SPATIAL DATA INFRASTRUCTURE IN NEW BRUNSWICK, CANADA: TWENTY YEARS ON THE WEB

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Abstract

In September 1996, the Province of New Brunswick, Canada became the first jurisdiction in the world to offer World Wide Web-based access to complete and integrated online property mapping, ownership and assessment information covering an entire province or state. Service New Brunswick's Real Property Information Internet Server (RPIIS) was originally developed by Caris/Universal Systems Ltd. (Caris) in conjunction with the University of New Brunswick Department of Geodesy and Geomatics Engineering and with substantial input from Service New Brunswick (SNB) staff. The Caris Internet Server technology on which it was based was recognized, at the time, to be "…the first commercial Internet/mapping GIS" platform.

The paper examines the twenty-year evolution of land information infrastructure refinement in New Brunswick since that time, beginning with the early vision of linking land information with environmental and resource-based information to support improved decision-making. Since 1996, policy and operational issues encountered by SNB included ones related to charging for data, use of geospatial data in eGovernment and eGovernance, data custodianship and incremental updating, involvement of the private sector, and the contrasting "push-pull" between open data initiatives and personal data privacy concerns – issues also faced by other jurisdictions across North America, Europe and Australasia over the same period.

After discussing early initiatives, challenges and issues mentioned above, the paper then tracks and analyzes the changes in Web-based services offered since 1996 in response to a widening and more sophisticated customer base, shifts in government/business relationships, and changes in technologies for data collection, management and communication. The paper concludes with a discussion of current key information initiatives of Service New Brunswick (SNB) and how they pertain to the fulfilment of the original vision.

Keywords: SDI, Web GIS, Internet, Land Administration, Cadastral

1. INTRODUCTION

The Canadian Province of New Brunswick's lengthy history of examining and adopting innovative approaches to land administration and to sharing and distributing the land information maintained by various provincial government departments has been chronicled by Palmer (1984); Coleman and McLaughlin (1988); Loukes and Nandlall (1990); (Doig and Patton, 1994); (Finley et al, 1998) and many others. As early as the 1960s, land information experts recognized the importance of an integrated data bank of information related to land (Dale and McLaughlin, 1988). In New Brunswick, it was recognized that in order for this information to support improved decision-making, it would have to be kept up-to-date and easily accessible; moreover, the public should be involved in the process (McLaughlin, 1991).

In September 1996, the Province of New Brunswick, Canada became the first jurisdiction in the world to offer World Wide Web-based access to complete and integrated online property mapping, ownership and assessment information covering an entire province or state (Arseneau et al., 1997). Service New Brunswick's Real Property Information Internet Server (RPIIS) was originally developed by Caris/Universal Systems Ltd. (Caris) in conjunction with the University of New Brunswick Department of Geodesy and Geomatics Engineering and with substantial input from Service New Brunswick (SNB) staff. The Caris Internet Server technology on which it was based was recognized, at the time, to be "…the first commercial Internet/mapping GIS" platform (Plewe, 1997). In the twenty years since that time, SNB has experienced the peaks, valleys, setbacks and triumphs experienced by public sector organizations world-wide in — especially in today's era of commercial on-line mapping and crowdsourced data — maintaining relevance and influencing the shared collection, updating, authentication and distribution of New Brunswick's provincial mapping and land-related information products.

This paper examines the forty-year evolution of land information infrastructure refinement in New Brunswick since the mid-1970s, beginning with the early vision of linking land information with environmental and resource-based information to support improved decision-making. After discussing early online initiatives, the authors briefly discuss the changes in related Web-based services, data products, data custodianship & management arrangements implemented since 1996 in response to a widening and more sophisticated customer base, shifts in government/business relationships, and changing technologies. The paper concludes with a discussion of current key information initiatives of Service New Brunswick (SNB) and how they pertain to the fulfilment of the original vision.

2. THE INSTITUTIONAL FRAMEWORK OF THE 1980S

Like many jurisdictions, the province of New Brunswick faced the benefits and challenges of several major departments collecting geospatial data to serve a variety of engineering, planning, resource inventory, and land administration activities on both short-term, project-related and long-term, program-related bases (Table 1).

Beginning in the 1970's, the provincial governments of Canada's three maritime provinces (New Brunswick Nova Scotia and Prince Edward Island) came together to establish and co-fund a long-term program to establish a shared monumented survey control framework, common topographic orthophoto base mapping, comprehensive property mapping and attribute information built atop this topographic base. By the early 1980s, this program was extended to digital vector mapping and Digital Elevation Model coverage as well (Dale & McLaughlin, 1988). In addition, separate programs were in place within each province to undertake forest and geological inventory mapping, highway mapping, environmental & land-use mapping, land registration and property assessment/valuation.

Table 1: NB Government Project- and Program-Related Activities supported by Geospatial Data Products and Services

	Short-Term	Ongoing and/or Long-term
Project	Highway Planning, Construction and Upgrading Urban and Rural Land Use Master Plans Adjustment of Electoral District Boundaries	Servicing Land-Use Planning and Change Applications Monitoring anomalies and longer-term effects of program planning and policy-level decisions.
Program	Flood-Plain Mapping School-Bus Route Planning	Forest Inventory & Management on Crown Lands Exploration & Mining Claims Land Registration Property Assessment Emergency Response Planning

In the mid-1980's, a provincial "Office of Government Reform" was established in New Brunswick to examine practices and actives in each department which were perceived to overlap with or duplicate those undertaken by another department. Not surprisingly, surveying and mapping activities were identified as being one such category. Despite pressure from some corners to amalgamate such activities within a single service agency, it was decided that a combination of shared and department-specific (but standards-based) geospatial products and services within the provincial government itself rather than the regional LRIS model) would best meet the needs of the province in the coming years (Coleman et al., 1987; Coleman et al., 1989). In 1989, the Province of New Brunswick instituted a Land Information Policy that was intended, for the first time, to provide clear province-wide guidelines for the collection, storage, retrieval, dissemination and use of land information (Simpson, 1990; Aiton, n.d.). To carry out the objectives of the policy, the functions of land registration, property assessment, and mapping in New Brunswick were amalgamated under a single entity, the New Brunswick Geographic Information Corporation (or NBGIC) (Geographic Information Corporation, 1989; Coleman, 1989; Nichols, 1993). NBGIC was established as a Crown Corporation to provide specialized expertise and a broad scope of services in the field of land information. Its responsibilities included (Arseneau et al. 1997):

- operating the real and personal property registration systems;
- assessing all land, buildings and improvements for the provincial property taxation system;
- maintaining the province's surveying and mapping systems; and
- providing land and geographic information services to the public.

In its early years, NBGIC inherited many of its information resources from earlier initiatives and devoted considerable effort to conversion of the information inherited from earlier initiatives into digital form and the subsequent loading of this digital data into an infrastructure of separate databases which initially included: (1) a *Property Assessment and Taxation Database* to support property valuation; (2) a *Parcel Index Database* containing ownership information and providing a parcel-based index to registered

documents on all land parcels in the Province; and (3) a *Property Map Database* which contained a digital graphical representation of the parcel mapping related to the Parcel Index (Arseneau et al., 1997).

NBGIC was, in turn, transformed and enlarged in 1998 into a new government organization called Service New Brunswick (SNB) with a view to consolidating "… in one corporation, the transactional services and information that New Brunswickers need to conduct their personal and business lives" and a mandate to "….improve access to government services and public information" (SNB, 2007). While SNB land information was publicly available at regional offices and could be purchased in hardcopy format or on diskette, studies revealed that a more convenient access mechanism to land-related information was required (Strunz, 1994; ADI, 1995).

3. TECHNOLOGICAL DEVELOPMENTS

Development efforts to this end progressed from the early-1970s onwards (Finley et al., 1998). Early conceptual land information system designs were originally based on large, centralized databases using the mainframe computer technology of the day (Roberts, 1976). However, plans exceeded both budgets and capabilities of the government agencies of the day; government departments instead began developing isolated, project-based spatial and attribute databases, and both organizational and institutional issues impeded the realization of the centralized database design. A shift in the LIS design became necessary, and by the 1980s, technology had advanced enough to support a shift from an LIS model to a Land Information Network (Palmer, 1984). Databases developed and maintained by departments and housed at departmental locations, rather than in a centralized data bank, were linked to other databases by the common parcel identifier. The success of the network model meant that participating government departments had access to shared information. However, the public still had no convenient access mechanism.

3.1. Online Provision of Property Mapping and Parcel Attribute Data

In 1995, SNB staff beta-tested the CARIS Internet Server™ from Universal Systems Ltd. (Or USL — today known as *Caris*) – software originally developed in 1994 as part of a federally-funded initiative involving USL and the Geographical Engineering Group at the University of New Brunswick (Arseneau et al. 1997). While the CARIS Internet Server was one of the earliest Internet-based mapping packages to allow search, query and display functionalities (Plewe, 1997), SNB staff provided enhancement suggestions to ensure it met government requirements including a fee-for-use administrative component (Dawe, 1996).

Based on this CARIS Internet Server™ as its backbone, SNB implemented in August 1996 one of the world's first commercially-available, Web-based land registry systems, providing access to integrated parcel-related data sets covering the entire province of New Brunswick. Known originally as the Real Property Information Internet Service (RPIIS), it allowed clients to access non-confidential, parcel-based information residing at a password-protected SNB Internet site (Figures 1, 2 and 3). Paying users of this prototype service could search for a property by specifying either textual, graphical, place-name or coordinate information, and the service allowed users to view and query maps and attributes, select display layers, and perform (very) limited GIS-type analysis operations (Arseneau et al., 1997).

Figure 1: Example of RPIIS Query Screen for NB Parcel Index Data (Arseneau et al., 1997)
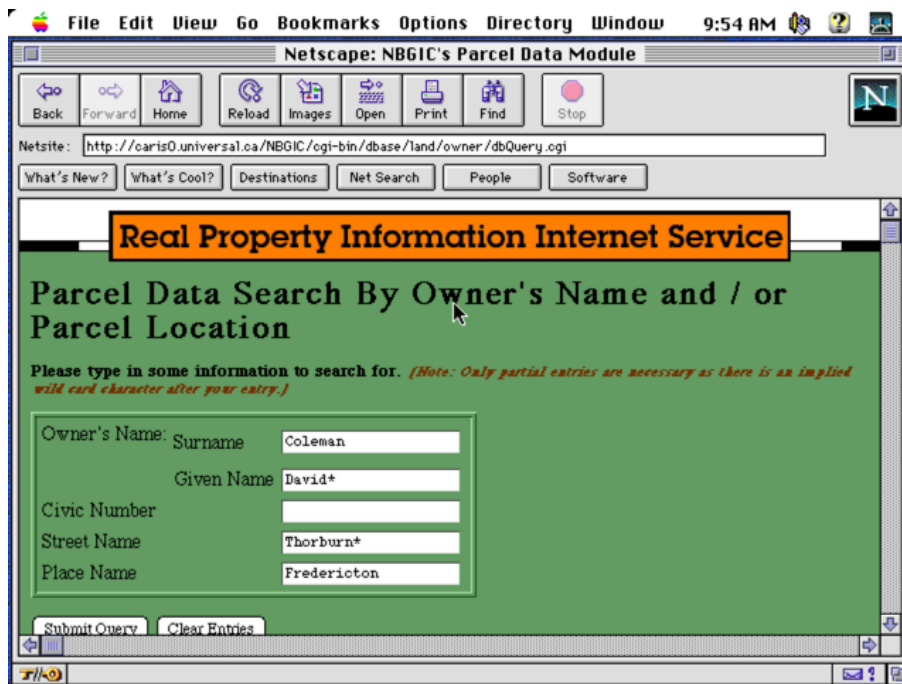

Figure 2: First Screen of Attribute Data Response to Query in Figure 1 (Arseneau et al., 1997)
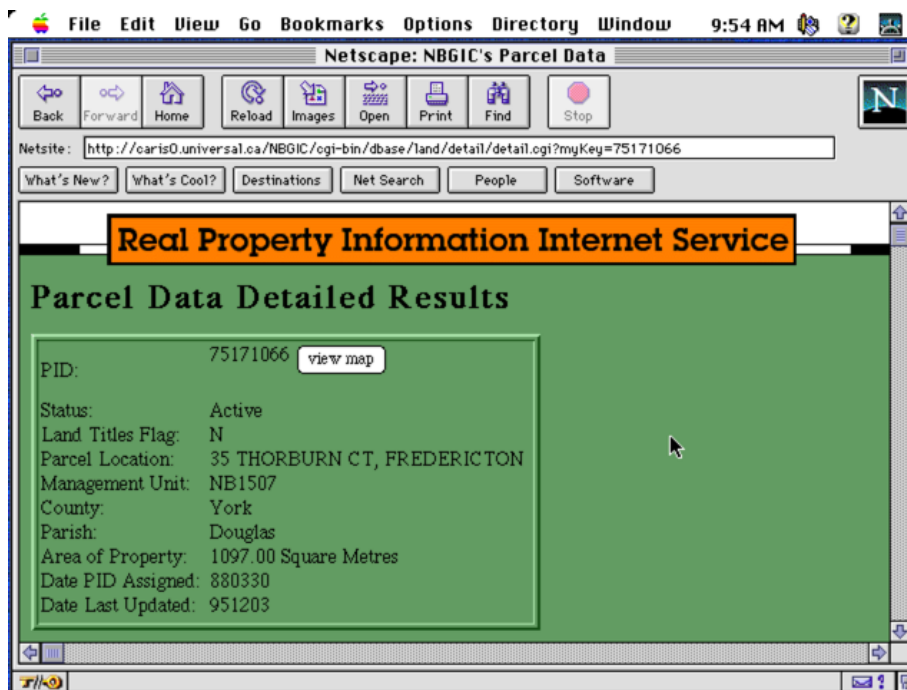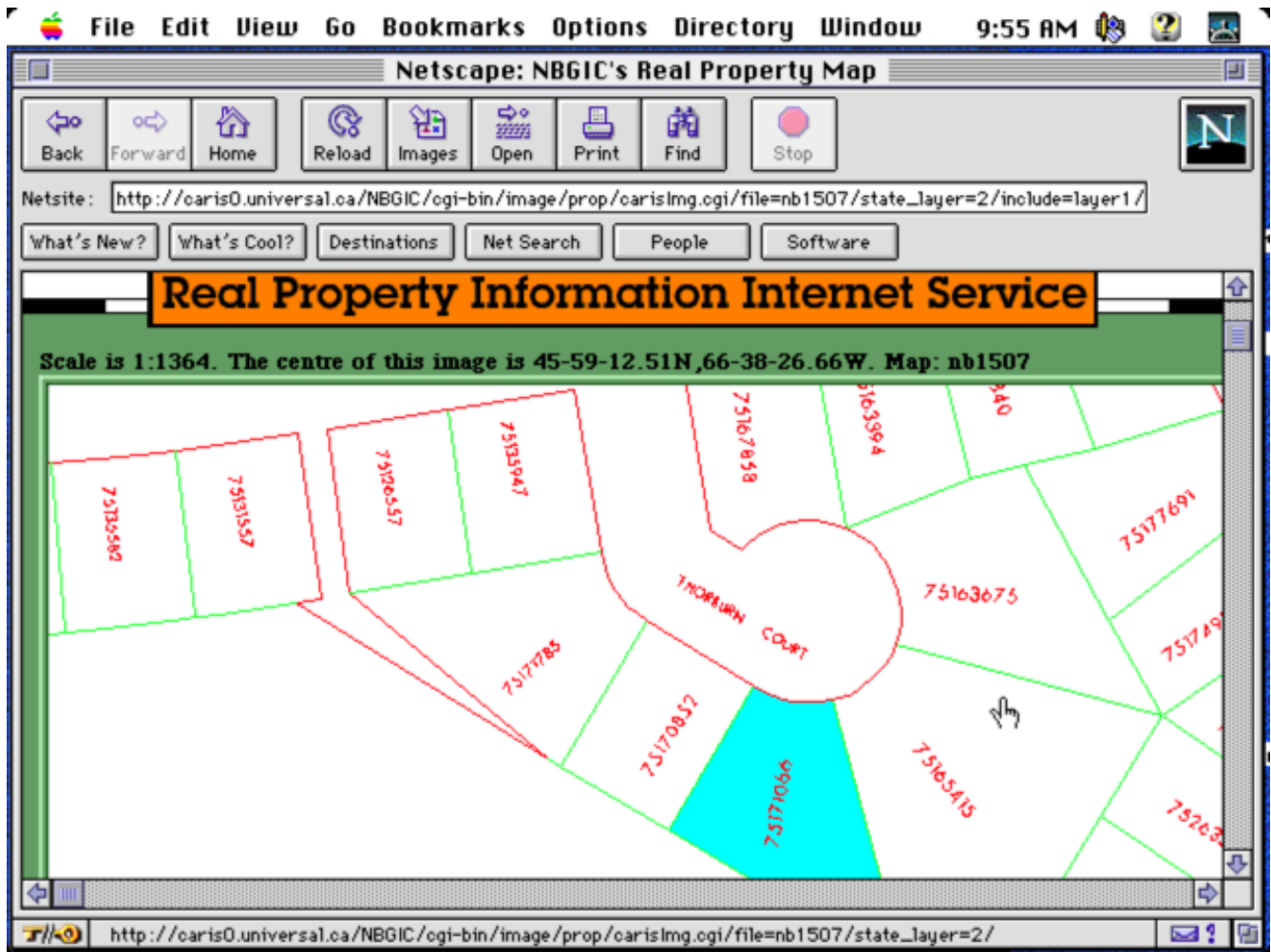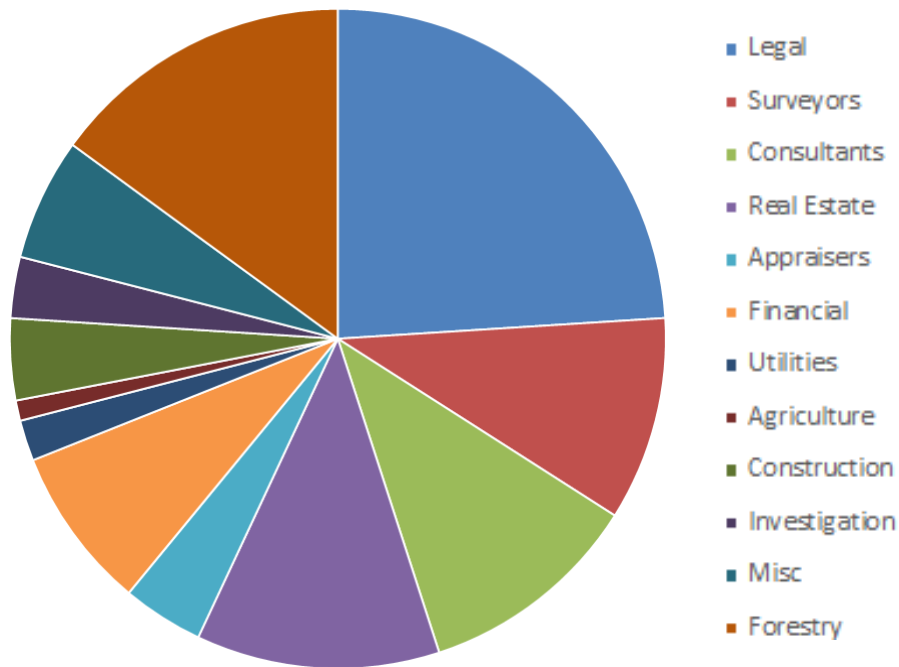
Figure 3: First Screen of Graphics Data Response to Query in Figure 1 (Arseneau et al., 1997)
(Note: Users could zoom in or out from this screen)

An early study of the users and usage patterns of the RPIIS commissioned by SNB and carried out by Hoogsteden and Coleman (2000) reported the number of registered system users had grown to over 700 by July 1999, with over 70% of these users being in the private sector. The pie chart in Figure 4 - adapted from the original report - illustrates the breakdown of RPIIS private sector customers at that time. The classification used for this sub-division was based on clearly identifiable core user-occupations (especially the professions) and specific industrial groupings, e.g. forestry and agriculture.

Figure 4: RPIIS Private Sector User Breakdown as of July 1999 (adapted from Hoogsteden and Coleman 2000)

Legend:
- Legal
- Surveyors
- Consultants
- Real Estate
- Appraisers
- Financial
- Utilities
- Agriculture
- Construction
- Investigation
- Misc
- Forestry

Lawyers and para-legals formed the largest single user group in those early days (24%), while forestry-related firms accounted for another 15% of the customer accounts. Surveyors, Consultants and Real Estate firms comprised the next tier of users, while a mixture of others made up the remaining users. Of these 700 registered users, approximately 40% were using the service regularly while another 20% showed little sign of activity after the first month.

Subsequent enhancements to the service through the late 1990s, including the launch and refinement of the *New Brunswick Land Gazette*, are described in detail by Arseneau et al. (1997b) and Finley et al. (1998) among others. In 1998, the original system was embedded within a much more comprehensive on-line information system called PLANET designed to support the administrative and legal processes involved in property transfer transactions.

Today, SNB's PLANET system is described as "… a comprehensive, integrated, online source of land registration, assessment, mapping and information services, allowing New Brunswickers to conduct land based transactions quickly, efficiently, and with good information" (SNB, 2009). Over the years, the system's name has come to represent, in one word, the attendant concepts and values associated with parcel-based land identification, computerized land registry, provincial government guarantee of land titles and boundaries, "single-window" online access to and transactions associated with property-related information.

The system continues to operate on a subscription basis and offers a per transaction option (Table 2). Generally speaking, the per transaction option is of interest to occasional users of the system whereas the subscription option offers value for frequent users. The system now has 2829 registered users with 694 being government users and the remaining 75% (2135), non-government accounts.

Table 2: PLANET Usage as of July 2016

User type	Account type		Sub totals
	Transaction	**Subscription**	**Sub totals**
Government	511	183	694
Non-Government	1484 (70%)	651 (30%)	2135
Sub-totals	1995	834	**2829**

Using system and subscriber information as of May 2015 and July 2016, provided by Service New Brunswick, a breakdown of registered external PLANET users was prepared by the authors. (See Figure 5.) The user base has grown from 700 users in 1999 to over 2800 today. Government users account for 25% of the user base. The number of different types of users has grown and the number of banks, credit unions and insurance firms accessing the service (i.e., the "Financial" Category) has also increased, as has the number of municipal and federal government users (included in the "Special Government and Misc." Category). That said, lawyers still constitute the largest number of users, with many large law firms possessing multiple accounts (i.e., one or more for each lawyer for billing purposes). Of the 2135 non-government users, 70% (1484) use the per-transaction option.

Figure 5: SNB PLANET External User Breakdown as of May 2015
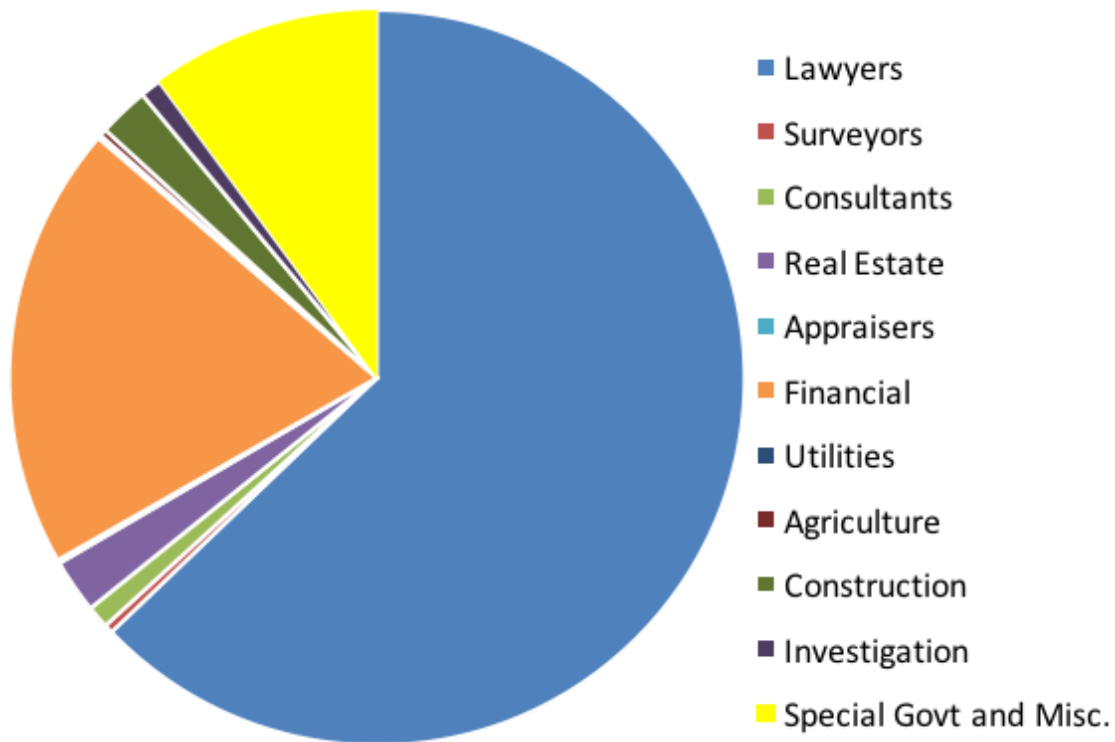
## 3.2.   Online Data Download Services and Web Mapping Applications

As requests for access to information increased and attitudes towards free, open data evolved, in 1999, SNB expanded its offerings to include not only fee-for-service access to the PLANET parcel-related information, but also the ability for users to access and download free digital topographic mapping and Digital Elevation Model datasets produced and distributed by SNB (Figure 6) (Finley et al., 1999).

Figure 6: Graphical Interface for Selection of Map Files for Download [from (Finley et al. 1999)]
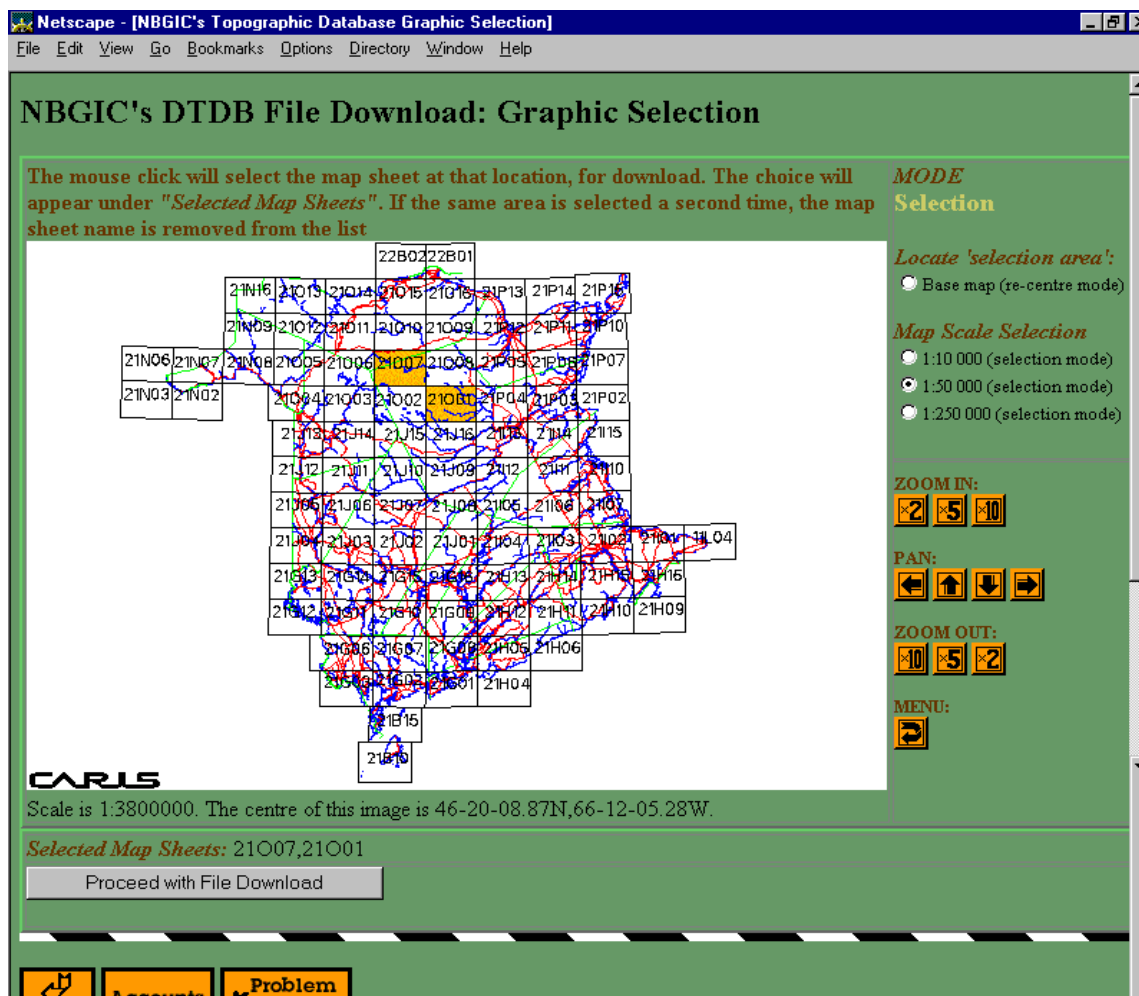
As a result of a provincial geomatics review in 2005, which among other things identified the need for more robust internet access of integrated data sets rather than simple downloads, a new GeoNB Internet Map Viewer service was developed. Based on Esri technology, it was made available to internal customers in April 2006, with its public launch taking place in 2009 (Figure 7). This version was designed to be a web-based map viewer with all data and functionality contained within the one application. As the user base grew and data was added and functionality increased, this model was at risk of becoming too cumbersome for the general user. SNB program managers realized that -- while a be-all, end-all map viewer might meet some needs of an advanced geomatics technician -- it would likely be too complex for the general use.

Figure 7: GeoNB Map Viewer 2009
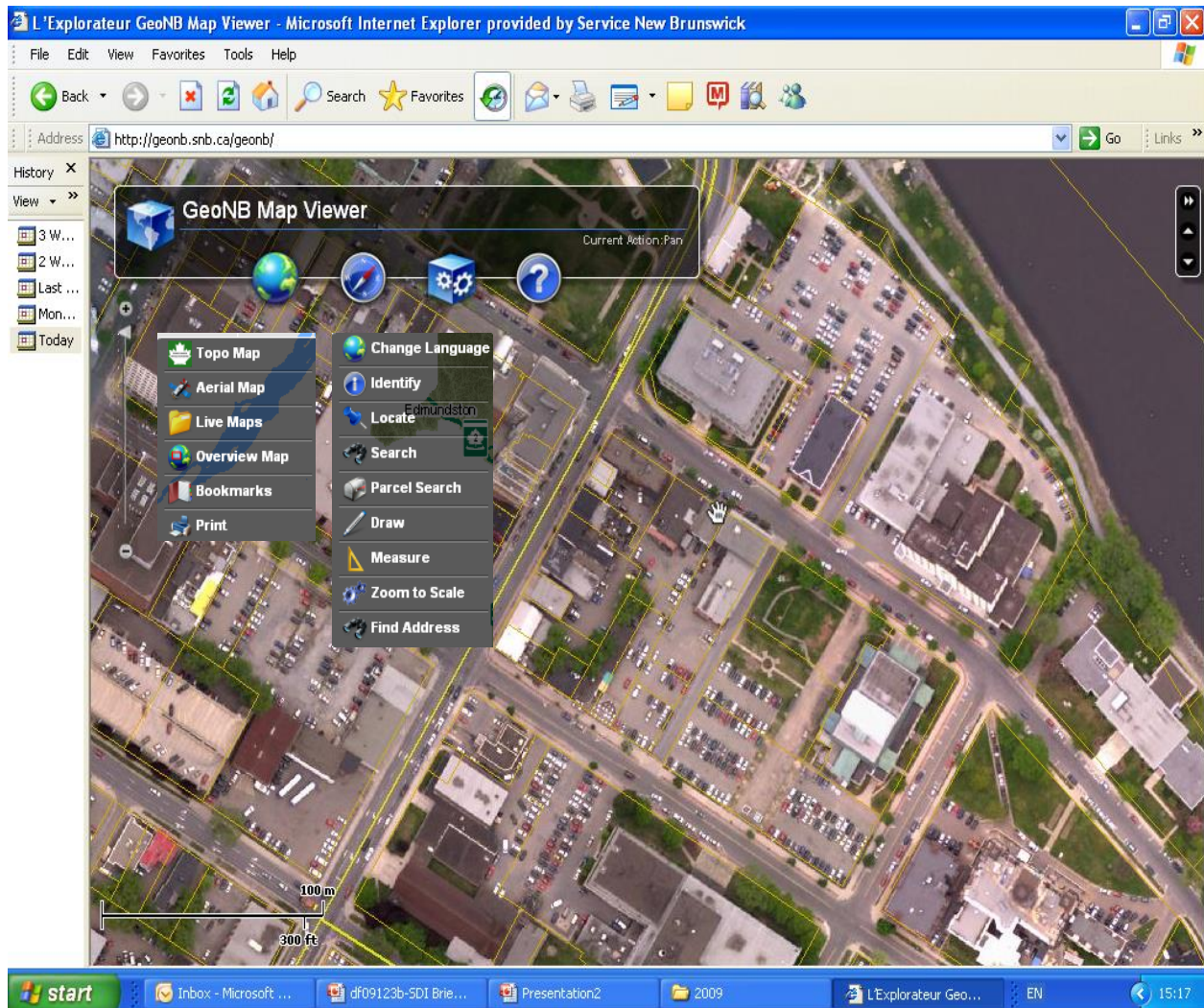
The result was a redesign of the interface to organize the data, functionality and intended use into separate areas – data download, applications, access to static products, and developer corner. This allowed expansion to include geomatics applications that were non-map based such as the coordinate transformation tool. The redesign, launched in 2013, evolved the single viewer to a "portal to all things geographic" and became known as the GeoNB Gateway (Figure 8). Applications were created with a specific user base in mind and rather than include access to all data and much functionality, each application was designed with limited data and functionality – only what was needed to solve the problem, to make it easier for the non-geomatics professional to use the tool.

Figure 8: GeoNB Gateway 2013

GeoNB utilizes ESRI ArcGIS Server and, in additional to downloads and Internet viewing, it makes data available as ArcGIS Server map services (http://geonb.snb.ca/arcgis/rest/services). GeoNB uses dynamic map services and tile cached map services. A current list of GeoNB map services can be browsed in the GeoNB REST services directory. Figure 9 provides one example of such a service that identified protected wellfields for environmental purposes.

Figure 9: GeoNB Application Mapping Protected Wellfields: Fredericton Area
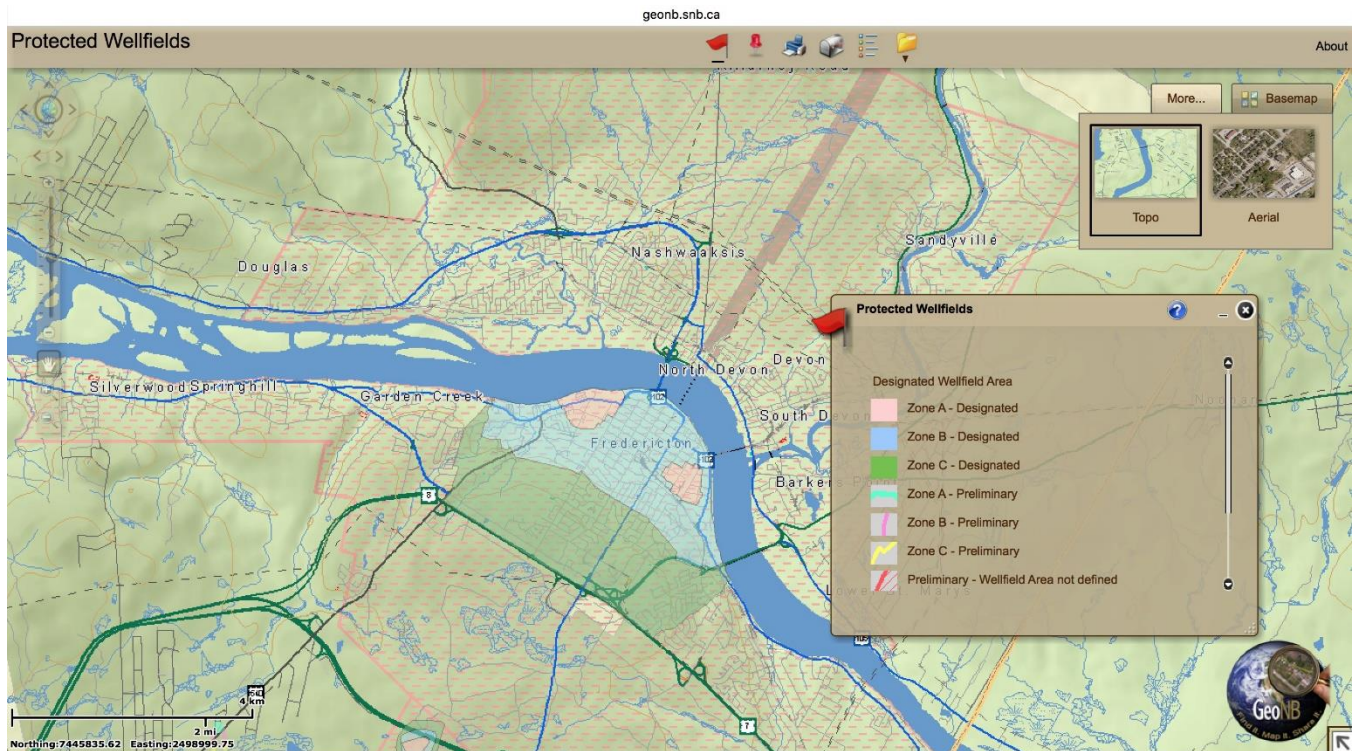
By mid-2016, in addition to province-wide property mapping, DEMs, scanned historical orthophotomaps, and civic address data, over 40 additional geospatial datasets containing specific features or areas of interest have been developed and are now available for download to GIS users in variety of formats depending on the product, including SHP, DXF, Caris and Esri Geodatabase Format (SNB, 2016a). Today, most of the data hosted by GeoNB is available as a map service. When data is available as a map service it can be accessed over the Internet when the data is required. It is not necessary to download a copy of the data to make use of it.

From the original GeoNB base product, over a dozen additional custom designed applications have since been developed which combine data and value-added functionality intended for specifically targeted user groups. These applications are summarized in Figure 10 (SNB, 2016b).

3.3.   Data Usage Metrics

Comparison of usage statistics between PLANET and GeoNB indicates and serves to highlight that both the options available for accessing data as well as the methods for monitoring and measuring usage have changed over the past twenty years. Obtaining reliable longitudinal information concerning growth and changes in user demand is problematic. That said, using the latest version of analytical tools now in use, a snapshot of recent usage is possible.

Figure 11 illustrates the monthly number of GeoNB-related data downloads over the past three years. These represent the number of individual files related to topographic mapping, property mapping and thematic overlay data related to the services listed in Figure 7. On average, approximately 23% of these counts relate to downloads of digital property mapping coverage files which are updated regularly.

Figure 10: GeoNB Applications from Service New Brunswick (SNB 2016b)

Name / Description	Details	Start Application	Fee
Candidate PNA Map Viewer - Displays the name, location, and size of existing and candidate protected natural areas	More Info	START	Free
Find Address - search and find an address in the Georeferenced Civic Address Data Base (GCADB) and display the address location on a map	More Info	START	Free
Flood Information - Display areas along rivers that have an increased risk of flooding	More Info	START	Free
GeoNB Coordinate Transformation Service (CTS) - an application for transforming coordinates between the common datums and map projections used in New Brunswick. (It is a replacement for the "NB GeoCalc" software)	More Info	START	Free
GeoNB Map Viewer – a general purpose map viewer for New Brunswick	More Info	START	Free
Grant Reference Plan (GRP) Viewer - online map application to provide access to the crown grant reference plans and the crown grant document index	More Info	START	Free
Municipal Election Viewer – maps supporting municipal elections	More Info	START	Free
New Brunswick Control Network - access information related to the conventional control survey network and GPS based infrastructures used to derive coordinates in New Brunswick	More Info	START	Free
Oil and Natural Gas (ONG) Viewer - displays location of leases and licenses for petroleum exploration and production, as well as wellheads for the oil and natural gas industry	More Info	START	Free
PLANET - SNB's Land Registry and Mapping Services	More Info	START	Fees
Protected Watersheds - displays locations of protected watersheds on top of GeoNB base maps	More Info	START	Free
Protected Wellfields - displays locations of protected wellfields on top of GeoNB base maps	More Info	START	Free
Recreation Infrastructure Planning Tool (RIPT) - access to mapped recreation facilities, demographic data, property assessment data, and spatial analysis tools to assist in the planning of the province's built recreation and sport infrastructure.	More Info	START	Free
River Watch Tool - a visual synthesis of forecasted flows and monitoring observations in the Saint John River Basin. It provides awareness of potential flood risks and encourages residents to be prepared for flooding events	More Info	START	Free
Wetlands Mapping - displays locations of regulated wetlands on top of GeoNB base maps	More Info	START	Free

Figure 11: Monthly Count of GeoNB Data File Downloads
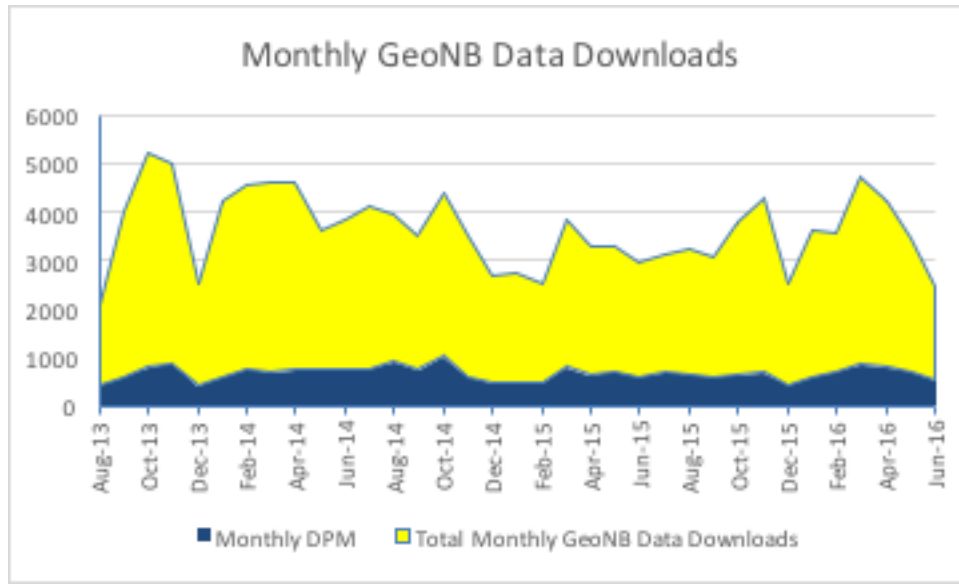
In terms of GeoNB Web Mapping Service usage, Figure12 illustrates the growth on a quarterly basis in the number of individual users accessing the service between the fourth Quarter (i.e., October-December) 2014 and the first Quarter (January-March) 2016. Figure 13 provides the corresponding growth in the number of GeoNB page views over that same 3+ year period.

Figure 12: Number of Individual GeoNB Users Q4 2012 – Q1 2016
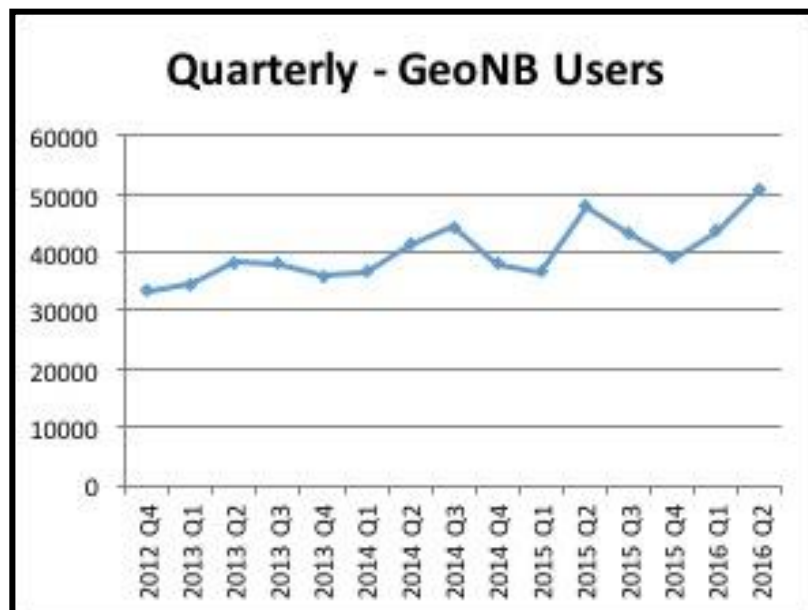
Figure 13: Number of GeoNB Page Views – Q4 2012 to Q1 2016
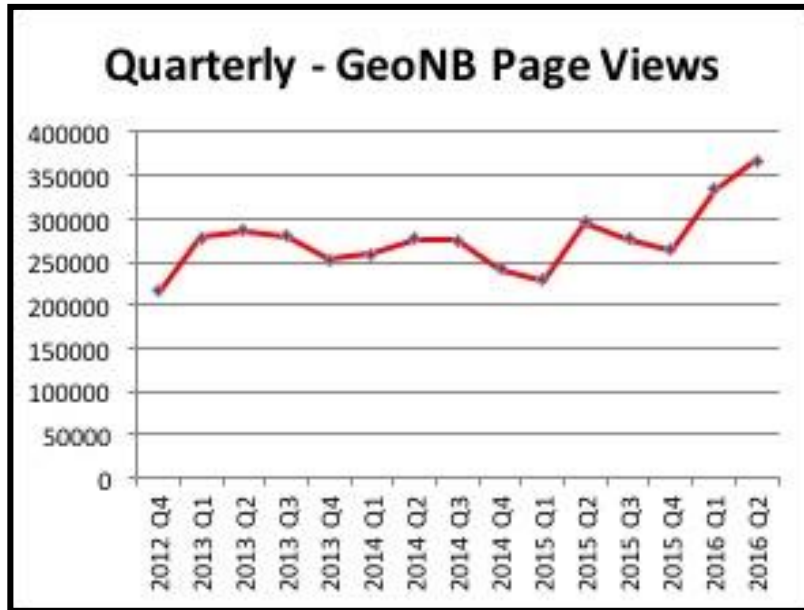
In terms of usage of GeoNB's Web Mapping applications, Figure 14 illustrates the individual usage activity of fourteen different online mapping services built upon the GeoNB server and data. Clearly, the basic GeoNB service is by far the most widely used, with its tracked activity growing overall from approximately 20,000 hits per month in April 2012 to over 50,000 hits in January 2016. All of the other services offer more specialized thematic information that may appeal to smaller user groups or, in the case of the River Watch flood risk mapping tool (labelled "Flood" in both graphs), are accessed principally during the "Spring thaw" months of April and May when there is a higher possibility of flooding along rivers and streams.

Figure 14: Monthly "Hit Count "of GeoNB Applications
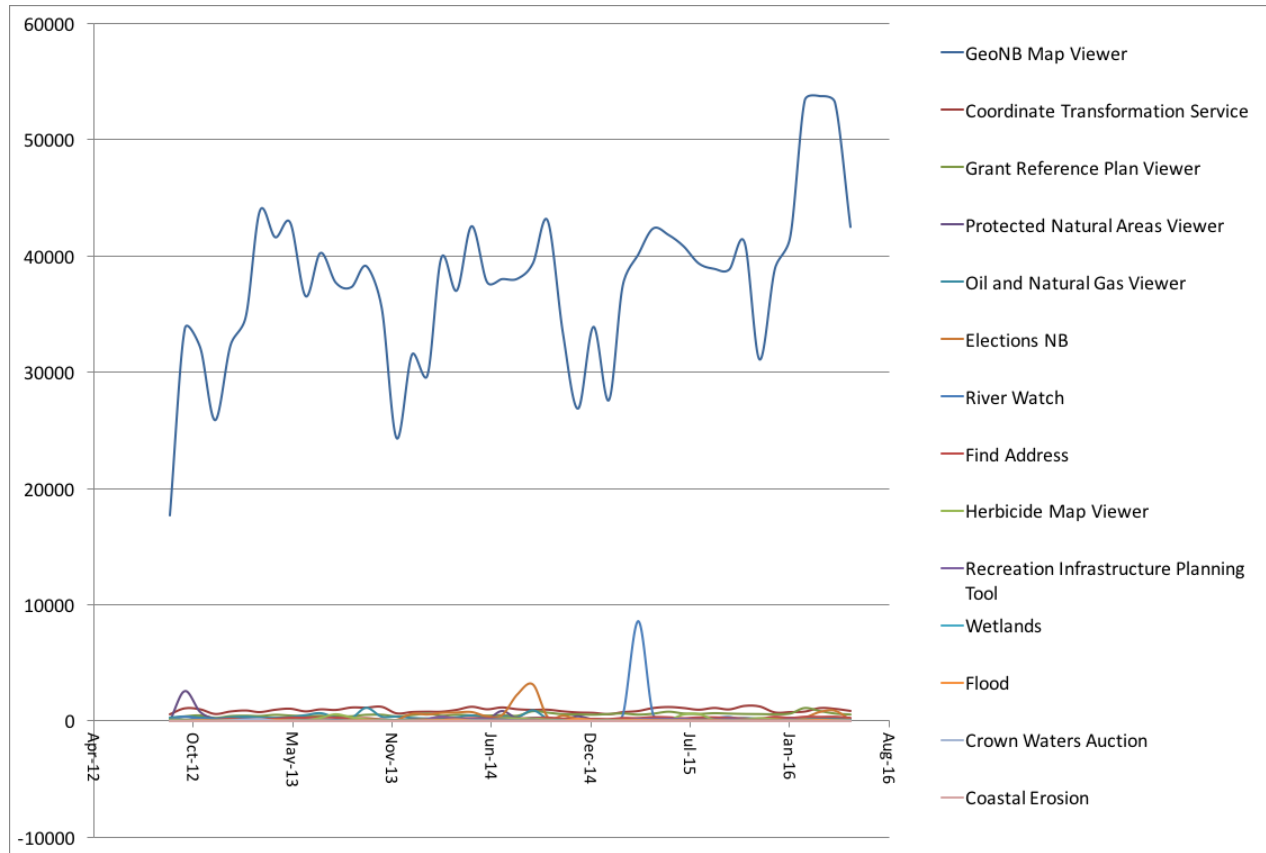
4. BUILDING AND MAINTAINING THE CURRENT INSTITUTIONAL FRAMEWORK

These technological developments did not take place in a vacuum. As the scope of Service New Brunswick expanded to include everything from motor vehicle registrations through hunting licenses through personal property registries, increased database management and online service delivery resources were added BUT maintaining and upgrading the geospatial framework itself (i.e., control framework and base mapping) played a smaller and smaller role on the organization and, in an increasingly challenging economic environment, funding diminished accordingly. Once first–round orthophoto, topographic mapping and DEM collection was completed, the task was thought by senior decision makers to be finished, that maintenance was not necessary and that SNB could move on to other (deserving) priorities also vying for attention.

At the same time, as GIS, Web Mapping and GPS technologies all became more inexpensive, new mapping and positioning activities began to proliferate within individual provincial government units and new geospatial datasets, databases and services emerged. Some of these took advantage of SNB base data but contained additional thematic data collected on a "project-specific" basis and held internally with little attention paid to provincial or national standards for collection and distribution. As in the 1950as and 1960s, all were collected in support of other government activities, were held internally, and were not seen as vehicles for updating or upgrading existing SNB provincial base data.

Further, in keeping with prevailing attitudes of the time through the 1990's, SNB saw its mapping as one channel of "cost recovery" and therefore charged external customers a fee to download topographic data and to access the PLANET service. Thus - and especially as the topographic, orthophoto and DEM data became increasingly out-of-date - larger users outside <u>and inside</u> government began

collecting their own road network data via GPS and their own digital imagery and LiDAR DEM data using industry contractors, sometimes resulting in duplication of effort and public spending.

Finally, especially in the mid-2000s and later, as services like Mapquest, Google, Bing Maps and others became available, even individual citizens began relying on these online services rather than SNB for up-to-date value-added mapping and (especially) imagery. In fairness, as described by Coleman (2012), the increasing public preference for reliance on emerging commercial and open source Web mapping services was and remains a challenge to the continued credibility and relevance of government mapping agencies across the developed world.

SNB faced these challenges by refocusing on desired outcomes rather than reinforcing existing policies and processes, to identify and determine how SNB could remove barriers to allow all users to have access to and use the best geospatial data available.

An internally-commissioned Geomatics Review (AMEC, 2005) confirmed concerns were valid – the New Brunswick geomatics environment was in decline and in trouble unless changes were made. With a strong refocus on geomatics, SNB updated and articulated a "provincial geomatics vision" (Opus, 2016) centered on a more collaborative approach moving forward designed to break down and better integrate the "silos" of geospatial data in place or being developed within the provincial government.

This new vision focused on 5 key result areas – Governance, Policy & Standards, Data, Access (infrastructure), and Communications – each of which is described briefly below.

1. *Governance* – proposed a 3-tiered approach to engage all levels of government, consisting of:

   a. Deputy Minister Oversight & Priorities Committee;
   b. An Assistant Deputy Minister/Executive Director-level committee to align business operations and problems with geomatics opportunities and solutions; and
   c. A Technical Committee to coordinate & identify collaboration opportunities, and deal with technical challenges.

2. *Policy & Standards* – focused on a commitment to update and revise policies and standards to mesh with todays' and future environment, to make it easy to discover, access and use data.

3. *Data* – in particular, transitioning from a lead organization with the mandate to develop base layers but with little business need for the data set to a data custodian/data steward model whereby the custodian has a business need for the data and therefore has more impetus to ensure it is maintained. Furthermore, the approach recommended was to work collaboratively to build one recognized "authoritative" data set rather than have several organizations independently maintaining different versions of the data.

4. *Access (infrastructure)* – the importance of establishing an on-line mechanism to provide discovery, access and use of geomatics data to all users was recognized. Related to this was the adoption of and support for principles such as free, open data. It allowed organizations at different levels of maturity and support of the open data principles to buy into the model according to their schedules, thereby slowly building support and momentum for the vision.

5. *Communication* – focused around building awareness of the potential of and opportunities for geomatics to solve organizational problems. Components of this KRA include: educational, awareness and communication pieces.

5. CURRENT STATUS

Implementing this Vision over the past decade has remained a challenge for all the reasons provided earlier. The Governance Model originally proposed has not worked out as well as hoped: while the Technical Committee has met regularly, it has been more difficult to schedule and ensure regular meetings of Deputy Minister- and Executive Director-level managers. Further, it has been more difficult than anticipated to establish an effective operating environment which incorporates effective proactive leadership while ensuring continued communication, "buy-in", and collegial direction from geospatial users across government.

Communication remains an important issue. Today's users of spatial data may employ the latest technologies but possess limited understanding of the capabilities and limitations of the technologies and datasets they are using. Those that do possess the technical background may be relatively new in their positions and have little "institutional memory" of past practices and decisions in terms of land information infrastructure development, and cooperation.

Regardless of the on-going challenges, important gains have been made in terms of addressing the KRAs and fulfilling the vision. For example:

1. The Data Custodian model has been used to develop and maintain the authoritative water base for New Brunswick. Between 2009 and 2012, the Department of Natural Resources (DNR), Service New Brunswick (SNB) and the Department of Environment & Local Government collaborated to produce the New Brunswick Hydrographic Network (NBHN,) a single, vector-based surface water database covering the entire province (NB Government News Release, 2013). The Department of Natural Resources has taken on the data custodian role as it recognized the importance of the NBHN to its core business. Built to a national water data standard and freely available as a database download or service, the NBHN includes vector representations of all surface drainage features (i.e., rivers, streams, lakes, islands, and watershed boundaries) and includes the names for many rivers and streams. Development of the NBHN has resulted in a huge reduction in internal duplications of effort within different departments, saving $300,000 in up-front costs and $50,000 annually in yearly maintenance costs.

2. The infrastructure shortcomings have been successfully addressed. In July 2013, Service New Brunswick's GeoNB Service was recognized with a Special Achievement in GIS (SAG) Award at the Esri International User Conference in San Diego, California. The service was recognized by Esri for its success in: (a) providing all users with easy access to geographic data, value-added applications and maps; (b) Reducing duplication and costs to government through collaboration and the sharing of geographic data and infrastructure; and (c) Promoting and increasing the use of geographic data and maps.

3. In 2015, a collaborative partnership between Service New Brunswick, Public Safety and Ambulance New Brunswick was recognized nationally for its innovative approach to building an authoritative road network. (NB Government News Release, 2015). The road network is available via GeoNB (http://snb.ca/geonb) as a database, download or view. It includes road centreline and related feature data as well as associated attribute information including road names, address ranges, road classification, surface type, and number of lanes. This cooperative approach has reduced duplication and identified annual savings estimated at $500,000.

4. Over the past two years, SNB has worked with the provincial government departments of Natural Resources and Environment in developing a plan for more coordinated and standards-based collection of LiDAR DEM data.

6. MOVING AHEAD…

While much progress has been made on many of the initiatives discussed above, work remains. In particular, maintenance and long-term sustainability are key areas that continued effort is required.

As New Brunswick moves forward there remain several challenges and questions yet to be resolved. These include:

- *Geomatics as an Enabler* – the evolution of geomatics and its ubiquitous incorporation into mainstream business. What is the proper role Geomatics can play to help New Brunswick, or for that matter, any jurisdiction, meet its business and fiscal challenges? Not surprisingly, a key component of this challenge will resolve around the communication KRA.

- *Geomatics and Open Data* - The relationship of geomatics data and related efforts with the "open data" movement. Geomatics practitioners have long been recognized as early supporters and early adopters of "open" principles and as a result, geomatics data is recognized as early examples of open data. . As non-geomatics practitioners embrace the "open" movement what impact will it have on geomatics efforts to date and in the future? What will become of provincial and national SDIs?

- *Geomatics as a Service* - As New Brunswick wrestles with serious fiscal challenges, the Province is exploring ways to find efficiencies and cost savings. One topic that has re-surfaced is centralization of geomatics expertise and services. The concept of Geomatics-as-a-Service (GaaS) is being considered as a possible model going forward. The province has followed this approach in several areas where overlap exists, including: centralization of Information technology and IT-as-a-Service, centralization of HR and communications. While GaaS has yet to be properly defined, some ideas being discussed include establishing a core group of geomatics expertise to provide service to departments that have not to date invested in geomatics and having a core group ready to be deployed when required to deal with crisis situations.

- *Geomatics Vision* – it has been 10 years since the provincial geomatics vision was re-newed. While much progress has been made toward fulfilling that re-newed vision, much has also changed over that same time period in both the geomatics world as well as the world in general. It would be wise to step back, re-evaluate and review where the province must go and the role geomatics should play.

  Of interest, given the changing environment, will be determining what role is appropriate for government, and the traditional mapping organization, and what role should "trusted partners" and even citizens play as we move forward. Is government nimble enough to compete with the time-lines set by non-government geomatics organizations such as Google and Bing and can government meet the increasing demands of the ever-growing geomatics user base and their expectations of instantaneous data?

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