CDM

Town of Milford, New Hampshire

GIS Strategic Plan

January 2010

Final Report

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January 20, 2010

Ms. Sarah Marchant
Town Planner & GIS Coordinator
Department of Community Development
1 Union Square
Milford, New Hampshire 03055

Subject: Final GIS Strategic Plan Report

Dear Ms. Marchant:

Enclosed are four printed copies and one digital copy of CDM's final GIS Strategic Plan report. This study was conducted to assess the GIS related needs of the Town of Milford. Included in this document are the following:

- Summary of Current GIS-related Activities;
- Summary of Departmental Needs;
- GIS Implementation Recommendations; and
- Summary of Recommendations and the Recommended GIS Strategic Plan.

Please feel free to distribute this report to all participating departments. When you are ready to schedule a presentation to summarize the report please contact me at (603) 222-8323 or my email address of brennenjd@cdm.com.

Very truly yours,

Jayson D. Brennen
Associate
Camp Dresser & McKee Inc.

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Section 1
Introduction

1.1 Introduction

Within the municipal government environment, nearly every decision made or action taken relates to geography. Whether a municipality is looking to identify potential economic development locations, responding to a fire incident, or planning the expansion of utility systems, instant access to geospatial information is vital.

To facilitate the instant access to vital geospatial information, local governments employ the use of geographic information system (GIS) technology. GIS technology provides municipalities with the means to more effectively organize, manage, analyze, and deploy information. Proper implementation of GIS provides municipalities with the data, tools, and processes to make more informed decisions, better plan for the future, compete for and control growth.

Milford has had GIS capabilities for several years and is now taking steps to implement a town-wide GIS environment that will benefit all departments. This reports provides recommendations for implementing the desired environment.

1.2 Overview of the Municipal GIS Life Cycle

The precise steps taken to implement GIS vary from community to community. However, during the GIS implementation process, several distinct tasks or processes are typically completed. These include:

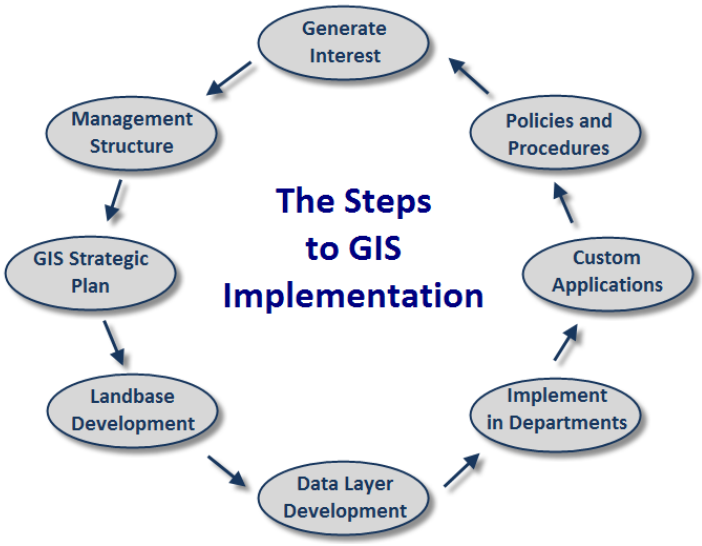
- Generation of Interest
- GIS Management Structure
- GIS Strategic Plan
- Land Base Development
- Data Layer Development
- Departmental Implementation
- Development and Implementation of Applications
- Policies and Procedures

Though a municipality may not complete all of these steps or execute them in the order outlined, it has become evident that the implementation of a fully-functioning GIS within municipal government requires that most or all of these steps be completed at some point during the implementation process. Below is a summary of

these steps and an identification of any progress that Milford has made related to the completion of these steps.

1.2.1 Generation of Interest

The forefront of development of a GIS within a municipality starts with the generation of interest. This process typically begins with municipal staff collecting information pertaining to GIS, attending meetings and conferences, talking with other communities, and becoming fairly knowledgeable with the GIS implementation process.



Milford is very "GIS-literate". Most departments understand the technology and are excited about the possibility of using it to support their daily processes.

1.2.2 GIS Management Structure

One of the most vital elements of a successful GIS implementation is a strong, organized management structure. In a town the size of Milford this structure may consist of a GIS Coordinator and GIS Steering Committee.

In most communities, a GIS Committee is formed to guide the overall GIS implementation process.

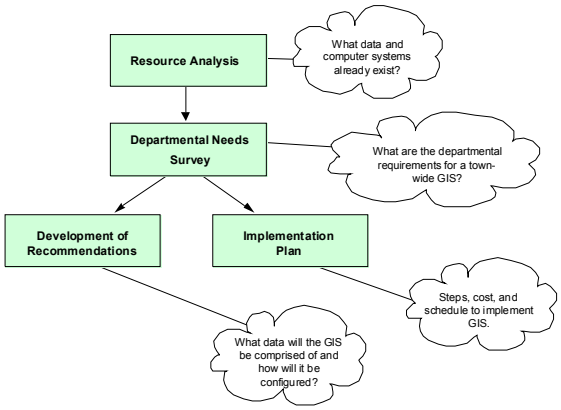
The GIS Steering Committee usually consists of representatives from departments that have a major interest in GIS. Their responsibilities involve overall management of the system, ensuring that the GIS involves a coordinated effort, developing budgets for GIS implementation, and guiding the development of the system.

The GIS Coordinator role is to implement the GIS at a town-wide level, keep data up to date, integrate the GIS with town systems and carry out the mission set forth by the GIS Steering Committee.

Milford currently has a staff member in the "GIS Coordinator" role but has yet to formalize a GIS Steering Committee.

1.2.3 GIS Strategic Plan

Prior to the implementation of GIS technology, many municipalities develop a GIS Strategic Plan. This plan is developed to assess the needs of town departments, provide recommendations for implementation, formulate a clear plan for implementing, operating, and managing a sustainable GIS environment.



A GIS Strategic Plan is developed to outline a path for implementation.

The GIS Strategic Plan typically consists of recommendations related to GIS hardware, software, data, training, management, and policies and procedures. In Milford, the result of this project will be a GIS Strategic Plan that provides the recommended GIS implementation strategy.

1.2.4 Land Base Development

The first major GIS data development task typically involved with the implementation of GIS is the development of a land base map. The land base map is the map to which all other maps are registered, and in most cases, is developed from aerial photography. From aerial photography, it is possible to accurately map features such as roads, buildings, water bodies, fences, pools, poles and even a high percentage of manholes, catch basins, and hydrants.

Milford's current GIS environment is primarily based on NH State digital orthophography. Though reasonably accurate this base map may not meet the needs of all departments in the long-term. Therefore, as part of this report, new mapping from aerial photography will be evaluated.

Most communities implement land base mapping from aerial photography.

1.2.5 Data Layer Development

Upon completion of the land base mapping process, GIS data layers are developed on top of the land base. These data layers may consist of parcels, wetlands, sewer, water, zoning, drainage, soils, catch basins, police incidents, and potentially dozens of other layers.

When implemented, these layers provide the information departments need to make decisions and provide the framework for "spatially enabling" town database systems (e.g., assessing records, permits, complaints, etc.).

Over the years, Milford has developed numerous GIS data layers including parcels, utilities, and zoning. This information will be integrated within a town-wide GIS environment and supplemented with additional data and applications.

1.2.6 Departmental Implementation

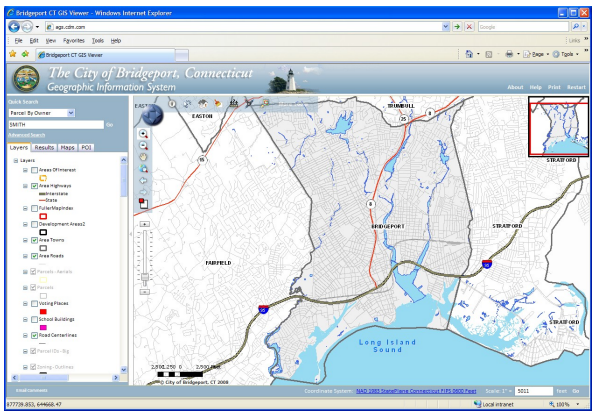
Once GIS data is developed, departments are provided with GIS capabilities. This process may include the following:

- Installation of GIS data on a centralized server.
- Integration of GIS data with town systems, such as the assessing, finance, and permitting systems.
- Definition of GIS users including editors, power users, and typical users.
- Installation of GIS software, such as ArcView and ArcInfo (ESRI), on data editors and power users' systems. Software to support web access for typical users is also installed.
- Implementation of a management structure to support and guide system expansion. This structure typically includes a GIS Steering Committee and GIS Coordinator.
- Implementation of policies and procedures for data management, standardization, and distribution.

1.2.7 Develop Custom Applications

Once GIS data is installed, custom applications are typically developed to provide customized access to data. These are primarily web-based and made available to all staff and potentially the public. Applications could include:

- A web site to allow town staff and public access to GIS data
- Economic development site finder
- Crime Tracking
- Utility and Asset Management
- A customer terminal which allows the public to easily access parcel information



GIS applications are developed to provide user-friendly access to GIS data.

1.2.8 Policies and Procedures

As the system is being implemented, the GIS Steering Committee must begin to develop policies and procedures to ensure the proper update, management, and distribution of GIS information. This step is vital as it sets in-place the procedures and methods for sustaining the system over-time.

1.3 Report Objectives

The objectives of this report are as follows:

- Review data that could be integrated with GIS
- Review the GIS-related needs of departments
- Develop recommendations for GIS system implementation
- Develop recommendations for system management and training
- Develop a plan for GIS implementation including cost and schedule

The intention of this report is to identify a GIS implementation strategy that will result in a system that benefits all Town departments.

1.4 Organization of Report

This report consists of six sections as follows:

- Section 1 - Introduction
- Section 2 - Summary of Current Activities and Available Data
- Section 3 – Summary of Departmental GIS Needs
- Section 4 - GIS Implementation Recommendations
- Section 5 – GIS Data Development Recommendations
- Section 6 – Summary of Recommendations and Strategic Plan

Section 2
Summary of Current Activities and Available Data

2.1 Introduction

This section provides an overview of the Town's current GIS capabilities, computer operating environment, and data that can be integrated with GIS.

Specific topics discussed in this section include:

- Existing GIS Software, Hardware, and Data
- Existing Computer Environment
- Data Available to be Integrated with GIS

2.2 Existing GIS Software, Hardware, and Data

The Town has had GIS capabilities for several years. Over the years the Town has implemented a significant GIS environment consisting of core GIS hardware, software, and data. This environment is summarized as follows:

2.2.1 Existing GIS Software

The Town has many core GIS application software products in-place. A summary of these products are as follows:

Software	Number of Copies/ Department(s)	Comments
ArcEditor 9.x (ESRI)	1 copy - Planning	Used for GIS data development, editing, analysis, and map production.
ArcView 9.x (ESRI)	1 copy – Planning 1 copy - Water	Used for GIS data viewing, analysis, and map production.
Pictometry's Electronic Field Study Software	Town Site License	Used for viewing oblique-level aerial imagery, provided through a grant.

2.2.2 Existing GIS Hardware

GIS hardware currently consists of the following:

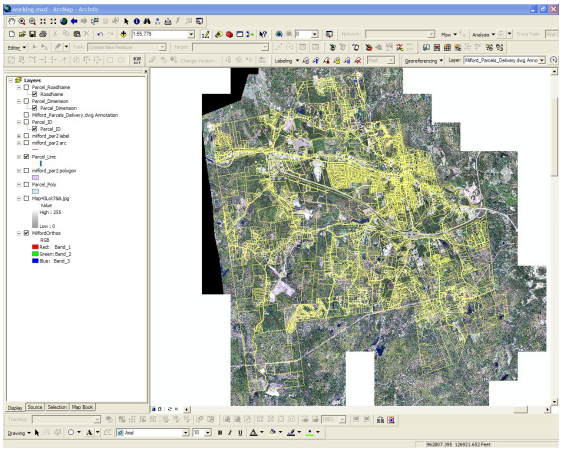
Hardware	Number/Location	Comments
GIS Editing Workstation	1 GIS Workstation in Planning	A GIS editing workstation exists in Planning.
Plotter	1 Plotter in Planning	1 HP 800-series color plotter existing in Planning
GPS Unit	No Current Units	Water borrows a high-accuracy unit from UNH to support water and wastewater system mapping. Police is planning to obtain GIS and survey capabilities to support plotting accidents.

2.2.3 Existing GIS Data

The Town has an extensive and impressive amount of GIS data that was developed or acquired by the Town over the years. This information primarily exists in Planning and is in ArcView format.

Milford's GIS database is based on the New Hampshire State Plane, NAD83 Feet Coordinate System. The "base map" that was used as the initial reference of Milford's GIS data was digital orthophotography acquired from the state. Though this base mapping is fairly accurate, it may not have the site-level accuracy required for all desired applications. A summary of existing GIS data is as follows:

- Digital Orthophotography – 1-foot pixel resolution digital orthophotography acquired from the State of NH.
- Parcels - Town-wide parcel mapping including lot lines, dimensions, and easement lines.
- Zoning – Town-wide zoning mapping
- Stormwater Outfalls – Approximate locations of stormwater outfall from GPS.



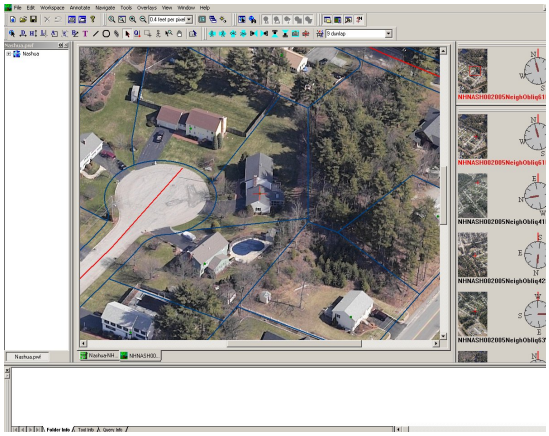
The Town has an extensive GIS database.

- Water System Mapping – Close to 100% of fire hydrants located using GPS. Approximately 50% of valves located using GPS. No GIS-based water pipe mapping exists but water does have an AutoCAD map that shows general locations of water system network.

- Sewer System Mapping – Approximately 98% of manhole locations located using GPS. Approximately 25% of sewer system piping mapped in GIS using GPS points to guide placement. An AutoCAD map that shows general locations of the sewer system network exists and is being used to help build the sewer GIS.

- Nashua Regional Planning Commission Layers – Several NRPC-created GIS data layers including building locations and many environmental and planning-related layers. These layers include road mapping, zoning, open space, and wetlands.

- State GIS Data Layers – Several State-available GIS data layers including soils, flood plains, topography, hydrography, and census information.



The Town uses Pictometry Software to view aerial imagery.

- Pictometry – A library of oblique-level imagery that assessing uses to assist with the real estate assessment process. A subset of this information is available on-line using the "bird's eye" function on http://local.live.com.

In summary, the Town has an extensive amount of GIS information available to them. This information, with slight modification, will be able to be integrated into a town-wide GIS environment. The primary layers that have yet to be developed include water, sewer, and stormwater.

2.4 Computer Systems Environment

The Town's current computer environment is comprised of a wide array of department-specific computer application software and hardware/communications equipment. A summary of Milford's existing computer environment is as follows:

Key Town Applications – Key town applications that have the ability to be integrated with the GIS environment include:

- Vision – Real Estate Assessment Property Appraisal

- MUNIS – Building permits and financials.
- IMC – Police Department records management
- FireHouse – Fire Department records management
- HMIS – Cemetery management software

Computer Systems Network – The Town's computer system network consists of very fast network connections within Town Hall, fast fiber connections from Town Hall to Police and Fire, and slower (768K) DSL connections to Water and Public Works.

In summary, the Town's existing computer infrastructure will easily accommodate a networked GIS environment. The only area of concern is the DSL network connection among Town Hall and Water and DPW. However, as a web-based GIS environment will be implemented, this concern should be minimized as a limited amount of information will be transferred over the Town's network. If full GIS access is required, copies of pertinent data could be provided to these offices or "cached map services" could be established to provide access to key information over the internet.

Section 3
Summary of Departmental GIS Needs

3.1 Introduction

GIS is a town-wide endeavor that will affect nearly every town department. Therefore, it is imperative that the GIS-related needs of departments be identified prior to the implementation of an enterprise-wide system. To assist in identifying GIS-related needs of town departments, CDM completed the following process:

- Met with key town staff prior to kick-off of the GIS needs assessment project to review the municipal GIS implementation process.
- Reviewed existing town GIS information.
- Completed interviews with several town departments including Community Development, Assessing, Public Works, Information Technology, Fire, Water/Wastewater, and Police.

Using information compiled from the interviews, a list of departmental comments, concerns, and needs was developed and is summarized below. This information will be used to assist with the development of the GIS strategic plan.

3.2 Summary of Comments, Concerns, and Findings

The GIS needs assessment interview process revealed numerous GIS-related concerns and needs by all departments. Below is a summary of the primary needs and concerns of town departments as identified during the interview process.

- GIS capabilities exist within the Planning and Water. To date, most departments rely on the skills of the Town Planner to access and create GIS information. Many departments mentioned that they would like to be able to perform basic GIS functions from their desktop so they do not have to rely on other town personnel.
- GIS data exists for parcels, hydrants, manholes, zoning, and several other layers. This information is well managed and organized by the Town Planner and Water. As the system evolves, departments would like this information centrally stored and accessible.
- Many departments stated the need for accurate aerial base mapping that will support site-level decision making, engineering, planning, and accurate utility mapping.
- Departments all stated the need for quick and efficient access to mapping, Vision, MUNIS, and utility information. Any system implemented should have these capabilities.

- Key data layers that departments felt needed to be developed include stormwater, water, wastewater, and base mapping. Stormwater is particularly important due to EPA mandates.

- Departments currently spend hours completing tasks that could potentially be completed in a matter of minutes using GIS. This was apparent in most departments as access to the data required is simply not available.

- Departments currently have few means of accessing data from other departments. Answering a simple question, or compiling information for a project, routinely takes hours and requires personnel to "run" from department to department to obtain information. This was a frustration of many departments.

- Many departments, such as Public Works, Police, Fire, and Assessing require access to GIS information in the field.

- Many departments stated the need for standardizing property addresses and developing an official address database.

- Departments are all excited about the possibilities of GIS and feel that it is a tool that will help them get more done in less time and make more informed decisions.

- Departments envision countless uses for GIS. Economic development, managing utilities, coordinating mapping, providing information to the public, making more informed decisions, and simply having efficient access to required data are common uses.

3.3 Summary of Departmental Needs

Below is a summary of key needs of several departments as described during the interview process.

- **Assessing –** To support daily assessing functions, Assessing requires access to parcel, zoning, utility, wetland, current use, topography, building permit, and planning information. Though this information exists, much of it is not readily available. They often have to spend considerable time going from "department to department" to acquire information they need to support their daily workflow.

  Assessing would like to use GIS to be able to easily access parcel, zoning, permit, utility, and other information from their desktop. It is important to that that GIS data be accessible in a user-friendly format, consistently updated, and tightly integrated with Vision and MUNIS.

- **Department of Public Works -** The Department of Public Works is responsible for maintenance of streets and sidewalks, parks, cemeteries, and stormwater. They use several data sources to help them manage town infrastructure. These include snow plow maps, various plans depicting parts of the town's stormwater system,

cemetery management software, and the occasional use of pavement management software.

One of the key uses of GIS within DPW would be to assist in the development of a town-wide stormwater inventory and management system. Though some paper mapping exists and many outfalls have been located, no computerized town-wide stormwater mapping system exists. This is a top priority for DPW as the most recent NPDES Phase II stormwater permit will require stormwater mapping of the entire town. To support this effort, DPW would like to have aerial mapping completed and maps and field research conducted with the goal of developing a town-wide stormwater GIS environment.

In addition to stormwater mapping, DPW sees many other uses for GIS. They would like to have instant access to base mapping, parcel, water, sewer, property, aerial photos, street, and topography information; have the ability to integrate pavement management with GIS to support the capital planning process; and eventually track complaints and work orders.

Once the GIS is implemented, DPW will become a large user of the system. Initially, it is envisioned that they will access GIS data via a web environment and eventually they may develop, edit, and maintain their own information using GIS software.

- **Information Technology –** Information Technology (IT) is responsible for implementing and maintaining the Town's IT applications and infrastructure. Key application software in Milford includes Vision (Assessing), MUNIS (permits and finance), IMC (Police), Firehouse (Fire), and HMIS (Cemetery). The Town's network environment is excellent and includes high-speed connections within Town Hall, fiber connections to Police and Fire, and DSL connections to Water/Waste Water and DPW.

  IT envisions that a centralized GIS will be established that consists of a GIS server, extensive GIS data, and key applications to support access by all levels of users. They also envision that the GIS will be integrated with key town IT applications, editable by several staff, and accessed using user-friendly web-based GIS applications. They feel that the GIS will integrate well within the Town's IT environment and is treating this technology not as a mapping tool but as another component to their IT system. Once the system is implemented, they are confident that staff in Planning will be able to maintain the system while they will support departmental access to GIS databases and applications.

- **Police –** Police requires access to information 24-hours per day. They routinely require access to parcel mapping, property ownership records, address, utility, topography, police sector, Pictometry, and IMC incident information and feel that GIS is a technology that will help "blend" these data sources together into a system that will give them the information they need through a single environment.

One of Police's key concerns is the lack of addressing standards. This lack of standards often makes it difficult for them to locate an address or properly store incident information that is coordinated with other town systems. They see GIS as a tool that will help support the development of addressing standards throughout the Town.

They also see GIS as a tool that will help them easily access town departmental information 24-hours per day. Currently, they often have to make several calls or visit multiple town departments to access the information they need. They also would like to use GIS to support analyzing incident information, plan for operations, and eventually track the locations of their vehicles. It is important to them that their information is secure and that they have the capability to edit/manipulate data to support incident reporting.

- **Fire -** Fire currently has limited access to mapping information but has many mapping and data-related needs. They have Pictometry mapping software in the Fire Chief's vehicle and use it occasionally and they maintain significant permit, inspection, incident and business listing information in their FireHouse system, as well as various other data in Excel spreadsheets. This information is primarily referenced by address and can be linked to the GIS System.

  The Fire Department has many uses for GIS. Primarily, they need access to town mapping information 24-hours per day. Information they need to access includes parcels, property ownership, hydrants, utility pipes, topography, addresses, water bodies, aerial photography, and base map data. Fire also wants to work with the State of New Hampshire to develop an E911 address database. This information may have address locations for all properties in Milford. Currently, Fire simple has limited access to the information they need to help prepare for and react for emergency situations.

  With GIS, Fire would like to provide key information to fire vehicles, map incident and inspection information, complete drive-time analysis, and be able to access town information 24 hours per day. They see GIS as a tool to support these needs.

- **Community Development –** The Community Development Department comprises of Building, Zoning, Planning, and Health. As a department, they rely on access to mapping and spatial information continuously throughout the day. In fact, nearly every decision that they make and action they take relates to geography. Therefore, efficient access to this information is vital.

  Currently, Community Development relies heavily on the Town Planner to acquire data, generate maps, and complete analysis. Community Development would like to reduce the reliance on the Town Planner and be able to access all GIS information via a user-friendly GIS environment. This will allow the Town Planner

to focus on planning and GIS data maintenance duties and reduce the time spent making maps for town departments.

- Community Development has many needs for GIS. They would like to have aerial accurate base mapping that includes buildings, roads, topography, and utility features; be able to more effectively access permit and Vision information through a GIS-based environment; and access data via a web environment from their desks, at home, or in a public meeting.

  Community Development is currently a large user of GIS and they envision that with the deployment of simple-to-use GIS tools that nearly every employee in the department will benefit from this technology. They hope to leverage what has been completed to-date and expand the system to support additional data, analysis, and access needs.

- **Water Utilities –** Water is responsible for providing drinking water and wastewater services to the Town. They maintain approximately 55 miles of water main and 40 miles of sewer main.

  Over the past several years, Water has started the implementation of a GIS program and has worked on developing GIS data as they have time. To date, they have GPS-located nearly all fire hydrants, approximately 50% of water gate valves, and approximately 98% of sewer manholes. In addition they have located approximately 40% of the water service "gate boxes". This information was GPS-located using a GPS unit that they borrowed from UNH. They would like to purchase their own unit so they can more effectively collect data and eliminate having to schedule the borrowing of a unit.

  Their intention is to eventually develop a town-wide GIS consisting of water and sewer pipes and nodes. Using ArcView GIS software that they own, they have "drawn in" approximately 25% of the sewer system pipes but have yet to start pipe mapping on the water system. They are using "rough" AutoCAD water and sewer maps to help place pipes. They do not know how long it will take them to complete this effort and work on it as time allows.

  Water sees GIS as a key technology that they will use to support utility planning, engineering, and operations. They would like to have access to accurate aerial base mapping depicting roads, buildings, topography, and other features and combine this mapping with parcel, zoning, water, sewer, and stormwater information. They eventually would like to make this information available to Water crews and scan their historical service connection card information.

Section 4
GIS Implementation Recommendations

4.1 Introduction

This section provides recommendations and options for implementing GIS in the Town of Milford. These recommendations were developed based on information compiled during the interview process, as well as standard practices in the industry. Section 5 provides recommendations specific to GIS data layer development. Recommendations are provided for the following:

- GIS System Management Structure
- GIS User Definition
- GIS Hardware and Software
- GIS End User Applications
- Integration with Town Systems
- GIS Policies and Procedures
- GIS Funding Strategies
- GIS Training and Assistance

These recommendations are being presented to help the Town promote the development of an enterprise GIS environment which has a clear mission, proper management strategy, and growth based on the needs of the users.

4.2 Summary of GIS Implementation Recommendations

The following is a summary of GIS implementation recommendations. Specifics related to each recommendation are provided in the remainder of this section. CDM recommends the following:

- The GIS be managed through a three-tiered management approach that includes a GIS Steering Committee, GIS Coordinator, and GIS Consultant.
- The Town defines user roles to assist with determining the hardware and software that will be provided to each user.
- The GIS continues to be based on ESRI GIS software products including ArcEditor, and ArcView desktop GIS products and ArcGIS Server web-based GIS server software products.

- The GIS data be centrally stored on a newly-purchased or existing GIS server. Users will access GIS information centrally stored on this server.
- The Town purchases a GPS unit to support water, sewer, stormwater, and other mapping.
- The Town implements end-user GIS applications including a "flag-ship" web-based GIS application that will allow employees and the public to access GIS data using a web-browser. This is being completed as part of the existing "Parcel GIS Development" project.
- The Town integrates GIS with town applications including Vision, MUNIS, IMC (Police), and FireHouse (Fire). Integration with Vision and MUNIS will be completed as part of the existing "Parcel GIS Development" project.
- The Water Department implements a field-based GIS program that provides field crews with instant access to GIS, scanned document, and base mapping data.
- The Town develops policies and procedures that will outline standards for data distribution, sale, development, and acquisition.
- The Town implements a funding strategy to assist with funding the long-term maintenance of the system.
- The Town implements a training and technical assistance program and promotes proper use of the system.

4.3 GIS Management Structure

One of the most important components of a town-wide GIS implementation is a strong management structure. By having a strong management structure that includes input from key town departments, the system is much more likely to meet overall departmental needs and achieve higher success.

It is strongly recommended that a formal GIS management structure be implemented.

For Milford, a three-tiered GIS management structure is recommended as follows:

- **GIS Steering Committee –** It is recommended that the Town form a GIS Steering Committee. This committee should be comprised of members from key Town departments including Community Development, Public Works, Water, Fire, Police, and Information Technology. A Committee Chairperson should be appointed to set the agenda and run the

meetings. Meetings should be held monthly during the GIS development stage and quarterly during the operational stage.

The mission of the GIS Steering Committee should be to guide the overall GIS implementation process, set short and long term goals, develop GIS policies and procedures, and help set GIS budgets. In essence, this committee will act as the "governing body" for GIS in the Town. All major GIS projects to be undertaken should be approved by this Committee.

- **GIS Coordinator –** It is recommended that the Town continue the position of GIS Coordinator that is currently held as a shared position with Town Planner. The GIS Coordinator's responsibilities should be to carry out the directives set by the GIS Steering Committee, manage consultants, take delivery of GIS products, and oversee the implementation of the town-wide GIS program. This position will assume the day-to-day management of the system. As the system expands, the Town can assess the need for hiring a GIS technician that would be shared by all town departments.

- **Information Technology Staff –** It is recommended that existing Information Technology staff be responsible for managing the GIS hardware, software, and integration of the GIS with other town systems while the GIS Coordinator focuses on managing GIS data. The Town currently has this skill set in-house.

- **GIS Consultant –** It is recommended that the Town retain a GIS consultant to assist the Town with data development and maintenance, training, applications programming, or other tasks that can not be completed in-house. The consultant would be retained on a yearly basis at a cost of between $6,000 and $12,000. If the Town hires GIS-specific staff, the reliance on a consultant will be reduced.

This management structure will ensure that all departments and users have input on the development of the system. It will also ensure that the GIS Coordinator has proper direction and accountability with respect to meeting the needs of users and furthering the development of the system. It is recommended that this GIS management structure be implemented immediately.

4.4 GIS User Definition

It is recommended that GIS users be classified by the GIS Steering Committee with the intention of identifying hardware and software solutions for each user. These users should be categorized into the following groups:

- **GIS Coordinator –** Uses ArcInfo of ArcEditor desktop GIS software that is capable of editing data.

- **GIS Power User –** Uses ArcView desktop GIS software for advanced GIS functions such as data analysis, basic editing, detailed map production, and modeling. It is

anticipated that there will eventually be up to five GIS Power Users including Water, Public Works, Police, Fire, and Community Development.

- **Typical GIS User** – Uses a web-based interface to access Town GIS information via a user-friendly environment. It is anticipated that most users will access GIS data using this method.

- **GIS Field User** – Uses field GIS software to access GIS data via a field laptop.

Classifying users will allow the GIS Steering Committee to understand what GIS capabilities are needed by each user and to provide appropriate hardware and software tools to users. By doing so, the Town will be able to more effectively manage users and maximize GIS software licenses.

4.5 GIS Hardware and Software

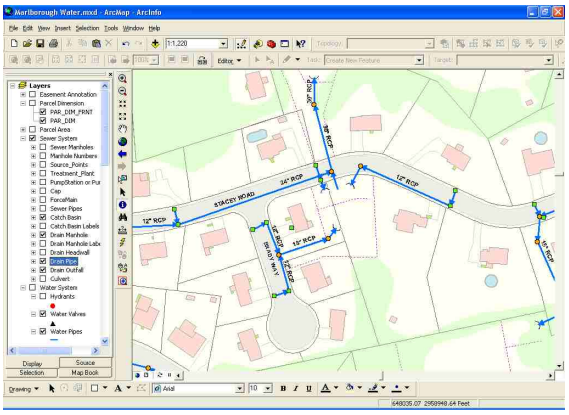
CDM recommends the implementation of an enterprise GIS software and hardware environment. Within this environment, GIS data would be centrally stored and managed and access to data would be through user designated software.

The Town currently has three GIS software licenses. These include an ArcEditor, which is used by the GIS Coordinator, and two ArcView licenses, one in Water and one in Community Development. Existing Hardware consists of a GIS PC (GIS Coordinator) and Plotter.

To implement an enterprise GIS environment, CDM recommends the following:

- **GIS Software -** The Town continue to base their GIS on ESRI software products including ArcEditor (for the GIS Coordinator), ArcView (for GIS power Users), and ArcGIS Server Web Applications (for Typical GIS End Users).

  At this time no new desktop GIS software is recommended but as the system evolves ArcView should be purchased for Power Users (Public Works, Fire, and Police). In addition, if required by the GIS Coordinator, the existing ArcEditor license can be upgraded to ArcInfo.



It is recommended that Milford's GIS be based on ESRI software products.

- **GIS Server -** The Town implement a centralized GIS data server or dedicate part of an existing server to GIS.

This server would centrally store GIS data, Pictometry information, and host GIS end-user applications. Typical server specifications include 3GHz processors, 4GB RAM, and substantial hard drive space. A server with these specifications will cost between $4,000 and $6,000.

- **WebGIS Application Software -** The Town implement an ArcGIS Server-based WebGIS application to support general access to data. Through the parcel GIS development project currently being completed, this application is being developed and hosted by CDM. As the system evolves, the Town should consider purchasing ArcGIS Server software and hosting the data internally. The cost of ArcGIS Server software is approximately $6,000.

- **GPS Unit –** The Town and Water purchase a "sub-foot" GPS unit to assist with mapping the sewer, water, stormwater, and other town infrastructure. The cost for this unit could be shared by departments. The recommended unit is the Trimble GeoXH sub-foot GPS, or similar. Cost for a unit with these specifications including applicable software, training, and support is between $6,000 and $10,000.

It is recommended that the Town purchase a GPS unit to assist with GIS data collection.

- The Town provides adequate PCs to Power Users (users using ArcEditor or ArcView desktop GIS software). These systems should have at least 3GHz processors, 2GB RAM, 160GB hard drive space, and large monitors.

- The Town eventually provides GIS capabilities to field crews using "ToughBook" computers. This should occur upon completion of water, sewer, and stormwater layers.

At this time, the Town has adequate desktop GIS software and plotting capabilities. No new desktop GIS software is recommended until the system evolves and is ready for editing by departments other than Community Development and Water.

4.6 GIS End User Applications

To customize the GIS for Town use, it is recommended that custom applications be developed and implemented. These applications will allow users to more efficiently access data, provide access to data by the public, and allow departments to rapidly complete daily tasks.

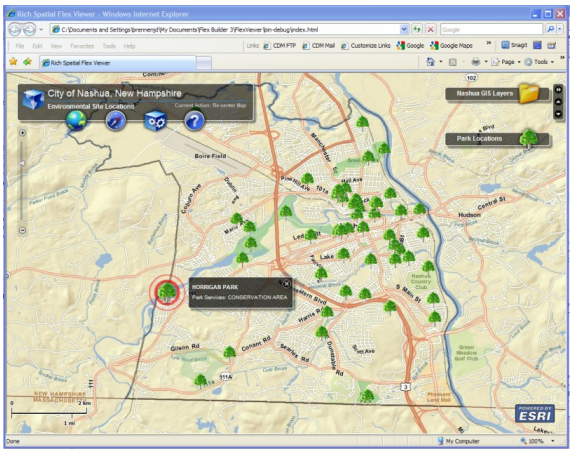
Through the "Parcel GIS Development" project, being completed by CDM, an ArcGIS Server-based WebGIS application will be implemented. This application will provide

town employees with user-friendly access to GIS data through web environment. This application will become the primary means in which user will access GIS information. As the Town's GIS matures, however, addition custom applications will be necessary to support department-specific or custom needs.

Additional applications that are recommended include:

- **WebGIS Application**s – A suite of WebGIS applications that provide departments, citizens, and interested parties with simplified access to GIS information. These applications would supplement the application currently being developed for Milford and may include custom applications for economic development, utility maintenance, citizen access, and general community information (where to vote, schools, parks, etc.).

  These applications are recommended to be developed within ESRI's ArcGIS Server environment using either the Flex or Silverlight programming interfaces. Cost for developing applications, if not completed in-house, will be between $5,000 and $10,000.



It is recommended that a web-based GIS application be developed to provide users with easy access to GIS data.

- **Field GIS Applications** – It is recommended that a field-based GIS application be developed for Water and Public Works. This application would provide GIS-based access to mapping and scanned image information to field crews. It should be based on ESRI's ArcEngine software (which is used to create a customized GIS interface) and include functions to support GIS data access, query of customer databases, view scanned plans and documents, trace utility features, and GPS functionality. Cost to implement this application would be approximately $4,000 - $8,000.

It is recommended that Water implement a field-based GIS application.

- Future GIS Applications – Many potential future GIS applications were mentioned during the GIS interview process. These included automated vehicle locations (AVL) systems, internet-based GIS access for citizens, cemetery management, and crime tracking. These are all feasible applications that should be discussed and decided on at the committee level.

4.7 Integration with Town Systems

A key component of any municipal GIS environment is the integration of the GIS with municipal information systems. As part of the Town's "Parcel GIS Development" project, the GIS will be integrated with Vision and MUNIS. This integration that is being completed will support many of the needs expressed by departments.

As the system matures and expands, it is recommended that the GIS be integrated with Police's IMC system and Fire's FireHouse system. This integration would be based on a "address" and would provide the capability to spatially depict, query, and analyze information in these databases. This process could be completed in-house, over time. However, prior to integration, a town-wide standard for addressing may have to be resolved to obtain a proper data linkage.

Milford's GIS will be tightly integrated with Vision and MUNIS.

4.8 Policies and Procedures

Policies and procedures are a key component of a successful GIS system. This is because policies set the guidelines, standards, and direction that the GIS Department must follow. It is recommended that through the GIS Steering Committee, several policies and procedures be implemented. These include:

4.8.1 GIS Data Disclaimers for Printed and Digital Products

It is recommended that the Town develop disclaimers for all GIS data and products. These disclaimers will "hold harmless" the Town for all uses of the GIS data. This disclaimer should be on any paper or digital product produced from the Town's GIS system. A sample disclaimer is shown below.

SAMPLE DISCLAIMER

The Town makes no warranty or representation as to the accuracy, timeliness or completeness of any of the data. The Town shall have no liability for the data or lack thereof, or any decision made or action taken or not taken in reliance upon any of the data.

It is also recommended that the Town develop a data release policy for digital data that is provided or sold. This data release policy will prevent unauthorized use or distribution of GIS data. A sample data release policy is provided below.

City of Cambridge, MA.
GIS Data Release Agreement

1. The City of Cambridge provides Geographic Information Systems ("GIS") data in good faith. The City makes no warranty in regard to the data whatsoever, including, but not limited to, a warranty of the accuracy of the data. The party requesting the data (hereafter "Requester") agrees that the City has no liability arising from any incomplete, incorrect, inaccurate or misleading data provided.
2. The City makes no warranties of fitness or merchantability either express or implied in regard to the data provided to the Requester hereunder. The data provided are provided "as is" and with all faults.
3. The Requester will have no claims to data updates.
4. The Requester shall indemnify and hold harmless the City and its officers, employees and agents from and against all losses, claims, demands, actions, payments, costs, suits, liabilities, including attorney's fees, expenses and damages (direct or consequential) whether or not caused by the negligence of the City, its officers, employees or agents, which are incurred by or recovered against the City for any reason whatsoever arising out of or relating to this Agreement, or the data, or to any use to which the Requester might put the data.

The Requester acknowledges that he/she has read this agreement, understands it and agrees to be bound by its terms and conditions.

_____

Signature

Printed Name:

Company:

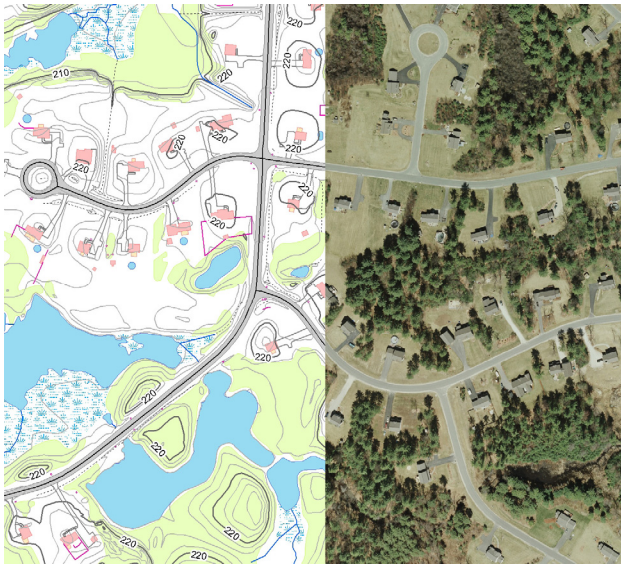
Address:

City or Town, State, Zip code:

e-mail address

Dated:

4.8.2 Sale of GIS Data and Maps



Milford must develop policies for the sale and distribution of GIS data.

It is recommended that the Town develop policies and procedures for the sale and distribution of GIS data. Communities approach selling data in various ways. Some communities sell paper and digital data, some sell only paper maps, and some do not sell any data. These are decisions that the GIS Steering Committee must make. To prepare for the sale of data, the following is recommended.

- The GIS Steering Committee decides on what data will be sold and in what formats. Many communities sell paper maps, digital orthophotography, and GIS data files.
- The GIS Steering Committee establishes prices for each product.

- The GIS Steering Committee assigns one person to be responsible for all GIS distribution tasks.

In general, cities in New England are selling GIS data for between $100 and $500 per layer or groups of layers. Some communities, however, sell data per tile or unit. This can result in increased revenues but will take additional time to assemble.

Policies for Data Maintenance and Update

It is recommended that the Town develop policies and procedures for periodic GIS data updates. This will ensure that data is properly maintained and is kept current. These policies should include:

- ***Timeframes for GIS updates***. For example, a policy should be developed to ensure that parcels and other major GIS layers undergo maintenance at least twice a year.

- ***Policies for GIS base map updates***. Once aerial mapping is completed, it will be necessary to update this information occasionally. Most communities update base map information every five to eight years. The Town's committee should develop guidelines for updating these data layers on a scheduled basis.

4.8.3 Planning Board Data Submission Requirements

It is recommended that the Town develop data submission requirements that will require developers to submit applicable data to the Town in CAD or GIS format. An example of this data might be a 10-lot subdivision or a major building project. This will help the Town keep GIS data up to date, save personnel time when updating data, and will make the Town's database more accurate. These submission requirements should be made part of the Planning Board process. Specifications included in this requirement include:

- Information shall be provided in the New Hampshire State Plane Coordinate System – NAD83 feet.

- Data shall be delivered as AutoCAD, DXF, or applicable GIS format.

- Layers shall be compiled according to a general layering scheme developed by the Town. The layering scheme should be well documented and provided to all builders during the permitting process.

These submission requirements should be included within the Town's Planning Board requirements.

4.9 GIS Funding Strategies and Operational Costs

Implementation of an enterprise-wide GIS program can involve significant start-up costs. However, it will also involve yearly maintenance costs (for software

maintenance and technical support) and capital costs (for updating aerial base mapping on a timely basis).

Initial Funding - Communities typically fund GIS programs through many ways. Most common methods include:

- General fund or appropriation.
- Departmental partnerships where several departments contribute to an overall budget.
- Through an existing project, such as a large utility projects, as GIS can help offset costs related to these types of projects.
- Using grants, such as homeland security and environmental data management grants.

Operational Funding - There are also other funding options that some communities use to help maintain GIS programs, these include:

- Sale of GIS data. It should be noted however, that the sale of GIS data rarely generates significant funds.
- Establishment of a "GIS Update" fee through the Planning, Zoning, and Building processes. In these cases, fees would be added to the site plan and subdivision process, and potentially the building permit process. Significant funds could be generated through these means. The Town of York, Maine funds their entire GIS program through this method.

Approximate Yearly Maintenance Costs - Aside from start-up costs, yearly occurring costs may include the following:

- GIS Software Maintenance – Yearly maintenance cost for ArcView ($600 per license), ArcEditor ($1,600), and ArcGIS Server ($2,500).
- GIS Data Maintenance – Yearly maintenance for GIS data layers. This includes parcel updates, any utility updates, or other typical data maintenance. These could be completed in house or by a consultant at a cost of $4,000-$8,000 per year.
- GIS Consulting – Yearly budget for general GIS consulting which could be used for applications development, training, data development, or general GIS assistance. This could range from $6,000 to $12,000.
- GIS Training – Yearly budget for GIS software training as needed.
- GIS Data Development – Development of additional data layers as required. Cost for this varies.

- Capital Reserve Costs – Some communities set aside funds to update aerial base mapping on a timely basis (i.e., every 5-8 years) and amortize the cost of the update (i.e., $20,000) over 5 to 6 years.

In Milford, GIS operating and capital budgets will be needed to support the GIS program. Communities of similar size often have a yearly GIS budget of $10,000 - $25,000 for general operating costs, not including salaries. The GIS Coordinator and Steering Committees must formulate these budgets and identify long and short term expenses.

4.10 Training and Assistance

It is recommended that a training and technical assistance program be implemented. This program would include:

- ArcView and ArcEditor training for GIS Power Users and the GIS Coordinator.
- Training for typical GIS users using the web-based GIS application.
- General as-needed consultation and technical assistance that would be provided by a GIS consultant.

Training can be completed using several methods. In general, it is estimated that proving proper training to users will cost between $3,000 and $5,000. As-needed consultation will be handled through a hired GIS Consultant as described in Section 4.3.

Section 5
GIS Data Development Recommendations

5.1 Introduction

This section outlines GIS data development recommendations for Milford. These recommendations were based on information compiled during the needs assessment interview process and reflect the primary needs of town departments. Recommendations are provided for the following:

- Aerial Land Base Mapping,
- GIS Data Layer Development, and
- GIS Data Organization.

A summary of recommendations is provided below. Specific details related to each recommendation are provided in the remainder of this section.

5.2 Summary of Data Development Recommendations

The following is a brief summary of recommended data development activities. CDM recommends the following:

- Complete an aerial land base mapping project. This project would be based on aerial photography, to be acquired in spring 2010, and result in an accurate base map that would act as the foundation for a town-wide GIS. Deliverable products from this project would include planimetric mapping (roads, buildings, driveways, utility points, parking lots, and other layers), 2-foot contours, and color digital orthophotography.
- Continue to use the parcel GIS data recently developed and modify the data as necessary to coordinate with new aerial mapping.
- Develop GIS data layers for water and sewer to support engineering functions, as well as town-wide GIS access.
- Develop a stormwater GIS environment that will involve GPS location of stormwater structures, stormwater pipe mapping, and GIS development.
- Continue to use the many existing data layers the Town has developed/acquired including zoning and wetlands and adjust data as necessary to coordinate with new parcel and aerial mapping.
- Develop new GIS data layers for recreation areas, town facilities, snow plow routes, police/fire districts, and address-geocoded road centerlines/point addresses to support departmental use.

- Acquisition and integration of all pertinent state and national GIS data layers. These include flood plains, soils, aquifers, and base information from surrounding communities.

- Development of several secondary data layers as the system develops. These include street signs, septic systems, and other points of interest.

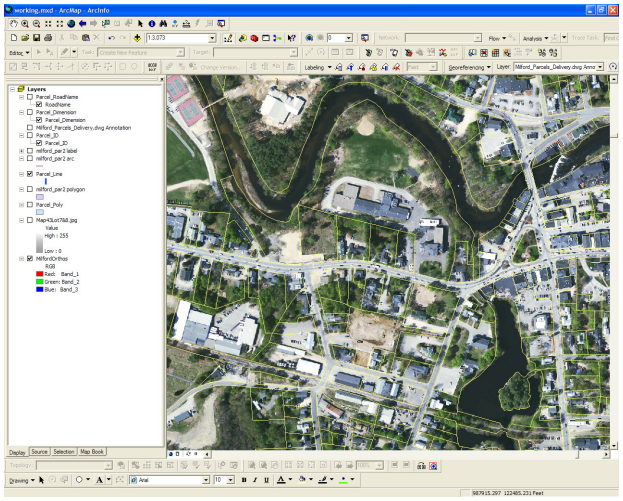
- Continue the use of Pictometry (oblique aerial imagery catalog) and participate in future Pictometry projects.

- Implement a series of ESRI "Geodatabases" to store GIS data and eventual migration to a centralized enterprise-wide Geodatabase.

5.3 Aerial Land Base Mapping

Development of a municipal GIS requires the initial development of a "base map". The base map is the map to which all GIS data layers (parcels, water, sewer, zoning, etc.) are registered. The concept of the base map is an important one, as the accuracy and completeness of the base map will drive the use of the system.

Milford's existing GIS is based on "fairly accurate" digital orthophotography (1-foot pixel resolution) acquired from the state. Though this mapping is adequate, it does not meet the long term needs of all departments. Therefore, several departments mentioned that they would like to see an accurate aerial land base map developed.



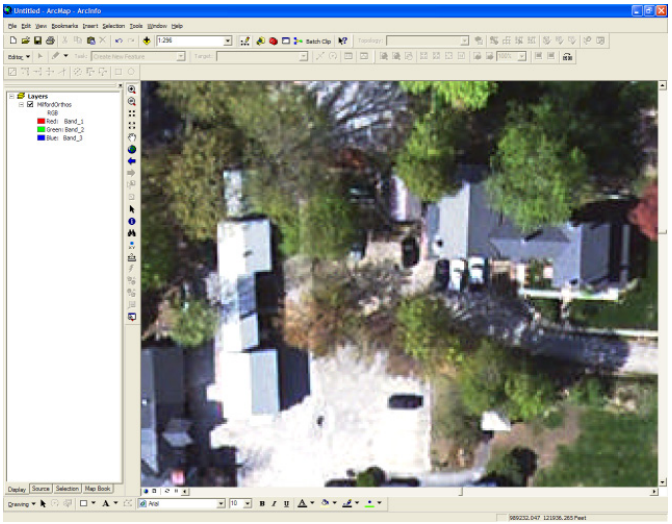
Milford's GIS is based on 1-foot pixel resolution digital orthophotography acquired from the state.

In addition to digital orthophotography, the Town also has GIS data layers for rights-of-way (from the parcel mapping project) and general building locations (as digitized by NRPC from the state digital orthophotography). Combined, with the existing digital orthophotography, these layers will provide an adequate base map but they are far from the quality of a base map developed from aerial photography.

Based on the needs of town departments and existing GIS information, the Town has two options related to base map development. They include:

Option 1 – Use Existing Mapping as the Town's Base Map

The Town could "get by" with the current base mapping that comprises of state digital orthophotos (1-foot pixel resolution), general building footprints (digitzed by NRPC) and rights-of-way lines (developed by CDM through the Parcel GIS Development project). However, due to its very limited feature capture, questionable accuracy, and low resolution orthophotography, the use of this base map for engineering or site-level purposes is minimal. However, its use for general GIS purposes may be sufficient.



Current Milford base mapping may not be adequate for site-level or engineering-quality purposes.

Option 2 – Acquire New Photogrammetric Base Mapping from Aerial Photography.

During the interview process, many town departments stated the need for accurate and complete aerial base mapping. Based on the needs of Town departments, this mapping would conform to the following specifications:

- Photography Date: Spring 2010 in Color
- Mapping Scale: 1"=100' Scale Mapping Accuracy
- Feature Capture: Roads, Buildings, Water Bodies, Pools, Driveways, Parking Areas, Visible Manholes and Catch Basins, Utility Poles, Fences, Hydrants, Vegetation, Street Trees, Swimming Pools, Sidewalks, Recreation Areas, and numerous other features.
- Topography: 2-foot Contours and Spot Elevations
- Digital Orthos: Color at a 3-inch to 6-inch Pixel Resolution

To obtain this mapping, the Town will have to develop a Request-for-Proposals and select a base mapping vendor. This vendor would then be responsible for completing aerial photography, ground control, and all base map development tasks.

The result of this process will be a seamless town-wide base map that includes accurate locations of features seen from the air. The mapping will conform to

"100-scale" mapping accuracy standards (accurate to within approximately ± 2.5 feet) and will act as the base to which all data layers will be developed.

New photogrammetric mapping from aerial photography would consist of highly-accurate planimetric mapping (left), topographic mapping (left), and digital orthophotography (right).

Deliverables for this project would include the following:

- Planimetric Mapping: AutoCAD and GIS Files showing locations of roads, buildings, water, bodies, driveways, manholes, catch basins, hydrants, and other features seen from the air.
- Topographic Mapping: AutoCAD and GIS files depicting 2-foot contour elevations.
- Digital Orthophotos: TIFF and MrSID files of scanned color aerial photography at a 3-inch pixel resolution.

Aerial Land Base Mapping Recommendation

To support the needs of all departments and uses, it is recommended that the Town acquire base mapping from aerial photography. To assist with the budgeting process, CDM solicited pricing from several aerial mapping firms. Cost to develop mapping that meet these specifications ranged from $70,000 to over $100,000. It is anticipated that these costs would be shared between town departments, water, and sewer.

Aerial Land Base Mapping – 100-scale	$70,000 - $100,000

5.4 GIS Data Layer Development

The Town currently has an extensive library of GIS data layers. Most departments do not even realize the extent of information that is currently available. The needs assessment process revealed numerous data layers that departments wish to have access to. The primary GIS data layers requested and recommendations for their integration, development or improvement are provided below.

Based on the results of the needs assessment process, it is recommended that the following primary GIS data layers be included in a town-wide GIS environment.

- Parcels
- Water and Sewer
- Storm Water
- Zoning
- Wetlands
- Open Space
- Town Facilities

It is recommended that existing GIS parcel mapping be integrated with new aerial base.

5.4.1 Parcel GIS Development

The parcel layer was the "number one" layer requested by departments and is typically one of the most important layers in a municipal GIS. This is due to the fact that the parcel layer provides access to valuable property information, as well as provides the "window" into many town database systems, such as the Vision database.

Milford just completed a parcel GIS development project that meets the needs of departments. It is recommended that the Town continue to use the existing parcel GIS information for their town-wide program and maintain this information as subdivisions are added. It should be noted, however, that when an aerial base map is

implemented, some parcel line rectification may need to be completed. It is envisioned that this would be completed in house.

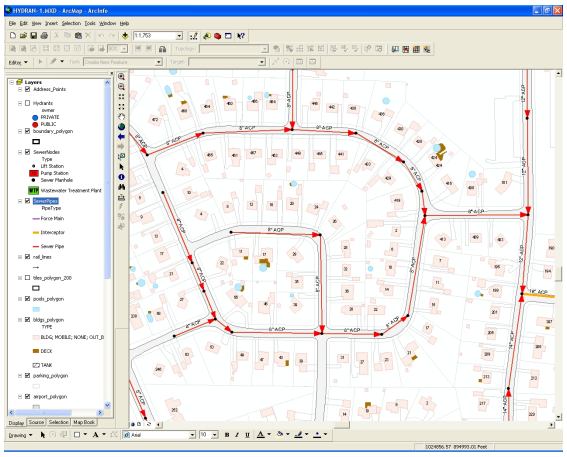
Parcel GIS Development Recommendation Summary

Make use of the existing parcel GIS data develop and maintain in-house as subdivisions are added. As an option, "parcel changes" could be contracted out yearly at a cost between $2,000 and $4,000	$2,000 - $4,000

5.4.2 Water and Sewer GIS Development

Many departments expressed the need to be able to access basic water and sewer information. To date, Water has GPS located hydrants, manholes, and approximately 50% of gate valves. However, limited GIS development work to developing a town-wide piping network has been completed.

Based on the needs of Town departments, the following is recommended:



It is recommended to implement a water and sewer GIS environment.

- The Town finish the manhole, hydrant, and gate valve GIS collection effort in-house using a newly-purchased GPS unit.
- The Town hire a consultant to develop a town-wide water and sewer GIS environment by transcribing pipe information, located on the Town's water and sewer map drawings, to GIS format.
- The Town supplement and update this information over-time and additions to the system are made or inconsistencies are found.
- The Town scan existing water and sewer service connection card information and integrate it with the GIS. This should be done over-time.

It was mentioned in the interview that the best source of water and sewer information are the town-wide water and sewer maps. These are single maps that show pipes, manholes, hydrants, and other features. Since the Town does not have complete "as-built" drawings of the water and sewer systems, the town-wide water and sewer maps should be used and supplemented with better information over time.

Water and Sewer GIS Development Recommendation Summary

Water – Town finish GPS work with newly-purchased GPS unit, consultant develops GIS environment	$12,000 - $20,000
Sewer – Consultant develops GIS environment using GPS work already completed by the Town.	$12,000 - $20,000

The budgets above outline approximate costs to be incurred by a consultant to develop water and sewer GIS information using the single town-wide water and sewer map.

5.4.3 Stormwater GIS Development

In late 2009, EPA intends to reissue the "Small MS4 General Stormwater Permit". One of the requirements of this permit will be that each municipality will have to "develop a map of the separate storm sewer system". The exact verbiage, as stated in the "Draft New Hampshire Small MS4 General Permit" text (http://www.epa.gov/ne/npdes/stormwater/MS4_2008_NH.html) is as follows:

> *2.3.4.5 The permittee must develop a map of the separate storm sewer system. The map of the separate storm sewer system must be finished by two (2) years from the effective date of this permit. This permit does not provide additional time for completion of the map that was required by the MS42003. The map must include the entire separate storm sewer system and all structures associated with the system, including, at a minimum, catch basins, manholes associated with the storm sewer system, pipes, interconnections to other small MS4s, and treatment structures associated with the separate storm sewer system. The map must show outfalls, receiving waters, and resource waters such as drinking waters. The map may also show the locations of sanitary sewers, a description of the land use areas including amounts of impervious cover, the drainage area of each outfall and the land use associated with that drainage. The map may be a hard copy or on a Geographic Information System (GIS). The permittee must report on the status of the complete map required by this permit in the annual report.*

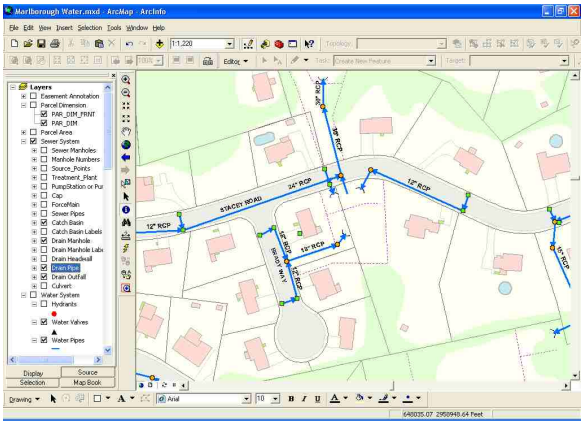
Based on a discussion with EPA, the intention of this requirement is to map all underground stormwater systems that directly or indirectly flow into "waters of the U.S.". This will help support many other requirements of the permit, especially the identification of illicit discharges. When asked about whether "road-side drainage ditches" are included, the EPA stated that the focus is on underground stormwater systems.

What this means to Milford is that a stormwater GIS including pipes, manholes, catch basins, outfall, and major drainage structures (i.e., detention ponds) will need to be mapped within two years of issuance of the permit.

According to the Town, there are approximately 1,100 town-owned catch basins and dozens of miles of stormwater pipe. Like many communities, Milford has limited stormwater system mapping. What does exist is scattered on various roadway, subdivision, and other plans. Therefore, the process to develop stormwater system mapping will require significant field investigation.

The recommended process for developing a stormwater system GIS that meets the requirements of the EPA MS4 General Permit is outlines below.

- Aerial Mapping be completed, as outlined in Section 5.3, to provide an accurate base map and map a significant percentage of manholes and catch basins.
- A field effort be completed to GPS verify aerial mapped features and locate stormwater features (catch basins, manholes, outfalls, and structures) not collected as part of the aerial mapping effort. This effort should be completed using sub-meter or sub-foot quality GPS equipment.
- A GIS "geodatabase design" be developed that includes "placeholders" for all layers, fields, and data that will be collected during this process. Of importance will be a pipe, manhole, catch basin, and outfall numbering system that will help the Town record maintenance history on stormwater features.
- The Town assemble all plan information available depicting the stormwater system. This includes plans, maps, and design drawings. These shall be provided to a consultant who will then develop a stormwater system GIS by mapping all pipe locations and developing a database containing pipe size, material, and other applicable information.



Stormwater mapping must be completed to meet requirements of the upcoming MS4 General Permit.

- Where gaps exist in mapping, the Town (or hired consultant) shall complete field research to locate pipes, outfalls, and direction of flow.
- Update the GIS based on pipe information collected in the field and complete quality review to ensure that the GIS data develop meets MS4 requirements and needs of the Town.
- Finalization of a stormwater GIS database and creation of data and map products required of the MS4 General Permit.

Actual cost to complete this effort would be dependent upon a) the amount of work completed in-house, b) whether the town completed aerial mapping, and c) the availability of map/plan information to determine pipe locations.

At the end of this process, the Town will have a town-wide stormwater system GIS that meets the requirements of the MS4 General Permit plus an information management system that will help the Town better manage the stormwater system.

Stormwater GIS Development Recommendation Summary

Stormwater GPS Location – Estimate that 2,000 stormwater features (MH, CB, and outfalls) need to be verified/located via GPS. Could be completed in-house or by a survey firm.	$15,000 - $30,000
Stormwater Mapping and GIS – Map stormwater system (i.e. pipes, direction of flow, etc) using GPS points as a base and plans provided by the Town. Develop GIS based on this information. This assumes there are approximately 500 plans to automate.	$25,000 - $50,000
Stormwater Field Work – Complete necessary field work to fill in missing areas not covered by plans or GPS.	TBD

As limited information is available on the actual number of drainage features (MHs, CBs, outfalls, and other structures) to be mapped, these numbers are approximate and will slide depending on if the numbers of greater or less.

5.4.3 Town Layers

Additional primary data layers that departments require include zoning, wetlands, open space, town facilities, and road centerlines. Many of these layers have already been developed through Planning or by NRPS and only need slight formatting to include in a town-wide GIS environment.

Layers to be developed as part of this process include:

- ***Zoning*** – Existing mapping needs to be coordinated with new town parcel mapping.
- ***Wetlands*** – Available from the state or NRPC.
- ***Open Space*** – Existing mapping needs to be coordinated with new town parcel mapping.
- ***Recreation Areas*** – Needs to be created based on Town input.

- ***Public Safety Layers*** (police/fire districts) - Needs to be created based on Town input.
- ***Plow Routes*** - Needs to be created based on Town input.
- ***Geocoded Road Centerlines and Point Addresses*** – Roads attributed with road name and address ranges and "point address" locations of residences.

The Town's Planning Department has an excellent library of GIS information that they maintain. The only major layer, of the ones requested above, that has not been developed is a town-wide road centerline file.

It is recommended that the Town develop a town-wide road centerline file with address ranges. Such a layer would support mapping all address-based information from nearly every town database. In addition, it would support the Fire and Police Departments need for incident and crime mapping. This process would be completed by assigning address ranges to every segment of road developed from aerial mapping. It would also include assigning speed limits, lane information, and other road-specific data. The State of NH is currently mapping towns and at this time, Milford has not been completed. Therefore, the Town should either coordinate with the State or start this effort on their own. This process could be completed in house or by a consultant.

Town Layer Implementation Recommendation Summary

Develop or Coordinate Town GIS Data Layers	$3,000 - $6,000
Develop Detailed Road Centerline Mapping	$6,000 - $10,000

5.4.4 Integration of Data from Regional, State, and Federal Sources

Extensive planning-level GIS information is available through regional (NRPC), State (GRANIT), and Federal (Census, FEMA, etc.) sources. The Town has acquired much of this information and has integrated it with their GIS environment. It is recommended that the Town compile this applicable information and include it with the GIS program. This information is typically available for free but it will require some processing and organization to include it within the Town's GIS environment.

It is recommended that the following information be compiled from other sources and included within the Town's GIS environment

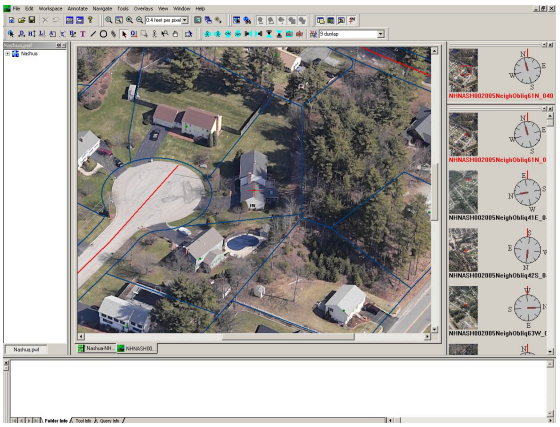
Flood Plains	Census Districts
Pictometry Information	Soils
Topography	Area Community Information
Land Use	Bedrock Geology
Wetlands	Environmental Data

Regional, State, and Federal Data Recommendation Summary

Acquire and process regional, state, and Federal data	$2,000

5.4.5 Pictometry Oblique Level Imagery

Milford participated in a regional oblique-level aerial mapping project which was completed by Pictometry. As part of the Pictometry project, the Town received a catalog of oblique-level imagery (which are "side shots" of houses that are useful for general planning purposes) and Pictometry software. Currently, several departments make use of this information via Pictometry Software (the Town has a site license). This data is also available in a limited form by using the "birds eye" function on http://www.bing.com/maps/.



It is recommended that the Town continue to make use of and participate in state oblique-level aerial imagery projects, like Pictometry.

Pictometry information will greatly complement a town-wide GIS program. It is recommended that the Town continue to participate in the regional oblique imagery programs and make reasonably priced upgrades to obtain more detailed information.

5.4.6 Secondary GIS Data Development Recommendations

The interview process revealed numerous data layers that can be implemented with GIS. The data layers previously outlined in this section were deemed to be the primary data layers, ones that will be used by Town departments on a frequent basis. However, there are numerous other data layers that departments require.

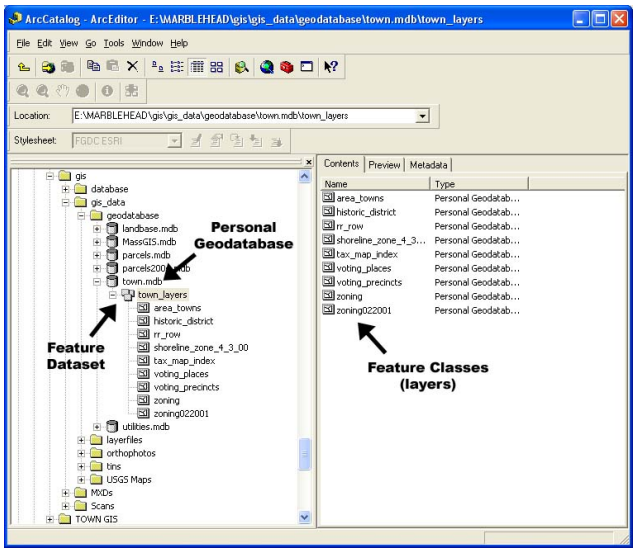
These data layers should be created after completion of the primary data layers, when deemed appropriate. Cost to implement these data layers will vary, but most will require minimal effort to develop. The Town may want to consider developing these layers in house as the system is developed. These layers include:

Cemeteries and Plots	Local Wetlands
Drug Free School Zones	Schools and Churches
Street Signs	Planning Board Decisions
Recreation Trails	Building permit Locations
Daycares and Playgrounds	Neighborhood Crime Watch
Speed Limit Zones	Septic Systems
Traffic Accidents	Evacuation Routes
Stop Lights	Historical Properties

It is anticipated that these layers will be fairly easy to develop and can be completed with minimal effort by Town staff or a GIS consultant. Cost for each will be minimal.

5.5 GIS Data Organization

Nearly all of the Town's GIS information is currently stored on a PC within the Planning. As stated in Section 4, it is highly recommended that a centralized GIS environment be implemented. Within this environment, all data would be stored on a GIS server and users would access this centralized data via ArcGIS, mobile, or web environments.



Milford's GIS data will be stored in ESRI Geodatabase format

It is recommended that all GIS information be initially be stored in a series of ESRI Geodatabases (either "file" or "personal" Geodatabases) and located on a central GIS server. Within each Geodatabase will be a series of "feature classes" or "layers" that users will be able to access. It is anticipated that Milford's GIS database may be organized into the following geodatabases.

- LANDBASE – All aerial land base layers as acquired from the aerial mapping project. This includes roads, buildings, driveways, parking lots, driveways, 2-foot contours, pools, utility points, and other features mapped as part of the aerial mapping process.

- PARCEL – All parcel-related layers will be stored in this Geodatabase. These include parcel lines, map borders, property IDs, easements, and applicable parcel map text.

- UTILITIES - All utility-related layers will be stored in this Geodatabase. These include water, sewer, and storm water utilities.

- TOWN – All "town" layers will be stored in this Geodatabase. These include zoning, wetlands, historic district, road names, parks, schools, snow plow routes, drug free school zones, and other applicable Town layers.

- ORTHOS – Digital orthophotography will be stored in a separate folder on the GIS server as TIFF and MrSID files.

- STATE – All data from the State or NRPC databases and other regional sources will be stored in this Geodatabase.

As the system evolves, and as additional data users and editors are accessing the system, it is recommended that the Town move to an "Enterprise Geodatabase" environment based on ArcSDE software. In this environment, GIS data would be stored in a centralized SQL Server database (with user roles and access rights) versus the Microsoft Access Personal Geodatabase.

Section 6
Summary of Recommendations and Strategic Plan

6.1 Introduction

The Town of Milford has had GIS capabilities for several years and has developed an excellent library of accurate GIS information, most of which is stored and maintained in Planning. This information is well organized and provides an excellent starting point for the implementation of a town-wide GIS program.

Though the Town has an extensive library of GIS information, this information has historically only been available to a small number of staff using specialized software. Through discussion with key town departments, it was evident that all departments require access to key mapping information continuously throughout the day and at this time, the information they need is not easily accessible or does not exist. Most departments envision that the GIS will be a tool that will support instant and easy access to this vital information by any town employee at any time.

When implemented properly, GIS can "revolutionize" the way a town conducts business and makes decisions. This is simply due to the fact nearly every town decision or action relates to geography and though efficient access to geographic information, the Town will be able to make more informed decisions, better react to emergency situations, and more effectively plan for the future.

This section summarizes recommendations provided in Sections 4 and 5 and provides a strategic plan that outlines the recommended GIS implementation path for Milford.

6.2 Summary of Recommendations

It is recommended that the Town proceed with the implementation of a town-wide GIS environment. This environment will organize and centralize mapping information, integrate mapping data with existing town applications, and provide departments with access to the data they need to support daily operations.

Overall, the Town's GIS environment will consist of a strong GIS management structure, extensive and accurate GIS data centrally stored on a GIS server, and a software and custom application environment that will provide distributed access to GIS information. The GIS will be integrated with applicable software systems (e.g., the Vision assessing system) and policies will be established to ensure proper data management and distribution.

When implemented, it is anticipated that this system will be used by nearly every department on a daily basis and will become a key information management tool that departments and the public will rely on for years to come.

Based upon a thorough review of the needs of town departments, CDM developed a series of recommendations relate to GIS management, data, implementation, and policy. These recommendations are detailed in Sections 4 and 5 and summarized below. CDM recommends the following:

GIS Management

- Implementation of a GIS management structure that includes a GIS Steering Committee and GIS Coordinator. The GIS Steering Committee will be the "governing body" of GIS and will set system goals and direction. The GIS Coordinator position, which currently resides in Planning, will be responsible for implementing the system based on the direction set by the GIS Steering Committee.

- Formalizing existing roles regarding GIS data and system management. It is recommended that Planning be responsible for maintaining GIS data while Information Technology be responsible for managing hardware, systems integration, and databases.

- Hiring of a GIS consultant to assist the Town with technical issues, data development and maintenance, and the establishment of GIS policy.

- Categorizing users as GIS Editors, GIS Power Users, or Typical GIS Users to assist with identifying appropriate software and hardware tools for staff.

GIS Implementation

- Implementation of a GIS software environment based on ESRI Software. This environment includes ArcInfo or ArcEditor (for the GIS Coordinator), ArcView (for GIS Power Users), and ArcGIS Server to provide all GIS users with access to information via a web-based GIS interface.

- Implementation of GIS hardware to support the system. This includes a GIS Server and a GPS unit.

- Development of department-specific GIS applications that will complement the WebGIS application currently being developed as part of the parcel GIS development project being completed by CDM.

- Development of a field-based GIS application to provide access to GIS and scanned document data in the field by Water, Sewer, and public safety personnel.

- Integration of the GIS with existing information systems including Vision (assessing data), MUNIS (finance and permits), Public Safety systems, and future scanned image databases (water cards, sewer cards, plan scans, etc.)

- Implementation of a training program to educate staff on the use of GIS software.

GIS Data

- Development of a detailed aerial base map that will provide an accurate foundation for the Town's GIS environment. This mapping will be developed from new aerial photography, to be flown in Spring 2010, and would include roads, buildings, driveways, manholes, catch basins, parking lots, pools, street trees, decks, and other applicable planimetric mapping layers; 2-foot contours; and color digital orthophotography.

- Integration, improvement, or development of several primary GIS data layers including parcels, water, sewer, zoning, wetlands, open space, town facilities, and road network.

- Development of a stormwater GIS data layer that will involve extensive GPS data collection, field verification, and mapping of pipes from plan and field information.

- Acquisition and integration of all pertinent state and national GIS data layers. These include flood plains, soils, aquifers, and base information from surrounding communities.

- Development of several secondary data layers as the system develops. These include street signs, septic systems, sidewalks, and other points of interest.

- Continued use of Pictometry oblique imagery and participation in future Pictometry acquisition projects.

- Implementation of a series of ESRI "Geodatabases" to store GIS data on the GIS server and potential eventual migration to a centralized enterprise-wide Geodatabase.

GIS Policy and Funding

- Development of policies and procedures that will outline standards for data distribution, sale, development, and acquisition.

- Implementation of a funding strategy to assist with funding the long-term maintenance of the system.

- Implementation of a training and technical assistance program and promote proper use of the system.

- Consideration of the implementation of a Town-wide permitting system to assist with the planning, conservation, and building permit process.

6.3 GIS Strategic Plan

It is estimated that the primary implementation of a town-wide GIS will cost between $176,000 and $319,000 and will take place over a three year period. This total includes

between $24,000 and $40,000 of Water and Sewer GIS development work. It also includes between $70,000 and $100,000 of aerial mapping work that could be funded across town departments, Water, and Sewer.

It is anticipated that the total project cost will be at the lower-end of the budget. However, as there are many "unknowns" related to the sewer, water, and stormwater GIS development efforts, a wide cost range was provided.

Provided in Table 6-1 is CDM's recommended GIS Strategic Plan. This plan summarizes recommendations provided in Sections 4 and 5 and provides a cost and timeline for each recommendation.

Town of Milford, New Hampshire
GIS Strategic Plan

	2010				2011				2012				Approximate Cost		Comments
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Low	High	
1 - GIS MANAGEMENT															
1.1 - Implement Formal GIS Management Structure	■												-	-	Implementation of a GIS Steering Committee. (Section 4.3)
1.2 - Categorize GIS Users	■												-	-	Categorize GIS users to assist with determining GIS software needed. (Section 4.4)
1.3 - Retain GIS Consultant	■	■	■	■									$6,000	$12,000	Retain GIS Consultant on a yearly basis, as needed, to provide technical, data development, programming, policy support. Yearly budget of $6,000 - $12,000. (Section 4.3)
ESTIMATED TOTAL COST - PHASE 1													**$6,000**	**$12,000**	
2 - GIS DATA DEVELOPMENT															
2.1 - Develop Aerial Land Base Mapping		■	■	■									$70,000	$100,000	Develop accurate base mapping from aerial photography. Specifications provided in Section 5.3. This process would begin in spring of 2010 and costs could be shared across departments.
2.2 - Parcel GIS Integration			■	■									$0	$4,000	Utilize newly-developed parcel GIS and maintain parcels on a yearly basis. Parcel updates typically cost between $2,000 and $4,000 but this could be completed in-house for no cost. See Section 5.4.1 for details.
2.3 - Water and Sewer GIS Development				■	■								$24,000	$40,000	Develop a water and sewer GIS as specified in Section 5.4.2. Approximate cost is $12,000 to $20,000 per utility. Some processes could be completed in-house.
2.4 - Storm Water GIS Development				■	■	■	■	■	■				$40,000	$80,000	Development of a storm water GIS program as detailed in Section 5.4.2.
2.5 - Integrate/Develop Town GIS Layers	■	■	■	■									$0	$16,000	Develop and integrate Town GIS data layers as described in Section 5.4.3. These could be completed in-house, over time.
2.6 - Integrate Regional, State, and Federal Data Layers	■	■	■	■									$2,000	$2,000	Acquire and integrate public domain data available from regional, state, and federal sources. Specifications provided in Section 5.4.4.
ESTIMATED TOTAL COST - PHASE 2													**$136,000**	**$242,000**	
3 - GIS IMPLEMENTATION															
3.1 - Implement GIS Software	■	■											$6,000	$6,000	Implement ArcGIS Server software ($6,000) and purchase additional ArcView ($1,200) licenses as necessary. See Section 4.5 for details.
3.2 - Install GIS Server	■	■											$0	$6,000	Install GIS Server ($4,000 - $6,000) or use existing server to store GIS data. Cost would be $0 if existing server was used. See Section 4.5 for details.
3.3 - Purchase GPS Unit		■	■	■									$6,000	$10,000	Implement GIS hardware including the GIS Server and a new sub-meter or sub-foot GPS unit as described in Section 4.5.
3.4 - Implement WebGIS Applications					■	■	■						$5,000	$10,000	Implement additional WebGIS applications (in addition to one currently being developed) to focus on department-specific functions. See Section 4.6 for details.
3.5 - Implement Field GIS Applications for Water & Sewer Crews					■	■	■						$4,000	$8,000	Implement a field GIS solution for Water & Sewer crews as specified in Section 4.6. There may be additional deployment costs depending on functionality required.
3.6 - Implement GIS Training Program			■	■									$3,000	$5,000	Provide initial GIS training to system users.
3.7 - GIS Implementation Technical Assistance					■	■	■	■	■	■	■	■	$10,000	$20,000	GIS implementation, setup, programming, and customization assistance.
ESTIMATED TOTAL COST - PHASE 3													**$34,000**	**$65,000**	
4 - GIS POLICY AND FUNDING															
4.1 - Develop General GIS Policies	■	■	■										-	-	Develop General GIS Policies as described in Section 4.8. These include data disclaimer, data sale, data distribution, data maintenance, and data submission policies.
4.2 - Develop GIS Funding Strategy	■	■	■										-	-	Develop GIS Funding Strategy which includes policies for the sale of GIS data and establishment of GIS update fees as described in Section 4.9.
ESTIMATED TOTAL COST - PHASE 4													**$0**	**$0**	
TOTAL COST OF INITIAL GIS IMPLEMENTATION													**$176,000**	**$319,000**	This total includes between $130,000 and $220,000 of Water and Sewer GIS development work. It also includes between $110,000 and $220,000 of aerial mapping work.

ESTIMATED YEARLY OPERATING COSTS															
1. Software Maintenance													$5,000	$10,000	Yearly Software Maintenance for ESRI software. ArcView ($400/ea.), ArcInfo ($2,500), ArcGIS Server ($1,900 or $2,500), ArcEditor ($1,600)
2. GIS Data Maintenance													$6,000	$12,000	Services provided by a GIS consultant to support GIS program.
4. GIS Implementation Assistance and Training													$5,000	$10,000	Funding to complete special projects, continue staff training, develop new data, and implement new applications.

Updated September 8, 2009