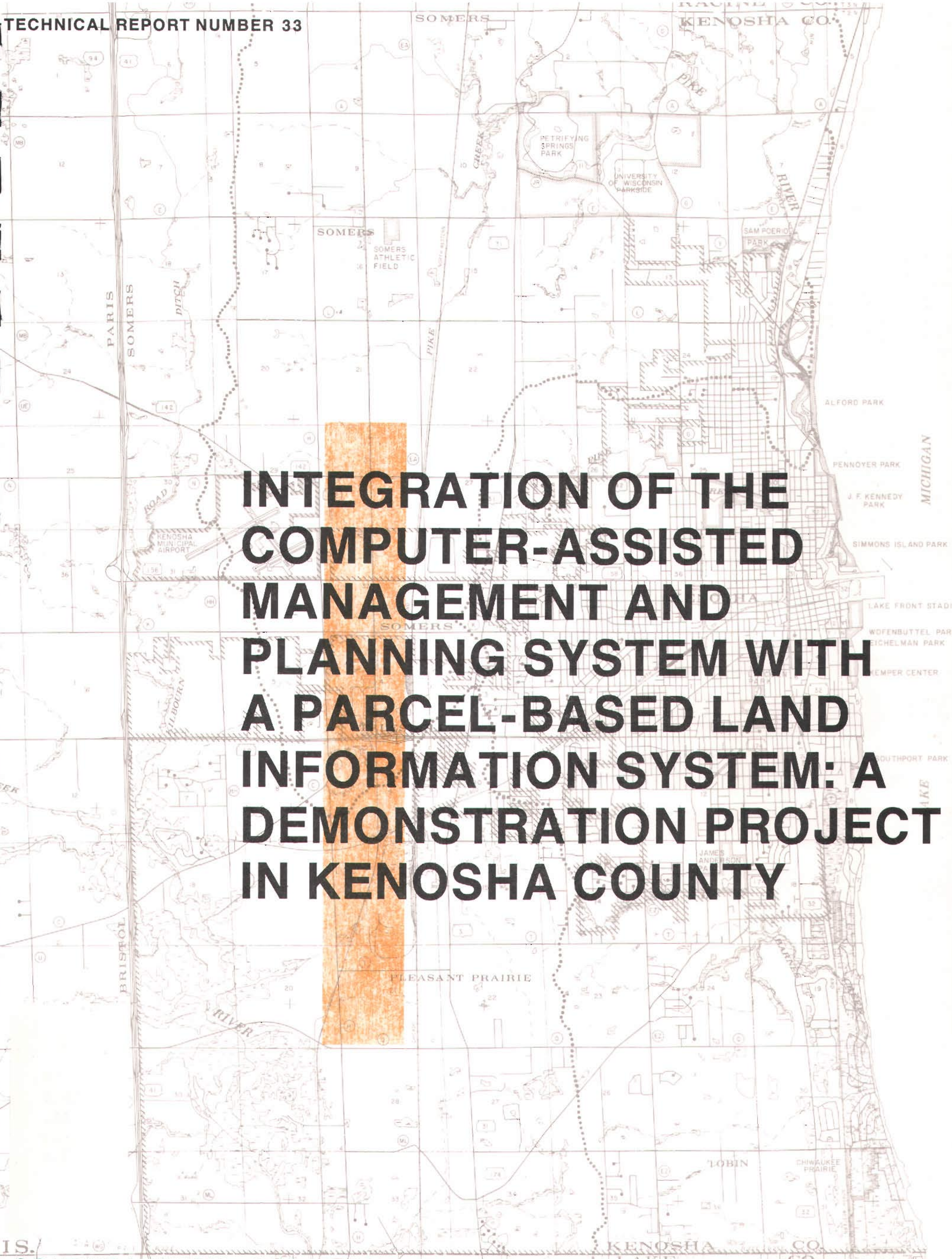
TECHNICAL REPORT NUMBER 33

INTEGRATION OF THE COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM WITH A PARCEL-BASED LAND INFORMATION SYSTEM: A DEMONSTRATION PROJECT IN KENOSHA COUNTY



SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

KENOSHA COUNTY

Leon T. Dreger
Francis J. Pitts
Sheila M. Siegler

RACINE COUNTY

David B. Falstad
Martin J. Itzin
Jean M. Jacobson, Secretary

MILWAUKEE COUNTY

John R. Bolden
William Ryan Drew
Thomas W. Meaux

WALWORTH COUNTY

John D. Ames
Anthony F. Balestrieri
Allen L. Morrison, Vice-Chairman

OZAUKEE COUNTY

Leroy A. Bley
Thomas H. Buestrin
Elroy J. Schreiner

WASHINGTON COUNTY

Daniel S. Schmidt
Patricia A. Strachota
Frank F. Uttech, Chairman

WAUKESHA COUNTY

Richard A. Congdon
Robert F. Hamilton
William D. Rogan, Treasurer

AD HOC REVIEW COMMITTEE KENOSHA COUNTY LAND INFORMATION SYSTEM/ COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM INTEGRATION STUDY

Kenneth L. Anderson . . . . .Production Adjustment and Compliance Specialist, Agricultural Stabilization and Conservation Service, U. S. Department of Agriculture, Madison
Arnold L. Clement . . . . .Director of Planning and Development, Racine County
Eileen Doyle . . . . .Program Assistant, Kenosha/Racine Agricultural Stabilization and Conservation Service, U. S. Department of Agriculture, Union Grove
Gerald L. Hebard . . . . .District Conservationist, Soil Conservation Service, U. S. Department of Agriculture, Union Grove
Perry M. Lindquist . . . . .County Conservationist, Washington County
George E. Melcher .Director of Planning and Development, Kenosha County
Lisa A. Morrison . . . . .Land Information Systems Specialist, Soil and Water Resource Management, Agricultural Resource Management Division, Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison
Charles L. Seeger . . . . .County Conservationist, Racine County
Dale R. Shaver . . . . .County Conservationist, Waukesha County
Elmer Strassburg . . . . .County Executive Director, Kenosha/Racine Agricultural Stabilization and Conservation Service, U. S. Department of Agriculture, Union Grove
James P. Vanden Brook . . . . .Unit Leader, Planning and Grants Management, Agricultural Resource Management Division, Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison
Pamela A. Wallis . . . . .County Land Conservationist, Kenosha County
Douglas C. Zwank . . . . .Information Resource Manager, Soil Conservation Service, U. S. Department of Agriculture, Madison

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION STAFF

Kurt W. Bauer, PE, AICP, RLS . . . . .Executive Director

Philip C. Evenson, AICP . . . . .Assistant Director

Kenneth R. Yunker, PE . . . . .Assistant Director

Robert P. Biebel, PE . . . . .Chief Environmental Engineer

Leland H. Kreblin, RLS . . . . .Chief Planning Illustrator

Donald R. Martinson, PE . . . . .Chief Transportation Engineer

John R. Meland . . . . .Chief Economic Development Planner

Thomas D. Patterson .Geographic Information Systems Manager

Bruce P. Rubin . . . . .Chief Land Use Planner

Roland O. Tonn, AICP . . . . .Chief Community Assistance Planner

Joan A. Zenk . . . . .Administrative Officer

Special acknowledgement is due Mr. John G. McDougall, SEWRPC Assistant Geographic Information Systems Manager, for his contribution to this report.

KENOSHA COUNTY LAND CONSERVATION COMMITTEE TECHNICAL ADVISORY COMMITTEE

Ronald L. Johnson . . . . .Kenosha County Board Supervisor
Chairman
Allen Brokmeier . . . . .Supervisor of Property Listers, Kenosha County Land Information Office
Dave Daniels . . . . .Farmer, Town of Brighton
Claude Epping . . . . .Farmer, Town of Salem
Gerald L. Hebard . . . . .District Conservationist, Soil Conservation Service, U. S. Department of Agriculture, Union Grove
Richard H. Lindgren . . . . .Kenosha County Board Supervisor
Michael Marchuk .Businessman, Town of Salem
George E. Melcher .Director of Planning and Development, Kenosha County
Elmer Strassburg . . . . .County Executive Director, Kenosha/Racine Agricultural Stabilization and Conservation Service, U. S. Department of Agriculture, Union Grove
Pamela A. Wallis . . . . .County Land Conservationist, Kenosha County

Mr. Leonard R. Johnson, former Chairman of the Kenosha County Land Conservation Committee, also participated on this Committee.

TECHNICAL REPORT
NUMBER 33

INTEGRATION OF THE COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM WITH A PARCEL-BASED LAND INFORMATION SYSTEM A DEMONSTRATION PROJECT IN KENOSHA COUNTY

Prepared by the

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

September 1992

Inside Region $ 5.00
Outside Region $10.00

(This page intentionally left blank)

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

916 N. EAST AVENUE • P.O. BOX 1607 • WAUKESHA, WISCONSIN 53187-1607 • TELEPHONE (414) 547-6721
TELECOPIER (414) 547-1103

Serving the Counties of: KENOSHA
MILWAUKEE
OZAUKEE
RACINE
WALWORTH
WASHINGTON
WAUKESHA

September 1, 1992

STATEMENT OF THE EXECUTIVE DIRECTOR

Mr. Ronald L. Johnson, Chairman, and
Members of the Kenosha County
Land Conservation Committee
Kenosha County Courthouse
912 56th Street
Kenosha, Wisconsin 53140

Dear Chairman and Members of the Committee:

On June 12, 1991, the Kenosha County Land Conservation Committee requested the Southeastern Wisconsin Regional Planning Commission to assist the Committee in a study of the potential for integrating two separate but related automated planning databases being developed in Kenosha County. Accordingly, with the aid of a grant obtained from the Wisconsin Department of Agriculture, Trade and Consumer Protection, a study was undertaken of the means by which the ready exchange of information between the Computer-Assisted Management and Planning System (CAMPS) database used by the U. S. Soil Conservation Service and the Kenosha County Automated Mapping and Land Information System (LIS) database being developed by the County could be achieved.

This report sets forth the findings and recommendations of the study. The findings and recommendations were reviewed and approved by a Committee composed of knowledgeable and concerned representatives of the state and county offices of the U. S. Soil Conservation Service and the U. S. Agricultural Stabilization and Conservation Service; the Wisconsin Department of Agriculture, Trade and Consumer Protection; the Kenosha and Racine County planning departments; and the land conservation departments of Kenosha, Racine, Washington, and Waukesha Counties.

The study found that the integration of the federal CAMPS and county LIS data systems was feasible and practical; would allow some planning and resource management tasks to be accomplished more effectively and economically; and would permit planners and other users to perform some tasks that currently cannot be readily performed. The study determined that there would be a number of practical and useful applications for an integrated system, including soil erosion control planning; administration of certain farm programs; comprehensive land use planning and related group administration; and public infrastructure system and facility planning and engineering. Indeed, the integrated system would, by permitting integration of the land ownership, natural resource, and farm management information presently contained in the two separate systems, comprise the foundation for a true rural resource management data system.

The report sets forth a series of recommendations intended to lead to the full integration of the CAMPS and the LIS databases, including the conduct of a pilot study to demonstrate the actual integration of the two systems. The Advisory Committee unanimously recommended that the Kenosha County Land Conservation Committee favorably consider the recommendations offered in this report.

The Regional Planning Commission is pleased to have been able to be of service to the County in this matter. The Commission stands ready to assist the County in any way possible in implementing the recommendations of the study.

Sincerely,

Kurt W. Bauer
Executive Director

(This page intentionally left blank)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure | Page

LIST OF MAPS

Map | Page

Chapter II

(This page intentionally left blank)

Chapter I

INTRODUCTION

BACKGROUND

On June 12, 1991, the Kenosha County Land Conservation Committee requested the Southeastern Wisconsin Regional Planning Commission to assist the Committee in investigating linkage and compatibility issues between two existing planning databases providing coverage of the Kenosha County area. More specifically, the Committee sought to examine possible interrelationships and data exchange procedures between the Computer-Assisted Management and Planning System (CAMPS) database used by the U. S. Soil Conservation Service and the Kenosha County Automated Mapping and Land Information System (LIS) database being developed jointly by the County and the Regional Planning Commission. Previous to this request, the Land Conservation Committee had obtained a grant from the Wisconsin Department of Agriculture, Trade and Consumer Protection to assist with the investigation of relating these two databases. As a result of these initiatives, the Regional Planning Commission agreed to assist the Land Conservation Committee by conducting a study of the compatibility issues between these two systems. This report sets forth the findings and recommendations of that study.

PURPOSE OF THE REPORT

The report documents the procedures and tasks undertaken in the examination of technical and institutional compatibility issues between the Kenosha County LIS comprehensive planning database and the CAMPS farm planning database, as well as the findings and recommendations of the examination. The report is intended to accomplish the following:

1. Describe the Kenosha County LIS database and the CAMPS database, focusing on the similarities and differences between the two information systems.

2. Describe the work effort undertaken by the Regional Planning Commission in the examination of the two databases.

3. Identify any problems which may hamper the ready exchange of information contained in the CAMPS database and in the Kenosha County LIS database.

4. Recommend technical and institutional solutions to any compatibility problems that exist between the two databases and recommend means by which the two systems may be integrated to improve information utility and exchange.

Although the study focused primarily on issues involved in the integration of CAMPS and the Kenosha County LIS, the conclusions and recommendations of the study have application in the integration of CAMPS with other land information systems similar to the Kenosha County system. In the Southeastern Wisconsin Region, several counties have initiated development of countywide land records systems as a result of recent state legislation. Following long-standing recommendations of the Regional Planning Commission, many of these parcel-based systems are expected to be comparable in design and concept to the Kenosha County LIS. The findings and recommendations of the study, therefore, extend beyond the scope of this demonstration project in Kenosha County and are applicable to integration efforts between CAMPS and other spatial database systems similar to the Kenosha County LIS, including such systems in Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties.

REVIEW COMMITTEE AND ADVISORY COMMITTEE STRUCTURE

Two committees were created to provide guidance and peer review in the preparation of this report and to seek agreement on the course of action to be recommended. The first of these, an Ad Hoc Review Committee, was convened by the Regional Planning Commission to evaluate and review the technical aspects of the report. This committee was composed of members of state and county offices of the U. S. Soil Conservation Service and the U. S. Agricultural Stabilization and Conservation Service; members of the Wisconsin Department of Agriculture, Trade and Consumer Protection; members of Kenosha County planning departments; and members of

County land conservation departments. A second committee, an Advisory Committee, was created by the Kenosha County Land Conservation Committee to examine the report and its pertinence to the institutional environment in Kenosha County. The Advisory Committee included members of the Kenosha County Land Conservation Committee as well as knowledgeable representatives of certain departments of Kenosha County government and local service agencies of the U. S. Department of Agriculture. Rosters of the two committees are reproduced on the inside front cover of this report.

The purpose of the Ad Hoc Review Committee and the Advisory Committee was to place the knowledge and experience of the committee members at the disposal of the study and to involve actively the various interests concerned in the study. The Committees carefully reviewed and approved the findings and recommendations of this report.

Chapter II

DESCRIPTION OF THE KENOSHA COUNTY AUTOMATED MAPPING AND LAND INFORMATION SYSTEM

INTRODUCTION

This chapter introduces the concept of the multipurpose cadastre, or parcel-based land information system, that serves as a model for the development of the Kenosha County Automated Mapping and Land Information System (LIS). The chapter outlines and discusses the five major components that comprise a multipurpose cadastre. Because the development of the Kenosha County LIS involves conversion of land information files into computer-readable format, this chapter also describes the process of translating conventional land-related information, such as that found on maps and aerial photographs, into a form whereby the data can be stored and manipulated in a computer. Finally, the chapter details the five main components of the Kenosha County LIS database and describes how each element is integrated into a functional parcel-based land information system.

THE CONCEPT OF THE MULTIPURPOSE CADASTRE

A cadastre may be defined as a record of interests in land, encompassing both the nature and extent of those interests. Historically, cadastres have been created and maintained for the primary purpose of taxing those interests. More recently, with the computerization of land information records, the concept of the cadastre has evolved to include multiple purposes in addition to taxation, including title registration and the integration of various data required for public planning, engineering and administration, and for the management of material and cultural resources.

A multipurpose cadastre can be conceptualized as a public land-related information system which is both operationally and administratively integrated. The system 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 1 for the development of multipurpose cadastres.[1] 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 that is also properly related to the geographic reference frame, 4) a unique identifying number assigned to each parcel, and 5) a series of records, 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

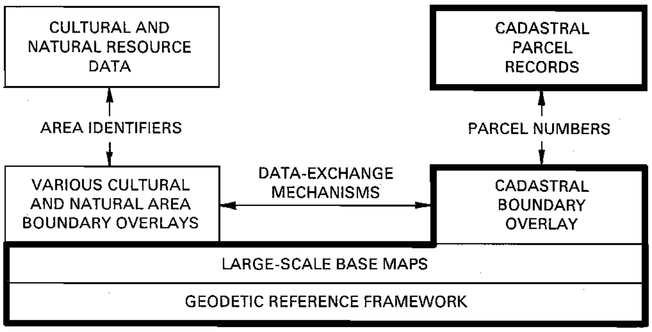
The first component of a multipurpose cadastre, the geodetic reference frame, consists of a system of survey monuments with the geodetic, or earth-based, coordinates necessary for defining the relative spatial location of all land-related data. Unfortunately, two different and generally uncoordinated systems of survey control have evolved in the United States. The first of these systems, the State Plane Coordinate System, is founded in the science of measurement and is intended to be used as a basis for the collection of earth-science data and the preparation of topographic, geologic, soils, and other earth-science maps. The second of these two systems, the United States Public Land Survey System, is based on the principles of property law as well as on the science of measurement. This system is utilized for the description and conveyance of real property ownership and the preparation of real property boundary line maps.

---

[1] *See 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.*

Figure 1

COMPONENTS OF A MULTIPURPOSE CADASTRE



The basic elements of a multipurpose cadastre (in heavy outline) provide a ready framework for the incorporation of additional land-related information in the form of maps and records.

Source: National Research Council and SEWRPC.

There are some important advantages, and some equally important limitations, inherent in each of these two survey control systems. The strength of the United States Public Land Survey System, for example, lies in its integration of systematic land survey procedures with a body of existing property law. Property rights, therefore, become part of the land survey and they cannot be altered or ignored. The Public Land Survey System 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 also simple and easy to comprehend and understand. This "rectangular" land survey system, however, has one serious flaw. Its use requires the perpetuation of monuments set by the original U. S. Government surveyors, the positions of which were not precisely related to the surface of the earth through a mathematically established map projection.

The State Plane Coordinate System, on the other hand, is a strictly scientific survey control system designed to provide basic control for topographic and other earth-science mapping operations. Established on a network of triangulation and traverse stations maintained by the National Geodetic Survey, this system transforms the spherical station coordinates of longitude and latitude into rectangular coordinates of eastings and northings on a plane surface. The strength of this system is that the plane surface is mathematically related to the surface of the earth, that is, to a mathematically defined spheroid which represents the geoid, and, therefore, makes it practicable to utilize the precise position data of the National Geodetic Survey control network for the reference and control of local surveying and mapping operations. A limitation of this system, however, is the relatively wide-spaced and inaccessible locations of the basic triangulation and traverse stations and the difficulties often encountered in the recovery and use of these stations.

Large-Scale Base Maps

The multipurpose cadastre is conceptually intended to integrate a wide variety of land information, ranging from earth science-related data such as flood hazard boundary line locations to cadastre-related data such as real property boundary line locations. For purposes of making decisions about land interests, this information should be collected, analyzed, and presented at a level of detail consistent with the individual proprietary parcel. These requirements call for base maps, in the form of topographic maps prepared to specified accuracy standards, as the second component of a multipurpose cadastre at scales significantly larger than generally available in the United States. Such large-scale maps must be true maps; that is, they must be compiled upon a mathematically correct map projection.

Cadastral Overlay

The third component of a multipurpose cadastre is the cadastral overlay. Preparation of this 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 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 legally acquired and transferred. The ownership parcels must be capable of being mapped at a specified level of accuracy.

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 of referring to a particular parcel without using a full legal description. There is general agreement that the identifier system should provide for the assignment of a unique identifying code to each parcel, should be easily understandable to the users of the system, should be capable of serving a variety of different uses, and should be reasonably permanent.

Land Information Files

The fifth and final 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 both natural and cultural features of the parcel. Perhaps the most familiar land information files are those of local land-title records systems and tax assessment and collections systems.

CONVERSION OF GRAPHIC DATA INTO A COMPUTER-COMPATIBLE FORMAT

Much of the current interest in multipurpose cadastres and in the modernization of land data systems has been centered on the use of electronic computers for the storage, manipulation, and retrieval of land related information. More recently, interest has focused on the use of computer-assisted graphic collection and display hardware for the reproduction of land information 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 topographic features and 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 that 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, called 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 that are related to some system of geometric control and that have at least three points for which an x-y coordinate pair can be determined. The coordinate system utilized may 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.

Map accuracy is an important consideration when digitizing. A digitizing system does not improve the accuracy of a map but only replicates the map features, including all inherent 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 include 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 digital 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 into 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 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. Coordinate geometry entry, however, incorporates all errors and discrepancies in the survey data entered into the system.

Once the initial map data are transformed into digital 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; information on the base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.

DESCRIPTION OF THE KENOSHA COUNTY AUTOMATED MAPPING AND LAND INFORMATION SYSTEM DATABASE

Following the procedural model of a multipurpose cadastre proposed by the National Research Council, the Regional Planning Commission and Kenosha County began in 1985 to develop an automated parcel-based land information database. The five major components of a multipurpose cadastre are incorporated into the Kenosha County Automated Mapping and Land Information System, building on programs of high-order survey control and large-scale topographic and cadastral mapping that have been in place in Kenosha County for several years. The remaining sections of this chapter will describe the important features of these five components as applied in Kenosha County and explain how each was assembled to make up the Kenosha County LIS database.

A Composite System for the Geodetic Reference Framework

From the preceding brief discussion of the United States 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 United States 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 location and conveyance of ownership rights in land. The other, the State Plane Coordinate System, is founded in the science of geodesy. This system 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 of these survey control systems have 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.[2] This ideal system includes the relocation and monumentation of all United States 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 United States 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.

The Kenosha County Automated Mapping and Land Information System is founded on this composite system of geodetic control. A survey control program of relocation, monumentation, and coordination of all United States Public Land Survey corners, initiated in 1966, was completed in Kenosha County in 1988. As a result of this program, relocated and remonumented corners were marked with reinforced concrete monuments with engraved bronze caps imbedded in the tops (see Figure 2). The bronze caps are inscribed with the corner notations: quarter section, town, and range. The program specifications also produced control station dossier sheets describing the monument, the state plane coordinates of the corner, the elevation of the monument, and other important characteristics (see Figure 3). Survey data from the program were summarized by means of control survey summary diagrams (see Figure 4). The Kenosha County survey control program, and its resultant products, combine the best features of the United States Public Land Survey System and the State Plane Coordinate System, thereby creating an ideal frame of reference for the establishment of a multipurpose cadastre.

The system of survey control in place in Kenosha County has several advantages as a geographic framework for land data systems. Among these benefits are: 1) the provision of an accurate system of control for the collection and coordination of cadastral data, 2) the provision of a common system of control for the collection and mapping of both cadastral and earth-science data, and 3) the ability to reproduce accurately and precisely upon the ground all boundary lines and area features that are entered into the database.

The geodetic reference framework is effectuated in the LIS database by establishing all spatial information on the Wisconsin State Plane Coordinate System, South Zone. Before any graphic information can be entered into the LIS database, a digital file must be created with spatial coordinates conforming to the State Plane Coordinate System. This digital file can be likened to an "empty" map sheet, with an x-y coordinate system onto which lines, points, and other graphic elements can be placed in order to build a map or spatial data file of an area.

The Kenosha County LIS is developed utilizing the United States Public Land Survey section as the primary unit of geographic reference. A digital file is first created in the computer for each section, using the State Plane Coordinates of the corners of the section as the map "space" for construction of the map. The digital file is

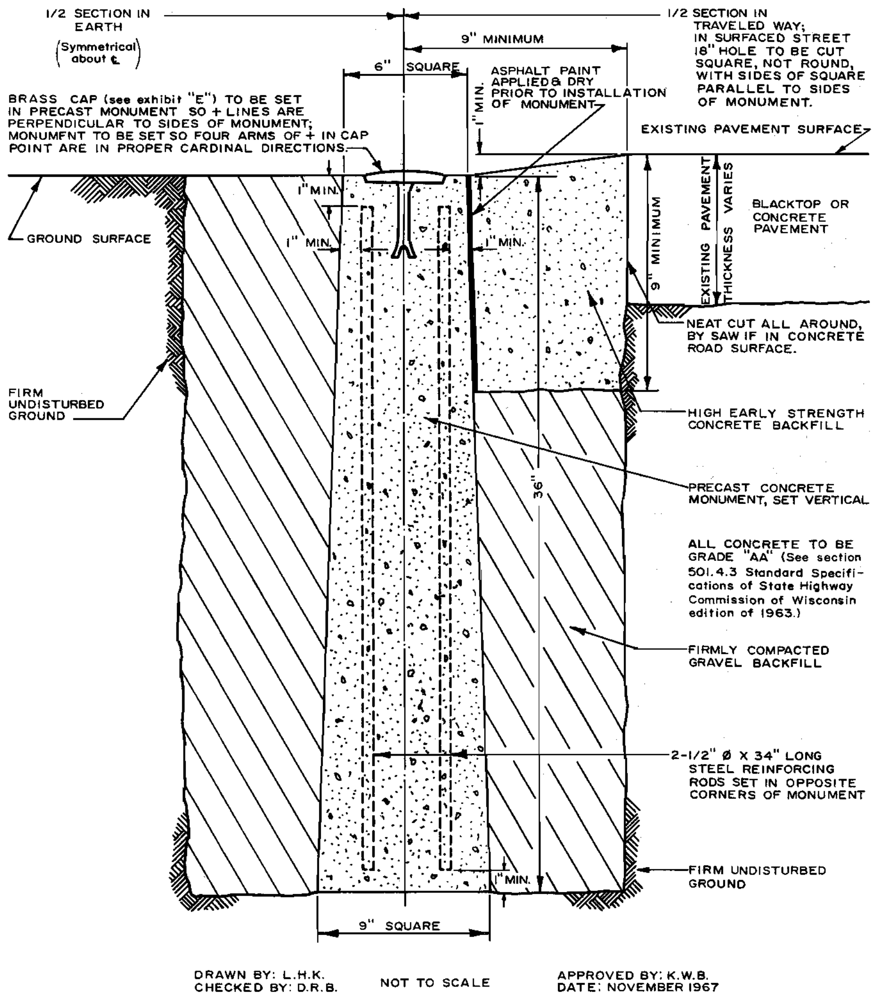
---

[2]*See K. W. Bauer, "Geometric Framework for Land Data Systems," Journal of the Surveying and Mapping Division, Proceedings of the American Society of Civil Engineers, Vol. 107, No. SU1, November 1981.*

therefore established on the State Plane Coordinate System as one element of the geodetic reference framework. Next, the northings and eastings of each section corner and quarter-section corner, obtained from the control survey records of the Kenosha County remonumentation program, are keyed into the digital file by coordinate geometry entry. This procedure creates point features in the digital map, representing the precise locations of the monumented section and quarter-section corners. These points serve as the basis for later entry of cadastral information about the section into the digital file, the points therefore tying the file to the United States Public Land Survey System, the other element of the composite geodetic reference framework.

Figure 2

DETAIL OF A MONUMENT INSTALLATION FOR SURVEY CONTROL STATIONS



Source: SEWRPC.

Base Map Features Obtained from Large-Scale Base Maps

In conjunction with the remonumentation, relocation, and coordination of all United States Public Land Survey section and quarter-section corners in its jurisdiction, Kenosha County has also undertaken a companion large-scale base mapping program to gather information about the basic geography of the County. The control survey work and attendant topographic mapping in Kenosha County have been carried out in accordance with a standard set of specifications developed by the Regional Planning Commission (see Map 1). These specifications call for the preparation of photogrammetrically compiled topographic maps that meet National Map Accuracy Standards at a scale of 1:2,400 (one inch equals 200 feet), with a vertical contour interval of two feet, with all maps based on the Commission specified combined survey control system.[3] The maps show all United States Public Land Survey quarter-section lines and corners established in the control survey in their correct position and orientation, together with the State Plane Coordinates of the corners and

---

[3]*Specifications have also been developed by the Regional Planning Commission for larger-scale (one inch equals 100 feet) topographic mapping. These specifications also recommend a vertical contour interval of two feet for the maps and are also based on the Commission specified combined survey control system. These larger-scale topographic maps are available for portions of Kenosha County, as well as portions of Milwaukee, Washington, and Waukesha Counties in Southeastern Wisconsin.*

Figure 3

A TYPICAL U. S. PUBLIC LAND SURVEY CONTROL STATION DOSSIER SHEET

RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION

U.S. PUBLIC LAND SURVEY CORNER 36|31 / 1|6 T 2 / 1 N, R 22 / 23 E, KENOSHA COUNTY, WIS.

GEODETIC SURVEY BY: AERO-METRIC ENGINEERING, INC. YEAR: 1988

STATE PLANE COORDINATES OF: TOWNSHIP CORNER
NORTH 219,199.94
EAST 2,582,897.38

ELEVATION OF STATION: 624.313

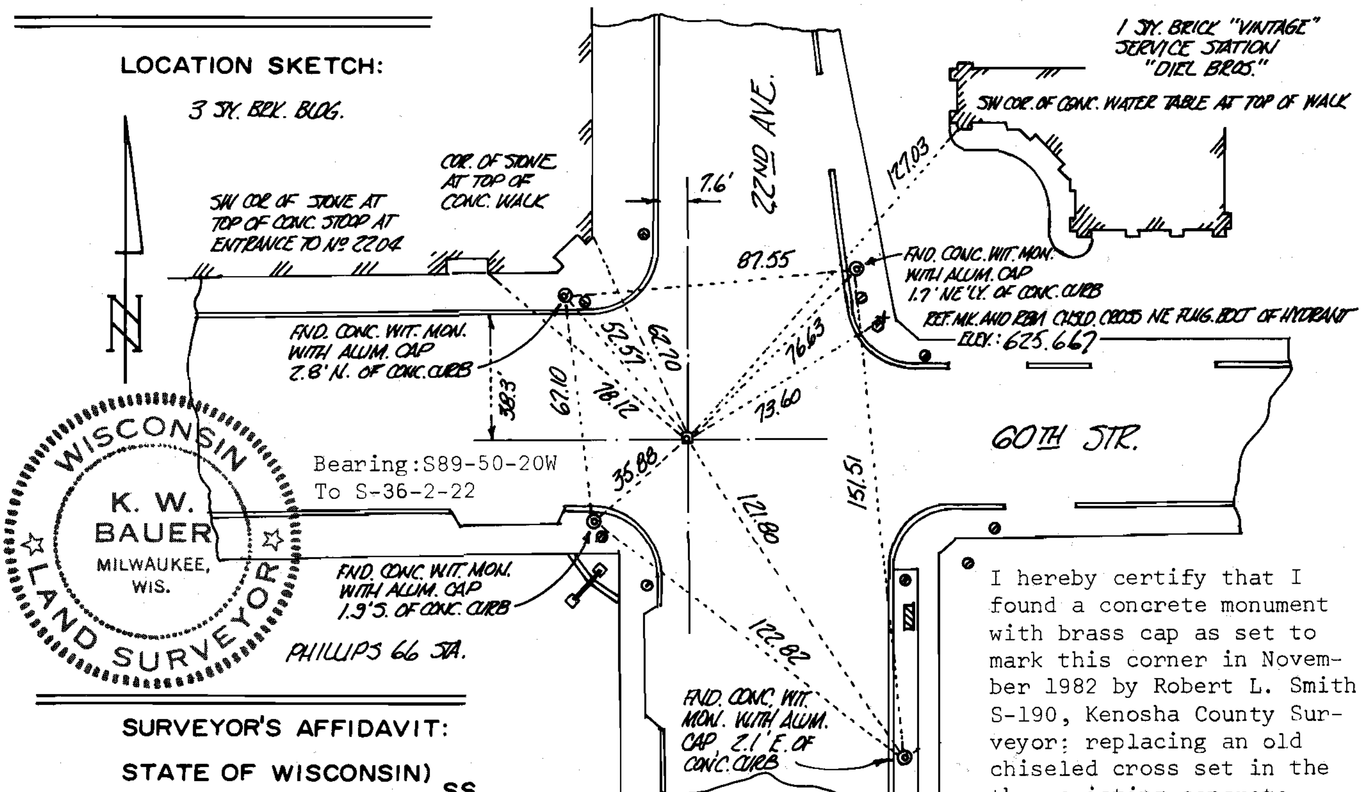
HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE

VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929

CONTROL ACCURACY: THETA ANGLE: + 1-29-14

HORIZONTAL: THIRD ORDER, CLASS I VERTICAL: SECOND ORDER, CLASS II

LOCATION SKETCH:



SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN)
 SS
WAUKESHA COUNTY)

I hereby certify that I found a concrete monument with brass cap as set to mark this corner in November 1982 by Robert L. Smith, S-190, Kenosha County Surveyor; replacing an old chiseled cross set in the then existing concrete pavement to mark this corner, said cross dating back at least to 1952, and said cross having been set following street reconstruction using ties to an old wood post found about 1915 by John G. Williams, Assistant City Engineer and former County Surveyor, during sewer excavation: said wood post being accepted by Mr. Williams as the township corner post set in November 1835 by John Brink, Deputy Surveyor, to originally mark this corner; and that I referenced the same as shown hereon.

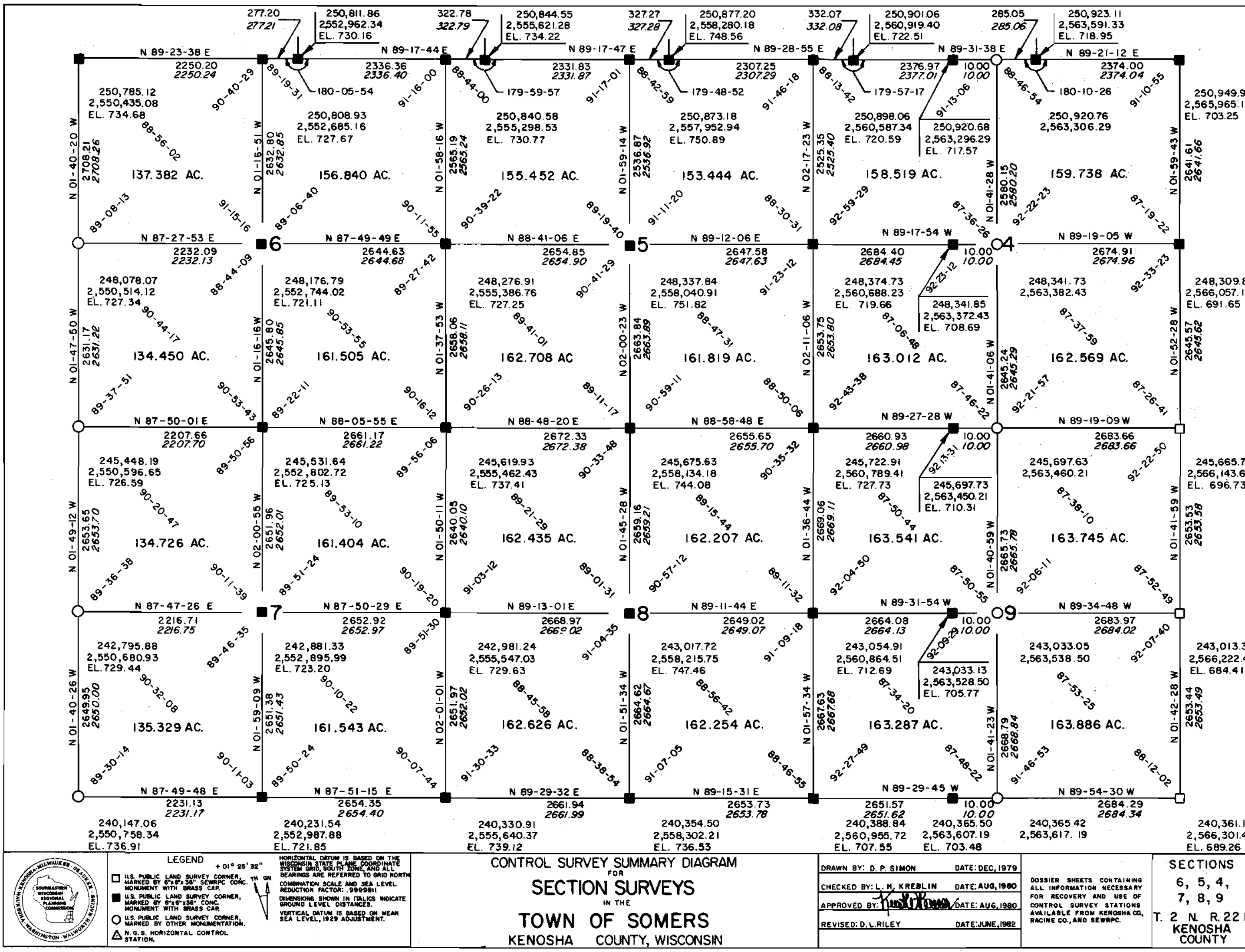
DATE OF SURVEY: 22 September 1988 Kurt W. Bauer S - 157
REV: 7 DECEMBER 1991 REGISTERED LAND SURVEYOR

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Source: SEWRPC.

Figure 4

A TYPICAL CONTROL SURVEY SUMMARY DIAGRAM



Source: SEWRPC.

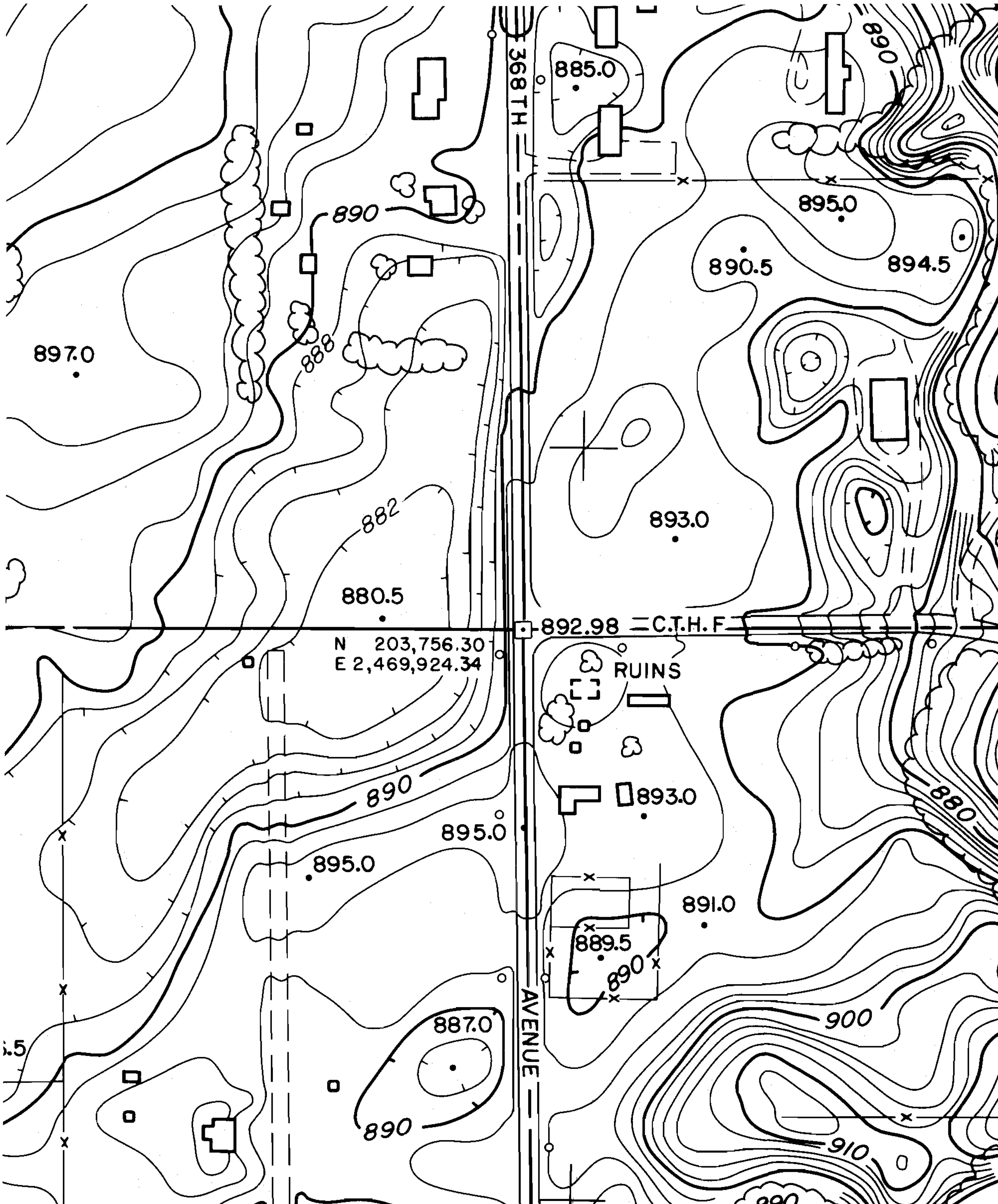
the grid and ground lengths and bearings of the one-quarter section lines. In addition, the maps display the usual contour information, as well as spot elevations, planimetric and hydrographic detail, structures and other cultural information, and State Plane Coordinate grid ticks.

Base map features are collected from the large-scale base maps and inserted into the LIS database by the previously described process of board digitization. The task begins by placing a one inch equals 200-feet-scale topographic map, which is produced on a dimensionally stable base material, onto a large-format digitizing board. A digital file, or "empty" map sheet, based upon the grid of the State Plane Coordinate System, is then created within the computer to receive the topographic information. After proper registration of the base map, the digitizer operator compiles the information into the graphic file by tracing the map features on the topographic map with the hand-held cursor.

Lines representing the boundaries of the mapped physical features are the primary type of graphic element gathered from the base maps. Some point features are also collected. When necessary, enclosed graphic polygons representing area features are generated from the boundary line features by computer processing.

Map 1

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



Shown here at drafted scale (1 inch equals 200 feet) is a portion of the topographic map prepared for Section 16 in the Town of Randall, Kenosha County. The figure is roughly centered on the center of the section and encompasses an area of approximately 50 acres, or about 8 percent of the area covered by the full map.

Source: SEWRPC.

Separation of base map features is achieved by establishing separate graphic files for each category of topographic information. As water lines are digitized, for example, they are inserted into a digital file or layer containing only water features. Additional feature separation is maintained by labelling each graphic element within the digital file. For example, stream boundary lines are differentiated from lake boundary lines within the water feature layer by this technique.

Textual information for the LIS database is also assembled for base map features during the digitization process. Separate digital files for feature text are produced, and the appropriate text is recorded into the digital file by keyboard entry. The result is a text file that is a companion to the boundary line file for a particular feature. Digitized water features such as streams and lakes, for example, will have an associated digital text file containing the names of those base map features, if available.

The base map component of the LIS database therefore consists of a series of digital map files, containing both topographic features and associated text features, all of which are properly related to the State Plane Coordinate System. The base map features include physical features such as water lines, street and highway pavement edges, railway lines, structures, and all affiliated text, as well as United States Public Land Survey geometry features such as section and quarter-section monument locations, section and quarter-section lines, and all bearings and grid and ground distances between monument locations. The inclusion of these natural and cultural features in the Kenosha County LIS facilitates automated mapping of the County and also provides a basis for the integration of other land-related information into the database.

Cadastral Map Features Obtained
from Large-Scale Cadastral Maps

The other principal product of the base mapping program conducted in Kenosha County are cadastral base sheets, which serve as the basis for large-scale cadastral mapping for the LIS database (see Map 2). The cadastral base sheets are dimensionally stable 1:2,400 (one inch equals 200-feet-scale) base maps, showing significant geometry features for each United States Public Land Survey section, including monument locations and coordinates, section and quarter-section lines, and grid and ground distances and bearings between monuments.[4] The base sheets also show other important planimetric and hydrographic details to aid in the construction of real property boundary lines, such as railway lines, electric power transmission lines, principal structures, wetlands, streams, and lakes. The large-scale cadastral maps prepared from these base sheets constitute the origin of the cadastral features acquired for the Kenosha County LIS database.

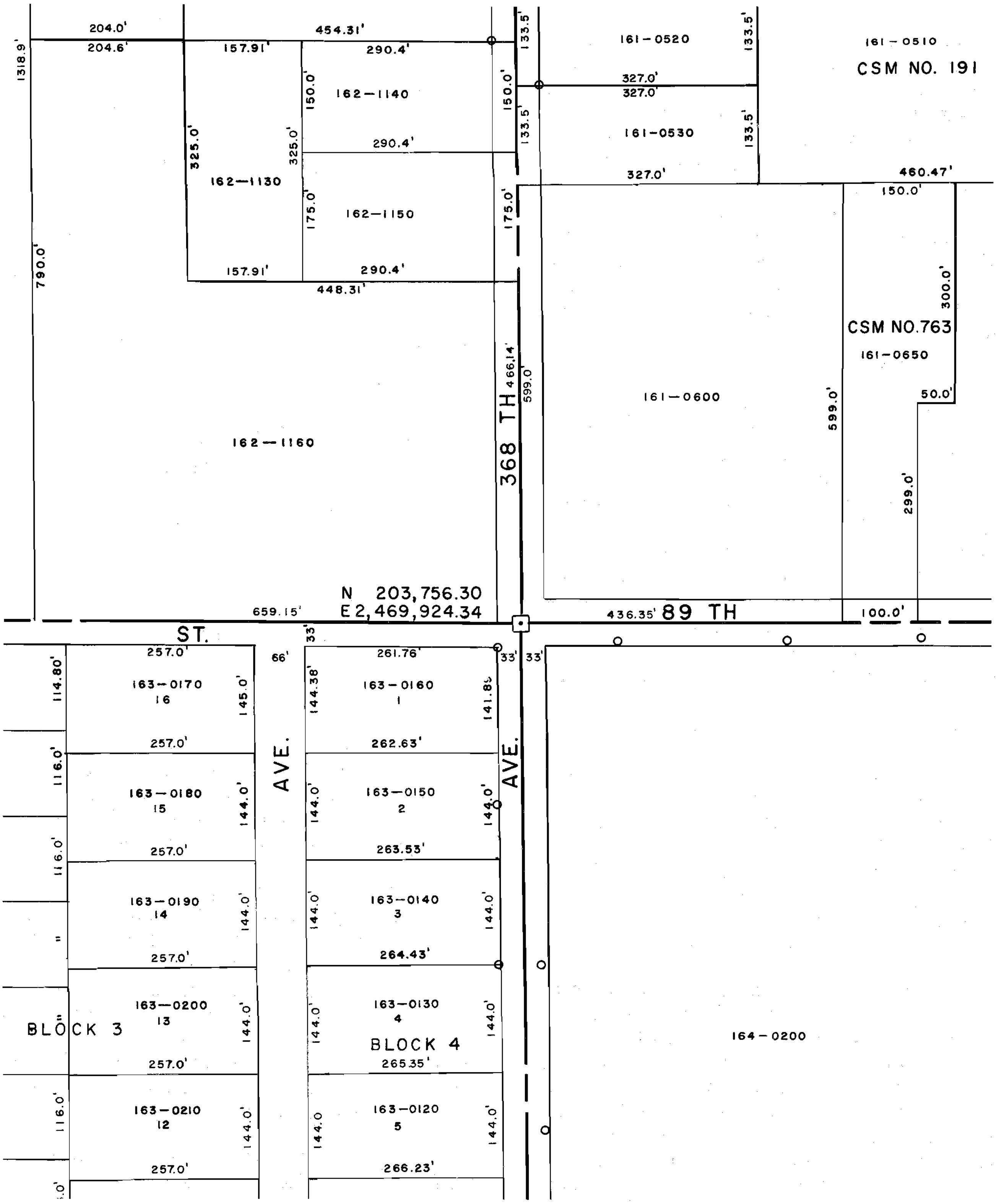
Compilation of the cadastral base maps is carried out to specifications prepared by the Regional Planning Commission and the work is performed by Commission staff. A variety of sources are used to locate the cadastral boundary lines and related information onto the base sheets. Real property boundary lines are placed on the base maps from source documents such as recorded subdivision plats and certified survey maps and from abbreviated legal descriptions taken from tax assessment records. Surveyor's field notes are also consulted as necessary. Public street, highway, and railway rights-of-way are located and aligned by examination of these documents and any available plats of right-of-way locations. In some cases, field surveys are conducted to relate the right-of-way locations to the United States Public Land Survey corners. Recorded easement descriptions are used to position major utility easements onto the cadastral base sheets.

The real property boundary lines and right-of-way and easement lines are manually drafted on the base maps in the same way a surveyor would construct those lines in the field. This is possible because of the framework of control provided by the known location of the United States Public Land Survey corners on the State Plane Coordinate System and the attendant known grid and

[4] *Cadastral base sheets at a scale of one inch equals 100 feet are available for those portions of Kenosha County and portions of other Southeastern Wisconsin counties that are covered by larger-scale (one inch equals 100 feet) topographic mapping. These larger-scale base sheets are not currently used in the development of the Kenosha County Automated Mapping and Land Information System, since this system is founded on one inch equals 200-feet-scale topographic and cadastral base maps.*

Map 2

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



Shown here at drafted scale (1 inch equals 200 feet) is a portion of the cadastral map prepared for Section 16 in the Town of Randall, Kenosha County. The figure is roughly centered on the center of the section and encompasses an area of approximately 50 acres, or about 8 percent of the area covered by the full map.

Source: SEWRPC.

ground lengths and grid bearings of all quarter-section lines. After extensive review and inspection, the finished cadastral base maps are ready for digitization.

Cadastral map features for the LIS database are obtained from the cadastral base maps in the same manner as physical features are taken from the topographic base maps. All line features are board digitized directly from the cadastral base maps, with similar cadastral features collected into separate graphics files in the database. Textual information for each feature category is key-entered into text map files. An example of a digitized cadastral map is shown on Map 3. The complete set of graphic and text files that contain the cadastral base map features make up the cadastral overlay component of the Kenosha County LIS database.

Parcel Identification Numbering System

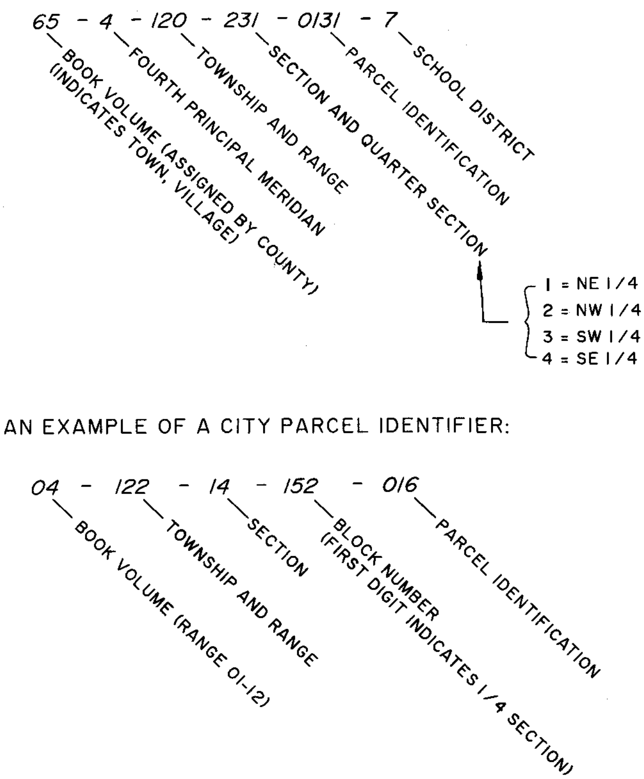
The parcel identification number provides the link between the cadastral maps, which show the location of a particular parcel, and the records, either computer-readable or traditional paper records, that contain information about the parcel. Two parcel identification schemes are utilized in Kenosha County, both maintained by the Kenosha County Assessor's office to keeping the records concerning the assessment of property for tax purposes. One of these schemes is used throughout Kenosha County except the City of Kenosha. The second scheme is used in the City of Kenosha only. Both schemes are directly relatable through modest computer programming effort to the Wisconsin Department of Revenue scheme recommended for use throughout the State. Both the schemes in use in Kenosha County are of a type known as "location identifier" and utilize the basic framework of the United States Public Land Survey System in the assignment of the parcel number. These schemes are illustrated in Figure 5.

Parcel identification numbers are incorporated into the Kenosha County LIS database in two ways. The first method is creation of a digital file for key-entry of the identification numbers as text for display purposes. This facilitates the automated mapping function of the Kenosha County LIS. The other method of incorporation requires generation of a closed polygon area feature for each cadastral parcel in the graphic computer files. After this procedure, the parcel number is key-entered and "attached" to the

Figure 5

KENOSHA COUNTY PARCEL-NUMBERING SYSTEM

AN EXAMPLE OF A COUNTY PARCEL IDENTIFIER:



Source: Kenosha County Assessor's Office.

graphic element to provide a unique identifier for that parcel. In this way the parcel identification number becomes a linkage mechanism between the graphical LIS database and other nongraphical parcel and land-related information files.

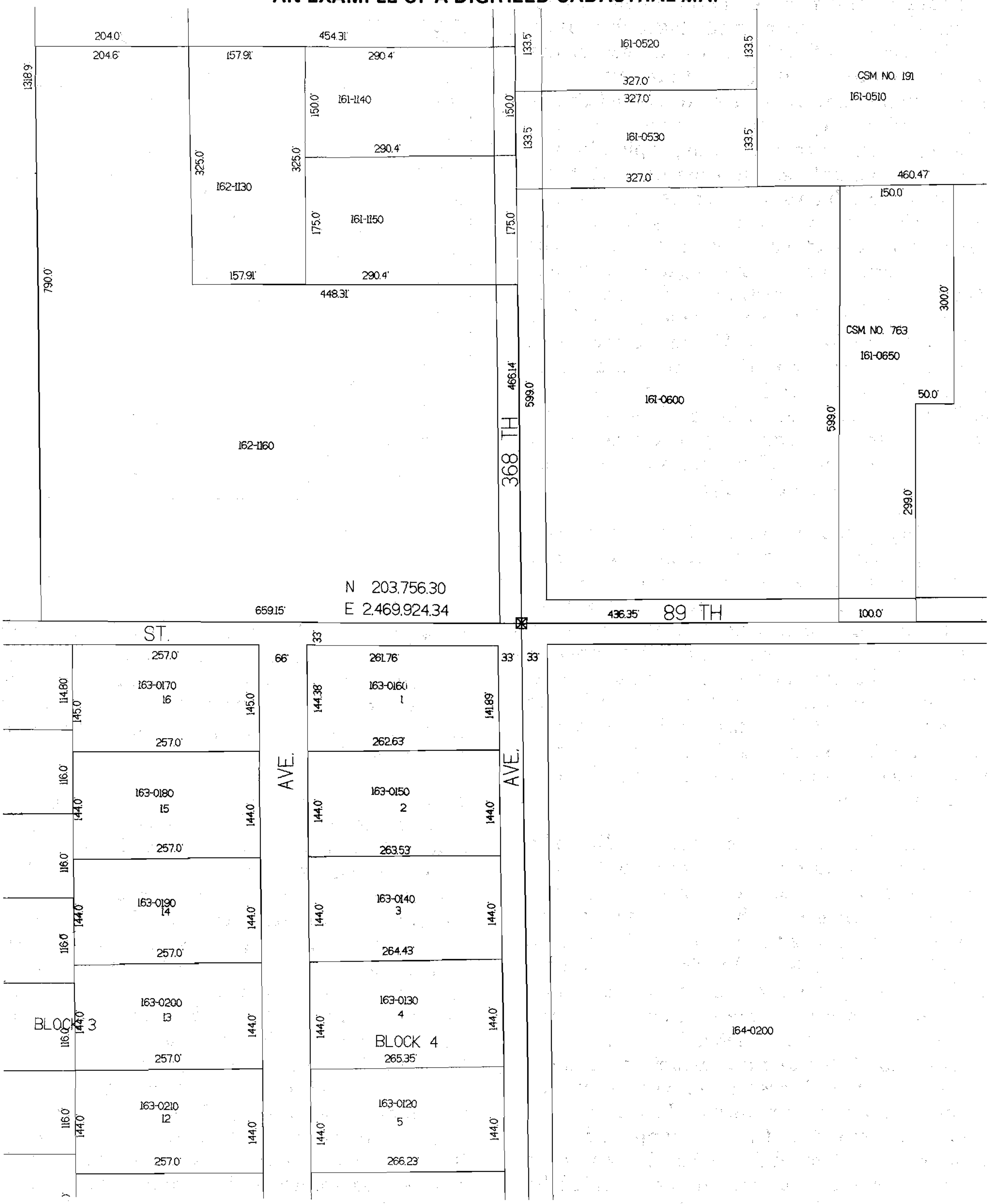
Associated Land Information Files

The final component of the Kenosha County LIS database consists of land-related files which contain information about the cadastral parcels. Five files of such information are presently incorporated into the database: 1) existing land use, 2) zoning districts, 3) soil units, 4) flood hazard areas, and 5) shoreland areas. All these land information files are graphic files maintained in the form of map overlays.

Land Use: The existing land use information developed for the Kenosha County LIS is derived from previously digitized land use maps prepared by the Regional Planning Commission.

Map 3

AN EXAMPLE OF A DIGITIZED CADASTRAL MAP



Shown here is a portion of the digitized cadastral map prepared for Section 16 in the Town of Randall, Kenosha County.

Source: SEWRPC.

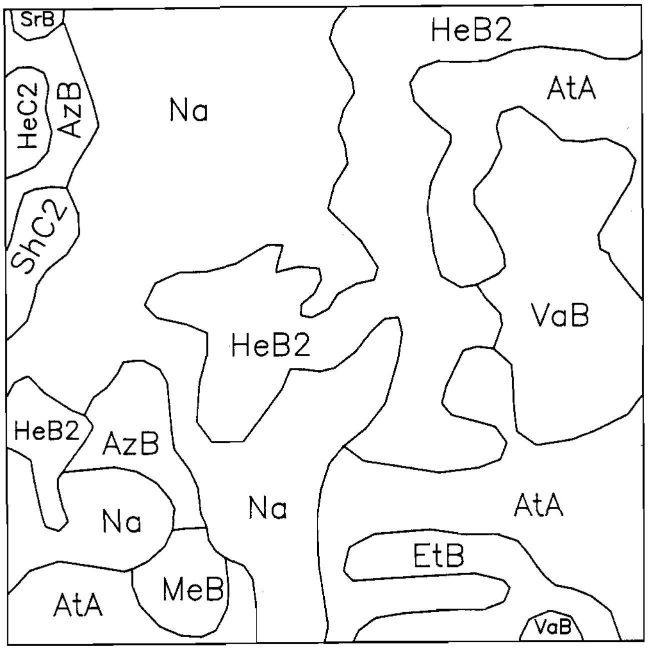
These maps were digitized from Commission interpreted 1:4,800 (one inch equals 400-feet-scale) ratioed and rectified aerial photographs, and are updated from new photography taken every five years by the Commission. Because the aerial photographs and digitized land use maps are coordinated and referenced to United States Public Land Survey section corners, it is only necessary to create copies of the graphic files to incorporate this data set into the LIS database. Some distortion due to relief exists in the aerial photographs, however, which may cause misalignment of boundary lines on the land use maps as compared to the higher-resolution cadastral maps. Accordingly, the cadastral maps are used to establish "ground truth" for the digital land use maps. Where discrepancies are noted between right-of-way and land/water boundary lines on the land use and cadastral maps, they are resolved in favor of the positions recorded on the cadastral map. These boundary lines and adjoining land use lines are adjusted accordingly on the graphic files.

Zoning Districts: The zoning district map overlays are prepared from source maps maintained by the County Planning and Zoning Department. A majority of the lines necessary to identify zoning district boundary lines in a survey section already exist as digitized lines in either the cadastral maps or the land use maps. Therefore a zoning district map overlay is prepared for the LIS database by "copying" appropriate line segments from the cadastral and land use maps and digitizing any additional line segments needed.

Soil Units: Soil information for the Kenosha County LIS database is taken from digital soils maps previously prepared by the Regional Planning Commission. The soil mapping unit boundaries were digitized from 1:15,840 (one inch equals 1,320-feet-scale) ratioed and rectified aerial photographs on which the soil mapping unit boundaries were delineated as part of the detailed soil survey conducted in Southeastern Wisconsin in 1963 under a contract between the United States Soil Conservation Service and the Regional Planning Commission. In this respect, it should be noted that the soil mapping did not follow "normal" United States Soil Conservation Service procedures, but procedures specified by the Commission with respect to the photo bases. An example of a digitized soil map is shown on Map 4. Since the photo maps and digital soils maps are also referenced to United States Public Land Survey section corners, they are in effect already integrated into the Kenosha County LIS, and it is only necessary to create copies of the graphic files for incorporation of the soils information into the database.

Map 4

AN EXAMPLE OF A DIGITIZED SOIL MAP



Source: SEWRPC.

Flood Hazard Areas and Shoreland Areas: Two water-related areas which often occur in conjunction with each other and which have implications for zoning administration are floodland and shoreland areas. Both of these areas are delineated and drafted onto the large-scale topographic base maps used for the Kenosha County LIS. The limits of the flood hazard areas for approximately half of Kenosha County are determined by detailed hydrologic and hydraulic engineering studies conducted under the Regional Planning Commission's comprehensive watershed planning programs. For the remainder of the County, flood hazard boundary lines are determined by examination of federal flood insurance data, which use both detailed engineering studies and approximation methods for floodplain boundary delineation. Shoreland boundaries are determined by certain specified statutory distances from waters assumed navi-

Table 1

AN EXAMPLE OF PROPERTY OWNERSHIP AND ASSESSMENT RECORDS

TAXT448S
15.05.36 06/25/91

REAL PROPERTY ASSESSMENT ROLL
TOWN OF SOMERS

PAGE 77

			---- PROPERTY SUBJ TO GEN PROP TAX ----					----- WTL/F.C. ----			- EXEMPT -	
PARCEL NAME/ADDRESS	SCHL	TAX KEY LEGAL DESCRIPTION	CD	ACRES	LAND	IMPRV	VALUE	CD	ACRES	VALUE	CD	ACRES
80-4-222-062-0170-0 OAKDALE ESTATES INC ROUTE 1 OAKDALE ESTATES STURTEVANT, WI 53177 VOL 1240 PAGE 0746	2793	80-4-222-062-0170-0 1ST STREET 90-H PT NW 1/4 SEC 6 T 2 R 22 CSM #1023 PARCEL B VOL 1171 P 863 19850.92 AC	A	.920	16600	85500	102100					
80-4-222-062-0200-0 VERNON D WOODWARD RT 1 BOX 402 STURTEVANT, WISC 53177 VOL 1069 PAGE 0064	2793	80-4-222-062-0200-0 301 120TH AV 00088 H N 50 AC S 1/2 FRAC'L NW 1/4 IN SEC 6 T2 R22 EX FOR HY AS IN 463 RECORDS PAGE 326 EX E 1315 FT EX N 15 FT EX E 50 FT	A	10.700	44200	69700	113900					
80-4-222-062-0250-0 ERVIN E & THERESA KOSER RT 1 OAKDALE ESTATES STURTEVANT, WI 53177	2793	80-4-222-062-0250-0 88-H-1 PT NW 1/4 SEC 6 T 2 R 22 COM 363 FT N OF SE COR TH CONT N 975.1 FT W 1315 FT S 975 FT E 1315 FT TO P.O.B. EX SE 2.5 AC PAR #88-H-2 ALSO EX E 3.91 AC PAR #88-H-3 1981 23 AC +-	B	23.000	167700	696300	864000					
80-4-222-062-0261-0 OAKDALE ESTATES INC RT 1 OAKDALE EST STURTEVANT, WI 53177	2793	80-4-222-062-0261-0 113TH AVENUE PT NW 1/4 SEC 6 T 2 R 22 BEG SE COR SD 1/4 SEC TH N 363 FT TO POB CONT N 480 FT W 267.67 FT S 150 FT W 62.44 FT S 330.11 FT E 330.11 TO BEG 1989 3.4 AC	D	3.400	4100	8500	12600					
80-4-222-062-0271-0 GARY S & NANCY KOSER RT 1 OAKDALE EST STURTEVANT, WI 53177	2793	80-4-222-062-0271-0 401 113TH AVE PT N 1/2 SEC 6 T 2 R 22 BEG SE COR OF NW 1/4 TH N 843.11 FT TO POB TH E 80 FT N 494.99 FT W 328.12 FT TO E'LY LN 13TH AV SW'LY 40 FT ALONG E'LY LN SD AV S 460.71 FT E 267.67 FT TO BEG V 1317 P 623 1989 3.94 AC	A	3.940	18400	174900	193300					
80-4-222-063-0100-0 OAKDALE ESTATES INC STURTEVANT, WISC 53177 VOL 1017 PAGE 0579	2793	80-4-222-063-0100-0 FRONTAGE RD 00089 H PT W 1/2 SEC 6 T2 R 22 BEG E & W 1/4 LN 337.34 FT E OF W 1/4 COR N 47.58 FT TO A PT OF BEG N 307.24 FT E 1899.73 FT S 665.42 FT W 1580 FT N 350 FT W 312.5 TO TO BEG	D E **	22.000 4.290 26.290	26400 1300 27700		26400 1300 27700					
80-4-222-063-0105-0 TOMMY A & DAWN M GREENO 403 120TH AVENUE STURTEVANT, WI 53177 VOL 1290 PAGE 0602	2793	80-4-222-063-0105-0 FRONTAGE 00089 H 2 PT W 1/2 SEC 6 T2 R22 BEG 337.34 FT E OF SW COR NW 1/4 (E LN I-94-#41) N 47.58 FT E 312.5 FT S 350 FT W 312.5 FT TO E LN RD N 302.42 FT TO BEG	A	2.500	24500	62000	86500					
80-4-222-063-0200-0 ROBERT HEIDERSDORF & WF RT 1 BOX 406 STURTEVANT, WISC 53177	2793	80-4-222-063-0200-0 7TH ST 00091 H S 1/2 SW FR'L 1/4 SEC 6 T2 R22 ALSO S 51 1/2 ACRES OF N 1/2 SW FR'L 1/4 SEC 6 EX FOR HY ALSO EX FOR HY AS IN 463 RECORDS PAGE 386, ALSO EX E 315 FT OF W 1755 FT OF S 290.4 FT OF SW 1/4	D E **	91.240 6.000 97.240	114400 1800 116200	3400 3400	117800 1800 119600					
80-4-222-063-0205-0 ROBERT HEIDERSDORF & WF 11518 7TH STREET STURTEVANT, WI 53177	2793	80-4-222-063-0205-0 11518 7TH ST 00091 H 4 PT SW 1/4 SEC 6 T2 R22 BEG 1590 FT E OF SW COR 1/4 N 290.4 FT W 150 FT S 290 4 FT E 150 FT TO BEG	A	.880	16200	63000	79200					

Source: Kenosha County Assessor's Office.

gable, perennial and intermittent streams as mapped by the U. S. Geological Survey being used as a surrogate for navigability, with some exceptions made for lands located adjacent to farm drainage ditches. Graphic files for the LIS database are prepared from these two features by board digitizing the floodland and shoreland boundary lines from the large-scale base maps.

Other Land Records Files: In addition to the graphic land information files as described above, there are a number of nongraphic land records files that can potentially be integrated into the Kenosha County LIS. Examples of these types of associated land information records are the property ownership and assessment records maintained as computer-readable files by the County Assessor (see Table 1). These files contain such information as an abbreviated legal description, owner's name and mailing address, property address, acreage of the property, and assessed value of the land and any improvements to that land. These records can be readily integrated into the LIS database using the linkage device of the parcel identification number, which is common to both the maps and the records. The only operational step required for this integration is proper programming access to the computer files of assessment records for the purpose of "reading" them.

SUMMARY

This chapter has described the concept of the multipurpose cadastre, which served as a model for the development of the Kenosha County Automated Mapping and Land Information System. A multipurpose cadastre can be conceptualized as a public, operationally and administratively integrated 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, 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.

Much of the information that would be incorporated within a multipurpose cadastre or an automated 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; information on base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.

Patterned after the procedural model of a multipurpose cadastre proposed by the National Research Council, the Kenosha County LIS incorporates five basic components into an automated parcel-based land information system. The first component, the geodetic reference framework, is a composite system that combines the best features of the United States Public Land Survey System and the State Plane Coordinate System to provide the geometric control necessary for development of the land information database. Physical features digitized from large-scale topographic base maps that are referenced to the geodetic network make up the second component of the LIS database. Cadastral map features, another element of the database, are collected from cadastral base maps that are also referenced to the geodetic framework. Compiled and manually drafted from a variety of source materials, these cadastral map features include real property boundary lines, right-of-way and easement lines, and all related dimensions and text. The fourth multipurpose cadastre component, the parcel identifier, uniquely locates the cadastral parcel and relates graphic information from maps with nongraphic information from other land-related records. The final component of the LIS database consists of land-related files containing information about the cadastral parcels. These are graphic files in the form of map overlays that show land use, zoning districts, soil units, and floodland and shoreland areas.

Chapter III

DESCRIPTION OF THE U. S. SOIL CONSERVATION SERVICE COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM

INTRODUCTION

This chapter introduces the Computer-Assisted Management and Planning System (CAMPS), a soil and water conservation planning tool developed by the U. S. Soil Conservation Service (SCS). Because CAMPS is based on electronic database technology, this chapter first provides some background on computerized database management systems. The chapter then describes the CAMPS database by explaining the features and development of the national CAMPS and Wisconsin CAMPS. The chapter concludes with a description and discussion of the geographic locators used in the two CAMPS systems.

BACKGROUND ON DATABASE MANAGEMENT SYSTEMS

A database can be defined simply as a body of information that is organized for ease of reference. Some common examples of databases are telephone books, city directories, and address books. The information stored in these databases is usually in the form of a table, with the information arranged in rows and columns for easy reference.

Electronic computers have made it possible to automate traditional paper databases and to allow more efficient organization and manipulation of database information. Computerized databases are often controlled by computer programs and systems called database management systems. These systems are powerful tools for managing data, for with these systems large amounts of information can be stored and related and retrieved quickly and efficiently. The systems can reorder, retrieve, and display data based on user-specified criteria. Database management systems vary in the way that they organize and manage information, ranging from simple single-table systems to complex systems that store data in many interrelated tables.

Simple Database Management Systems

At one end of a spectrum are simple database management systems, or flat-file systems. In these types of systems, data are organized into a simple table or into loosely structured groups of tables. The tables are arranged much like a common address book, with rows and columns of information. The entries for each row of data correspond to all the information about an individual, for example, and the entries for each column of data correspond to items of information about individuals, such as name, address, zip code, and telephone number. Flat-file database management systems access data by physically searching rows and columns in the table until the proper information is found. For many database applications, this simple table format provides an adequate scheme for data management.

The simplicity of flat-file databases is a major drawback, however, when dealing with large amounts of data. The structure of single-table databases, for example, can be inflexible, since only a fixed number of data items can be included in each row of data. Also, the same data item, such as zip code, may need to be added to every row of data, creating a redundancy that represents an inefficient use of computer storage space. Updating the information in a flat-file system can also be inefficient, because modifying a data item may require identical changes to be executed on several rows in the table. Simple flat-file systems, therefore, are generally not practical for use in solving complex database management problems.

Relational Database Management Systems

In contrast to simple flat-file systems, relational database management systems are comprised of several data storage tables that are designed to relate to each other in various specified ways. This multi-table approach calls for the database system to classify data into associated categories, group the data into tables, and then link the tables together in an efficient manner. Data are accessed logically rather than physically in relational database management systems. This means that data are selected by relational names and values, and not by explicitly searching through rows and columns in each table. The system, rather than the user, determines the most effective way to organize and access data in many of the more complex relational database systems.

A good application of the use of multiple, interrelated tables is an address list. Although the list may include thousands of items, there need to be at most 50 state names to match all those addresses. A relational database management system can solve this problem by creating one table with 50 entries corresponding to the various states, and then linking each address from other tables to the proper entry in the state table. City names or zip codes can also be grouped together into tables, and can be accessed by links or pointers from other address tables within the database management system.

Relational database management systems have many advantages over simple single-table systems. In addition to reducing data storage requirements, the relational systems are more flexible, since they permit tables and records to be expanded as needed. Many of the systems allow new relations to be created from existing tables without modifying the structure of the tables. Multi-table systems are also readily updated, since a change made in one place in the database is also made in every related place. Relational databases are in general more powerful than simple database systems because they have the ability to handle greater amounts of information both quickly and efficiently.

DESCRIPTION OF THE COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM DATABASE

To support the work of its local field offices, the U. S. Department of Agriculture, Soil Conservation Service, has developed the Computer-Assisted Management and Planning System. In Wisconsin, this comprehensive software system is used as a soil and water conservation planning tool by the SCS and county Land Conservation Departments (LCD) in local field offices. Recently, CAMPS has been expanded to encompass two distinct databases: national CAMPS and Wisconsin CAMPS. The two CAMPS databases complement each other, permitting SCS and LCD field offices in Wisconsin to better meet their resource management and information requirements.

National CAMPS[1]

The U. S. Soil Conservation Service has developed the national version of CAMPS to assist its local field offices in working with farmers and ranchers in all parts of the United States. CAMPS consists of an integrated set of software tools built around a relational database management system and is designed to combine cooperator case files with local soils information. Using this management system, conservation field office staffs can retrieve information about individual land users or groups of users and quickly relate this information to existing and planned land uses and management practices to determine their effect on soil loss. Other types of soils information can also be retrieved upon request. CAMPS also helps local SCS and LCD field offices carry out daily tasks such as managing information about farm fields and resources, maintaining lists of clients and cooperators, and preparing farm conservation plans. Software utilities in CAMPS can also generate detailed reports and prepare and print public information mailings.

The nucleus of CAMPS is a powerful relational database management system. Two variations of relational database systems are used for CAMPS, each tailored to a specific type of computer system. The majority of CAMPS installations utilize a database management system known as "R:BASE System V." This database system is suited for personal computers using the DOS computer operating system. The other variation of CAMPS is built around a relational database system called "Prelude," and is designed for small and mid-sized computers employing the UNIX computer operating system. The two variations of CAMPS are similar in design and operation, since each uses the traditional relational approach of tables, rows, and columns for storage and access of data.

The various tables that hold and manage data for CAMPS are divided into two major data sets, designated as the Client Operating Records (COR) and SOIL databases. Information about cooperators and their agricultural practices is contained in the COR database (see Figure 6). The types of information in this database include operator and farm identification

[1] *For more detailed information about national CAMPS see: USDA Soil Conservation Service Field Office Support Staff, CAMPS MS-DOS 1.5 User's Manual, Fort Collins, Colorado, 1989.*

Figure 6

A PORTION OF THE SCHEMA DIAGRAM FOR THE CAMPS COR DATA SET ILLUSTRATING TABLE STRUCTURE AND CONTENT

Operating Unit Information

Table: opunit

opid	TEXT	12
opunitnm	TEXT	40
comunity	TEXT	25
status	INTEGER	
oplocode	TEXT	4
opcdcode	TEXT	3
opcntycd	TEXT	3
opnotes	NOTE	
ownedac	INTEGER	
leasedac	INTEGER	
coopdate	DATE	
priority	TEXT	2
farmtype	TEXT	2
opssaid	TEXT	3

Table: notes

opid	TEXT	12
notetype	TEXT	1
notedate	DATE	
noteindv	TEXT	3
notentry	NOTE	
notetrct	TEXT	7
fmo	INTEGER	
fyr	INTEGER	

Table: opperson

personid	INTEGER	
opid	TEXT	12
position	TEXT	1
authorty	TEXT	1

Table: person

personid	INTEGER	
lname	TEXT	20
frstname	TEXT	12
mname	TEXT	10
sufname	TEXT	5
title	TEXT	4
phone1	TEXT	14
phone2	TEXT	14
addr1	TEXT	25
addr2	TEXT	20
city	TEXT	15
state	TEXT	2
zip	TEXT	10
pstatus	INTEGER	
persnkey	TEXT	10

Table: tract

countycd	TEXT	3
tract	TEXT	7
opid	TEXT	12
ascsnum	TEXT	7
tractdes	TEXT	40
tractac	REAL	
cropac	REAL	
ircropac	REAL	
sodswamp	TEXT	1

Field Inventories

Table: field

opid	TEXT	12
tract	TEXT	7
fldnum	TEXT	4
fldac	REAL	
landuse	TEXT	4
wshed	TEXT	25
invdate	DATE	
loccode	TEXT	4

Table: fsoil

opid	TEXT	12
tract	TEXT	7
fldnum	TEXT	4
ssaid	TEXT	3
musym	TEXT	5
musymac	REAL	
slope	REAL	
slopelen	INTEGER	
cfact	REAL	
pfact	REAL	
kfact	REAL	
rfact	INTEGER	
tfact	INTEGER	
usleloss	INTEGER	
usleei	REAL	

Table: ffeature

opid	TEXT	12
tract	TEXT	7
fldnum	TEXT	4
fldfcode	TEXT	4
fldfac	REAL	
fldfdate	DATE	
fldfindv	TEXT	3
fldfdesc	NOTE	

Conservation Planning

Table: planrms

opid	TEXT	12
tract	TEXT	7
planduse	TEXT	4
rmsflds	TEXT	40
rmsindv	TEXT	3
rmsnar	NOTE	
rmsstart	DATE	
rmsend	DATE	

Table: plannar

opid	TEXT	12
pcode	TEXT	6
varnum	INTEGER	
narid	TEXT	2
addnar	NOTE	

Table: planaply

opid	TEXT	12
pcode	TEXT	6
varnum	INTEGER	
planduse	TEXT	4
tract	TEXT	7
fldnum	TEXT	4
helprct	TEXT	4
planindv	TEXT	3
planamt	REAL	
pmo	INTEGER	
pyr	INTEGER	
aplyamt	REAL	
aplydate	DATE	
aplyindv	TEXT	3
finproj	TEXT	3
clascode	TEXT	2
loccode	TEXT	4

FSA Tracking

Table: ad1026

ad1026no	INTEGER	
cropyear	INTEGER	
personid	INTEGER	
rcvdate	DATE	
agcyfrom	TEXT	4
quest6	TEXT	1
quest7	TEXT	1
quest8	TEXT	1
fsaprty	TEXT	2

Table: cpa026

ad1026no	INTEGER	
countycd	TEXT	3
tract	TEXT	7
ascsnum	TEXT	7
cdcode	TEXT	3
ssavail	TEXT	1
date026	DATE	
planaprv	TEXT	1
tracthel	TEXT	1
tractsod	TEXT	1
tracthyd	TEXT	1
appealdt	DATE	
redetdt	DATE	
findetdt	DATE	
qual26dt	DATE	

Public Information

Table: maillist

title	TEXT	4
lname	TEXT	20
frstname	TEXT	12
minit	TEXT	1
sufname	TEXT	5
salut	TEXT	25
addr1	TEXT	25
addr2	TEXT	20
city	TEXT	15
state	TEXT	2
zip	TEXT	10
mname	TEXT	10
affpos	TEXT	30
personid	INTEGER	

Table: affpersn

personid	INTEGER	
affcode	TEXT	4
affpos	TEXT	30

Table: affcodes

affcode	TEXT	4
affname	TEXT	40

Table: letters

ltrkey	TEXT	8
ltrdesc	TEXT	20
prgph1	TEXT	450
prgph2	NOTE	
prgph3	TEXT	200
signame	TEXT	30
sigtitle	TEXT	40

Planning Lookup Tables

Table: practice

pcode	TEXT	6
pname	TEXT	50
punit	TEXT	6
agency	TEXT	6
reptype	TEXT	1
mastrfg	TEXT	1

Table: practnar

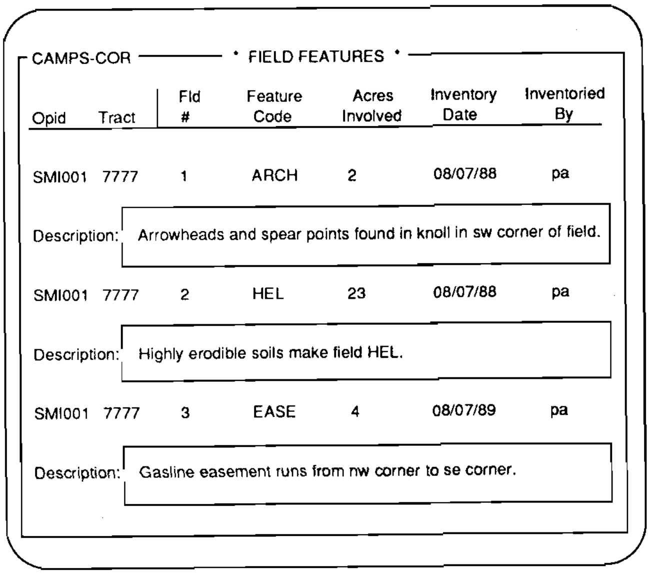
pcode	TEXT	6
narid	TEXT	2
pnar	NOTE	

Source: U. S. Soil Conservation Service.

numbers, field inventories, conservation planning data, and farm program monitoring data. Most of the information in the COR database is key entered by SCS or LCD field office staff through electronic data entry forms offered by the CAMPS software. An operator may chose to enter information about farm fields, for example, and the system will display a data entry form on the computer monitor (see Figure 7). After all pertinent information is entered via the keyboard, CAMPS will store each item in an appropriate table, where the data can be retrieved as necessary. The remainder of the information in the COR database consists of material such as prewritten forms and narratives, together with relational look-up tables used by CAMPS to find information referenced by codes or values.

Figure 7

AN EXAMPLE OF A DATA-ENTRY SCREEN THAT THE CAMPS SOFTWARE DISPLAYS ON A COMPUTER MONITOR



Source: U. S. Soil Conservation Service.

Soil survey information is contained in the SOIL database, the other major data set in CAMPS (see Figure 8). This database is derived from several soils and natural resources databases maintained by the U. S. Soil Conservation Service and other federal agencies. The SOIL database is also a portion of the State Soil Survey Database located in SCS state offices. Although the SOIL database is part of a comprehensive statewide database, it can be customized to meet the conditions of local SCS offices. State SCS personnel are able to adjust crop yields, soil interpretations, and descriptions to adapt the SOIL database to reflect local field office conditions. By integrating detailed soils information from the SOIL database with operator records from the COR database, CAMPS provides the information necessary to assist local SCS and LCD field offices with conservation planning and program management.

Wisconsin CAMPS[2]

Developed and supported by the SCS, the national version of CAMPS has been designed as a general purpose management system suitable for land conservation planning in all regions of the United States. In practice, CAMPS has proven to be a valuable conservation tool. Nevertheless, some shortcomings have been noticed in the system, and some parts of CAMPS have not worked satisfactorily. Some important data management features have been overlooked in the software. As a result, many SCS and LCD field offices use CAMPS in a limited fashion, while others do not use it at all.

Recognizing the need to adapt CAMPS to local conditions, the SCS has designed the software system to allow for additions and enhancements. The "state and local options" component of CAMPS permits the software to be modified to suit local requirements, while at the same time maintaining the compatibility of the system with future revisions of CAMPS. In Wisconsin, representatives of several state and county agencies involved in conservation programs joined together in 1988 to assess their data management needs, and collectively decided to expand CAMPS to fit conditions within the State. The participating agencies, the Wisconsin Department of Natural Resources; the Wisconsin Department of Agriculture, Trade and Consumer Protection; the Wisconsin Association of Land Conservation Employees; and the SCS, established a design team to work jointly with the staff of the original CAMPS development team. Together these developers enhanced and expanded the capabilities of CAMPS, creating an improved conservation planning system known as Wisconsin CAMPS.

The Wisconsin version of CAMPS is a single data management system that has been designed to serve the information needs of various state and county conservation agencies. Wisconsin CAMPS improves on the capabilities of the national CAMPS in several ways. Some of the enhancements include: 1) an expanded section for field inventory and management, with field locators and inventory conditions, 2) a section for sediment delivery inventory and management, 3) sections for streambank erosion

[2]*For more detailed information about Wisconsin CAMPS see: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; Wisconsin Association of Land Conservation Employees; and U. S. Soil Conservation Service, Wisconsin CAMPS Version 2.0 User's Manual, Madison, Wisconsin, 1990.*

Figure 8

A PORTION OF THE SCHEMA DIAGRAM FOR THE CAMPS SOIL DATA SET ILLUSTRATING TABLE STRUCTURE AND CONTENT

Soil Survey Area Tables

Table: ssarea		
state	TEXT	2
ssanum	TEXT	5
stssaid	TEXT	5
ssaid	TEXT	3
ssaname	TEXT	80
ssaacres	INTEGER	
cordate	TEXT	5
edstat	TEXT	4
eddate	DATE	
comment	NOTE	

Table: ssacoac		
stssaid	TEXT	5
cntycode	TEXT	3
cntyname	TEXT	20
sacoac	INTEGER	

Table: stssarea		
stssaid	TEXT	5
ssaid	TEXT	3
ssacfact	INTEGER	
ssarfact	INTEGER	

Map Unit Tables

Table: mapunit		
stssaid	TEXT	5
ssaid	TEXT	3
musym	TEXT	5
muid	TEXT	8
muname	TEXT	110
mukind	TEXT	1
mlra	TEXT	4
primfml	TEXT	1
muacres	INTEGER	

Table: mucoacre		
stssaid	TEXT	5
muid	TEXT	8
cntycode	TEXT	3
mucoacre	INTEGER	

Table: helclass		
stssaid	TEXT	5
muid	TEXT	8
helcfact	REAL	
helrfact	INTEGER	
muwndhel	TEXT	1
muwathel	TEXT	1
muhelcl	TEXT	1

Table: muyld		
stssaid	TEXT	5
muid	TEXT	8
cropname	TEXT	30
nirryld	REAL	
irryld	REAL	

Table: inclusn		
stssaid	TEXT	5
muid	TEXT	8
inclsoil	TEXT	50
inclpct	INTEGER	
hydric	TEXT	1

Table: stmu		
stssaid	TEXT	5
muid	TEXT	8
elevl	INTEGER	
elevh	INTEGER	
pptl	INTEGER	
ppth	INTEGER	
ffsl	INTEGER	
ffsh	INTEGER	
intensty	TEXT	2

Component Tables

Table: compoon		
stssaid	TEXT	5
muid	TEXT	8
musym	TEXT	5
compname	TEXT	30
seqnum	INTEGER	
s5id	TEXT	6
comppct	INTEGER	
slopel	INTEGER	
slopeh	INTEGER	
surftex	TEXT	8
otherph	TEXT	40
compkind	TEXT	1
compacre	INTEGER	
clascode	TEXT	20
anflood	TEXT	5
anflodur	TEXT	11
anflobeg	TEXT	3
anfloend	TEXT	3
gsflood	TEXT	11
gsflodur	TEXT	5
gsflobeg	TEXT	3
gsfloend	TEXT	3
wtdepl	REAL	
wtdeph	REAL	
wtkind	TEXT	5
wtbeg	TEXT	3
wtend	TEXT	3
pnddepl	REAL	
pnddeph	REAL	
pnddur	TEXT	11
pndbeg	TEXT	3
pndend	TEXT	3
rockdepl	INTEGER	
rockdeph	INTEGER	
rockhard	TEXT	5
pandepl	INTEGER	
pandeph	INTEGER	
panhard	TEXT	5
subinitl	INTEGER	
subinith	INTEGER	
subtotl	INTEGER	
subtoth	INTEGER	
hydgrp	TEXT	3
frostact	TEXT	8
drainage	TEXT	5
hydric	TEXT	1
corcon	TEXT	8
clnirr	TEXT	1
clirr	TEXT	1
sclnirr	TEXT	2
sclirr	TEXT	2

Table: interp		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
grpcode	TEXT	2
rating	TEXT	2
restctl	TEXT	2
restct2	TEXT	2
restct3	TEXT	2

Table: compyld		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
cropname	TEXT	30
nirryld	REAL	
irryld	REAL	

Table: wlhabit		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
wlgrain	TEXT	9
wlgrass	TEXT	9
wlherb	TEXT	9
wlhard	TEXT	9
wlconif	TEXT	9
wlshrub	TEXT	9
wlwetplt	TEXT	9
wlshlwat	TEXT	9
wlopen	TEXT	9
wlwood	TEXT	9
wlwet	TEXT	9
wlrange	TEXT	9

Table: windbrk		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
plantsym	TEXT	8
wndbrkht	INTEGER	

Table: stcomp		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
aspect	TEXT	5
slopeshp	TEXT	2
slopepos	TEXT	5
geomorph	TEXT	5
landform	TEXT	7

Table: woodland		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
suitcode	TEXT	2
plantsym	TEXT	8
sitind	INTEGER	
woodprod	INTEGER	

Table: woodmgt		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
ordsym	TEXT	3
wderosn	TEXT	8
wdequip	TEXT	8
wdseed	TEXT	8
wdwind	TEXT	8
wdplant	TEXT	8

Table: forest		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
plantsym	TEXT	8
plantcov	INTEGER	

Table: plantcom		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
plantsym	TEXT	8
plantpct	INTEGER	

Table: rsprod		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
rsid	TEXT	10
rsname	TEXT	50
prodfav	INTEGER	
prodnorm	INTEGER	
produnfv	INTEGER	

Layer Tables

Table: layer		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
s5id	TEXT	6
layernum	INTEGER	
layerid	INTEGER	
laydepl	INTEGER	
laydeph	INTEGER	
texture	TEXT	23
kfact	REAL	
tfact	INTEGER	
weg	TEXT	2
inch101	INTEGER	
inch10h	INTEGER	
inch31	INTEGER	
inch3h	INTEGER	
no41	INTEGER	
no4h	INTEGER	
no101	INTEGER	
no10h	INTEGER	
no401	INTEGER	
no40h	INTEGER	
no2001	INTEGER	
no200h	INTEGER	
clayl	INTEGER	
clayh	INTEGER	
lll	INTEGER	
llh	INTEGER	
pil	INTEGER	
pih	INTEGER	
unified	TEXT	20
aashto	TEXT	19
aashind	REAL	
awcl	REAL	
awch	REAL	
bdl	REAL	
bdh	REAL	
oml	REAL	
omh	REAL	
phl	REAL	
phh	REAL	
salinl	INTEGER	
salinh	INTEGER	
sarl	REAL	
sarh	REAL	
cecl	REAL	
cech	REAL	
caco3l	INTEGER	
caco3h	INTEGER	
gypsuml	INTEGER	
gypsumh	INTEGER	
perml	REAL	
permh	REAL	
shrinksw	TEXT	10

Table: stlayer		
stssaid	TEXT	5
muid	TEXT	8
seqnum	INTEGER	
layernum	INTEGER	

Source: U. S. Soil Conservation Service.

controls and barnyard runoff controls, and 4) two sections that track information about farmland preservation and other land owner/ operator programs. Wisconsin CAMPS also includes additional software tools to generate reports and mailing lists.

To accommodate these enhancements, Wisconsin CAMPS contains many new and expanded tables. The COR database from CAMPS has been enlarged with completely new look-up tables and some augmented data tables. A major new database, named H2OQUAL, has also been added for Wisconsin CAMPS. This database is comprised of the data and look-up tables needed for streambank management, farmland preservation participation, and other state and county conservation programs. The Wisconsin CAMPS software complements CAMPS by operating "on top of" the parent system. This is possible because Wisconsin CAMPS has been built on the DOS/R:BASE variation of CAMPS, the system used in the vast majority of SCS and LCD field offices in Wisconsin. To access Wisconsin CAMPS, field office personnel choose the "state and local options" alternative within CAMPS to reach the Wisconsin Program Management modules of the software (see Figure 9). From this point, an operator can select a module and key-enter information on data entry forms or retrieve and print information from the data tables. Wisconsin CAMPS is designed to function transparently within CAMPS, managing and integrating conservation data for state and local programs.

Figure 9

AN ILLUSTRATION OF THE SCREEN MENU STRUCTURE IN THE CAMPS SOFTWARE THAT LEADS TO ACCESS OF WISCONSIN CAMPS

```
WISCONSIN PROGRAM MANAGEMENT MENU

CAMPS MAIN MENU
(2) Inventory and Evaluate

    INVENTORY AND EVALUATE
    (7) State and Local Options

        WISCONSIN PROGRAM MANAGEMENT Ver 2.0
        (1) Inventory and Planned USLE
        (2) Barnyard and Manure Management
        (3) Streambank Management
        (4) Farmland Preservation
        (5) Program Participation
        (6) Record Notes/Contacts
        (7) Summary Reports
        (8) Change Opunit
```

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; Wisconsin Association of Land Conservation Employees; and U. S. Soil Conservation Service.

GEOGRAPHIC LOCATORS IN CAMPS[3]

Both CAMPS and Wisconsin CAMPS can be described as nonspatial databases that contain spatial data. This apparent contradiction can be explained by noting that the data in CAMPS do not contain x-y coordinates, and therefore are nonspatial or nongraphic; nevertheless, they do contain information or attributes about areas and locations. Since the databases lack coordinate information, they do not have any inherent boundary line information and consequently cannot reference lines or areas by drawing these features. In this respect, the data in CAMPS are nonspatial. On the other hand, much of the information in CAMPS is composed of facts and records about farms, fields, or other specific locations. The data are in this respect spatial characteristics that can be managed in a tabular relational database, such as the database management system used in CAMPS, or they can potentially be linked to an automated spatial database to furnish attribute information about geographic locations.

Although the information contained in CAMPS is nonspatial by nature, there are many geographic locators contained in the data. These locators, consisting of user-defined codes or text, are data items that reference geographic locations. Rather than explicitly describing a point by its position or an area by its boundary, the geographic locators refer to these locations on other documents, such as maps or aerial photos. For example, one of the geographic locators in CAMPS is an identifier for watersheds. In order to use this identifier, conservation personnel can assign farms to certain watersheds based on drainage boundaries delineated on topographic maps or other sources. The watershed identifier can then be key entered into CAMPS to become a location device for farms, placing the farms within a specific watershed area on the source document. In addition to their descriptive function, some of the geographic locators in CAMPS can be used to manage and query the data for information retrieval.

The geographic locators employed in CAMPS vary in their usage in the database management system. A number of locators appear in only one or two data tables, and therefore can be considered as secondary geographic locators. Some of these secondary locators, such as the identifiers for county, survey township, and section, are well-known political or U. S. Public Land Survey features. Other secondary geographic identifiers like watershed and subwatershed are defined by natural boundaries. In Wisconsin CAMPS, cadastral parcels are represented by a geographic locator, but this identifier is not well developed in the database, since it appears in only one data table. Wisconsin CAMPS also

[3]*For the remainder of this chapter and the chapters that follow, the term CAMPS will refer to both the national version of CAMPS and Wisconsin CAMPS, unless otherwise noted.*

contains an auxiliary locator known as a hydrologic unit or parcel, which is used specifically in conjunction with the application of the Wisconsin nonpoint sediment delivery model in watershed water quality planning and management programs.[4] A final secondary locator, the community identifier, is a general purpose geographic locator intended to define any area where people share interests and responsibility for soil, water, and other related resources. This type of a geographic locator gives CAMPS users greater flexibility in organizing and defining conservation data.

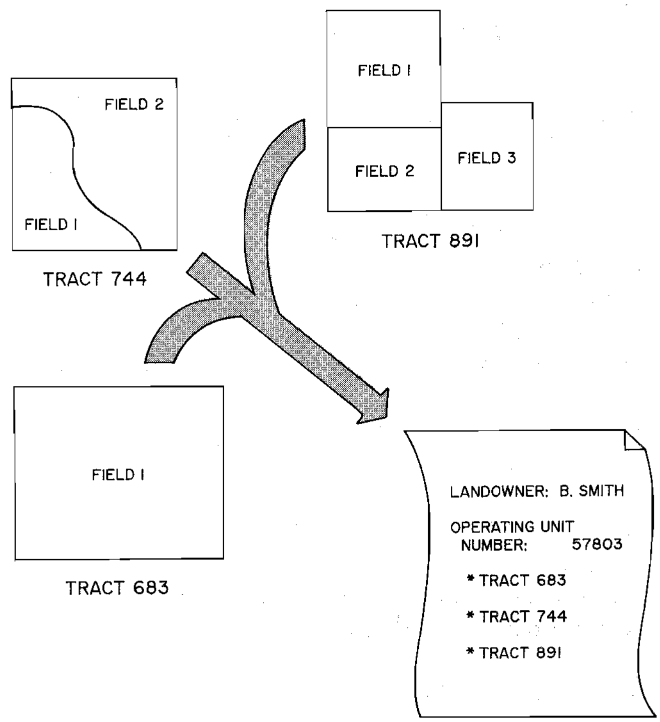
In addition to these secondary identifiers, there are also certain primary geographic locators utilized by the CAMPS database. These primary identifiers are called fields and tracts. These two important geographic locators are related and are also the units of geographic reference most often used within the software system. Fields are defined simply as the smallest body of land or treatment unit described in CAMPS. Fields may be combined to form tracts, which are individual units or parcels of land that are identified and numbered within counties. In the CAMPS system, field identification numbers and tract identification numbers are the data identifiers that refer to the geographic units of fields and tracts.

There is one other special geographic locator that is fundamentally related to the areas of fields and tracts. The U. S. Soil Conservation Service and Land Conservation Departments in many Wisconsin counties cooperatively aggregate tracts into areas called operating units, defined as one or more tracts of land managed as a single unit by a landowner or other entity. Because the SCS and LCD emphasize the ownership of agricultural land in their record-keeping practices, the operating unit and its identification number are convenient tools used by these two agencies to organize and associate fields and tracts with particular landowners. The operating unit identifier is also the most used data item in the CAMPS database, appearing in nearly twenty tables in the national and the Wisconsin CAMPS. The concept of combining fields to form tracts and combining tracts to form operating units is central to the farm program monitoring and conservation planning functions of the agencies that use CAMPS. The field, tract, and operating unit identifiers are also major relational data links in the software system. An example of the relationship between fields, tracts, and operating units is shown in Figure 10.

The field and tract identifiers are originated and maintained by the U. S. Agricultural Stabilization and Conservation Service (ASCS), a sister agency of the SCS, for administration and management of its agricultural programs. The ASCS offers programs of conservation incentives and price supports to farmers and cooperators. In order to manage these programs, the ASCS divides farms into fields and tracts based on past tract configurations and recent information obtained from the program participants. As the fields and tracts are delineated on aerial

Figure 10

THE RELATIONSHIP BETWEEN FIELDS, TRACTS, AND OPERATING UNITS AS GEOGRAPHIC LOCATORS IN CAMPS



Source: SEWRPC.

---

[4]*For the remainder of this chapter and the chapters that follow, the term "parcel" will indicate a cadastral or real property parcel, rather than a hydrologic parcel.*

photographs, these features are given numbers that are recorded for use in identification of the fields and tracts in ASCS programs (see Figure 11). ASCS staff may also aggregate tracts into units called farm numbers to provide an identifier for larger geographic areas in its farm programs. Since the ASCS emphasizes producership rather than ownership of land, these farm numbers may represent the same tracts of land as the SCS and LCD operating units, but the two geographic units may also differ. When farm ownership or operating arrangements change, the fields and tracts may be divided and renumbered by ASCS staff to reflect new program participation. The field and tract information is then transmitted on to SCS and LCD field offices, where office personnel may combine the tracts into ownership operating units, as already noted, and then enter the identifiers and other conservation data into the CAMPS system. Ironically, ASCS does not use CAMPS to administer its farm programs, but instead relies on the SCS to use the field and tract geographic identifiers to monitor soil erosion and landowner compliance with ASCS programs.

The geographic locators in CAMPS serve several functions. They can be used to describe and identify items, as when a field is described as belonging to a particular tract. The geographic locators can also be used to classify and manage data. For example, the CAMPS data tables can be queried to produce a list of all landowners within a survey township. Another potential function of the identifiers is for use as a link to a multipurpose land information system. The geographic locators support the potential for linking the nonspatial conservation data in CAMPS with spatial land records in a land information system.

SUMMARY

Information can be organized into databases for easier access and reference. For even greater efficiency, database information can be automated and controlled by computerized systems called database management systems. These systems vary in the way that they relate and manage information. Simple database management systems organize data into single tables or groups of tables and access information by physically searching through rows and columns of data items. These simple flat-file database systems are adequate for management of relatively small amounts of data, but are usually inefficient and impractical for use in large, complex databases. Relational database management systems, on the other hand, are well suited for application to difficult data management problems. These types of systems use multiple tables to store and link data together into associated categories. By accessing data logically through relational names and values, relational systems can effectively organize and relate large amounts of information. Relational database management systems also minimize data storage requirements, are easily expanded and updated, and are generally more powerful than simple flat-file database management systems.

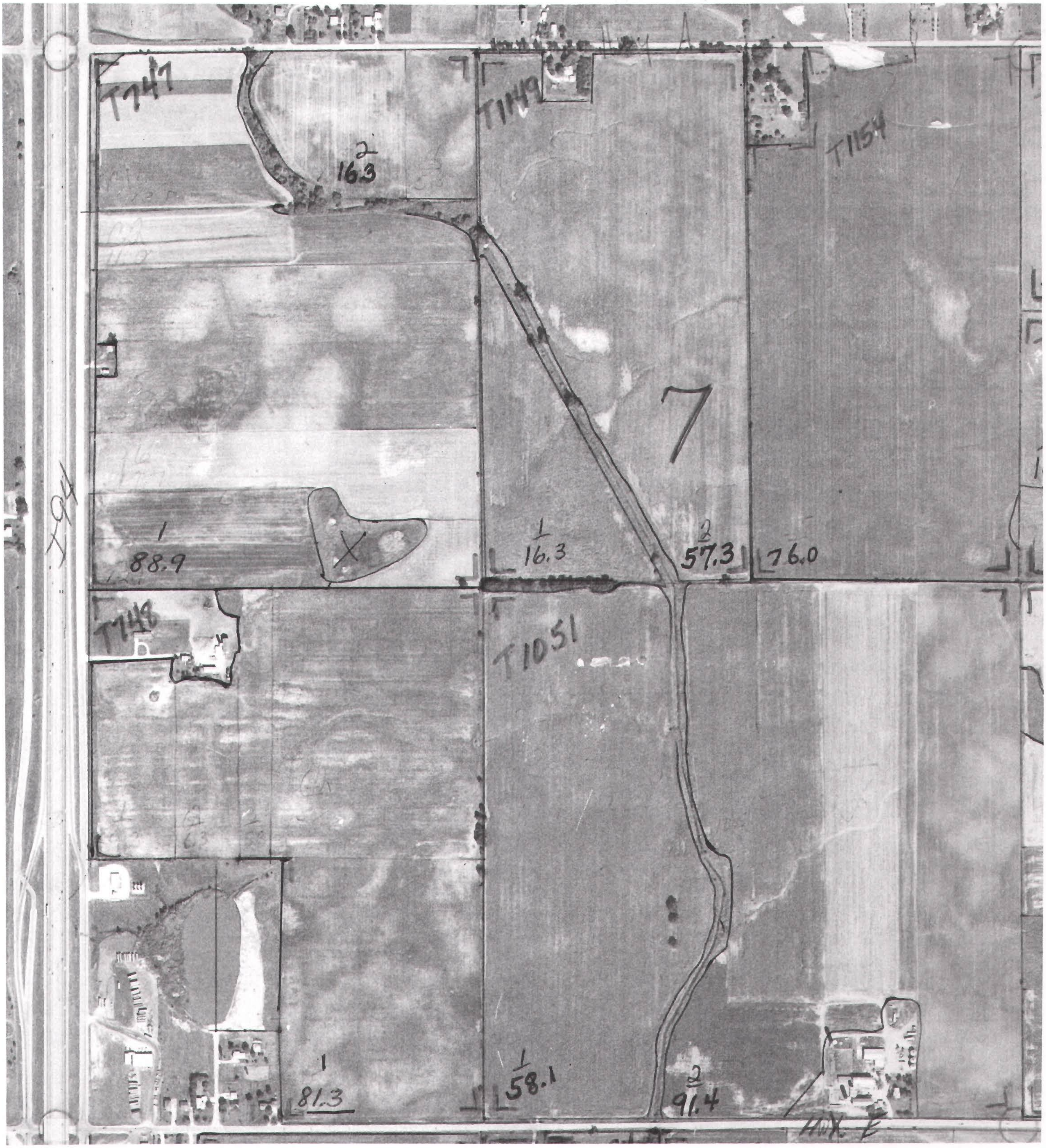
The Computer-Assisted Management and Planning System (CAMPS) is a soil and water conservation planning tool built upon a relational database management system. Developed by the U. S. Soil Conservation Service (SCS), the national version of CAMPS is designed to combine land owner/operator case files with local soils information in order to prepare conservation plans and administer farm programs. The Client Operating Records (COR) database, one of the two major data sets contained in national CAMPS, is generated by local SCS and county Land Conservation Department (LCD) field office staff. This database holds information about cooperators and their agricultural practices. The other major data set, the SOIL database, contains soil survey and crop yield information. National CAMPS assists local SCS and LCD field offices by integrating the information in these two databases to help manage resource data and conservation plans.

In Wisconsin, the national version of CAMPS has been expanded by federal, state, and county conservation agencies to create Wisconsin CAMPS. This enhanced version improves on some of the shortcomings of national CAMPS, and is meant to constitute a single data management system to serve the needs of the SCS and LCD field offices and other state agencies. Wisconsin CAMPS accommodates these enhancements by the use of new and enlarged relational data tables. Accessed through the "state and local options" alternative within the national CAMPS software, Wisconsin CAMPS operates on top of the parent system to provide the specific information needed for state and county conservation programs.

Figure 11

AN EXAMPLE OF TRACTS AND FIELDS DELINEATED BY THE ASCS ON AERIAL PHOTOGRAPHY

Township 2 North, Range 22 East, Section 7



Source: U. S. Agricultural Stabilization and Conservation Service.

Much of the data in the two CAMPS systems consist of spatial attributes that help to describe farms, fields, or other locations. CAMPS also contains many user-defined geographic locators. These data records reference geographic locations drawn on documents such as maps or aerial photos, rather than describing the locations explicitly by coordinates. Two primary geographic locators, fields and tracts, are delineated by the U. S. Agricultural Stabilization and Conservation Service (ASCS) for use in administration and management of its agricultural programs. These often-used identifiers are related, since fields can be combined to form tracts. Soil Conservation Service and Land Conservation Department personnel also aggregate tracts into a special geographic locator, called operating units, for the purposes of organizing tracts under common landownership and administering conservation programs. In addition to their use in describing and classifying the data within CAMPS, the geographic locators have the potential to function as links between the nonspatial conservation data in CAMPS and spatial land records in a multipurpose land information system.

Chapter IV

INVESTIGATION OF THE COMPATIBILITY OF THE KENOSHA COUNTY LAND INFORMATION SYSTEM WITH THE COMPUTER-ASSISTED MANAGEMENT AND PLANNING SYSTEM

INTRODUCTION

This investigation into the compatibility of the Kenosha County Automated Mapping and Land Information System (LIS) and the Computer-Assisted Management and Planning System (CAMPS) has as its premise the assumption that the integration of these two systems will help to solve local planning and resource management problems in a timely and cost-effective manner. This assumption raises a number of issues, including:

- Will integration of the two information systems allow some planning and resource management tasks to be accomplished more quickly and more cost-effectively?

- Will integration of the two information systems allow planners and other users to accomplish some tasks that they are currently unable to perform?

- Will the cost of the integration be acceptable, with the benefits outweighing the costs by a margin that would clearly indicate that the integration of the two systems should be pursued?

These issues were addressed in this investigation and were important considerations in determining the practicality of integrating the LIS and the CAMPS databases.

Another important consideration in this investigation was the dual nature of the compatibility problems inherent in the integration of the LIS and CAMPS systems. The compatibility problems that have emerged are of two types: technical and institutional. Technical problems, such as incompatible hardware or software, can be relatively readily defined and addressed. The solutions to such problems are tangible and may be as simple as recommending the purchase of compatible computer hardware or software. In contrast, institutional problems are more difficult to define, since they may involve the ways an agency performs its work programs or the ways in which information is passed from one agency to another. Solutions of such compatibility problems may be less obvious, and, in many cases, more difficult to achieve. Furthermore, some database compatibility problems may involve a combination of technical and institutional issues. In these cases, it may not be possible to clearly separate the technical aspect from the institutional aspect; the solutions to these problems may be correspondingly more complex.

This investigation into the compatibility of the LIS and CAMPS databases has focused on these considerations. The study has examined the practicality of integrating the two planning systems, given the technical and institutional problems entailed in such an effort. Accordingly, the next section of this chapter compares the LIS and CAMPS databases, outlining the differences and similarities of the two planning systems. The chapter then considers the possibility of using some common geographic locators as potential links between the two databases. Since both technical and institutional problems are involved in the use of geographic locators as linkage devices, the chapter includes a section that offers some possible ways in which the Kenosha County LIS and CAMPS could be integrated. Some examples of the application of an integrated CAMPS/LIS system, demonstrating the practicality and usefulness of combining the two databases, are given in the concluding section of this chapter.

COMPARISON OF THE LIS AND CAMPS DATABASES

The Kenosha County LIS and the CAMPS databases are very different types of data management systems. From the description of these two databases in the previous chapters, it is apparent that the LIS is primarily a spatial database, whereas CAMPS is essentially a nonspatial database. As a spatial database, the LIS stores x-y coordinates and references geographic locations explicitly, with the ability to display graphically points, lines, and areas as true map features related to the State Plane Coordinate System. CAMPS, on the other hand, can reference geographic locations only indirectly. Since it does not contain x-y coordinates, this database uses geographic locator codes or names to reference features delineated on ancillary maps or aerial photographs. As a primarily spatial database, the land parcels in the automated base map of the LIS are linked to complementary tabular databases as the system is developed. As a primarily tabular database, CAMPS does not have spatial display capabilities.

There are some other differences between the two systems that are worth noting. As of early 1992, the two systems were located on two quite different computer systems that cannot be readily interfaced. The Kenosha County CAMPS database serves both Kenosha and Racine Counties and is located at the U. S. Soil Conservation Service (SCS) field office at Union Grove in Racine County, where the database resides on a small personal computer with a disk operating system (DOS). This database is supposed to be moved to a UNIX computer operating system in the near future as part of a statewide enhancement of the CAMPS software. Still under development, the Kenosha County LIS database is located at the office of the Regional Planning Commission, where it resides on a mid-size computer using a UNIX operating system. When completed, the LIS database will be situated in Kenosha County. Any solution for integrating the CAMPS and LIS databases must overcome these technical differences so that data can be readily shared between the two systems.

In spite of the differences in the computer systems used, the LIS and CAMPS databases do have some things in common. They both contain soils and zoning data, although the zoning information in the CAMPS database is restricted to those areas that are included in farm program participation in any one year. More importantly, the two databases share a common geographic locator, the cadastral parcel identification number. In the LIS this identifier is the primary link between the land parcel and a large universe of data. The cadastral parcel identification number is of less importance in the CAMPS database. The identifier is found in only one table in the Wisconsin CAMPS, it is not well-developed, and it is difficult to sort and query other tables with this data item. Nevertheless, the existence of the parcel identification number as a common geographic locator creates the possibility of using this item to interrelate the CAMPS and LIS databases.

GEOGRAPHIC LOCATORS AS A LINK BETWEEN THE TWO SYSTEMS

Much of the data in CAMPS and in the Kenosha County LIS consist of records that describe geographic features. For example, CAMPS contains information about farm management practices for various fields and tracts, while the LIS database contains tax and assessment information relating to real property parcels. A common function of the two systems is to refer data to geographic locations within the area of coverage of each database. Because both CAMPS and the LIS reference and describe geographic units, it is beneficial to examine these units to discover whether they can be used to link the two databases. Accordingly, this section of the report evaluates some of the geographic units and geographic locators defined by CAMPS and the LIS and explores the practicality of integrating the two systems by means of commonly defined units of geography.

Cadastral Parcels and Parcel Identification Numbers

The cadastral parcel is generally recognized as the most fundamental unit of geography for land information systems. The basic reason for this importance is that parcel-based data can provide information on the nature of ownership, control, and interests in land resources in a particular area or jurisdiction.[1] The information associated with cadastral parcels is necessary for public and private property conveyancing and assessment, land use planning and resource management, and infrastructure development. Importantly, land records organized at the level of the cadastral parcel, when properly referenced to established systems of survey control, can provide the ownership information and other attribute data needed to make decisions about the land and its resources.

Associated with each cadastral parcel is a geographic locator, or identifier, called a parcel identification number. In an information system environment, this data item has several important characteristics. The parcel identification number is relatively stable, since it changes only

---

[1] *See J. D. McLaughlin and S. E. Nichols (1987), "Parcel-Based Land Information Systems,"* *Surveying and Mapping, Vol. 47, No. 1, pp. 11-29.*

when land ownership boundaries are changed to create a new parcel or parcels. The identifier serves a variety of users, including such different departments of government as assessment, public works, and planning departments. In addition, if a "location identifier" scheme is used for the parcel identification number, then the number can be used to locate the parcel to within a quarter section of the U. S. Public Land Survey System. For these reasons, the cadastral parcel and its identification number provide a virtually ideal geographic locator on which to base a land-related information system, provided that the cadastral boundaries are accurately related to a geodetic control network that permits the correlation of real property boundary data and earth-science data.

Because of these advantages, the cadastral parcel is utilized as the basis of the Kenosha County LIS; the parcel identification number serves as both the primary geographic locator and principal linkage device for parcel-related information in this database. Unfortunately, the cadastral parcel and its identification number are not given the same importance in the CAMPS database. The parcel identification number is not used at all in the national CAMPS. In Wisconsin CAMPS, as already noted, the parcel identification number appears in only one table, where it is associated with Farmland Preservation Program records, such as operator identification number, type and year of program participation, certification status, and date of monitoring by the Land Conservation Committee. However, the parcel identification number in Wisconsin CAMPS is not well developed, and can be used to sort or query other data records only with some difficulty. The use of the parcel identification number as a geographic locator and identifier is thus very limited in CAMPS. Since there is so little emphasis on cadastral parcels in the CAMPS database, it is apparent that the parcel identification number is not now a good linkage mechanism between the LIS and CAMPS databases, but may potentially prove to be a viable means of integrating the two information systems.

Fields, Tracts, and Operating Units

Unlike the Kenosha County LIS, the CAMPS database uses fields and tracts as its primary units of geography. These areas are defined and delineated by U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS), staff for the purpose of administration of ASCS farm programs. Farm fields and tracts are delineated with colored pencil on 1:7,920 (one inch equals 660-feet-scale), uncontrolled, aerial photographs by staff personnel, utilizing historical tract configurations and other information given to them by farmers and operators who are participating in ASCS programs. Tracts are then given identification numbers by ASCS staff. Fields, which are subunits of tracts, are numbered sequentially within each tract. The ASCS, which is concerned with the operatorship of agricultural land, may then group tracts into units called farm numbers in order to manage the agency's farm programs. A somewhat similar activity is performed by county SCS and Land Conservation Department (LCD) field office staffs, which jointly aggregate tracts into agglomerations called operating units. Because these two agencies emphasize land ownership rather than operatorship, the operating unit is intended to encompass all the land that one operator owns; this can be just one tract, or it may be several tracts scattered over a wide area that are grouped together under the name of a single landowner. As operating units are designated, they are also given unique identifying numbers by SCS and LCD personnel.

Tract and field identification numbers are the most common geographic locators and identifiers in CAMPS. These identifiers are each used in several data tables in the national CAMPS database; in many of these tables the identifiers are key fields, with the ability to access other data tables. Because of their frequent use both as data items and key fields, it would appear that these two identifiers, the tract identifier in particular, offer the best means for linkage of CAMPS with another database.

Although CAMPS is oriented toward the use of fields and tracts as primary spatial units, there are some unique concerns associated with these units of geography. One disadvantage of tracts is that they are used almost exclusively by the ASCS. The U. S. Soil Conservation Service and County Land Conservation Departments do use tracts out of necessity to help administer ASCS farm programs, but tracts are not used by any other agency or governmental department as a means of geographic reference. More importantly, tract identifiers are ephemeral, since these identification numbers can change annually due to farmland sales and fluctuating enrollment in farm programs. In Kenosha and Racine Counties, another common reason for yearly variations in tract identification is frequent annual changes of farm operatorship from one county to the other.

Another drawback of the tract system is the ASCS emphasis on farm producers, rather than farm owners. In the administration of farm programs, the main interest of the ASCS is in farm operators; consequently, the tract operatorship is recorded and tract ownership information is recorded only incidentally. U. S. Soil Conservation Service field offices in some counties, including Kenosha and Racine Counties, have been rectifying this situation by moving toward an owner-based system, in which tract ownership as well as operatorship is recorded in the CAMPS database.

One more disadvantage of tracts is worth noting. Tract numbering follows an ambiguous numbering system in that tracts are numbered uniquely only within a county, so that tract identification numbers may be duplicated between counties. A tract identification number must be prefaced with a county code number to create a unique and distinctive identification number. More importantly, tract identification numbers are not location identifiers and cannot be used to find the location of tracts within a county.

In spite of these drawbacks, the system of fields and tracts is the geographic foundation of CAMPS, and as such is the most likely means of linking this database with the parcel-based Kenosha County LIS. A key to any pursuit of such a strategy is an examination of the differences between parcels and tracts. In order to recognize some of the spatial dissimilarities between these two units of geography, a comparison was performed between parcels and tracts in Kenosha County. An area of approximately four square miles in the Town of Somers was chosen as the study area for this comparison, comprising Public Land Survey Sections 5, 6, 7, and 8, Township 2 North, Range 22 East. This study area was chosen because it contained nearly complete coverage of tract delineations and also had been incorporated into the Kenosha County LIS. Duplicate copies of portions of ASCS aerial photography of the study area were obtained from the U. S. Soil Conservation Service Kenosha/Racine field office by Regional Planning Commission staff. These copies showed tract and field boundaries and tract and field identification numbers as delineated by ASCS staff at the Kenosha/Racine field office.

To prepare the tracts for digitization, it was necessary for Regional Planning Commission personnel to recompile the tract boundaries onto a controlled photographic base. The tract boundary lines were manually transferred and drafted onto 1:4,800 scale (one inch equals 400 feet), ratioed and rectified aerial photography obtained in 1990 by the Regional Planning Commission. The boundary lines were duplicated as accurately as possible, following fencerows and other occupation lines visible on the aerial photograph. Then the redrawn tract boundaries were board digitized from the controlled aerial photograph and placed into a graphics file, where they could be compared with a digital file of parcel boundaries from the LIS. A computer-generated plot of parcel boundaries and tract boundaries for the study area is shown in Figure 12.

The comparison between tracts and parcels in Figure 12 reveals that in some cases these geographic units are nearly the same, but in most cases they are quite different. The reasons for the discrepancies between tract boundaries and parcel boundaries include digitization errors, displacement due to relief in the aerial photographs on which the tract boundaries were delineated, and recompilation errors. The most important discrepancies, however, are caused by interpretation differences and lack of concurrency in time of the data sets. The ASCS photointerpreters do not use parcel boundaries in the delineation of tract boundaries. Rather, the tract boundary lines follow fencelines and field edges. The tract boundary delineations around nonfarmland are inconsistent, as in some cases small parcels are included in tracts while in other instances they are not. The data sets were not concurrent in time, because the parcel boundary lines were current as of 1990, whereas the tract boundaries were current as of late 1991. Some tract lines may reflect divisions or combinations of parcels made since the parcel lines were last updated.

One more reason for the differences between the parcel and tract boundary lines should be noted. The U. S. Department of Agriculture administers an erosion control program known as the Conservation Reserve Program (CRP), under which farmers pledge to cease cropping highly erodible lands in return for annual cash payments from the ASCS for a period of up to 10 years. The lands committed to the CRP are usually planted to grass or some other restorative vegetation and are taken out of crop production for the period of the contract. In recent years, the ASCS has considered CRP lands to be separate tracts, even if only a few highly erodible acres out of a larger field are enrolled in the program. This accounts for some of the differences between parcels and tracts in the upper left corner of Figure 12, where tracts 11177 and 11178 are areas under the CRP. In situations like this, tract boundaries may more closely follow natural resource or soil boundaries than cadastral parcel boundary lines.

This comparison indicates that with more consistent delineation of tracts using ancillary parcel boundary information, tracts can be made to coincide with parcels or with aliquot parts of parcels. To illustrate this point, Regional Planning Commission staff modified tract boundary lines within the study area and compared these adjusted tract boundaries to the parcel boundaries (see Figure 13). Tract boundaries were adjusted only in those cases where they were nearly coincident with parcel boundaries. For example, some original tract lines followed road edges, and these boundaries were adjusted to follow the parcel boundaries, located at road centerlines. Moving tract boundary lines in this way did not appear to greatly change the spatial definition of each tract. This exercise indicates that it may be feasible to relate tracts to parcels and thereby provide a practical link between the CAMPS and the Kenosha County LIS.

POSSIBLE SOLUTIONS TO THE LIS/CAMPS INTEGRATION PROBLEM

There is no single solution to the problems inherent in the integration of the CAMPS and LIS databases. Because of the numerous technical and institutional issues involved, a set of solutions will be required to achieve a fully functional integration of the two database systems. Some of these solutions may provide only a partial linkage of the two systems. This section of the chapter presents a series of possible solutions toward integration of the CAMPS and the Kenosha County LIS. Some of these solutions are technical in nature and are more easily achieved, while others are institutional in nature and may be more difficult to achieve. The advantages and disadvantages of each solution are discussed. The last part of this section presents a proposal to integrate CAMPS and the Kenosha County LIS into a shared comprehensive database that would encompass cadastral and natural resource data suitable for multi-agency decision making.

Incorporation of Parcel Identification Numbers into CAMPS

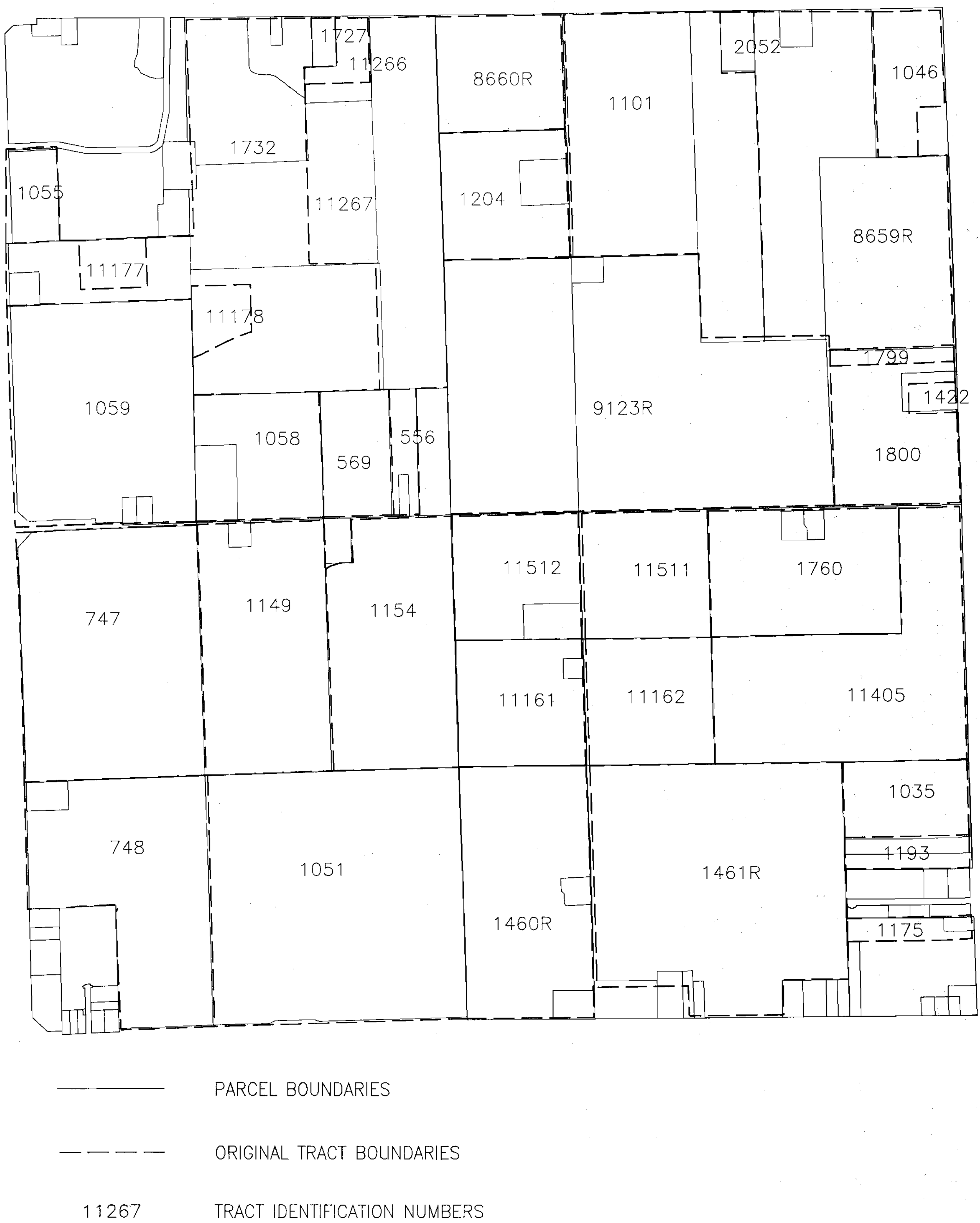
A key step toward integrating the CAMPS and Kenosha County LIS databases is to emphasize the cadastral parcel as one of the primary units of geography in the CAMPS system. This can be accomplished by fully incorporating the parcel identification number into the CAMPS database. As already noted, the parcel identifier is used only once in the Wisconsin CAMPS, and it is not used at all in the national CAMPS. This situation should be remedied by updating the CAMPS software to include the parcel identification number as a basic data item. New data relationships should be established, such as parcel identifiers linked to farm fields and parcel identifiers linked to operating units. The parcel identification number should be a key data field in all instances so that it can be used to sort and access other data. Emphasizing the parcel identification number in CAMPS will improve the value of the farm planning information in the database by more closely relating this data with land ownership information.

Some of these suggested corrections may be forthcoming in the new version of the national CAMPS software, scheduled for release probably in late 1993. According to the U. S. Soil Conservation Service, the national CAMPS is being updated and will become part of the Field Office Computing System for use in various U. S. Department of Agriculture field offices. This new version of national CAMPS will be written for the UNIX computer operating system and will be based on a relational database management system called "Informix." The new CAMPS software is expected to contain many new data relationships, such as relating owners and operators to tracts and farm fields. It is not known at this time to what extent parcel identification numbers will be incorporated into the software update. Once the new national CAMPS is released, Wisconsin CAMPS is slated to be

Figure 12

COMPARISON OF ORIGINAL TRACT BOUNDARIES AND PARCEL BOUNDARIES IN THE STUDY AREA

Township 2 North, Range 22 East, Sections 5, 6, 7, 8

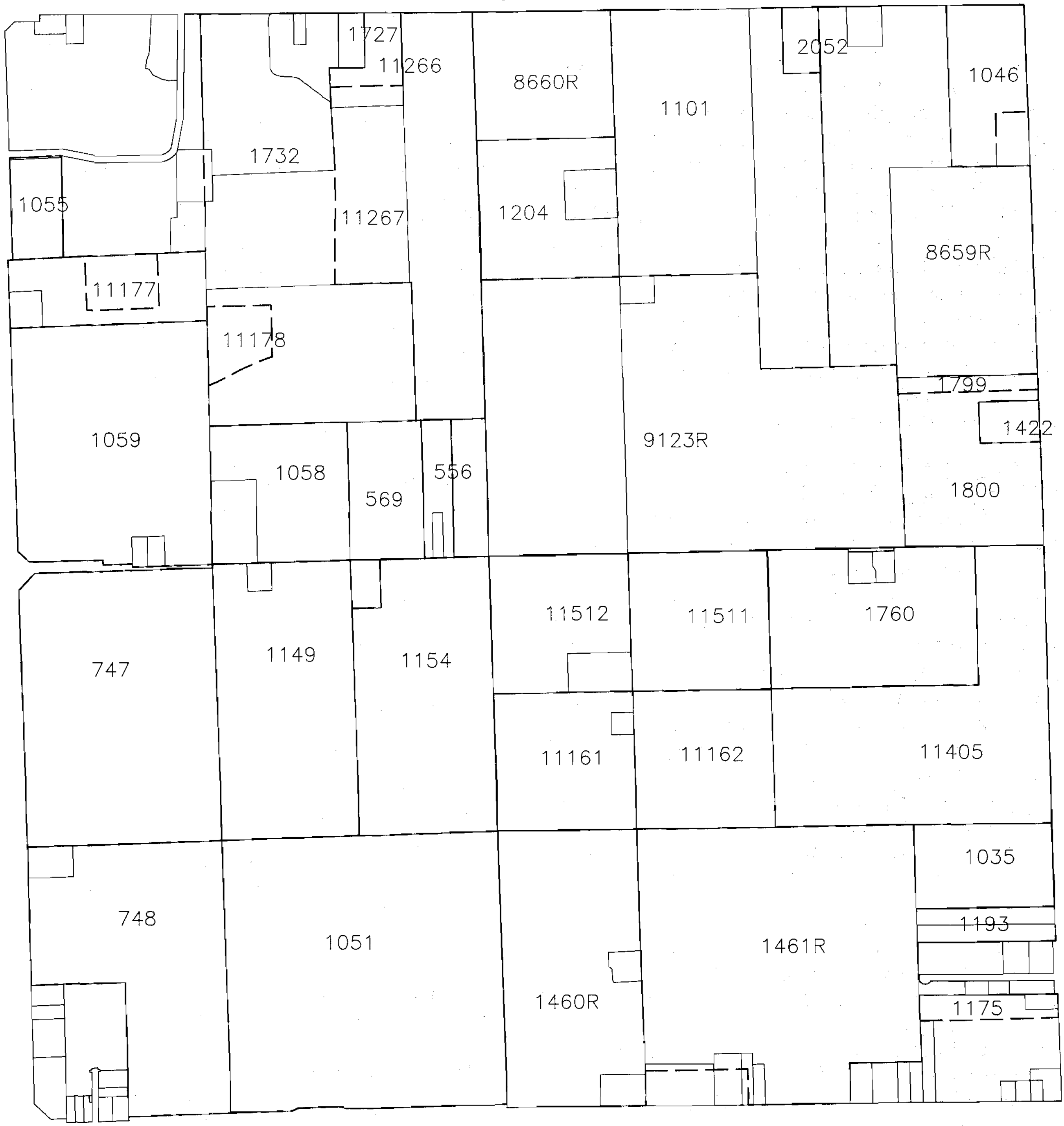


Source: Agricultural Stabilization and Conservation Service, Soil Conservation Service, and SEWRPC.

Figure 13

COMPARISON OF ADJUSTED TRACT BOUNDARIES AND PARCEL BOUNDARIES IN THE STUDY AREA

Township 2 North, Range 22 East, Sections 5, 6, 7, 8



PARCEL BOUNDARIES

ADJUSTED TRACT BOUNDARIES

11267 TRACT IDENTIFICATION NUMBERS

Source: Agricultural Stabilization and Conservation Service, Soil Conservation Service, and SEWRPC.

updated and will include new uses for parcel identification numbers in relation to farm fields, operating units, and other data items.[2]

The incorporation of parcel identification numbers into CAMPS would provide an important, even though partial, technical solution to the integration of the two databases concerned. Although parcel identifiers will improve access and retrieval of ownership information within the CAMPS database, this step does not address the source of the incompatibility between CAMPS and the LIS, namely, the incongruity between tract and parcel boundary delineations. More extensive use of parcel identification numbers in CAMPS would assist in data management in the present situation, but this measure would be even more useful if the tract and parcel boundaries are properly related.

Creation of a Spatial Field and Tract Layer for the LIS

Land information system technology can be used to help overcome the incompatibility of the two databases. Certain types of mapping software are adept at comparing and analyzing dissimilar units of geography. These types of software can, for example, spatially combine graphical map layers and produce a derived map showing the distribution of one layer within another. In concept, this is much like overlaying a transparency of one thematic map on top of another, with the resulting map a combination of the two original maps. With the aid of computer software, area measurements can easily be taken from the new map, and other types of spatial analysis can be accomplished.

The ability to perform this type of map comparison is one of the strengths of the Kenosha County Automated Mapping and Land Information System. For example, floodplain boundaries can be accurately overlaid with maps of cadastral parcels in the LIS, yielding a map showing all parcels within the floodplain area. Similarly, parcel and soil layers can be combined to display and quantify all of the soil units within a particular cadastral parcel. Many computerized land information systems, including the Kenosha County LIS, are designed for spatial comparisons of this sort.

The creation of a farm field and tract layer for the Kenosha County LIS can utilize these analytical functions to link the CAMPS and LIS databases. Just as dissimilar geographic units such as parcels and floodplains can be compared in the LIS, it is also possible to overlay graphically parcels and tracts in a digital environment to determine, for example, which parcels lie in certain tracts. The key to this strategy involves creating and maintaining a digital layer of farm fields and tracts for the LIS. A separate layer for operating units would not be necessary, since these units are by definition aggregates of tracts, but this layer could be easily derived if needed. By establishing digital layers for fields and tracts, CAMPS essentially becomes an attribute database of the LIS. Once the relationship between tracts and parcels has been determined by overlaying the two layers, then additional information can be extracted from either CAMPS or the LIS by knowing the tract number or parcel identification number.

The development of a digital field and tract layer would involve addressing some technical and institutional issues, such as custodianship of these layers of the database. One possible scenario would charge either U. S. Department of Agriculture or Kenosha County personnel in the Kenosha/Racine field office with creation and maintenance of these information layers. A technical consideration would be acquisition of computer hardware and software as well as specialized digitizing tables for line collection. Actual map layer development would begin by obtaining source documents from the ASCS; this information would have to be recompiled onto controlled photographic bases. Farm fields and tracts could then be digitized from the recompiled boundary lines on the controlled aerial photographs. Since maintenance of these digital layers would require continual updates of field and tract information from the ASCS, institutional arrangements between the agencies concerned would have to be developed to ensure the timely transfer of information. The custodianship of these information layers may be expected to be a full-time responsibility involving a commitment of both time and resources from the agency in charge.

---

[2] *Telephone conversation with Ms. Sherrie L. Beyer, CAMPS Coordinator, U. S. Department of Agriculture, Soil Conservation Service, Madison, Wisconsin, November 25, 1991.*

Linking CAMPS and the LIS by means of field and tract layers, while technically feasible, presents some problems. One technical problem is entailed in the overlaying of dissimilar spatial units. When different map layers are compared in a computerized land information system by using a map overlay process, the resulting map is a composite of the original layers and can contain many small and oddly shaped areas or polygons. These small polygons are to be expected when comparing natural resource themes, such as soils and floodplains, but they can be a nuisance when comparing and analyzing administrative units like tracts and parcels.

To illustrate this problem, an overlay analysis of tracts and parcels was performed by Regional Planning Commission staff for a small portion of the study area. The relationship of parcels to tract number 9123R in Section 5 of Township 2 North, Range 22 East, is shown in Figure 14. From this figure it is apparent that the original tract boundaries, as digitized from recompiled ASCS documents, do not neatly coincide with parcel boundaries. Three parcels seem to fit entirely within Tract 9123R, but four small "sliver" polygons in the upper right corner of the tract create a problem. These odd-shaped areas are portions of adjoining parcels that appear to lie within the tract. If map overlay procedures were the linkage mechanism between the two databases, then a query of the LIS based on this example would show that Tract 9123R is composed of all or parts of seven different parcels. Because of the known errors in delineation and digitization of tract boundaries, the four sliver polygons are a result of differences in the delineation of the boundaries of the tract. In an actual land information system query of this type, a decision would be needed about what to do with these small, "inconvenient" polygons.

When adjusted tract boundary lines are used in the overlay analysis, the sliver polygon problem disappears, but other problems persist. As shown in Figure 15, the modified tract boundaries create a much closer relationship between the parcels and Tract 9123R. The tract boundaries have been adjusted slightly to follow parcel boundaries. Consequently, the four erroneous polygons have been eliminated and the tract is composed of just three parcels. The resulting relationship between Tract 9123R and its parcels is simpler, but is still not ideal. The fact that the tract covers three parcels is not convenient, since as many as three queries must be made and three sets of land records must be accessed to get parcel information about the tract. If a query were initiated in the other direction, for example to access farm management data in CAMPS for parcel number 402220530200 as shown in Figure 15, the results might be difficult to interpret. This is because the parcel does not neatly coincide with a single tract, but instead constitutes a portion of Tract 9123R. If the management data for the tract were recorded as a consolidation of the management procedures used on each component parcel, then the generalized management data for the tract may or may not apply to each individual parcel. The difficulty in this case would be how to apportion or apply the management data of the entire tract to the smaller parcel. The difficulty in interpreting and apportioning information from the larger tract to the smaller parcel could be alleviated by recording the management data at the level of the agricultural field, and then relating tax parcels to these fields. Problems of this type, involving the relation of dissimilar units of geography, complicate the use of a field and tract layer as a link between CAMPS and the LIS.

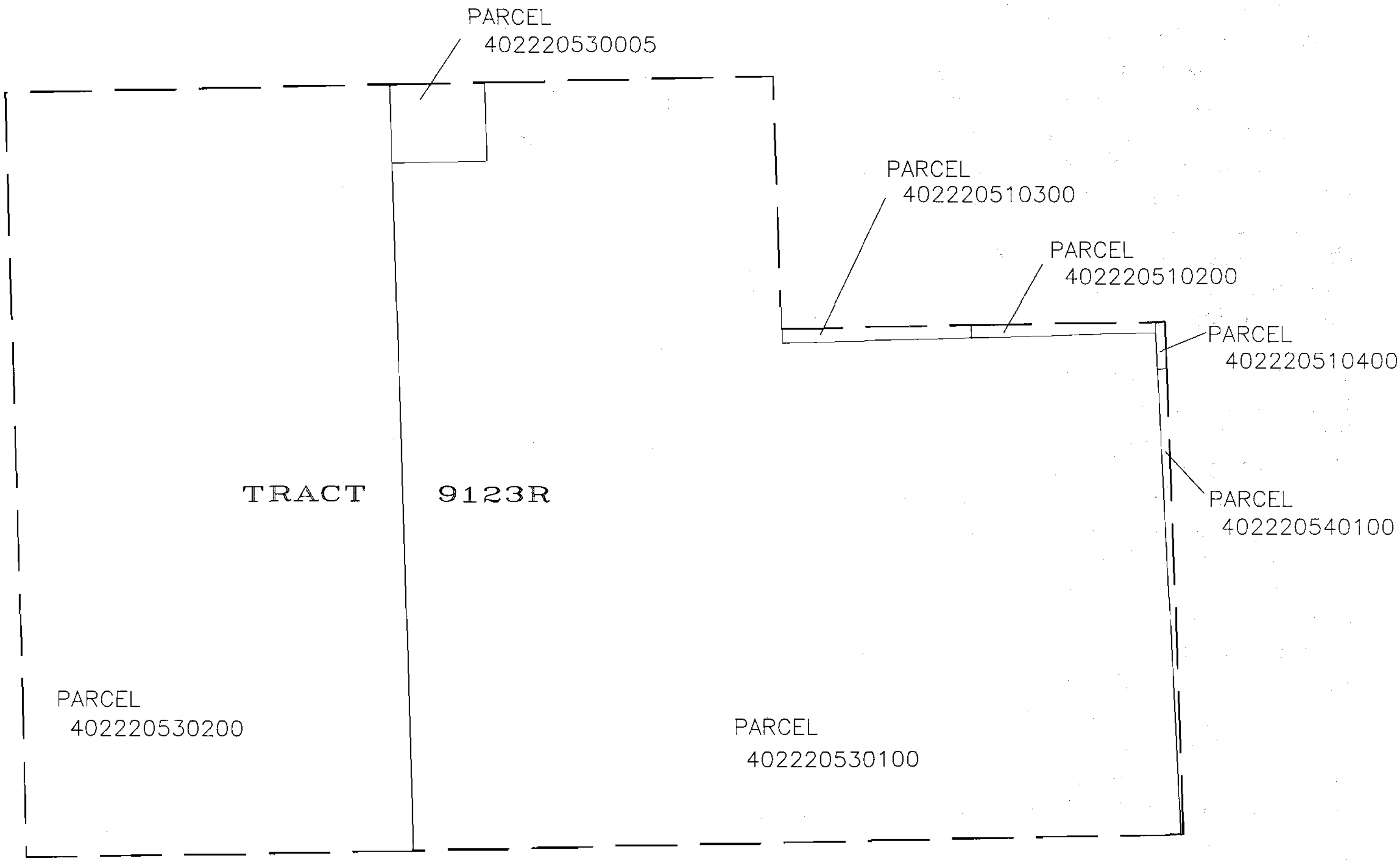
In addition to the problems of slivers and tract/parcel relationships, there are some other disadvantages to this approach to the CAMPS/LIS integration dilemma. An important consideration is the commitment needed to build and maintain the field and tract layers, since this effort would conceivably require substantial staff effort to keep current with changes from the ASCS. Another consideration is the institutional arrangements necessary between ASCS and the custodial agency to ensure timely delivery of update materials for digitization. In this respect, it should be noted that attempts at maintaining field and tract layers in land information systems have been tried and failed. The Dane County, Wisconsin, Land Conservation Department built and maintained a countywide tract layer for a land information system but eventually ceased maintaining the graphic database because the updates were too numerous and costly.[3]

---

[3]*Telephone conversation with Mr. Kevin F. Connors, County Conservationist, Dane County Land Conservation Department, Madison, Wisconsin, December 17, 1991.*

Figure 14

ANALYSIS OF TRACT 9123R IN THE STUDY AREA USING ORIGINAL TRACT BOUNDARIES



Source: Agricultural Stabilization and Conservation Service, Soil Conservation Service, and SEWRPC.

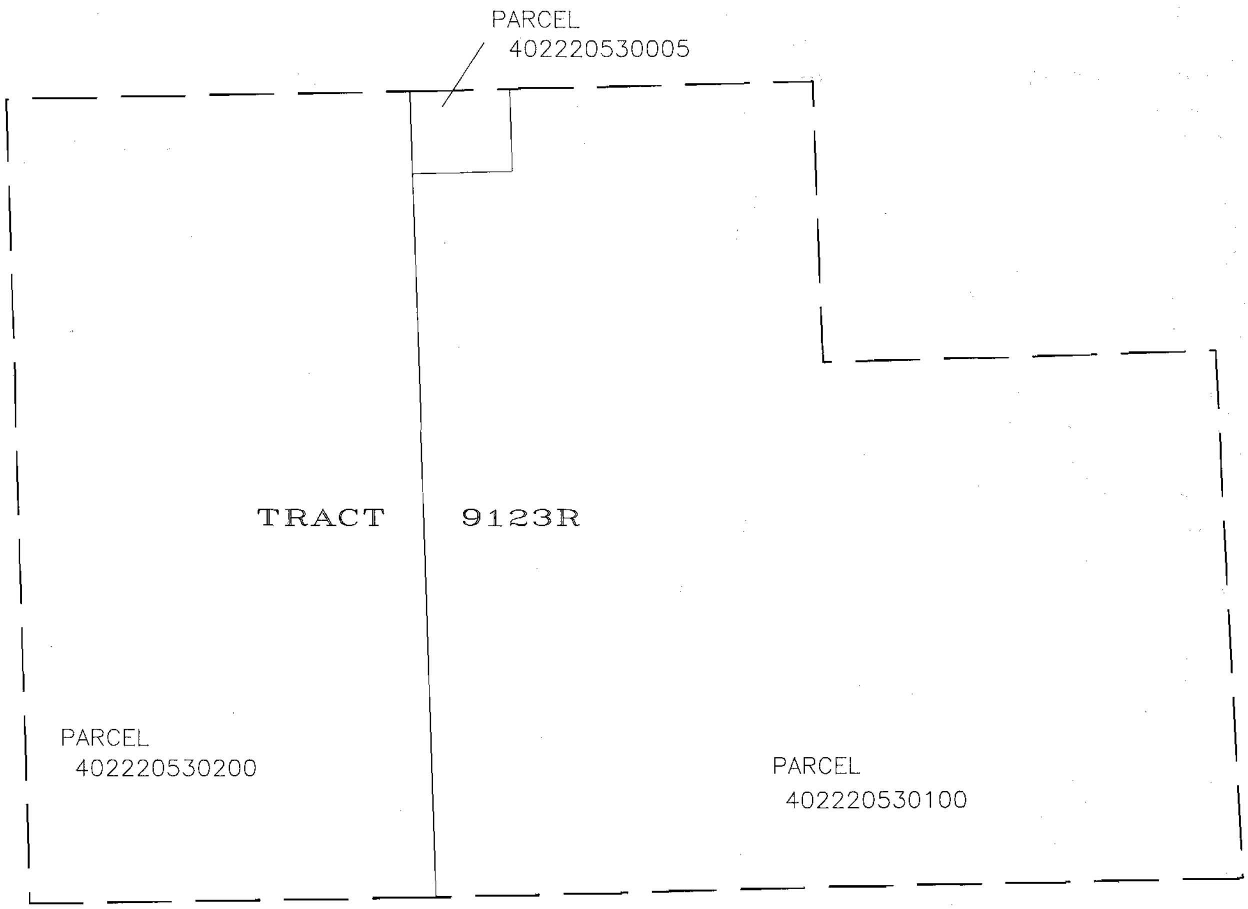
There are clearly a number of serious disadvantages to the inclusion of a field and tract layer in the Kenosha County LIS. The approach does not establish an elegant link between CAMPS and the LIS and creates a number of analytical problems. Also, the cost of maintenance of the field and tract layers likely would be high. Therefore, it does not appear that the creation of field and tract layers is a practical link between the two database systems at this time.

Improvement in the Definition, Delineation, and Numbering of Tracts

Both solutions described above, incorporation of parcel identification numbers into CAMPS and creation of a field/tract layer for the LIS, are not viable in the present situation because they do not deal with the critical obstacle to integration of the two databases, the disparity between tracts and parcels. Since these two database systems are founded on basically different units of geography, there can be no simple solution to the compatibility problem without resolution of the conflict between tract and parcel delineation. This section of the chapter addresses this predicament and then offers some recommendations to reconcile the differences between tracts and parcels. The strategy that is proposed seeks to redefine tracts to be more like parcels, since parcels are generally thought to be the more fundamental geographic unit for a land information system. The recommendations constitute a three-step approach: 1) improved definition of tracts, 2) improved delineation and interpretation of tracts, and 3) improved numbering of tracts. Any of these steps taken individually should improve the discrepancies between tracts and parcels. If all of the steps can be implemented, then a more direct linkage between CAMPS and the LIS should follow.

Figure 15

ANALYSIS OF TRACT 9123R IN THE STUDY AREA USING ADJUSTED TRACT BOUNDARIES



Source: Agricultural Stabilization and Conservation Service, Soil Conservation Service, and SEWRPC.

Better Definition of Tracts: As already noted, tracts are often inconsistently delineated. Some tract boundaries are drawn following road edges, while other boundaries follow road centerlines. There are also inconsistencies regarding the inclusion of nonfarmland in tracts. For example, inspection indicates that the small parcel (identification number 40220530005) at the top of Figure 15 contains a set of buildings and a residential dwelling, yet this parcel is included in Tract 9123R. At other times, small parcels like this are left out of tracts.

What is needed is a better definition of tracts. Guidelines should be established and followed to ensure that tracts are consistently defined. Tract boundaries should follow parcel boundaries whenever possible, and tracts should exclude nonfarmland real property parcels. If the small residential parcel in Figure 15 is excluded from Tract 9123R, then the tract would correspond to only two cadastral parcels instead of three. Refinements in the definition of tracts would simplify some of the tract and parcel discrepancies.

Many of the apparent inconsistencies in the definition and delineation of tracts may be attributed to the fact that ASCS photointerpreters do not have access to deed or cadastral boundary information when marking tracts on aerial photography. Instead they must rely on information obtained from producers and on historical tract configurations from previous years. The ASCS staff could be directed to utilize cadastral information in the delineation of tracts if such information were made available. With this information, and with a more consistent definition of tracts, ASCS personnel could delineate tracts so as to be coincident with parcels, or so as to comprise aliquot parts of parcels. Improvements in the definition of tracts is at once a technical and an institutional issue. Better rules and instructions may conceptually improve the definition of tracts, but institutional cooperation between and within the agencies concerned will be needed to put these guidelines into practice.

Better Delineation of Tracts: Another step toward the integration of the CAMPS and LIS databases can be taken by improving the delineation and interpretation of tracts. This can be accomplished, as already noted, by utilizing ancillary data such as cadastral boundary information in the delineation process. Certain technical considerations would be important in this step, such as the specification of the use of proper aerial photography in the delineation. The institutional considerations, however, are more complex. One requirement would be that a custodial, or lead, agency be willing to furnish the ASCS with cadastral information and that ASCS management and staff be agreeable to incorporating these materials into their work effort for delineation of tracts.

In order to assist ASCS personnel with tract delineation, a designated agency such as the County Land Conservation Department would have to supply the ASCS field office with current parcel boundary and parcel identification number information. A good choice for this information would be cadastral overlays, which could be generated by the automated mapping capabilities of the Kenosha County LIS. The overlays could be produced at the scale of the ASCS aerial photography and furnished as dimensionally stable film transparencies intended for overlay on top of the aerial photographs. The ASCS staff could then use the cadastral overlays as ancillary information to the photography during the delineation of tracts and fields. Tracts could be outlined directly on the cadastral overlays, or they could be drawn on a separate transparency placed on top of the aerial photograph and cadastral overlay. Using the parcel lines as a guide, tracts could then be traced to coincide exactly with parcel boundaries. The use of ancillary cadastral overlays would facilitate more accurate and consistent delineation of tracts.

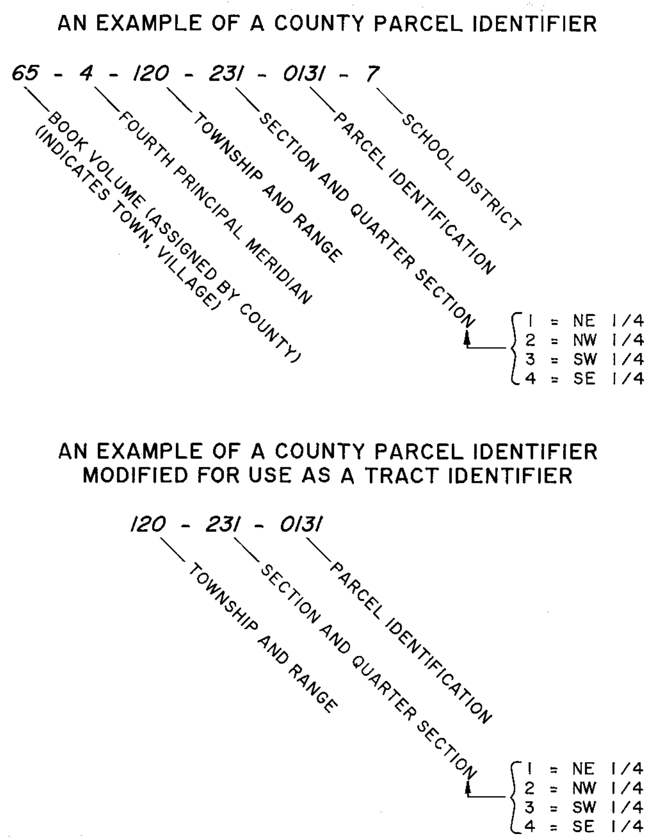
One technical consideration regarding such overlays to aerial photography should be noted. Currently, the Kenosha/Racine ASCS office uses 1:7,920 (one inch equals 660-feet-scale) aerial photography that exhibits some distortions due to relief displacement, camera tilt, and other causes. Accurately plotted cadastral overlays will not fit well on top of this photographic base because of these inherent distortions. The poor fit will be noticed where field edges fail to align with cadastral boundaries, or where some right-of-way intersections do not match Public Land Survey section and quarter-section corner locations. A solution to this problem is to obtain controlled aerial photography. One ready source of such photography would be the 1:4,800 (one inch equals 400-feet-scale), ratioed and rectified aerial photographs acquired by the Regional Planning Commission at five-year intervals. Utilizing larger-scale controlled aerial photographs such as these would provide a more accurate base for the cadastral overlays; the greater detail of the prints will assist ASCS staff in more accurately interpreting and delineating tracts. Other alternatives for aerial photography may be considered, but the most important issue is that accurate, controlled aerial photography should be used to provide the best base possible for the tract delineation using cadastral overlays.

With the aid of cadastral overlays, it would be possible to delineate consistently tract boundary lines to coincide with parcel boundaries. And by following a more rigorous definition of tracts, these geographic units could be delineated so that they are never larger than a single parcel. This means that in many cases tracts would occupy single parcels. One exception to this rule would occur in the case of Conservation Reserve Program tracts, which tend to be subunits of parcels whose limits follow natural boundaries as well as parcel boundaries. The only other exception would occur when a parcel is farmed by more than one operator, so that the parcel is split into more than one tract. By using the cadastral overlays as a guide, tracts could easily be drawn either to match parcels exactly or to conform to these or other exceptions. The effect of these improvements in the delineation and definition of tracts would be a simpler, more consistent relationship between tracts and parcels.

Better Numbering of Tracts: The numbering system used for tracts has already been described as being a variable system that cannot be used to find the location of tracts within a county. A change in the way tracts are numbered is the final step toward the goal of

Figure 16

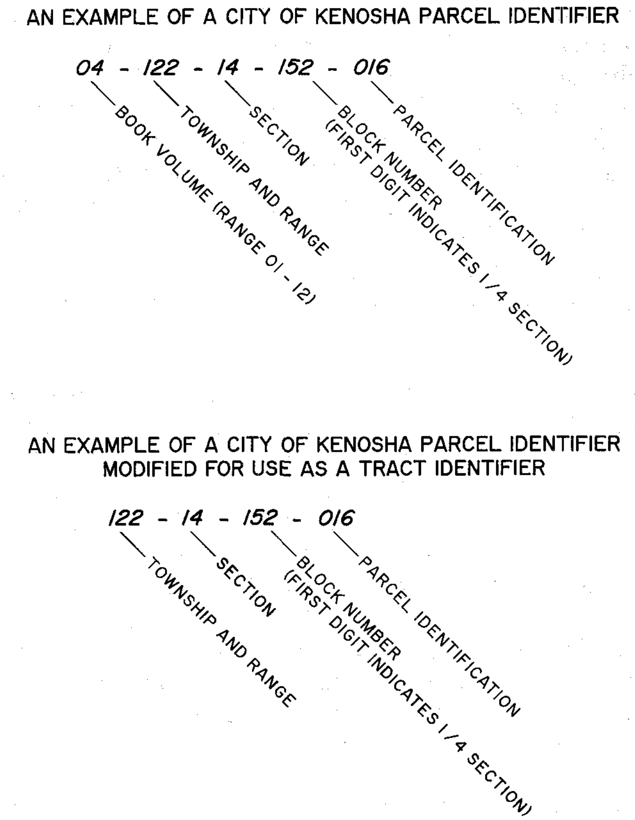
EXAMPLES OF A COUNTY PARCEL IDENTIFIER AND A MODIFIED TRACT IDENTIFIER



Source: Kenosha County Assessor's Office and SEWRPC.

Figure 17

EXAMPLES OF A CITY OF KENOSHA PARCEL IDENTIFIER AND A MODIFIED TRACT IDENTIFIER



Source: Kenosha County Assessor's Office and SEWRPC.

conforming tracts to parcels. Since the only advantage of the present tract numbering system is that tracts are identified uniquely within a county, it should be possible to adopt a different numbering system that can offer some additional benefits beyond this capability.

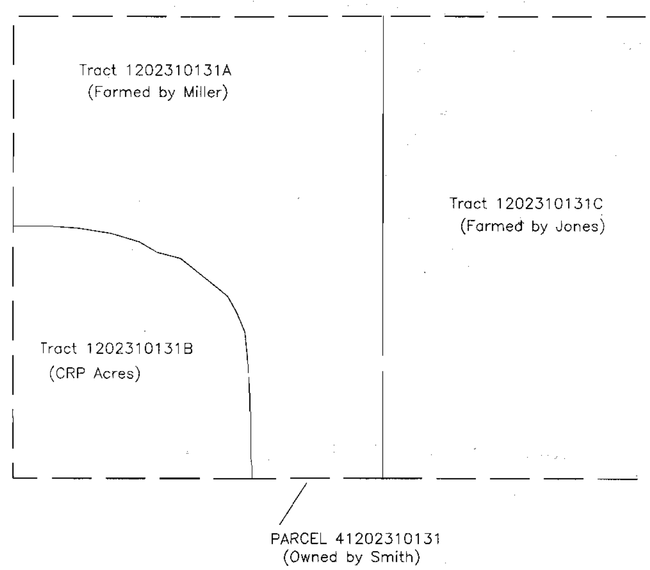
One means to improve the numbering of tracts is to use a modified version of the parcel identification system for tracts. Parcel identification numbers are unique, they are relatively stable, and the location identification scheme used in parcel numbering associates parcels with a particular location. With a small amount of effort parcel identification numbers could be applied to tracts. To modify the two parcel numbering schemes used in Kenosha County, each parcel identifier could be reduced to a 10 or 11 digit number containing all the significant information about the parcel. For a county parcel identifier, the modified number would include the 10 digits that signify U. S. Public Land Survey System township and range, section and quarter section, and parcel identification (see Figure 16). For a City of Kenosha parcel identifier, the modified number would include the 11 digits with township and range, section, block, and parcel identification information (see Figure 17). If tracts were delineated to coincide with parcels as much as possible, then these modified tract numbers could be taken off the cadastral overlays and assigned to tracts at the time of delineation.

In the exceptional cases where a tract is smaller than a parcel, such as CRP lands or parcels split by more than one operator, this modified system could still be implemented. Attaching a single character suffix to the modified tract identifier would designate that the tract is a subset of a parcel. An example of this feature of the modified tract numbering system is illustrated in Figure 18. In this figure, the imaginary parcel has been divided into three separate tracts, each of which uses a modified version of the parent parcel's identification number with a unique one-character suffix attached ("A", "B", or "C"). With this identification system, tracts with a suffix would be smaller than a parcel and all tracts with the same 10 or 11 digit prefix would together constitute one cadastral parcel. The suffix designation for tracts should not be heavily used, because with better delineation procedures the majority of tracts would coincide with exactly one parcel.

Implementation of this new numbering system for tracts would require some technical changes in the CAMPS database. The present size of the data field for tract identifiers in the two CAMPS systems is seven characters; this would need to be increased to accommodate the larger modified tract number. Expansion of the tract identification field to 12 characters (11 digits for the prefix, one character for the suffix) would be sufficient for modified versions of both the county and city parcel identification schemes used in Kenosha County.

Figure 18

AN EXAMPLE OF A MODIFIED TRACT NUMBERING SYSTEM FOR A PARCEL COMPOSED OF THREE TRACTS



Source: SEWRPC.

The three steps discussed in this section, better definition of tracts, improved delineation of tracts, and changes in the tract numbering system, should resolve most of the conflicts between tracts and parcels. The goal of these three steps is to arrive at a common spatial definition for tracts and parcels, so that these two geographic units are, in effect, identical in most cases. In the remaining cases, a simple agglomeration of two or more tracts will yield a single cadastral parcel. These measures, if put into effect, would facilitate implementation of the first two recommendations discussed in this chapter. The first of these, incorporation of parcel identifiers into CAMPS, would be practical because of the closer relationship between tracts and parcels. An improved system of tracts would also remove some of the technical obstacles to the second recommendation, creation of a tract layer for the LIS. In general, refinements in the delineation and numbering of tracts would expedite the integration of the CAMPS and LIS databases.

Enactment of these steps requires that certain institutional adjustments must take place, with the bulk of these adjustments applying to the ASCS. Revamping the tract delineation and numbering system would involve some modifications to the agency's work program. The ASCS would also become dependent on another organization to furnish them with source materials, such as aerial photographs and cadastral overlays, for tract delineation. But there are certain benefits available to the ASCS for participating in this work effort. One benefit would be the ability to obtain easy and accurate acreage quantification of fields and tracts. If field and tract layers were included as graphic components of the Kenosha County LIS, then acreage totals for these units could be easily derived by machine and provided to the ASCS. This automated method of acreage measurement would be faster and more accurate than the manual measurement techniques currently used by ASCS staff.

Another advantage to the ASCS for contributing to this tract simplification effort would be the availability of current, easily-produced maps and overlays for parcels, fields, and tracts. The automated mapping capabilities of the LIS could generate these materials relatively quickly and easily if a tract and field layer were maintained for the system. Still another benefit to ASCS would be manifested by the fewer number of tract updates required each year. Because tracts would be defined to be more like parcels, they would be more stable, and tract boundaries should change less often than they do presently. Also, with the numbering system recommended here, tract identification numbers would be linked to parcels and would change less from year to year. And if ASCS were to participate fully in a CAMPS/LIS integration project and become full-time custodians of a graphical field and tract layer, then updates could conceivably be performed more easily in a digital environment as farm operators visited the field office for annual certification of their croplands. For the ASCS, the benefits of making these technical and institutional changes should outweigh the costs. The potential improvements in the speed and efficiency of their work should convince the agency to enhance the tract system in order to make CAMPS and the LIS more compatible.

CAMPS as a Component of an Integrated Rural Resource Land Information System

The goal of the recommendations outlined in this chapter is to modify the tract system in order to bring about the integration of the CAMPS and LIS databases. The immediate focus of consolidating the land ownership and natural resource data in the Kenosha County LIS with the farm management information in CAMPS is to assist the local U. S. Department of Agriculture, Agricultural Stabilization and Conservation and Soil Conservation Services, and the County Land Conservation Department field offices in carrying out their work effort. Beyond this, the proposed integration of the two systems should benefit other users as well, including departments of county government such as zoning and planning and state agencies such as the Wisconsin Departments of Natural Resources; Transportation; and Agriculture, Trade and Consumer Protection. The integration of CAMPS with the Kenosha County LIS should better satisfy the information needs of these users and aid those making decisions in planning, administering, and monitoring urban and rural resources.

The linkage of the CAMPS and LIS databases should not be the final goal of this project. There is a need to incorporate additional information about rural features and resources into a multipurpose land information system. Farms and rural landscapes contain many important and often overlooked features that should be considered for inclusion in a land information database. Many elements of the rural infrastructure have never been inventoried or mapped, yet these features can have significant implications for the proper conduct of environmental protection programs and planning and engineering functions. An inventory of these elements of the rural infrastructure would be a valuable enhancement to a comprehensive multipurpose land information system.

One answer to the increased need for this type of rural information would be to expand the integration of the CAMPS and LIS databases. This proposal envisions CAMPS and the Kenosha County LIS as components of a larger, more extensive land information database, which may be called a Rural Resource Land Information System (RRLIS). An expanded, comprehensive information system such as the RRLIS would be designed and implemented so that maps, tabular data, and land records from any number of agencies could be integrated as components into the shared information database. The Kenosha County LIS is well suited as the framework component of this enhanced system, because it is founded on techniques of precise geodetic control and has the graphic and tabular database capabilities to serve a diversity of users. The LIS component also contributes essential cadastral and natural resource information to the proposed RRLIS. Farm management practices, soil and water conservation planning information, and other field-specific data are the anticipated contributions of the CAMPS database component to the suggested information system. Other graphic and tabular components can be added to the RRLIS when feasible. The design of the system should be driven by the needs of its users, and, in concept, the contents of the rural information system should intentionally be left open-ended, so that additional databases can be attached as necessary.

A number of features of the rural landscape would be valuable elements of the Rural Resource Land Information System. One group of such features, many of which are not currently inventoried or mapped, is listed in Table 2. An example of some of these features and attributes that can be mapped for a RRLIS is shown in Figure 19. Some of the constructed features on the list in Table 2 constitute capital improvements made by operators to their farms; these features represent a rural infrastructure that merits incorporation into an automated mapping and land information system. A particularly important example of this infrastructure are the farm drainage-tile lines utilized to improve the drainage of farm fields. The exact location of many older tile lines is not known, and some tile systems have been abandoned and forgotten. Newly installed tile lines are not mapped or inventoried in any systematic fashion. But the existence of these tile lines can be very important for certain land use and zoning decisions. For instance, an area served by an existing or abandoned tile system would be an unfavorable location for a residential development, so information about tile systems should be available when planning or zoning for urban and suburban development. The lack of this information could, in certain situations, be costly.

Some features of the rural infrastructure must be included in a RRLIS because of the associated potential for environmental pollution. Existing and abandoned wells, for example, present a threat for groundwater contamination; if these features were mapped they could be monitored in wellhead protection programs. Sites of severe agricultural chemical spills and underground fuel storage tanks represent other hazards that may need to be monitored because of their potential to contaminate groundwater. Fertilizer storage tanks and manure holding tanks can cause serious damage if they should rupture and spill their contents onto surrounding fields and streams. There are other environmental threats in abandoned rural landfills, some of which have been covered over by soil and are practically forgotten. A systematic effort to inventory and map these hazards for a comprehensive resource information database would assist in environmental protection activities in rural areas.

A final group of infrastructure features proposed to be mapped for the RRLIS is important for the provision of emergency services. Modern farm operations use many hazardous agricultural chemicals and fertilizers, which are often stored in large quantities at farm sites. Fertilizer and chemical plants in rural areas often house large volumes of these materials, and some liquid and gaseous fertilizer storage tanks can hold several thousand gallons of these substances. These sites represent a special class of hazards to disaster preparedness and emergency services personnel. The locations of unique hazards like fertilizer storage tanks would be valuable and essential information for emergency medical services staffs, fire departments, law enforcement personnel, and other emergency services workers.

In addition to these elements of the rural infrastructure, certain other natural features should be included in the proposed RRLIS. Many

Table 2

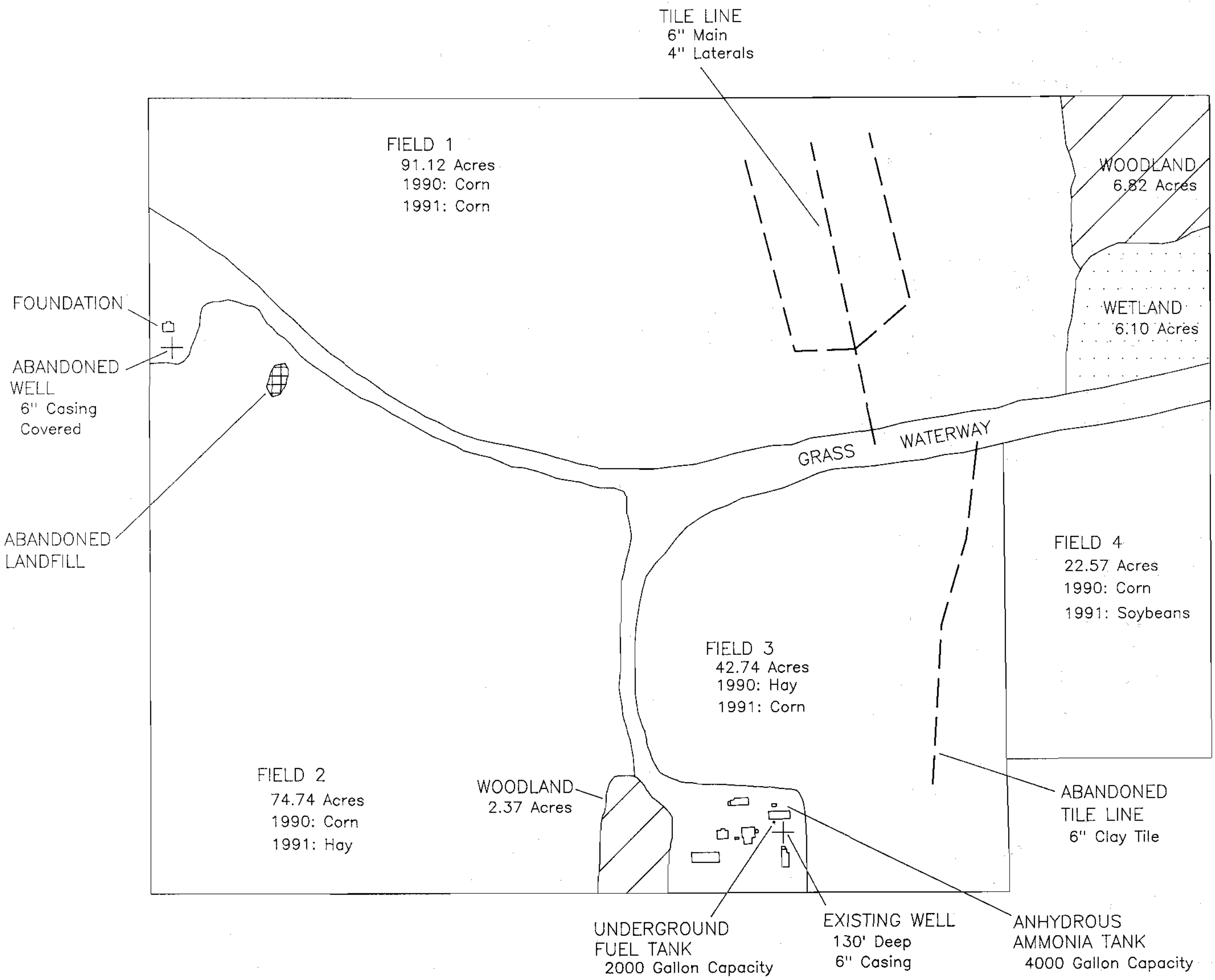
PROPOSED FEATURES TO BE INCLUDED IN A RURAL RESOURCE LAND INFORMATION SYSTEM (RRLIS)

Constructed Features
• Existing and abandoned farm tile lines
• Constructed ponds, dikes, and spillways
• Irrigation wells and irrigation pipelines
• Manure pits and tanks
• Constructed field terraces
• Grassed waterways and other drainageways
• Fences
• Culverts
• Farm buildings and foundations
• Drainage ditches and irrigation ditches
• Existing and abandoned wells
• Abandoned rural landfills
• Locations of chemical spills
• Chemical and fertilizer storage areas
• Chemical and fertilizer plants
• Liquid and gaseous fertilizer storage tanks
• Existing and abandoned underground storage tanks
• Old quarries
• Nonfarmed areas
Natural Features
• Wetlands
• Woodlands and woodlots
• Natural ponds, lakes, and streams
• Floodplain areas
• Shoreland areas
• Steep slopes
• Topographic and elevation information
• Wildlife habitats and natural areas
• Soils

Source: SEWRPC.

Figure 19

AN EXAMPLE OF SOME OF THE FEATURES AND ATTRIBUTES THAT MAY BE MAPPED IN A RURAL RESOURCE LAND INFORMATION SYSTEM (RRLIS)



Source: SEWRPC.

of the natural features listed in Table 2 are currently incorporated into the Kenosha County LIS. With the aid of appropriate site-specific information, some of these features could be redefined and mapped for the common requirements of participating users. Wetland features in the LIS, for example, are part of the land use layer that is interpreted from 1:4,800 scale aerial photography by Regional Planning Commission staff. The criteria for delineation of these features is the presence of hydrophytic or wetland vegetation as an indicator of wetland areas. Some agencies, such as the U. S. Soil Conservation Service, include all areas covered by hydric soil types in their definition of wetlands. A wetland layer for the comprehensive rural land information system could be comprised of both wetland delineations, showing areas of overlap.

Other natural features in the Kenosha County LIS would constitute worthwhile additions to an integrated RRLIS. Woodlands and woodlots are important features for wildlife habitat and forest inventories; the boundaries and attribute characteristics of these features would be useful inclusions for an expanded rural resource database. Information about flood hazard areas, necessary for zoning and land use decisions, could be further refined with site-specific floodplain boundary delineation. Comprehensive data about soils, topography, and slopes would also be vitally important to a multipurpose land records database.

The need to map and inventory these important natural and constructed features of the rural landscape should motivate the development of a comprehensive rural resource information system. The integration of the CAMPS and the LIS databases would provide a solid framework for the proposed RRLIS and would be the nucleus for the incorporation of additional graphic and attribute data into an expanded multipurpose land information system. Such a system would supply a wide range of users with extensive land resource and ownership information.

APPLICATIONS OF THE INTEGRATED CAMPS/LIS DATABASE

The recommendations proposed in this chapter focus on the modification of the tract system as the key mechanism for integrating the CAMPS and the LIS databases. Although several difficult technical and institutional obstacles must be overcome to achieve this goal, the effort should create a resource planning and management system that can meet the information demands of a variety of users. To illustrate the practicality of a combined CAMPS/LIS database, this section of the chapter describes some potential specific applications of an integrated database system. The two examples described demonstrate the utility of linking the CAMPS and LIS databases to assist in resource planning and management efforts at the local level.

Soil Erosion Control Planning

One application of an integrated CAMPS/LIS database pertains to soil conservation. The U. S. Department of Agriculture, through its Agricultural Stabilization and Conservation and Soil Conservation Services, administers soil erosion control programs mandated by federal legislation. In practice, these programs offer financial incentives and other benefits to landowners and operators who meet certain standards. The ASCS provides financial assistance and oversees the management of these programs, while the SCS supplies technical support to program participants in the form of soil erosion control planning and engineering.

The focus of the federal conservation legislation involves identification of fragile lands that need to be carefully managed. One provision of the legislation seeks to locate SCS-defined wetlands threatened with conversion to cropland and attempts to discourage this practice by denying program benefits to operators who convert these wetlands. Some other provisions of the legislation refuse benefits to landowners and operators who produce crops on highly erodible lands (HEL) without an approved conservation plan. These lands are determined by soil type, slope, and other inherent characteristics. Much of the administration of the federal conservation provisions centers on the key task of locating and identifying wetlands and highly erodible lands.

To identify highly erodible lands, the SCS employs the Universal Soil Loss Equation (USLE) to calculate the annual soil loss from water erosion for a soil type. The USLE is used to calculate the soil erosion rate on the basis of four environmental factors: rainfall, soil erodibility, length of slope, and slope gradient; and of two management factors: cropping practices and land management practices. A variation of the USLE is used to identify highly erodible lands. This procedure calculates an Erodibility Index (EI), which is the product of the environmental factors of the USLE divided by the tolerable erosion rate for a given soil. Soils with an EI of eight or more are considered highly erodible.

In Kenosha and Racine Counties, the location and identification of HEL is initiated when a landowner or operator contacts the SCS field office to request that a conservation plan be developed for his land. Conservation plans, required by the ASCS in order to receive farm program benefits, are written agreements outlining the management practices to be used on farm fields with highly erodible soils. In order to develop a conservation plan for an individual, SCS personnel must obtain tract and field information from the ASCS. Tract and field boundaries are taken from ASCS 1:7,920 (one inch equals 660-feet-scale) aerial photography. The boundary lines are then manually recompiled onto 1:15,840 (one inch equals 1,320-feet-scale) SCS soil survey photomaps. Next an EI is calculated for the soils in each field, utilizing information from topographic maps to determine specific slope lengths for those soils that may have an EI that varies due to slope. If HEL are located in any field, the operator is notified that he must develop a conservation plan, with the assistance of the SCS, to be able to receive farm program benefits from the ASCS. The identification and location of HEL in Kenosha and Racine Counties is a time-consuming process that requires the SCS staff to compare and cross-reference manually a variety of source materials, including ASCS tract and field boundaries, soil surveys, and topographic maps.

The task of locating highly erodible lands in these two counties could be greatly simplified by integrating the CAMPS and LIS database systems. With the aid of automated soils maps and attribute data in a comprehensive land information system, highly erodible soils can be identified and mapped at a countywide scale.[4] Those soils that have an EI that varies due to slope could be identified separately and compared with either digital or analog topographic information to determine whether they are considered highly erodible for specific locations. Once HEL are located on a countywide basis, they could be correlated with field location information from an automated field and tract layer in the integrated CAMPS/LIS database. The location of HEL for individual agricultural fields can be determined in the combined land information system by graphically overlaying a field boundary layer with a highly erodible soil layer, producing a map of highly erodible soils in each field. Finally, ownership and operator information for each field and tract could be extracted from the CAMPS portion of the integrated database. By assembling assorted data about soils, fields, and operators in an automated environment, an integrated CAMPS/LIS system would facilitate the comparison of this diverse information and locate highly erodible lands quickly and efficiently.

There are a number of important benefits to be gained by linking the CAMPS and LIS systems for use in soil erosion control planning. One such benefit would be the increase in speed and efficiency in locating highly erodible lands, thereby eliminating the tedious job of referencing several different source documents and manually calculating an erodibility index for each soil type. Another such benefit of a combined land information system would be faster and more accurate acreage measurements of highly erodible soils, fields, tracts, and other areas. This would be a distinct improvement over the time-consuming manual techniques currently used by SCS personnel for area measurements.

Perhaps the greatest benefit of an integrated CAMPS and LIS database would be the flexibility to deal with conservation program alternatives. For instance, digital soils and field information could be used to calculate and identify acreage modifications automatically if program requirements were to change. In the area of soil erosion control planning, this could happen if the definition of highly erodible lands were to be refined and additional highly erodible soils had to be identified. Another example of this system flexibility could occur in estimating the impacts of certain conservation programs, such as determining the number of acres that could be returned to production and the number of acres that would be threatened by serious soil erosion when Conservation Reserve Program agreements expire. This ability to plan for alternatives, to ask and quickly answer "what if" questions, in soil erosion control planning and other areas is potentially the most significant benefit of the integration of the CAMPS and the Kenosha County LIS.

Farmland Preservation Program Administration

A second application of an integrated CAMPS/LIS database involves the preservation of farmlands. The rapid conversion of farmland to urban use has become a matter of public concern in many communities. Agricultural lands need to be preserved for many purposes, including prevention of urban sprawl, maintenance of open space, preservation of the local economic base, retention of natural systems and natural processes, and maintenance of agricultural reserves.[5] In response to these concerns, the Legislature of the

[4]*See S. J. Ventura, N. R. Chrisman, K. Connors, R. F. Gurda, and R. W. Martin (1988), "A Land Information System for Soil Erosion Control Planning," Journal of Soil and Water Conservation, Vol. 43, No. 3, pp. 230-233.*

[5]*See SEWRPC Community Assistance Planning Report No. 45, A Farmland Preservation Plan for Kenosha County, Wisconsin, June 1981.*

State of Wisconsin in 1977 adopted what is commonly known as the "Farmland Preservation Act," designed to encourage individuals and local units of government to take action toward preserving Wisconsin farmland.

Under the Farmland Preservation Act, a farmland owner may agree not to develop his or her land for urban uses and in return becomes eligible for tax relief in the form of a state income tax credit. Certain requirements determine whether a farmland owner is eligible for the tax-relief program. In the initial five years of the program, farmland owners with 35 or more acres were automatically eligible if their land was located in an exclusive agricultural zoning district and the land had produced farm products of a specified minimum value for three consecutive years. In addition, an SCS farm management plan needed to be under preparation or in effect for the land. If the farmland owner met these requirements and his farm preservation agreement received approval from the Wisconsin Department of Agriculture, Trade and Consumer Protection, the owner became eligible for the income tax credit. The owner also became exempt from special tax assessments for sewer, water, and other urban public services.

A permanent tax-relief program took effect after the initial five-year program expired in 1982. The eligibility requirements for acreage and value of farm products remain the same, but some other requirements changed slightly. Basically, Wisconsin farmers can participate in the permanent program only if the county or town in which their farmland is located takes action to preserve such farmland by adopting a farmland preservation plan and/or an exclusive agricultural zoning ordinance. Farmers in urban counties, such as Kenosha County, generally can participate in the permanent program only if the town or county in which their land is located adopts exclusive agricultural zoning. However, some exceptions were made for certain periods of time whereby farmland located in towns without exclusive agricultural zoning could be enrolled in the permanent program with farmland preservation agreements. The permanent tax-relief program also requires that a farm management plan, approved by the County Land Conservation Committee, that meets certain minimum soil and water conservation standards, be in effect for the land. Under the permanent program, the landowner is responsible for repaying the tax credits received over the past 10 years when land is removed from an exclusive agricultural zone.

To request participation in the Farmland Preservation Program, a landowner in Kenosha County must contact the County Land Conservationist, who administers the program. The Land Conservationist then begins to collect and examine information about the parcel in order to determine if it qualifies for the tax-credit program. Cadastral information is consulted to get parcel boundaries, tax and assessment information and the parcel identification number. Zoning maps are examined to determine and measure what portion of the parcel is zoned for exclusive agriculture, since only that portion of the parcel is eligible for the program. Another requirement of the program is that the landowner must have an approved conservation plan for the farmland. In many cases this plan may be exactly the same as the SCS conservation plan, but in other cases a stricter conservation plan must be developed in order for the land to be eligible for the Farmland Preservation Program.

To check on the existence of conservation plans, the Land Conservationist needs to access the CAMPS database and ASCS aerial photographs to ascertain which tracts correspond to the parcel being considered for the program. In the case where a parcel is divided into more than one tract, all those tracts must be inspected for conservation plans. The Land Conservationist also needs to reference soils and topographic maps to modify any existing conservation plans, or to help develop a new plan, for the parcel. The eligibility of a parcel for the Farmland Preservation Program can be determined only by accessing and consulting land records from a great variety of sources.

A practical solution to the time-consuming task of determining farmland preservation eligibility is to incorporate all pertinent land records into an automated land information system. The integration of the CAMPS and the LIS databases would consolidate all of the cadastral, natural resource, and farm management information needed for administration and management of the Farmland Preservation Program. With such an integrated land records system, the Kenosha County Land Conservationist could readily access parcel identification numbers, the locations of parcel boundaries, and other necessary cadastral information. To determine program eligibility based on exclusive agricultural zoning, parcel boundaries could readily be compared with zoning district map overlays in an automated environment in order to find and quantify the portions of parcels eligible for tax-credit relief.

Tract boundaries and other farm management information are also needed for administration of the Farmland Preservation Program. An integrated CAMPS/LIS database would include a graphical field and tract layer which could be used to spatially relate parcels and tracts. From this operation, the Land Conservationist could ascertain which tracts correspond to eligible parcels, and then access the CAMPS component of the integrated database to find and evaluate conservation plans for those tracts. Any necessary modifications to the conservation plans, such as finding the location and extent of highly erodible soils, would be facilitated by referencing the automated soils component of the combined CAMPS/LIS system. Automated information about land use, flood hazard areas, and shoreland boundaries would also be readily accessible to aid the Land Conservationist in managing the Farmland Preservation Program.

The advantages of utilizing an integrated CAMPS and LIS database for Farmland Preservation Program administration are significant. An obvious benefit is that most of the spatial and attribute information needed to determine program eligibility could be brought together and accessed by means of land information system technology. In this scenario, there would be no need to compare and cross-reference conventional hardcopy documents and maps, since these materials could more easily be examined in a digital environment. Another advantage of linking the CAMPS and LIS databases is faster and easier quantification of areas. For example, inexact and tedious manual techniques are currently used to measure the number of acres that are zoned as exclusive agriculture for a parcel being considered for the Farmland Preservation Program. By automating this procedure with a computerized map overlay operation, the number of eligible acres for a parcel could be determined quickly and accurately.

An additional important benefit of linking the CAMPS and the LIS systems would be the opportunity to increase the scope and effectiveness of the Farmland Preservation Program in Kenosha County. At present, the program serves only those landowners in the county who voluntarily request to participate in the tax-credit program. With an integrated and functional CAMPS/LIS database, areas of candidate prime farmlands could easily be identified on the basis of characteristics of soils, acreage, zoning, and existence of conservation plans. The Land Conservationist could then actively seek out landowners for participation in the program, with the goal of preserving as much of the prime farmland in the county as possible. The integration of the two information systems would allow the Land Conservationist and other planners to accomplish some tasks, such as actively soliciting participation in the Farmland Preservation Program, that they are currently not able to perform. For applications such as soil erosion control planning and farmland preservation, the benefits to be gained by integrating the CAMPS and LIS databases appear to far outweigh the cost of such an effort.

SUMMARY

This chapter has investigated the compatibility of the Kenosha County Automated Mapping and Land Information System (LIS) and the Computer-Assisted Management and Planning System (CAMPS) on the assumption that the integration of these two systems will aid in solving local resource planning and management problems in a timely and cost-effective manner. Some important compatibility problems emerged in the course of this study. Technical problems, such as incompatible hardware, are generally easy to define and address. Institutional problems, on the other hand, are more difficult to define and solutions to these problems may be harder to achieve. This investigation has examined the practicality of integrating the CAMPS and LIS databases in light of the technical and institutional problems that accompany such an effort.

The Computer-Assisted Management and Planning System and the Kenosha County LIS are very different types of data management systems. The LIS is primarily a spatial database, while CAMPS is predominantly a nonspatial database. As of early 1992, the two systems were located on two quite different computer systems which cannot be readily interfaced to share information between the two databases. In spite of these differences, CAMPS and the LIS do have some things in common. Both databases contain soils and zoning information, but, more importantly, they also share a common geographic locator, the parcel identification number. This identifier is used more extensively in the LIS than in the CAMPS database. The existence of the parcel identification number as a shared geographic locator establishes the potential of using this item to link the CAMPS and LIS databases.

A common function of the two database systems is to refer data to geographic locations. Since both CAMPS and the LIS reference and describe geographic units, it is beneficial to examine these units to determine whether they can be used to interrelate the two databases. One important geographic unit, the cadastral parcel, is generally recognized as the most fundamental unit for land information systems. Associated with each cadastral parcel is a geographic locator, or identifier, called a parcel identification number. For a variety of reasons, the parcel and its identification number provide a virtually ideal geographic locator on which to base a land-related information system. The cadastral parcel is the basis of the Kenosha County LIS and the parcel identification number serves as the primary linkage device for parcel-related information in this database. Unfortunately, the cadastral parcel is not as important in the CAMPS database, where the parcel identification number appears in only one data table, and it is difficult to sort or query other data records with this data item. Because there is so little emphasis on the cadastral parcel in the CAMPS system, it appears that the parcel identification number is not a good linkage mechanism between the CAMPS and LIS databases at present, but holds the potential for future integration of these two databases.

Other spatial units called fields and tracts are used by the CAMPS database as its primary units of geography. These areas are defined and delineated on aerial photography by Agricultural Stabilization and Conservation Service (ASCS) personnel for the purpose of administering ASCS farm programs. Related areas called operating units are created by Soil Conservation Service (SCS) and Land Conservation Department (LCD) personnel by aggregating tracts under common landownership. The tract and field identification numbers are the most common geographic identifiers used in CAMPS. Since tract identification numbers are used so frequently, it would appear that these data items offer the best means for linking CAMPS with another database. However, there are some unique problems associated with this unit of geography. Some of the disadvantages of tracts are that they are used almost exclusively by the ASCS, their identification numbers can change annually, and they utilize an ambiguous numbering system. Tract identification numbers also cannot be used to find the location of tracts within a county.

In spite of these disadvantages, the system of fields and tracts is the geographic basis of CAMPS, and therefore is the most likely means for linking this database with the parcel-based Kenosha County LIS. To examine the differences between parcels and tracts, a comparison was performed between these two units of geography for a small study area in Kenosha County. Tract boundaries obtained from ASCS aerial photography were recompiled onto a controlled photographic base and board digitized. The comparison of graphics files of tracts and parcels reveals that the boundaries of these two geographic units are at times quite similar, but in most cases they are quite different. The boundary line discrepancies are generally caused by interpretation and delineation errors and lack of currency of the parcel and tract data sets. Another reason for boundary differences is the recent practice of the ASCS to delineate Conservation Reserve Program lands as separate tracts. A second comparison in the study area examined parcel boundary lines against tract boundaries that had been modified with the aid of ancillary parcel boundary information. This comparison indicates that tracts can be made to coincide with whole parcels or adequate parts of parcels; therefore it may be feasible to relate these two units of geography to provide a link between CAMPS and the LIS.

This chapter has presented the following four potential solutions toward making CAMPS and the LIS more compatible:

1. The first solution is to emphasize and fully incorporate parcel identification numbers into the CAMPS database. This step would require updating the CAMPS software to create new and expanded data relationships. Emphasizing the parcel identifica-

tion number will more closely relate the farm management records in the database with land ownership information. It appears that some enhancements and corrections may be forthcoming in the new version of the national CAMPS software, but these measures would provide only a partial technical solution to the integration problem. Although parcel identifiers will improve data access and retrieval within the CAMPS database, this step does not address the disparity between tracts and parcels, which is the real source of the incompatibility between the CAMPS and LIS databases.

2. A second solution to the CAMPS/LIS integration problem is the creation of a spatial field and tract layer for the Kenosha County LIS. Certain types of mapping software used with land information system technology permit graphic map overlays to be compared and analyzed, producing derived maps and statistics depicting the distribution of one layer within another. The creation of a farm field and tract layer for the LIS can utilize these analytical functions to link the system to the CAMPS database, where parcels and tracts can be compared to determine, for example, which parcels lie in certain tracts. With a graphic layer for fields and tracts, CAMPS essentially becomes an attribute database for the LIS. Information can then be extracted from either CAMPS or the LIS by knowing the tract number or parcel identification number obtained from a map overlay process.

   The development of a field and tract layer for the LIS involves addressing some institutional and technical compatibility issues. One of these issues is determination of a custodial office or agency to collect and maintain the data layer. Another technical problem occurs when comparing dissimilar geographic units in a map overlay operation, in which many small and oddly shaped areas are created as a result of this process. To illustrate this problem, an overlay analysis of tracts and parcels was performed for a portion of the study area. Because the original tract boundaries do not neatly coincide with parcel boundaries, the analysis shows that several small "sliver" polygons are created. These odd-shaped polygons are portions of adjoining parcels that appear to lie within a single tract, but they are more likely to be caused by errors in the placement of tract boundaries. When adjusted tract boundary lines are used in a similar analysis, these problematic sliver polygons disappear. Other problems persist, however, such as how to interpret and apportion management data for a large tract to a smaller parcel. In addition to these technical problems, other institutional arrangements hamper the development of a field and tract layer as a solution to the CAMPS/LIS integration dilemma. Because this approach does not establish an elegant link between the two databases, and because it also creates a number of analytical problems, it does not appear that the creation of a field and tract layer is a practical link between the two databases at this time.

3. A third solution to the CAMPS/LIS compatibility problem addresses the critical obstacle to integration of the two databases, that is, the disparity between tracts and parcels. This solution proposes to redefine tracts to be more like parcels, because parcels are generally considered to be the more fundamental geographic unit for a land information system. The recommendations outlined in this solution constitute a three-step approach:

   a. The first step, better definition of tracts, involves establishing and following guidelines to ensure that tracts are consistently defined. Tract boundaries should follow parcel boundaries whenever possible. With access to ancillary deed and parcel boundary information and with a more consistent definition of tracts, ASCS personnel could delineate tracts to be coincident with parcels, or to comprise major parts of parcels.

   b. A second step in this solution is improvement in the delineation and interpretation of tracts. This can be accomplished by utilizing cadastral boundary information in the delineation process. A good choice for this information would be cadastral overlays, which could be generated by the Kenosha County LIS as film transparencies intended for overlay on top of ASCS aerial photographs. Using the parcel lines as a guide, tracts could then be traced to exactly coincide with parcel boundaries, and in most cases tracts could be delineated so that they would occupy single parcels.

c. The third and final step in this solution, better numbering of tracts, proposes to use a modified version of the parcel identification system for tracts. With a small amount of effort parcel identification numbers could be applied to tracts; the result would be a unique and stable numbering scheme that could also be used to geographically locate tracts. In the exceptional cases where tracts are smaller than parcels, the modified system would include a suffix notation to designate that a tract is a subset of a parcel.

Enactment of these three steps should resolve most of the conflicts between tracts and parcels, but would require that certain institutional adjustments take place, particularly for the ASCS. The ASCS would benefit by participating in this work effort, however, and the potential improvements in the speed and efficiency of their work should convince the agency to enhance the tract system to make CAMPS and the LIS more compatible.

4. The fourth and final solution for linking the two databases envisions CAMPS and the LIS as components of an expanded and integrated multipurpose land information system. There is a need to map and inventory many important and often overlooked features of the rural landscape. These elements of the rural infrastructure could be included along with CAMPS and the LIS as components of a larger, more extensive land information database, which may be called a Rural Resource Land Information System (RRLIS). The Kenosha County LIS, with its cadastral and natural resource data, is well suited as the framework of this database, and CAMPS would contribute farm management and planning information to the suggested information system. Many features of the rural infrastructure, such as existing and abandoned tile drainage systems, existing and abandoned wells, fertilizer storage facilities, and old landfills, should be included in the RRLIS because of their environmental importance. Other features that should be mapped and inventoried for the comprehensive database include sites of potential hazards, such as chemical storage areas. The development of an enhanced rural land information database would provide extensive land resource and ownership information to a wide range of users.

Two applications of an integrated CAMPS/LIS database demonstrate the utility of linking the two systems to assist conservation planning efforts in local agencies. The first application pertains to soil erosion control planning. To administer federal conservation programs, the SCS must locate and identify highly erodible lands and then inform landowners and operators that they need to develop and implement conservation plans for those lands in order to receive farm program benefits from the ASCS. The identification of highly erodible lands is a time-consuming task that requires SCS personnel to compare and cross-reference manually a variety of source materials, including ASCS tract and field boundaries, soil surveys, and topographic maps. This task could be greatly simplified by integrating the CAMPS and LIS database systems. Such a system would facilitate the comparison of diverse information by assembling the various data about soils, fields, and operators in an automated environment. Some benefits to be gained from an integrated system are faster and easier identification of highly erodible lands and more accurate acreage measurements. Perhaps the greatest benefit of an integrated system is the flexibility to plan for farm program alternatives.

A second application of an integrated CAMPS/LIS database involves administration of the Farmland Preservation Program. This act of the Legislature is designed to encourage individuals and local units of government to take action toward preserving Wisconsin farmland by offering state income tax credits to owners who agree not to develop their land for urban uses. In

Kenosha County, the Land Conservationist administers the program by examining applications from landowners to determine if the parcels meet certain eligibility requirements. Cadastral information, zoning maps, tract boundary information, and soils and topographic maps all need to be consulted to determine the eligibility of a parcel for the tax-credit program. A practical solution to this time-consuming task is to incorporate all pertinent land records into an automated land information system. The integration of the CAMPS and LIS databases would consolidate much of the cadastral, natural resource, and farm management information needed for administration of the Farmland Preservation Program. The advantages of this approach are numerous. The land records could be accessed faster and easier in a digital environment and area measurements could be determined faster and with greater accuracy than with the manual techniques currently used. An additional important benefit of linking the CAMPS and LIS systems is the opportunity to increase the scope of the Farmland Preservation Program by seeking all eligible participants, in order to preserve as much prime farmland as possible.

(This page intentionally left blank)

Chapter V

SUMMARY AND RECOMMENDATIONS

INTRODUCTION

This study has examined the means by which two existing planning databases that provide coverage of the Kenosha County area could be integrated. The study was conducted by the Southeastern Wisconsin Regional Planning Commission at the request of the Kenosha County Land Conservation Committee. The study was funded, in part, by a grant from the Wisconsin Department of Agriculture, Trade and Consumer Protection. More specifically, the study sought to examine information exchange procedures and data interrelationships between the U. S. Department of Agriculture, Soil Conservation Service (SCS) Computer-Assisted Management and Planning System (CAMPS) and the Kenosha County Automated Mapping and Land Information System (LIS).

The study focused on the technical and institutional problems inherent in the integration of the CAMPS and the LIS systems. A number of these problems originate in basic operational and conceptual differences between the two databases. The Kenosha County LIS is primarily a spatial database and references geographic locations explicitly, with the ability to manipulate, analyze, and display information graphically as map features. Founded on the cadastral parcel as its primary unit of geography, the LIS is linked to complementary tabular databases that supply ancillary information about the features in the spatial database. In contrast, the U. S. Department of Agriculture CAMPS is primarily a tabular database that can reference geographic locations only indirectly. It uses geographic locators to reference features delineated on analog maps or aerial photographs but does not have spatial display capabilities. The CAMPS also uses a system of fields, tracts, and farm operating units as its basic units of geography. The primary difference in the two database systems, the fact that they are founded on different units of geography, is the source of most of the technical problems facing the integration of the CAMPS and LIS databases.

The study considered modification of the CAMPS field, tract, and farm operating unit system as a means to effectively and efficiently integrate the two databases. The study indicated that if tracts could be so defined and delineated under the CAMPS system that their boundaries would coincide with cadastral parcels as defined and delineated under the LIS system it would then be feasible to create and maintain a spatial field and tract layer under the Kenosha County LIS. This measure, coupled with improvements in the numbering of tracts, should establish an accurate relationship between tracts and parcels, and permit tract and parcel identifiers to be used as linkage devices between the two databases. If these measures are taken, CAMPS would essentially become a complementary tabular database for the LIS, linked to that system via the identifiers in the spatial field and tract layer.

There are certain technical and institutional difficulties to be overcome in this approach to integration of the two planning databases. The technical problems are more readily solved, while the institutional issues are more difficult to solve. There are certain important benefits to be gained, however, by all agencies and users who participate in the integration. The greatest number of institutional adjustments apply to the U. S. Agricultural Stabilization and Conservation Service (ASCS), but this agency also stands to benefit the most from integration by realizing significant improvements in the speed and efficiency of their work. The modification of the tract system appears to be the most practical means to achieve integration of the two database systems. With potential applications in many agencies and departments of government, the integration of the CAMPS and the LIS databases should help to solve local planning and resource management problems in a timely and cost-effective manner.

RECOMMENDATIONS

As already noted, the findings of the study suggest that the most feasible means to link and integrate the CAMPS and LIS planning databases is to revise and enhance the system of tracts used by the ASCS. To this end, the following recommendations are offered. These suggestions are evolutionary in concept, and begin with initial steps that may provide only partial linkage of the two systems. If the complete set of recommendations can be effectuated, then a fully functional integration of the two database systems should be achieved.

1. It is recommended that the CAMPS software be updated to emphasize the cadastral parcel by fully incorporating the parcel identification number as a basic data item in the database. New data relationships between the parcel identifier and other data records should be established and the parcel identification number should be developed as a key data field so that it can be used to sort and access other data. This step will help to more closely relate the farm planning records in CAMPS with land ownership information. Some of these changes may be forthcoming in a revision of the national CAMPS software, scheduled for release probably late in 1993.

2. It is recommended that improvements be made in the definition, delineation, and numbering of tracts. New guidelines for the definition of tracts should facilitate more consistent tract delineation. The utilization of cadastral parcel boundary information provided by the LIS, such as cadastral overlays, should also improve interpretation and delineation of tracts. To improve the numbering of tracts, a modified version of the parcel identification system could be employed to help conform tracts to be more like parcels. The goal of these enhancements is to arrive at a common spatial definition for tracts and parcels, so that these two geographic units are identical. With these measures in place, the creation of a spatial field and tract layer for the LIS would be feasible.

3. It is recommended that large-scale, controlled aerial photography be acquired and utilized for ASCS tract delineation. The ASCS currently uses 1:7,920 (one inch equals 660-feet-scale) aerial photography that exhibits scale distortions. An alternative is the use of ratioed and rectified 1:4,800 (one inch equals 400-feet-scale) aerial photographs obtained from the Regional Planning Commission. Utilizing larger-scaled controlled aerial photographs such as these would provide a more accurate base for the cadastral overlays and the greater detail of the prints would assist ASCS staff in more accurately interpreting and delineating tract boundaries.

4. It is recommended that the Kenosha/Racine field office of the U. S. Agricultural Stabilization and Conservation Service take an active role in the CAMPS/LIS integration project by assuming custodianship of a digital field and tract layer for the Kenosha County LIS. For the ASCS, the task of creating and updating this graphic database would be very similar to their current responsibility of maintaining a comparable database in analog format on aerial photographs. The following procedures are envisioned in the custodianship of this database layer:

   a. Using the automated mapping capabilities of the Kenosha County LIS, the County would produce and provide cadastral parcel boundary line maps for use by the ASCS staff as an overlay to Commission ratioed and rectified aerial photographs also provided by the County. Plotted on dimensionally stable transparent film, the cadastral overlays would display, in addition to real property boundaries, parcel identification numbers, notations of common ownership of parcels, and other pertinent cadastral information. The overlays would be produced at the scale of the aerial photography, and could be plotted to cover full U. S. Public Land Survey sections or parts of sections.

   b. The ASCS personnel would use the mapping capabilities of the LIS also to generate transparent overlays of current field and tract delineations. The field and tract boundaries could be produced on separate transparencies or may be plotted on the same transparencies as the cadastral boundary lines, using appropriate symbology for each of these line features. Tract and field identification numbers should also be included on these overlays.

   c. With the aid of these overlays placed on top of the controlled aerial photographs, ASCS personnel could then delineate or update fields and tracts in their usual manner using information obtained from farm owners and operators. Field and tract boundary lines would be traced directly upon the film transparencies, with tract boundaries following parcel boundaries wherever possible. Identification numbers for fields and tracts could also be assigned or changed at this time. The tract identifiers would be modified versions of the parcel identification numbers shown upon the cadastral overlays. The field and tract overlays would constitute an analog data set similar to the field and tract delineations currently done by the ASCS directly on aerial photographs.

d. The field and tract overlays would be board digitized on a regular basis by ASCS staff to automate this data set for incorporation into the Kenosha County LIS. Initially, all field and tract boundary lines would need to be digitized to create this digital data layer, but eventually less time and effort would be required to maintain this layer because fewer boundary lines would need to be modified during the update process. Parcel boundary lines would be used as an ancillary screen display during board digitization in order to copy existing parcel lines that coincide with tract lines. To complete the graphic data layer, all fields and tracts would be created as area features and labelled with appropriate field and tract identification numbers. Current field and tract information would then be available to all users of the integrated CAMPS/LIS database, accessible as a graphic map overlay linked to the farm management records in CAMPS by means of the field and tract identifiers.

e. The ASCS personnel would continue to furnish tract and field information to the Kenosha/Racine field office of the SCS, so that this agency can update and maintain the tabular CAMPS database in the usual manner.

While accepting the custodianship of a digital field and tract layer for the LIS means that the ASCS must make certain adjustments to its work program, the agency stands to benefit substantially from their active participation in maintaining automated tract and field records. One benefit would be accurate and fast automated acreage computations for tracts and fields, a distinct advantage over the manual techniques currently used by ASCS staff. Another benefit would be the ability to produce up-to-date maps and overlays of tracts, fields, and parcels, which could be displayed at any scale for any part of the County.

5. It is recommended that the linkage of the CAMPS and LIS databases should not be the final goal of this project, but that the full integration of these two databases be effected to include other important features of the rural landscape. Many elements of the rural infrastructure have never been inventoried or mapped, yet these features can have significant implications for environmental monitoring programs, planning and engineering functions, and the provision of emergency services. To meet the increased need for information about rural features and resources, the integration of CAMPS and the LIS should be expanded into a larger, more extensive land information database, which may be called a Rural Resource Land Information System (RRLIS). Important permanent features of the rural infrastructure, such as tile drainage lines, underground storage tanks, existing and abandoned landfills and wells, and chemical and fertilizer storage areas, as well as natural features, such as wetlands and woodlands, should be included in the proposed comprehensive rural resource database. By utilizing the Kenosha County LIS as a framework component of the RRLIS and employing the farm management data from CAMPS, the proposed RRLIS could be designed and implemented so that maps, tabular data, and land records from any number of agencies could be integrated as components in the shared multipurpose land information database.

6. It is recommended that a pilot project be initiated to demonstrate the practicality of creating and maintaining a digital field and tract layer for a selected area of Kenosha County. The project is envisioned as a joint effort between the Kenosha/Racine field office of the ASCS and the

SCS, the Kenosha County Land Conservation Department, and the Southeastern Wisconsin Regional Planning Commission. Work agreements and program procedures regarding data standards and information exchange must be established between the participating agencies; the Regional Planning Commission could perform the initial digital file creation and maintenance. The demonstration project should be closely integrated with the Kenosha County LIS, in order to illustrate the feasibility of supporting a digital field and tract layer for that system. The project would provide the opportunity to compare the cost and labor expenditures of the development of a digital tract and field layer to the current costs of maintenance of a similar analog data layer. Once the field and tract data layer has been established, the pilot project should also investigate the potential database links between CAMPS and the LIS. Funding for this demonstration project could come from a grant from the Wisconsin Land Information Board.

7. Finally, it is recommended that a long-term goal of this integration project should be the implementation of tract and field delineations in a total digital environment. Rather than perform this operation on aerial photographic prints, ASCS staff could make tract delineations at a computer work station with the aid of photographic images on a computer screen. Scanned aerial photography would provide a digital image as a background for on-screen delineation and a digital map overlay of cadastral boundary lines would also assist personnel in outlining tract and field boundaries to create and maintain a map overlay for the LIS. This activity could conceivably be performed by ASCS staff at the service counter as farm operators visited the field office for annual certification of their croplands. Some advantages of tract delineation in such a computerized environment are ready access to a controlled photographic image base, the opportunity to use up-to-date parcel boundary information as an aid to delineation, and automatic acreage quantifications for area features.

CONCLUDING STATEMENT

The recommendations set forth in this report are intended to lead to the full integration of the Computer-Assisted Management and Planning System (CAMPS) and the Kenosha County Automated Mapping and Land Information System (LIS). Modification of the tract system, creation and custodianship of a digital field and tract layer for the LIS, improved cooperation and information exchange between agencies, and a greater use of both photographic and cadastral digital ancillary data should facilitate the linkage of these two database systems. The consolidation of the land ownership and natural resource information in the Kenosha County LIS with the farm management data in CAMPS should immediately benefit local conservation agencies by improving the speed and efficiency of their work program. The integration of the two systems would also provide a solid framework for the proposed Rural Resource Land Information System (RRLIS) and would be the nucleus for the incorporation of additional graphic and attribute data into this shared, comprehensive land information database. Such a multipurpose system would better satisfy the information needs of a wide range of users and aid decision makers in planning, administering, and monitoring urban and rural resources.