Canada's National Mapping Strategy

National Mapping Strategy Working Group
Canadian Council on Geomatics
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Preface

Mapping efforts since before Confederation have resulted in products and tools that are essential to industry, government, and citizens. The Canadian mapping community has established a global reputation for its achievements. Now with the map infrastructure nearly complete, the focus is shifting to maintenance and updating of these national assets. The National Mapping Strategy has been developed to speed the transition of mapping in an increasingly digital world, mainly by re-organizing and re-thinking the way the community does business by taking advantage of today's technology and focussing on future trends.

Geography is widely recognised as the link that allows the combination of disparate sets of data into a cohesive picture. The expanding use of geography and maps in particular, has led to a growing expectation by citizenry that information will be geographically related and easily available.

The National Mapping Strategy, a long-term approach to the planning and coordination of mapping in Canada, was developed to ensure that mapping continues to support the nation's initiatives while recognizing the increasingly rapid social and technological advances that are taking place in this field. The Strategy is designed to take advantage of future changes in technology and mapping requirements.

The Strategy provides direction to the nation's mapping programs through a set of distinct yet related elements. Elements of the Strategy are: Consultative and Inclusive Governance; National Approach, Regional and Local Decision Making; Common Technological Foundation; Current and Available Data; Geographical Data as a Public Asset; Outreach and Communications; a Vibrant Geomatics Industry; and, an Available Educated Labour Force.

This background document examines the rationale for promoting a National Mapping Strategy at this time; identifies stakeholders in the mapping community; looks at the vision and core values identified through the consultation process; and provides insight into each of the Strategy's elements.

Executive Summary

The development of a National Mapping Strategy is a concerted effort by those in the geomatics community interested in forging a long-term approach to the planning and coordination of mapping in Canada.

Several considerations were taken into account. First, most mapping is now done digitally using computerized geographic information systems (GIS). Second, Internet based geographical data portals have been developed and have matured in recent years. Third, collaborative relationships between stakeholders in the geomatics community have advanced. Finally, the growth of mass market geomatics applications is presenting policy and operational challenges. With Canada's small and medium scale map infrastructure almost complete, the focus of the geomatics community is shifting towards the maintenance and updating of these national assets as well as providing more detailed mapping in areas of particular interest.

Eight components have been identified as necessary requirements for initiating and implementing a National Mapping Strategy in Canada. They are:

1) **Consultative and Inclusive Governance;**

   Working cooperatively will provide clarity, direction, and certainty for Canada's mapping community by providing a forum to share information, methodologies, approaches to mapping and timelines.

2) **National Approach, Regional and Local Decision Making;**

   Effective and responsive policies that respect the autonomy of mapping agencies and organizations while promoting cooperation and coordination are crucial to the implementation of the National Mapping Strategy.

3) **Common Technological Foundation;**

   A major challenge for the National Mapping Strategy will be to ensure that the broad technical and data standards required for interoperability continue to be promoted and their adoption encouraged.

4) **Current and Available Data;**

   New approaches to data maintenance and updating cycles will be designed and implemented to ensure that data sets required by decision makers are as current and accurate as required.

5) **Geographical Data as a Public Asset;**

   The National Mapping Strategy recognizes the importance and value of 'no charge', unrestricted access to government mapping data when there is no threat created by the release of the data.

6) **Outreach and Communications;**

   A concerted effort will be made to inform non-traditional users of Geomatics technologies, and to inform policy and decision makers of the enriched information and analytical power that can be obtained through the use of geomatics and how this can substantially benefit the work they do.

7) **A Vibrant Geomatics Industry;**

   A central component of the National Mapping Strategy is a competitive, productive geomatics industry, able to provide made-in Canada solutions, strongly benefiting the Canadian economy.

8) **An Available Educated Labour Force.**

   Promoting opportunities for education in geomatics, ranging from technologists, to engineers to analysts, in order that there are qualified Canadian workers to meet the challenges of the future is important for the sustainability of the community.

The National Mapping Strategy will contribute towards: enhancing Canada's infrastructure and competitiveness; promotion of the safety and security for the people and the nation; and, will assist in maintaining a balance between environmental, economic, and social responsibilities. The National Mapping Strategy proposes to accomplish this by recognizing and taking advantage of technical and social advances in the realm of mapping while recognizing the autonomy and independence of members of the private, public, NGO, academic and industry sectors of Canada's mapping community, whether they be producers, consumers, or both.

By taking advantage of today's technology and focussing on future trends, this National Mapping Strategy will help ensure we meet the growing needs for mapping in an increasingly digital world, mainly by re-thinking the way our community does business.

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1 Introduction

This section introduces what the National Mapping Strategy is; its importance to Canada; the need for developing a national strategy; why now is an appropriate time to consider a National Mapping Strategy; and the relationship between the Strategy and the effective governance of Canada. The remaining section will discuss who the stakeholders are; the consultations that took place; and the elements of the strategy. This is followed by a discussion of the economic, political, and social considerations and finally, the path forward.

1.1 What is the National Mapping Strategy?

In the fall of 2007, the Canadian Council on Geomatics (CCOG) embraced the concept of creating a mapping strategy for the nation. The development of a National Mapping Strategy is a concerted effort by all interested parties towards forging a long-term approach to the planning and coordination of mapping in Canada. The Strategy recognizes that there are different requirements for local, regional, national and global mapping efforts and at the same time, takes into consideration the need for each level of mapping to work in concert.

Eight components make up the Strategy and they address the necessary requirements for initiating and implementing the National Mapping Strategy in Canada. They are: Consultative and Inclusive Governance; National Approach, Regional and Local Decision Making; Common Technological Foundation; Current and Available Data; Geographical Data as a Public Asset; Outreach / Communications; A Vibrant Geomatics Industry; and, An Educated Labour Force.

1.2 The Importance of a National Strategy for Mapping the Nation

Several considerations were taken into account in the development of a national mapping strategy for Canada. First, most mapping is now created in digital form through the use of computerized geographic information systems (GIS). Second, Internet based geographical data portals have been developed and have matured in recent years. Third, relationships between various levels of government for the purposes of mapping have advanced. And finally, the growth of mass market applications is presenting policy and operational challenges to mapping organizations.

Taking into account the considerations noted above along with the jurisdictional and inter-jurisdictional requirements of governmental mapping issues and programs, greater efficiencies can be garnered by the various levels of government. These efficiencies – whether by increasing coordination, by developing and sharing approaches aimed at addressing particular issues, or by sharing geographic knowledge and information with confidence - support recognized Canadian priorities. Community and organizational mapping initiatives are also generating a growing demand for accessible and compatible geographical data.

The National Mapping Strategy for Canada will contribute towards: enhancing Canada's infrastructure and competitiveness; promoting the safety and security for the people and the nation; and, maintaining a balance between environmental, economic, and social responsibilities. The National Mapping Strategy proposes to accomplish this by recognizing and taking advantage of technical and social advances in the realm of mapping while respecting the autonomy and independence of members of the private, public, and NGO sectors of Canada's mapping community, whether they be producers, consumers, or both.

1.3 The Motivation for a National Mapping Strategy

With Canada's small and medium scale map infrastructure almost complete, the focus in the mapping community is shifting towards the maintenance and updating of these national assets. By taking advantage of today's technology and focussing on future trends, this National Mapping Strategy has been developed to speed the transition of mapping in a increasingly digital world, mainly by re-thinking the way the community does business.

1.4 Why address this now?

Most mapping is now done electronically; Internet based spatial data portals have matured; relationships between various levels of government with respect to mapping are increasingly stable and productive. Mass market distribution systems such as those provided by Google, Microsoft, and MapQuest are helping meet some of the demands for mapping and complement existing industry and government services.

One particularly significant impact resulting from the introduction of mass market systems has been the proliferation of easy-to-use tools for amending and adding information to maps – whether providing updates to a road file, or by linking photos to specific locations. These tools are providing interested citizens with the opportunity to enhance the nations' mapping with minimal investment.

The data administration function is more important now, than ever before. In some cases a preponderance of data exists that requires assessment for the intended purpose. The question also relates to accessing the 'right' data for the intended business application.

Governments are expected to demonstrate leadership with respect to accuracy, utility, and accessibility of spatial information. More than ever, governments at all levels require up-to-date and reliable spatial data to meet the needs of their clients, to deliver programs, to develop policies and to enhance their decision-making.

1.5 The Relationship between Mapping and Effective Governance

With geomatics being the resultant merger between data capture of the earth's geography and technology[1], the ability to depict our environment in new and different ways allows for greatly improved decision making. It also simplifies the communication of policies

and actions as well as the measurement of their results. Not only can we compile different sets of data into one image to illustrate what a parcel of land looks like, we can include data that allows us to look 'beneath' the land (soil composition) and above it (atmospheric data). By visualizing the environment this way, we can not only 'see' what comprises our environments, but we can also predict with reasonable accuracy potential impacts of a variety of policies or activities. This form of visualization supports decision making at all levels in a multitude of ways.

1.5.1 Local

e.g. Providing emergency response services, conducting environmental assessments, managing infrastructure investments, including water and sewer systems, or conducting property assessments for taxation purposes

Municipal governments are concerned about water and sewer infrastructures and maintenance. For example, the City of Quinte, Ontario was concerned about contacting residents quickly and efficiently after a series of possible contamination events in the municipal water supply. The city, and its partners, developed the *Protective Response Interactive Services Management* (PRISM) system[2]. The PRISM system has two components: PRISM-GIS and PRISM-911. PRISM-GIS is a web-based GIS application while PRISM-911 is a software tool linked to the city's PRISM-GIS that "provide[s] automatic notifications during an emergency."[3] The system allows the city to:

> …activate a call-out campaign within 15 minutes of ascertaining an emergency. The entire process can be activated remotely from wireless laptops and is available to city officials, the fire department, and the Quinte West OPP [Ontario Provincial Police] as a full 24/7 municipal service.[4]

Along with having an efficient means of notifying the public regarding water advisories, the system can be used for any type of emergency as "users can communicate real-time information, such as accident sites, evacuation routes, road closures, staging areas, helicopter landing sites, and triage areas."[5] The City's situational awareness has improved dramatically as responders have access to the most up-to-date information regarding a situation.

At times, significant growth or change in a particular sector may bring great opportunities while giving rise to concerns. In the early 2000's for example, several rural areas in western Canada found themselves at the heart of a boom in intensive livestock operations. By the turn of this century, the Rural Municipality of Hanover, Manitoba had seen a near doubling of its hog production within one decade.[6]

Residents became concerned about the cumulative impacts of these operations with respect to manure and waste management as well as possible impacts on water quality and quantity as many smaller operations were located close to residential areas. The municipality, taking resident concerns into account, was having difficulty in accessing new applications for further expansions in livestock operations.[7]

The municipality addressed this concern by expanding their geographic information system (GIS) to include both agricultural and rural residential information. By collecting data from intensive livestock operations (including location) within the municipality and by combining this data with residential information and soil data, the municipal administration could now produce a more complete picture. Interactive maps showed proposed livestock operations including proximity to residential areas and options for alternative livestock locations.[8]

Using a robust GIS, with multiple themes of data, helped the community determine its 'saturation' point with respect to intensive livestock operations and permitted the municipality to be more proactive in determining its future. A final benefit to the municipality was that the mapping system was set up in a way that allowed for the sharing of information and data between the municipality and the provincial and federal governments to respond to other concerns.

1.5.2 Regional

> e.g. Ensuring the safety of water and food supplies, natural resource management, establishing and maintaining efficient transportation infrastructures, or managing land use

The overall management of natural resources, such as land, water, or forests, are often beyond the jurisdiction of any one entity and may require the involvement of numerous stakeholders. Maintaining the health of the Bras d'Or Lakes system, located in Cape Breton, Nova Scotia is one such example.

The Bras d'Or Lakes covers an area "of approximately 1,099 square kilometres, the extents of Bras d'Or Lake measures roughly 100 km in length and 50 km in width [and is] surrounded almost entirely by high hills and low mountains."[9] The lake system has nearly 1,100 kilometres of shoreline and its beauty attracts visitors from around the world. A significant portion of human activity in the area is dependant on natural resources and includes: mining, farming, fishing, hunting, science and state-of-the-art wind farms among others.[10]

While the lakes remain relatively healthy, water quality is declining with the cause being primarily a result of human activity. This change in water quality has affected some local industries such as the area's shellfish beds, most of which are closed due to contamination. The contamination – by fecal coliforms - is a result of three sources: "overloaded municipal sewage treatment facilities, malfunctioning domestic septic systems and pleasure boats".[11] 'Protection' of the lake system is seen as key in reversing the decline and maintaining quality of life in Cape Breton. Jurisdiction over the lake system is mixed:

> As with many areas of public concern in Canada, responsibility for the management of water resources is divided between the Federal and Provincial governments. In addition, provinces also delegate responsibilities to municipal governments within their boundaries. In particular, provinces normally delegate

> substantial responsibilities for land use planning and regulation to local government. Municipalities are also normally responsible for a variety of services that may impact, influence, or improve water quality, such as sewage collection and disposal, water supply, and storm water management.[12]

Federal, provincial, municipal, and First Nations governments and other stakeholders formed *The Bras d'Or Lakes Collaborative Environmental Planning Initiative* (CEPI) for the express purpose of "assist[ing] and coordinat[ing] the actions of municipal governments and related agencies to preserve the watershed".[13]

Through the use of a customized GIS, regional data was assembled to provide 1) a clear picture of the current environment, 2) developing potential best management practices suitable for the Bras d'Or Watershed[14] 3) and, to "determine potential challenges and facilitating factors associated with implementation of best practices".[15]

The GIS allowed the CEPI and their consultants to examine and model best practices from other jurisdictions to determine what will work best for the Bras d'Or Lakes watershed.[16] Watershed (or regional) planning in this manner allows for multiple jurisdictions to participate and contribute towards the development of a strategy that addresses the current issue while taking into consideration land and water use needs and requirements by each level of authority.

1.5.3 National

e.g. Ensuring the safety and security of the people and the nation, enhancing infrastructure, supporting growth while maintaining a balance between environmental, economic, and social responsibilities, or ensuring Canada's competiveness on the world market

Of all the challenges facing administrators and regulators today, deciding how to make best use of lands and resources is likely one of the most challenging, with competing interests and the need to balance development with protection of the environment. Two tools available to help the planning process are environmental assessments and land use plans. Both of these are heavily dependent on having access to current, authoritative and reliable geographic data and information.

Environmental assessments (EA) are a regulatory tool designed to protect the environment while building a strong economy by "helping to eliminate or reduce a project's potential impact on the environment before a project begins".[17] EAs do this by "ensuring that environmental effects are considered before decisions are taken that allow projects to proceed".[18]

The Mackenzie Valley Environmental Impact Review Board for example is responsible for any potential developments that require some form of licensing. If it is likely that a proposed development would have "significant adverse impacts on the environment, or might cause public concern",[19] the application undergoes an environmental assessment

which is a more thorough study. A proposed development might be allowed to go ahead at that point, or it may be referred for an environmental review.[20]

Spatial data is often used to illustrate how the proposed development will impact on the environment and landscape thus making it much easier for participants involved in an EA or environmental review to comprehend the scale of impact.[21]

Land use plans differ from EAs in that a region or community has predetermined in a general way which types of activities are taking place, or will take place in a given location. The goals of the two processes are similar. In Northern Ontario for example, the objective of community based land use planning is to:

> [protect] the unique ecology and vast boreal environment of the Far North of Ontario while ensuring the region's resources contribute to a more prosperous, healthy and sustainable future for its people and communities.[22]

The Yukon Land Use Planning Council, which is a Regional Planning Commission, is responsible for the following:

> …identifying regional issues; defining cultural, ecological and economic values; collecting and analyzing data; considering alternative future scenarios and preparing recommendations about appropriate levels and types of human activity.[23]

The Yukon Land Use Planning Council recognized the need for different users and stakeholders within the territory to have access to high quality data. In response, the Council created the Internet based 'Yukon Planning Atlas' using data generated by the land use planning process in the territory and other areas in northern Canada. Anyone can use the atlas to create a map of an area of interest using data supplied by the atlas.

About the atlas, Council Chair Doug Phillips says that "Government and Yukon First Nation decision makers need to keep this information in front of them when they consider allowing land uses that could affect our landscapes, our wildlife, and the sustainability of our communities. Public and industry will find it valuable to have regional resource information gathered and displayed at a single website."[24]

Both EAs and land use planning depend on having access to high quality authoritative geographical data and information in order to support economic activity and growth while maintaining a balance between environmental, economic, and social responsibilities.

1.5.4 Global

e.g.: Responding to pandemics, global economic issues, monitoring climate change and reporting on Canada's international commitments

Some issues cross national borders. Pandemics and invasive species know no boundaries and sometimes seem to spread at will. Coordination and cooperation between jurisdictions and national authorities is necessary in order to tackle such issues. Using spatial information is vital to these efforts.

In the case of a pandemic like the H1N1 influenza, being able to collect and collate reliable data on the spread of the virus is essential to help direct resources. Flu Tracker, an Internet site backed by a web based mapping application is described as:

> …the Web's most comprehensive and up-to-date resource for tracking suspected and confirmed cases of H1N1 swine flu. Flu Tracker enables health officials and the general public to input new information, using simple online tools. The result is faster access to the most current information about the status and progression of outbreaks worldwide.[25]

Flu Tracker reports on H1N1 worldwide and allows a user to:

- View summaries of cases by geographic region
- Map the progression of infections over time
- Create maps that breakdown cases by status (suspected, confirmed and fatal)[26]

Through the site, one can see how many suspected, confirmed/probable & fatal cases there are in a country, a region or town. The site also provides the sources of the data provided.

Invasive species "are plants, animals, aquatic life and micro-organisms that outcompete native species when introduced outside of their natural environment and threaten Canada's ecosystems, economy and society."[27] Invasive species impact on our environment and economy in several ways including "reducing productivity in forestry, agricultural, and fishing sectors"[28] and by "having export and import trade restrictions imposed"[29]. Knowing where these invasive species are and tracking their spread is essential to resource management and effective countermeasures.

A Government of Canada Internet initiative, ***Invasive Species***[30] has made publically available a number of map products that depict the survey sites for a variety of non-native species. Mapping is helping to manage these threats by compiling and disseminating data and by soliciting input from the public on sightings[31].

Natural resources are vital to the nation's economy in terms of employment, international trade, labour productivity, and their contribution to Canada's real gross domestic product (GDP). The resource sector is the second largest contributor to Canada's GDP at 13%.[32] Four hundred and fifty communities[33] across the nation and over one million workers are dependent on natural resources[34] for their livelihoods. In terms of trade, Canada's resource sector in 2005 was valued at 40% of total exports[35] giving the nation a $93 billion trade surplus[36]. Mapping plays a central role in helping manage the nation's resource base in several ways and by a number of authorities.

Another way that mapping is helping manage resources is by keeping track of resource consumption activities. Many provinces and territories manage geographical databases that track harvest licenses in order to keep aware of what resources are being consumed, how much and where.

1.5.5 Summary

Whether studying water quality in small towns, tracking issues that cross national borders such as pandemics, or by helping Canada maintain its role as one of the major international suppliers of natural resources, mapping is an essential activity. Mapping plays an important role in the planning, execution, monitoring, and measuring of many of our daily activities, whether they are the replacement of a water main valve, the selection of a plant site, the routing of hazardous cargo, or responding to a disaster half way across the globe. The users and contributors to the mapping (i.e. the Stakeholders) range from individuals to government to multi-national organizations.

2 Stakeholders

As can be imagined, stakeholders in the realm of mapping are many and represent all segments of society. Understanding who the stakeholders in the National Mapping Strategy are is important for several reasons. First and foremost, stakeholders in the mapping community represent a knowledgeable and experienced resource. Each stakeholder segment brings a particular perspective to the National Mapping Strategy and each stakeholder group has specific interests in mapping. The National Mapping Strategy is meant to be responsive to the needs and requirements of the mapping community. Therefore, a forum needs to be in place to hear from stakeholders and allow stakeholders to participate.

Stakeholder groups that have been identified include: federal, provincial and territorial governments; municipal governments; industry and user associations and consortiums; academia; and citizens. Due to Canada's involvement and participation globally, the international community is a necessary consideration in the National Mapping Strategy.

The following outlines stakeholders and their role in Canada's National Mapping Strategy.

2.1 Industry as Mapping Users

Mapping products are used in many ways, by many people and for a multitude of purposes. There is broad private sector use of mapping information in applications as diverse as:

- Tracking and managing national and local truck fleets to reduce fuel costs and improve delivery times;
- Precision farming to optimise seeding and fertilising operations while reducing input costs and environmental impacts;

- Analysing markets, traffic patterns, and utility locations to optimise the location for a new business or plant; or

- Promoting the location of their business and providing potential customers directions on how to get there.

It is important that industry continue to have venues to make their requirements and needs known so that they can continue helping develop the field. At the same time, industry sectors will need to better coordinate and express their data and technological needs and challenges that will allow the production of applications that better meet their end-user demands. Whatever governance structure is adopted for The National Mapping Strategy, it will need to ensure that it can support mechanisms that respond to industry requirements and provide opportunities for industry to communicate its needs.

2.2 Citizens

The advent of mass market distribution systems such as those provided by Google, Microsoft, and MapQuest help meet some of the demands for mapping and complement existing industry and government services. Mass market geomatics tools and services along with advances in user-friendly open source and proprietary applications have significantly advanced ordinary Canadians' understanding of the potential of geomatics. With the proliferation of Internet applications and mass market advances, a new class of user, the 'neo-geographer', is a growing segment in the mapping community. Casual citizen users, those who want travel directions or who are simply curious about the world is also a growing faction. Citizens have both an indirect and a direct stake in the National Mapping Strategy. Indirectly, citizens are affected by the decisions that governments and other stakeholders make with respect to data availability and access and advances in technology.

Directly, citizens use geographical applications or services for their own work or leisure. Probably the greatest growth in general public use of mapping is in the use of GPS enabled navigation systems, both handheld for outdoor/fitness use and in-car for navigation use. (One manufacturer, Garmin, reported a 38% increase in unit sales in FY2008[37].) Navigation applications are also increasingly showing up on cell phones, further expanding the accessibility of mapping to the general public. The newest extension of navigation applications is the availability of real time updates allowing citizens to plan their routes to avoid congestion, accidents and road closures.

The increase from hundreds to millions of downloads from the National Topographic Database since these data were made available free of charge is a clear indicator that free, accurate government geographical data is a much wanted commodity.

General public awareness of how mapping is carried out in Canada is low and is likely to remain so. Awareness-raising efforts thus far were designed to target those who are actively engaged in mapping and not the general public. Most data portals require specialized geomatics software that is not generally in widespread use thus restricting use of the portals to professionals and technicians. The advent of user-friendly mass market

technologies, such as those mentioned above, creates similar expectations for the usability of the Canadian Geospatial Data Infrastructure (CGDI). At some point, governments will need to assess the importance of aligning the accessibility and usability of mapping data and techniques with the expectations of the growing ranks of neo-geographers as a means of entrenching map use into daily life – much like the Internet has become.[38]

The Association of Canadian Map Libraries and Archives (ACMLA) has also acted in the interests of citizen users. When Natural Resources Canada announced plans to close the Canada Map Office and to stop printing National Topographic Data Base (NTDB) maps (making them available only through the Internet), the ACMLA was instrumental in reversing the decision.[39] Amongst the arguments advanced by members of the ACMLA was that in 2006, one-third of Canadian households did not have Internet access.[40] The Association felt it important to ensure widespread public access to basic federal spatial information. This attribute of the Association makes it a valuable stakeholder in the National Mapping Strategy. It is likely that ACMLA will continue to advance citizen interests.

2.3 Mapping Industry

In 2007 there were 3,289 companies in Canada that reported to Statistics Canada that they were wholly or partially involved in Surveying and Mapping. These companies also reported $2.8 billion in surveying and mapping revenues that year[41]. A 2005 survey reported that there were over 23,000 Canadians employed in our surveying and mapping industry. The industry is the major source of mapping services in Canada. Not only does it provide mapping services to other private sector companies but most of the governments in Canada depend on it for contractual mapping.

With its strong links to other segments of the Canadian information and communications technology (ICT) sector - both as a user of their technologies and as a supplier of inputs - the Geomatics industry is a driving force of products and services that improve the efficiency and quality of services of other key industries. In fact, there are few other industries touching as many other sectors of the Canadian economy as Geomatics.

It is clear that a strong and healthy industry is essential to the success of a national mapping strategy and the realisation of the benefits that mapping brings to the Canadian economy.

2.4 Professional and Industry Associations

There are several associations that represent Canada's mapping community. Industry and professional associations, such as the Association of Canadian Map Libraries and Archives (ACMLA), Geomatics Industry Association of Canada (GIAC) and the Canadian Institute of Geomatics (CIG) are included in this stakeholder group. Such associations and consortiums encourage partnerships and collaboration amongst members and stakeholders along with providing venues for stakeholder involvement.

GIAC is Canada's "national business association dedicated to serving the geomatics industry"[42] and is concentrated on "increasing partnership opportunities, stakeholder involvement…"[43] Along with serving the geomatics industry, GIAC hosts forums addressing various topics of interest to the sector[44] and has advocated for a geomatics strategy for Canada.[45] With such objectives and activities, GIAC is a vital party in the development and implementation of the National Mapping Strategy

ACMLA represents Canadian map librarians, cartographic archivists and others interested in geographic information. Two of the Association's objectives are: "[t]o encourage and support the development of high standards in the management of and access to geographic information"[46] and "[t]o encourage and support activities which further the awareness, use, and understanding of geographic information."[47]

CIG is a non-profit scientific and technical association that among other things is working "to advance the development of geomatics sciences in Canada" and "to enhance public awareness on the role geomatics plays in their daily lives"[48]. CIG's members are from a variety of fields including government, the private sector, academic and non-governmental organizations.[49] Through their range of interests, from promoting education to professional development, to publishing the quarterly journal *Geomatica,* to providing networking opportunities, CIG has a vested interest in the future of mapping in Canada.

The Urban and Regional Information Systems Association (URISA) has four active provincial chapters in Canada (BC, AB, ON, QC). URISA is "a non-profit professional and educational association that promotes the effective and ethical use of spatial information and information technologies for the understanding and management of urban and regional systems.[50]" URISA provides a unique access point to the municipal users of mapping information at the local level.

There are many other professional associations with a interest in mapping, including the provincial and national land surveyors associations as well as industry specific associations like the Canadian Forestry Association (CFA), the Canadian Association of Petroleum Producers (CAPP), and the Prospectors and Developers Association of Canada (PDAC), to name a few.

It can be expected that industry and professional associations will continue to play an important role in promoting awareness and understanding of mapping, geography, and geomatics issues and in achieving success through the implementation of the strategy.

2.5 Academia

Academia has a major and ongoing role in helping educate new geomatics professionals. Academic institutions often conduct research in the realm of geography and geomatics through partnerships with both private and public sector organizations. Currently, the two leading academic partnership geomatics entities are; GEOmatics for Informed DEcisions (GEOIDE) funded through Canada's Network Centers of Excellence program, and Tecterra.

GEOIDE, headquartered at the University of Laval, Québec City, but engaging a network spread across the country, has a far-reaching mandate to:

> …consolidate and strengthen the domestic geomatics industry, while making optimum use of Canada's Research and Development resources and to create a sustainable networking structure integrating all sectors of the Canadian geomatics community.[51]

Amongst GEOIDE's objectives are the following:

> To engage both existing and new communities of research and development, including those concerned with the environmental and social relevance of information and equity in a broader context, such as the medical and social sciences, the humanities, and do so both domestically and internationally;
>
> To accelerate the development of the training infrastructure needed to ensure the delivery of the highly qualified personnel necessary to the economy, and train a generation of new personnel to support the current market expansion[52]

Headquartered at the University of Calgary, Tecterra, one of five Alberta Ingenuity Centres for Research and Commercialisation, has a vision to develop intelligent integrated resource management tools to observe, monitor, forecast and manage Alberta's land and natural resources.

Tecterra will build a substantial, sustainable geomatics-based ICT capability in Alberta and Canada. It will be involved in four activities critical to the advancement of integrated resource management: education and training; R&D; pre-commercialization of R&D, and partnering with and providing services to industry.

The roles of these geomatics organisations make them key stakeholders for the National Mapping Strategy as they influence numerous researchers and industry partners through their work to "leave behind a permanent legacy towards building a sustainable society"[53].

2.6 Municipal Governments

Generally, municipal governments manage their local geographic requirements. More and more municipalities are using IT and geo-technologies to assist them in coordinating and leading geographical activities within their administrative boundaries. Municipal governments are responsible for their spatial databases and often share/exchange data with provinces and other authorities. Municipalities also liaise and coordinate with provincial-territorial authorities. As noted in Sections 1.5.1 and 1.5.2, a number of municipal geomatics projects have, and continue to achieve results with respect to efficiencies, decision-making and coordinating with other authorities and jurisdictions. The aims and objectives of the National Mapping Strategy would support municipal efforts.

Municipal governments have great potential to contribute to the objectives of the National Mapping Strategy. To accomplish this, municipalities would need greater involvement and a closer working relationship with the mapping community.

2.7 Federal, Provincial and Territorial Governments

The federal government is generally responsible for leading and/or coordinating national initiatives in cooperation with provincial and territorial counterparts through programs such as GeoConnections[54] and by providing national-scale databases, either through multi-stakeholder partnerships as in GeoBase[55] or directly as in the Atlas of Canada[56]. Federal agencies coordinate their activities through venues such as the Inter Agency Committee on Geomatics (IACG) whose purpose is "the effective and efficient utilization of geomatics within the Canadian government"[57] and the Canadian Council on Geomatics (CCOG) which is the "federal-provincial-territorial consultative body for geographic information management."[58] Internationally, Canada participates through membership in organizations like the Open Geospatial Consortium (OGC)[59].

Federal agencies and departments are both producers and consumers of data, and as noted above, their concerns surrounding geomatics and issues are addressed primarily through the IACG representing 14 federal government departments.[60] The Committee recognizes that sharing geographical data and raising the profile of geomatics within the federal system is an important catalyst towards reducing domestic and international barriers to data sharing. One objective of the IACG is to promote the maintenance and widespread use of an efficient and useful data infrastructure.[61] IACG member departments have a vested interest in supporting and realizing a National Mapping Strategy.

The federal government, through the departments of Natural Resources, Environment and Fisheries and Oceans, holds responsibility for carrying out 'technical surveys' which are "…geological, geophysical, geochemical, geographical, geodetic, topographical, hydrographic, hydro-geological, geotechnical, oceanographic, meteorological and other similar surveys"[62] of Canada's land mass.

Provincial and territorial governments are responsible for the management and coordination of geomatics activities within their geographic areas, liaising and coordinating with local government agencies and providing, directly or indirectly, provincial and territorial databases to meet their requirements. Provincial and territorial governments also collect, manage, and maintain data that assists in developing and maintaining provincial and national databases.[63]

Since 1972 federal, provincial and territorial coordination on geomatics has had as its venue the Canadian Council on Geomatics (CCOG). The CCOG acts as:

> …the major federal-provincial-territorial consultative body for geographic information management. Its aims are to provide a forum for exchanging information on programs, to consider common operational issues, to discuss proposed legislation relevant to geomatics (particularly land surveying), and to develop and promote national geomatics standards.[64]

Representatives to the CCOG "serve as the primary contact to coordinate input and follow-up related to CCOG business on behalf of their government."[65] Thus, representatives to the CCOG are the authoritative voices on geographic information management for the provincial, territorial and federal governments. CCOG members also provide the primary means of linking with municipal governments.

Provincial and territorial agencies, through the CCOG, are key partners in any future effort to plan, coordinate and enhance mapping capability in Canada in a consistent manner.

For federal, provincial and territorial governments, formal recognition of the growing desire for collaboration and partnerships initiatives on mapping projects between levels of government came in 2002 with the signing of the *Canadian Geomatics Accord*.[66] As stated in the Accord, its purpose was simply "…to create a framework to allow federal, provincial and territorial government agencies to collaborate and provide support for geomatics initiatives; and focus their efforts on more efficient geomatics data collection, distribution, and maintenance."[67] The 5-year Accord was unanimously renewed in 2007 with the same intent.[68]

Prior to the adoption of the Accord, mapping in Canada was generally undertaken through specific mandates and legislation given to various governmental departments[69] [70] and on occasion, by common agreement on an initiative-by-initiative basis. One example of an extremely successful cooperative effort is GeoBase, established in 2001, when:

> …multiple government mapping agencies realized that current resource levels allocated to their tasks were inadequate. At its annual meeting in Fredericton, October 2001, the Canadian Council on Geomatics (CCOG) approved the GeoBase vision, principles and [initial] data definitions. CCOG commissioned the GeoBase Steering Committee to develop and propose an action plan. *This initiative was to be the beginning of a new era of cooperation between various data-producing stakeholders*.[71] (Emphasis added)

The purpose of GeoBase is "to ensure the availability of high-quality geographical base information covering the entire Canadian landmass"[72] and through a series of partnerships with provincial, territorial and federal agencies[73], it accomplished this objective. GeoBase demonstrates conclusively how the mapping objectives of different agencies can be met successfully through cooperation and the pooling of resources.

2.8 International Considerations

Standards organizations develop global standards to provide interoperability. They mobilize government, private industry and academia to create open and extensible software application programming interfaces for geographic information systems (GIS) and other mainstream technologies. Canada, through the Canadian General Standards Board (CGSB) and membership in the Open Geospatial Consortium (OGC) [74], supports and adopts mapping related standards in the interests of promoting interoperability. Canada is likely to continue to support such efforts into the future.

While under no requirement to comply with International Standards Organisation (ISO) or OGC standards, Canada along with many other nations and organizations recognize that interoperability is important and that the need for interoperable data standards and technology will continue in the future. At the same time, standards organizations will continue to have an impact on any national strategy. Maintaining strong partnerships with standards organizations will help harmonize digital geographic information and a continued commitment to building upon endorsed specifications. This will ensure interoperability today and tomorrow. Ongoing collaboration with the ISO and OGC will also be important to ensure the evolution and adoption of new standards to advance technology.

International governments, institutions and organizations use and provide a wide variety of products and services to meet wide ranging geo-political needs. The United Nations is increasingly using mapping in developing, operating, and monitoring its many activities. Canadian responses to international imperatives need to continue to be consistent. This involvement provides opportunities to meet international commitments and build effective and efficient geographical information exchange around the world.

3 Consultation Synopsis

As noted in Section 1.1, the CCOG accepted the concept of creating a national strategy to address the future of mapping in Canada. A Working Group was created and was tasked to develop the National Mapping Strategy. The role of the Working Group was defined as:

> To define the vision, scope and approach of a national mapping strategy;
>
> To address the basic questions surrounding a national mapping strategy[75]

To facilitate discussion on the subject and to obtain the widest range of perspectives, the Working Group hosted a series of 10 workshops across Canada in cooperation with the Geomatics Industry Association of Canada (GIAC) in 2008/09. More than 700 stakeholders participated in the workshops.[76]

From the workshops, stakeholder views were gathered on a series of questions:

1) What top three challenges should a National Mapping Strategy address?

2) What would be three significant benefits of having a National Mapping Strategy?

3) What key indicators would demonstrate the success of the National Mapping Strategy?

Results of the consultations were complied into *Consultant's Report to the National Mapping Strategy Working Group: Summary of the Working Group's Discussions and Decisions* prepared by KIM Geomatics Corporation in April 2009.

3.1 National Mapping Strategy Vision

The Vision for the National Mapping Strategy and the subsequent development of the Strategy's Core Values, are a reflection of what was heard during the consultations. The Vision for the National Mapping Strategy is as follows:

We will enhance Canada's prosperity and well-being through modern mapping and geographic information.

By implementing the National Mapping Strategy we will:

- Capture the essence and meaning of our geography for Canadians and the world;
- Develop uniquely Canadian partnerships responding to the needs and desires of our governments, industry and academe;
- Anticipate and lead the creation of innovative, high quality products, processes, and applications using our geographic information;
- Create geographic information that is accessible and useful to all Canadian decision makers in government and industry as well as the public at large;
- Make Canada's economy more competitive and economically and environmentally sustainable; and
- Assume a leadership position in the collection and use of geographic information, a burgeoning field Canada and Canadians helped invent.[77]

3.2 National Mapping Strategy Core Values

The Core Values defined by the National Mapping Strategy Working Group fall into two categories: People and their Work Environment; and, Valued Activities. These core values are meant to inform and guide the Strategy as it evolves.

3.2.1 People and Their Work Environment

Three components addressing the principles of collaboration, joint working relationships and fiscal responsibility are included in this category.

1. Collaboration; in order to be inclusive and consultative we need to:
   - Engage stakeholders;
   - Engage first nations communities;
   - Work in partnerships in a team environment
   - Share risks and benefits
   - Agree on Roles and Responsibilities

- Operate openly and transparently.

2. Joint Working Relationships; in order to create positive working environments necessary for the National Mapping Strategy to work we need to:
   - Act with integrity to make decisions in a manner that is consistent, professional, fair and balanced;
   - Respect one another in interactions with co-workers and members of the public so that each individual is valued and heard;
   - Act in the public interest at all times in such a way as to uphold the public trust;
   - Ensure a high level of openness and transparency in everything;
   - Follow standards of fairness, equitability and quality of department programs and services that lead to equality between individuals, generations and nations; and
   - Recognize diversity and value workplaces where diversity in all its forms is encouraged and is recognized for its contribution to a more creative, rewarding, and productive public service to our broader community.

3. Fiscal Responsibility; in order to implement affordable public policies we need to:
   - Build efficient, cost-effective and sustainable services to the public while investing taxpayer dollars wisely;
   - Ensure accountability whereby our actions and interactions, the objective and wise use of resources, and responsibility for our successes and failures is reflected in how we conduct ourselves.
   - Recognize that we are accountable to Canadian citizens, our co-workers, and our many partners in service delivery; and
   - Value the special relationship we have with our co-citizens by being committed to developing and delivering services that are in the public interest, are for the public good, and are deserving of the public trust.

3.2.2 Valued Activities

Valued Activities captures the objectives of the National Mapping Strategy by clarifying expected outcomes. This category addresses; the delivery of quality services, the alignment of the Strategy with principles of sustainability, the value of Canada's geographic infrastructure, and the nation's continued competitiveness, and consideration for the safety and security of citizens and the nation. These components are intended to demonstrate the standard of excellence inherent in the Strategy.

1. Deliver High Quality Services
   - Deliver high-quality, competent advice, assistance and information to satisfied clients;

- Deliver service to the public that is excellent, efficient, objective and impartial; and
- Monitor our government's results and our client results in order to continuously improve our products and services.

2. Ensure that our products and services facilitate and enhance the practices of Sustainable Resource Management and Environmental Responsibility
   - Provide the best information to allow for sustainable development and to manage our environment to sustain a high quality of life;
   - Ensure ecological integrity in our own products and services.

3. Value Geographic Information as part of Canada's Infrastructure
   - Ensure that governments nationwide accept geographic information as an important component of the national infrastructure and value it accordingly;
   - Define government and industry geographic information needs;
   - Reduce the barriers to sharing of geographic information;
   - View and use base geographic datasets without fees;
   - Conduct all work to prescribed and/or agreed upon standards; and
   - Coordinate the development, effective use, and sharing of geographic information by administering geomatics direction, policy, standards and projects established and approved by stakeholder consensus.

4. Enhance Competitiveness
   - Foster a culture of innovation;
   - Support commercialization and foster a culture of innovation through cooperation and partnerships including building links between the private sector and governmental institutions;
   - Support technology transfer, enhanced R&D capacity, and protection of intellectual property;
   - Position Canada as a competitive economy;
   - Broaden education and skills development;
   - Foster economic development and growth through the broader availability of geomatics information and technology;
   - Instil confidence; and
   - Influence decisions of other governments and agencies.

5. Promote Safety and Security for the People and the Nation
   - Safeguard public and environmental health;
   - Ensure the safety of our communities; and
   - Protect our sovereignty.

4 Components of the NMS

The National Mapping Strategy provides direction to the nation's mapping programs through a set of distinct yet related elements. Each element is discussed below with the strategy itself being the sum of the elements.

4.1 Consultative and Inclusive Governance

The following section outlines the need for an inclusive governance structure and consultation process while demonstrating how inclusiveness and consultation will benefit the overall Strategy. The discussion centers on 'why' a consultative and inclusive structure is beneficial and considerations to take into account which will help ensure consultation and inclusion.

4.1.1 Introduction

The world of mapping has changed dramatically over the last several decades: from how maps are created to how they are distributed and used, the methodologies, techniques and uses are changing rapidly. Mapping now has a dynamic quality as more people find new ways to use maps. No longer simply hung on the wall or found between the pages of a book, maps have infiltrated nearly all aspects of life in a manner that has made their use indispensible and nearly second-nature. From users who want to find driving directions or append their photos to a public map to producers who are creating visualization techniques that bring the world to your computer screen, maps and mapping are evolving to keep pace with our modern technological society.

With discoveries and explanations being made about the world and our environment, academics and scientists are fuelling a demand for different ways of depicting the world around us. The near instantaneous transmission of data from the 'field' to computer systems is demanding that standardized methodologies be created and followed to permit both on the spot analysis that can be used to refine the fieldwork taking place as well as generating savings in time and effort.

With local governments needing to address more and more complicated and intersecting issues, municipalities are finding that the combination of maps and technology can help make many administrative tasks easier. The private sector has also experienced growth as they find themselves with new opportunities in the marketplace. On one side, they are helping users such as local governments create capacity to address spatial issues while on another they are finding that customized solutions are often required to make best use of available resources and data.

There are many stakeholders, some old and some new, with a vested interest in the future of mapping in Canada. Having adopted mapping and geomatics into their organizations and administrations, these stakeholders want and need continuity and consistency in future mapping initiatives. Thus it is important for all of Canada's mapping community to have a voice in the way the nation's mapping systems operate. Voices that need to be

recognized and accommodated include mapping producers and users, the private and public sectors, the scientific community as well as occasional users.

Working cooperatively, more inclusive governance structure would provide clarity, direction, and certainty by providing a forum for Canada's mapping community to share information, methodologies, approaches to mapping and timelines. It would also provide a venue to refine evolving roles and responsibilities of various stakeholders, develop mapping related policies, and address issues and opportunities such as innovation, contracting and exports.

With partnerships becoming commonplace as a means of conducting business within the mapping community, it is anticipated that partnership initiatives will only continue and increase into the future as the benefits of sharing objectives are realized. The National Mapping Strategy will encourage and support partnering within Canada's community of mapping producers and consumers as well as with other organizations who share common interests and objectives. Partnerships are a foundational principle of the National Mapping Strategy.

4.1.2 Considerations

Primary considerations of any governance structure selected for the National Mapping Strategy is that it should clearly demonstrate that it is based on a sustainable business model and that it satisfies the public interest. The challenge will be to decide on a structure that can accommodate different levels of governments along with private sector, academic, and NGOs, each with its own definition of public interest, and each holding its own expectations for a chain of accountability.

In evaluating governance models, there are key elements that must be considered including sustainability, legitimacy and voice[78]; direction/strategic vision[79] ; performance[80]; accountability[81]and, fairness[82]. Each of these principles must be present to ensure trust and participation.

The National Mapping Strategy is founded on partnership and the willingness of Canada's mapping community to work cooperatively. Commitment to partnerships has already resulted in reducing duplication, improving efficiencies and delivering benefits to public and private sectors alike.

Effective and responsive policies are crucial to the development and implementation of the National Mapping Strategy. In the sharing of geographical data, it is recognized that the barriers are not only technical, but also political, legal, cultural or inter-jurisdictional. As the data sharing landscape evolves, so too does the need to pro-actively address policies.

4.1.3 Recommendation

Develop a more inclusive governance structure and expand partnering.

4.2 National Approach, Regional and Local Decision Making

Mapping is undertaken by various agencies for many reasons. Whether it is to enhance knowledge about Canada's landmass, or to create a common national 'layer' such as the road network[83]; to educate;[84] or to undertake community / urban planning, maps and the techniques used to create them are valuable resources. The following outlines the need for consistency to allow 'interoperability' between map data, mapping approaches, and 'expandability'.

4.2.1 Introduction

There are many common mapping requirements across Canada. Maps that depict transportation systems (roads, public transit, railways etc.) are required by many private sector transportation companies, by every level of government, and by individuals in one way or another, in one form or another. The same holds true for other common map themes such as hydrology, land cover, etc.

While many standard approaches have been developed and adopted at particular levels and on particular data themes, there is still a great deal of work to be done on mapping issues. Mapping approaches to specific issues vary as individual administrations and organizations have used different methodologies to meet specific needs and to address similar issues. This often leads to duplication of efforts and products which are usually not easily interoperable or compatible. Suppose for instance, that the approach and method used in a project to map water wells in Alberta was different from the approach and methodology used in Nova Scotia. In such a case, the work needed to accomplish similar objectives would have created duplication of effort as each jurisdiction would have developed their approaches and methodologies in isolation. An additional result would be that a third party organisation, like Environment Canada or Ducks Unlimited, would have to treat the two data sets independently, increasing their effort to use the information for their projects.

If it were possible to share approaches and methodologies to mapping, one administration or organization could borrow or adopt an existing model thus reducing effort and allowing for inter-jurisdictional analysis should the need arise. While mapping proposals and projects may be initiated locally at a municipal, provincial or territorial level to address a specific need or issue, it would be beneficial to the mapping community as a whole if they were extendable to a national scale and be interoperable with other mapping. This would help ensure that problem solving applications in one area are more easily transferred across jurisdictions, while also supporting broader initiatives to ensure that economic, social and environmental benefits accrue to all Canadians.

Adopting or sharing approaches and methodologies does not mean that the same issue would or should be addressed across the nation in the same way at the same time. It is understood and recognized that mapping requirements with respect to regional and local priorities will differ across the nation. What it does mean is that administrations would be free to share approaches to mapping issues without having to reinvent the process anew with a view to consistency and interoperability if and when the need arises.

The National Mapping Strategy recognizes the autonomy and discretion of the members of Canada's mapping community and is concerned with promoting cooperation and collaboration, not competition. A key role for the inclusive governance structure (as discussed in the previous section) is to provide a forum for this cooperation and collaboration.

4.2.2 Considerations

Effective and responsive policies that respect the autonomy of mapping agencies and organizations while supporting cooperation and collaboration are crucial to the development and implementation of the National Mapping Strategy. In the sharing of mapping approaches and methodologies, it is recognized that the barriers are not only technical, but also legal, cultural or inter-jurisdictionally related. Pro-active policies and guidelines that keep these sensitivities in mind will need to be developed.

4.2.3 Recommendation

Encourage and support coordination and cooperation in mapping approaches and methodologies across jurisdictions and sectors.

4.3 Common Technological Foundation

Technology has changed rapidly and dramatically over the last few decades in all aspects of life and can be expected to continue to do so at an increasingly rapid pace. This section looks at some of the implications the introduction of technology has had in the realm of mapping including technical and data standards, accessibility of data, and interoperability.

4.3.1 Introduction

As noted in Section 1.5, technology has revolutionized the field of mapping through the fusion of geography and information technology, thereby leading to new ways of capturing, storing, analysing, and disseminating map data. At the same time, technology has created challenges with respect to the accessibility of data and has raised questions and concerns regarding spatial data collection and storage.

To meet the challenges and questions wrought by technology, Canada has been pro-active by investing in the development of the Canadian Geospatial Data Infrastructure (CGDI) over the last ten years[85]. The CGDI is helping by advocating a set of national geomatics policies, promoting standards it has endorsed[86], and providing access to standardized data sets through the Discovery Portal[87]. Canada's mapping community has already demonstrated strong acceptance of the CGDI by incorporating these elements into their business practices.

The CGDI includes an inclusive governance model[88] that supports its evolution as technology and mapping requirements continue to advance. At the same time, the CGDI is fully compatible with the spatial data infrastructures of other nations meaning that

Canada's data can be integrated and is compatible with that of our international partners. By endorsing international standards, the CGDI further ensures that all commercial geographic information systems (GIS) can be used with Canadian data.

The CGDI has proven itself to be an important public asset. As the use of standards ensures data quality and interoperability, the National Mapping Strategy will emphasize the development, adoption, and maintenance of CGDI endorsed standards for the collection, storage, and distribution of Canadian map data.

The National Mapping Strategy will adopt the CGDI as a foundational plank for mapping efforts in Canada. The National Mapping Strategy will further ensure that the CGDI will continue to grow and evolve.

4.3.2 Considerations

Geomatics technologies as a whole are exploding on the Internet[89] and on the ground[90]. The technological underpinnings in use by Canada's mapping community are acknowledged to be robust and sophisticated and help the mapping community realize the value of geographical data within business and personal lives. Furthermore, Web 2.0 models of data collection and sharing are pushing the frontiers of mapping. Canada's mapping community will need to adapt, adopt, and innovate within these developing contexts.

A major challenge for the National Mapping Strategy in going forward will be to ensure that the broad technical and data standards required for interoperability will continue to be promoted and their adoption encouraged.

4.3.3 Recommendation

Continue to adopt and enhance the Canadian Geospatial Data Infrastructure.

4.4 Current and Available Data

Management and maintenance of digital spatial data sets is an area of concern, especially with the proliferation of data brought about by technology. Just as technology can make life easier, it can also make it confusing and disorganized unless there are dependable guidelines and processes in place for managing data of any kind. This section will define some of the issues related to data management and maintenance with respect to the provision of mapping services.

4.4.1 Introduction

While maps have traditionally been produced as a printed product, they are now primarily available as digital data sets to be used on a computerised GIS and other specialised applications. In many instances, data consumers have had to download, manage, and maintain large digital data sets onto their own systems. This creates issues and concerns regarding the currency and accuracy of the data if a process is not in place to confirm that

the data used is the most current and up-to-date. If a consumer is using an out-dated data file, it can cause inaccurate analyses or inappropriate decisions.

In response to this issue, new approaches to data maintenance and updating cycles will be designed and implemented to ensure that data sets available to decision makers are as current and accurate as required. Maintenance schedules will be tied more directly to user needs for updated information.

Using new and existing CGDI endorsed standards and processes; the potential exists for distribution systems to include an expanded 'data on demand' service. This will allow consumers to directly access the data they require on an as-needed basis. This ability would eliminate the need for users to store and maintain copies locally and will ensure that the most current and up-to-date data is being used. Costs related to copying and storing mapping data would be eliminated thereby saving consumers' time, effort and money.

The ability to re-create maps that were used for decision making is often necessary. The National Mapping Strategy will explore options for establishing a national map data archive system in response to this requirement. An archival system would also make it possible to develop time series maps that would depict changes that have taken place over a given period. Such a capability could also be used to predict future changes.

With the increasing rise in popularity of neo-geography, the National Mapping Strategy will look at ways to use citizen contributed data to improve the currency and accuracy of mapping information.

4.4.2 Considerations

Mapping is instrumental to problem solving and decision making. It is essential that map data be accessible, accurate and current as stakeholders have a vested interest in ensuring that the data they use is reliable and authoritative. Users also need to know that updating will be undertaken on a regular and timely basis.

As in Section 4.3.2, the Discovery Portal and other data portals will be essential for the discovery, access, exchange and use of geographical data and there must be commitment to supporting these portals into the future. Growing consumer and producer reliance on portals as a means of publishing and disseminating data makes this issue imperative.

4.4.3 Recommendation

Design and implement responsive data maintenance and data-on-demand options and a data archival system.

4.5 Geographical data as a public asset

Geographic data is a crucial element for many decision-making processes and is as necessary to public well-being as other public services. This section points out just a few of the ways that investment in mapping by public authorities benefits the nation as a

whole, and gives recognition to the on-going and future role of the private sector in this area.

4.5.1 Introduction

Much in the same way that some physical infrastructures are public assets that provide services to communities and facilitate the working of a healthy economy, so too, are geographical data and information public assets. Investment in mapping programs provides Canadians with information about our land that facilitates exploration, economic development, and sustainable living within our environment as well as protecting our lands and oceans.

The National Mapping Strategy recognizes the importance and value of 'no charge', unrestricted distribution of government mapping data when there is no threat to existing commercial interests, personal privacy, public security or other types of potential harm. The strategy endorses the continuation and expansion of this practice. Significant progress has been made in achieving this objective although some jurisdictions will need additional time to achieve this strategic goal.

While this element of the strategy is directed foremost at government data, other data producers, particularly NGOs and academia, will also be encouraged to make their data freely available. Many private sector firms currently sell value added products and specialised data as part of their business and this is expected to continue.

4.5.2 Considerations

The data served via Internet portals such as the Discovery Portal positions Canadians to better respond to social, economic and environmental challenges and opportunities. Canada's wealth of geographical data is a public asset that must be easily discoverable, accessible, usable and sharable for the broadest range of users to support sound and efficient decision-making. Good decision making is dependent on having access to good, relevant data.

For (government?) agencies who produce data and who provide access at no cost, enabling *greater* access brings particular benefits. Collecting and compiling geographical data into a useful product comes at a price which remains the same no matter how often, or by whom the product is used. In fact, if one is to consider the value of a mapping data set to be the sum of the benefits that that data set brings then the value of the data is increased by reducing the price of the data to zero. This is because the lower the price the greater the number of users of the data, thus the greater the benefit realised from the data set. Reliable, accurate data, when seen as a 'public good'[91], creates economic benefit.

4.5.3 Recommendation

Provide no charge access to fundamental government mapping data wherever possible.

4.6 Outreach / Communications

It has been said that approximately 80% of all information can be linked to a geographic location.[92] With this in mind, incorporating geomatics techniques and approaches into fields and disciplines not traditionally associated with mapping has the potential to exponentially enhance our understanding of the world. Generating awareness about this untapped potential will be a challenge for the National Mapping Strategy. The following proposes a two pronged approach to communicating the National Mapping Strategy: an awareness and communication program; and, supporting existing users.

4.6.1 Introduction

With 80% of information having a location component, geography has a potential to enhance our understanding and knowledge of issues not traditionally associated with mapping. For example, the Government of Canada GeoConnections program encourages the introduction and use of geomatics in four targeted areas: Public Health, Public Safety and Security, the Environment and Sustainable Development and Matters of Importance to Aboriginal Peoples.[93] Geomatics is assisting these communities by supporting the development and implementation of 'decision-support-systems' that will enable more informed decision-making and spatial analyses on issues of concern.

There are likely other communities who may not have the awareness, expertise or resources but who could also benefit from the use of geomatics. The National Mapping Strategy will address this lack of awareness, expertise and resources.

The first phase will focus on developing and implementing an awareness and communication program. The program will initially target new users to help them integrate mapping into their programs.

The second phase of the National Mapping Strategy's communication approach will be directed towards supporting existing users. Here the focus will be on expanding the use of mapping data in specialized areas; promoting the adoption of new mapping systems and the approaches resulting from this strategy; and, encouraging advances in technology.

Each phase in this approach will help raise the awareness of mapping and its utility in non-traditional areas of study and will provide support for a solid foundation for the future of mapping in Canada.

4.6.2 Considerations

One premise of the National Mapping Strategy is that accurate, available mapping enhances decision making in many areas of economic activity, as well as in public policy. However, students studying to be social workers (as just one of many examples) are not routinely taught about mapping or geography and so are not aware of ways that mapping can be used in their profession. Similarly, students studying mapping and geography are not typically taught the basics of social work and so would typically be unaware of what aspects of social work can be helped by the use of modern digital mapping. An outreach

program will need to be a two-way learning partnership to properly assist new users in applying mapping in their areas of expertise.

While it is important to identify and assist new mapping users, it is equally important to keep existing users and mapping experts current in this rapidly evolving field. Standards will continue to evolve, new/revised mapping data sets will continue to be made available, and new applications and services will continue to be developed. The user community will need to be kept informed of these actions so that they can benefit from them.

4.6.3 Recommendation

Implement a two pronged, on-going communications and outreach program targeting both potential and existing mapping users.

4.7 A Vibrant Geomatics Industry

The geomatics industry is increasingly relied upon to support a wide-range of critical applications across diverse sectors including public safety and national defence, natural resource management, public health, infrastructure, transportation, utilities, manufacturing, and environmental and sustainable development.

Geomatics is a cutting edge technology that must be leveraged more effectively in Canada as an essential driver for growth, and as a tool to better manage dwindling resources. The Canadian geomatics industry has been a significant source of innovation and has the potential to be a world leader. Across Canada, many governments at all levels rely on the geomatics industry to provide essential mapping services and expertise in support of their mandates.

Both these objectives require a co-ordinated national action plan in partnership with government, the research community, academia, users and industry.

4.7.1 Introduction

Worldwide experience has clearly demonstrated that geomatics technology is an important tool to improve innovation, productivity and competitiveness. Our global competitors have grasped the importance of doing so and over the past decade have made or are in the process of planning significant strategic investments in geomatics and geo-information.

Although geomatics technologies are being used in Canada because of the benefits they bring, there is further potential to strategically leverage geomatics to advance a wide range of public and private sector initiatives; increasing productivity in the Canadian economy. Based on their international and domestic successes, the Canadian geomatics industry is well positioned to partner in the provision and facilitation of the adoption and growth of geomatics.

4.7.2 Considerations

For the geomatics industry to invest in its future with confidence it must move beyond typical contractual arrangements. It needs to operate under a national policy framework that promotes a mutually beneficial relationship between the geomatics community and government. This framework must employ the skills, resources and capabilities of Canada's industry along with those of the government, and academic/research sectors, in an integrated manner in order to address our collective challenges, opportunities and goals.

With its strong links to other segments of the Canadian information and communications technology (ICT) sector - both as a user of their technologies and as a supplier of inputs - the geomatics industry is a driving force of products and services that improve the efficiency and quality of services in both the public and private sectors of the Canadian economy. In fact, there are few other industries touching as many other sectors of the Canadian economy as geomatics.

4.7.3 Recommendation

Identify challenges and opportunities for a mutually beneficial relationship between industry and government including the identification of areas of growth for the geomatics industry and jointly work to exploit them.

4.8 An Educated Labour Force

4.8.1 Introduction

The professional capacity shortage in the mapping field will be addressed by promoting geomatics within academia and encouraging students to consider mapping programs at the secondary and post secondary level. The result of this will be to increase the number of specialists available to support the collection, maintenance, and analysis of mapping data.

4.8.2 Considerations

Good data creation and use will only result from the ability to employ and engage people with the right expertise and knowledge. In their 2009 federal budget submission, GIAC identified "An acute shortage of skilled workers" as a limiting factor for the industry.[94] At the same time a large portion of the current government work force is nearing retirement. Replenishing these positions will place a significant strain on the availability of new skilled personnel. This coupled with geomatics tools and practices increasingly finding value within cross-cutting and diverse sectors, further stretches the expert human resources available in any given area.

With the proliferation of technology into all aspects of life in recent years, and the demand for skilled professionals, appropriate communication efforts and raising awareness of how mapping can help, will be crucial. Mapping can bring great benefit to

non-traditional fields, but only if it is implemented in a sustainable manner with appropriate support and resources.

4.8.3 Recommendation

Work with secondary and post-secondary schools to introduce units on mapping and its uses to the curriculums, including non-traditional uses of mapping.

Facilitate innovative skills development approaches, such as apprenticeships, internships, and other approaches like multi-sectoral research and development.

5 Shared Considerations

Along with the considerations given for each element of The National Mapping Strategy in Section 5, there are additional issues that are applicable including the following.

5.1 Economic

Arguments for investing in the National Mapping Strategy can emphasize that it would save money by enhancing efficiencies and reducing duplication in traditional industries especially resource industries as geomatics tools have become almost commonplace for efficient and economical resource consumption.

5.2 Policy

The National Mapping Strategy is dependent on partnerships. This will result in multilateral investments in sharing geographical information between different orders of government (i.e., federal / provincial / territorial / municipal) and also the public, educational and NGO sectors. Partnerships offer several benefits: reduced duplication and costs, greater efficiencies, more effective information for decision-making, and, the creation of a neutral and productive forum for discussing issues of mutual concern. All stakeholders have a vested interest in the future of mapping in Canada.

5.3 Social

Just as the Internet has triggered an ongoing social revolution, so has the emergence of "geo-web"[95]. Combining the Internet with geomatics along with 'crowd sourcing' (the wisdom of crowds) is revolutionizing how we see the world. New avenues for individuals to record and display data are now emerging by both expert[96] and non-expert geographical data users[97] such as geo-tagging vacation photos and posting them on-line.

6 Next Steps

A significant effort has been made by the National Mapping Strategy Working Group thus far in planning for the future of mapping in Canada. Initiating consultations involving more than seven hundred stakeholders across Canada, initiating discussion among different levels of government, seeking input from many in the mapping

community, consolidating input and drafting reports – each activity has been undertaken with the objective of maintaining excellence in this field.

A great deal of work still needs to be done and it is up to the mapping community as a whole to decide what the next steps will be. With the framework presented here through the strategy elements, the Working Group has laid the foundations of the strategy. Now specific tasks need to be defined and carried out by both the working group and other members of the mapping community.

Appendix A - Notes and References

[1] The Inter-Agency Committee on Geomatics, a committee comprised of federal governmental departments with an interest in geomatics, defines geomatics as:

… a fusion of geography and information technology, geomatics is the suite of activities and services involved in the collection, management, analysis, and integration of location-based data to enable improved decision and policy making for Canadians.

Retrieved October 05 2009 from URL: http://www.iacg-cmoig.org/public/GeomaticsPolicy_3_%202Complete_final.pdf

Similar definitions are provided by the Earth Sciences Sector of Natural Resources Canada and by the University of Calgary's Department of Geomatics Engineering.

Geomatics is the science and technology of gathering, analyzing, interpreting, distributing and using geographic information. Geomatics encompasses a broad range of disciplines that can be brought together to create a detailed but understandable picture of the physical world and our place in it

Natural Resources Canada, Retrieved October 05 2009 from URL: http://ess.nrcan.gc.ca/geocan/about_e.php

Geomatics Engineering is a modern discipline, which integrates acquisition, modelling, analysis, and management of spatially referenced data, i.e. data identified according to their locations. Based on the scientific framework of geodesy, it uses terrestrial, marine, airborne, and satellite-based sensors to acquire spatial and other data. It includes the process of transforming spatially referenced data from different sources into common information systems with well-defined accuracy characteristics.

University of Calgary, Retrieved October 05 2009 from URL: http://www.geomatics.ucalgary.ca/about/whatis

[2] Retrieved October 05 2009 from URL: http://www.esri.com/news/arcnews/summer09articles/quinte-west.html

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] The municipality went "[f]rom providing 10% (or 1.608 million hogs) of the national total in 1988, the Rural Municipality of Hanover produced 19% in 1998 (or 3.995 million hogs) of the national total." Rural Municipality of Hanover (Proponent); PFRA - Agriculture & Agri-Food Canada; Manitoba - Intergovernmental Affairs; Manitoba – Conservation. *Rural Municipality of Hanover Mapping Overlay Project. Proposal to the Sustainable Communities Initiative*, Natural Resources Canada. Pp. 2. Retrieved October 05 2009 from URL: http://ess.nrcan.gc.ca/2002_2006/sci/pdf/27prs.pdf

[7] Sustainable Communities Initiative, Natural Resources Canada. Retrieved October 05 2009 from URL: http://ess.nrcan.gc.ca/2002_2006/sci/project_details_e.php?ProjID=27

[8] Ibid.

[9] Wikipedia. Retrieved October 08, 2009 from URL: http://en.wikipedia.org/wiki/Bras_d%27Or_Lake

[10] Bras d'Or Lakes Collaborative Environmental Planning Initiative. Retrieved October 08, 2009 from URL: http://www.brasdorcepi.ca/

[11] Great Canadian Lakes. Retrieved October 08, 2009 from URL: http://www.greatcanadianlakes.com/nova_scotia/brasdor/eco_page7.htm

[12] Environmental Design and Management Limited: **Bras D'Or lakes Development Standards**. Bras d'Or Lakes Collaborative Environmental Planning Initiative: 2008. Retrieved October 08, 2009 from URL: http://www.brasdorcepi.ca/sites/default/files/reports/Bras%20d%27Or%20Dev_Final.pdf pp. i.

[13] Ibid. pp. 1.

[14] Ibid. pp. 4.

[15] Ibid. pp. 51.

[16] Ibid. pp. 51.

[17] Canadian Environmental Assessment Agency. Retrieved October 30 2009 from URL: http://www.ceaa-acee.gc.ca/010/index_e.htm

[18] Canadian Environmental Assessment Agency. *Departmental Performance Report*. March 31 2007. Pp. 10

[19] Mackenzie Valley Review Board. *About the Review Board*. Retrieved October 30 2009 from URL: http://www.mveirb.nt.ca/about/

[20] Ibid.

[21] Mackenzie Valley Review Board. For an excellent example of the spatially depicted landscape impact of the proposed De Beers Canada Inc. Gahcho Kue Diamond Mine - EIR0607-001 [2006], see Site Visit Presentation File#3. November 9th, 2007available at http://www.mveirb.nt.ca/upload/project_document/1194652062_070921%20GKP%20EIRP%20Site%20Tour%20Presentation%20Part%20B.pdf Retrieved October 20 2009.

[22] Ministry of Natural Resources. Community Based Land Use Planning. Retrieved October 30 2009 from URL: http://www.mnr.gov.on.ca/en/Business/FarNorth/2ColumnSubPage/275048.html

[23] Yukon Land Use Planning Council. Retrieved October 30 2009 from URL: http://199.247.233.101:8080/atlas.php

[24] Yukon Land Use Planning Council. Planning Atlas On-line. Retrieved October 30 2009 from URL: http://www.planyukon.ca/index.php?option=com_content&task=view&id=35&Itemid=1

[25] Flu Tracker. Tracking the Global Flu Pandemic. Retrieved October 30 2009 from URL: http://www.rhizalabs.com/flutracker/

[26] Ibid.

[27] Government of Canada. *The threat of invasive species*. Retrieved October 30 2009 from URL: http://www.invasivespecies.gc.ca/english/View.asp?x=501

[28] Ibid.

[29] Ibid.

[30] Invasive Species internet site, launched in May 2009, can be found at www.invasivespecies.gc.ca

[31] Invasive Species. *Steps You Can Take*. Retrieved October 30 2009 from URL: http://www.invasivespecies.gc.ca/english/View.asp?x=526

[32] Natural Resources Canada North Star Team. *evolution Improving the Quality of Life of Canadians through Natural Resources*. Natural Resources Canada. November 17 2006 pp.2.

[33] Ibid. Note: Three hundred and fifty communities are dependent on forestry while one hundred communities are highly reliant on mining. pp.2.

[34] Ibid.

[35] Ibid.

[36] Ibid.

[37] Garmin 2008 annual report. Retrieved February 2, 2010 from URL: http://www8.garmin.com/aboutGarmin/invRelations/reports/2008_Annual_report.pdf

[38] Much information / data is now available to the neophyte user. See GeoCommons as one example of how the geomatics world is becoming more accessible to the non-professional. http://www.geocommons.com/ Another example is The Open Source Geospatial Foundation. For more information, see http://www.osgeo.org/home

[39] CBC News. *Canada shreds plan to scrap paper maps*. October 12, 2006. Retrieved October 23 2009 from URL: http://www.cbc.ca/canada/ottawa/story/2006/10/12/map-office.html

[40] Ibid.

[41] Statistics Canada; Retrieved February 2, 2010 from URL: http://www.statcan.gc.ca/pub/63-254-x/63-254-x2009001-eng.htm

[42] Geomatics Industry Association of Canada (GIAC). Retrieved October 23 2009 from URL: http://www.giac.ca/singlepage.asp?itemtypecode=WHOAREWE&page=about

[43] Ibid.

[44] GIAC. See: http://www.giac.ca/home.asp Retrieved October 23 2009.

[45] GIAC. *Shaping Canada's Landscape Towards a National Geomatics Strategy for Canada*. Retrieved October 23 2009 from URL: http://www.giac.ca/lib/db2file.asp?fileid=179

[46] Association of Canadian Map Libraries and Archives. Retrieved October 23 2009 from URL: http://www.ssc.uwo.ca/assoc/acml/about.html

[47] Ibid.

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[49] Ibid.

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[52] Ibid.

[53] Ibid.

[54] GeoConnections: http://www.geoconnections.org/Welcome.do

[55] GeoBase: http://www.geobase.ca/geobase/en/index.html

[56] Atlas of Canada: http://atlas.nrcan.gc.ca/site/english/index.html

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[58] Canadian Council on Geomatics. Retrieved October 30 2009 from URL: http://www.ccog-cocg.ca/index_e.html

[59] For more information, see http://www.opengeospatial.org/ ; members of the OGC can be found at: http://www.opengeospatial.org/ogc/members Retrieved October 23 2009.

[60] For more information, see: http://www.iacg-cmoig.org/home/about_e.php

[61] See: http://www.iacg-cmoig.org/home/tor_e.php

[62] Resources *and Technical Surveys Act*. R.S., c. R-7, s. 1.

[63] For example, see Land Information Ontario at http://www.mnr.gov.on.ca/en/Business/LIO/index.html or GeoBC at http://geobc.gov.bc.ca/apps/gga/detailHome.do?action=showAboutGeoBCPage on how spatial data is being shared. Other provinces have similar initiatives.

[64] Canadian Council on Geomatics. Retrieved October 24 2009 from URL: http://www.ccog-cocg.ca/index_e.html

[65] Canadian Council on Geomatics. *Canadian Council On Geomatics (CCOG); Terms of Reference*. Revision adopted 2000 October 04. Section C. Membership. Retrieved October 24 2009 from URL: http://www.ccog-cocg.ca/about_e.html

[66] Inter Agency Committee on Geomatics (IACG). http://www.iacg-cmoig.org/public/Geomatics-Accord-August-2001-Final.pdf Retrieved October 14 2009.

[67] Ibid.

[68] Canadian Council on Geomatics. "Canadian Geomatics Accord 2007-2012". Un-published. 2007. Wording as given in the 'Purpose' section of the Accord is slightly different, "The purpose of the 2007 Accord is to create a framework to allow federal, provincial and territorial government agencies involved in geomatics to collaborate and provide support for geomatics initiatives and focus their efforts on more efficient data collection, distribution, and maintenance", however, the intent is the same.

[69] For example: *Department of Natural Resources Act* S.C., 1994, c. 41. S 5 (c). Natural Resources Canada is also responsible for the *Canada Lands Surveyors Act* S.C., 1998, c. 14 as well as the *Canada Lands Surveyors Act* S.C., 1998, c. 14. CHAPTER L-6 and the *International Boundary Commission Act*. CHAPTER I-16 and shares responsibility with two other federal departments for the *Resources and Technical Surveys Act*. R.S., c. R-7, s. 1.

[70] For example, see Ontario's *Ministry of Natural Resources Act* R.S.O. 1990, CHAPTER M.31 which states that the Ministry shall have "a Surveyor General who shall be appointed by the Lieutenant Governor in Council and who shall perform such duties in connection with the surveying of lands, investigation of water powers, engineering, inspection, research and such other matters as are assigned by the Lieutenant Governor in Council or by the Minister. R.S.O. 1990, c. M.31, s. 5 (1). Also see British Columbia's *Land Act*. [RSBC 1996] CHAPTER 245 S.6, (1) as a further example: "The minister is responsible for and may undertake, commission, coordinate and set standards for base mapping and land related information systems in British Columbia and for related remote sensing and survey control functions."

[71] GeoBase. Retrieved October 15 2009 from URL: http://www.geobase.ca/geobase/en/about/index.html

[72] Ibid.

[73] Ibid. http://www.geobase.ca/geobase/en/partners/index.html

[74] The OGC membership list has GeoConnections – Natural Resources Canada listed as a 'Principle' member. Retrieved October 23 2009 from URL: http://www.opengeospatial.org/ogc/members

[75] National Mapping Strategy Working Group. *Terms of Reference*. Un-Published. January 08, 2008.

[76] Ryerson, Robert A. *Consultant's Report to the National Mapping Strategy Working Group: Summary of the Working Group's Discussions and Decisions*. Un-Published Consultation Draft. May 1 2009. pp 53.

[77] Ryerson. pp 2.

[78] "…appropriate *voice* accorded to those whose interests are affected by decisions" Laura Edgar, Claire Marshall and Michael Bassett. *Partnerships: Putting Good Governance Principles in Practice*; Institute On Governance. August 8, 2006. pp.5.

[79] Ibid. "…a guide to action" pp.5.

[80] Ibid. Responsiveness to stakeholders; Effectiveness and efficiency of resources. pp. 5.

[81] Ibid. "…transparency – free flow of information and openness" pp.5.

[82] Ibid. "…conformity to the rule of law and the principle of equity" pp.5.

[83] See: http://www.geobase.ca/geobase/en/data/nrn/index.html Retrieved October 27 2009.

[84] For example, see *The National Atlas* at http://atlas.nrcan.gc.ca/site/english/index.html . The objectives of the Atlas are as follows:

Vision

The Atlas of Canada Web site will provide the most interesting, dynamic and comprehensive collection of maps and related information about Canada available anywhere on the Internet, with effective and intuitive tools for users to access them.

Mission Statement

The Atlas of Canada provides authoritative, current and accessible geographic information products at a national level. Working with partners, the Atlas facilitates the integration and analysis of diverse data in order to increase overall knowledge about Canada.

The Atlas is considered a valuable learning resource. Retrieved October 27 2009.

[85] For more information about the Canadian Geospatial Data Infrastructure, see http://www.geoconnections.org/en/aboutcgdi.html . Retrieved October 29 2009.

[86] For standards endorsed for the CGDI, see http://www.geoconnections.org/en/communities/developers/standards ; http://www.geoconnections.org/en/communities/developers/standards/indexToSpecs ; and http://www.geoconnections.org/en/communities/developers/standards/gc . Retrieved October 29 2009.

[87] See: http://geodiscover.cgdi.ca/gdp/

[88] See: http://www.eoc.csiro.au/ceos/wgiss-10/day1/04/sld007.htm . Retrieved October 29 2009.

[89] An example is the growing popularity of Google Maps/Google Earth, MapQuest et al.

[90] For example, the growth of in-car or hand-held navigation systems using GPS are making the technologies more and more commonplace.

[91] …a **public good** is a good that is non-rivalrous and non-excludable. This means, respectively, that consumption of the good by one individual does not reduce availability of the good for consumption by others; and that no one can be effectively excluded from using the good. Wikipedia. Retrieved November 24 2009 from URL: http://en.wikipedia.org/wiki/Public_good

[92] Mike Flinton. *A Heavenly View of the Customer*. http://lbs360.directionsmag.com/LBSArticles/Location%20Based%20Services%20Flinton%20-08072002%20final.pdf pp.3. Flinton's article for example notes that "Approximately 80% of the information that a business relies upon is geographically related and location-based. Knowing where raw materials, suppliers, employees and customers come from is all vital information." Retrieved October 30 2009.

[93] See http://www.geoconnections.org/en/communities.html for more information. Retrieved October 30 2009.

[94] .Towards a National Geomatics Strategy: Shaping Canada's Landscape, Federal Budget 2009 Consultations, submitted by the Geomatics Industry Association of Canada, January 2009; http://www.giac.ca/lib/db2file.asp?fileid=169

[95] "The GeoWeb is the shared representation of our world, and while you may erect fences around your location, we all share the content of our planet and it all should be discoverable. … The GeoWeb framework provides the means of integrating our collective knowledge." Ball, Matt. *What is a GIS?* Retrieved from URL: http://www.vector1media.com/dialogue/perspectives/what-is-a-gis?/

[96] See "The Participatory Geoweb" a research initiate sponsored by GEOIDE at http://rose.geog.mcgill.ca/geoide/

[97] Neogeography for example combines "the complex techniques of cartography and GIS and places them within reach of users and developers." http://oreilly.com/catalog/9780596529956/ . Wikipedia defines neography as: ""new geography", and is commonly applied to the usage of geographical techniques and tools used for personal and community activities or for utilization by a non-expert group of users." http://en.wikipedia.org/wiki/Neogeography