THE CENTER FOR

Rural Pennsylvania

HANDBOOK - GUIDE

The PENNSYLVANIA GIS RESOURCE and IMPLEMENTATION GUIDE

A HANDBOOK FOR UNDERSTANDING GEOGRAPHIC INFORMATION SYSTEMS

A LEGISLATIVE AGENCY OF THE PENNSYLVANIA GENERAL ASSEMBLY

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A HANDBOOK FOR UNDERSTANDING GEOGRAPHIC INFORMATION SYSTEMS

FEBRUARY 1997

This information guide was assembled from project work conducted by the SSHE - GIS Consortium, and Dr. Robert Sechrist, Spatial Sciences Research Center at Indiana University of Pennsylvania.

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Note: *The Center for Rural Pennsylvania does not endorse, recommend or otherwise promote any of the organizations, individuals, agencies, hardware or software which are mentioned in this guide or its appendices. The information provided in Appendices B, C, D, E, and F is for information and reference only.*

Introduction

Geographic Information Systems (GIS) are a relatively new technology which can assist progressive communities to envision future development in an exciting new way. With GIS, existing community parameters can be incorporated into projected future development to create a model of the community as it might appear in the future. Effective planners can then utilize this model to anticipate successful growth or predict potential problem areas.

The Center for Rural Pennsylvania recognizes the great potential of GIS as a community management tool. However, the rapid proliferation of Geographic Information System (GIS) technology has left some communities unaware of potential GIS benefits and therefore unprepared to make effective acquisition and utilization decisions. This guide is provided to introduce and encourage GIS technology implementation in the Commonwealth of Pennsylvania.

Useful appendices to this guide include: a glossary of GIS terms; a partial list of consultants and vendors; a list of potential GIS data sources; other potential sources of information; a partial list of software manufacturers; three sample GIS systems; and three GIS case studies in the Commonwealth of Pennsylvania.

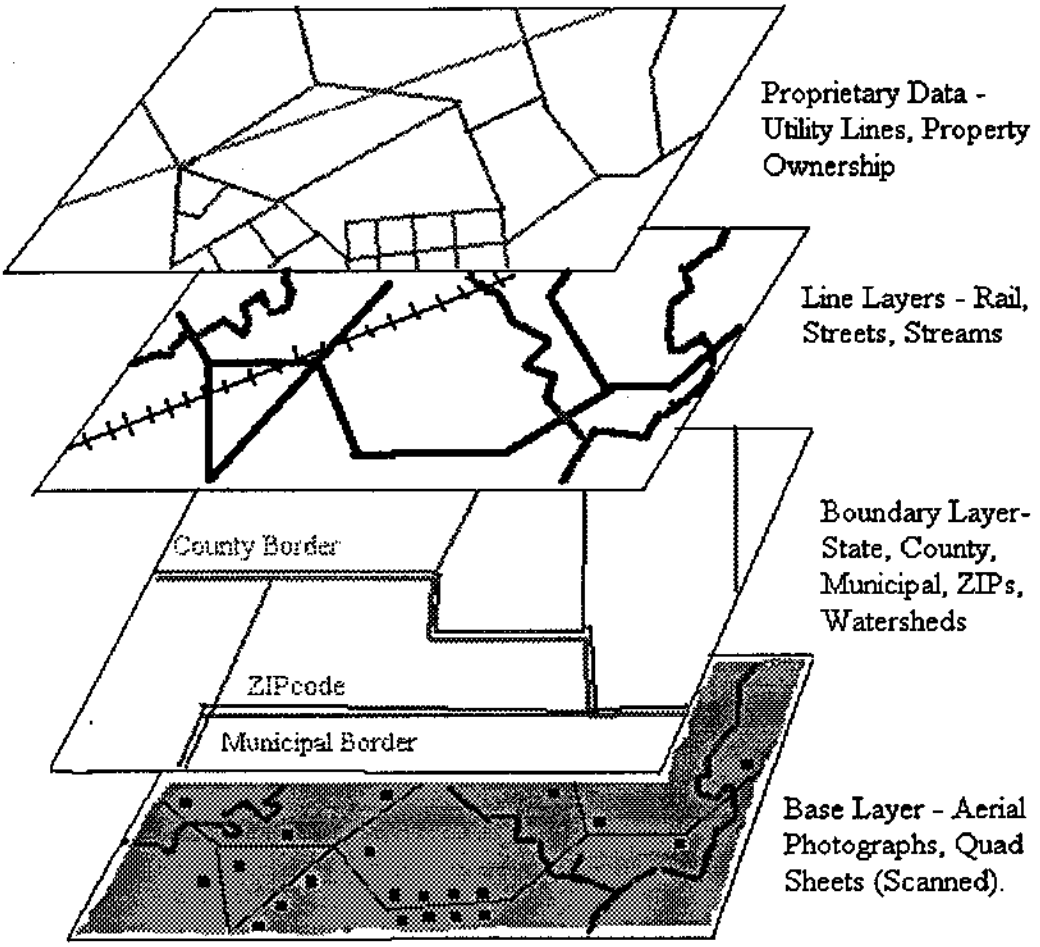
What is GIS?

A Geographic Information System (GIS) is a relatively new technology which combines database features with powerful mapping tools to present information in a pictorial format. Since communities are defined geographically and since a picture can be, "worth a thousand words", GIS is rapidly emerging as an excellent tool which can be utilized to address and manage complex community problems.

GIS utilizes locally-defined demographic and geographic features to create computer generated maps in response to a variety of community issues. Many communities are now using a GIS to manage utilities, transportation, zoning, community services, construction, planning and taxation.

How does GIS work?

GIS employs a georeferenced base (e.g., a map) in combination with various data layers (e.g., boundaries, streets, streams, schools, fire service areas). Layers can be added or deleted to simulate the effects of various factors as they relate to a particular problem. Following are a series of illustrations which demonstrate how a GIS works.



Data in a GIS are organized into layers. Each type of geographic entity (point, line, area) is stored in its own layer. Typically, a GIS begins with a base layer. A scanned raster image of the area, such as a USGS DOQQ of USGS DRG, makes an excellent base. The base is the final judge of location and all other data are corrected to the base. If your system does not support raster, boundary layers can be used as a base for identifying control points. Boundary layers, such as county, municipal, quad sheets, and ZIP codes are common components of GIS systems because they are readily available and easy to include. Line layers representing features such as road centerlines, streams, and railroads are readily available from the Census Bureau, but generally do not have the accuracy necessary for municipal level applications. These layers will probably be digitized in, or corrected, by you or your vendor. Detailed local data such as property parcels, sewer lines, water lines, gas lines, etc. will be entered by you or your vendor.

Figures x.x (8 total) are examples of area, line, and point layers from a statewide environmental resource inventory GIS. The files that created these layers are available from the Pennsylvania DEP. The point layers are not included on the composite map.

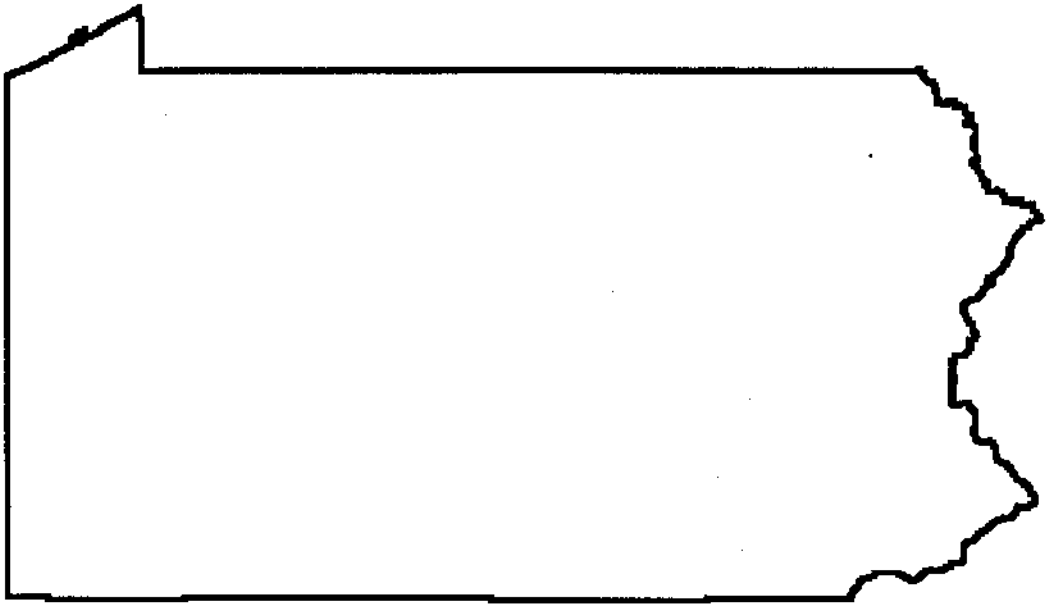


Figure x.x: State Boundary layer depicted as a polygon

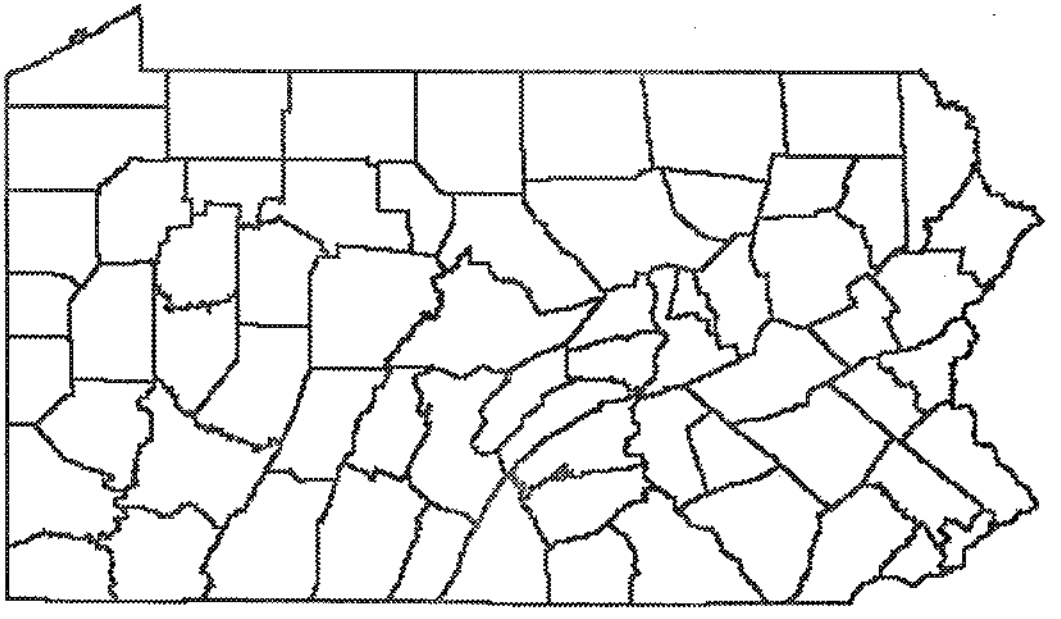


Figure x.x County Boundaries depicted as polygons

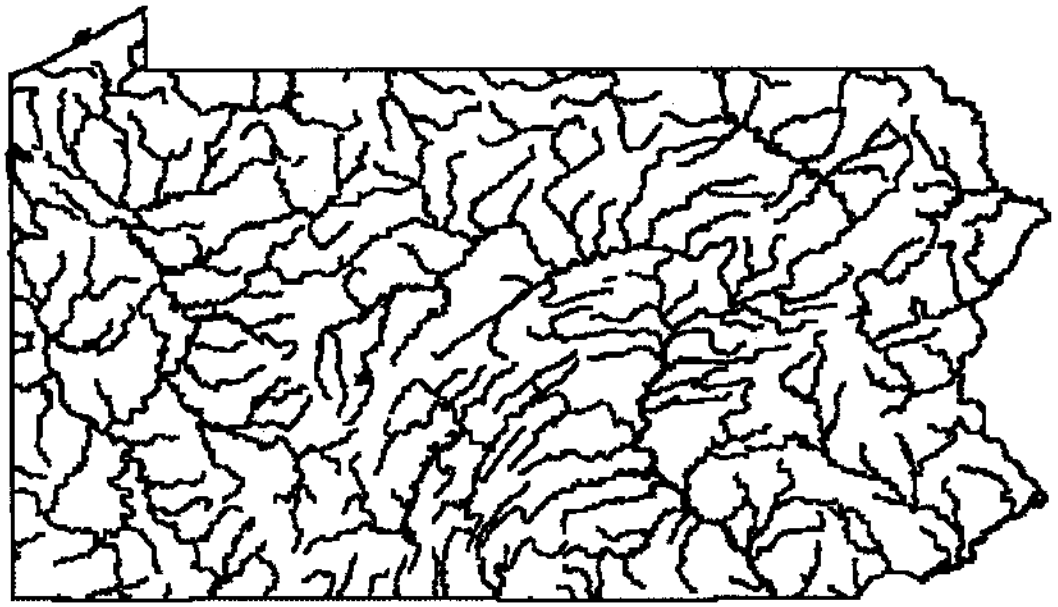


Figure x.x: Major waterways depicted as lines

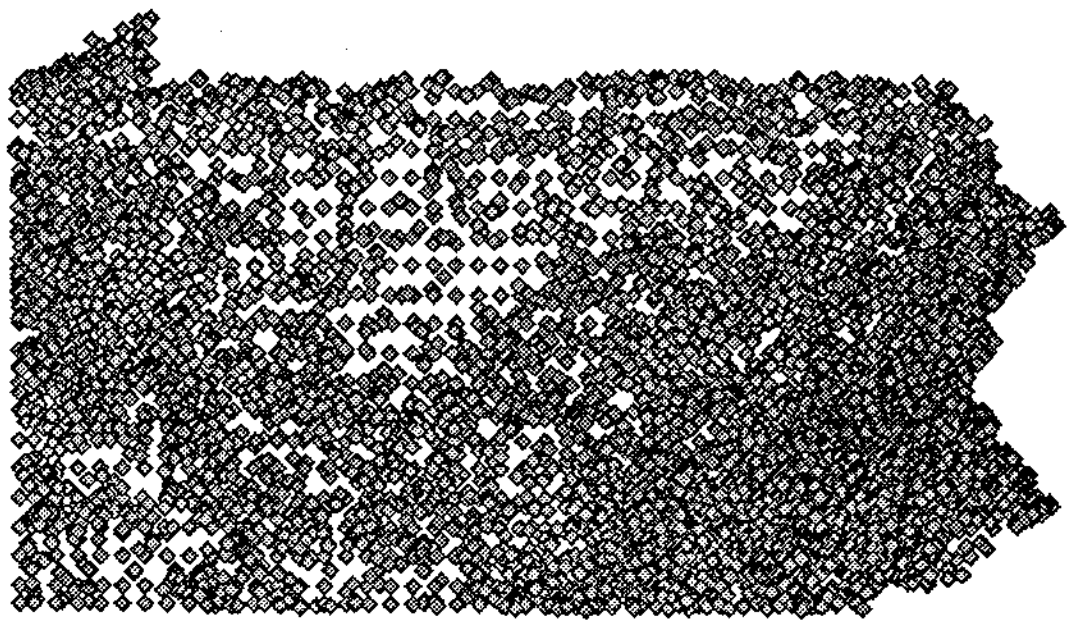


Figure x.x: Locations of Public Water Supplies depicted as points

Figure x.x: Locations of Oil and Gas Wells depicted as points

Figure x.x: Location of State Parks depicted as polygons

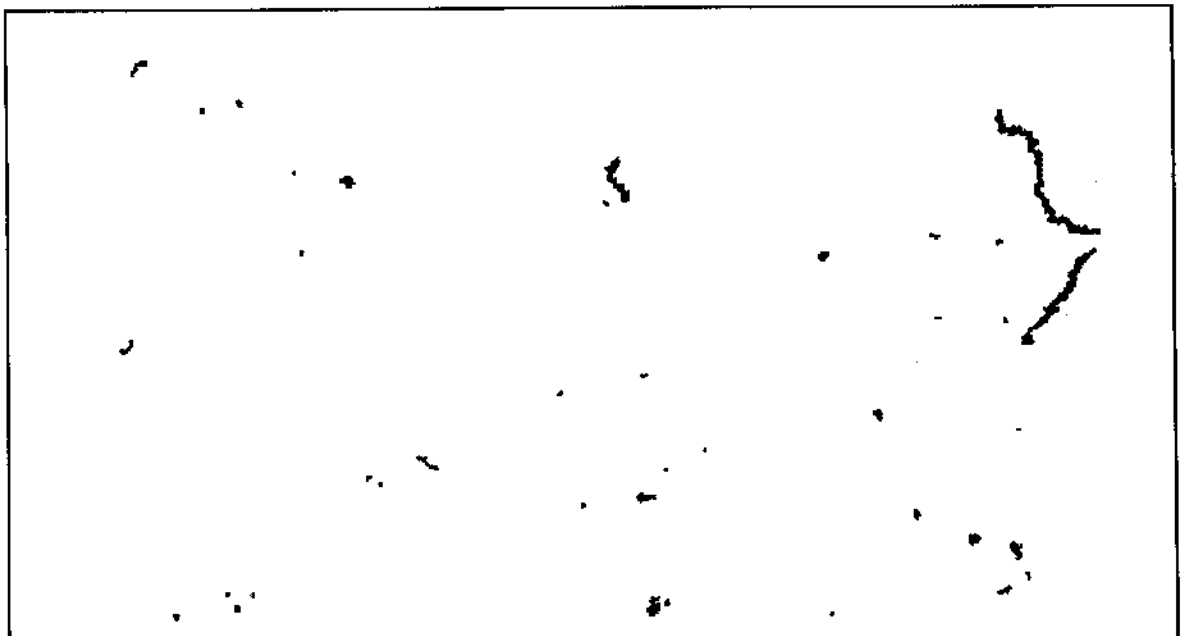


Figure x.x: Locations of National Parks and Landmarks depicted as polygons

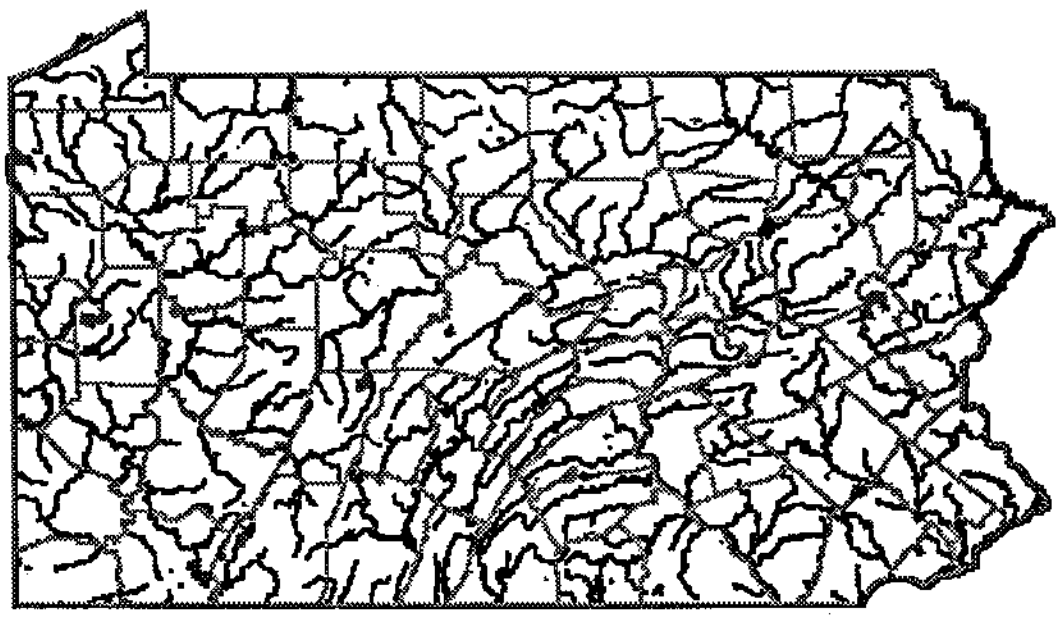
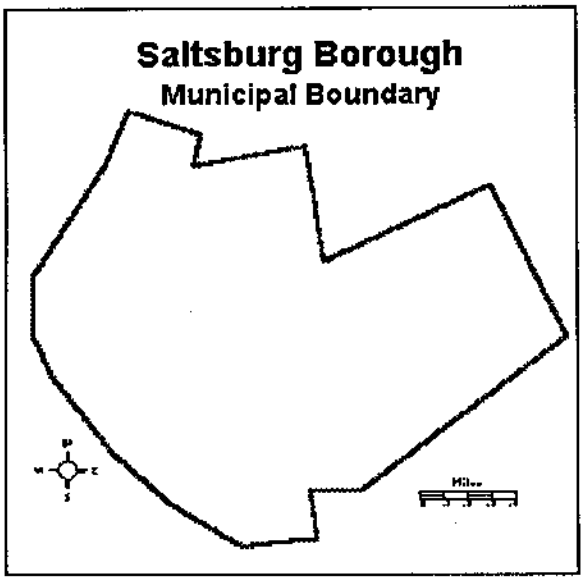
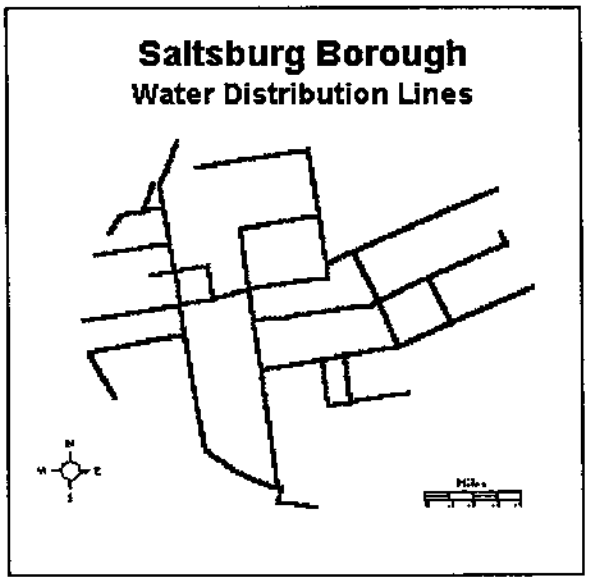
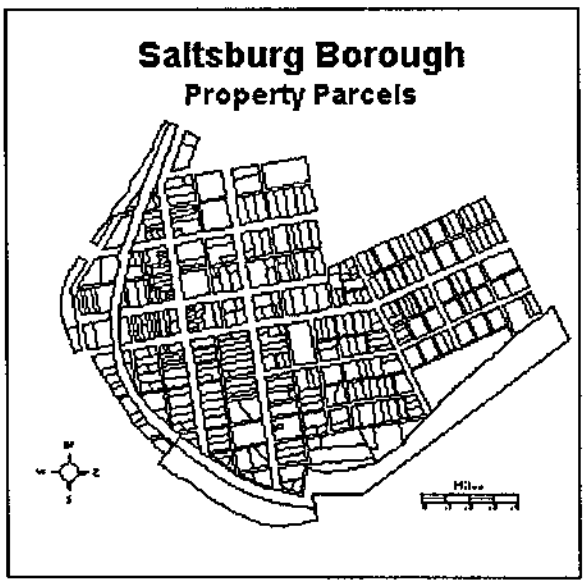


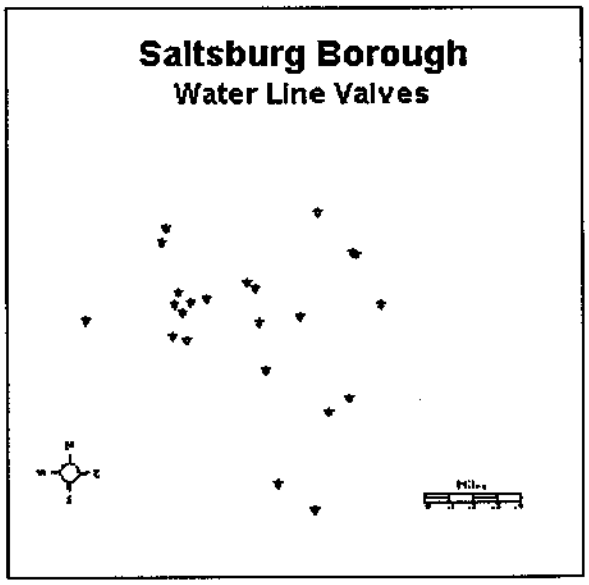
Figure x.x: Combinations of data layers can be displayed together for visual inspection or geographic analysis.

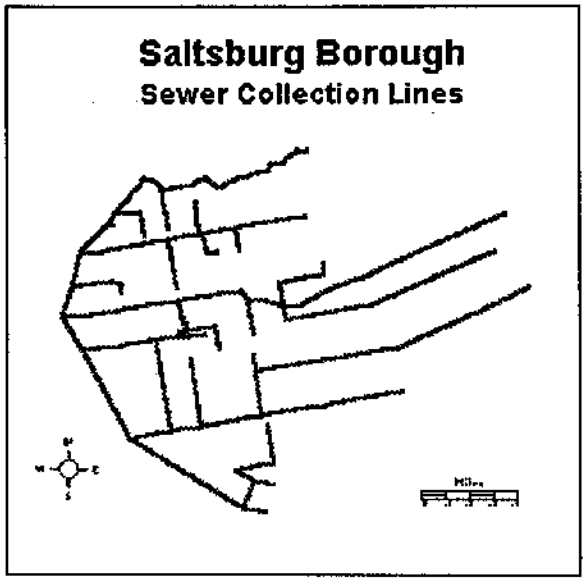
The following 8 Saltsburg Borough maps are examples of area, line, and point layers from a municipal GIS. These layers are typical of municipal systems. The parcel layer in a municipal system often serves the function of a base layer and water and sewer lines are positioned relative to parcel boundaries.

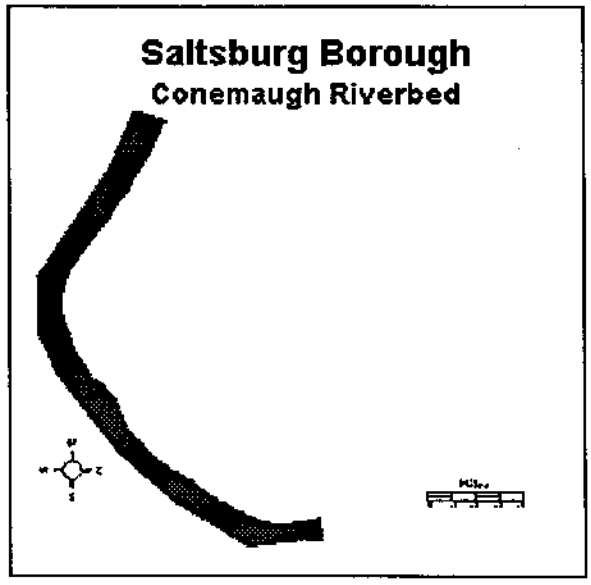


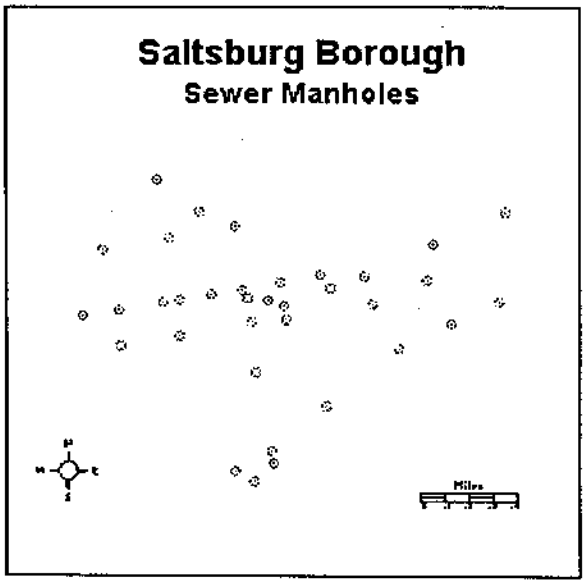


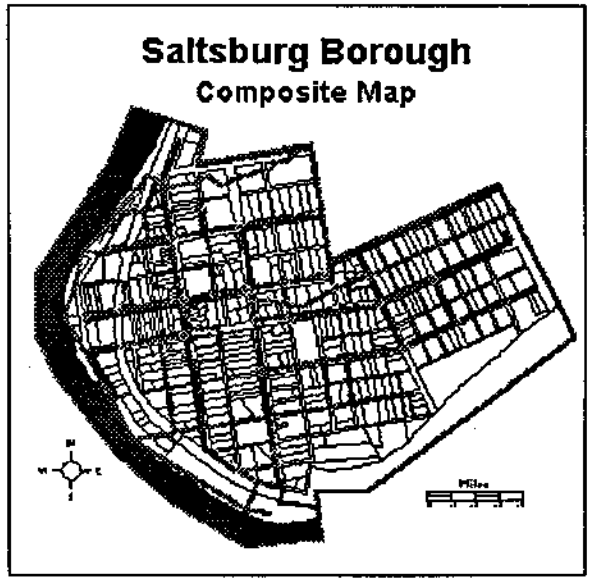





Saltsburg Borough
Sewer Collection Lines


Saltsburg Borough
Conemaugh Riverbed


Saltsburg Borough
Sewer Manholes


Saltsburg Borough
Composite Map

How can GIS technology be used?

GIS uses are virtually unlimited. Following are a few sample applications.

- Boroughs and townships store property records for each parcel of land within a local area and incorporate this data into a combined GIS map which indicates ownership, structures, land use, zoning regulations and other relevant property information.

- Utility companies maintain precise details of underground pipe and wire networks, thus resulting in improved safety and effective repairs.

- Transportation authorities pinpoint traffic and accident troublespots and develop solutions to complex traffic safety issues.

- Emergency service providers determine the origin of "911" calls and automatically dispatch an appropriate response.

How might GIS technology be applied in my community?

Following are a few sample problems which demonstrate how GIS might be utilized to address local problems and issues.

- Provide all parcels of land in this township, which are: over two acres in size; within three miles of an interstate highway exit; are zoned for agricultural use; have sewer and water; are within five miles of an elementary and middle school; and which are currently for sale.

- Provide all intersections in this county which do not have a traffic signal and which have been the scene of a personal injury accident within the past five years. Highlight those intersections which have been the site of at least one fatal accident.

- Given certain demographic characteristics, denote potential locations for a prospective new business and weigh the effects of accessibility to transportation arteries, overhead costs (rent), and proximity to competitors, to determine the best potential site.

- Provide the optimum school bus routes, based upon child population by age/grade level and the hours of operation for each area school.

- Provide information and establish routes for police vehicles, based upon: crime demographics, traffic patterns, and availability of staff.

Who is Using GIS in Pennsylvania?

The following information was compiled from a survey of GIS users in the Commonwealth of Pennsylvania.

What Types of Organizations use GIS?

Businesses are currently the predominant GIS users (36%) in the Commonwealth of Pennsylvania. Counties are the second most common users (26%). Additionally, 18 universities, 11 municipal governments, 11 regional agencies, 9 state agencies and 7 Federal Agencies are current GIS users in Pennsylvania.

Which Software Packages are most commonly used?

GIS software preferences are more diverse than expected. Survey respondents reported 32 separate software packages currently in use although many of these are utilized by only a few organizations. According to the survey participants, the most common software used was ArcInfo.

Another interesting finding is that more that half of the organizations surveyed use more than one GIS package. Only 46% rely on a single package, while the balance of the users listed two to four packages–a pattern which is perhaps indicative of experimentation. County agencies own the fewest packages (1.5), while universities averaged 2.8 software packages per respondent.

Are some GIS Packages more suited to specific uses?

According to the survey, the functions included in a software package are generally defined to meet specific needs. Some packages are specifically designed to support government and analytic tasks. Others are designed to provide routing and locating information. Still others provide demographic, market or environmental analysis.

What is the predominant hardware and software currently in use?

Seventy-six percent of the survey respondents use PC compatible computers with DOS or Windows, while slightly more than half utilize UNIX systems. As noted, many organizations run more than one type of system. Only three organizations reported using Macintosh computers.

The following table details the distribution of computer platforms by organization. State, county, and municipal agencies are evenly split between DOS and UNIX platforms. Federal agencies favor UNIX based systems, while businesses and universities favor DOS/Windows platforms.

Platform/ Organization	MAC	DOS/ Windows	UNIX	Windows NT	Mainframe
County	0	26	25	1	1
Federal	0	3	6	0	0
Municipal	0	7	6	0	5
Corporate	3	44	30	3	8
Regional	0	10	2	0	0
State	0	6	5	0	2
University	0	17	6	1	1

How much will it cost?

Typically, a low cost GIS can be obtained at a cost between $10,000-$15,000. This includes: hardware ($5,000), software ($800-$1,500), data ($3,000-$5,000), and training ($2,000). Such a system might be used to schedule and route deliveries, prepare documents, serve as a base to plan municipal projects, and track trouble areas (e.g., pot hole, accident, and crime scene reports).

A higher performance GIS can be obtained at a cost between $45,000-$90,000. This includes hardware ($15,000-$25,000); software ($5,000-$10,000); data ($20,000-$50,000); training ($2,000); and miscellaneous costs ($3,000). A high performance system might be employed by medium-sized municipal authorities, large county offices, utility companies, regional planning agencies, and researchers. Typically, an organization might have several of these units located in different offices, each performing specialized functions. These systems are used for transportation modeling, project management, watershed analysis, environmental analysis, and facilities management.

Advanced systems are used by state and federal agencies to develop complex models or simulations. These are invariably networked multi-user systems and their cost can vary greatly depending upon the size of the network.

Geographic Information Systems are now available to meet a wide variety of needs and budgets. Three sample GIS systems, with hardware, software and itemized costs, are provided as an appendix to this publication.

What is the best method to acquire a new GIS?

Following are the integral steps to a GIS acquisition. The scope of each phase increases in direct proportion to the size of an organization and/or system installation. The appendices contain more detailed guidance regarding the processes involved in each step.

System Visualization–A GIS purchase is considered and potential uses are visualized as they relate to the information management needs of the organization.

Needs Assessment–Organizational tasks are analyzed in regard to current personnel, time and economic expenditures and weighed against the potential benefits which GIS could provide to each task.

Feasibility Study–Cost/benefit analysis is performed regarding potential GIS solutions. What is the cost of "business as usual" as compared to various GIS platforms?

Conceptual Design–Hardware, software and access controls are visualized.

Implementation Plan–An implementation plan can cover various aspects of the installation, depending upon the size of an organization. These aspects may include: a Request for Proposals (RFP), vendor selection, contract specifications, delivery, system development and expansion, training, and production schedules.

As noted above, a GIS acquisition requires complex planning. For this reason, a **vendor-independent** GIS consultant (a consultant which is not connected to the vendors or installation in any other way) can provide objective advice and is recommended for most organizations.

A consultant can provide the in-depth knowledge of photogrammetry, computer science, geography, cartography, database architecture, and information interchange which is frequently required to perform the tasks associated with each phase of the acquisition process. A skilled consultant can: determine detailed GIS requirements which are tailored to the acquiring organization; develop a Request for Proposals (RFP) based upon those requirements; evaluate vendor proposals in response to the RFP; ensure that all technical specifications are met; and reconcile problems between the vendors and the organization. A list of potential consultants is provided as Appendix B to this manual.

Questions to Ask Regarding Prospective GIS Consultants

1. What qualifies this consultant to undertake our project? What similar projects has this consultant undertaken? Can the consultant provide references?

2. Does the consultant sell GIS software/hardware/data services, etc.? What GIS companies (hardware, software, and service agencies) does this prospective consultant routinely work with? Is there potential for a conflict of interest?

3. What are the specific qualifications of each individual who will work on our project?

4. Can this consultant conduct a needs analysis, feasibility study, and develop a Request for Proposal (RFP)? What is the cost for each of these steps?

5. Can this consultant provide training?

6. Will this consultant provide some or all of the necessary data?

Conclusion

A Geographic Information System is an effective planning and analysis tool which can be effectively utilized by municipal governments and small businesses in the Commonwealth of Pennsylvania. Further, the technology and expertise to install GIS at a local level is readily available at prices which are no longer prohibitive.

The Center for Rural Pennsylvania supports the establishment of GIS in rural communities and believes that GIS can be an effective tool to address growth and development while maintaining and enhancing the rural environment in Pennsylvania's communities. However, effective leadership and citizen involvement remain as the essential elements to successful community planning, without which no tool can be effective.

For further information about GIS, please contact Dr. Robert Sechrist, Indiana University of Pennsylvania, at (412) 357-2251. For information about this or other Center for Rural Pennsylvania programs, please contact the Rural Center at (717) 787-9555.

Appendix A

GIS Glossaries

There are many more complete GIS glossaries available. The most comprehensive we have found are:

The PHB Practical Handbook of Digital Mapping Terms and Concepts by Sandra Arlinghaus. CRC Press. 1994.

A Practitioner's Guide to GIS Terminology: a Glossary of GIS Terms by George Prescott. Data West Research Agency. 1995.

A PARTIAL GLOSSARY OF COMMONLY USED GIS TERMS

ARC/INFO: A computer software product used to automate, manipulate, analyze, and display geographic data in digital form.

ARRAY: a method by which information is stored in a computer. Multiple elements are linked. A two-dimensional array is a matrix of values each stored in its own cell. Standard VGA monitors display information in a 640 by 480 cell array.

ATTRIBUTE: A characteristic of a geographic feature described by numbers or characters and linked to the feature by a user assigned identifier.

BASE MAP (BASE LAYER): A map containing geographic features, used for locational reference. This layer establishes accuracy levels. The locations of other features are tied to the base through registration.

BOUNDARIES: A standard map data feature consisting of political boundaries that identify States, counties, cities, municipalities, and administrative boundaries which identify areas such as National and State forests.

CAD: Computer-aided Design. An automated system which designs, drafts, and displays graphically oriented information.

CADD: Computer-aided Drafting Design (See CAD)

CD: Compact Disk

COMMANDS: Instructions which control the activity of a computer system.

COORDINATES: An x,y location in a Cartesian coordinate system, or an x,y,z location in a three-dimensional coordinate system, representing a geographic location on the Earth's surface.

COVERAGE: A digital map which forms the basic unit of vector data. A coverage contains primary feature data in the form of ARCS, NODES, POLYGONS and LABEL POINTS and secondary features in the form of TICS, MAP EXTENT, LINKS, and ANNOTATION.

DATA BASE: A logical collection of interrelated information, managed and stored as a unit, usually on some form of mass-storage system.

DATA LAYER: A digital map which forms the basic unit of vector data, is thematically associated, and contains selected attribute data links. A data set, like a coverage, contains primary feature data in the form of ARCS, NODES, POLYGONS and LABEL POINTS and secondary features in the form of TICS, MAP EXTENT, LINKS, and ANNOTATION as well as attribute data fields used in relational database linking.

DATA PROCESSING Using a computer system to collect, arrange and refine data into a usable form or to achieve a particular result.

DATA TYPES: Categories of data. Standard definitions exist in data base and GIS systems for a limited number of primitive data types. Examples include numeric, string (or text), byte, logical, and coordinates.

DEM Digital Elevation Model: A database or file containing elevation data by map sheet produced by the National Mapping Division of the U.S. Geological Survey (USGS).

DIGITIZER (TABLET): A device consisting of a flat bed and movable cursor with crosshairs and keys which is used to digitally record x,y locations from maps and other similar two dimensional media, or the person who uses the digitizer tablet.

DIGITIZING: The process of recording locations into a coordinate system usually done with a digitizer tablet.

DISTRIBUTED PROCESSING: A process by which work is completed through simultaneous use of several computer terminals at different sites which communicate through a common network.

DLG: Digital Line Graph. A digital format standard and data file in that standard published by the U.S. Geological Survey (USGS) and used to exchange cartographic data. Each data file represents a map of a particular category such as transportation, hydrography, contours, and boundaries.

DOS: Disk Operating System

DOQQ: Digital Orthophoto Quarter Quadrangles (See Orthophoto Quadrangles).

ELEVATION: A vertical measurement of altitude above a known reference point, usually sea level.

FEATURE: A prominent or distinctive entity on a map such as a point, line, or area.

FEDERAL GEOGRAPHIC DATA COMMITTEE (FGDC): A high level federal committee, currently chaired by the Secretary of Interior. FGDC coordinates federal mapping and GIS policy. FGDC establishes standards for federal GIS data quality.

FLOATING SEAT LICENSE: A computer software licensing procedure based upon the concept of any single user using a single log-in session of the product (a seat) at any location on the network regardless of processor (floating).

FORMAT: The pattern into which data are systematically arranged for use on a computer. A file format is the specific design by which information is organized in a file.

GEOGRAPHIC ANALYSIS: A process by which modeling, examination and interpretation is based upon a set of geographic features. Also known as spatial analysis and divided into four traditional types: spatial overlay and contiguity analysis, surface analysis, linear analysis, and raster analysis.

GEOPROCESSING: A set of computer algorithms which utilize geometry to determine spatial relationships among objects which contain a geographic coordinate.

GIS Geographic Information System: An organized collection of computer hardware, software, geographic data, and personnel which is designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

GEOSPATIAL DATA: Information regarding the attributes and location of phenomena. Generally stored in a computer as a collection of data base tables, these data define the location of an object of interest, its size, shape, and other characteristics of interest such as age, color, diameter, value, or ownership.

GLOBAL: The sharing of a single database or collection of data across a network.

GPS: Global Positioning System. A satellite-based device that records x,y,z coordinates and other data related to measurement. Ground locations are calculated from signals which emanate from NavStar satellites as they orbit the earth.

GRASS: Geographical Resource Analysis Support System. A public-domain raster modeling product of the U.S.Army Corps of Engineers' Construction Engineering Research Laboratory (CERL).

GRID CELL: A single element of a Raster data base. This unit is the resolution of the raster data.

HARDWARE: The physical components of a computer system which consist of the computer, plotters, printers, terminals, digitizers, and other related items.

HOTLINE SUPPORT: A vendor service, provided over the telephone, which provides answers to customers about the vendor's product.

HYDROGRAPHY: A standard map data feature which consists of streams, bodies of water, wetlands, coastal water, and water used for transportation.

HYPSOGRAPHY: A standard map data feature denoting topographic relief.

KEY FIELD: Component field of a data base table. Key fields are used to relate data across tables. Two tables with records with common key field values can be linked. Data from both tables is then treated as a single table.

LATITUDE: One of two parts of a spherical reference system used to measure locations on the Earth's surface. Latitude measures angles from the center of the earth in a north-south direction.

LAYER: See Data Layer or Coverage

LIBRARY: In GIS, a library is a collection of spatial data sets which have been collected, checked for quality, and cataloged to provide base data for analysis.

LINE (SEGMENT): A line is defined by two points and continues indefinitely. A line segment terminates at the defining points. In GIS, line and line segment are used interchangeably.

LOCATIONAL IDENTIFIER: A set of coordinates identifying the relative location of an entity on the earth's surface.

LONGITUDE: One of two parts of a spherical reference system used to measure locations on the Earth's surface. Longitude measures angles from the center of the earth in an east-west direction.

MACRO: Customized format code to accomplish a routine set of computer commands. Macros are used to define report formats or create map templates.

MEMORY: The site in a computer in which data are electronically or magnetically stored for use. This includes computer chips, magnetic disks, magnetic tapes, and compact disks.

METADATA: Data about data. Information about a set of collected data used to document it's history, collection techniques, source, custodian, restrictions, and availability.

MICROCOMPUTER: A small computer. Due to the rapid development of technology it is difficult to define microcomputer further.

MULTI-USER LICENSE: Also known as a Node-locked License, permits a licensed software product to be locked to a specific CPU (Central Processing Unit or computer node) on a network, but allows a set number of users to run the product.

NAD: North American Datum. The Earth, not being an exact ellipsoid, requires a constant evaluation of it's deviations. To keep map projections as accurate as possible requires an official standard of the shape of the ellipsoid. USGS utilizes a system adopted in the mid-1920's known as NAD27. This Datum has been updated through the use of satellite mapping (NAD83) and is used on all new or updated cartographic products.

NAVSTAR: A Department of Defense satellite network comprised of 24 satellites in high earth orbit and used for GPS navigation.

NETWORK: A group of communication devices which may include terminals, workstations, and various types of other computing, input, and output devices, and which are interconnected for the purpose of sharing software and data.

OPERATING SYSTEM: A master control program which governs a computer's methods of operation.

ORACLE: A relational database management system developed by Oracle Corporation.

ORTHOPHOTO QUAD: Distortion-free aerial photographic images which are formatted as standard 7.5-minute quadrangles or as quarter- quadrangles at a scale of 1:12,000.

OVERLAY: A method which combines layers of different data themes for simultaneous display and analysis.

PANNING: Shifting the reference point for map. Moves a selected point to the center of the map or display.

PERIPHERALS: A generic term indicating the input/output devices which are attached to a computer. They include, but are not limited to disk drives, tape drives, CD readers, printers, and scanners.

PIXEL: Picture Element. It is the smallest dot that an output device (monitors and printers) can produce; although originally restricted to video monitors. Each pixel is a grid cell for that device. A VGA monitor displays 640x480 pixels on the screen. A laser printer commonly produces 300 or 600 pixels per inch.

PLANIMETRIC DATA: Commonly known as digital line graphics (DLG) Planimetric Data are digital representations of the cartographic line information commonly portrayed on paper maps.

PLOTTER: A computer output device used to draw pictures, graphs, maps, and other pictorial representations.

POINT: a zero-dimensional object. Defined by a single x,y coordinate.

PRINTER: A computer output device used to produce text and some limited graphics.

PROJECTION: A systematic conversion of locations on the earth's surface from spherical to planar coordinates. A mathematical model which is used to transform the locations of features on the Earth's ellipsoidal surface to a two-dimensional surface.

PROJECTION UNIT: A unit such as meters, feet, or degrees in which a map projection is measured.

PROPRIETARY: A product in which the vendor retains control or rights under copyright or trademark laws.

QUERY: A question formatted for the computer software. In a traditional data base environment, the query takes the form of a "list of objects which meet the following criteria". In a GIS environment, the query takes the form of "show me the locations of the objects that meet the following criteria".

RAM: Random Access Memory

RASTER CELL: A single element of a raster. See Grid Cell.

RASTER DATA: A cellular data structure composed of rows and columns. Groups of cells represent features. Used to store image data.

ROM: Read Only Memory

REGISTRATION: The act of matching locations on multiple maps or images.

RELATIONAL DATABASE: A method of structuring data as a collection of tables, logically associated with each other through shared attributes. Any data element can be found in a relation by knowing the name of the table, the attribute column name, and the value of the primary key.

RESOLUTION: The level of detail inherent in the system. The term generally refers to the smallest observable unit in a raster system. The resolution is usually given in meters. The resolution is the measurement of the length of a grid cell.

SCALE: The degree of reduction necessary to display a representation of the Earth's surface on a map.

SERVER: A computer which runs software that offers file, printer, or disk services to personal computers or workstations connected to a network.

SINGLE-USER LICENSE: A software licensing method which permits a product to run on a single computer by one user at a time.

SOFTWARE: A generic term for computer programs.

SPATIAL DATA: Information regarding location, shape, and relationships between geographic features, usually stored as coordinates and topology.

SURVEY CONTROL: Points of established position and elevations used as fixed references in positioning and correcting map features.

THEMATIC (MAP): Specific attribute values represented by colors, patterns, and symbols in association with map features to depict a distribution.

TOPOLOGY: The spatial relationship between connecting or adjacent features.

TRANSPORTATION: Data collected about major transportation systems; roads and trails, railroads, and miscellaneous features like pipelines and transmission lines.

USGS: United States Geological Survey. The mapping division of the U.S. Department of the Interior

VECTOR: A coordinate-based data structure commonly used to represent linear map features. Each feature is represented by a list of ordered x,y coordinates.

VEGETATIVE COVER: A category of GIS surface cover data consisting of woods, scrub, orchards, and vineyards. Also vegetative features associated with wetlands, such as marshes and swamps.

ZOOMING: Changing the scale of a display or map. Allows users to examine selected areas in greater detail.

Appendix B

Consultants and Vendors

ADR, Aerial Data Reduction, Inc.
280 Kappa Drive,
Pittsburgh, PA 15238
Phone: (412) 967-9577
ADR is an $11,000,000 a year company which manipulates and analyzes aerial photographs. ADR also provides comprehensive GIS development and consulting services.

Aerial Design Data
1207 Clay Pike
North Huntingdon, PA 15642
Phone: (412)863-1456
FAX: (412)864-0666
Company offers Photogrammetric specification services.

Applications Unlimited, Inc.
800 Vinial St., Suite 402A
Pittsburgh, PA 15212
Phone: (412)321-8867
Fax: (412)321-8531
Custom maps and charts of client data.

ATS, Advanced Technology Solutions, Inc.
Contact: Bruce Stauffer
1837 William Penn Way
Lancaster, PA 17601
Phone: 717-399-7007
FAX: 717-399-7015
E-mail address: atsinc@epix.net
ATS offers a full range of GIS services, with specialty in large systems and transportation modeling.

Benatec Associates
101 Erford Rd.
Camp Hill, PA 17011
Phone: (717)763-7391
Fax: (717)763-7397

Boucher & James, Inc.
Buckingham Professional Building
P.O. Box 904
Doylestown, PA 18901
Phone: (215)345-9400
Fax: (215)794-3987
Comprehensive GIS service provider for municipal authorities. Specializes in designing water and sewer information systems.

Buchart - Horn, Inc.
PO Box 15055, 55 S. Richland Ave.
York, PA 17405
Phone: 717-843-5561
FAX: 717-845-3822
E-mail address: buchart@epix.net
Buchart-Horn specializes in environmental planning, tax assessment and surveying services. The company offers a full range of GIS products and services.

Carroll Engineering Corp.
949 Easton Rd., Suite 100
Warrington, PA 18976
Phone: (215)343-5700
Fax: (215)343-0875
Carroll Engineering Corporation is a Bucks County consulting civil engineering firm with offices in Warrington, Trappe, and Bensalem, Pennsylvania. Carroll Engineering's primary clientele includes municipal governments and authorities. The GIS department provides clients with powerful tools to maintain and manage maps and records.

Chester Engineers
600 Clubhouse Drive
Moon Township, PA 15108
Phone: (412)269-5877
Chester incorporates GIS into its municipal, county, and transportation projects. They offer GIS consulting and system development services.

Consad Research Corp.
121 North Highland St.
Pittsburgh, PA 15206
Phone: (412)363-5500
Performs public policy research using GIS.

Classic Development Consultants
1001 East Entry Drive, Suite 301
Pittsburgh, PA 15216
Phone: (412)341-4886
Transportation GIS and traffic analysis specialists.

Dataplan, Inc.
347 Franklin St.
Slippery Rock, PA 16057
Phone: (412)794-1651
Municipal consultant specializing in permitting, code enforcement, and planning.

Day and Zimmerman Information Solutions
280 King of Prussia Rd.
Radnor, PA 19087
Phone: (610)975-6883

EADS Group
R.D. #3, Box 52
P.O. Box 684
Clarion, PA 16214
Phone: (814)764-5050
Fax: (814)76405055
GPS Services

Earth Information Services
1240 North Mountain Rd
Harrisburg, PA 17112
Phone: (717)541-0644
GIS consulting, data conversion and ArcInfo training.

Entech Engineering, Inc.
4 South Fourth St.
P.O. Box 32
Reading, PA 19603
Phone: (610)373-6667
Fax: (610)373-7537
A full service engineering company specializing in water and waste water systems.

GeoDecisions, Inc.
301 N. Science Park Road
State College, PA 16801
Phone: 814-234-8625
FAX: 814-234-8086
GeoDecisions offers complete GIS services.

Gilmore and Associates
331 Butler Ave.
New Britain, PA 18901
Phone: (215)345-4330
Fax: (215)345-8606
Comprehensive GIS service vendor. Developers of GIS for over fifteen municipalities and county projects in Southeast Pennsylvania. Gilmore specializes in complete needs assessment and system design as well as data development and system implementation. Gilmore has also developed environmental GIS for industrial clients.

Hartmann Associates
5637 Brownsville Rd.
Pleasant Hills, PA 15236
Phone: (412)881-4400
Fax: (412)653-3909
GPS and geodetic controls for GIS.

Herbert, Roland & Grubic, Inc.
369 East Park Drive
Harrisburg, PA 17111
Phone: (717)564-1121
Fax: (717)564-1158.
Engineering, Planning, Financial Services.

Hinks & Locher Engineers, Inc.
416 Main St., Suite 100
Johnstown, PA 15901
Phone: (814)536-6767
Fax: (814)536-6770
Combines experience and training with the latest GIS technology, Hinks & Locher use sophisticated scanning, digitizing, and CAD capabilities to bring together information gathered from multiple sources to provide clients with the most accurate and up-to-date data base and geographic information available.

InfoTrax, Inc.
90 Beta Drive
Pittsburgh, PA 15238
Phone: (412) 936-0465
InfoTrax provides customized programming for municipal permitting.

Keystone Aerial Surveys, Inc.
P.O. Box 21059
N.E. Philadelphia Airport
Philadelphia, PA 19114
Phone: (215)677-3119
Fax: (215)464-2889
KAS provides remote sensing and aerial photographic services and has a special expertise in airborne magnetic data acquisition. They have an extensive film library that covers much of Pennsylvania.

Keystone Consultants
300 Bilmar Drive, Suite 290
Pittsburgh, PA 15205
Phone: (412)937-1227
AM/FM/GIS consulting, conversion, implementation planning.

L. Robert Kimball & Associates
615 West Highland Ave.
P.O. Box 1000
Ebensburg, PA 15931
Phone: (814)472-7700
They offer full and complete GIS services. Kimble has conducted many GIS related projects. There are branch offices in Coraopolis, Horsham, and West Chester.

Michael Baker Corp.
4301 Dutch Ridge Road
Beaver, PA 15009
Phone: (412)495-4128
Fax: (412)495-4078
Full and complete GIS services. Michael Baker has completed numerous GIS projects. There are branch offices in Pittsburgh, Philadelphia, and Harrisburg.

Municipal Mapping Services
1243 South Center St.
Grove City, PA 16127
Phone: (412)458-4488
Fax: (412)458-4498
Cadastral mapping from original deed records. GIS design, implementation, and training.

On Target Mapping
1051 Brinton Road
Pittsburgh, PA 15221
Phone: (412)241-7622/(800) 700-6277
Fax: (412)241-7709
On Target offers services to support MapInfo. On Target specializes in customized software development and strategic business planning.

Pennoni Associates
1600 Callowhill St.
Philadelphia, PA 19130
Phone: (215)561-3020
Pennoni is a full service engineering company that offers a full range of GIS support and consulting services.

Peregrine Geo-Systems
RD2, Box 2945
Ellwood City, PA 16117
Phone: (412)758-3025
Fax: (412)774-4944
Environmental and land use specialization. GIS support services are offered.

Regional Planning Technologies
247 Fort Pitt Blvd.
Pittsburgh, PA 15222
Phone: (412)471-8333
Fax: (412)471-8382
Consulting in all aspects of GIS. Experienced in 911 projects.

RDDD International
130 East Main St.
Ephrata, PA 17522
Phone: (717)738-8307
Software and database development, systems integration, applications for E911, GIS training

RETTEW Associates, Inc.
3020 Columbia Ave.
Lancaster, PA 17603
Phone: (717)394-1063
Fax: (717)394-1063

RKR Hess Associates
Contact: Paul DeBarry
112 North Cortland St.
East Stroudsburg, PA 18301
Phone: (717)421-1550
Mapping, programming, data conversion, digitizing, PC ARC/INFO and ArcView sales, training, installation, and setup, municipal services.

Scangraphics
700 Abbot Drive
Broomall, PA 19008
Phone: (610)328-1040
FAX: (610)543-6257
Transforms existing paper maps and photographs to raster images. They can also convert the raster images to vectors.

Senate Engineering Co.
U-PARC
430 William Pitt Way
Pittsburgh, PA 15238
Phone: (412)826-5454
Fax: (412)826-5458
GIS in support of civil and municipal engineering projects.

SE Technologies, Inc.
98 Vanadium Rd.
Bridgeville, PA 15017
Phone: (412)221-1100
Fax: (412)257-1520
GIS consulting, implementation planning.

Skelley and Loy, Inc.
520 Seco Road
Monroeville, PA 15146
Phone: (412)856-1676
Fax: (412)856-5730
GIS in support of mining engineering and environmental consulting, including wetlands delineation, archaeological evaluation, and habitat analysis.

TVGA Engineering, Surveying, P.C.
State Route 2035
P.O. Box 197
Lanse, PA 16849
Engineering, surveying, and photogrammetry services

WEC Engineers, Inc.
1370 Washington Pike, Suite 304
Bridgeville, PA 15017
Phone: (412)257-8774
Fax: (412)257-8815
Experienced in transportation and utility GIS development. WEC offers a full range of GIS and data services. Offers monthly ArcView training classes in the Pittsburgh area.

Whitney, Bailey, Cox, Magnani, Inc.
4909 Louise Drive, Suite 106
Mechanicsburg, PA 17055
Phone: (717)790-9838
Fax: (717)790-9839
Uses GIS for comprehensive planning projects for municipalities and counties. WBCM conducts about five planning projects per year in Pennsylvania.

Wilbur Smith Associates
501 Martindale St.
Pittsburgh, PA 15212
Phone: (412)323-8101
Fax: (412)323-8127
Transportation and traffic planning GIS consultants.

Appendix C

GIS Data Sources

GIS software normally provides some free sample data. Typically, this might include: the world by country, the United States by State, major US highways and cities, and the United States by County. This information is useful to present the local area in a regional setting.

Detailed local data must be obtained separately. Most software vendors have data libraries. However, these are frequently offered at a premium price. A better source for much of the same data is the United States Government. Many federal agencies produce and distribute geospatial data at nominal cost. State agencies are also beginning to distribute data to the public. Finally, several universities have established GIS data libraries.

Ultimately, there will be a need to enter data which is not available from commercial sources. Usually this effort is contracted out to profession GIS specialists. There are several internationally known Pennsylvania firms which can design GIS data bases to individual specifications.

Following are some potential data sources.

Federal Agency Data Resources

Many federal agencies produce geospatial data. The single best source to identify federal resources is The Manual of Federal Geographic Data Products. Much of the following information has been extracted from this publication. Copies of the complete manual, publication #PB-93236503, can be ordered for $44.50 from:

National Technical Information Service
Attention: Order Desk
5285 Port Royal Rd.
Springfield, VA 22161
Phone: (703)487-4650

The United States Geological Survey

The USGS provides a comprehensive range of data products. Following are three examples.

Digital Elevation Models–These files each cover a 7.5 minute quadrangle. They contain a regular 30 meter grid which records elevation at the grid intersection. They are also available at cruder resolutions which cover larger areas (for example–files which cover the entire US with a five arc-minute grid, or files which cover one degree areas with a three arc-second (90m) grid).

Digital Raster Graphics–These files each contain a scanned image of a 7.5 minute quadrangle map, scanned in color at 400 dots per inch. These files are easily registered to several coordinate systems and provide a good base layer for a new GIS. Currently every area north of 40 degrees latitude is available. By the end of 1996, all areas of the Commonwealth should be available.

Digital Orthophoto Quarter Quadrangle - Much like the Digital Raster graphics in format, these files only cover 1/4 of each quadrangle. Aerial photographs are transformed to planimetrically correct digital representations. The digital representations have a 1-meter resolution. These files represent the ultimate in accuracy and information content commonly available. This data file provides a superlative base layer for a municipal GIS. Currently files for eleven Pennsylvania Counties are available. These counties are: Carbon, Clinton, Delaware, Lackawanna, Lawrence, Lebanon, Monroe, Philadelphia, Susquehanna, Wayne, and Wyoming. A timetable for the remaining counties is not available.

The United States Census Bureau

Topologically Integrated Geographic Encoding and Referencing (TIGER) Line files - Developed by the Census Bureau to collect the 1990 Census, these files have become the standard base for national, state, and regional scale GIS. They generally lack the level of detail necessary for a local GIS effort (roads are represented by a single line). While not generally appropriate for local applications, these files are useful to define, model, and analyze a region.

The Environmental Protection Agency

Landview II-Displays EPA regulated sites, demographic and economic information from the 1990 census, and key geographic features of the United States. Landview II includes complete 1992 TIGER files and a subset of the facilities, sites, and monitoring stations represented in the five EPA data bases. These are: Aerometric Information Retrieval System (AIRS); Biennial Reporting System (BRS); CERCLA Information System (CERCLIS); Permit Compliance System (PCS); and the Toxic Release Inventory System (TRI).

State Agency Data Resources

Pennsylvania Department of Transportation (PennDOT)

The PennDOT CD contains a number of digital and GIS files covering Pennsylvania in two formats: Intergraph design files and ARC/INFO export files. All files have geographic coordinates with latitude and longitude recorded in decimal degrees. The files are: county centerlines and drainage for all roads; county road data including: width, surface, traffic, and number of lanes; district base maps; statewide traffic volume; statewide boundaries; railroads, airports, and a grid of all topographic maps.

Department of Environmental Protection (DEP)

DEP GIS data includes detailed geologic surveys, mineral and groundwater data, and coal models.

Department of Conservation and Natural Resources (DCNR)

DCNR, Forest Pest Management is developing a CIMPADS system which will ultimately use registered and corrected aerial photos as the primary data source. It is anticipated that CIMPADS will be fully operational by the spring of 1997.

Pennsylvania One Call System, Inc. (POCS)

POCS is the commonwealth's designated underground infrastructure protection system. All underground facility operators in Pennsylvania belong to POCS, which uses and maintains a statewide GIS to record and manage excavations.

Also, POCS has sponsored the creation of low cost discs which contain regional GIS data at levels ranging from counties to block groups, and converted PennDOT highway segment files. These may be obtained by contacting POCS at 412-464-7110.

University Data Resources

Bloomsburg University
Department of Geography and Earth Science–717-389-4569

Carnegie Mellon University
CMU Heinz School 412-268-8471 (Specializes in data for Allegheny County)

Indiana University of Pennsylvania
Spatial Sciences Research Center–412-357-2251

Kutztown University
Department of Geography–610-683-4364 (Berks County and PennDOT files)

Mansfield University
Department of Geography and Earth Science–717-662-4612

Millersville University
Department of Geography–717-872-3557 (Lancaster County and PennDOT CD-ROMs).

Penn State University
Office of Remote Sensing of Earth Resources–814-863-5541

Pennsylvania State Data Center
Penn State Harrisburg
777 W. Harrisburg Pike
Middletown, PA 17057
Phone: (717)-948-6182

Slippery Rock University
Department of Environmental Studies–412-738-2388

West Chester University
Geography Department–610-436-2724

Commercial Data Resources

American Digital Cartography
715 West Parkway
Appleton, WI 59414
Phone: (414)734-3375

BonData
245 W. High St.
Hummelstown, PA 17036
Phone: (717)-566-5550
Fax: (717)-566-4460

EOSAT, Inc.
5850 T.G. Lee Blvd., Suite 650
Orlando, FL 32822
Phone: (407)856-7828
Fax: (407)856-9550

ETAK, Inc.
1430 O'Brien Drive
Menlo Park, CA 94025
Phone: (414)-733-6658
Fax: (415)-328-3148

Geographic Data Technologies
13 Dartmouth College Highway
Lyme, NH 03768-9713
Phone: (800)331-7881

Wessex
1015 Tower Rd.
Winnetka, IL 60093
Phone: (847)501-3662
Fax: (847)501-3691

Importing Data

Data come in a variety of formats which frequently are not compatible with an existing GIS. The data formats must be translated and registered and some software packages require translator software at an additional price. It may be advisable to seek an outside contractor to accomplish data importation tasks.

Appendix D

Information Sources

FEDERAL

Federal Geographic Data Committee
FGDC Secretariat
590 National Center,
Reston, VA 22092
Phone: (703)648-5514
Fax: (703)648-5755
e-mail: gdc@usgs.gov

FGDC created the Manual of Federal Geographic Data Products, coordinates GIS implementation for the Federal Government, and serves as a clearinghouse for federal GIS information.

STATE

SSHEGIS - State System of Higher Education Geographic Information System Consortium
Kutztown University.
Department of Geography
Kutztown, PA 19530
Phone: (610)683-4364
Fax: (610)683-1352

SSHEGIS produces a quarterly GIS newsletter focusing on GIS in Pennsylvania.

Pennsylvania Geologic Survey
P.O. Box 2357
Harrisburg, PA 17105-2357
Phone: (717)787-8077
Fax: (717)783-7267

This is a great source for maps to add into your system.

JOURNALS and MAGAZINES

GIS World
155 E. Boardwalk, Suite 250
Fort Collins, CO 80525
Phone: (303)223-4848

GIS World Magazine is the premier subject matter periodical. GIS World also publishes The Annual GIS World Sourcebook which is the definitive guide book for power GIS systems.

Geo Info Systems
P.O. Box 7678
Riverton, NJ 08077-7678
Phone: (800)949-6525

Geo Info Systems provides a broad based presentation of GIS applications and commentary.

Business Geographics
155 E. Boardwalk, Suite 250
Fort Collins, CO 80525
Phone: (303)223-4848

Published by GIS World. This magazine focuses on business applications of GIS.

ARC News
Environmental Systems Research Institute, Inc.
380 New York St.
Redlands, CA 92373-8100
Phone: (909)793-2853

ARC News specializes in ESRI products and their uses.

MapWorld Magazine
Mapinfo Corporation
One Global View
Troy, NY 12180

MapWorld Magazine specializes in Mapinfo products and their uses.

INTERNET GIS SITES

Spatial Odyssey http://www.odyssey.maine.edu/gisweb–Full text of GIS conference proceeding articles. Includes full text of all articles from major geographic publications (start 1994).

Arkansas GIS http://www.cast.uark.edu–Center for Advanced Spatial Technologies at University of Arkansas. Contains library of global, US, and Arkansas GIS data files. Census data are also available.

Florida GIS http://www.cs.fsu.edu:80/~fldocs–Florida Growth Management Data Network Coordinating Council operates this site which makes GIS and socio-economic data for Florida available.

Texas GIS http://tnris.twdb.texas.gov–The Texas Natural Resource Information System is the state's clearinghouse for natural resource data, including GIS and socio-economic data files covering Texas.

GIS Discussion Group GIS-L–Send message "Subscribe GIS-l" to listserv@ubvm.cc.buffalo.edu to subscribe. Technical discussion of GIS issues.

GIS for Business Discussion Group GISBUS-L-Send "subscribe gisbus-l" to gisbus-l@ecuvm1.cis.ecu.edu. Discussion of use of GIS in business.

USGS-data available for download. The address is dcwww.cr.usgs.gov/doc/eroshome/ndcdb/ndcdb.htm

Appendix E

Software Manufacturers

Novis GIS users should utilize a consultant to select software. However, following is a partial list of GIS software manufacturers.

Arc/Info/ArcView/ArcCAD
ESRI
5 Great Valley Parkway, Suite 356
Malvern, PA 19355
Phone: (610)725-0901
Fax: (610)725-0903
or
380 New York Street
Redlands, CA 92373
Phone: (909)-793-2853
Fax: (909)-793-5953
Internet: info@esri.com
Discussion list: ESRI-L

ER Mapper
Earth Resource Mapping
4370 La Jolla Village Drive, Suite 900
San Diego, CA 92122
Phone: (619)558-4709
Fax: (619)558-2657

Mapinfo
Mapinfo Corp.
One Global View
Troy, NY 12180
Phone: (518)-285-6000
Fax: (518)-285-6070
E-mail: sales@mapinfo.com

*Atlas*GIS*
Strategic Mapping
3135 Kifer Road
Santa Clara, CA 95051
Phone: (408)-970-9600
Fax: (408)-970-9999
Email: info@stratmap.com

Maptitude
Caliper Corp.
1172 Beacon Street
Newton, MA 02161
Phone: (617)-527-4700
Fax: (617)-527-5113
Email: info@caliper.com

Idrisi
Clark University
950 Main Street
Worchester, MA 01610
Phone: (508)-793-7526
Fax: (508)-793-8842
Email: idrisi@vax.clarku.edu

Intergraph/MGE
Intergraph Corp.
Huntsville, Al 35894
Phone: (205)-730-7014
Fax: (205)-730-6750

Appendix F

Three Sample GIS Systems

Following are three sample system configurations which were compiled in early 1996 for reference and comparison only. Price estimates may vary.

The systems described are single user installations. Large organizations require multiple desktop stations of each type and may require additional resources for data sharing and distributed processing.

Low Cost

A. Hardware ($5,000)

1) Intel P5 or P6 PC running MS Windows 95.
2) 16 or more Mbytes of internal RAM.
3) 14" SVGA Monitor (17" preferred).
4) 1 Gbytes or better hard disk drive.
5) Tape backup system.
6) CD/ROM drive.
7) Color Inkjet printer
8) Internet Access (modem, network, etc.)

B. Software ($800 to $1,500)

1) One of the following GIS software packages.

   a) PC ARC/Info and ARCView2 for Windows
   b) MapInfo
   c) Atlas GIS
   d) Maptitude
   e) Idrisi

2) One of the following suite packages

   a) MSOffice
   b) Lotus Smart Suite
   c) Perfect Office.

3) One of the following desktop publishing or graphic art software packages

   a) Adobe Publisher,
   b) COREL Draw,
   c) PowerPoint,
   d) Harvard Graphics

C. System Data

1) Canned data (free)

a) United States by State
b) United States by County
c) World by Country
d) Example City level data

2) Off-the-Shelf data for region ($100)

a) Pennsyldatia CD-ROM from IUP
b) Review Vendor data catalogs

3) Off-the-Shelf local area data ($100)

a) Elevation data as contours or Digital Elevation Model
b) Digital Raster Graphics

4) Available Detailed Data ($100)

a) Digital Orthophoto Quarter Quads
b) Pennsylvania One Call Landbase
c) County Planning (not always)
d) County Emergency Management (not always)

5) System Specific Data ($3-5,000)

a) Facility location

D. Training Requirements ($2,000)

1) College level Introduction to GIS course
2) Week long, vendor provided software training class
3) Working knowledge of hardware and operating systems

E. Systems Procedures

1) Backup

a) scheduled-not always adhered to
b) tapes are stored off site

2) Data Management

a) data dictionary
b) metadata
c) file management
d) updates performed by single individual for entire system

3) Security

a) minimal–door is kept locked
b) master files and records stored off site

High Performance

A. Hardware ($15,000 to 25,000)

1) Intel P5 or P6 PC running MS Windows 95/NT.
2) 64 or more Mbytes of internal RAM.
3) 19" SVGA Monitor.
4) 4 to 8 Gbytes or better hard disk drive.
5) Tape backup system.
6) CD/ROM writeable drive.
7) Color Inkjet printer, plotter access
8) Internet Access (modem, network, etc.)
9) Digitizing Tablet
10) Desktop scanner

B. Software ($5,000 to $10,000)

1) One of the following GIS software packages.

a) PC ARC/Info and ARCView2 for Windows
b) MapInfo
c) Atlas GIS
d) Maptitude
e) Idrisi

2) One of the following suite packages

a) MSOffice
b) Lotus Smart Suite
c) Perfect Office.

3) One of the following desktop publishing or graphic art software packages

a) Adobe Publisher,
b) COREL Draw,
c) PowerPoint,
d) Harvard Graphics

C. System Data

1) Canned data (free)

a) United States by State
b) United States by County
c) World by Country
d) Example City level data

2) Off-the-Shelf data for region ($100)

a) Pennsyldatia cd-rom from IUP
b) Review Vendor data catalogs

3) Off-the-Shelf local area data ($100)

a) Elevation data as contours or Digital Elevation Model
b) Digital Raster Graphics

4) Available Detailed Data ($100)

a) Digital Orthophoto Quarter Quads
b) Pennsylvania One Call Landbase
c) County Planning (not always)
d) County Emergency Management (not always)

5) System Specific Data ($20,000 to $50,000)

a) Facility location
b) Aerial Photographs

D. Training Requirements ($2,000)

1) Six college credits in GIS, computer science or MIS background
2) Extensive vendor provided and self training
3) One year's experience with GIS software
4) Thorough understanding of hardware and operating systems.

E. Systems Procedures

1) Backup

a) schedule is well maintained and centrally performed
b) tapes are stored off site

2) Data Management

a) data dictionary - complete at implementation and maintained
b) metadata - usually tracked
c) file management - clear plan, usually shared resource
d) updates performed

3) Security

a) password protection
b) master files and record stored off site

Advanced System

A. Hardware ($25,000 to $50,000)

1) UNIX workstation (SUN Microsystems, Digital Alpha AX, etc.) .
2) 128+ Mbytes of internal RAM.
3) 19" or larger Monitor.
4) 10 to 100 Gbytes or better hard disk drive.
5) 4 or 8 mm Tape backup system.
6) CD/ROM drive.
7) Network or Internet capable TCP/IP or SLIP for large data transfers.
8) High speed 36" wide color printer
9) Digitizer tablet
10) Scanner

B. Software. ($10,000 to $25,000)

1) One or more of the following GIS software packages.

a) UNIX ARC/Info and ARCView2
b) MapInfo
c) ERDAS

2) A database management package (e.g., ORACLE)
3) Desktop publishing or graphic art software for reports and maps.

C. System Data

1) Canned data (free)

a) United States by State
b) United States by County
c) World by Country
d) Example City level data

2) Off-the-Shelf data for region ($100)

a) Pennsyldatia CD-ROM from IUP
b) Review Vendor data catalogs

3) Off-the-Shelf local area data ($100)

a) Elevation data as contours or Digital Elevation Model
b) Digital Raster Graphics

4) Available Detailed Data ($100)

a) Digital Orthophoto Quarter Quads
b) Pennsylvania One Call Landbase
c) County Planning (not always)
d) County Emergency Management (not always)

5) System Specific Data ($20,000 to $500,000)

a) Facility location
b) Satellite imagery
c) Aerial Photographs
d) Field surveys

D. Training Requirements ($2,000)

1) Advanced degree in Geography specializing in GIS
2) Strong computer science or MIS background
3) Capable of teaching advanced topics in GIS
4) Five years experience with GIS software
5) Thorough understanding of UNIX hardware and systems

E. Systems Procedures

1) Backup

a) scheduled and performed centrally
b) tapes are stored off site

2) Data Management

   a) data dictionary
   b) metadata
   c) file management

3) Security

   a) password protected individualized access
   b) master files and record stored off site

Appendix G

Pennsylvania GIS Case Studies

The following case studies provide some examples of GIS Systems currently in use in Pennsylvania.

Huntingdon County Planning Commission

Huntingdon County is a predominately rural county which is located in central Pennsylvania. The Huntingdon County Planning Commission (HCPC) utilizes a low cost GIS to make planning decisions.

In 1994, HCPC sought assistance from Indiana University of Pennsylvania's Spatial Sciences Research Center (SSRC) to provide GIS implementation assistance. This relationship has expanded into an ongoing development, consultation and support program.

The HCPC GIS, as implemented, was a single user system which was originally designed to produce maps for proposals and public meetings. Subsequently, the HCPC GIS has expanded to support municipal and economic development planning, which includes a comprehensive new countywide address plan and an information sharing arrangement with other organizations, particularly the Southern Alleghenies Regional Planning Commission.

HCPC purchased inexpensive software which is relatively easy to learn (i.e., "user friendly") but which could be adapted to support a variety of file formats. SSRC installed the system, provided on-site training and continues to provide unlimited telephone support–all for a continuing financial commitment of only $8,000 per year.

HCPC's implementation plan was designed to quickly demonstrate the benefits of the system in order to generate enthusiasm and thus encourage continuing support for the project. A base map was developed as a common layout for all HCPC maps. Map templates were then developed to accommodate a variety of situations and design considerations in an attractive and meaningful map layout.

The first product developed for HCPC was a municipal demographic profile fact sheet that included maps, text and tables. The profile included thematic maps of population, age, income, race, housing units and a variety of other socio-economic characteristics. HCPC staff can now map over 1000 census variables.

HCPC has utilized existing state, federal, regional and local agency systems to download additional data. Many of these agencies share existing data which can be utilized to "jump start" a new system. Through data sharing, HCPC has reduced development costs and system start-up time.

Summary

The HCPC experience can be duplicated in small, remote areas. Significant free data for local applications is readily available, while a small system can be obtained and installed at a reasonable price. The HCPC experience further indicates that a "start-up" partner can assist a small community to quickly and effectively realize the benefits of a GIS System.

Lancaster County

Lancaster County is a formerly rural county which has experienced considerable urban development. It is located in the southeastern corner of the Commonwealth.

The Lancaster County Planning Commission established a small GIS System during the late 1980's. This system grew modestly due to budget limitations, which confined data acquisition to public domain data or small projects which were developed in cooperation with the Millersville University Geography Department. Though results were inconsistent, the system was used to develop a comprehensive county plan.

As part of the plan, GIS was utilized to designate urban growth boundaries and implement an automated county-wide property tax reassessment. These results would have been very cumbersome to effect using traditional methods.

Another challenge resulted from the continuing friction created between farmland preservationist and urban developers. Because land use and environmental data had never been effectively coordinated, the county undertook a major project to create a county-wide GIS digital base map which provided for accuracy to within two feet of true location in Lancaster City and to within five feet for the rest of the county. This project is currently being developed.

Lancaster County now envisions its final GIS to include: roads, railroads and bridges; building outlines; municipal and urban growth boundaries; tax parcels and zoning districts; terrain and surface water configuration; utility, sewage and water systems; emergency and public service provider sites; and numerous miscellaneous features (e.g., pay telephones, fire hydrants, cemeteries, parking lots, and monuments).

Summary

The project, while not yet complete, is generally proving to be successful. While not entirely problem free, when development is complete, Lancaster County will have a highly accurate and detailed GIS which can be utilized to address complex planning problems.

Slippery Rock Borough's Municipal Sewer and Water Authority

Slippery Rock Borough is located in the northwest corner of Butler County and has a population of approximately 2,500. In 1991, the Slippery Rock Municipal Authority decided to establish a digital mapping system.

Slippery Rock originally obtained outside assistance from the Cartographic Services Laboratory at Slippery Rock University. When the Lab was closed in 1992, Municipal Mapping Services (MMS) of Grove City, PA assumed responsibility for the project.

Approximately twenty layers of digital information are maintained. including: municipal boundaries, road right-of-ways, property lines, streams, street text, sewer lines, water lines, valves, curb boxes, manholes, fire hydrants, storm sewers, building setbacks and selected building footprints. Customized data bases have also been created for account numbers (i.e., customers), valve boxes, and curb boxes.

Slippery Rock Municipal Authority is committed to, "doing it right the first time." Money is regularly budgeted for digital mapping and the overall system is updated annually. Patience and detail have characterized the development process and a fully developed GIS has not yet been implemented. However, the system is regularly utilized and its uses continue to increase as more data is entered.

Summary

Although much needs to be done and the system is not expected to be fully operational for at least another year, the Slippery Rock Municipal Authority has proven that a small rural community can afford to develop and implement a GIS. The resulting benefits are slowly but surely being realized.

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