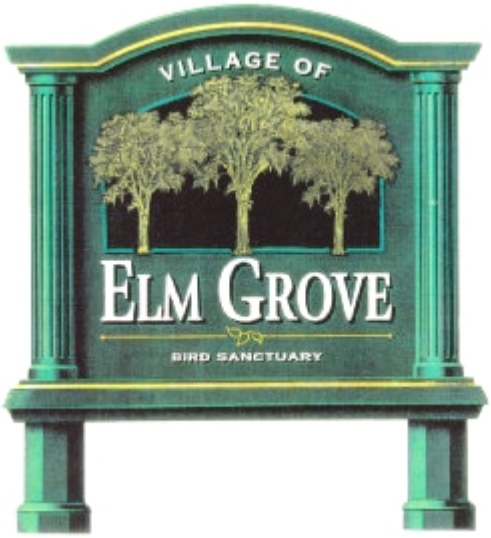

Village of Elm Grove
Geographic Information System
Needs Analysis

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Executive Summary

Scope

In September 1999, the University of Wisconsin-Milwaukee was asked to perform a study of Elm Grove Wisconsin's needs for a Geographic Information System. The primary focus of this project was to assess and analyze the needs and user requirements of Village Departments for the development of GIS technology. The needs analysis does not provide specific hardware or software recommendations. The results of this project are designed to provide Elm Grove with the foundation for development of a GIS Implementation plan. A GIS Implementation Plan is a detailed description of the specific hardware, software, and implementation techniques to be used by the Village. It also includes a timeline for implementation and a cost-benefit analysis of the system as compared to existing conditions.

Methodology

This summary is based on the findings of a GIS Needs Analysis. The analysis surrounded a series of interviews and investigations conducted in October 1999. The interviews were conducted on-site and through conference calls with the Village staff and department managers. Personnel in each department were provided a GIS survey prior to the interview (See Appendix B). They were asked specific questions concerning their functions, information used, use of maps and databases, and future responsibilities. The survey provided a foundation on which to conduct the interviews. During the interviews, personnel were asked specific questions about their current use of data and were asked to expand upon their survey answers. The following Village Departments participated in the interviews and provided information regarding their functions and the necessary data requirements to fulfill these functions:

Village Clerk / Zoning Administrator
Deputy Clerk
Village Treasurer
Police Department
Fire Department
Department of Public Works
Special Projects Intern
Village Manager

Findings

Based upon interviews with Village staff, common concerns arose regarding laborious methods of managing and analyzing Village data. There was a general consensus that the current system of information management often requires unnecessary amounts of staff time to answer simple operational questions. Listed below are general problems, found through an investigation of maps, data, and techniques currently used by Elm Grove.

- Limited Digital Data: Much of Elm Grove's infrastructure data is stored within institutional memory or in paper files which, are inherently insecure. Paper media is costly to store and reproduce, while Institutional memory is subject to unexpected loss in the form of employee attrition. Each form of data is in effect difficult to update and share.

- Multiple locations of data: There is no centralized system for storage, maintenance, retrieval, and display of Village information. A disconnected and redundant scheme of information management is inefficient. Data may be updated in multiple places at variable times, which means user confidence in the accuracy of this data is decreased.

- Limited Map updates: Multiple individuals and departments gather information needed to update maps. Updating this information is, currently performed by contractors outside of the Village. This situation is time-consuming and inefficient.

- Slow production of Thematic maps: Thematic maps show features by ranges of values or attributes. An example for Elm Grove would be a property map showing the range of effects

due to flooding. These maps are very useful and generally show a great deal of information. Currently, these maps are produced by hand outside of the Village (contractors).

Recommendations

Listed below are the specific recommendations determined in this study.

- Construct an accurate digital property map based upon parcel polygons
- Convert all property records to digital form for better management
- Integrate other useful digital data layers available from governmental organizations
- Incorporate a system to track changes and lineage of the data within the GIS
- Contract the customization of the GIS interface and functionality

As stated earlier, simply migrating Elm Grove's paper-based information management system into a flexible and easy to use digital system will alleviate many of the problems described throughout the interview process.

Village of Elm Grove
Geographic Information System
Needs Analysis

Table of Contents

Introduction and Overview

Introduction

The emphasis of this report is on the Village of Elm Grove's GIS needs. These needs are contrasted with the data available and information management techniques departments currently use, that will be either replaced by or support a departmental and or enterprise GIS.

A departmental GIS is an information system that serves project-based analysis, departmental data collection, data sharing, and directly supports departmental functions such as dispatch, utility management, assessment, or subdivision drainage analysis. An enterprise GIS is operated Village-wide in support of Village activities. It can be thought of as a "spatial-data" server that can handle data sharing, distribution, Village-wide analysis, and public access. In general, geographic information in local government is used to respond to public inquiries, perform routine operations such as application reviews and permit approvals, and provide information on the larger policy issues requiring action by the Village board. In addition, a GIS can be used for Fire, EMS, or Police dispatching, routing, and recording the locations of public and private utilities. Definitions of municipal GIS uses are contained in Appendix I.

Data requirements for the Village focuses on spatial or geographic data, which define or are connected to a geographic location in some way. For example, roads are defined by their geographic positions of centerlines, right-of-ways, and pavement edges. The road locations can be tied to intersections, address locations, or road segments. Attribute data tied to the locations could include pavement conditions, street openings, signage, or shoulder conditions. The attribute data which, may or may not be handled within the GIS, could include ties to other locations and information such as parcel data and land use.

This report focuses on the department-level GIS users as well as the data and techniques they need to perform their responsibilities. An implementation plan is needed to describe specifically how each department and the Village as a whole will move from what they currently have to what they will need from GIS. The implementation plan is dependent on the technology selected by the Village and the users needs. GIS selection is based on which system will best meet the Village's future needs and desired levels of service. Training is also a significant part of the GIS selection. Current staff skills, resources, and the learning curve must be incorporated into the selection decision.

Overview

In early September 1999, the Village of Elm Grove requested assistance with the development of a plan for the possible implementation of a computerized data management system, to be focused on a GIS. The first step in developing such a plan is the creation of a GIS Needs Analysis as presented here. This analysis is intended to be an intensive study of Elm Grove's current use of Village records and spatial data. Analysis of the study results will yield descriptions of existing problems in the way data is utilized in daily operations. In response to these problems, the report will suggest how a GIS can be used to improve the efficiency with which these operations are conducted. These suggestions combined with foresight on behalf of the staff members will enable a vision of the system under development.

Vision of the future system will then function to inform the next step in the process, which is the implementation plan. This implementation plan should address such issues as hardware and software specifications, detailed costs and cost savings, personnel issues, data management and other operational questions. The implementation study is a highly detailed report that will enable the Village to determine specific tradeoffs as they prepare to establish all the components of their new institutional information management system.

Scope and limitations

The GIS Needs Analysis for the Village of Elm Grove is intended to be an intensive study of the Village's effective use of geographical information. First, the flow of geographic information through the Village must be understood. The initial step of this analysis was to determine what problems the Village encounters with their geographic information. A detailed matrix of Village-wide map usage is presented later, and shows how information is distributed among the various maps used by the Village. Finally, recommendations are presented showing how Village operations may be improved.

The purpose of this report is to develop a comprehensive GIS needs assessment for the Village of Elm Grove. It is not intended to provide a cost-benefit analysis, implementation plan, or to recommend specific software packages.

Methodology

The Village of Elm Grove staff was first presented a definition and short demonstration of GIS technology and its municipal applications. This presentation performed by Professor Huxhold, provided a foundation for those Village staff members that had little knowledge of the technology or its possible benefits. This presentation along with a pre-interview survey (Appendix B) served as a mechanism to get employees thinking about how a GIS could be used in their respective departments. Information from the GIS Needs Analysis was obtained primarily from a series of interviews conducted with Village of Elm Grove staff. Personnel in each department were asked a series of questions regarding their tasks and the information they use to complete them. The results of these interviews were compiled and any questions from these interviews were referred back to the specific department for clarification as well as changes. Detailed information from the final reviews is found in Section 2: Department Summaries.

Department Summaries

This section will present a summary of each functional unit in the Village of Elm Grove. Each summary will contain six basic parts.

- Department Mission
- Responsibilities
- Maps used
- Other data used
- Current Map and Data Problems
- Future Needs
- Potential GIS Applications

The interviews conducted at the outset of this study provided detailed information concerning the mission and workflow within each department. This section will describe these details as they pertain to GIS application needs of the Village. First, the mission and or responsibilities of the unit will be summarized. Second, the maps and other data used by the unit will be described. A Departmental Map Matrix will summarize the important features of the maps used. A Citywide Map Matrix appears in Appendix D of this report. Third, a listing of current map or data problems will be defined followed by a prospective list of future departmental needs. Finally, the unit summary will conclude with a list of GIS applications that could potentially be used to address the unit's map and data problems.

Where applicable, the *Department Mission* is presented as described by the representatives or interpreted from each interview. R*esponsibilities* provide a description of how the department fits into the organization of the Village, including specific departmental duties. *Maps and Other data used* summarize the data currently used to accomplish the departmental goals. The map or themes listed in the departmental sections are those that were identified as being critical to the current operation of the department. Because the Village does not currently store records in digital form or in a GIS, the items shown are usually referenced from paper records. The base-map is a large-format map used for reference by all Village staff and is available to the public. *Current Map or Data Problems* are issues specified by the representatives as hindrances to the operation of the unit that might benefit from the introduction of a GIS. *Future Needs* are potential responsibilities that the department may take on in the future. Lastly, *Potential GIS Applications* offer a list of GIS-based solutions that would address the department's map and data problems along with providing techniques to increase the efficiency and effectiveness of the department.

The departments described below include:

- Assessor
- Clerk / Zoning Administrator
- Deputy Clerk / Treasurer and Accountant
- Police
- Fire / EMS
- Public Works
- Special Projects Intern
- Village Manager

ASSESSOR

Responsibilities
The assessor's responsibility is to assess all general property for taxation in the Village. This is achieved by implementing widely accepted assessment standards and techniques guided by Wisconsin Statutory Law.

Maps used
Paper based Plat maps of Elm Grove indicating property tax key identification numbers.

Other data used
The Wisconsin Property Record Card, which contains property characteristics such as square footage, bedrooms and bathrooms. Wisconsin Transfer Returns specifying data relevant to the transfer of ownership of property. Wisconsin Personal Property forms, which are filed by businesses every year.

Current Map or Data problems
- All assessor records are currently stored on paper based files, which makes thematic mapping of assessed value by parcel incredibly difficult.

Future Needs
- A digital parcel based map tied to a database that contains the tax rolls and Wisconsin Property Record Card information.

Potential GIS Applications
The Village will be reassessing in 2001 and a GIS could be used to map the updated assessments as well as historical property assessments. Thematic mapping could then be used to show not only current values but percentage or absolute changes in property values. A GIS could also be used to track the locations of tax-delinquent properties.

Residential and commercial real estate sales could be stored in a GIS and tied to parcels via tax key id numbers. Sales information could be analyzed and mapped to give the Assessor's office better tools to perform future assessments.

A GIS could potentially allow the Assessor's office to map any known presence of hazardous waste or environmental pollution that might affect property values.

CLERK / ZONING ADMINISTRATOR

RESPONSIBILITIES

The Office of Village Clerk / Zoning Administrator performs two jobs for the Village of Elm Grove. On one hand, this office is responsible for all of the typical functions of a Village Clerk. Some of the main responsibilities of the Clerk include providing citizens access to government, administrative support to elected officials, licensing and permits, preparation of the property tax assessment roll and conducting and supervising Village elections. On the other hand, this office acts as the Zoning Administrator. Some of the primary functions of the Zoning Administrator are setting up Plan Commission meetings, handling complaints made relating to the location of structures and the use of structures, lands and waters within the Village, conducting site inspections for building permits or zoning changes, and disseminating information on floodplains. It is also this department's responsibility to interpret and administer all Village ordinances and zoning codes. The administrator also maintains a record of these ordinances and zoning codes, which are available for public inspection at the Village hall. The ordinance book records all ordinances, rules, regulations, and by-laws under which the Village operates.

Maps and Data

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
¼ ¼ Section Numbers	Basemap	Spatial reference only	No	None	Basemap
Lot Dimensions	Individual property files, paper	Tax and zoning purposes	Updated at Village and County	Less then 10 per year	Available to Village staff and to public upon request
Neighborhood Boundaries	Basemap	No true neighborhoods. Reference only	No	None	Basemap
Parcel Acreage	Individual property files, paper	Tax and zoning purposes	Updated at Village and County	Less then 10 per year	Available to Village staff and to public upon request
Parcel Numbers	Individual property files, paper	Tax and zoning purposes	Updated at Village and County	Less then 10 per year	Available to Village staff and to public upon request
Property Lot Lines	Basemap	Tax and zoning purposes	Updated at Village and County	Less then 10 per year	Basemap
School District Boundaries	Maintained by school boards	Tax and zoning purposes	Updated by school board	Rarely	Available to Village staff and to public upon request
Village Street Map	Basemap	Spatial reference only	Updated at Village and County	Rarely	Basemap
Zoning Codes	Referenced on large zoning-landuse map	Tax and zoning purposes	Updated by Clerk as needed	Less then 10 per year	Available to Village staff and to public upon request

OTHER DATA USED

The Village Clerk / Zoning Administrator uses numerous paper files for the storage and retrieval of information. The property file contains information on parcel ownership, dimensions, zoning, Council or Plan Commission action taken on the property, building permits, acreage, and other property information. There are also separate files that contain any additional deed restrictions or covenants for specific subdivisions that need to be cross-referenced whenever permits are issued. There is also a tax key file.

CURRENT MAP OR DATA PROBLEMS

- The office of Village Clerk/ Zoning Administrator does not currently use any digital databases. All information is contained in paper-based files which makes data updating and retrieval cumbersome and time consuming. In order to access information, the Administrator has to look at as many as 3 separate files or maps. First, a map is used to identify the address of the parcel in question, next the administrator uses the tax key file to match the address to the tax key, finally, the tax key is cross-referenced with the land records book to find out the zoning, previous Council actions, or other pertinent information.

- Updating the existing maps is also difficult. When a property is subdivided, an address is changed, or any lot lines are altered, the changes are penciled in until the Village decides that the maps need to be updated which is then performed at the county level and returned to the Village.

- Reproducing the "as built" sewer maps is also cumbersome and time consuming. The Village Clerk/Zoning Administrator usually has to find someone to help him carry the book to the copy machine and hold it in place.

- The Village does not currently have a Land Use Map. In order to find out the type of use for a specific property, the Village Clerk / Zoning Administrator needs to look in the property's file to find out what the land use is.

- The maps currently contain a rough estimate as to a building's location and position on a lot. This building envelope does not give a detailed outline of the actual building footprint nor does it allow for the accurate measuring of setbacks or lot coverage.

- There are also separate files that contain additional deed restrictions or covenants that specific subdivisions enact which are stricter than the Village ordinances require. Whenever a building permit application is submitted, the Administrator must check to see that, in addition to the Village restrictions, the building meets the additional subdivision restrictions.

- The floodplain delineation is only recorded on a Village paper map. It is difficult to determine the floodplain boundaries on specific parcels. Since there are also no detailed building footprints, it is also difficult to accurately determine which structures are located in or near the floodplain

Future Needs

- A kiosk in the Village Hall or Library where citizens can access various property information.

Potential GIS applications

This department could use a GIS for creating mailing lists for public hearing notices when there is a proposed rezoning. The user can have the GIS create the required buffer around the property that is up for rezoning. The GIS can then create a mailing list which can be merged into envelopes and notification letters.

During recent summers, Elm Grove has experienced severe flooding resulting in private and public property damage. A GIS could help the Village identify properties that are located within the floodplain or properties that may be prone to flooding. Having the floodplain boundaries in a GIS also would assist FEMA in allocating flood relief funds if another flood occurs in the Village.

Parcel maps and land records can be integrated into a GIS to provide instant access to information that is usually kept in separate departments. Land records information can contain assessment data, code violations, legal descriptions, dimensions, zoning, land use, and any other pertinent information.

The GIS could be used to prepare high quality maps that can be used for site plan review, public presentations, Planning Commission meetings, or for public dissemination.

A GIS could also be used to assist the economic development of the Village. The system could be used to track available sites and buildings suited for industrial or commercial development.

Offices of Deputy Clerk / Treasurer and Accountant

Responsibilities
Accountant: Budgeting, financial statements, payroll, and human resources.

Deputy Clerk / Treasurer: Tax rolls and tax collection, records management, accounts payable and accounts receivable, including billing for commercial sewer service.

Maps Used
The Deputy Clerk / Treasurer and Accountant use the Village base map.

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
Voting Districts	U.S. Bureau of the Census	Voter registraion, preparation of absentee ballots, maintain voting list	Updated by census period	10 years	None
Tax Records	Assessor	Provides the value of land and improvements for all real property in the Village that is not tax-exempt.	Updated by independent assessor.	When Village wide assessment are conducted (usually every 2-3 years)	Available to Village and Staff
Village Services Payment Records	Collected from Residents	Accounting of Fees	By Accountant	Constantly	None

Other Data Used
The Clerk uses voter registration data as well as census tract and demographic data. The budget information is stored in an Excel spreadsheet. The treasurer tracks, changes to the tax rolls and conveys the changes to the Assessor. These changes are also conveyed to Waukesha County, which maintains a digital copy of the tax rolls.

Current Map or Data Problems
- There are currently multiple locations for tax and property records; updates to information must be performed at each location.
- Manual entry of paper records is time consuming; organizing paper records is inefficient.
- Inaccessibility of data from other departments creates a reliance on direct communication with other staff members, this dependence slows the flow of information.
- There is a high public demand for property information such as zoning and tax rates in relation to the available staff resources and time needed to retrieve the information.
- Conducting spatial analysis in support of improvement projects is, currently performed by hand and or contractors, making the process time consuming.
- Preservation of records is currently done on paper at Village Hall. A copy of electronic data could be kept off-site in case of flooding, fire, or other damage to Village Hall

Future Needs
- The ability to easily manage and graphically display voter registration information and calculate voter turnout and registration levels by ward.
- The ability to track and plan solid waste pickup for the Village.
- Possible user-friendly computer terminal in the Village library allowing public access to property and tax records.

Potential GIS Applications
The Departments can create thematic maps showing a variety of data themes such as voter registration level by ward, locations of tax delinquent properties as well as responses to Village wide surveys.

A GIS could assist in the Village reassessment planned for 2001. Spatial analysis of changes in property values and real estate and land sales will provide invaluable information.

A solid waste pickup plan could be implemented with a GIS using linear analysis to develop pickup schedules that effectively remove waste while minimizing fuel and time consumption and wear and tear on DPW vehicles.

POLICE DEPARTMENT

Mission
The Elm Grove Police Department is a team of dedicated professionals, committed to providing the community with as much safety, security and service possible in an efficient manner.

Responsibilities
The Elm Grove Police Department is responsible for providing the Village with safety, security, and service. The are responsible for running the dispatch system for the Police Department as well as the Fire Department and EMS/Ambulance. They also provide support to other Village departments including Fire, Police, Public Works, Municipal Court, the Village Clerk / Zoning Administrator, and all other departments.

Maps and Data

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
Village Street Map	Basemap	Spatial reference only	Updated at Village and county	Rarely	Basemap
Maps of Surrounding Communities	Various sources	Spatial reference only	Depends	Depends	None

Other Data Used
Crime data (break-ins, accidents, hot spots) are all kept in a database that is indexed on specific addresses. They also currently maintain a database used to monitor people's houses while they are on vacation. Since the Department is responsible for dispatching police, fire, and ambulance/EMS services, they keep a database of all of the locations where personnel were dispatched.

Current Map or Data Problems
- The Department currently uses a few different database software packages but they would like to see all records kept in one single database with mapping capabilities.

- The Police Department shares data with the Fire Department and EMS and would like to see one integrated system. The Fire Department currently uses Macintosh computers, which also poses compatibility problems.

- The current maps also only show a general outline of where a building is located on a lot, they would like to have a more detailed footprint and possibly floor plans, to assist with potential evacuations and hostage situations.

- Another major concern for the Police Department is the security of data. The Police are often asked to "keep an eye on" residents homes when they are on vacation. In order to monitor these properties, the Police Department keeps a "Vacation Database," which lists the names, addresses, and dates that a family is gone. It is imperative that only the Police Department has access to this sensitive information. There is additional data that also requires authorized access only.

Future Needs
- The Police Department would like to see a GIS that is integrated with their current 911 system. They are unsure about the specifics of the new 911 system and are concerned with how it could be interfaced with a GIS. They believe that the new system will require that all

911 are located within 30 meters of where the incident took place. This may involve using GPS and cell-phone triangulation.

- The Police Department would like to have an Integrated system with Fire and EMS
- They would also like to have a GIS that can be integrated with home alarm systems.

Potential GIS Applications

A GIS would allow the Police Department to track incidences of crime or accidents to identify areas where there needs to be a greater police presence or where traffic safety measures should be implemented and or changed.

Although the Police Department has indicated that they would not need a GIS for routing or dispatch, they did indicate that there are times when officers need to enter surrounding municipalities. A GIS could be used to assist in the routing of officers into unfamiliar areas.

A GIS could potentially allow the Police to print out maps of homes where the owners are on Vacation to distribute to patrol officers so they can monitor the properties.

FIRE / EMS

MISSION

The Elm Grove Volunteer Fire Department is comprised of a proficient team of fire service professionals, providing quality service to the Village of Elm Grove, stressing safety for residents and department members.

RESPONSIBILITIES

The Fire and EMS Chiefs are responsible for the management of their respective Departments, which are comprised of volunteers who live or work in or near the Village. The Chiefs' duties include overall management of their departments with an emphasis on safety, as well as budget preparation and management. The Fire Department is responsible for fire suppression, rescue operations, fire prevention education building preplanning and fire inspections, as well as being the first to respond to hazardous materials, confined space, water, and high angle incidences. The EMS is responsible for providing Emergency Medical Services to the Village. EMS also responds in conjunction with the Fire Department on fire-related incidences.

Maps and Data

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
Village Street Map	Basemap	Spatial reference only	Updated at Village and county	Rarely	Basemap
Water Source Map	Basemap	Spatial reference only	Updated at Village and county	Rarely	Basemap

OTHER DATA USED

The Fire Department has several databases which are used for day-to day operations. They include inventory of equipment, equipment testing records (date, pass/fail), fire hydrant location, fire incidence locations, water supply locations, building inspection information, location of equipment on fire trucks, and information on each building on each parcel to help determine what type of equipment is needed. They also use a "Box Card" type multiple alarm system to identify the sequence and type of mutual aid unit request for a specific type of incident. This is currently in hard copy.

CURRENT MAP OR DATA PROBLEMS

- The Fire Department has indicated that there are no current problems with maps or data management. Updating of data is done whenever time permits. The only real problem is data sharing with other departments. The Fire Department uses Macintosh computers to manage their data and run any necessary software which could pose a compatibility problem with the rest of the Village's Windows-based PCs.

Future needs

- The Fire Department would like to see a GIS that could be integrated with the current CAD System or any system that may be required by law in the future.

POTENTIAL GIS APPLICATIONS

A GIS integrated with a CAD would quickly locate incident locations and determine which units are the closest, water sources, and the quickest route for responding. This type of a system becomes valuable when there are multiple incidences or when mutual-aid units that may be unfamiliar with the area are called upon for assistance. The Elm Grove Volunteer Fire Department assists Brookfield and other surrounding municipalities, so this GIS capability is very

desirable. The system could also contain information about the fire location such as floor plans, hazardous materials, hydrant type, building use and occupancy.

Using GPS technology in combination with a GIS, the Fire Department can also track the location of fire trucks or volunteers to visualize their location in reference to the fire, accident, or emergency.

DEPARTMENT OF PUBLIC WORKS

Responsibilities

The Department of Public Works is responsible for overseeing the improvements and maintenance of the Village physical infrastructure. This includes street paving, grass cutting, forestry, storm sewers, park and parkway upkeep, and snow and ice removal. The department also operates and maintains the Village landfill, Village vehicles, and the recycling facilities. The Department does not directly provide engineering services, but does coordinate, supervise and inspect all work done by contractors.

Maps and Data

The Department of Public Works currently uses a variety of paper maps to store and convey its spatial information. A current Village base street map is used to overlay recycling and solid waste pickup schedules. Similarly, the department chief uses a color-coded map to track regular maintenance and cleaning of the sanitary sewers. The Department uses plat maps, which delineate section and quarter section corners as well as distance and bearings. Certified survey maps and subdivision maps are used to track lot lines, right of way lines and easement locations.

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
100 yr. Flood Plain	FIRM	Delineates flood plain boundaries for navigable waterways.	None	Rarely	None
Address Ranges	Basemap	Locating addresses on the street map	Updated at Village & County	Rarely	Basemap
Brush Schedule	Tracked on Paper	Assists in coordination of brush pickup.	As needed	Common	None
Culvert Diameters	As built engineering plans	Provides information for stormwater management.	As needed	After additions and/or renovations	None
Culverts	As built engineering plans	Provides information for stormwater management.	As needed	After additions and/or renovations	None
Recycling Schedule	Tracked on Paper	Assists in coordination of recycling program.	As needed	Common	None
ROW Widths	As built engineering plans	Delineates boundaries of public responsibility.	Updated at Village & County	After additions and/or renovations	Available to Village & staff
ROWs	As built engineering plans	Delineates boundaries of public responsibility.	Updated at Village & County	After additions and/or renovations	Available to Village & staff
Salting and Snowplowing	Tracked on Paper	Assists in coordination of salting and snow removal.	As needed	Common	None
Sanitary Manholes	As built engineering plans	Provides information for maintenance of sanitary sewer system.	As needed	After additions and/or renovations	None
Sanitary Sewer Lines	As built engineering plans	Provides information for maintenance of sanitary sewer system.	As needed	After additions and/or renovations	None
Solid Waste Schedule	Tracked on paper	Provides information for maintenance of sanitary sewer system.	As needed	Common	None
Storm Manholes/Basins	As built engineering plans	Provides information for stormwater management.	As needed	After additions and/or renovations	None

Storm Sewer Improvements	As built engineering plans	Provides information for stormwater management.	As needed	When improvement are made to the system	None
Street Centerlines	As built engineering plans	Provides information regarding the plan and profile of Village roads.	As needed	When improvement are made to the system	None
Street Names	Basemap	Attaches name identifiers to Village roads.	As needed	Rarely	Available to Village and Staff
Street Resurfacing	Held in Pacer System	Assists in the systematic maintenance of Village roads	As needed	Common	None
Street Widths	As built engineering plans	Allow the department to determine the potential carrying capacity of Village roads.	Updated at the Village & County	Rarely	None
Streets	Basemap	Show the general location of Village roads.	Updated at the Village & County	Rarely	Available to Village and Staff
Surface Material	Held in Pacer System	Indicates the composition of Village roads and walkways.	As needed	Rarely	None

Other Data Used

The Department of Public Works also relies heavily on utility as-built drawings for, sewer locations, horizontal and vertical road profiles, and utility easement locations.

Current Map or Data Problems

- The Department Head has indicated that the primary problem is the current system of paper-based records that is difficult to manage and has been historically incomplete and sometimes inaccurate.
- Many changes to the Village's infrastructure are not reflected in the small-scale planning maps, but are shown in the large-scale as-built drawings which are created for each project. The size of the as-built drawings along with the generally cumbersome nature of paper records, make access, retrieval, and analysis of this information difficult for Village employees.
- There is a significant amount of "institutional memory" within the department that has not been captured in a digital or paper based format. There is no current "backup" system for the invaluable information the current Department Staff provides.
- The current paper based system has made road and sewer inventory and the development of long-term maintenance schedules very difficult.
- Changes to the extent of the Underwood Creek floodplain as well as the Village's current surface drainage patterns and open conveyance systems are also difficult to track and display with the current mapping and data management system. Lack of building footprint data makes predicting possible flood damage less accurate than typically desired for this type of analysis.

Future Needs

The Department of Public Works identified the following needs for their geographic information management system.

- Linking ground positions such as manhole locations with digital photos to create an inventory catalog.
- The Department requires better tools for planning the costs of projects and their long-term maintenance.
- Recording all locations and specifications of infrastructure in digital format. This could include information from Diggers Hotline field results and utility information from gas, electric, telephone, and cable companies.
- The ability to update digital records in-house would facilitate tracking small changes made to the Village infrastructure.
- Development of an electronic information workflow with contracted engineering firms will facilitate the transfer of information more efficiently.

- Incorporation of in house records with those currently held by engineering contractors to have as much Village-related data as possible in the system.

Potential GIS Applications

By incorporating digital versions of all as-built plans into the database, the department could map existing infrastructure more accurately and comprehensively. For example, the location of storm sewers could be overlaid with property ownership, which would allow the Department to more accurately determine what infrastructure is under publicly controlled land.

Digital elevation modeling, location of building footprints, right of ways, and storm sewer line locations and attributes, such as pipe diameters, could be used with GIS software to develop stormwater conveyance models for the Village. This would also allow the Village to more accurately assess its preparedness for major storm events.

A GIS could be used to develop a systematic method for the inventory and maintenance of sections of road and sewer. Attribute information such as pavement type, thickness and age could be related to spatial data showing the particular road section on a map. For example, a DPW staff member could do a simple query to determine all road sections that are concrete, seven inches thick, and have not been repaired since 1990. The results of this query would show all road sections that met these criteria. The GIS could then determine which properties are in the address ranges of the road sections that need repair and create a mailing list to notify the affected residents.

SPECIAL PROJECTS INTERN

Responsibilities
Projects as assigned by the Village Manager including: Improving the Village's FEMA Community rating to improve the Villages flood insurance rating.

Maps Used
Village basemap and FEMA floodplain maps.

Map or Theme name	Source	Functions	Data additions or updates?	Frequency of changes	Dissemination
Flood Insurance Rate Map	U.S. Dept. of Housing and Urban Development	For evaluation of damages and planning	As needed	Rarely	None
City Street Map/ Address ranges	Basemap	Spatial reference only	No	None	Basemap
Parcel locations, dimensions, and value	Individual property files, paper	For evaluation of damages and planning	Updated at Village and county	Less then 10 per year	Available to Village staff and to public upon request

Other Data Used
Village property files. Written correspondence with affected homeowners on the issue of flooding.

Current Map or Data Problems
- The current process for evaluating a property's flood readiness is time consuming because of an incomplete paper based records system and a heavy reliance on the institutional memory of certain staff members.
- Since the current maps lack detailed building footprints/outlines and lot dimensions accurate assessment of flood readiness is difficult.
- Because databases are not integrated, calculating flood damage as a percentage of total property value is a time consuming endeavor.

Future Needs
- The ability to modify the system in-house, as recommended by the Federal Emergency Agency (FEMA)
- Linkage of property information with historical flood data via a relational database.

Potential GIS Applications
A GIS could be used to improve the Village's flood readiness by predetermining what properties are in flood prone areas. This information would be accessible to residents and others who inquire about properties in the Village

The Village could map not only flood damage extent, but also the specific type of problem each property encountered, i.e. flooding, ponding, sewer backup, and the dollar amount of the damage.

Village Manager

Mission
The mission of the government of Elm Grove is to provide for the health, safety, and welfare of the residents of Elm Grove

Responsibilities
The Village Manager is an appointed position. As the chief administrative officer, she is responsible to the Village Board for administering and enforcing policies, programs and ordinances within the Village. She is also responsible for the coordination and supervision of the activities of Village departments, in addition to serving as the treasurer.

Maps used
Since the Village Manager is responsible for the supervision and management of all departments within the Village, she comes in contact with many of the maps used by Village departments. Although she may not directly use all of the Village maps, department heads and other Village employees often use maps to assist the Manager in making administrative decisions.

Other Data used
In addition to the common village base map, the Village manager receives value-added reports from the staff members, including special projects staff.

Current Map or Data Problems
As a decision-maker, the Village Manager relies on the accuracy of these information products to support her decisions. The manager, who is also responsible not only for the state of the Village, but also the staff that supports it, is affected by inefficiencies in all Village Departments. That is, unnecessarily laborious workflow increases the cost of operation of the village and reduces the value that taxpayers receive for their taxation. On a related note, as an overseer of the individual departments, any department that incurs map and data problems becomes the concern of the Village Manager.

Future Needs & Potential GIS Applications
The village manager is not likely to need regular direct access to any GIS implemented for Elm Grove, with the exception of using the browsing capabilities for occasional reference. However, the requirement of the future system will be partially determined by the manager's needs, as she will be one of the primary end users of any information products it generates. The Village Manager's primary need for this future system is it's ability to present timely and detailed information that can be trusted as accurate.

Recommendations

Results from this study show that the services and management of the Village of Elm Grove operate effectively, but not efficiently using its current system of information management. This lack of efficiency is of primary concern to the staff members and is the focus of the recommendations outlined below. The primary concern was that large amount of time was taken to reference data, even for common and simple queries. Furthermore, once the data was found, the accuracy was often questionable, as the date of last update was unknown. In some instances incomplete records meant that no data was available for some queries.

The installation and use of a digital information management system, based upon geographic information, will help correct many of the inefficiencies mentioned above. In order to create such a system, commonly used records that are used by the Village and currently held on paper or in memory must be transferred to a compatible digital form for incorporation into the chosen GIS. Much of this work has already been completely or partially completed by other governmental entities in the area. These common data layers should provide the first and most important foundations for development of a system that is useful far into the future. In response to the goals determined by this study, conclusions of this report are summarized as five specific and two general recommendations as described below. These should be considered in the design of a GIS implementation plan.

A. CONSTRUCT AN ACCURATE DIGITAL PROPERTY MAP AND MAKE PROVISIONS FOR ITS MAINTENANCE

This study determined that a majority of the functions requested of the proposed system could be accomplished with accurate parcel maps associated with the attributes found in common municipal property files. The following are specific recommendations concerning the digital property files.

1. *Convert the contents of the individual, paper-based property files to database records*. Elm Grove currently maintains detailed information regarding each property (tax key, lot dimensions, acreage, zoning, year built, ownership, etc.) in paper file folders. The textual information found in these folders, along with textual data from the assessor, should be entered into the central database.
2. *Begin the digital property map base with polygon data from the County of Waukesha*. This study determined that parcel polygons as held in digital form by the County of Waukesha are appropriate as the first data layer to be included in the future system. Each polygon in this layer, representing parcels, will be attached to property records in a database. The polygon theme will serve as a visual representation of the parcels and allow spatial calculations to be made (eg. area, proximity, perimeter)
3. *Assess the accuracy of the data from external governmental organizations before its use.* This polygon data layer will likely require an accuracy review to make certain that it correctly reflects the current status of parcels within the Village. This layer should also be calibrated for spatial accuracy to allow for usable spatial calculations.
4. *Include data some distance outside of the Village, perhaps in separate data layers.* The fire, emergency medical, and police departments have requested the inclusion of parcel and street data for the areas immediately surrounding the Village. Occasionally responses must be made to areas immediately outside the Village and records on these instances must kept as well.
5. *Make agreements with the appropriate organizations to receive data updates and edits on a regular basis.* The governmental organizations that supply data to the Village can make available updates to the data provided to the Village. The Village should plan on including these data into the system as they become available.
6. *Provide for future uses of the system during its initial design.* The GIS software could be connected to an external relational database. This database and map should contain all of the pertinent attribute data used in the common Village tasks. Furthermore, the software, hardware and database structure should be constructed

as to be scalable for potential future applications. Examples of this scalability could be the inclusion of non-standard attributes such as those developed during special and intermittent projects (e.g. surveys, studies, rezoning) and links to objects such as images of physical places (manholes, pipe installations, signs) and perhaps scanned images of engineering drawings. The size of the basic underlying database for Village of Elm Grove will be small at first. However, it is the size and sophistication of the database at the end of its lifecycle that must considered in its specifications.

B. CONVERT ALL PROPERTY RECORDS TO DIGITAL FORM FOR BETTER MANAGEMENT

All detailed records held within the Village are currently stored as paper at the Village Hall. The sole exception are those records tracked by the MS-DOS based system for road maintenance planning (PACER). As stated earlier, the reliance on paper records is an impediment to a more efficient information management system. Similarly, the inability of this system to allow for simultaneously data sharing within the Village hall slows the process of many common tasks. The records used by the Clerk/Zoning Administrator, Assessor and Accountant/Deputy Clerk should provide the first attributes to populate the property file database.

1. *Make common data available to all Village staff members in a client/server environment*. The utility of the future system will increase as more users are allowed access to the data. The initial cost will be higher to implement a client/server environment as opposed an individual stand-alone workstation. However, the Village will likely migrate to the client/server model in time and would benefit from its immediate development. This data-housing scheme would increase access to the data not only for Village staff, but for the public as well. Village staff has indicated that significant time is required to reference individual property information by public request. Allowing the public to access the system directly or indirectly through the use of current staff will immediately reduce the amount time for each request for information. For example, simply entering a street address could automatically generate a summary report and map ready for printing. Because this system would be accessing the same central data used by Village staff, it would be highly accurate.
2. *Design security measures that would restrict access to sensitive fields in the database*. Because the database is likely to contain both common and sensitive data, some means of restricting access privileges should be designed as data access is broadened.

C. DETERMINE OTHER CRITICAL DATA LAYERS FROM GOVERNMENTAL ORGANIZATIONS THAT ARE SUITABLE FOR INCLUSION.

In addition to cadastral data layers, the County of Waukesha, Southeastern Wisconsin Regional Planning Commission (SEWRPC) and perhaps the City of Brookfield maintain other high quality data layers that could be made available to Elm Grove and would be useful for inclusion in the first phases of implementation. These data should also be examined for accuracy before the incorporation is considered complete.

1. Additional data layers that are of interest should be referenced from the data theme matrix provided as Appendix D in this report. As additional layers to the parcel map, the most useful of these might be:

   a) STREET CENTERLINES WITH LINKAGES TO APPROPRIATE ATTRIBUTES (NAME, DIRECTION, SURFACE). Basic uses of this data layer would simply be to visually represent the location of roads and their names. Inclusion of other attributes such as address ranges, speed limits, date of last repair and pavement widths would allow other GIS options like the ability to conduct address matching, surface area and network analyses.
   b) BUILDING FOOTPRINTS. The actual footprint of buildings will be useful when determining structure proximity to other data elements.

c) TOPOGRAPHIC ELEVATION LINES. The elevation of features on a map is a useful tool for planning purposes, particularly for public works activities. These line features are most useful for simple visualization.

d) FLOODPLAIN OUTLINE (100-YEAR AND 500-YEAR). Elm Grove has a recent history of flooding. A digital layer constructed from the Federal Emergency Management Agency (FEMA) maps and perhaps one created from recent knowledge of actual flood extents would be critical for GIS planning and analysis of flood issues. Also, such digital data will be useful in acquiring needed 'points' in insurance cost reduction programs based upon flood readiness.

e) HIGH-RESOLUTION DIGITAL ORTHOPHOTOS. The ability to overlay digital line maps onto digital imagery is very useful for allowing users to get a better idea of the physical features on the maps they are viewing. Such imagery is available as SEWRPC maintains a program of developing high-resolution digital aerial photography coverages of the region including Elm Grove. These must be corrected for distortion before they are supplied for use in information systems.

f) DIGITAL ELEVATION MODEL (DEM). In addition to the elevation contours, a digital elevation model of the same region will enable better analyses of problems regarding relative elevation.

D. INCORPORATE A SYSTEM WITHIN THE GIS TO TRACK METADATA (See Appendix G)

Data within this system will only be current so long as changes are continually made to them. Unless these changes are tracked and their status made known to the users of the system, the accuracy of the data will be uncertain at all times. The value of this system would then be reduced, as the consumers of the final information products would not fully trust the results being presented to them. The currently favored method for dealing with this issue is to develop a complimentary body of data known as metadata. These 'data about the data' store information that allow this status tracking ability, as well a reference of other information regarding the primary data that would normally be lost as institutional memory fades.

Modern geographical information systems are being supplied with capabilities to include metadata text files along with the proprietary data files and databases used by the system. This capability is matched with features allowing reference of these metadata with easy to use interfaces, an the ability to be able to index and search on the attributes found within these metadata.

E. HIRE A CONSULTANT TO CUSTOMIZE THE INTERFACE AND HIGH-LEVEL FUNCTIONS OF THE GIS FOR EACH DEPARTMENT'S USE.

Very sophisticated and robust information systems have been implemented at great expense only to remain unused for years after. One cause of a scenario like this is the fact that a powerful system that is hard to use will be used less than a powerful system that is easy to use. In designing the proposed system, features that allow its immediate use by the targeted users should be considered to avoid the occurrence of the unfortunate scenario above. The interviews with the staff members of the Village of Elm Grove indicated that none of the users considered themselves "expert" users of personal computers. These respondents all cited concerns regarding the time taken to learn the system. However, all departments requested the ability to directly access primary data and to have the ability to edit and update this data. Furthermore, most of the functionalities requested of the proposed system could be reduced to about five common tasks per department.

General Recommendations:

F. HIRE A GEOGRAPHIC INFORMATION COORDINATOR

The study group recommends that the Village of Elm Grove employ a coordinator to oversee the implementation of the GIS. This person could be hired on full or part-time basis, or appointed from existing staff. Recent studies provide strong evidence that GIS implementations that are directed by a dedicated, management-level staff member have a much higher chance of succeeding. Staff in this position typically provides specialized skills to the organization that allow for best use of their GIS. These people typically posses knowledge of geographic phenomena and how to conduct spatial analyses that would support a municipal government. People in this position would also have the skills to "troubleshoot" problems with the system, and provide in-house training for other staff. They would also understand the dynamics of managing a centralized information management system. More details on this position are provided in Appendix F.

G. DEVELOP AN IMPLEMENTATION PLAN

As stated earlier, this report serves only to assess the current status of information management within the Village of Elm Grove and to provide a vision of the future system. The next step in the process of creating this efficient information management system is to develop an implementation plan. This detailed document will be the roadmap that will describe the specifics of hardware, software, personnel, data sharing agreements, contractors, and budgets for the phased implementation.

It is not the purpose of this evaluation to present a detailed cost analysis, nor will we promote the use of particular software or hardware solutions. However, there are some criteria that may be applied when attempting to ascertain development and implementation costs. For example, we know that the specialized software needed to access information held in a geographic information system (GIS) will have higher costs than standard office-oriented applications. In addition to software licenses, the specialized nature of modern GIS software requires that users have training. Similarly, hardware requirements are greater than those of more basic software.

BASIC DATA ENTITIES	SOURCE	COST ESTIMATE
Topographic coverage	Provided by Waukesha County	Governmental data sharing costs
Planimetric features	Delineation provided by Waukesha County, attribution will be needed	Governmental data sharing costs
Surface waters		
Pavement centerlines		
Edge of pavement		
Railroads		
PARCEL-LEVEL DATA	Delineation provided by Waukesha County, attribution must be contracted	[1]Current bid $7,000
FLOOD PLAIN DELINEATION	SEWRPC	Governmental data sharing costs

ADDITIONAL NEEDS	SOURCE	COST ESTIMATE
Software license	Local dealer	[2]Approximately $1,000 per station
Software training	Local dealer or consultant	[2]On site training, approximately $1200
SOFTWARE CUSTOMIZATION	Consultant	[1]$1,000 - $2,500
COMPUTER HARDWARE	Dealer	As required

[1] Consultant proposal, Ruekert|Mielke (1999/06/08)
[2] Internet resource, Environmental Systems Research Institute

Appendix A
Strategic Plan

University of Wisconsin – Milwaukee
Elm Grove-GIS Needs Analysis-Strategic Plan

Project Name: Village of Elm Grove GIS Needs Analysis

Client: Village of Elm Grove
13600 Juneau Boulevard, Elm Grove, Wisconsin 53122
Contact: Andrea Steen Crawford, Village Manager, (414) 782-6700

Client Mission: The mission of the Village of Elm Grove is to provide the highest quality municipal services tailored to the needs of our residents and business community in a cost-effective manner.

Client Vision: Elm Grove would like to develop a tool by which their managing staff can update records, manage projects, provide public information and more efficiently and effectively manage the properties and utilities of their Village. Elm Grove envisions GIS providing an efficient and effective information management and data sharing tool for their departmental and administrative staff.

Project Scope: The analysis pertains specifically to the needs of the Village of Elm Grove. The purpose of the needs analysis is to provide a brief description of what GIS is capable of doing and what GIS can do for the Village of Elm Grove. That analysis will further describe the benefits of implementing a GIS system in the Village. Lastly, the needs analysis will recommend what will need to be done to successfully meet the needs of the Village.

It is not the purpose of this project to address specific arrangements with contractors, software packages, or implementation strategies. These are tasks to be addressed by the Village upon the completion of the needs analysis.

Project Objectives: The primary objectives of this project are:

- A general demonstration explaining what a GIS is, defining some widely used GIS terminology, and describing how GIS technology could benefit the entire Village of Elm Grove.
- Development of needs analysis by department explaining how GIS can improve the accuracy, efficiency, and effectiveness within and between each department.
- A preliminary report for the Village Administrator illustrating very generally the needs analysis that will be done in detail.
- A written report including all of the elements of the needs analysis and the recommendations.
- A formal presentation to the Village staff, summarizing the Needs Analysis, with recommendations on how a GIS can fulfill these needs.

Conceptual Model: Currently the Village relies on many outside sources for management and analysis of digital data. Maps and data are often incompatible depending on the source and age. Since the Village is so reliant on outsourcing of its data management, requests such as creating a thematic land use map are extremely expensive and inconvenient. Implementation of a GIA will allow for quick and relatively inexpensive retrieval and manipulation of data and will create a mechanism for data to be shared across departmental boundaries.

Data Model: The actual spatial features and data attributes needed by the Village of Elm Grove will not entirely be known until the interview and analysis process is completed. Some of the possible layers and their attribute data may include:

Data Layers:

1. Sanitary Sewer Systems
2. Building footprints
3. Floodplain areas
4. Zoning
5. Land Use
6. Right-of-ways
7. Streets
   - Street name
   - Alternate name
   - Width
   - Last year resurfaced
8. Water, Electric and other utility lines
9. Recreation trails
10. Topography lines
11. Elevations
12. Parcel boundary lines
    - Zoning
    - Owner Name
    - Tax Key
    - Assessed value
    - Square footage of buildings
    - Acreage of property
    - Year built
    - Address
    - Phone Number
    - Land Use
    - Previous Council or Planning Commission actions
    - Covenants or Deed Restrictions

Appendix B
Questionnaire

University of Wisconsin – Milwaukee
GIS Needs Analysis Questionnaire

Name:

Position:

What are the Primary functions of your position? What job do you perform?

What are your Responsibilities to the Village of Elm Grove?

What Maps do you use in performing your daily responsibilities?

Are there other forms of data that you use regularly? For example, data bases with property addresses, EXCEL or ACCESS spreadsheets, forms or documents, historical information, economic data etc…

Do you have Map or Data Problems? E.g. Availability, accuracy, complete, up to date etc…

What do you see are the future tasks of your position? What responsibilities will your position have to serve in the future?

From your knowledge (whether little or great) of GIS, what potential applications do you see a GIS assisting with? What issues do you hope would be resolved by an efficient, accurate and easy to use information system?

Appendix C
Preliminary Report

University of Wisconsin – Milwaukee
Elm Grove-GIS Needs Analysis- Preliminary Report

Current state: The Village of Elm Grove, a small close-knit community, enjoys a stable and effective government. The mission of the Village is to,"… provide the highest quality municipal services tailored to the needs of our residents and business community in a cost-effective manner." Currently, information that is vital to the operation of the Village is derived from paper-based record systems, personal knowledge, as well as some use of non-integrated digital records.

This study suggests a phased implementation of a digital information management system centered on the databases, software and workflow that creates a Geographic Information System (GIS). The evolution of the system firsts involves user-friendly management information solutions that are used strictly for rapid data retrieval and basic analysis. This simplistic implementation could then be easily upgraded so that Village staff could conduct data maintenance and elaborate analyses. Implementation of this system will allow the Village to better meet the goals set forth in it's mission statement.

Common Deficiencies: Based upon interviews with Village staff, common concerns arose regarding laborious methods of managing and analyzing Village data. There was a general consensus that the current system often requires unnecessary amounts of staff time to answer simple operational questions. Listed below are contributing factors to this issue.

Multiple locations of data: There is no centralized system for storage, maintenance, retrieval, and display of Village information. For example, map features such as streets appear in maps used by assessor, public works, and Village clerk. Changes made to the position of the streets would need to be updated on each of these individual maps. Other features are likely to change more often than streets and would benefit more from this reduction in replication. While the DPW may be making changes to a property line, the Zoning Administrator may be making similar changes to multiple properties, and still the Assessor could be making different changes. This disconnected and redundant scheme is inefficient. Data gets updated in multiple repositories at variable times. Because different versions of data may exist, user confidence in the accuracy of these data is decreased.

Data maintenance and safety: Data stored in institutional memory is inherently secure. Data stored on paper media is costly to store and reproduce. Paper records are generally secure, though the proximity of the Village hall to a known flood path makes the problem of reliance on single copies of records especially acute. Institutional memory is subject to unexpected loss in the form of employee attrition. Data that are lost in this process are often irrecoverable and costly studies would have to be made to reproduce them.

Common Benefits: Implementation of a GIS will help to solve the above-mentioned issues. Such improvements will increase the ability of each division within the Village to accomplish its mission and related goals. In specific, other benefits include those listed below.

A Village-wide method of referencing digital records that would allow rapid analyses to be conducted across the entirety of all records. For example, police inquiries could quickly and accurately determine spatial relatedness of incidences, which are referenced to a common parcel identifier.

Transferring Village records to an electronic medium will allow access by an unlimited number of authorized users. Easily implemented security measures will allow individual user groups access

only to appropriate data. For instance, property tax records could be made accessible to the entire Village staff, while many police records would have highly restricted access.

Specific Benefits: Village employees have suggested possible tasks that they would like to perform with a GIS. Listed below are a few examples of tasks that would be simplified with a GIS.

Re-zoning and reassessment: The Village would benefit from a unified information management system that is able to reference properties in a spatial manor (by map or data inquiry). Such a system would be very useful during tasks such as re-zoning and Village-wide assessments. For example, a simple mouse-driven interface would allow the selection of properties in a range of blocks by assessed value. From the results summary reports and mailing labels could be printed automatically. Users should be able to access property information along with the accompanying maps in one location both quickly and effectively. Based on the interviews, such elaborate undertakings need to be conducted in the near future.

Flood impact analysis: A GIS will enable the Village to make very accurate determinations regarding cost and extent of flooding related damages.

Land Records Information: Village employees and residents will have instant access to property information including, but not limited to, zoning, land use, assessed value, building code violations, legal description, and lot acreage. Based on resident requests for information; providing this information in an easily accessible and effective format will serve both the Village staff in responding to requests and the publics ability to access the information on their own.

Costs: It is not the purpose of this evaluation to present a detailed cost analysis, nor will we promote the use of particular software or hardware solutions. However, there are some criteria that may be applied when attempting to ascertain development and implementation costs. For example, we know that the specialized software needed to access information held in a geographic information system (GIS) will have higher costs than standard office-oriented applications. In addition to software licenses, the specialized nature of modern GIS software requires that users have training. Hardware requirements are greater than those of more basic software.

BASIC DATA ENTITIES	SOURCE	COST ESTIMATE
Topographic coverage	Provided by Waukesha County	Governmental data sharing costs
Planimetric features	Delineation provided by Waukesha County, attribution will be needed	Governmental data sharing costs
Surface waters		
Pavement centerlines		
Edge of pavement		
Railroads		
Parcel-level data	Delineation provided by Waukesha County, attribution must be contracted	[1]Current bid $7,000
Flood plain delineation	SEWRPC	Governmental data sharing costs

ADDITIONAL NEEDS	SOURCE	COST ESTIMATE
Software license	Local dealer	[2]Approximately $1,000 per station
Software training	Local dealer or consultant	[2]On site training, approximately $1200
Software customization	Consultant	[1]$1,000 - $2,500
Computer hardware	Dealer	As required

[1] Consultant proposal, Ruekert|Mielke (1999/06/08)
[2] Internet resource, Environmental Systems Research Institute

Appendix D
Map-usage Matrix

Village-Wide Map Usage Matrix

PURPOSE

In addition to individual staff interviews, a secondary Village spatial data review was conducted. This process involved examining the maps and data sources that are used in the typical operations of the Village. Also, key staff members contributed specific information about the nature of how the data is used within the Village. The results of the review were recorded in reference to 'map themes'. Themes are groups of data elements that share a common definition. The levels of detail by which these themes can be broken down into is variable. For example, paved surfaces can be grouped in a theme called 'roads'. However, this group maybe further refined into 'highways' and 'Village roads'. The level of detail is determined by the requirements of the application of the data. Themes are analogous to the data constructs, or layers, by which a GIS maintains spatial data. The review results were used to create a summary matrix describing the status of each theme. The included themes are currently used by the Village, or were requested for inclusion into the proposed system.

DESCRIPTION

The rows of the matrix are separated into feature types, which are broken down into distinct map themes. The columns in the matrix further describe characteristics and resources for each map theme. The theme ID column enumerates each map theme. The note ID refers to detailed notes regarding the status of the referenced theme. These notes are found in a summary table below (Table A). The third column identifies which map theme features are available in digital format. Within this column, the designator "B" indicates that the theme is present on the common Village map. Column four names each map theme. The next five columns identify each department in Elm Grove that was involved with this analysis. The last four columns are different informational entities that indicate whether or not information for each map theme feature is available.

Theme Matrix				Village Owner					External Source			Data
Theme ID	Note ID	Digital?	Map features	Clerk	EMS	Fire	Police	Public Works	Consultant	County	SEWRPC	Other entity
			Base layers									
1	1		Political Districts	P/D								
2	2		School District Boundaries	P/D								
3	3		Neighborhood Boundaries	P/D								
4	4		Recycling Schedule					P/D				
5	4		Solid Waste Schedule					P/D				
6	4		Brush Schedule					D				
7	5		PUD Areas	12								
8	6		Property Lot Lines	P/D								
9	7		Parcel Numbers	P/D								
10	7		Parcel Acreage	P/D								
11	7		Lot Dimensions	P/D								
12	8		Zoning Codes	P/D								
13	9	**B**	1/4 Sections	P/D								
14	9		1/4 Section Numbers	P/D								

			Monuments									
15			Section Corners					P/D				
16		B	1/4 Section Corners					P/D				
17			Distance/Bearings					P/D				

			Roads/Pavement									
18	10	B	Streets					O				
19	10	B	Street Names					O				
20	10,20	B	ROWs					O				
21	11		Address Ranges	P/D								
22	12		Street Centerlines					P/D				
23	12		Street Centerline Grades					C				
24			Streets w/C&G					P/D				
25			Divided Streets w/C&G					P/D				
26			Sidewalks					P/D				
27	12		Driveways					C				
28	10		Surface Material					O				
29	10		Street Resurfacing					O				
30	10		Street Widths					O				
31	10, 20		ROW Widths					O				
32	10		Pavement Striping					O				

			Planimetric									
33	13, 21		Parks	12								
34	13	B	Public Buildings	12								
35	13	B	Library	12								
36	13	B	School	12								
37	13		Cemeteries	12								
38	14		Streams					P/D				
39	15		Trees					C				
40			Building footprints					C				
41			Wetland delineation					P/D				

			Utilities									
42			Street Lights					C				
43			Street Light Numbers					C				
44			Telephone Poles					N				
45			Power Poles					N				
46			Gas Lines					N				
47			Water Lines					N				
48			Water Line Dimensions					N				
49			Water Valves					P/D				
50	17		Fire Hydrants					P/D				
51	17		Water Main Laterals					P/D				
52	17		Water Main Profile					P/D				
53			Sanitary Sewer Lines					P/D				
54			Sanitary Pipe Lengths					P/D				
55			Sanitary Pipe Diameters					P/D				
56			Sanitary Pipe Inverts					P/D				
57			Sanitary Manholes					P/D				
58			San. Manhole Rim. Elev.					P/D				

59			Sanitary Lift Stations					P/D				
60			Sanitary Force Mains					P/D				
61			Sanitary Laterals					P/D				
62			Sanitary Sewer/House Laterals					C				
63			Sanitary Sewer Cleaning					D				
64			Sanitary Sewer Inspection					D				
65			Sanitary Profile					P/D				
66			Storm Sewer Lines					P/D				
67			Storm Sewer Line numbers					N				
68			Storm Pipe Lengths					P/D				
69			Storm Pipe Diameters					P/D				
70			Storm Pipe inverts					P/D				
71			Storm Manholes/Basins					P/D				
72			Culverts					P/D				
73			Culvert Diameters					P/D				
74			Private Storm Sewers					N				
75			Storm Profile					P/D				
76			Storm Sewer Improvements					P/D				
77			Stm. Swr. Watershed Bndy.					N				
78			Strm. Swr. Watershed Acre.					N				
79			100 yr. Flood Plain					P/D				
80			500 yr. Flood Plain					P/D				
81	18		Easements					C				
82			Flood Elevations					C				

			Miscellaneous									
83			Traffic Signs					C				
84			Speed Limit Signs					C				
85			Weight Limit Signs					C				
86			Village Name Signs					C				
87			Parking Restrictions Signs					C				
88			Subdivision Names					C				
89			Recreation Signs					N				
90			Buffers					C				
91			Parking Areas					C				
92			Spot Elevations					C				
93			2 ft. Contour Intervals					C				
94			5 ft. Contour Intervals					N				
95			Salting and Snowplowing					D				
96			Tree Planting Areas					D				
97			Storm sewer Cleaning Areas					D				
98			Proposed Parks					N				
99			Park Service Areas					N				
100			Existing Recreation Corridor					C				
101			Traffic Accident Locations.					D				
102			Traffic Flows					D				
103	22		Railroad ROWs					C				
104			Sanitary Sewer Usage/Address					D				
105			Private Roads					C				
106	16		Private Wells					C				
107	16		Private Water Lines					C				

P/D = Content is held on paper. Users desire it digital format

D = Content is tracked and users desire it in digital format

P = Content is held on paper and digital conversion is not desired at this time

N= Content is not tracked and digital conversion not desired at this time

C= Content is not tracked. Tracking in digital form is desired

Number = Content is tracked using another theme. Alternate theme ID is indicated

O = Content is held digitally in a text-based system and integration is desired

Note ID	
1	The boundaries of the eight wards are important to the Village clerk and treasurer and are available through the County of Waukesha.
2	The Village clerk is interested in school district boundaries, which are maintained by the school districts.
3	Neighborhood boundaries are tracked only as platted subdivisions on the zoning map.
4	The recycling and solid waste schedules are compiled and used by the DPW. A separate schedule exists for the removal of brush and debris.
5	Planned Unit Development (PUD) areas exist only as hybrid regions in the zoning map. No true PUD areas exist at this time.
6	Property lot lines are contained in the parcel files in individual surveys. They are shown in the section maps and three others, including the common Village map.
7	Parcel numbers, acreage, and lot dimensions are available through the County of Waukesha.
8	The Village Clerk retains all zoning data and attributes are available through SEWRPC.
9	The Village lies at the convergence of four quarter sections. Accurate data should come from SEWRPC
10	Street condition information is tracked, by the PC application PACER, by the DPW.
11	Address ranges are referenced on the common Village map. Further detailed information can be obtained from the county.
12	Street centerlines, centerline grades, and driveways are found in certified surveys and as-built plans where available.
13	Planimetric features are currently found only in the common zoning map and common Village map.
14	Small surface waters are not tracked at this time, but are available through the county and SEWRPC.
15	Locations of trees and plantings are held in the forestry inventory. Reference and updates to these could be made during demolition permitting.
16	Private-well locations are sparsely kept on paper by the Village and County
17	Watermain and sanitary sewer line information is found in Village as-builts. Many locales are not available.
18	Easement information is accurate only as textual information in individual property files. Utility easements from WEPCO and railroads would be useful.
19	There is no land use map currently used by the Village. The typical contents of a land use map are tracked in tax roll records.
20	The Village's street right-of-ways are not always equidistant from the centerline. There are locations where the Village has 5 feet of right-of-way on one property and 20 feet on a property across the street. The Village has had to order certified surveys to "prove" the location of their R.O.W.
21	Parks are currently identified as institutional zoning.
22	Existing maps do not contain railroad R.O.W.'s. This data will be obtained from RR's.

SUMMARY

Currently, Elm Grove does not directly use digital map data. Rather, paper reference maps are used, which are often created by the consulting firm of Ruekert & Mielke. The common Village map, a large-format map produced by Ruekert & Mielke, is used extensively by many staff members throughout the Village. In addition to the large common map, fifty-two percent of identified map theme features are currently documented on paper and are desired by particular department to be in digital format. Many of these features are contained in numerous, large-scale as-built drawings maintained by the Public Works Department.

Though the Village does not posses any digital data layers, many vital layers are available digitally from several governmental agencies. Approximately one third of map theme features are available through Waukesha County. Through the general staff interviews and the data review 24 unrecorded map themes were identified as important features to future operation of the Village.

Appendix E
GIS Funding

In order to help offset the costs involved in implementing a GIS, grant support can provide local governments with much needed funding for GIS implementation or expansion. There are several Federal, State, and private organizations which offer grants to purchase equipment and software, or to create new data layers. Listed below are some of the GIS grant resources.

1. ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) GRANTS

a. The ESRI Local Government Start-up Grant Program

This program was established to provide assistance to local government agencies with the establishment of organization-wide GIS projects. The Grants consist of ESRI GIS software and training.

All forms of local government are eligible to receive this grant including Councils of Governments, Metropolitan Planning Organizations, Regional Planning Commissions, County Governments, City Governments, and Townships. Priority is given to organizations that demonstrate collaborative efforts with multiple departments, projects that promote public access to GIS databases and maps, and projects that communicate innovative government through the use of GIS.

Governments who receive this Grant must agree to develop GIS framework databases, which must include a parcel/cadastral base map, a street right-of-way base map, and a street centerline base map.

b. ESRI Livable Community Grants

This grant program was designed to build off the foundation of the Local Government Startup Grants. However, these grants are specifically aimed at developing a GIS for each of the 10 following community sectors:

Cadastral Mapping	Community Development
Environmental Protection	Health and Human Services
Law Enforcement	Library Services
Public Access – Internet	Public Safety
Public Utilities	Schools

For more information on ESRI grants, please contact:

ESRI
Attn.: Grants Administrator
380 New York Street
Redlands, CA 92373-8100
E-mail:locgovgrant@esri.com
http://www.esri.com/industries/localgov/grants-new.html

2. FEDERAL GRANTS/FUNDING SOURCES

a. National Institute of Justice (http://www.ojp.usdoj.gov/ocpa/NewAct/nij.htm)
Very competitive grant program (1999 funding is already been allocated) to assist units of local government to identify, select, develop, modernize, and purchase new technologies for use by law enforcement.

b. The National Science Foundation (http://www.nsf.gov/home/grants.htm)
Provides funding for research and education in the sciences, mathematics, and engineering.

c. Federal Geographic Data Committee (FGDC) (http://www.fgdc.gov/funding/funding.html)

FGDC offers three funding programs:

1.Cooperative agreements for projects that will establish clearinghouses to find and access geospatial data, develop standards related to geographic data, implement educational programs to increase awareness and understanding of the National Spatial Data Infrastructure, and build or strengthen relationships among organizations to support digital geographic data coordination.

2.Framework demonstration projects that support efforts to implement and test the data, technology, and organizational aspects of the framework. Consortia propose projects in which their members work together to produce, maintain, and disseminate framework data needed for national, regional, state, and local analyses.

3.The National Spatial Data Infrastructure (NSDI) Benefits program funds cooperative projects that assess the impact of inter-organizational cooperation and data sharing to address important issues or solve problems over a particular geographic area. Projects may focus on environmental, economic, social, or cultural problems.

d. Telecommunications and Information Infrastructure Assistance Program (TIIAP)
(http://www.ntia.doc.gov/otiahome/tiiap/index.html**)**

Provides matching grants for projects that improve the quality of, and the public's access to, education, health care, public safety, and other community-based services. Grants are used to purchase equipment for connection to networks, including computers, video conferencing systems, network routers, and telephones; to buy software for organizing and processing all kinds of information, including computer graphics and databases; to train staff, users, and others in the use of equipment and software; to purchase communications services, such as Internet access; to evaluate the projects; and to disseminate the project's findings.

e. USGS Contracts & Grants Information (http://www.usgs.gov/contracts/index.html**)**

Provides information about all of the agency's contracts and grants programs, many of which are directly related to GIS.

f. USGS Innovative Partnerships
(http://mapping.usgs.gov/mac/isb/pubs/factsheets/fs21496.html**)**

Offers cooperative agreements under which the agency provides support (financial or non-financial) for assistance in obtaining digital elevation, vector line, orthophotos, and similar data, in USGS or compatible formats, for the public domain from non-Federal producers.

g. USGS Cooperative Research & Development Agreements
(http://mapping.usgs.gov/www/crada/crada.html**)**

Provides opportunities for private sector entities to partner with the USGS on technology transfer projects related to the cartographic, geographic, and information sciences.

h. Environmental Protection Agency (http://www.epa.gov/epahome/partners.htm**)**

EPA's State, Local and Tribal Projects section includes programs that provide support for open space preservation, parks creation, brownfields clean up, water quality improvement, environmental protection, and pollution prevention. The Agency also offers funding opportunities related to specific geographic regions, as well as environmental management, financing, and technology.

i. Department of Housing and Urban Development (http://www.hud.gov/fundsavl.html**)**

HUD provides support for projects related to housing and community development, economic empowerment, and targeted housing and homeless assistance. Information about all of HUD's grant support is provided via one annual Super Notice of Funding Availability (SuperNOFA). HUD also makes available for purchase Community 2020, a desktop GIS that includes an array of U.S. Bureau of the Census geographic and demographic data and HUD program data. In addition, the software can integrate data from a range of data sources provided by the user.

3. STATE GRANTS/FUNDING SOURCES

a. Wisconsin Department of Natural Resources (http://www. http://www.dnr.state.wi.us**)**

The DNR offers several grants, including the Urban Forestry Grant, which allow funds to be used to purchase equipment and software, provided the equipment and software is used for the specific grant project.

b. Wisconsin Department of Administration - Office of Land Information Services (http://www.doa.state.wi.us/olis/wlip/wlip.asp**)**

The Office of Land Information Services prepares guidelines to coordinate the modernization of land records and land information systems, implements a grant program for local governmental units, reviews for approval county-wide plans for land records modernization, maintains and distributes an inventory of land information available for Wisconsin, serves as the clearinghouse for access to land information and provides technical assistance and advice to state agencies and local governmental units with land information responsibilities.

In addition, the Wisconsin Catalog of Community Assistance is a comprehensive catalog of all state-sponsored grants and funding sources. It can be found at http://www.doa.state.wi.us/deir/wcca.htm.

.Appendix F

Geographic Information Officer

Dangermond Proposes Geographic Information Officer Position

During the opening session of the 1999 ESRI User Conference, Jack Dangermond, president of ESRI, proposed that organizations promote the importance of geographic information by adding a new management position—the Geographic Information Officer (GIO). The following describes the role of the GIO in an organization. Organizations in need of GIO skills will find it useful, as will potential GIO candidates seeking to define the responsibilities of this new position.

Geographic information provides the basis for planning activities, monitoring operations, and developing strategic direction for many organizations. Today, GIS and spatial databases help to coordinate these activities digitally, with associated benefits in accuracy, reliability, and accountability. Enterprise information technology and geographic information technology within these organizations come together, creating a common information environment that supports new strategic directions.

A geographic information officer heads an enterprise-wide GIS. Part of the executive management team, the GIO helps formulate business strategies that incorporate geographic information technology while gaining a competitive advantage or improving the organization's overall performance.

The GIO is responsible for:

- Development of the geographic information plans and associated policies to achieve the strategic business objectives of the organization.
- Development of organization-wide information product and technology requirements.
- Directing the investment of information technology funds to maximize organization benefits and maintaining a managed portfolio of those investments.
- Providing external representation for the organization on all matters relating to geographic information.
- Supporting the creation and management of the enterprise geographic data model with respect to content, standards, quality, geographic reference, integration, interoperability, and appropriate documentation, including metadata.
- Providing open access to data where appropriate and promoting sharing of commonly needed data resources.

As with the chief information officer, a GIO brings specialized skills to the organization. A GIO has a comprehensive knowledge of geographically distributed phenomena and the processes that create and modify the geographic landscape. The GIO has knowledge of geographic information technologies and the digital representation of geographic phenomena, and has knowledge of the role of geospatial information in organization-wide operations such as management, decision-making, and policy formulation.

A GIO has an advanced degree in geographic information science, geography, remote sensing, computer science or a closely related field and has demonstrated GIS management experience.

Appendix G
Metadata

What is metadata and why is it valuable?

(exerpted from the resources found at the Federal Geographic Data Committee homepage www.fgdc.gov)

Metadata consist of information that characterizes the primary data. Metadata are used to provide documentation for data products that are viewed, edited and referenced as the primary content of an information system. In essence, metadata answer who, what, when, where, why, and how about every facet of the data that are being documented.

The Value of Metadata

Two very similar paintings of circus performers by Picasso from 1904 are put on the auction block; one brings tens of millions of dollars, the other hundreds of thousands. What is the difference? In one case, the ownership of the painting can be traced through sales slips and auction house records back to the estate of Picasso's dealer. The other painting appeared suddenly on the art market. It looks almost identical, but lacking documentation, how can one be sure it's authentic?

Just as a work of art can change hands many times, so can geospatial data. Once created, data can travel almost instantaneously through a network and be used for any number of different kinds of spatial analysis. Thus transformed, these data can be retransmitted to another user. Change is the essence of geospatial data in a networked environment. The word metadata shares the same Greek root as the word metamorphosis. Meta means change and metadata, or "data about data" describe the origins of and track the changes to geospatial data.

Why bother with Metadata?

Metadata helps people who use geospatial data find the data they need and determine how best to use it. Metadata benefit the data producing organization as well. As personnel change in an organization, undocumented data may lose their value. Later workers may have little understanding of the contents and uses for a digital database and may find they can't trust results generated from these data. Lack of knowledge about other organizations' data can lead to duplication of effort. It may seem burdensome to add the cost of generating metadata to the cost of data collection, but in the long run it's worth it.

How can Metadata be produced?

The information needed to create metadata is often readily available when the data are collected. A small amount of time invested at the beginning of a project may save money in the future. Data producers and users cannot afford to be without documented data. The initial expense of documenting data clearly outweighs the potential costs of duplicated or redundant data generation. A recently developed metadata standard provides a systematic way to collect metadata.

Appendix H
Glossary

The following glossary has been adapted from the online GIS Glossary found at http://danpatch.ecn.purdue.edu/~caagis/tgis/course/glossary.html.

Other resources can be found at:
http://buffy.co.jefferson.co.us/dpt/gis/glos/term/gisterms.htm#P
http://www.sara.nysed.gov/pubs/gis/glossary.htm#P
http://www.state.mn.us/intergov/metrogis/glossary.htm

AREA 1. A homogeneous extent of the Earth bounded by one or more arc features (polygon) or represented as a set of polygons (region). Examples: states, counties, lakes, land-use areas, and census tracts.

2. The size of a geographic feature measured in unit squares. ARC/INFO stores an area measure for each polygon and region.

ATTRIBUTE A non-graphic descriptor of point, line, and area entities in a GIS.

ATTRIBUTE ERROR Incorrect or missing attributes.

BUFFER A zone of a specified distance around coverage features. Both constant- and variable-width buffers can be generated for a set of coverage features based on each feature's attribute values. The resulting buffer zones form polygons-areas that are either inside or outside the specified buffer distance from each feature. Buffers are useful for proximity analysis (e.g., find all stream segments within 300 feet of a proposed logging area).

CONTOUR A line connecting points of equal surface value.

DATA Data is a collection of attributes (numeric, alphanumeric, figures, pictures) about entities (things, events, activities)

Spatial data represents tangible features (entities)

Aspatial data is usually an attribute (descriptor) of the spatial feature

DEM (DIGITAL ELEVATION MODEL) 1. A digital representation of a continuous variable over a two- dimensional surface by a regular array of z values referenced to a common datum. Digital elevation models are typically used to represent terrain relief. Also referred to as `digital terrain model'"(DTM).

2. An elevation database for elevation data by map sheet from the National Mapping Division of the U.S. Geological Survey (USGS).

3. The format of the USGS digital elevation data sets.

DIGITAL ORTHOPHOTO Digital version of aerial photographs that are constructed to eliminate image displacement due to changes in aircraft tilt and topographic relief.

ELEMENT Points, lines, and polygons as they are represented by computerized cartographic data structures.

ENTITY	A collection of objects (persons, places, things) described by the same attributes. Entities are identified during the conceptual design phase of database and application design.
ENTITY-ATTRIBUTE ERROR	Related to attribute error. A mismatch between entity objects and the attributes assigned to them.
GEOREFERENCE	Information that identifies the geographic locale and attributes of natural or constructed features and boundaries on the earth. This information may be derived, for example, from remote sensing, mapping, and surveying technologies.
GIS	A computer system which permits the user to examine and handle numerous layers of spatial data. The system is intended to solve problems and investigate relationships. The data symbolizes real-world entities (houses to neighborhoods to cities to world scale) including spatial and quantitative attributes of these entities.
GPS	A satellite-based device that records x,y,z coordinates and other data using global positioning. GPS devices can be taken into the field to record data while driving, flying, or hiking. Ground locations are calculated by signal from satellites orbiting the Earth. GPS devices play a significant role in geographic data collection.
GROUND SURVEY / GROUND TRUTH	Uses compass, linear measurement and levels to establish spatial location. Observe and record attributes through actual physical inspection.
INFORMATION	Information is the organization of data such that it is valuable for analysis, evaluation, and decision making
INFORMATION SYSTEMS	Information systems are the means to transform data into information. They are used in planning and managing resources.
LARGE SCALE	In mapping, it means to cover small areas in great detail.
LINE	1. A set of ordered coordinates that represents the shape of geographic features too narrow to be displayed as an area at the given scale (e.g., contours, street centerlines, or streams), or linear features with no area (e.g., state and county boundary lines). 2. A single arc in a coverage. 3. A line on a map (e.g., a neatline).
METADATA	Metadata is data about data. Consider the card-catalogue in a library, which is a form of metadata. There is no real information on a particular card, but the card tells the user where to look for the data, what type of data it is, the age of the data, etc. Metadata also defines database and table names, field names, field lengths, field definitions, and a description of the data within a field. (see Appendix H)
OVERLAY	The operation of comparing variables among multiple coverages or data layers.
POINT	1. A single x,y coordinate that represents a geographic feature too small to be displayed as a line or area; for example, the location of a mountain peak or a building location on a small-scale map.

POLYGON A multisided figure representing an area on a map. A polygon is an areal feature defined by the series of arcs comprising its boundary.

It contains a label point inside its boundary and has attributes that describe the geographic feature it represents.

REMOTE SENSING Any means other than direct observation that estimates the entity location and attributes.

RESOLUTION 1. Resolution is the accuracy at which a given map scale can depict the location and shape of geographic features. The larger the map scale, the higher the possible resolution. As map scale decreases, resolution diminishes and feature boundaries must be smoothed, simplified, or not shown at all. For example, small areas may have to be represented as points.

2. Distance between sample points in a lattice.
3. Size of the smallest feature that can be represented in a surface.

4. The number of points in x and y in a grid or lattice (e.g., the resolution of a U.S. Geological Survey one-degree DEM is 1201 x 1201 mesh points).

SCALE The reduction needed to display a representation of the Earth's surface on a map. A statement of a measure on the map and the equivalent measure on the Earth's surface, often expressed as a representative fraction of distance, such as 1:24,000 (one unit of distance on the map represents 24,000 of the same units of distance on the Earth). Map scale can also be expressed as a statement of equivalence using different units; for example, 1 inch = 1 mile or 1 inch = 2,000 feet.

SCALE-DEPENDENT ERROR Spatial error data that is primarily a function of the scale of the input map document.

SMALL SCALE In mapping, it means to cover large areas in less detail.

SPATIAL Spatial data represents tangible features (entities)

Appendix I
Local Government Uses of GIS

Local Government Uses of GIS
The use of geographic information systems by local government falls into five major categories: browsing, simple display (automated mapping), query and display; map analysis; and spatial modeling.

Browse
This function is equivalent to the human act of reading a map to find particular features, patterns or points of interest. This is the simplest method of viewing spatial data and requires the least amount of GIS training.

Simple Display
This function is the generation of a digital map or diagram using a GIS. This is a more efficient means of reproducing frequently used paper maps or renderings. Examples of simple display maps are site plans, street maps, sanitary sewer maps, and orthophotos.

Query and Display
This function is used for answering specific questions with regards to geographic locations and their attribute data. For example, a user could query the GIS to identify parcels tax delinquent and display their locations on a map.

Map Overlay/Spatial Analysis
This function is used to analyze relationships between layers of spatial layers of data. The overlay function was developed to accomplish the combination of maps in a computer. This combination of layers is done by calculating the logical intersection of polygons, lines, or points on two or more map layers. For example, a parcel map may be overlaid with the floodplain map to identify properties that may be prone to flooding.

Spatial Modeling
This application is the use of spatial models or other numerical analysis methods to predict an expected outcome. Spatial modeling is the most demanding use of a GIS and provides the greatest benefit. Most spatial modeling tasks are very difficult to perform by hand and are not usually done unless a computerized system, such as a GIS, is available. For example, the Public Works Department could use the spatial modeling capabilities of a GIS to compare flow rates for different size sewer lines.

Appendix J
Presentation Slides