



A LAND INFORMATION SYSTEM PLAN FOR OZAUKEE COUNTY

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**COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 142**

A LAND INFORMATION SYSTEM PLAN FOR OZAUKEE COUNTY

Prepared by the
Southeastern Wisconsin Regional Planning Commission
P. O. Box 1607
Old Courthouse
916 N. East Avenue
Waukesha, Wisconsin 53187-1607

April 1992

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April 17, 1992

Mr. James L. Swan, Chairman, and
Members of the Ozaukee County
Board of Supervisors
Ozaukee County Courthouse
121 W. Main Street
Port Washington, Wisconsin 53074

Dear Chairman and Members of the County Board:

On February 7, 1990, the Ozaukee County Board of Supervisors created a Land Information Office pursuant to Section 59.88 of the Wisconsin Statutes. The Board also created a Land Information Committee to provide policy oversight for that Office, and designated the County Register of Deeds as the official contact person for the Office. On June 6, 1991, the Board requested that the Regional Planning Commission provide staff support to the Land Information Office in the preparation of a countywide plan for land records modernization. This report sets forth that plan as developed by the Land Information Committee working with the Land Information Office, the latter being representative of the local units of government, the private utilities, and other private sector interests in Ozaukee County.

After a careful review of pertinent information, the Land Information Committee and Office members concluded that a modernized land records system in Ozaukee County could best be created by providing a single automated mapping base for the entire County. This single mapping base would be prepared to a set of specifications sufficient to meet the most stringent of accuracy and map feature content requirements of all users concerned. Each organization, including Ozaukee County, intending to use the automated base would provide its own operating environment in terms of computer hardware, software, and supporting staff. Only the computerized maps and common parcel identification system would be shared. With the use of a shared automated mapping base in such a decentralized land information system, it would be possible for individual units of government and utilities to proceed at their own pace in establishing an automated land information system, preserving, however, the capability for the ready exchange of data among the decentralized data banks that ultimately would be established.

The Land Information Committee recognized that it will take many years to complete the development of the recommended common automated mapping base, although the Committee noted that significant progress has been made to date in preparing base maps to Regional Planning Commission specifications, work that now needs only to be converted to computer-readable form. Over the next five years, the Committee recommended that Ozaukee County focus available resources toward completing the recommended automated mapping base for the entirety of Township 9 North, Ranges 21 and 22 East, which encompass the City of Mequon, the Village of Thiensville, and the small portion of the Village of Bayside lying in Ozaukee County. These resources include monies already being made available to the County Surveyor for remonumentation work, as well as the monies that are accumulating in an account maintained by the Register of Deeds from state-mandated recording and filing fees. If the City of Mequon and Village of Thiensville desire larger scale, one inch equals 100-foot, base mapping than the standard scale selected by the Land Information Committee of one inch equals 200 feet, then local cost-sharing monies from Mequon and Thiensville, as well as supplemental county tax levy monies, would be required. If Mequon and Thiensville determine not to proceed with the larger scale mapping, then the entire project recommended over the next five years can be completed with the County Surveyor and Register of Deeds recording and filing fee monies.

The plan also calls for the County Surveyor to do additional remonumentation work north of the Mequon-Thiensville area over the next five years, and for the County Register of Deeds to continue the preparation of automated parcel maps throughout Ozaukee County as the resources of that Office permit. Finally, the plan encourages those local units of government in the County that may desire to accelerate the completion of an automated mapping base for a portion of the County to do so, but in a manner consistent with the standards and specifications for automated base mapping set forth in the plan.

On March 31, 1992, the Land Information Committee acted unanimously to adopt the five-year plan set forth herein and to recommend the adoption of the plan and its implementation to the County Board. The Committee further unanimously recommended that the plan be submitted by the County to the Wisconsin Land Information Board for endorsement in order to qualify the County and the local units of government in the County for grants from the State in support of the recommended plan implementation work.

Sincerely,



Kurt W. Bauer
Executive Director

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Chapter I

INTRODUCTION

BACKGROUND

On June 6, 1991, the Ozaukee County Board of Supervisors requested the assistance of the Southeastern Wisconsin Regional Planning Commission in the preparation of a plan for the modernization of land records within the County. A copy of the resolution requesting that assistance is reproduced in Appendix A. This initiative by the County Board was a direct result of the establishment of the Wisconsin Land Information Program under Section 16.967 and 59.88 of the Wisconsin Statutes. The resultant plan is documented in this report.

LAND INFORMATION OFFICE

Under the Wisconsin Land Information Program, counties are encouraged to establish a Land Information Office. A Land Information Office was created by the County Board on February 7, 1990 (see Resolution reproduced in Appendix B). The ordinance designates the County Register of Deeds as the official contact person, that is, as the County Land Information Officer, for the County Land Information Office. Thus, the designated County Land Information Officer currently is:

Mr. Ronald A. Voigt
Register of Deeds
Ozaukee County Courthouse Room 135
P. O. Box 994
Port Washington, Wisconsin 53074-0994
(414) 284-9411

The policy-making body for the Land Information Office is the Ozaukee County Land Information Committee, comprised of five County Board Supervisors. The Committee was appointed by the County Board Chairman with the concurrence of the County Board on March 6, 1991.

The activities of the County Land Information Office have been organized into eight divisions, each of which constitutes a subset of land records modernization issues: the divisions of finance data interchange, municipalities, technical; users, infrastructure, education, and utilities (see Figure 1). Each division consists of

several individuals who meet to consider issues of land records modernization as these relate to the specific area of interest of the division concerned. Formal Land Information Office meetings are held periodically to coordinate the efforts of the divisions. Voting representatives at these meetings are the eight Division Coordinators, or their designees, as well as the Register of Deeds functioning as the Land Information Officer. Members of the Land Information Committee are also generally in attendance at the Land Information Office meetings.

PURPOSE OF THE REPORT

The purpose of this report is to set forth a land records modernization plan for Ozaukee County, with emphasis on the development of an automated mapping and parcel-based land information system. The report is intended to provide sufficient information to permit the Ozaukee County Board of Supervisors, the affected Ozaukee County departments, the concerned local units of government within the County, and the public and private utilities operating within the County to consider the need for such a system and to determine the desirability of proceeding with the creation of such a system. To this end, the report is intended to accomplish the following ancillary objectives:

1. To provide county and local appointed and elected officials, utility managers, and concerned citizens with a basic understanding of the components of an automated mapping and land information system and the manner in which these components must be assembled to provide a conceptually and technically sound system.
2. To identify and describe briefly existing automated mapping and land information systems whose operation pertains to all or portions of Ozaukee County.
3. To propose an organizational arrangement for the development of an automated mapping and land information system for Ozaukee County.

4. To identify those technical issues which, in the case of a shared, multi-user, automated mapping and parcel-based land information system, must be resolved before a shared system can be developed.
5. To identify the steps needed to implement an automated mapping and parcel-based land information system for Ozaukee County.

In addition to meeting the needs of Ozaukee County, the local municipalities in Ozaukee County, and the public and private utilities operating in Ozaukee County, it is intended that the land information system plan set forth herein meet the requirements of the Wisconsin Land Information Program. Toward this end, it is recommended that, upon approval of the plan by the Ozaukee County Board of Supervisors, Ozaukee County seek approval of the plan by the Wisconsin Land Information Board. The plan is summarized in a format specified by that Board in Appendix C.

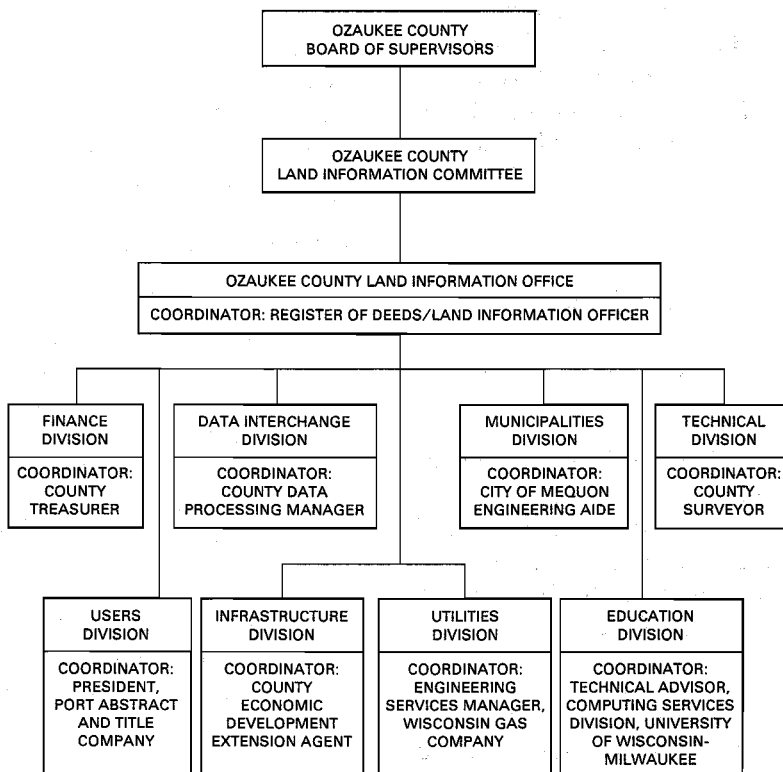
PLAN REVIEW COMMITTEE STRUCTURE

To provide a proper forum for preparing the plan and for seeking agreement on the course of action to be recommended, a Plan Review Committee, consisting of the members of the County Land Information Committee, the Land Information Office Division Coordinators, and the Land Information Officer, was established. That Committee included knowledgeable representatives of Ozaukee County, concerned local units of government within Ozaukee County, private utilities serving Ozaukee County, and the private abstract and title companies serving Ozaukee County. A roster of the Plan Review Committee is reproduced on the inside front cover of this report.

The purpose of the Plan Review Committee was to place the knowledge and experience of the Committee members at the disposal of the study and to involve the various interests actively in the study. The Committee carefully reviewed and approved unanimously the findings and recommendations of this report.

Figure 1

OZAUKEE COUNTY LAND INFORMATION OFFICE



NOTE: The Plan Review Committee consisted of the members of the Land Information Committee, the Land Information Officer, and the Coordinators of the Divisions of the Land Information Office.

Source: Ozaukee County.

Chapter II

AUTOMATED MAPPING AND LAND INFORMATION SYSTEMS: AN OVERVIEW

INTRODUCTION

For over a decade there has been growing interest in the United States in land information systems. This interest ranges from a relatively narrow concern about the need to modernize land title recordation systems to a relatively broad concern about the need to create entirely new land-related data banks for multipurpose applications. This growing interest has involved practitioners of many disciplines, ranging from surveyors, abstractors, assessors, and attorneys concerned with the fiscal and legal administration of real property to planners, engineers, public utility managers, public administrators, and elected officials concerned with resource management and community development. Much of the interest was initially centered on the use of electronic computers for the storage, manipulation, and retrieval of land-related information and, more recently, for the use of computer-assisted graphics collection and display hardware for the reproduction of the data in mapped as well as tabular form.

As interest in the area of land data systems has grown, the topic has become increasingly prominent as a subject of professional papers, reports, conferences, and the meeting programs of various professional organizations. Accordingly, a body of professional literature on the subject of automated mapping and land information systems has begun to coalesce and accumulate. During this same period, an increasing number of local units of government and private utilities have undertaken the creation of automated mapping and land information systems, including systems that currently cover all or parts of Ozaukee County.

This chapter presents a summary of pertinent literature on automated mapping and land information systems and identifies and briefly describes currently operating automated mapping and land information systems which pertain to all or portions of Ozaukee County.

NATIONAL RESEARCH COUNCIL STUDIES

In 1979, the National Research Council convened a Panel on a Multipurpose Cadastre to review the status of cadastral activities at the federal, state, and local governmental levels and in the private sector and to review a number of demonstration projects already undertaken at various locations. The Council was responding to the growing interest in land data systems and to the perceived increasing need for land-related information by all levels of government and by the private sector. In 1980, a report was issued, the principal finding of which was that:

There is a critical need for a better land-information system in the United States to improve land-conveyance procedures, furnish a basis for equitable taxation, and provide much needed information for resource management and environmental planning.¹

The report set forth the concept of the multipurpose cadastre as a basis for a dynamic public process that could effectively collect, maintain, and disseminate land-related information. It identified the land resource-related problems faced by public and private organizations and outlined the basic structure of a multipurpose cadastre to help to remedy those problems. However, the report did not address how governments, especially local governments, could carry out the recommendations made in the report.

To address the questions left unanswered by its 1980 report, the National Research Council prepared a second report, which set forth a set

¹*National Research Council, Assembly of Mathematical and Physical Sciences, Committee on Geodesy, Panel on a Multipurpose Cadastre, Need for a Multipurpose Cadastre, National Academy Press, Washington, D. C., 1980.*

of recommended procedures and standards for the design and implementation of a multipurpose cadastre.² It was the intent of this report to assist the local units of government wishing to pursue the development of cadastral records systems for their own jurisdictions and also the many other regional, state, and federal agencies and private businesses whose participation will be needed for the development, over time, of true multipurpose land information systems.

The procedural model put forth by the Panel identified the basic components of a modern land information system as: 1) a spatial reference framework consisting of monumented geometric control points, 2) a series of accurate, large-scale topographic base maps, 3) a cadastral overlay to the base maps that delineates all cadastral, that is, real property ownership, parcels, 4) a cadastral parcel numbering scheme that provides for unique identification of each cadastral parcel, and 5) a series of compatible registers of interests in, and data about, the land parcels keyed to the parcel identifier. It is important to note, in this regard, that the creation of such land information systems requires as a foundation a means of spatial reference for the data. An adequate geometric framework for such spatial reference must, if it is to serve even the narrowest purposes of a land information system, permit identification of land areas by coordinates down to the individual ownership parcel level. A geometric framework of adequate accuracy and precision to permit system operation at the highly disaggregated parcel level is the most demanding specification possible, but, once achieved, permits ready aggregation, as may be necessary, of information from the more intensive and detailed level to the more extensive and general level.

The local mapping and survey control network recommended by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) since 1964, described in greater detail in Chapter III of this report, provides two of the five

basic components of a modern land information system as set forth by the Panel, namely: 1) the required spatial reference framework, and 2) the required accurate large-scale topographic base maps and facilitates the creation of the third component, a cadastral map overlay. The spatial reference framework is provided by the relocation, monumentation, and placement on the State Plane Coordinate System of the U. S. Public Land Survey corners. The Commission-recommended topographic maps provide the base maps specified by the Panel. In addition, by placing the U. S. Public Land Survey corners on the State Plane Coordinate System, the Commission-recommended system provides the basis for the ready and economical preparation of accurate cadastral, that is, real property boundary line, overlays to the topographic base maps, since all real property boundary descriptions in Wisconsin are, by law, tied to these corners. Less obvious, but of equal importance, is the fact that the Commission-recommended survey control network ties these real property boundary descriptions to the State Plane Coordinate System and, in turn, to latitude and longitude, thereby facilitating the precise correlation of real property boundary lines and earth science data, a necessary precondition to the creation of a modern, automated, land information system.

The Commission-recommended local mapping and survey control network program was one of a select few local land information system modernization efforts described by the Panel in its reports, and therefore put forth as a system for emulation across the nation. It is important to note, particularly within the context of the development of this report, that both National Research Council reports determined that for much of the United States the county presented the most logical locus for the development of multipurpose land information systems.

WISCONSIN LAND RECORDS COMMITTEE

Within Wisconsin there has also been growing interest in land information systems and land records modernization. In 1985, then-Governor Anthony Earl appointed the Wisconsin Land Records Committee, a group representing state, regional, and local governmental interests, private utilities, and other private businesses that utilize local maps and land records. Over a period of two years, this group issued 13 reports

²*National Research Council, Assembly of Mathematical and Physical Sciences, Committee on Geodesy, Panel on a Multipurpose Cadastre, Procedures and Standards for a Multipurpose Cadastre, National Academy Press, Washington, D. C., 1983.*

on various aspects of automated mapping and land records modernization and a final report that summarized the more important findings of the Committee's deliberations.³

Like the National Research Council Panel, the Wisconsin Land Records Committee determined a need for continued efforts directed toward land records modernization and recognized the contribution that could be made by computer technology in certain aspects of this modernization process. The Committee determined that the costs to develop modernized land records systems would not be trivial, but that these costs would be reasonable, nonetheless, in view of the sums already being expended for current outdated and inefficient land information management practices. The Committee recognized, correctly, that the ultimate costs of land records modernization would be borne by citizens in the form of tax bills and utility bills and accordingly recommended that various levels of government, private utilities, and other private businesses involved in the use of land information make every effort to develop, and use jointly, automated systems to minimize their total societal costs.

The Committee recognized that its recommendation for the development of shared approaches to land information systems modernization would create new organizational and institutional strains that would be as demanding in their solutions as the technical issues involved in the creation of new, automated land information systems. The Committee accordingly recommended that the educational and coordinative aspects of land records modernization receive as much attention as the technical issues.

The deliberations of the Committee and its published reports reaffirmed the validity of the procedural model advanced by the National Research Council Panel for the development of modern, automated, land information systems and, as did the National Research Council

reports, highlighted the Commission-recommended local mapping and survey control network program as a basis for the development of modern, automated, land information systems.

Also, like the National Research Council Panel, the Wisconsin Land Records Committee recognized that there is a central role to be played by counties in the land records modernization process. Although the Committee chose not to define that role precisely, preferring instead to have individual counties make the determination that, at the minimum, a coordinative role was seen as necessary in view of the records maintenance functions given to the counties by the state constitution and state statutes.

WISCONSIN LAND INFORMATION PROGRAM

Among the final recommendations of the Wisconsin Land Records Committee was a proposal for the creation of a Wisconsin Land Information Program overseen by a state-level board that would provide a focal point for land records modernization issues and efforts within Wisconsin. During 1989, the Wisconsin Legislature enacted legislation creating the Wisconsin Land Information Program. The legislation was signed into law by Governor Tommy Thompson, and, late in 1989, the Wisconsin Land Information Board began to meet following the appointment of the Board members by the Governor. Voting members of the Board are defined by statute as follows:

1. The Secretary of the Department of Administration, the Secretary of the Department of Agriculture, Trade and Consumer Protection, the Secretary of the Department of Natural Resources (DNR), and the Secretary of the Department of Transportation, or their designees.
2. Four representatives from county and municipal government appointed by the Governor to six-year terms, including at least one member of a county board of supervisors, at least one member of a city council or village board, and at least one person who is a county officer active in land information management.
3. Four representatives chosen from public utilities and private businesses appointed

³ *Wisconsin Land Records Committee, Final Report of the Wisconsin Land Records Committee, Modernizing Wisconsin's Land Records, University of Wisconsin-Madison, Center for Land Information Studies, Madison, Wisconsin, 1987.*

by the Governor to six-year terms, including at least one public utility representative and at least one representative of a professional land information organization.

4. The State Cartographer.

In addition, the State Historic Preservation Officer, the Secretary of the Department of Revenue, the State Geologist, or their designees; a representative of a regional planning commission who is selected by the Board; a county employee active in land information management who is selected by the Board; and representatives of state and federal agencies active in land information management who are selected by the Board shall serve as nonvoting, advisory members of the Board.

As set forth in the legislation, the duties of the Board include:

1. The provision of technical assistance and advice to state agencies and local units of government with land information responsibilities.
2. The preparation of guidelines and standards to coordinate the modernization of land records and land information systems.
3. The creation and administration of a grant program for local units of government to assist in the development of modernized land records systems.

In its initial meetings, the Board identified the creation of a grants program to provide a source of partial funding for land records modernization as one of its high-priority issues and took steps to encourage the passage of a bill in the Wisconsin Legislature that would provide such a funding mechanism. This bill was passed by both houses of the Legislature in March and April 1990. The Governor signed the legislation into law in April 1990.

Under the Wisconsin Land Information Program, it is envisioned that counties throughout the State will prepare and implement plans to modernize land records systems. Toward this end, the legislation provides for Wisconsin Land Information Board review and approval of countywide land information systems plans. On January 7, 1991, the Land Information Board

adopted final guidelines pertaining to the preparation of such county plans.

To help fund the Wisconsin Land Information Program, including the preparation and implementation of county land information systems plans, the new legislation requires counties to increase register of deeds filing and recording fees from \$4.00 to \$8.00 in state fiscal year 1991, July 1, 1990, through June 30, 1991, and to \$10 in the five subsequent state fiscal years, resulting in a six-year program that under present state law would terminate on June 30, 1996. At that time, the present state law requires that the register of deeds filing and recording fee return to the \$4.00 level that preceded the new law.

For the first year of the six-year program, counties are permitted to retain \$2.00 of the \$4.00 increase in filing and recording fees. For the remaining five years of the program, counties are permitted to retain \$4.00 of the increased fee. Such monies can be retained, however, only if: 1) the county has established a Land Information Office, 2) the county has received approval from the Land Information Board of a county plan for land records modernization, and 3) the county uses the monies to develop, implement, and maintain the countywide plans.

The law also provides that counties must remit to the State the incremental register of deeds filing and recording fees not retained at the county level. Over the six-year period, this means that the State will receive \$2.00 for each filing in the State. Such monies under the new law are to be used by the State to fund the activities of the Wisconsin Land Information Board and to provide grants of up to \$100,000 to county and local governments for activities designed to implement approved county plans. Under the law, only counties are eligible to apply for such grants. Counties may act, however, on behalf of local units of government in the county to apply for grants.

ALTERNATIVE TYPES OF OPERATIONAL COMPUTER SYSTEMS AVAILABLE FOR THE DEVELOPMENT OF AN AUTOMATED MAPPING AND LAND INFORMATION SYSTEM

The professional literature currently categorizes operational automated mapping and land information systems into three general types: strictly automated mapping or computer-assisted draft-

ing (CAD) systems, automated mapping-facilities management (AM-FM) systems, and geographic and land information systems (GIS/LIS). The distinction between these types of systems is somewhat artificial and stems from marketplace segmentation strategies adopted by vendors of computer hardware and software. Nevertheless, as long as it is recognized that operational systems comprise a continuum and that many systems will resist being neatly categorized as one or another of the three general types of systems, the tripartite division is a useful one for discussion purposes.

The computer hardware components comprising these three types of systems usually provide no basis for categorization, and the different systems are virtually identical in a physical sense. Computer software available for operating the different system types generally provides a basis for distinguishing between CAD systems on the one hand and the AM-FM and GIS systems on the other; but the differences between the software utilized to operate AM-FM systems and GIS systems is often less clear. Indeed, a number of proprietary software products currently purport to support either type of operation equally well.

Functionally, the CAD systems are perhaps the easiest of the three to categorize since they tend to be almost exclusively automated mapping systems with little or no capability for the management of associated land records. Both AM-FM and GIS systems possess automated mapping and records management capabilities, although the distinction between the two as often as not is a function of the type of associated land information managed by the system rather than of any pronounced functional difference between system components. Typically, systems categorized as AM-FM systems are found where the predominant function is to manage information associated with networks: for example, water distribution systems, sanitary sewerage systems, telephone systems, and electric power and natural gas distribution systems. GIS systems are usually systems that manage information associated with areas: real property parcels, administrative districts, land use polygons, and soil mapping units. While these distinctions between predominant functions of AM-FM and GIS systems are helpful in a taxonomic sense, in practice these distinctions are often more apparent than real as virtually

all currently available AM-FM software systems, while they may, in fact, be designed for optimal operation in network data analysis environments, are capable of analyzing polygon data. Likewise, virtually all currently popular GIS software is capable of performing network data analysis functions.

CONVERSION OF GRAPHIC DATA INTO A COMPUTER-COMPATIBLE FORMAT

Much of the current interest in the modernization of land data systems has been centered on the use of electronic computers for the storage, manipulation, and retrieval of the data and, more recently, the use of computer-assisted graphic collection and display hardware for the reproduction of the data in mapped as well as tabular form. Nongraphic land information, such as parcel identification numbers, legal descriptions, and assessment information, for example, can be entered into a computer through standard keypunch data entry procedures. Land information that has traditionally been maintained in the form of maps, such as real property boundary lines, however, must be converted into a numeric, or digital, format before it can be entered into a computer. This is most often accomplished by a device, sometimes itself computer controlled, called a "digitizer," and the process by which the conversion is completed is often identified as "board digitizing."

A digitizer, therefore, is a machine system which transforms mapped information into a computer-readable form to facilitate information manipulation and display. A digitizer is usually comprised of the following hardware components:

1. A controller, which is often a small- to medium-size computer.
2. An on-line data storage device.
3. An operator work station, which consists of a keyboard for entering commands and nongraphic data into the system and a graphic display screen or screens for viewing collected information.
4. A digitizing board or tablet which allows for determining the accurate relative location of a point identified on the surface of the board using a device, a cursor, which

is able to move freely over the surface of the board.

Additional equipment may include a printer, a computer tape unit, and graphic production devices called "plotters." Each component can vary greatly in size and capability depending on the operating requirements of the particular system.

The transformation of mapped information into computer-readable information requires maps which are related to some system of geometric control and which have at least two or three points for which an x-y coordinate pair can be determined. The coordinate system utilized can vary from an arbitrary scale unique to the base map to some more universal system such as the State Plane Coordinate System. Once the base map has been placed on the digitizer board, the known coordinates of the map are entered into the digitizer and located on the base map with the cursor. When this operation is complete the map is said to be "scaled," and positions of other points on the map can be established based upon their relative positions to the known points.

Each line on the map is defined as a series of connected points. The cursor is used to identify each point, which is then assigned an x-y coordinate pair based on the position of the point relative to the known base points used to scale the maps. Each map line is then stored in the system as a series of x-y coordinates. Each line or segment can be stored separately or combined with other segments to form closed polygons with defined attributes and measurable areas.

Base map accuracy is an important consideration when digitizing. A digitizing system does not improve the accuracy of a base map but only replicates the map features, including errors and discrepancies. While the board digitizing procedure just described is the most common technique for conversion of map data into digital form, several other techniques have been developed which work well in certain specialized situations or with certain specific types of map information. These are optical scanning, direct digitizing from stereoscopic models, and coordinate geometry entry.

An optical scanning system is a machine system that is much like a board digitizing system in its physical arrangement. It merely substitutes an optical scanning device for the digitizing board

or tablet. In operation, the document to be converted to digital form is mounted on a large drum that rotates at high speed under an optical device that scans the drum and "reads" the document. While these devices are capable of converting documents to digital form more rapidly than can board digitizing, they have typically required quite complex software to perform editing and categorizing of the converted data. For anything other than very simple maps, these devices have yet to supplant board digitizing.

Direct digitizing from stereoscopic models is relatively more recent in origin than either board digitizing or optical scanning. It is, however, based upon long-established photogrammetric engineering procedures. In a direct, stereoscopic digitizing system, the digitizing board or tablet that would be present in a board digitizing system is replaced by a stereoscopic map compilation machine. Stereoscopic aerial photography acquired for map compilation purposes can be used to establish a stereoscopic model in the traditional manner, but rather than utilizing the model to prepare an analog map manuscript for subsequent board digitization, the operator optically "digitizes" map features directly from the model, thereby producing the digital map files directly.

An additional means of converting map information into maps is coordinate geometry entry, sometimes referred to as "precision digitizing." In coordinate geometry entry, there is no analog device present in the machine system for the conversion of map documents to digital maps. All of the information needed to construct a map is key entered and the map is constructed utilizing plane geometry relationships and formulae contained in highly specialized computer software. Conversion of map data by coordinate geometry is exceedingly tedious and is generally used only for relatively small project areas, or for areas where the quality and precision of the data available warrant the additional effort of this procedure. Of all the currently available methods of data entry, however, coordinate geometry procedures are the only procedures that do not result in a loss of precision and are the only conversion procedures that produce digital map data that are truly scale independent.

Once the initial map data are transformed into digital form with the digitizer, a variety of

manipulations become possible. Data mapped at one scale can be reproduced at different scales, provided that the accuracy limitations of the original maps are recognized in any enlargement, as opposed to reduction, in scale. Graphic base files collected from different sources can be merged and reproduced at a uniform scale. Data for special study areas can be identified, reproduced, and measured; and information on the base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.

EXISTING AUTOMATED MAPPING AND LAND RECORDS SYSTEMS PERTAINING TO ALL OR PARTS OF OZAUKEE COUNTY

There are several automated mapping and land information systems already in existence whose areas of operation cover all or portions of Ozaukee County. Since one of the primary purposes of this report is to determine the feasibility of some type of shared or joint operation of a countywide automated mapping and land information system, these existing systems are identified and their operations briefly described below.

The different map coordinate systems utilized by the different automated mapping operations in the Ozaukee County area represent an issue of central importance in any consideration of cooperative mapping efforts and of the transfer of existing digital map information between the existing automated mapping sites. Therefore, the map coordinate system or systems utilized and the horizontal map datum upon which the coordinate system is based are identified for each operation.

The universe of all map coordinate systems is rather large, although currently only three such systems are in regular use in the Ozaukee County area: the State Plane Coordinate System, the Universal Transverse Mercator (UTM) Coordinate System, and a special derivative of the UTM system called the Wisconsin Transverse Mercator (WTM) Coordinate System. These three systems are based upon the North American Datum of 1927 (NAD-27), which is, in turn, derived from the Clarke 1866 mapping spheroid. Since these three systems are based upon NAD-27, it is possible, albeit computationally tedious, to translate with mathematical precision from one of these coordinate systems to another. It is,

in an analogous fashion, further possible to move with mathematical precision between either of these systems and any other map coordinate system derived from NAD-27, although again, the procedure is tedious.

Recently, the National Geodetic Survey of the National Oceanic and Atmospheric Administration of the U. S. Department of Commerce, the federal government agency responsible for the maintenance of the nation's geodetic control system, has begun to move all federal mapping activity from the Clarke 1866 mapping spheroid onto the Global Reference System of 1980 (GRS 80), a newly defined mapping spheroid. As part of this transfer, an entirely new horizontal datum, NAD-83, has been developed for use with GRS 80. Any precise conversion between NAD-27 and NAD-83 requires recomputation utilizing the original control survey field measurements. The implications for the conversion from NAD-27 to NAD-83 of the type of control network and related large-scale planimetric mapping typically prepared by local units of government and utilities are therefore both technically severe and operationally costly. A similar situation exists for large-scale topographic mapping with the proposed replacement of the National Geodetic Vertical Datum of 1929 (NGVD 29) by the North American Vertical Datum of 1988 (NAVD 88), which has been developed for use with GRS 80 and NAD-83. Importantly, the replacement of NAD-27 and NGVD 29 with NAD-83 and NAVD 88 will be costly, while offering no improvement in map accuracy or precision for locally oriented large-scale mapping operations.

Southeastern Wisconsin Regional Planning Commission

The Southeastern Wisconsin Regional Planning Commission installed CALMA hardware and software in 1976 to begin conversion to digital format of its land use and natural resource inventory data. Since then, the Commission has converted its analog land use inventories for 1963, 1970, and 1975 for its 2,689-square-mile planning area and has completed digital land use inventory updates for 1980 and 1985. A digital land use inventory update for the base year 1990 is underway and scheduled for completion in 1992. During 1990 the Commission completed digitization of the detailed operational soil surveys, which includes maps completed by the U. S. Soil Conservation Service under con-

tract to the Commission in 1966 for the entire planning area. That area includes Ozaukee County. The primary Commission system products are land use maps, interpretive soil maps, wetland maps, wildlife habitat maps, floodplain maps, civil division boundary maps, watershed and related analytical hydrologic unit maps, summary areal extent statistics, and thematic maps prepared in support of regional and local planning activities. The Commission utilizes the State Plane Coordinate System, NAD-27, for its digital mapping activities.

The experience gained by the Commission in more than a decade of automated land use and natural resource mapping provided a valuable base upon which to evaluate the available hardware and software products when, in 1986, the Commission reached a decision to acquire new computer hardware and software for its automated mapping operation. In 1987, a completely new automated mapping system was installed comprised of DELTAMAP software running on Hewlett-Packard and Calcomp hardware. The enhanced operational capability provided by this new system allowed the Commission staff to begin taking steps in 1988 to convert its large-scale and intermediate-scale base mapping operations from analog to digital format.

State of Wisconsin

Four agencies of state government currently possess and use automated mapping systems: the Department of Transportation, the Department of Natural Resources, the Wisconsin Geological and Natural History Survey, and the Legislative Reference Bureau.

The Department of Transportation installed INTERGRAPH hardware and software in 1982. This system is used primarily for maintaining and updating the Department's official State Highway Map and the Department's statewide series of county highway maps. Some of the map data for these two programs were created by optical scanning of color separation plates that had been used for color map printing. The system is also used for project mapping in support of highway construction and improvement projects. The map data for this activity are usually acquired through direct digitization from stereoscopic models. All the Department's digital mapping currently utilizes the State Plane Coordinate System, NAD-27, although the Department is in the process of shifting its mapping datum to a modified NAD-83.

The Department of Natural Resources began building a digital map data collection system in 1980. The initial system was, in effect, custom built by DNR staff who configured purchased hardware components and wrote their own computer software. The system was used primarily in support of DNR land acquisition, improvement, and management projects, but was also used to create a statewide inventory of wetlands. Other statewide inventories are in the process of being developed.

The Department of Natural Resources has developed the aforereferenced Wisconsin Transverse Mercator Coordinate System, which was derived from the Universal Transverse Mercator System. Like the UTM System, the WTM System is based on the NAD-27 datum. The DNR also utilizes the UTM coordinate system, NAD-27, and the State Plane Coordinate System, NAD-27, for some projects, as well as local coordinate systems on occasion. The Department possesses computer software translation capability between WTM, UTM, and State Plane coordinates.

In addition, both the Department of Transportation and the Department of Natural Resources have acquired the proprietary software ARC/INFO and are building geographic information system data bases throughout their respective areas of functional responsibilities. The Department of Transportation continues to perform automated mapping functions on the INTERGRAPH hardware and software system noted above. The Department of Transportation has purchased multiple APOLLO brand work stations for geographic information system use. These work stations are located throughout the State and many are connected through communications networks. Finally, the Department of Natural Resources has acquired the Department of Transportation's original MicroVax system for use in development work along with other work stations. This system will be used to support various geographic information systems residing on personal computers.

The University of Wisconsin-Extension Geological and Natural History Survey is also developing geographic information system capabilities. Digital data bases attendant to such items as bedrock and surficial geology, water supply wells, and water table maps are being developed on a project-by-project basis. The Survey efforts are carried out on personal computers utilizing the ARC/INFO software. The Survey uses the

WTM Coordinate System, NAD-27, for its statewide digital mapping activities; for some special projects applicable to portions of the state, the Survey uses the UTM and State Plane Coordinate Systems, NAD-27.

Finally, the Legislative Reference Bureau recently established a digital data base focused initially on the legislative and other election district redistricting efforts required following the Federal decennial Census in 1990. The Bureau acquired the Topologically Integrated Geographic Encoding and Referencing (TIGER) map files from the U. S. Census Bureau and is using both IBM and ARC/INFO software, as well as uniquely developed software, in its digital mapping system. The TIGER files were initially built upon the longitude and latitude coordinate system, based upon the NAD-27 mapping datum. The Bureau has converted those files to the WTM Coordinate System, NAD-27.

Wisconsin Electric Power Company

The Wisconsin Electric Power Company (WEPCo), a subsidiary of the Wisconsin Energy Corporation, has developed a digital mapping base upon which to place its electric service network. This effort was based upon INTERGRAPH hardware and software. WEPCo serves all of Ozaukee County except the City of Cedarburg, which is served by the municipally owned Cedarburg Light and Water Commission.

Throughout much of the Southeastern Wisconsin Region, WEPCo utilized data from large-scale topographic mapping and control survey projects prepared to Commission-recommended specifications to establish its spatial reference framework. These data were acquired in State Plane Coordinate System, NAD-27, format and converted by WEPCo to the UTM coordinate system, NAD-27.

WEPCo has recently completed a project to convert its automated mapping system to IBM hardware and software. All the base mapping and electric utility network data is now stored in a Geo-Facilities Information System (GFIS) data base on a mainframe IBM computer. Maintenance of the data base is accomplished via downloading to personal computers where the updating work occurs. The changes are then reloaded to the GFIS data base on the mainframe computer.

Wisconsin Gas Company

The Wisconsin Gas Company is franchised to serve all of Ozaukee County. The Company installed IBM hardware and software in 1984 to begin its automated mapping activities. It is currently creating a digital mapping base through a combination of board digitizing and direct digitizing from stereoscopic models.

The development of an automated mapping base in Ozaukee County by the Company is being confined to all cities and villages and those portions of towns where gas pipeline facilities are in place. That mapping base in Ozaukee County has now been completed. For all that area north of the City of Mequon, planimetric information included in the base was prepared from aerial photography flown in 1987. For the City of Mequon, the photography was flown in 1989. Work efforts are now underway to place the natural gas facility layer on the planimetric base.

Wisconsin Gas is using the State Plane Coordinate System, NAD-27. The Company obtained the spatial reference framework for its automated mapping system from the Regional Planning Commission.

Wisconsin Bell

Wisconsin Bell, Inc., serves that portion of Ozaukee County lying generally south of the Towns and Villages of Fredonia and Belgium. In 1990, Wisconsin Bell reached a decision to acquire an INTERGRAPH system to use for the automated mapping of its facilities. Wisconsin Bell intends to begin its automated mapping work in Ozaukee County in 1992. Wisconsin Bell uses the Universal Transverse Mercator Coordinate System, NAD-27, for its digital mapping system.

General Telephone and Electronics (GTE)

General Telephone and Electronics serves approximately the northern one-quarter of Ozaukee County. The Company has developed a digital mapping base built upon the TIGER files made available by the U. S. Bureau of the Census. The TIGER files are digitized from U. S. Geological Survey 1:100,000 scale quadrangle maps based upon the spherical coordinates of latitude and longitude, NAD-27.

County and Local Programs

There are four digital mapping programs currently underway in Ozaukee County. These four programs are briefly described as follows:

1. Ozaukee County

In 1985, Ozaukee County began to automate the parcel mapping function housed in the Office of the Register of Deeds. This work is being accomplished on a AUTOCAD automated drafting system. On a time available basis, the Register of Deed's staff is replacing hard-copy, hand-drafted real estate parcel maps with digital maps. Coordinate geometry techniques are being used to enter parcel data in the automated system. The work is being done on a U. S. Public Land Survey quarter-quarter section basis, with the file maps produced at scales ranging from one inch equals 50 feet to one inch equals 400 feet. Where State Plane Coordinates, NAD-27, of U. S. Public Land Survey section and quarter-section corners are available, those data are used to provide the geodetic control for the mapping. If such data are not available, then the work is completed on a uncontrolled basis in the same way in which the hand drawn maps have been for many years.

Ozaukee County has no planned sequence of digital parcel map preparation, nor is there a specified schedule for completing such mapping. Rather, the work is usually driven by the need to aid in resolving specific parcel-related problems in a given quarter section. The County has completed about 23 square miles of such mapping to date, representing about 10 percent of the total area of the County. About 12 square miles have been prepared in areas where the State Plane Coordinates of the section and quarter-section corners are known. Due to the inherent limitations of the AUTOCAD system, the parcels are maintained in a vector rather than a polygon format. Thus, as currently configured, the Ozaukee County automated mapping system has map drafting, but not analytical capabilities.

In addition to the automated map drafting system in the Register of Deed's Office, the Ozaukee County Emergency Government office has installed an emergency management computer software package that contains a digital map of Ozaukee County. This package is called CAMEO (Computer Aided Management of Emergency Operations). The version of the software

installed in Ozaukee County operates on a MacIntosh personal computer. The software was developed by the National Oceanic and Atmospheric Administration and the City of Seattle, Washington, to provide assistance in fire response and emergency planning for fires involving dangerous chemical substances. In practice, the system is used to provide advance warning of the presence of dangerous chemical substances to fire response personnel, to aid in determining fire equipment requirements, and to aid in developing evacuation plans of nearby residents.

The digital map contained in the package was obtained by optical scanning of a base map of Ozaukee County, although no one involved with the work effort could identify the particular map concerned. In addition, the package has been enhanced to include more detailed street maps of several communities in the County. Those maps were scanned from community profiles prepared by SEWRPC using the State Plane Coordinate System, NAD-27. The map is not separated into features in the system data base, so individual map features cannot be selectively manipulated or extracted. The primary purpose served by the maps is to provide a general spatial reference for personnel involved in fire response and for the modelling of toxic fume plumes to assist in the planning of emergency evacuation requirements.

Finally, Ozaukee County has developed a number of nongraphic computerized programs related to land records management. These include a grantor/grantee index established in 1976 and a tract index established in 1982. These systems reside in the Offices of the Register of Deeds and both are related to the Ozaukee County real property parcel numbering system. In addition to internal use of these systems by County departments, public access to the two index systems is possible through computer terminals linked to the Register of Deeds's Office.

2. Village of Grafton

In 1985, the Village directed its consulting engineering firm, Donohue and Associates, Inc., to prepare a digital base map for the

Village. Using INTERGRAPH hardware and software, the Donohue firm prepared a digital cadastral mapping base at a scale of one inch equals 100 feet by U. S. Public Land Survey one quarter section, although the mapped areas are confined to the Village limits. This digital mapping base was then used to prepare the Official Map of the Village at a scale of one inch equals 300 feet. A secondary product is a one inch equals 600 feet scale base map used for other purposes. The mapping was recompiled utilizing State Plane Coordinate values, NAD-27, for the section and quarter-section corners provided by the Regional Planning Commission.

The Village maintains no in-house digital mapping environment. The maps are periodically updated by the consulting engineering firm.

3. City of Cedarburg

Like the Village of Grafton, the City of Cedarburg commissioned the Donohue firm to prepare a digital base map for the City. This map was completed in 1986. Again, the primary end product was the preparation of the new Official Map of the City. The mapping was recompiled, utilizing State Plane Coordinate values, NAD-27, for the section and quarter-section corners provided by the Regional Planning Commission.

Subsequently, the City changed engineering firms, retaining the firm of Ruekert and Mielke, Inc. That firm redigitized the maps initially prepared by the Donohue firm, using the AUTOCAD format. The Ruekert and Mielke firm maintains current the automated base map, with the primary product a compiled base map of the City at a scale of one inch equals 400 feet. The City has had the Ruekert and Mielke firm add sanitary sewerage and stormwater drainage facilities overlays to that map in digital form. The City is also considering adding a water supply overlay. The City of Cedarburg has established an in-house capability to store, manipulate, and retrieve its digital mapping files. That capability is based upon the AUTOCAD software format. Thus, digital files created by the City's consulting engineering firm can be used on a day-to-day basis

in the City of Cedarburg Engineering Department.

4. City of Mequon

The City of Mequon has established a computer mapping capability using the AUTOCAD software format. To date, the City has obtained in digital form from the County Register of Deeds parcel maps of 13 U. S. Public Land Survey one-quarter sections at various locations throughout the City. The city engineering staff has enhanced the digital files for city planning and engineering purposes. For example, the city staff added sanitary sewer and stormwater drainage easements to the digital file. Since this mapping has been obtained from Ozaukee County, it is based upon the State Plane Coordinate System NAD-27. The City Administrator has indicated that for consistency for regional efforts, the City's mapping will remain on this datum.

In connection with its mapping efforts, the City has undertaken a program of monumentation of the U. S. Public Land Survey section and quarter-section corners, expanding upon earlier efforts in this respect of the Regional Planning Commission and the City itself. In addition to relocating and monumenting such corners, the City has the capability to carry out horizontal and vertical control surveys and to determine the State Plane Coordinates for such corners.

Digital Map Data Exchange Issues

The ability to exchange digital map data between different automated mapping sites and systems is an important consideration in the development of a county land records modernization plan. In this regard, it should be noted that the use of different hardware and software systems and the use of different map coordinate systems by the various governmental units and private utilities that currently maintain digital mapping capability in Ozaukee County may affect the ability to exchange digital map data between different automated mapping sites and systems.

Commercial software products that will provide for the "translation" of digital map data between specific sets of proprietary automated mapping and systems are increasingly avail-

able; however, basic incompatibilities between the instruction sets, data structures, and the basic architecture of different systems may render some digital map data "untranslatable," even between systems that supposedly have translators available. Accordingly, digital map data translation cannot be taken for granted. Generally speaking, translations will be most successful between systems that have a high degree of compatibility between basic software instruction sets, data structures, and hardware architectures or in instances where the need to translate digital map data is anticipated in advance and influences the basic decisions on the manner in which digital map data will be captured and stored.

The use of different map coordinate systems does not affect the ability to exchange digital map data provided that the different map coordinate systems have been developed on the same horizontal datum. The use of mathematically unrelated horizontal datums, however, does pose potential problems for the exchange of digital map data. Simply stated, the relative mapped position of geographic features can be expected to differ between maps prepared on mathematically unrelated datums. This situation can be expected to adversely affect, at least at higher required levels of precision, the correct integration of digital map data between sites using NAD-27 and NAD-83.

SUMMARY

Over the past 10 years, there has been a significant and growing interest in the United States in developing land information systems. The interest is indeed broad, involving many disciplines, and centers on the use of electronic computers to store, manipulate, retrieve, and, most recently, graphically display land and land-related information. This chapter presents an overview of the growing body of professional literature in this area and summarizes the automated mapping and land information systems which to date have been developed and which pertain to Ozaukee County. The following summarizes the material included in this chapter:

1. National interest on land information systems was focused in 1979 by a Panel on a Multipurpose Cadastre convened by the National Research Council. A 1980 report

of this Panel found that there is a critical need to modernize land information systems in the United States and thereby to improve land conveyance procedures, to furnish a basis for equitable taxation, and to provide information for resource management and environmental planning. The Panel's report emphasized the concept of a multipurpose cadastre as a basis for a dynamic public process that could effectively collect, maintain, and disseminate land-related information. In a subsequent report issued by the Panel, the basic components of a modern land information system were identified as: 1) a spatial reference framework consisting of monumented geometric control points, 2) a series of accurate, large-scale topographic base maps, 3) a cadastral overlay to the base maps that delineates all cadastral, that is, real property ownership, parcels, 4) a cadastral parcel numbering scheme that provides for unique identification of each cadastral parcel, and 5) a series of compatible registers of interests in, and data about, the land parcels keyed to the parcel identifier.

2. The local mapping and survey control network recommended by the Southeastern Wisconsin Regional Planning Commission since 1964 possesses two of the five basic components of a modern land information system: the spatial reference framework and the accurate large-scale planimetric and topographic base maps. In addition, the Commission-recommended program facilitates the creation of the cadastral map overlay as a third component. Finally, the Commission-recommended survey control network provides a mechanism for relating real property boundary descriptions to the State Plane Coordinate System and, in turn, to latitude and longitude, thereby facilitating the precise correlation of real property boundary lines and earth science data, a condition necessary for the creation of a modern, automated land information system.
3. Following issuance of a report by the Wisconsin Land Records Committee which recommended that counties perform a central role in the land records moderniza-

tion process, new state legislation was enacted to create a Wisconsin Land Information Program. That Program is overseen by the Wisconsin Land Information Board. The duties of the Board include providing technical assistance to state agencies and local governments establishing land information systems, promulgating standards to coordinate the modernization of land records and the establishment of land information systems, and administering a grant program to assist local governments in developing modernized land records systems. The Wisconsin Land Information Program, which is scheduled to be carried out over the six-year period from July 1, 1990, to June 30, 1996, is being funded by increased register of deeds filing and recording fees. A portion of the increased fees is retained by counties and a portion is remitted by the counties to the State. In order to retain monies at the county level, however, counties must establish a land information office, prepare and receive Land Information Board approval of a county plan for land records modernization, and use the retained monies to implement the county plan. Counties are also permitted to apply for grants from the Wisconsin Land Information Board to help carry out the plans. In so doing, counties may act on their own behalf or on behalf of local units of government in the county.

4. Three general types of automated mapping and land information system operational structures are currently recognized: strictly automated mapping or computer-assisted drafting (CAD) systems, automated mapping/facilities management (AM-FM) systems, and geographic and land information systems (GIS/LIS). Although the distinctions between the types are not always clear, the CAD systems are perhaps the easiest of the three to categorize since they tend to be almost exclusively automated mapping systems with little or no capability for the management of associated land records. Both AM-FM and GIS/LIS systems possess automated mapping and records management capabilities, although the distinction between the two systems is quite often a function of the type of associated land information managed by the

system rather than of any pronounced functional difference between the two system types. Typically, systems categorized as AM-FM systems are found in situations where the predominant function is to manage information associated with networks: for example, water distribution systems, sanitary sewerage systems, telephone systems, and electric power and natural gas distribution systems. GIS systems are usually systems that manage information associated with areas: real property parcels, administrative districts, land use polygons, and soil mapping units.

5. Much of the information that would be incorporated within a multipurpose cadastre or an automated mapping and land information system has traditionally been stored in the form of maps. Conversion of map information into a digital format where it can be manipulated and operated upon by a computer requires the use of a device called a digitizer. Alternatively, certain forms of specialized data conversion procedures, such as optical scanning, direct digitizing from stereoscopic models, or coordinate geometry entry, can be utilized. Once the initial map data are transformed into numeric form, a variety of manipulations become possible. Data mapped at one scale can be reproduced at different scales, provided that the accuracy limitations of the original maps are recognized in any enlargement, as opposed to reduction, in scale. Graphic base files collected from different sources can be merged and reproduced at a uniform scale. Data for special study areas can be identified, reproduced, and measured and information on base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.
6. There are a number of automated mapping and land information systems already in existence within Ozaukee County whose areas of operation include all or portions of the County. Several of these systems, including those of the Southeastern Wisconsin Regional Planning Commission and the Wisconsin Electric Power Company, have been functional for a decade or more and have developed extensive digital

map holdings. These existing systems currently utilize a variety of proprietary computer hardware and software products in their operation and are using several different map coordinate systems, all of which presently are mathematically relatable to the State Plane Coordinate System, North American Datum of 1927. The use of different proprietary products, however, may affect the ability to readily exchange digital map data between different automated mapping sites and systems, as commercial software products may not be available that can "translate" digital map data between different proprietary automated mapping systems.

7. Ozaukee County and three local units of government in the County have taken

steps to develop automated mapping systems. The County, through the Register of Deed's Office, is gradually converting its parcel mapping by U. S. Public Land Survey one-quarter section to digital form. Both the City of Cedarburg and Village of Grafton have retained consulting engineers to prepare digital base maps; at present, however, only the City of Cedarburg has established an in-house computer mapping capability. The City of Mequon has also established such a capability and is enhancing parcel-based mapping prepared by the Ozaukee County Register of Deeds for selected U. S. Public Land Survey quarter sections in the City. It will be important to coordinate these various mapping efforts in Ozaukee County through the preparation of an Ozaukee County land information system plan.

Chapter III

COMPONENTS OF AN AUTOMATED MAPPING AND LAND INFORMATION SYSTEM

INTRODUCTION

This chapter provides a description of the major elements of a multipurpose cadastre, or parcel-based land information system, and discusses such a cadastre within the more general context of geographic information systems. In addition, the chapter describes remonumenting and base mapping efforts previously carried out in the Region and in Ozaukee County which provide the essential base for the establishment of an automated mapping and land information system.

THE CADASTRE AS PART OF A LARGER SYSTEM OF LAND INFORMATION

A cadastre may be defined as a record of interests in land, encompassing both the nature and extent of these interests. Historically, cadastres have been created and maintained for the purpose of taxing these interests, and evidence of the existence of cadastres goes back through hundreds of years of human civilization. It is possible to develop an automated version of a cadastre defined in this more narrow, historical sense, and, in fact, the development of such single-purpose cadastres has been advanced on the premise that the development of more complex multipurpose cadastres and land information systems ought to begin with the development of single-purpose cadastres relating only to the value of real property as a basis for taxation, and perhaps the registration of land ownership, but extended later in an evolutionary manner to other applications.

Thus, the development of a more narrowly defined cadastre, or parcel-based land information system, can be considered a preliminary step in the development of a broader land-related information system. Additional information subsequently incorporated into such a system may include data on land use; certain natural characteristics of the land such as soil and geologic conditions; natural hazards such as flooding and shoreline erosion; environmentally sensitive areas such as woodlands and wetlands; permits; public and private infrastructure sys-

tems; and selected social and economic data, to name just a few. These broader land information systems are considered to contain, in addition to the information considered to be part of a single-purpose cadastre, all types of land-related information both cultural and natural.

ELEMENTS OF A MULTIPURPOSE CADASTRE

A multipurpose cadastre can be conceptualized as a public, operationally and administratively integrated, land-related information system which provides continuous, readily available, and comprehensive information at the ownership parcel level. The Panel on a Multipurpose Cadastre of the National Research Council has proposed the procedural model shown in Figure 2 for the development of multipurpose cadastres. This model consists of the following five basic elements: 1) a geographic reference frame consisting of a geodetic survey network, 2) a series of current, accurate, large-scale base maps properly related to the geographic reference frame, 3) a cadastral map overlay delineating all cadastral parcels which is also properly related to the geographic reference frame, 4) a unique identifying number assigned to each parcel, and 5) a series of registers, or land data files, each including a parcel index for purposes of information retrieval and cross referencing with information in other land data files.

Additional elements in the form of maps and records of land-related information can be readily added to the base over time.

Geodetic Reference Framework

A reference frame, or survey control network, consisting of a system of survey monuments having geodetically based coordinates, is necessary for defining the relative spatial location of all land-related data and, as such, comprises the first component for a multipurpose cadastre. In the United States, two different, and heretofore largely uncoordinated, systems of survey control have evolved. One of these two systems, the State Plane Coordinate System, is founded in the science of measurement and is intended to be

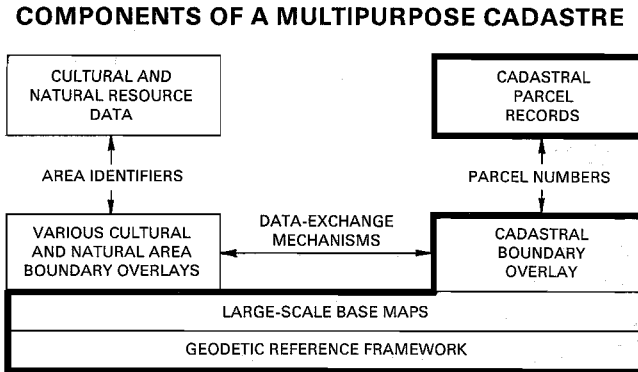
utilized as a basis for the collection of earth science data and the preparation of earth science maps, such as topographic, geologic, soils, and hydrographic maps. The other of these two systems, the U. S. Public Land Survey System, is founded in the principles of property law, as well as in the science of measurement, and is utilized for the collection of cadastral data and the preparation of cadastral maps, such as real property boundary line maps.

U. S. Public Land Survey System: For most of the United States, the federal government has provided the basic survey control system for cadastral mapping in the form of the U. S. Public Land Survey System. Under regulations imposed by the Congress, the U. S. Public Land Survey System has been extended into 30 of the 50 states, including Wisconsin.

This system is founded in the best features of the English common law of boundaries, superimposing on that body of law systematic land survey procedures under which the original public domain is surveyed, monumented, and platted before patents are issued; legal descriptions are by reference to a plat; lines actually run and marked on the ground control boundaries; adjoining are respected; and the body of law in effect at the time of the issuing of the deed is controlling, and forever a part of, the deed. Unlike scientific surveys, which are made for the collection of information and can be amended to meet improved standards or changing conditions, the original government land survey in an area cannot be legally ignored, repudiated, altered, or corrected as long as it controls rights vested in lands affected.

The U. S. Public Land Survey System is one of the finest systems ever devised for describing and marking land. It provides a basis for a clear, unambiguous title to land, together with the physical means by which that title can be related to the land it describes. The system is ingenious, being simple and easy to comprehend and administer, and without it, the nation would unquestionably have been poorer. The "rectangular" land survey system, however, has one serious flaw. Its use requires the perpetuation of monuments set by the original government surveyors, the positions of which are not precisely related to the surface of the earth through a scientifically established map projection.

Figure 2



Source: National Research Council and SEWRPC.

State Plane Coordinate System: A strictly scientific control survey system designed to provide the basic control for all federal, and most private, topographic and other earth science mapping operations exists separate from the U. S. Public Land Survey System in the triangulation and traverse stations established by the National Geodetic Survey (formerly U. S. Coast and Geodetic Survey). The triangulation and traverse stations established by this agency comprise a nationwide network connecting thousands of monumented points whose geodetic positions, expressed in terms of latitude and longitude, are known. In order to make the National Geodetic Survey control network more readily available for local use, the U. S. Coast and Geodetic Survey devised the State Plane Coordinate System in 1933. This system transforms the spherical coordinates, latitudes and longitudes, of the stations established in the national geodetic survey into rectangular coordinates, eastings and northings, on a plane surface. This plane surface is mathematically related to the spheroid on which the spherical coordinates of latitude and longitude have been determined. The mutual relationship, which makes it practicable to pass with mathematical precision from a spherical to a plane coordinate system, makes it also practicable to utilize the precise scientific data of the National Geodetic Survey control network for the reference and control of local surveying and mapping operations. A limitation on such uses, however, is imposed by the relatively widespread location of

the basic triangulation and traverse stations and the difficulties often encountered in the recovery and use of these stations.

Large-Scale Base Maps

To satisfy the growing need for an integrated, land-related information base, a system capable of handling a variety of information ranging from such earth science-related data as flood hazard boundary line locations, to such cadastre-related data as real property boundary line locations, is required. It is also mandatory that field work, data resolution, and information presentation be consistent with the most detailed level of land-related decision-making, that of the individual proprietary parcel. These requirements call for base maps at scales significantly larger than those generally available in the United States as the second component of a multipurpose cadastre. These maps should be topographic maps showing in their correct location and orientation the principal natural and cultural features of the area concerned and the elevation and configuration of the surface of the earth.

Cadastral Overlay

The third component of a multipurpose cadastre is the cadastral overlay. Preparation of the cadastral overlay requires identifying and delineating the most fundamental unit of land, a cadastral parcel. This unit of land becomes the basic building block for maintaining real property boundary line-related information, including information on rights and interests. A cadastral parcel is, therefore, an unambiguously and uniquely defined unit of land within which rights and interests are legally recognized and for which there is a unique and complete group of rights. The primary type of interest, for this definition, is land ownership associated with that set of rights and interests that may be acquired and transferred.

Parcel Number

The fourth component of a multipurpose cadastre is the parcel identifier, defined as a code for recognizing, selecting, identifying, and arranging information to facilitate storage and retrieval of parcel records. It may also be used for spatial referencing of information and as a means for referring to a particular parcel in lieu of a full legal description. There is general

agreement that the identifier system used should provide for the assignment of a unique code to each parcel, should be easily understandable and usable to the general public, or at least to that segment of the public that may have cause to use the system, should be capable of serving a variety of different uses, and should be reasonably permanent.

Land Information Files

The fifth and last component of a multipurpose cadastre consists of the land information files, or land data files, which contain facts about the land parcel in question and are related to the cadastral map through the parcel identifier. The various types of information that may be compiled about the land are potentially voluminous, and may include information about both natural and cultural, that is, man-made, features of the parcel. Perhaps the most familiar land information files are those of local land-title records systems and tax assessment and collection records systems.

EXISTING FRAMEWORK FOR THE DEVELOPMENT OF MULTIPURPOSE CADASTRES WITHIN SOUTHEASTERN WISCONSIN

The first three elements of the procedural model for the creation of a multipurpose cadastre as proposed by the National Research Council have long been embodied in the Regional Planning Commission's recommended large-scale base mapping program. Recognizing the importance of good large-scale maps and attendant survey control to sound community development and redevelopment, the Commission has, for almost three decades, encouraged the preparation of large-scale topographic and cadastral maps within its 2,689-square-mile Planning Region. These maps are based on a unique system of survey control that combines the best features of the U. S. Public Land Survey System and State Plane Coordinate System. The large-scale maps and attendant control survey system, where they already exist, provide, in a highly cost-effective manner, the technical foundation for the creation of multipurpose cadastres within the Region. Because of their critical and central importance to the implementation of a multipurpose cadastre, these three elements, the geodetic

reference frame, large-scale base maps, and the cadastral overlays, are discussed in greater detail in the following sections.

A Composite System for the Geodetic Reference Framework

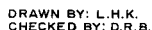
From the preceding brief discussion of the U. S. Public Land Survey and State Plane Coordinate Systems, it is apparent that two essentially unrelated control survey systems have been established in the United States by the federal government. One of these, the U. S. Public Land Survey System, is founded in the legal principles of real property description and location and was designed primarily to provide a basis for the accurate location and conveyance of ownership rights in land. The other, the State Plane Coordinate System, is founded in the science of geodesy and was designed primarily to provide a basis for earth science mapping operations and for the conduct of high-precision scientific and engineering surveys over large areas of the earth's surface. Both systems have severe inherent limitations for use as a geographic framework for a local land data system. By combining these two separate survey systems into one integrated system, however, an ideal system for the geometric control required for land data systems is created.¹ This ideal system includes the relocation and monumentation of all U. S. Public Land Survey section and quarter-section corners, including the centers of sections, within the geographic area for which the land data system is to be created, and the utilization of these corners as stations in second order traverse and level nets, both nets being tied to the National Geodetic Datum. The traverse net establishes the precise geographic positions of the U. S. Public Land Survey corners in the form of state plane coordinates, while the level net establishes the precise elevation above mean sea level of the monuments marking the corners.

Such a system of survey control has at least the following three advantages as a geographic framework for a multipurpose cadastre:

1. It provides an accurate system of control for the collection and coordination of cadastral data, since the boundaries of the original government land subdivision form the basis for all subsequent property divisions and boundaries. As all subsequent legal descriptions and plats must be tied to the U. S. Public Land Survey System, accurate reestablishment and monumentation of the quarter-section lines and corners permits the ready compilation of accurate property boundary line data and the ready maintenance of these data in current form over time. These data can be readily and accurately updated and extended since, in Wisconsin, all new land subdivisions must by law be tied to corners established in the U. S. Public Land Survey, and since the accuracy of the surveys for these subdivisions can be readily controlled by state and local land subdivision regulations. The recommended survey control system thus fully meets the needs of a narrowly defined cadastre for the fiscal and legal administration of real property, yet this cadastre can be developed readily and soundly into a multipurpose land data system.
2. It provides a common system of control for the collection and mapping of both cadastral and earth science data. By relocating the U. S. Public Land Survey corners and accurately placing them on the State Plane Coordinate System, it becomes possible to accurately correlate real property boundary line information with earth science data. This placement of property boundary and earth science data on a common datum is absolutely essential to the sound development of any multipurpose land data system. Yet such a common control datum is rarely used. The establishment of state plane coordinates for the U. S. Public Land Survey corners permits the correlation with mathematical precision of data supplied by aerial and other forms of earth science mapping with property boundary line data compiled through the usual land surveying methods. Only through such a common geometric control system can all of the information required for a multipurpose land data system be accurately collected for, and correlated in, the system.

¹See K. W. Bauer, "Geometric Framework for Land Data Systems," *Journal of the Surveying and Mapping Division, Proceedings of the American Society of Civil Engineers*, Volume 107, Number SU1, November 1981.

DETAIL OF MONUMENT INSTALLATION FOR SURVEY CONTROL STATIONS



NOT TO SCALE

APPROVED BY: K.W.B.
DATE: NOVEMBER 1967

3. It permits lines and areas entered into the data base, whether these lines represent the limits of land to be reserved for future public uses, the limits of land to be taken for immediate public use, the limits of districts to which public regulations are to be applied, or the location and alignment of proposed new property boundary lines or of proposed constructed works, to be reproduced accurately and precisely upon the ground.

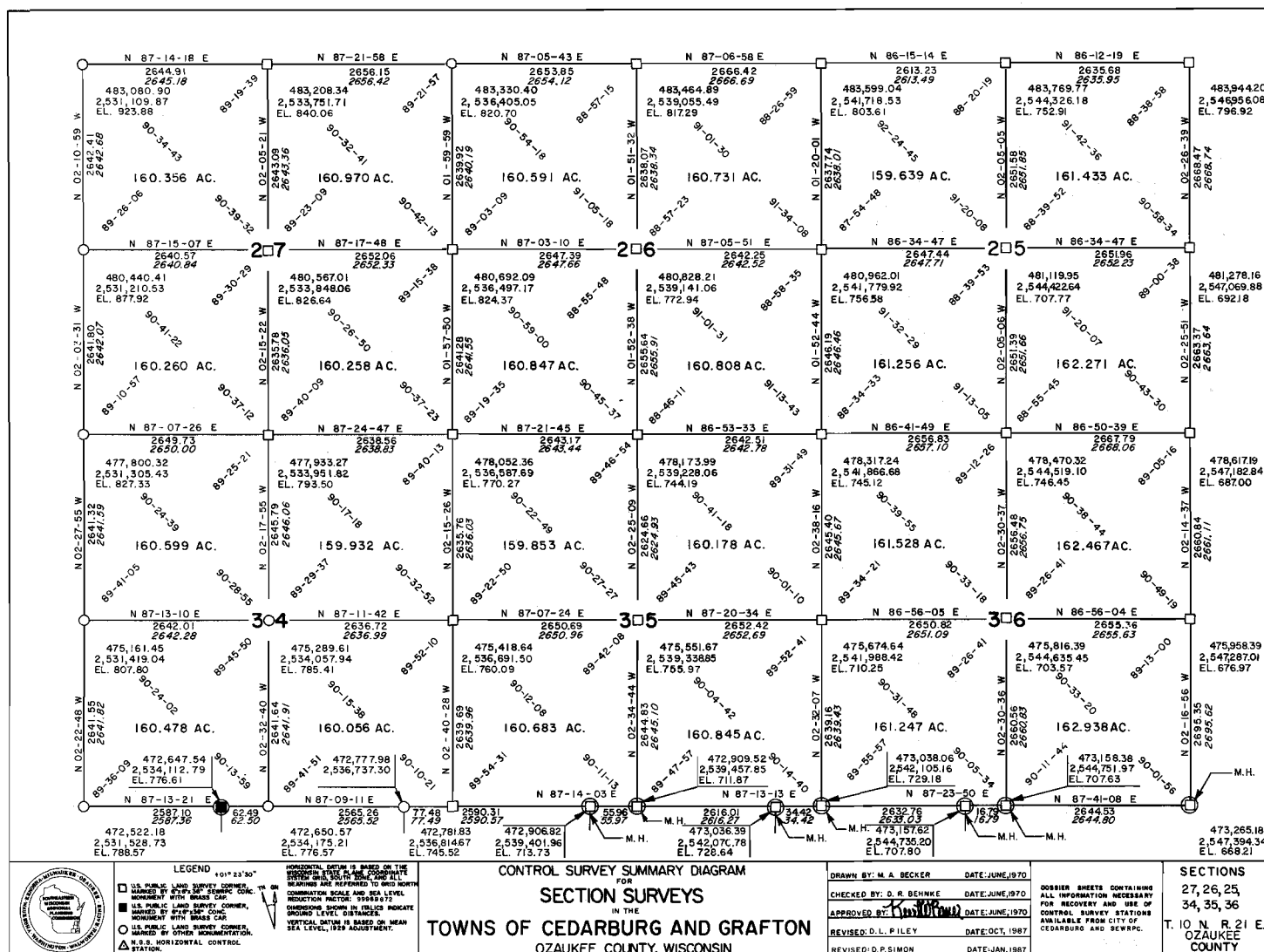
As already noted, the Regional Planning Commission has, since 1961, promoted the prepara-

Specifications for Relocation, Monumentation, and Coordination of U. S. Public Land Survey Corners: The Commission specifications governing the creation of the necessary survey control network requires the relocation of all U. S. Public Land Survey corners in the areas to be mapped, and the marking of the relocated corners by reinforced concrete monuments, having engraved bronze caps imbedded in the tops (see Figure 3). The bronze caps are inscribed with the corner notation, quarter section, town, and range. The monuments placed are referenced by

21

Figure 4

A TYPICAL CONTROL SURVEY SUMMARY DIAGRAM



and control survey engineer familiar with higher order field methods and procedures and with the attendant geodetic survey computations and adjustments and whose crews were properly equipped with state-of-the-art survey instruments. Electronic distance-measuring equipment was employed in the work, as well as optically reading theodolites and appurtenant traverse equipment, automatic levels, and precision level rods. Indeed, the control survey system used is made economically feasible only through the application of these relatively recently developed instruments, particularly the electronic distance-measuring devices.

Although the specifications governing the work make the photogrammetric engineer responsible for overall supervision and control of the mapping work, as well as for the quality of the finished maps, they require that the actual relocation of the public land survey corners be done by a local land surveyor employed as a subcontractor by the photogrammetric engineer or as a contractor by the Commission directly. The specifications thereby recognize that this portion of the work requires expert knowledge of local survey custom and boundary and title law, as well as the assembly and careful analysis of all authoritative survey information, such as title documents and attendant legal descriptions, land subdivision plats and certified survey maps, survey records, and, of cardinal importance, records on existing land survey monumentation and land occupation, in order to arrive at the best possible determination of the location of the land survey corners. In the areas mapped, the land survey portion of the control survey work requires a very high degree of professional competence, as almost all of the Public Land Survey corners fall under the federal definition of either obliterated or lost corners. The importance of this phase of the work and its impact on real property boundaries throughout the community can hardly be overemphasized.

Specifications for Topographic Mapping: The specifications provide for the completion of finished topographic maps that can serve as the base maps for the preparation of a multipurpose cadastre by accurately recording the basic geography of the area mapped. In addition to showing the usual contour information, spot elevations, planimetric and hydrographic detail, and coordinate grid ticks, the maps show, in their correct position and orientation, all U. S.

Public Land Survey quarter-section lines and corners established in the control surveys (see Figure 5). The specifications require that all state plane coordinate grid lines and tick marks and all horizontal survey control stations be plotted to within 1/100 inch of the true position as expressed by the coordinates for the control survey stations. The specifications further require that the planimetric features and contours shown on the maps conform to National Map Accuracy Standards. Thus, 90 percent of all well-defined planimetric features must be plotted to within 1/30 inch of their true positions and no such features may be off by more than 1/20 inch. Ninety percent of the elevations indicated by the solid-line contours must be within one-half contour interval of the true elevation and no such elevation may be off by more than one contour interval. A combination sea level and scale-reduction factor and the angle between geodetic and grid bearing are noted on each map sheet, as is the equation between any local datum and mean sea level.

Specifications for Cadastral Mapping: The Commission's specifications visualize the preparation of real property boundary line maps, complementing the topographic maps, by the local units of government concerned utilizing resident engineering and planning staffs or consultants. The property boundary line maps are compiled at a scale matching that of the topographic maps, each map sheet covering, like the topographic maps, a U. S. Public Land Survey section or quarter section.

As the topographic maps are being compiled, the Commission specifications require that the photogrammetric engineer provide cadastral base sheets. These sheets consist of reproducible duplicates of the partially completed topographic maps showing, in addition to the state plane coordinate grid, the U. S. Public Land Survey section and quarter-section lines and corners in their correct position and orientation, together with the attendant ground lengths and grid bearings and such salient planimetric detail and hydrographic features as may be helpful in the subsequent plotting of real property boundary lines, including railway tracks, electric power transmission lines, principal structures, wetlands, and such hydrographic features as streams and lakes.

Utilizing recorded subdivision plats, certified survey maps, and legal descriptions, all real property boundary lines, including street right-of-way lines and major utility easement lines, are then constructed on the base sheets, working within the framework of control provided by the ground lengths and grid bearings of the U. S. Public Land Survey quarter-section lines. The property boundary lines are constructed in a manner that parallels the location of these lines on the surface of the earth following land surveying practice in the State of Wisconsin. The specifications require that all real property boundary lines be plotted within 1/40 inch of their true position based on analysis of all authoritative information available. Dimensions are shown for all platted areas as shown on the recorded subdivision plats. Wisconsin Statutes have long required that such plats be prepared to an accuracy of 1 part in 3,000, as compared to the accuracy of 1 part in 10,000 required by the specifications for the basic survey control network. Any overlaps or gaps between adjoining property boundary lines, as indicated by the constructions and plotting of those lines, are noted on the cadastral maps. Finally, a cadastral parcel identification number is added.

The property boundary line maps thus show the ground length and grid bearing of all quarter-section lines; the state plane coordinates of all quarter-section corners; the monuments marking these corners; the recorded dimensions of all street lines, alley lines, and boundaries of public property; recorded street widths; platted lot dimensions; and a parcel identification number. In unplatted areas, real property boundaries are shown by scale alone. Railway tracks, electric power transmission lines, principal structures, fences, wetlands, lakes, streams, and drainage ditches are also shown (see Figure 6). As previously noted, these boundary line maps can be readily and accurately updated and extended as new land subdivision plats and certified map surveys, utilizing the survey control, are made and recorded.

STATUS OF SURVEY CONTROL, LARGE-SCALE TOPOGRAPHIC BASE MAPPING, AND CADASTRAL MAPPING IN OZAUKEE COUNTY

As previously noted, the Regional Planning Commission has long recognized the importance of good large-scale maps to the proper adminis-

tration of local government functions and has encouraged counties, cities, villages, and towns within the Region to prepare such maps. Over the last 25 years, Ozaukee County, the Cities of Cedarburg, Mequon, and Port Washington, the Village of Saukville, and the Regional Planning Commission have undertaken large-scale base mapping projects in Ozaukee County (see Table 1). These projects, all of which were carried out according to Commission-recommended specifications, have resulted in the preparation of large-scale (one inch equals 200 foot) topographic base maps for 52.75 square miles, or about 23 percent of the area of Ozaukee County (see Map 1). These mapping projects included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey section and quarter section corners included within the mapping areas. While each of these mapping projects resulted in the preparation of large-scale planimetric and topographic base maps, none of the projects was carried forward to include the preparation of companion cadastral maps, although in some cases the project produced companion cadastral base sheets upon which cadastral maps could be constructed.

In addition to the foregoing mapping projects, the Wisconsin Department of Transportation, as a part of its IH 43 freeway project, carried out a large-scale topographic mapping program to Commission-recommended specifications. The map sheets were prepared in strip fashion along the IH 43 corridor, rather than by whole U. S. Public Land Survey section. Since the maps were prepared prior to the construction of the freeway, they are of limited utility today and, indeed, in the Village of Saukville, they have been replaced.

Each of the base mapping programs identified in Table 1, including the Wisconsin Department of Transportation IH 43 mapping program, involved the relocation and monumentation of U. S. Public Land Survey corners, together with the establishment of horizontal and vertical survey control for such corners. In addition, mapping programs in neighboring Milwaukee and Washington Counties have accomplished monumentation and survey control work attendant to U. S. Public Land Survey corners located along common boundaries with Ozaukee County. Other programs conducted by the Ozaukee County Surveyor and the City of

Mequon have contributed significantly to the U. S. Public Land Survey corner monumentation and control survey program in the County.

The status of that corner monumentation and control survey program is summarized in Table 2 and on Map 1. There is an estimated total of 1,119 U. S. Public Land Survey section and quarter section corners in Ozaukee County, including the centers of the sections. The collective efforts of the units and agencies of government concerned, as described above, have resulted in a total of 438 corners, or 39 percent of the total of all such corners in the County, having been relocated, monumented, and placed on the State Plane Coordinate System to Commission specifications, including the establishment of elevations for the corners and for attendant reference benchmarks. An additional 52 corners have been relocated, monumented, and placed on the State Plane Coordinate System, but elevations have not as yet been obtained for the corners. The Wisconsin Department of Transportation has relocated four additional corners and has established horizontal control for these corners; however, these four corners have not as yet been monumented. A total of 261 additional corners have been relocated and monumented by either Ozaukee County, Sheboygan County, or the City of Mequon. Finally, a total of 142 corners have been relocated by Ozaukee County, but have yet to be monumented.

In summary, then, 751 corners, or about 67 percent of all corners in the County, have been relocated and monumented. Horizontal control data and attendant state plane coordinates have been established for 494 corners, or about 44 percent of the total. Vertical control data has been established for a total of 438 corners, or about 39 percent of the total.

In a related effort, Ozaukee County and the City of Mequon carried out in 1991 a First Order Global Positioning System (GPS) survey. This survey was intended to densify the existing national geodetic control network in Ozaukee County. The GPS survey incorporated four stations established by the former U. S. Coast and Geodetic Survey, and three stations established by the Wisconsin Department of Transportation. A total of 66 additional GPS stations were established throughout Ozaukee County, including 30 in the City of Mequon (see Map 1).

The resulting densification of control survey stations is intended to aid survey personnel in running control survey traverses to U. S. Public Land Survey corners.

The status of cadastral mapping in Ozaukee County as of the end of 1991 is summarized on Map 2. As reported in Chapter II, Ozaukee County has embarked upon a program to prepare, as resources permit, digital cadastral maps largely through the use of coordinate geometry programs using automated drafting software where the geodetic reference framework is in place. As of the end of 1991, Ozaukee County had completed digital cadastral maps for about 12 square miles, or about 5 percent of the area of the County, with all of such mapping occurring in areas where the geodetic reference framework is in place. The City of Mequon has obtained some of that mapping within its city limits and enhanced the mapping through the addition of easement data. This mapping will have to be further enhanced to fully meet the specifications for such mapping set forth in Chapter IV. In addition, Ozaukee County has prepared digital cadastral diagrams for an additional 11 square miles of Ozaukee County where the geodetic reference framework is not available. Such diagrams do not meet Commission-recommended specifications and these areas will eventually have to be properly mapped.

Digital cadastral mapping is also available in the City of Cedarburg and Village of Grafton. This mapping, which together approximates nine square miles, was obtained by recompilation and digitization using the recommended geodetic reference framework. This mapping will also have to be enhanced and extended in order to fully meet the specifications for such mapping set forth in Chapter IV.

OZAUKEE COUNTY PARCEL IDENTIFICATION NUMBER SYSTEM

The parcel identification number provides the link between the cadastral maps, which show the location of a particular parcel, and the records, either computer-readable or traditional paper records, that contain information about the parcel. Ozaukee County, through the Register of Deeds, administers a parcel numbering

**A PORTION OF A TYPICAL LARGE-SCALE TOPOGRAPHIC MAP PREPARED
IN ACCORDANCE WITH THE COMMISSION-RECOMMENDED SPECIFICATIONS**

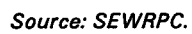
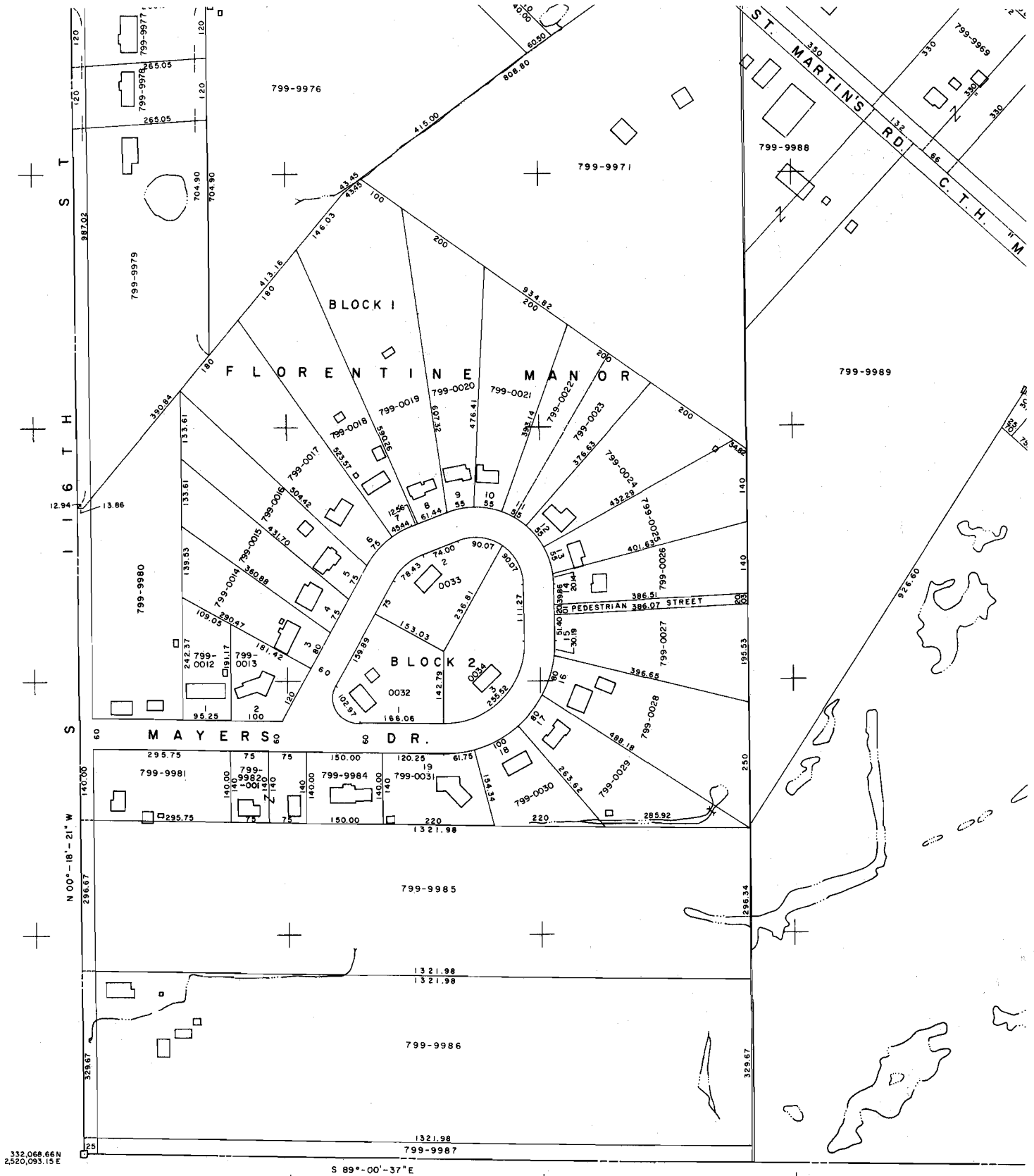


Figure 6

A PORTION OF A TYPICAL CADASTRAL MAP PREPARED IN
ACCORDANCE WITH THE COMMISSION-RECOMMENDED SPECIFICATIONS



Source: SEWRPC.

Table 1

**LARGE-SCALE BASE MAPPING PROJECTS IN OZAUKEE COUNTY
CARRIED OUT ACCORDING TO COMMISSION-RECOMMENDED SPECIFICATIONS**

Project Sponsor	Year ^a	Area Mapped ^a (square miles)	Scale	Planimetric and Topographic Maps	Cadastral Maps	
					Base Sheets Prepared	Maps Completed
Southeastern Wisconsin Regional Planning Commission	1969	15.25	1" = 200'	Yes	No	No
City of Mequon	1969	2.00	1" = 200'	Yes	No	No
Southeastern Wisconsin Regional Planning Commission	1976	0.50	1" = 200'	Yes	No	No
Southeastern Wisconsin Regional Planning Commission	1977	4.25	1" = 200'	Yes	No	No
Ozaukee County	1986	11.75	1" = 200'	Yes	Yes	No
Village of Saukville	1986	4.00	1" = 200'	Yes	Yes	No
City of Cedarburg	1987	14.00	1" = 200'	Yes	Yes	No
Multi-Agency ^b	1991	1.00	1" = 200'	Yes	Yes	No

^aIncludes only most recent mapping. Original mapping may have been updated by other agencies.

^bSponsored by Ozaukee County and City of Port Washington.

Source: SEWRPC.

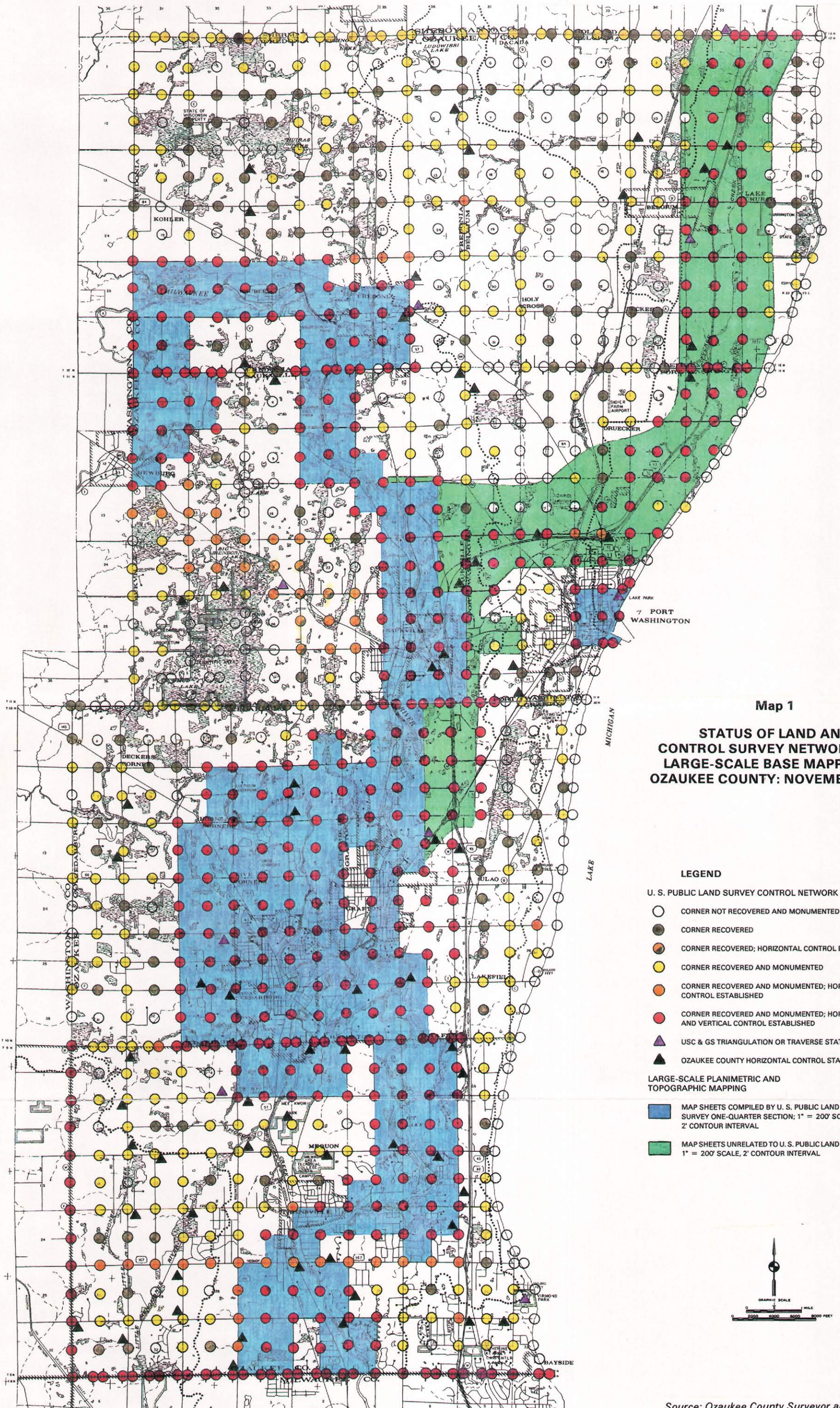
system over the entire County (see Figure 7). The system consists of three separate identifiers, one for unplatted lands, one for platted lands with blocks, and one for platted lands without blocks.

The format of the parcel identifier for unplatted lands is "AABBBCCDDDEE." "AA" is a two-character field that identifies the minor civil division, the town, village, or city, in which a particular parcel is located. Each civil division is identified by two numeric characters ranging from 01 for the Town of Belgium to 19 for the Village of Newburg. "BBB" is a three-number field that identifies the U. S. Public Land Survey section in which the parcel is located. "CC" is a two-character field that identifies the quarter-quarter section in which the parcel is located, according to the County's numbering system within each section that divides the section into 16 numbered quarter-quarter sections. "DDD" is a three-character numeric code that identifies an

individual parcel. "EE" is a two-character numeric code used to identify parcels divided from previously numbered parcels.

The format of the parcel identifier for platted lands with blocks is "AABBBCCDDEEE." "AA" is a two-character field that identifies the minor civil division in which the subdivision is located. "BBB" is a three-character numeric code that identifies the subdivision. "CC" is a two-character numeric code that identifies the block number within the subdivision. "DD" is a two-character numeric field that identifies the lot number of the parcel in question. "EEE" is a three-character numeric code which is used to identify redivisions of the original lot.

The format of the parcel identifier for platted lands with no blocks is "AABBBCCCCDDD." Again, "AA" is a two-character numeric field that identifies the minor civil division. "BBB" is



Map 1

**STATUS OF LAND AND
CONTROL SURVEY NETWORK AND
LARGE-SCALE BASE MAPPING IN
OZAUKEE COUNTY: NOVEMBER 1991**

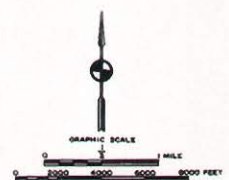
LEGEND

U. S. PUBLIC LAND SURVEY CONTROL NETWORK

- CORNER NOT RECOVERED AND MONUMENTED
- CORNER RECOVERED
- CORNER RECOVERED; HORIZONTAL CONTROL ESTABLISHED
- CORNER RECOVERED AND MONUMENTED
- CORNER RECOVERED AND MONUMENTED; HORIZONTAL CONTROL ESTABLISHED
- CORNER RECOVERED AND MONUMENTED; HORIZONTAL AND VERTICAL CONTROL ESTABLISHED
- ▲ USC & GS TRIANGULATION OR TRAVERSE STATION
- ▲ OZAUKEE COUNTY HORIZONTAL CONTROL STATION (GPS)

**LARGE-SCALE PLANIMETRIC AND
TOPOGRAPHIC MAPPING**

- MAP SHEETS COMPILED BY U. S. PUBLIC LAND SURVEY ONE-QUARTER SECTION; 1" = 200' SCALE, 2' CONTOUR INTERVAL
- MAP SHEETS UNRELATED TO U. S. PUBLIC LAND SURVEY SYSTEM; 1" = 200' SCALE, 2' CONTOUR INTERVAL



Source: Ozaukee County Surveyor and SEWRPC.

Table 2

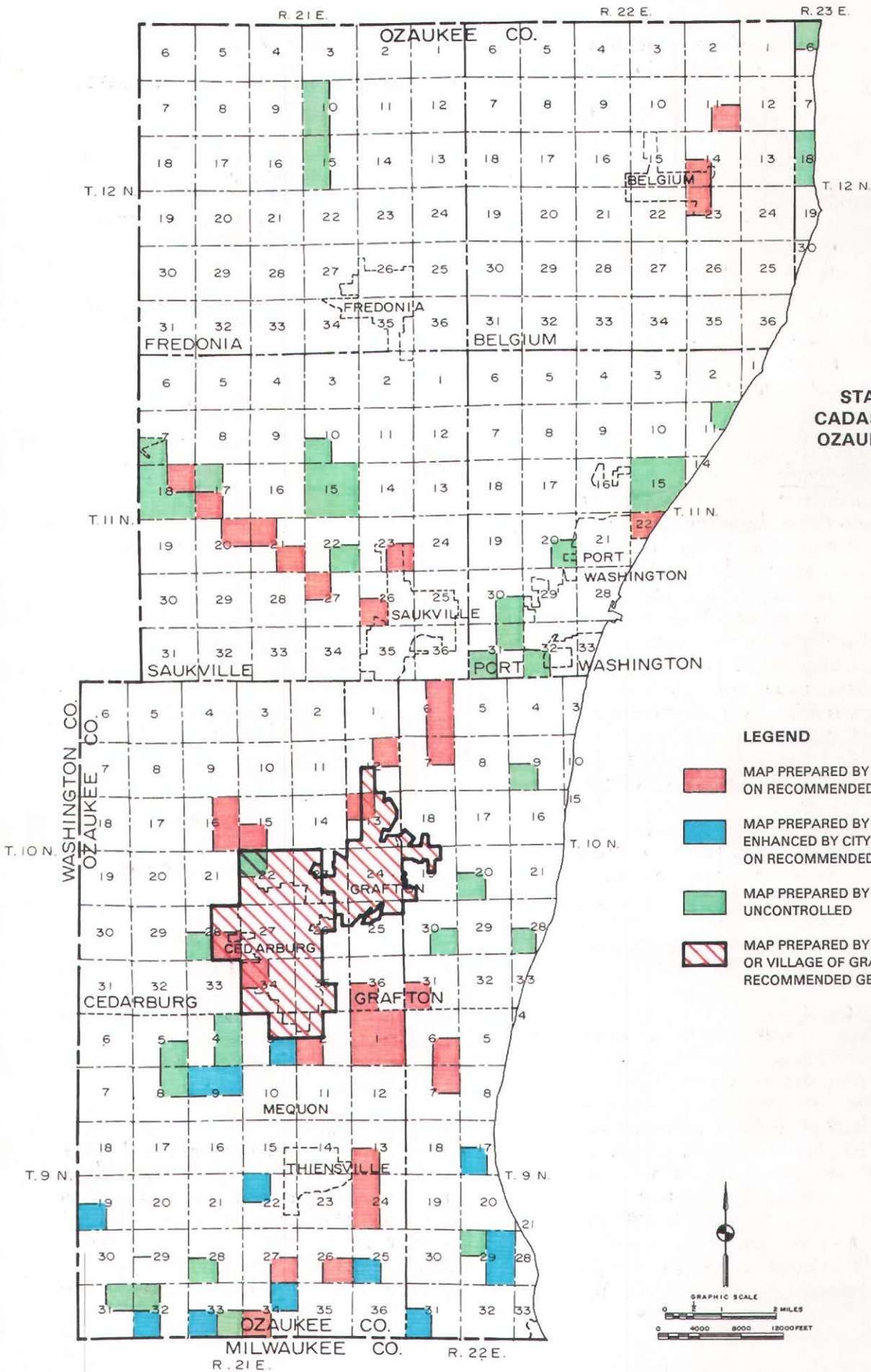
**STATUS OF U. S. PUBLIC LAND SURVEY CORNER MONUMENTATION
AND CONTROL SURVEY PROGRAM IN OZAUKEE COUNTY: NOVEMBER 1991**

Item	Amount
Estimated Total Corners ^a	1,119
Corners Relocated and Monumented and Horizontal and Vertical Control Established by:	
Wisconsin Department of Transportation	99
Southeastern Wisconsin Regional Planning Commission	161
Ozaukee County	69
Bordering Counties	33
Multi-Agency	9
Local Governments	67
Total ^b	438
Percent of Total Corners	39.1
Corners Relocated and Monumented and Horizontal Control Established by:	
Wisconsin Department of Natural Resources	30
Southeastern Wisconsin Regional Planning Commission	18
Local Governments	4
Total	52
Percent of Total Corners	4.6
Corners Relocated and Horizontal Control Established by	
Wisconsin Department of Transportation	4
Percent of Total Corners	0.4
Corners Relocated and Monumented by:	
Ozaukee County	174
Sheboygan County	18
City of Mequon	69
Total	261
Percent of Total Corners	23.3
Corners Relocated by Ozaukee County	142
Percent of Total Corners	12.7
Summary	
Corners Relocated and Monumented	751
Percent of Total Corners	67.1
Corners with Horizontal Control	494
Percent of Total Corners	44.1
Corners with Vertical Control	438
Percent of Total Corners	39.1

^aIncludes all corners along adjoining counties.

^bSome of the corners for which control surveys were completed by WisDOT and local units of government were monumented by the Ozaukee County Surveyor.

Source: Ozaukee County Surveyor and SEWRPC.



Source: SEWRPC.

a three-character numeric field that identifies the subdivision. "CCCC" is a four-character numeric field that identifies the lot number. "DDD" is a three-character numeric field to identify subsequent redivisions of the lot.

NEEDS ASSESSMENT

Given the conceptual framework of a multipurpose cadastre as set forth by the National Research Council and as summarized earlier in this chapter, and given the progress made to date in developing the foundation elements necessary for the creation of a modern land records system, the following basic needs exist within Ozaukee County:

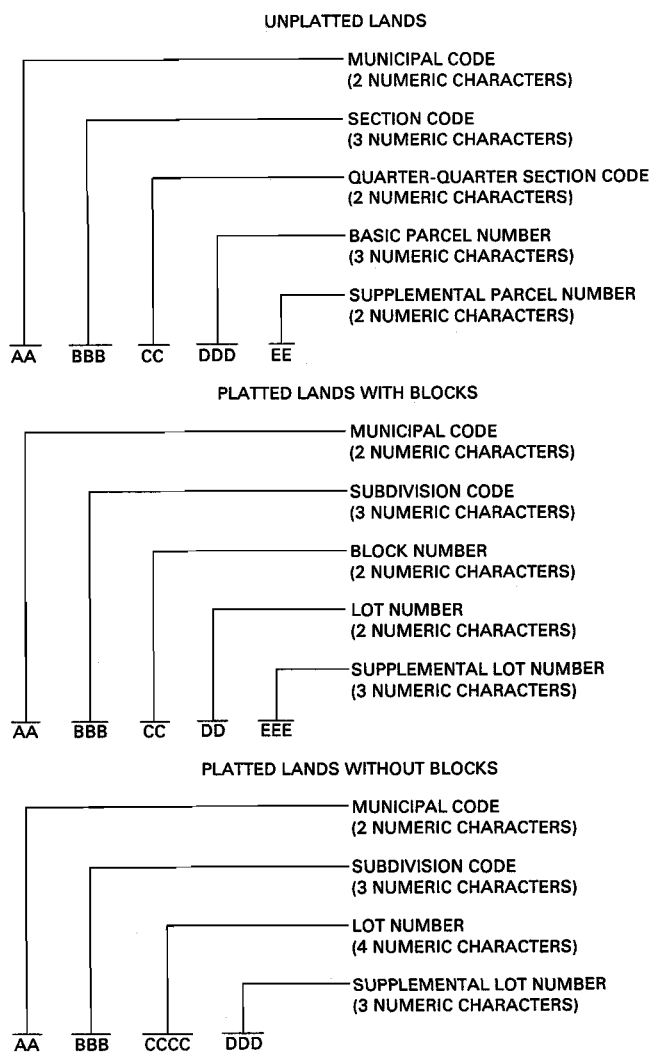
1. Completion of the Geodetic Reference Framework

The most basic need to be addressed in the Ozaukee County land information system plan is the completion of the geodetic reference framework which combines the U. S. Public Land Survey and the State Plane Coordinate System. More particularly, a need exists to relocate and monument the remaining 368 U. S. Public Land Survey section and quarter-section corners, including centers of sections, that have not been relocated to date; to monument the 146 U. S. Public Land Survey corners that have previously been relocated but not monumented by the County Surveyor; to obtain horizontal survey control data for the 625 U. S. Public Land Survey corners for which such data have not been obtained to date; and to obtain vertical survey control data for the 681 U. S. Public Land Survey corners for which such data have not been obtained to date.

2. Large-Scale Base Maps

A need exists to complete large-scale topographic base maps throughout Ozaukee County. As noted earlier in this chapter, large-scale (one inch equals 200 foot) topographic base maps have been prepared for nearly 53 square miles, or about 23 percent of the total area of Ozaukee County. The remaining 181 square miles of the County need to be mapped. In addition, the City of Mequon has made a policy decision to obtain such mapping at a scale of one inch equals 100 feet. Accordingly,

Figure 7
OZAUKEE COUNTY PARCEL NUMBERING SYSTEM



Source: Ozaukee County Register of Deeds and SEWRPC.

the older smaller scale, one inch equals 200 feet, topographic mapping in the City of Mequon and Village of Thiensville, encompassing a combined area of 13 square miles, will need to be replaced with larger scale mapping.

3. Cadastral Overlay

A need exists to prepare cadastral maps for the entire area of the County. Such maps should be prepared as "overlays" to the topographic maps in order to permit the accurate correlation of earth science and cadastral information. As noted earlier in this chapter, Ozaukee County, the

Cities of Cedarburg and Mequon, and the Village of Grafton have taken steps to begin cadastral map preparation and to make such cadastral maps available in digital form. All cadastral mapping completed to date in the County, which totals about 21 square miles, needs to be reviewed for conformance with the recommended standards for cadastral mapping set forth in the following chapter of this report. As necessary, the existing digital cadastral mapping should be enhanced to fully meet such standards. In those cases where the standards cannot be met, the mapping should be redone over time. In addition, maps should be completed to the recommended standards for the remaining areas of Ozaukee County totaling about 213 square miles.

4. Parcel Number

A need exists to assign common parcel identifiers to all real property ownerships and to facilitate the storage and retrieval of various parcel-related data. The existing parcel identification system in Ozaukee County needs to be reviewed with reference to the data interchange standard attendant to parcel numbering systems promulgated by the Wisconsin Land Information Board.

5. Land Information Files

A need exists to create a series of land information files containing needed information related to the topographic and cadastral maps through the parcel identifiers.

SUMMARY

This chapter presents a description of the major elements of a multipurpose, parcel-based land information system, placing that system within the more general context of geographic information systems. In addition, this chapter summarizes the work that has been accomplished in Ozaukee County to date to provide the essential base for the establishment of an automated mapping and land information system for the County. The following summarizes the material included in this chapter:

1. A multipurpose cadastre can be conceptualized as a public, operationally and administratively integrated, parcel-based land

information system which provides for continuous, readily available, and comprehensive land-related information at the parcel level. The National Research Council has proposed that multipurpose cadastres consist of the following five elements: 1) a geographic reference frame consisting of a geodetic network, 2) a series of current, accurate, large-scale topographic base maps properly related to the geographic reference frame, 3) a cadastral map overlay delineating all cadastral parcels, which is also properly related to the geographic reference frame, 4) a unique identifying number assigned to each parcel, and 5) a series of registers, or land data files, each including a parcel index for purposes of information retrieval and cross-referencing with information in other land data files.

2. The first three elements of the procedural model for the creation of a multipurpose cadastre as proposed by the National Research Council have long been embodied in the Regional Planning Commission-recommended large-scale base mapping and attendant survey control program. Recognizing the importance of good large-scale maps and attendant survey control to sound community development and redevelopment, the Commission has for almost three decades encouraged the preparation of large-scale topographic and cadastral maps within its 2,689-square-mile Planning Region. These maps are based on a unique system of survey control that combines the best features of the U. S. Public Land Survey System and State Plane Coordinate System. The large-scale maps and attendant control survey system, where they already exist within the Region, provide in a highly cost-effective manner the technical foundation for the creation of multipurpose cadastres within the Region, providing the first two of the five elements of such a cadastre, and a part of the third element.
3. Through large-scale topographic mapping programs conducted by Ozaukee County, the Cities of Cedarburg, Mequon, and Port Washington, the Village of Saukville, and the Regional Planning Commission, topographic maps at a scale of one inch equals 200 feet, with a two-foot contour interval,

have been prepared to Commission-recommended specifications for nearly 53 square miles, or about 23 percent of the total area of the County. Each of the projects so carried out included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey corners included in the mapped area. Within the context of the conceptual framework of a multipurpose cadastre, then, two of the five elements, geodetic reference framework and large-scale base maps, have been completed for substantial portions of Ozaukee County.

4. There are an estimated total of 1,119 U. S. Public Land Survey section and quarter-section corners in Ozaukee County, including the centers of the sections. Taking into account surveying and mapping efforts conducted by the units and agencies of government operating in Ozaukee County, a total of 438 corners, or about 39 percent of the total of all such corners in the County, have been relocated, monumented, and placed on the State Plane Coordinate System to Commission specifications. An additional 52 corners have been relocated, monumented, and placed on the State Plane Coordinate System, but without vertical control; with an additional four corners having been relocated and placed on the State Plane Coordinate System but without monumentation. A total of 261 additional corners have been relocated and monumented; while 142 additional corners have been relocated but not yet monumented. In summary, then, 751 corners, or about 67 percent of all corners in the County, have been relocated and monumented. Horizontal control data in the form of state plane coordinates have been obtained for 494 corners, or about 44 percent of the total. Vertical control data have been obtained for a total of 438 corners, or about 39 percent of the total.
5. Digital cadastral mapping efforts have been undertaken by Ozaukee County, the City Cedarburg, and the Village of Grafton. Together, the cadastral maps encompass an area of 21 square miles, or about 9 percent of the total area of the County. None of the digital cadastral mapping completed to date fully meets the specifications for such mapping recommended by the Regional Planning Commission, although the work completed to date for this area has utilized the recommended geodetic reference framework. Most of the completed work could be enhanced to meet the full set of recommended specifications. In addition, cadastral diagrams have been completed for a total area of 11 square miles, or 5 percent of the County. The areas concerned will eventually have to be remapped.
6. Ozaukee County, through the Register of Deeds, administers a parcel numbering system over the entire County. Three separate parcel identifiers are used; one for unplatted lands, one for platted lands with blocks, and one for platted lands without blocks. Only that part of the system pertaining to unplatted lands identifies the U. S. Public Land Survey section and quarter section within which a parcel is located.
7. The basic needs to be addressed in the Ozaukee County land information system plan include the completion of the geodetic reference framework to provide the foundation for an automated land information system; the completion of large-scale topographic base maps throughout the County; the completion of cadastral maps throughout the County, including the enhancement of existing cadastral mapping; the review of the Ozaukee County parcel numbering system to ensure that it meets the standards promulgated by the Wisconsin Land Information Board; and the creation of land information files that are related to the topographic and cadastral maps through the parcel identifiers.

Chapter IV

RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM FOR OZAUKEE COUNTY

INTRODUCTION

The previous chapters of this report have presented an overview of the current status of automated mapping and land information system capability within Ozaukee County, and have identified the National Research Council model for the creation of automated cadastres as the suggested model for the development of a multi-purpose, multi-user automated mapping and land information system in Ozaukee County. The elements of such a system have been identified, and the status of implementation of those elements within Ozaukee County has been reported.

This chapter sets forth a recommended automated mapping and land information system plan for Ozaukee County. The chapter begins with a statement of goals and objectives and follows with sections on the planning time period; system development standards; a multi-year program to begin to continue building the land information system, including consideration of system development costs and sources of potential revenue; and proposed organizational arrangements to carry out that program.

PROGRAM GOALS AND OBJECTIVES

The Ozaukee County land information system planning effort seeks to meet the following two basic goals:

1. To implement over time in Ozaukee County a multipurpose, multi-user, parcel based, automated mapping and land information system, such system following the National Research Council model and consisting of the following five basic elements:
 - a. Geodetic reference framework.
 - b. Large-scale planimetric and topographic base maps.
 - c. Overlays, including cadastral boundaries and boundaries of various cultural and natural areas.

- d. Identifiers, including parcel numbers and codes associated with various cultural and natural areas.

- e. Nonspatial land information files, including cadastral parcel records and various cultural and natural resource data.

2. To reach agreement among Ozaukee County, the local units of government in Ozaukee County, and the various public and private utilities operating in Ozaukee County on the design of a common automated mapping and land information system so as to ensure economy and efficiency in the development and use of that system and so as to ensure the ready entry, retrieval, and exchange of data by and between the various users of the system.

To meet these two goals, the following represent the specific objectives of the current planning effort:

1. To lay out a course of action that will focus part of the available fiscal resources on efforts to continue the development of the geodetic reference framework throughout the entire County; to prepare, as the remaining resources may permit, large-scale planimetric and topographic base maps in those portions of the County not yet mapped; and to continue the county program to prepare digital cadastral mapping, producing such cadastral mapping, insofar as possible, as overlays to the topographic base mapping.
2. To encourage local units of government in Ozaukee County who desire to move at a more rapid pace toward establishing new, or refining existing, automated mapping and land information systems for local government use to commit additional fiscal resources toward that end; recommending, however, that such resources be expended for work efforts which meet the agreed-upon system development standards.

3. To facilitate applications by Ozaukee County and by local units of government in Ozaukee County for state grants in support of the development of the recommended automated mapping and land information system for Ozaukee County.
4. To encourage partnership efforts between public sector governments and utilities and private sector utilities that will contribute toward the development of the recommended automated mapping and land information system for Ozaukee County.

PLANNING PERIOD

The planning period for this initial land information system plan for Ozaukee County is the five-year period beginning January 1, 1992, and extending through December 31, 1996. The end of the planning period generally corresponds with the expiration of the current state law concerning the Wisconsin Land Information Program and the funding of that program through supplemental Register of Deeds recording and filing fees.

RECOMMENDED STANDARDS

When discussing the design of an automated mapping and land information system, it is often assumed that the "system" is the computer hardware and software and that the "system" is physically centralized, that is, a single hardware configuration upon which reside all of the digital maps and associated land information of all system users. Users of this type of system operate in terminal fashion from the central computer. For many years, this type of operation was dictated in large part by the available computer technology. Recent advances in computer hardware and software technology, particularly as they pertain to decreasing unit costs for computational and mass data storage capability, to networking between the hardware of different vendors, and to translation capability of digital map data between some different proprietary software products, now permit a different type of "system" to be specified; that is, one in which the system users share digital

maps and an agreed-upon set of map-related information, but maintain their own separate, or distributed, computing capability.

If the centralized system concept is discarded, then a number of issues that have in the past been impediments to the development of shared automated mapping and land information systems are no longer pertinent. These are the organizational structure and the cost allocation among participants of a centralized operation, and the maintenance of data security on "proprietary" files in a centralized operating environment.

More importantly, perhaps, the ability to replace the centralized operating concept with a distributed operating concept permits attention to be focused on the true system components of an automated mapping and land information system. In a distributed operating environment, the "system" is not defined in terms of hardware and software, but in terms of an agreed-upon set of procedures and specifications for the production and maintenance of a basic set of digital maps and map-related information, and an agreed-upon set of procedures and specifications for the interchange of these data between system users. It must be stressed that no amount of state-of-the-art computer technology can compensate for the absence of a robust set of specifications and standards for those elements that will be used in common.

The following recommended standards for an automated mapping and land information system for Ozaukee County assume that the following set of elements would be developed for joint use: a survey control network, large-scale topographic base maps, and a cadastral map overlay with parcel identifiers. Discussions held over the past several years among local operators of automated mapping systems indicate that these elements in the aggregate represent a set of map feature information common to most of the users. The provision of a common automated mapping base in this manner would provide a base sufficient to support a wide variety of uses, including county and local government and utility preliminary site engineering, outside plant utility network mapping, the design and construction of public and private works, planning and zoning administration, vehicle routing, emergency services provision, tax assessment, and various types of statistical analyses, among others. It is envisioned, however, that more

specialized applications would be developed by the users either singly or in small groups as may be appropriate or necessary, rather than being jointly developed.

System Accuracy

The issue of map accuracy in a multi-user environment has been the subject of intense debate among mapping organizations, particularly as this issue may affect the allocation of the costs of shared development among the various participants in a multi-user system. In spite of past discussion, however, the ramifications of this issue are still not fully understood or appreciated by all participants in the dialogue. Debate, unfortunately, has focused on the relative cost of various levels of accuracy and how those costs might be allocated rather than on the more basic issue, which is the level of accuracy required to support a true multipurpose, multi-user system of digital map resources. If the agreed-upon system is incapable of supporting the needs of the most demanding of the users, the development of multiple systems is inevitable and the creation of a multipurpose, multi-user system cannot, by definition, occur.

In this regard, the recommended standards for a joint automated mapping and land information system as set forth herein are based upon the Commission-recommended standards for the development of survey control networks and local large-scale mapping programs. These Commission programs already represent formally adopted or de facto standards for much of Southeastern Wisconsin, including Ozaukee County. In addition, these programs have been subjected to critical review by knowledgeable professionals who have judged them to be both conceptually and procedurally sound.

The large-scale mapping and survey control systems recommended by the Commission have been in use for more than 25 years in manual mapping environments, and within the most recent decade have been successfully carried into digital mapping environments. They therefore represent successfully "field tested" standards and specifications. The maps and attendant survey control have been demonstrated to support a wide variety of operations to necessary levels of accuracy in both the public and private sectors, and are, therefore, ideally suited to a multipurpose, multi-user environment.

Map Projection System

It is recommended that the State Plane Coordinate System, North American Datum of 1927 (NAD-27), be used as the map projection system for a countywide automated mapping and land information system. This system is already the system of choice of the local mapping community, and a great deal of effort and expense has been expended in its establishment and maintenance. Those organizations operating in the local area that have chosen to use the Universal Transverse Mercator (UTM) system have converted much of their existing basic map information to the UTM system from the State Plane Coordinate System. The methodology for the precise conversion process between the two map projection systems already exists, as long as both coordinate systems are based upon NAD-27, and the organizations concerned can continue to "load data" into their systems.

The map projection grid should be constructed inside the computer memory through key entry procedures. This requirement, if combined with the key entry of all survey control network data, will produce a map projection that is essentially independent of map scale. Constructed in this manner, the map projection will be able to accept and accurately reference not only digitized data from mapped sources at any scale, but also numeric data derived from direct field measurements. This capability is as important as it is subtle, given the increasing availability and affordability of high technology survey instruments, such as "total stations."

Survey Control Network and Large-Scale Base Mapping

It was reported in Chapter III that the Commission-recommended survey control network and large-scale topographic base maps already exist throughout a large portion of Ozaukee County, and that such data are already being utilized by units of government and certain utilities in both analog and digital mapping. Accordingly, this program should be pursued over time in the remainder of Ozaukee County, and it should be considered the standard for common use.

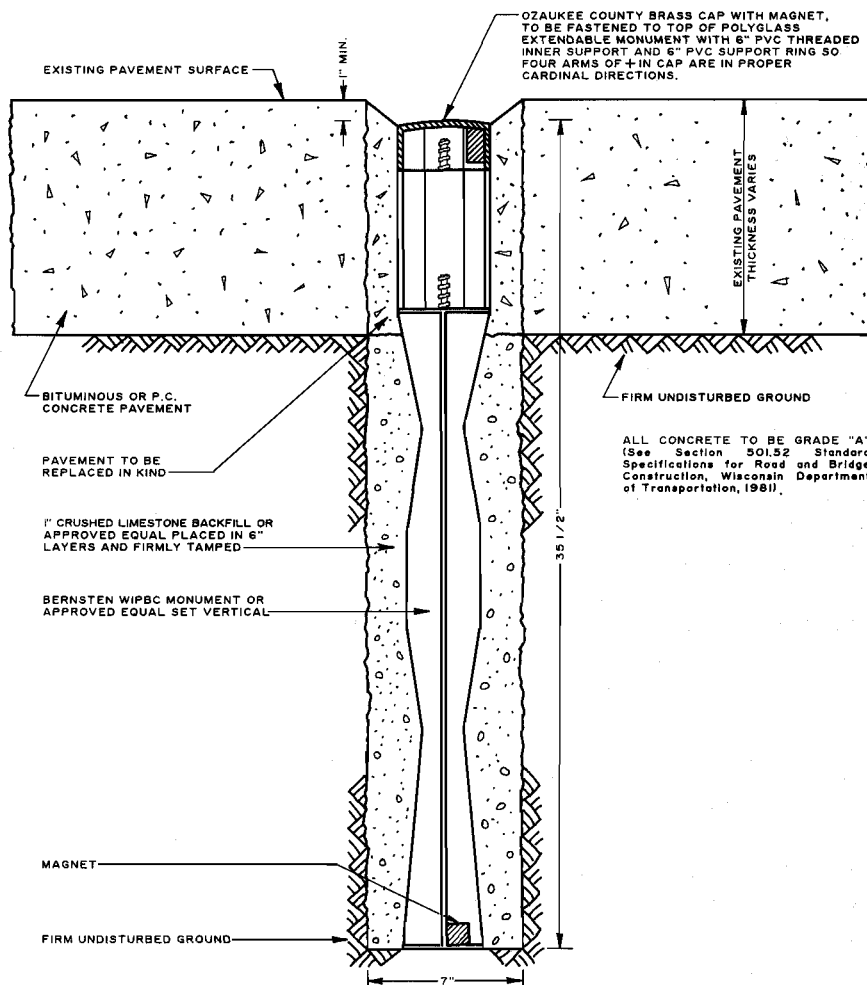
Control Surveys: The horizontal control survey work to be completed in Ozaukee County should include the recovery, or relocation, and monumentation of the 368 U. S. Public Land Survey corners not previously recovered or relocated and monumented, including section and quarter-

section corners and centers of sections, as well as the monumentation of the 146 U. S. Public Land Survey corners that have previously been relocated but not yet monumented by the County Surveyor. The specifications for the relocation and monumentation of U. S. Public Land Survey corners recommended by the Regional Planning Commission and documented in Chapter III of this report are incorporated by reference herein as the specifications for work in Ozaukee County with the exception of those monuments to be installed in the traveled way of streets and highways. In those cases, the County Surveyor has determined to install adjustable Berntsen monuments (see Figure 8). The County Surveyor has determined to use for each control station the dossier form shown in Figure 9.

Subsequent to the recovery or relocation and monumentation of the U. S. Public Land Survey corners, high-order control survey traverses should be run which utilize and incorporate all of the monumented corners as stations to determine the coordinates of the corners and the lengths and bearings of all quarter-section lines. Coordinates of the corners should be computed upon the Wisconsin Coordinate System, South Zone (NAD-27), and sufficient survey connections should be made to basic National Geodetic Survey (NGS) control stations, as well as the supplemental stations established by Ozaukee County in 1991, to permit the proper checks and adjustments to be made both in the traverse lengths and bearings and in the coordinate values of the monumented U. S. Public Land Survey corners. The procedures and accuracy of the horizontal control surveys should conform to the specifications for NGS Third-Order, Class I traverses. In some cases, the use of Global Positioning System technology to establish coordinate values may be more cost-effective

Figure 8

DETAIL OF ALTERNATIVE CONTROL SURVEY MONUMENT INSTALLATION IN SURFACE TRAVELED WAY OF STREETS AND HIGHWAYS



Source: Ozaukee County.

than traversing and should accordingly be utilized. Such horizontal survey control work needs to be completed for 625 corners in Ozaukee County.

The vertical control survey work to be completed should be based upon National Geodetic Vertical Datum, 1929 Adjustment (NGVD-29), as established by the NGS. Closed level circuits should be run as necessary to establish permanent bench marks in the area eventually to be mapped. The procedures and accuracy of the vertical control surveys should conform to the specifications for NGS Second-Order, Class II level circuits. Elevations should be determined

Figure 9

OZAUKEE COUNTY RECORD OF U. S. PUBLIC LAND SURVEY CONTROL STATION

U.S. PUBLIC LAND SURVEY MONUMENT RECORD

Note: This form is intended and designed to fulfill all requirements of Wisconsin Administrative Code, Chapter A-E 5.02, U.S. Public Land Survey Monument Record (3)(a)(b)(c)(d)(e)(f)(g)(h)(i).

(a) CORNER LOCATION: S 1/4 SECTION 28

TOWNSHIP 11 NORTH

RANGE 21 EAST

(TOWN) CITY/VILLAGE SAUKVILLE

STATE PLANE COORDINATES OF CORNER:

NORTH
EAST

ELEVATION OF CORNER:

THETA ANGLE:

Horizontal Datum: Wisconsin State Plane Coordinate System, South Zone
NORTH AMERICAN DATUM 1927 1983

Vertical Datum: National Geodetic Vertical Datum of 1929

(b)(f)(g)(h) Description of monument found at this corner and if it was accepted, state all evidence (material, testimonial, occupational, plats, records, other monuments) used as a basis for accepting. If not accepted or if nothing was found, state evidence used as a basis for establishing location. If reestablished through lost corner proportionate methods, indicate all monuments, distances and directions used to establish.

Using H. Brabender, R.L.S. 294, 1977 survey, excavated and found pk nail two inches below pavement surface. Limestone monument good condition called for on L. Tousley County Surveyor's 1887 remonumentation map found eighteen inches below pk nail. Limestone monument located three feet south of Hillcrest Road pavement centerline.

Accepted limestone monument as corner and replaced with a Berntsen Aluminum monument.

I, THOMAS J. GENSKE S- 1317
(type or print name) certify that the corner location on this record was determined by me or under my direction and control and that this U.S. Public Survey Monument Record is correct and complete to the best of my knowledge and belief.

Thomas J. Genske 3/13/92
Signature COUNTY SURVEYOR

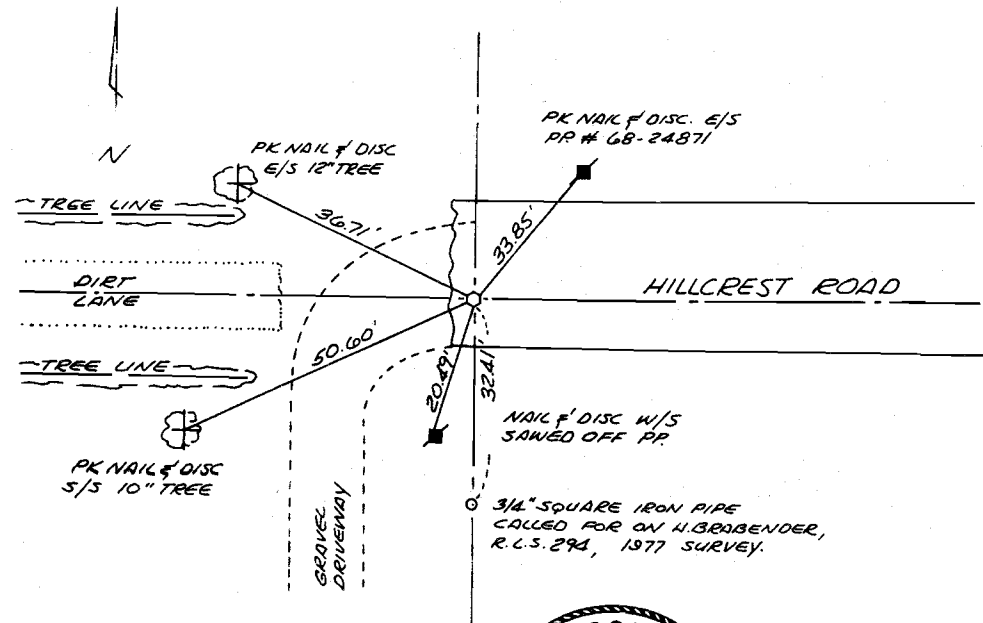
Date



INDEX NO 138

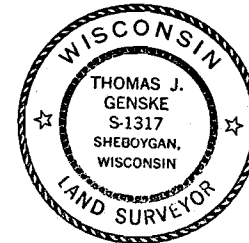
S 1/4 OF SECTION 28 T. 11 N; R. 21 E.

(c)(d)(e) Plan view of corner with ties to at least 4 witness monuments. If in disagreement with previously established corner, show the distances between the two corners and also indicate the ties to the disputed corner.



MAINTENANCE RECORD

Date	Init	Remarks



I, THOMAS J. GENSKE S- 1317
Ozaukee County Surveyor, do hereby certify that the above location is accepted as the original location for the U.S. Public Land Survey corner.

Thomas J. Genske 3/13/92
Signature Date

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for the monuments marking the section, quarter-section, and center of section corners throughout the areas remaining to be mapped, and these monuments should serve as permanent bench marks, each monument being supplemented by at least one reference bench mark. Such vertical control survey work needs to be completed for 681 corners in Ozaukee County.

Large-Scale Topographic Base Maps: For those areas of Ozaukee County where large-scale base maps have yet to be prepared, such maps should be acquired in digital form. The digital map files should be prepared to National Map Accuracy Standards at a scale of 1:2400 (one inch equals 200 feet). Use of these standards will ensure that all map projection grid lines, horizontal control stations, section corners, and quarter-section corners will be plotted on finished maps to within 1/100 of an inch of their true coordinate position. Ninety percent of all well-defined planimetric features will be plotted to within 1/30 of an inch of their true coordinate position, and no point will be more than 1/20 of an inch from its true coordinate position. Ninety percent of the elevations determined from the solid-line contours of the map will have an accuracy with respect to elevation of one-half contour interval, and no elevation will be in error by more than a full contour interval.

In some cases, local communities may desire to undertake large-scale base mapping at a scale of 1:1200 (one inch equals 100 feet). The City of Mequon, for example, has indicated an interest in obtaining such larger scale base mapping. Local governments in Ozaukee County desiring to obtain topographic maps at this larger scale should be encouraged to do so. As a matter of policy, Ozaukee County should encourage such large scale base mapping through a cost sharing program whereby the County would share the cost of the base mapping effort with the requesting local government.

The digital map files should contain the following map information:

1. Hypsometry by contour lines having a vertical interval of two feet.
2. All planimetric detail, such as pavements, curbs, walks, trails, railways, power lines, buildings, fences, wooded areas, dams,

piers, dock walls, culverts and bridges, retaining walls, airport runways and taxiways, and other identifiable salient features on the aerial photography from which the maps are compiled.

3. All hydrographic features, such as marshes, lakes, streams, watercourses, and drainage ditches.
4. All section and quarter-section lines and U. S. Public Land Survey corners in their correct position and orientation, together with the attendant exact grid lengths and bearings.
5. Such lettering as may be secured from available maps of the area or as may be furnished by the participating organizations relative to the names of salient geographic features. The names of all state and county trunk highways, public streets, and major streams and lakes are shown on the maps.

In addition to ultimately obtaining new topographic base maps in digital form for all areas of Ozaukee County not yet so mapped, those large-scale maps prepared by Ozaukee County, local governments in the County, and the Regional Planning Commission in past years in conventional form should be converted to an automated format through both digitizing and/or scanning procedures.

Cadastral Maps

Much of what has been historically identified as cadastral mapping in southeastern Wisconsin cannot be mathematically accurately related to the surface of the earth, and therefore does not meet the definition of a map. These "cadastral maps" are more properly identified as cadastral diagrams and are manifestly unsuited to be digitized as the cadastral layer of an automated mapping and land information system where one of the stated intents is the ability to correlate real property boundary line information with earth science information accurately, such as floodplain boundaries. To meet the rigorous requirements of a modern, parcel-based, land information system, it is usually necessary that the real property boundary line maps be recompiled on the map projection established for the land information system utilizing a permanently monumented survey control network as the mechanism for this recompilation. As reported

in Chapter III, Ozaukee County and certain local units of government in the County have begun to prepare cadastral maps for portions of the County, although at this time the mapping that has been completed does not fully meet the specifications set forth below.

Each cadastral map should cover one U. S. Public Land Survey Section at a scale of 1:2400. In those cases where base mapping is obtained at a scale of 1:1200, the cadastral overlay map should also be prepared at that scale, and each cadastral map would cover one U. S. Public Land Survey quarter section. The maps should utilize the Wisconsin State Plane Coordinate System as the map projection and should show all section and quarter-section lines and corners together with their grid and ground level lengths and grid bearings, all in their correct position and orientation. The State Plane Coordinate grid should be plotted to within 1/100 of an inch of its true position, and each U. S. Public Land Survey section and quarter-section corner likewise should be plotted to within 1/100 of an inch of its true position as expressed by the State Plane Coordinate values for the corner. Ninety percent of all well-defined planimetric features plotted on the maps as an aid in the delineation of real property boundaries, such as the threads of major streams and watercourses, fence lines, pavements, and principal buildings, should be plotted to within 1/30 of an inch of their true positions. Real property boundary lines should be plotted to within 1/40 of an inch of their true positions.

Determination of the location of real property boundary lines should be based upon the examination and interpretation of all recorded subdivision plats and certified survey maps within the area to be mapped; legal descriptions and, where available, plats of all major public utility easements in the area to be mapped; copies of legal descriptions and, where available, plats of all street right-of-way openings, reservations, or dedications in the area to be mapped; and legal descriptions contained in the most recently recorded deed transaction in the records of the County Register of Deeds for all real property boundaries in the area to be mapped not included within recorded subdivision plats or certified survey maps.

Based upon review and interpretation of these materials, the cadastral maps should show, all in their correct position and orientation, all real

property boundary lines, all street right-of-way lines, and all major cross-country public and utility easement lines. These lines should be graphically constructed in a manner which parallels the location of the lines on the surface of the earth, following good land surveying practice in southeastern Wisconsin.

It is recognized that the recorded dimensions and orientation of real property boundaries plotted in this manner may not always agree with the horizontal control survey data also shown on the maps. This is to be expected since most property descriptions were written using field survey data obtained prior to the relocation of section and quarter-section corners and completion of the horizontal control network tied to the Wisconsin State Plane Coordinate System, and some property descriptions were written without benefit of any field survey data other than that provided by the original government survey. Further, the required survey accuracy for property boundary descriptions for land subdivisions, as defined in Chapter 236 of the Wisconsin Statutes and generally adhered to in other property boundary surveys, is 1 part in 3,000, as compared with the Third-Order, Class I accuracy of 1 part in 10,000 for the horizontal control surveys.

For these and other reasons, overlapping or separated property boundary descriptions may be expected to exist. The property boundary line maps should record all dimensions as contained in the official records of the County Register of Deeds, and wherever an overlap or gap of 2.5 feet or more exists, such overlap or gap should be shown as a mapped line. Overlaps or gaps of less than 2.5 feet will be evident only from an examination of the recorded property line dimensions.

For areas covered by recorded subdivision plats and certified survey maps, the following map annotation is to be provided:

1. Subdivision name or certified survey map number.
2. Block and lot numbers.
3. Street names.
4. Street, alley, and other public way right-of-way widths to the highest degree of accuracy permitted by the data source.

5. Recorded lot dimensions to the highest degree of accuracy permitted by the data source.
6. Easement right-of-way widths to the highest degree of accuracy permitted by the data source together with the purpose of the easement.
7. Parcel identification numbers.

For all properties other than those contained in a recorded subdivision plat or certified survey map, the following map annotation is to be provided:

1. Street names.
2. Street, alley, and other public way right-of-way widths to the highest degree of accuracy permitted by the data source.
3. Recorded property dimensions to the highest degree of accuracy permitted by the data source.
4. Easement right-of-way widths to the highest degree of accuracy permitted by the data source together with the purpose of the easement.
5. Parcel identification numbers.

Once the cadastral maps are completed, they are ready for digitization. All line features are digitized directly from the cadastral maps. Textual information, including the parcel identification number, is key entered from the cadastral maps and placed in its approximate location on the digital maps.

With respect to those cadastral maps already prepared by Ozaukee County, the City of Cedarburg, and the Village of Grafton, such maps need to be reviewed to determine the extent to which the maps do not meet the above specifications. Such review should determine the effort needed to enhance the existing cadastral mapping to meet such specifications.

Parcel Identification Numbers

The parcel identification number provides the link between the cadastral maps, which show the location of a particular parcel, and the records, either computer-readable or traditional paper records, that contain information about the parcel. The parcel identification scheme

utilized in Ozaukee County was described in Chapter III. That scheme has been selected by the Ozaukee County Land Information Committee as the standard parcel identification scheme for at least the next five-year period. In selecting the current scheme, the Committee rejected the immediate conversion to the uniform parcel identification numbering scheme proposed by the Wisconsin Land Information Board. The Committee agreed, however, that Ozaukee County would undertake the provision of an algorithm that would enable the conversion by computer of the Ozaukee County parcel identification scheme to the state-recommended parcel identification scheme.

Property Ownership and Assessment Records

The property ownership and property tax assessment records maintained by Ozaukee County already exist as computer-readable files. These files contain such information as an abbreviated legal description, owner's name and mailing address, acreage of the property if available, and assessed value of the land and any improvements to that land. These records can be readily integrated into an automated mapping and land information system in Ozaukee County utilizing a parcel identification numbering scheme which is common to both the maps and the records. The only operational step required for this integration is the establishment of proper programming access from the digital map files to the existing computer files of ownership and assessment records for the purpose of "reading" them.

Soil Unit Maps

Digital soil unit maps already exist for all of Ozaukee County through the efforts of the Southeastern Wisconsin Regional Planning Commission. A detailed operational soil survey for all of southeastern Wisconsin was conducted by the U. S. Soil Conservation Service in 1963 under contract to the Regional Planning Commission. The soil survey conducted in southeastern Wisconsin departed from the standard soil survey conducted in other areas of the State and United States in one important respect—namely, the type of aerial photography used as a base map for the field operation. The work specifications prepared by the Commission required that the boundaries of all soil mapping units be identified on prints of then current (1963) Commission aerial photographs. These photographs consisted of ratioed and rectified enlargements at a scale of one inch equals 1,320 feet

of Commission one inch equals 6,000 feet scale high-altitude photographic negatives. Each field sheet base map covered six U. S. Public Land Survey sections. The specifications also required that the Commission be furnished with reproducible half-tone positives of the field sheets on dimensionally stable base material at a scale of one inch equals 2,000 feet. The reproducible positives were to be suitable for the preparation of clear blue-line or black-line prints by diazo process, and were to show clearly the soil mapping units with delineations and identifying symbols so that the prints could be used in conjunction with a published Commission report on the soils of southeastern Wisconsin. The specifications further required that finished photo maps be prepared to accompany the published soil surveys at a scale of one inch equals 1,320 feet, also using the negatives of current photography provided by the Commission. Key planimetric features, such as major highways, railroads, streams, and lakes, were to be identified on the finished photo maps, as were all U. S. Public Land Survey township, range, and section lines.

These base mapping specifications for the soils mapping program in southeastern Wisconsin were unique in that the normal U. S. Soil Conservation Service practice up to that time had been to prepare controlled photomosaics for the soil mapping. The revised base mapping procedure required by the Commission, consisting of the preparation of ratioed and rectified enlargements to eliminate all distortion except that due to relief, provided instead "photo maps" on which distances and areas could subsequently be measured. Such distances and areas cannot be reliably measured on controlled photomosaics.

Soil mapping unit boundaries were digitized from the 1 inch equals 1,320 feet scale photo maps for use in the project, this scale photo print being more convenient for the digitizer operators to scale and interpret. Because the salient features of the U. S. Public Land Survey System had been previously marked on these photos, they were readily scaled for digitization using the previously computed State Plane Coordinates for the section and quarter-section corners. Because the digital soil unit maps prepared by the Regional Planning Commission utilized the same geometric reference framework as that proposed for Ozaukee County, they are already

"integrated" with the other land information being specified for that system.

Land Use

Digital historic and current land use information for Ozaukee County already exists for the entire County, again through the efforts of the Southeastern Wisconsin Regional Planning Commission. The Commission's land use inventory, which utilizes 63 different major land use categories, also incorporates the statutorily defined wetlands originally identified by the Wisconsin Department of Natural Resources as part of a statewide inventory of these areas. The digital land use maps were originally digitized from interpreted one inch equals 400 feet scale ratioed and rectified prints of aerial photography flown for this purpose by the Commission in 1963. The ratioing and rectification of the photographs was controlled to the U. S. Public Land Survey System corners as those corners had been coordinated with the State Plane Coordinate System. The digitized land use maps were subsequently updated using aerial photography flown in 1970, 1975, 1980, and 1985. These maps are currently being updated to 1990 conditions by the Commission utilizing new aerial photography flown for this purpose during the spring of 1990. Because the digital land use maps prepared by the Regional Planning Commission—like the digital soil unit maps—utilized the same geometric reference framework as proposed for the Ozaukee County automated mapping and land information system, they—like the digital soil unit maps—are already "integrated" with the other land information in the system.

The aerial photo enlargements upon which the land uses were originally delineated had been ratioed and rectified to provide, in effect, "photo maps" upon which distances and areas could subsequently be accurately scaled and measured. Some distortion due to relief, however, still exists in aerial photographs after ratioing and rectification. Accordingly, the cadastral maps—when completed—should be used to adjust the land use maps as may be necessary. Where discrepancies are noted between right-of-way and land/water boundary lines on the land use and cadastral maps, they should be resolved in favor of the positions recorded on the cadastral map and adjoining land use lines adjusted accordingly. Such adjustments should all be relatively minor.

Zoning Districts

Zoning district boundaries commonly follow real property boundary lines. For this reason, digital zoning district map overlays should not be prepared until digital real property boundary line maps have been completed. The digital zoning district map overlays should then be prepared by "copying" appropriate line segments from the real property boundary line maps and digitizing any additional line segments needed.

Flood Hazard and Shoreland Areas

The digitization of surface waters and stream channels occurs as part of the digital base mapping process and in the conversion to digital format of existing topographic maps. Two additional water-related areas which have particular implications for planning and engineering, and for zoning administration, and which are related one to another—floodlands and shorelands—should also be digitized as part of the creation of a countywide automated mapping and land information system. As topographic maps are prepared, the limits of the 100-year recurrence interval floodplains can be delineated by the Regional Planning Commission on the large-scale topographic base maps based upon flood profiles prepared by the Commission as a part of its watershed planning programs. This information would then need to be digitally captured. Through the application of the statutory definition, the limits of shorelands in Ozaukee County on the large-scale topographic base maps should also be determined and digitally encoded.

Digital Graphic Data Exchange

In order to exchange digital map data between two or more physically separated automated mapping and land information systems, one of two conditions must exist. Either the systems must have compatible data structures for the storage of digital map data or an interchange mechanism between the two systems must be provided. It has been noted in this report that the existing automated mapping and land information systems in the Ozaukee area are of several different proprietary types; therefore, before digital map data can be shared, agreement must be reached between the various organizations concerning the manner in which digital map data may be exchanged.

Currently there is no uniform, widely accepted and used, mechanism for the exchange of digital

map data. Such a mechanism, if it did exist, would constitute an industrywide, or formal, standard. For the present time, it will be necessary to exchange digital map data through the use of informal digital map data exchange mechanisms. Informal exchange standards are simply those methods and formats for exchanges that can be agreed upon between two or more data compilers and/or users that want to exchange digital map data. Examples of some currently available mechanisms of the informal type are: Drawing Exchange Format (DXF); Initial Graphic Exchange Standard (IGES); Intergraph Standard File Format (ISFF); and Digital Line Graph 3 (DLG3). The specific informal exchange mechanism utilized between any two specific sites will be largely a function of the specific vendor software and hardware existing at the sites.

It should be noted that the majority of currently available digital map data exchange mechanisms are "batch-oriented," meaning that they are used to load entire files of digital map information. Therefore, to update digital map files involving a transfer of files between two different vendor sets of hardware and software, it is usually necessary to reload the entire affected file rather than to load only the revisions. "Transaction-oriented" file update capability, or the ability to load only the revisions to a file, is a less well-developed capability and may be relatively easy or relatively difficult between different vendor sets of hardware and software, depending upon the similarity or dissimilarity of the internal architecture of the involved systems. As a practical matter, transaction-oriented capability may be available only through custom computer programming, or through the acquisition of the same hardware and software by the different operators involved.

In this regard, it should also be noted that the use of many of the currently available mechanisms for digital map data exchange may be expected to pose some problems for operations using IBM mainframe computers to operate automated mapping systems. IBM mainframe systems utilize digital map data storage models that differ from the models used by most other vendors, and translation between IBM models and non-IBM models is not a trivial programming task. This issue has not been addressed in the commercial market to the extent that digital graphic data exchange

between other systems has been. The efficient and effective exchange of digital map data between IBM and non-IBM sites, therefore, may well require custom programming.

Finally, it should be noted that the foregoing is intended to apply to map feature elements rather than to data that may relate to map features. The National Research Council model, proposed as the model to guide the creation of the recommended automated mapping system for Ozaukee County, utilizes the parcel identifier as a "key" to link location, or geometry, of features on maps to nongeometric information about the feature. The transfer of files of nongeometric, or attribute, data can be accomplished using existing procedures for the transfer of character data between different computer systems.

COST ESTIMATES TO CREATE THE RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM BASE FOR OZAUKEE COUNTY

While recognizing that the fiscal resources available for land records modernization will be limited, and that the development of the recommended automated mapping base for Ozaukee County will require a period of time longer than the five-year planning period selected for this report, the Ozaukee County Land Information Office desired that cost estimates attendant to the creation of the entire base be included in the plan document. In this way, all parties concerned will have a good understanding of the capital investment required to complete an automated mapping base that is suitable for a multi-user environment of the most demanding kind. Accordingly, Table 3 summarizes the cost of completing the recommended automated mapping base for Ozaukee County, taking into account the geodetic reference framework, base mapping, and cadastral mapping work completed to date in the County as reported in Chapter III. These costs do not, however, include such commonly desired overlays as zoning or school or election district boundaries.

The estimated cost of completing the entire automated mapping base in Ozaukee County is \$2.18 million. Of this total, about \$0.82 million, or 38 percent, is required to complete the geodetic reference framework, including the recovery, or relocation, and monumentation of public land survey corners and the establishment of State

Plane Coordinates and vertical elevations for those corners; about \$0.87 million, or an additional 40 percent, is required to prepare in digital form one inch equals 200 feet scale topographic base maps for about 181 square miles within the County that have not yet been so mapped, and to convert the existing topographic base mapping, which approximates 53 square miles, to digital form; and the remaining \$0.49 million, or 22 percent, is required to enhance the existing digital cadastral maps covering about 21 square miles to meet the recommended standards and to compile new digital cadastral maps for about 213 square miles.

POTENTIAL SOURCES OF REVENUE TO SUPPORT PROGRAM

There appear to be five potential sources of revenue that could be used to support the work efforts needed to build the recommended automated mapping and land information system base for Ozaukee County. These five sources are:

1. Register of Deeds Filing
and Recording Fees

By the end of the five-year planning period in 1996, it is estimated that a total of \$307,700, or \$61,500 annually, will become available to Ozaukee County from the state-mandated supplemental Register of Deeds recording and filing fees (see Table 4). This includes the fees that have been accumulated through January 1, 1992, by Ozaukee County which total nearly \$65,000, plus estimated receipts for the years 1992 through 1996. The estimates assume that the average number of recordings and filings that occurred over the period 1984 through 1991 will continue over the next five years. The total number of recordings is estimated at 13,500 annually.

The number of annual recordings subject to document filing fees may be expected to vary with changes in the national and local economies, interest rates, tax legislation, and in urban and rural land market activity. Experience in southeastern Wisconsin indicates that fluctuations of about 10 percent more or less than the average may be expected. Accordingly, the annual revenue available from this source may be expected to vary and the amount of program work that can be supported by such

Table 3

**SUMMARY OF COSTS TO COMPLETE RECOMMENDED AUTOMATED
MAPPING AND LAND INFORMATION SYSTEM BASE FOR OZAUKEE COUNTY**

Program Element	Description of Work Needed to be Completed	Average Unit Cost of Work	Total Cost to Complete Work
Geodetic Reference Framework	Recover and monument 368 U. S. Public Land Survey corners	\$400 per corner	\$ 147,200
	Monument 146 U. S. Public Land Survey corners previously recovered	\$200 per corner	29,200
	Establish State Plane Coordinates for 625 U. S. Public Land Survey corners	\$650 per corner	406,250
	Establish vertical elevations for 681 U. S. Public Land Survey corners	\$350 per corner	238,350
	Subtotal	- -	\$ 821,000
Large-Scale Base Maps	Prepare digital 1" = 200' scale topographic base maps for 181 square miles	\$4,100 per square mile ^a	\$ 742,100
	Convert planimetric features of existing 1" = 200' scale topographic base maps to digital form for 53 square miles	\$500 per square mile	26,500
	Convert hypsometry of existing 1" = 200' scale topographic base maps to digital form for 53 square miles	\$2,000 per square mile	106,000
	Subtotal	- -	\$ 874,600
Cadastral Maps	Enhance existing digital cadastral maps to meet specifications for 21 square miles containing 8,300 parcels	\$12.50 per parcel	\$ 103,750
	Compile digital cadastral maps for 213 square miles containing 21,900 parcels	\$17.50 per parcel	383,250
	Subtotal	- -	\$ 487,000
- -	Total	- -	\$2,182,600

^aRepresents the average cost of mapping both urban and rural areas. The average cost for preparing digital base maps at a scale of 1" = 100 feet is \$10,500 per square mile.

Source: SEWRPC.

revenue may also be expected to vary from year to year.

**2. State Grants from Wisconsin
Land Information Board**

Upon approval of the Ozaukee County land information system plan, Ozaukee County will be eligible to apply for state grants of up to \$100,000 to support work program activities consistent with the plan. The state grant program has recently been activated and as presently structured provides two opportunities annually for eligible county and local governments to submit

applications. As more and more county and local governments in the State become eligible for such monies, the state grant competition is expected to become intense.

The Wisconsin Land Information Board has established a grant application review process that includes an evaluation and ranking of all applications submitted. The ranking is based upon a point scoring system. Points are assigned based upon criteria that relate to categories of integration and cooperation as measured by the number of governmental units and agen-

Table 4

**ANTICIPATED REVENUE FROM RETAINED
REGISTER OF DEEDS RECORDING AND FILING
FEES IN OZAUKEE COUNTY: 1992-1996**

Year	Amount
Accumulated Fund Balance:	
January 1, 1992	\$ 64,656
Estimated Receipts: 1992	54,000
Estimated Receipts: 1993	54,000
Estimated Receipts: 1994	54,000
Estimated Receipts: 1995	54,000
Estimated Receipts: 1996	27,000
Total	\$307,656
Average Annual Revenue: 1992-1996	\$ 61,530

NOTE: The estimated receipts assume an average annual rate of 13,500 document filings over the period 1992-1996. This rate approximates the average annual number of filings over the period 1984-1991.

Source: SEWRPC.

cies involved; the focus of the project on completing a foundational element of the plan; the consistency of the project with the adopted county land information system plan; the likelihood of project success as measured by the local funding commitment to the project, as well as by the performance of the applicant in completing projects; and the extent to which the project results in tangible completed end products. While Ozaukee County is expected to become eligible to compete for such state grants, the work program should be structured in such a way as not to be dependent upon grant monies.

3. Contributions by Local Governments and Utilities

A third potential source of revenue to support the recommended Ozaukee County work program consists of contributions by local governments in the County and by public and private utilities operating in the County. Depending upon the intensity with which a local government wishes to secure an operational automated mapping base for local planning, engineering, and other municipal purposes, that local government

may be willing to commit local monies toward that end. For example, the City of Mequon has indicated an interest in developing an automated mapping base and may be willing to provide local monies that could be combined with other monies in completing the required work in that City.

4. County Tax Levy

At the present time, County tax levy monies expended through the Ozaukee County highway maintenance budget are being used to fund a County program to recover, or relocate, and monument U. S. Public Land Survey corners. The Ozaukee County Surveyor is responsible for this annual work program. Over the past several years, Ozaukee County has budgeted about \$25,000 annually for support of the monumentation program. Of this total, about 90 percent, or \$22,500 annually, has been spent on development work, that is, the recovery or relocation of U. S. Public Land Survey monuments. The remaining 10 percent, or about \$2,500 annually, has been spent on carrying out the other duties of the County Surveyor, primarily record keeping. There is no formal, systematic maintenance program attendant to the system of recovered or relocated monuments. Accordingly, in past years, some of the money intended for development of the system, perhaps 10 percent, has been diverted to maintenance work when such work is called to the attention of the County Surveyor. At the present level of expenditure, then, about \$20,000 annually may be considered available to support further development of the geodetic reference framework element of the recommended automated mapping base for Ozaukee County, with the remaining \$5,000 required for the office duties of the County Surveyor and for occasional maintenance work.

5. Mapping Grants from the Wisconsin Coastal Management Program

Although it should not be viewed as a large or sustaining source of revenue, coastal management funds are occasionally available to support large-scale mapping work along the Lake Michigan coastline. Such funds are made available

in Wisconsin through a program operated by the Wisconsin Coastal Management Council. That Council is staffed by the Wisconsin Department of Administration. Over the years, Kenosha, Racine, and Milwaukee Counties have been able to secure coastal management matching monies for large-scale topographic mapping programs along the Lake Michigan shoreline. In addition, in 1991 a federal coastal management grant was secured by the Regional Planning Commission to map a one-square-mile area of the City of Port Washington, including the development of the required geodetic framework. Ozaukee County and the City of Port Washington provided local matching funds.

PROPOSED OZAUKEE COUNTY WORK PROGRAM: 1992-1996

The work program outlined below for the five-year period 1992 through 1996 is premised upon the following basic assumptions:

1. That there will not be sufficient revenue from all potential sources during the planning period to enable Ozaukee County to complete the recommended automated mapping base by the end of 1996.
2. That it is most desirable to focus available resources and complete the automated mapping base for a subarea of the County, rather than dispersing available revenue in small, scattered locations throughout the County or toward developing only one element of the automated mapping base.
3. That in terms of targeting available revenue in a geographic sense, it is most desirable to complete the automated mapping base in the County moving from south to north, owing to the pattern of urban development within the greater Milwaukee area and Ozaukee County.
4. That in addition to committing the retained Register of Deeds filing and recording fees to work efforts that would complete the recommended automated mapping base, Ozaukee County and the local units of government in the County will be willing to commit some tax levy monies toward that end.
5. That Ozaukee County will seek all available federal and state aids in support of the proposed automated mapping base work program, but that the program will not be structured in such a way as to be dependent upon receiving such aids. Rather, if any federal or state aids are made available to Ozaukee County for this purpose, such monies would be used in furtherance of the objectives of the plan, thus permitting additional automated base mapping work to be completed during the five-year planning period.

Proposed Automated Base Mapping Program

It is proposed that during the five-year period 1992 through 1996, Ozaukee County sponsor a program to complete an automated base map for the entirety of U. S. Public Land Survey Township 9 North, Ranges 21 and 22 East. This geographic area encompasses the City of Mequon, the Village of Thiensville, and the small portion of the Village of Bayside lying in Ozaukee County. The probable costs and proposed revenues associated with this work effort are set forth in Table 5.

The total cost of completing the automated mapping base for this area, which comprises about 21 percent of the area of Ozaukee County, is estimated at nearly \$790,000. This represents an average annual cost over the planning period of about \$158,000. The costs include about \$2,560 annually to complete the land survey work; about \$24,000 annually to complete the horizontal and vertical control survey work; about \$100,800 annually to complete the large-scale base mapping work, recommended mapping to be secured at a scale of one inch equals 100 feet under an assumption that the City of Mequon desires to obtain such larger scale mapping; and about \$30,600 annually to complete the digital cadastral maps.

It is recommended that the program be funded through a combination of county and local monies. More specifically, the following funding arrangements are proposed:

1. All the land survey work entailed, involving the recovery and monumentation of 24 corners and the monumentation of 16 additional corners, at a cost of about \$12,800, or \$2,560 annually, would be paid for under the normal County Surveyor

Table 5

**COSTS AND REVENUES ASSOCIATED WITH PROPOSED OZAUKEE
COUNTY AUTOMATED BASE MAPPING PROGRAM: 1992-1996**

Program Element	Proposed Program Expenditures: 1992-1996			Proposed Program Revenues: 1992-1996		
	Work Item	Total	Average Annual	Source	Total	Average Annual
Geodetic Reference Framework: Land Survey	Recover and monument 24 corners	\$ 9,600	\$ 1,920	County Surveyor	\$ 12,800	\$ 2,560
	Monument 16 corners	3,200	640			
	Subtotal	\$ 12,800	\$ 2,560	Subtotal	\$ 12,800	\$ 2,560
Geodetic Reference Framework: Control Survey	Establish State Plane Coordinates for 113 corners	\$ 73,450	\$ 14,690	County: retained filing fees	\$120,000	24,000
	Establish vertical elevations for 133 corners	46,550	9,310			
	Subtotal	\$120,000	\$ 24,000	Subtotal	\$120,000	\$ 24,000
Large-Scale Base Mapping (1" = 100')	Prepare digital topographic base maps for 48 square miles	\$504,000	\$100,800	City of Mequon	\$353,000	\$ 70,600
				Village of Thiensville	7,500	1,500
				County: retained filing fees	34,500	6,900
				County: matching tax levy	109,000	21,800
	Subtotal	\$504,000	\$100,800	Subtotal	\$504,000	\$100,800
Cadastral Mapping	Enhance existing digital cadastral maps for six square miles containing 1,139 parcels	\$ 14,240	\$ 2,850	County: retained filing fees	\$153,140	\$ 30,630
	Compile digital cadastral maps for 42 square miles containing 7,937 parcels	138,900	27,780			
	Subtotal	\$153,140	\$ 30,630	Subtotal	\$153,140	\$ 30,630
Entire Program	Land survey	\$ 12,800	\$ 2,560	County surveyor	\$ 12,800	\$ 2,560
	Control surveys	120,000	24,000	County: retained filing fees	307,640	61,530
	Large-scale base mapping	504,000	100,800	County: matching tax levy	109,000	21,800
	Cadastral mapping	153,140	30,630	City of Mequon	353,000	70,600
				Village of Thiensville	7,500	1,500
--	Total	\$789,940	\$157,990	Total	\$789,940	\$157,990

NOTE: Covers completion of automated base map for the entire Township 9 North, Ranges 21 and 22 East: City of Mequon, Village of Thiensville, and Village of Bayside.

Source: SEWRPC.

program and accomplished by the County Surveyor. Since that program is funded at about \$20,000 annually for such work, this aspect of the recommended base mapping program could be completed in the first year.

2. All the control survey work, including the establishment of State Plane Coordinates

for 113 corners and vertical elevations for 133 corners, with a cost of about \$120,000, or \$24,000 annually, would be paid for with the retained filing and recording fees. This work would be accomplished by a qualified control survey engineer retained directly by Ozaukee County or through the Regional Planning Commission, acting as agent for the County.

3. The cost of preparing the large-scale, one inch equals 100 feet, topographic mapping in digital form would be paid for in part by the City of Mequon and Village of Thiensville and in part by Ozaukee County. The Ozaukee County share was determined by estimating the cost of preparing one inch equals 200 feet scale maps for that portion of the project area not already so mapped. This would represent the cost to Ozaukee County of completing the topographic mapping if the City of Mequon and Village of Thiensville determined not to share costs of the proposed program and seek the larger scale one inch equals 100 feet scale base mapping. That cost was estimated at \$143,500, or about \$28,700 annually over the five-year period. It is proposed that the County fund this amount by using the available retained filing fees, about \$6,900 annually, and a new matching county tax levy in the amount of \$21,800 annually. The City of Mequon and Village of Thiensville would pay the remaining \$360,500. That cost would be divided between the City and the Village on the basis of area. This results in an average annual cost to the City of Mequon of \$70,600 over the five-year period and to the Village of Thiensville of \$1,500 annually over the same period. This work would be accomplished by a qualified photogrammetric engineer retained directly by Ozaukee County or through the Regional Planning Commission, acting as agent for the County.
4. All the cadastral mapping work, including the enhancement of the existing digital cadastral maps for six square miles and the compilation of new cadastral maps for 42 square miles, totaling about \$153,140, or \$30,630 annually, would be paid for by retained filing and recording fees.

The foregoing proposal is predicated upon the willingness of the City of Mequon, the Village of Thiensville, and the Ozaukee County Board of Supervisors to provide the monies in the manner noted above. In the event that agreement cannot be reached between the legislative bodies concerned to provide the required monies, then it is recommended that Ozaukee County proceed to use the available retained filing and recording

fees to prepare one inch equals 200 feet scale base maps in the subject program area. If it is assumed that the legislative bodies will provide no tax levy monies and that the only monies available will be the retained filing and recording fees in the amount of about \$307,700 over the five-year period, then it would be possible over a five-year period to complete one inch equals 200 feet scale topographic maps for the 35 square miles in the program area not already so mapped, and to begin the preparation of digital cadastral maps.

Additional Land Survey Work

Over the five-year planning period it is expected that the Ozaukee County Surveyor will have available for land survey work about \$20,000 annually, or a total of \$100,000. As noted above, about \$12,800 will be required to complete the land survey work in the proposed Mequon-Thiensville-Bayside project area. This would leave about \$87,200 available to program for additional land survey work north of the project area. It is recommended that the County Surveyor complete the required land survey work in Township 10 North, Range 21 East (Town of Cedarburg), and Township 10 North, Range 22 East (Town of Grafton), and then proceed north to accomplish additional required work in the Saukville and Port Washington town-ranges. It is expected that the monies available to the County Surveyor during the five-year period will enable the completion of about 50 percent of the land survey work remaining to be done in Ozaukee County north of the Mequon-Thiensville-Bayside project area.

Continued Preparation of Partial Cadastral Maps by Register of Deeds

It is recommended that the Ozaukee County Register of Deeds continue, over the next five years, to prepare cadastral maps as the resources of that office permit. Such work efforts should be focused north of the proposed mapping project area and, to the extent possible, should be confined to those U. S. Public Land Survey quarter sections in the County where the geodetic control framework is already in place. The continuation of this limited-purpose mapping program by Ozaukee County will contribute toward the ultimate development of the recommended automated mapping base to be undertaken in future planning periods.

Adjustment of Horizontal Control Survey Network

As reported in Chapter III, Ozaukee County and the City of Mequon, using global positioning system survey technology, established 66 control survey stations within the County in 1991. These stations were established to meet the standards for Order C1, the global positioning survey technique standard approximately equivalent to conventional technique First Order Class Surveys. State Plane Coordinates for each of these 66 stations were obtained as part of the survey on both NAD-27 and NAD-83/91.

Once these new stations were established, it became necessary to determine how to adjust the already existing horizontal control survey network in Ozaukee County to fit the new high order control stations. This matter was considered by the Technical Division of the Ozaukee County Land Information Office at a meeting held on March 9, 1992. At that meeting, the Division members considered three alternative courses of action: 1) adjust all previous horizontal control survey work attendant to U. S. Public Land Survey corners to fit the control data established for the 66 Ozaukee County stations; 2) adjust the positions of the 66 Ozaukee County stations to fit all U. S. Coast and Geodetic Survey stations within and adjacent to the County, combined with adjustment of some of the previous U. S. Public Land Survey station work to fit the revised Ozaukee County station positions; and 3) adjust the positions of the Ozaukee County stations so as to fit all previous work attendant to U. S. Public Land Survey corners. Order of magnitude of cost estimates were considered by the Technical Division members. Those cost estimates ranged from as much as \$450,000 for the first alternative, to \$50,000 for the second alternative, to nominal costs for the third alternative.

In considering these alternatives, the Technical Division members had to address the basic question as to the practical need for establishing control survey data on U. S. Public Land Survey section corners at a higher level of accuracy than Third Order, Class I. It was agreed by the Division members that such a higher order of accuracy was not justified either for day-to-day land and public works engineering survey work or for computer-based mapping work. Accordingly, the Division members did not believe it sound public policy to invest substantial

amounts of money in adjusting previously completed horizontal control survey work for U. S. Public Land Survey corners in the County to the higher order Ozaukee County stations. Rather, it was determined that it would be best to adjust the positions of those higher order stations in the manner reflected in the second alternative. This would mean that some of the coordinates attendant to U. S. Public Land Survey corners would have to be adjusted as the higher order control survey data is integrated into the network.

Given the proposal previously referenced to remap the Mequon-Thiensville area, it was noted that the old survey control work in that area could be revised as a part of that mapping effort. It was agreed that the necessary control survey adjustment work could be undertaken jointly by the Regional Planning Commission staff, the County Surveyor, and the engineering staff of the City of Mequon as work proceeds to implement the plan over the five-year period, and that any costs associated with the adjustment could be met as part of the normal work efforts of the agencies involved.

PROPOSED COLLATERAL STUDIES AND WORK EFFORTS

As work proceeds over the next five years to begin to develop the automated mapping base for Ozaukee County, additional activities must be undertaken to help direct the development and management of the overall system. Toward this end, the following specific work activities are recommended to be undertaken by Ozaukee County during the planning period:

1. Specifications and Standards for Digital Conversion

A technical study should be undertaken to develop and document specifications and standards for the conversion to digital format of the survey control network, the large-scale planimetric and topographic maps, and the real property boundary line maps. This study should be undertaken at the beginning of the planning period, since specifications need to be in place before resources are committed to digital conversion efforts. In part, this work effort involves defining the digital "layers" of information to be developed. As a first step in this work effort, Table 6 includes an

Table 6

**PROPOSED INITIAL SET OF DIGITAL LAYERS OF INFORMATION
UNDER THE OZAUKEE COUNTY LAND INFORMATION SYSTEM PLAN**

Multipurpose Cadastre Element	Information Category	Digital Information Layer
Geodetic Reference Framework	Map projection system	<ul style="list-style-type: none"> • Wisconsin State Plane Coordinate System, South Zone, North American Datum of 1927, 1,000 feet interval grid intersections and corresponding state plane coordinate values^a
	U. S. Public Land Survey System	<ul style="list-style-type: none"> • U. S. Public Land Survey corners and monument symbols and state plane coordinates • U. S. Public Land Survey section and quarter-section lines and grid lengths and grid bearings
Large-Scale Base Maps	Natural features	<ul style="list-style-type: none"> • Lakes, ponds, streams, watercourses, and drainage ditches symbolized as open water and associated lettering • Streams, watercourses, and drainage ditches not symbolized as open water and associated lettering • Marshes and associated lettering • Wooded areas and their associated lettering • Accentuated contour lines and elevations • Other contour lines • Accentuated depression contour lines and elevations • Other depression contour lines • Spot elevations and associated lettering • Water surface elevations and associated lettering • U. S. Public Land Survey corner elevations
	Cultural features	<ul style="list-style-type: none"> • Pavements and curbs and their associated lettering • Unimproved roads and their associated lettering • Driveways and their associated lettering • Trails and their associated lettering • Power line towers and fences and their associated lettering • Railways and their associated lettering • Buildings, building foundations, and ruins and their associated lettering • Dams, piers, dock walls, and similar water-related structures and their associated lettering • Culverts and culvert headwalls and their associated lettering • Bridge decks and their associated lettering • Bridge wing walls, retaining walls, and similar transportation-related structures and their associated lettering • Runways, taxiways, and similar aviation-related features and their associated lettering • All other identifiable planimetric features not separately enumerated above and their associated lettering
Overlays	Cadastral boundary	<ul style="list-style-type: none"> • Right-of-way lines and their associated lettering • Public easement lines and their associated lettering • Land subdivision boundaries and their associated lettering • Certified survey map boundaries and their associated lettering • Real property parcel lines • Real property parcel dimensions • Real property parcel polygons

Table 6 (continued)

Multipurpose Cadastre Element	Information Category	Digital Information Layer
Overlays (continued)	Cultural area boundary	<ul style="list-style-type: none"> • Civil division boundary lines and their associated text • Land use polygons • Zoning district polygons • Shoreland district polygons
	Natural area boundary	<ul style="list-style-type: none"> • Floodplain polygons • Soil mapping unit polygons
Identifiers	Parcel numbers	<ul style="list-style-type: none"> • Ozaukee County real property parcel identification numbers
	Area identifiers	<ul style="list-style-type: none"> • SEWRPC land use codes • Local jurisdiction zoning district identifiers • SCS soil mapping unit identifiers
Land Information Files	Cadastral parcel records	<ul style="list-style-type: none"> • Real property ownership records • Real property assessment records • Real property tax records • Permits
	Cultural Data	<ul style="list-style-type: none"> • Civil division areas • Land use areas • Zoning district areas
	Natural resource data	<ul style="list-style-type: none"> • SCS soil suitability and characteristic records

^aAssumes standard one inch equals 200 feet scale mapping; for one inch equals 100 feet scale mapping, the grid interval would be 500 feet.

Source: SEWRPC.

initial set of such digital "layers." This initial set should be reviewed and revised as may be necessary. Coordination with a similar work effort in Milwaukee County is recommended. It is recommended that this work effort be undertaken by the Data Interchange Division of the Ozaukee County Land Information Office and be under the direction of the County Data Processing Manager. No new costs to the County should be entailed in this effort, which can be completed by existing county staff with the assistance of the Regional Planning Commission staff.

2. Parcel Identification Numbers

During the planning period, Ozaukee County should undertake a work effort to develop an algorithm to enable the conver-

sion by computer of the current Ozaukee County parcel numbering system to the parcel identification numbering system to the parcel identification numbering system promulgated by the Wisconsin Land Information Board. It is recommended that this work effort be undertaken by the County Land Information Office under the direction of the County Data Processing Manager. No new costs to the County should be entailed in this effort which can be completed by existing County staff.

3. Data Custody, Control, and Maintenance

During the planning period, it is recommended that Ozaukee County also conduct a cooperative study with the local units of government in the County relating to issues involving the custody, control, and

maintenance of land records information, including issues attendant to the security of the system and to public access. Agreement should be reached in such a study on the best way in which to maintain the cadastral maps throughout the County. Consideration should also be given in the study to the costs associated with maintaining the digital land information base once that base is completed. This would include the maintenance efforts associated with the U. S. Public Land Survey system, topographic mapping, and cadastral mapping. The study should ascertain any needs concerning the security of the land information system. The study should propose recommendations on all these interrelated matters and, as necessary, include a recommended system maintenance budget for consideration by the Ozaukee County Board of Supervisors. It is recommended that this work effort be undertaken by the Ozaukee County Land Information Office and be under the direction of the County Register of Deeds. No new costs to the County should be entailed in this effort which can be completed by the existing county staff.

4. State Grant Applications

It may be expected that both Ozaukee County as a unit of government and perhaps one or more local units of government in Ozaukee County will, over the five-year period, seek state grants in support of the development of the recommended automated mapping and land information system. It is recommended that any such grant applications, before being submitted to the Wisconsin Land Information Board, first be found to be consistent with the program objectives and standards set forth in this document. It is recommended that, upon such a finding, Ozaukee County submit to the Wisconsin Land Information Board any application by a local unit of government in the County with a recommendation for approval. It is further recommended that the Ozaukee County Board of Supervisors formally delegate to the Ozaukee County Land Information Committee, working with the Ozaukee County Land Information Office, all

responsibilities connected with the review and filing of county and local applications for state grants.

PROPOSED ORGANIZATIONAL ARRANGEMENTS

Institutional Structure to Conduct Program

The following institutional structure is recommended to carry out the aforescribed work program during the period 1992 through 1996:

1. It is recommended that all activities related to the development of the proposed Ozaukee County automated mapping base be under the policy direction of the Ozaukee County Land Information Committee, which was designated by the Ozaukee County Board of Supervisors as having policy responsibility for land information matters. It is further recommended that the Ozaukee County Land Information Office, with the Register of Deeds serving as the Office Coordinator and County Land Information Officer, work with the Land Information Committee in carrying out the recommended work program. The County Land Information Committee, working through the Land Information Office in the manner described above, should oversee the conduct of the proposed large-scale mapping program in the southern portion of the County, as well as those special work efforts attendant to the determination of specifications and standards for digital conversion, to ensure that the parcel identification numbering system in the County can be converted by machine processing to the uniform state numbering system proposed by the Wisconsin Land Information Board, and to address issues of data custody, control, and maintenance.
2. It is recommended that the Ozaukee County Land Information Officer serve as agent for Ozaukee County in the preparation and submittal of grant applications by Ozaukee County that seek state grants from the Wisconsin Land Information Board. It is further recommended that the Land Information Committee, working with the Land Information Office, serve as

the body for reviewing any applications submitted by a local unit of government in Ozaukee County for state funds in support of land information system development work. If the Land Information Committee finds that an application by a local unit of government is consistent with the plan objectives and standards set forth in this document, it should forward the application to the Wisconsin Land Information Board with a favorable recommendation for approval. If the Committee cannot make such a finding, then it should return the application to the local unit of government, together with a statement of the reasons why the application is inconsistent with the objectives and standards set forth in this plan and giving any suggestions the Committee might have to modify the application to make it consistent with the plan.

Public Access to Records

The information that comprises the Ozaukee County Land Information System base—including monumentation and survey control data, potential planimetric and topographic base mapping data, cadastral mapping data, and parcel identification data—may constitute public information under the Wisconsin Open Records Law. Consequently, Ozaukee County will have to make such data available to both public and private interests upon request. In adopting this plan document, Ozaukee County recognizes the County Land Information Officer as the official custodian of all data attendant to the County Land Information System base. All requests for data from that base should be submitted to the Land Information Officer on such forms and in such manner as may be prescribed. All reasonable costs associated with fulfilling such requests shall be paid for by the requesting party.

As Ozaukee County in future years completes the automated mapping base described in this plan, it may be expected that additional data sets, or "flat files," will be added to that base. Some of those data sets may consist of data that under Wisconsin law is to be kept confidential in order to protect individual rights of privacy. As such information is developed over the years, Ozaukee County should explicitly address considerations of public access to these additional sets of information.

Administrative Considerations

The guidelines promulgated by the Wisconsin Land Information Board call for the explicit response of Ozaukee County to certain administrative standards and requirements. The following explicitly addresses those guidelines:

1. Relationship to Wisconsin Land Information Program

By adopting the Ozaukee County Land Information System Plan set forth in this document, Ozaukee County agrees to observe and follow the Wisconsin Statutes regarding to the Wisconsin Land Information Program.

2. Access to Books, Records, and Projects

By adopting the Ozaukee County Land Information System Plan set forth in this document, Ozaukee County agrees to permit the Wisconsin Land Information Board, upon reasonable notice, access to books, records, and project materials for inspection and audit purposes.

3. Annual Report

By adopting the Ozaukee County Land Information System Plan set forth in this document, Ozaukee County agrees to prepare an annual report on the status of plan implementation and submit that report to the Wisconsin Land Information Board.

4. Plan Update and Revision

By adopting the Ozaukee County Land Information System Plan set forth in this document, Ozaukee County agrees to revise, update, and extend the Ozaukee County plan, such updating work to be undertaken during calendar year 1996.

SUMMARY

This chapter sets forth a recommended automated mapping and land information system plan for Ozaukee County. The following summarizes the salient elements of that plan:

1. It is the goal of Ozaukee County to implement over time a multipurpose, multi-user automated mapping and land information system, such system to follow the National Research Council model. The system would have five basic elements including a geodetic reference framework; large-scale

planimetric and topographic base maps; overlays, including cadastral boundaries and boundaries of various cultural and natural areas; identifiers, including parcel numbers and codes associated with various cultural and natural areas; and non-spatial land information files, including cadastral parcel records and various cultural and natural resource data. It is also the goal of Ozaukee County to assist in the modernization of the land records system by establishing a parcel identification system consistent with that recommended by the Wisconsin Land Information Board.

2. The planning period for the initial land information system plan for Ozaukee County is the five-year period beginning January 1, 1992, and extending through December 31, 1996. It is intended that as much work as possible in completing the recommended automated mapping base for Ozaukee County be completed by the end of that planning period, recognizing, however, that fiscal constraints will preclude the full establishment of the recommended automated mapping base by the end of that period.
3. The recommended standards for the automated mapping and land information system for Ozaukee County are based upon the standards for the development of survey control networks and local large-scale mapping programs promulgated by the Southeastern Wisconsin Regional Planning Commission. The standards have been used for many years throughout Southeastern Wisconsin, including Ozaukee County, and have proven to be both conceptually and procedurally sound. The standards include the use of the State Plane Coordinate System, North American Datum of 1927 (NAD-27), as the map projection system for the Ozaukee County automated mapping and land information system; the recovery, or relocation, and monumentation of U. S. Public Land Survey corners, including section and quarter section and center of section corners; the establishment through high order control surveys of coordinates for such corners based upon the Wisconsin Coordinate System, South Zone, (NAD-27); the establishment through high order control surveys of elevations of all such corners based upon National Geodetic Vertical Datum, 1929 adjustment (NGVD-29); the preparation to National Map Accuracy Standards of large-scale planimetric and topographic base maps; the preparation of companion large-scale cadastral maps identifying real property boundary lines and related information; and parcel identification numbers.
4. The total cost of completing the entire recommended automated mapping base for Ozaukee County is estimated at \$2.18 million. Of this total, about \$0.82 million, or about 38 percent, is required to complete the geodetic reference framework, including the recovery, or relocation, and monumentation of public land survey corners and the establishment of State Plane Coordinates and vertical elevations for such corners; about \$0.87 million, or an additional 40 percent, is required to prepare large-scale topographic base maps to complete the entire County; and the remaining \$0.49 million, or 22 percent, is required to compile cadastral maps for the County and convert those maps to digital form, as well as to enhance existing digital cadastral maps in the County to meet the recommended specifications.
5. Five potential sources of revenue were identified to support the recommended work program. These include the supplemental Register of Deeds recording and filing fees mandated under the Wisconsin Land Information Program, potential State grants from the Wisconsin Land Information Board, contributions by local governments and utilities, County tax levy monies, and mapping grants from the Wisconsin Coastal Management Program. The Ozaukee County-retained Register of Deeds filing and recording fees are anticipated to total about \$307,700 over the five-year planning period, or about \$61,500 annually. State land information program grants of up to \$100,000 can be sought twice annually under present rules. At the present time, no local government or public or private utility in the County has come forth with a firm commitment to provide additional funds to support the program. Also at the present time, county tax levy monies in the amount of about

\$20,000 annually are being made available through the County Highway Department budget to the County Surveyor to recover, or relocate, and monument the U. S. Public Land Survey corners in the County.

6. The County Land Information Committee and Land Information Office have recommended that Ozaukee County focus available resources over the five-year period 1992 through 1996 on completing the recommended automated mapping base for the entirety of Township 9 North, Ranges 21 and 22 East. This geographic area encompasses the City of Mequon, the Village of Thiensville, and the small portion of the Village of Bayside lying in Ozaukee County. This work effort, which is predicated upon the fiscal support of the City of Mequon and the Village of Thiensville and which assumes that these communities desire the larger one inch equals 100 foot scale base mapping, would complete the automated mapping base for about 21 percent of the area of the County. The total cost of this project over the five-year period is estimated at \$790,000. Of this total, about \$12,800 is required to complete the land survey work in the project area. It is proposed that this work be completed in the first year under the normal County Surveyor work program. An additional \$120,000, or about \$24,000 annually, would be required to complete the recommended control survey work. It is proposed that this work be funded entirely with the retained filing and recording fees. In addition, about \$153,140, or \$30,630 annually, would be required to prepare new cadastral maps in the project area and to enhance existing digital cadastral maps in that area. It is also proposed that this portion of the work effort be paid for by the retained filing and recording fees. The remaining cost of about \$504,000, or about \$100,800 annually over the five-year period, is required to prepare large-scale, one inch equals 100 feet, topographic mapping in digital form. It is proposed that Ozaukee County share in this cost to the extent of the cost of preparing one inch equals 200 foot scale mapping for that portion of the project area not already so mapped. The County's share in this respect would be \$143,500, or about \$28,700 annu-

ally. It is proposed that the County fund this amount by using the remaining \$6,900 annually in retained filing fees and provide matching county monies in the amount of \$21,800 annually. The City of Mequon and Village of Thiensville would be obligated to pay the remaining \$360,500. Dividing that cost on the basis of area, this would result in an average annual cost to the City of Mequon of about \$70,600 over the five-year period and to the Village of Thiensville about \$1,500 annually over the five-year period. If intergovernmental agreement cannot be reached on the foregoing work program, it is proposed that Ozaukee County proceed to use the retained filing and recording fees over the five-year period to complete one inch equals 200 foot scale topographic maps within the project area. The control survey, topographic mapping, and cadastral mapping work would be accomplished by qualified surveyors and engineers either retained directly by Ozaukee County or through the Regional Planning Commission acting as agent for the County.

7. In addition to the work that would complete the automated mapping base for the Mequon-Thiensville-Bayside project area, it is proposed that the Ozaukee County Surveyor focus all remaining available resources, totaling about \$87,200 over the five-year period, toward completing the required land survey work in the County. Work efforts are recommended to begin in the Cedarburg-Grafton areas and proceed north. It is expected that the County Surveyor will be able to complete about 50 percent of the remaining land survey work in the County north of the Mequon-Thiensville-Bayside mapping project area during the five-year period. It is also recommended that the County Register of Deeds continue over the next five years to prepare partial cadastral maps, focusing available resources on that portion of the County north of the proposed Mequon-Thiensville-Bayside project area and in those U. S. Public Land Survey quarter sections where the geodetic control framework is already in place.
8. The Land Information Committee and Land Information Office also recom-

mended that three related work activities essential to the modernization of land records in the County be undertaken over the next five years. These activities consist of a special technical study to agree upon specifications and standards for the conversion to digital format of the survey control network, of the large-scale topographic base maps, and of the real property boundary line maps; the conduct of a work effort to develop an algorithm to enable the machine conversion of the existing Ozaukee County parcel identification system to the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board; and the conduct of a study of issues pertaining to the custody, control, and maintenance of the Ozaukee County land records information base.

9. Upon approval of the Ozaukee County land information system plan by the Ozaukee County Board of Supervisors and by the Wisconsin Land Information Board, local units of government in Ozaukee County would be eligible to seek state grants from that Board. It is recommended that any locally sponsored land information project seeking such state funds meet

the system standards identified in this chapter. In that way all projects will contribute toward achieving the overall objectives underlying the Ozaukee County plan. All local applications for state grants should be reviewed by the County Land Information Committee, working with the Land Information Office. Upon a finding by that Committee that an application is consistent with the Ozaukee County plan, the application should be forwarded to the Wisconsin Land Information Board with a favorable recommendation for approval.

10. In order to meet the administrative standards and requirements promulgated by the Wisconsin Land Information Board, Ozaukee County by adopting this document agrees to observe and follow the Wisconsin Statutes regarding the Wisconsin Land Information Program; to permit the Wisconsin Land Information Board access to books, records, and project materials for inspection and audit purposes; to prepare and submit to the Wisconsin Land Information Board an annual report on the status of plan implementation; and to revise, update, and extend the Ozaukee County plan by the end of calendar year 1996.

Chapter V

SUMMARY AND CONCLUSIONS

INTRODUCTION

On June 6, 1991, the Ozaukee County Board of Supervisors requested the Southeastern Wisconsin Regional Planning Commission to assist the County in the preparation of a plan for land records modernization, focusing on the development of an automated mapping and parcel-based land information system. That request was preceded by the creation, on February 7, 1990, by the County Board, of a Land Information Office. The Board appointed the County Register of Deeds as the County Land Information Officer. The policy-making body for the Land Information Office is the Ozaukee County Land Information Committee, comprised of five County Supervisors. The County Land Information Office is organized into eight divisions, each of which is intended to address a subset of land records modernization issues: the divisions of finance, data interchange, municipalities, technical, users, infrastructure, education, and utilities. Each division of the office consists of individuals from throughout Ozaukee County who meet to consider issues of land records modernization. Each division has a coordinator. The eight division coordinators, together with the County Register of Deeds, function as the Land Information Office. The division coordinators and the Register of Deeds frequently meet jointly with the Land Information Committee.

This report sets forth the findings and recommendations of the Land Information Committee and the Land Information Office. The Committee and Office members reviewed the pertinent conclusions of previous research efforts in the area of land records modernization, including, importantly, the reports of the National Research Council of the National Academy of Sciences, the reports of the Wisconsin Land Records Committee, the guidelines promulgated by the Wisconsin Land Information Board, and the long-standing recommendations of the Southeastern Wisconsin Regional Planning Commission. Members of the Committee and Office also reviewed the accomplishments to date of public and private efforts to create automated mapping and land records systems covering all or portions of Ozaukee County.

The Land Information Committee and Office members concluded that a modernized land records system in Ozaukee County could best be created by provision of a single automated mapping base for the entire County. This single mapping base would be prepared to a set of specifications sufficient to meet the most stringent of accuracy and map feature content requirements of all of the users concerned. Such specifications are set forth in Chapter IV of this report. Each organization using the automated base would provide its own operating environment, that is, computer hardware and software. Only the digital maps and parcel identification system would be shared. This basic system would provide an automated mapping capability suitable for the development by individual operators of a wide variety of applications such as land ownership and title recordation systems, real property assessment and taxation systems, public and private utility inventory and management systems, environmental inventory and management systems, zoning and other code monitoring and enforcement systems, and emergency and service vehicle response and routing systems. The Committee and Office also concluded that the land modernization efforts of Ozaukee County should include the conversion of the existing Ozaukee County parcel identification system to the uniform system recommended by the Wisconsin Land Information Board.

The plan set forth in this document is recommended to the Ozaukee County Board of Supervisors for adoption. Upon adoption of the plan, the Land Information Committee recommends that the plan be formally submitted to the Wisconsin Land Information Board with a request that the plan be approved by that Board. Upon approval by that Board, Ozaukee County would be in a position to begin expending the supplemental Register of Deeds filing and recording fees authorized under the Wisconsin Land Information Program in a manner consistent with the plan recommendations. In addition, Ozaukee County would be in a position to submit applications for state grants in support of the activities specified in the plan. Finally, local units of government in Ozaukee County would also be in a position to submit applica-

tions for state grants. Such applications under Wisconsin law would have to come through Ozaukee County and be endorsed by the County so that any state funds expended are directed at activities consistent with the adopted plan.

RECOMMENDED CONCEPTUAL FRAMEWORK

The conceptual framework for a multipurpose cadastre as set forth by the National Research Council and as adapted for use by Ozaukee County consists of the following elements:

1. A geodetic reference framework to identify the spatial location of all land-related data. This reference framework, or survey control network, consists of a system of survey monuments for which geodetically based coordinates have been determined through high order control surveys. In accordance with the long-standing recommendations of the Southeastern Wisconsin Regional Planning Commission, the geodetic reference framework to be used in Ozaukee County is to consist of the corners of the U. S. Public Land Survey System tied to the State Plane Coordinate System.
2. Large-scale topographic base maps showing in their correct location and orientation the principal natural and cultural features of the area concerned and the elevation and configuration of the surface of the earth. Within the context of the Ozaukee County program, large-scale means one inch equals 200 feet scale, two-foot contour interval topographic maps, although those local units of government in the County that desire to prepare one inch equals 100 feet scale, two-foot contour interval topographic maps should be encouraged to do so. In either case, these maps should meet National Map Accuracy Standards in accordance with specifications promulgated by the Southeastern Wisconsin Regional Planning Commission.
3. A cadastral overlay to the topographic base map which identifies and delineates the most fundamental units of land ownership, the cadastral parcels. Such cadastral overlay maps are also to be prepared in accordance with specifications promul-

gated by the Southeastern Wisconsin Regional Planning Commission.

4. A parcel identifier constituting the means for linking all spatially related data to the mapping base and of storing, retrieving, and exchanging such data. Every parcel must have a unique identifier code.
5. Land information files which contain data about the land parcels and which are related to the mapping base through the parcel identifier. Such files can be either graphic or nongraphic in nature.

It is intended that the first four of the five elements of the multipurpose cadastre in Ozaukee County ultimately be provided by the County and that such elements be made available in digital, that is, computer-readable, form. These elements collectively would constitute the automated mapping base. Building upon that base, Ozaukee County, the local units of government in the County, and public and private utilities operating in the County can create the fifth element of the cadastre, namely, the supplemental land information files required to support the particular functions of the public and private agencies concerned. It is recognized that resource constraints will prohibit the full development of the automated mapping base by Ozaukee County in the relatively near future. Accordingly, the Land Information Committee encourages those local units of government in the County which may desire to do so to proceed at their own pace with the development of the automated mapping base attendant to their jurisdictional area. Such base, however, should be constructed in accordance with the standards recommended in the Ozaukee County plan.

The recommended standards for the automated mapping and land information system for Ozaukee County are based upon the standards for the development of survey control networks and local large-scale mapping programs promulgated by the Southeastern Wisconsin Regional Planning Commission. These standards have been used for many years throughout the Region, including Ozaukee County, and have proven to be both conceptually and procedurally sound. The standards include the use of the State Plane Coordinate System, North American Datum of 1927 (NAD-27), as the map projection system for the Ozaukee County automated

mapping and land information system; the recovery, or relocation, and monumentation of U. S. Public Land Survey corners; the establishment through high order control surveys of coordinates for such corners based upon the Wisconsin Coordinate System, South Zone, (NAD-27); the establishment through high order control surveys of elevations of all such corners based upon National Geodetic Vertical Datum, 1929 Adjustment (NGVD-29); the preparation to National Map Accuracy Standards of large-scale planimetric and topographic base maps; the preparation of companion large-scale cadastral maps identifying real property boundary lines and related information; and parcel identification numbers.

STATUS OF DEVELOPMENT OF AUTOMATED MAPPING BASE

The following summarizes the status of the development of the recommended automated mapping base in Ozaukee County as of November 1991:

1. The Regional Planning Commission, Ozaukee County, and certain local units of government in the County have collectively contributed to the development of the required geodetic reference framework over the past three decades. Of the estimated 1,119 U. S. Public Land Survey corners in Ozaukee County, 438 corners, or about 39 percent, have been relocated and remonumented and fully coordinated through the establishment of horizontal and vertical survey control data to the recommended specifications. An additional 52 corners have been relocated and monumented with attendant horizontal control survey data. An additional four corners have been relocated with the attendant horizontal control; however, these four corners have not yet been monumented. An additional 261 corners have been relocated and monumented by the Ozaukee County Surveyor or others; however, no horizontal or vertical control survey data have been established for such corners. Finally, a total of 142 corners have been relocated by the Ozaukee County Surveyor, but have yet to be monumented. In all, then, 751 corners, or about 67 percent of all corners in the County, have been relocated and monumented.

Horizontal control data and attendant State Plane Coordinates have been established for 494 corners, or about 44 percent of the total. Vertical control data have been established for a total of 438 corners, or about 39 percent of the total.

2. Through large-scale mapping programs conducted by Ozaukee County, the Cities of Cedarburg, Mequon, and Port Washington, the Village of Saukville, and the Regional Planning Commission, about 53 square miles, or about 23 percent of the 234-square-mile area of Ozaukee County, has been mapped to the recommended specifications. All of the mapping completed to date has been at a scale of one inch equals 200 feet, with a two-foot contour interval. These mapping programs have included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey corners included in the mapped area.
3. Digital cadastral mapping efforts have been undertaken by Ozaukee County, the City of Cedarburg, and the Village of Grafton. Together, the completed cadastral maps encompass an area of about 21 square miles, or about 9 percent of the total area of the County. None of the digital cadastral mapping completed to date fully meets the specifications recommended by the Regional Planning Commission, although the work completed to date for this area has utilized the recommended geodetic reference framework. The completed cadastral mapping work could be enhanced the full set of recommended specifications.

RECOMMENDED PLAN

The recommended Ozaukee County land information system plan was prepared for the five-year period 1992 through 1996. This planning period generally corresponds with the state legislation which established the supplemental Register of Deeds recording and filing fees. Based on current state law, the additional filing fees expire at the end of the State's fiscal year 1996. It would be desirable to complete the entire automated mapping base recommended for Ozaukee County by the end of 1996. The Land

Information Committee and Office members recognize, however, that there are fiscal constraints that will preclude reaching that goal by the end of this initial five-year planning period.

The total cost of completing the entire recommended automated mapping and land information system base for Ozaukee County is estimated at \$2.18 million. Of this total, nearly \$0.82 million, or about 38 percent, is required to complete the geodetic reference framework, including the recovery, or relocation, and monumentation of U. S. Public Land Survey corners and the establishment of State Plane Coordinates and vertical elevations for such corners; about \$0.87 million, or an additional 40 percent, is required to prepare large-scale topographic base maps to complete the entire County; and the remaining \$0.49 million, or 22 percent, is required to compile cadastral maps for the County and convert those maps to digital form, as well as to enhance existing digital maps in the County to meet the recommended specifications.

The Land Information Committee identified five potential sources of revenue to support the recommended work program. These include the supplemental Register of Deeds recording and filing fees mandated under the Wisconsin Land Information Program, potential state grants from the Wisconsin Land Information Board, contributions by local governments and utilities, county tax levy monies, and mapping grants from the Wisconsin Coastal Management Program. The recording and filing fees are expected to total about \$307,700 over the five-year planning period, or about \$61,500 annually. State grants of up to \$100,000 can be sought twice annually under present rules. At the present time no local government or public or private utility in Ozaukee County has come forth with a firm commitment to provide additional funds to support the program. Also at the present time, County tax levy monies in the amount of about \$20,000 annually are being made available through the County Highway Department budget to the County Surveyor to recover, or relocate, and monument the U. S. Public Land Survey corners in the County.

The County Land Information Committee and Land Information Office have recommended that Ozaukee County focus available resources over the five-year period 1992 through 1996 toward completing the recommended automated mapping base for the entirety of Township 9

North, Ranges 21 and 22 East. This geographic area encompasses the City of Mequon, the Village of Thiensville, and the small portion of the Village of Bayside lying in Ozaukee County. This work effort, which is predicated upon the fiscal support of the City of Mequon and the Village of Thiensville and which assumes that these communities desire the larger one inch equals 100 foot scale base mapping, would complete the automated mapping base for about 21 percent of the area of the County.

The total cost of the recommended base mapping effort over the five-year period is estimated at \$790,000. Of this total, about \$12,800 is required to complete the land survey work in the project area. It is proposed that this work be completed in the first year under the normal County Surveyor work program. An additional \$120,000, or about \$24,000 annually, would be required to complete the recommended control survey work. It is proposed that this work be funded entirely with the retained filing and recording fees. In addition, about \$153,140, or \$30,630 annually, would be required to prepare new and enhance existing cadastral maps in the project area. It is also proposed that this portion of the work effort be paid for by the retained filing and recording fees.

The remaining cost of about \$504,000, or about \$100,800 annually over the five-year period, is required to prepare large-scale one inch equals 100 feet topographic mapping in digital form. It is proposed that Ozaukee County share in this cost to the extent of the cost of preparing one inch equals 200 foot scale mapping for that portion of the project area not already so mapped. The county share would be \$143,500, or about \$28,700 annually. It is proposed that the County fund this amount by using the remaining \$6,900 annually in retained filing fees and provide matching County monies in the amount of \$21,800 annually. The City of Mequon and Village of Thiensville would be obligated to pay the remaining \$360,500. Dividing that cost based upon area would result in an average annual cost to the City of Mequon of about \$70,600 over the five-year period and to the Village of Thiensville of about \$1,500 annually over the five-year period. If intergovernmental agreement cannot be reached on the foregoing work program, it is proposed that Ozaukee County proceed to use the retained filing and recording fees over the five-year period to complete one inch equals 200 foot

scale topographic maps within the Mequon-Thiensville-Bayside project area.

In addition to the foregoing, the plan recommends that the Ozaukee County Surveyor focus all available remaining resources, totaling about \$87,200 over the five-year period, on completing the required land survey work in the County. Work efforts are recommended to begin in the Cedarburg-Grafton areas and proceed north. It is expected that the County Surveyor will be able to complete about 50 percent of the land survey work in the County during the five-year period. It is also recommended that the County Register of Deeds continue over the next five years to prepare partial cadastral maps, focusing available resources on that portion of the County north of the proposed Mequon-Thiensville-Bayside project area and in those U. S. Public Land Survey quarter sections where the geodetic control framework is already in place.

The Land Information Committee and Land Information Office also recommended that three related work activities be undertaken over the next five years: 1) a special technical study to agree upon specifications and standards for conversion to digital format of the land information system base data, 2) the conduct of a work effort to develop an algorithm to enable the conversion by computer of the existing Ozaukee County parcel numbering system to the recommended parcel identification numbering system promulgated by the Wisconsin Land Information Board, and 3) the conduct of a study attendant to issues pertaining to custody, control, and maintenance of the land records information base. It is also recommended that Ozaukee County seek available grants from the Wisconsin Land Information Board and support those local governments in the County who are also seeking such grants, provided that the monies would be spent in a manner consistent

with the standards and specifications for automated base mapping set forth in the report.

It is recommended that the Ozaukee County Land Information Committee, working with the members of the Land Information Office, oversee all work associated with the development of the Ozaukee County automated mapping base over the next five-year period. Finally, the Land Information Committee also recommends that Ozaukee County commit to meeting all of the administrative requirements for County land information programs established by the Wisconsin Land Information Board. In particular, Ozaukee County should prepare and submit to that Board an annual report on the status of plan implementation. Furthermore, Ozaukee County should commit to revise, update, and extend this plan by the end of calendar year 1996.

CONCLUDING STATEMENT

The Ozaukee County Land Information Committee has herein set forth a plan and program for the development over time of an automated base map suitable for the development within the County of a parcel-based land information system ultimately usable by all Ozaukee County departments, by local governments in Ozaukee County, and by public and private utilities. The plan includes technical specifications for the mapping work involved, a five-year program to prepare the automated base map for about one-fifth of the area of the County, and a recommended organizational structure for the conduct of the required work. The Land Information Committee and Land Information Office recommend that the plan and program set forth herein be approved by the Ozaukee County Board of Supervisors and that work efforts proceed over the next five years in accordance with the outline and organizational structure recommended in this report.

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APPENDICES

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Appendix A

RESOLUTION OF THE OZAUKEE COUNTY BOARD OF SUPERVISORS REQUESTING THE SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION TO HELP PREPARE A COUNTY LAND INFORMATION SYSTEM PLAN

RESOLUTION NO. 91-14

COUNTYWIDE PLAN FOR LAND RECORDS MODERNIZATION

WHEREAS, the Wisconsin Legislature adopted 1989 Act 31 creating the Wisconsin Land Information Program and the Wisconsin Land Information Board; and

WHEREAS, the Ozaukee County Board adopted Resolution No. 89-72, which established the Ozaukee County Land Information Office, to become a component in the Wisconsin Land Information Program; and

WHEREAS, part of the duties of the County Land Information Office is to establish, develop and receive approval for a countywide plan for land records modernization by July 1, 1992; and

WHEREAS, the Southeastern Wisconsin Regional Planning Commission has prepared countywide plans for other counties and has indicated a willingness to prepare such a plan for Ozaukee County, at no cost to Ozaukee County.

NOW, THEREFORE, BE IT RESOLVED, that the Ozaukee County Board of Supervisors requests the Southeastern Wisconsin Regional Planning Commission to prepare the Ozaukee County countywide plan; and

FURTHER RESOLVED, that the Ozaukee Land Information Office be directed to provide guidance in the preparation of the Ozaukee County Plan; and

FURTHER RESOLVED, that the plan, when completed, shall be forwarded to the Ozaukee County Board of Supervisors for review and approval.

Dated at Port Washington, Wisconsin, this 5th day of June, 1991.

TO WHOM IT MAY CONCERN:

I, Harold C. Dobberpuhl, County Clerk for Ozaukee County, Wisconsin, hereby certify that the foregoing is a true and correct copy of a Resolution adopted by the Ozaukee County Board of Supervisors on June 6, 1991.

s/ Leroy A. Bley

Leroy A. Bley

s/ Frederick Kaul

Frederick Kaul

s/ Howard Cralley

Howard Cralley

(S E A L)

s/ Robert C. Eickstedt

Robert C. Eickstedt



Harold C. Dobberpuhl
County Clerk

s/ Rodger L. Rahn

Rodger L. Rahn

LAND INFORMATION COMMITTEE

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Appendix B

RESOLUTION OF THE OZAUKEE COUNTY BOARD OF SUPERVISORS ESTABLISHING A COUNTY LAND INFORMATION OFFICE

RESOLUTION NO. 89-72

A M E N D E D

LAND INFORMATION OFFICE

WHEREAS, it is desirable to modernize existing methods of mapping and indexing land information within Ozaukee County to increase the efficiency of such methods; and

WHEREAS, programs are being created at the state and federal levels to modernize county land information systems and to help fund such county modernization; and

WHEREAS, a modernized land information system would be beneficial to the general public, municipalities, businesses and county offices within Ozaukee County; and

WHEREAS, recently created Wisconsin Statute Section 59.88 allows the County Board to establish a County Land Information Office to coordinate land information projects within the county and to develop a countywide plan for land records modernization and to review and recommend projects from local government units for grants from the State Land Information Board to aid in funding this modernization.

NOW, THEREFORE, BE IT RESOLVED, by the Ozaukee County Board of Supervisors that the Ozaukee County Land Information Office be and hereby is established; and

FURTHER RESOLVED, that the duties of the Ozaukee County Land Information Office shall be performed within the existing Register of Deeds office and that the current Register of Deeds, ~~Ronald A. Voigt~~, be appointed as coordinator of the Land Information Office; and

FURTHER RESOLVED, that the Land Information Office is authorized to perform the tasks assigned to it under Section 59.88 and 16.967, Wisconsin Statutes.

Dated at Port Washington, Wisconsin, this 7th day of February, 1990.

TO WHOM IT MAY CONCERN:

I, Harold C. Dobberpuhl,
County Clerk for Ozaukee
County, Wisconsin, hereby
certify that the foregoing
is a true and correct copy
of a Resolution as amended
by the Ozaukee County Board
of Supervisors on February
7, 1990.

(S E A L)



Harold C. Dobberpuhl
County Clerk

s/ Howard Neubauer

Howard Neubauer

s/ Christine Nuernberg

Christine Nuernberg

s/ Theodore C. Egelhoff

Theodore C. Egelhoff

s/ Bruce J. Schroeder

Bruce J. Schroeder

s/ Gus W. Wirth, Jr.

Gus W. Wirth, Jr

PERSONNEL COMMITTEE

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APPENDIX C

OZAUKEE COUNTY LAND INFORMATION SYSTEM PLAN

(Set forth in the format specified by
the Wisconsin Land Information Board)

A. INTRODUCTION

1. Land Information Office

On February 7, 1990, the Ozaukee County Board of Supervisors established a Land Information Office. The County Board established a Land Information Committee, comprised of five County Board Supervisors, to oversee the activities of that Office. The County Board also designated the County Register of Deeds as the official contact person for the Land Information Office. The present Register of Deeds is:

Mr. Ronald A. Voigt
Register of Deeds
Ozaukee County Courthouse, Room 135
P. O. Box 994
Port Washington, Wisconsin 53074-0994
Phone: (414) 284-9411

The County Land Information Office has been organized into eight divisions: finance, users, infrastructure, data interchange, municipalities, technical, education, and utilities. Each Division consists of several individuals who meet to consider issues of land records modernization from time to time. Formal Land Information Office meetings are held periodically to coordinate the efforts of the Divisions. Voting representatives at these meetings are the eight division coordinators or their designees, as well as the Register of Deeds functioning as the Land Information Officer for the County. Members of the Land Information Committee generally also attend the Land Information Office meetings.

2. Participants in the Planning Process

The planning process was overseen by a Plan Review Committee. That committee consisted of members of the County Land Information Committee, the Land Information Office Division coordinators, and the Land Information Officer. The Committee included knowledgeable representatives of Ozaukee County, concerned local units of government in the County, private utilities serving the County and the private abstract and title companies serving the County. The Southeastern Wisconsin Regional Planning Commission provided staff assistance in the preparation of the plan. The membership of the Plan Review Committee is reproduced on the inside front cover of this report.

B. CURRENT ACTIVITIES AND INVENTORY

The County Land Information Committee and Office determined that the focus of the land records modernization plan would be on the development of an automated mapping and parcel-based land information system. The following summarizes the current activities and inventory of work efforts attendant to that system.

1. Existing Automated Mapping and Land Records Systems

a. SEWRPC

The SEWRPC, which encompasses Ozaukee County in its jurisdictional area, maintains an extensive digital data base of land use and natural resource inventory data. This

includes land use maps, soil maps, wetland maps, wildlife habitat maps, floodplain maps, civil division maps, and watershed maps, among others. The SEWRPC uses the State Plane Coordinate System, NAD-27, for its digital mapping work.

b. WEPCo

The Wisconsin Electric Power Company, which serves virtually all of Ozaukee County, maintains a digital mapping base upon which it has placed its electric service network. The WEPCo uses the UTM Coordinate System, NAD-27, for its digital mapping work.

c. Wisconsin Gas Company

The Wisconsin Gas Company serves all of Ozaukee County. The Company has developed an automated mapping base for most of its franchised area and is currently placing its facilities on that base. The Company uses the State Plane Coordinate System, NAD-27, for its digital mapping work.

d. Wisconsin Bell

Wisconsin Bell serves most of Ozaukee County and is scheduled to begin automated mapping work in the County in 1992 using the UTM Coordinate System, NAD-27.

e. Ozaukee County

In 1985, Ozaukee County began to automate the parcel mapping function housed in the Office of the Register of Deeds. Hard copy, hand drafted real estate parcel maps are being replaced with digital maps. Coordinate geometry techniques are being used to enter parcel data in the automated system. Where State Plane Coordinates, NAD-27, of U. S. Public Land Survey section and quarter-section corners are available, those data are used to provide the geodetic control for the mapping. If such data are not available, then the work is completed on an uncontrolled basis.

f. Local Governments

Three local units of government in Ozaukee County have established automated mapping capabilities. The Village of Grafton and the City of Cedarburg commissioned private engineering firms to prepare digital base maps for their respective communities. Each of these two communities had previously completed conventional large-scale topographic mapping programs using specifications provided by SEWRPC. Accordingly, the new digital parcel-based maps were recompiled using State Plane Coordinate values, NAD-27, for control. The City of Mequon has established an in-house capability to enhance the digital cadastral maps prepared by the County Register of Deeds.

2. Status of Remonumentation and Control Survey Work

There are 1,119 U. S. Public Land Survey section, quarter section, and center of section corners in Ozaukee County. A total of 751 corners, or about 67 percent, have been relocated and monumented. Horizontal control data in the form of State Plane Coordinates have been obtained for 494 corners, or about 44 percent. Vertical control data have been obtained for a total of 438 corners, or about 39 percent (see Map 1, page 29).

3. Status of Base Mapping

Through a series of large-scale topographic base mapping programs coordinated by the Regional Planning Commission, topographic maps at a scale of one inch equals 200 feet, with a two-foot contour interval, have been prepared for nearly 53 square miles, or about 23 percent of the area of the County (see Map 1, page 29).

4. Status of Cadastral Mapping

Large-scale cadastral mapping efforts have been undertaken by Ozaukee County, the City of Cedarburg, and the Village of Grafton. Together the completed maps encompass an area of about 21 square miles, or about 9 percent of the area of the County (see Map 2, page 31).

5. Existing Parcel Numbering Systems

Ozaukee County, through the Register of Deeds, administers a parcel numbering system over the entire County. Three separate parcel identifiers are used: one for unplatted lands, one for platted lands with blocks, and one for platted lands without blocks. Only that part of the system pertaining to unplatted lands identifies the U. S. Public Land Survey section and quarter section within which a parcel is located.

6. Recent Budget Expenditures for Land Records Projects

Over the past three years, the following monies have been expended for land records modernization activities in the County:

<u>Project Name</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>Total</u>
Ozaukee County GPS Project	\$ --	\$ --	\$25,000	\$ 25,000
City of Port Washington Mapping Project	--	--	22,947	22,947
County Surveyor Remonumentation Program	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>	<u>60,000</u>
Total	\$20,000	\$20,000	\$67,947	\$107,947

7. Needs Assessment

The County Land Information Committee and Office determined that the following basic needs exist with respect to land records modernization in the County:

- The completion of the geodetic reference framework, including relocating and monumenting all U. S. Public Land Survey corners and obtaining State Plane Coordinates and vertical elevation data for such corners.
- The completion of large-scale topographic base mapping for the 181 square miles not yet mapped.
- The preparation of cadastral maps as "overlays" to the topographic maps to permit the accurate correlation of earth science and cadastral data; such mapping needs to be completed for about 213 square miles.
- The conduct of a work effort to develop an algorithm to enable the conversion by computer of the existing Ozaukee County parcel numbering system to the recommended parcel identification numbering system promulgated by the Wisconsin Land Information Board.
- The creation over time of a series of land information files, including—but not limited to—soils, flood hazard areas, land use, and zoning.

C. GOALS AND OBJECTIVES

1. Goals

The County Land Information Committee and Office adopted the following two basic goals:

- To implement a multipurpose, multi-user, parcel-based, automated mapping and land information system consisting of a geodetic reference framework; large-scale planimetric

and topographic base maps; overlays, including cadastral boundaries and boundaries of various cultural and natural areas; identifiers, including parcel numbers and codes associated with various cultural and natural areas; and nonspatial land information files.

- b. To design a common automated land information system for the County so as to ensure economy and efficiency in the development and use of that system and so as to ensure the ready entry, retrieval, and exchange of data by and between the various users of the system.

2. Objectives

To meet these goals, the Board adopted the following specific objectives:

- a. To lay out a course of action that will focus part of the available fiscal resources on efforts to continue the development of the geodetic reference framework throughout the entire County and to prepare, as the remaining resources may permit, large-scale planimetric and topographic base maps in those portions of the County not yet mapped, as well as to continue the county program to prepare digital cadastral mapping, producing such cadastral mapping as overlays to the topographic base mapping.
- b. To encourage local units of government in Ozaukee County to move forward at a more rapid pace to complete automated land information systems.
- c. To facilitate applications by the County and local units of government in support of state grants-in-aid of developing the recommended automated mapping system.
- d. To encourage partnership efforts between governments and utilities that will contribute toward the development of the recommended mapping system.

3. Planning Period

The Land Information Committee and Office recognized that the foregoing goals and objectives would not be fully reached during a reasonable short-term planning period. The Committee then determined to set as the planning period for an initial land information system plan the five-year period beginning January 1, 1992, and extending through December 31, 1996. The Committee determined that it would scale its work program for that planning period to the resources anticipated to be made available.

D. MODERNIZATION AND IMPLEMENTATION PLAN

The following describes the recommended modernization and implementation plan for land records established by the Ozaukee County Land Information Committee for the planning period.

1. Foundational Elements

a. Geographic Frameworks (Base Map)

- 1) Ozaukee County intends to continue using the large-scale mapping and survey control systems recommended by SEWRPC. Each U. S. Public Land Survey section, quarter section, and center of section corner will be relocated and monumented; high order control survey traverses will be run which utilize and incorporate all of the monumented corners as stations to determine the coordinates of the corners and the lengths and bearings of all quarter section lines; and vertical control surveys will be completed to determine elevations for each monument. Coordinates of the corners will be computed upon the Wisconsin Coordinate System, South Zone, (NAD-27). The procedures and accuracy of the horizontal control surveys will conform to the specifications for NGS Third Order, Class I Traverses. The vertical control survey work will be based upon National Geodetic Vertical Datum, 1929 Adjustment (NGVD-29). The procedures and accuracy of the vertical control surveys shall conform to the specifications for NGS Second Order, Class II level circuits.

- 2) Large-scale topographic base maps will be prepared to standard SEWRPC specifications which incorporate National Map Accuracy Standards. The standard base map scale for Ozaukee County is one inch equals 200 feet, two-foot contour interval, although local units of government are encouraged, should they so desire, to proceed with larger scale, one inch equals 100 foot topographic mapping.
- 3) Over the five-year period, it is anticipated that Ozaukee County—using available resources consisting of county tax levy monies and retained Register of Deed's filing fees—will complete an automated mapping base for the entirety of Township 9 North, Ranges 21 and 22 East. This geographic area encompasses the City of Mequon, the Village of Thiensville, and the small portion of the Village of Bayside lying in Ozaukee County. The area represents about 21 percent of the total area of the County. Should the City of Mequon and Village of Thiensville desire larger scale one inch equals 100 foot topographic mapping, additional local and county tax levy monies would have to be provided. It is also possible that other local units of government in the County will proceed with locally focused land and control survey and topographic mapping programs during the five-year period. In addition, the Ozaukee County Surveyor will be able to complete about 50 percent of the remaining land survey work in the County north of the aforereferenced town range.

b. Parcels

1) Cadastral Maps

Ozaukee County has accepted the standard SEWRPC specifications for the preparation of cadastral maps. While it is not expected within the planning period that Ozaukee County will complete cadastral maps for the entire County, the ongoing program of the County Register of Deeds will continue focusing any available in-kind staff resources on that portion of the County north of the proposed Mequon-Thiensville-Bayside project area and in those U. S. Public Land Survey quarter sections where the geodetic control framework is in place. Each cadastral map shall cover one U. S. Public Land Survey section where base mapping has been obtained at a scale of one inch equals 200 feet, and one U. S. Public Land Survey quarter section where base mapping has been obtained at a scale of one inch equals 100 feet. The cadastral map shall utilize the State Plane Coordinate System as the map projection. Determination of the location of real property boundary lines should be based upon the examination and interpretation of all recorded subdivision plats and certified survey maps within the area to be mapped; legal descriptions, and where available, plats of all major public utility easements in the area to be mapped; copies of legal descriptions and, where available, plats of all street right-of-way openings, reservations, or dedications in the area to be mapped; and legal descriptions contained in the most recently recorded deed transaction in the records of the County Register of Deeds for all real property boundaries in the area to be mapped not included within recorded subdivision plats or certified survey maps. Overlapping or separated property boundary descriptions may be expected to exist. The property boundary line maps should record all dimensions as contained in the official records of the County Register of Deeds, and wherever an overlap or gap of 2.5 feet or more exists, such overlap or gap should be shown as a mapped line. Overlaps or gaps of less than 2.5 feet will be evident only from an examination of the recorded property line dimensions.

2) Parcel Identification

Every parcel identified on a cadastral map shall have a unique parcel identification number assigned to it. During the planning period, Ozaukee County intends to develop an algorithm to enable the conversion by computer of the existing Ozaukee County parcel numbering system to the recommended parcel identification numbering system promulgated by the Wisconsin Land Information Board.

c. Wetlands Mapping

Ozaukee County intends to incorporate into its ultimate land information system digital wetlands maps prepared by SEWRPC. Those maps are based upon the Wisconsin Department of Natural Resources wetland maps. It is not anticipated, however, that Ozaukee County will be in a position during the five-year planning period to accomplish this task.

d. Soils Mapping

Ozaukee County intends to incorporate into its ultimate land information system the digital soil survey maps prepared by SEWRPC. Those maps are based upon the U. S. Soil Conservation Service soil survey maps. It is not anticipated, however, that Ozaukee County will be in a position during the five-year planning period to accomplish this task.

e. Zoning Mapping

While Ozaukee County intends to ultimately develop a zoning mapping "layer" in its land information system, any work on this element has been deferred for further consideration during the next planning period. Local units of government, however, may undertake the development of a zoning mapping layer during the planning period. That layer must be based upon and related to, as may be appropriate, the cadastral maps, the wetland maps, and the floodplain maps developed as part of the topographic base maps.

f. Institutional Arrangements

1) Policy Oversight

All activities to be conducted in connection with the development of the proposed Ozaukee County automated mapping base will be under the policy direction of the Ozaukee County Land Information Committee. As the designated contact person for the Ozaukee County Land Information Office, the Register of Deeds will work with the Land Information Committee and the Land Information Office Division Coordinators in carrying out the recommended work program.

2) Land Survey Work

All land survey work will be carried out by the County Surveyor. The present County Surveyor is: Mr. Thomas J. Genske, 121 W. Main Street, Port Washington, Wisconsin 53074-0994, telephone: (414) 284-9411.

3) Control Surveys and Base Mapping

Ozaukee County intends to engage a consulting engineering firm to perform the proposed control survey and base mapping work in the Mequon-Thiensville-Bayside area.

4) Supplemental Studies

Over the planning period, Ozaukee County intends to undertake two special studies. The first is a study to agree upon specifications and standards for conversion to digital format of the land information system base data. The second is a study attendant to issues pertaining to custody, control, and maintenance of the land records information base.

g. Communications, Education, and Training

The County Land Information Office will disseminate copies of the adopted land information system plan to all local governments in the County and to other interested parties as may be appropriate. This will communicate the County's intent to sponsor, over time, the cooperative development of an automated mapping base. As appropriate, the

County will develop additional education and training efforts to ensure that all parties concerned are fully aware of the capabilities of the developing automated mapping base.

h. Public Access Arrangements

Ozaukee County will make all data developed under the automated base mapping program available to public and private interests upon reasonable request. The Register of Deeds is recognized as the official custodian of all such data and will prescribe forms and the manner in which such data may be requested. In accordance with state law, Ozaukee County reserves the right to charge reasonable costs associated with fulfilling such requests.

3. Data Interchange Standards

Ozaukee County recognizes that there are informal exchange standards currently being used to share digital data, and encourages the use of such informal standards to promote data use and integration. Ozaukee County also recognizes that formal data interchange standards may be proposed from time to time. When such formal standards are recommended by the Wisconsin Land Information Board, the Ozaukee County Land Information Board will evaluate such recommendations.

Ozaukee County does understand the data interchange standard proposed by the Wisconsin Land Information Board with respect to parcel identification numbering systems. To meet this standard, Ozaukee County will during the five-year planning period develop an algorithm to enable the conversion by computer of the existing Ozaukee County parcel numbering system to the recommended parcel identification numbering system promulgated by the Wisconsin Land Information Board.

4. Administrative Standards

Ozaukee County explicitly agrees to the following administrative standards:

- a. Ozaukee County agrees to observe and follow the Wisconsin Statutes concerning the Wisconsin Land Information Program.
- b. Ozaukee County agrees to grant the Wisconsin Land Information Board, upon reasonable notice, access to books, records, and project materials for inspection and audit purposes.
- c. Ozaukee County agrees to prepare an annual report on the status of plan implementation and to submit that report to the Wisconsin Land Information Board.
- d. Ozaukee County agrees to revise, update, and extend the County plan during calendar year 1996.