CITY OF GREATER SUDBURY

CORPORATE GIS STRATEGY

GROWTH AND DEVELOPMENT DEPARTMENT

INFORMATION TECHNOLOGY

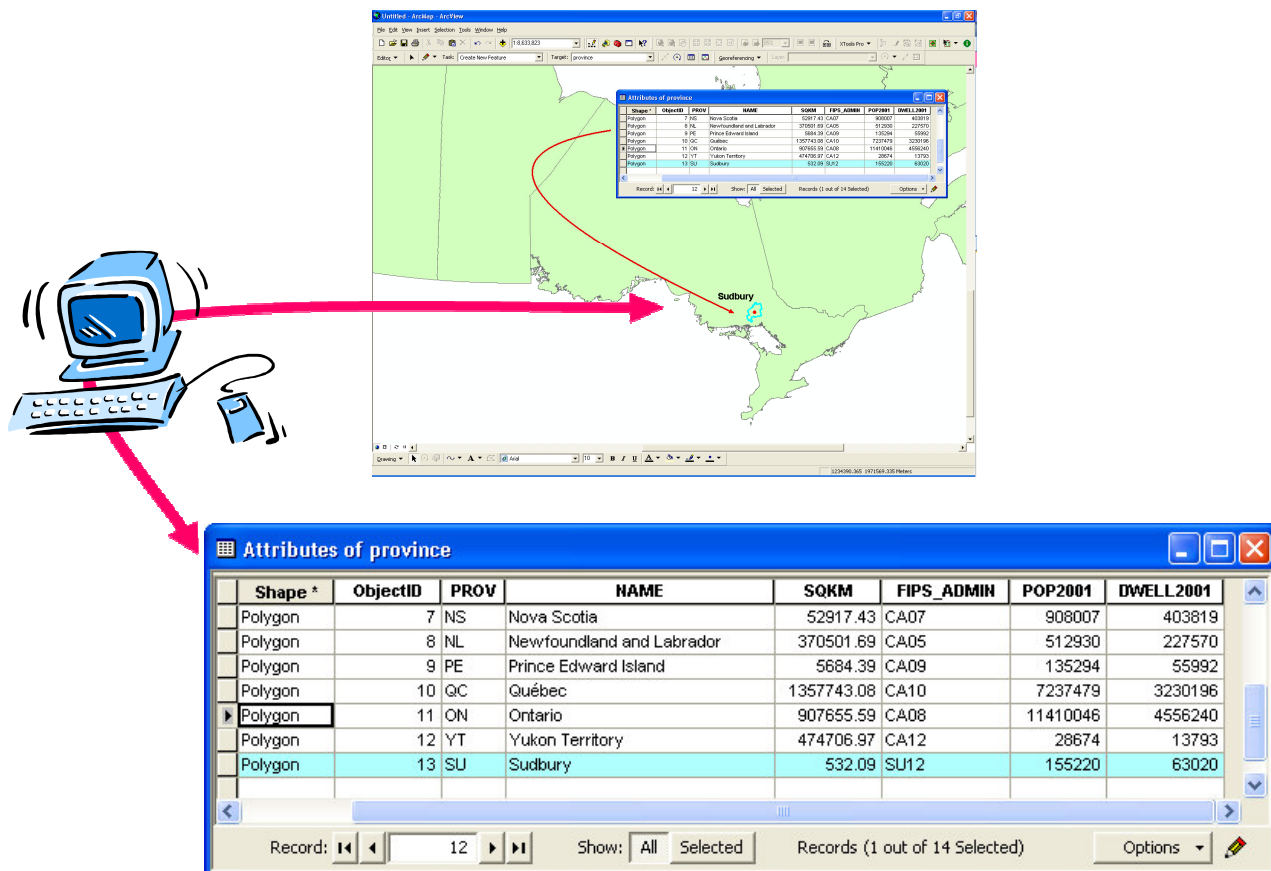## OCTOBER 15, 2008

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CITY OF GREATER SUDBURY CORPORATE GIS STRATEGY

1. WHAT IS AN CORPORATE GEOGRAPHIC INFORMATION SYSTEM (GIS)

Geographic Information Systems have emerged as the preferred way to organize and view much of the data required and used by municipalities and other organizations.

A GIS is a system for capturing, storing, finding, viewing, analyzing and managing data which are spatially referenced.   Because GIS handles both spatial and aspatial data types a GIS has the ability to manage spatial data across the entire organization. GIS could also aid us in doing what-if scenarios.

Current estimates indicate that more than 80% of the information used within a municipality is directly linked to location.

Shape *	ObjectID	PROV	NAME	SQKM	FIPS_ADMIN	POP2001	DWELL2001
Polygon	7	NS	Nova Scotia	52917.43	CA07	908007	403819
Polygon	8	NL	Newfoundland and Labrador	370501.69	CA05	512930	227570
Polygon	9	PE	Prince Edward Island	5684.39	CA09	135294	55992
Polygon	10	QC	Québec	1357743.08	CA10	7237479	3230196
Polygon	11	ON	Ontario	907655.59	CA08	11410046	4556240
Polygon	12	YT	Yukon Territory	474706.97	CA12	28674	13793
Polygon	13	SU	Sudbury	532.09	SU12	155220	63020

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A GIS links data to maps, creating an intelligent map. GIS software links location data with the attribute data (databases/information tables to the map).

1

Large volumes of data collected by a municipality directly support decision making and the operational activities of the corporation. By modelling the real world GIS provides an effective way to gain more value from municipal data sets, resulting in better decisions.

Data collected by the municipality includes assessment information, public works infrastructure, zoning, environmental features, addresses and aerial photography to name just a few examples. Some information is for internal use; some is shared with other agencies; other data can be made available to the public over the web using GIS applications.

A GIS is a critical component of our corporate infrastructure just as our roads, sewer and water are key infrastructure elements for city residents. With a high quality operational GIS, the City of Greater Sudbury will gain significant efficiencies and be more effective in collecting and utilizing information it has at hand to help get the City's work done.

As a result of a long term commitment by the City to develop a strong control survey network, the City's property mapping has good geographic accuracy. Global Positioning Satellite (GPS) technology as well as traditional control survey methodology, are used to maintain and densify the control survey network

The key map and data sets in a municipal GIS are:

Property - including Property Fabric, Assessment mapping, etc.;

Street/Road Network - including the linear road map, names, addresses, structures and such attributes as speed, direction, surfaces, etc.;

Photography / **Topography** - including images/maps of the physical shape of the terrain & features - this provides data location and background referencing;

Utilities - including sewer, water, hydro, gas, etc. - location and servicing data

In particular the Property map and the Street map (with addresses) are the two elements linked to practically every other record that the municipality deals with. For a GIS to work effectively, these two data sets must comply with standard information system requirements. They must be accurate, current and complete for the intended use.

While accurate data is the foundation of a GIS, there are several other elements which make up a successful GIS.

• Policies and procedures for the use of data, access to data and responsibility for maintaining data need to be formally established.

- Applications which allow GIS features to be utilized in business processes.

- Computer hardware to house the GIS databases and GIS software which provides analytical and viewing tools for staff and the public.

- GIS staff to maintain and develop the GIS, its databases and its applications, and other staff in the corporation trained to use GIS in their business areas.
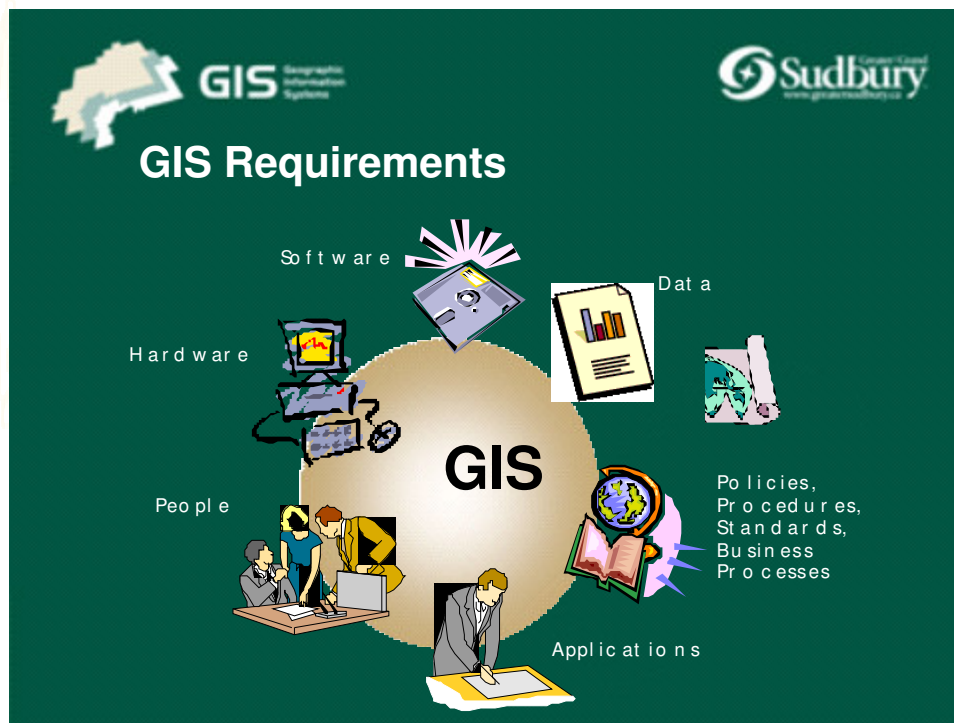
In summary, a GIS is an organized system of computer hardware and software, geographic data, procedures and personnel designed to efficiently and effectively capture, store, update, manipulate, analyze, display and model the real world for use in decision making throughout the corporation. GIS could also assist with the preparation of Council reports in that the information could be used in support of certain actions being brought forward.

2. HOW IS THE CORPORATION PRESENTLY POSITIONED WITH RESPECT TO GIS TECHNOLOGY

There are pockets of GIS excellence within the Corporation and several key champions; but GIS technology has not been fully embraced by the corporation. This is slowly being altered incrementally, but GIS has still not been made a key corporate priority as it has in other municipalities.

Although hardware and software costs may go down over time, the real cost of a GIS is in the capturing and maintenance of data. The longer full implementation takes, the higher the costs. In the meantime the City loses the benefits of being able to manipulate, store, analyze and model data to its advantage.

In 2004, The City of Greater Sudbury obtained funding from the Province of Ontario for a GeoSmart project to buy the tools to help build the basic structure of a municipal GIS. The project also provided a high level strategic plan with suggested steps for implementing a corporate data base. The initial data sets developed through the GeoSmart program demonstrated GIS capabilities.

Recent Accomplishments

The City has made significant gains in recent years as a result of the GeoSmart program and with co-operative efforts amongst departments. We now have basic high quality parcel mapping and municipal addressing for the entire city. This enables us to really begin to link municipal data to maps. This means better access to corporate information internally and also better ways to provide information to the public.

Beginning in the fall of 2006 and continuing late in 2007, staff and resources from Growth and Development and Infrastructure and Emergency Services worked together on a project to bring the Assessment Property Mapping base to a largely complete and current level.   At the same time, they located and determined the addresses of every building on every road in the entire municipality. Subsequently staff worked with IT to link property owner's names and addresses to the parcels (Vailtech - taxation records).

 In addition, the Zoning category for each Parcel is being captured and verified. There is a list of additional data sets (business, institutional, municipal services, hazardous areas) that will be, added to the property and street/address sets once they are complete and operational.

A new GIS application - called iQuestor – has been brought on-line employing these maps, datasets and background ortho-photography as the basis for internal viewing and queries - including report generation and automated mailing list generation.

With the completion later this fall of a detailed parcel fabric map and municipal addressing for the entire City, along with the existing aerial map coverage, the opportunity exists for the City to begin to use GIS to a much greater advantage. The City will be able to develop numerous business applications such as tracking where and how development is taking place and what has to be done with respect to short term and long term infrastructure enhancements and allow for the implementation of other computerized tools that will benefit the City's operations.

3. GIS BASE INFORMATION – MAP PRODUCTS

3.1 PRESENT PRODUCTS

At the present time the vast majority of the City base mapping products are developed and produced by the Geographic Information, Surveys and Mapping Section. These mapping products are the basic platform upon which all the rest of the Geographic Information System functions. This base mapping layer includes:

(1) all aerial photography including the 1:40 000 aerial colour photography for the entire city. It also includes high resolution black and white photography for the old City and all of the historical black and white photography;

(2) 1:2000 contour mapping for all urban areas of the City and most of the major flood plains;

(3) the parcel fabric maps for all 70,000 properties in the City including all registered lots, reference plans and various easements;

(4) draft plans of subdivision mapping for all draft plans moving to registered lots;

(5) the control survey fabric into which all of these coordinates are tied or linked;

(6) the Digital Terrain Model for the production of contour mapping and ortho-images;

(7) PINS (property identifier numbers) and ARNs (assessment roll numbers) which are part of the property's unique identifier;

(8) the road network for the entire city.

With the assistance of the Assessment Office, Tax, City Clerks and IT Divisions, property roll numbers and assessment data are also added to each new parcel created. This information is collected and updated by the Geographic Information, Survey and Mapping Section to keep the entire base system as up to date as possible.

In 1975 the Regional Municipality of Sudbury entered into an agreement with the Province to build and maintain a Horizontal Control Network and tie all subsequent mapping to that network. Since then, we have expanded the network from 680 stations and a few hundred bench marks to over 4,000 stations and over 10,000 three dimensional markers. All mapping, ortho-imagery, legal subdivisions, and recent engineering works have used the control survey network to geographically reference mapping and engineering final products.

3.2 FUTURE PRODUCT REQUIREMENTS

A basic infrastructure building block for the Corporate GIS is digital aerial photography and mapping. In order to best provide for current and future mapping needs in all Departments, ortho-imagery is required. Ortho-imagery is digital aerial photographic mapping that has been geometrically corrected so that distances are uniform and can be measured like a map and underlain with digital contours. This type of mapping provides the most visual and useful form of map product for a wide range of City applications.

To enhance this product, a Digital Terrain Model (DTM) which provides accurate spot heights, break lines (ridges, troughs, slope changes for ground shape differentiation) and contour lines is required for mapping. The DTM will allow the City to establish digital contour mapping at 1 metre and ½ metre interpolated contour intervals which is an essential component for environmental (drainage, floodplain mapping, source water protection), engineering (subdivision layout, lot grading, and major engineering projects e.g. roads, sewer and water), public works, parks/leisure, planning, economic-development and hydraulic water modeling. This DTM will be spatially referenced to the City's control survey network. The DTM is a good investment because it will reap continuing dividends for the City and all agencies by reducing subsequent mapping cost by approximately 70%.

The surveys group under the Construction Services Section moved to GPS mapping approximately four years ago. Data collected will now be in proper format to support DTM.

Future work which is required to advance the GIS base platform includes the following:

(1) Continue with the addition and clean up of the legal property base completing all PINs and ARNs linkages as this impact on all parcel based application fields;

(2) Create a Digital Terrain Model for the entire City which will provide digital elevations for all properties and allow for digital contour mapping on aerial photography (ortho-imagery)

(3) Finish converting map coordinates to the new national spatial standard from NAD 27/NAD83 to CSRS (Canadian Spatial Reference System);

(4) Continue to densify the Control Survey Network.;

(5) Begin transition from current paper as-built requirements to digital as-builts utilizing photogrammetry and ortho-photography and spatially orient the as-builts;

(6) Require all new subdivisions and consents in digital formats;

(7) Continue transition from paper based mapping products to full digital based mapping products;

(8) Place base mapping and survey products on the City's website for access by the public.

4. GIS DATA PRODUCTS

4.1 CURRENT GIS SERVICES

At the present time GIS mapping services which link map location and digital data bases are just beginning to be established at the corporate level. This is largely due to the fact that the City did not have a digital parcel fabric onto which digital data bases could be attached. Because of the GeoSmart program and the development of the new official plan, the City was able to create an aerial photo mosaic and a digital parcel fabric for the entire City which is now largely completed but still being verified. This parcel fabric along with the aerial photography and the road network is the base platform upon which data base information can be placed.

Public access to this mapping information is now available on the City's website using the IQuestor application. Citizens can enter an address and IQuestor will show the location along with other information chosen by the user. The site has both a public access point which has limited information to protect privacy and an internal access point for use by City staff. This application or a similar one could be expanded in the future to include a wider range of data.

For internal City use, the IQuestor application with the parcel fabric is linked to Vailtech tax assessment data which provides a way for staff to quickly ascertain ownership and other information on properties.

 As we continue to refine and improve base mapping and parcel information more data can be geo-referenced to create the mapping and analysis capabilities required within each Division of the Corporation. These services and others will enhance the business

solutions required to more efficiently operate each Division of the corporation with respect to the information system.

Data Sets which the City has already completed include the following:

- Property Fabric

- Municipal Addressing – 911 Addressing

- Assessment Data

- Transportation Network

- Draft Plans of Subdivision

- Official Plan

- Wards and Polls

- Demographics

- Crown Lands

- Emergency Service Zones

- Ambulance and Fire Stations

- Arenas/Recreation Centres

- Parks, Playgrounds and Tot Lots

- Rainbow Routes Trails

- Cemeteries

- Citizen Service Centres and Libraries

- Water Drafting Sites

- Environmental Databases - Waterbodies and other Natural Features

- Critical Infrastructure Inventory

- Sanitary Sewer System

- Storm Sewer System

4.2 GIS SERVICES REQUIRED

To be truly corporate in scope GIS data sets must be accurate for the requirements of all users with respect to data content and spatial location; it must be current - in time for the needs of the users with respect to day, week or year depending on need and it must be complete with respect to the user's requirements.

In building new GIS services the GIS group will assist Divisions and Sections to assemble their spatially related data and assist the Software and Business Applications Section to build internal and external applications. This assistance will enable others to develop new data sets and use existing data to support their business processes. It will also help the CGS to quickly integrate GIS throughout all Divisions of the organization as an efficient and effective tool.

As we move in this direction, the GIS group will conduct needs assessments within each Division to identify opportunities to utilize GIS. Goals and objectives will need to be developed at a corporate level so that projects can be prioritized.

To give an indication of the wide range of possibilities for the application of GIS at the City, GIS services could be utilized as an important tool for Automating Mailing List, Complaint Tracking, Site Selection, Promoting Economic Development, Promoting Tourism Information, Critical Infrastructure Inventory, Asset/Infrastructure Management, Facilities Management, Engineering Planning and Design, Network Analysis, Emergency Response Planning, Contamination Analysis and Mapping, Vehicle Routing, Development Tracking, Elections Management, Transportation Planning, Planning and Zoning, Environmental Monitoring, Ecosystem Management, Site Location Analysis, Site Selection Opportunities, Trend Modeling Analysis, Demographic Analysis, Soil Sampling, Borehole Data/Reporting, and what-if scenarios etc.

4.2.1 Related Data Sets and Mapping and Analysis Opportunities

In order to develop these GIS services to serve the broad needs of the corporation and its divisions, consideration will need to be given to expanding existing data sets, establishing new data sets, and converting existing data sets for GIS use. What follows are examples of potential data sets and corporate GIS services which should be developed to enhance business application purposes.

Corporate Data Platform

Property Fabric

- PINS – Property Identification Number
- ARNs – Assessment Role Number

- House Numbering
- Address Ranges

Road Network
- Street Names

Control Survey Network
- Bench Marks Vertical and Horizontal
- Control Survey Monumentation
- Maintain Grid File
    Integrated Surveys – Subdivisions, 53R-Plans

Corporate and Division Data Sets
- Digital As-Builts
- New Zoning Bylaw
- Source Water Protection Database
- Easement Inventory
- Floodplain Hazards and Hazard Lands
- Watershed and Sub-watershed Mapping
- Speed Limits
- Road Surface Type – Number of Lanes - Direction
- Hazardous Materials, Gas Stations, Industrial Sites, Chemical and Gas Plants
- Municipal Property
- Well Head Constraints, Municipal Water Supply
- Building Permit History
- Planning Application History
- Asset Inventories
- Bus Stop Locations
- Road Conditions
- Industrial Land Inventory by Categories
- Social Housing Databases
- Special Need Housing – Group Homes
- Parking Spaces and Location
- Traffic Signs and Signals
- Day Care Demographics and Locations
- Traffic Accident Locations and Histories
- Pits and Quarries
- Environmental Monitoring
- Tourism Opportunities and Information

- Water Distribution Network
- Water and Wastewater Facilities
- Sewer Distribution Network
- Storm and Sanitary Sewer Condition Surveys and Analysis
- Watermain Break Tracking/Analysis
- Watermain Condition Analysis
- Parks and Recreation Facilities Inventories
- Monitoring Lake Quality
- Polling Stations
- Service Delivery Areas
- Engineering As-Built Drawing Index

Corporate Applications Enhanced By GIS
- Asset Management – (Legislative Requirements)
- IQuestor
- Automated Mailing List Capability
- Complaint Tracking (Potholes, Bylaw Infractions)
- Property Searches
- Work Scheduling ie. Building Inspections, water hydrant maintenance, road line painting, road sign replacement/maintenance
- Municipal Facility Site Selection
- Urban Design – 3 D Visualization
- Sidewalk Inspections
- Asset Maintenance Scheduling/Tracking
- Transit Routing with Ridership Demographics
- Fire Hydrant Inspections
- Manhole/Catchbasin Inspections
- Culvert Inspections
- Welfare Recipient – Caseworker Visit Scheduling
- Watermain Corrosion Protection Program Tracking
- Green Space Potential Acquisitions
- Crime Incident Tracking and Trends
- Fire and Ambulance Routing
- Computer Aided Design Opportunities
- By-law Enforcement – Property Standards Complaints
- Land Use Changes over Time
- Vacant Lands and Brownfields Assessments

Each of these data sets and applications will form a thematic layer in the Corporate GIS. This information can then be placed over base layers and manipulated in various ways for decision making and/or analysis purposes.

5. GIS HUMAN RESOURCE REQUIREMENTS

5.1 PRESENT STAFFING

At the present time the GIS group consists of a small dedicated group within the Geographic Information, Surveys and Mapping Services Section of the Corporation and several additional staff within other Departments (see staff complement on page 14).

5.2 STAFFING REQUIRED

Our future success in GIS depends on maintaining current mapping products, developing data bases further and developing applications for utilization in City business processes. Mapping products, for example, are subject to constant change as new development occurs and it is important to keep these products current and accurate. This requires regular aerial photography upgrades (every 3-5 years) and daily/weekly upgrades to the parcel fabric.

With over 70,000 parcels in the system, maintenance of these property-based records is a critical factor in running an operational corporate GIS. To this end, staff and budget resources must be specifically allocated to the data and system maintenance processes, and the processes for reporting and recording of changes to the information must be identified and followed. The data maintenance component will involve a significant portion of the time of two people - given the amount of change that currently occurs in the property and addressing related records.

Changes to assessment information from Municipal Property Assessment Corporation (MPAC), Registry information from Teranet and direct street and addressing information from Development Engineering and Building Controls are happening constantly. These changes arrive in Tom Davies Square by various computerized or paper reporting methods that have quarterly, monthly, weekly or daily timetables - necessitating a rigorous and continuous maintenance process. Meanwhile, the increasing server, hardware and software demand require the ongoing attention and time of IT staff.

In the 2008 Budget, Council approved two new fulltime Surveys and Mapping positions to carry out data base related work. One of the positions has been permanently filled and is fully funded. The second position did not receive the necessary Council funding of $64,000 at the time of budget. However, it was anticipated that it would be funded by contributions from other divisions. This funding shortfall should be addressed through contributions in the form of permanent budget transfers from benefiting Departments

and Divisions to Surveys and Mapping or as an alternative be addressed in Council's 2009 budget. This key corporate infrastructure will only be maintained and upgraded in a timely fashion with adequate staffing complements.

In proposing a staff complement to achieve our corporate GIS objectives, consideration was given to the Geosmart Strategic Plan in addition to the existing work relationships among staff undertaking GIS related tasks. In the longer term, additional staff support is required to fully realize the GIS benefits available to the Corporation. Three GIS Specialists should be created from existing permanent positions. These positions would be filled by the (3) existing Technologist and Technicians within the Section. A fourth and fifth position (new) titled GIS Specialist-Business Analyst (1) and Business Analyst-GIS Application Specialist (1) should be created. These new positions would reside in the Geographic Information, Surveys and Mapping Section and Information Technology respectively and would need to be approved and funded by Council.   In addition the temporary rod person (7 month position) in the Surveys and Mapping group should be converted to a full time position.

 A sixth position (new) entitled GIS System and Data Base Administrator (1) should also be created. This IT person would be dedicated to support the Geographic Information System and its IT requirements. This position would reside in the Information Technology's Software and Business Applications Section and would need to be approved and funded by Council.

The base mapping, legal fabric and control survey for this group which is essential for providing the basic mapping platform for GIS is provided by the Survey and Mapping staff and includes the following: Survey Technologist (1), Survey Technician (2), and a field survey staff of a Control Survey Leader (1), Vertical Control Person (1) and Rodman (1) – convert part time hours to create a FTE).
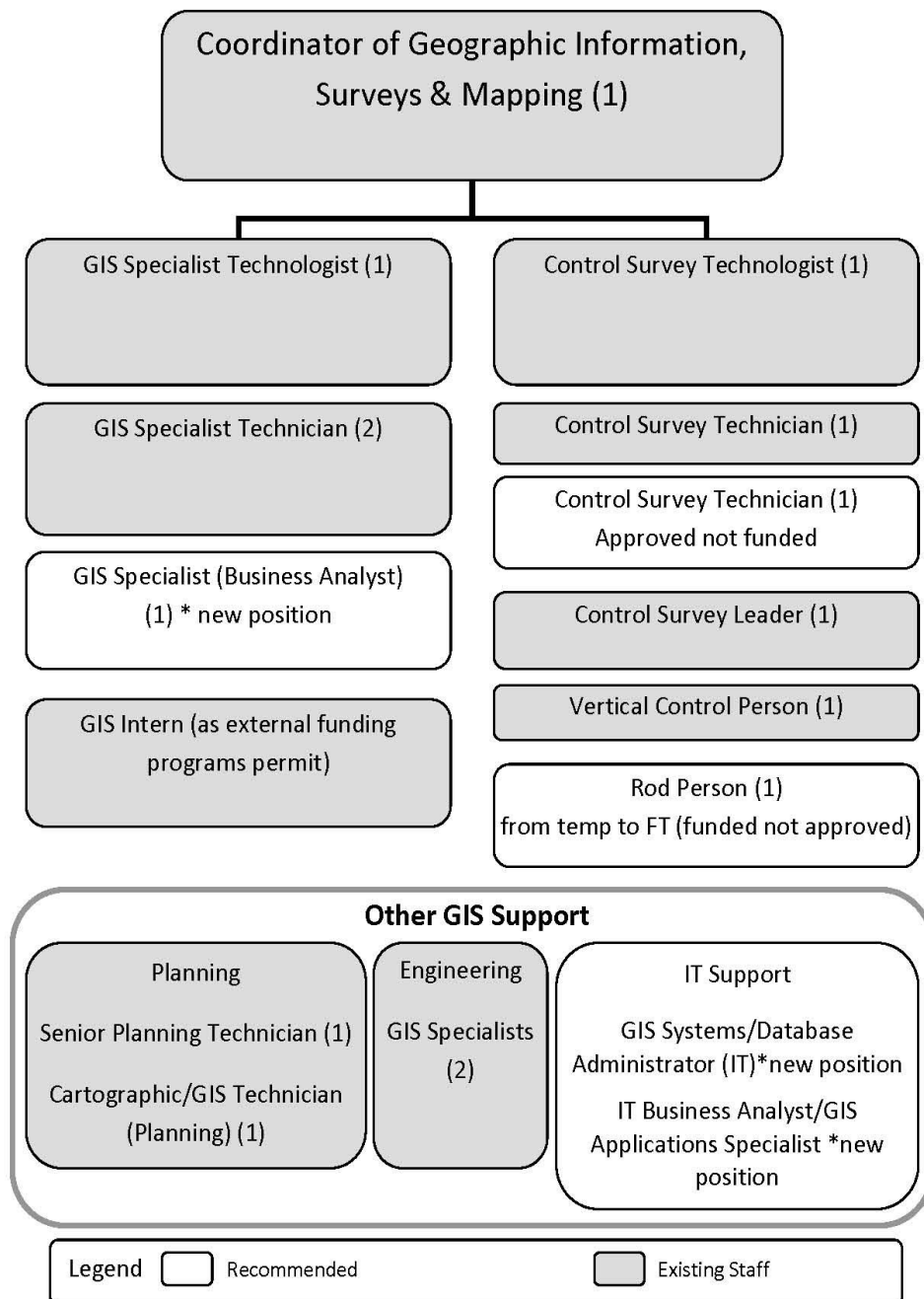
Both the Geographic Information, Surveys and Mapping Section and IT's proposed new staff positions are portrayed in the following Organizational Chart.

In addition, Planning Services has (1) GIS Mapping Technician and (1) Information Technician, Infrastructure has (2) GIS Technicians or specialists, and IT has additional staff who provide hardware and software support. This additional GIS staff support is dedicated to development within their respective Departments. Other Departments will need to convert some of their current staff roles to information specialists in the future.

On the Engineering side retraining on the use of GIS software by their technicians will be required and no new personnel are envisioned at this time. AutoCad Map software sits on top of AutoCad and the current users of AutoCad would not require extensive training on the software.

Geographic Information, Surveys & Mapping

Recommended Staff Complement

Coordinator of Geographic Information, Surveys & Mapping (1)

GIS Specialist Technologist (1)

GIS Specialist Technician (2)

GIS Specialist (Business Analyst) (1) * new position

GIS Intern (as external funding programs permit)

Control Survey Technologist (1)

Control Survey Technician (1)

Control Survey Technician (1) Approved not funded

Control Survey Leader (1)

Vertical Control Person (1)

Rod Person (1) from temp to FT (funded not approved)

Other GIS Support

Planning

Senior Planning Technician (1)

Cartographic/GIS Technician (Planning) (1)

Engineering

GIS Specialists (2)

IT Support

GIS Systems/Database Administrator (IT)*new position

IT Business Analyst/GIS Applications Specialist *new position

Legend ☐ Recommended ▨ Existing Staff

6. GIS INFORMATION TECHNOLOGY REQUIREMENTS

A Geographic Information System will not exist independently of the other aspects of the municipal operation, particularly Information Technology (IT). Several components of the IT Strategic Plan that will interact directly with the GIS in the short and long term are:

Data Management - Given the huge volumes of GIS data (thousands of digital aerial photographs, many thousands of vector map sheets and related ortho-images, property records for over 70,000 parcels, location and building information for over 57,000 addresses, hundreds of thousands of utility records) the basic aspects of storage, handling, and security of this data have to be part of the comprehensive IT Data Management process.

Document and Records Management - Applications for zoning and subdivisions, Draft Plan Conditions, final plans of Survey, Subdivisions, Permits, Licences, other legal agreements with the City such as easements and rights-of-way are all documents that are directly related to the GIS and will be linked in the system to the other Parcel and Address records. This assumes that a comprehensive program and policies are in place for conversion or updating of the old paper-based records and the submission and storage of the new digital forms.

The GIS will require support and expertise in the area of Information Technology in the following respects:

Business Applications: IT is responsible for working with the Departments to plan, develop and implement business applications and solutions.

Database Administration - Given the volume and complexity of GIS data, the design and maintenance of the data warehouse is important to the success of the GIS. Related matters to be addressed include data structure, user access and security, data restoration, protocols for sharing databases, data custodianship and custom database development.

GIS Systems – The GIS depends on hardware (servers), desktop computers and software which require maintenance and support. IT support will also be required to assist in the development of new applications and the installation and maintenance of "off the shelf" applications to address business process needs in the organization.

e-Government - There will be substantial linkage between GIS and e-Government Services such as permits, billing services, bus and event ticketing, service scheduling and routing (buses, garbage, blue box), the location and availability of services, and the event scheduling/ availability/ payment for Parks and recreational facilities such as arenas and soccer and ball fields.

6.1 PRESENT HARDWARE AND SOFTWARE

An overview of the current use of GIS hardware and software is illustrated in Figure 1. ArcSDE uses a centralized corporate repository of geographic information. Data is published for internal and external users of GIS. As well, data is shared with other agencies in file based formats such as shapefile and dxf. Some GIS information is used in conjunction with other CGS business systems such as the Vailtech System and the Active Citizen Response (ACR) System.

The City has standardized on the Windows platform and Dell is the primary hardware vendor. On the desktop, GIS clients are installed on Windows XP. There are approximately 8 GIS Technicians who use ArcView 9.2 to view data stored in ArcSDE. Only one user maintains data in ArcSDE, using ArcEditor 9.0. Although ArcSDE is the corporate repository, many data sets are being maintained outside of ArcSDE in shapefile format.

Figure 1 – Logical GIS Architecture
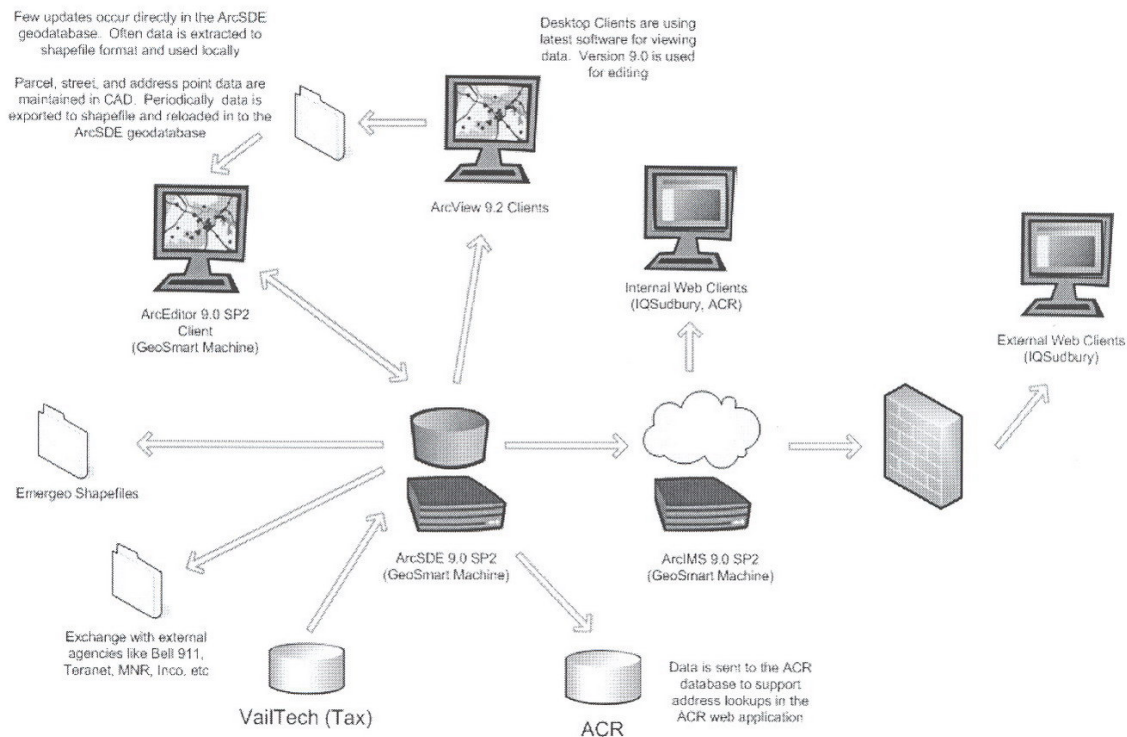
Both the Control Mapping and Surveys Section and the Construction Services Section have state of the art GPS and Surveying equipment for the identification and recording of property and infrastructure assets. Although no new equipment is currently required a

budget allocation for maintenance should be built into the operating budget of each division.

Much of the hardware and software for a GIS was purchased through the GeoSmart program. In 2004 the City invested $375,000 in the GeoSmart Program to purchase computer hardware, software and develop basic data structures. This money was matched by the Province.

6.2 HARDWARE AND SOFTWARE REQUIRED

A review of the current system design has revealed that it is adequate for how GIS is currently being used internally at CGS. Updating the ArcIMS to the most current version needs to be undertaken and certain security and maintenance issues regarding system access have been identified and require attention. It has been recommended that a test environment or staging environment be created in connection with this. Figure 2 shows this updated system architecture requirement.

Figure 3 – Future System Design
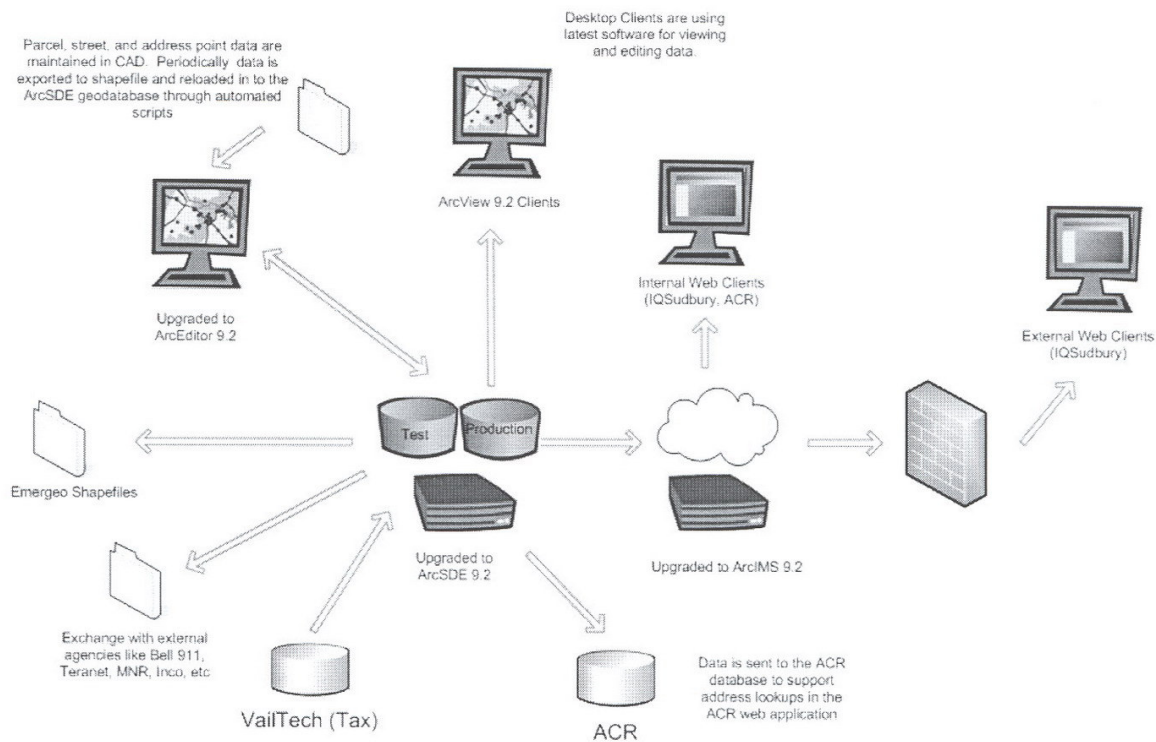
The Control Surveys and Mapping Section currently has the most up to date GIS software and hardware. When additional personnel are hired they will require the necessary hardware and software to perform their respective duties.

The Engineering department currently has the most up to date GIS software and hardware for their GIS technicians and no new purchases will be required. The Engineering technicians and technologist are currently utilizing Autocad as their digital software client and they will require upgrading to Autocad Map.

Additional hardware and software may also be required for the new positions in IT.

7. CORPORATE PRIORITIES FOR GIS

To achieve greater corporate efficiencies within all Departments, digital base data and applications necessary to support their programs are required.

One of the key ways of making GIS benefits permeate the Corporation is to select applications which will significantly assist staff and citizens in more efficiently addressing their tasks. To most effectively deliver on this strategy one needs to focus efforts on priorities which will deliver the greatest corporate returns. Once these initial applications are achieved the focus is then to continue to implement additional applications in ever widening circles to fully penetrate the daily business needs for applications of all Divisions within the Corporation.

As examples: Infrastructure or Emergency Services can use GIS to plan efficient routes for emergency and maintenance vehicles, for emergency response planning, for predicting spill and plume impacts; and to assist with asset management, transportation planning, and managing extensive infrastructure systems ; Growth and Development require GIS for managing and analyzing all of the land based information that goes into land development and environmental protection issues, for linking transit fare box data to rider route scheduling and to incorporate GIS into automated processes; Community Development can use GIS for establishing detailed databases of parks and facilities for easy viewing and access by staff and the public. All groups can utilize GIS for inspection and property maintenance and management functions.

Senior Management Staff and the GIS Technical Committee to be established should select priority applications which would have the widest benefit to the City. Initial priorities which pose some of the greatest returns on corporate investment include the following:

(1) New Zoning Bylaw

(2) Asset Maintenance Management – Location/Valuation/Effective maintenance and inspection of existing City Assets (Buildings, Roads, Sewer and Water, Parks Facilities, Fleets, etc.)

(3) New subdivision and lot creation and application tracking system by year

(4) As-built confirmation through photogrammetry

(5) Transit stops, routes and schedules

(6) Building permits and file by type and year

(7) Creation of GIS templates for Division data sets, mapping and analysis services

8. GIS BENEFITS TO THE CORPORATION AND PUBLIC

One of the key benefits of GIS methodology in a municipality is the ability to take advantage of the built-in spatial relationship of all the different mapped elements and attached records to make both current and long-term decisions possible. The intention is to have all of the current and relevant information immediately available. Data that is maintained can be used without being questioned or cross-checked. Maintenance of other related data becomes easier and more efficient.

This is not possible if the information is dated, incomplete, or incorrect. If data is not maintained, all reporting processes, analysis and work depending on the data becomes slower, more complicated and less reliable and attaching any related data becomes questionable or impossible.

A separate, but related, benefit of GIS methodology is in the area of Waste Reduction and avoidance. In the past, work done preparing maps and assembling data for individual projects or one-off reports was filed away after it was used - never to be seen again. This was because the products became dated almost immediately and the work had to be completely redone to be updated. With the GIS in place, the maps and report data are just time-stamped versions of the ongoing system and can be brought up and processed at whatever interval is desired. Comparison reporting for months, years or even decades becomes possible and viable without re-spending scarce staff resources. Existing products can also be readily modified in digital format.

Significant gains will accrue to the municipality with a well maintained GIS in the areas of emergency services, environmental assessment, source water protection, disease mitigation (West Nile) and infrastructure maintenance and development. The Emergency Operations Center (EOC) requires (in addition to the base street and addressing data sets) comprehensive data about critical infrastructure (schools, hospitals, day cares, seniors facilities, public buildings, utilities) as well as a complete hazardous material inventory in order to function. The benefits of maintaining the GIS data will be felt most dramatically in the case of emergencies and disaster situations.

However, the EOC is just one example of how the City already is reliant on information in a GIS format.

Additional GIS benefits which result from a full functioning GIS include the following:

- Provides decision support that helps staff and Council in problem solving and in making more informed decisions
- Saves time/money/avoids costs
- Increases communication and collaboration
- Builds an information base / manages data
- Leads to increased data accuracy
- Increases productivity and efficiency
- Organizes data (data warehouse increases accessibility)
- Enhances application capabilities
- Eliminates duplication of data
- Provides consistent data for the entire Corporation
- Improves data accessibility and sharing in City Departments and with the Public
- Improves access to government

8.1 GIS EFFICIENCIES

With a fully developed corporate GIS all departments of the City which are linked to parcel fabric or spatial locations on the ground within the City will see major improvement in their data utilization efficiencies. Information which is digitally collected can now be tied to points on the City's digital map base, stored for future reference and quickly recalled for any work related purpose. Since GIS data is stored in one location which can be accessed by many departments and individuals the task of finding data for a specific task becomes as easy as clicking on a few keyboard buttons. The location of features such as, transit stops, fire hydrants, stop signs, city trees would only have to be collected and inputted into a data base once and then could be stored as a permanent record until they are modified and updated, while still retaining the old data. These features would be globally positioned and then located on the map base in the computer for quick reference. This represents huge cost saving opportunities in data storage, locating a feature in the field, maintenance scheduling and in report writing and searching.

Field requirements are reduced and tracking of key information is made easier. A corporate GIS reduces the amount of data collection for similar purposes throughout the

corporation and helps to eliminate duplication of effort. GIS can also help to re-engineer work processes and streamline tasks.

A GIS also gives the user the ability to go back in time to see what changes have occurred over a period of time, quickly and accurately.

The ability to overlay multiple data sets allows the user to determine the best scenario for a particular purpose. Data overlay sets such as, floodplain information, road network, zoning, official plan designations, soils, infrastructure and existing population within an area in one data set allows engineering and planning staff to see firsthand how a proposed development would impact a neighbourhood. This ability to see all the data sets pertinent to a development application in one data set is an invaluable decision making tool for staff and council.

An accurate and spatially correct property fabric is the most important data set that a municipality undertakes towards a corporate GIS. Every function that the City undertakes from booking fields and arenas to assessing property values for tax purposes to identifying hazardous areas is property based. There is not one department that does not refer to property in their day to day business. Having one property layer which everyone can access will greatly increase the efficiencies of every city departments' area of responsibility.

The engineering department will not have to create their own property maps for capital works projects and the planning department will not have to create their own property map for zoning by-laws and official plan designations. One property data set that all departments can access will greatly increase the efficiencies of all departments and sections within the City.

With respect to emergency services, an accurate and spatially correct property fabric will also let us identify properties where hazardous materials are being stored and manufactured, from gas stations to manufacturing plants that use chemicals and or gases hazardous to human health. By accurately identifying and mapping these hazardous sites, Emergency Services (Police, Fire and Ambulance) can better prepare for emergencies that may arise. In situations where residents have to be evacuated, a GIS can quickly identify who these residents are and inform them of not only the best evacuation route to take but also where the nearest emergency shelter is located. The location of especially vulnerable facilities like schools, day cares and nursing homes can be quickly identified on the GIS.

The Fire department can also attach data listing all chemicals and gases which are being stored in industrial and commercial areas so that if an emergency situation should occur they would have a better understanding of the type of fire they will be responding to, and prepare accordingly.

The City also has many railways which traverse residential areas and are near major sources of the City's drinking water. Many hazardous materials are also transported on our roadways. An accident either on our roadways or on the rail lines can quickly be located using a GIS and emergency vehicles can respond appropriately.

Another example of where data plays an important part is within the Land Division and Committee of Adjustment Section within the Growth and Development Department. This Section developed an application to input all current and past applications. Agendas for Committee meetings are now generated from automated report templates. The number and type of applications for Minor Variances and Consents for the year can also be tracked and generated quickly. An example of this would be a report showing all Consent applications in a geographic area and the size of the proposed lot split.

A GIS can present the data in a graphical output in the form of a map. It also allows the user to ask questions such as show where these splits have occurred by size, year and area to see what has transpired over time. What infrastructure, if any is near-by, is strip development taking place and if so, how will this impact on future infrastructure needs.

8.2 CORPORATE EFFECTIVENESS

Having accurate information which can be immediately recalled significantly increases the City's ability to become more effective in its decision making processes and decision outcomes. More significant questions can now be asked by senior management of staff and real time data can be provided and visualized by Council.

For example, the acquisition of accurate colour ortho -photography has allowed the City's Planning Committee to see an applicant's site location and visualize the surrounding land uses and features at a glance. Accurate data base information associated with the parcel would allow staff and Council to quickly see the current zoning of the parcel, building permit history, bylaw infractions, infrastructure surrounding it etc.   As all this information forms separate layers in the GIS data base, these layers can be easily turned on and off as required. This available information will help citizens to have better input into public hearings and allow the Councilors to ask more informed questions of staff and applicants all leading to more effective decision making. It has also helped an under staffed development section keep reasonable pace with the development boom currently underway and not be overwhelmed.

Questions which can be sought range from the simple to the more complex as illustrated in the following diagram:

Evolution of GIS Applications

Location	Condition	Routing	Pattern Modeling	Trend Modeling	What-if Modeling
What is at 200 Brady Street?	What is the condition rating of all the sewers? What is the condition of Bridges / Culverts?	Which is the best route to get to an emergency at 123 John Street?	What is the pattern of complaint calls after a major snow storm within in a particular neighbourhood / ward?	At the current rate of growth, how long will it take before the inventory of residential land is used up?	What would be the effect of increased development density in a specific area?

Simple Questions……………………………………………Complex Questions

9. GIS CORPORATE STRUCTURE AND GOVERNANCE ISSUES

9.1 STRUCTURE

Responsibility for developing the Corporate GIS will primarily reside with the Geographic Information, Survey and Mapping Section of the Corporation. Their work will be directly linked to IT who will supply the hardware and software technology which will support the system, store all of the digital information and who will be responsible for providing business solutions that can be enhanced by GIS or can in turn enhance GIS products. This work will also be linked into each Division who will have additional champions responsible for assisting in the development of GIS services.

The basic structure of the GIS will be overseen by the Coordinator of Geographic Information, Surveys and Mapping. The Coordinator will basically oversee two integrated groups which both have key responsibilities for GIS success. The Surveys and Mapping Group would be the individuals responsible for all of the base mapping platform data or core foundational data required to underlay the system. The Geographic Information Group and IT's Software and Business Applications Section would be responsible for integrating GIS services with corporate and departmental business solutions. The Software and Business Applications Section would be responsible for developing applications and business solutions. The GIS group would be responsible for developing mapping and analysis services and set policies for data integration into the corporate GIS to ensure compatibility with other data sets. These groups would also require ongoing assistance from champions located throughout the corporation.

The structural functions of the two groups within the Geographic Information, Surveys and Mapping Group is primarily driven by the roles each group is providing. This can be illustrated by the following chart:

GEOGRAPHIC INFORMATION, SURVEYS AND MAPPING SECTION ROLES

Geographic Information Group	Surveys and Mapping Group
Mapping Products	Development of Base Platform
Spatial Analysis	Core Mapping and Data
Business Solutions/Applications	(Aerial Photography, Base Maps,
Needs Assessments	Ortho-imagery, Control Surveys,
Integration of GIS with Business Processes	Parcel Fabric, PINS, ARNS,
Data Development and Standards	Digital Terrain Model, Contours)
Products and Partnerships	Data Sharing Agreements
Data Sharing Agreements	Products and Partnerships

INFORMATION TECHNOLOGY GIS ROLES

Information Warehouse Maintenance

Hardware

Software Applications

Business Solutions/Applications

Business Process Computerization

Data Standards and Protocol

Data Sharing Agreements

Partnership and Products

9.2 GOVERNANCE ISSUES

To assist the Corporation in developing and shaping this strategic vision for GIS a Technical Committee should be established. This Committee would be chaired by the Coordinator of Geographic Information, Surveys and Mapping and be comprised of representatives from all corporate departments as well as other key individuals and champions within the corporation. This would include representatives from Planning Services, Infrastructure (Roads, Sewer and Water and Assets), Community Development, Information Technology, Emergency Services, Finance, My Sudbury, EMS, Fire and Police.

The purpose of this technical committee would primarily be twofold:

(1)   to continue to shape and define the strategic vision for GIS development within the corporation, and

(2)   to assist in moving Corporate GIS priorities forward

(3)   the prioritization of the GIS work plan

This Committee would also assist in the development of Corporate applications. To determine how best to build these services several key process steps are usually required. These include the following:

(1)   establish data base protocols for collecting meta data and creating data bases;

(2)   establish data development standards;

(3)   conduct needs assessments within each Division for integrating GIS capabilities with business processes;

(4)   develop business process solutions and business case;

(5)   build mapping and analysis solutions which can be geo-referenced;

(6)   develop partnerships where appropriate;

(7)   develop data disclosure and sharing protocols or agreements;

10. GIS CORPORATE STRATEGY PROPOSED

In order to be successful, it is important that the City initiate the GIS strategy. As can be seen from the background information provided, the CGS already has many of these elements in place. SMT and Council can further assist by implementing the strategic

recommendations contained in this report. The GIS Technical Committee will further assist by completing this GIS strategy.

The time to create and implement a fully working Corporate Geographic Information System is now. The recommendations contained in this report lay out a strategy to implement a working GIS for all divisions of the City for the benefit of all departments, Council and the general public. To achieve a true Corporate GIS the following recommendations are proposed as follows:

- Fund the development of the Digital Terrain Model over 4 years at $200,000 per year in the 2009, 2010, 2011 and 2012 capital budget

- Increase the Mapping maintenance operating budget by $50,000 per year

- Fund the existing Survey Technician position approved in the 2008 budget at $64,000 from internal funding sources

- Create three additional GIS permanent positions in order to maximize GIS penetration and utilization within all City Departments including (1) GIS Specialist – Business Analyst position at $85,000 and (1) IT Business Analyst-GIS Application Specialist at $85,000 and (1) GIS Systems and Database Administrator position at $95,000

- Make the temporary rod person in Surveys and Mapping permanent – Convert temporary hours for zero budget increase

- Establish the GIS Technical Committee

11. GIS BUDGET REQUIREMENTS MOVING FORWARD

The recommendations proposed for the Corporate GIS Strategy will have implications for both the Operating and Capital Budgets (See Chart A).

11.1 OPERATIONAL BUDGET REQUIREMENTS

Business process analysis and data set development all require a significant time commitment and specialized skills. To assist in carrying out these necessary steps and better penetrate GIS technology throughout the corporation three additional permanent staff are required. Specifically (1) GIS Specialist-Business Analyst, (1) Business Analyst-GIS Application Specialist (IT position) and (1) GIS Systems and Data Base Administrator (IT position) are needed. It is estimated that these three fulltime positions

will cost $265,000 annually which will need to be approved and placed into the annual operating budget.

Many mapping upgrades are required to map products which now have become dated. Updated topographic mapping is presently being provided through a mapping maintenance operating budget of $50,000. Although this is not sufficient for the City's needs for current data, it does allow for some annual upgrading of outdated topographic mapping in areas with rapid development. All of this new mapping is digital and most of it is completed with the assistance of new aerial photography acquisition. Consideration must be given to increasing this operating account from $50,000 per year to $100,000 per year to insure the currency of base mapping products.

As we move forward with a corporate GIS, emphasis will be placed on developing or purchasing applications to use in a wide range of business processes at the City. An increased amount for purchased services of $25,000 per year should also be included in the operating budget for this purpose.

It is recommended that Council adopt the following Operating Budget option:

- Create three additional GIS permanent positions in order to maximize GIS penetration and utilization within all City Departments including (1) GIS Specialist – Business Analyst position at $85,000 and (1) IT Business Analyst-GIS Application Specialist at $85,000 and (1) GIS Systems and Database Administrator position at $95,000

- Fund the existing Survey Technician position approved in the 2008 budget at $64,000 from internal funding sources

- Make the temporary rod person in Surveys and Mapping permanent – Convert temporary hours for a zero budget increase

- Increase the Mapping maintenance operating budget by $50,000 per year

- Increase the purchased services of the Geographic Information, Surveys and Mapping Section by $25,000 per annum for specialty contracts.

11.2 CAPITAL BUDGET REQUIREMENTS

Information Technology will commit funds from the IT reserve to support the Corporate expansion of GIS. These funds will be used to expand the software and hardware infrastructure of the current GIS technology and meet the requirements for the proposed plan.

The Digital Terrain Model (DTM) is the largest capital budget request. The estimated cost of the DTM at 1:10,000 scale for the entire City is $4,000,000. If the City only mapped the urban areas the cost would be $1,200,000. In a cost sharing agreement with the Nickel District Conservation Authority (NDCA), the City's portion for the urban areas is estimated at $800,000. The most efficient process is a 4-year program, whereby a quarter of the City's urban area is flown and mapped each year for $200,000.

For the past 7 years this item has been requested as part of the City's Capital Budget. As Planning Service does not have a capital envelope, this item has not been seriously understood or considered and therefore has not been funded to date. The NDCA through its source water protection program has been able to secure some Provincial grant funding which has been used in some key areas.

It is recommended that Council adopt the following budget increase to the City's Capital budget:

- Fund GIS hardware and software required by IT and key users at $100,000 from the IT reserve.

- Fund the development of the Digital Terrain Model over 4 years at $200,000 per year in the 2009, 2010, 2011 and 2012 capital budget for urban areas.

		CHART A			
		INTERDEPARTMENTAL GIS OPERATING BUDGET REQUEST			
PURPOSE:		To continue development and maintenance of core GIS (Geographic Information System) and implement initial GIS applications.			
	ITEM	**NEEDED**	**FUNDED**	**GAP**	**CONTRIBUTIONS**
1	Aerial Photography & Mapping Maintenance	$100,000	$ 50,000	$ 50,000	Operating Budget Option (2010)
2	Completion & Maintenance of Core Data & Provision of Mapping	6.0 FTE	4.7 FTE	1.3 FTE ($84,000)	Internal Recoveries :Finance, EMS, Fire, Assets, Sewer&Water, Roads, Police (Survey GIS Technician) Part time hours Planning Services Budget Option (rod person)
3	Development of GIS Services	6.0 FTE	4.0 FTE	2.0 FTE ($170,000)	Operating Budget Options IT Business Analyst/GIS Application Specialist (1), GIS Specialist/Business Analyst (1)
4	Database & GIS Hardware/Software Support	1.0 FTE	1.0 FTE	1.0 FTE ($95,000)	Operation Budget Option GIS System and Database Administrator (1)
	TOTAL		-	3 FTE $399,000	

CHART A				
INTERDEPARTMENTAL GIS CAPITAL BUDGET REQUEST				
PURPOSE:	To continue development and maintenance of core GIS (Geographic Information System) and implement initial GIS applications.			
ITEM	**NEEDED**	**FUNDED**	**GAP**	**CONTRIBUTIONS**
1 Hardware	$100,000	-	$100,000	IT Reserve
2 Digital Terrain Model	$1,200,000 for urban areas only	$400,000 (NDCA)	$800,000	Capital Budget (unfunded) G&D, IS, NDCA
TOTAL		-	$900,000	

Ultimately $4,000,000 will be required to create a DTM for the entire City.

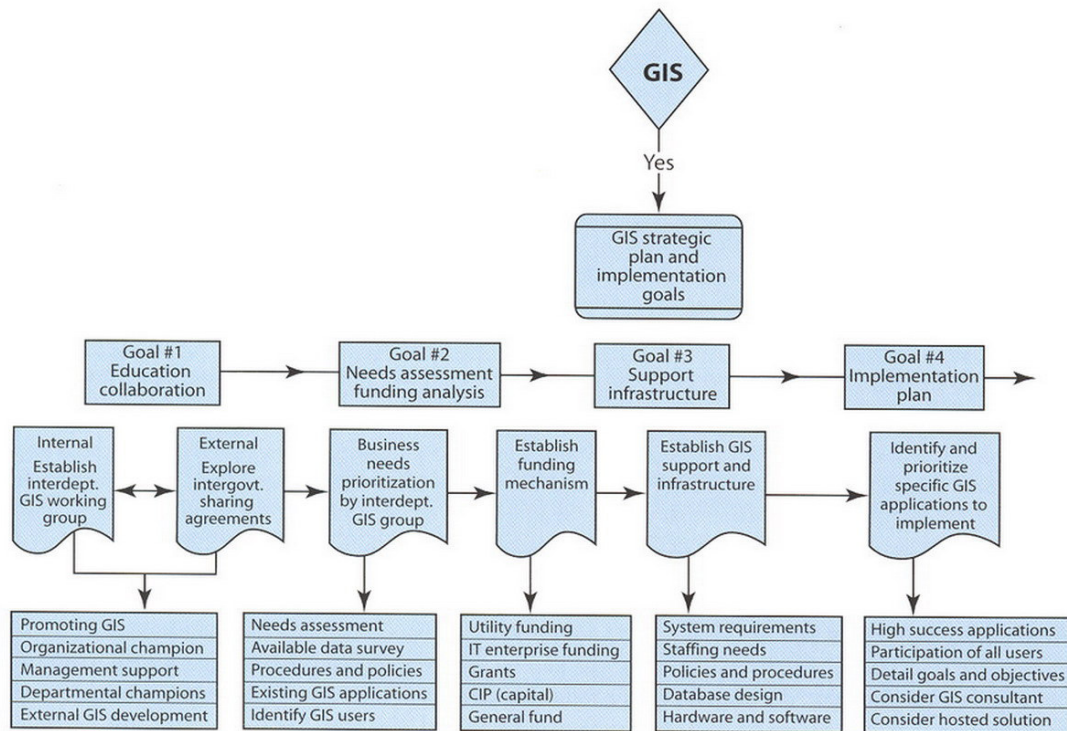**October 15, 2008 Version**

APPENDIX 1

Figure 2.1 Identifying key goals and establishing how decisions will be made for the operations of a local government GIS are critical for ensuring its long-term success. The City of Issaquah, Washington, established this decision tree to help guide the development of its GIS program.

Source: Bill McGill, former Information and Administrative Services Director, City of Issaquah.

Diagram from The GIS Guide for Local Government Officials International City/County Management Association, ESRI Press 2005.

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APPENDIX 2 – GIS PROPONENTS

Infrastructure

Nick Benkovich	Director Water / Waste Water
Danielle Braney	Director Asset Services Division
Peter Chiesa	Manager Project Engineering
Greg Clausen	General Manager of Infrastructure Services
Bob Falcioni	Director of Roads and Transportion
Guy Gionet	GIS Technician
Brad Johns	Water / Waste Water Engineer
Chantal Mathieu	Manager Environmental Services
Nathalie Mihelchic	Manager operations
Kevin Shaw	Director of Engineering Services
Keith Forrester	Real Estate Coordinator
Ron Norton	Drainage Engineer
Alastair Cook	Water/Waste Water
David Shelsted	Roads Engineer

Growth and Development

Paul Baskcomb	Manager of Community and Strategic Planning
Jody Cameron	Technical Integration Coordinator
Krista Carre	Planning Cartographer Technician
Robert Gauthier	Manager of Transit Operations
Bill Lautenbach	Director of Planning Services

Joyce Lafantaise	Secretary / Manager of Community and Strategic Planning
Gavin Lawrence	Coordinator Geographic Information Surveys and Mapping
Guido Mazza	Director Building Services / Chief Building Official
Stephen Monet	Manager of Environmental Planning Initiatives
Helen Mulc	Manager of Business Development
Doug Nadorozny	General Manager of Growth and Development
Roger Sauve	Director of Transit Services
Rob Skelly	Manager of Tourism, Culture and Marketing
Bill Tanos	GIS Technologist

Community Development

Real Carre	Director of Leisure Services
Ron Henderson	Director of Citizen Services
Randy Hotta	Director of Pioneer Manor
Catherine Matheson	General Manager of Community Development
Luisa Valle	Director of Social Services/Ontario Works
Denis Desmeules	Manager of Housing Services
Tony Parmar	Manager of Quality, Administration and Financial Services

Administrative Services

Caroline Hallsworth	Executive Director-Administrative Support Services
Angie Hache	City Clerk
Bruno Mangiardi	Chief Information Officer
Jim Dolson	Manager Hardware and Technology
Ron St. Onge	Manager of Software and Business Applications

Ron Swiddle City Solicitor/Director of Legal Services

EMS

Tim Beadman Acting General Manager of Emergency Sevices

Marc Leduc Acting Fire Chief

Joseph Nicolls EMS Chief

Rob Smith EMS Deputy Chief

Financial Services

Paddy Buchanan Finance Administration

Lorella Hayes Chief Financial Officer / City Treasurer

John VandeRydt Manager of Financial Information Services

Human Resources

Patrick Thomson Director – Human Resources/Organizational Development

GIS Technical Committee - Transition Team Members

Gavin Lawrence Coordinator Geographic Information Surveys and Mapping

Bill Tanos GIS Technologist

Paul Baskcomb Manager of Community and Strategic Planning

Jody Cameron Technical Integration Coordinator

Brad Johns Water / Waste Water Facilities Engineer

Kevin Shaw Director of Engineering Services

Guy Gionet GIS Technician

Bruno Mangiardi Chief Information Officer

Ron St. Onge   Manager of Software and Business Applications

Rob Smith   EMS Deputy Chief

Ron Henderson   Director of Citizen Services

Paddy Buchanan   Finance Administration