April 10, 2006

Final Report

Town of Concord, Massachusetts

GIS Program Needs Update

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1.0 INTRODUCTION

The Town of Concord GIS Program has become one of the most respected of its kind in New England. This was no accident. The Concord GIS Committee has worked hard over the past several years to continually expand the program and ensure that GIS in Concord had the support it needed to succeed. In addition, a great deal of credit is due to the Town's leadership, including the many boards and committees that have supported GIS and the Town Manager who has set the bar high for GIS in Concord.

In addition, the GIS Committee demonstrated its commitment to GIS with the execution of this project. There were some in the industry that might wonder why Concord would re-evaluate such a respected program in the first place. The answer is simple: if you always do what you have always done, you will always get what you have always got. Concord wants more.

The purpose of this Needs Assessment, or Needs Update, was to review the GIS Program in the Town of Concord from the technical perspective and from the perspective of the end users. Needs change. Technology changes. Therefore, it can be assumed that a Needs Update might find several areas where improvement can be realized.

This study certainly did find areas for improvement. Working closely with the GIS Committee, and especially with the Town's GIS Coordinator, PeopleGIS was able to define a future for the Concord GIS that truly fits the community's direction and intentions for its staff and their use of technology. But know this: not all of our recommendations involve technology. Many of our concepts and ideas revolve around the Town's approach to GIS and the role of the GIS Coordinator. With these recommendations in-place, we believe that Concord will raise the level of their program significantly and continue to provide leadership throughout New England in regards to municipal GIS programs.

The following pages summarize our findings and recommendations in the following areas:

- General Program
- Map Layers and Data
- Applications
- Data Maintenance
- Training
- Hardware & Software

2.0 GENERAL PROGRAM RECOMMENDATIONS

2.1 The Role of GIS Coordinator

Everyone likes Matt. This is an important finding. The Town's GIS Coordinator has successfully built relationships with every department in the community. This is no small feat and should be recognized here.

However, not everyone has a clear understanding of Matt's duties, responsibilities, goals, or objectives. This finding has led us to our core set of recommendations to discuss in this report: to redefine the role of the GIS Coordinator in Concord. While we documented needs for new mapping layers, databases, and other "inventory-type" items, we can confidently state that if the Town institutes this core set of general recommendations (and nothing else) then the Concord GIS Program will begin to fulfill its potential. Stated another way, we believe these core general recommendations will take care of all other needs.

To date, the GIS Coordinator has been focused on the technical aspects of the GIS Program, including Data Maintenance and Map Production which have accounted for 83% of his time (see Figure 1.1).

If you remove the 10% of his time spent in support of CPW operations (which focused on tasks outside the GIS Program), this left only 2% of his time for Training and Conferences and 5% of his time for Technical Support.

This last category is the single most important finding in our study. On average, the GIS Coordinator has been spending only 2 hours per week supporting end-users.

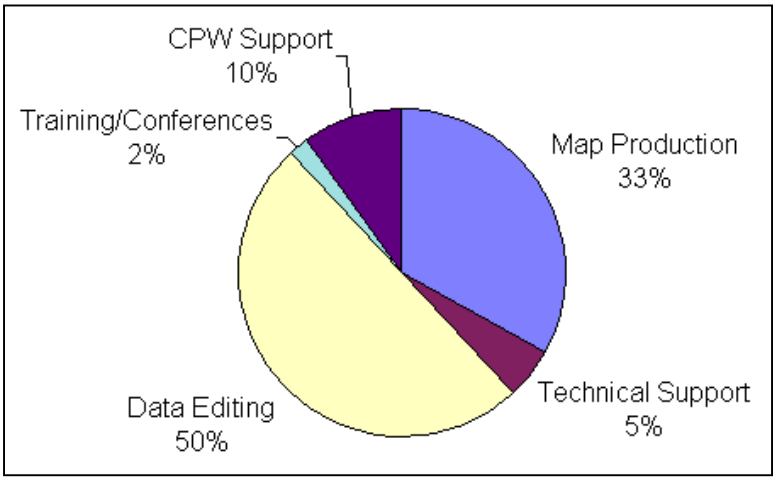


Figure 1. Historical Breakdown of GIS Coordinator Role in Concord

The net result of this approach is that the data in Concord is very up-to-date, but we have found end-users that are frustrated with the system. While we did not find serious levels of frustration, we did find this situation being the primary impediment for system growth and vision. Technically, Concord's GIS Program is state-of-the-art. As an organization, we recommend that Concord's GIS Program take a new direction.

We recommend that we change the role of the GIS Coordinator to be "people-focused". We know that GIS is a technology, and that information management is a technical industry. But we feel strongly that the success of an entire GIS program is largely determined by the success of each individual in the program. In order for individuals to achieve their potential with GIS, they need support.

End-users need technical training when the program begins, routinely scheduled training that they can plan around, and opportunities for training support for acute situations that arise due to work demands.

End users need to know enough about the technology they are using in order to ask constructive questions.

End users need to have someone to go to with their questions, concerns, and curiosities (curiosities are often responsible for the best ideas for program growth and expansion). Additionally, end-users need to know that their questions, concerns, and curiosities will be heard, documented, and considered by program leaders. Otherwise, why bother?

End users need to know that the GIS Program has direction, vision, goals, and the necessary levels of support for success.

Lastly, and likely most importantly, end users need to feel that the GIS Program is built for them. Imagine if everyone in Concord felt that way. How successful would each individual be then?

To achieve such a program, we recommend changing the role of the GIS Coordinator to that depicted in Figure 2. In this chart we can see that the technical duties of Data Maintenance and Map Production have been reduced to 29% of the Coordinator's time. With the addition/definition of a few new categories of tasks, we see the Coordinator spending 71% of his time on people-oriented tasks such as User Support (actual time spent with end users), Applications Development (time devoted towards the development of tools that expand an individual's capabilities with the GIS), and Program Development (time devoted towards the expansion of GIS in the community). We will outline the specifics of each of these task categories in subsequent sections.

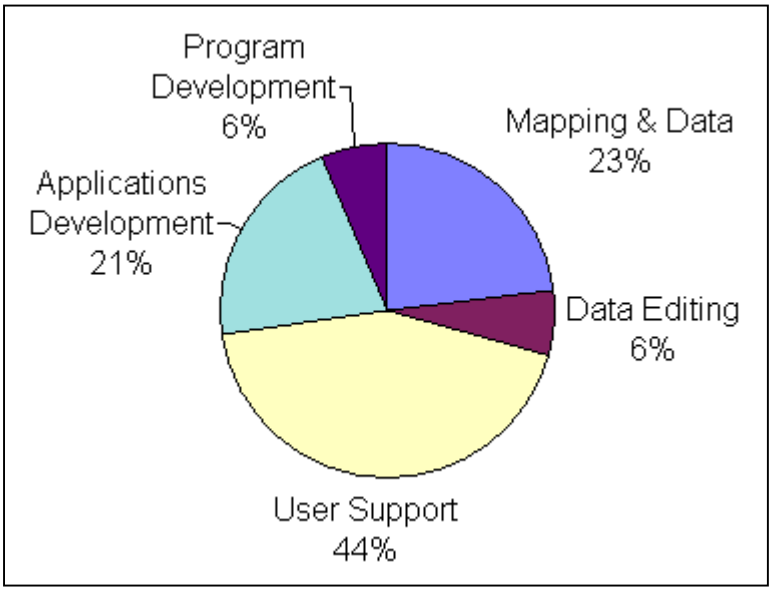


Figure 2. Proposed Breakdown of GIS Coordinator Role in Concord

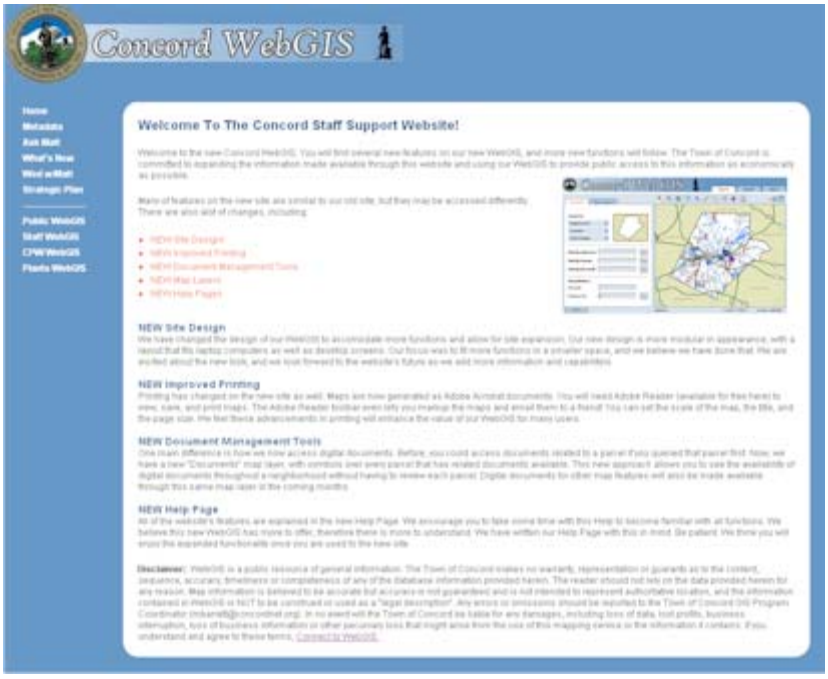
2.2 Wednesday with Matt

We recommend that the Concord GIS Program devote one day a week of the GIS Coordinator's time for staff interaction. We envision a "Wednesday with Matt" approach where staff members can sign-up for time with the Coordinator to discuss their questions, concerns, and curiosities. Staff needs would be considered priority on this day every week, enabling the staff and the Coordinator to plan their schedules accordingly. We believe this program component will be extremely effective at raising the level of program involvement for many staff members across the community.

2.3 GIS User Website

We recommend that the Concord GIS Program implement a new GIS User's Website. This website will become the "home" for the program where everyone will go to first to meet their needs. This page will include links to dozens of destination pages that provide for end-user needs, including (at a minimum):

Wednesday with Matt Page: This page would include a calendar for staff to sign-up for time on upcoming Wednesdays with the Coordinator. As staff sign-up for time, they would provide basic information about their needs to allow the Coordinator to plan ahead and be prepared. An email would be sent out to the Coordinator by the web page each time a staff person signs up for time to make sure that the schedule request is communicated effectively.



Metadata Page: The term Metadata refers to documentation about the individual mapping layers and databases that constitute the GIS system in Concord. The Metadata Page will include a link to metadata for every mapping layer and database, allowing end-users to research the origin of data, accuracy of data, persons responsible for data creation and/or maintenance, and more. This source of information will enable users to become more comfortable and confident with the GIS, and allow them to conduct such research quickly and easily without having to rely on "finding the right person who might know" in order to answer their questions.

Strategic Plan Page: The Strategic Plan Page would provide the most up-to-date strategic plan for the GIS Program. Initially, this page would contain this report. As time passes, this page would either be updated or appended to allow for program growth and change. If staff is curious about the direction of the program, they should be able to read this page and understand the strategies behind the program.

What's New Page: We envision that this new approach to the GIS Program in Concord will lead to more people doing more with the GIS. Subsequently, we should document these new activities so that everyone not only appreciates the raised level of activity but can also learn from what others are doing and possibly apply what others are doing to their own routines. This page will also provide a means of promoting the theme that everyone is using the GIS.

Ask Matt: We envision a listserv web page that allows users to ask questions of Matt and other end users. We know that staff could just phone Matt, and we do not want to discourage phone calls to Matt. We just want to encourage this communication mechanism as well because questions can be shared amongst all end users, promoting the effect of group education and support whenever Matt (or another staff member) answers a question online. Listservs are extremely popular with user groups from all types of programs world wide, and we believe a GIS Program Listserv could be effective in Concord as well.

Interactive Web Mapping Pages: Links would be provided to the various interactive mapping pages available, including the Public web mapping page, Staff web mapping page, and CPW web mapping page. We believe that other mapping pages will become available over time, and this website will provide the links to all of them as they come online.

Prepared Maps: The Coordinator has prepared a number of maps for public and staff use, including a Zoning Map, Street Index Map, Parcel Maps, and many others. These maps would be accessible on this page in PDF format for any staff person to download and use 24/7. In addition, the Coordinator often produces custom maps for staff that may be appropriate for publication to this web page as well for others to use.

This web page should also be a home for map products prepared by other staff as well. Individuals that create map products they would like to share should provide their maps in PDF format to the Coordinator for inclusion on this page.

All maps should be accompanied by metadata (see explanation of metadata above) to provide background information on the map source, featured data, author, and any particular composition specifics.

Other Pages: We envision more and more pages coming online as more and more staff become active participants in the program.

As of the writing of this report, the creation of this website has already begun. We are building each page working closely with the Coordinator so that the pages can be maintained by the Coordinator in-house for routine additions and changes.

We believe the implementation of this website is entirely consistent with our overall core recommendation of user support and interaction, and encourage Concord to use this tool as a platform for GIS Program communication and sharing.

2.4 The GIS Committee

We recommend that the Concord GIS Committee redefine itself to address the new direction of the GIS Program as defined in this report. With the new “people-focus” and desire to reach out to all end-users and new partners, the GIS Committee will need to adapt. We recommend that a core “Executive GIS Committee” be created, consisting of 3 or 4 of those individuals that have formed the GIS Committee in years past. This Executive Committee would meet quarterly with the GIS Coordinator to review progress, address concerns, and ensure that the GIS Coordinator has the resources necessary to carry out his duties.

Additionally, we recommend monthly meetings for a “General GIS Committee”. This general GIS Committee would be open to all staff as “members-at-large”. Departments and divisions requiring input and/or support can attend monthly Committee meetings to discuss their projects. The intent of this new committee design is to encourage participation from all staff when and as they need to participate. For example, if the Police Department wishes to

enhance their GIS tools, they can participate in monthly General GIS Committee meetings for several months as they accomplish their goals. Once satisfied with their progress, they can withdraw from membership until it is necessary to participate again. This same opportunity would exist for all departments and divisions in Concord. We would recommend that this same opportunity exist for all boards and committees as well. A good example of such a group would be the Concord Neighborhood Network (CNN). Their use of the GIS would build a bridge between the staff and public, with a definable impact on the quality of life in the community.

2.5 Program Expansion & Development

2.5.1 School Partnership

We were able to determine that the schools in Concord are very interested in the GIS Program. Our meeting with them indicated that further discussion is warranted to define how the schools could partner with the staff to promote this aspect of the program's development.

From our discussions and experience, we envision the GIS supporting the schools operationally through school bus routing support. To a higher degree, we envision the GIS supporting schools educationally through classroom projects and modern teaching techniques. With the addition of the Town's Global Positioning Systems (GPS), the GIS Program may well interest many students and spark opportunities for education that may not be available otherwise. Young people love maps, are intrigued by GPS and aerial photography, and are interested in what people at Town Hall are doing day-to-day. A partnership between the Town Staff and Schools may lead to new programs that address such potential.

We recommend that the GIS Coordinator lead the effort of communication with the schools to develop this School Partnership. We also recommend that the Town Manager and/or Assistant Town Manager actively participate in this process due to their existing relationships with school officials. This relationship will need to be developed through consistent and persistent discussion. We encourage the Town to plan for several meetings with the Schools to present the GIS, the possibilities for partnership, and the benefits (as we understand them today) for all parties involved, including the students. This opportunity is worth the effort.

2.5.2 Student Intern Program

Concord has worked with student interns in the past for data collection and field GPS efforts. We recommend formalizing this approach through the creation of a Student Intern Program. The Town could commit to supporting a student (or multiple students) every summer. The GIS Coordinator would identify those priorities in the program that could be addressed by the student(s) and oversee the quality of their deliverables.

We would recommend that the work done by students be treated like a professional contract. For example, the work should be defined clearly at the beginning of each project, and agreed upon by the Coordinator, student, and affected department leadership. The result would be a scope and schedule that would set expectations for everyone. The internal benefits of this approach for the Town are obvious, with the added benefit of providing invaluable experience for the student(s) as to how the real world works. The GIS

Coordinator should be involved in all such projects to ensure that all data products are honor the standards of the GIS Program and provide full functionality upon completion.

We also recommend that the Town consider several tasks for the student intern program to execute that were identified by our Needs Update but represent lower priority for the program. By this we mean there are tasks that users talked to us about that would be "nice" to have, but probably not worth the cost if they were executed by the staff or outside consultants. Examples of such tasks would including the following:

- Street Tree Database
- Sign Database
- Speed Sign Database
- Schools Mapping/Documentation
- Town-wide Virtual Tour Photos
- Cemetery Database & Mapping
- Mapping of Concord Water System Outside of Concord

While these items would be great to have for the GIS Program, they fall towards the bottom of the priority list due to other greater needs and due to the cost of developing and maintaining this data as compared to its overall value. Such projects sometimes only make sense if they can be conducted at extremely low cost, which would be possible with the student interns.

We recommend that the Town consider the student intern program for the unselfish reason of sharing the system with the young people in Concord and the selfish reason of developing data the Town might not otherwise be able to develop. Properly defined and managed, this program can be a win-win for everyone involved.

2.5.3 CMLP Partnership

Certainly, the Town and CMLP have been partners on the GIS Program from the very beginning with CMLP funding the original base mapping. In the past few years, CMLP has actively integrated GIS technology into their daily operations, with some very big steps directly in front of them.

CMLP would like to integrate ArcSDE into its operations and has been considering either the purchase of their own SDE license or sharing of the Town's SDE license. We strongly recommend that CMLP share the Town's existing SDE license. The Town's SDE can easily support their needs, and actually exists in CMLP's facility already anyways. There is no need to make an additional purchase or pay any additional annual maintenance fees. This will save CMLP several thousand dollars in capital cost and two thousand dollars annually in maintenance fees.

We recommend that the GIS Coordinator continue to work closely with CMLP on the integration of their data into SDE. We recommend that CMLP define/design their own geodatabase (separate from the Town's geodatabase) so as to avoid potential conflicts, with no limitation on both parties leveraging each other's data as needed.

CMLP is also very interested in Internet mapping technology for the distribution of their data to their own staff. We recommend that CMLP leverage the MapsOnline technology already in-place in the Town, thereby removing the costs of new software. This should save CMLP several thousand dollars in capital cost and a few thousand dollars annually in maintenance fees.

The partnership with CMLP has always been strong. We recommend the sharing of the Town's software platforms as a means of continuing this partnership and providing an economy of scale that will save time and money while enhancing data sharing.

2.5.4 Regional GIS Partnership

Our discussions with town management indicated the need for data sharing between communities as a means of supporting decision-making that might affect multiple communities. Towards that end, we recommend the development of a regional Internet mapping website that would include GIS data from Concord and all abutting communities. This website would be password-protected, with the Town Manager sharing passwords with his counterparts in surrounding communities. With this tool, the Town Manager and his counterparts could use this website to address their mutual concerns and issues either in meetings (that occur monthly) or over the phone as the need arises.

This same website might very easily serve the needs of the Fire and Police departments, each of which expressed the need for GIS support beyond the Town's borders for their purposes as well as to support their work with other communities for mutual aid and collaboration. As well, CPW would benefit from GIS mapping outside the Town boundaries in those areas where the water system extends beyond Concord. With these examples, it is clear that Concord's services do not always stop at the border of the community. Therefore, our plans for the GIS need to think the same way.

2.5.5 Document Management

The Concord GIS Program has had a certain volume of digital documents linked to the GIS in the past. Available digital documents were provided via parcel queries on the previous online mapping system. We recommend that digital documents be treated as "mapping layers" in the new online mapping system. This approach will give these documents a larger "identity" as a specific information source and enable us to pursue the subject of "Document Management" as an add-on to the GIS Program.

Document Management means different things to different people. In its simplest form, well organized digital documents that are uniquely identified in a database and accessible via a computer interface constitutes a document management system. In its most comprehensive form, documents would be managed in a sophisticated database system complete with keywords, dates, descriptive summaries, etc. with several built-in software techniques to access documents.

We recommend that Concord take the first steps towards document management by consolidating all currently available digital documents, managing them in a simple database table, converting them to a consistent format, and making them accessible through the GIS as a mapping layer. We recommend two levels of security; staff and public. The staff would have access to all documents, including property photos. The public would not have access to property photos, but would have access to deeds and plans.

We recommend the use of PDF format at this point in time. PDF has become a standard on the Internet, is generally accessible for everyone due to freely distributed viewing software, and provides for a very user-friendly interface that allows documents to be saved locally, emailed to colleagues, marked-up for discussion, etc. In the document management world, there are other (often proprietary) compression formats for documents that would make file sizes (and therefore storage requirements) much smaller than PDF. These formats should be considered by Concord as the Document Management Program grows.

We mentioned property photos above. As part of our recent work with Concord, we were able to move all property photos from the Vision Appraisal System database in Assessing to the GIS for integration with the new MapsOnline Internet mapping system. Many properties have multiple photos of buildings and other structures that, previous to this task, were only accessible to the Assessing Department. Having taken this step, this valuable information is now available to all staff, with particular value being brought to those staff in Public Safety and Public Works.

2.5.6 Permit Tracking

There was a high level of interest in permit tracking software expressed by many in this study. While permit tracking is considered outside the scope of this project, it cannot be ignored by this project. Permit Tracking software has its own industry, with several companies providing this type of software in New England. Many see the value of permit tracking to be greatly enhanced by its integration with GIS, which is why we need to discuss this issue here.

The Town is currently embarking on a study to review permit tracking software products in order to assess your options. We recommend that the Town define their goals for permit tracking before vendors visit and present their products. We also recommend that the Town consider all aspects of a vendor company and their products, including costs (both capital and operational), history of service and support, software user-friendliness, GIS integration capabilities and techniques, and local recommendations from communities.

Regardless of the system selected, we recommend that the Town integrate the permit tracking database with the Town's desktop GIS and WebGIS for staff use and possible public use. The scope of this integration cannot be defined at this point in time because of the staff's limited experience with this type of software. We recommend that discussions about this integration become a part of the software review and selection process.

3.0 Map Layers and Data Recommendations

3.1 Master Address Table

A Master Address Table is critical to the new direction of Concord's GIS. We did find that there are several databases that have never been linked to the GIS largely because they lacked address information. A master address table will provide everyone in Concord with a known set of addresses that exist in the community. By using this set of addresses in their spreadsheets and databases, all GIS users will be able to bring their data into the GIS easily.

A good example of this situation exists with the Dog License database. This data source has never been linked to the GIS because of the lack of a Master Address Database to bring the two together. At the time of the writing of this report, work is underway on the Master Address Database and the Dog License database will be the first new dataset linked to the GIS as a proof of concept.

Another example of this situation is the potential relationship between the GIS and the Police Department's Computer-Aided Dispatch software. The Master Address Table will be able to supply the Police with all existing addresses, and enable the mapping of all calls-for-service once these addresses have been put in place.

3.2 Dogs Database

As discussed above, we recommend mapping the Dogs Database once the Master Address Table is constructed to enable the integration. The Dogs Mapping Layer will be useful for Public Safety in the field and for responding to calls from the public about nuisance pets.

3.3 Census Database

The Census Database is not for all staff to use, but certain staff (including public safety departments) could benefit greatly from access to this information through the GIS. This integration would enable certain users to know all residents of a certain property, as opposed to the owner of that property.

3.4 School Mapping

We recommend that the Police and Fire Departments work with student interns for the mapping of school facilities in Concord. The resulting databases can assist greatly in the event of a fire or active-shooter situation involving the schools. These projects are subject to Homeland Security funding grants and other school/public safety grant opportunities, and the Town should consider seeking grant funding for this task.

3.5 Town-Wide Virtual Tour Photography

We recommend that the Town work with either staff or students (see Student Intern Program above) for the compilation of town-wide virtual tour photography. These photos enable a very realistic photo experience that could be effective on the public Internet mapping WebGIS, for Planning efforts, for public meetings in support of discussions and disputes, for

Public Safety planning and response efforts, and more. This form of multi-media is inexpensive to create and provides for a tremendous return on capital investment.

3.6 Vision Building Photos

Several thousand building and site photos exist in the Assessor's Vision database. Until now, these photos were only accessible to the Assessing Department. At the time of the writing of this report, these photos have been integrated into the staff-version of Concord's WebGIS. We recommend that these photos be integrated into the desktop GIS as well. These photos will be particularly useful for Public Safety and Public Works.

3.7 Curbside Collection Subscribers & Public Barrel Collection Points

There was a request to map the curbside collection subscribers as listed in the Tax Collector's database and build a point layer of scheduled recycling points.

3.8 Posted Roads

We recommend the creation of a Posted Roads map.

3.9 Life Support/Critical Needs Citizens

We recommend that the GIS Coordinator work with CMLP, the Council on Aging, the Fire Department, and the Police Department on the compilation of a database of Concord citizens requiring life support systems and those citizens with critical needs. This database would reveal the locations of these citizens on the GIS in the event of a power outage or other situation that might threaten their welfare.

This database will enable all of these departments to quickly understand their priorities for assistance given the particular circumstances of an event. CMLP already maintains their own "life support systems" database, and would likely be the home for this expanded database with updated information coming from other departments.

Lastly, this database could be extended further to include all senior citizens, so as to provide the COA with mapping to support their provision of services across the community.

3.10 Utility Customers

We recommend that existing utility customer databases (water, sewer, CMLP) be integrated with the GIS for use by pertinent departments, Planning, and others. The Master Address Table will play the critical role in this process by providing the full set of known addresses. This table will provide a check on the addresses already present in these databases, enable many-to-one address relationships to be resolved, and provide the source for all new addresses as they are entered for new accounts. All addresses in these databases not found in the Master Address Table should be updated and documented so that the pertinent department can check to see if other systems might be affected by the same incorrect information.

3.11 New Aerial Photography, Updated Planimetrics, Contours

Concord's planimetric base mapping is based on aerial photography from 1995, and many interviewees expressed their belief that the Town is ready for a new flight and updated base map. In light of this support, we recommend that Concord conduct a new flight and update the planimetrics. We also recommend that Concord include a new color orthophoto and 2-ft contours as part of this task's deliverables (both of these items were not included in the 1995 project). The contours will be particularly useful in support of the stormwater management efforts now underway in Concord. The orthophoto will greatly enhance each user's experience with the GIS and represent a significant upgrade from the MassGIS orthophotos that Concord has been using (while we feel that MassGIS's orthophotos are a great resource to communities in Massachusetts, they are not of the same quality as a community's own orthophotography flown at low altitude).

3.12 Hanscom Air Force Base

The Police and Fire Departments would benefit from any mapping that could be compiled for Hanscom Air Force Base. Their operations in the vicinity of this facility would be enhanced by more mapping data. Clearly, the new orthophoto discussed above would provide the basis for this information to be compiled.

3.13 Traffic Counts

We recommend that the GIS Coordinator begin to work with the Highway Department and others on the integration of traffic data into the GIS. Local traffic counts, MHD traffic counts, and more could be integrated to provide a means of trend analyses, forecasts, permit review support, and more. Local communities have been slow to adopt such practices, but Concord has all of the tools necessary to move forward with these tools. We recommend a significant level of discussion up front to determine the goals of all parties before the Coordinator builds any data.

Street centerlines with integrated traffic count data can be mapped in color and/or varying widths to express traffic volumes. The Town would be able to isolate "school-in" and "school-out" traffic, rush hour volumes, and more given an appropriate data structure. We envision this particular database playing a significant role on the public WebGIS, at public meetings, and for images provided to the local newspapers.

3.14 Registered Sprinkler Systems

We recommend a mapping layer be prepared for Registered Irrigation Sprinkler Systems via a relationship between an existing sprinkler system database and the parcel map. This relationship would be based on address information, thereby making it very important that the sprinkler database utilize the Master Address Table for all entries.

3.15 Enhanced Bridges Layer

A point layer of bridges currently exists. Engineering would like to enhance this layer with attribute information to support condition assessment, maintenance, and planning. We also recommend the integration of field photography in order to document conditions over time.

3.16 Enhanced Railroad Crossings

A map layer of railroads currently exists. Engineering would like to enhance this layer with attribute information to support condition assessment, maintenance, and planning. We also recommend the integration of field photography in order to document conditions over time.

3.17 Zoning Buffers

The GIS Coordinator conceived of the idea of creating a buffers layer for the Town's Zoning information. This layer could be turned on and off by public users of the WebGIS as well as by the staff. Buffer distances from property lines (and building footprints) would be based on the zoning regulations for each respective property line. Property lines that cross more than one zone would need to be addressed by the Planning Department prior to creating their buffers.

This layer would be more difficult to create than it appears, but the usefulness of the data is unquestionable (especially on the WebGIS). As with many of the new map layers discussed herein, we recommend a great deal of discussion prior to creating this map layer to ensure the most efficient means of layer creation and maintenance.

3.18 Upgrade Current Parcels to MassGIS Level II

MassGIS is currently encouraging the adoption of parcel mapping standards by communities across the Commonwealth. The ultimate goal is to enable the parcel maps for all communities to come together in support of regional/statewide economic development, public safety efforts, transportation planning and management, and more.

These standards are offered at three levels (I, II, and III) with each level representing higher degrees of accuracy and information integration. We recommend that Concord consider the Level II MassGIS Standard

To support the coming together of parcel maps from all communities, MassGIS has prepared a state-wide community boundary map layer based on survey coordinates for each boundary marker around the perimeter of each city or town and maintained by the Mass Highway Department. Concord should implement this MassGIS town boundary layer as part of this task.

We have included the MassGIS document outlining the details of these parcel standards as Appendix A. We have also reviewed this document with the GIS Coordinator in preparation for this task.

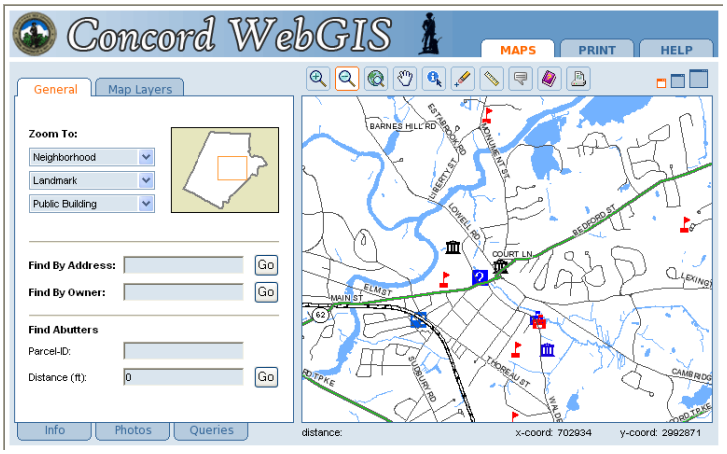
3.19 Public Works Infrastructure Mapping (Completion & Management)

Concord contracted a local engineering firm to map the drainage system four years ago. This mapping is considered incomplete by the staff due largely to a lack of maintenance over the past years. The lack of maintenance seems due to a lack of a system and/or software that would make maintenance an efficient process. We recommend that the Town either develop or purchase GIS-based tools to complete this mapping and maintain these mapping layers over time. We have discussed options for this task with CPW and the GIS Coordinator, and provided costs to cover these options. All options would also include management of the sanitary sewer and water systems as well, resulting in a single system that would be used to update/maintain all CPW infrastructure.

We see this task as paramount to the success of the Stormwater Management Program currently underway in Concord. We recommend that the GIS program provide the basis for the Stormwater Management Program with all mapping, databases, and documentation being integrated into the GIS for internal use and public presentation/education. We envision the GIS Coordinator and Engineering working closely together to ensure that the system constructed meets the short and long-term goals of the Stormwater Management Program (which are currently being defined).

3.20 Student Mapping to Support Bus Routing

In continued efforts to build a partnership with the schools, we recommend that the GIS Coordinator work with the schools to map all students for the coming school year early each summer. This mapping layer will significantly help the schools with their school bus routing efforts and provide for a time savings each year for the schools.



4.0 APPLICATIONS

4.1 Public WebGIS

The public version of Concord's WebGIS has been upgraded with a new interface and new functionality. The addition of QuickZoom functionality will allow new users to find areas of interest quickly. Linked documents are now a separate mapping layer, allowing document management to become its own component within the GIS. The change in the flow of the interface is also expected to enhance the user-experience.

Most importantly, the website is now based on open-source technology. This will relieve the Town from annual software maintenance fees associated with the previous software platform. This new website is expected to be completed at or around the time of publication of this report.

4.2 Staff WebGIS

A staff version of Concord's WebGIS is currently being prepared for use by all staff. This website will resemble the public website, but will contain more mapping layers, all Vision Appraisal System building photos, and more documents (including utility tie cards). We recommend that this site become the focus for new layers as they are developed from the GIS Coordinator's increased interaction with the staff. We envision this website's functionality growing as Internet mapping technology continues to improve.

4.3 CPW WebGIS

CPW will get its own WebGIS website including their utility infrastructure. We anticipate their needs for special functions and data access to grow beyond that of the general staff, therefore requiring their own website. This may well be the upcoming trend for other departments as well, as their use of these websites grows along with their support from the GIS Coordinator.

The CPW WebGIS site may well incorporate a customer complaint tracking function, as was discussed with members of the Water & Sewer Division as part of our research. There is a need to track complaints as they are made and responded to by the staff. The advantage of this function happening online is the real-time nature of the data and availability of this real-time data for everyone in CPW. Complaints would be entered into a simple interface and committed to the database. Complaint points would appear on the map immediately after they are entered, color coded to represent their date and/or symbolized to represent their complaint category.

Whether or not this application leads to a Work Order Management System was not determined at this time. Our findings did not support this decision at this time. We recommend that CPW work with their WebGIS over the next year and assess the impact on their operations in order to reassess the possibility of a Work Order Management System in the near future.

4.4 Regional WebGIS

Town Management expressed their desire for a WebGIS that included surrounding communities in support of their discussions/meetings with town management in those

communities. For those issues that affect multiple communities, such a mapping platform would provide a common basis for decision-making and assessment. We recommend communication with surrounding communities, data sharing with surrounding communities, and discussions with surrounding communities about the creation of such a website.

4.5 Police Dept Mapping

We learned that previous GIS efforts to map the police calls-for-service have ceased. While there are still officers using GIS, the organization of standard procedures and protocols are no longer being followed (largely due to a change in computer-aided dispatch software vendors). We recommend the Police Department re-engage in the process of automating their mapping, with their calls-for-service being integrated into the GIS for use at the Police Department and in the field.

We recommend the department employ an ArcView license for their more demanding GIS needs, including mapping, creation of field books, analyses, reporting, etc. We also recommend that the Police Department employ their own WebGIS website within their building computer network in order to provide all officers with access to the mapping layers and mapped calls-for-service. This approach will maximize their access to data while minimizing the costs associated with their program. It should be noted that the Police Department's computer network is not currently "separated" from the Town's computer network. Therefore, their data may be accessible from users of the Town network. We recommend that the Police Department work with IT staff to address this situation and work towards blocking unwanted access to their systems and data.

Our discussions with the Police Department included a focus on public access to their calls-for-service information. It is common to see calls-for-service in the local paper. Therefore, we talked about possibly providing the paper with a map of calls instead of a report. Calls could be "filtered" to keep sensitive calls and information out of the deliverable to the local press. The map would be seen as providing a visual perspective on the activities of the Police Department in a way that a list of calls does not accomplish. We recommend that the Police Department finish their calls-for-service mapping first, and then revisit this idea with possible trials and testing to ensure they would achieve the results they are after in regards to public relations.

This task may be subject to Homeland Security and other public safety funding sources. We recommend that the Police Department pursue such grant funding in support of this task.

4.6 Fire Dept Mapping

The Fire Department does have GIS capacity currently, and is experimenting with Network Analyst. We learned that the Fire Department is thinking about purchasing ArcEditor in order to expand their capabilities. We recommend discussion between the Fire Department and the GIS Coordinator in advance of this purchase to see if the Coordinator's ArcInfo license might be shared with the Fire Department instead (especially during evening hours when the GIS Coordinator is not at work but the Fire Department is working). The purchase of ArcEditor is expensive, carries a large annual maintenance fee, and requires additional training and support. If the Fire Department wants to create data over the next few months with ArcEditor, and not use it thereafter, then a sharing situation should be considered in lieu of a purchase.

Additionally, the Fire Department is having difficulty accessing their data in their computer-aided dispatch software. We recommend the department automate the export of data from their CAD system and employ their ArcView license for their more demanding GIS needs, including mapping, creation of field books, analyses, reporting, etc. We also recommend that the Fire Department employ their own WebGIS website within their building computer network in order to provide all officers with access to the mapping layers and mapped calls-for-service. This approach will maximize their access to data while minimizing the costs associated with their program.

This task may be subject to Homeland Security and other public safety funding sources. We recommend that the Fire Department pursue such grant funding in support of this task.

4.7 Natural Resources WebGIS

Natural Resources has requested their own WebGIS website, with the layers and attribute data that best support their needs. More discussion will be required before this website can be assembled.

4.8 GeoPhones

We received a tremendous amount of interest from staff regarding the GeoPhone application that we discussed at the GIS101 Training. The GeoPhone application enables staff in the field to take photos with their cell phone and have those photos automatically embedded in their WebGIS. This would enable the staff to efficiently manage field photography and ensure that their photos become part of the GIS database.

We recommend that Concord take short steps in regards to GeoPhones with the purchase of 2-3 phones in this task and sufficient field testing to prove the concept and define the value this technique might have for various departments. This program component could grow into a very significant component in the next year, with the potential of providing tremendous support for Public Works, Public Safety, Planning, and others. All of these departments should be included in this "demonstration" phase to get their feedback and input.

The GeoPhones can also provide for vehicle tracking. We recommend that this also be assessed as part of this demonstration task in order to document the value and effectiveness of this technique. Public Safety, Public Works, and others have expressed their desire to research this topic, acknowledging the potential shortcomings/disapproval of certain staff members. This approach using the GeoPhones would allow for user control, i.e. users in the field could simply turn off the source of location information (their cell phone). This certainly provides for increased staff control while addressing the needs for tracking at a low cost.

One aspect of the GeoPhones that appealed to leadership was the ability to track personnel in the field. The safety aspect of this capability was considered to be the most important benefit of the GeoPhones. Police Officers that leave their vehicle to conduct a pursuit or search could effectively be tracked, thereby enabling their position to be known in the event of a problem. Assessor's, Planners, and other staff in the field could also similarly benefit. Such a capability is not available with vehicle-based tracking systems.

4.9 CMLP/COA/Public Safety Emergency Support WebGIS

A Life Support/Critical Needs Citizens database was discussed in Section 3 to support CMLP, the COA and Public Safety in assisting those in Concord with special needs in the event of a power outage or other similar situation. Individuals dependent on life support equipment would be included in the database as a priority response location, and other conditions would be included as appropriate. The concept is to enable these departments to get this information quickly and easily in order to conduct their work in a time-critical manner.

We recommend that another WebGIS interface be developed that maps this database and provides access to this information 24/7. This website would certainly not be public or even accessible to the general staff. Only CMLP, the COA and Public Safety departments would have access. Locations would be color-coded and/or symbolized to reflect the nature of the support required and time period that requires a response.

4.10 Concord Neighborhood Network Support

Concord enjoys the support of the Concord Neighborhood Network (CNN), a community-based organization staffed by residents that look after one another, their neighborhoods, and their community. Town Management thought it would be wise to support their work with the Town's GIS. The GIS Coordinator has already provided support to the CNN over the past few years, and we recommend that the Coodinator work with CNN and the new WebGIS to see how a new website might fit their needs.

4.11 CMLP WebGIS

CMLP wishes to put their data online for staff use. We recommend that CMLP leverage the WebGIS technology that the Town is currently putting into place. This will save time and expense, while also providing more partnering between the Town and CMLP that will benefit both parties.

CMLP is still in the midst of defining the functionality that would be required online. The document management components that were discussed in our meetings with CMLP are largely available currently. So too are the query functions and searches. We anticipate the need for dialog with CMLP as the Town's websites come online to see which functions are appropriate as they exist today, and which will need to be augmented to produce different results.

4.12 CMLP WebGIS Complaint Calls Tracking

We envision this tool resembling the complaint calls tracking discussed for CPW. We recommend that the CPW tool be completed first and shared with CMLP to determine if the same application can serve their needs as well.

4.13 Mapbooks

While many have talked about a "paper-less" office for several years, we still have not seen one. Paper maps are still a valuable component to a GIS program, especially in the field for use by staff that have been using paper maps for decades. We recommend that the GIS Coodinator work closely with all departments to assess their needs for Mapbooks in the field and in their offices. Mapbooks can be automated using several techniques, including a free

ArcView 9 extension from ESRI, various third-party mapbook tools, and PDF-creation tools. We urge the design and creation of each mapbook to be accompanied by discussion about their maintenance as well. As the GIS is updated, new mapbooks will need to be issued.

4.14 Public Safety Dispatch WebGIS

We recommend that Dispatch be provided with GIS tools to assess the location of an incoming call, its proximity to other calls-for-service, and the history of calls-for-service from the same and surrounding locations. We recommend that Concord consider another WebGIS site for this function to control cost and to keep the interface simple.

4.15 Replacement Kiosks

We recommend that Concord's kiosk applications be replaced with WebGIS interfaces. This approach will enable the kiosks to advertise the fact that the same capabilities exist online, thereby promoting the use of these tools online instead of forcing public users to drive to town facilities.

4.16 Link Sewer Video

We recommend that sewer video be produced to support automatic linking to respective sewer segments in the GIS. This would enable rapid review of video via the GIS, and produce an archiving methodology far superior to the placement of video (digital or analog) on the shelf.

4.17 Error Reporting

It is common for staff to find errors in GIS mapping layers as they use the data in support of their daily routines. It is also common for this knowledge to get lost because of the time required to pass this information to the GIS Coordinator or other party.

To address this situation, we recommend a function be added to the WebGIS and ArcView 9 seats that enables users to simply click a button to send the current map and their message to the GIS Coordinator immediately. If this process takes only a minute or less, then it will likely happen more often than not, and the GIS Program will benefit. The GIS Coordinator will benefit in that most of the reported errors will come to him in an organized, unified form. This will allow the Coordinator to address the errors on his own schedule, as opposed to handling random phone calls and emails with less than descriptive information.

Those departments that are setup to correct their own spatial databases (such as the Water & Sewer Division) should continue their current editing operations and keep providing the GIS Coordinator with their updates.

4.18 PDF Maps

The PDF format is vastly popular on the Internet and desktop due to the quality of the viewer software and the fact that these viewers are free. Therefore, it is not surprising that PDF tools have found their way into GIS Programs as well. We recommend creating a set of

PDF parcel maps for users to download from the GIS Support Website. We also recommend a PDF Zoning Map, as well as copies of any maps that are prepared for one staff person or department and may serve others as well. This volume of PDF maps should grow over time and become a source of mapping information for staff that they can access themselves 24/7.

There are also "interactive" PDF tools that enable the creation of interactive PDF products, allowing users to click on zones (for example) and retrieve zoning information, or to click a parcel index map and retrieve that parcel map. These tools are inexpensive to purchase and use, and can produce very light-weight products that staff will find easy to use and distribute. We envision these products being downloadable off the same website as the above "static" PDFs, and available to the staff 24/7.

5.0 DATA MAINTENANCE

While it is true we are recommending significant changes for the role of the GIS Coordinator, with significant reductions in the time spent on data maintenance, it is also true that data maintenance cannot be ignored. The highest level of maintenance is required for the parcels mapping layer. After that, lesser levels of the Coordinator's time are necessary for the maintenance of buildings, utilities, etc.

We recommend that the GIS Coordinator use all available time not scheduled by staff on Wednesdays for such data maintenance. We are confident that there will be Wednesdays that will not be completely or significantly booked by staff, which we believe will allow sufficient time for routine maintenance activities on an annual basis. Of course, the GIS Coordinator will need to assess if acute situations require additional editing time in any given week.

We wish to note here that the possibility exists for Concord to outsource their data maintenance, or portions thereof, in the event that the GIS Coordinator becomes too busy with other activities involving support, training, and program development. While we do not anticipate this happening at this point in time, it is an option the Executive GIS Committee can consider if necessary. GIS data maintenance is becoming a commodity item in the industry, with costs being relatively low compared to other activities. This situation makes outsourcing an option if other higher-priority tasks are keeping the GIS Coordinator busy.

From our review, the GIS Coordinator has all of the skills and tools necessary for data editing and maintenance, so no additional recommendations are required.

6.0 TRAINING

Given the new focus on end-users, it is appropriate to recommend a significant training program. Our recommendations include:

- Quarterly Training Events: Regularly scheduled events that would be publicized on the GIS Users Website and via email to all users. We would suggest 2-4 hours for these events. The GIS Coordinator would decide on the topics based on current projects in Concord, questions from end users, etc. Training could cover aspects of ArcView software, and extension to ArcView, procedures in ArcView that are not commonly known, or new features of the software that are available with a new software release. The goal is to provide for continued education.
- WebGIS Training: Users of the new web mapping technology would benefit from a training event, with subsequent training events as the site grows and adds functionality. Subsequent training might be offered as part of the Quarterly Training above.
- Individual Training: We envision users signing up for individual training time as part of Wednesdays with Matt. Therefore, there will be opportunities for individual training attention for those who learn better this way.

7.0 HARDWARE & SOFTWARE

7.1 New GIS Coordinator Laptop

We recommend the purchase of a new production laptop for the GIS Coordinator. In keeping with the theme of our core recommendations, we believe that the Coordinator should be much more mobile, being able to even conduct a day's work in another location in support of another department's needs, such as CMLP, to support a Town Manager's meeting, or to collaborate with school officials.

This laptop should have a large hard drive (100 meg+), a large amount of RAM (1gig+), a large screen (i.e. large for laptops; 14+ inches), Windows XP Professional OS, and a 7200-rpm hard drive (if possible, some manufacturers do not provide for such hard drive speeds in laptops). We would also recommend the Centrino chip technology over typical Pentium technology due to the extended battery life. The loss of speed is more than compensated for with the extended battery.

Hardware should also be purchased to enable this laptop to "dock" into the Coordinator's office setup and quickly connect to a desktop monitor, keyboard, and mouse. This entire setup will enable the Coordinator to use more comfortable equipment when in the office and bring the entire GIS Program with him into the field.

7.2 Virtual Tour Camera

Several departments expressed interest in the integration of virtual tour technology into the GIS. We demonstrated the use of this technology for schools and the entire community for use by Public Safety, Public Works, Town Management, Planning, and others. We recommend that the Town purchase the hardware and work closely with the Student Intern Program and/or through the School Partnership to get a lot of photography done. This purchase may be subject to Homeland Security grant funding as part of the school mapping project recommended above.

7.3 Consumer-Grade GPS

While there is a lot of talk about professional grade GPS equipment suitable for GIS mapping and data maintenance, few people talk about consumer-grade GPS and its value to a municipal GIS program. We recommend that Concord purchase three compact-flash GPS units (approximately $150 each) that can plug into the side of a laptop computer. Different members of the staff that use GIS in the field could plug-in this technology and see their location updated in real-time in ArcView 9 software, ArcPad, and other software. This not only makes the use of GIS in the field more interesting, but more productive as well.

7.4 Mobile Computers

There has been discussion in Concord regarding the expansion of GIS use in the field (especially in CPW trucks), both for data access and data updating/editing. However, there has not been enough discussion to date to warrant a specific purchase recommendation.

One issue with the addition of mobile computers is the additional software licenses that would be required to take laptops and PDAs into the field with the GIS (if open source software was used in these installations, the cost to install the GIS for mobile use would be very low for laptops, but we know of no open source mapping software for PDAs). The addition of software licenses goes against the Town's desire to reduce their software licensing in general.

Alternatively, the Town can wait for a town-wide wireless network to arrive. Many communities (including the City of Boston) are considering plans for the implementation of wide-area wireless networks. In this case, Concord would only need Internet browsers on their laptops and PDAs. This approach would enable each user to simply connect to the Town's WebGIS sites, thereby making the cost of each unit significantly less expensive. We recommend that the GIS Committee discuss this potential future with CMLP and plan accordingly.

An added advantage of using the Internet via a town-wide wide area wireless network is that the data would be up-to-date. With the data being loaded on each individual computer/PDA, individuals would have to be responsible for ensuring that the data on their mobile units is updated regularly. With the Internet, this would be taken care of for them.

Certainly, we can recommend that individuals who feel the need to be mobile with the GIS sooner consider their next desktop computer upgrade to lead them to a laptop computer. Today's laptop computers are becoming as powerful as their desktop counterparts, and along with docking stations that enable quick connections to full-size keyboards and monitors inside the office, laptops are becoming the computer hardware of choice in many situations. While this may result in a small incremental cost over a desktop replacement, the flexibility of being able to take your computer/GIS with you can be worth it.