Division of Waters
Information Systems Plan

Minnesota
Department of
Natural Resources
Division of Waters

June 1992

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATERS

INFORMATION SYSTEMS PLAN

St. Paul, MN.
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DIVISION OF WATERS

INFORMATION SYSTEMS PLAN

EXECUTIVE SUMMARY

The Division of Waters has developed a strong focus on data and information management in order to fulfill its vision in managing Minnesota's water resources. This focus has led to the development of several databases specifically created to accurately record data about lakes, rivers, wetlands, climate, water use, and related factors.

This plan identifies and documents the Division's past and present information management activities. The plan details the current (baseline) condition of the DOW information systems. A needs assessment was completed by DOW staff to focus on short and long term needs for information management.

This plan is intended to guide the DOW's Water Management Committee in strategic planning by identifying a strategy for future actions related to information systems. The main recommendations of this plan include:

* Leadership by the Water Information Systems Unit in managing and coordinating the Division's information systems.

* Completion of DOW data systems development efforts and widespread use of the systems by staff for their day-to-day responsibilities.

* Additional training for DOW staff to attain specific skill levels in personal computer use.

* Establishment of standardized policies, procedures, and components for data systems development and hardware/software purchases.

* Wide acceptance and use of the concept of a corporate database ensures that data is collected and stored in a comprehensive and coordinated manner to benefit DOW, DNR, and its clientele.

* Development of a **Comprehensive** Water Resource Management Information System (CWRMIS) to integrate water resource data collection, analysis, and distribution.

This plan was prepared over the period from August 1991 - May 1992 by a subcommittee of the DOW's Management Information Systems Committee. This subcommittee developed the planning process and verified the endorsement of the Water Management Committee throughout the process.

The Division should periodically review and update this initial plan and focus on additional strategic issues.

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Chapter 1

INTRODUCTION

A. HISTORY

The Division of Waters began managing information with its first typewriter and file cabinet. Over the years, paper files have grown and now contain important historical and resource information dating back to the 1920s. Lake files, permit files, survey and engineering documents, well logs and pumping reports chronicle past Division activities.

The Division's earliest use of the computer was to print mailing labels for the water appropriation use reports in the mid-1960s. By the early 1970s, the Division had begun to use the University of Minnesota's mainframe computers for surface water technical investigations. The DOW finished the Mississippi River Floodplain Study in 1971; a task not feasible without the aid of computers.

The Systems Unit was first created in the Division in 1979 primarily to develop the State Water Use Data System (SWUDS). SWUDS was developed through a cooperative arrangement between the U.S. Geological Survey (USGS) and the Division. Observation Well Network (OBWELL) was also developed at this time using Division staff.

A variety of information systems have been developed through LCMR-funded projects. The watershed delineation and digitization project was completed in 1979. This project resulted in a statewide raster-based (EPPL) map of watersheds. A shoreland update project was conducted from 1980 to 1982 to examine shoreland development on Minnesota lakes. Stream Information and Data Retrieval System (SIDRS), often called River Kilometer Index (RKI), was completed in 1981. The SIDRS project digitized 93,000 miles of streams and rivers. Regional Water Data Network (RWDN) was started in 1981 to replace an existing permit tracking system (Master Permit Index). The Well Log Listing System (WELLS) was developed with the Minnesota Geological Survey (MGS) in 1988 as an index of all automated well information in the state.

The Office of Planning originally provided the DOW with data processing support principally for Regional Water Data Network. During much of the 1980s, LCMR-funded staff often assisted the rest of the Division with various data processing projects. Presently, the Division's Water Information Systems Unit contains seven staff positions.

The Ground Water Unit began the shift away from the University mainframe computer to the personal computer (PC) in 1985. Today virtually all DOW staff have a PC on their desk and use it on a daily basis. Lakes DB was the first PC-based information system developed within the DOW, beginning in 1987. SWUDS is now completely PC-based, as PIX will be when it becomes fully operational.

The State Climatology Office began electronically-storing climate data in the early 1970s. The first application software to effectively use these data was developed by the University of Minnesota Extension Service in the late 1970s. The shift of data

and application software to the PC began in 1983. Long-term National Weather Service data has recently been electronically filed by Division staff. Additional application programs to analyze and easily retrieve the massive quantities of climate data are being developed.

The future holds unlimited possibilities to further utilize the computer's abilities to improve the way we do business and provide service. Geographic Information Systems (GIS), image processing, electronic mail (E-mail), and automatic document generation are some of the capabilities that may become as commonplace within the DOW as word processing is today.

B. PURPOSE

The purpose of this project is to plan for the future development and use of Division of Waters information systems.

Careful planning and diligent effort toward development of effective information systems should reduce the percentage of time DOW staff spend on paperwork. As a direct benefit, more time can be spent on water resource management, providing for better resource-based decisions and better service to the public. Both are in direct support of "Directions" and Governor Carlson's CORE initiative.

This planning project is not a one-time effort. The rapid change in technology and the explosion of potential applications make it imperative that the DOW constantly monitor its progress and chart the most advantageous direction for information systems development.

C. PLANNING PROCESS

The following chronology describes the steps taken by the Division of Waters to accomplish information systems planning. The Planning Subcommittee's underlying objectives for this planning process included:

- a desire to develop a plan that accurately reflects the specific status, needs, issues, and vision of the Division of Waters;
- regular communication and approval by the Water Management Committee (WMC) of drafts, procedures, and timelines;
- regular opportunities for comments on plan drafts by Water Management Committee, the Water Information Systems Unit, and MIS Committee;
- teamwork with the MIS Committee in coordinating needed surveys and inventories;
- updating and conducting research that identified the current status of various aspects of DOW's data management;
- increasing awareness and understanding of terms relating to information management; and
- a desire to recommend implementation tasks that would help achieve DOW's vision for the future.

Chronology

Winter 90/91: Preliminary discussions about DOW information systems (IS) planning between WIS Unit, MIS Committee Chair, and MIS Bureau Planner.

April 17, 1991: MIS Committee recommended to WMC that a group begin work on an information systems plan for the Division. WMC requested recommendations on the best way to proceed.

May 21, 1991: MIS Committee discussed how information systems planning for the Division could be accomplished. All other divisions and several other bureaus had completed IS plans using outside consultants, except for Forestry which used an LCMR-funded mobility position. Because of lack of staff time, the Committee recommended an outside consultant be hired to prepare a DOW IS Plan.

July 29, 1991: WMC agreed that an IS plan is important and should be prepared. Charged selected staff to hold a working retreat with participation from MIS Bureau in order to generate text for a plan, and submit further recommendations for completing unfinished tasks.

Aug. 27-28, 1991: A 2-day meeting with six-member Planning Subcommittee. Reviewed status of DOW information systems; reviewed other DNR IS plans and developed outline for DOW's plan; developed mission statements; developed planning process timeline; and devised ways to achieve broad communication and participation.

September 1991: DOW Computer User Ability and Confidence survey conducted to update 1987 survey. Coordinated by MIS Committee representatives.

Sept. 25, 1991: Proposed planning process timeline and preliminary draft submitted to WMC and MIS Committee for comments. MIS Committee established procedures and questions for needs assessment.

Oct. 8-9, 1991: WMC reviewed and approved mission statement, draft IS Plan, and planning process timeline. Comments incorporated.

October 1991: DOW IS needs assessment conducted. MIS Committee representatives coordinated survey for their unit/region to help define direction and priorities.

1982 DOW database inventory updated, using the IS Steering Committee form with additional questions.

Hardware inventory updated.

Software inventoried.

November 1991: Incorporated results of research assignments, surveys and inventories into draft. Revised draft sent to WMC and MIS Committee for comments.

Nov. 20, 1991: Planning Subcommittee meeting - amended revised draft; analyzed needs assessment results and derived issue statements; and developed information systems visions for the years 1995 and 2000.

Dec. 6, 1991: Previous comments incorporated. Second revised draft sent to WMC and MIS Committee for comments.

Dec. 11, 1991: Progress report made to WMC; discussion focused on visions and software legalization procedures.

Dec. 19, 1991: Planning Subcommittee meeting with emphasis on implementation recommendations for identified issues.

Jan. 27-28, 1992: Planning Subcommittee meeting with WMC representatives, Acting WIS Unit Supervisor, and DOW Strategic Planning Coordinator with continued focus on implementation recommendations. Comments incorporated.

Feb. 4, 1992: Third revised draft submitted to WMC, MIS Committee, and WIS Unit for comments. Water Management Committee revised DOW Vision Statement. Requested comments from members by the end of February.

March 1992: Personal contacts made to Water Management Committee to solicit comments.

March 31, 1992: Planning Subcommittee meeting with Director and WIS Unit Supervisor. Final comments discussed and next steps established.

May 1992: Final plan submitted to WMC for approval.

Chapter 2

BASELINE ANALYSIS

A. BUSINESS FUNCTIONS

A business function is a description of a particular activity performed by DOW staff. These functions occur at all levels of DOW staff in both the field (regional/area) and central offices.

1. Climatological and Water Resource Data Collection

DOW staff collect and report climatological and water resource data, such as precipitation, recorded lake and aquifer levels, stream flows, wetland acreages and water use. This data is important to evaluate trends of concern and arising water resource management issues such as flooding, droughts, and available water supply. The DOW also maintains and updates maps of state protected waters and wetlands. Extensive databases have been and are being developed to retain relevant climatological and water resource data.

2. Data Analysis, Surveys, and Special Studies

Examples of this business function are analyses and studies of collected data to evaluate the hydrologic effects of proposed changes to a dam or structure, or to predict flooding events, droughts, or stream flows. The DOW has three separate central office technical units:

a. Hydrographics Unit -- performs surveys of lakes, rivers and wetlands for activities such as ordinary high water level determinations and permit violation investigations; drafts technical documents; and inspects state-owned dams;

b. Surface Water Unit -- performs hydrologic and hydraulic studies of water resources; and

c. Ground Water Technical Analysis Unit -- performs studies and investigations of ground water systems and geophysical/seismic activities.

Hydrologic evaluation of mining activities is a specialized component of this function in the Region 2 (Grand Rapids) office. Field staff and the Floodplain Unit also perform many of the above surveys and analyses for permit review and land use activities.

3. Water Resource Permitting

The DOW administers three water resource permit programs:

a. Protected waters -- any project that will change or diminish the course, current or cross-section of state protected waters;

b. Water appropriation -- any use or diversion of waters of the state, whether surface or ground water, in excess of 10,000 gallons per day or 1 million gallons per year; and

c. Dam safety -- construction, repair, modification of a dam, and monitoring of the safety and integrity of existing dams.

Water resource permitting involves the greatest percentage of the DOW's field staff time. Permitting functions are decentralized with the exception of dam safety and a few types of protected waters and water appropriation permits. Activities relevant to this function include field inspections, review, coordination with other units of government and DNR staff, tracking, and decisions to issue, modify or deny permit applications.

Permit follow-up efforts, violation enforcement, and public hearings are also included in this function. The DOW also administers the state dam safety grant program to provide financial assistance for necessary repairs and construction of dams.

4. Land Use Regulation and Local Government Assistance

DOW staff are responsible for overseeing three water-related land use management (zoning) programs which are implemented and administered by counties, cities, and townships:

a. Shoreland -- land adjacent to lakes, rivers and wetlands managed in order to protect water quality and aesthetics and promote orderly development;

b. Floodplain -- lands subject to flooding by the 1 percent chance flood managed in order to protect public health and safety and reduce public and private flood damages; and

c. Wild and scenic rivers -- lands adjacent to specifically designated outstanding rivers managed in order to preserve and protect unique scenic, natural, recreational or other values.

Within this function DOW staff provide technical assistance to local planners and zoning officials with respect to ordinance adoption, review of proposed developments, variances and conditional use requests. Also the DOW provides grant assistance to local governments in the shoreland and floodplain programs.

5. Public Responsiveness (Informational Services and Complaint Investigation)

DOW staff distribute information on water resources and related management programs through verbal and written requests, seminars, presentations, mailings, and brochures. DOW field staff investigate complaints relating to the DOW's regulatory permit function or local government's land use authority. The Division produces a quarterly newsletter, *Water Talk*, as a component of this function. Field staff are actively involved in assisting special interest and

advocacy groups, such as lake associations and river advocates, in addressing specific issues under this function.

6. Water Resource Planning and Coordination

The DOW coordinates with other federal, state and local agencies in carrying out water resource policies and strategies. Included in this function are cooperative planning, review and technical analysis activities involving DOW and many other agencies. Specific activities include environmental review, local water planning assistance, public ditch review, section 404 permit review, national flood insurance coordination, and the stream maintenance grant program. The DOW provides specialized multi-agency coordination in the Region 1 (Bemidji) office for Red River of the North flooding issues, and in Region 2 (Grand Rapids) for local rivers planning and the North Shore Management Board for Lake Superior.

7. Administrative and Support Services

DOW staff provide administrative and support services within the DOW for activities such as financial/budget management, data management and processing, word processing, file management, and telephone answering. Also included in this function is graphic arts support for informational services. The Water Information Systems Unit provides computer programming and analytical expertise for the DOW. Related supervisory activities in all units include personnel actions, such as hiring, discipline, and performance review; work planning; and training.

8. Program Planning and General Administration

DOW staff are responsible for developing policy and planning as program issues and needs are identified. Examples of this activity include revising shoreland management program rules and legislative coordination for new programs such as the Wetland Conservation Act of 1991. This activity occurs mainly at the central office level. The DOW has established a Water Management Committee which provides management oversight of all DOW functions. The WMC is comprised of the Director, Assistant Director, Section Administrators, and Regional Hydrologists. The WMC has established working committees to assist them: Land Use, Permits, Management Information Systems, and Training.

B. ORGANIZATIONAL FRAMEWORK

1. Department of Natural Resources

a. Information Systems (IS) Steering Committee

The IS Steering Committee was created in 1989 to coordinate and plan for information systems development in the Department of Natural Resources. This body is made up of 10 members appointed by the Commissioner's Management Team (CMT) for a two-year period. These

members were chosen from the list of unit coordinators designated by each DNR unit as responsible for information systems issues.

The IS Steering Committee reviews and approves the recommendations of the following working subcommittees:

Telecommunications;
Data Standards;
Training and Education;
Office Automation;
Microcomputer Systems;
MIS Planning and Administration; and
GIS/LIS.

The Committee makes policy and procedure recommendations to CMT on computer and telecommunication hardware, software, information systems planning, training, and education. A main goal is to foster integration and linkage within the Department and eliminate duplicative efforts. Current activities include implementation of the telecommunications plan, establishment of microcomputer standards, development of the GIS plan, GIS training, development of a data dictionary, and collation of a catalog of data sets and collections.

b. Management Information Systems (MIS) Bureau

The MIS Bureau provides administrative and support services relating to management systems. The Bureau operates the Department's AS/400 minicomputer; manages various data systems, including hunting and boat licenses, land records, and law enforcement violations; and supports other departmental administrative functions.

The Bureau has not historically provided PC support to the DNR. However, they have taken a lead role in planning for and implementing telecommunication networks within and among the various Department offices. A "backbone" network is currently being installed in the central office to connect various local area networks (LAN) within the central office to the AS/400. As part of a pilot project, the Brainerd regional office will be set up with a LAN connected by high speed cable (through an agreement with MN Department of Transportation) to the central office AS/400. No decision has been made as to the level of continuing communication and network support the Bureau will provide once the hardware is installed.

The Bureau has also been actively developing GIS/LIS software and technology. The Bureau recently finished an LCMR-funded study on using GIS for resource management. A GIS lab is now located in the St. Paul office. Future plans call for workstations at other locations to be connected via a network in order to share data and facilities. Again, the long-term role the MIS Bureau will play in the development of Department-wide GIS applications is unknown at this time.

The MIS Bureau will soon add five staff, including one position in the Brainerd regional office. Some have suggested that the IS Steering Committee needs to have approval authority over systems development in the Department. There will be changes in the roles and responsibilities of the IS Steering Committee and the MIS Bureau as system initiatives are undertaken more on a departmental scale.

2. Division of Waters

a. Water Information Systems Unit

The Water Information Systems Unit (WIS Unit) is responsible for data system development and maintenance, equipment management, operation and maintenance of the State Water Use Data System (SWUDS), general consulting, and data entry.

Throughout the early and mid-1980s, data management activities were the responsibility of the Policy, Planning and Data Systems Section. During this period there was typically one permanent complement position, which was primarily responsible for selecting, installing, and maintaining hardware and software. Usually there were one to three additional unclassified positions funded by LCMR. In addition to completing their assigned LCMR projects, the LCMR-funded staff would also be called upon to work on the ever-increasing demands for other data management applications. A major problem with this staffing arrangement was the uncertain budget situation every two years and whether these staff would be available to complete major database development projects.

With the funding of two complement positions and the reorganization of the DOW in September 1987, data functions and climatology were combined into one unit and called the Data/Climatology Unit. This was the first time that the Division could realistically begin planning long-term projects (e.g., Lakes DB) without relying on LCMR funding. The climatology and data management functions were separated when a data management supervisor was hired in the spring of 1990.

The programming efforts of the WIS Unit have been dominated first by the development of Lakes DB in 1987 - 1988 and by PIX from 1988 to the present. DOW staff have been frustrated by the length of time taken to develop and implement these two applications. The frustration stems from data processing capabilities (permit processing and access to updated permit and resource data) not being available to accomplish day-to-day job responsibilities. There has been additional frustration in that all other projects have been given a low priority or put on hold. Many units, regions and individuals have set out on their own to use and develop PC-based data applications. Lakes DB has largely been developed by the Hydrographics and Surface Water Section.

The existing staff positions and their general assigned responsibilities are identified below:

EDP Programmer/Analyst Supervisor - Supervises DOW data processing activities. Assigns and supervises WIS Unit staff developing computer systems. Develops in-house computer training. Designs specific procedures for optimal, efficient access and computerization of DOW data. Develops plan to address DOW information system needs. Provides DOW staff with computer applications to address water resource problems. Coordinates data linkages with other agencies. Identifies computer and system needs. Responsible for overseeing work of topical data specialists.

EDP Programmer/Analyst - Selects, acquires, installs, and maintains computers, telecommunications, Local Area Network, hardware, and software. Maintains inventory of hardware and software. Coordinates backup and recovery procedures.

EDP Programmer Senior - Designs, develops, implements and maintains computer programs. Analyzes needs so that most efficient data management approach is used. Prepares user manuals and program documentation. Currently responsible for migration of PIX data and computerization of Inventory of Dams.

EDP Programmer - Designs, writes, documents, and maintains computer programs as assigned. Responsible for completing the PIX program system, installing it in regional and area offices, and training staff in its use. Coordinates DNR's State Fair display of the SWIM lake summary database.

Systems Analyst (vacant) - [The incumbent] works on special DOW and DNR GIS development projects. Develops GIS databases, capabilities, and expertise. Consults and provides support for GIS work in EPPL7 and ARC/INFO. Participates in and coordinates with departmental GIS development efforts in order to achieve DOW GIS goals. Assists in DOW database management and development activities. [The responsibilities and tasks of this position are currently under review.]

Research Analyst Intermediate - Develops, implements, modifies, and maintains a PC-based, water use data system, known as State Water Use Data System (SWUDS). Provides computer programming and support for annual water use reports as part of the Water Appropriations Program. Prepares data summaries for clientele in different media. Prepares special analyses of water use data. Oversees the collection and input of annual water use data, appropriation permit information, and fees.

Data Entry Operator - Researches, collects, and enters data in databases and other DOW systems. Customarily enters historic water levels, gage run results, obwell data, daily precipitation readings, and historic permit data. Locates, maps, and assigns identification numbers to nonprotected waters.

b. DOW Policies, Procedures, and Standards

There are few formal written policies and procedures for MIS activities, except for responsibilities and tasks contained in position descriptions and staff work plans.

Hardware and software purchases are usually initiated by the interested party discussing their needs with the EDP Programmer/Analyst (P/A). A written request for the purchase through the WIS Unit has not always been required. The P/A has typically recommended specific hardware and software for the particular user/unit. The P/A writes up an order, submits it to the unit supervisor for approval, and then submits it to Administrative Services/Director's Office for final approval. In the past, the MIS Committee made annual recommendations for purchases, but this practice has been discontinued.

An inventory of DOW software has now been added to the long-standing inventory of DOW hardware. These inventories are updated by the P/A as purchases come in or changes are made on individual PCs. Software purchases have not been coordinated on a Division-wide basis. Ten different word processors are currently used by DOW staff. Nine different database management packages are in use. Inefficiencies in areas of user support, training, and transfer of documents and data are inevitable when software standards are not developed and followed.

These problems will be addressed as the Division proceeds to comply with the Commissioner's directive to legalize all software. The software inventory has been used to determine what software is really needed by each employee. New software is being purchased that complies with Department standards. Illegal copies will be removed from all PCs.

Maintenance of DOW's fleet of computers is also handled by the Programmer/Analyst. If there is a problem with equipment in a regional/area office, the P/A is able to resolve it over the phone most of the time. Unresolved problems result in a follow-up visit from the P/A. When problems cannot be solved in-house, the P/A coordinates vendor maintenance.

Central office backups are conducted by the P/A for network servers on a weekly basis, network-connected PCs on a biweekly basis, and nonnetwork PCs upon request. Regional staff are responsible for backing up data on their PCs. No guidelines are in place to specify how they proceed.

No standardized process is used to determine the priority, timeframe, and feasibility of DOW or DNR requests for services from WIS Unit. Most requests are received verbally, by memo, or through broad priorities

recommended by the MIS Committee and approved by WMC. There has been no procedure established for prioritizing requests that are received from DOW versus requests received from other units and agencies. Small requests for assistance from other units have often developed into major time commitments. WIS Unit prefers that all requests be detailed in writing. WIS Unit expects that a project work plan will be completed before the work is started. This project work plan describes the tasks to be done, priorities, responsible staff, and timeframe. A project work plan was completed and agreed upon for PIX in 1989. Realistic timeframes for completion of programs still remain a problem.

[Note: A *WIS Unit Request Form* was developed and distributed to DOW staff on March 19, 1992.]

Documentation and training are formal responsibilities in the position descriptions of the EDP Programmer Senior and Programmer for all program development. Program documentation is expected to be completed for PIX by WIS Unit staff, but the drafting of the user manual is being coordinated by the Permits Unit PIX Coordinator. Procedures for data base development, testing, screen standards, training, maintenance, and modification have not been standardized and remain the decision of the programmer and/or supervisor.

c. Topical Data Specialists

Computer expertise resided almost wholly within the WIS Unit when DOW data processing was limited to mainframe computers at the University of Minnesota and LMIC. This started to change with the introduction of personal computers in the mid-1980s. Many DOW staff have become very proficient with data management applications on the PC.

An outgrowth of this change is the concept of a "topical data specialist." A topical data specialist is an individual with a resource background who is responsible for a particular data system. The topical data specialist may develop new applications, generate standardized and special reports and assist other users of the system. This division of labor frees the WIS Unit to concentrate on other development and maintenance tasks.

A major advantage of a resource person in charge of a particular data system is their familiarity with the data itself. Data accuracy is improved since the specialist understands the data and has a feel for correct/incorrect data. The topical data specialist is also in a better position to interpret the data, prepare reports and work with outside users of the data. Advanced computer skills held by the TDS can facilitate communication with WIS Unit and enable the TDS to perform additional data management activities. This individual is in the best position to work with the WIS Unit to design and implement changes to the data system.

The use of topical data specialists is not without cost. An existing professional employee is generally assigned the new duties, which may require that some of the individual's existing responsibilities be

reassigned, eliminated or placed at a lower priority. The individual also may not possess all of the required computer-related expertise.

d. MIS Committee

A Division MIS Committee was established in 1986 to help guide data system development efforts. This committee now includes 17 members, including a representative from each region. Recommendations are made to the Water Management Committee by the MIS Committee regarding priorities for data system development, training, and hardware/software purchases. Committee meetings are also used to update members (as unit representatives) on the status of various system development activities. The MIS Committee has also sponsored training for DOW employees, established PIX and Lakes DB design subcommittees, conducted a user survey, developed a data set catalog, made recommendations on staffing needs, and initiated this planning effort.

However, the MIS Committee has not been as effective as it could be. The original role and function of the MIS Committee has not been redefined to meet the changing needs of the Division. Meetings have been infrequent in recent years, with little follow-up activity between meetings.

e. Computer Use Survey

In 1986, the MIS Committee conducted a survey of DOW staff as to their utilization of computers. A second written survey was sent to all DOW staff in September 1991 to measure the change in computer use during the past five years.

Over 140 personal computers are currently in use, compared to 21 PCs in use as of the September 1986 survey (see Table 1 on page 16). Three central office staff do not have individual computers at present, but all indicated a desire for a PC to efficiently do their job.

Central office clerical (average of 20 hours/week) lead all users followed by central office professionals (18), regional clerical (18), central office administration (12), regional professionals (8), and regional administration (7). This is a dramatic change from 1986 when most staff answered "never," "seldom," "rarely," or less than 10 hours per week of computer use.

Forty-two staff noted they were creating their own databases. All indicated that the information could be exported in an ASCII format and therefore transferred among computers and other applications. Virtually everyone (37) created the databases for their own use. Other DNR groups (20) and local government (11) were the next most often recipients of products from these individual databases.

Only 9 central office staff and 11 regional staff use the DNR's mainframe computers. E-mail (17) and calendaring (14) were the most widely used applications. These low numbers reflect the fact that few DOW staff have direct access to the AS/400.

Survey questions regarding user's comfort level in formatting a disk, changing colors on a monitor, backing up a hard drive, changing printer ribbons, installing boards and installing software were meant to assess the degree of confidence and ability staff have with respect to computer operations outside the realm of running programs. Most staff felt comfortable with typical computer operations except for installing a new board or new software.

Training is eagerly sought by DOW staff. The most typical requests for training included word processing (55), PIX (53), computer operation and maintenance (53), database management programs (52), spreadsheet programs (48), Lakes DB (43), AS/400 (37), BASIC programming (18) and CLIMON (17). Thirty-two other specific training requests were indicated, including nine for HEC-1 and five for HEC-2 and EPPL7.

C. TECHNOLOGY

1. Communications/Office Automation

The DOW relies almost entirely on the ageless methods of communication and office procedures, i.e., telephone, mail, handwritten notes and paper files. These tried and true methods will likely remain dominant for years to come. However, the use of newer technology is beginning to occur.

A fax machine is now accessible by all DOW staff and is receiving ever greater use as a means to quickly and easily transfer documents. Transferring electronic files using a modem is used far less often even though the capability to do so has been around for several years. The current procedures to transfer electronic documents are not user-friendly.

The September 1991 Computer User Survey found that only 20 DOW staff have access to the Department's AS/400 computer. Since few DOW staff have access, the use of electronic mail, centralized calendaring and bulletin boards receives limited use within the DOW. Greater use will undoubtedly occur when more staff obtain access.

Each regional office has access to the central office AS/400 computer, either directly or via an IBM System 36/38. It is not anticipated that hydrologists outside of regional offices will be directly connected to the AS/400. A recently completed study on the telecommunication needs of sub-regional offices recommended that the "DNR should plan for, design and implement a telecommunications architecture that links the central computer system to Local Area Networks, workstations, and personal computers at all remote locations into a single Wide Area Network." The study further recommends a hierarchical communication network in which telecommunication connections are established between the central and regional offices and between regional and sub-regional offices.

All central office staff will soon be hooked into the DOW network. This network has been primarily used to access large databases and to share

peripherals (printers). Greater use is now being made with network versions of major software packages, including word processors and spreadsheets.

Paper files are the predominant means to store records of Division activities. Permit files and pumping records through 1976 were microfiched in the mid-1970s to early 1980s. This effort has not been continued because of lack of funding. DOW staff have investigated IBM's "Image Plus" electronic filing system (the electronic storage and retrieval of paper files). While this technology holds great promise for the future, it was recommended that the DOW not proceed to purchase this system at this time primarily due to its high cost.

Data has been stored in Lakes DB, OBWELL, SWUDS and other resource databases for the last several years. Retrieval of data from these databases (and PIX and LUMIX when they are on-line) will occur more frequently as new user-friendly applications are developed and refined.

Central office secretaries still primarily use IBM's Displaywrite to generate documents and correspondence. Greater use of PC word processors is occurring as many staff now generate their own draft and final documents on PCs or request greater style and format capabilities than Displaywrite offers. Word processing at regional/area offices is occurring in a similar fashion.

2. Hardware

Virtually all DOW field and central office staff have a personal computer on their desk. The first personal computers purchased by the DOW were IBM XTs and XT clones. These computers, as well as the newer PS/2 model 30s, use an Intel Corporation 8086 microprocessor (the brains of the computer). As shown in Table 1, one-third of the Division's computers [42% in the field offices] are 8086 machines. These computers still function adequately for limited word processing and data entry functions, but by today's standards, they are painfully slow and have very limited hard disk storage capacities. Lakes DB and other DOW programs will work on this class of computer, but any type of data maintenance activities or extensive data retrieval is very slow or unable to be done because of limited storage capacities.

The next major upgrade occurred with IBM's introduction of their AT personal computers. AT, AT clones and PS/2 model 50s use an 80286 microprocessor. These machines are both faster than the XTs and generally contain greater hard disk capacities (30 to 60 megabytes (MB) is most common).

The Department's current standard calls for an 80386 microprocessor PC (IBM PS/2 models 55, 70 and 80 or equivalent clones). These machines are considerably faster than 80286 computers and are generally purchased with hard disk capacities of 80 to 320 MBs. Most new major commercial software (spreadsheets and word processors) are now being developed for 80386 PCs and will not run efficiently or at all on the slower machines.

The current state-of-the-art personal computer uses an 80486 microprocessor. The DOW has recently purchased three 486 computers, one for the Ground Water Unit and two for Region III. These PCs may become the standard

configuration for GIS applications. Table 1 tallies DOW personal computers by central office unit or regional location.

Table 1

DOW Personal Computers

Location	80486	80386	80286	8086	Portable	Other
Region 1		2	5	3		
Region 2		2	4	3		
Region 3	2	3	1	2		
Region 4		4	1	6		
Region 5		2	2	2		
Region 6		1	3	6		
Network Servers		1	2	0		
Admin Services		1	2	6		
Climatology		1	2	2	1	
Ground Water	1	9	3	0	2	
Data Mgmt		4	5	1		
Hydrographics		0	2	2		MacIntosh
Surface Water		7	3	0	1	
Permits		5	4	2		
Land Use		1	3	3		
Wetlands GIS		2	0	0		Workstn
On Loan		0	1	7	1	
TOTALS	*3*	*45*	*43*	*45*	*5*	*2*

Source: DOW Hardware Inventory, March 1992

Printer use is evenly split between dot matrix and laser printers in the field offices, primarily due to the availability of a particular printer rather than personal preference. Laser printer use is more prevalent in the central office because of the ease of access through a LAN.

From the user survey, 53 staff responded that they have modems but 87% indicated they used them only occasionally or never. Forty-seven staff indicated that they have a mouse with 60% indicating frequent use of it.

3. Software

The Division has purchased over 160 copies of various software packages. Word processors, spreadsheets and, to a lesser extent, database managers are the predominant commercial software used in the Division. Selected results of software use from the Computer Use Survey are tallied in Table 2. Table 3 notes mean proficiency ratings for the main categories of software. While there is not a Division-wide standard, there seems to be a trend for standards by unit or region. Prior to the legalization effort, PFS Write was the predominant word processor used in the Permits Unit while the Land Use Unit used Microsoft Word.

Table 2

Software Currently in Use

	Regional Staff			Central Office Staff		
	Clerical	Prof.	Admin.	Clerical	Prof.	Admin.
Word Processing						
WordPerfect	15	29	4	2	19	4
MS Word	1	5		2	19	
PFS Write	3	11	1	1	13	1
Displaywrite	7	6		3		
Others [1]	4	3	1		8	
Spreadsheets						
Lotus 123	5	24	2	2	26	1
Excel		1			12	
Others [2]	1	6	1		1	
Database Managers						
DBase	7	13		1	12	
FoxBase		1			8	
Others [3]		2			5	1
Utilities						
Norton	6	24	1		31	
PC Tools	1	7	1		3	
Fastback	3	15	1		5	
XTree	7	23	1		30	1
Sidekick	5	11	1	1	9	
Others [4]					5	

[1] Wordstar, Multimate, First Choice, Enable, Window Write and Pagemaker.
[2] SuperCalc, Quattro Pro and Enable
[3] Paradox, Reflex, Dataease, Enable, ORACLE and WORKS
[4] QEDIT, PKZIP and PKARC

Table 3

User Proficiency *

	Regional Staff			Central Office Staff		
	Clerical	Prof.	Admin.	Clerical	Prof.	Admin.
Word Processing	3.9	3.6	3.0	3.2	3.5	3.4
Spreadsheets	1.8	2.9	3.0	4.0	3.3	4.0
Database Managers	2.0	3.0		5.0	3.5	3.0
Utilities	2.2	2.5	1.0	5.0	3.4	4.0

* Mean response for each category based on 1 = low proficiency; 5 = high proficiency

Source: DOW Computer Use Survey, November 1991

Ten word processors are currently used by DOW staff as determined by the user survey. The most widely used word processing software is WordPerfect (65% of all staff), followed by PFS Professional Write and Microsoft Word. In response to the Commissioner's directive to legalize all software used within the DNR, WordPerfect (& LetterPerfect) has been chosen as the preferred word processing package. Microsoft Word will be purchased for current users and those users primarily operating in a "windows" environment.

Seventy-five percent of spreadsheet users are using LOTUS 123. Microsoft Excel has 13 users, with all but one stationed in the central office. Quattro Pro has been chosen as the preferred spreadsheet for the DOW and has been purchased for current LOTUS 123 users. Microsoft Excel will be purchased for current users.

DBase III or IV (33) is the most often used database management program within the DOW. FoxBase is the second most often used database management program with 9 users. DBase IV will be the preferred database manager for future purchases.

Norton Utilities, XTree and Fastback are the most frequently used utility programs with 62, 62 and 24 users, respectively. Professional staff from both the regions and central office are the predominant users. A backup software package will be purchased for each office.

Thirty-one technical programs were identified as being used by DOW staff. Professional staff are almost exclusively the users of these programs. Most of these technical programs are very specialized and typically only used by a single person. Programs used by a single professional show the highest degree of proficiency (normally rated as 5 on a scale of 1 to 5). The most commonly used technical programs are USGS regression equations (32), TR-20 (30), Drawdown (27), HEC-2 (25), HEC-1 (23), and HYDRP (23).

The greatest use of databases is limited to Climon, Lakes DB, PIX and PERMSRCH. Database use is almost exclusively carried out by central office and regional professional staff, with the exception of PIX. Proficiency is highest for PERMSRCH (5) while the other three listed databases have an average proficiency of 3. Eight other databases were noted, but only one of these had more than one user.

A total of 40 "other" software packages were identified in the survey, most of which had no more than three users.

D. DATA SYSTEMS

1. Climatology Data Systems

The State Climatology Office has developed four major data systems to collect and store precipitation, temperature, snow depth and other climatology data. Data is collected from numerous public and private organizations and individual volunteers. A brief description of each system is provided below:

High Spatial Density Daily Precipitation Data - Daily precipitation totals have been collected by as many as 1300 volunteers across Minnesota. These volunteers forward their data to various local, state and federal agencies. These data are then transferred to the State Climatology Office where they are digitized, archived and ultimately analyzed. Data are placed in a PC-based database and are readily retrievable for a specified time period or geographic location.

Long-term Daily Climate Data (CLICOM) - Long-term daily precipitation and temperature data are collected by National Weather Service cooperators. These data are provided to the State Climatology Office by the National Climatic Data Center. The data reside on a PC-based database and are readily retrievable. Many of the over 150 stations have data from the turn of the century. Approximately 20% are still available only in paper format; efforts continue to digitize these data.

Monthly Temperature and Precipitation (CLIMON) - This data set is similar to the daily data set except that these data are compiled and stored on a monthly basis. This data set has long been available in a PC format from the CLIMON database. However, keeping the database up-to-date has been a problem. Future plans are to place these data on the DNR IBM AS/400.

Weekly Rainfall/Snow Depth Summary - Weekly rainfall totals or snow depths are gathered by DNR Forestry, DNR Parks, University of Minnesota and National Weather Service personnel. These data are entered onto a U of MN mainframe computer for analysis. Weekly maps with a historical perspective are prepared and distributed to interested parties, including the media, water resource managers and agricultural interests.

Other climate-related data, such as lake ice-out, frost depth, wind speed, pan evaporation, solar radiation, soil temperature, relative humidity and sunrise/sunset are compiled and sorted by several cooperating agencies in a variety of formats.

Hardware/Software:

- Control Data Corporation CYBER Computer
- IBM PS/2 Model 80
- Data entry and retrieval software designed in-house

Input:

- data provided by volunteer readers (high spatial density daily precipitation data)
- electronic file transfer (CLIMON & CLICOM)
- remote data entry onto a common mainframe computer (weekly precipitation summary)

Output:

High Spatial Density Daily Precipitation Data:
- annual and hydrologic year precipitation maps
- county precipitation summaries
- monthly and/or seasonal precipitation maps
- flash flood analyses
- miscellaneous data requests
- special reports (e.g., *Sixteen Year Study of Minnesota Flash Floods*)

CLICOM & CLIMON:
- numerous data summaries are provided to a broad client base

Weekly Rainfall/Snow Depth Summary:
- weekly precipitation and percentage of normal maps
- snow depth and snow depth rank map

Linkages:

The raw climate data are provided by public and private groups entirely outside the DOW. The collected data are assimilated, analyzed and presented in a useable form and provided to a large client base. Cooperating agencies include the National Weather Service, U.S. Army Corps of Engineers (USCE), DOT, PCA, MN Department of Agriculture, University of Minnesota, Soil and Water Conservation Districts and DNR Divisions of Parks and Fish and Wildlife.

Existing Plans:

The primary need is to improve access to the database by the wide variety of clients. The plan is to place the data systems on either the University of Minnesota or DNR AS/400 mainframe computer. When accomplished, anyone with a PC and modem or a direct connection to one of the above mainframe computers would have access to these data sets.

2. Lakes DB

Lakes DB is a menu-driven database containing baseline and detailed information on lakes throughout Minnesota. The program has four components: the main module, names module, water level module and background module. Each module can be run independently. The main module contains information on basin characteristics, size, location, mean depth, major and minor watersheds, etc. The lake names module contains all named protected waters and wetlands and named nonprotected basins. Data elements in this module include the ID number, lake name and alternate name(s). The lake level module includes recorded lake levels data and information on lake gage locations, gage type and datum adjustments. This module also gives the user the ability to graph water levels. The background module includes information on administrative water levels (e.g. OHW, highest known water level), hydrographic surveys, drawings and maps, special studies and general comments.

Hardware/Software:

- IBM PCs, PS/2 and compatibles
- dBASE, compiled in Clipper

Input:

- file transfer from LMIC
- direct entry by both DOW staff and outside users

Output:

- on-line queries of specific data
- water level summary reports and graphs by lake
- lake level monitoring stations - statewide list
- lists of administrative water levels, including OHWs
- wetland types and acreages
- shoreland classification lists

Linkages:

- LMIC (SWIM database)
- DNR Section of Fisheries
- other units of government (lake level readings)
- PIX and LUMIX (future)

Needs:

- help screens
- training
- distribution and update schedule

3. HEC-2/TR20 data files

This data system is a collection of technical input data files for various surface water hydrologic and hydraulic computer models. The vast majority of these files were developed by consultants to the Federal Emergency Management Agency (FEMA) for the preparation of flood insurance studies for the National Flood Insurance Program. Additional computer models developed by the DOW Surface Water Unit are also stored. The most common computer programs include the USCE *Flood Hydrograph Package* (HEC-1) and *Water Surface Profiles* (HEC-2) and the Soil Conservation Service *Computer Program for Project Formulation - Hydrology* (TR-20). Frequent users of these files are the Floodplain Management Unit, USCE, MN Department of Transportation and engineering consultants.

Input:

Copies of input files are obtained from the responsible individual or agency as new hydrologic and hydraulic studies are completed.

Output:

A list of available hydrologic and hydraulic data files has been generated on a yearly basis and provided to frequent users of these data.

Linkages:

None.

Existing Plans:

Data files are currently transferred by floppy disk through the U.S. mail. Easier access to these files is needed either through the DOW network or by modem connection. The index should also be transferred from its current spreadsheet format to a database format to allow searches for files based on community name, resource name or number, and other attributes. This would allow direct linkage to Lakes DB and LUMIX.

4. OBWELL

This data application contains information relevant to the DNR Observation Well Network to monitor the state's ground water resource. Over 1300 wells are included in this application; approximately 650 of these wells are actively monitored. System information describes each well, identifies geologic formations drilled through, and contains all water level measurements performed for each well. Water level measurements are collected at various times throughout the year. The majority are measured ten times per year, March through December.

Hardware/Software:

- IBM PS/2 model 80
- FoxPro and R&R Relational Report Writer

Input:

Water level measurements are read by SWCD and USGS staff as well as individuals under special contract. The data are recorded on paper forms and transmitted to the DOW.

Output:

Upon request, the hydrograph data are provided in either tabular or plotted form for individual wells. General water level information is also available on request. An OBWELL data summary is published annually.

Linkages:

LMIC's Ground Water Clearing House will be providing the interface for DOW data to the public. LMIC will actually be incorporating the data into their larger, more comprehensive database. DOW will periodically update their files, although procedures have not yet been fully determined.

Existing Plans:

- telephone access for field staff through the AS/400.

5. Permit Information eXchange (PIX)

The PIX system is the DOW's permit information database. The system was designed to collect new permit application information, track the progress of application review, and search and retrieve historic permit information.

Hardware/Software:

- IBM PCs, PS/2 and compatibles
- Clipper

Input:

Information for new permits is obtained from the permit application. These data are entered into the system by the regional secretary. Updates to the database will eventually be entered by the hydrologist assigned to review the permit application.

Output:

- historical and pending permit information searches
- permit activity and fee reports
- computer-generated permits and correspondence
- electronic transfer of permit files

Linkages:

- SWUDS
- Division of Enforcement (citations and criminal records)
- Lakes DB

Existing Plans:

Major refinements and upgrades will likely be required even after the initial installation in the field offices. The system is currently lacking a project manager to oversee the technical design and development. System and user documentation need to be completed. The sharing of maintenance, operation and data integrity responsibility among the WIS Unit, Permits Unit and field offices has not been clearly defined.

6. MN Wetlands GIS Project

The Minnesota Wetlands GIS Project is currently digitizing National Wetlands Inventory maps, labeling protected water basins and digitizing height of land watershed boundaries. This information will be used by state and local agencies in the management of the state's wetland resources. This project will also create important "layers" for future GIS-related applications. The driving

force behind this data collection effort is the Wetland Conservation Act passed by the 1991 Minnesota Legislature.

National Wetlands Inventory (NWI) - The NWI data layer consists of digitized wetland polygons based on the U.S. Fish & Wildlife Service delineations. Mylar quad corrected air photos were used as the primary source for interpretation of wetlands. These data are delineated on 1:24,000 USGS quadrangles and are currently available only in a hard copy format. The Land Management Information Center (LMIC) is converting the digitized data to ARC/INFO format and will maintain a copy for distribution to general users. The master copy will reside at DNR where official changes can be made.

Protected Waters Inventory (PWI) - Digitized PWI data will be developed using the National Wetlands Inventory. The computer will be used to make a "first cut" by using attributes assigned to NWI polygons to define PWI wetlands. A check of the information will be made to manually add PWI identifiers and make corrections to selected NWI polygons. Size information and county highway maps will be used to ensure integrity of basin shapes and sizes.

Watershed Boundaries - A set of mylar 1:24000 quad overlays with watershed boundaries currently exists in the DOW. These overlays will be scanned and vectorized to capture the linework into digital form. Identifiers for each watershed will be taken from existing raster data files. Once completed, the watershed boundaries will be used in combination with the NWI and PWI data layer to manage water resources on a watershed basis.

Hardware/Software:

- IBM RS6000 Workstation
- PRIME 9955 (LMIC)
- Environmental Systems Research Institute ARC/INFO Version 5.01

Input:

- U.S. Fish & Wildlife Service interpretation of vegetation on aerial photographs, delineated on 1:24,000 USGS quads (NWI)
- combination of NWI digital data and PWI maps; Lakes DB will be used to generate PWI identifiers (PWI)
- DOW 1:24000 USGS quad watershed delineation overlays in conjunction with existing digitized watershed delineations (watershed boundaries)

Output:

- ARC/INFO format data files
- applications being developed in EPPL7 and ARC/INFO & ARC/Vision

Linkages:

Procedures are being developed for these three data sets to be used by DNR, Board of Water and Soil Resources (BWSR), LMIC, Pollution Control Agency (PCA), local water planning organizations and other potential users. LMIC will act as a distribution house for users.

Existing Plans:

The digitization of the NWI, PWI and watershed boundaries is anticipated to be completed during the current biennium. Applications to effectively use these data will be developed concurrently with the digitization project.

7. State Water Use Data System (SWUDS)

SWUDS summarizes permit and pumpage information collected through the water appropriation permit program. DNR permits are required for all major water users, i.e., those withdrawing more than 10,000 gallons per day, 1 million gallons per year or domestic supplies serving more than 25 people. Permit holders must report their water use annually as a condition of their permits.

Permit information includes specific data regarding the permittee; pump location; allowed pumpage rates and volumes; county, watershed and aquifer references; and various well identifiers. Pumpage information includes the reported monthly and annual pumpage rates. Summary reports and retrievals combine the above information, or can be used to examine specific areas of interest.

Input:

- water appropriation permits (Permits Unit)
- aquifer codes (Ground Water Unit)
- USGS aquifer, watershed and use codes (USGS)
- watershed codes (LMIC)

Output:

- DNR appropriation permit indexes by location, permittee, permit number, use category, county and watershed
- annual summaries of permit counts and pumpage totals for counties and use categories
- address lists by location, use category or resource type

Linkages:

LMIC - Permit master files, pumpage files, and watershed code updates are exchanged via floppy disks.
USGS - Permit master files, pumpage files, aquifer updates, use categories, and use coefficients are exchanged via floppy disks.
Permits Unit - When PIX is operational, various permit-related data will be electronically exchanged.

Existing Plans:

- expanded geocoding (latitude/longitude, UTM and MCD codes)
- menu-driven access to standard reports that are already developed
- summary databases established (annual totals, use categories, etc.) that can be maintained over time for trend analysis
- summary maps of permit locations (annually)
- GIS compatibility and use

8. Inventory of Dams

This database currently contains information on approximately 1000 dams throughout the state. Up to 50 data elements, such as ownership, location, size, drainage area and impoundment size, will be collected for each dam from field inspections, permit applications and lake files. Information will be made available to regional DOW staff and to the Federal Emergency Management Agency. This database was started in the 1970s as a mainframe computer application. FEMA recently provided a grant to the DNR to develop and maintain a PC version.

Hardware/Software:

- IBM AT, PS/2 or compatible
- Paradox

Input:

- permit applications
- dam inspections
- lake and river files

Output:

- lists of dams by county, watershed, size, ownership, etc.
- update of dam inventory provided to FEMA on an annual basis

Linkages:

- Lakes DB

Existing Plans:

Transfer of the existing electronic data to the new PC database is currently required. Since these data are not current or complete, there will need to be a continuing effort to research the files and enter data to keep the database current. Additionally, FEMA used Paradox to develop the database structure. This database will eventually be reprogrammed using dBASE to be more compatible with other DOW data systems.

9. Land Use Management Information eXchange (LUMIX)

LUMIX is currently in the development stage. This database is based on local unit of government administration of land use management programs, including floodplain and shoreland management and the wild and scenic rivers program. Key components of this data system are:

- ordinance administration;
- tracking of variances, violations, floodplain studies and maps, and permits;
- lake and river classifications; and
- monitoring.

Land Use Unit staff have been managing portions of these data using spreadsheet applications. Programming of LUMIX was begun by a student intern but not completed. Completion of the data system is dependent upon staff assistance from the Water Information Systems Unit.

Hardware/Software:

- IBM AT, PS/2 and compatibles
- dBASE

Input:

Local units of government:
- shoreland, floodplain, wild & scenic river ordinance information
- ordinance checklists
- local unit of government land use decisions
- grant applications
- land use district maps

Federal Emergency Management Agency:
- flood insurance studies
- flood insurance rate maps
- insurance reports
- raw flood data

DOT: bridge data
Minnesota Municipal Board: annexations
PCA: NPDES permits
DNR: lake, river, and program files

Output:

- ordinance adoption/amendment chronology
- variance reports
- violation reports and follow-up
- CAV/CAC activity reports
- community status reports
- FEMA quarterly progress reports
- grant status reports
- permit reports
- lake and river classifications
- river evaluation reports

Linkages:

FEMA - community status reports (shared diskettes)
Lakes DB - Various data elements will be common to both data systems, including shoreland classifications, 100-year flood elevations, OHWs, shoreline length, basin size and type of basin.
LMIC - SWIM information

Needs:

The greatest need for LUMIX is to complete the initial programming, testing, installation, documentation and user training. Once the basic system is operational, additional work will be needed to develop standard

reports, forms and checklists. This system is initially intended for central office use; access by field staff is planned for the future. Various GIS capabilities are contemplated, including monitoring how much acreage is affected and where by the various land use programs.

10. ZBASE

ZBASE is a database manager for local units of government to use in administering their land use zoning programs. The database is used by the local government to issue permits and track zoning actions. Summary data are occasionally submitted to the DNR. This database was developed by the InterTechnologies Group of the Minnesota Department of Administration. Funding and support have been provided by the DOW.

Since this database was provided to numerous cities and counties, there has been very limited follow-up. No one in the DOW has been assigned clear responsibilities for program maintenance, user support, training, and data analysis. The number of communities who attempted or still use this program is unknown.

Hardware/Software:

- IBM PCs, PS/2 or compatible
- FoxBase

Input:

- building permit applications
- variance and conditional use permit applications
- sewage treatment system permit applications
- landscape alteration permit applications

Output:

- permits
- fee reports
- type action reports
- Uniform Building Code fee table report
- fee calculations

Linkages:

- none

Existing Plans:

- none

Chapter 3

NEEDS ASSESSMENT

The needs assessment phase of this planning process identified information needs that are not being met and the relative priority in addressing each identified need. This process was started at a meeting of the MIS Committee on September 25, 1991. The committee spent an afternoon identifying general and specific information system needs. Each of the needs identified at this meeting was incorporated into a questionnaire. This questionnaire was circulated to MIS Committee members to coordinate the response from their unit or region. Space was provided on the questionnaire to indicate whether the identified need was a high, medium or low priority or not applicable. Respondents were also asked to identify additional needs.

Responses to this questionnaire were received from nearly all units and regions. The high/medium and low responses for each of the initially identified needs were tallied separately for field and central office staff. Additional comments were also compiled by unit or region.

The more typical (and preferred) means to conduct an information needs assessment is to conduct detailed interviews with selected staff. This approach was not taken due to the additional time commitment it would have required of the Planning Subcommittee. The MIS Committee discussions and survey did a reasonable job of soliciting comments and concerns from professional staff, but did a relatively poor job of getting input from secretarial and administrative staff. During the formulation of recommendations it was attempted to address known concerns of these staff.

The MIS Planning Subcommittee developed issue statements from the survey results at its November meeting. These issue statements are grouped into eleven categories and are listed below.

DOW ORGANIZATION

* The information systems needs of the Division must be accommodated by the organizational structure.

* The MIS Committee has not been as effective as it could be.

* The role of topical data specialists needs to be addressed.

WIS UNIT POLICIES AND PROCEDURES

* WIS Unit has not written and implemented a unit work plan.

* Clear policies, procedures, and decisions need to be established and made.

    * The roles of WIS Unit staff need to be better defined.
    * Conflicts and lack of communication among WIS Unit staff and between WIS Unit and DOW staff need to be resolved.
    * Projects need to be coordinated.

DATA & APPLICATION NEEDS

* Division-wide distribution of updated data and data systems has not been done in a systematic manner.

* DOW still doesn't have a fully functioning, user-friendly, user-trained data system being widely used by DOW staff.

* A wide variety of data are not easily accessed by DOW staff.

* DOW staff are not using available data systems to their full capabilities.

* Data entry continues to outpace staff availability and will only increase as new data systems are brought on board.

* Data sharing of both personal data sets (e.g. status reports) and hard copy files (e.g. lake files in region and central office) has only occurred sporadically.

* Continuing reliance on paper files makes it difficult to share information among DOW offices.

* DOW does not have a means to effectively collect, analyze, and distribute water resource information in a comprehensive way.

* Few GIS applications have been developed and none are in general use by DOW staff.

* Integration of DOW data systems with GIS has not occurred.

APPLICATION DEVELOPMENT

* PIX and development of Lakes DB Water Level Module have dominated WIS Unit's efforts during the last six years at the expense of other data system development.

* A lack of work request procedures for both DOW and other units/agencies has led to a haphazard method of setting priorities, delays for DOW requests, and confusion on how to get something done.

* Potential new applications are not being conveyed to DOW staff.

* Some DOW staff have requested the development of a rivers database.

* Standardized system development procedures have not been formalized or followed.

    * Project timeframes have not been predicted realistically nor followed.
    * Procedures have not been written down and formalized.
    * Documentation and flow charts need to be produced for applications as they are written.
    * User manuals have not been produced prior to distribution of applications, resulting in users not being able to use the application immediately.

  * Nonstandardization of screens of applications has multiplied users' learning curve for new applications.

* Future data systems need to be network compatible.

* Existing data systems may not be compatible with the network (e.g. able to be used by more than 1 person at a time and interactive with network).

* Compatibility with data systems of other DNR units and agencies needs to be considered for existing and proposed data systems.

* Opportunities for linkages with data systems of other DNR units and agencies have been missed.

HARDWARE, SOFTWARE & DATA MAINTENANCE

* Systems maintenance responsibilities are unclear.

* Data maintenance responsibilities are unclear.

* Responsibility for data maintenance has not been formalized and assigned for all data systems/data elements.

* Data entry continues to outpace staff availability and will only increase as new data systems are brought on board.

HARDWARE PURCHASE PROCESS AND DISTRIBUTION

* Purchases have not been coordinated nor controlled in accordance with standardized procedures, set priorities, or standards.

  * DOW standards for hardware purchases have not been formalized.
  * Hardware and software purchases in DOW have not been coordinated by one person.
  * A future image processing system may not be compatible with clones.
  * Newly-purchased Zeos SX clones are incompatible with the network.
  * Although cheaper to purchase, there is a risk in developing DOW applications on nonIBM machines.

HARDWARE UPGRADE NEEDS

* Many DOW staff desire to upgrade from 86 and 286 computers to Department standard.

* DOW staff desire more speed than is available on their present computers.

* New software being written will require Windows which cannot be run on 86 & 286 computers.

* Much of the new software takes an amount of RAM memory that is not available on 86 & 286 computers.

* Some software and data systems will require more storage space than is available on present computers.

* Not all computers are connected with a laser printer.

* Few staff have access to DNR's mainframe computers in order to fully utilize E-mail, calendaring, etc.

* Lack of dedicated phone lines in field offices causes problems with transferring data.

* Area offices need to be connected with their regional office and the central office.

* Modems are not up to speed.

SOFTWARE NEEDS

* Upgrades of software need to be considered and justified.

* Some DOW staff find it difficult to justify new software purchases without a trial period, especially when their current software may be adequate but not necessarily the best for getting the job done.

* There is a continuing desire on the part of DOW staff for new types and varieties of software.

* Information about new software, evaluation products, and actual purchases has not been disseminated to DOW staff.

* Standardization of software needs to be considered.

* Support for software use has been mostly informal and not uniformly available.

* User manuals are often missing or not available.

* Disposition of still useable, outdated software needs to be addressed.

SECURITY ISSUES

* Many copies of software are currently illegal.

* Security issues on data and on-site and off-site backup have not been formalized and implemented in a consistent manner.

* There is a lack of standardized procedures and technical computer expertise in all regions.

* Software has been stolen prior to distribution.

* Some DOW staff fear the reliability of using network software.

TRAINING NEEDS

* DOW staff have asked for training in (in order of number of requests):
  word processing
  operations/maintenance
  PIX
  data bases
  spreadsheet
  Lakes DB
  EPPL7

TRAINING

* Many DOW staff do not have basic skills in computer use.

* A coordinated program for training DOW staff has not been planned nor implemented.

* Available training and demonstrations have not been publicized to all DOW staff in a timely fashion.

* Past training has been ineffectual and not user-friendly.

* IMB & Ameridata training has not been personalized or specific enough.

* Personalized training is needed -- some staff prefer manuals; others tutorials or oral instruction.

* Some DOW staff have noted the lack of time to take training because of pressing deadlines.

Chapter 4

MISSION & VISIONS

A. DIVISION OF WATERS MISSION

The Division of Waters management and administrative programs are guided by the state water law (Minnesota Statutes, Section 103). The statutes outline the State's policy "to conserve and use water resources of the state in the best interests of its people, and to promote the public health, safety, and welfare...."

The *Minnesota State Water Plan* (January 1991), prepared by the Minnesota Environmental Quality Board, sets forth the following goals which are to be part of the statewide agenda for protecting and conserving water:

> to improve and maintain the high quality and availability of Minnesota's water for future generations and long-term health of the environment; and
>
> to ensure that our uses of water are sustainable, and that in meeting our needs for water, we recognize its limits and interconnections, accepting its changing and variable nature, and adjust our demands upon it when necessary to safeguard it for future needs.

The DOW is also guided by the Department of Natural Resources' stated vision, "We will work with the people of Minnesota to manage the state's diverse natural resources for a sustainable quality of life."

Recognizing the foregoing guidance, the DOW's Mission is:

> **We will provide leadership in the cooperative management of activities affecting Minnesota's water resources to promote resource protection while allowing reasonable use.**

B. DOW INFORMATION SYSTEMS VISION

We will use information systems to further accomplish the Division's vision. Specifically we seek to:

1. **View information as an integral resource of the Division;**
2. **Promote orderly management of information systems with a Division-wide perspective;**
3. **Integrate information systems activities with all other resource management entities;**
4. **Improve staff efficiency; and**
5. **View information as a marketable commodity for DOW's clientele.**

As a result, information systems will enable the DOW to adjust and refine its vision and develop more effective management strategies.

C. DIVISION OF WATERS IS VISION FOR 1995 AND 2000

The DOW MIS Committee conducted a user needs assessment during October 1991. The results of this needs assessment led to identification of issues by the MIS Planning Subcommittee at its November 21 meeting. Those issues were used to develop specific information systems visions for 1995 and 2000 as outlined below.

VISION 1995

The DOW's Water Information Systems Unit will lead in managing DOW's information systems and will proactively coordinate services to meet the needs of DOW staff, including:

data systems development;
standards and methodologies for data systems development;
linkages to users, networks, etc.;
acquisition and management of hardware/software; and
training.

DOW data systems (e.g., Lakes DB, PIX and LUMIX) will be operational. All staff will be using these systems for day-to-day activities.

Data collected, stored and used by DOW staff will be viewed as a Division-wide resource. Data will be shared among various data systems. Responsibilities for maintaining and enhancing the data will be clearly established.

All DOW staff will have the necessary "tools" to do their job. The physical communications network will be available for DOW staff to access DNR and DOW data systems.

All DOW staff will achieve a basic skill level in computer use, as follows:

Clerical:	Professional:	Administrators:
Word processing	Keyboard fluency	Keyboard fluency
AS/400 access & use	DOW data systems	AS/400 access/use
Disk format/backup	Disk format/backup	DOW data systems reports
PIX		
Printer functions		

Staff will be encouraged to develop skills in:

Clerical:	Professional:	Administrators:
Lakes DB	Word processing	Word processing
Spreadsheets	Spreadsheets	Spreadsheets
Operation & maintenance	Operation & maint.	Operation & maint.
	GIS applications	GIS applications
	Database managers	

The DOW will assist staff in achieving and maintaining the above skills through DOW's comprehensive training strategy as defined by the DOW Training Committee.

The LCMR Wetlands GIS Project work program is completed and GIS databases will be maintained beyond the LCMR project deadline. Applications to utilize GIS capabilities with existing data systems will begin to become available.

A comprehensive water resource management information system to integrate all data collection, analysis, and distribution will be planned, designed and funded.

VISION 2000

All DOW staff will have easy access to a wide variety of data systems.

A comprehensive water resource management information system will be fully operational and accessible to DOW customers.

Interdisciplinary sharing of data will be commonplace.

Existing DOW data systems will be integrated with all GIS data systems and useable by all DOW staff.

DOW staff will be using data imaging systems for filing, long-term storage, and retrieval.

Chapter 5

DATA ARCHITECTURE

A. INTRODUCTION

Data is becoming an increasingly important component of information systems. Traditionally, data files have been viewed as places to store input and output for applications. If two applications needed the same data, redundant data files were often created. Data is now being viewed as a resource that exists independent of application programs.

As a resource, data has value to the organization and must be managed. The term "corporate database" reflects the change from viewing data as belonging to a single application or organizational unit to viewing it as something of value available to meet the entire organization's needs. Data which resides in a regional or central office file cabinet or a personal database is of limited value to others in the organization. Data needs to be shared among staff and various data systems. Wide acceptance and use of the concept of a corporate database should ensure that data is collected and stored in a comprehensive and coordinated manner to the benefit of all.

Lake and ground water level data, water use data, climate data, and historic information on permit and land use activities will always be needed by resource managers. Building accurate and complete data files should be equally, if not more, important as building the applications. Applications will change to take advantage of technological improvements. PIX, Lakes DB, OBWELL and other applications will likely be far different ten years from now. However, the data used by these applications must last for generations; this is especially true for natural resources data.

The term "data architecture" is a vision of how data will be managed. Data architecture builds on the concept of a corporate database by identifying how data will be managed, who shares responsibility, and relationships among data.

B. DATA DICTIONARY

A data dictionary is a detailed description of each data element and an explanation of how the data is used in the organization. Development of a Department data dictionary is a high priority for the IS Steering Committee. The development and maintenance of a comprehensive data dictionary for the Division is strongly recommended.

An initial task in developing a data dictionary is to inventory and describe existing data within the Division. The inventory process should reveal existing data flows (sources and destinations), redundant data, and inconsistent descriptions of data. Once identified, various characteristics (attributes) of each data element are described. The data dictionary is made available to all individuals responsible for developing data systems within the Department and outside agencies. Formal definitions in existing and proposed systems will be critical if the Division is to achieve its goal of integrating systems.

A sample entry in a data dictionary following the preliminary guidelines of the IS Steering Committee is shown below:

Common Name: Permit application number

General Description: Unique number assigned to all appropriation, protected waters and dam safety permit applications.

Data Item Name: PANUM

Value Type: Character, 6 fields

Example: 915032
Displayed as 91-5032
91 = fiscal year permit application received
5 = DNR region
032 = consecutive number for that fiscal year

Unit of Measurement: NA

Allowable Values: 340001 - 996999

C. DATA RELATIONSHIPS

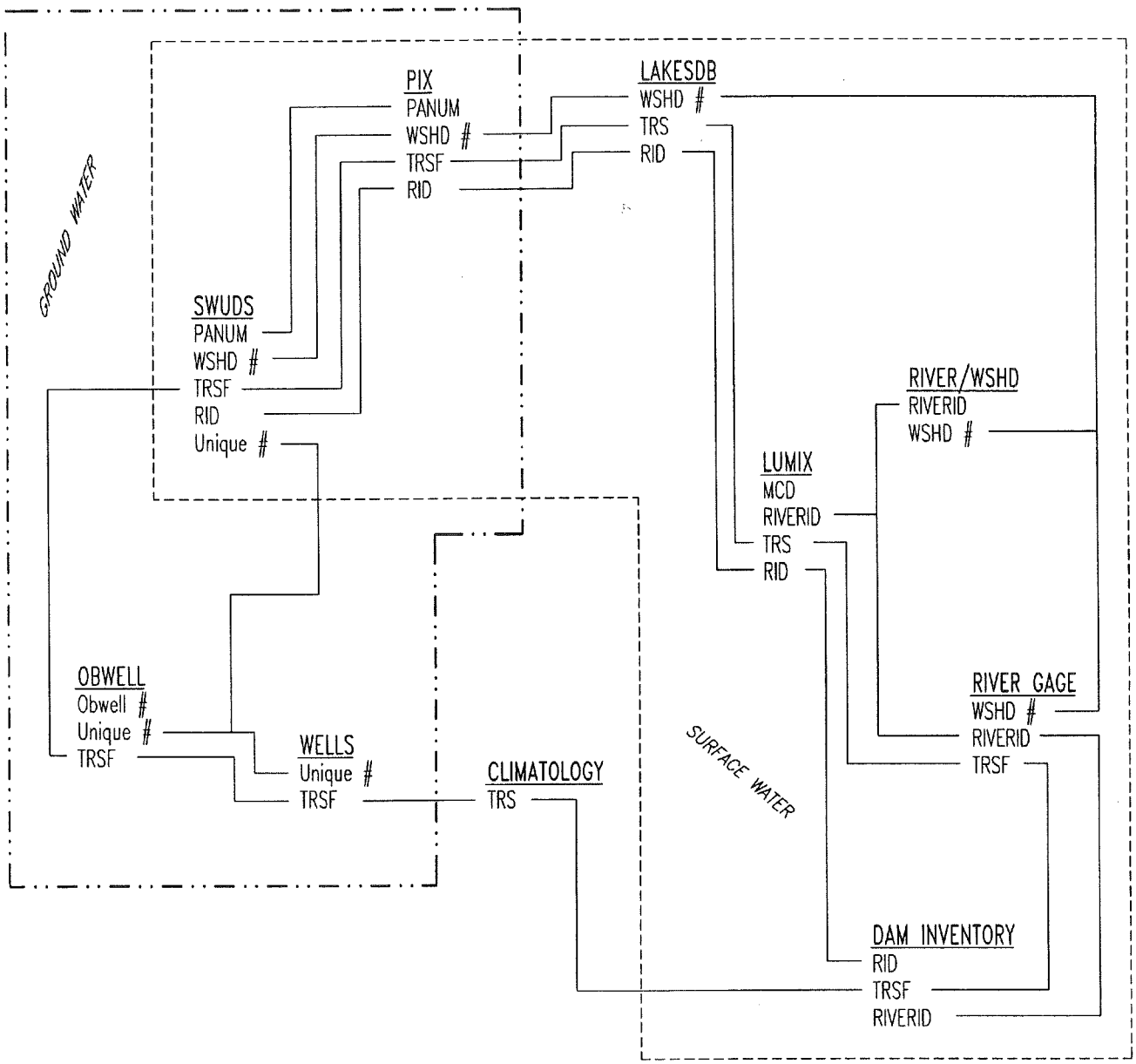
The development of a comprehensive water resource information system is an evolutionary process involving several phases. PIX, Lakes DB, SWUDS and other DOW data systems have largely been developed independent of each other. These data systems will eventually evolve into a larger system.

The ability for interaction has been designed into each data system. The diagram on the following page shows some of the logical interconnections of data and their relationship to each other. Some data sets will have strong interactions while others will have weak connections. For instance, ground water data sets, enclosed by a dashed/dotted box on the diagram, are often used together or in subgroups. The key elements of Unique# and TRSF [Township, Range, Section, Forty] allow the interaction of data between SWUDS, OBWELL and WELLS. This interaction is important in ground water activities such as well interference studies. Similarly, there are strong relationships between surface water data sets shown by the dotted area.

Electronic data files can be used by several data bases, yet stored in only one location. This simplifies updating tasks, increases data integrity, and reduces the amount of storage space needed. The potential interaction between PIX and SWUDS serves as a good example. Following approval of an appropriation permit, information developed and already entered into PIX will be electronically accessible by SWUDS. Information will be maintained by the people closest to the data and made available to others interested in the information.

Key data elements (e.g., unique well number, resource identification number and permit application number) are the means which allow computerized data sets to be interconnected. Key data elements also make it possible to use the information in a Geographic Information System.

Examples of DOW Data Relationships



KEY ELEMENTS

Obwell # = Observation well
MCD = Minor Civil Division
PANUM = Permit application number
RID = Resource identification number
RIVERID = River identification number
TRSF = Township range section forty
Unique # = Unique well number
WSHD # = Watershed number

Developing a data dictionary which standardizes definitions and establishing key elements in DOW data sets will greatly ease the process of implementing a fully integrated information system. Using standardized definitions will also improve the quality of information collected and entered into the data system.

Lack of standardized definitions can lead to major problems. For example, an outside group may collect and enter lake level data into their own data system. If their coding scheme uses the same Lake ID number used by the DOW, there should be relatively little problem merging that data with Lakes DB. Merging the two data sets would be very difficult if each basin were identified by a different method (e.g., "HENN-MTKA" for Lake Minnetonka instead of 27-0133).

The concept of a "corporate database" extends beyond the Division to include the entire Department. Efforts to share data between the Divisions of Fish & Wildlife and Waters are already underway. The coordination of lake ID numbers started over three years ago. The process for sharing water level readings and lake sounding map information is also being developed. These efforts will improve the ability of both divisions to draw upon a broad library of information on which to base resource management decisions.

The ability to share data sets among the Department's various disciplines will be greatly enhanced once effective electronic communication facilities are operating among all units, including central and field offices. A major priority of the MIS Bureau is to develop a "backbone" network within the central office to connect the local area networks of each discipline with each other and the AS/400. Additionally, improved communication facilities are being developed with the regional offices. The result of network development will provide the physical structure to integrate all DNR data systems.

Access through the Department's network will facilitate the availability and timeliness of shared information. For example, digitized PWI basins can be used to map information ranging from changes in historic water levels over a particular five-year period to the last walleye stocking date for lakes in Crow Wing County. The use of Fisheries' water level reading data increases the number of lakes for which DOW has information. This in turn improves what can be shown on a particular map. The ability to map using a DOW-developed GIS data layer will give Fisheries an additional analysis tool useful in planning stocking efforts.

The final extension of this evolutionary process will be the sharing of integrated data with the general public and agencies outside the Department. This is already occurring to a limited extent, especially with ground water data and the Division's involvement with LMIC. A fully operational network, clearly defined data and key elements, and the use of a GIS are critical to establishing a comprehensive information system.

The evolutionary process of developing a comprehensive waters resource information system will never end. Data systems must change as resource management needs change. For example, the data collected and computerized as part of the protected waters inventory program is not detailed enough to meet the needs of the Wetlands Conservation Act. New data systems, primarily GIS applications, are being developed to carry out the Act's requirements.

D. RESPONSIBILITIES FOR DATA INTEGRITY

Data collectors generally have a specific need for the data they collect. As networks and distributed data systems become a reality, data may be used by other agencies for their own particular needs which may differ from DOW's original intent. In order to meet multiple needs, data contained within DOW data systems must be as accurate and complete as possible.

All users of a particular data system share in the responsibility of integrity of the data within a particular information system. Miscellaneous data collected by various Division staff must be permanently stored. A ground water or lake level reading jotted on a scrap of paper, in a notebook or in a personal diary can be lost or quickly forgotten. The more the user ensures correct data is entered, the more the user will have trust in the data system, and the more the user will want to use the system. All users will gain confidence with the data system as the data within that system improves.

Procedures are needed detailing how data is to be inputted and by whom. It may be necessary to assign an individual with primary responsibility for particular data elements. This will usually be the topical data specialist, but not always. For example, as new flood insurance studies are completed, the Floodplain Management Unit should ensure that new or revised 100-year lake levels are entered into LUMIX. The 100-year lake levels in Lakes DB will then be updated, since LUMIX and Lakes DB will eventually share common data files.

Investment in data quality continues to pay dividends for as long as the data are used. The Division's credibility rests on the information that is distributed to the public and other agencies. The issue of data quality must be considered in all phases of data management, from data capture to processing and distribution.

Ultimately, the reason for collecting and assuring the quality of data is to make it available for use. Both internal and external use of DOW data hinges on the ease with which this information can be retrieved. Ease of use, accessibility and reliability of data retrieval applications are critical to the success of the Division as an information provider and user.

Chapter 6

RECOMMENDATIONS

A. INTRODUCTION

Many of the pieces needed by the Division to have a fully functioning information management system are in place. Various data systems are developed and nearing implementation stage, including Lakes DB, PIX, OBWELL and Climatology data systems. Virtually all staff have rudimentary computer skills; many have advanced skills and knowledge. Nearly all staff have a personal computer on their desk, most of which are now 286 class machines or better. The Water Information Systems Unit, consisting of seven complement positions, allows the DOW to accomplish most development and maintenance tasks with Division staff. Finally, the MIS Bureau is beginning to implement high speed communication links among field offices to allow for the rapid electronic transfer of information.

While many of the pieces exist, the overall picture and direction has been obscured. The responsibilities of the Water Information Systems Unit, MIS Committee, and topical data specialists need to be better defined. The development process of the various data systems has been frustrating to both users and programmers. Data systems are not yet routinely used as part of day-to-day activities.

The primary focus of this plan is to achieve the 1995 Vision. The first step is to get the various data systems operational and widely used by Division staff. Use of data systems will hopefully become as routine as checking PWI maps for protected waters and wetlands. The Division must implement a training program so that all staff can effectively use the available data systems.

The Division must develop standards and procedures so that the maintenance and development of existing and future data systems are accomplished in the most efficient manner as possible. Standards for hardware and software purchases must be developed and followed so that new hardware and software are compatible with each other, networks, and telecommunications facilities. Concurrently, the Division must better coordinate data system activities among the WIS Unit, the topical data specialists, and other disciplines by identifying common information needs, data elements, data collection and maintenance activities.

The number of calls received each day by DOW clearly shows the desire on the part of the public and other resource managers for information on water resources. Although each of the DOW's data systems are a piece of the big picture, there are still large areas of information that are missing, not easily accessed, or not coordinated. The Division must have a means to effectively collect, analyze, and distribute water resource information in a comprehensive way to meet both its needs and the needs of its clients. The final recommendation of this plan is for the DOW to begin the design and implementation of a Comprehensive Water Resource Management Information System. Improved quality and access to information for the public will result in better support, understanding, and trust.

B. DOW ORGANIZATION

1. 1995 Vision

The DOW's Water Information Systems Unit will lead in managing DOW's information systems and will proactively coordinate services to meet the needs of DOW staff, including:

data systems development;
standards and methodologies for data systems development;
linkages to users, networks, etc.;
acquisition and management of hardware/software; and
training.

2. Recommendations and Implementation Tasks

a. Water Information Systems Unit

Data management activities have become a significant function of the DOW. The WMC should consider whether the current organizational structure places enough emphasis/importance on the WIS Unit.

The WIS Unit should annually prepare a unit work plan. The WIS Unit should prepare quarterly status reports identifying accomplishments and deficiencies from the unit work plan.

The WIS Unit Supervisor will prepare a status report on the implementation of the IS Plan semiannually.

Position descriptions of WIS Unit staff should be updated to reflect current responsibilities.

b. MIS Committee

The MIS Committee has accomplished the tasks assigned to it by the Water Management Committee. This committee will be replaced by work groups established by the WIS Unit Supervisor. These work groups shall advise and assist the WIS Unit in completing various elements of this plan.

c. Topical Data Specialists (TDS)

All DOW data systems must have an assigned TDS. For new data systems, the TDS should be designated during the design phase. General responsibilities for TDSs include user training and support, report generation, data maintenance and general coordination between users and the WIS Unit. Specific responsibilities and priorities for TDSs should be clearly defined for all data systems. [See implementation task in Data Systems section on page 49.]

Position descriptions of TDSs should be updated to reflect current responsibilities and percentage of time involved.

d. Technical Regional Specialists (TRS)

Regional Hydrologists should designate a TRS for their region and adjust work plans accordingly. TRSs will be responsible for installing hardware and software, database updates, and first-line support for their respective regions. This recommendation will formally recognize the computer support already provided by several existing field staff. TRSs should receive additional training, preferential treatment for new hardware and software, and recognition of time spent on this task.

The concept of a technical regional specialist may not work equally well in all regions. The Regional Hydrologist may choose another approach. The WIS Unit will work with the Regional Hydrologist to ensure the necessary tasks are accomplished.

> Implementation Task: Formalize an approach for responsibilities for hardware and software installation, regional database updates, and support. Coordinate with WIS Unit. Change work plans accordingly.
>
> Lead Responsibility: Regional Hydrologist
>
> Others Involved: WIS Unit Supervisor
>
> Timing: August 1, 1992 for written formalization of approach.

C. DATA SYSTEMS

1. 1995 Vision

DOW data systems (e.g., Lakes DB, PIX and LUMIX) will be operational. All staff will be using these systems for day-to-day activities.

Data collected, stored and used by DOW staff will be viewed as a Division-wide resource. Data will be shared among various data systems. Responsibilities for maintaining and enhancing the data will be clearly established.

The LCMR Wetlands GIS Project work program is completed and GIS databases will be maintained beyond the LCMR project deadline. Applications to utilize GIS capabilities with existing data systems will begin to become available.

2. Recommendations and Implementation Tasks

a. Standards and Procedures

DBase IV and Nantucket's Clipper have been chosen as the database programming languages for data systems supported by the WIS Unit on the PC. Concentric Data Systems, Inc.'s R&R Relational Report Writer has been selected as the standard package for report generation. Other PC programming languages, e.g., FoxPro and Paradox, will not be

supported by the WIS Unit. EPPL7 and ARC/INFO have been selected as the standard for GIS application development. A code generator should be used where applicable to expedite data system development. Standards for a common user interface (look and feel) for existing and new data systems should be developed. Other standards and procedures should be developed to smooth operations.

A standard methodology for application development is needed to ensure coordination and increase efficient use of staff and resources. Use of the methodology must be adapted to fit the scope of the project. A primary objective is to obtain agreement between users and programmers as to scope, design, timetable, and final product.

Implementation Task: A standard procedure/form to request WIS Unit assistance will be developed and used.

Lead Responsibility: WIS Unit Supervisor

Timing: Completed March 1992.

Implementation Task: A standard methodology for application development will be identified and implemented. The chosen methodology should be coordinated with the MIS Bureau and tested during the next application development or upgrade project.

Lead Responsibility: WIS Unit Supervisor

Others Involved: MIS Bureau

Timing: By January 1, 1993 or before implementation of any new data system.

Implementation Task: Standards and procedures for system documentation and user manuals will be developed. Documentation and manuals should be completed for existing and all future data systems.

Lead Responsibility: WIS Unit Supervisor

Others Involved: Topical Data Specialist

Timing: By October 1, 1992

Implementation Task: A code generator should be selected for use by the WIS Unit. WallSoft System's UI2, used in the development of Lakes DB and other division databases, should receive strong consideration as the selected code generator.

Lead Responsibility: WIS Unit Supervisor

Timing: Prior to the development of any new data system.

b. Data Systems Coordination

A detailed plan of action for existing and future data systems should be developed by WIS Unit, TDSs, and system user representatives. These plans should include responsibilities, timelines and activities for data and program maintenance, distribution of updated data sets, report generation, user training, backup, system documentation, user manual, and system enhancements.

These plans of action should be incorporated into work plans and used by the WIS Unit and the MIS Committee to determine priorities for future development activities.

This task should be used to identify opportunities for data system linkages. These plans should identify responsibilities for coordination among WIS Unit, TDSs, other DNR disciplines, and other agencies.

Implementation Task: A meeting(s) will be held to establish responsibilities, timelines and activities for existing and proposed data systems. A plan of action will be written for each data system and updated on a periodic basis.

Lead Responsibility: WIS Unit Supervisor

Others Involved: Program supervisor, TDS, WIS Unit staff; user representatives for plan of action development

Timing: Initial meeting by October 1, 1992 to agree on process. Plan of action by January 1993.

c. Data Maintenance

A comprehensive data dictionary for the DOW should be developed and maintained. A data dictionary includes data structure diagrams, entity descriptions, attribute descriptions, and an explanation of how the data is used in the organization.

An initial task in developing a data dictionary is to inventory and describe existing data within the Division. The inventory process will reveal existing data flows (sources and destinations), redundant data, and inconsistent descriptions of data. Inconsistencies must be resolved when identified. Agreed-upon decisions must be incorporated into the existing data systems during their next upgrade.

A DOW data dictionary should be developed consistent with department standards. This dictionary will catalog and describe all data elements used by DOW staff. The catalog should identify data systems which use each data element, who has primary responsibility for maintaining each data element, and how staff use the data. This activity will help ensure compatibility among data systems.

Implementation Task: Develop data dictionary.

Lead Responsibility: WIS Unit Supervisor

Others Involved: IS Steering Committee, Topical Data Specialists

Timing: By January 1, 1993

d. GIS

GIS will play an important role in comprehensive data management and the Division should remain committed to the development of GIS applications. Implementation of LCMR projects should be continued and should become catalysts for GIS application development. Many groups are beginning to develop GIS projects and DOW needs to be a proactive partner to ensure compatibility and integration.

Implementation Task: Establish a work group to assist GIS Project Leaders. This group should explore future funding options for maintenance of existing GIS data sets and developing new applications. A second task is to identify DOW's approach in integrating and assuring compatibility of DOW's GIS activities with other DNR disciplines and agencies.

Lead Responsibility: GIS Project Leaders/WIS Unit Supervisor

Timing: Initiate by October 1, 1992.

e. Image Processing

Image processing holds tremendous potential for the Division, but the cost is prohibitive at the present time. A department-wide initiative would result in cost savings, particularly with respect to hardware, AS/400 mass storage capacity, and telecommunications facilities for field office access to the AS/400. DOW should pursue image processing and support any Department change level requests.

D. HARDWARE AND SOFTWARE

1. 1995 Vision

All DOW staff will have the necessary "tools" to do their job. The physical communications network will be available for DOW staff to access DNR and DOW data systems.

2. Recommendations and Implementation Tasks

a. Hardware and Software Purchases

All software used by DOW staff must be legal. After legal software has been purchased, each individual will be responsible for ensuring the software on their computer remains legal. Software for new employees must be purchased from the recommendation list at the same time as their computer is purchased.

> Implementation Task: Implement Commissioner's directive to legalize all software used by DOW staff.
>
> Lead Responsibility: WIS Unit Supervisor
>
> Timing: By July 1, 1992

DOW users have a high stake in the hardware and software that are used daily. Passions can run high during discussions of the merits of one system/software package versus another. Many DOW staff are very knowledgeable about hardware and software, but lack a forum to contribute to decisions on purchases. A dialogue needs to be initiated so that optimal choices for hardware and software purchases are made from a Division-wide perspective. The WIS Unit Supervisor will set up a work group to help develop hardware/software standards and purchase procedures, evaluate new software and disseminate information.

Procedures for purchasing hardware and software and standards for those purchases need to be developed to meet needs and eliminate compatibility problems. All purchases should be in compliance with

DOW and DNR established standards and priorities. Exceptions must be justified.

Decisions on the allocation of funds for hardware and software purchases clearly remain with the Director. After funds have been appropriated, the WIS Unit Supervisor should make final decisions on specific hardware (manufacturer and model) and software (package and version number) purchases based on established standards and priorities.

> Implementation Task: Develop written hardware and software standards (consistent with DNR minimum standards) for future purchases and upgrades. Disseminate to DOW staff following approval.
>
> Lead Responsibility: WIS Unit Supervisor
>
> Timing: By January 1, 1993

> Implementation Task: Develop written procedures for the purchase of hardware and software. These procedures should also establish guidelines for hardware and software maintenance/upgrades, purchase priorities, registration, disposition of surplus hardware and software and evaluation of hardware/software effectiveness.
>
> Lead Responsibility: WIS Unit Supervisor
>
> Timing: By January 1, 1993

b. Hardware and Software Support

DOW staff in need of software support have the options of consulting user manuals, vendors via free help lines, and other experienced users.

The WIS Unit should disseminate information on new software, evaluation products, potential glitches, and purchases. In addition to the WIS Unit, all DOW staff have the responsibility to share with the Division their experiences using specific hardware/software. The MIS Bureau is planning to prepare and distribute a newsletter on Department MIS activities.

c. Communications

DOW should work with the MIS Bureau to ensure DOW access to AS/400, dedicated phone lines in field offices and improved modem connections among offices. Modems should be upgraded to DNR standards as funds become available and phone lines are improved.

d. Backup

Hardware failures are a reality of using computers. The loss of valuable data could be irretrievable or result in time-consuming tasks to recreate the information. Staff are responsible for regularly backing up their computer.

> Implementation Task: Develop standards and procedures for backups and disseminate to all DOW staff. Train staff in backup procedures and provide them with the necessary tools. These standards should contain recommendations and/or facilities for remote site backup storage.
>
> Lead Responsibility: WIS Unit Supervisor
>
> Timing: By January 1, 1993

E. TRAINING

1. 1995 Vision

All DOW staff will achieve a basic skill level in computer use, as follows:

Clerical:	Professional:	Administrators:
Word processing	Keyboard fluency	Keyboard fluency
AS/400 access & use	DOW data systems	AS/400 access/use
Disk format/back-up	Disk format/back-up	DOW data systems reports
PIX		
Printer functions		

Staff will be encouraged to develop skills in:

Clerical:	Professional:	Administrators:
Lakes DB	Word processing	Word processing
Spreadsheets	Spreadsheets	Spreadsheets
Operation & maintenance	Operation & maint.	Operation & maint.
	GIS applications	GIS applications
	Database managers	

The DOW will assist staff in achieving and maintaining the above skills through the Division's comprehensive training strategy as defined by the DOW Training Committee.

2. Recommendations and Implementation Tasks

DNR MIS Bureau is assuming greater responsibility for basic computer training of all DNR employees, e.g., DOS, word processing, AS/400, databases, and spreadsheets. This includes providing training sessions, as well as evaluating existing training opportunities and identifying other available educational tools. DOW staff should take advantage of these opportunities to the greatest extent possible.

The DOW Training Committee should develop a strategy to assist staff in achieving and maintaining the expected computer skills which cannot be met through the MIS Bureau. Options include:

- DOW Training Committee identifies training opportunities, e.g., training demos, tutorials, classes.
- DOW avails itself of vendor-provided training.
- DOW Training Committee works with WIS Unit Supervisor and Topical Data Specialists in exploring options for the most effective way to conduct in-house training. This group should utilize the list of training facilities and costs developed by the Education and Information Subcommittee of the IS Steering Committee.

WIS Unit staff have special training needs in order to maintain and improve skills.

> Implementation Task: Individual work plans will include expectations of computer skills enhancement. The means by which this is achieved shall be completed consistent with DOW's training strategy. Expectations for improving computer skills will be a component of an employee's annual evaluation.
>
> Lead Responsibility: DOW supervisors
>
> Timing: Beginning of each fiscal year

F. COMPREHENSIVE WATER RESOURCE MANAGEMENT INFORMATION SYSTEM (CWRMIS)

1. 1995 Vision

A comprehensive water resource management information system to integrate all data collection, analysis, and distribution will be planned, designed and funded.

2. Recommendations and Implementation Tasks

The Water Management Committee is adopting the concept that the Division is **the** information broker for water resource data and analysis. In order to meet this goal, the design and implementation of the Comprehensive Water Resource Management Information System should be a high priority for DOW. This comprehensive information system will allow easy retrieval, analysis, and meaningful presentation of a large amount of information that currently resides in many systems or is not computerized. Improved service to our clientele will result in better support, understanding, and trust.

This project, with DOW as the lead coordinator, is becoming a key component in both DOW and DNR's Strategic Plans. Implementation responsibilities must be assigned to a high-level DOW employee who can champion and coordinate this comprehensive system.

Chapter 7

PLAN UPDATES

Information systems technology has undergone dramatic changes during the past ten years and no doubt will continue to change in the future. Within the DNR, major changes are occurring with the role of the MIS Bureau and the services it will be providing. Use of the AS/400 by the DOW will grow as new communication facilities are developed and more staff gain access. GIS initiatives will likely become the primary means to correlate, analyze and present data from a wide variety of data systems. Although it is difficult to look too far into the future, this plan did identify strategic issues in a Year 2000 vision and a proposal for a Comprehensive Water Resource Management Information System (CWRMIS).

This plan has focused on achieving elements of a 1995 vision. Many short-term tasks have been recommended, concentrating on completing data system development projects already underway and developing formalized standards and procedures for various IS-related activities .

The WIS Unit Supervisor has been charged with preparing semiannual status reports on the implementation of this plan and submitting this report to the Water Management Committee. The DOW must periodically review and update this initial plan. Hopefully future plans can focus on additional strategic issues, in part through the design and implementation of CWRMIS. It is recommended that the next major update occur by 1995. At that point the MIS Committee should know to what degree the Division achieved the 1995 vision and be able to effectively plan for the year 2000.

GLOSSARY

Analyze
To separate a whole into constituent parts with a view to examine and interpret. In the case of data and systems analysis, its result is the foundation on which new data and information systems are built.

Application
One or more computer programs that support a specific end-user activity or need for data.

ARC/INFO
A vector-based Geographic Information System produced by Environmental Systems Research Institute (ESRI).

Archive copy
A data copy retained for backup or historic reasons. Also called backup copy.

ASCII format
The internationally accepted binary code (zeros and ones) representation for letters, numbers and symbols. In addition to its use in text files, it is also an important standard since it provides a common ground through which one coding system can be converted to another, such as the conversion of the Microsoft Word coding system to that of Wordperfect.

Attributes
1) A name characteristic or descriptor of an entity. Also called Data element, Data item, Data field.
2) A characteristic of map features. For example, a point may represent a well location, and attributes are information about the well such as depth, pump type, or owner.

Automatic document generation
As used in PIX: The production of documents (letters, reports and tables) which uses existing data to avoid duplicate entry of information.

Backup
Electronic copying of data and/or programs to separate storage media (diskettes or tape) to reduce the possibility of information loss.

Board (Circuit Board)
A set of electronic components assembled on a single board to perform peripheral or central processing tasks. A 'Mother board' refers to the circuit board containing the central processor and memory chips. Internal modems are a good example of a peripheral board.

CAD Computer-Aided Design
An automated system for the design and display of graphically-oriented information.

Clipper
A programming language which uses data file format and most of the commands of DBase. Additional Clipper commands provide enhancements for programmers which make it possible to write sophisticated applications. It is compiled and does not require users to own any other software such as DBase to run an application.

Code generator
Software which writes programs based on predefined information such as screen design, data definitions and desired functions. Code generators can speed the development of commonly used data base functions and give a consistent look and feel to many different applications.

Compatibility (hardware, software data)
Capable of performing in harmonious combination with others. In the case of hardware and most cases software, compatibility is obvious, i.e. it works or it does not. Especially in the case of data and sometimes in the case of software, this line becomes fuzzy. The degree of compatibility becomes important. For instance: Lotus and Twin use the same file types and are highly compatible. Excel and Lotus use different structures yet still have some compatibility because with some effort you can translate one into the other. Various levels of network compatibility also exist. Compatibility at a low level on a network machine allows any one network user to use the software at one time, high compatibility software allows many users.

Data
Characteristics or facts, resulting from observations or measurements, used as a basis for describing real world entities in one of three ways: descriptively (attributes), positionally (spatial reference), or temporally (time). Commonly used in the singular ("Data is...") rather than the grammatically correct plural ("Data are...").

Data accessibility
The capability for a user to extract needed information from a database.

Data conversion
The process of changing the format of data from one physical structure to another physical structure (e.g., migration of PIX data from Water Data Network).

Data element
The smallest unit of named data in a data set, e.g., the data of a reading of a water level measurement.

Data entry
The process of changing the form of data from manual (or manuscript) to computerized using digitizing, scanning and/or processing procedures.

Data linkage (relationship)
The connecting of two or more separate data files through the use of a common key or descriptor. For example: the linkage of data files containing lake names and hundred year flood levels through the lake ID common key.

Data maintenance
The tasks necessary to assure data remains current, correct and available.

Data management
Planning, designing, development, implementation and maintenance of data.

Data processing
Performing operations on digital data in a computer which changes its value or organization.

Data security
The ability to prevent unauthorized accesses to a database and actions on it.

Data set
A named collection of logically related data records arranged in a prescribed manner. A physical grouping of data elements pertaining to one thematic topic.

Data structure
The physical organization of data; how it is defined, grouped and the relationship between data groups. For example, PIX data is structured by common permit data, Protected Waters data, Appropriations data and special information. Each data group is structured in a separate data file.

Database
A mechanized, shared, formally defined collection of interrelated data sets stored together which is protected and managed to retain its value.

Database administrator
A person or organization responsible for physical database design.

Database management system (DBMS)
An integrated, user-machine system for providing information to support operations, management, analysis, and decision-making functions in an organization. Also referred to in this plan as data systems.

Delineation
Defining boundaries of an areally distributed feature through interpretation of source information. For example defining the boundaries of wetlands off color infrared air photos.

Design, conceptual (also logical design)
A generalized user-understood view of the data that are related to an application or problem. It is independent of any software or data storage structure. It answers the question: "What is the logical grouping of our information and how do we want to use it?"

Design, physical
The way the data are physically structured to allow hardware and software interaction. It is the refinement of the conceptual design and describes a detailed data structure.

Digitization
A process to convert images or maps into a digital format usable by a computer.

Distributed database
A database with components on different computers connected by local area networks (LANs) or linked through a wide area telecommunications network (WAN).

Electronic mail (E-mail)
A system of distributing messages through the use of a network. Usually with features which alert users where messages have been sent, allow forwarding and the use of distribution lists.

Entity
Something that has separate and distinct existence, i.e., objects about which information is recorded in a database.

EPPL7
A raster-based Geographic Information System written by Land Management Information System [of late associated with Dept. of Administration].

File
A collection of logically related record occurrences that are treated as a unit by an application, i.e., lake level data in Lakes DB.

Format
1) To prepare a diskette for use on a computer by defining how information will be stored on the disk. 2) The structure of electronic data; a general index of "what" is located "where".

Geocode
1) A system of encoding used to represent map features in a data base. 2) Assigning geographic (map, spatial) coordinates to data.

Geographic Information System (GIS)
1) A collection of data that are individually or collectively attached to geographic location. Spatial data is a term used synonymously with geographic data. 2) An information processing technology to input, store, manipulate, analyze, and display spatial data (Earth-referenced) to support the decision making processes of an organization. Within the DNR, spatial data refers to spatial resource data; and GIS is a tool to help effect specific decisions about the land base and its natural resources.

Graphical User Interface (GUI)
A display standard which allows the control of every picture element (pixel) on input and output devices, i.e., Windows is a graphical user interface. . This is different from character-based interface which relies on codes which define a limited number of characters which may be used or displayed.

Hard disk
A rigid, permanently mounted magnetic disk which stores electronic data.

Hardware
Any physical equipment used in the processing of electronic information.

Icons
Symbols which represent actions or commands which can be executed in a Graphical User Interface.

Identifiers
Labels or codes which uniquely identify an entity.

Image processing
A technology for classifying or converting remotely sensed images into a form that is meaningful to a use in a computer.

Information management
Managing processes and characteristics of information movement for manual as well as electronic information.

Information systems
All aspects of information flow from the time it is received until it is disposed. This may include manual steps such as receiving mail and phone calls. It is often shortened to "Systems" and is easily confused with computer "systems" which only refers to hardware, software and data.

Key
One or more attributes whose values uniquely differentiate one entity from another. For example, if the Lake ID is known, many other information items (name, lake depth, area, etc.) can be found through that key.

Layers
A collection of data dealing generally with one thematic topic, e.g., water, soils, timber stands, transportation net, etc. When the data are represented and stored on map media, the term layer is sometimes used as a qualifier.

Linkage (Relationship)
A quality that connects two or more things or parts as being or belonging or working together or being of the same kind; i.e., in database terms, the association between two or more entities.

Local Area Network (LAN)
A data communications system which allows the interconnection of various devices such as word processors and computers over a limited geographic area.

Mainframe
A large computer designed to handle a large volume of users and/or processing tasks simultaneously.

Management information systems
The design, development and maintenance of all aspects of information flow for the purposes of managing a business function.

Megabyte
One million bytes or characters of data.

Memory
Temporary, chip-based data storage used by a computer's central processing unit (CPU) to hold information currently being processed. Often referred to as Random Access Memory (RAM). Memory is often confused with storage, which is disk-based, long-term storage.

Menu-driven
All computer actions are initiated through the use of a multiple choice menu selection process, as opposed to a command driven system which requires the user to remember and enter a command.

Microcomputer
Originally these were defined as eight bit processors but as systems have developed 16 & 32 bit processors have become prevalent. One way to define them is as primarily single user machines.

Minicomputer
Computer used for medium load multi-user environments. Originally characterized by 32 bit processors.

Modem
A electronic device used to translate digital information into modulated signals for the purpose of transferring information over communication lines.

Mouse
An input device use to control an onscreen pointer and select onscreen options.

Needs assessment
The process of assisting a user to define his/her potential GIS applications by assessing task, function, and data needs. This is often ascertained by interview and/or survey.

Network
A series of computer locations connected by communications channels for the purpose of sharing hardware, software and data resources.

Network server
A computer used to control the function of a network and do network-related processing.

Peripherals
Additional input and output devices connected to a computer.

Project manager
A person responsible for the resource usage and results of a project. A project manager is the person who assigns programmers to the project, determines timelines and signs agreements of what will be developed.

Program documentation
Information which explains in programmer terms how a program works and hints at how to fix it when it breaks.

Programming
Writing of a series of computer commands for use at a later time. This implies an understanding of how commands function and the ability to anticipate all possible ways that a series of commands may be put to use.

R&R Relational Report Writer
Software that extracts data from databases or files and produces formatted reports, typically with controlled pagination, page headers and footers, subtotals and grand totals.

RAM (Random Access Memory)
See memory.

Raster
A grid cell (checkerboard) approach to GIS; map data subdivided into elements -- much like tiles in a mosaic; cell data arranged in a regular gridded pattern in which each cell in the grid is assigned an identifying value based on its characteristics.

Relational database manager
A database made up of flat files that uses a DBMS that has the capability to recombine the data items and elements to form different files thus giving great flexibility in the usage of data (Martin). Software used to interconnect groups of files which have information arranged in rows and columns (flat files). Files are interconnected through the use of shared data elements called keys. In Lakes DB, a relationship between the file containing lake names and historic water level readings can be established using Clipper or DBase. Both are relational database managers.

ROM (Read Only Memory)
Instructions or data which are permanently recorded on a computer chip, e.g., A BIOS chip is a ROM which contains basic initial operating system and contains the instructions needed to get the computer to read the operating system off the disk.

Scanning
A procedure to record text, maps or pictures as digital images. The images are composed of very small, evenly spaced cells. Each cell has a brightness value assigned to it. A representation of the original scanned manuscript is produced by displaying the cells in row column order with brightness of each cell based on its value.

Screen standards
Consistent arrangement and definition of commands used in all applications being developed for a series of applications. In Waters case, commands such as Add, Next and Delete used in PIX, Lakes DB and other developed applications should all function the same and be found under the same headings. In other words, a standard look and feel to a set of applications commonly used by a group of users.

Software package
A computer application, usually commercial, designed to perform a specific set of computer processing tasks. It often comes packaged with a user manual.

Spreadsheet
Software which organized information in a matrix that allows calculations to be preformed on rows, columns and cells. Summary reports can be produced from the results.

SQL
The standard data definition and data manipulation language for relational databases. The original version was named Sequel.

Storage
Capacity of a disk to hold data which remains recorded without the need for continuous power. May be fixed hard disk, floppy diskette or optical disk media.

Support
Assistance in the installation, learning, trouble shooting, repair and/or enhancement of computer hardware, software or data.

System
Two relevant definitions apply and often cause confusion between them. 1. A computer (hardware, software and data). 2. A business process or part of a business process which forms a beginning to end set of tasks having a set of predefined decisions or procedures.

System administration
The management of all tasks associated with the operation of a computer.

System administrator
The person responsible for system administration.

System design
The analysis and planning of a set of predefined decisions and procedures which achieve a specific business function or goal.

System development
To apply a system design and make modifications to enhance that design with the goal of fully implementing the system.

System maintenance
Assure the continued and efficient operation of a computer system, e.g., update operating system, add and service hardware, backup and recovery, add/subtract users trouble shoot problems.

Systems management
See management information systems.

Telecommunications
Transmitting of digital data over communication lines.

Topology
The location or relationship of point, line and area features with respect to one another. This is the information in the computer which makes it possible for a GIS to know a road is on the edge of a township, a lake is in a city, or two counties share a boundary.

User interface
Method by which the human operator communicates with the various database and applications modules.

User manual
An instruction and/or reference document for a particular computer, peripheral equipment, software package, application or program.

Users
In the DNR context, all individuals routinely engaged in the work of the organization, and in the use of information processing technologies to accomplish this work; includes managers, resource specialists, technicians, and clerical staff alike.

Utility programs
A set of programs for use in maintaining the operation of a software product, application or computer equipment. e.g.,: backup and recovery, data and file cleanup functions, reindexing, file downloading, change program settings such as color or warning bells.

Vector
A vector is an arrow having a beginning and end point, therefore length and direction. A set of vectors are the basic units which make up lines and polygons in a vector-based GIS such as Arc/Info. The computer stores points, lines and polygons to describe geographic features.

Wide Area Network (WAN)
A group of computers connected over a large geographic area or multiple networks connected together. The goal of interconnection is to allow the sharing of computer resources (hardware, data and software) in a way that minimizes the importance of where on a network that resource is located.

Windows
The appearance of a window on the screen of a computer may be any size or shape. The importance of a window lies in the concept of a session. Each window represents a computer work session. It is possible to open many sessions or windows at the same time. The advantage is it is easier to move from one computer task to another by closing one window and opening another than it is to stop one program and start up another.

Word processor
A software package used to enter, modify, format and print text documents.

Workstation
As a general term, workstation refers to any desktop or deskside computer and its peripheral equipment. It may also include the work desk and area. As a type of computer, it refers to desktop or deskside computer with processing power comparable to minicomputers, often running a UNIX operating system and capable of supporting several users simultaneously.