIFIC COMPUTING DURING AND AFTER DIS-II

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All scientific data exist in a highly generalized scheme spanned by four dimensions:

- feature
- space
- time
- scale

A great many scientific analytical operations can be thought of as manipulations of data within and among these dimensions. For example:

- A histogram manipulates the scale of a single feature.
- A scattergram views two features within the same space, time, and scale dimensions.
- Map overlay views two or more spatial features at the same time and place.
- A hydrologic model manipulates multiple features in the same place and at the same scale but over multiple time periods.
- Rock fractures can be understood by examining their multiscaling behavior.

Although DIS-II had the potential for delivering these capabilities to a large number of scientists, many perceive it as having fallen short of this goal. The question to be explored in this session is what kind of computing environment is needed by U.S. Geological Survey (USGS) scientists for:

- data sharing
- visualization
- animation
- advanced analysis
- modeling
- transformations in space, time, and scale

Participants should be prepared to share concrete examples from their work and contribute to what may be an opportunity for shaping the future computing environment of the USGS.

DESCRIPTION OF BASINSOFT, A COMPUTER PROGRAM TO QUANTIFY DRAINAGE-BASIN CHARACTERISTICS

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A computer program named Basinsoft currently is being developed to use geographic information system (GIS) software to quantify 27 selected morphometric characteristics for a drainage basin using digital cartographic data. The characteristics quantified include the basin measurements of area, length, slope, relief, shape, and aspect and the channel (stream) measurements of length, slope, sinuosity, density, order, and frequency. Basinsoft was originally developed in 1988 to use digitized topographic-map data to quantify 16 selected morphometric characteristics. Since the original coding of Basinsoft in 1988, the programs comprising Basinsoft have been further developed and extensively upgraded. They have been converted from PRIME to Data General Unix operating systems, tested to verify the accuracy of quantifications, and documented. The programs now comprising Basinsoft are written entirely using Arc Macro Language to ensure portability between computer platforms running ARC/Info revisions 7.0 or greater.

Basinsoft requires the generation of four source-data layers representing the drainage divide, hydrography, hypsography, and an elevation model of a drainage basin and the assignment of attributes to three of the four source-data layers. Generation of and assignment of attributes to these data layers is facilitated by utility programs developed specifically for these purposes. An optional program included with Basinsoft can be used to quantify area-weighted characteristics for a drainage basin. Area-weighted characteristics can be quantified from a variety of potential data sources that represent the distribution of characteristics such as precipitation, land use, soils, and geology.

Comparison tests between Basinsoft quantifications and manual topographic-map measurements of 12 primary basin characteristics support the validity of Basinsoft computations. Results indicate that Basinsoft quantifications of basin slope are dependent on source data used to generate the hypsography source-data layer. Because of inherent differences between the data sources, basin slope is accurately quantified when digitized topographic-map data are used to generate the hypsography source-data layer and significantly underestimated when digital-elevation-model data are used.

Compared to manual methods of measurement, Basinsoft significantly decreases the amount of time and effort required to quantify selected basin characteristics. The simplicity and automation of Basinsoft, and accompanying utility and optional programs, facilitates application of Basinsoft without requiring extensive GIS experience. Basinsoft has been used by the U.S. Geological Survey (USGS) to quantify characteristics for 164 drainage basins in Iowa for the development of statewide flood-estimation equations and for more than 500 watersheds in the Columbia River Basin in the northwestern United States, for analyses used in the interagency (U.S. Forest Service and U.S. Environmental Protection Agency) Eastside Ecosystem Management Project. Basinsoft

is currently being used by the USGS to quantify characteristics for drainage basins in Nebraska for the development of statewide flood-estimation equations. The USGS National Water-Quality Assessment Program (NAWQA) National Synthesis Team is investigating the use of Basinsoft to provide consistent basin-characteristic quantifications for the Nation's NAWQA study units. In addition to multiple-basin processing for regional studies, Basinsoft also can be used to process single basins to quantify input characteristics for hydrologic modeling.

A Mechanism for Distributed Use of a User-Supported Software Pool (Computer Operations and Management)

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Traditionally, software installation on a Unix system has been a duty that could only be performed by a system administrator because root privilege is usually required. With personnel cuts putting a higher demand on system administrators' time, it becomes harder to answer users' demands for the installation of small utility software, which must take a backseat to mission-critical production systems. The only alternative, then, is to enable the users to install and maintain this software themselves.

The method devised at the U.S. Geological Survey's Mid-Continent Mapping Center allows system administrators to take advantage of the ability of more sophisticated users to build and maintain such utility software packages without root privilege. Little or no intervention from system administrators is required, and the security of the system isn't compromised. When a user has installed a package, a single copy of that package is available to the entire site, preventing duplication by multiple users. Clever use of automount and symbolic links allows the software pool to look like a single resource to end users across multiple platforms, with a minimum of duplication. Redundancy can be added for load sharing or higher availability as necessary. Individual packages are still kept separate from each other so that package removal or upgrade can be done cleanly, without leaving remnants of the old package behind.

THE ACCESS USGS REGIONAL WEB SERVER

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A new regional World Wide Web server, Access USGS—San Francisco Bay and Delta, guides clients from other agencies and the public directly to the latest U.S. Geological Survey reports, data, digital maps, and interpretations for the region. Most of the Access USGS content originates with work done for the San Francisco Bay Ecosystem Program, but other related work also is presented. A highlight is the Bay area regional database, which provides access to, and transfer of, USGS digital map data.

The Access USGS design is purposely duplicative. Content is organized by overlapping themes that will interest users: Overview, Water Flow, Wetlands, Water Quality, Hazards, Urban, Digital Maps, and Other Links. For example, clicking on Water Flow makes presentations on that topic available. Some of these same presentations also may be listed under Water Quality. This reduces user frustration at being forced to guess under which topics data will be filed or having to know a hierarchy of directories. Full design implementation calls for organizing the material in even more ways, providing views for students, educators, agency managers, the public, and others.

The first ("home") page of Access USGS shown by the server contains a map of the Bay area, the topic selection menu, several search-tool buttons, and a Current Highlight. The highlight, changed on a biweekly basis, keeps the service fresh and interesting, inviting return visits. In the short time since the service has been officially available, it has attracted a lot of attention. One mark of its success is the number of other local web servers that have established links to it.

A MULTI-THREADED BACKUP SYSTEM FOR DISTRIBUTED NETWORKS (COMPUTER SYSTEMS APPLICATIONS)

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As the use of computer systems matures in industry, the need for a reliable, low-maintenance backup and recovery system becomes increasingly evident. There is no easy way to use the old backup and recovery tools on modern distributed networks where files reside on hundreds of machines. The few systems that are able to handle distributed file systems tend to consume too many resources and make poor use of the backup media. Rather than force an old application to do a job that it was not designed for, programmers developed a new method of backing up a distributed file system for the Unix environment.

This new multi-threaded backup program is designed to simultaneously backup distributed file systems located on various machines connected by a local area network. A configuration file specifies what file systems and machines to backup, when to start the backup, how many concurrent backups to run, and what tape devices to use. Two queues are maintained: the first is for file systems waiting to be backed up, and the second is for finished backups waiting to be written to tape. Several threads are spawned to service the two queues. The first set of threads takes entries from the first queue and performs a backup on that client. The backup is done by connecting to a remote process on the client and bringing a compressed image back on a stream socket. The backup is then placed in the second queue, and another entry from the first queue is serviced. Meanwhile, a second set of threads takes entries from the second queue and writes them to tape. Each backup is postpended to the previous backup on tape, making more efficient use of the backup media. This process continues until both queues are empty, at which time the tapes are rewound and the program terminates.

Surprisingly, the load on the backup server is not affected much. Whenever a thread blocks because of input/output, another thread takes over; this allows the backup process to use almost all of its allotted CPU time. The load on the network can be controlled by changing the number of threads the backup server process spawns. Decreasing the number of threads also decreases the number of clients transmitting a backup over the network. Maintaining the system is very easy. As new machines are added to the network and old ones removed, only the configuration file needs to be changed.

THE LEARNING WEB

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As a publishing medium, the World Wide Web (WWW) transforms linear, static documents into dynamic information offering interactivity and connectivity. For educational resource providers, the WWW provides an environment where concepts and activities can be technologically enhanced to promote exploration and learning. "Exploration" is a strong educational concept that can engage students in their own learning process. Technologically-rich environments, such as the WWW, amplify the power of "exploration" by significantly increasing the size of the informative world accessible by students.

Visitors to the U.S. Geological Survey (USGS) WWW pages will discover The Learning Web, a portion of the USGS web that focuses on and highlights USGS educational products for kindergarten through grade 12. The uniform resource locator (URL) for this site is *http://www.usgs.gov/education/learnweb/*. The Learning Web promotes the idea that visual identity, navigation, and innovative use of technology determine the effectiveness of the WWW as a learning tool. Goals for the production of educational resources for the WWW include (1) accentuating concepts and activities with visual, textual, and technological emphasis; (2) designing materials that encourage on-line exploration and navigation; (3) developing pages that will retain their context when printed by users; (4) establishing feedback and announcement pages; and (5) constructing links to other WWW materials that support the content.

FUTURE PLANS FOR THE TELECOMMUNICATIONS NETWORK OF THE DEPARTMENT OF THE INTERIOR

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The DOINET is the wide-area backbone network for the Department of the Interior (DOI). As of November 1995, the backbone network is composed of 15 locations including the Denver and Washington administrative service centers and the DOI Main Interior Building in Washington, D.C. All DOI bureaus use DOINET in varying degrees. This year promises continuing evolution and growth of the network.

Most DOI bureaus, including the Bureau of Indian Affairs, National Park Service (NPS), National Biological Service, and the Bureau of Land Management, are planning to expand network use. The DOINET backbone plans for Fiscal Year 1996 include the addition of three new backbone node locations. Sites under consideration are Salt Lake City, Utah, and Billings, Montana, with the third site optional. In addition, DOI bureaus located in Alaska will increase connectivity to DOINET through connections to the Alaska Regional Telecommunications Network (ARTNET).

The current backbone network is composed of T1 [1.544 mbps (megabits per second)] dedicated circuits. With the continuing increase in traffic on the network (especially on circuits linking major concentrations of employees, such as between the Washington, D.C., and Lakewood, Colorado, areas), additional trunk capacity will be required. A prototype is planned for two sites with equipment enhancements to support Asynchronous Transfer Mode (ATM) (standards-based cell relay) connected with either T3 (45 mbps) or fractional T3 (6-12 mbps) circuit capacity. This capacity will be provided either by a dedicated circuit(s) or a public ATM service, depending on cost.

For connectivity to the backbone, many bureaus are sharing access to the backbone network by sharing equipment and the circuit which links the location to the backbone network. U.S. Geological Survey and NPS are exploring shared implementations at a number of locations where offices are either in the same city or collocated within the same building. Other agencies outside DOI have been inquiring about using DOINET. In particular, the U.S. Department of Agriculture (USDA) has a signed memorandum of agreement which establishes the basis for sharing DOINET. The USDA, Forest Service is planning a prototype connection to DOINET from Alaska to either Portland, Oregon, or Boise, Idaho.

Demands for higher-speed remote access for employees on travel, telecommuters, and access from home continue to increase. Prototypes are underway using the Integrated Services Digital Network service in Reston, Menlo Park, and several smaller offices.

DEVELOPMENT OF A CLIENT/SERVER ADMINISTRATIVE SYSTEM FOR PROPERTY MANAGEMENT

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The U.S. Geological Survey (USGS) has undertaken an initiative to fully re-engineer the existing property management functions using client/server technology. This system will employ several computing architectures; the bureau's accounting system, which resides on the USGS mainframe computer; a minicomputer, which will contain the entire property database; and end-user microcomputers, which will serve as client workstations. Development is being done using an object-oriented design and development software tool. Third party open systems software allows connectivity to the mainframe computer in order to perform the real-time edits and updates to the bureau's accounting system, where applicable.

This project is being developed in three phases. Phase One will include the General Services Administration Excess Property System. This database resides on a Unix database but performs edit checks and table updates in the bureau's accounting system and produces an electronic file sent to the Bureau of Land Management. The third party open systems software enables calls to the mainframe computer based on actions performed by end-users. The second phase will replace functions currently being keyed into the bureau's accounting system by a property management service group. These functions include the property acquisition, property disposal, and custodial property officer (CPO) maintenance processes. The third phase will provide CPO's tools in which to perform electronic acknowledgment of transferred property, acceptance of new property, certification of CPO's annual inventories, transfer of existing property, both at the CPO and employee level, and provide querying and reporting capabilities, making full use of a graphical user desktop computing environment.

An overview of the system features and capabilities, as well as the progress towards implementation within the USGS, will be presented.

LABLINK: A COMPUTER APPLICATION TO MANAGE SAMPLE DATA BETWEEN THE NATIONAL WATER INFORMATION SYSTEM-II AND THE LABORATORY ANALYTICAL DATA SYSTEM OF THE U.S. GEOLOGICAL SURVEY

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LabLink is a U.S. Geological Survey (USGS) computer application consisting of an Ingres Windows/4GL graphical-user-interface to an Ingres relational database management system (RDBMS), a set of Unix computer routines, and an Internet file transfer protocol. LabLink manages sample data, including sample descriptions, analytical services requests (ASR's), and analytical results between two USGS RDBMS's: the National Water Information System-II (NWIS-II), distributed at nodes across the Nation, and the Laboratory Analytical Data System (LADS) at the National Water Quality Laboratory at Arvada, Colorado. The NWIS-II portion of LabLink stores sample data in the local NWIS-II database and transmits files of sample data to the Laboratory. The LADS portion of LabLink stores sample data in LADS and transmits files of sample data back to the originating NWIS-II Internet node. The LADS portion also includes the Unix file transfer protocol between Internet nodes.

LabLink was developed for use by the Laboratory and its customer agencies—primarily USGS field offices. A demonstration by field and Laboratory users shows how the use of LabLink reduces transcription errors, eliminates the need to enter analytical services requests multiple times as is now done, eliminates the duplication and maintenance of much of the field data in the Laboratory's database, and makes the data easily accessible and quickly available to both the Laboratory and the field offices. Using LabLink interactively, a field person stores data in the local NWIS-II database for an ASR, which includes all the data required by the Laboratory to identify and analyze the sample, and transmits the data to the Laboratory in LabLink-formatted files. At the Laboratory, LabLink automatically loads the data from the transmitted files into the Laboratory's database and transmits an ASR acknowledgment back to the originating field office. At the field office, the field person prints the sample label and the corresponding ASR, affixes the label to the physical sample, and mails the sample and the paper ASR to the Laboratory. When the sample arrives, Laboratory personnel interactively scan the bar-code on the sample label, retrieve the field's sample data, and store additional data about the sample's arrival condition. LabLink automatically transmits files of the sample arrival data back to the field office and automatically loads the data into the local NWIS-II database. After the sample is analyzed and the analytical results are entered into the LADS database, LabLink transmits the result files to the field office. At the field office, LabLink automatically loads the results into the NWIS-II database and prints a sample analysis report for the field person.

ADAPTING AN URBAN WATER DEMAND MODEL TO A WATERSHED SETTING

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The Institute for Water Resources-Municipal and Industrial Needs System (IWR-MAIN) version 5.1 is a menu-driven software package for personal computers that is designed to forecast urban water demand. The IWR-MAIN data input modules and algorithms were adapted to accept data at a watershed scale for the Columbia Dam project in central Tennessee. The project assessed the impact of increasing water demands on the available water resources in the Duck River watershed through 2050.

Version 6.1 replaced 5.1 in June 1995, solving many of the data reduction problems of version 5.1. Version 6.1 is engineered as an open-architecture system that allows the user full control over each data element. Because all of the econometric models and water-use coefficients are data-driven, the user can readily customize the model to the watershed.

Many U.S. Geological Survey (USGS) studies are now focusing on solving water problems at the watershed level. Changes in water demand within a watershed can have significant impacts on water availability and water quality. Sophisticated econometric models such as IWR-MAIN that were initially designed for urban settings can be transferred to a watershed setting. Data from existing USGS databases, such as SWUDS, AWUDS, and GWSI, as well as from NOAA and the U.S. Census Bureau, can be used to validate the model. Results from IWR-MAIN may stand alone or be input to other models, such as the Stream Quality Model (QUAL2E) (as used in the Duck River watershed) or the basin-budget Water Evaluation And Planning System (WEAP).

DEVELOPMENT OF A PLATFORM-INDEPENDENT PAPERLESS TIME AND ATTENDANCE SYSTEM

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The U.S. Geological Survey (USGS) has developed a platform-independent client/server Time and Attendance system. The initial release, a character-based version for operation on MS/DOS computers using the Sybase database, has been in use in a number of organizational units of the USGS since late 1995. An enhanced Windows version is replacing the DOS-character version. The new version also is capable of running under all major flavors of Unix, supports the Sybase, Oracle, and Ingres database engines, and can interface with a variety of project management systems in use at the USGS. A version for small offices that do not have networks or high-end database technology is planned for later in the year.

The system has been designed not only to operate on all major desktop technology platforms but also with the flexibility to adjust to variations in time and attendance business rules found in USGS offices and in most Federal agencies. In a departure from past reliance on control and supervision, the system optionally allows employees to enter their own arrival and departure times and hours worked.

Being one of only several Federal agencies to use a cross-platform development tool and put into production a mission critical, client-server application system has produced a wealth of experiences, both good and bad. A description of these experiences and the lessons learned from them is the basis of this presentation. Topics to be discussed include cross-platform development tool selection, required areas of expertise, contractor selection, change management, and issues related to software development, system testing, performance, scalability, end-user acceptance, implementation, and production processing.

METHODS AND RESULTS OF A COMMITTEE TO STUDY HARDWARE/SOFTWARE COMPATIBILITY IN THE COLORADO DISTRICT

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As part of a Colorado District planning initiative, the lack of timeliness in producing reports to meet cooperator needs was identified as a major concern of the Colorado District. A Colorado District Reports Core Group was formed to determine ways to improve the timeliness of report processing in the District. One area of concern was the electronic preparation of reports, especially when various types of computer hardware and software were being used. To address this concern, the Reports Core Group appointed a committee composed of project personnel, computer specialists, and illustrators—all of whom had knowledge and experience with a variety of hardware platforms and software packages and had experience in writing and preparing reports. One of the primary duties of the committee, known as the Hardware/Software Compatibility Committee (HW/SW Committee), was to determine the compatibility of the various hardware and software being used by the Colorado District authors with the FrameMaker and Adobe Illustrator packages being used by the Publications Section of the District. The committee completed its primary tasks within 3 months as a result of excellent team interaction and a high level of individual responsibility.

The HW/SW Committee met about seven times; however, electronic mail was the principal form of communication between the members. A survey distributed to Colorado District personnel assessed the types of hardware and software used by authors to prepare reports. The survey was distributed January 15, 1995, and by February 1, the HW/SW Committee had received 108 responses. Hardware or software used by five or more people was included for evaluation by the committee. The most commonly used hardware and software in the Colorado District included the DOS/Windows, the Macintosh, and the DG/UX platforms and their associated software.

The committee members then divided up the identified software, according to each committee member's expertise, to evaluate performance and write recommendations about the conversion of the software into FrameMaker and Adobe Illustrator. Each narrative included a short summary of the software package, its compatibility with FrameMaker and with Adobe Illustrator, its slide-making capabilities, and helpline and technical-support telephone numbers or contacts. The HW/SW Committee designed flow charts to illustrate the conversion of specific software and hardware into FrameMaker and Adobe Illustrator and designed a series of guidance matrices for converting the different types of software into FrameMaker and Adobe Illustrator. A glossary of acronyms for the evaluated software was completed, and a draft report was submitted in late April to the Reports Core Group for their review.

The final report was distributed with a letter from the District Chief to all personnel of the Colorado District on June 22, 1995. The committee, with the concurrence of the Reports Core Group and the District Chief, decided to place the entire report on World Wide Web (WWW) and

make it available Division wide. The report can be accessed from the Colorado District Home Page or by using the Uniform Resource Locator (URL) of *http://webserver.cr.usgs.gov.*

Since its publication, the report has received national attention. Presently, several requests from other Districts and Reston have been made for a hard copy of the report. The document will be a living document, and changes and updates will be made to the hard copy and to the electronic WWW copy as needed. Recommendations, suggestions, and changes to the document are welcome. T.J. Lane (tjlane@cr.usgs.gov) of the HW/SW Committee is the contact for requests for, changes to, and suggestions concerning the report.

AUTOMATED PERFORMANCE TESTING OF THE NATIONAL WATER INFORMATION SYSTEM-II

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Automated performance testing was implemented on the National Water Information System-II (NWIS-II) software using preVue-x. Testing was performed to provide assurance to Water Resources Division District and field offices that NWIS-II will operate in a multi-user environment, to identify areas within the NWIS that require code and database improvement, and to assist in making recommendations about District hardware configuration requirements.

The automated tool, preVue-x, is capable of capturing and reproducing user input and of recording metrics on selected user and system time requirements. Several scripts simulating critical district database operations were captured; they include data input, data processing and computation, data retrieval, and database applications and maintenance. Captured scripts were run individually or in user-specified combinations, concurrently or consecutively or both, simulating the efforts of up to 16 persons.

The performance tests were executed on various cpu and memory configurations of AV6000, AV8500, and AV9500 series Data General servers using a baseline version of the NWIS-II software and Arizona District database. At the conclusion of each test, the database was returned to its original state from backup so that all tests were conducted under identical database conditions.

Testing focused on the time it took to accomplish tasks under known hardware configurations and on the accuracy of the results. During the development of test scripts, all data that were entered and data that were displayed in output reports were verified; data are reverified during subsequent tests.

Automated testing will be a continuing process for each new image of the software to ensure that performance and functionality have not degraded from earlier NWIS-II software images.

DIGITAL ANALYSIS OF CHANGES IN CHANNEL MORPHOLOGY, LOWER VIRGIN RIVER, ARIZONA AND NEVADA

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In 1993, the U.S. Geological Survey began a study of the channel morphology of the lower Virgin River. Aerial photography from 1938 to 1995 and recent satellite images were being digitally analyzed to determine quantitative changes in channel morphology.

For a 30-mile stretch of the river, 8 separate reaches, each about 1 to 1.5 miles long, were being processed. Aerial photographs from 29 dates were optically scanned into digital images and registered to a standard coordinate system, using control points and image-processing techniques. Channel boundaries, sand bars, and the thalweg—the deepest part of the channel—were manually delineated onto prints of the registered images and then digitized into ARC/Info coverages. The coverages were verified for accuracy of locational coordinates and feature coding. These coverages were used as the base for further digital processing.

All digital processing was done using a combination of ARC/Info and FORTRAN programs developed for this study. The entire process was controlled through an interactive menu, designed for rapid sequential processing of a large number of image coverages for each reach. To begin processing, the reach orientation, or overall linear direction of the river within that reach, was delineated. The reach orientation was used in subsequent processing of each available image for that reach. Next, the area of the sand bars, the area of the channel, the thalweg sinuosity, and the maximum width of the channel meander belt, perpendicular to the reach orientation, were calculated for each image coverage. In addition, the reach was subdivided into a series of about 25 equal-width segments along the reach-orientation line. For each segment, lines were constructed that were perpendicular to the average orientation of the channel boundaries within that segment. These lines were used to calculate the width of the channel at the center of each segment. The calculated data were stored for further geomorphic comparison and interpretation.

The channel-area features for any two selected images can be overlaid for planimetric analysis, showing changes from one date to another. Also, several different types of stability maps can be produced using any of the delineated channel features. The selected channel features can be superimposed on a common base and the frequency of occurrence computed. Regions with high frequency of occurrence represent greater channel stability. Stability maps are a quantitative as well as visual way of looking at channel stability.

By using digital methods, a large data set can be processed and analyzed quickly and easily. These results can then be used to document channel changes through time, assess channel stability, and help understand geomorphic processes.

PREPARING FOR DATA TRANSFER TO THE NATIONAL WATER INFORMATION SYSTEM-II

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The purpose of this paper is to explain the use and advantages of the checking and verifying programs of the National Water Information System (NWIS) Program Office in preparing for the initial release of NWIS-II. Each District needs to be aware of how to minimize the impact of the NWIS-II transfer process on the District and to ensure all their data are transferable.

NWIS Program Office testing of the transfer software using data from several Districts indicates the transfer process will take approximately 4 to 6 weeks to complete. This process includes unloading the NWIS-I data from the MIDAS files, analyzing and converting the data to the NWIS-II format, writing to external files those data that contain "fatal" errors, and loading the converted data into the NWIS-II database. Because the transfer is already a lengthy process, it is important to keep the "fatal" errors to a minimum. This can be accomplished by cleaning up the data prior to transfer. To aid in the cleanup process, the NWIS Program Office released checking software to be used as a guide in the cleanup of the Ground Water Site Inventory System and the Water-Quality System. Since the initial release of the checking software, additional software was released to guide in the cleanup of the Automated Data Processing System and the NWIS-I sitefile using the VERIFY program and the Feature Parsing program, respectively.

Determining the necessity of a data cleanup would mean running the checking and verifying software then evaluating the output as to how to proceed with a cleanup of the NWIS-I data before transfer or to input later to NWIS-II the data that had been removed during transfer. Preparing for data cleanup would mean (1) designating a person to do this work, (2) running the programs available, (3) planning what databases would need to be transferred, and (4) deciding what updating and deleting to do (this should include some liaison between Districts when using the Feature Parsing software).

ATTRIBUTE SELECTION: A QUERY CONSTRUCTION AND ATTRIBUTE RETRIEVAL APPLICATION

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Attribute Selection (AS) is a dynamic query language generator designed and optimized for a large relational database. The development database for AS has been the National Water Information System II (NWIS-II), a complex water-resources database containing more than 480 tables. A portion of the code is specific to the NWIS-II data structure; however, the techniques used are applicable to other large relational databases.

Boolean logic is available for all attributes in AS. The choice of boolean operators is related to the attribute data types. AS augments the database query optimization by parsing queries into pieces that the database system can process efficiently. Relational joins that could overwhelm the database system are implemented outside the system using rdb commands. The width of data files produced by AS also is independent of the database system's limitations.

Query construction is tunable to specific areas of the database, and AS uses templates to provide the rules for query construction. These templates are structured query language maps of connections between entities for a given database section and connections to database sections that exist in other templates.

SCANNED MAP GRAPHICS AS TOOLS FOR THEMATIC DATA COLLECTION (SOFTWARE APPLICATIONS)

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Digital raster graphics (DRG) are computer images of maps made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator grid. Colors are standardized to remove scanner dependencies and artifacts. The final data set is about 10 megabytes in Tagged Image File Format with packbit compression.

DRG's can be easily combined with other digital cartographic products such as digital elevation models and digital orthophotoquads. Using DRG's and derivative products as source material makes vector data collection and revision faster, cheaper, and more accurate. Collecting vector data from DRG's on a computer screen results in fewer errors than collecting with digitizing table procedures, and it eliminates check plots and digitizing tables. The DRG combined with a digital orthophotoquad image gives collectors of thematic data a stronger frame of reference than either base source alone.

The USGS is currently producing DRG's of standard quadrangles through private-sector partnerships. All quadrangles at 1:24,000, 1:100,000, and 1:250,000 scales will be scanned over a period of approximately 2 years. Data are being produced in 1-degree blocks and delivered on CD-ROM.

THINNING REACH FILE 3 TO ENHANCE THE NATIONWIDE RIVERS INVENTORY GEOGRAPHIC INFORMATION SYSTEM

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The Nationwide Rivers Inventory (NRI) is a National Park Service database identifying 2,600 stream segments of the Nation's most outstanding recreational and ecologically significant waterways. The Mapping Applications Center of the U.S. Geological Survey is incorporating the NRI into a geographic information system (GIS) using the U.S. Environmental Protection Agency's (USEPA) Reach File 1 (RF1) as the primary base map for the project. To further enhance this somewhat coarse stream network of RF1, Reach File 3 (RF3) streams were added to selected stream basins where NRI stream segments were found. The integration process removed specified streams and their attributes from the RF3 and put them into the RF1 database, adding smaller tributaries and headwaters to the existing stream network. Recently, the USEPA made the RF3 database available to the public, triggering this national-scale project.

Each stream reach in the RF1 contains a stream basin identification or eight-digit hydrologic unit code (HUC). The corresponding HUC can be found in the RF3 database with a hierarchal relationship code between a stream and all of its tributaries within a given basin. This relationship code was used to remove specific reaches from the RF3 that were upstream from all NRI stream sites. The thinning process added an extensive stream network to the RF1, enhancing the assessment applications of the NRI.

RELEASING SOFTWARE ON COMPACT DISC-READ ONLY MEMORY (CD-ROM)

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In the development of specifications for Geographic Information Systems (GIS) software in early 1993, the Water Resources Division (WRD) of the U. S. Geological Survey greatly reduced costs by requiring "central site support" for software maintenance. An aspect of the central site support maintenance agreement was that the Spatial Data Support Unit (SDSU) in Reston, Virginia, would receive one copy of the most current version of the software. SDSU would then be responsible for reproducing and distributing the GIS software to each field office that had purchased it. The software, ARC/Info by Environmental Systems Research Institute (ESRI), was initially distributed on a single, quarter-inch cartridge (QIC) magnetic tape, which has a maximum storage capacity of 150 megabytes. As ARC/Info expanded in functionality and included on-line documentation, a single QIC tape could no longer be used to distribute the software. After researching many types of data storage media, the least expensive and most efficient media type proved to be CD-ROM. Since December 1994, two versions of ARC/Info have been released on CD-ROM to WRD field offices.

For several years now, CD-ROM has been the most popular media used to distribute software and data by organizations with a large user base. Technological advances and lower costs in CD-ROM publishing systems have now made CD-ROM a viable and cost-effective medium for organizations with a much smaller user base. There are several methods of writing to and reading from a CD-ROM. A major advantage that CD-ROM has over magnetic tape is that programs and data can be accessed directly from the CD-ROM without being copied to magnetic hard disk. However, the most effective method of implementing frequently used software is to store it on magnetic hard disk; therefore, writing software to CD-ROMs in a "live" format for the distribution of that software may not be the most efficient method. The CD-ROM International Standards Organization (ISO) 9660 standard format supports only Unix read and execute file and directory permissions. If software is to be copied from a CD-ROM, it is best written to the CD-ROM in a Unix tape file archiver (tar) command format because it preserves Unix read, write, and execute permissions, as well as symbolic links, set group-ID's, set user-ID's, and sticky bits. Data files are best written to CD-ROM in their native format because they can be copied from CD-ROM as easily as they can be accessed directly from the CD-ROM. Combining both the tar and native formats in programs, data and documentation has made the two releases of GIS software by SDSU successful. Determining which method is best for your end user along with the preparation of programs, data and documentation is the key to a successful CD-ROM distribution.

A COMPARISON OF GIRAS AGRICULTURAL LAND-USE DATA WITH 1994 LARGE-SCALE AGRICULTURAL LAND-USE DATA

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A major component of the Albemarle-Pamlico drainage study unit of the U.S. Geological Survey's National Water-Quality Assessment Program (ALBE-NAWQA) is the investigation of possible correlations between land use and water-quality characteristics in various subbasins. Subbasin boundaries, digitized from 1:24,000-scale maps, were used to characterize land use in small (less than 60 square miles in area) basins from U.S. Geological Survey 1:250,000-scale Geographic Information Retrieval and Analysis System for Handling Land Use and Land Cover Data (GIRAS) land-use data, digital maps based on photointerpretations completed in the mid-1970's. The agricultural areas from the basin-clipped GIRAS data were totaled and compared to 1994 crop and animal data provided by the U.S. Department of Agriculture 's Farm Service Agency (FSA) and Natural Resource Conservation Service (NRCS).

The purpose of the analysis was to determine if there were significant differences in agricultural land use estimated by using the two methods. Differences in basin area between the cropland-pasture GIRAS classification and the FSA cultivated-crop data for 1994 ranged from 1 to 48 percent of basin area. Of the 21 basins studied, GIRAS Confined Feeding Operations data consistently underestimated the presence of these operations when compared to the 1994 NRCS data.

IMPLEMENTATION OF A COMMENT TRACKING SYSTEM FOR THE NATIONAL WATER INFORMATION SYSTEM-II

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During testing of the National Water Information System II (NWIS-II), a need was identified to organize and archive user input on design, operational errors, and other general comments about the system. A comment tracking system was developed to meet this need. This comment tracking system accommodates the following functions:

1. Provide a way for testers and developers to comment on NWIS-II, suggest enhancements, and report problems.
2. Allow each comment to be associated with a specific component and application in NWIS-II.
3. Allow each component in NWIS-II to be associated with a responsible party. Consequently, all comments submitted to the system are directed to a specific person to resolve the comment satisfactorily.
4. Allow responsible parties to respond to each comment and to indicate how the comment has been addressed.
5. Provide a way for testers to find the status of comments.
6. Provide a mechanism for verifying the satisfactory resolution of a comment.
7. Provide reports for developers and managers regarding problems or comments about a particular application and the status of ongoing development.

An Ingres database was developed to store the comments and associated information as part of the comment tracking system. This database is available from any NWIS-II test site to registered users of the system. A Windows/4gl application was developed to access and update this database.

Testers of the system may comment on an application or report problems noted during testing. These comments are reviewed by NWIS-II management, assigned a priority, and then assigned to a responsible party on the NWIS-II development team. Each responsible party is able to remark on comments assigned to them. Developers also are able to enter their own remarks on a comment as a way of answering a question or comment from a tester.

Developers and testers are able to use the comment tracking system to build tabular reports of comments. Comments, remarks, and current status can be displayed. The application has the ability to retrieve comments using several different criteria, including application, developer, date, the person who made the comment, and the status of a comment.

IMPLEMENTATION OF CONFIGURATION MANAGEMENT FOR THE NATIONAL WATER INFORMATION SYSTEM-II

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The National Water Information System II (NWIS-II) supporting software consists of many different components that are written in several different languages by as many as 20 different programmers in 8 different locations. The NWIS-II development effort requires that automated configuration management procedures be used to ensure consistency, reliability, and repeatability. Because NWIS-II supporting software consists of Windows/4gl, Fortran77, and C 3gl code and various types of scripts, and because it is necessary to age the software through development, testing, and release phases, no available proprietary configuration management package fits the need. A Configuration Management System (CMS) was developed with several specific goals in mind:

1. For each component in NWIS-II, identify the responsible party, the associated application, and when the component was last changed.
2. Provide an automated way for developers to submit and retrieve components that need to be modified or reviewed.
3. Identify and archive distinct versions of the software needed for development, testing, and release.
4. Develop a script to build and install NWIS-II executable programs from the base components.

As part of the CMS, an Ingres database was developed to store information about components, applications, versions, and programmers. This database is accessible from each NWIS-II development site, allowing each programmer to access information about any component in the system, or to enter information about new components or applications. A Windows/4gl application was developed to provide access to this database and allow developers to move components in and out of the system using Background File Transfer Protocol (BFTP). This allows developers at remote locations access to current versions of software.

To archive the distinct sets of software needed for development, testing, and release, a Unix file system was created and dedicated to the CMS. A directory tree was created for each component in each application in NWIS-II. This directory tree is identical for software used for development, testing, and release. When software is ready for testing, it is copied from the development area and archived. When the software is ready for release, it is copied from the test area and archived. As the software goes through each stage of the development cycle, it is archived and saved to tape or disk.

To build the NWIS-II software, a Perl script was written to move through the appropriate directory structure and build each application. For "C" or Fortran programs, the script accesses a makefile that each developer submits with the application. For Windows/4gl applications, the script determines the sequence of applications to be rebuilt and then issues the appropriate commands to execute them.

A Collaborative Approach to Telecommunications Infrastructural Design and Development

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The U.S. Geological Survey (USGS) and Hampton University (HU) are partners in cooperative education project efforts designed to provide innovative solutions to complex telecommunications issues. The main thrust of this effort is to combine selected USGS resources with a viable historically black higher education institution that is capable of providing useful collaborative network solutions. This partnership continues to reap significant benefits for both USGS and HU. The success of this partnership and project collaboration proves the viability of establishing active and long-term partnerships with academia in response to diminishing USGS resources.

Using HU's campus network as a testbed, the USGS/HU team's first project was to modernize HU's existing campus network. The project goal of the USGS/HU team was to successfully demonstrate how an outdated and inefficient telecommunications infrastructure is transformed into a reliable and robust network. The project was divided into two phases. Phase 1, which consisted of infrastructural conceptualization and redesign, was scheduled for completion in five months. During the first phase, the team focused on the following tasks: (1) understanding the existing physical components of the HU network, (2) assessing current and future communications needs of HU's staff and students, (3) crafting a efficient and low-cost network redesign plan, and (4) determining the physical components needed for implementation. The USGS team made an initial site visit to meet with its HU team members and view physical network node layouts. The combined team also conducted analyses of the network's management of various protocol traffic flow. Subsequent communication among team members was conducted via email and teleconferencing.

Four months after careful analyses of various telecommunications infrastructural solutions, the USGS/HU team reached consensus on an efficient and cost-effective network redesign plan. The plan featured the use of router technology. The routers were used to (1) simplify network topology, (2) provide fault tolerance for the entire network in the case of a segment failure, and (3) keep local traffic generated within each node from saturating the campus backbone. The use of routers also allowed the team to take full advantage of HU's Class B network address by subnetting at and below the campus node levels. Combined resources of the USGS and HU were used to procure the hardware necessary for implementation of the new network infrastructure.

Phase 2 of the project consisted of a two-day USGS campus site visit to assist in the implementation of the new hardware and subsequent network quality-assurance testing. On day one, a meeting was held to outline the schedule and delegation of tasks. The implementation schedule included the following: (1) disconnection of existing network components at each node, (2) physical connection of the new network equipment (routers, repeaters, transceivers) to existing campus fiber, (3) router configuration, and (4) connection of local area network (LAN) hubs to the router. The unexpected difficulties experienced in completing implementation were the complexity in altering the configuration of certain LAN hubs, the lack of technical knowledge by some LAN administrators, and unlabeled node-internal fiber connections. Despite these obstacles, network redesign was successfully completed by the end of the first day. Day two consisted of

network quality assurance testing. Connectivity across campus nodes as well as access to the Internet was verified. A network sniffer was used to examine the various types of network protocol traffic and to determined if LAN-generated traffic was in fact remaining local. Response times were compared against those taken before network reconstruction to gauge performance enhancements as a result of the redesign.

Completion of the reconstruction of the HU campus network yielded the following conclusions. Redesign of a telecommunications infrastructure requires detailed planning and coordination. Setting attainable goals at the start of such a project provides sustainable focus through its completion. Flexibility in design and implementation of a network is crucial to accommodating future infrastructural growth. Newly constructed networks should be inherently static in nature and require minimal human intervention in administration and maintenance. Lack of standardization of physical design elements and network protocols makes implementation of a new telecommunications infrastructure more complex and timely. Network quality-assurance testing should be conducted routinely to insure that throughput is sustained at a desired performance level.

The network reconstruction project allowed the USGS to grow its relationship with HU. In this era of declining federal resources, establishing mutually beneficial relationships with historically valued and well-respected academic institutions like HU is key to validating its existence. The USGS has benefitted from this project and its relationship with HU in several ways. First, the USGS is largely an unknown entity, particularly among this country's minority population. The partnership with HU gives the USGS badly needed exposure and access to a student body that is internationally renowned for the students it produces. In addition, HU offers academic programs in the areas of environmental and marine science, disciplines that are directly related to earth science. Second, the USGS has and continues to benefit from the creative talents of HU students in the development of educational multimedia products for middle school students as well as numerous other interdivisional projects. Third, HU has and continues to make itself available to the USGS for collaborative beta testing of network management and security software. HU is a valuable asset, given the decline in USGS personnel, technical, and budgetary resources. Finally, the USGS benefits from direct access to HU's best students in the areas of computer science and computer graphic design. Such access allows the USGS to position itself to achieve the diversity it needs to reflect the cognizance of its service to all of our country's citizens.

IMPLICATIONS FOR INFORMATION TECHNOLOGY IN THE USGS STRATEGIC PLAN

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The U.S. Geological Survey (USGS) has developed a strategic plan that is intended to guide its activities through the year 2005. The plan was developed from a process based on three scenarios of alternate futures describing society's needs. Each scenario led to significant implications for the USGS. Many of the options available to address each implication were consistent across all future scenarios. Certain of these robust options, known as the core competencies, have extremely important impact across all organizational units and business activities of the USGS. The strategic plan identifies those actions that the USGS should take to assure a high level of success with the core competencies.

The strategic plan asserts that the business of the USGS is to provide information about the Earth to society. The implications for the use of information technology are crucial to the business of the USGS. This presentation will explore five key issues that will impact information technology in the USGS:

1. What changes in information technology should we expect when earth science information, including long-term databases, is destined for digital productions, archiving, and distribution?
2. What information technology skills will the USGS of the future need to support a multidisciplinary scientific workforce?
3. How do we hire, train, and use the right mix of information technology skills for an organization that changes quickly?
4. What information technology is needed to protect and project the reputation of the USGS for credible and impartial information about the Earth?
5. Why are more and different partnerships and relationships important to the future of information technology in the USGS?

NEW FEATURES IN HYDRA

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Hydra, the graphical and tabular time-series curve editor developed for the National Water Information System II (NWIS-II), has many new features at version 1.0. Hydra now allows the user to graphically select a subset of points from one curve and paste them into another curve. This feature can be useful when copying curve points from a backup recorder or from Missing Time Series Estimator to fill in a period of missing values. These copied points are flagged to indicate the source of data.

Multiple independent axes comprise another capability. For multiple data sets with widely ranging values, separate axes can be created, and the curves can be reassigned to any axis. Each axis can support multiple curves and can be assigned a linear or logarithmic scale. For example, the user may plot a time series of discharge ranging from 100 to 100,000 cubic feet per second on a logarithmic scale coincident with stage ranging from 1 to 50 feet on a linear scale, facilitating easy visual correlation of the two variables.

Loading curves into Hydra from a separate independent executing process such as Missing Time Series Estimator now can be accomplished by an event-driven input channel that appears as a file. This curve-loading mechanism is activated by the appending of a data file pathname into the channel. Hydra loads the data file specified by that path. In fact, the user may be interacting with Hydra when another process triggers the loading of a curve into Hydra. Any external process that can append a pathname into a file can load a curve into Hydra. This simplifies the moving of data into Hydra from another running process, minimizes the time spent polling that channel, and allows the user to interact with Hydra while the external process is generating the data file curve.

PARALLEL EXECUTION OF SYSTEM ADMINISTRATION COMMANDS

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A parallel method of executing system administration commands has significantly increased the productivity of the system administrator of a multi-host computer network who often must execute one or more commands on a group of computers and monitor the output from each of those executions. A system is being used in the Arkansas District of the U.S. Geological Survey to allow those commands to execute in parallel over any subset of computers being managed. The result is a reduction of the amount of time spent waiting for one computer to finish a task before proceeding to the next computer. Tasks such as stopping and starting the database server or the print scheduler, which may take sequentially tens of minutes on multiple computers, now can be completed in the time it takes for a single execution. The system uses for-loops, remsh, and environment variables submitted from the command line or embedded in shell scripts. This approach can be used for system administration jobs or any task that can be run in parallel.

VISUALIZING THE COMPUTING ENVIRONMENT

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A FrameMaker document is being used in the Arkansas District of the U.S. Geological Survey to help spatially visualize the computing environment. A floorplan of the office, showing rooms and hallways, is the base starting point of the document. Computer hardware devices represented by graphical pictures are overlaid on the floorplan to show their placement in the office. The devices include workstations and servers, X-terminals, desktop and laptop personal computers, printers, plotters, modems, a T1 network line, and a Local Readout Ground Station satellite dish. Furthermore, software such as Network Information System and Network File System installations and server locations can be graphically denoted to show their location. A legend shows what each graphical object represents.

The document is updated to match the changing distribution of software and hardware devices in the office. When a device or software is relocated in the office, the graphical icon in the document is moved to reflect it's new location. Similarly, new icons can be created for new hardware or software, and icons can be deleted when that hardware or software is removed from the computing environment. This visualization tool is used as a working guide for planning, implementing, and maintaining the computing environment in Arkansas. It also provides a way to illustrate to others the spatial distribution and type of hardware and software in the District.

HYDROGRAPHY FRAMEWORK PARTNERSHIP

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Synchronization of the U.S. Geological Survey 1:100,000-scale hydrography digital line graphs and the U.S. Environmental Protection Agency Reach File (RF3) is under way and will be completed in fiscal year 1996. These synchronized data are being developed with the active participation of California, Arizona, Washington, Oregon, Idaho, Montana, Florida, Wisconsin, Illinois, Kentucky, and other states. A special effort has been made to obtain the latest enhancements developed by the states at 1:100,000 scale and incorporate these enhancements into the synchronized data. These data will be feature based, and all of the features will have a unique feature identifier (reach code). Therefore, the development of these synchronized data provides a concrete and practical focal point for testing and further investigation and development for Version 1 of the National Digital Geospatial Data Framework as defined by the Federal Geographic Data Committee.

USING A GEOGRAPHIC INFORMATION SYSTEM TO CREATE A GAGING STATION DATABASE FOR MINNESOTA AND PARTS OF NORTH DAKOTA, SOUTH DAKOTA, IOWA, AND WISCONSIN

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The U.S. Geological Survey (USGS), in cooperation with Minnesota Department of Transportation, created a regional peak-flow Geographic Information System (GIS) database. This database contains all peak-flow gaging station data for rivers flowing into or out of Minnesota. The database helps the Minnesota Department of Transportation evaluate their participation in the USGS High-Flow Gaging Station Program. The data are associated with high-flow and continuous recording gaging stations. Data were retrieved from the peak-flow file in WATSTORE, which is part of the national computerized water database of the USGS. Computer programs were developed to format the peak-flow data for use with a GIS. All USGS district offices will be able to use the automated procedure to create a gaging station GIS database for their state or region. Other custom programs are being developed to add low-flow gaging station data to the database.

MANAGEMENT OF DATA USED IN DATA ANALYSIS PROGRAMS OF THE U.S. GEOLOGICAL SURVEY

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The Hydrologic Analysis Support Section (HASS) is developing a series of interactive programs (collectively referred to as QWGRAF) for use in the analysis of hydrologic data. The current list of programs includes boxplots, probability plots, frequency plots, x/y coordinate plots (with regression), Lilliefors test for normality, Piper diagrams, Durov diagrams, Stiff diagrams, and geopolitical boundary maps with data mapping. New programs are to be added on a continuing basis. Both Unix and PC versions of the programs will be supported. The programs all use a common interactive interface and come with on-line help and printed documentation. Each program has a robust list of options for configuring the output to meet user's needs.

The programs are supplemented with an extensive data-management capability, which provides for importing data from a variety of external data formats and then modifying the data to meet user's needs. ASCII flat files, Fortran formatted files, and NWIS-I QWFLATOUT, 1 and *-Card and PSTAT files are converted transparently to rdb file format, which is the default file type used internally by all QWGRAF programs. HASS has developed extensions to the column definition line of an rdb file to provide additional data definition capability used by the QWGRAF programs to enhance functionality. The information to populate these extensions comes from format definition files that accompany the ASCII, QWFLATOUT, PSTAT, and Fortran data files. The user-editable format definition files designate variable names, data types, variable descriptions, column delimiters, remark code options, and algorithms for adding new variables to the converted file.

QWGRAF includes a program specifically designed for modifying data in the input file prior to output to the rdb file. The DATA MANAGER program includes functions for sorting; Boolean logic filtering of data rows; aggregation of rows to a summary statistic based on unique values of a partitioning variable; creation of new variables with algorithms; variable subset selection and reordering; relational algebra functions for joining, subtracting, and concatenating files; column to row and row to column transformations; duplicate row removal; and computation of percentiles. Missing values are accommodated. The user has the option of creating a new rdb file from each function or transparently stringing the requisite commands together in an editable executable script that can be used as an input file to any QWGRAF program, obviating the need to create a sequence of data files, each built on a previously created file.

USING A GEOGRAPHIC INFORMATION SYSTEM TO INTEGRATE NATIONAL WETLANDS INVENTORY DATA WITH DIGITAL LINE GRAPHS

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The U.S. Geological Survey (USGS) conducted research using data from the U.S. Fish and Wildlife Service (FWS) as a source for USGS products. Comparisons of wetland collection criteria and sources were evaluated for both the USGS 1:24,000-scale and the FWS National Wetlands Inventory (NWI) 1:24,000-scale mapping programs. Wetland definitions and classifications were evaluated to determine if a workable cross-walk could be developed between the two data sources. The NWI data were obtained through the Internet and loaded into a geographic information system for reformatting, processing, and integration.

Several computer programs were developed to automate the data integration process. Tools were developed to perform the attribute cross-walk, detect and resolve feature conflicts, automate the attribution process, and reformat the data into the standard USGS digital map format. These modular tools can be adapted easily for dealing with other data integration problems.

USE OF A WEB-BASED VIRTUAL POSTER PRESENTATION STYLE AS A COMPLEMENT TO STANDARD U.S. GEOLOGICAL SURVEY PAPER REPORTS

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Growth in the use of the World Wide Web has provided the U.S. Geological Survey (USGS) with an opportunity to reach a larger and more varied audience. The Nebraska District of the USGS has taken a new approach to report presentation by creating a "virtual poster session," accessible on the World Wide Web, which highlights current research within the District. The virtual poster session consists of an imagemap, which allows a user to click on different parts of the image to access reports and view visually-enhanced graphics and abbreviated text from the selected report.

This method of presentation has several advantages: (1) the report can be placed on the World Wide Web immediately following official approval—perhaps months prior to publication of the paper copy; (2) the enhanced version of the report on the World Wide Web is visually appealing and can act as an "advertisement," drawing an audience to the paper report; (3) this style can reach individuals who may not normally come into contact with USGS reports and might otherwise be unaware of our products; and (4) the virtual poster session is user-friendly and engaging. A virtual poster can be an important publication medium for the presentation of a project and its results.

DEVELOPMENT OF A COMPUTER-BASED INFORMATION KIOSK

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The Pennsylvania District of the U.S. Geological Survey has developed an experimental, computer-based information kiosk to provide information to visitors of the District office and to enhance public outreach efforts at local scientific events. The kiosk is comprised of a 75-MHz multimedia Pentium PC running Windows95, a 17-inch surface-wave touch-screen monitor, a 16-bit sound card, a modem, an ethernet adapter, and stereo speakers. All hardware is securely enclosed in a specially designed cabinet, and access to hardware components by kiosk users is limited to the monitor's touch-screen.

Information is served from hypertext (html) files by use of the Mosaic World Wide Web browser software. Mosaic is configured to operate in full-screen presentation mode, preventing users from exiting the program or escaping to the operating system. Users navigate through the kiosk's information screens by touching various text and graphical widgets on the monitor screen. Each "page" of information has been designed to fill one screen, so scrolling of multiple-screen pages is not necessary. The bottom of each page contains special navigation buttons allowing users to return to the first screen or step sequentially through screens in forward or reverse order as applicable.

The kiosk is initially designed to be completely self-contained; all hypertext files and required software reside locally on the PC's hard drive. This design allows the kiosk to be taken from its primary location in the District Office lobby to provide public outreach at local scientific events. Network capabilities are incorporated to allow for the future possibility of serving data from the District's data-collection platforms or databases.

National Park Visualization Using Surveyor and U.S. Geological Survey Data

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To support National Park Service (NPS) graphics requirements and a visual demonstration prototype, the U.S. Geological Survey (USGS) developed a perspective scene and a ground level fly-by from USGS orthorectified images and digital elevation models (DEM) covering Greatbasin National Park, Nevada. These visualization products were created using a Silicon Graphics workstation with the Jet Propulsion Laboratory's Surveyor program and ESRI's ARC/Info geographic information system software. ARC/Info was used to merge, resample, and cut the DEM's and orthorectified images for use by Surveyor. The route and image rendering for the perspective scene and fly-by were done with Surveyor. These products can be used by the NPS to create visual demonstrations of national parks for potential visitors to the park lands. The perspective scenes and fly-bys can be used in NPS visitor centers or on World Wide Web home pages to help visitors choose parks they wish to visit, aid hikers in researching potential hiking routes, and assist the NPS with various management decisions, such as determining the visual impact of development in or near national parks.

DEVELOPMENT OF A COMPUTER PROGRAM TO GRAPHICALLY PRESENT WELL-LOG DATA

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Jackson County, located on the Gulf Coast in southeastern Mississippi, is experiencing rapid economic and industrial growth. Continued growth in the area depends largely on the availability of an adequate supply of potable water. In 1994, the U.S. Geological Survey, in cooperation with the Jackson County Board of Supervisors, began a hydrologic investigation to compile information on the location and depth of water-bearing sands and intervening clay intervals in Jackson County. More than 1,600 driller's logs and geophysical logs from various sources were used in the investigation.

Data from the investigation are assembled in a geographic information system (GIS) database, but for the general public, a graphical presentation of each individual well log is probably the most useful format. Because of the large number of individual graphics required to present the more than 1,600 well logs, a computer program was developed to read the database text file and to output corresponding device independent PostScript files that graphically depict each well log. The user simply invokes the program, names an input file, and prints the resulting camera-ready output file. The program places the well-log graphics on a landscape page with the corresponding well identifier, land-surface altitude, and log type. The sand and clay intervals are shown with graded fills, which give the graphic a 3-dimensional appearance. The program determines the scale needed to fit each graphic into the allotted space on the page, draws the scale and associated tics, and indicates the depth below land surface adjacent to the sand and clay renderings. To produce camera-ready illustrations for publication, the program creates an explanation box and illustration caption using a common PostScript font (Times New Roman) for all text. The program saved about 3 man-months originally budgeted in the project for the task and eliminated most of the error associated with drawing accurate sand and clay thickness intervals manually. The program is written in the C programming language and can easily be modified to accept a wide range of data input types to graphically present data in other formats, such as pie charts or graphs.

REPLICATION OF REFERENCE LISTS FOR THE U.S. GEOLOGICAL SURVEY'S NATIONAL WATER INFORMATION SYSTEM

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The U.S. Geological Survey continues to develop and enhance the National Water Information System (NWIS). NWIS stores, analyzes, and displays water-resources information for the Nation.

One part of the NWIS design is a network of reference lists. A reference list consists of allowable column entries for a particular data field. The NWIS will use CA-Ingres Replicator software to distribute reference list data updates across databases on local or remote sites. CA-Ingres Replicator software is an interface between the database and an application and is transparent to the users. CA-Ingres Replicator will help NWIS meet dependability, availability, and performance issues by replicating designated data between specified local and remote sites. It ensures data integrity between source and target databases, enforcing transaction consistency. When the NWIS reference list manager changes a number of rows in a table to be replicated, these rows are transferred together in sequence (as a single replicated transaction) to each target database. Replicated transactions are always applied to each target database in the order that the transactions were committed on the source database. In addition, CA-Ingres Replicator maintains its replication queues and all control information within each source database. The software also will allow the NWIS reference list manager to monitor remote replicated transactions, allowing for the detection and resolution of collision errors necessary to ensure consistency between replicated databases.

Through CA-Ingres Replicator, the NWIS will be able to provide both current and consistent data availability of reference list domains to the Water Resources Division District Offices nationwide.

EXAMINATION OF THE INTERNET AS A VENUE FOR CONDUCTING ADMINISTRATIVE BUSINESS

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The Internet has, in a short two years, become a prominent feature in the American workplace. Long a fixture in the academic and scientific community as a conversational medium and a place to share scientific information, it has, with the addition of the graphical World Wide Web and browsing software, exploded on to the desktops of the business world. Organizations in the public and the private sector, and even individuals, are eagerly posting information about themselves, their products, and their services. Concurrently, there is growing use of the Web in many organizations as an internal mechanism for disseminating commonly used work related information such as manuals and procedures to its employees.

This first generation of Web use—passive and one-directional—is about to change. Fred Travnicek will discuss the Web as an interactive business tool and its potential as a unifying technology superset residing on top of incompatible administrative systems and desktop environments. He will present a survey of new, "under construction," and conceptual Web sites which permit:

- ordering of GSA approved supplies (with electronic payment methods)
- providing employee updatable locator information which may include dialable telephone number, property data, skills, even a snap shot
- registering for training classes
- processing of time and attendance data
- processing of employee clearances (Form 9-090)
- scheduling conference rooms and equipment
- querying financial, property and procurement information
- processing of travel data (authorizations and vouchers)
- subscribing to reports and publications
- making airline, rental car, and hotel reservations, and
- operating a help desk.

In spite of its attractiveness as a universal user interface and a tool for breaking down walls among functional organizations, the Web is still fraught with technical, political, and operational risks which will also be explored.

Gerry Lebing will demonstrate a redesigned AVADS as the prototype of a second generation, interactive Web application which permits job seekers not only to review vacancy announcements but to initiate a search for suitable jobs by specifying their skills. The applicant will then be able to apply, on-line, for the vacancy by completing the required forms and attaching a resume. Gerry will diagram the design of this new AVADS application which may serve as a model for similar administrative Web applications, with the ultimate goal of an administrative applications home page. Gerry will also discuss lessons learned and make recommendations for future Web development initiatives.

MAPS-ON-DEMAND: IT'S NOT WYSIWYG!!!

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The U.S. Geological Survey (USGS) has been testing print-on-demand capabilities for maps; the results show that this process is far from "What You See Is What You Get" (WYSIWYG), especially with regard to color. Colors should be selected from a hard-copy palette because screen colors are rarely rendered true in hard-copy output. Furthermore, color selection should be based on the file format and output device (for example, electrostatic or ink-jet plotter). Typical print-on-demand devices produce a limited number of discernible shades of each color.

In the near future, print-on-demand maps for customers may be produced off-site, with the mapmaker sending only an electronic file to the map printing facilities. If this remotely generated hard-copy output is to look similar to the hard-copy output that the mapmaker proofed and approved, certain variables need to be standardized. These include, but are not limited to, the output device, its environment, the file format, and the consumables (for example, paper and toners). Management of all these variables is necessary to achieve predictable output.

THE GIS WEASEL - AN INTERFACE FOR THE DEVELOPMENT OF PARAMETER INPUTS FOR WATERSHED MODELING

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The GIS Weasel is a graphical user interface (GUI) that is being developed as a tool to aid hydrologists in the delineation, characterization, and parameterization of hydrologic response units (HRU's) for use in distributed- or lumped-parameter hydrologic models. HRU's are defined here as land surfaces that are delineated within a watershed to reflect a model's treatment of spatially distributed characteristics. HRU's can be treated as homogeneous or heterogeneous with respect to some or all of the physical characteristics. The interface does not require user expertise in geographic information systems (GIS). The user does need knowledge of the hydrologic model that will use the output from the GIS Weasel. The interface currently uses ARC/Info and the Arc Macro Language, as well as C subroutines. This application is being developed to use ArcView3's functionality, GUI, and a programming language, Avenue. Where ArcView3 capabilities are deficient, processing will be done by C subroutines or an ARC/Info server to the ArcView application.

Applications require an ARC/Info grid of a digital elevation model (DEM) that contains the area of interest. A set of watershed boundaries are automatically delineated from the grid of the DEM. A watershed may be selected from this set or derived on the basis of a user-digitized point. After the watershed area is determined, the user is asked for the minimum drainage area assumed to support a channel. This value controls the density and configuration of the delineated drainage network. Summary statistics and iterative trials allow the user to experiment before choosing the final value. Once the basin and drainage network are established, HRU's can be delineated according to one of several different methodologies: (1) fixed interval grids, (2) irregular polygons, and (3) non-contiguous pixels. A menu for examining and modifying the HRU map and its attributes is provided. Data derived from the original elevation grid (e.g., slope, aspect) or other grids of attribute data (e.g., vegetation, soils) can be examined on the basis of HRU, grid cell, or attribute. The statistical distribution of an attribute within single HRU's or groups of HRU's can also be shown. HRU's can be grouped, divided, or eliminated. The GIS Weasel provides version control and documentation to track modifications of HRU maps. Once HRU's are defined, selected model parameters can be generated using HRU attributes and their statistical measures.

GRAPHIC DISPLAY OF SPATIAL DATABASE QUERY RESULTS (DATABASE APPLICATIONS DEVELOPMENT AND USE)

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Spatial databases are easier to interpret if the data can be displayed on a base map instead of in a table of coordinates. Likewise, querying a spatial database by selecting areas of interest on a base map is easier and less tedious than typing coordinate lists.

The Cartographic Products System (CPS) is an X Window query tool for Oracle databases. The CPS presents the user with a graphic base map of geographic grids, state and county boundaries, roads, hydrographic features, and cities. The user can select areas of interest on the graphic base map to use in database queries. Results of queries are also displayed on the base map. The system supports text, spatial, and image output.

The CPS provides a general-purpose query builder that can be used to construct and store queries to Oracle databases. Building queries with the CPS is done by selecting tables, views, synonyms, and columns from lists provided by a dynamic read of the Oracle data dictionary. The constraint editor supports table join, interactive textual input, and spatial input clauses. Query definitions can be saved to a file for later re-use. No knowledge of Spatial Query Language syntax is needed to formulate queries, and no knowledge of the data organization or location is needed to use previously defined queries.

The Oracle database supports simultaneous queries to many databases, so the CPS can be used to display the results of queries made to different databases in different locations. For example, it can display the intersection of cartographic data availability with water-quality data availability.

USE OF A GEOGRAPHIC INFORMATION SYSTEM AND OTHER COMPUTER RESOURCES FOR EVALUATING CHLORIDE DISTRIBUTION IN THE COASTAL PLAIN AQUIFERS OF VIRGINIA

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The U.S. Geological Survey, in cooperation with the Hampton Roads Planning District Commission, is evaluating spatial and temporal variations of chloride concentrations in aquifers in the Coastal Plain Physiographic Province of Virginia. Well-construction and water-quality data were compiled from several sources, including state, local, and private agencies, to interpret the distribution of chloride concentrations in these aquifers. Computer software available on the Unix operating system was used to reformat the digital data, of various formats, to a common format for use as a spatial database in a geographic information system (GIS). Other spatial databases in the GIS include a multi-layered hydrogeologic framework and ground-water-flow model of the Coastal Plain Physiographic Province of Virginia that delineate aquifers, confining units, and ground-water flow. The model and framework are related to well-construction and water-quality data, by means of the GIS, to estimate spatial and temporal trends in chloride distribution. The use of GIS and other computer resources greatly enhances the ability to manage, view, and interpret ground-water data. As demand for ground-water resources increases, management tools, such as GIS, help ground-water resource managers plan for future water needs of the Virginia Hampton Roads region.

CASE STUDY ON EVALUATING EDUCATIONAL HYPERMEDIA SYSTEMS FOR TEACHING EARTH SCIENCE TO MIDDLE SCHOOL STUDENTS

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From 1991-1994, the U.S. Geological Survey (USGS) conducted phase one of a hypermedia research and development project. The objective of this phase of the project was to design and implement prototype hypermedia educational systems aimed at middle school students (grades 6-9). Two prototypes known as the GeoMedia series were developed for operation on Apple Macintosh computers. The GeoMedia series includes the following topics: water cycle, carbon cycle, greenhouse effect, measuring time and environmental change, earthquakes, and understanding maps. MacroMedia Director was used as the hypermedia authoring software.

In addition to developing the two prototypes, the project team focused on evaluating the effectiveness of hypermedia systems in teaching complex earth science topics. The evaluation phase of the project was based on conducting (1) a survey by sending questionnaires to 3,000 educators, (2) student and teacher workshops, and (3) student focus groups. Results of the evaluation phase show that although GeoMedia increased interest in the earth sciences among students, operating robust hypermedia systems on minimally- configured computers posed problems for integrating high-resolution animations, imagery, video sequences, and sound.

During evaluation of the GeoMedia series, the USGS entered into a cooperative research and development agreement with InterNetwork Media, Inc., the industry partner that co-produced the prototype systems. The cooperative agreement calls for conducting research into computer science techniques that advance the design and deployment of hypermedia systems. In addition, the project team will develop methods for migrating from producing prototypes to publishing education products for mass-distribution that support the outreach campaign of the USGS.

The first planned product is a GeoMedia hybrid that is an integration of the topics contained in the two prototypes. Evaluation comments from teachers and students have been used to improve the existing graphical user interface to facilitate navigating through the information. The GeoMedia hybrid is being replicated for operation in the Windows environment and the Apple Macintosh suite of computers.

Concurrent with publishing the GeoMedia hybrid, the project team is developing a series of titles on natural hazards: volcanoes, earthquakes, and storms. The Earth Power series is intended to expand the hypermedia functionality to allow students to create their own hypermedia notebooks. The research focus is on designing a graphical user interface that is both transparent to the user and is further integrated with the content of the educational system.

Navigation through the system is enhanced by a spatially-referenced approach to the topics and the use of a "personal data assistant" tool. The "personal data assistant" tool includes a notebook feature that allows students to (1) create hypermedia reports on natural hazards, (2) write fictional accounts that are stimulated by understanding earth science concepts, or (3) develop study guides to organize information.

The project team continues to design software that is in concert with national curriculum standards and reform movements, such as Project 2061 sponsored by the American Association for the Advancement of Science (AAAS). The AAAS emphasizes several key concepts for teaching science as part of the Project 2061 initiative. Among the principles of learning as stated in Science for all Americans by F.J. Rutherford and A. Ahlgren are two key philosophies embraced by the project team during the hypermedia design process: do not separate knowing from finding out, and science teaching should reflect scientific values-welcome curiosity, reward creativity, and encourage a spirit of healthy questioning.

Project results show that students who participated in case studies conducted by the USGS are progressively more critical in their expectations of hypermedia educational systems. The student expectations for system functionality and digital data quality frequently exceeded the computing capability available to them. The project team also observed that active participation on the part of the students in creating hypermedia reports and presentations promoted understanding of the earth science topics that were taught.

MANAGING TAPE BACKUPS ON EVER-CHANGING COMPUTER SYSTEMS OVER A LOCAL-AREA NETWORK

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A computer system cannot be considered reliable without dependable backups. The success of backups requires an operation which is easy to use and which can be adapted to continually changing computer systems and platforms.

A backup program, consisting of a set of shell scripts, was developed to meet these needs. This program will back up both remote and local file systems, using individualized schedules. Adaptation to changing computer systems is made easy by using only a single table to control the hosts, their respective file systems, and the daily dump (1M) levels. Additional flexibility is provided through the use of various command-line options such as compression, appending multiple backup operations, tape media type, and forced overwrite to meet special needs. This program improves the quality control of backups by labelling each file system backed up, providing protection from accidental overwrites, and sending automatic electronic mail messages regarding success or failure.

Tapes cannot, or do not, always get changed as scheduled. Plus, device or media errors can cause the tape to rewind prematurely. Therefore, this program is designed to protect tapes by not allowing an overwrite under the following three conditions: (1) when the tape contains data and is not a labeled backup, (2) when the backup operation is incremental and the tape is labelled as a full backup which is less than 30 days old or, (3) when an error occurs.

Equally important to the backup operation is the restore process. Restoring is made easy through automatic location of a particular file system on the tape. This is possible because of the labelling of each file system. It also is extremely beneficial because the sequence of tape files can be ordered differently from what would be expected as a result of failures of individual file-system backups.

This program is host-independent and can be installed on most Unix-based computers with little or no modification.

CUSTOMIZED SOFTWARE FOR MODEL CALIBRATION AND VISUALIZATION OF RESERVOIR WATER-QUALITY MODEL RESULTS

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The U.S. Geological Survey, in cooperation with several local and State agencies, is developing water-quality models for selected reservoirs and estuaries in North Carolina. The two-dimensional, laterally-averaged computer model CE-QUAL-W2, developed and supported by the U.S. Army Corps of Engineers, is being implemented to evaluate the effects of changes in nutrient loadings on water quality conditions—primarily dissolved-oxygen concentrations and algal biomass. The model can accurately simulate time-varying flow, transport, and chemical transformation processes in natural waterbodies by numerically solving the complete nonlinear partial differential equations describing conservation of mass and momentum. Model inputs generally include a description of waterbody bathymetry, together with time series of inflow rates, inflow constituent concentrations, meteorological conditions, and outflow rates (or downstream water levels). Following model calibration, flows and constituent concentrations within the waterbody are simulated for the period of interest. Simulations are typically provided at small spatial (on the order of 100 meters) and temporal (on the order of minutes) intervals.

The model is calibrated by comparing simulation results to measurements of physical conditions. Vertical profiles of water temperature, dissolved-oxygen concentration, specific conductance, and pH measured at monthly to semi-monthly intervals at more than 10 locations are compared with model results. In addition, nutrient and chlorophyll *a* concentrations, measured less intensively, are compared with model results during model calibration. Calibration can be a tedious process involving many simulations in which model parameters are adjusted slightly and comparisons are made between large sets of measured and simulated data. Water-quality simulations made to evaluate the effects of management actions are generally made for simulation periods of a year or more. Because of the large number of simulations which are required and the small temporal and spatial discretizations used in the models, water-quality models produce large amounts of data which can be difficult to process and analyze quickly. Moreover, the tabular format output produced by the model does not easily facilitate decision making.

Staff from the Water Resources Division and Office of Program Support, working cooperatively, have developed customized software which facilitates model calibration and visualization of model results. A fast, portable relational database management system (rdb) is used to maintain both the measured and simulated data sets. The rdb structure provides a means of querying and extracting pertinent data from both data sets. A graphical user interface has been developed to extract pertinent data from the rdb data sets. 'Tcl' (a tool command language) and 'Tk toolkit' (a toolkit extension for X-Windows Systems) were used to build and customize the interface. The

menu-driven interface permits extraction of the data, based on the region of the reservoir, time frame, and desired constituent or physical parameters. The interface also provides for visualization of the extracted data through connections to G2, an object-oriented system for producing two-dimensional graphs for comparing measured and simulated data at one point in time.

The graphical user interface also provides connections to the Application Visualization System (AVS) software, which is used to analyze model results for long simulation periods. AVS provides an extensible visual programming environment for the creation of visualization applications. Applications are created by combining AVS program components, or modules, into executable flow-networks. Custom networks have been created to display and animate the time-dependent scalar values, including water temperature, dissolved-oxygen concentrations, nutrient concentrations, and conservative tracer concentrations, generated by CE-QUAL-W2.