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FINAL

City of Newburgh, NY

GIS Needs Assessment

May 2008

Reviewed and edited by the City of Newburgh GIS Analyst Jamie Lo, June 23, 2008

City of Newburgh, New York

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EXECUTIVE SUMMARY

The City of Newburgh (City), located in Orange County, New York, received a grant from the New York State Archives and Records Administration (NY SARA) to perform a Geographic Information System (GIS) Needs Assessment in order to develop a comprehensive municipal GIS. Bowne Management Systems (Bowne) was contracted to conduct such a study by departmental interviews. This report identifies the City's active records management needs and priorities that can be addressed by developing a GIS, as well as key benefits and necessary steps for future GIS implementation. The methodology used was intended to create an objective assessment of the City's GIS and to provide a phased plan for advancing the various components of the system

Specifically, the intention of this report is to:

- Identify current and potential City records and external geographic databases which will serve as the foundation of the City GIS;
- Identify the best method to leverage existing computer systems and databases for successful GIS implementation;
- Prepare a GIS implementation strategy which is realistic to the existing and anticipated resources of the City; and,
- Recommend a set of GIS activities within the City, which is based on industry standards and consistent with evolving local, state, and federal government programs.

The primary objective expressed by the City in undertaking a GIS Needs Assessment, is to improve the quality of services delivered to residents and to increase internal efficiency. As with many municipalities, data is distributed throughout the City in varied digital and paper formats and access to such data is limited and cumbersome. A disproportionate amount of time and resources are spent obtaining the necessary information needed to perform everyday tasks.

This study is divided into three major segments: 1.) Needs Assessment, 2.) Conceptual System Design, and, 3.) Implementation Plan. The Needs Assessment segment consists of a review of the current environment, lists key findings, and reports the results of departmental interviews. The Conceptual System Design segment is the blueprint for a successful GIS implementation, which discusses GIS applications that will fulfill the needs of the departments and the strengths and weaknesses of alternative GIS design approaches. This segment also presents an array of recommendations about applications, database design, and information technology infrastructure that will have an effect on the City as it moves ahead with further investment in GIS technology. The Implementation Plan, when followed, will help the City maximize resources and satisfy the needs outlined in the report.

This report will demonstrate that the City will benefit from an Enterprise GIS approach by enabling City departments to utilize GIS in a cost effective manner. The City will benefit from a robust and sustainable City-wide GIS implementation approach that improves City department information exchange and decision making as well as services to the public.

1. INTRODUCTION

1.1 Background

This report is an essential business document that will guide the City in making effective and cost conscious decisions regarding GIS technology. As in any business plan, it is a living document and, maintained over time, will provide a roadmap for ongoing future decision making and spending.

1.2 What is GIS?

GIS is a collection of computer hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS is a rapidly growing technological field that incorporates physical features of an asset with tabular data in order to assess real-world problems. GIS technology employs a series of tools to convert, create, link, and manage information and features to locations or assets (e.g. owners' profile to addresses, building structures to land parcels, water infrastructure and connectivity to streets). Multiple data can be layered, calculated, and analyzed together to depict and /or predict patterns, trends, and correlations in a geographic context (See Figure 1)..

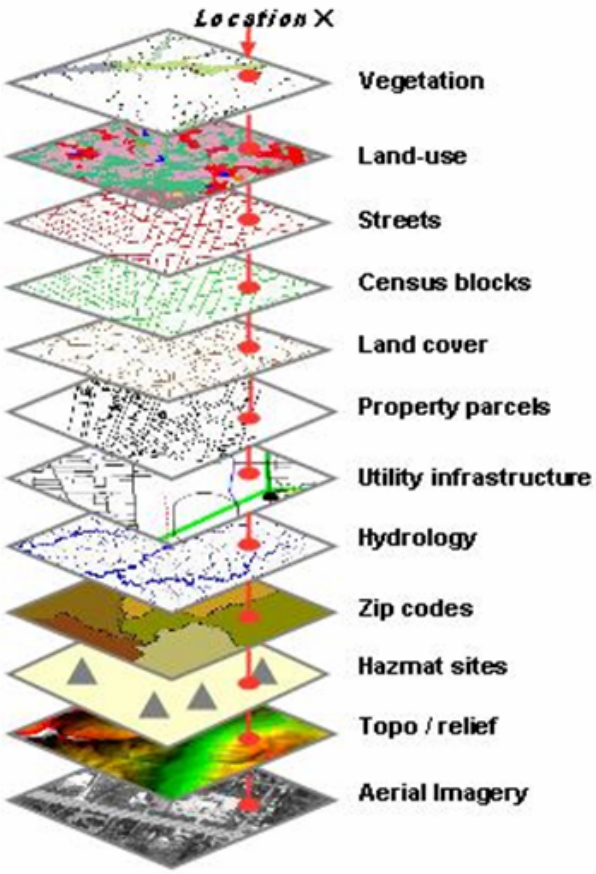


Figure 1 - The Concept of GIS "Layers

1.3 Document Overview

The remainder of this report is divided into the following four sections:

Needs Assessment (Section 2) – This section provides an overview of the role GIS currently plays in the City's day to day operations and reviews of areas in the City where inefficiencies occur due to duplicate record creation or lack of means to openly distribute records among departments. Also presented are the findings from the eighteen (18) interviews that Bowne conducted with departments and staff within the City. The following criteria were assessed:

- Responsibilities and functions;
- Existing software;
- Data;
- Staffing;
- Metrics;
- Spatial data in use;
- Non-spatial data in use; and
- Uses for GIS and non-GIS applications.

Conceptual GIS Design (Section 3) – In this section, the expected uses and applications for the GIS are identified and described.

- Alternative GIS implementation approaches;
- Database design considerations;
- Conceptual GIS database design;
- Master data list;
- Conceptual GIS system design; and
- Design for appropriate staffing, training, financial support and organizational infrastructure.

Recommendations (Section 4) – This section presents Bowne's recommendations for all future GIS activities, including::

- General recommendations;
- Application recommendations;
- Data recommendations;
- IT infrastructure recommendations; and
- Staffing, training and organizational infrastructure recommendations.

Implementation Plan (Section 5) – This report concludes with the presentation of a detailed implementation plan that consists of three Phases. It specifies the tasks, costs and scheduling of activities and acquisitions necessary to complete each phase of the GIS implementation.

2. NEEDS ASSESSMENT

A Needs Assessment is the first step in implementing a successful GIS within any local government. A Needs Assessment is a systematic look at how each department functions and a comprehensive assessment of the various records that are necessary to perform their work. This process is very important because it entails a thorough examination of resources available to the City that could support a GIS implementation in terms of hardware, software, personnel, and data.

Although each of these components is necessary for a successful GIS implementation, perhaps most important process to the Needs Assessment is finding and utilizing the appropriate data. The form of the data is critical to the overall database design and the success of any data integration or future analyses performed within the system. The quality of the results produced by GIS and its applications ultimately resides in the quality of the data.

The following sixteen (16) departments and two (2) City personnel were interviewed with the goal of assessing their unique responsibilities and potential uses for GIS.

- Assessor's Office
- City Clerk's Office
- City Comptroller's Office
- Civil Service Department
- Code Compliance Department
- Executive Department
- Fire Department
- GIS Analyst
- City Historian
- Human Services
- Information Technology Department
- Planning and Development Department
- Police Department
- Public Works Department
- Records Management/Engineering Department
- Tax Collector's Office
- Wastewater Treatment Plant
- Water Department

The interviews were conducted at Newburgh City Hall on November 7th and 8th, 2007. Follow up questions and responses were communicated via email and phone conversations.

2.1 Current Environment

During the interview process, departments collectively expressed the desire to increase the efficiency and effectiveness of decision making through sharing existing and newly created data records, maintaining data currency, and an increased ability to query and compare data from different sources. Sharing records that are dated or incorrect defeats

the purpose of sharing data records. Thus, the principal aspect drawn from departmental interviews was a mechanism that would allow departments to maintain records that fall under their jurisdiction and allow other departments to view and query those records.

Much of the information City departments utilize on a daily basis is created and stored in various software packages, each of which utilize unique data formats and databases that cannot readily be viewed by other department's software. Several departments also create, store, and share data records in paper format which can be cumbersome and inefficient to share with other City departments and agencies. Because records that are maintained by departments are stored and created through different mechanisms, requests for information are done so in person and usually result in access to a copy of the paper based record with not tool to analyze the information in the record. It was estimated during the interviews that these types of request consume as much as 30 minutes of the requestor's time, as much as 1 hour of the record provider's time, and each request can take up to 10 business days to be fulfilled. Most City staff are aware that the records' exist, but facilitating the transmission of pertinent records requires considerable time and departmental resources.

When records in paper format are shared with other departments, the method for doing so is by supplying a copy of the original document. The copy is used by departments while the original data might be updated, thereby creating two versions of data, one up-to-date version and an outdated inaccurate copy. Each version of the data is used to make daily decisions throughout the City, albeit the old data might be inaccurate. There are no controls to manage the distribution and update of paper copies of data.

The City has an existing Information Technology (IT) infrastructure that supports its daily operations. The IT Department maintains and supports the network. Servers are currently in use that facilitates input from offices in City Hall and from satellite offices such as the Fire and Water Departments. The IT infrastructure includes a Local Area Network (LAN) and a Virtual Private Network (VPN) connection to servers where data is backed up nightly. Any GIS implementation plans should include using the server in the GIS Office. The network design lends itself to the sharing of GIS data between departments (See Figure 2).

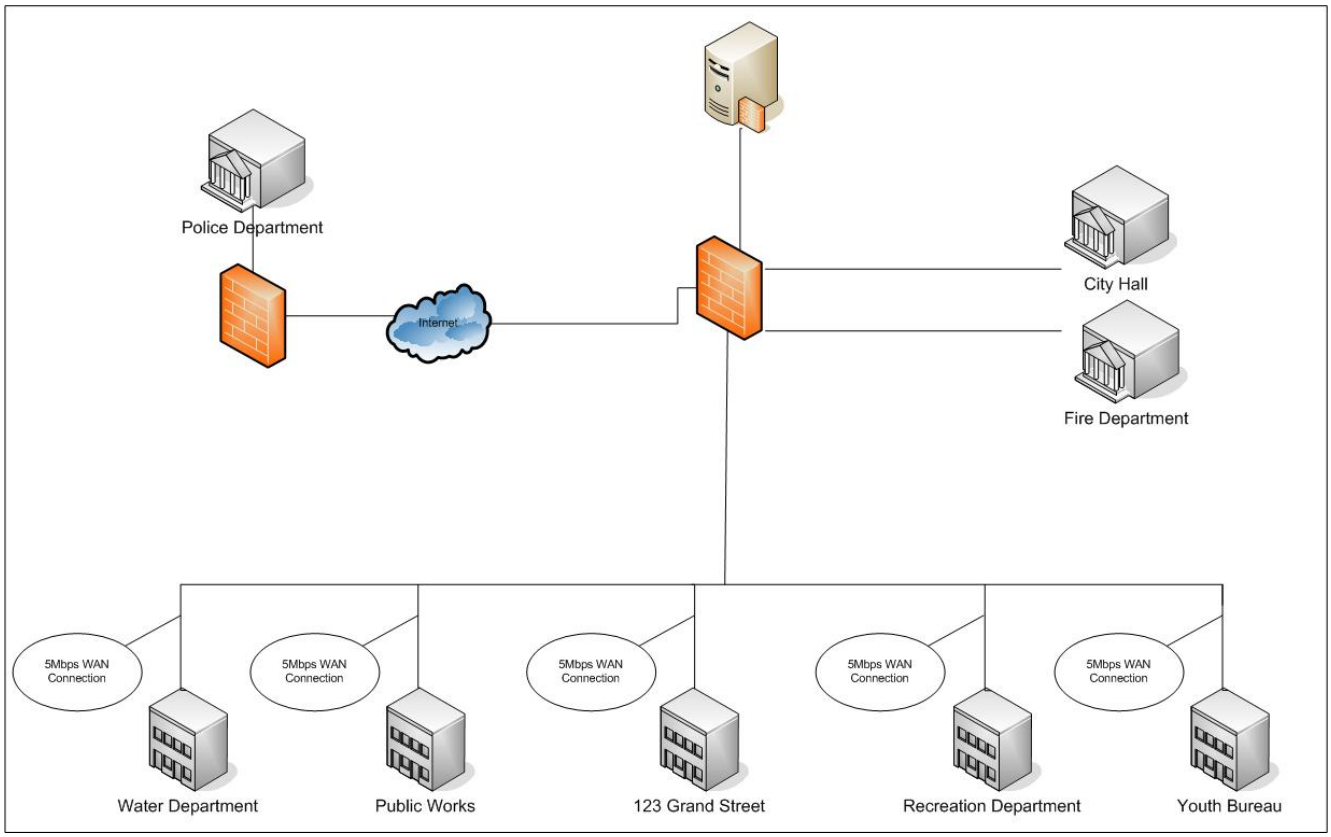


Figure 2 – Existing Citywide Network Diagram

2.2 Key Findings

Several key conclusions were drawn from the interviews conducted with representatives from the City's departments. The most important conclusions focus on the City's need to share data records and the capability to query the data efficiently.

The City has an existing IT infrastructure that facilitates sharing active and inactive digital records among the departments. Many departments utilize software packages that store records in a manner that does not allow other departments to view these records. Of the sixteen (16) departments interviewed, nine departments expressed interest in accessing the most up to date property address and owner information. The official address and owner change records are created and maintained in the Assessor's Office. Official address and owner changes can take months to be fully executed due to paperwork and necessary communication with Orange County. The Water Department has a working copy of the addresses and property owners' names for the 6,900 parcels in the City. They are able to update their records in a more timely fashion due to no constraints of paperwork and communication with the

County. Because of this fact, many City departments looking for current address and/or owner information often contact the Water department via telephone or email instead of contacting the Assessor's Office for the official records. Access to this information, regardless of the official status of the records would be a significant time savings tool for all departments.

Departmental requests for records that reside in another department are usually made in person. It was noted during the interview process that approximately half of all records requested are in hardcopy format and thus the only manner in which the data can be shared is through a copy of the original record. The remaining requests result in records being communicated through both digital and verbal means. Both manners of record sharing take time from the person or department making the request and the person or department providing the answer. Sharing records among departments would see an efficiency increase if the departments had the ability to store and share data in a centralized repository. With the appropriate configuration, centralized data storage would make digital records available to departments on an as needed basis without any time required to request or retrieve the record by City personnel. This would expedite decision making processes and improve the overall management of City resources.

The Assessor's Office maintains property assessment information with New York State's Office of Real Property Service's RPS software, assigns 911 addresses, and is a major contributor to creating and maintaining City records. The Assessor's RPS software is maintained within the Office and is not directly connected to Orange County. In 2007, the Office hired Taylor Technology to conduct a re-evaluation of the properties that reside in the City. During this process, all property record information is being entered digitally to the RPS software. This new data format should allow increased indexing and search capabilities, but will not allow easier analysis or comparison with other data. Also, the Assessor's Office and Orange County's Department of Real Property Tax Service Agency shares the tax parcels. That is, the County has the authority to make and print tax maps and the City edits and prints this parcel data.

Newburgh does maintain its own version of the tax parcel data in the Water Department. When the City Assessor's Office receives documentation from the County that a change to a tax parcel is required or that is has been performed by the County (i.e. merge or split), the GIS Analyst changes the City's version of the tax parcel data. The City's version is maintained in addition to the County's version because the City can make these edits quicker than the County due to the volume of changes the County is faced with on a daily basis. Although only the County can produce legal tax maps, the City is more agile with its changes and the data helps City departments function more efficiently than they would have if they had to wait for the same records to be provided from the County. The GIS Analyst also receives property records from the Assessors Office once per month in a digital format. These records are matched with their corresponding tax parcel record in GIS and made available in the City's existing on-line mapping application and to map or data requests.

The Code Compliance Department is in constant contact with the Assessor, Planning and Development, and Water Departments to exchange data records such as permits and Certificates of Occupancy. The Code Compliance Department uses IPS software for maintaining its records, but is unable to use the software to create or maintain certificates of occupancy records. Maintaining these records is a manual task which was noted as cumbersome and proved difficult when other departments inquired about these records. As with other departments, Code Compliance is interested in obtaining the most current and accurate address and owner information which is mandatory when code violations are mailed. As many as twenty violations are returned to the department each day because the department has outdated and incorrect property owner address information. By law, it is required to mail the violation to the legal owner at the legal address as is maintained by the Assessor's Office. The IPS software is linked to the Assessor's RPS software and can display property information as stored in RPS. There is a data management problem within the IPS software were record deletions or additions in RPS are not shown in IPS. The same record could appear several times making it difficult for the Code Compliance Department to reference the correct record.

When code violations are returned due to wrong name or address, the department contacts the Water Department for the most current, albeit not official, property owner and/or property owner address. The Office is considering mailing violations to the name and address on record and also to the name and address maintained by the Water Department if those two records differ. By doing so, the Code Compliance Department will deliver the violation to the official name address as is required by law and to the most up to date, unofficial address and owner. Violations are sure to be received when they are sent to both addresses allowing the City to better marshal properties that do not follow City Codes.

The City Fire and Police Departments recognize the power of having large amounts of information about a building or parcel available prior to responding to an event. The records most often requested are the current address and owner information for a property. When the Fire Department receives a call requiring response, the information is in text form and is not displayed on a map. The address or location of the emergency is noted and then compared to street maps for route and response planning. They would like the ability to map the emergency location and overlay other sets of information for quick investigation of the situation. For example, they want the ability to display sources of water, roads, highway construction, and bus routes on top of a map of the City with the emergency location clearly marked. The Fire Department recognized that this type of analysis can be performed within minutes with GIS. Access to display and query capabilities for all relevant City spatial and non-spatial data will improve the services the Fire Department can provide the City. Currently, there are no mechanisms that allow any City department to share spatial and non-spatial data with the Fire Department except for paper maps or Microsoft Word or Excel documents. When the Fire Department requires a phone number for properties in the City, they contact the Water Department.

The Police Department currently utilizes Computer Aided Dispatch system. The department employees a Crime Analyst that uses MapInfo software to assist with analyzing types and locations of crimes throughout the City.

The City's existing GIS program was developed in December 2006 and functions within and under the authority of Water Department. The GIS Analyst collects, integrates, maintains, and delivers up to date spatially referenced information about and pertaining to the City and the neighboring areas. The City has also developed a GIS Steering Committee to function as a coordinating body. Members are appointed by the City Manager with representatives from various City departments which provide guidance and advice on GIS services and functions. The Committee regularly reviews GIS policies and task activities that are meant to encourage the appropriate utilization of GIS and the City's spatial data records in an effective, efficient, and coordinated manner. The GIS Analyst acts as the data steward and is responsible for the content, maintenance, and distribution of data maintained in the GIS. In her role, the GIS Analyst responds to GIS service requests, investigates GIS technologies, participates in the implementation of appropriate tools, develops recommendations and policies, edits, quality assures and controls geospatial data and metadata, provides technical support and trainings, and initiates new projects as necessary.

The City has formalized access to its GIS data records through its data sharing and distribution regulations as stated in the City's GIS Policy Guidelines (see Appendix A – GIS Policy Guideline and Appendix B – GIS Data License Agreement). The online GIS Viewer that is maintained by the GIS Analyst has all of the existing spatial data records available for viewing. The online GIS Viewer is available to City departments and to the general public through a subscription fee of $100 per year (see Appendix C – GIS Fee Schedule).

The GIS Viewer has the existing map functions available to users:

- Zoom in
- Zoom out
- Pan
- View Previous Map Extent
- View Next Map Extent
- View Full Map Extent
- Identify
- Measure Distance or Area
- Show/hide overview map

The GIS Viewer also has several unique query functions that allow users to search through layers that meet certain user defined criteria. The Viewer allows users to search property records and tax parcel information by entering search criteria in the following categories:

- Parcel Section, Block, Lot number
- Parcel Account Number
- Property Owner
- Address

- Property Acreage
- Vacant Registry

These records are made available through a manual manipulation of the property records from the Assessor's Office.

It has been determined that departments would benefit from the ability to create, edit, share, and analyze data in a GIS environment as well as print, save, and email maps as an adobe acrobat file. The creation of buffer maps and the ability to export address information for mailing lists would benefit a number of departments and save a significant amount of time. Many departments, including the Fire, Planning and Development, Public Works, Recreation, and Water Department are responsible for geographically expansive areas. These departments requested the ability to document and better manage City assets for which they are responsible.

The City has chosen an excellent time to conduct a GIS Needs Assessment. The management of City information and the ability to share that information has reached its point of maximum, albeit limited, effectiveness, limited by its own organizational and information technology structure. A successfully implemented GIS will create better efficiencies, currently unknown to City departments, and strengthen daily operations due to increased access to the appropriate data.

2.3 Departmental Interviews

The interviews below describe the tasks that the department performs on a daily or periodic basis. The interviews are broken down into the following sections:

- Departmental Tasks – a qualitative description of departmental activities and inefficiencies that the departments are faced with. This section also describes how records are created and shared and how coordination with other departments and outside agencies is conducted.
- Software Resources – a list of software that is used at the department.
- Data Sources – a list of organization or resources the department utilizes for the creation of records it uses on a daily basis.
- Staffing – the current number of part-time and full-time department personnel.
- Metrics – a list of quantitative processes which the department is required to perform or periodically reassess. Metrics noted are unique to the departments area of expertise and are valid only within the departments certain domain. Metrics listed are not to be directly benchmarked or interpreted outside of the departmental roles.
- Spatial Data in Use – a list of records the department uses that directly correlates to a geographic map or a geographic location on a map.
- Non-Spatial Data in Use – a list of records which has no geographical context from which the department basis its daily decisions.

- Uses for GIS – a list of GIS uses that were directly requested by the department or were synthesized based on needs uncovered during the interview process.
- Other Non-GIS Application Needs – Other pressing needs were brought up during the interview process with City departments such as data entry tools and query tools for existing databases and legacy applications. Although the scopes of these needs are beyond the extent of this report, they are identified and documented.

2.3.1 Assessors Office

Personnel Interviewed: Steve Ruelke, Assessor

Angelo Lallis, Assistant Assessor

Primary Contact: Steve Ruelke

Phone: (845) 569-7333

Email: sruelk@cityofnewburgh-ny.gov

Departmental Tasks**:**

The Assessor's Office manages assessments on more than 6,900 properties in the City, administers exemption programs, tracks sales and handles matters involving property valuation. The Office also answers questions from the public both via telephone and walk in requests.

The Assessor's Office holds the official address information for all parcels in the City. When parcels are subdivided, new parcel numbers and addresses are assigned. When parcels are split or merged, parcel numbers and addresses may change. Managing the address information requires several forms to be completed in addition to the changes being sent to the Orange County Office of Real Property Tax Services and the official change being accepted by the County. This process can take several weeks due to the paper work involved and there is nothing that triggers an address change in other City departments. Thus, once the address information is updated in the Assessor's Office, excluding a yearly address update that is sent from the Office, the only means for address records to be updated in other departments is by a request for the parcels information.

Assessment data is stored in a software package provided by New York State Office of Real Property Services called RPS v 4. The City maintains a database of assessment data at the Assessor's Office as opposed to Orange County maintaining the data. Physical changes to the tax parcel map are performed by Orange County. The Assessor's Office is completing a re-evaluation of parcels within the City. During this process parcels undergoing re-assessment have their property cards, house pictures, and taxes updated in a database.

The Assessor's Office notifies the GIS Analyst of a tax parcel split or merge and that an address change has occurred. The GIS Analyst maintains an unofficial version of the tax parcels and edits the tax parcel data to reflect changes that the Assessor' Office would receive from the County in time. The process is a manual series of manual tasks for both the Assessor and the GIS Analyst.

The Office tracks parcels based from the standards created by NYS, using the SBL (section, block, and lot) unique identifier for parcels.

Software Resources:

- RPS V.4
- MS Office

Data Sources:

- Assessment data created in-house
- Tax maps from Orange County
- GIS parcel data from GIS Analyst
- Property cards
- Pictometry (Year 2004 and 2006)
- House pictures

Staffing:

- 3 Full time

Metrics:

- Handles approx. 20-40 address changes per moth
- Records approx. 30-90 deeds per month
- Receives approx. 30-60 requests for information from other departments per month
- Lists approx. 100 bank codes per month

Spatial Data in use:

- Zoning data
- Special districts

Non-spatial Data in use:

- Monthly sales data sent to NYS
- Property class codes
- Exemptions
- Vacant registry data
- Property tax rates

Uses for GIS:

- The ability to generate a map displaying sales distributions
- The ability to view Pictometry
- The ability to view and query all appropriate City base map layers
- The ability to view all building permits by their parcel location and expiration date

- The ability to view a complete history of all data pertaining to a parcel
- The ability to link assessment photos to parcel data in GIS
- Create a 300' and 500' buffering tool to help map parcels that should be part of a mailing list, create the mailing list and print from letters and envelopes needed for the mailing
- The ability to print property layouts
- Connect the Property Record Card data to parcel locations with query capability
- The ability to measure building footprints, parcel frontage, and depth
- The ability to map and query vacant lots data in a map including sales status and number of days on the market
- The ability to export maps to Adobe Acrobat files
- The ability to search tax parcels by deed book number and deed page
- The ability to search all tax exemptions for a parcel
- The ability to query IDA / City-owned properties
- The ability to track vacant buildings and their status
- The ability to track dates of expired tax parcel lines

Other Non-GIS Application Needs:

- The ability to generate a form that automatically populates address information for exemptions
- Access to Certificates of Occupancy as they are issued
- The ability to associate building pictures with parcel records

2.3.2 City Clerk's Office

Personnel Interviewed: Lorene Vitek, City Clerk/ Registrar

Primary Contact: Lorene Vitek

Phone: (845) 569-7311

Email: lvitek@cityofnewburgh-ny.gov

Departmental Tasks**:**

The City Clerk's Office, located on the first floor of City Hall, issues permits and licenses for various purposes, including:

- Licenses for taxis, taxi drivers, peddlers, and towing
- Marriage licenses
- Certified copies of birth and death certificates
- Dog licenses, adoptions, and redemptions
- Handicap Parking Permits
- The taxi driver and peddler license information is shared with the Police Department. Maintains and files for all contracts and agreements with the City.

The Clerk's Office handles all FOIL requests and all vital records for the City. The Office also maintains records on property tax liens and as such must be in contact with the Tax Collectors Office to identify property tax issues that require action.

The Office uses ISYS software to store City Council meeting minutes. ISYS can search the meeting minutes by key-word search records from 1940 to the present day. The department also uses BAS software to maintain birth, death, and marriage certificates.

Software Resources:

- ISYS
- BAS

Data Sources:

- Council proceeding and minutes from 1940 to present

Staffing:

- 3 Full time

Metrics:

- Creation of approx. 1,200 birth records per year
- Creation of approx. 500 deaths certificates per year
- Creation of approx. 200 marriage licenses per year
- Creation of approx. 100 cab drivers licenses and 75 cab car licenses per year.
- Receives approx. 10 FOIL requests per month

Spatial Data in use:

- Zoning Map
- Street Map

Non-spatial Data in use:

- Licenses for taxis, dogs, towing, peddlers, death and birth certificates
- Taxes

Uses for GIS:

- N/A

Other Non-GIS Application Needs:

- Establish a link between the Tax Collector's Office and the KVS software, with the Clerk's Office to identify property tax issues that require action.

2.3.3 City Comptroller's Office

Personnel Interviewed: Charles Emberger, City Comptroller

Primary Contact: Charles Emberger

Phone: (845) 569-7320

Email: cemberger@cityofnewburgh-ny.gov

Departmental Tasks**:**

The City Comptroller's Office is responsible for administering the City's annual budget, including the collection of tax revenue and grants from federal and state sources, and making all expenditures, including the payroll for the City's employees, payments to outside vendors for services rendered, and servicing the City's financial portfolio.

The Office also maintains City payroll, capital project budgets, equipment expenses, bonding, and City department's budgets. The Comptroller also receives payments from invoices sent by the Tax Receiver from Water Department.

Software Resources:

- KVS Accounting Software
- Payroll
- MS Office

Data Sources:

- Budget
- Vouchers

Staffing:

- 7 Full time
- 1 Part time

Metrics:

- N/A

Spatial Data in use:

- City Street Map

Non-spatial Data in use:

- N/A

Uses for GIS:

- Ability to view where the City has clusters of abandoned properties.
- Ability to view different districts and determine pay rates for analysis.
- Ability to identify and map capital project locations for presentations and planning meetings.

Other Non-GIS Application Needs:

- N/A

2.3.4 Civil Service Department

Personnel Interviewed: Michelle Mills, Administrator

Primary Contact: Michelle Mills

Phone: (845) 569-7340

Email: mmills@cityofnewburgh-ny.gov

Departmental Tasks**:**

The main tasks for the department include administering Civil Service exams and maintaining copies of the exams, tracking probation periods for City employee applicants, and maintaining the City personnel files. Upon request, the department provides lists of prospective employees to City departments and also generates reports of prospective applicants based on hierarchical rules for the various Civil Service openings in the City. The department also handles all union contract issues as well as provides information on employee benefits.

Due to the large volume of physical data the Office is required to maintain, the Civil Service Administrator is looking for a solution to alleviate the hard copies of all exams, personnel transaction records, and other records that her department must maintain.

A concern of the Office is the lack of a standardized list of names and addresses for City employees and job applicants. Currently there are three personnel files which are maintained by different departments and it is difficult to reconcile these three sources to determine which is most relevant.

Software Resources:

- N/A

Data Sources:

- N/A

Staffing:

- 1 Full time
- 3 Part time

Metrics:

- N/A

Spatial Data in use:

- N/A

Non-spatial Data in use:

- Employee Records, including exam results, physical copies of exams, payroll, probationary period timeline & list of potential City employees.

Uses for GIS:

- Ability to view applicant addresses within the City limits to accommodate employee selection based on City resident preferential treatment program.
- Ability to map locations of current employees and the City facility to which they are assigned. This would accommodate a better means of locating City employees in case of emergency.

Other Non-GIS Application Needs:

- Database with standardized format for name and address for applicants and employees that could be shared among relevant departments.
- Digitally archive hard copy exams and personnel transaction records using Laserfiche
- Share data with the Comptroller's Office for payroll.

2.3.5 Code Compliance

Personnel Interviewed: Steve Hunter, Code Compliance Supervisor

Ann Morrill, Secretary to Department Head

Primary Contact: Steve Hunter

Phone: (845) 569-7400

Email: shunter@cityofnewburgh-ny.gov

Departmental Tasks**:**

The Department of Code Compliance enforces regulations and requirements of the Newburgh City Code and the New York State Fire Prevention & Building Code. Responsibilities of the Office include exterior and interior inspections of code issues, determining compliance with codes, and generating violations. The Office also assigns 20 different types of permits for the city, issues complaints, and manages City projects such as architectural review, subdivision, land use, zoning, variance, and site plans.

Currently the department uses the IPS software package to create and maintain building permits and violations. IPS has an established link with the Assessor's RPS software and is able to auto-populate tax parcel identification numbers. IPS cannot physical create certificates of occupancy (CO). Because of the inability to digitally create CO, department staff is forced to create, maintain and track CO manually. The department has a strong desire to go paperless and to reduce the number of inaccurate data sources such as address and owner information. Because the

department does not have up to date address and owner information, up to 20 violations sent to property owners are returned each day. To find the appropriate address, phone calls are made to the Assessor and Water Departments who both maintain a set of address information.

The Code Compliance Department has also launched the Targeted Enforcement Initiative with the purpose of cleaning up certain areas of the City. The City is enforcing a zero tolerance policy in regard to code violations with the goal of holding negligent property owners accountable. The effort has consumes many man hours for the initial inspections, documenting all violations in the field on paper and entering those records into the IPS software, and also the re-inspection of those properties. When violations are sent out, properties have one week to address the violations or the matter is referred to court. The violations must be sent to the legal address of the property owner due to the potential for the matter to be referred to court. With up to 20 violations being retuned with wrong address or wrong owners, the Office has had difficulty enforcing code laws in a timely fashion.

Software Resources:

- MS Office
- IPS (BAS)
- File Maker Pro

Data Sources:

- Paper Tax and Zoning Maps
- Records kept by hand
- Records kept in MS Excel
- Site Plans
- Permit Applications
- Inspection Reports

Staffing:

- 7 Code Officers
- 8 Other staff

Metrics:

- 500 inspections per month
- 500-700 violations issues per month
- All violations require re-inspection
- 20 violations returned per day due to incorrect owner address

Spatial Data in use:

- Zoning Maps
- Historic Districts
- Waterfront
- Historic Water Maps
- Historic Sewer Maps

Non-spatial Data in use:

- Address and owner information

Uses for GIS:

- The ability to view and query all appropriate City map layers with zoning information and related districts (Historical, Waterfront, etc.)
- The ability to update and view location of vacant buildings weekly
- The ability to update and view location building permits daily
- The ability to perform buffer analysis
- The ability to view and overlay flood plain and FEMA information
- The ability to scan and input paper maps into a digital format via Laserfiche
- The ability to input field verified data (from a GPS source)

Other Non-GIS Application Needs:

- The ability to open, track, and close building permits
- The ability to generate certificates of occupancy

2.3.6 Executive Office

Personnel Interviewed: Courtney Kain, City Manager Administrator

Primary Contact: Courtney Kain

Phone: (845) 569-7342

Email: ckain@cityofnewburgh-ny.gov

Departmental Tasks:

The Executive Office staff coordinates all communication between other departments. The Office reports to the City Council on key indicators about the City to ensure the Council's goals are being met.

The department often has the need to create abutters list for select mailings based on public information (i.e. street closures or street directional changes). Currently this is a manual effort which is complicated with issues regarding where the correct names and address reside.

The City is currently setting up a precursor to a 311 system titled Requests System. Next phase would be to put online all forms for the DPW, Assessor, City Clerk offices for the general public to access.

Software Resources:

- ICYS
- EGOV

Data Sources:

- Presentations
- Complaint records

Staffing:

- 5 Full time

Metrics:

- N/A

Spatial Data in use:

- N/A

Non-spatial Data in use:

- N/A

Uses for GIS:

- The ability to view and query all appropriate City map layers
- Ability to generate charts for presentations to other departments using GIS
- The ability to create abutters list for select mailings based on public information

Other Non-GIS Application Needs:

- Ability to use raw data to perform analysis and aid policy makers with decision process
- Assist with identifying challenges by reviewing quality of life indicators within a community or ward and aid in recommending solutions

2.3.7 Fire Department

Personnel Interviewed: James Merritt, Fire Chief

Christopher Barrett, Deputy Fire Chief

Primary Contact: James Merritt

Phone: (845) 569-7412

Email: nfdchief@cityofnewburgh-ny.gov

Departmental Tasks:

The task of the Fire Department is to provide a range of programs and services designed to protect the lives and property of the citizens in the City from the adverse effects of fires, sudden medical emergencies, or exposure to dangerous conditions created by either man or nature, and to provide these services in a safe and efficient manner.

The department focuses on Fire rescue and prevention, maintenance of the Computer Aided Dispatch (CAD) system, and is available for Orange County 911 operations if necessary. The department also maintains a database of incidents. These incidents have not been shared with other departments, but it might be useful to map these incidents in a map form.

Software Resources:

- CAD system
- MS Office
- File Maker Pro (on Apple computer)

Data Sources:

- County call system
- Self generated reports

Staffing:

- 63 Uniformed
- 7 Support staff

Metrics:

- Responded to 2550 calls in 2007
- Responded to 63 structure fires in 2007
- Department has 2 engines companies and 1 truck company in service at all times
- Responds to 30-40 mutual aid calls per year outside of the City

Spatial Data in use:

- Parcel information
- Hydrants
- Streets
- Municipal facilities (schools, police stations, churches, and EMS)

Non-spatial Data in use:

- Incidents
- Emergency Calls
- Phone Numbers

Uses for GIS:

- The ability to view, query, and print all appropriate City map layers
- The ability to view to spatially accurate address information
- The ability to view owner information
- The ability to view building inspection status
- Incorporate gas infrastructure and water distribution system and other utility data into GIS layers

Other Non-GIS Application Needs:

- The ability to generate printed reports for emergency plans

2.3.8 Geographic Information Systems Analyst

Personnel Interviewed: Jamie Lo, GIS Analyst

Primary Contact: Jamie Lo

Phone: (845) 569-7488

Email: gis@cityofnewburgh-ny.gov

Departmental Tasks:

Serving under and funded by the Water Department, the GIS Analyst provides integrated digital data development for the City, enabling accurate and efficient administration of geographic and location-related services. The GIS Analyst also provides non-sensitive geographic information and maps to the public for a fee.

The GIS Analyst maintains, develops, and distributes a wide variety of maps and digital data. Geographic information is developed internally or acquired from the federal, state, and local governments as well as private sources. Because conditions are always changing, the geographic data is constantly being updated and requested by many different City departments and the public. The Office also utilizes global positioning system (GPS) technology to map out features throughout the City.

The GIS Analyst has created an online mapping application that is available to City staff. To access this resource, users are required to have a username and password. The mapping application has not been frequently used by other departments or the public although it is advertised through the City's website.

It was noted that the GIS Analyst maintains property address and owner records which are updated to reflect the most current information regardless of the official status of the records as is determined by the Assessor's Office. Many departments including Code Compliance, Water, and Fire require address and owner information to appropriately perform their duties. They often contact the GIS Analyst to obtain this information as opposed to the Assessor's Office.

For an eight month time frame spanning from December 2006 to July 2007, the GIS Analyst received 130 requests for maps from City departments. The time required to create these maps totaled 66 hours, not including the time to take the request and understand the map and data requirements, and the time it takes to deliver the hard copy maps. These requests also consumed other department's time to make the request and also delayed decision making until the maps were created and delivered. It is estimated that half of the requests for maps required simple map production with no data analysis. Many of these requests could have been avoided if the departments were better equipped to view GIS data and were aware of what data was available to them.

Software Resources:

- MS Office
- ArcGIS Server Basic Workgroup
- ArcGIS ArcInfo
- ISYS
- IPS
- GPS Pathfinder Office

Data Sources:

- Data developed internally through GPS or GIS
- Federal Agencies
- NYS CSCIC
- Orange County
- Private consultants
- Engineering plans

Staffing:

- 1 Full time

Metrics:

- Approx. 200 map production requests per year

Spatial Data in use:

- Approx. 40 GIS layers currently in use by the department

Non-spatial Data in use:

- Records of all data and map requests

Uses for GIS:

- The ability to maintain data accuracy
- The ability to create new data
- The ability to integrate data when necessary
- The ability to perform advanced spatial analysis
- The ability to link video clips of sewer and storm drain system to GIS data

Other Non-GIS Application Needs:

- The ability to extract data from InHance
- The ability to create customized tools in the online mapping application

2.3.9 City Historian

Personnel Interviewed: Mary McTamaney, City Historian

Primary Contact: Mary McTamaney

Phone: (845) 569-8090

Email: NewburghHistory@usa.com

Departmental Tasks:

The City Historian answers inquiries about the City's past and maintains, promotes, and add to historical records. The City Historian also promotes the community's history and participate in discussions about City planning or activities that can benefit by information from the past.

The City Historian is appointed by the City Council after selection by an independent search committee. The Historian reports to the City Manager.

Software Resources:

- ISYS

Data Sources:

- Paper Maps

Staffing:

- 1 Part time

Metrics:

- Approx. 60-75 requests per month from City departments and/or outside agencies
- Request takes an average of 4 days to fulfill
- Could use City GIS data 2-3 times per week to fulfill request from City departments for property history for City requests
- Could use City GIS data 8-10 times per week to fulfill request from City departments for council proceedings
- Could use City data 10-20 times per week to fulfill map requests for maps and property history for the public

Spatial Data in use:

- Historical hardcopy maps

Non-spatial Data in use:

- City proceedings
- Planning data

Uses for GIS:

- The ability to query street information such as opening dates, mapping changes, and name attribution
- The ability to view the changes in City boundaries
- The ability to cross reference old and new street addresses
- The ability to cross reference section/block/lot numbers with historical records
- The ability to view parcel subdivisions and associated dates

- The ability to view significant property changes or catastrophes such as fires, floods, and accidents
- The ability to view all district maps
- The ability to create a layer of 'street aliases' due to the number of historical street names
- The ability to view demographic data to analyze trends

Other Non-GIS Application Needs:

- The ability to query historical owner information
- The ability to better index City Council proceedings and the generation of a City calendar
- The ability to generate a historical City personnel list to include the name, job title, and relevant dates

2.3.10 Human Services

Personnel Interviewed: Courtney Kain, Interim Director

Primary Contact: Courtney Kain

Phone: (845) 569-7342

Email: ckain@cityofnewburgh-ny.gov

Departmental Tasks:

The newly named Human Services Department is responsible for the use of and activities in the City's numerous parks, memorials, and smaller open spaces. These include the Delano-Hitch Recreational Park, the beautiful Downing Park, the recently dedicated Audrey Carey Park, and several others.

Parks are open to the public during posted hours, but larger groups and special activities require that a reservation request form be filed with the Recreation Dept. The multipurpose Activity Center can be rented by nonprofit organizations for various events.

Recreation & Youth Department manages the use of public spaces, offers family services, and is a partner with 21st Century Learning.

Software Resources:

- 21st Century – Youth Bureau evaluation tool
- Excel

Data Sources:

- N/A

Staffing:

- 5 Full time

- 1 Part Time
- 40 Seasonal staff

Metrics:

- N/A

Spatial Data in use:

- N/A

Non-spatial Data in use:

- N/A

Uses for GIS:

- The ability to view different types of parks, neighborhood, and public space (open)
- The ability to map youth program participants

Other Non-GIS Application Needs:

- The ability to allow City residents access to a viewer that allows them to check bills and payments using an address search

2.3.11 Information Technology Department

Personnel Interviewed: Glenn Kurcon, IS Manager

Donna M. Rickey, Data Processing Supervisor

Primary Contact: Glenn Kurcon

Phone: (845) 569-7324

Email: gkurcon@cityofnewburgh-ny.gov

Departmental Tasks:

The department is responsible for complete oversight of the City technology systems and applications. These applications handle payroll, sanitation bills, parking violations, school taxes, and parking lots.

Additional responsibilities of the department include network maintenance, server maintenance, and server back up which occurs on a nightly basis.

Software Resources:

- AS400 OS

Data Sources:

- Off-site server

Staffing:

- 3 Full time

Metrics:

- N/A

Spatial Data in use:

- Addresses

Non-spatial Data in use:

- N/A

Uses for GIS:

- The ability to generate mailing lists based off of identified addresses
- The ability to view and query spatial and non-spatial data
- The ability to maintain and back up the system

Other Non-GIS Application Needs:

- N/A

2.3.12 Planning and Economic Development

Personnel Interviewed: Bob McKenna, Director

Lourdes Zapata-Perez, Director of Community Development

Ian MacDougall, City Planner

Garrett Duquesne, Intern

Primary Contact: Bob McKenna

Phone: (845) 569-9400

Email: bmckenna@cityofnewburgh-ny.gov

Departmental Tasks:

The Department of Planning and Development provides technical assistance to the City Council, City Manager, and the Newburgh community at large on housing, community and economic development, and land use issues. The department also administers a number of federal and state grant programs to assist local residents and businesses. The department also creates and submits annual reports the U.S. Department of Housing and Urban Development (HUD) which contain information that the department maintains regarding City housing properties.

The department currently uses Community 2020, a software package used for community planning that provides citizens, community-based organizations, state and local governments, housing authorities, and non-governmental organizations with a means to access HUD program information. The software is built on Caliper's Maptitude GIS software and incorporates a wide range of demographic variables, estimates and projections. The City plans to replace this software with the use of HUD's eGIS.

The department also uses Integrated Disbursement & Information System (IDIS). This is a nationwide database that provides HUD with current information regarding program activities underway across the Nation, including funding data. The system allows grantees to request their grant funding from HUD and report on what is accomplished with these funds.

The department would like the ability to develop and/or view several GIS layers including school boundaries, public transportation routes, Zip codes, zoning areas, and environmentally sensitive areas in the City.

The department expressed the interest to share their data with other departments and also to have access to view other departments' data. This includes acquiring and incorporating data related to building uses, structure types, code violations, certificates of occupancy, permits with dates and business locations, and residential and commercial tax records.

Through a cooperative effort with the Water Department, the Planning Department would like to have access to water billing information, including timeliness of payment and locations of delinquent customers. This would also assist with questions of property owners versus occupants due to the completeness of the Water Department's record keeping.

Software Resources:

- MS Office
- Community 2020
- Integrated Disbursement & Information System

Data Sources:

- Paper copies of existing City maps
- Consultant reports
- Engineering plans
- Planning studies

Staffing:

- 5 Full time
- 2 Part time

Metrics:

- N/A

Spatial Data in use:

- Paper Copies of City Tax Maps, Zoning Map, Street Map

Non-spatial Data in use:

- Grant Projects

Uses for GIS:

- The ability to view, query, and print all appropriate City map layers
- The ability to view, query and print school districts, Zip codes, environmentally sensitive areas, public transportation, zoning boundaries, and tax parcels
- The ability to view tax parcels and determine the property owners versus occupants
- Additional information the department would like to determine from the tax parcel layer is building use information, structure types, code violations, certificates of occupancy, permits with dates and business locations. Although this data is not spatial by nature, the department desires to see this data for a parcel by clicking on the tax parcel map

Other Non-GIS Application Needs:

- The ability to access residential and commercial tax records
- The ability to access the Water Department's water billing information, including timeliness of payment and locations of delinquent customers
- The ability to analyze data regarding past and present property conditions

2.3.13 Police Department

Personnel Interviewed: Andrea M. Vey, Crime Analyst

Primary Contact: Andrea Vey

Phone: (845) 569-7526

Email: avey@cityofnewburghpolice.org

Departmental Tasks:

The mission of the Police Department is to provide an environment that addresses community concerns by reducing social disorder and the fear of crime. This is accomplished by the promotion and support of organizational strategies, utilizing problem-solving methods and tactics that build partnerships between the police and the community.

The City Police Department is a modern day, technically trained unit of ninety-seven sworn officers. In 2004, officers handled 41,615 calls for service patrolling this aged and multi-cultural City of 3.9 square miles. This is considered a high number of calls

for this type of patrol area. Officers solve daily problems while maintaining open lines of communication and cooperation among City neighborhoods.

The department is in the process of migrating their data to the Impact software package for record keeping and also reporting information to NYS. The department also uses GIS to create maps of crime statistics on an as needed basis. Most of the data that is mapped is data that is created internally at the department. It was noted that additional data would be useful during the daily activities at the department including correct address and owner information, vacant registry dataset, and code violation information.

Software Resources:

- MapInfo v. 8
- Impact

Data Sources:

- Internally created GIS data
- Police reports

Staffing:

- 97 Full time sworn officers
- 15 Part time citizen officers

Metrics:

- 3.9 square mile patrol area
- Approx. 42,000 calls for service in 2004

Spatial Data in use:

- Digital data provided by the GIS Analyst
- Data created in-house from crime statistics

Non-spatial Data in use:

- N/A

Uses for GIS:

- The ability to view, query, and print all appropriate City map layers
- Incorporate gas infrastructure and water distribution system and other utility data into GIS layers
- The ability to view tax parcels with any associated code violation data,
- The ability to view tax parcels that are on the vacant registry list

Other Non-GIS Application Needs:

- N/A

2.3.14 Public Works

Personnel Interviewed: George Garrison, Director

Primary Contact: George Garrison

Phone: (845) 565-3297

Email: ggarrison@cityofnewburgh-ny.gov

Departmental Tasks:

With over 60 employees, the Department of Public Works is responsible for the physical well-being of the City and its geographically dispersed assets.

Activities include:

- Sanitation and recycling collection
- Maintenance of City streets and bridges
- Maintenance of City Parks and other properties
- Maintenance of municipal buildings, including City Hall, Unified Courts, the 1841 Courthouse, Youth Bureaus, and police substations.
- Supervision of the City's sanitary sewers
- Administration of City and police garages and vehicles
- Snow removal
- Enforcement of environmental standards

It was reported that the computers in the department were out of date and that to accommodate future GIS use, the computers should be replaced or upgraded. Although the department does not use GIS or have formalized GIS training, they do see the inherent usefulness of the technology as it relates to their daily activities.

DPW houses new maps created by the GIS Analyst and copies of historic City infrastructure maps, the most recent dating back to the 1970's. In conjunction with the GIS Analyst, DPW is currently compiling their existing hard copy maps and converting the data to GIS features. DPW records relative locations/addresses of trees that the department removes and/or maintains. DPW also maintains a cleaning history table for the City's storm water catch basins.

DPW would benefit greatly from the completion of the City's GIS/GPS infrastructure mapping effort that is being conducted by a consultant. Approximately 80% of the City's public infrastructure has been mapped including the identification of storm water conveyance structures, water distribution infrastructure, traffic signals, poles and fire alarms. Once the infrastructure mapping has been completed, the department expressed interest in a GIS-based work order system. This would help the department better track current and past maintenance on City infrastructure/assets. The primary goal of this initiative would be departmental efficiency.

The department also expressed interest in utilizing GIS to better document and track changing pavement conditions within the City. In the future, DPW would like the ability to notify City employees and/or residents of daily street closures.

Software Resources:

- BAS IPS System (maintained by the Code Compliance Department)

Data Sources:

- N/A

Staffing:

- 70 Full time
- 7 Part time

Metrics:

- 57 center lane miles of roads maintained
- Over 48 miles sanitary sewer lines maintained
- Over 11 miles of storm sewers maintained
- Utilizes 18 snow plowing vehicles

Spatial Data in use:

- Historic City infrastructure maps
- City owned properties

Non-spatial Data in use:

- Relative locations/addresses of trees that the department removes and/or maintains
- A cleaning history table for the City's storm water catch basins

Uses for GIS:

- The ability to view, query, and print all appropriate City map layers
- The ability to create a City tree removal layer
- The ability to view slope layer in GIS
- The ability to view the location and query information from the City's storm water conveyance structures, water distribution infrastructure, traffic signals, poles and fire alarms
- The ability to document and track changing pavement conditions within the City
- The ability to notify City employees and/or residents of daily street closures The ability to link video camera clips of sewer and storm conditions into GIS

Other Non-GIS Application Needs:

- The ability to track and manage City assets
- The creation of a GIS-based work order system could allow the department to better track current and past maintenance on City infrastructure/assets
- The ability to perform sewer modeling

2.3.15 Records Management

Personnel Interviewed: Elizabeth McKean, Records Management Officer

Primary Contact: Elizabeth McKean

Phone: (845) 569-8092

Email: records@cityofnewburghny.gov

Departmental Tasks:

The department is responsible for managing the internal records for all departments. The department also is the curator of City engineering plans, infrastructure, boundary, and City map record archives dating from the late 1700's to present time. At one time there were sixteen personnel staffed in the department to manage these records, but the current staff size is one full time and one part time.

The department is involved with aspects of City records that require retention according to guidelines set forth by NY SARA records retention and disposition schedule. The Department maintains a municipal Records Center that houses more than 6,000 storage cartons for all departments, as well as the extensive Engineering records collection.

Software Resources:

- ISYS
- MS Access
- MS Office

Data Sources:

- Records from various departments

Staffing:

- 1 full time
- 1 part time

Metrics:

- Maintains 250 standard storage cartons of documents on projects & structures & infrastructure
- Maintains 28 legal-size file cabinets of documents on projects & structures & infrastructure
- Maintains 110 flat file drawers of plans on projects, structures, infrastructure
- Maintains over 2,000 unsorted plans in piles & boxes - projects, structures & infrastructure
- Maintains 300 surveyor & engineer field books from the late 1700's to 1980's
- Engineering archive researchers currently average one citizen a week, and six departmental requests per week

Spatial Data in use:

- Archived maps

Non-spatial Data in use:

- Records Center inventory

Uses for GIS:

- Ability to scan and present historical maps and drawings public and staff over the internet

Other Non-GIS Application Needs:

- N/A

2.3.16 Tax Collector's Office

Personnel Interviewed: Marie Gida, Tax Collector

Primary Contact: Marie Gida

Phone: (845) 565-7330

Email: mgida@cityofnewburgh-ny.gov

Departmental Tasks:

The Tax Collector's responsibilities include collecting revenue from sanitation bills, property taxes, parking permits, and parking violations. The Office also performs research on Property Tax records.

The Office expressed the need to access standardized property address and name information. The Water Department is felt to have the most accurate name and address and held on a separate system. Ability to review this database for information would reduce the burden of locating this information. Currently the Tax Collector's Office uses data from the Assessor's Office and Water Department.

Software Resources:

- InHance
- Internally developed applications on AS400

Data Sources:

- Bills from various departments

Staffing:

- 3 Full time

Metrics:

- N/A

Spatial Data in use:

- N/A

Non-spatial Data in use:

- Property class code – used to determine number of units in a building
- Certificates of Occupancy

Uses for GIS:

- Ability to view where and if the City has clusters of abandoned property
- Ability to view different districts and determine pay rates for analysis

Other Non-GIS Application Needs:

- The need for access to standardized name and address data from the Water Department.

2.3.17 Wastewater Treatment Plant

Personnel Interviewed: Dale Post, Area Manager (Severn Trent Services, Inc.)

Primary Contact: Dale Post

Phone: (845) 565-6182

Email: dalep@stes.com

Departmental Tasks:

The Wastewater Treatment Plant is tasked with maintaining the City's combined sewer and storm water system including the City's treatment plant. The facility is currently operated by a private firm, Severn Trent Services.

On behalf of the City, Severn Trent Services submits reports to the NYS Department of Environmental Conservation and the U.S. Environmental Protection Agency detailing City storm water infrastructure improvements, maintenance, and the occurrence and severity of combined system overflows. The department also maintains the renewal of the City's permits to the State Pollutant Discharge Elimination System.

Because the Wastewater Treatment Plant uses historic system maps of the City, they would benefit from a City map detailing locations and addresses of buildings from which roof drains discharge into the City's combined system. This map could be used as a reference during the planning phases of a future initiative to separate the septic sewer from the storm sewer. Also for daily operations, the treatment plant would benefit from digitally mapping and documenting attributes of the City's existing wastewater infrastructure.

Software Resources:

- N/A

Data Sources:

- Engineering reports and plans

Staffing:

- N/A

Metrics:

- N/A

Spatial Data in use:

- Historic system maps

Non-spatial Data in use:

- N/A

Uses for GIS:

- The ability to view and query all storm and wastewater structures in the City
- The ability to create maps from existing City map layers

Other Non-GIS Application Needs:

- N/A

2.3.18 Water Department

Personnel Interviewed: John Platt, Superintendent

Diane McGraw, Secretary to the Department Head

Primary Contact: John Platt

Phone: (845) 565-3356

Email: jplatt@cityofnewburgh-ny.gov

Departmental Tasks**:**

The department is responsible for the purification and distribution of all the water systems within the Newburgh, and through an agreement, New Windsor. The City supplies water to over 6,500 parcels but only 6,100 are currently in use. Many of these parcels have several water meters due to multiple accounts. The department also provides water services to 300 customers that reside outside of the City limits.

The department is broken down into 4 divisions each with the following responsibilities:

Administration
- Office staff
- Payroll
- Billing
- Requisitions
- Purchasing
- Meter reading

Ponds & Reservoirs
- Watershed monitoring
- Water retention
- Water supply laws and regulations

Purification
- Water treatment
- Operation of water filtration plant
- Maintenance of on site water and chemical storage tanks

Distribution
- Maintenance of fire hydrants
- Maintenance of water mains
- Bi-annual flushing of water distribution system
- Leak detection and surveys
- Respond to any water quality questions

The department often makes contact with and receives questions from the public. This customer contact often takes the form of customer support, answering questions pertaining to water delivery or billing, and looking up information as requested by customers.

The Water Department has the most current mailing address, phone number and owner information as is required to send water bills to the appropriate address and person. Although the official parcel address information is stored in the Assessor's Office, the Water Department maintains their own list which they can update faster than the Assessor's Office. When a change is necessary, the Assessor's Office often takes several months to update the data.

The department noted the need to share information with other departments and also be able to view data records from these departments. One example of this is when the Water Department needs to shut off water to a structure, the Codes Department should issue a vacancy document because it is illegal to live in a house without water within City limits, but at times there is disconnect between the Codes and Water Department.

Water meters that transmit their counts to a receiving computer via radio transmission have been installed in every customer's structures. Reading water

meters involves driving the receiving computer around in a van and the device collects the readings as the van drives past the structure. During each water meter installation, a digital picture was taken and saved with a naming convention that corresponds to an account number and is stored at the Water Department's server.

Software Resources:

- ArcGIS ArcView 9.2
- MS Office
- InHance
- Sensis AutoRead (meter reading application)

Data Sources:

- Scanned historic water system maps
- In-house development using GIS and GPS
- outside consultants
- GIS data
- Engineering plans

Staffing:

- 20 Full time
- 1 Part time

Metrics:

- Currently produces 4 million gallons per day (GPD)
- Plant has capacity for 10 million GPD
- Provide service to 6100 customer (current estimate)
- Flush hydrants and system twice per year
- Prepare and mail of Annual Water Quality Report
- Conduct over 1000 underground utility mark outs per year
- Conduct over 7000 water quality tests per year
- Repair 25 to 45 water main breaks per year
- Install an average of 25 new fire hydrants and 35 valves per year
- Monitor over 2000 meters and 800 radio read units

Spatial Data in use:

- Infrastructure data is being developed (A/O 11/8/2007 ~90% complete)
- Water & Sewer lines (tiff format)
- Curb boxes (scanned but not geo-referenced)

Non-spatial Data in use:

- InHance system data
- Pictures of nearly every meter installation (named by account numbers)

Uses for GIS:

- The ability to track hydrant status
- The ability to track violations of properties
- The ability to create a hydraulic model

- The ability to geoprocess often used forms and records such as billing records, work order records, hydrant maintenance records, and violations for termination of service
- The ability to map and query all of the water accounts in GIS

Other Non-GIS Application Needs:

- The need to streamline data flow between other City departments
- The need to create a work order system (potentially GIS based)

3. CONCEPTUAL SYSTEM DESIGN

The purpose of the Conceptual System Design is to provide the City with a blueprint for a successful GIS implementation. Like many other municipalities, understanding that the City has constraints in terms of limited staffing and financial resources, this Conceptual System Design attempts to help the City to maximize the benefits from GIS technology while minimizing initial and long-term financial costs.

3.1 Categories of GIS Usage

According to the NY SARA *Local Government GIS Guides* (http://www.archives.nysed.gov/a/records/mr_pubGIS03.shtml), the use of geographic information systems by local government falls into five major categories:

- Browse;
- 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 or patterns. Browsing usually leads to identification of items of interest and subsequent retrieval and manipulation by manual means. For single maps, or relatively small areas, the human brain is very efficient at browsing. However, as data volumes increase, automated methods are required to effectively extract and use information from the map.

Simple Display

This GIS function is the generation of a map or diagram by computer. Such maps and diagrams are often simple reproductions of the same maps used in a previous manual oriented GIS environment. Examples of this type of use are preparation of a 1:1000-scale City map, a sketch of an approved site plan, maps of census data, etc.

Query and Display

This function supports the posing of specific questions to a geographic database, with the selection criteria usually being geographic in nature. A typical simple query would be: "draw a map of the location of all new residential units built during 1989." A more complex query might be: "draw a map of all areas within the City where actual new residential units built in 1989 exceeds growth prediction." Such a query could be part of a growth management activity within the City. Queries may be in the form of regular, often asked questions or may be ad hoc, specific purpose questions. The ability to respond to a variety of questions is one of the most useful features of a GIS in its early stages of operation. In the long run, other more sophisticated applications of GIS may have a higher value or benefit, but to achieve these types of benefits,

users must be familiar with GIS and its capabilities. Such familiarization is achieved through the use of a GIS for the simpler tasks of query and display.

Map Analysis (Map Overlay)

This involves using the analytical capabilities of GIS to define relationships between layers of spatial data. Map analysis is the super-imposition of one map upon another to determine the characteristics of a particular site (e.g., combining a land use map with a map of flood prone areas to show potential residential areas at risk for flooding). Map analysis (often termed overlay or topological overlay) was one of the first real uses of GIS. Many government organizations, particularly those managing natural resources, have a need to combine data from different maps (vegetation, land use, soils, geology, ground water, etc.). The overlay function was developed to accomplish the super-imposition of maps in a computer. The data are represented as polygons, or areas, in the GIS data base, with each type of data recorded on a separate "layer." The combination of layers is done by calculating the logical intersection of polygons on two or more map layers. In addition to combining multiple "layers" of polygon-type data, the map overlay function also permits the combination of point data with area data (point-in-polygon). This capability would be very useful in a City for combining street addresses (from the Assessor's files) with other data such as parcel outlines, census tract, environmental areas, etc. Many facility sighting problems, location decisions, and land evaluation studies have successfully used this procedure in the past.

Spatial Modeling

This application is the use of spatial models or other numerical analysis methods to calculate a value of interest. The calculation of flow in a sewer system is an example of spatial modeling. 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. These models allow engineers and planners to evaluate alternate solutions to problems by asking "what if" type questions. A spatial model can predict the result expected from a decision or set of decisions. The quality of the result is only as good as the model, but the ability to test solutions before decisions have to be made usually provides very useful information to decision makers. Once again, this type of use of a GIS will evolve over time, as the GIS is implemented and used.

3.2 GIS User Matrix

Based on the department interview results, Table 1 – GIS User Matrix was developed. The first three user categories (“Browse”, “Simple Display” and “Query and Display”) can be accommodated through the development of an application that would perform specific department specific tasks. Data created by the City would be combined with GIS data available from County, State and Federal sources to generate integrated databases and maps. In the future, users who may be

responsible for editing City data and performing sophisticated analyses would be using a desktop software product such as ESRI's ArcEditor or ArcInfo.

Table 1 – GIS User Matrix

DEPARTMENT	GIS USAGE				
	Browse	Simple Display	Query and Display	Map Analysis	Spatial Modeling
Assessor	✓	✓	✓		
City Clerk	✓	✓			
City Comptroller	✓				
Civil Service	✓	✓			
Code Compliance	✓	✓	✓	✓	
Executive	✓	✓	✓		
Fire	✓	✓	✓		
GIS Analyst	✓	✓	✓	✓	✓
City Historian	✓	✓	✓		
Human Services	✓	✓	✓		
Information Technology	✓				
Planning and Development	✓	✓	✓	✓	✓
Police	✓	✓	✓	✓	✓
Public Works	✓	✓	✓		
Records Management	✓	✓	✓		
Tax Collector	✓	✓	✓		
Wastewater Treatment	✓	✓			
Water	✓	✓	✓	✓	✓

3.3 GIS Applications

As a direct outcome of the Needs Assessment, a web-based GIS application has been proposed with multiple modules that perform specific functions. For the purposes of this document, an application is defined as a computer solution that can perform a task based on user input. The result of the operation is an output generated from the combination of input variables and parameters and the application's processing and response. For example, the Code's Office must inform all residents within 300' and 500' of a building requesting a variance. A buffer utility tool can be designed in the application to perform this task where the user can select a property and create a 300-ft parameter as the input, and then, the computer will generate a list of properties within 300-ft of the building requesting the variance as the output. In addition, it can generate mailing labels in Microsoft word document or other format to be inserted onto letters that need to be sent for notification. Applications can vary depending on the tasks and the level of complexity users desire to perform. GIS applications could be created for use in single department, but the value inherent in them is such that they will fulfill the collective needs of several departments. Applications described in this section allow data to be shared by

several departments as there is progression in the processes performed at the City. For example, as Code Compliance issues a building permit; the Assessor's Office, by using the same application, would be alerted that a permit was completed and that property, whose permit closed, should undergo reassessment.

While personnel from several departments would access data through these applications, only key personnel from each department would edit and maintain the data using thick client desktop software. Access to various layers would be determined throughout the City. Sensitive data such as crime statistics could be restricted using database level security.

3.3.1 New GIS Applications

The proposed application will automatically perform a nightly extraction of non-spatial data from three main databases and combine these records with the existing spatial data. This application takes into consideration the existing GIS software, data, computer hardware, and personnel resources that reside in the City.

GIS Viewer *(Phase I):*

An easy to use intranet application that allows users to browse, display, query, and print data maintained by different department is recommended. This application will have new functionality, compared to the City's existing mapping service. The GIS Viewer application should have the following minimum GIS functionality:

- Zoom in
- Zoom out
- Show/hide Overview map
- Go to Full Extent map
- Go to Last Extent map
- Identify
- Measure
- Select
- Turn on/off Legend

Since the City's IT infrastructure can support the GIS Viewer on the LAN, Bowne recommends that the GIS Viewer be hosted from the City servers. The GIS Viewer should be designed and implemented as an Intranet application that will be available only to City staff.

The primary purpose of the recommended GIS Viewer is to display data from three City departments (Water, Code, and Assessor's Office) from a central GIS Repository, termed Geodatabase.

The following non-spatial City data should be extracted from three City departments' databases:

Assessor (RPS)	Water (InHance)	Code (IPS)
• owner	• account number	• building permits
• address	• customer name	• certificate of occupancy status
• property class	• customer address	• violation status
• assessment value	• customer phone	• applicant name
• acreage	• meter number	• issue date
• frontage	• serial number	• location
• depth	• MSU number	• permit number
• neighborhood	• meter installation date	• permit type
• zoning district	• meter location (x,y)	• permit status
• historic district	• reading	• description
• view preservation	• route	• compliant number
• Colonial Terraces	• average consumption	• compliant type
• waterfront	• meter size	• comply date
• number of rooms	• inspection card	• fee
• year built	• picture	• vacant registry
• stories	•	•
• style	•	•
• heat	•	•
• fuel	•	•
• exemption	•	•

Figure 3 – Extract, Transform, Load Data Types

Since the databases in each department follow the standard database access method of Open Database Connectivity (ODBC), the data should be extracted and combined with spatial data layers such as tax parcels with unique identification numbers such as Section-Block-Lot or account numbers. Bowne recommends that the data be Extracted, Transformed, and Loaded (ETL) using the back-end (Microsoft SQL Server 2005) Integration Services. The ETL process should be set up to run nightly for seamless data updates.

The GIS Viewer application should have the following custom GIS functionality:

Search:

This function will locate parcels/properties by

- Account Number
- SBL
- Owner Name
- Permit Number

The application should center the selected or found parcel/property and display related records in a map frame in the browser screen. For example,

when a water account number (previously extracted from the Water Department's InHance system) is searched, the GIS Viewer should display associated attribute data such as Service Address, Account Type, Owner Name, and Contact Person.

Query:

Custom query functionality should be developed within the GIS Viewer to retrieve multiple parcels or properties satisfying user-defined criteria. With this function, users should be able to query multiple parcels or properties that are of interest such as "locate all properties with a parcel ID that starts with 211" to select for additional analyze. The results should be displayed in the map screen with parcels satisfying the criteria defined by the user along with associated attributes.

Address Management/Consolidation:

One of the most important functions of the GIS Viewer application is the ability to display addresses extracted from different departmental databases. Initially, this functionality should be designed and developed to display potential discrepancies between two City departments' address data (InHance and RPS v4).

Individual addresses: As a result of searching by one of the four options shown above or by selecting a parcel from the map on the screen, two different sets of address data should be displayed. First are records retrieved from the Assessor's RPS v4 system which should be displayed and labeled as "Current Address". The second address should be the Water Department's InHance address, which should be labeled as "New Address". With the ability to see other departments' address data for a particular parcel, City departments will be able to correct their own address data and/or use the correct address data to reach out to the residents.

Address Discrepancy Reporting: The GIS Viewer application should have a way of creating weekly discrepancy reports displaying all addresses from RPS v4 and InHance and generate an email automatically sent to designated City staff for corrections.

Buffer:

Several departments interviewed expressed an interest in using GIS to produce a buffer around parcels. The Buffer functionality should be developed as a button in the GIS Viewer and would allow users to select parcels within a specified distance of a selected parcel. For example, the buffer would allow the user to select tax parcels on the map that are within 200 feet of a selected tax parcel. This would allow departments to create a buffer of a specified distance around a property requesting a building variance or to choose properties that share a boundary with a specific property. Currently, any department requiring this type of functionality performs it manually. The

amount of time and effort used to perform this task would be greatly reduced through the use of a GIS.

Retrieve/Display Relevant Electronic Documents & Images:

The ability to retrieve relevant electronic documents and images is an important function to be developed within the GIS Viewer application. This functionality pertains to displaying electronic documents and images stored in City servers from within the GIS Viewer such as property images, water meter inspection cards, and scanned documents.

Print and Save:

The City's existing online GIS Viewer allows users to display any combination of existing map layers they desire in the map view. Currently, there is no method to print a formal map from the Viewer other than using the print function from their browser. This method of printing denies formal map elements such as a map legend, north arrow, scale bar, title, and map surrounds with City logo, date, and any disclaimer information. Bowne recommends the development of a custom Map Print tool that will place these formal map elements in a pre-formatted design on a user defined map.

When the user clicks the Map Print tool button, a dialog window will open with a dialog for a user entered title and an option for the user to choose between two map sizes for them to print including the standard 8.5" x 11" page size or the larger legal paper size 8.5" x 14". A layer legend, north arrow, scale bar, title, and map surrounds with City logo, date, and any disclaimer information will automatically populate a map in a print preview mode which will allow the user to print the map or close the preview window and return to the Viewer to make changes to the information in the map viewer. This function should also allow saving of the previewed results in html format.

GIS-based Online Work Order System *(Phase II):*

Bowne recommends that the City develop a GIS-based Online Work Order System that will be initially used by the Water Department. This application will increase the efficiency of managing water infrastructure maintenance and work requests in the department and can also serve as a pilot program to determine if and how the use of a GIS-based Work Order System could be useful to other departments throughout the City. The Work Order System will be served and accessed through the same hardware and software that will host the City's GIS Viewer. Because of the common software components, the Work Order System will allow users to browse, display, query, and print the City's spatial data along with the functionality provided for work order management.

An important component of this application is that all water system assets be recorded as layers in GIS with descriptive attributes, unique identifier numbers, and

an address when appropriate. The application will also require an up-to-date list of all staff available to be assigned to a work order and a list of the department's equipment resources which can be assigned to a work order. As more departments are included in the system, additional assets and staff will need to be added to the system. Each staff member will have a user name and password that will allow them to log on to the system and view/print all work orders for which they have been assigned by an Administrator. Only Administrators will be able to schedule maintenance, repair, or service requests on an asset or a group of assets. The work order will be associated with the person or group of people who are to perform the task(s) listed on the work order.

In the system, work orders can be created for work that is to be performed at a future date. The Administrator who created the work order can change the work order at any time. If a work order is modified after it has been created, an email will be sent to the departmental staff who were assigned to perform a task(s) on the work order. The Administrator who opened the work order also has the ability to close out the work order upon confirmation of their completion. Images or other digital files can be linked to the asset upon which the work was performed.

The Work Order System will also have a reporting tool that allows the Administrators to track work orders based on user specified dates or on the status of the work order (e.g. open/closed).

Additionally, the Work Order System application should have the following minimum GIS functionality:

- Zoom in
- Zoom out
- Go to Full Extent map
- Go to Last Extent map
- Identify
- Measure
- Select
- Print
- Turn on/off Legend

Online Map Library *(Phase III):*

An Online Map Library (OML) is recommended to be developed within the GIS Viewer application. The intended purpose of OML is to organize frequently used data into GIS Viewer maps that are pre-defined and formatted. The OML will contain map templates that can be populated with the most current City data. While the GIS Viewer will provide a large set of spatial data accessible to City staff, the OML is meant to provide quick access to often used spatial data layers and information in several of the City's business processes.

There were many maps and map-related data that were suggested during the Needs Assessment interviews. These specific requests are considered as high priority in the

OML. For example, during the Needs Assessment interviews, the Assessor indicated that one of the most time consuming tasks is to track the building permits. The OML View that is recommended would be designed to show building permits combined with parcel numbers and display all permits and permit status on a GIS map. The OML tool for building permits, once selected, would automatically turn on/off the City's relevant GIS layers and bring custom designed symbology to the screen. Since only the relevant information is presented, the users will be able to query available attribute information from the underlying RPS v4 database.

Similarly, another OML View that is recommended is the Code Compliance View. This View will turn off all relevant layers from the previous Online Map Library View and turns on the following layers:

- Tax Parcels
- Zoning Boundary
- Building Foot Prints
- Orthoimagery
- District Boundaries
- Flood Plain maps

This View would also show all permits, violations, and certificate of occupancies in both building footprints and tax parcels layers with different color schemas and symbology such as all parcels that have violations are shown with red.

The list below outlines the high-priority OML tools that should be prepared as map templates that will require little user effort to create:

1. Code Compliance View (Code Compliance, Assessor's Office, Fire Department): Focus will be on the Code Compliance and Assessor related GIS layers and Basemap layers with different symbology assigned to Permits, Violations, COs, and Building Inspection status.

2. Asset Tracking View (All Departments): Automatically adjusts the View to all City assets with Basemap layers. All assets will be presented with different symbology.

3. Planning View (Planning and Development Department): In addition to the Basemap layers, this View will turn on Environmentally Sensitive Areas, Public Transportation, Zoning Boundaries, and Land Use GIS layers.

4. Vacant Lot and Abandoned Building View (Assessor's Office, Comptroller's Office, Code Compliance, and Tax Collector's Office): All Basemap layers with Tax Parcels and Building Footprints will be presented. The vacant lots in the Tax Parcels will be shown with a different color than all other parcel. Similarly, Building Footprints layer will be modified to show abandoned buildings with a different color.

5. Capital Project Locations View (Comptroller's Office): This View will show the Basemap layers and Capital Project locations only. The project locations can be created as a point layer and utilize different symbology for different project types.

6. City Facility/Staff Locations View (Fire Department, Civil Service Department): The facility locations will be presented to the users in this View. The users will be able to view all City facility locations (Parcels and Building Footprints) with staff assigned to each building.

7. Recreation Facilities Tracking View (Human Services): All recreation facilities such as parks and their corresponding facilities will be turned on as a layer in addition to Basemap layers. Appropriate symbology should be used for the corresponding facilities.

3.3.2 Application Summary

The recommended application and modules are intended to enhance the City's daily operations. Because the City has an existing IT framework that can support these applications, application development and data record population can be the focus of implementation. There is no need to establish additional hardware as part of their implementation. The application and modules should be developed to use existing City data, data created at the City during GIS or GPS usage, and data available from County, State, and Federal resources. Below, Table 2 – Application Summary summarizes the applications and the departments that would consume the application data:

Table 2 – Application Summary

DEPARTMENT	GIS VIEWER APPLICATION								
			Online Map Library Views						
	GIS Viewer	Online Work Order System	Code Compliance View	Asset Tracking View	Planning View	Vacant Lot and Abandoned Building View	Capital Project Locations View	City Facility/Staff Locations View	Recreation Facilities View
Assessor	√		√	√		√			
City Clerk	√			√					

City Comptroller's	√			√		√	√		
Civil Service	√							√	
Code Compliance	√		√	√		√			
Executive	√			√		√	√		
Fire	√		√	√		√		√	√
GIS Analyst	√	√	√	√	√	√	√	√	√
City Historian	√			√	√	√	√		
Human Services	√			√					√
Information Technology	√								
Planning and Development	√			√	√				√
Police	√		√	√		√		√	√
Public Works	√	√		√				√	√
Records Management	√			√	√			√	
Tax Collector	√	√				√			
Wastewater Treatment Plant	√			√					
Water	√	√		√		√			

3.3.3 Application Usage Type and Estimated Usage Frequency

The following table lists all of the GIS applications with their estimated frequency of usage within the City's departments. Estimates are based on interviews with the City departments and the current and anticipated City resources. In order from simplest to GIS usage that is most complex, usage types include:

1. Browse
2. Simple Display
3. Query and Display
4. Map Analysis
5. Spatial Modeling

Table 3 below lists the usage type for each application includes all usage types up and to the level indicated (e.g. map analysis would include query and display, simple display and browse, but would not include spatial modeling which is the most complex).

Table 3 - Application Usage Type and Estimated Usage Frequency

DEPARTMENT	GIS VIEWER APPLICATION								
			Online Map Library Views						
	GIS Viewer	Online Work Order System	Code Compliance View	Asset Tracking View	Planning View	Vacant Lot and Abandoned Building View	Capital Project Locations View	City Facility/Staff Locations View	Recreation Facilities View
Browse	√	√	√	√	√	√	√	√	√
Simple Display	√	√	√	√	√	√	√	√	√
Query and Display	√	√	√	√	√	√	√	√	√
Map Analysis	√								
Spatial Modeling									
Estimated Usage Frequency/Month	650	110	900						

3.3.4 Priority Applications and Necessary Data

The intended results of the application will never be achieved without the appropriate data for analysis. Table 4 below lists the high priority applications along with data that is readily available for the application and the modules consumption and data that requires development by the City:

Table 4 - Priority Applications and Necessary Data

DEPARTMENT	GIS VIEWER APPLICATION								
			Online Map Library Views						
	GIS Viewer	Online Work Order System	Code Compliance View	Asset Tracking View	Planning View	Vacant Lot and Abandoned Building View	Capital Project Locations View	City Facility/Staff Locations View	Recreation Facilities View
Assessment Data	√								
Building Footprints	√		√		√	√		√	√
Cadastral Data (Tax Parcels)	√	√	√	√	√	√	√	√	√
Census Tracts	√	√	√		√	√			
City and Adjacent Municipal Boundaries	√	√	√		√	√	√	√	√
City Districts (Historic, Colonial Terrace, Waterfront, View Preservation)	√				√	√	√		
City Owned Facilities	√			√	√			√	√
Floodplains	√		√		√				√
Hazardous Material Storage Locations	√		√					√	√
Hydrography	√	√	√		√				√
Legislative Boundary	√								
Orthophotography	√	√	√	√	√	√	√	√	√
Railroads	√	√	√	√	√				
Right of way	√	√	√	√	√				

Sanitary Sewer Districts and Boundaries	√	√			√				
Sanitary Sewer System	√	√		√					
Storm Drainage Network	√	√	√	√	√	√			√
Storm Drainage Tributary Areas	√	√			√	√			√
Street Centerline	√	√	√	√	√		√	√	√
Treatment and Storage Facility Locations	√	√		√					
Water Distribution System	√	√		√	√				
Vacant Registry	√				√	√			
Wetlands	√	√	√		√	√			√
Zoning Districts	√		√		√	√			

3.4 Alternative GIS Implementation Approaches

There are many alternative approaches possible when a municipal government decides to implement GIS technology. Three different alternative conceptual GIS system design approaches are presented and discussed in this section:

- Standalone Departmental GIS approach
- Enterprise GIS approach
- Hybrid approach

3.4.1 Standalone Departmental GIS Approach

The Standalone Departmental GIS approach is one of the widely exercised approaches in New York State municipalities, albeit usually not by design. Departments of municipal governments such as the Department of Assessment, Highway, Buildings, and Planning are often the first to identify the need to use GIS tools in carrying out their day-to-day tasks and purchase GIS software without consulting other departments. Installation of single GIS software on a Personal Computer (PC) can be considered as a standalone desktop GIS system.

Once deployed, other departments may learn more about the capabilities of GIS and may start noticing how GIS could be used in their departments. A Standalone Departmental GIS system consists of multiple standalone desktop software tools installed throughout the municipal government where there is limited or no connectivity among the PCs. The Standalone Departmental approach may be a viable solution when municipalities do not have an existing organization-wide network to handle large volumes of GIS data being transferred from one computer to the other.

Figure 4 shows an illustration of the Standalone Departmental GIS approach. The GIS users located in each department utilize their own datasets since there is no "centrally stored" GIS data.

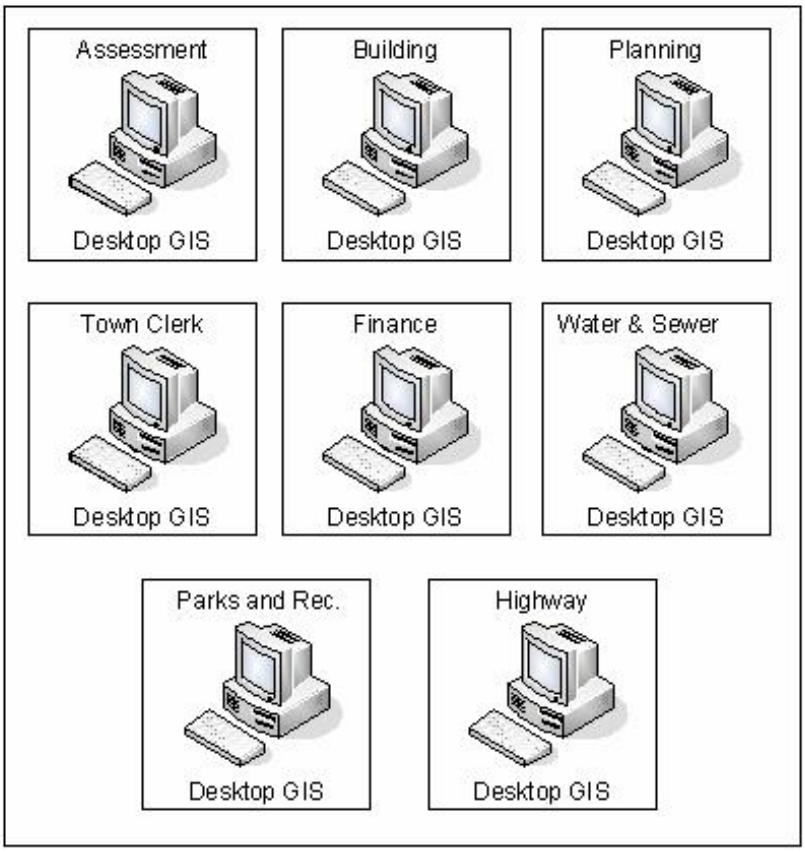


Figure 4 - Standalone Departmental GIS Approach

The advantages and disadvantages of a standalone GIS implementation approach in terms of hardware, software, data, and staffing perspectives are as follow:

<u>Hardware:</u>

Since the Standalone Departmental GIS approach consists of mostly standalone PC installations, both software and data are handled by the PC that belongs to the users.

Despite the fact that the PCs have become more capable and inexpensive, efficient handling of software and data on the same PC is somewhat problematic as GIS software usually requires more computing power (i.e. more memory, more processing power). Also, as GIS usage grows, more data needs to be duplicated on multiple PCs. This dramatically increases the storage requirements of each GIS user's PC.

The Standalone Departmental GIS approach will also require multiple hardware peripherals (plotters, printers, scanners, digitizers) to be purchased for each department, if not each user, as these resources cannot be shared due to lack of IT networks.

Software:

Each user will need to run selected GIS software on his or her individual PC. GIS software vendors have improved the out-of-the-box functionality of the desktop software dramatically in the last decade. Therefore, installing desktop GIS software on each users PC in each department will provide the users with a great deal of functionality. However, one may argue that this would be a costly option as installations on each individual PC will require purchasing the software and potentially an additional licensing fee due each year thereafter. Also, not all users will need or utilize all the functionality that is built into the desktop GIS software.

Data:

One of the most important elements of any GIS is spatial data. Spatial data, also known as geographic or geospatial data, refers to data that identifies the geographic location of natural or man-made features and boundaries of real world. Spatial data is important because it needs to exist in the GIS for the system to be useful. For example, without street data (as a map layer) all street signs may look simply like a series of points in space. Therefore, data must pre-exist for GIS to be meaningful to the user. The production of spatial data usually is expensive and time consuming and therefore requires special care. Once it is produced (i.e. collected from the field or extracted from other sources), it needs to be maintained. When it comes to Standalone Departmental GIS, since GIS users run GIS software on their individual PC, and usually without a connection to a central storage such as a server, the data needs to be duplicated. This situation causes spatial data maintenance issues as the update and maintenance processes become the biggest impediments of any GIS initiative.

Municipalities with few departments (e.g. less than five) may find it easier to handle data related issues such as creation, distribution, and maintenance in the Standalone Departmental GIS design option. However, as the number of users increases the data needs to be handled more carefully because coordination may become a significant problem over time.

Staffing:

Although each PC that runs desktop GIS will offer individuals a great deal of out-of-the-box GIS functionality, not all users in a municipal environment will be able to utilize the functionality. Some of the functionality may never be used by some municipal staff as GIS may not be mission critical to what the department does. Often, municipal governments chose to train staff on highly complex GIS desktop tools and find that the learning curve may be too steep or that many of the advanced GIS functionality is unnecessary for departmental usage.

The Standalone Departmental GIS may be a good fit for smaller municipalities with limited IT and financial resources. As a starter, purchasing a single GIS software license and installing it on an existing PC may be a short-term practical solution. However, often municipalities find it very difficult to extend the same approach to more than a couple of departments as this situation represents many obstacles in the long run. In summary:

Advantages:

1. *Lower level of initial ownership cost:* Initial costs include purchase of GIS software and computer peripherals such as large format printers or scanners. The benefit of this approach is low initial costs when there are less than five users.

2. *High Level of functionality availability*: The desktop tools installed on individual PCs will have a great deal of functionality available to the users.

3. *Higher level of initial software customization:* Initially each user in municipal departments can customize the GIS software according to their needs as GIS software tools are highly customizable.

4. *Lower level initial planning and coordination need:* Since a municipal government may start with minimal equipment and software purchases, the initial set up does not require planning and coordination among departments.

Disadvantages:

1. *Higher level of total ownership cost:* As the GIS needs of the departments increase, municipalities start purchasing more GIS desktop software. Also, it is common to pay a considerable amount for maintenance of the software purchased each year, which will increase the total cost of ownership over the long run. Purchase of supporting hardware such as PCs with more computing power will add to the overall cost of ownership.

2. *Lower level of efficiency in using resources:* Since there are no shared resources in terms of hardware and peripherals, municipalities are often unable to utilize the hardware resources to their full potentials.

3. *Higher level of data discrepancy:* Spatial data handled by multiple departments will require a coordination mechanism for general data updates. Even with a good mechanism in place, when the amount of spatial data reaches a certain limit, coordination will become inefficient. This results in departments having multiple versions of spatial data layers in use without knowing which dataset was updated by whom and when. Having inconsistent and less accurate spatial data will negatively affect the municipal operations.

4. *More difficult administration*: As software vendors release patches or updates of their products, each individual PC needs to be updated. This usually means making trips to each individual department and user PC to apply updates. (Please note that there are ways to handle that remotely, however, this may require a network to be in place)

Overall, the Standalone Departmental GIS approach may seem to be an easy and attainable solution to many municipalities. A careful look at the hardware, software, data and staffing requirements of each department and user may reveal that the Standalone Departmental approach may be a costly option as these requirements are not static and can change over time. If planned correctly, the Standalone Departmental GIS approach can be used to start a GIS program, show the capabilities and benefits to each department, and expand towards a more organization-wide approach.

3.4.2 Enterprise GIS Approach

Enterprise GIS can be defined as a collection of hardware, software, and applications to *centrally* store, share, and distribute spatial and non-spatial data and information. The most important difference between the Standalone Departmental GIS and Enterprise GIS approaches is that the Enterprise GIS tends to utilize the Internet and Intranet for data distribution and store spatial and non-spatial data centrally. While designing and implementing an Enterprise GIS has many advantages over other approaches, it may require more hardware, software, and skills. In addition, this approach may take more time because it requires more careful planning. However, over the long run the benefits may exceed the related costs.

Figure 5 below shows a generic Enterprise GIS architecture. The “heart” of the system is a Relational Database Management System (RDBMS) such as Microsoft SQL Server, Oracle, or Sybase etc. Since spatial and non-spatial datasets are stored centrally, the Enterprise GIS approach will address many issues that relate to spatial data creation, maintenance, and distribution previously mentioned in the Standalone Departmental GIS approach section.

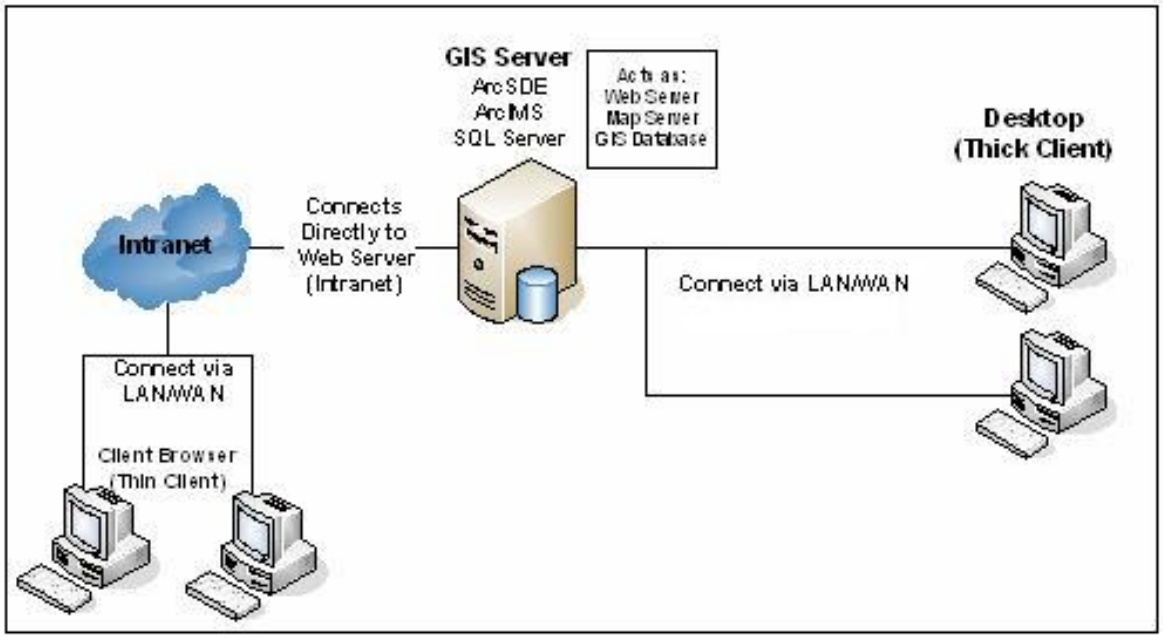


Figure 5 - Enterprise GIS

Hardware:

Given that the Enterprise approach tends to centralize data, it will require a more robust collection of hardware. The hardware must have the capacity to run RDBMS such as Microsoft SQL Server, GIS specific software, and handle multiple requests from GIS users both internal and external to the municipality. Because this approach utilizes the Internet and/or Intranet as a way of distributing data, there are certain security requirements which need to be addressed with more software and hardware such as firewalls. Once an Enterprise GIS is implemented, it will be easy to use, less costly, and provide an efficient means to utilize peripherals from a single location. For example, a plotting device that is part of a LAN in a municipality can be used by many departmental users without leaving their workstations. Initially, this approach requires more capital resources to be allocated.

Software:

As with the hardware, software will also be more than just a collection of desktop tools installed on individual PCs. For example, particular software called ArcSDE (Spatial Database Engine) is usually used to convert user requests back and forth between the RDBMS and the user. Also, other software products such as ArcIMS (Internet Mapping Servers) are utilized to serve spatial data over an intranet or the Internet. While this approach may increase the initial software investments, it can produce significant savings in the long run. The reason for the savings is simply that GIS users will only require a PC, high speed Internet connection, and free browser software such as Internet Explorer to start using the GIS data and applications on the

Web. No special desktop tools would be required to consume the spatial data and applications.

Data:

The Enterprise approach simplifies data creation and maintenance by creating a central data storage location that is controlled by the GIS Coordinator or an administrator. Because this approach utilizes an RDBMS, maintaining data integrity will be preformed by one designated staff, much of which will be automated and come standard with the database product tools. Also, instead of using flat files (i.e. shapefiles) both spatial and non-spatial data can be stored in a single server environment as database entities where the database manages and forces rules to ensure data integrity.

Staffing:

The Enterprise GIS approach shifts the burden from users to technical administrators. Municipalities with limited or no technical assistance in terms of hardware, software, and IT infrastructure may find the Enterprise approach too complex to handle. The Enterprise GIS approach may be a good fit for larger municipalities with better IT infrastructure and technical and financial resources.

Advantages:

1. *Lower level of total ownership cost:* It may be argued that the cost of implementing Enterprise GIS is higher compared to other approaches. While it is true that the Enterprise GIS does require more initial funding, it offers more advanced services to both the municipality and the public

2. *Easier Application Administration:* Because the data and applications are usually served from a single location, administering the systems is easier and more cost effective. User PCs do not need to be updated when newer versions of desktop GIS software tools are released as Enterprise GIS minimizes the number of software applications to be installed on individual PCs.

3. *Easier Data Maintenance:* Departments and users will not need to download individual data sets to their individual PCs since data will be stored in a central location. As the data updates will be seamless to the end users, all users will see the same up-to-date version of the data, which increases data accuracy dramatically. Enterprise GIS will eliminate data duplications that may lead to inefficiencies in municipal service delivery. Also, multiple users will have the ability to make concurrent edits to any data sets as long as they have the right security permissions. This feature allows data log transactions and check-in and check-out processes, which have the potential for a positive impact on the field data collection process of any municipal government.

4. *Role based Security:* Because the backbone of the system is an RDBMS, it enables municipalities to handle data related security issues. As long as roles are defined and good security policies in place, data access and updates can be handled by multiple users securely.

5. *Spatial Data Integrity:* Enterprise GIS ensures the integrity of data storage in RDBMS due to the ability to set defined spatial rules and control what users can edit the data. This ensures well-formed geometric integrity of all spatial data stored in the database. The benefit of this feature is that business rules can be incorporated on large spatial data collections when coupled with application logic.

6. *High performance:* Despite the fact that performance of any Enterprise GIS system may be dependent on many variables such as the network bandwidth, the number of users accessing the system, hardware and software platforms, systematic planning and implementation will ensure a high performance of GIS related service delivery. Enterprise GIS is highly scalable and performance related issues can be addressed initially at the planning phase or as they arise during system usage.

7. *Less steep learning curve for users*: Because the functionalities of applications are designed for specific purposes, the GIS users will only need to learn how to use them, thus smoothing the learning curve.

Disadvantages:

1. *Higher level of initial investment cost:* Enterprise GIS does not have the ability to serve both GIS specific application and data to the departments and users from a central location. It requires more capable hardware and software which are more expensive in terms of initial cost.

2. *Lower Level of functionality availability*: In Enterprise GIS, applications are designed for user specific functionality as required by each department. Prior to application development, desktop GIS software tools tend to be more capable than out-of-the-box Enterprise GIS tools. Municipal government who want to take advantage of out-of-the-box Enterprise GIS functionality will not find most desktop like functionalities available to their applications.

3. *Steeper learning curve for GIS administrators:* Maintaining Enterprise GIS is definitely not a trivial task. It requires understanding of Databases, Networks, and GIS technologies. Municipalities that do not have staff to deal with these technologies often find it difficult to address issues that relate to Enterprise GIS. The learning curve is steep for novice Database/Network/GIS administrators.

4. *Higher level initial planning and coordination need:* Most Enterprise GIS implementations require (depending on the size) careful planning. Department needs differ greatly in terms of required GIS capabilities,

datasets etc. Careful planning will address issues like these and address them before moving ahead with implementation.

5. *Higher level of IT Infrastructure requirements:* Enterprise GIS requires certain IT infrastructure to be in place (or it can be designed/improved in the planning stage). Municipal governments that do not have a robust infrastructure may have difficulty pursuing an Enterprise GIS as the networks (i.e. Internet and Intranet) are greatly utilized for data and application distribution.

Overall, Enterprise GIS has a lot to offer municipal governments that have sufficient financial and technical resources. The efficiency gained from an Enterprise GIS approach over the long run for larger municipalities is vast because it offers security, efficient data and application delivery and cost savings.

3.4.3 Hybrid Approach

A Hybrid approach that takes advantage of both the Standalone Departmental GIS and Enterprise GIS approaches while minimizing their disadvantages. This middle ground is a practical solution if a municipality is able to utilize existing resources better and has a plan to pursue an Enterprise GIS gradually over time.

A Hybrid GIS involves the systematic growth of GIS within any organization. It follows a system design that utilizes existing resources to facilitate future growth of GIS data, user skills, awareness, and scalability. This approach is ideal for maximizing the return on GIS investments and the services that it can provide when there is limited staff and or financial resources.

GIS usage in the early stages of the Hybrid GIS is conducted in a manner that develops the GIS data, GIS applications, hardware, and personnel with respect to increased access to information and data analysis. Because no two organizations have the same infrastructure or same set of complications during system development, holding the Hybrid GIS approach to a strict definition is impossible. By placing scalable components of a GIS within an organization and following a plan to advance GIS usage and data creation, a Hybrid GIS approach can have an immediate positive impact on the work performed by the end users.

Using a Hybrid GIS approach, municipalities are able to decrease the initial financial burden of implementing a full blown Enterprise GIS system while still realizing benefits from their initial GIS usage. This is because the Hybrid GIS approach has no specific development cycle that it must follow to be successful. The usage and maturation of a Hybrid GIS will be different for each municipality because at the foundation of this approach is the goal to maximize existing resources and to implement GIS as a tool to bring the greatest good to the greatest number of users. Implementation, training, data development and maintenance, and coordination of the Hybrid GIS approach can progress as resources become available to the City's GIS initiatives.

The Hybrid GIS approach may be a more efficient solution in deploying GIS as opposed to other approaches since it addresses some disadvantages of either approach. For example, with the Hybrid GIS approach, municipalities may purchase and utilize desktop GIS tools and still store data in a central location as flat files. Flat files can still be served through an Intranet/Internet application to departmental users. Serving data without utilizing a RDBMS would still have some issues such as security, performance, and concurrent editing as discussed previously, however, with good planning and developing policies, municipal governments may be able to reduce the potential negative impact of not utilizing a RDBMS.

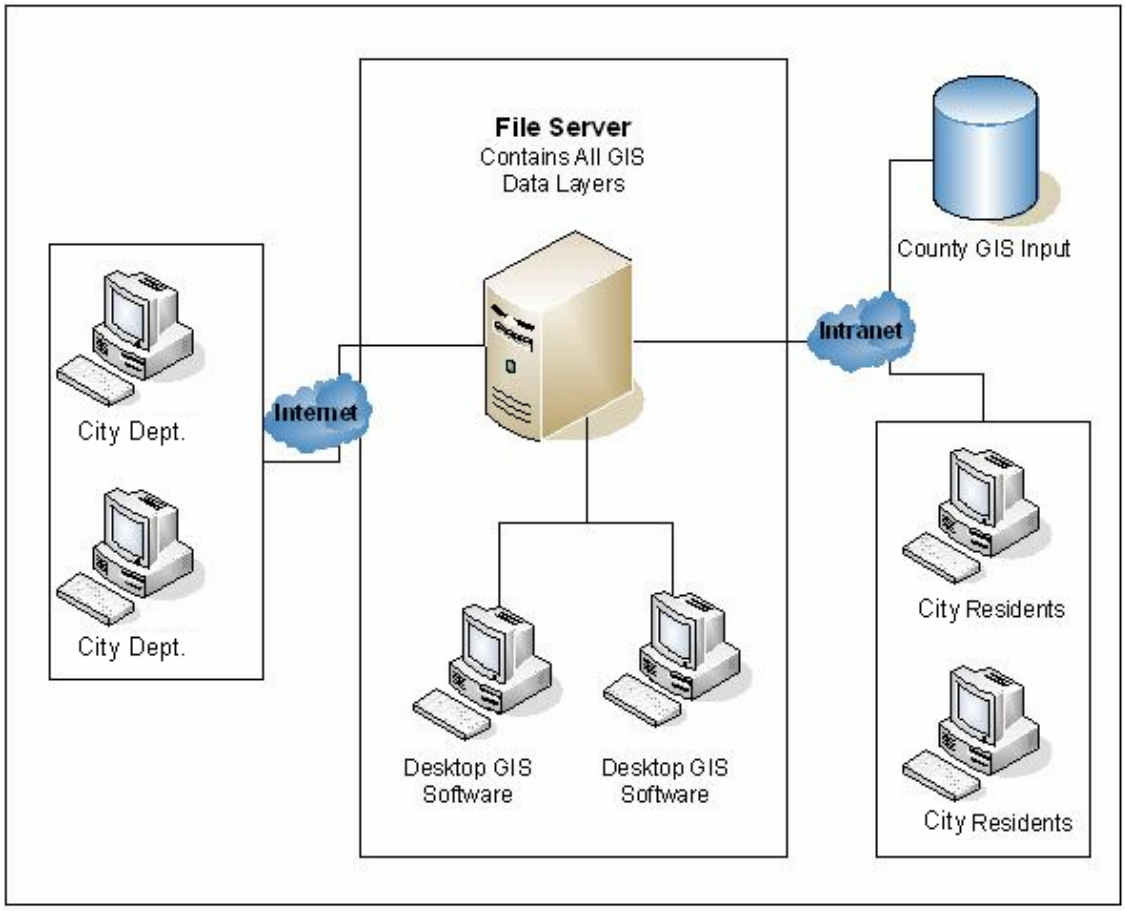


Figure 6 - Hybrid Approach

Hardware:

Hardware that is required for a Hybrid GIS approach differs in every implementation instance because no two hardware or networking situations are the same. The hardware that is required will depend on what IT infrastructure is in place at the time of implementation. The Hybrid GIS approach should blend existing hardware with

anticipated hardware purchases. Hardware utilization will change over time as the GIS system matures.

Software:

As with the hardware, software should change as the GIS system grows and as the need for access grows. The software used in this approach could start out as a collection of desktop tools installed on individual PCs. Use of ArcSDE software could also be implemented early in the GIS development to allow use of RDBMS for data sharing for all GIS users. This will increase data creation and consumption, and increase the familiarity with GIS as a tool for decision making.

Other software products such as ArcIMS can then be utilized to serve spatial data on an intranet or internet. By increasing the time frame between software purchases, a Hybrid system can mitigate the financial impact of a City-wide GIS implementation.

Data:

Spatial datasets available to the organization may be not centralized completely in this approach. That is, while there may be some datasets stored in a central server environment, some departments may still have spatial data kept and used in their own departments. The datasets that are not stored centrally will present some problems as the end users may still need to utilize the spatial data in their own PCs by duplicating them. Any updates made to these duplicate copies will need to be reconciled somehow, which usually is not an easy task. The Enterprise GIS approach usually addresses related issues more elegantly. Therefore, when creating a new GIS program, municipalities should consider moving towards an Enterprise GIS, as the data will be centrally stored addressing the maintenance issues. Please see the Data section in the Enterprise GIS approach.

Staffing:

The Hybrid GIS approach allows for those who will champion the GIS efforts to start using the system to produce tangible results that should increase interest in GIS usage throughout the City. The Standalone Departmental GIS approach required each user to learn about the different aspects of the GIS tools installed on their PC and required individual spatial data creation and maintenance. The Enterprise GIS approach shifts the burden from users to technical administrators. The Hybrid GIS approach facilitates a logical progression of GIS knowledge transfer between different users and system administrators. As the Hybrid GIS is rolled out to users, formal training sessions may be attended or existing users can assist the new users. This allows for an organic growth of GIS knowledge and maintenance of the City-wide system.

The Hybrid approach may be a good fit for municipalities that are progressively thinking about their IT infrastructure and have staff that can support the advancement of the GIS. The growth of a Hybrid system will require a financial commitment to purchase additional hardware as new phases are met. As the GIS grows within the municipality, the ability to efficiently supply data to City residents may increase data

consumption and the request from residents for more information from the GIS. Eventually, a Web enabled GIS that serves data to the constituents should be implemented. This will occur at a minimal cost to the municipality due to the already created spatial data, software, hardware, and staff usage of the City-wide GIS.

The summary below is a generalized list of advantages and disadvantages of the Hybrid GIS approach. Generalizations must be made because specifics to a Hybrid GIS are dependent upon the unique conditions that are present at the time of planning and implementation. Some Hybrid GIS may develop quicker than others and as such, advantages and disadvantages might be experienced for different lengths of time. With this in mind, no two situations are the same, thus no two Hybrid GIS are implemented the same:

Advantages:

1. *Higher level of interest among initial users:* Because users of the GIS during its first phases will be those who supported the implementation, the number of committed GIS users will be higher than other approaches. Having committed users early in the GIS life-cycle may have a positive effect on GIS usage throughout the municipality.

2. *Highest level of functionality availability*: In the early phases of a Hybrid GIS implementation, desktop tools installed on individual PCs will have a great deal of functionality available to the users. As GIS migrates toward an Enterprise GIS, much of the functionality will be made available to other users through use of intranet/internet applications.

3. *Highest level of software customization:* Initially each user in municipal departments can customize the GIS software according to their needs as GIS software tools are highly customizable. As the GIS is phased into organization-wide usage, the highly desirable tools can be made available to all users through intranet/internet applications.

4. *Mild learning curve for GIS administrators:* GIS administrators will be the initial users of the GIS because they will be involved with the system design and installation. Using Hybrid GIS from its beginnings will increase the knowledge of overall system architecture and maintenance requirements. As the municipal GIS advances, administrators will have had experience with the GIS implementation and maturation, and therefore be in better position to administer the advanced phases of the Hybrid GIS.

5. *Mild learning curve for users*: In the later stages of a Hybrid GIS approach, the functionalities of applications will be designed for specific purposes. The GIS users will only need to learn how to use the applications, not the desktop software, thus smoothing the learning curve.

6. *High level of efficiency in resource utilization:* The Hybrid GIS approach is unique in that its justification for existence is the immediate efficient utilization of all resources. By maximizing opportunities for shared resources in terms of hardware and peripherals, municipalities are often able to utilize the hardware, software data, and staff resources to their full potentials.

7. *Reasonable level of IT Infrastructure requirements:* Early phases of the Hybrid GIS approach are carefully scripted to maximize existing resources with being mindful of future IT enhancements. Hybrid GIS implementations vary depending on the municipality, but the goal is to maximize return on existing IT infrastructure to keep initial costs as low as possible.

8. *Low level of data discrepancy:* Spatial data handled by multiple departments requires a coordination mechanism for general data updates. Hybrid GIS approaches attempt to utilize RDBMS as soon as possible to coordinate data distribution among users and to minimize data duplication.

9. *Easier Data Maintenance:* Depending on the scope of the Hybrid GIS, departments and users will not need to download data sets to their individual PC because by the first or second phase, data will be stored in a central location. As the data updates will be seamless to the users, all users will see the same, most up-to-date version of the data, which increases data accuracy dramatically. Initially, accessing data will be allowed to one user at a time, but as improvements to the Hybrid system take place, multiple users will have the ability to make concurrent edits to any data sets as long as they have the right security permissions.

10. *Role based Security:* Because RDBMS are usually implemented early in the Hybrid GIS life-cycle, it enables municipalities to handle data related security issues. As long as roles are defined and good security policies in place, data updates can be handled by multiple users securely.

Disadvantages:

1. *Higher level initial planning and coordination need:* Because the early phases of a Hybrid GIS approach encompasses much of Standalone Departmental GIS and progresses towards the Enterprise GIS approach, initial planning is paramount to logical and efficient GIS enhancement. Careful planning will address the GIS and IT needs of different departments and create a blueprint for GIS enhancements for years in advance.

2. *Potential higher level of overall cost:* Depending on existing IT infrastructure and staff knowledge, completing a Hybrid GIS implementation may have a total cost higher than other approaches. Long term Hybrid GIS costs should be less than Standalone Departmental GIS long term costs due to decreased dependency on Desktop GIS software and hardware.

3. *Eventual higher level of IT Infrastructure required:* As the Hybrid GIS progresses towards the functionality of an Enterprise GIS, the IT infrastructure must be in place to support the activity. Municipal governments that are unsuccessful in implementing and maintaining a robust infrastructure may have difficulty pursuing advanced functionalities that come from an Enterprise-like GIS.

3.4.3 Recommended GIS Implementation Approach

The key to successfully implementing GIS is to find an approach that best meets the needs of the City. Evaluating the City's GIS needs and existing hardware, software, and data sources, Bowne recommends that the City pursue the Enterprise GIS approach that will enable the City to realize immediate benefits of the hardware and software and maximize the utility that GIS can provide. With the Enterprise GIS approach, the City can centralize GIS and non-spatial data records and the basic GIS functionality and data needed by departments can be delivered via internal servers and Web-based GIS applications all departments regardless of access to GIS desktop software.

The City is in a unique position to take advantage the existing IT infrastructure which connects all departments to central data storage servers. By connecting to the same central server as other City departments, the Enterprise GIS can utilize ETL tools to extract operational data used and maintained in City departments to populate existing GIS layers or to create new layers. After input from the ETL tool, these data records can be displayed and analyzed with other records. The existing inability to compare records from various departments of uncommon formats is due to no common medium in which to put the records side by side.

3.4.4 ETL Tools

As data record volumes increase along with the number and complexity of data models in the City's departments, creating an application that provides data interoperability is important. Vital to implementing an application that could allow diverse systems and organizations to work together, is creating a system that is practical, far reaching, and independent of data source input format or data model. ETL (extract, transform, load) tools can eliminate barriers between diverse applications by supplementing software and applications used throughout the City with enhanced data sharing capabilities.

The conceptual driving force of the ETL tool is the ability to redefine existing data records to a format that can be viewed and analyzed through GIS. The goal of using an ETL tool at the City is to create new ways of interpreting the data, allowing users the better uncover relationships, patterns, or trends that are not possible to see with the records native format, or in traditional charts, graphs, or spreadsheets.

Data records that are created and maintained in proprietary software applications are difficult to share between departments. By extracting a database that characterizes an application, records can be transformed into a format that is useful to other departments and delivered through GIS. This will allow multiple departments' access

to these records and enhance the analytical processes that can be performed on this data. Departments can analyze the data in reference to their specific departmental tasks

The remainder of this section explains the recommended system in terms of hardware, software, IT infrastructure, application functionality, and staffing.

3.5 Database Design Considerations

A Conceptual Database design framework is presented in this section to guide spatial data acquisition, creation, and update processes. The main goal is to keep data in a central and secure location, where spatial data can be served efficiently.

The majority of spatial data to be used in the City GIS may be acquired from Federal, State, and County governments or created internally from data analysis or GPS data collection. Since data creation is an expensive process, acquiring spatial data available from other sources is crucial. The City should adapt a GIS data model that groups data into functional categories.

A key GIS design concept is that of the shared database. The shared database implies that departments with different functions and responsibilities have common data needs. For example, several departments require knowledge of land records information to assist in their day-to-day functions. Using a shared GIS database, it is no longer necessary for each department to store, manage, and update information independently because the opportunity exists for all departments to access the data electronically in a shared database, where data are updated periodically and accuracy is maintained by the source department. User from each departments will have access to both shared spatial and attribute data. Using RDBMS technology is an important aspect of implementing the shared database.

An example GIS Database model is shown in Figure 7. The model organizes geographic data into six categories, each of which includes a set of layers and associated tabular attributes. These categories are designed to organize geographic data efficiently and non-redundantly. The categories are the groundwork for all GIS data to be used in the GIS Database. Careful evaluation by City staff should confirm each category assignment based on each dataset's functional need and expected use. Once complete, this logical data model can be used to organize physical storage of the data on the computer storage devices and will provide for easier data access by the users. As the GIS expands, it may also be necessary to define additional categories to this logical data model.

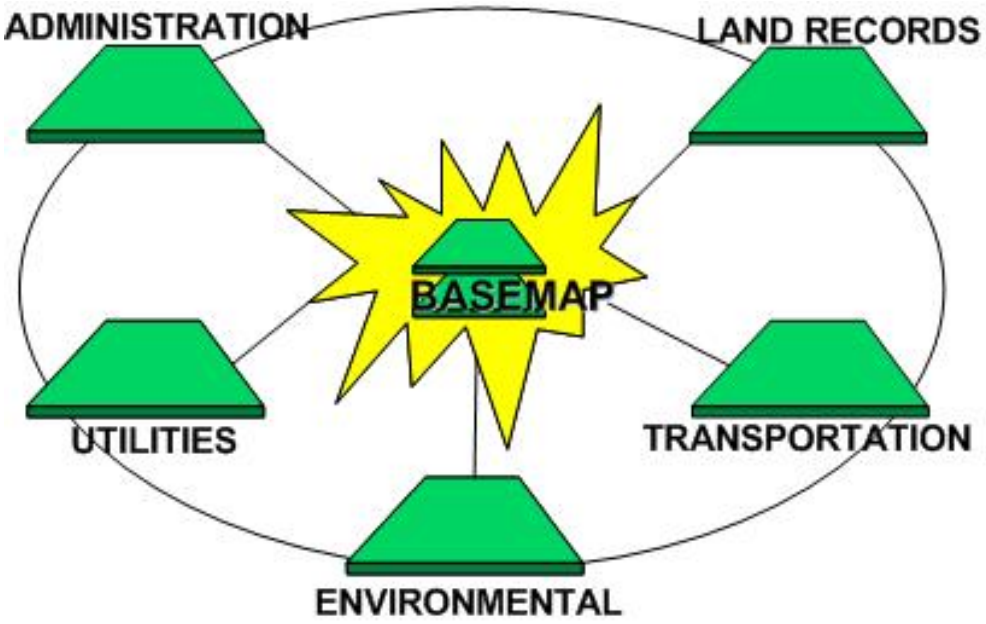


Figure 7 - GIS Database Model

3.6 Conceptual GIS Database Design

This section presents the conceptual data model for the City's GIS. The data model is intended to serve as a conceptual framework to guide the City in the process of implementing the GIS database over a period of several years. The layers described in the model represent distinct themes of information that were identified in the user needs assessment study which are important in supporting City functions. Some of the layers include important attribute data sets, which are related to the spatial features. In the physical implementation of the database, some of these layers may be further subdivided into several layers, and new layers will be defined, as user requirements are refined. Prior to automation and application development, the City will need to perform a detailed physical design of each layer and its associated attribute sets. Also instrumental in designing and developing the City's GIS database will be information presented in Figure 8. The data model categories are described in more detail in the following subsections.

3.6.1 Basemap Layers

These data records are the foundation for the GIS database. They define the coordinate control and accuracy for the entire GIS database, and provide planimetric[1] detail such as curb lines and surveying control points and monuments. Also,

[1] Planimetric data shows only the horizontal position of features on the earth without regard to elevation. Planimetric data can include natural or man-made features.

basemap layers often include aerial photography, building footprints, parks, and landmarks. Limited attributes should be stored with these basemap features as their main purpose is to provide background information and locational referencing for other data layers.

3.6.2 Land Records Layers

These spatial data records include cadastral features such as sections, blocks, lots, parcel centroids, and tabular information about those features. The associated tabular information is often in the assessment role and may include a wide variety of data about characteristics of ownership, development activity, and assessed values. Records such as zoning and special tax districts boundaries should also be included in this category.

3.6.3 Transportation Layers

These spatial data records include street centerlines, roads and road network, intersections, signs, signals and other features that comprise the transportation facilities in the City. Street centerlines from the City's E911 file may carry address ranges for automatic address matching and mapping of address-based information, such as resident complaints, inspection scheduling, permit tracking, traffic accidents, or locations of sensitive data such as law enforcement information, vital statistics, or public health information.

3.6.4 Utility Layers

These spatial data records include utilities data contain the location and relationship between City owned facilities such as water and sewer lines, as well as other utilities including gas and electric lines. Tabular information associated with these maps includes characteristics of the lines and related facilities such as pump stations and valves. Utilities map data may also contain links to engineering drawings and plans, which may be viewed in conjunction with a specific facility.

3.6.5 Administrative Layers

These spatial data records include census boundaries, land use boundaries, election districts, political boundaries, fire districts, and other community zones. These layers should illustrate the boundaries of various administrative, service, and statistical analysis areas. Police incident data, traffic accidents, and other public safety data should be included in this category.

3.6.6 Environmental Layers

These data records include features of the natural environment such as hydrography, soils, surface geology, wetlands, rivers, ponds, floodplains, steep slopes, open spaces, and elevation models. Environmental layers provide information on the shape and location of natural features within the City and potential threats to the quality of the natural environment. Threats would be represented in features such as

hazardous materials storage, permitted industrial discharge locations, or other high impact threats to the environment.

3.7 Master Data List

The Master Data List found below is a sample of the datasets that will be implemented and created during the first phases of the City's GIS development. Because data will be created during GIS usage and through GPS data collection, the data listed is only a representation of a greater list that will be realized when the City's GIS is implemented and data consumption and analysis begins.

3.7.1 Basemap

Table 5 - Typical Basemap Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: BASEMAP				
Planimetric	CAD	N/A	< 11	Orange County City of Newburgh
Streams & Rivers	Line	Name Grade	< 1	NYS CSCIC
Lakes, Reservoirs	Poly	Area Name	< 1	NYS CSCIC
Municipal Boundaries	Poly	Name	< 1	Orange County
ALIS Roads	Line	N/A	N/A	NYS CSCIC
FEATURE DATASET: CONTROL				
Control Points	Point	Elevation	< 1	*City of Newburgh
FEATURE DATASET: ELEVATION				
10' Contours	Line	Elevation	< 50	US Geological Survey
Spot Elevation	Point	Elevation Category	< 3	*City of Newburgh
Slope	Poly	Class	< 12	NYS Geological Survey
FEATURE DATASET: IMAGERY				
Digital Orthophotography	Raster	N/A	< 300	NYS CSCIC

* - denotes data to be developed from other layers or by GPS data collection

3.7.2 Administration

Table 6 - Typical Administration Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: DEMOGRAPHIC				
1990 Census Blocks	Poly	Census Block Code Demographics	< 1	Census - CUGIR
2000 Census Blocks	Poly	Census Block Code Demographics	< 1	Census – CUGIR
1990 Census Block Groups	Poly	Block Group Code Demographics	< 1	Census - CUGIR
2000 Census Block Groups	Poly	Block Group Code Demographics	< 1	Census - CUGIR
1990 Census Tracts	Poly	Census Track Code Demographics	< 1	Census - CUGIR
2000 Census Tracts	Poly	Census Track Code Demographics	< 1	Census - CUGIR
FEATURE DATASET: ELECTORAL				
Voting Districts	Poly	District ID SWIS Code	< 1	Orange County
Assembly Districts	Poly	District ID	< 1	NYS CSCIC
FEATURE DATASET: SPECIAL DISTRICTS				
School Locations	Point	Name	< 1	City of Newburgh
School Districts	Poly	Name District Code	< 1	City of Newburgh
Economic Development Zones	Poly	Name	N/A	Empire State Development Corporation City of Newburgh
Fire Districts	Poly	District Code	< 1	Orange County
FEATURE DATASET: MUNICIPAL CENTERS				
Municipal Halls	Point	Name	<	City of Newburgh
Parks/Open Space	Poly	Name	N/A	City of Newburgh

3.73 Environmental

Table 7 - Typical Environmental Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: HYDROGRAPHY				
Streams & Rivers	Line	Name Grade	< 1	NYS CSCIC
Lakes, Reservoirs	Poly	Area Name	< 1	NYS CSCIC
NYSDEC Wetlands	Poly	Wetland ID Class	< 3	NYS CSCIC
Federal Wetlands	Poly	Wetland ID Class	< 2	US Fish and Wildlife
100' Protected Wetland Buffer	Poly	Wetland ID	<2	City of Newburgh
Watershed Boundaries	Poly	Area River Basin	< 2	NYS CSCIC
100 Year Flood Plain	Poly	Area Zone	< 5	NYS CSCIC
500 Year Flood Plain	Poly	Area Zone	< 5	NYS CSCIC
FEATURE DATASET: HAZARDOUS MATERIALS				
Hazardous Waste Sites	Point	Name Site ID	< 1	EPA
Contamination Sites	Point	Description	< 1	*City of Newburgh
Industrial Discharge Locations	Point	N/A	N/A	*City of Newburgh
FEATURE DATASET: SOILS				
Hydric Soils	Poly	Class Type	< 7	USDA
Soil Type	Poly	Type	< 3	USDA
Permeable Soils	Poly	Type	< 6	USDA
Surface Geology	Poly	Material	< 1	NYS Geological Survey
Bedrock Geology	Poly	Type	< 1	NYS Geological Survey

3.7.3 Land Records

Table 8 - Typical Land Record Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: CADASTRAL				

Tax Parcels	Poly	Parcel ID Address Assessed Value Property Cass Owner Name Owner Address District ID	N/A	Orange County City of Newburgh
Building Footprints	Poly	N/A	N/A	City of Newburgh
FEATURE DATASET: HISTORIC				
Historic Places	Point	Name	< 1	NYS Parks, Rec. & Historic Preservation
National Register Sites	Point	Name	< 1	NYS Parks, Rec. & Historic Preservation
FEATURE DATASET: CODE				
Zoning	Poly	District ID	< 1	City of Newburgh
Building Permit Locations	Poly	Type Owner Name Address Status	N/A	*City of Newburgh
FEATURE DATASET: SPECIAL USE				
Easements	Poly	ID Name	N/A	*City of Newburgh
Right of Way	Poly	ID Name	< 1	*City of Newburgh

3.7.4 Utilities

Table 9 - Typical Utility Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: DRAINAGE				
Catch Basin	Point	Material type Size Invert Elevation Condition	N/A	City of Newburgh
Storm Manholes	Point	Material type Size Invert Elevation Condition	N/A	City of Newburgh
Outfalls	Point	Material type Size Condition	N/A	City of Newburgh
Drainage Basin Boundaries	Poly	Name	N/A	City of Newburgh
FEATURE DATASET: ELECTRIC				

Transmission Line	Line	N/A	N/A	NYS CSCIC *City of Newburgh
Substations	Point	Name	N/A	NYS CSCIC *City of Newburgh
Utility Poles	Point	Owner Type material Attachments	N/A	NYS CSCIC *City of Newburgh
Street Lights	Point	Owner Wattage	N/A	*City of Newburgh
FEATURE DATASET: GAS				
Transmission Pipes	Line	Size	N/A	NYS CSCIC *City of Newburgh
Gas Substations	Point	Name	N/A	NYS CSCIC *City of Newburgh
FEATURE DATASET: RAILROAD				
Track Centerline	Line	Name Owner	< 1	NYS CSCIC
State Structures	Point	Name	< 1	NYS CSCIC
FEATURE DATASET: SANITARY SEWER				
Sewer Districts	Poly	Name	N/A	City of Newburgh
Sewer Manholes	Point	Material Type Size Invert Elevation Condition	N/A	City of Newburgh
Sewer Pipes	Line	Material Type Diameter Upstream Invert Elev Downstream Invert Condition	N/A	City of Newburgh
FEATURE DATASET: TRAFFIC				
Signs	Point	Type Condition Date Installed	N/A	City of Newburgh
Signals	Point	Type Condition Date Installed	N/A	City of Newburgh
FEATURE DATASET: WATER DISTRIBUTION				
Water Districts	Poly	Name	N/A	City of Newburgh
Water Mains	Line	Material Type Diameter Upstream Depth Downstream Dept Condition	N/A	City of Newburgh
Fire Hydrants	Point	Model Condition Connections	N/A	City of Newburgh

Water Valves	Point	Type Condition Depth	N/A	City of Newburgh
Water Supply Facilities	Point	Name	N/A	City of Newburgh

3.7.5 Transportation

Table 10 - Typical Transportation Features

FEATURE CLASS	TYPE	TYPICAL ATTRIBUTES	APPROX. SIZE (MB)	SOURCE
FEATURE DATASET: TRANSPORTATION				
Street Centerlines	Line	Name Category Owner Address Ranges Snow Removal Route	< 10	NYS CSCIC City of Newburgh
Transportation Structures	Line	Name Category Owner	< 4	*City of Newburgh
Address Points	Point	Address Ranges	N/A	Orange County
FEATURE DATASET: EMERGENCY MANAGEMENT				
County EMS Districts	Poly	Name District	N/A	Orange County
Hospitals	Point	Name	N/A	NYS CSCIC
Emergency Service Boundaries	Poly	Owner Service Number Area Population	N/A	Orange County
Helicopter Land Sites	Point	Name	N/A	*City of Newburgh
FEATURE DATASET: FIRE				
Fire Districts	Poly	Name District Code	N/A	Orange County
Fire Station Locations	Point	Name	N/A	City of Newburgh
Fire Incident Locations	Point	Type Date Severity	N/A	*City of Newburgh
FEATURE DATASET: POLICE				
Police Stations	Point	Name	< 1	Orange County
Crime Incident Locations	Point	Type Date Severity	N/A	*City of Newburgh

When physically implemented, these major categories (Basemap, Land Records, Administration, Environmental, Utility, and Transportation) can become Database elements such as Feature Datasets[2] and Feature Classes[3] that store individual spatial data layers. A sample database structure is shown below (See Figure 8)

Figure 8 – Sample GIS Database Structure

[2] Feature Dataset is a collection of feature classes stored together that share the same spatial reference and similar traits. Feature Datasets often group feature classes into logical categories.

[3] Feature Class is a collection of geographic features that allow homogeneous GIS data to be grouped into a single unit for data storage purposes

3.7.6 Priority Data Needs

The City should focus on spatial data development from the first day of the implementation. The Master Data List should be constantly updated as new datasets become available from external sources and developed internally. Table 11 below shows the minimum GIS data layers for the proposed GIS as well as the fields that should be extracted from other City departments through an ETL routine:

Table 11 – Priority Data Needs

APPLICATION NAME	DATA FOR APPLICATIONS			
	SPATIAL DATA	NON SPATIAL DATA		
GIS Viewer	• Orthophotography • Roads • Tax parcels • City boundary • Easements • Right-of-way • Zoning boundaries • Water mains • Sewer mains • Storm sewer mains	*From RPS* • Owner • Address • Property class • Assessment value • Acreage • Frontage • Depth • Neighborhood • Historic district • View preservation • Colonial Terraces • Waterfront • Number of rooms • Year built • Stories • Style • Heat • Fuel • Exemption	*From InHance* • Account number • Customer name • Customer address • Customer phone • Meter number • Serial number • MSU number • Meter install date • Meter location • Reading • Route • Average consumption • Inspection card • Picture	*From IPS* • Building permits • CO status • Violation status • Applicant name • Issue date • Location • Permit number • Permit type • Permit status • Description • Complaint number • Complaint type • Comply date • Fee • Vacant registry

3.7.7 Metadata

Metadata can be defined as data about data. That is, each time spatial data is acquired, created, or modified; data about acquisition, creation, and modification must be recorded to prevent potential future confusion about the data. For example, when parcel data is created and each time it is updated, the metadata entries must

be maintained as part of the process. Figure 9 shows metadata for the Parcels data layer.

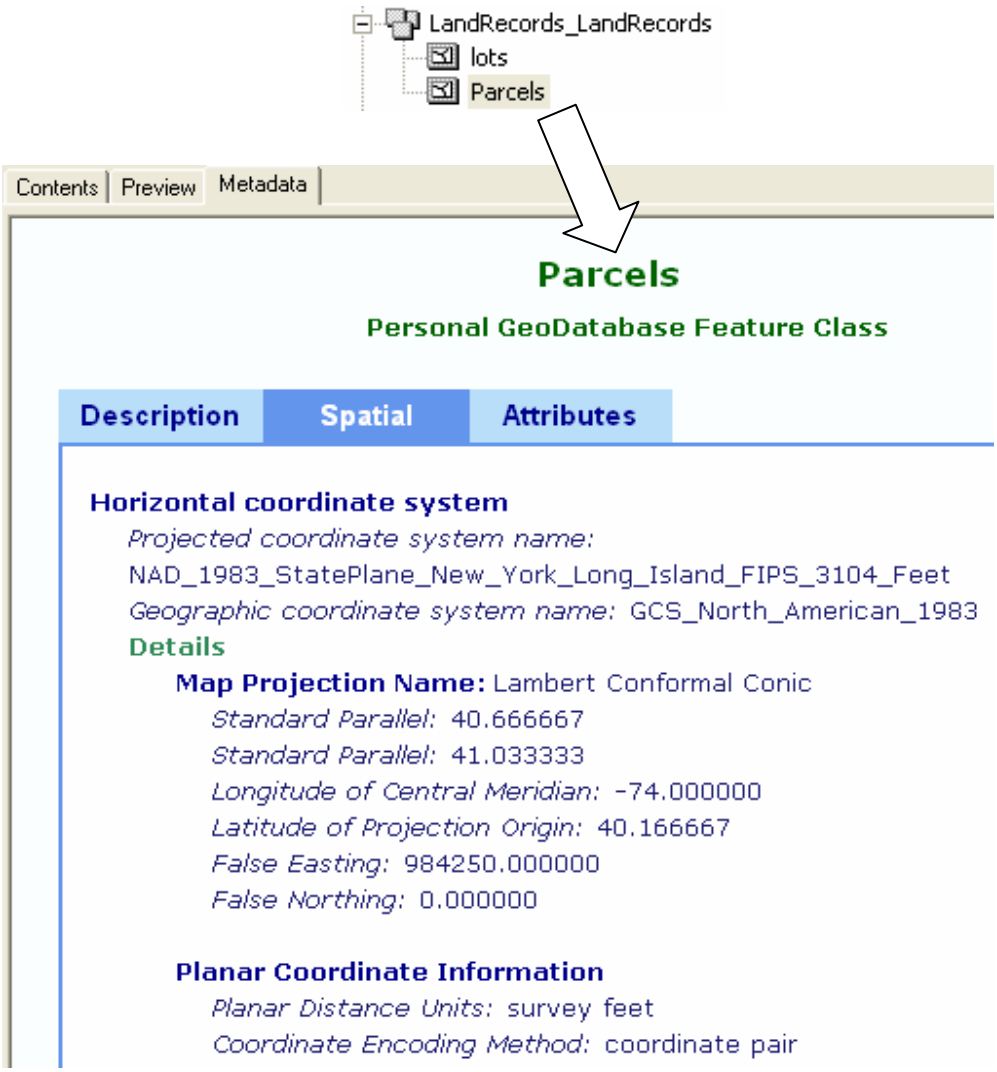


Figure 9 – Metadata Example

Many GIS software platforms provide easy to use tools to keep metadata up-to-date. Bowne recommends that the City make necessary and appropriate modifications to metadata using the out-of-the-box tools that come with ArcGIS.

3.8 Hardware and Software Considerations

This conceptual system design includes a recommended configuration of hardware, software and network infrastructure required to support the GIS applications and data specified in this report for the City.

3.8.1 Hardware

The recommended hardware that will support the City-wide GIS is described below.

GIS Server

It is recommended that the City continue to utilize the server that is available in the GIS Analyst's office as the central storage location for all GIS related datasets.

Desktop GIS Personal Computers

End users who will not utilize desktop GIS software packages will use their existing PCs to access online GIS applications. The only requirement for each PC is to have Internet connection and a standard browser, such as Internet Explorer, to use the City's GIS. The users who will run desktop GIS software packages will need PCs with the following minimum recommended specifications:

- Windows 2000 or XP
- Pentium Processor
- 512 MB RAM (1 GB is suggested)
- 120 GB Hard Disk
- CD and/or DVD read/write Drive
- 17" or 19" Monitor
- High speed Internet Connection

Mobile GIS Unit

For field data collection, a handheld Global Positioning System (GPS) device is recommended. It is important that the GPS device conform to municipal mobile GIS industry standards. Because this device will be used by all departments in the City, it must meet the requirements of the highest level of usage, which will be an added benefit to other department's whose projects do not require the highest possible level of accuracy. Although there are many GPS devices commercially available, it is recommended that the City continue to utilize its existing GeoXH handheld GPS unit from Trimble Navigation Ltd. This device is ideal for use by local government organizations for managing assets or mapping critical infrastructure at a sub-foot level of positional accuracy. The Trimble device is suggested over its competitors because, in addition to its proven reliability and prevalent usage throughout government agencies, Trimble has established a considerable support network of local Trimble Dealers readily available in the surrounding area. Trimble Dealers are available to provide technical support, repair equipment, offer rental GPS equipment, and provide additional training.

It is also important to select the proper software to generate the intended results while collecting field data and when data is brought into the office GIS. By using the suite of software below, the City will have the ability to collect or update existing GIS data in the field, to verify positional accuracy levels and to seamlessly input data into the geodatabase.

- Trimble GeoXH GPS
- Trimble TerraSync Software
- GPS Pathfinder Office Software
- Hurricane Antenna
- Vehicle Charger
- Serial Clip

Large Format Color Plotter

A large format printing/plotting device capable of generating plots 36" wide (or wider) is recommended. The plotter should have a built-in network interface card so that it is configurable as a network-accessible device.

It is recommended that the City continue to utilize the plotter that is available in the GIS Analyst's office for all GIS related plotting needs.

3.8.2 Software

One of the key decisions every municipality should make is to decide which collection of software products should be implemented. Established software vendors include Autodesk, Bentley Systems, Environmental Systems Research Institute (ESRI), Intergraph Corporation and MapInfo Corporation. The following criteria should be considered when selecting a software vendor:

- **Compatibility with the City's existing IT infrastructure:** Do the vendor's products work with existing operating systems, databases, web servers and other key pieces of IT infrastructure?

- **Experience with municipal government:** Does the vendor have a track record of supporting the development of GIS solutions for municipal government?

- **Installed base:** Who else is using the vendor's products? What is the installed base in the state, nationally and internationally?

- **Cost:** Are the software products competitively priced? It is important to consider not only the cost of initial acquisition but also maintenance, support and upgrade fees.

- **Technical Support:** Is technical support from the vendors or their business partners available? How is contact made? During what days of the week and working hours is technical support

available? What are the sources of product related information? (e.g. websites, knowledge bases, etc.). Does the vendor have business partners that can assist with implementation issues and provide value-added products?

Having evaluated the range of software choices using these criteria, Bowne recommends that the City continue to utilize ESRI software products as the City has already made a financial commitment to using this software. ESRI has the broadest product portfolio with the largest install base world-wide. NYS governments at local, county, and state levels have been using ESRI tools to create, share, and distribute spatial data. Therefore most of the data available from other government agencies are available in ESRI or ESRI-compatible formats. ESRI's software packages are competitively priced and technical support is available from both ESRI and several ESRI business partners in New York State.

The products that will support the City-wide GIS include:

ArcGIS Server Standard Enterprise Edition – ArcGIS Server Standard is designed for GIS users who want to provide a central, server-based GIS for publishing geographic data as maps and globes. It provides spatial data management and visualization (both 2D and 3D) capabilities. The Enterprise level of ArcGIS Server supports an unlimited number of users via either direct connect or connection to an application server. It offers DBMS support for IBM DB2, IBM Informix, all editions of Microsoft SQL Server, and Oracle. It has no data or memory limits

ArcGIS Server will be replacing some of the existing server based products that ESRI currently offers. The Spatial Database Engine (ArcSDE) that communicates with Relational Database Management Systems (RDBMS) and the Internet Mapping Server (ArcIMS) will be bundled and released as the ArcGIS Server product.

ArcGIS ArcInfo – ArcInfo is a powerful GIS desktop system for editing and managing geographic data, advanced spatial analysis, extensive data manipulation, and provides high-end cartography tools. ArcInfo provides all the tools to build and manage a complete, intelligent GIS including maps and globes, data, metadata, geodatasets, and workflow models.
This functionality is accessible via an easy-to-use interface that is customizable and extensible through models, scripting, and applications.

3.8.3 Network Infrastructure

Although network infrastructure is not part of the scope of this project, it should be noted that the City has an advanced network infrastructure. Bowne recommends that this infrastructure continue to be maintained as solid network infrastructure has a impact on the success of the City's GIS.

3.9 Staffing, Training, and Financial Support

3.9.1 Staffing

GIS planning and implementation is no different from other information systems or technology projects. An important aspect of GIS implementation is its staffing. Prior to the GIS implementation it is recommended that the City task one individual to take on the following role:

> GIS Coordinator - This individual will coordinate the efforts of department resources towards effective use of GIS in the City. A successful implementation will require leadership and ownership, while effective GIS usage will require someone who can coordinate and oversee the growth of GIS data, applications, hardware, and software. The City currently has a GIS Analyst who should be also tasked as a GIS Coordinator.

The City has formed a GIS Steering Committee as described in the City's GIS Policy Guideline (see Appendix A – GIS policy guideline). The formation of an additional committee is recommended. The purpose and structure of these committees is described below:

> GIS User Committee - This group would be comprised of a larger number of active GIS users from various departments. Its primary focus is to act as an informational and educational forum. Issues, problems or concerns relating to GIS activities would be brought to the attention of the GIS Steering Committee. User Committees are most useful when they are established after GIS technology has been implemented and users develop needs or wants that should be shared with other GIS users.
>
> The User Committee is the driving force of any GIS community. They are the front line users of the system and reflect the needs of data consumers throughout the City. In this role they are positioned to make recommendations which will best utilize available resources. Project ideas will most often be generated by this group. Traditionally these groups also exchange ideas and assist each other by providing solutions to problems already resolve by one or more members. Many times data is shared among interested members.

Relationships with other organizations and consultants should continue to be fostered. Partnerships with organizations such as local governments, County, and State agencies are recommended including:

- NYS Office of Cyber Security and Critical Infrastructure Coordination (CSCIC), New York State Data Sharing Cooperative – there appears to be a benefit to membership in the Cooperative as existing data records available to the City are limited. By joining the Cooperative, increased data would be available for increased analysis and improved decision making. The City has an existing Fee Schedule (see Appendix C – GIS Fee Schedule) for its data and map production services and an agreement with any data sharing cooperative could conflict with the City's existing program

and visa versa. Many datasets that are in the CSCIC Data Sharing Cooperative are free to download without becoming a member. Data necessary for the City to properly function should be reviewed by the GIS Steering Committee. The Committee can then determine is sharing City data is worth the benefit that could be accessed through becoming a member of the data sharing cooperative.

An attempt should be made to contact and work with the following organizations to determine what GIS and GIS-related data they have and are or would be willing to share:

- New York State Department of Environmental Conservation (NYS DEC)
- New York State Department of State (NYS DOS)
- New York State Department of Agriculture and Markets
- New York State Empire Economic Development
- State University of New York at New Paltz
- Mount Saint Mary College
- Federal Emergency Management Agency (FEMA)
- United States Census Bureau
- United States Army Corps of Engineers (USACE)
- Orange County Division of GIS

Additional resources will be required to support the GIS and the City must decide the most appropriate and cost beneficial staffing strategy to meet these needs, be it through adding new staff, re-training existing staff, utilizing consultants, or some mix thereof.

Bowne also recommends that representatives of the GIS Steering Committee participate in local and state user group meetings and conferences. Attendees can take advantage of the networking that takes place at local user groups, conferences, and seminars. User Groups, conferences, and seminars offer the opportunity to meet face to face with other GIS professionals, teachers, developers and users. The following are key local and state GIS organizations, events and resources most relevant to the City:

New York State GIS Conference – Annual 2-3 day event held in October in upstate New York (e.g. Albany in 2007, Lake Placid in 2006, Rochester in 2005). The conference consists of a multi-track agenda with dozens of presentations and specialty topic meetings/work sessions. Participants include federal, state and local government, the non-profit community, academia and private industry. URL: http://nysgisconf.esf.edu

New York State GIS Association GeoSpatial Summit – "The NYS GIS Association is a non-profit organization for New York professionals involved in GIS, Global Positioning Systems (GPS), land information systems (LIS), remote automated mapping and related geospatial technologies. The organization is designed for those involved in the GIS community to exchange knowledge and ideas regarding important

topics facing the industry in the coming years. The Association promotes a forum for open discussion regarding the direction of the GIS profession. The mission of the New York State GIS Association is to assist, educate, coordinate and guide the implementation, development and maintenance of GIS technology in the State of New York. The Association welcomes and encourages additional involvement from government administrators, managers and other geospatial technology professionals." (www.nysgis.org)

Northeast Arc Users Group – The Northeast Arc Users Group (NEARC) is one of several independent regional organizations that represent users of GIS software developed by Environmental Systems Research Institute (ESRI). The yearly conference features keynote sessions, vendor demonstrations, poster displays and over 60 technical workshops and user presentations. The geographic area encompassed by the group includes New England, New York and New Jersey, with some participation from users in Pennsylvania and Delaware. (www.northeastarc.org)

New York State GIS-LIS listserv – Over 1,000 people have joined the NYS GIS-LIS listserv, which is an e-mail-based forum for communication among GIS users across the state. Topics include notification of upcoming GIS events and educational opportunities and technical discussions. Interested individuals can sign-up for the list-serv at: http://lists.plattsburgh.edu/mailman/listinfo/nys-gis-lis

3.9.2 Education Types and Sources

Wide arrays of GIS training options are available. Outlined below is a brief list of available training options that can be used in addition to the recommended training that accompanies the first three phases of GIS implementation (see Section 6).

Instructor-Led Study

- *ESRI's Instructor Led Courses:* "ESRI offers a wide variety of instructor-led courses that explain GIS concepts, explore GIS applications, and teach people to use ESRI GIS software and related technologies. Instructor-led courses combine personal delivery, hands-on experience, and class participation to create a rich learning environment. With class time divided about equally between lectures and exercises and ESRI's policy of one person per computer at ESRI's modern training facilities, students have ample time to practice their skills and apply what they learn. Individual attention, direct peer interaction, professional networking, and the ability to get answers to questions immediately are essential benefits of instructor-led training" (http://training.esri.com).

- *Local Vendors through ESRI's Authorized Training Program (ATP):* ESRI's Authorized Training Program (ATP) allows third party instructors to train students using ESRI courseware. All ATP courses utilize the same learning materials as ESRI instructor-led classes. One advantage of ATP classes over

- ESRI instructor-led courses is the convenience of local expertise and increased instructor availability.

- *Instructor-Led Virtual Classroom Course:* "The Virtual Classroom combines the focus of an instructor-led course with the convenience of Web-based training. Students can remain productive while they learn, and organizations can save on the costs associated with employee travel. Each Virtual Classroom course includes nine hours of training on a focused topic delivered in three consecutive half-day sessions over the Internet. Morning and afternoon sessions allow students to schedule training that best fits their workday. Small class sizes support communication among students and with the instructor. Expert instruction, convenience, and an interactive classroomlike environment are hallmarks of Virtual Classroom training. Access to the latest ESRI software via Citrix and the ability to ask questions and get answers in real time make for a complete training experience" (http://training.esri.com).

- *Instructor-Led Course offered by Professional Services:* Leveraging their expertise in real-world projects, the ESRI Professional Services consulting staff design and teach courses for specific industry solutions or products. The format varies from course to course based on the needs of the client.

- *SUNY New Paltz:* Available through SUNY New Patlz, GIS, cartography, and remote senses courses provide students with the fundamental concepts of GIS technology, while contributing three college credits toward a degree.

Self-Study (Virtual Campus)

- *ESRI Virtual Campus Web Courses:* ESRI Virtual Campus offered self-paced training over the Internet. It is an affordable, high-quality learning experience using interactive exercises, examples, and instructional resources to create a rich learning environment. Web courses teach a variety of topics related to ESRI software, the theory underlying GIS technology, and the application of GIS tools in particular fields. Each learning module takes approximately three hours to complete. Some courses are free of charge." (www.esri.com)

- *ESRI Online Training Seminars*: ESRI offers free, live, online training seminars hosted by technical experts. The seminars are designed to introduce new topics, tips and tricks to the existing GIS user community through short, online presentations and demonstrations. Users can also download previously recorded demonstrations after the live seminar is complete. (http://training.esri.com)

Seminars

- *New York State GIS (NYSGIS) Training Classes & Workshops :* Affiliated with the New York State GIS Clearinghouse, hosted by the NYS Office of Cyber Security and Critical Infrastructure Coordination, NYS GIS provides access to GIS training opportunities, tools, educational institutions and curriculums

professional associations, publications and reference and research programs (www.nysgis.state.ny.us)

- *ESRI Worldwide Seminars*: ESRI provides one-day seminars free of charge at locations around the world on a regular basis. They are designed to encourage the use of the latest ESRI products and to teach GIS professionals the newest tools and software available to the GIS user community.

3.9.3 Funding Sources

There are a variety of possible approaches for funding GIS development and operation:

- City Operating Budget - Use of the City's operating budget is the first avenue of funding for GIS activities. It is important to note that GIS is a support service for many City functions and users. Operating funding can be used for GIS staff, materials, and equipment necessary for the system's operation.

- Capital Project Budget - The use of capital funding for GIS development is feasible within the State guidelines for capital projects. Typically capital funding can be used for acquisition of hardware, software, licenses, applications, and even data as long as the City can document that the proposed purchases will have an expected life of at least several years. Capital funding can not generally be used for operating expenses related to the GIS. The use of capital funding can give the City a larger initial level of funding without significant impact on the operating budget but the decision is purely one to be made at the Executive and Legislative levels.

- Revenue Generation - There are two schools of thought regarding revenue generation from GIS programs. Some governments have adopted the approach that GIS data is a government product paid for by the taxpayers and therefore must be offered at minimal or no cost to anyone requesting it. Other governments have adopted the attitude that GIS data is a valuable commodity, paid for by the taxpayers, and that outside users should be required to repay that taxpayer investment through fees for the sale of data and/or subscription services for access to it. Both approaches are viable - the decision is purely one of politics and policy to be made at the Executive or Legislative level.

- Grants - A number of State and Federal agencies offer grants that can be used for specific projects. The main drawback to grant funding is that it is typically a one shot source of revenue with varying levels of control and limitation on their use. The City should aggressively pursue any grant opportunities but should not depend on grants as a stable or long term funding source.

3.9.4 Grant Opportunities

There are many resources available to the City for obtaining grants to expand the usage and capabilities of GIS. Many of these opportunities are from state and federal agencies which require specific goals be achieved that pertain to the mission of the agency. These goals include agencies whose missions focus on environmental protection, transportation, records management, housing, disaster mitigation, etc. It should be noted that while GIS may play a part in achieving an agency's goals, it is usually not the primary focus of the agency's funding programs.

Seeking funding is an ongoing process that should be pursued with diligence. This process can be time consuming. An option for the City to employ a Grant Writer as a permanent or part-time staff to research potential technology and GIS related funding sources and develop the necessary grant proposals. The list below, although comprehensive, provides funding opportunities to enhance GIS.

New York State Funding

- *New York State Archives and Records Administration (SARA)* - Provides support for projects that improve the creation of records and the design and implementation of records systems. Funding has been provided for GIS needs assessments and implementation plans, as well as some limited initial GIS implementation. Projects must follow the process described by the New York State Archive's (http://www.archives.nysed.gov/a/grantsawards/index.shtml/).

- *Shared Municipal Services Incentive Grant Program (SMSI)*- from the New York State Department of State – this grant provides support for the development of projects including two or more units of local government that will achieve savings and improve municipal efficiency through shared services, cooperative agreements, mergers, consolidations and dissolutions which includes any technology related project that involves multiple municipalities (i.e., County and City) sharing data and/or services and any technology related project that involves multiple municipalities consolidating data and/or services. (http://www.dos.state.ny.us/lgss/smsi/smsihome.html)

- *Governor's Traffic Safety Committee* - Provides start up or seed money for new programs directed at identifying and correcting highway safety problems. Funding for data capture, software and hardware (such as GPS equipment) is available. Mapping signs, bridges, and road conditions are typical projects. (http://www.nysgtsc.state.ny.us/overview.htm)

- *Department of Environmental Conservation, Water Quality Monitoring/Improvement Programs* - Provides support to municipalities and soil and water conservation districts for water quality improvement projects. Project areas may include municipal wastewater treatment improvement, agricultural and nonagricultural non-point source abatement and control, aquatic habitat restoration, and pollution prevention. (Funded under the Environmental Quality Bond Act) (http://www.dec.ny.gov/pubs/grants.html)

Federal

- *Department of Commerce's Technology Opportunities Program (TOP)* – Promotes the widespread availability and use of advanced telecommunications technologies in the public and non-profit sectors. As part of the Department's National Telecommunications and Information Administration (NTIA), TOP gives grants for model projects demonstrating innovative uses of network technology. TOP evaluates and actively shares the lessons learned from these projects to ensure the benefits are broadly distributed across the country, especially in rural and underserved communities.

- *Office of Community Oriented Policing Services from the U.S. Department of Justice (commonly referred to as COPS)* – this grant can be used to apply for technology projects that promote community oriented policing in a government. These include: Technology Grants (TECH) – fund projects to develop technologies that will advance community policing and help fight crime, 311 Grants (311) – responds directly to the emerging needs of state and local law enforcement. COPS funded the first 311 systems in the county. The new number helps eliminate the dependence on the 911 system for non-emergences. : (http://www.cops.usdoj.gov)

- National Institute of Justice - Very competitive grant program to assist units of local government to identify, select, develop, modernize, and purchase new technologies for use by law enforcement. (http://www.ojp.usdoj.gov/funding/)

- *Federal Geographic Data Committee - T*he Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis. This nationwide data publishing effort is known as the National Spatial Data Infrastructure. The FGDC has created the Cooperative Agreements Program (CAP) for projects that will establish clearinghouses to find and access geo-spatial 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. (http://www.fgdc.gov/grants)

- *U.S. Geological Survey* - The US Geological Survey (USGS) offers multiple grant and/or cooperative agreement opportunities to local governments for projects performed in partnership with the USGS. (http://www.usgs.gov/contracts/grants/)

- *U.S. Environmental Protection Agency* - The Environmental Protection Agency (EPA) provides support for open space preservation, parks creation, brownfields clean up, water quality improvement, environmental protection, pollution prevention and public education/outreach programs. (http://www.epa.gov/epahome/grants.htm)

- *U.S. Department of Housing and Urban Development* - The U.S. Department of

- Housing and Urban Development (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. (http://www.hud.gov/offices/adm/grants/fundsavail.cfm)

- *Federal Emergency Management Agency Assistance to Firefighters Program* - The goal of the Assistance to Firefighters Grants (AFG) is to meet the firefighting and emergency response needs of Fire Departments and nonaffiliated emergency medical services organizations. The AFG helps firefighters and other first responders to obtain critically needed equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards. The National Preparedness Directorate in the Federal Emergency Management Agency administers the grants in cooperation with the U.S. Fire Administration. (http://www.firegrantsupport.com/afg/)

Other Sources

- ESRI sponsors grant programs that promote innovations in applying GIS to real-world problems and help organizations that serve society and better the environment. (http://www.esri.com/grants/index.html)

3.10 Conceptual GIS Configuration

The City has an established network infrastructure in place, and by incorporating the existing hardware and recommended software listed above in Section 5 an Enterprise GIS can be easily incorporated into the existing environment. This approach makes use of the exiting infrastructure while centralizing the GIS data and data from other departments. The data will be widely accessible and shareable, unlike purely standalone desktop deployments, due to the creation of a secure centrally managed GIS data repository. All related GIS applications proposed will use this repository to “serve” the necessary data to thin (browser based) or thick (desktop) clients. Figure 10 below is a high-level representation of the conceptual system design of the City of Newburgh GIS. Data is centrally stored and delivered to users through the intranet and through direct connections to the GIS server.

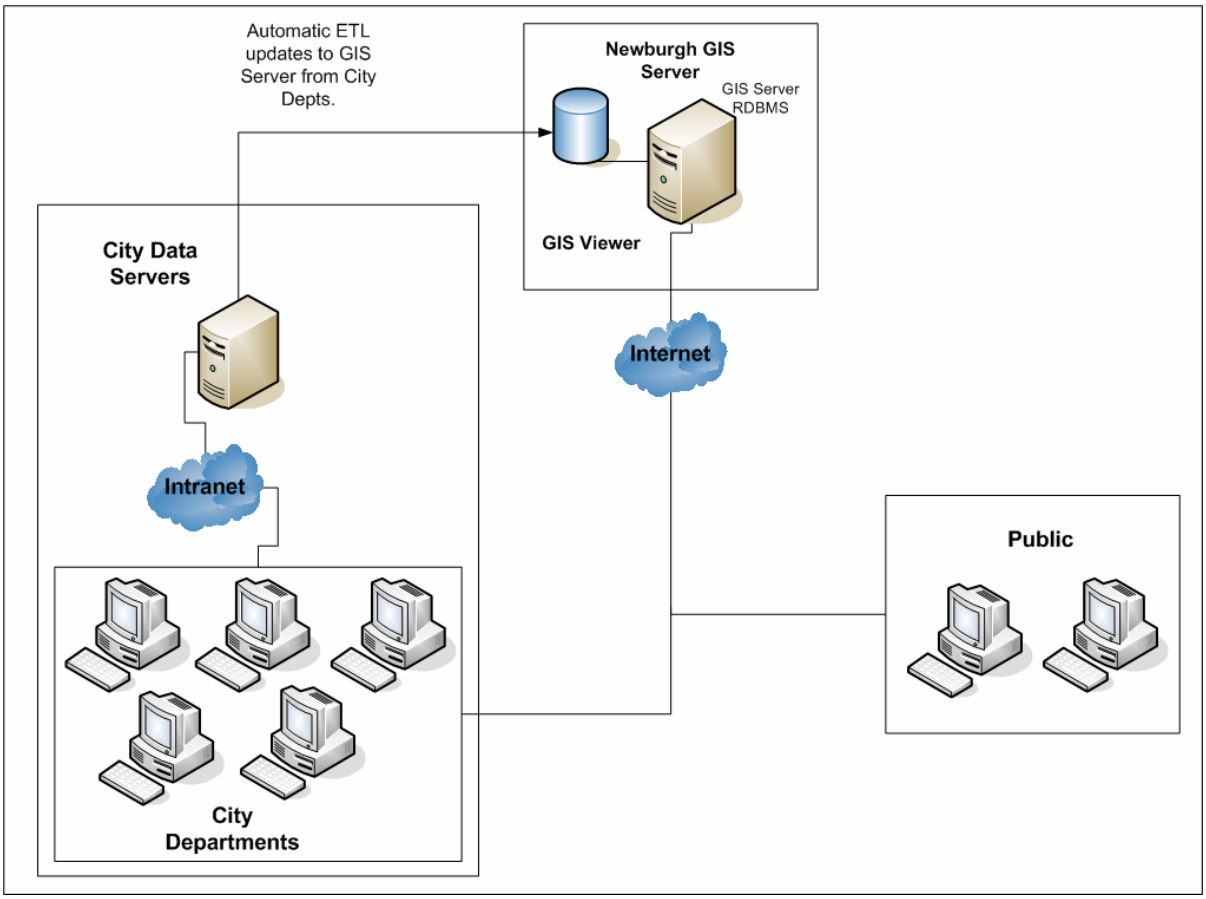


Figure 10 - Conceptual GIS Configuration

4. RECOMMENDATIONS

The recommendations in this Section cover general, GIS and non-GIS specific applications, data, IT, staffing, and training. They are suggested for the entire development life-cycle of the City's GIS.

4.1 General Recommendations

Bowne's general recommendations regarding GIS implementation include the following:

G.1 - Implement using the Enterprise GIS approach;

G.2 - Use a phased approach to implementation (three phases are defined in Section 7 of this document); and,

G.3 - Tie the implementation phases to the City's fiscal-year cycle.

Specific recommendations in the areas of GIS applications, data, systems infrastructure, staffing and organizational infrastructure are presented in the rest of this section.

4.2 Application Recommendations

4.2.1 GIS Applications

Bowne recommends the following GIS applications:

A.1 – Develop an ETL tool that extracts, transforms, and loads existing City data into a central geodatabase

A.2 – Develop a web-based GIS Viewer that provides access to the most frequently used spatial and non-spatial data with standard and custom designed tools;

A.3 – Develop Online Work Order System; and,

A.4 – Develop the Online Map Library to function within the GIS Viewer.

4.2.2 Non-GIS Related Applications

The following non-GIS related application needs were identified during the Needs Assessment process. Although these needs are outside the scope of this document, they are offered as issues that directly effect City departments' ability to effectively provide services to residents. Bowne recommends that these potential applications be further explored:

A.5 – The ability to generate a form that automatically populates address information for exemptions;

A.6 – Access to Certificates of Occupancy as they are issued:

A.7 – The ability to associate building pictures with parcel records;

A.8 – The ability to establish a link between the Tax Collector's Office and the KVS software, with the Clerk's Office to identify property tax issues that require action;

A.9 –The need to standardized name and address fields in a database for applicants and employees that could be shared among relevant departments;

A.10 – The ability to digitally archive hard copy exams and personnel transaction records using LaserFich;

A.11 – The ability to share data with the Comptroller Office for payroll;

A.12 – The ability to open, track, and close building permits;

A.13 – The ability to generate certificates of occupancy;

A.14 – Ability to use raw data to perform analysis and aid policy makers with decision process;

A.15 – Assist with identifying challenges by reviewing quality of life indicators within a community or ward and aid in recommending solutions;

A.16 – The ability to generate printed reports for emergency plans;

A.17 – The ability to query historical owner information;

A.18 – The ability to better index City council proceedings and the generation of a City calendar;

A.19 – The ability to generate a historical City personnel list to include the name, job title, and relevant dates;

A.20 – The ability to allow City residents access to a viewer that allows them to check their bills and payments using an address search;

A.21 – The ability to access residential and commercial tax records;

A.22 – The ability to access the Water Department's water billing information, including customer phone numbers, timeliness of payment and locations of delinquent customers;

A.23 – The ability to analyze data regarding past and present property conditions;

A.24 – The ability to track and manage City assets;

A.25 – The creation of a GIS-based work order system could allow departments to better track current and past maintenance on City infrastructure/assets;

A.26 – The need for access to standardized name and address data from the Water Department;

A.27 – The need to streamline data flow between City departments; and,

A.28 – The ability to extract and convert data from the AS400 server.

4.3 Data Recommendations

To support the GIS applications, existing GIS data will have to be gathered and new datasets will have to be developed. Specific recommendations for GIS data collection and development include the following:

D.1 – Implement these GIS data standards:

Vector data format: Personal geodatabase (.mdb)
Coordinate system: New York State Plane Coordinate System
Zone: Eastern Zone
Unit of measure: U.S. survey foot
Horizontal datum: North American datum 1983 (NAD 83)
Vertical datum: North American vertical datum of 1988 (NAVD 1988)
Addressing/street naming standard: New York State Accident Location Information System (ALIS)
Parcel identification: ORPS standards

D.2 – Implement a centralized database to support GIS applications and user access;

D.3 – Collect the available datasets identified in the Master Data List included in Section 5 of this document from the providers noted;

D.4 – Develop and maintain the new (i.e. not available) datasets identified in the Master Data List;

D.5 – Compile and maintain metadata for the datasets collected and developed;

D.6 – Designate sufficient GIS resources to update datasets that change over time and are important to keep current and accurate; and

4.4 IT Infrastructure Recommendations

4.4.1 Hardware

Acquire the GIS-related hardware identified in the Conceptual System Design (in Section 5) which includes:

I.1 – Continue to maintain and properly support the City's GIS/database server;

I.2 – Continue to maintain and properly support the City's mobile GIS unit; and,

I.3 – Continue to maintain and properly support the City's color plotter.

Implementation of the following IT best practices is also recommended:

I.4 - Ensure that the City's GIS database and applications are periodically backed up and store the backups off-site in a separate facility from the server and other significant computers.

4.4.2 Software

I.5 – Standardize on the use of ESRI GIS software;

I.6 – Update the existing license of ArcGIS Server Standard Workgroup to ArcGIS Server Standard Enterprise;

I.7 – Continue to fund the ESRI license maintenance agreements;

4.4.3 Network Infrastructure

I.8 – Ensure that the GIS/database server is connected to the relevant network switch with Cat 5e cabling or better; and,

I.9 – If needed, upgrade the network cabling to the PC(s) that will be using ArcGIS Server to Cat 5e or better.

4.5 Staffing, Training and Organizational Infrastructure Recommendations

4.5.1 Staffing

S.1 – Select and appoint a GIS Coordinator for the City.

4.5.2 Training

S.2 – Provide basic (foundation) GIS training to City staff;

S.3 – Provide advanced GIS training to City staff;

S.4 – Provide training on GIS Viewer and future applications and enhancements;

S.5 – Provide training on mobile GPS device;

S.6 – Participate in the annual New York State GIS conference; and,

4.5.3 Organizational Infrastructure

S.7 – Form a GIS User Committee.

5. IMPLEMENTATION PLAN

5.1.1 Introduction

In order for City Newburgh to improve GIS services a three phase implementation approach is recommended. The three phase approach is used to allow the City to spread the ultimate cost of implementation over a number of years, while at the same time enabling the City to have a powerful GIS data repository and a web-based GIS application in place by the end of Phase I. Taking the Needs Assessment and Conceptual Design recommendations into account, the activities and tasks for each phase are outlined along with their associated costs. Areas of consideration include

organization structure and staffing, hardware and software needs, data acquisition and development. This plan breaks the recommendations and the necessary components of the GIS conceptual design into three implementation phases. The items to be acquired and activities for each phase and the associated cost are presented.

5.2 Phase I

The first phase of any project implementation is the most critical. In this phase, the City will develop the GIS Viewer as explained in the New Applications Section 3.3.1. The primary purpose of the GIS Viewer is to allow the City personnel access three City department's data (Water, Code Departments and Assessor's Office) from a central GIS Repository in order to improve information sharing and processing among City departments. All required Phase I activities are as follows:

5.2.1 Contract for GIS Services

A qualified and experienced consulting firm should be contracted to assist the City in designing, implementing, and potentially maintaining the GIS project. The selected consulting firm should have experience not only in preparing GIS applications but also in assisting the City in all other tasks as explained in Phase I tasks and activities.

5.2.2 Hardware and Software Acquisition

The Conceptual GIS System Design section specified all necessary hardware and software for a successful City-wide GIS implementation. The City should procure all software as listed below:

- Upgrade to ArcGIS Server Enterprise Standard Edition
- Microsoft SQL Server 2005

No hardware is required to be purchased at this Phase.

5.2.3 System Development

5.2.3.1 Prepare Requirements Definition and Design Document

The City should discuss the details of the application requirements and functionalities with the consulting firm. The consulting firm should then prepare a brief Requirements Definition Document for the City to review and comment upon. The document should include definitions of functionality to be built and provide mock-up screenshots of the GIS Viewer.

5.2.3.2 Install and Configure Software

The consulting firm should work with the City GIS Analyst and IS Manager to upgrade the existing ArcGIS Server Standard Workgroup edition to ArcGIS Server Standard Enterprise with Microsoft SQL Server edition. The consulting firm should uninstall the existing ArcGIS Server and install and configure both MS SQL Server and ArcGIS Server Enterprise Standard edition on the City servers. The City's IT staff and the consulting firm should configure the system to have proper connections to the Assessor's RPS v4 system for the ETL tool development.

5.2.3.3 Design and Load Geodatabase

The consulting firm should design a Geodatabase as shown in the Conceptual System Design Section of this report. This database design should facilitate the storage of all acquired spatial data. At the very least the following feature datasets should be included in the design:

- Basemap
- Land Records
- Transportation
- Utilities
- Administrative
- Environmental

Since the proposed GIS is going to be implemented based on ESRI's ArcGIS Server, the Geodatabase design should be in ArcSDE format.

5.2.3.4 Design and Implement an ETL Tool

As explained in Section 3.4.5, an ETL (Extract, Transform, Load) tool should be developed using Microsoft's SQL Server 2005 Integration Services. The ETL tool will automatically extracts, transfers, and loads, on a nightly basis, a list of pre-determined data that is maintained departmentally in RPS v4, InHance, and IPS applications into the GIS repository.

The consulting firm should develop the tool to

- Extract related data from the City's RPS v4, InHance, and IPS applications.
- Make necessary data transformations
- Load extracted data into GeoDatabase

Once the tool is implemented, the consulting firm should set the tool to run overnight for updates that were made to RPS v4, InHance, and/or IPS the prior day. Please note that the applications (RPS v4, InHance, and IPS) and the Geodatabase need to be up and running when the ETL tool is run for automatic data updates.

5.2.3.5 Develop GIS Viewer Application

The GIS Viewer application should be developed by the consulting firm. The application's functionality has been defined in the Section 3.3 of this report. The two sets of functionality defined in that section are as follows:

Standard GIS Functionality:

- Zoom in
- Zoom out
- Show/hide Overview map
- Go to Full Extent map
- Go to Last Extent map
- Identify
- Measure
- Select
- Turn on/off Legend

Custom Application Functionality:

- Search
- Query
- Address Management/Consolidation and Discrepancy Report
- Buffer
- Retrieve/Display Relevant Electronic Documents & Images
- Print and Save

Install, Configure, and Test Application

Once the GIS Viewer is developed, the consulting firm should install, configure, and test the application. Once the application has been successfully tested by the consulting firm, City users including the GIS Analyst (also the GIS Coordinator) and the Committee members will perform user acceptance testing. The user acceptance testing should include a thorough review of the functionality, data requirements, and general capabilities of the GIS Viewer application. Any bugs and/or issues with the application should be reviewed with the consulting firm to determine the most appropriate resolution.

5.2.4 Training and Documentation

Training is essential to guaranteeing the success of any GIS initiative.

Application Training: The City staff that will utilize the GIS and consume the spatial data acquired should be familiar with the GIS Viewer application. The consulting firm should deliver three four-hour training sessions to the City staff. The training proposed for City Departmental staff should include how to use the functionality developed by the consulting firm.

The consulting firm will also incorporate on-line help documentation available within the GIS Viewer application. In addition, hard copy user manuals should be created and distributed to the City for training and reference purposes.

It is crucial to keep the proposed system up-to-date in terms of technology and data. The GIS Analyst and IS Manager should be familiar with the application system and its maintenance. The administration training should primarily include how to update data stored in the Geodatabase as well topics that relate the administration of ArcSDE with MS SQL Server.

Documentation: The consulting firm will provide system administration documentation illustrating the system architecture, GIS administrative features, database administrative features, and a detailed listing of all software components, configuration files, and installation locations on the City's server.

Table 12, shows all Phase I related cost estimates by hardware, software, system development, and training and documentation:

Table 12 - Phase I ImplementationCost Estimates

DESCRIPTION	QUANTITY	UNIT PRICE	COST
HARDWARE & SOFTWARE			
ArcGIS Server Upgrade to Standard Enterprise Edition	1	8,500	8,500

Microsoft SQL Server 2005 (5 CAL Standard Edition)	1	6,000	6,000
Subtotal Software			**14,500**
SYSTEM DEVELOPMENT			
Prepare Requirements Definition and Design Document	1	7,500	7,500
Install and Configure Software	1	1,200	1,200
Design & Load Geodatabase	1	6,000	6,000
Design and Implement an ETL Tool	1	14,000	14,000
Develop GIS Viewer Application	1	24,500	24,500
Install and Configure Application	1	3,000	3,000
Subtotal System Development			**56,200**
TRAINING and DOCUMENTATION			
Application Training & Documentation	1	12,000	12,000
Administration Training & Documentation	1	6,000	6,000
Subtotal Training			**18,000**
TOTAL			**$88,700**

5.3 Phase II

The City will have completed implementation of the proposed GIS Viewer application, running from a single central location in the City Hall that serves GIS and relevant attribute data such as addresses from several departments. Phase II activities and tasks will focus on a GIS-based Work Order System.

5.3.1 Organization Structure

In this phase, it is recommended that the City consider establishing a User Group. The goal of this group, made up of staff members from each department, is to offer feedback and make recommendations and/or suggestions to the GIS Committee. The Committee then will evaluate and prioritize requests and act on them accordingly. The GIS Committee and the User Group should continue to meet on a scheduled basis.

5.3.2 Hardware and Software

The following hardware and software are proposed to be purchased by the City to support the system application and City staff.

- GIS Workstation to be made available to departments requiring access to GIS-based Work Order System

No software purchase is recommended at this phase; however, the City will need to keep their existing GIS Software current by making payments to ESRI for software maintenance fees.

5.3.3 System Development

The GIS-based Online Work Order System is to be developed and implemented in the existing GIS server hardware and software and will be initially used by the Water Department. Since, the City does not have the staff with GIS application development experience it is recommended that the City hire a qualified consulting firm to develop the application. The consulting firm should perform the following subtasks under this task:

- Provide guidance for Data Collection (Missing Asset Records)
- Enhance the existing Geodatabase Schema
- Develop Online Work Order System application
- Install, Configure, and Test Application

5.3.4 Training and Documentation

Application Training: Water Department staff that will utilize the GIS-based Online Work Order System should be trained to properly use the new application. This training will also introduce the capabilities of the application to the users. The consulting firm should deliver two four-hour training sessions to the application users. The training proposed for Water Department staff should include how to use the functionality developed by the consulting firm.

The consulting firm should also incorporate on-line help documentation available within the Online Work Order System application. In addition, hard copy user manuals should be created and distributed to the City for training and reference purposes. Additionally, the GIS Analyst and IS Manager should be provided with two four-hour training sessions. The administration training should include how to update data stored in the application. These sessions should also educate the administrators about the advanced functions of the application and to ensure system abilities are fully utilized.

Documentation: The consulting firm should provide system administration documentation illustrating the system architecture, general and database features, as well as a detailed listing of all software components, configuration files, and installation locations on the City's server.

Table 13 – Phase II Implementation Cost Estimate:

DESCRIPTION	QUANTITY	UNIT PRICE	COST
HARDWARE & SOFTWARE			
GIS Workstations	2	2,000	4,000
Subtotal Software			**4,000**
SYSTEM DEVELOPMENT			

Provide guidance for Data Collection (Missing Asset Records)	1	7,500	7,500
Enhance the existing Geodatabase Schema	1	4,000	4,000
Develop Online Work Order System application	1	36,000	36,000
Install, Configure, and Test Application	1	9,000	9,000
Subtotal System Development			**56,500**
TRAINING and DOCUMENTATION			
Application Training and Documentation	1	16,000	16,000
Administration Training and Documentation	1	7,500	7,500
Subtotal Training and Documentation			**23,500**
TOTAL			**$84,000**

5.4 Phase III

In Phase III, the primary emphasis is on the continuous update of spatial and non-spatial datasets, making the Online Work Order application available for other City departments, and developing a series of Online Map Library Views to make the GIS Viewer customized to address specific needs of several City business domains. The City may consider making the GIS Viewer application available to the public via the Internet; however, Bowne understands that this is a decision that needs to be made by the City Manager. Phase III will focus on the Online Map Library Views.

5.4.1 Organizational Structure

At this stage, the City will have a well established Enterprise GIS that will not require changes to its basic structure. The GIS Committee will be required to work with the consulting firm that will develop the Online Map Library Views. They will determine jointly which spatial datasets should be included in this application as there will potentially be more spatial datasets available for the City.

5.4.2 Hardware and Software

Web Server is recommended by Bowne. No software purchase is recommended at this phase; however, the City will need to keep its existing GIS software maintenance current.

5.4.3 System Development

Bowne proposes that the Online Map Library be developed by a consulting firm. In order to accomplish that the following tasks will need to be performed:

- Modify and Enhance ETL Routines
- Develop OML Views
- Install and Configure, and Test OML Application

5.4.4 Training and Documentation

Application Training:

User training should be provided on an ongoing basis. As new applications and functionality enhancements are introduced, users should receive instructions on its use. In Phase III, the Bowne recommends that only the City's GIS Analyst and IS Manager be trained in the OML portion of the GIS Viewer application in order to train other City staff internally.

Documentation:

The consulting firm should develop required application documentation. Also, online help documentation should be developed and made part of the GIS Viewer application.

Table 14 - Phase III Implementation Cost Estimate

DESCRIPTION	QUANTITY	UNIT PRICE	COST
HARDWARE & SOFTWARE			
Web Server	1	4,000	4,000
Subtotal Software			**4,000**
SYSTEM DEVELOPMENT			
Modify and Enhance ETL Routines	1	7,000	7,000
Develop OML Views	1	15,000	15,000
Install, Configure, and Test OML Application		9,600	9,600
Subtotal System Development			**31,600**
TRAINING and DOCUMENTATION			
Application Training	1	5,000	5,000
Documentation	1	5,000	5,000
Subtotal Training			**10,000**
TOTAL			**$45,600**

5.5 Implementation Costs

Each phase's Implementation Cost Schedule (estimates) has been shown in the previous Implementation Plan Section to assist the City with budget planning. The cost breakdown by phase will also assist the City with securing additional funding from external sources. The cost schedule contains the estimated cost of required hardware, software, consulting fees (for system development), staff training, and

documentation. At the time of actual implementation all of these costs may be different than the provided estimates, though actual costs should be relatively close to dollar figures shown in this report.

Table 15 below shows the summary of all hardware, software, application development, training, and estimated operational expenditures for the three phases:

Table 15 – Summary of Implementation Costs

DESCRIPTION	COST
PHASE I	
Hardware & Software	14,500
System Development	56,200
Training & Documentation	18,000
Subtotal Phase I	**88,700**
PHASE II	
Hardware & Software	4,000
System Development	56,500
Training & Documentation	23,500
Subtotal Phase II	**84,000**
PHASE III	
Hardware & Software	4,000
System Development	31,600
Training & Documentation	10,000
Subtotal Phase III	**45,600**
TOTAL	**$218,300**

APPENDIX A – GIS POLICY GUIDELINES

City of Newburgh
City Hall 83 Broadway Newburgh, NY 12550
Phone (845) 569-7488
gis@cityofnewburgh-ny.gov
www.newburgh-ny.com

GIS Policy Guideline

INTRODUCTION

The City of Newburgh has established a Geographic Information System (GIS) in an effort to enable integrated digital data development initiatives as well as to provide information accessibility at the local government level. GIS is an assembly of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. The use of GIS technology employs the geographic element of data from a wide array of sources, thereby providing opportunities for enhancing service-delivery, management, planning and decision-making processes in innovative ways. The purpose of this document is to provide a framework for city employee and members of the public to access to both information contained in the City's centralized GIS as well as mapping products developed by the system. It offers users the general guidelines and terms for usage. It is not intended to be comprehensive nor is it complete.

MISSION

The City of Newburgh recognizes GIS technology as a powerful tool for advancing problem solving, geographic inquiry, research, record storage, and acting upon the findings in today's networked society. An essential function of Newburgh City GIS is to collect, integrate, maintain, and deliver up-to-date spatially-referenced information about and pertaining to the City and its neighboring areas. Currently, the need to collect and maintain digital infrastructure data on water networks has been identified as a high priority. As the City's GIS matures, the City will continue to expand GIS services and encourage the implementation of the best available technology for supporting all of its departments' distinctive missions throughout City infrastructure and individual disciplines.

GIS STEERING COMMITTEE

The GIS Steering Committee is a coordinating body, members appointed by the City Manager, with representatives from various City departments which provides guidance and advice on GIS services and functions. It is charged with regular review of GIS policies and task activities that encourage the appropriate utilization of GIS and to City's geospatial data in an effective, efficient, and coordinated manner.

DATA STEWARD

The GIS Analyst is responsible for the content, maintenance, and distribution of tabular and spatial data located on the centralized GIS Data Warehouse. The GIS Analyst responds to GIS service requests, investigates GIS technologies, participates in the implementation of appropriate tools, develops recommendations and policies, edits, quality assures and controls geospatial data and metadata, provides technical support and trainings, and initiates new projects as necessary. Any errors, omissions, or issues found in GIS data should be brought to the attention of the GIS Analyst as soon as possible.

GIS SERVICE REQUEST & PROCEDURE

All GIS service requests shall be directed to the City agency or official designated to receive such responses. Requests shall be made upon such form and the City shall prescribe for such purpose. Upon receipt of the properly completed application and payment, if applicable, the request will be processed *(See GIS Service Request Form).* A cost estimate and anticipated completion date will be provided at this time. The applicant will be notified if additional information is

needed before the service can be rendered. Hardcopy maps are subject to printing charges based on the GIS Fee Schedule that is adopted by the City Council *(See GIS Fee Schedule*). In addition, a $40 per hour labor fee will be applied to all non-governmental applicants unless exceptions are made by the City Manager.

GIS DATA WAREHOUSE

A centralized GIS Data Warehouse of spatially-referenced data, databases, tables, graphs, maps, and drawings is stored on the City's server and securely protected by the Information Technology Manager. Data standards, file and attribute information are detailed in the GIS Data Warehouse Summary *(See GIS Data Warehouse Summary Table).* Each department may wish to designate a GIS liaison to discuss data development initiatives or issues with the GIS Analyst. The Information Systems Manager grants data viewing privileges based on the individual user privilege. A version of the desired datasets can be made available in-house or outside of the City departments upon a written request and the signing of the GIS Data License Agreement and compliance with City Policies.

DATA SHARING & DISTRBUTION

The City of Newburgh promotes the sharing of data and distributes GIS data originated by the City and received by the City from other sources, as a service to the public with a cost *(See GIS Fee Schedule)*. Requests for data originated outside of the City will be directed to the specific data custodian or entity from which the data were acquired or purchased by the GIS Analyst or will be provided by the City according to the City GIS Policy and provided by law. A formal written request and the signing of the Data License Agreement may be required *(See GIS Data License Agreement*). Any unauthorized data distribution is strictly prohibited.

DISCLAIMER

The City of Newburgh acquires and develops data from the relevant federal, state, local governments and private consultants. Information is always changing. Maps and data are provided by the City without warranty concerning the accuracy, completeness or suitability for any particular purpose. The City of Newburgh makes no representations and assumes no liability from any damage arising out of reliance upon the information contained therein. By signing the Disclaimer Agreement on the GIS Service Request Form or by receiving data from the City, data limitations are made known to and agreed to by users.

COPYRIGHT

A creative work is copyrighted from the moment it is fixed in a tangible medium. No statement or registration is required. The City may add the following general copyright statement to all maps: Copyright © 2006 The City of Newburgh, New York. All Rights Reserved; however all copyright and laws shall apply whether or not such statement appears on the data.

MAKING DATA ACCESSIBLE

On-line mapping applications with embedded links to other databases maintained by City departments will be made available internally or through a subscription fee to the general public. Ready-to-view PDF files of commonly used maps, such as parcel, street, and zoning, will also be accessible from both the GIS Data Warehouse Map Gallery and the City's GIS website.

APPENDIX B – GIS DATA LICENSE AGREEMENT

City of Newburgh – GIS

City Hall, 83 Broadway
Newburgh, NY 12550
Phone (845) 569-7488
gis@cityofnewburgh-ny.gov
www.newburgh-ny.com

GIS Data License Agreement

Licensee Name / Entity (LICENSEE):

_____

Address:

_____

Licensed Geographic Information System Datasets / Information Requested (GIS DATA):

_____

_____

_____

_____

THIS GIS DATA LICENSE AGREEMENT ("License Agreement") is made and entered into by and between the City of Newburgh ("City"), a municipal corporation of New York State, having its principal office at 83 Broadway, Newburgh, New York 12550, and the individual or entity identified above as "Licensee."

WHEREAS, the City represents that the geographic information system datasets ("GIS Data") identified above are public government data that have commercial value and were developed with significant expenditures of public funds by the City; and

WHEREAS, pursuant to Resolution 39 adopted by the City Council on March 26, 2007 concerning Chapter 163 of the City Code, entitle "Fees", the City is authorized to charge a reasonable fee for the GIS Data to recover actual development costs as well as the costs of making, certifying and compiling copies of the GIS Data; and

WHEREAS, the purpose of this License Agreement is to make public government data accessible to the public and protect the public's interest in recovering the significant expenditures of public funds used to develop the commercially valuable GIS Data.

NOW THEREFORE, in consideration of the mutual terms and conditions stated in this License Agreement, the City and Licensee agree as follows:

I. Term: This License Agreement shall continue for as long as Licensee uses the files for his or her intended purpose. However, if Licensee fails to comply with any of the terms or conditions set out in this document the License will terminate. Licensee agrees, upon termination, to destroy all copies of any files or documents obtained as part of this agreement. The Limitations of Warranties and Liability set out below shall continue in force even after any termination.

II. Limitation: Licensee agrees not to:

a) Rent, lease, assign, or transfer the GIS Data
b) Use GIS Data in published works for commercial use and / or sale
c) Redistribute, sell or publish the GIS Data

III. Warranty: The GIS Data are made available to Licensee subject to the following limitations and restrictions:

a) The City will use its best efforts to ensure the GIS Data are delivered free from physical defect at the time of delivery. Licensee is responsible for the installation and use of the GIS Data and the results or consequences obtained from Licensee's uses of the GIS Data

b) The City does not warrant that the GIS Data are error free. The GIS Data were developed for the City's own internal business purposes and the City does not represent that the GIS Data can be used for navigational, tracking or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features.

c) The City disclaims any other warranties, express, or implied, respecting this License Agreement or the GIS Data. The GIS Data and associated reference materials and technical documentation if any are provided as is without any support whatsoever and without warranty as to their performance, merchantability or fitness for any particular purpose. The entire risk as to the results and performance of the GIS Data is assumed by Licensee.

IV. Payment: Licensee shall pay the City the fees set forth on the attached GIS Fee Schedule.

V. Authorized Use: Licensee is granted a perpetual, non-exclusive right to have and use the GIS Data, provided Licensee is complying with the terms and conditions of this License Agreement. Licensee may use the GIS Data in the form provided by the City for Licensee's own internal business or organizational purposes.

VI. Ownership of Material: This License Agreement does not constitute a transfer of title or interest in the GIS Data. Any portion of the GIS data that is modified or converted into another digital file or computer program by the License, or is integrated with other programs or Data to form derivative products, shall continue to be subject to the provisions of this License Agreement. License shall not remove or obscure any City copyright, proprietary, or trademark notices, if any.

VII. Distribution of data: The data is to be solely retained by the Licensee. In no instance is the Data to be copied, sold, leased, published, sub-licensed, loaned, or transferred, in whole or part. Licensee shall protect the Data from unauthorized use, reproduction, distribution, or publication.

VIII. Request for data: Licensee agrees to forward any requests for GIS Data to the City, unless disclosure of Licensee's records containing such data is otherwise required by law; and, in such latter case, Licensee agrees to notify the City of such disclosure.

IX. Confidentiality: All information and data relating to the Data operations shall be treated as confidential by Licensee and shall not, unless otherwise required by law, be disclosed to any other person or entity without the prior written consent of the City.

X. Licensee Responsibly and Information: Licensee shall be solely responsible for its actions and the actions of its officers, employees, agents, or other representatives with regard to the performance of this License Agreement.

XI. Consultant: Should the Licensee utilize the services of a consultant, said consultant must execute a separate agreement with the City prior to receiving any copies of the Data.

XII. Independent Contractor: The parties to this Agreement are independent contractors. Neither party is an agent, representative, or partner of the other party. Neither party shall have any right, power or authority to enter into any agreement for or on behalf of, or incur any obligation or liability of, or to otherwise bind, the other party. This Agreement shall not be interpreted or constructed to create an association, agency, joint venture or partnership between the parties or to impose any liability attributable to such a relationship upon either party. The Licensee, as an independent contractor agrees that its employees or agent will not hold itself / themselves out as, nor claim to be an employee or agent of City, and that its employees or agents will not make claim, demand or application to or for any right or privilege applicable to an officer or employee of City.

XIII. No Assignment: Licensee shall not assign, sublet, or transfer this License Agreement in whole or in part, without the prior written consent of the City. Any attempt to assign, sublet or transfer this License agreement without prior written consent shall be void and of no force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this agreement the day and year first written.

Licensee Name / Entity:	City of Newburgh
_____	
Signature of Authorized Person:	By:
_____	_____
Name of Authorized Person:	Title:
_____	_____
Date:	Date:
_____	_____

APPENDIX C – GIS FEE SCHEDULE

City of Newburgh

City Hall, 83 Broadway, Newburgh, NY 12550
Phone (845) 569-7488 Fax (845) 569-7314
gis@cityofnewburgh-ny.gov
www.newburgh-ny.com

GIS Fee Schedule

Mapping:
A $40 per hour labor fee in 15 minute increments and a 15% administrative fee are applied to all non governmental map requestors.

Printing:

Map Size	Price (1st Copy)	Price (Additional Copies)
8.5x11	$5	$3
11x17	$10	$6
Customized size up to 36x40	$25	$15
Larger than 36x40	$30	$18

Data:
The following datasets are maintained by the City of Newburgh and are available for purchase. All datasets are in State Plane NAD 83 New York East Coordinate System. A signed GIS Data License Agreement between the City and the authorized licensed user is required.

Data	Price	Originator
Parcel	$100	Orange County Real Property, Newburgh City Assessor, Newburgh GIS
Building Footprint	$50	Newburgh GIS
April 2007 Aerial Photography 6" Resolution	$200	NY State CSCIC, Newburgh GIS
Miscellaneous *(see GIS Data Warehouse sheet)*	$20	Newburgh GIS

Map Gallery:
The following maps are already made and ready to print. They are subject to printing costs based on the size and the correspondent charges indicated above.

Theme	Description	Theme	Description
Zoning	Zoning District, Overlaying District, Parcel, Street	Election District	Election District, Street, Polling Site
Street	Street, Point of Interest	Census Tract	Census Tract, Street
Population by Ward	Ward District, Population Breakdown by Age Group, Gender, and Ethnicity	Ethnicity by Census Tract	Census Tract, Population Breakdown by Ethnicity
Water Resource	Waterbody, Floodplain, Wetland, Surface Water Supply Protection Zone, Municipal Boundary, Watershed Boundary, Topography	Environmentally Sensitive Area	Steep Slope Area, NYS DEC Wetland & 100-Ft Adjacent Area, USFS National Wetland, 100-Yr & 500-Yr Floodplain, Waterbody

Subscription:
The City of Newburgh offers subscriptions to ready-to-print maps as well as information maintained by various departments and partners through a website with an interactive mapping application that is password protected. Once

a subscriber, the customer will be provided a username and password to login into the website. The datasets that are made available through this website will be updated with the most current GIS data. Prior to purchasing or subscribing to GIS data, a license agreement must be signed between the City and the subscriber. An annual subscription fee is $100. The subscriber has the option to cancel or renew at the end of the term.

APPENDIX D – RECORD MANAGEMENT CONCERNS [4]

New and evolving technologies such as GIS, GPS, and eGovernment present challenging issues for records management for local governments. While both state and national records management has traditionally focused on the maintenance and scheduling of paper based records, it has only been within the last decade that the NY SARA has begun to focus on the management and scheduling of electronic records created by information systems such as GIS. The influence directly associated with GIS is growing at a tremendous rate which can quickly outpace existing standards, definitions, and schedules of electronic records.

The NY SARA has material available online that explores basic issues and concepts in the field of record management (http://www.archives.nysed.gov/a/grants/grants_lgrmif.shtml).. The material presented is specific to state record management initiatives and it is recommended that the City continue to work closely with the NY SARA officials in defining and expanding their GIS records programs. The NY SARA website offers a series of links to resources that cover the spectrum of records management, from beginner's guides on the subject to advanced instruction on electronic records. Examples are as follow:

1. Records Retention and Disposition - One of the foundations of records management is controlling the retention and disposition of records: knowing how long you must keep the records under your control and disposing of the records efficiently and on schedule.

2. Active Records - Organizations find active records to be among their most important records because they use them the most frequently, spend the most money to maintain them, and rely on them to manage their day-to-day work. Many of the most active records tend to be electronic because users require the easy access provided by electronic systems. The resources on this page provide detailed guidance on all aspects of managing active and electronic records.

3. eGovernment - With the exponential growth of the Internet and related commercial services, governments have found it impossible to ignore the possibility that the Internet and private networks can provide a means to carry out government business.

Additional publications include:

1. Geographic Information System Development Guides June 1996 - The State Archives, in cooperation with National Center for Geographic Information and Analysis, produced this series of development guides to help officials in New York's local governments develop and implement geographic information systems.

2. Guidelines for Planning and Conducting a Records Inventory - Archives Technical Information Series #24, 1995.

3. Laws and Regulations Relating to Local Government Records - Archives Technical Information Series #39, 1994.

4. Electronic Document Imaging Systems: A Reader for Local Governments - Archives Technical Information Series #46, 1996.

[4] Portions of this Appendix are accredited to Westchester County GIS, Department of Information Technology

APPENDIX E – ESRI ROI STUDY

City of Charlotte, NC – Refuse collection in the City utilized out dated scheduling and routing techniques such as wall maps, pushpins and colored pencils. Residents requiring refuse pickup were manually entered into a customer service database that contained 150,000 addresses. There was a disconnect between routing refuse pickup efforts and the customer service database. The result was wasted time entering data, inaccuracies because of the manual efforts, frequently routes required overtime and overstressed equipment while other routes were plagued by non-productive downtime, all of which contributed to diminished revenues.

GIS technology implemented by RouteSmart Technologies of Columbia, Maryland, was able to configure pickup routes that balanced equipment usage while leveling crew workloads. The GIS technology implemented also has the ability to factor in nonproductive work time as part of its calculations. Also, because different vehicles have varying capacities, the GIS technology was able to best match the appropriate vehicle with the most relevant routes taking into consideration an array of street restrictions.

The City saw tangible results in one year. Staff estimates the technology saved the City a significant number of work hours. The technology has been so successful that Charlotte has purchased an additional system for its Water Department.

Northeast Illinois Planning Commission – The Northeast Illinois Planning Commission (NIPC) is the regional planning agency for metropolitan Chicago and the surrounding six counties, comprising a total of 272 municipalities. One of NIPC's primary responsibilities is maintaining a thirty-year growth forecast that underpins regional transportation investments and other infrastructure planning (http://www.nipc.org/). The NIPC shares development information with the 272 local governments including preferences for growth boundaries and future land-use patterns. Historically, this involved creating manual drawings on paper maps which were then converted into population and employment estimates for eventual reconciliation with regional forecast totals. The process was cumbersome, inefficient and prone to error. In all, working with the participating local governments took more than 4,500 hours.

GIS technology was utilized to streamline this process and increase the translation of individual meetings to the overall region-wide estimates. A web-based interactive deployment of GIS technology enabled users to interactively draw growth boundaries and land uses directly into GIS during public meetings. As analysis is performed the GIS calculates which households and jobs are being added to the community based on pre-established algorithms. The interactivity of this system has allowed local officials to indicate their preferred growth scenarios, giving them the flexibility to run different models until they are satisfied with the results. Once data is entered, there is a digital record that can be aggregated into the multi-county growth forecasts.

After the GIS implementation, NIPC noted a time savings of 46% from previous meeting methods. This non-technical deployment of GIS allowed interactive collaboration between

gencies which resulted in a time savings of approximately 2,400 work hours (approximately one person-year of labor)[5].

City of Albuquerque, New Mexico – Albuquerque was one of the first municipal governments to deploy GIS. With one of the fastest grown populations in the U.S., it is under constant pressure to expand development and provide services to support the growth (fire, police, affordable housing, utilities, and education choices). Prior to GIS implementation, manual drafting method used in the previous two decades were used to support planning purposes and map atlas books were used to assist with policy making.

By implementing GIS technology, the City's Planning Department could answer in minutes questions from developers such as lot size, development status, or zoning status. Prior to using GIS, the department would take weeks contacting real estate agents, searching zoning atlases to determine zoning, and then cross-referencing that data with other information to determine if the land was developed[1]. Additionally other data such as water and sewer details were also available due to data sharing among other City departments.

Money savings associated with GIS is also noted in several studies. Below are examples of GIS use in Richland County South Carolina, Riverside County, California, and the City of San Antonio, Texas.

Richland County, South Carolina – Richland County's Vector Control Department decided to implement GIS technology to overcome its dependency on inefficient methodologies (paper maps, colored pencils, redundant paperwork, etc.). Work prior to GIS required staff to complete multiple paper forms in the field and then transpose the documents again onto a form that would then be entered into digital form. The data was text based which did not lend itself to visual representation on a map and trends were difficult to uncover. The department spent the majority of its time dealing with paperwork instead of performing its intended duties for the County.

With the deployment of GIS, departmental staff started using digital forms in the field by entering the data into a digital PDA (personal data assistant). This information could then be directly transferred to the master database in the office thereby alleviating redundant data entry. GIS allows the new data to be represented spatially and analyzed against rainfall and mosquito count. Through spatial representations of the data, targeted spraying areas are easily identified which makes spraying efforts more effective.

By cutting the time spent recording and transposing paper forms the department has saved approximately 15-25 hours per week, which equates to $11,000 to $20,000 savings per year on labor. Additionally, the department's efforts are more effective which is also associated to cost savings[6].

San Antonio, Texas – San Antonio is the seventh largest city in the U.S. and receives an estimated 90,000 applications for street-cutting permits per year. Before anyone can dig in streets or rights-of-way to repair or install utilities, they must apply for a permit with the city. The volume of applications created a significant backlog within the Department of Streets.

[5] Ospina, Milton, & Thomas, Christopher, 2004. *Measuring Up: The Business Case for GIS*. Redlands, CA: ESRI Press.

[6]

The permitting process was paper-based, very slow and the outflow of approvals and/or denials could not keep up with the inflow of requests. The process caused backlogs, inadequate compliance revenue, and infrastructure project conflicts and delays. Often the same sections of streets would be worked on twice due to lack of data coordination within the department.

It was estimated that the paper based system which lacked a centralized data repository and easy access to records took an average of two hours to amend, approve, or reject a single permit application. By implementing an Internet-based application, the City was able to integrated permitting functionality with GIS. The application allows staff and the public to access and view all street, zoning, and permit activity online using maps created in the application. The application allows contractors to apply for permits, obtain automatically calculated permit fees, while staff can review and approve permit applications and track permit compliance.

The application's centralized data storage, immediate access to information, and ability to view all ongoing projects concurrently has all lead to 71% decrease in the time required to approve a single permit. Currently 90% of all permits are received electronically[3].

The examples above demonstrate some of the benefits that GIS can have within an organization. Expedited work flow, enhanced reaction time to public requests, increased access to information, and collaborative data sharing, can all be included with the benefits that are expected with a successful GIS implementation. At times it can be difficult to construct a tangible measure of the return on a GIS investment because in some cases measurable benefits experienced by agencies will be intangible. Benefits derived from improved data management and increased analyses are subjective, but still contribute significantly to the overall success of an agency. Both data management and displaying analysis results visually can be the most tedious component of decision making.

ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
Newport News Waterworks, Virginia	Water Department	State permits require right-of-way view, profile, and vicinity maps. Hand drawing these maps was very time-consuming.	The State automated map production using ArcView GIS.	Production time for each map was reduced from between two to four hours to just 15 minutes using ArcView GIS.
City of Bartlett, Tennessee	Planning and Finance Departments	A review of the City budget revealed that the City sticker fee of $25 per vehicle was not keeping pace with the estimated number of households in the City.	The City found that the County Trustees Office had vehicles listed as located in unincorporated Shelby County. City staff performed a simple address match against these addresses and identified a gap between the County and City record caused when a revised annexation was not communicated.	Geocoding 16,000 additional records by ZIP Code yielded 2,100 households that were not paying the required City sticker fee. The inclusion of these households will generate $52,500 annually in revenue.
Pierce County, Washington	Sheriff's Department and County GIS Division	Pierce County wanted to supply citizens with information on sex offenders residing in the County.	The Pierce County Sheriff's Crime Unit developed an online sex offender registry.	Pierce County offers a greater level of citizen service in a cost-effective manner. The registered sex offender Web site receives 5,000 visitors per month. Since each visitor represents an estimated five minutes of staff time, without the Web site, the County would need an additional 12 employees to handle these requests.
State of Indiana	State Department of Health	Screening of all children on Medicaid for lead poisoning is federally mandated. However, such large-scale screening is prohibitively expensive, so State health officials wanted a more efficient and targeted method of screening.	Officials geocoded State health records and developed an application that provides regression analysis and predictive modeling so that high-incidence areas can be identified.	This analysis revealed that the majority of cases of elevated blood lead in children were concentrated in just a few counties. By redirecting screening efforts to these areas, the State saved nearly $2 million and secured a grant from the Center for Disease Control for $239, 980 that will fund the State's lead poisoning prevention program.

ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
City and County of Honolulu, Hawaii	Honolulu Wastewater Information Management System (WIMS)	Maps of sewer infrastructure facilities were needed to support facility maintenance and management programs. Updated and comprehensive maps were also needed for facilities master planning that would support capital improvement program funding, planning, scheduling, and tracking.	Created digital model of sewer infrastructure facilities for the island that supports data maintenance procedures, capacity modeling programs, and production of work order maps.	Avoided more than $6 million in federal fines while providing more accurate assessments of facility capacity requirements, creating more effective preventive maintenance programs, and developing more accurate budgeting for projects.
City of St. Paul, Minnesota	Public Works and Information Systems	Right-of-way permit system needed.	GIS-based right-of-way permit system sets fees for permits to dig up or obstruct street rights-of-way in Saint Paul. These fees are based on street characteristics stored in the GIS.	The Public Works Department now uses GIS to set fees that yield revenue of $800,000 annually.
Spokane, Washington	Central Valley School District	The school district needed improved school bus routing.	School district automated routing using a GIS-based solution, SMARTR for Schools Transportation Module.	The school district reduced the time needed for State-mandated reports by one week and eliminated six routes by enforcing the school district walking policy. These changes save the district $125,000.
City of Vallejo, California	Economic Development	The City needed to attract companies to increase revenues and employment..	Developed a GIS-based Internet site that supplies information on available commercial and retail buildings and land, demographics, and traffic counts to companies looking for relocation sites.	Retail vacancy rate was reduced 45.3 percent between 1998 and 2000 after the economic development Web site was introduced.
Fairfax County, Virginia	Solid Waste and Recycling Department	Needed to optimize routes for 38,400 residential customers.	Used RouteSmart, an ArcView GIS-based solution from ESRI business partner RouteSmart, to optimize vehicle routing.	The County reduced the number of crews from 16 to 10 and had an estimated annual savings of $200,000.

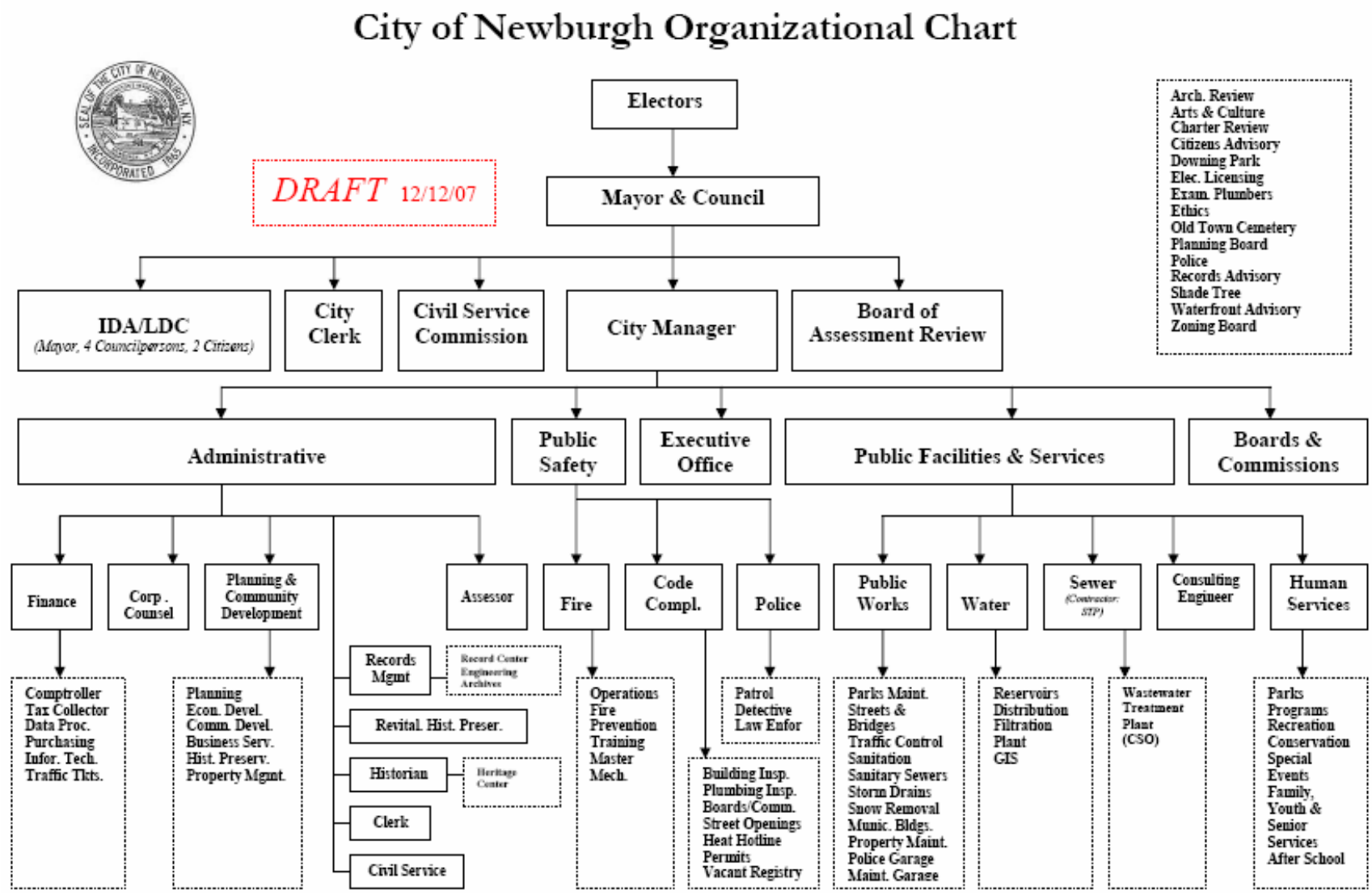
ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
Martin County, Florida	County Assessor and Information Services Department	County Commissioners requested an inventory of telecommunications towers to assist them in writing a new ordinance.	Geocoding an FCC telecommunication database against County parcel data revealed many parcels with towers that were under assessed.	The parcels were reassessed and generated an additional $3.5 million in tax revenue for the County.
City of Tucson, Arizona	Tucson Water District	Implement City mandate for cost cutting and increased efficiency.	Implemented GIS that is saving staff time associated with information gathering, planning, map production, and inspection activities.	Over a five-year period, the water district expects to realize a net return from the investment in GIS of $5,356,943 due to increased staff efficiency.
State of Montana	Department of Environmental Quality	The State wants to reduce carbon monoxide emissions and demonstrate these reductions so that cities can move from nonattainment to attainment status.	Average daily carbon dioxide emission data for Billings and the surrounding area was modeled to a much higher degree of accuracy using ArcInfo.	This data will be used to support a redesignation request to the U.S. Environmental Protection Agency for a change in status.
City of Lincoln, Nebraska	Police Department	Formulate an effective response to numerous complaints relating to drinking parties held near the University of Nebraska.	Mapped party complaints to target areas with high-risk drinking parties and started media campaign to create perception of risk of arrest. Established special enforcement projects	Complaints reduced 27 percent within one-mile radius of the campus.
City of Lincoln, Nebraska	Police Department	Need to identify high crime areas and reduce burglaries in those areas.	Identified problem neighborhoods and trends. Monitored program results. Initiated community outreach programs to targeted neighborhoods.	Crime reduced in target neighborhoods 67 percent in seven weeks.
County of Bernalillo, New Mexico	County Assessor	Unrealized revenue caused by undervalued properties.	Overlaid digital orthophotography to GIS parcel base and verified the use status of properties with the tax rolls. Uncovered $1.4 billion dollars worth of unsurveyed or undervalued properties.	Increased tax revenue by $6 million per annum.
Citrus County, Florida	County Assessor	Properties not assessed because building permit information is inaccurate or missing.	Used image analysis to identify changes in property improvements.	$200 million in unrecorded property improvements and building additions detected, causing adjustments to 5 percent of the tax base.

ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
Elsinore Valley Water District, California	Public Works Department GIS Division	Need to determine which parcels in the district are subject to annual standby assessments.	A standby charge on unimproved parcels is used to fund the maintenance and replace the District's current facilities.	Improved parcels were identified and assessed, generating $5,000 in revenue.
Culver City, California	Public Works Sanitation Division	Desire for increased efficiency in special pickup routing.	Routed trucks more efficiently using ArcLogistics Route.	Decreased overtime and lowered vehicle maintenance costs, producing savings of $15,000 in first six months in addition to improving service to residents.
City of Los Angeles, California	Emergency Management	Need to ensure quicker response times during emergencies.	Developed GIS Internet-based solution for quick access to data.	Response times decreased by 25 percent, and operations were more efficient during year 2000 drills.
Western Australia, Australia	Fire and Emergency Services Authority	Choosing the best of three possible sites for a fire station.	Loss and response time modeling showed all sites were equal.	Saved more than $300,000 on the cost of the land by choosing the least expensive parcel.
City of Newton, Massachusetts	Information Technology Department	Production of labels for abutter notifications was time-consuming.	GIS used to generate mailing labels for abutter notifications required by zoning board of appeals, traffic council, conservation commission, and other city agencies.	Savings of approximately 500 hours of staff time annually across four departments.
City of Newton, Massachusetts	Inspections Department	Need to streamline permit assistance procedures.	Developed automated front counter system using GIS.	System saves approximately 250 hours of staff time annually.
City of Newton, Massachusetts	Public Works	Customers connected to the sewer system were not being billed because the properties were not in the sewer billing system.	Mapped those properties not entered in the City sewer system and rectified customer billing for properties connected to the sewer system.	More accurate billing system's database generates an additional $8,000 in revenue annually.
City of Newton, Massachusetts	School Department	Need to improve school bus routing.	Developed custom tools in ArcView GIS to assist the school department with transportation planning.	Improved bus stop assignments and saved $49,000 annually.

ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
Clark County, Washington	Weed Management Department	Difficulty in identifying the owners of properties needing weed abatement.	The weed control officers now use laptop computers with access to a custom GIS application that uses GPS to locate each parcel with noxious weeds and identify the property owner.	Weed control officers now identify more than 100 outbreaks of noxious weeds per day compared to eight to 10 before using the GIS.
City of Sunnyvale, California	Community Development Department	The City wanted to develop an e-government one-stop permitting application to better serve the community.	The City implemented an ArcIMS-based application providing online permitting.	Despite the fact that Sunnyvale construction valuations increased from $240 million in 1997 to $320 million in 2000, the Building Safety Department has not had to increase staff. Building Department officials estimate that application time has decreased from approximately two hours (including driving to the City Hall, standing in line, and filling out forms) to just a few minutes when permits are obtained using the online system.
County of Orange, Florida	County Auditor/GIS Division	Comptroller's Office requested an audit of the County's cable TV customers.	The GIS Division did a complete audit of the auditor's database by geocoding and comparing jurisdictional boundaries.	Traditional random or partial audits performed by Comptroller's Office typically resulted in $2,000 per year in revenues. The GIS audit netted $63,000 in franchise fees and identified customers that had been assigned to wrong county and/or whose locations were erroneously reported in incorporated or unincorporated areas. Subsequently, a cellular telephone audit netted $650,000, and a resort tax audit of condominiums collected $700,000.
City of Richmond, Virginia	Community Development Department/ Division of Land Use Administration	The City needed to automate map and data maintenance. Traditional methods required separate maps with varying scales for property, zoning, and land use. These maps were manually updated.	GIS was used to simultaneously update both maps and data.	Map and database maintenance was coordinated resulting in an optimized work process. Individual map production went from 5 to 7 hours to 30 minutes with an overall productivity increase of 90 percent.

ESRI ROI EXAMPLES				
Organization	**Discipline**	**Problem**	**Solution Using GIS**	**Return on Investment**
District of North Vancouver, Canada	GIS Department	The District needed to automate routine data maintenance and entry tasks.	The GIS Department decided to design, develop, and implement two new components that would allow them to work more efficiently.	The system has resulted in a 75 percent reduction in staff hours.
District of North Vancouver, Canada	GIS Department	District mandate required improved citizen services.	The District established a Web portal, GeoWeb, that provides access to spatial data. Using ArcIMS, the District has created four applications that supply information to citizens—Property Information Explorer, Parks Online, Air Photos, and North Vancouver Public Art.	Maps are the Department's most popular product. The automated mapping system produces more than 75 percent of the District's cartographic products. GeoWeb, which averages more than 100 visitors each day, improves GIS staff productivity by allowing staff members to work on other projects and administer the system instead of filling counter requests.
Grason County, Texas	Planning Department/ 911 Emergency Center	The County wanted to develop other uses for the GIS database.	The County automated production of emergency center map books using the street and structure information from databases maintained by the Planning Department.	By applying the GIS database to ongoing processes, the County was able to save approximately $4,000 by producing the map book in-house rather than outsourcing it.
City of Portage, Michigan	Community Development Department	Tasks associated with the notifications process performed by the Department were time intensive.	The City developed an ArcView application that reduced the time clerical staff spent handling the notification process.	The City has realized a staff savings of two man-hours per notification.
City of Rivera Beach, Florida	Community Development Department	City staff wanted to increase productivity and efficiency.	The staff developed a centralized GIS resource center that assists employees in performing routine project research.	The resource center has made staff research more efficient and saves approximately 520 staff hours per year. Now staff members have time to perform additional tasks.

APPENDIX F – CITY OF NEWBURGH ORGANIZATIONAL CHART



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