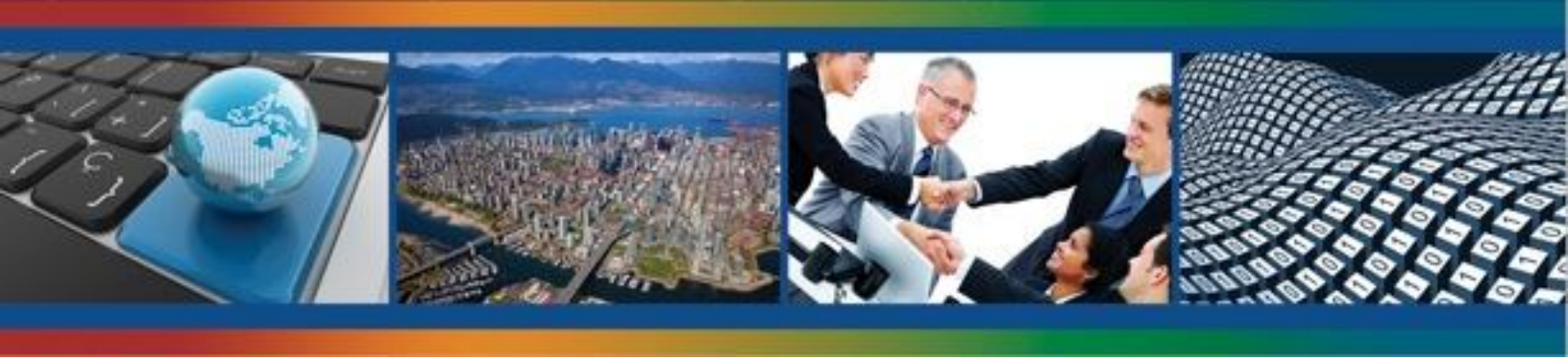

CANADIAN GEOSPATIAL DATA INFRASTRUCTURE
INFORMATION PRODUCT 9

GeoConnections Framework Data Guide

GeoConnections

2009

Natural Resources Canada | Ressources naturelles Canada

Canada

GeoConnections
Framework Data Guide

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Overview

Purpose

Welcome to the GeoConnections Framework Data Guide. This online course is designed to introduce you to framework data concepts, sources and uses. Does your job require you to present information in a geospatial or map form? Do you need to bring together geospatial information from different sources and integrate it on a common base map? Have you had difficulties finding and using common base mapping data? If the answer to any of these questions is yes, this guide is for you.

Framework data is common base map data that provides geospatial reference across Canada to physical features and other types of information that is linked to geography. You can access it from a number of sources at a variety of scales or levels of information detail. Framework data is important because it provides you with a foundation for integrating other kinds of data, which is often required for analysis and reporting purposes.

The guide has two purposes:

- To inform you of the benefits of framework data.
- To help you find and access framework data.

If you have a general background in information technology or use it to analyse data, prepare charts and reports, etc., but are not familiar with geospatial information and its manipulation, this guide will help you. Once you have read the guide, you will know where to find framework data, understand the benefits of different data sources, be in a better position to choose the type of data that best suits your needs, and know how to access it from your own computer.

Structure

This guide consists of five chapters, frequently asked questions, and two annexes:

Each chapter builds on the previous one, so if you are unfamiliar with geospatial framework data it is probably best to at least review each chapter in order. You can then return and focus on the chapters of most interest to you and follow the links to additional information as appropriate.

The Chapter Highlights section at the start of each chapter summarizes the chapter's contents for you. The frequently asked questions (FAQ) section provides a summary of the important points in the guide.

Links throughout the chapters will direct you to more in-depth information on specific topics. Annex A, Where to Obtain More Information, will also allow you to pursue specific interests or get answers to specific questions.

Annex B, Glossary, provides you with a summary of the many specialized terms and acronyms that are endemic to geospatial information.

Frequently Asked Questions

Q1 What distinguishes "framework data" from other kinds of geospatial data?

A1 Framework data is the set of continuous and fully integrated geospatial data that provide context and reference information for the country. Framework data are expected to be widely used and generally applicable, either underpinning or enabling geospatial applications. There is a loose division in definition between data that has more narrow and specific applications (thematic data), and data that is more general in applicability (framework data). Framework data is often used as the foundation for the display of thematic data. More information is available in the Framework Data Concepts section.

Q2 Why are framework data so important?

A2 Framework data make an important contribution to "interoperability" of systems on the Internet. Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged. The concept of interoperability is important for developing geospatial applications that can easily access and integrate data from a variety of data bases developed by multiple organizations that may be using different software packages. Interoperability is important because it significantly reduces the time users need to spend on data conversion, leaving more time for the important activities of analyzing and presenting information. The essential rationale for standardizing framework data layers is to improve their useability, and to make interoperability easier. More information is available at The Importance of Framework Data

Q3 What kinds of data are typically included in the category of framework data?

A3 Framework data in Canada typically take three principal forms: Alignment layers (e.g., Canadian Spatial Reference System, Data Alignment Layer,); Land Feature/Form layers (e.g., Roads, Railroads, Transmission Systems, Structures, Hydrography, Elevation, Satellite and Aerial Imagery); and Conceptual layers (e.g., International, Provincial and Municipal Boundaries, Electoral Districts, DND Properties, Indian Reserves, Crown Subdivisions, Parks, Ecological Units, Watersheds, Toponymy). More information is available at Examples

Q4 What is base map data?

A4 Base map data is synonymous with framework data; it is another term that many people use to identify framework data.

Q5 What is thematic data?

A5 Thematic data are those datasets that describe the characteristics of geospatial features or provide information on specific topics or themes, such as forest types, water contamination, historical flood areas, or disease patterns and trends. These types of thematic information are geospatially referenced so they can be tied to locations on the Earth and shown in map form. Almost any subject or theme that can be expressed as a geographical distribution or has a location-based component can be mapped.

Q6 What is the connection between framework data and the Canadian Geospatial Data Infrastructure (CGDI)?

A6 The Canadian Geospatial Data Infrastructure (CGDI) is Canada's spatial data infrastructure (SDI). SDIs formalize the structure and process for organizing, using and sharing geospatial data and services common to a broad spectrum of applications and users within a country and between countries. The

CGDI consists of the technology, standards, access systems and protocols necessary to harmonize all of Canada's geospatial databases, and make them available on the Internet. The CGDI facilitates the access to and use of the geospatial framework data in Canada that is being developed through partnerships between federal, provincial and territorial governments. More information is available at The Canadian Geospatial Data Infrastructure

Q7 What organizations are involved with collecting and facilitating access to framework data?

A7 The key Canadian organizations are:

- **GeoConnections**, the national partnership program (among federal, provincial and territorial governments, industry and academia) led by Natural Resources Canada that is implementing the CGDI and supporting the development of framework data

- **The Canadian Council on Geomatics** (CCOG), the major federal-provincial-territorial consultative body for geographic information management, which has been instrumental in the establishment of the partnership arrangements for development and maintenance of Geobase

- **The Inter-Agency Committee on Geomatics** (IACG), an inter-departmental federal co-ordinating body for the effective and efficient utilization of geomatics within the Canadian government, which plays a strong role in ensuring that all federal government information systems that use geospatial information are linked to the CGDI and use the framework data

More information is available at Canadian Organizations

The key international organizations are:

- The **Open Geospatial Consortium** (OGC), a consortium of companies, agencies and universities that promotes the development and use of advanced open systems standards and techniques in the area of geoprocessing and related information technologies

- The **International Organization for Standardization** Geographic Information/Geomatics Technical Committee 211 (ISO/TC 211), which is responsible for the ISO geographic information series of standards

More information is available at International Organizations

Q8 What is the primary source of framework data in Canada?

A8 GeoBase is a set of common, up-to-date and maintained framework data covering all of Canada that was developed and is being maintained by multiple levels of government working together.

The current data themes that are available in GeoBase are:

- Canadian Digital Elevation Data (CDED), an ordered array of ground elevations at regularly spaced intervals

- Canadian Geodetic Network, horizontal and vertical geodetic control information for thousands of geodetic markers distributed across Canada

- Canadian Geographical Names Database (CGNDB), the data bank of Canada's geographical names maintained by Natural Resources Canada

- Administrative Boundaries, which includes: Canadian Geopolitical Boundaries, the international, inter-provincial and territorial boundaries, as well as the boundaries of Canada's exclusive economic zone; and Aboriginal Lands, polygon entities that depict the administrative boundaries (extent) of lands that are set aside for the benefits of specific Aboriginal groups in Canada

- National Hydro Network (NHN), the data representing the inland surface waters of Canada

- National Road Network (NRN), a representation of the centerline of all non-restricted use roads in Canada

- Satellite Orthoimagery, which includes orthoimagery created from Landsat 7 data acquired between 1999 and 2003, updated orthoimagery derived from SPOT 4 and SPOT 5 satellite data, and several Radarsat 1 scenes, circa 2001-2002 covering far northern Canada

- Data Alignment Layer, the control points that were used for the geometric correction of Landsat 7 satellite imagery

- Land Cover, the result of vectorization of raster thematic data originating from classified Landsat 5 and Landsat 7 orthoimages, for agricultural and forest areas of southern Canada and for the Northern Territories

More information is available at Current Data Themes

It is expected that the number of available GeoBase data themes will continue to grow. Work is underway to define the data standards and data models for the Municipal Boundary data theme, and these data are expected to be available by 2010. Other potential data themes include:

- Cadastral Mapping

- Railroads

- Power lines

- Structures

- Key buildings

- Electoral boundaries

- Parks

More information is available at New Data Themes

Q9 How can I access the GeoBase data?

A9 GeoBase data can be accessed at the Internet portal created for that purpose. Users have the option of directly downloading data in complete themes or by specific geographic area, or dynamically retrieving data using a Web Map Service (WMS). Detailed instructions on the use of these options are available at How to Access GeoBase Data

Q10 Are there other sources of geospatial data for Canada that are available on the Internet?

A10 While the primary source of framework geospatial data is the GeoBase Portal, which contains integrated layers of framework data contributed by federal and provincial mapping agencies, there are

other sources as well, including municipal governments and commercial data suppliers. The following sources of geospatial data available on the Internet are key CGDI resources:

- The **GeoConnections Discovery Portal** provides infrastructure tools and services for the discovery of, and access to, geospatial organizations, data and services. It is a gateway for Canadian industry to distribute services and millions of geospatial data products. Data can be browsed by metadata or searched by subject, coverage or product type to find, evaluate, visualize and access what is available. The Discovery Portal is the prime discovery and access component of the CGDI

- **GeoGratis** provides geospatial data at no cost and without restrictions. The data are compatible with the most popular geographic information systems (GIS), with image analysis systems, and with graphics editing software. The data are grouped in about 80 collections and include raster data, such as satellite images or scanned topographic maps, vector data, such as national-scale frameworks (grouped by theme), and a database of ground control points that can be used to correct and validate satellite, vector and raster data.

- The **Atlas of Canada** provides authoritative, current and accessible geographic information products at a national level. The Atlas of Canada data covers all of Canada and data elements are feature-coded and structurally clean. Base map components are available in five scales and in a number of data exchange formats. The 1: 2,000,000 and 1: 7,500,000 scales are the primary bases for all Atlas products. The 1: 30,000,000 scale data have been generalized from the two larger scales.

- **Provincial Portals** have also been established by a number of Canadian Provinces and Territories to provide access to geospatial data. Much of this data is also available through the Discovery Portal.

More information is available at Other Sources of Data

Q11 How can framework data be used in information system applications?

A11 Many Canadian organizations are using framework data in information applications that cover a wide range of uses. Some examples of the application of framework data that illustrate its potential use include:

- **Geo Portal for Eeyou Istchee**, an Internet portal to help an Aboriginal community to manage tourism and land use harmoniously.

- **MapSherpa**, an on-line mapping service that allows users to make maps for their personal, organizational or customer needs.

- **Radio Mobile**, freeware that was developed for amateur radio users to help predict radio frequency patterns and the performance of radio systems.

- **National Forestry Information System**, an information infrastructure to provide answers on matters relating to sustainable forest management in Canada.

- **Online Injury Atlas for Ontario,** a password protected Web site that allows health care workers to view the distributions of injuries by type and age ranges, according to census subdivisions or local health integration network (LHIN) areas.

More information is available at Example Applications of Framework Data

1. Chapter 1: An Introduction to Framework Data

The purpose of this Chapter is to introduce you to the concept of 'framework data'. The following sections provide important definitions and describe framework data forms and characteristics. The Chapter concludes with some examples to illustrate the types of information most commonly found in framework data sets.

1.1 Chapter Highlights

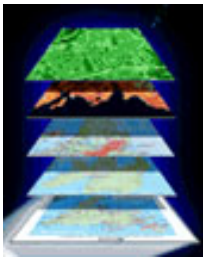
In this Chapter, you will learn about:

- Framework data concepts and definitions of key terminology
- The principal forms and characteristics of framework data
- Examples of each of the principal forms of framework data

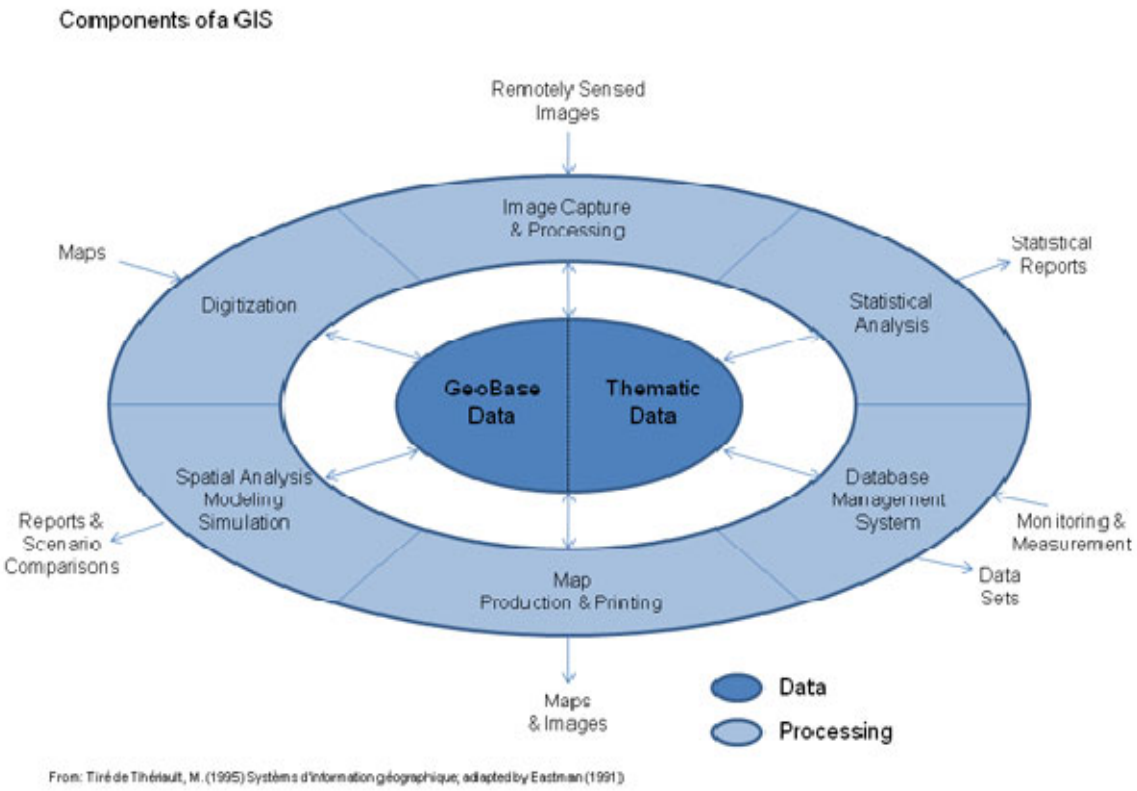
1.2 Framework Data Concepts

Framework data is the set of continuous and fully integrated geospatial data that provide context and reference information for the country. Framework data are expected to be widely used and generally applicable, either underpinning or enabling geospatial applications.

Typically, geospatial data are stored and displayed in 'groups' called 'layers'. Each data layer shows one type of feature (such as roads, rivers, administrative boundaries, satellite imagery, or elevation), as depicted in the following figure.



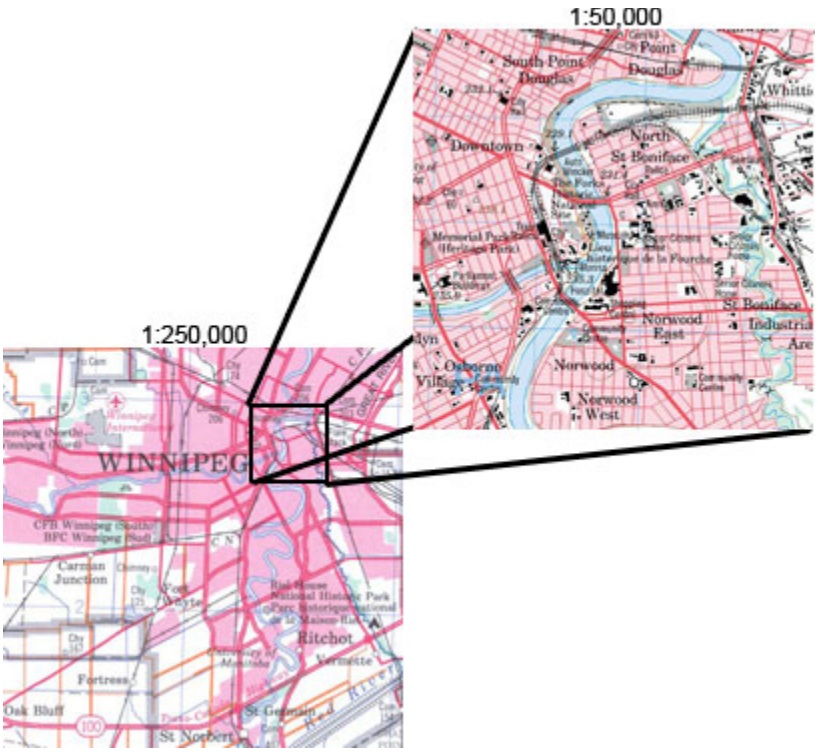
Data layers can then be easily and independently manipulated in a Geographic Information System (GIS). As illustrated in the following figure, typical GIS components include existing framework data sets (such as GeoBase) and thematic data sets, new types of data input (such as maps, images and data from monitoring and measuring instruments of different kinds), and data processing capabilities (such as digitization, spatial analysis, database management, etc.), which are combined to produce various types of outputs (such as statistical reports, scenarios, maps and images).



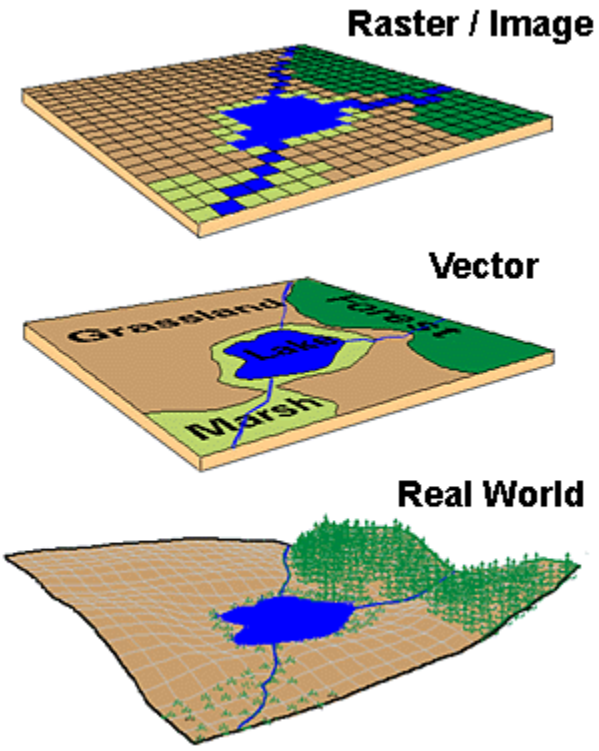
There is a loose division in definition between data that has more narrow and specific applications (thematic data), and data that is more general in applicability (framework data). Framework data is often used as the foundation for the display of thematic data. The focus of this guide is framework data.

Specifying any type of data as framework data is subject to its availability over large areas of the country, its geometric integration to alignment layers, and a consensus among major stakeholders on the general importance of the data.

Geospatial data can be displayed at a number of different scales. Scale is a ratio between the size of the area displayed and the size of the area in the real world, as illustrated in the following figure. At larger scales (e.g. 1:50,000), geospatial data can be seen in greater detail (i.e. at greater resolution) than at smaller scales (e.g. 1:250,000). In order to depict data in greater detail, higher accuracy is required in the compilation of the geospatial data.



Geospatial data can be displayed in vector or raster formats, as shown in the following figure. Raster data consists of a matrix of values, each representing a color or grayscale level. These are displayed on screens or paper as pixels. Raster data is often associated with images (digital photos, etc). Raster data can be visualized and manipulated with software designed for graphical applications, but such software cannot maintain any geographic coordinates in the data. Specialized geospatial software available from a number of suppliers can maintain geographic coordinates and provide tools to create, manage and analyze satellite, airborne and ground level geospatial imagery. Examples of files in raster format are: .gif, .tif and .jpg. Raster data in GeoTiff format require GIS software to maintain the geo-referenced information.



Vector data is made up of geometrical objects (points, lines and surfaces or polygons) having attributes of form, color and position. This type of data can be displayed and manipulated with drawing software and GIS software. Examples of GIS files in vector format are: .shp, .E00, .tab, .dxf, and .gml.

The advantages and disadvantages of each of these formats of geospatial data are identified in the table below.

Format	Advantages	Disadvantages
Vector Data	Can be magnified without loss of graphics quality Can be displayed in layers Allows advanced spatial analysis (e.g., measuring the length of a street segment or the area of a lake, or identifying the number of houses within a certain radius of a hospital) Easier to register, scale, and re-project, simplifying combining layers from different sources More compatible with relational database	Location of each vertex needs to be stored explicitly Must be converted into a topological structure for effective analysis, which is processing intensive and may require extensive data cleaning Updating or editing the data requires re-building of the topology Algorithms for manipulative and analysis functions are complex and may be processing intensive, often limiting the functionality for large data sets Continuous data, such as elevation data, is not effectively represented

	environments Easier to update and maintain (e.g., a new road segment can be added to a vector data set while the raster image will have to be completely reproduced) Can be represented at its original resolution and form without generalization Has a relatively compact data structure so storage requirements are less Individual features can be accurately located	Spatial analysis and filtering within polygons is impossible Overlay operations are difficult to implement Manipulation and enhancement of digital images cannot be effectively performed
Raster Data	Data analysis is usually easy to program and quick to perform because of the nature of the data storage technique Ideally suited for mathematical modeling and quantitative analysis due to inherent nature Very compatible with raster-based output devices such as electrostatic plotters, graphic terminals Simpler data structure Overlay operations are easily and efficiently implemented Scanning technologies can supply huge quantities of data cheaply Area and polygon analysis is simpler Well suited to subdividing spatially continuous variables	Require more storage space Visual quality decreases at higher magnifications Specific objects in the image (e.g., a building) cannot be manipulated The cell size determines the resolution at which the data is represented Difficult to adequately represent linear features so network linkages are more difficult to establish Processing of associated attribute data may be cumbersome if large amounts of data exist Raster maps inherently reflect only one attribute or characteristic for an area Data often must undergo vector-to-raster conversion since most data is in vector form, requiring increased processing and often reducing data integrity due to generalization and choice of inappropriate cell size Output maps may not meet high-quality cartographic needs, especially those produced on cheaper GIS software Topological relationships are difficult to represent Does not always contain georeferencing, making overlays with other datasets difficult

1.3 The Importance of Framework Data

Why are framework data so important? Due to their applicability to such a wide variety of important government and industry business uses, framework data functions as the underpinning for many geospatial information applications across multiple organizations, as well as important 'anchors' for the development of integrated data sets for data collection, reporting and analytical processes.

Framework data make an important contribution to "interoperability" of systems on the Internet. Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged. The concept of interoperability is important for developing geospatial information applications that can easily access and integrate data from a variety of data bases, developed by multiple organizations that may be using different software packages.

One reason that interoperability is important is that it significantly reduces the time users need to spend on data conversion, leaving more time for the important activities of analyzing and presenting information. An equally important reason is that interoperability means that organizations in different departments or jurisdictions can share and exchange information or work on joint projects. Use of common framework data facilitates the breaking down of "information silos" that often inhibit the development of cross-organizational spatial information projects that are required to address complex policy issues.

The essential rationale for standardizing framework data layers is to improve their useability, and to make interoperability easier. Adoption of common standards for framework data improves the ability to not only integrate data for analysis, but also to reduce the potential for duplication and having to create and maintain framework data within different organizations.

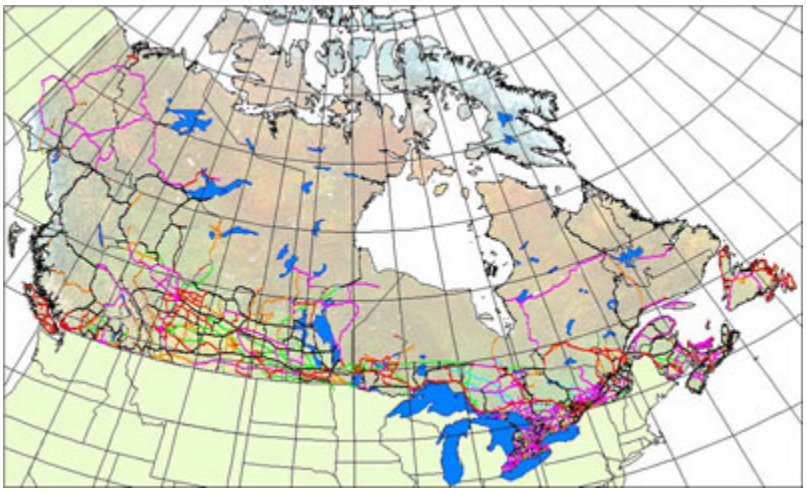
The GeoConnections program consulted widely with federal and provincial/territorial agencies, the private sector and academic community to develop a working definition for framework data in support of the Canadian Geospatial Data Infrastructure (CGDI). Through this initial consultation and needs assessment, 22 "framework data layers" were identified. These layers are described in the 'Examples' section of this Chapter.

1.4 Forms of Data

Framework data take three principal forms:

- Alignment layers;
- Land Feature/Form layers; and,
- Conceptual layers.

Alignment layers include visible features such as road intersections on maps and imagery and control points required to adequately position geospatial information. By themselves, these layers do not represent physical, economic or social phenomena, as do other framework layers or application specific layers, but these layers are critical to the reliability and use of all other layers.



Map of Geodetic Control Locations

Land Feature/Form layers contain representations of well-defined and readily observable natural or manmade physical features that are not subject to interpretation or speculation. These layers include many of the same features that are visible on topographic maps and Internet mapping applications like Google Maps, such as roads, rivers and elevation. Although useful for many applications by themselves, they are also used to provide reference information for the conceptual layers.

Map of Elevation

Conceptual layers are the frameworks that society develops and uses to describe and administer the country. These layers complement a vast amount of application-specific data. They are often interpreted from observations of physical, economic or social factors, and include features such as municipal boundaries, federal electoral districts, and ecological areas.

Map of Administrative Boundaries

1.5 Data Characteristics

All framework data sets comply with certain standards regarding: content (i.e., what features are included in each data layer); structure (i.e., how the data is stored in the computer); and semantics (i.e., the meaning of the data, such as its type, what it represents (e.g., buildings, land cover, rivers), and what the spatial relationships and characteristics of those things are (e.g. that the river is connected to the lake); as well as the metadata (i.e., data about the data) that describes it. In Canada, those standards are defined by the Canadian Geospatial Data Infrastructure (CGDI). More information on the CGDI can be found in Chapter 5.

In order to satisfy urgent needs for framework data, data sets are offered as soon as they become available. This implies that some data may be initially only available locally through partner organizations such as provincial mapping agencies. The GeoConnections program is working to provide a complete framework data set for Canada. More information on the GeoConnections program can be found in Chapter 5.

In order to make the framework data usable, a coherent or logical, orderly and consistent relationship between data layers, and integration of the data have to be ensured. Down the road, as new subsets of data themes get included in the framework, the desired evolution of data integration could be achieved on four different levels. The approach is incremental so that each level is based on the previous ones. Accordingly, the last level is the most demanding, but offers the greatest integration. The four levels are:

- Spatial reference system: All horizontal and vertical coordinates of data themes that form the layers of the framework have to be based on the Canadian Spatial Reference System. This is the minimum requirement.

- Scales of data themes: All data sets of the same scale and themes have to be horizontally integrated. Data sets having the third dimension (3D) and Digital Elevation Models (DEM) are vertically integrated.

- Geometric identifiers: Each geometric representation has its unique identifier, which is a number that is used for maintenance (revision) purposes. It is also used to ensure that all users' applications refer to the same feature. The identifier is unique per data theme and per scale.

- Unique geometry: One – and only one – identifier and set of geometries is maintained for each feature (i.e., features are not stored at multiple scales or detail levels). Going beyond the level of a unique geometry is not expected within the scope of the existing GeoConnections program.

Metadata exists for all framework data and is very important because it is the primary means by which users can decide if the data will meet their needs. Metadata describes different aspects of the framework data, including:

- Identification -- What is the name of the data set? Who developed the data set? What geographic area does it cover? What themes of information does it include? How current are the data? Are there restrictions on accessing or using the data?

- Data Quality -- How good are the data? Is information available that allows a user to decide if the data are suitable for his or her purpose? What is the positional and attribute accuracy? Are the data complete? Were the consistency of the data verified? What data were used to create the data set, and what processes were applied to these sources?

- Spatial Data Organization -- What spatial data model was used to encode the spatial data? How many spatial objects are there? Are methods other than coordinates, such as street addresses, used to encode locations?

- Spatial Reference -- Are coordinate locations encoded using longitude and latitude? Is a map projection or grid system, such as the State Plane Coordinate System, used? What horizontal and vertical datums are used? What parameters should be used to convert the data to another coordinate system?

- Entity and Attribute Information -- What geographic information (roads, houses, elevation, temperature, etc.) is included? How is this information encoded? Were codes used? What do the codes mean?

- Distribution -- From whom can I obtain the data? What formats are available? What media are available? Are the data available online? What is the price of the data?

- Metadata Reference -- When were the metadata compiled? By whom?

1.6 Examples

This section provides descriptions of possible framework data layers. While many of these layers are often available in different base map data sets, they may not be currently available in, or planned for addition to, GeoBase (those Geobase layers currently available are indicated below). Current framework data layers are available from the GeoBase Portal, described in Chapter 2 and other Internet portals, described in Chapter 3.

1.6.1 Alignment Layers: Horizontal and Vertical Control

Canadian Geodetic Network (part of GeoBase)

This layer normally includes the geodetic control points as well as the active control systems that allow observations to be related to geodetic reference systems as defined by those geodetic control points. Real-time and post-mission processing systems that link positioning systems to the Canadian Spatial Reference System (CSRS) are also included.

The horizontal and vertical location of these points is known to a high degree of accuracy, but they are not visible on imagery, unless targeted on the ground or symbolized on maps. Although you (and most other geospatial data users) may not directly use them, these points are fundamental to the correct positioning of the entire framework.

Data Alignment Layer (part of GeoBase)

These points are highly visible features such as the intersections of roads. They are known to a lesser degree of accuracy than the geodetic control points, but they are easy to identify on most maps and imagery. You can use these points to align data sets derived from base maps of different sources, vintages and scales.

1.6.2 Land Feature/Form Layers: Well defined and observable features

Roads (part of GeoBase)

Streets and numbered roads are normally included in this layer. In some areas, resource extraction roads may also be included in this layer.

Railroads

Both current and abandoned railway lines are normally included in this layer.

Transmission Systems

This layer normally consists of electricity transmission lines and pipelines that are visible features of the landscape and help to register other information.

Structures

This layer normally consists of significant man-made structures such as bridges, airport terminals, lighthouses, ferry terminals, ports and dams.

Hydrography (part of GeoBase)

This layer normally consists of rivers, lakes, glaciers, snowfields and coastlines. Both freshwater and marine features are usually included in this layer.

Elevation (part of GeoBase)

Digital Elevation Model (DEM) data that cover both terrestrial and marine areas are normally included in this layer.

Imagery (part of GeoBase)

This layer is visual reference imagery from aerial and satellite earth observation systems.

1.6.3 Conceptual Layers: Interpreted boundaries

These boundaries delineate a wide variety of jurisdictions and responsibilities. Boundaries included in the framework data are in general usage, or are of interest to multiple sectors of society.

International Boundaries (part of GeoBase)

The current international boundaries, including marine international boundaries, at national and regional resolutions.

Provincial Boundaries (part of GeoBase)

The current provincial and territorial boundaries at national and regional resolutions.

Electoral Districts

Federal and provincial electoral boundaries at national and regional resolutions.

Municipalities

Counties, regional municipalities, urban municipalities and/or rural municipalities at regional and national resolutions.

DND Properties

The external boundaries of the Department of National Defense (DND) properties at regional and national resolutions.

Indian Reserves (First Nations) (part of GeoBase)

The external boundaries of Indian Reserves (First Nations) at regional and national resolutions.

Crown Subdivisions

Original Crown subdivisions, including lots and concessions, sections and quarter sections and similar land parcel information at the regional resolution.

Parks

The boundaries of national and provincial parks at regional and national resolutions.

Ecological Units

At the national resolution, all five levels of the ecological framework (ecozones, ecoprovinces, ecoregions, ecodistricts and soil landscapes) for terrestrial areas, but currently only ecozones and ecoregions for marine areas.

Watersheds (part of GeoBase)

Watershed boundaries at national and regional resolutions. The national resolution is included down to the sub-sub-watershed level.

Toponymy (part of GeoBase)

The contents of the Canadian Geographic Names Database (CGNDB), which includes the names of municipalities, rivers and lakes, highway numbers, etc., are included as part of the conceptual framework for the country. Toponymy attached to other framework layers may be used to derive portions of this national toponymic data set.

2. Chapter 2: GeoBase Framework Data

This Chapter introduces GeoBase, the primary source of framework data that has been developed as part of the Canadian Geospatial Data Infrastructure. The following sections describe its technical characteristics, the current and proposed data themes, and how you can access the data.

2.1 Chapter Highlights

In this Chapter, you will learn about:

- GeoBase, the primary source of framework data in Canada
- The important technical characteristics of GeoBase data
- Details of each of the currently available GeoBase data themes including: a description, online sources of documentation, metadata details, use and restrictions, available access data formats, and current status
- New data themes that are planned
- Navigating GeoBase and downloading GeoBase data to your own computer

2.2 What Is GeoBase?

GeoBase is a set of common, up-to-date and maintained framework data covering all of Canada; multiple levels of government work together to collect and maintain the data.

The GeoBase portal provides you with access to national coverage of framework data through a single access point. There are currently nine framework data themes (Digital Elevation Data, Geodetic Network, Geographical Names, Administrative Boundaries, National Hydro Network, National Road Network, Satellite Imagery, Data Alignment, and Land Cover). Additional data themes will be added in the coming years.

The data is available at no charge and without limitations on its subsequent use, under a common data license. You can access the data in two ways: by downloading the datasets in files, or by direct application access to data in real time, eliminating the need for users to store or manage datasets. Instructions for accessing the data are provided here.

The data is maintained according to published standards and meets or exceeds a minimum standard for accuracy, resolution and currency. The standards meet international norms, making the data compatible with both commercial and custom geospatial information applications. The frequency of updates varies with the volatility (rate of change) of the data theme.

All GeoBase data themes include Federal Geographic Data Committee (FGDC) compliant metadata. Metadata are "data about data". They describe the content, quality, condition, and other characteristics of data, thus helping you to locate and understand the data so that you can decide if it meets your needs.

GeoBase data is seamless across Canada; data provided by different data custodians is edge matched to ensure seamless data. GeoBase data is also consistent across themes; as far as technically possible and feasible all GeoBase data themes fit together correctly.

2.3 Current Data Themes

In 2003, seven data themes or layers having national coverage were made available to the Canadian framework data user community via the GeoBase portal and in 2007 and 2008 the eighth and ninth data themes were added. By 2010, one additional data theme will be available. Other data themes are also under consideration for future additions <See New Data Themes>.

Currently the GeoBase portal contains the nine framework data themes or layers described in the following sections.

2.3.1 Canadian Digital Elevation Data

The Canadian Digital Elevation Data (CDED) layer consists of an ordered array of ground elevations at regularly spaced intervals. CDED plays a similar role to contours and relief shading on conventional paper maps (i.e., it allows users to see the differences in elevation between different features shown on the map) but is more powerful analytically. For example, you can use CDED for determining orientation and the slope of each point when used in GIS applications, for terrain modeling, for calculating the influence of the terrain on line-of-sight, for radar imaging, for simulating flooding, and similar applications.

The source data for CDED are the hypsographic (i.e., the elevation of above ground terrain features) and hydrographic (i.e, the elevation of under water terrain features) elements of the 1:50,000 and 1:250,000 scale data in the National Topographic Database (NTDB) produced by Natural Resources Canada and/or data acquired from the provinces and territories. The 1:250,000 scale CDED dataset contains complete coverage of the Canadian landmass. The 1:50,000 scale CDED dataset continues to be built. In 2009, 75% of the 1:50,000 scale CDED dataset was completed. Most of the remaining work to be done was in northern Quebec, the Northwest Territories and Nunavut. The 1:50,000 CDED dataset is scheduled to be completed by 2012.

A CDED file consists of elevation data relative to Mean Sea Level, with coordinates based on the North American Datum 1983 horizontal reference datum. With few exceptions, each CDED file covers one half of a National Topographic System (NTS) map sheet. Depending on the latitude of the CDED section, the

grid resolution varies from 8 to 23 metres for the 1:50,000 NTS tiles, and from 32 to 93 metres for the 1:250,000 NTS tiles respectively.

2.3.2 Canadian Geodetic Network

The Canadian Geodetic Network contains horizontal and vertical geodetic control information for thousands of geodetic markers or monuments (i.e., permanent and stable survey markers for which precise coordinates have been established) distributed across Canada. The point information for each marker includes geographic and UTM coordinates, orthometric height, marker information description, and inspection data.

The Canadian Geodetic Network includes points in four principal control networks:

- Canadian Base Network
- Primary Vertical Bench Marks
- Federal 3-D Densification Network
- Federal 2-D Densification Network

More detailed technical information can be found at: www.geod.nrcan.gc.ca/index_e.php

Canadian Base Network

The Canadian Base Network consists of an array of pillars at an average spacing of 200 km in the built-up areas of southern Canada, 500 km in the middle regions of Canada, and 1,000 km in the northern areas. As well as being a GPS control network, the Canadian Base Network can serve as a monitoring network for deformation studies of the Canadian landmass.

Map of Geodetic Markers in Canadian Base Network

Primary Vertical Bench Marks

The Primary Vertical Bench Marks are monuments established about every 2 km along major highways and railways across Canada. Elevations issued by the Geodetic Survey Division (GSD) are those based on the 1928 adjustment of the national leveling networks - Canadian Geodetic Vertical Datum 1928 (CGVD28).

Map of National Leveling Networks

Federal 3-D Densification Network

The Federal 3-D Densification Network consists of approximately 2,000 monumented stations, positioned three-dimensionally with GPS to centimetre-level accuracy with respect to the Canadian Active Control Systems (CACS). The network densifies 3-D control within the Canadian Base Network.

Federal 2-D Densification Network

Geodetic Survey Division (GSD) provides a horizontal 2-D (NAD83) network of interconnected control surveys with approximately 13,000 monuments spaced 20 to a maximum of 100 km apart for the Yukon Territory, Northwest Territories and Nunavut. These networks are comprised of physically marked survey stations across Northern Canada for which horizontal coordinates are determined.

2.3.3 Canadian Geographical Names

The Canadian Geographical Names Database (CGNDB) is the data bank of Canada's geographical names maintained by Natural Resources Canada, examples of which are shown in the following figure. The CGNDB stores the names and attributes of geographical locations (e.g., municipalities, rivers, lakes, etc.) that have been approved by the Geographical Names Board of Canada (GNBC). These authoritative records are made available for government and public use. Changes to the CGNDB are provided by naming authorities across Canada.

A subset of CGNDB data is available on the GeoBase Portal for data extraction and visualization. This dataset contains the officially approved names, and is referred to as the Canadian Geographical Names collection. Additional attributes for this dataset as well as information on formerly approved names are available through the Canadian Geographical Names Service (CGNS).

The CGNDB covers the Canadian landmass and water bodies and the names have been collected from 1897 to present. While GeoBase allows for batch extraction of geographical names for Canada, it is suggested that you visit the Canadian Geographical Names Data Base Web site to locate a specific name or place.

2.3.4 Administrative Boundaries

The Administrative Boundaries layer is currently made up of two types of boundaries:

- Canadian geopolitical boundaries
- Aboriginal lands

Canadian Geopolitical Boundaries

This data theme contains the international, inter-provincial and territorial boundaries, as well as the boundaries of Canada's exclusive economic zone. It is not intended for legal use, and should be utilized for cartographic and edge matching purposes only.

The dataset is comprised of three files: an administrative boundary file, an administrative areas file and a metadata file.

The administrative boundary file is made up of non-overlapping, topologically correct (i.e., the line segments are connected, with no gaps or overlaps) simple features. A line that bounds two adjacent administrative areas defines an administrative boundary (e.g., the boundary between Alberta and Saskatchewan). An administrative boundary may be split into several smaller segments, due to changes in attribute information (e.g., a part of the national boundary may also be a provincial boundary).

The administrative areas file is made up of adjacent (contiguous) polygons (e.g., the province of Alberta). The polygon boundaries are aligned with the corresponding features in the administrative boundary file.

Each boundary segment has metadata that provides associated accuracy values. Depending on the type of boundary, the accuracy of a segment will vary, consistent with the following map scales:

- Exclusive economic zone of Canada: 1:1,000,000
- Inter-provincial/territorial boundary: 1:100,000
- International boundary: 1:5,000

Aboriginal Lands

The Aboriginal Lands product consists of polygon entities that depict the administrative boundaries (extent) of lands that are set aside for the benefits of specific Aboriginal groups in Canada. More specifically it includes the following lands:

Indian Reserves

Lands that include:

- Surrendered lands or a reserve, as defined in the Indian Act. This definition excludes Indian Settlements and Indian Communities.

- Sechelt lands, as defined in the Sechelt Indian Band Self-Government Act, chapter 27 of the Statutes of Canada, 1986.

Land Claim Settlement Lands

Lands created under the Comprehensive Land Claims Process that do not or will not have Indian Reserve status under the Indian Act. They include:

- Category IA lands or Category IA-N lands, as defined in the Cree-Naskapi (of Quebec) Act, chapter 18 of the Statutes of Canada, 1984. Category IB and Category II lands are excluded from this definition.

- Settlement lands, as defined in the Yukon First Nations Self-Government Act, and lands in which an interest is transferred or recognized under section 21 of that Act. Only Yukon First Nations Settlement Lands that were surveyed and for which the survey plan was recorded are included in the dataset.

Indian Lands

Lands that include:

- Lands in the Kanesatake Mohawk interim land base, as defined in the Kanesatake Interim Land Base Governance Act, other than the lands known as Doncaster Reserve No. 17.

- The Aboriginal Lands that are created and maintained on a monthly basis by the Surveyor General Branch (SGB) of Natural Resources Canada. Polygon entities are generated from the cadastral land parcels which form part of the Canada Lands Survey System and updated as new survey plans are recorded in the Canada Lands Survey Records (CLSR).

The purpose of this product is to provide a national coverage and promote the use of a common geometric representation for Aboriginal Lands in Canada. This data set is not to be used for defining boundaries. Administrative decisions should be based on legal documents and legal survey plans.

2.3.5 National Hydro Network

The National Hydro Network (NHN) is framework data representing the inland surface waters of Canada. The NHN is the evolution from a graphical representation of Canada's inland surface waters (i.e., topographic maps that show only the locations and names of water features) to an intelligent network organized by drainage basins, or watersheds (i.e., data that includes not only locations and names of, but also the connections between, different water features). It provides geospatial vector data describing hydrographic features such as lakes, reservoirs, rivers, streams, canals, islands, obstacles (e.g. waterfalls, rapids, rocks in water) and constructions (e.g. dams, wharves, dikes), as well as a linear drainage network and the toponymic information (geographical names) associated with hydrography.

Map Depicting the National Hydro Network

The modeling work of the NHN is based in part on Linear Referencing System (LRS) concepts. This approach allows the management of geometric representations separately from attribute information (referred to as events in LRS). Unique identifiers (called National Identifiers - NID) associated with each NHN feature allow for efficient management of updates.

The NHN is primarily designed for hydrographic network analysis applications such as water flow analysis, water and watershed management, environmental and hydrographical applications, as well as for a multitude of cartographic applications. The NHN enables the management of watersheds and the species that live in them. In emergency situations such as flooding or toxic spills, NHN data can be used to monitor conditions and to assist decision-making processes to minimize flood damage or optimize control of a spill. For planning, the NHN can be used to decide where to most effectively place a dam or power plant. NHN data can also be an important tool in managing and monitoring drinking water and fresh water supplies.

NHN data is being delivered in staged 'levels of completion' which describe the content of the data:

- First level of completion is the output of an automatic process whereby watershed data is extracted from the federal National Topographic Data Base (NTDB). The result of this processing is linear networks, including direction of flow and names for more than 80% of the linear network segments.
- Second level of completion defines all the water body areas.
- Third level of completion involves the structuring of the linear network into drainage areas.
- Fourth level of completion finishes and updates the names of the NHN.

In 2009, coverage of at least the first level of completion was achieved for all of Canada (close to 1,100 drainage areas). The fourth level of completion was achieved for all of British Columbia, and for a number of drainage areas in the Yukon, Manitoba and Newfoundland and Labrador.

The NHN data standards and data model were developed in consultation between federal, provincial and territorial partners. As delivery and maintenance schedules for NHN data are reached, NTDB data will be replaced by the closest-to-source provincial and territorial data. As provincial and territorial data become available, higher levels of completion are achieved.

2.3.6 National Road Network

GeoBase offers access to over 1,000,000 kilometres of accurate, up-to-date road network data as illustrated in the figure below. The National Road Network (NRN) is a representation of the centerline of all non-restricted use roads in Canada (5 meters or more in width, drivable and with no barriers denying access). NRN data is composed of a network of line, point, and related descriptive attributes.

In the fall of 2007, the second edition of the NRN was launched. In addition to the centreline data, NRN 2.0 includes place names, street names, and address ranges between intersections.

Road network data provides the framework for many geospatial information applications such as mapping, geo-coding, geographic searching, and area delineations. NRN data can be used in a wide variety of activities, including: managing road operations, business development and marketing, transportation, routing of package delivery and emergency vehicles, and government services delivery (e.g. census and elections).

The modeling work of the NRN is based in part on Linear Referencing System (LRS) concepts. This approach allows the management of geometric representations separately from attribute information (referred to as events in LRS). The NRN contains a standardized and homogeneous data representation. Each geometric feature has an assigned National Identifier (NID). The NID is populated with a universally unique identifier (UUID). The NIDs are needed for the management of the data over time and will also be used to identify what changes have occurred between two distributed versions.

The new NRN model and content has been defined through national consensus. The NRN is created and maintained through partnerships between Natural Resources Canada and their provincial and territorial counterparts. In more remote areas of Canada, the centrelines are extracted from the National Topographic Data Base (NTDB), while in the more populated areas the data has been captured by driving the roads and streets with GPS equipped vehicles.

2.3.7 Satellite Orthoimagery

Since 2003, GeoBase has provided full national coverage of satellite orthoimagery (i.e., satellite imagery that has been processed to remove errors and distortions so that it is geometrically correct).

The first set of GeoBase satellite orthoimagery was created from Landsat 7 (United States satellite) data acquired between 1999 and 2003. Several Radarsat 1 (Canadian satellite) scenes, circa 2001-2002, complete the satellite orthoimagery coverage over far northern Canada.

The GeoBase satellite orthoimagery is being updated with the addition of orthoimagery derived from SPOT 4 and SPOT 5 (French satellite) data, which improves upon the resolution of the Landsat 7 orthoimagery. In January 2008, the first 1,000 SPOT 4 and SPOT 5 orthoimages were released on the GeoBase portal. Approximately 5,000 images will complete the 2005-2010 dataset.

Landsat 7 Orthorectified Imagery

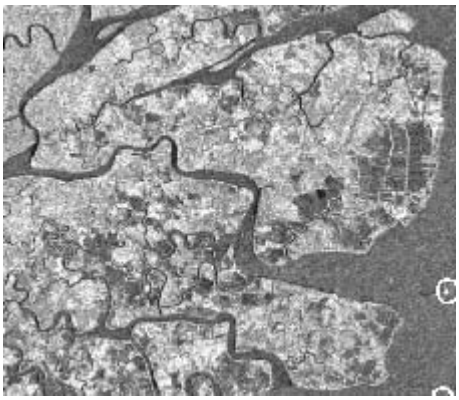
A complete set of cloud-free (less than 10%) orthoimages covering the Canadian landmass using data from the Landsat 7 satellite are available. Images were captured between 1999 and 2003.

Landsat 7 orthoimages are stored as raster data and comprise 9 spectral bands (panchromatic, multispectral and thermal infrared) at a number of ground resolutions, details of which can be found here. They have been produced in accordance with NAD83 (North American Datum of 1983) using the Universal Transverse Mercator (UTM) projection.

The best sources of control data currently available in Canada were used to generate the orthoimages. A number of control sources were used to correct the Landsat 7 images, namely provincial vector data, roads resulting from the global positioning system (GPS), data from the National Topographic Data Base (NTBD), and geometrically corrected aerial photography (orthophotos).

RADARSAT-1 Orthorectified Imagery

The 5 RADARSAT-1 images (processed and distributed by MDA Geospatial Services Inc.) complete the Landsat 7 orthoimagery coverage (see example in the following figure).



RADARSAT-1 orthoimages are stored as raster data produced from SAR Standard 7 (S7) beam mode (i.e., one of the imaging options available from the satellite) with a pixel size (i.e., the size of the smallest feature identifiable in an image) of 15 m. They have been produced in accordance with NAD83 (North American Datum of 1983) using the Universal Transverse Mercator (UTM) projection. RADARSAT-1 orthoimagery were produced with the 1:250,000 Canadian Digital Elevation Data (CDED) and photogrammetric control points generated from the Aerial Survey Data Base (ASDB) maintained by Natural Resources Canada.

SPOT 4/5 Orthorectified Imagery

GeoBase Orthoimage 2005-2010 is made from SPOT 4/5 earth observation data covering Canada's landmass south of the 81st parallel during the period 2005-2010. Each GeoBase Orthoimage 2005-2010 covers an area of approximately 3,600 km^2, or 60 km x 60 km of the Earth's surface.

SPOT 4/5 orthoimages are available at different resolutions in panchromatic and multispectral bands, which are aligned, details of which can be found here. The minimum cloud-free (2% maximum) coverage required for an image (selected zone) is 40 km x 40 km, panchromatic and multispectral taken simultaneously.

2.3.8 Data Alignment Layer

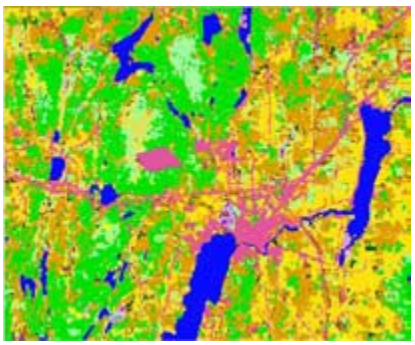
An auxiliary product of the satellite orthoimagery is a Data Alignment Layer containing the control points that were used for the geometric correction of Landsat 7 satellite imagery. These can also be used to correct vector data and, as georeferenced point data, can be displayed with geographic data from various sources and at various scales.

The control data come from different sources, with selection priority being given to the most accurate sources. The normal ranking in decreasing order is: updated road network vector data, provincial vector data, accurate National Topographic Data Base (NTDB) data, federal aerotriangulation data, and other sources.

A map context is also associated with each control point (control point context). The intersections of linear topographic features (e.g., road, railway, watercourse, etc.) and the perimeters of lakes and islands are extracted in order to facilitate identification of control points. Each control point is unique and has been selected so as to simultaneously cover the greatest possible number of Landsat 7 images (i.e., locations in areas of image overlap).

2.3.9 Land Cover Layer

Land Cover is a classification of land surface materials into themes such as forests, wetlands, crops and pasture, snow and ice, rock, and urban development. Land Cover can be used in a wide variety of applications in forestry, the environment, agriculture, wetlands and land use in general, to make crucial decisions about urban development and resource management.



Land Cover Map

GeoBase Land Cover information is the result of vectorization of raster thematic data originating from Landsat 5 and Landsat 7 orthoimages acquired between 1999 and 2003. The forestry coverage of the provinces was produced by the Canadian Forest Service (CFS) with the collaboration of the Canadian Space Agency (CSA) and in partnership with the provincial and territorial governments. The agricultural coverage of the provinces was produced by the National Land and Water Information Service (NLWIS) of Agriculture and Agri-Food Canada (AAFC). Northern Territories land cover was produced by the Canada Centre for Remote Sensing (CCRS).

Land Cover data are classified according to a harmonized legend built from the partner's legends. This legend is principally based on the legend described in the following publication: EOSD Land Cover Classification Legend Report, on which CFS and AAFC collaborated. Some classes related to Northern environments where added in order to meet the interpretation of the Northern land cover classification experts.

2.4 New Data Themes

It is expected that the number of available GeoBase data themes will continue to grow. Work is underway to define the data standards and data models for the Municipal Boundary data theme, and these data are expected to be available by 2010.

Other potential data themes include:

- Cadastral Mapping
- Railroads
- Power lines
- Structures
- Key buildings
- Electoral boundaries
- Parks

There is no formal mechanism for identifying new themes to be added to GeoBase. Instead, GeoBase relies on the Canadian Council on Geomatics (CCOG) members and the GeoBase user community to propose new data themes for GeoBase.

The GeoBase Steering Committee makes use of user needs surveys, in conjunction with input from other organizations such as GeoConnections and the Inter-Agency Committee on Geomatics (IACG), to help identify what data themes users would like to be made available through GeoBase. When a Steering Committee review has been completed, results are brought forward to CCOG for consideration.

Should your organization wish to identify a data theme for inclusion in GeoBase, you should contact the Chair of the GeoBase Steering Committee, through the GeoBase Secretariat at Natural Resources Canada.

2.5 How to Access GeoBase Data

This Section is intended to help you navigate Geobase and obtain data for analysis with a geographic information systems (GIS) or Web mapping application. The emphasis is on helping you to successfully download data sets with a variety of uses in the field of geomatics. It is divided into three sections. The first section introduces what you need before using Geobase: registration and browser requirements. The second section focuses on navigating through the contents of the portal. The third section guides you through the basic steps of downloading and storing data acquired from the site. This latter section delves briefly into the nature of the data formats available on GeoBase and identifies what resources exist for you to work with it.

- Introduction
- Navigating
- Downloading Data

2.5.1 Introduction

Getting Started

The Canadian Council of Geomatics (CCOG), the body overseeing GeoBase, requires that every data user registers prior to download through Geobase. Registration allows the GeoBase Initiative to observe the diversity of applications created using the provided data across different sectors. It also allows you to stay current on new data availability through regular emails from GeoBase. By following the link under **User Registration** on the homepage, you will be directed to a form where you choose a username and password for future use (Figure 1).

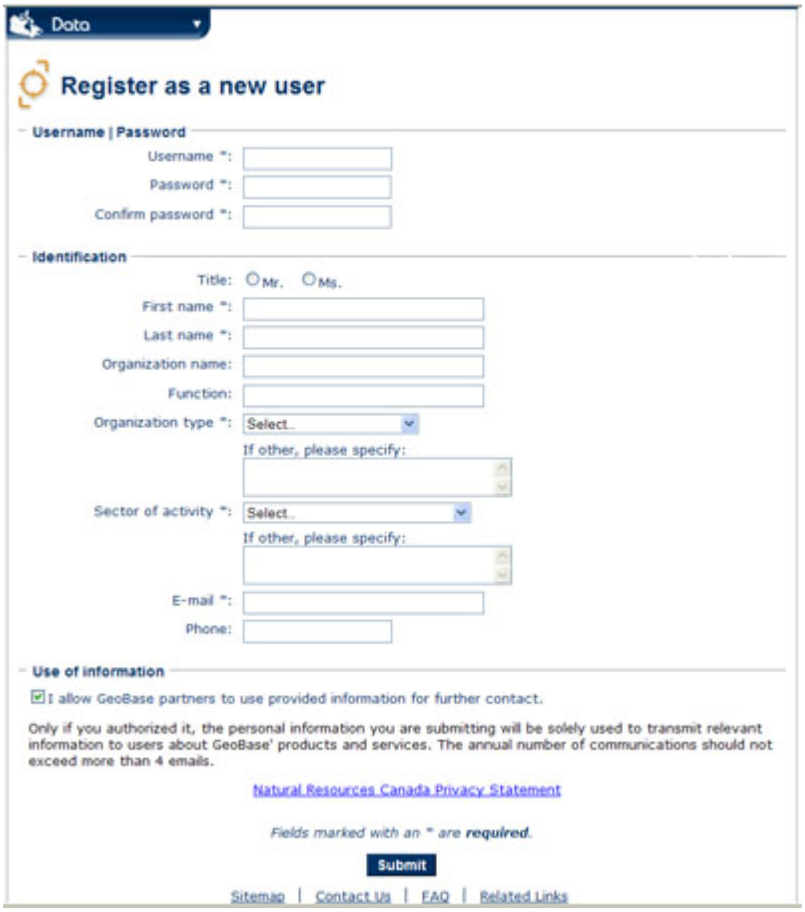


Figure 1. New User Registration

Browser Considerations

Successful downloads have been confirmed using all major web browsers (Mozilla Firefox, Internet Explorer, Google Chrome, and Safari).

As of August 2009, only HTTP direct download is possible using Google Chrome. Direct launch into an FTP download prompt for a single file will not work, though it is possible to access and browse an FTP directory.

2.5.2 Navigating GeoBase

Available Data Layers

Click the **Data** drop down list below the site's menu bar. Below will appear a short list identifying the nine data layer types currently available through the GeoBase portal (Figure 2).

These are:

- Administrative Boundaries
- Digital Elevation Data
- Geodetic Network
- Geographical Names
- Land Cover
- National Hydro Network
- National Road Network
- Satellite Imagery
- Data Alignment

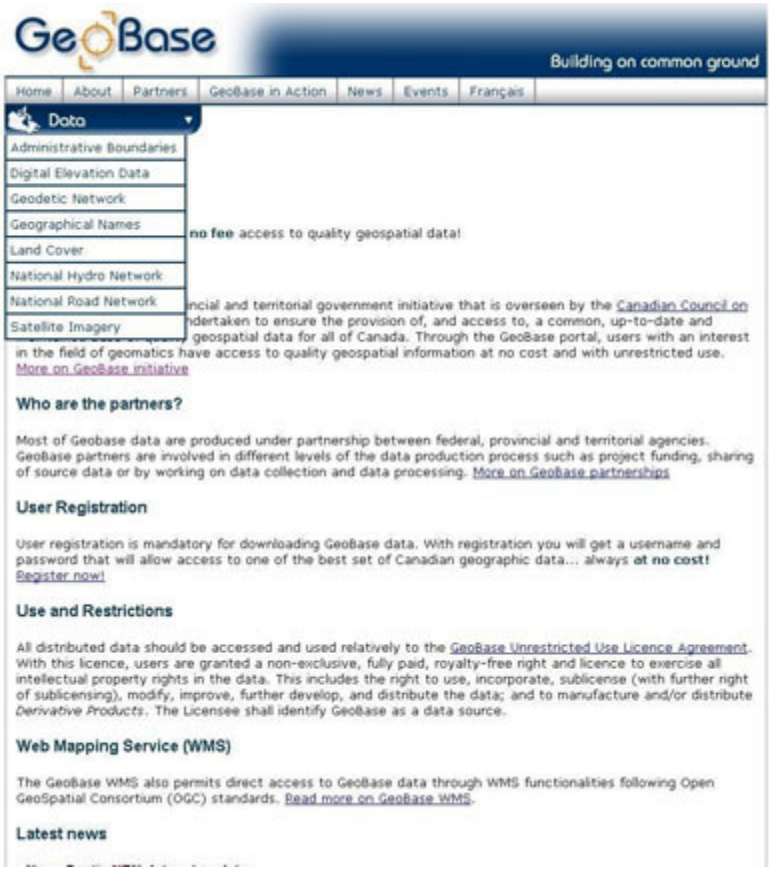


Figure 2. Data list at GeoBase home page

Click on any title beneath **Data** to direct the browser to a page of resource links about the chosen data type. For detailed descriptions regarding the exact nature and content of each data layer, more can be found under the headings **Description** or **Description and Documentation** on the resource webpage, particularly the section on metadata. This resource page will also be the best place to find links to dates of the most recent update as well as the identity of any data owners or custodians. This is also where you will navigate to the download itself.

First, it may be a good idea to preview the data available to ensure the features represented closely match what you are looking for.

Previewing Data Sets

Click the **View** link on the data layer resource page. For the example in Figure 3, the National Road Network data layer type was selected.

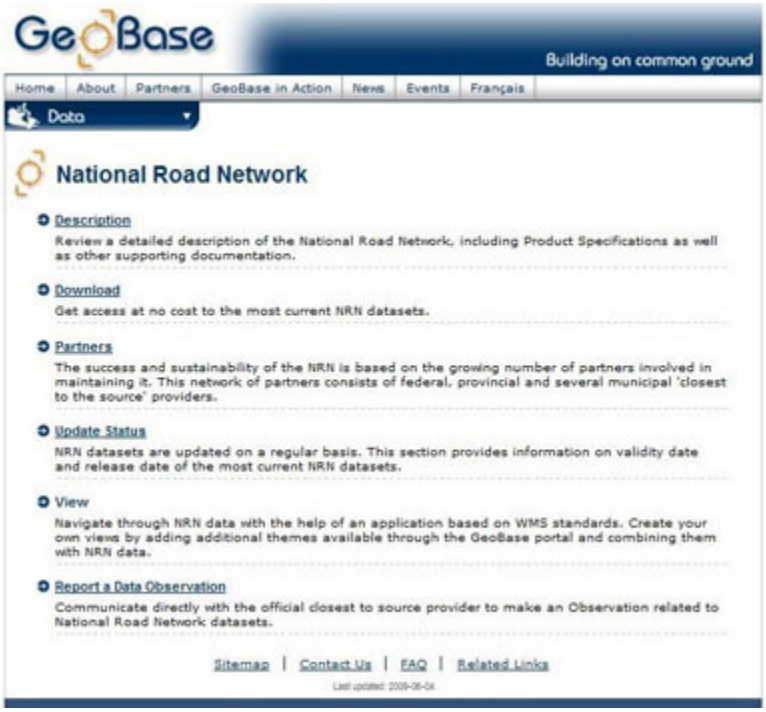


Figure 3. GeoBase Data Layer Resources - National Road Network

A new browser window will open for the GeoBase Viewer (Figure 4). In this window, you can preview the appearance of the chosen data.

Figure 4. GeoBase Viewer Application

Above the map, simple controls are provided to **zoom in** and **out** . Click on these magnifying glass tools and then on the desired location in the map area to move in or out from any location. From this same line, click the **'center on'** tool and any location in the map to select a new center point for the screen. To view the data in areas adjacent to the current map view, use the arrow symbols around the map perimeter. To the left of the 'FAQ' tool, click on the drop-down list titled **'Quick zoom to region'** to zoom to many of the major cities or regions in Canada.

Above the sidebar to the left of the map are two tabs: **Layers** and **Legend**. Click on **Layers** (the default when the Viewer loads) and the sidebar will display a list with checkboxes. If you would like to see how additional datasets appear against the one chosen for download, clicking (turning on) any of these checkboxes will add another data layer to the map Viewer. To remove the new layer, click the checkbox a second time. Once the desired layers have been indicated with checkmarks, clicking the **redraw** button above the map will refresh the data presented in the Viewer. Clicking on **Legend** displays the meaning of any symbols that appear in the map window.

2.5.3 Downloading Data

The following sections outline three ways to access and download GeoBase data and the formats in which the data is available:

- Direct Data Download
- Search-Based Data Download
- Accessing the GeoBase Web Mapping Service
- Available File Formats

Direct Data Download

The following steps describe how to download data directly from GeoBase.

1. Click **Download** from the data layer resource page. This will take you to a new page listing the datasets available for download such as the one for the National Road Network in Figure 5 below.

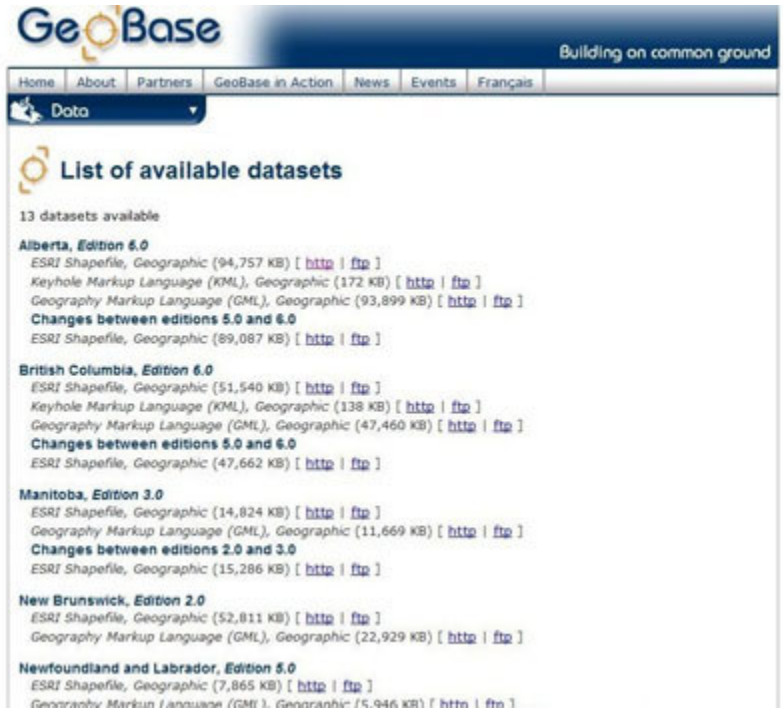


Figure 5

The list indicates each of the datasets offered for download as well as the file formats available for every dataset. At the end of each file's line, a link is provided to download the file by either **http** or **ftp**. These only specify different ways of interacting with the web server and website in getting the requested files. The data saved from either choice will be the same.

2. Click on the link for either **http** or **ftp** download. An authentication page may appear (Figure 6).

Figure 6

3. Enter the username and password chosen at the time you registered and click **Submit**. A brief summary of your profile is brought up for review.

4. Click **Download** at the bottom of the profile display to proceed without making any changes to profile information. A download prompt will appear (Figure 7).

Figure 7

In the download prompt that appears, you are presented with the options of either opening the compressed file that contains the datasets directly, or saving the file to a chosen directory and extracting the dataset(s) later. For this example, the .zip file will be opened and the data saved immediately.

5. Click **Open With**. If your computer has a file compression application installed (such as WinZip or WinRAR), it will appear as the default in the dropdown list to the right. If not, a compression application must be installed to view and remove the files that have been compressed within the downloaded file. Click **OK**.

When the download completes and the compressed file has been opened, the list of files making up the requested dataset(s) is shown. The files shown in Figure 8 represent the geodata for the road network in British Columbia.

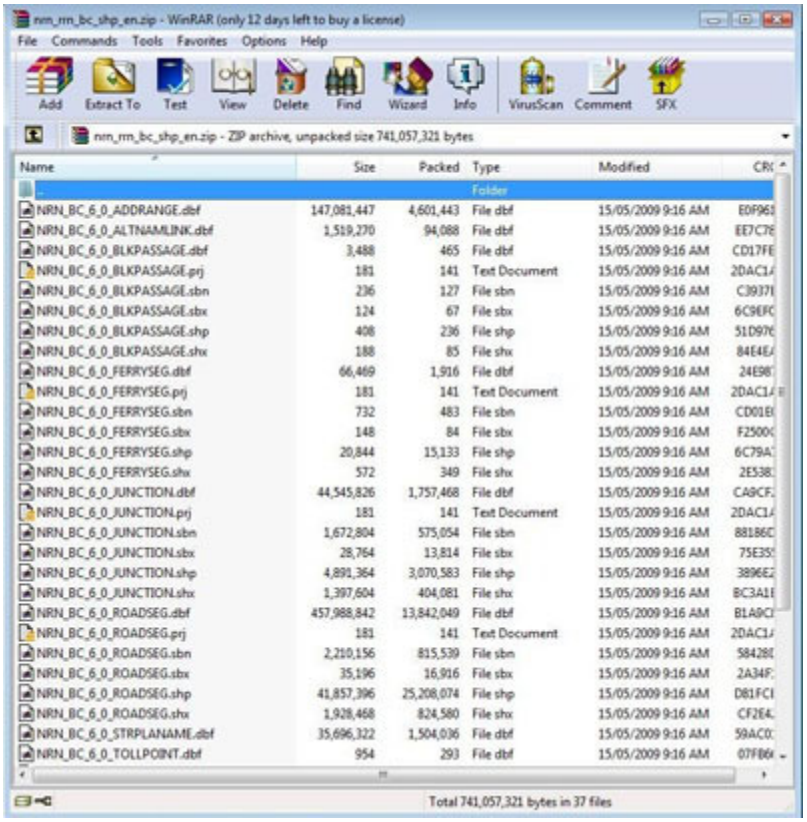


Figure 8

6. **Save (extract)** all the compressed files to an appropriate directory. Make sure all files are saved in the same location. If a GIS application does not see all file extensions relevant to an opened file, **an error may result**.

Search-Based Data Download

Some datasets contain too much information to cover large areas in one file. It is for this reason that data in the Digital Elevation, Land Cover, National Hydro Network and Satellite Imagery layers are made available in many files covering smaller map areas. Although GeoBase does provide the opportunity to download as many files as desired in one massive download (which may be extremely time-consuming),

it is expected that the average user may only be interested in localized areas. To find these data for more precise areas, the GeoBase portal's download service has a search-and-select feature built in.

1. Click **Download** from the data layer resource page for any one of these data sets**.** This will take you to a new page titled **Find Data** providing three options for choosing what specific areas the user needs the data to cover. Figure 9 below reflects the options displayed when downloading Digital Elevation Data.

Figure 9

For these larger datasets, the area covered by each file is identified by the National Topographic System (NTS) reference numbers established for corresponding paper-based maps. The GeoBase search tool allows you to select the map scale and map identifier or region.

Graphical Search

If you are unfamiliar with the reference system for NTS maps, you may choose data for areas visually by location. The first choice presented is the map scale/coverage to obtain the data. In this example, data is available at either a scale of 1:50,000 (where 1 cm on screen or paper represents 0.5 km on the earth's surface) or 1:250,000 scale (where 1 cm equals a surface distance of 2.5 km). Data at a scale of 1:250,000 will cover the same area as sixteen 1:50,000 areas that fall within it, but with a much lower level of detail available.

2. Click on a **map** for either 1:50,000 scale data or 1:250,000 scale data. In this example, Figure 10 shows the result of selecting 1:50,000.

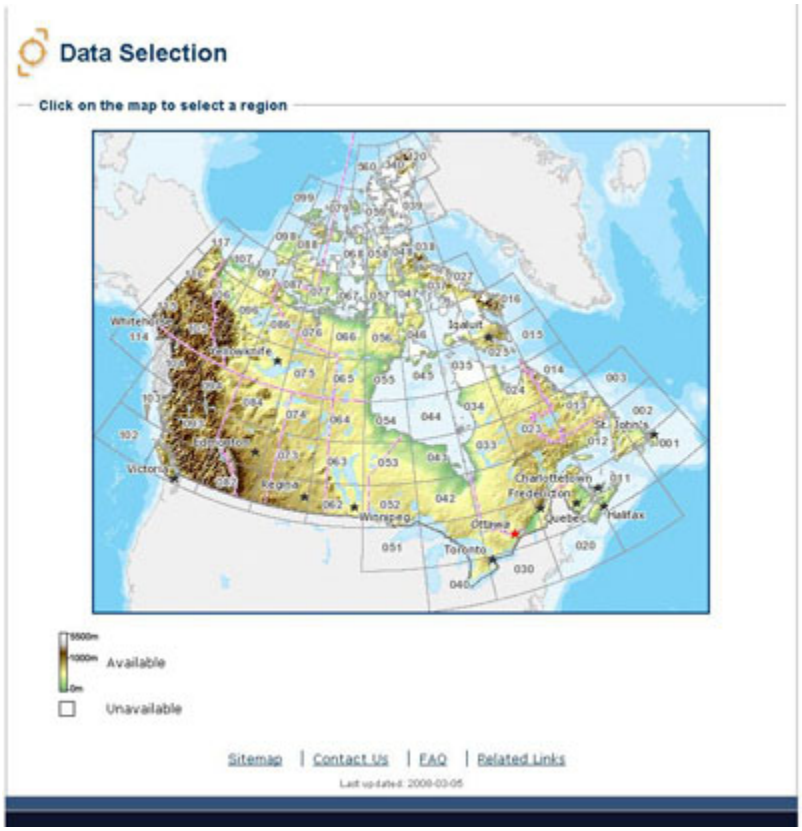


Figure 10

The screen should be filled with a map of Canada and a grid overlay numbered by map reference numbers.

3. Click **any grid square**. In this example, Figure 11 shows the result of selecting the map square containing Ottawa, ON (Reference number 031). If, at any time, you would like to reverse the level of map zoom, click **'Back to previous map'** to select a different grid square.

Figure 11

4. Click another **map square**, zooming on a smaller map area. Still focusing on Ottawa, ON, Figure 12 reflects the result of selecting square 031G.

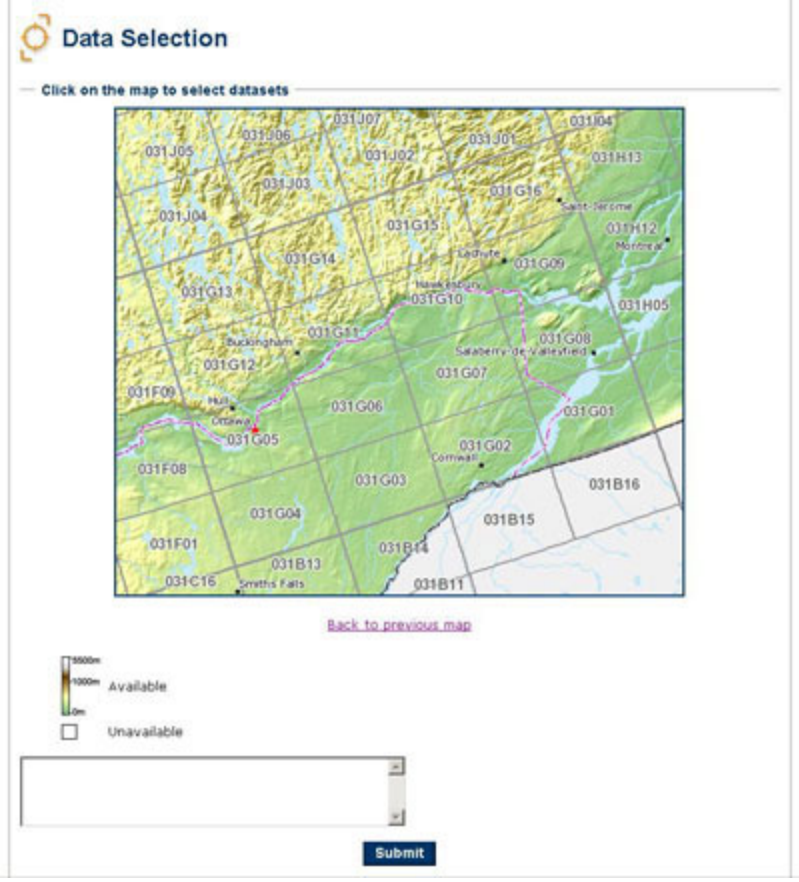


Figure 12

When a text area and Submit button appear at the bottom of the Data Selection screen, this indicates the map squares on-screen represent datasets available for you to download.

5. Click a **square in the map** to select datasets for download. You will notice that the reference number corresponding to the square clicked appears in the text area at the bottom of the screen; clicking multiple squares retrieves multiple datasets at one time. In this example, Figure 13 demonstrates a selection of maps 031G05, 031G10, and 031G02.

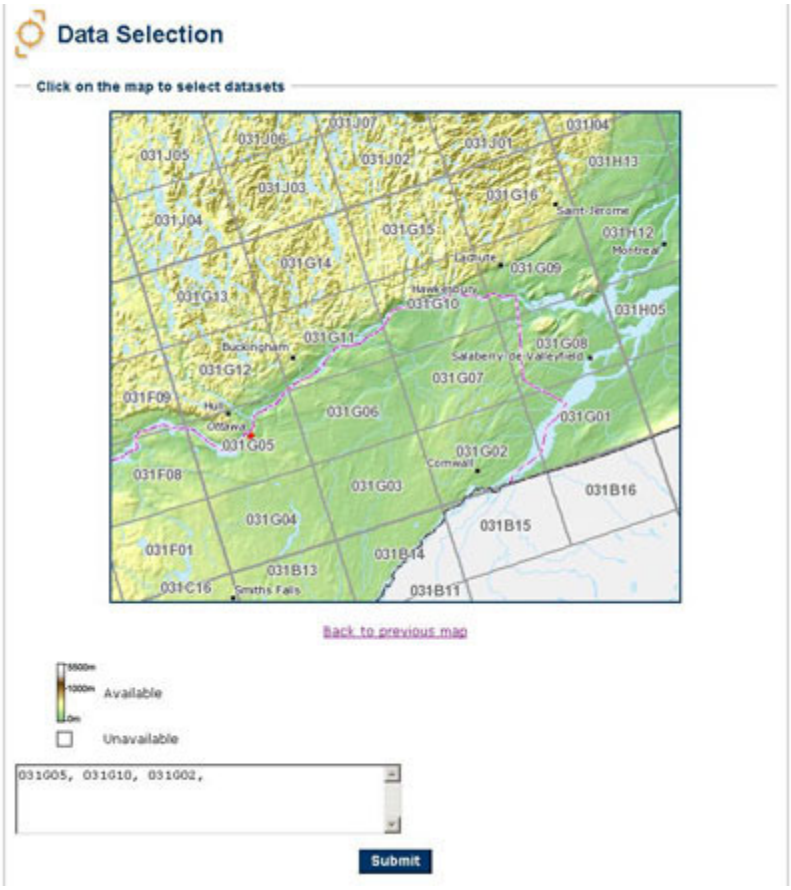


Figure 13

6. Click **Submit**.

If any selected map areas touch more than one province or territory, you will have the option of downloading data for the entire area covered by that map, or the area within each province or territory individually. Figure 14 demonstrates a list including data for each map reference chosen in this example, as well as a dataset for the area within only Ontario or Quebec in each case.

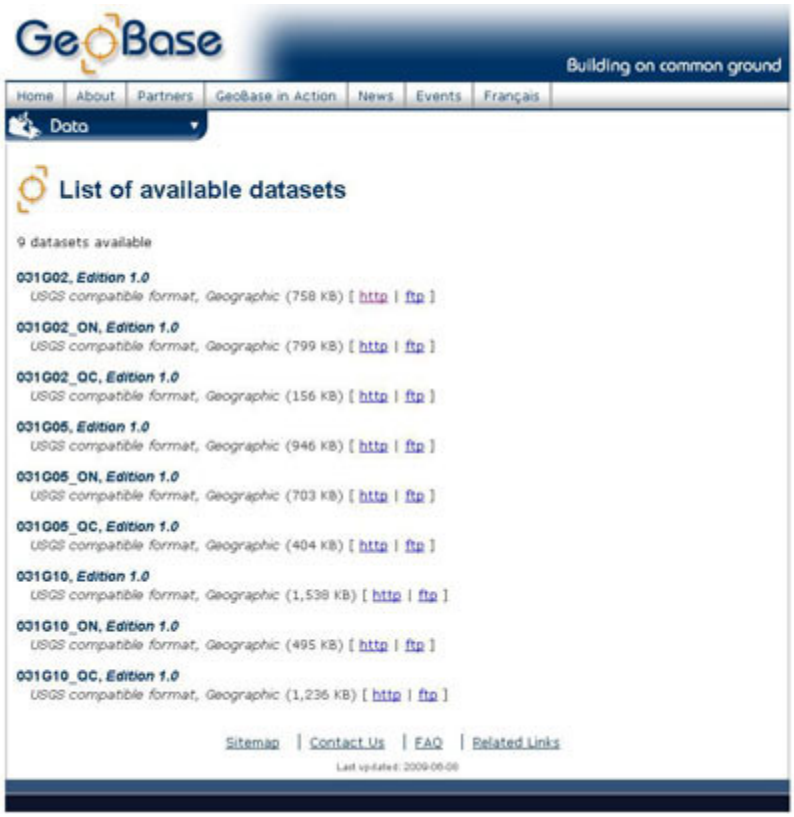


Figure 14

Once the desired datasets have been found in the list, the download is executed as in Steps 2 through 6 under **Direct Data Download**.

Advanced Search

If you are familiar with map reference numbers used by the NTS, you can use the Advanced Search for a fast query based on specified map areas. With this option, it is helpful to know the number prefix identifying an area of Canada (e.g., 031 in specifying the area including Ottawa used above).

2. Enter a NTS map number in the Identifier text box.

3. Select Canada or the name of a province/territory from the Region dropdown list.

4. Select an available map scale from the Coverage dropdown list.

5. If a specific date of publication for the area of interest is known, enter a month and year of publication in the Publication Date text box. [Optional]

6. Click **Submit**.

In this example, Figure 15 demonstrates choosing 1:250,000 scale maps in the area of Alberta that match the NTS map identifier '082'.

Figure 15

After clicking **Submit**, the browser again redirects you to a list of results matching datasets for the area and coverage requested. While it is possible to leave the defaults and click **Submit**, the resulting list will have too many datasets to be useful. Once you have found the desired datasets in the list, you can execute the download as in Steps 2 through 6 under **Direct Data Download**.

Browse the FTP directory for massive download

If you are experienced with NTS reference conventions and know that you will be working with larger areas of interest, you will want to download more than one file at a time. To download groups of multiple datasets simultaneously:

2. Click the link 'FTP download directory'.

Figure 16 displays the root directory accessed through this link. At this level, you may either download a full coverage of Canada (either 1:50,000 or 1:250,000), or proceed to view smaller levels of datasets. In this example datasets for a smaller area will be downloaded.

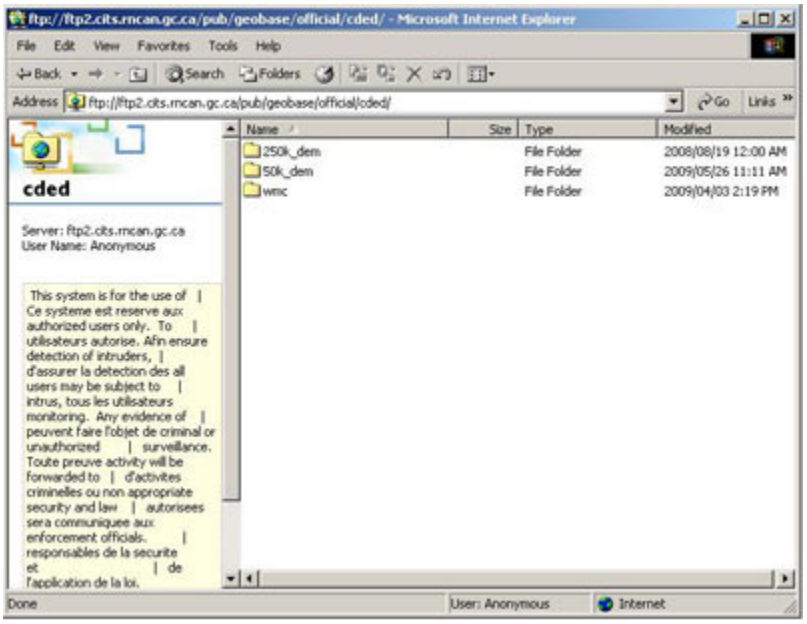


Figure 16

3. Double-click a desired **folder**. The FTP site will display any subdirectories. In this example, Figure 17 shows the NTS map area directories shown when the '50k_dem' folder is entered.

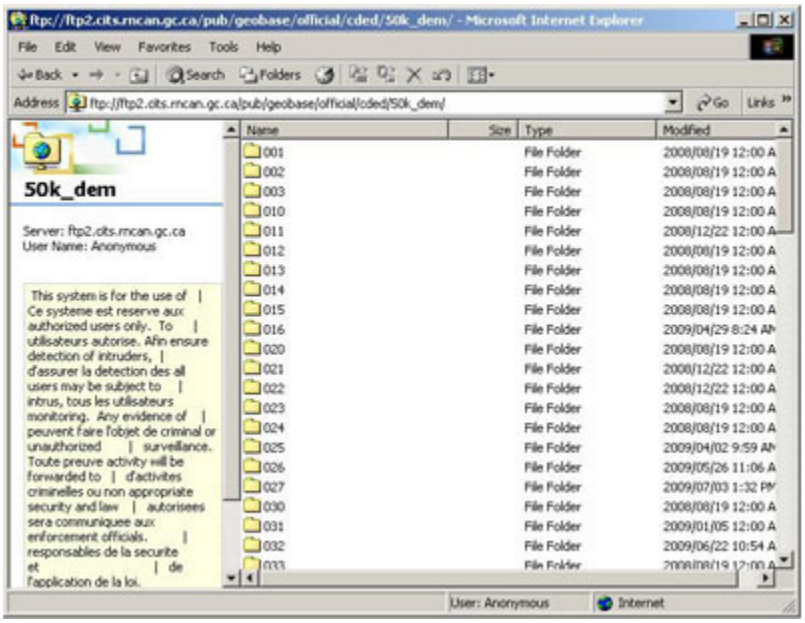


Figure 17

4. Double-click a **folder** representing the desired NTS map area. In this example, map area 022 is selected.

5. Hold CTRL and Click to **highlight the desired files** (Figure 18).

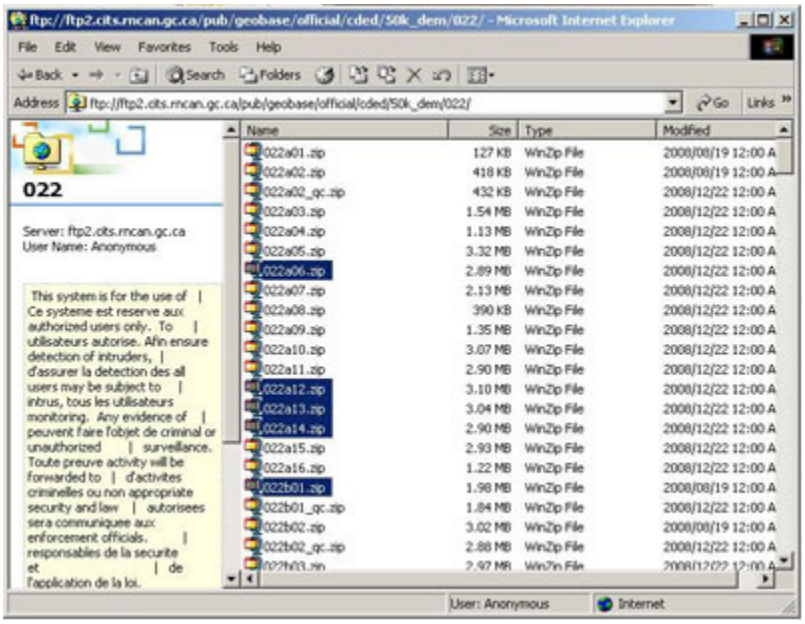


Figure 18

6. Click **'File'** in the browser's Menu bar.

7. Click 'Copy to Folder'.

8. Open the desired directory for your downloaded geodata.

9. Open the location of the saved datasets and Save (extract) all the compressed files as in Step 6 under Direct Data Download.

2.5.4 GeoBase Web Mapping Service (WMS)

Web Mapping Service (WMS) is an open standards specification that allows interactive mapping through requests for information over the internet. To access a WMS, you must have GIS software or a Web application compatible with OGC standards that supports the service. This will allow your GIS or Web application to communicate directly with the GIS database on the map server. The GeoBase WMS allows fast access to show requested geodata layers in a map or workspace directly from the server.

If you do not already have a GIS or Web application, several freeware applications can be found by searching the Web (e.g., Quantum GIS, Gaia (The Carbon Project), OGC-compatible visualization software by Intergraph and the UDig application by Refractions). A more complete list of free data viewers can be found in the More Information Annex. In your GIS or Web application, you will use the function or command allowing the addition of a map service and where you will normally have to copy the Internet address of the GeoBase WMS service.

To access the GeoBase WMS:

1. Click the link **'Read more on GeoBase WMS'** on the GeoBase home page.

2. Click **'I want to access GeoBase WMS'** after reading the information on use of the WMS and the layers available.

3. If registration has already been completed, you will be asked to sign in and click **'Submit'**. If not, first follow the link to the registration form.

After successful login, GeoBase will redirect you to the Access to GeoBase WMS page (Figure 19).

Figure 19

4. A notification will be sent to the E-mail address given in your profile information. This E-mail will provide the information and web links you will need to connect your GIS software or Web application to the GeoBase WMS.

2.5.5 Available File Formats

Datasets on GeoBase are offered in multiple file formats. Each format has benefits and its own methods of use. Provided below are descriptions and some examples of software that facilitate the use of each.

ESRI shapefile

The shapefile (.shp) is a popular data format developed by the company ESRI and largely used with their ArcMap and ArcView software packages. It has continually grown and now serves as one industry standard; many other GIS platforms, both free and proprietary, have adapted to allow interoperability with this file format. In a shapefile, each record represents a basic geographic shape – line, point, or polygon – that can be displayed or modified in the appropriate software to produce geographic analysis.

Digital Elevation Model (DEM)

Digital Elevation Models (DEMs) are a digital representation of earth's surface height over a set or grid of geographic coordinates. They are the most common base for 'three-dimensional' relief maps of the earth's terrain. All major GIS software packages have a toolset for processing DEMs. Some smaller applications specializing in extrapolation of the earth's surface, such as MicroDEM, are also available for free download.

For further links and recommendations to software used to view downloaded data, refer to the FAQ through the link at the bottom of any GeoBase page, and click on the question, "How can I open a vector data file if I don't have GIS Software?".

Geography Markup Language (GML)

GML is a text-based representation of geographic information, and it is a specific language for representing geodata with simplicity and usability via the Internet. It is a way of including encoded geographic properties in a way that can be understood by any Internet server or browser. When a GML document is included in an internet tool, the features it describes are interpreted into a map or graphical representation in the style specified by the web page designer or user. Commands built into a web page can reference specific elements within this document and change the way they are displayed by a web browser or other software.

Some free GML Viewers can be found for download. These allow for simple viewing of the geometric shapes described in the file, as well as the attributes and values assigned to each.

Keyhole Markup Language (KML)

KML files also use text-based encoding of geographic information and are intended to express geographic features for the purpose of two- or three-dimensional visualization. Their use of features and information is limited to internet-based Earth browsers and the Google Earth application.

Similar in format, KMZ – a compressed-folder version of the KML – is made available for the National Hydro Network datasets. They are split into smaller files and compressed in this way to allow the Google Earth application to handle the information, but in some cases the resultant file may still be cumbersome and result in slower performance.

To view KML/KMZ files in this application:

1. Download and Install from the Google Earth website.

2. After successful installation, run the application and choose File > Open from the menu bar.

3. Navigate to the location of the files downloaded and saved from GeoBase. Click Open (Figure 20).

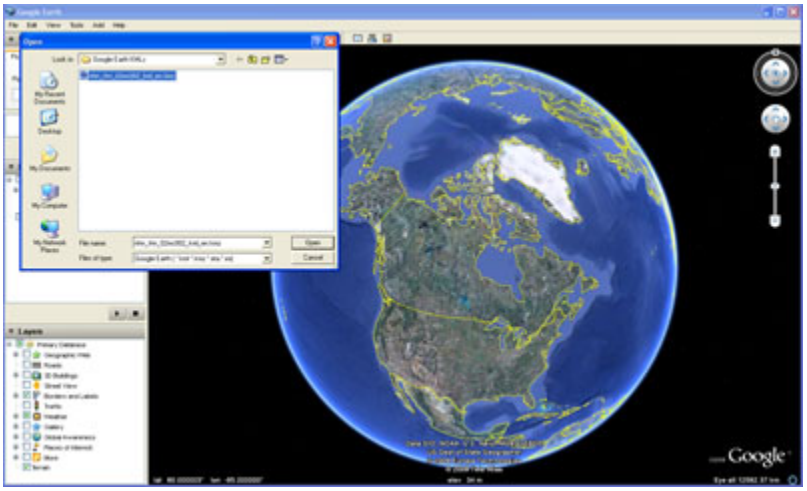


Figure 20: Open files in Google Earth

4. In larger data sets like the National Hydro Network KMZ in this example, the file first appears in Google

Earth as a shaded region (Figure 21).

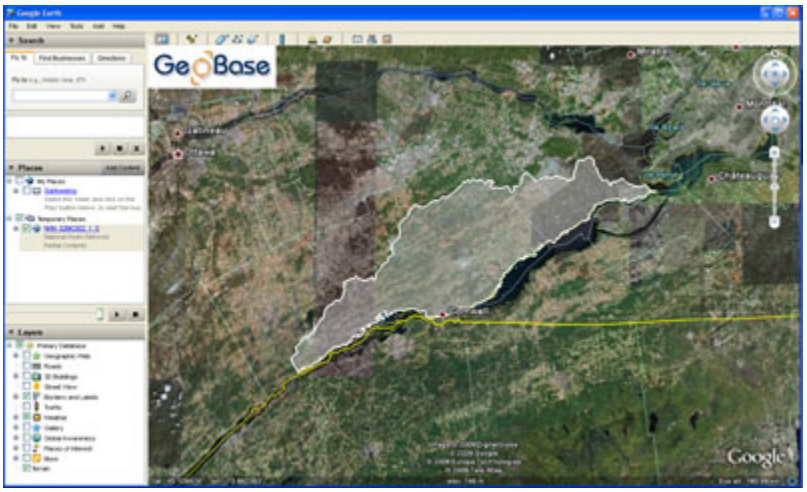


Figure 21: First appearance of NHN file

5. Zoom In on the shaded area using either the zoom control in the upper right corner of the Google Earth interface or the mouse's scroll wheel. By zooming to a small enough area, lines representing hydrographic features will appear. At an even closer view, points containing information for each feature will appear.

6. Click on points appearing on the Earth's surface to view an information window describing the feature found in the downloaded file (Figure 22).

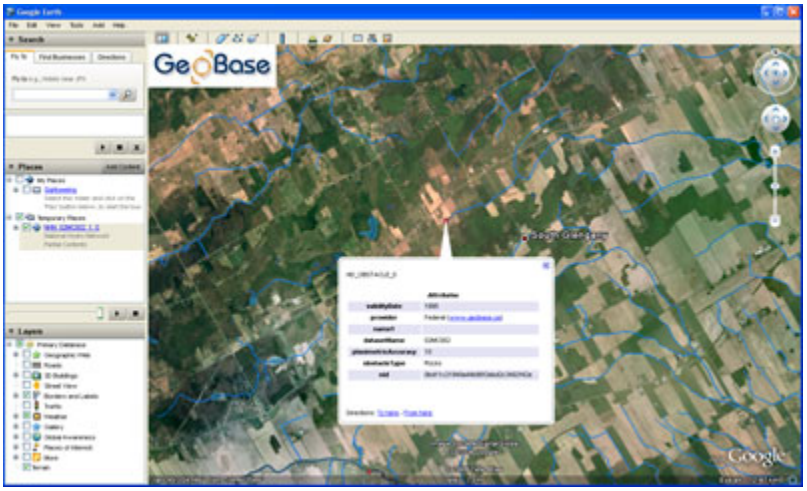


Figure 22: NHN Google Earth Info Window

7. The window displayed by each point shows the GeoBase dataset in which the point can be found (top-left of info window) and selected attributes that describe the type of information the point represents.

8. Refer to the data layer Description and Documentation page for feature catalogues and attribute profiles. Here, attribute definitions and data layer information can be found in greater detail.

3. Chapter 3: Other Sources of Data

As discussed earlier in this guide, framework data provides reference, context and underpinning to a wide variety of other geographical data themes. Framework data are expected to be widely used and generally applicable, in contrast to thematic data which is of narrower interest, either in terms of its range of potential users or its geographical extent.

However, there are no hard and fast rules differentiating framework and thematic data – the matter is somewhat one of personal interests. As was discussed in Chapter 2, the GeoBase website provides nine types of framework data, and the site will be adding more over time. If you need other Canadian geospatial data, defined formally as framework or not, there are a number of other possible sources to explore. This Chapter looks at three such sources, and if these sources cannot provide what you need, they will point you in other directions.

3.1 Chapter Highlights

In this Chapter, you will learn about:

- The Discovery Portal and its use by geospatial data product and service suppliers and geospatial information application developers
- Several other Internet portals that provide geospatial data at no cost and without restrictions – GeoGratis, Toporama, the Atlas of Canada, and Provincial Portals

3.2 Discovery Portal

The GeoConnections Discovery Portal provides infrastructure, tools and services for the discovery of, and access to, geospatial organizations, data and services. It is a gateway for Canadian industry to distribute services and millions of geospatial data products. Data can be browsed by metadata or searched by subject, coverage or product type to find, evaluate, visualize and access what is available. The Discovery Portal is the prime discovery and access component of the CGDI.

The Discovery Portal supports a broad range of stakeholders:

- Users: people who wish to discover, evaluate and access geospatial resources through the web;
- Suppliers: organizations who wish to make themselves and their services and geospatial data available for discovery through the web;
- Developers: people who wish to incorporate geospatial tools into their own web pages;
- Peers: other geospatial data infrastructures which export directory information to the Discovery Portal's Directory, import directory information from the Discovery Portal or which perform on-line searches through the Discovery Portal's Directory; and
- Other stakeholders: people with key interests in the development of the geospatial data infrastructure (such as managers, planners and geospatial community members).

The Discovery Portal provides access to over 10,000 databases, including both Canadian and international sources. These databases may be viewed by the type of data (e.g., digital copy of a paper map, satellite image, ground measurement) or by application (e.g., geology, forestry, climate change). Databases are provided by contributing organizations and some may have specific services that apply to them.

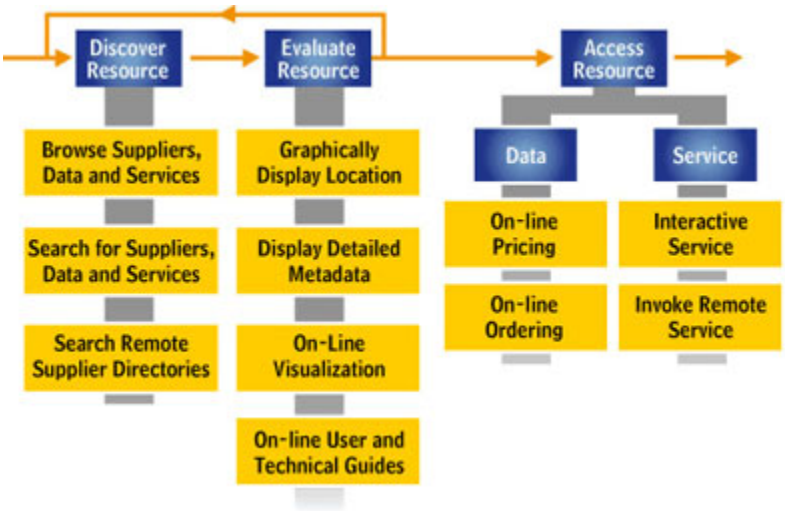
The Discovery Portal also provides access to over 400 services. Services are provided by organizations and may apply to specific databases. Services include professional services offered by industry, government services, education services, and on-line or Web mapping services.

A number of sources of framework data can be found on the Discovery Portal. On the portal's Home page, the Quick Links menu on the left hand side provides direct links to several primary data sources, including GeoBase, GeoGratis, Atlas of Canada and Toporama. Links can also be found to provincial portals that provide access to framework data by clicking on Search Organizations at the top of any Discovery Portal page. A list of Provincial/Territorial Government portal links are found on the page that is displayed.

To find out more consult the Discovery Portal User's Guide.
<See: www.geodiscover.cgdi.ca/gdp/help?request=helpConsumersGuide>

3.2.1 Data and Service Use

The Discovery Portal can provide access to either geospatial data or services. The steps involved in using the Discovery Portal are discovery, evaluation and access. This process is shown in the figure below.



3.2.2 Participation as a Supplier

Any organization can participate as a supplier of resources. Participation can take place at several levels, depending on what is most appropriate. For example:

- An organization can connect their databases or catalogues to the Discovery Portal to allow the user to discover the full set of specific geospatial data that they provide. <To find out more, consult the Supplier's Guide>;

- A developer, such as the developer of a web based application of geospatial data, can make use of Supplier Toolkits, the APIs and ReUsable Components. ReUsable Components can be used by developers to embed maps, popup tools and web searches within their web site. <To find out more, consult the Developer's Guide>.

3.2.3 Connections with other GeoPortals

Within Canada, the Discovery Portal interacts with other catalogs and services, including the Canadian Geoscience Knowledge Network, the National Forestry Information System, the Marine Geospatial Data Infrastructure, and the Ecological Monitoring and Assessment Network. In addition to these subject area infrastructures, the Discovery Portal also connects to provincial geospatial data infrastructures such as SaskGIS, Quebec's GéoSelection, and Land Information Ontario.

Internationally, the Discovery Portal co-operates and interacts with spatial data infrastructures and services around the world For example:

- The Discovery Portal is the Canadian node of the International Directory Network (IDN). Under this arrangement metadata about Canadian databases are made available through an international network of directory systems. In return, descriptions of international databases are made available to Discovery Portal users.
- The Discovery Portal co-operates with the U.S. FGDC Geospatial Clearinghouse in making databases or catalogues commonly searchable. Through the use of common standards and specifications, databases that are connected to the Discovery Portal for distributed search are likewise searchable through the FGDC Clearinghouse. Similarly, international databases or catalogues become searchable to Discovery Portal users.
- CEONet Technology provides a search gateway to NASA's EOSDIS system. This enables Earth observation catalogues from around the world to be searchable by Discovery Portal users.

3.3 GeoGratis

GeoGratis is a portal (linked to the Discovery Portal) that provides geospatial data at no cost and without restrictions. The data are compatible with the most popular geographic information systems (GIS), with image analysis systems, and with graphics editing software. A number of the collections meet international geospatial information standards.

The data are grouped in about 80 collections. The collections include raster data, such as satellite images or scanned topographic maps, vector data, such as national-scale frameworks (grouped by theme), and a database of ground control points that can be used to correct and validate satellite, vector and raster data.

Raster data includes:

- Orthorectified RADARSAT-1 and Landsat-7 satellite images covering all of Canada;
- Atlas of Canada and Atlas of North America thematic maps;
- Historical and recent land use maps, etc.

Vector data includes:

- Canvec vector data at 1:50,000 scale for Canada;
- National-scale framework data (grouped by theme);
- Vector Map Level 0 (VMAP0) for Canada, etc.

There are several ways for you to access the GeoGratis collections. Search tools are provided to search by keywords and products. Frequent visitors to the portal can go directly to the Download Directory. A service that you can access through GeoGratis is the Toporama Web Map Service (Toporama WMS), which is an Internet service that is intended mainly for online map application users and developers. You can use this service to build a customized map using data that are known for being accurate and up-to-date. The Toporama WMS is available in both official languages through a separate URL for each language and the mapping data selected will come with textual elements in English or French depending upon the URL selected. If you have some experience with WMS services, you can obtain detailed information on accessing framework data through this service at the Toporama Web Map Service page on the GeoGratis portal.

You must access and use all distributed data in accordance with the GeoGratis Unrestricted Use Licence Agreement. With this licence, you are granted a non-exclusive, fully paid, royalty-free right and licence to exercise all intellectual property rights in the data. This includes the right to use, incorporate, sublicense (with further right of sublicensing), modify, improve, further develop, and distribute the data; and to manufacture and/or distribute Derivative Products. The Licensee shall identify the source of the Data, in the following manner, where any of the Data are redistributed, or contained within Derivative Products: "© Department of Natural Resources Canada. All rights reserved."

They are grouped together under 16 information themes developed, depending on the scale, using CanVec 1:50,000, the National Topographic Data Base (NTDB) 1:250,000 and baseline data from the Atlas of Canada (1:1,000,000 to 1:30,000,000 scales).

3.3.1 How to Access Framework Data with GeoGratis

This section is intended to help you to find and access framework data through the GeoGratis portal for use in GIS software or Web applications. Information is first provided to help you navigate through the portal to find framework data, followed by guidance on how to access and download the required data.

3.3.2 Navigating GeoGratis

On the GeoGratis home page, click on **Search by Product** in the Collections menu on the left hand side, which will direct the browser to a search page. Click the **Type of Data** drop down list, select Topographic and click **Search** (Figure 1).

Figure 1

The browser will take you to a page where a number of topographic data sets are listed. The most appropriate framework data set in this list is CanVec, Canada. CanVec is produced by Natural Resources

Canada from a number of sources, including the National Topographic Data Base (NTDB), the GeoBase initiative, and data updates using Landsat 7 imagery coverage.

Click the **CanVec, Canada** link and the browser will open the CanVec viewer page (Figure 2). Full details about CanVec can be found by clicking the **Documentation** link.

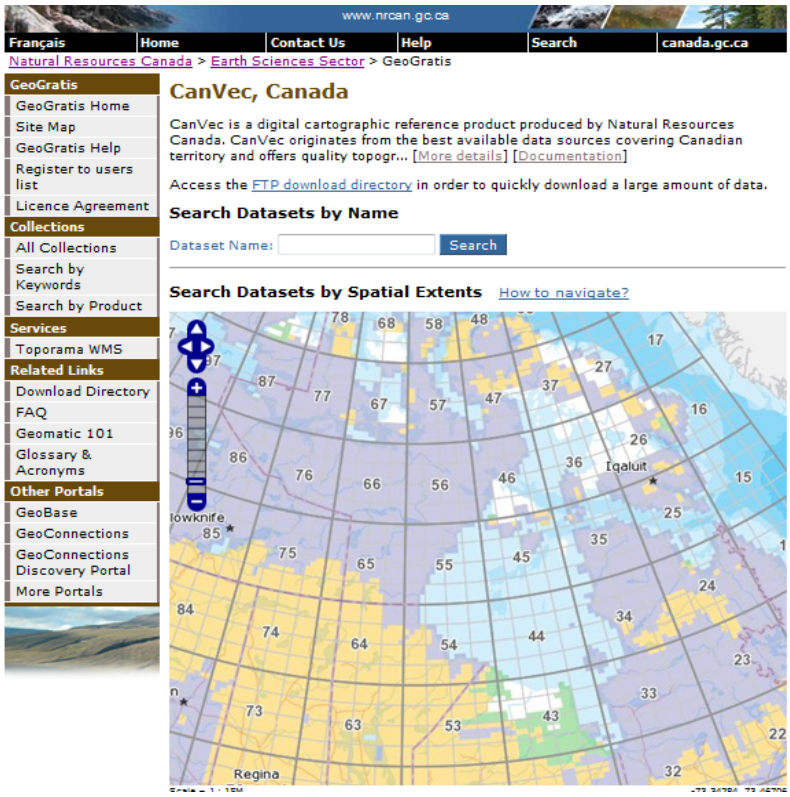


Figure 2

There are a number of functions provided to search available CanVec datasets. One option is to use the methods identified under "Locate an area of interest on the map" at the bottom of the viewer page to limit the spatial extents of searches, if you know a geographical name, postal code, NTS mapsheet number or geographical coordinates in the area of interest. By entering one of these types of search choices, you will be presented with a list of options that match that criteria. Click the most appropriate option and the viewer will zoom into the area of interest. In the example shown in Figure 3, the City of Winnipeg is chosen. Click Search available datasets under the viewer window and the browser will present a list of datasets in that area. In this example, 6 files are available for the area shown in the viewer window. Information about each dataset can be reviwed by clicking the Metadata link for each.

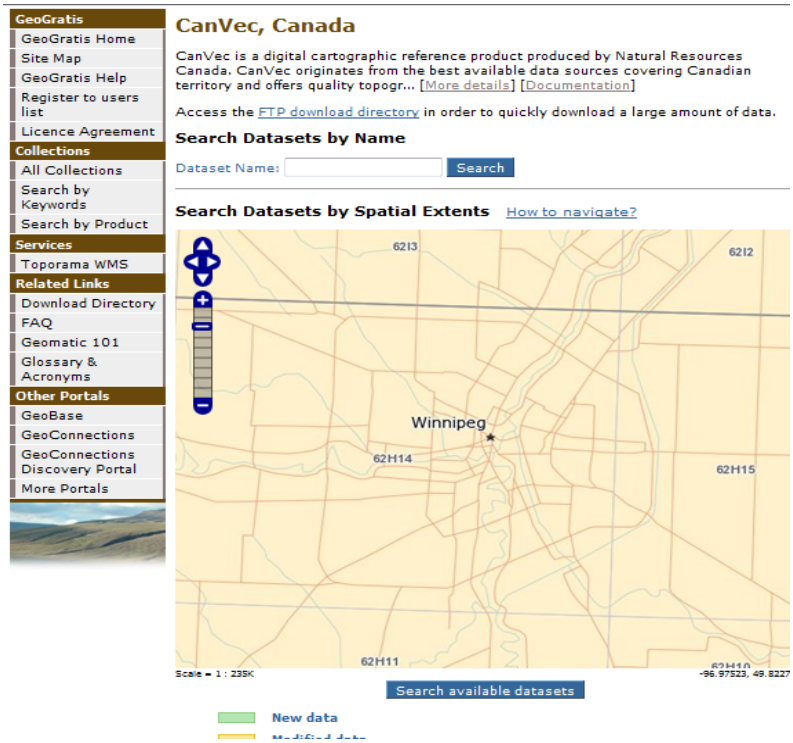


Figure 3

A second option is to conduct a spatial search using the "Search Datasets by Spatial Extents" on the viewer itself. The serach function limits the number of files to a maximum of 25, so you need to refine your searches to stay within this limit. This is accomplished using the viewer navigation tools, which can be learned by clicking on the **How to navigate?** link at the top of the viewer window. After zooming in to the geographical area of interest using the navigation tools, click on **Search available datasets** under the viewer window and the browser will present a list of datasets in that area, similar to the first option. In the download prompt that appears, you are presented with the option of either opening the compressed file that contains the dataset directly, or saving the file to a chosen directory and extracting the dataset(s) later. For this example, the .zip file will be opened and the data saved immediately.

3.3.3 Downloading Data

Once the available data files have been discovered as described above, you can download them using the following steps.

1. Identify which files are to be downloaded by placing a check mark in the box beside the files, then click **Submit**. A new window will appear where you need to select the format for the data to be downloaded (Figure 4). The two format options are ESRI Shape File and Geographic Markup Language (GML), which are described in the Downloading section of Chapter 2.

Figure 4

2. Select the desired data format and click **Download**. The browser will open the Download Page, where the selected file(s) will be identified. Click on the file to be downloaded and a download prompt will appear (Figure 5).

Figure 5

3. Click **Open**. If your computer has a file compression application installed (such as WinZip or WinRAR), it will appear as the default in the dropdown list to the right. If not, you must install a compression application to view and remove the files that have been compressed within the downloaded file. Click **OK**. When the download completes and the compressed file has been opened, the list of files making up the requested dataset(s) is shown. The files shown in Figure 6 represent the geodata for NTS map sheet 062H10 in Winnipeg.

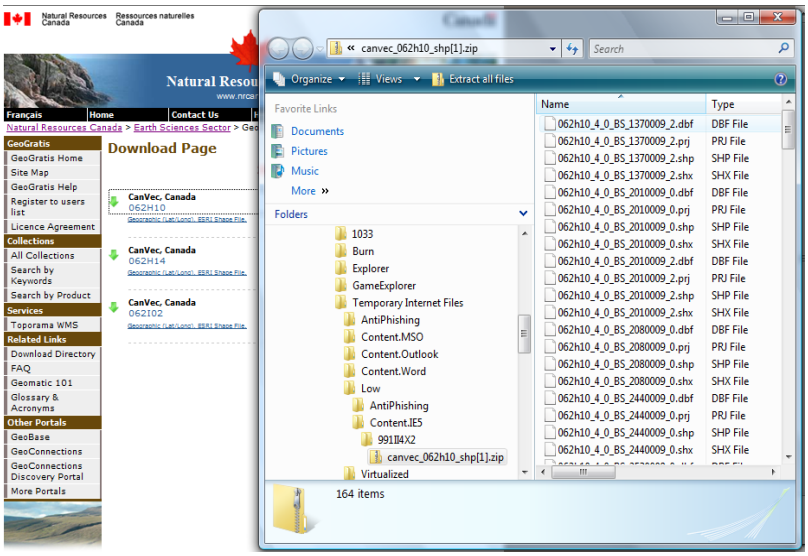


Figure 6

4. **Save (extract)** all the compressed files to an appropriate directory. Make sure all files are saved in the same location. If your GIS or Web application does not see all file extensions relevant to an opened file, an error may result.

3.4 Atlas of Canada

The Atlas of Canada (also linked to the Discovery Portal) 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 collection of maps and related information is interesting, dynamic and comprehensive with effective and intuitive tools for you to access them.

The Atlas of Canada data covers all of Canada and data elements are feature-coded and structurally clean. Base map components are available in five scales and in a number of data exchange formats. The 1: 2,000,000 and 1: 7,500,000 scales are the primary bases for all Atlas products. The 1: 30,000,000 scale data have been generalized from the two larger scales.

Some of the base components currently available in The Atlas of Canada Digital Data Base include:

- Drainage: coastlines, rivers, lakes
- Boundaries: federal, provincial, Canada-Kalaallit Nunaat dividing line
- Transportation: primary and secondary highways, selected ferry routes, rail networks
- Populated places
- National parks

Atlas base map information is two-dimensional vector data. Geographic coordinates (latitude, longitude) or Lambert Conformal Conic projection coordinates, in metric, can be provided. The data are distributed through an FTP transfer.

You can download the following Atlas digital vector products from GeoGratis.

3.4.1 Canada Base Maps

The Atlas of Canada Base Map series includes all federal, provincial and territorial boundaries as well as the international boundaries, major road and rail transportation networks, hydrography and ice cover, a selection of populated places along with administrative, provincial and national capitals. The data is suitable for Geographical Information Systems (GIS) applications, electronic publishing and customized digital products.

- 1:2,000,000 Base Map Data
- 1:7,500,000 Base Map Data
- 1:20,000,000 Base Map Data
- 1:30,000,000 Base Map Data

3.4.2 North America and North Circumpolar Region

In June 2004, the Atlas of Canada released a new set of 1:10,000,000 North American framework data as part of a unique partnership with the National Atlas programs in the United States (USGS) and Mexico (INEGI). The key value-added element was cross-border harmonization of feature geometry and attributes. North American framework layers include populated places, administrative boundaries, roads, railways, hydrology, bathymetry, glaciers and sea ice.

The North Circumpolar Region map provides a comprehensive view of the area of Canada and the World situated between 55º N latitude and the North Pole.

3.4.3 Atlas Frameworks

Hydrology, Rail, Roads, Populated Places are part of an on-going effort to integrate a growing set of base maps depicting human and environmental themes. The digital maps are national-scale (1:1,000,000), integrated and free. To access them go on-line at GeoGratis and select 'National-Scale Frameworks'.

3.4.4 How to Access Framework Data with the Atlas of Canada

This section is intended to help you to find and access framework data through the Atlas of Canada portal for use in GIS software or Web applications. Information is first provided to help you navigate through the portal to find framework data, followed by guidance on how to access and download the required data. The Atlas of Canada portal is the best place to access smaller scale framework data in the range of scales shown under Canada Base Maps above.

3.4.5 Navigating the Atlas of Canada

On the Atlas of Canada home page, click **Free Data** on the menu at the left hand side, which will direct the browser to a page describing the free data available through this portal. Scroll down to Canada Base Maps where there are links to the different scales of base mapping data listed above (Figure 1).

Figure 1

By clicking on any one of these links, you will be taken to a page on the GeoGratis portal that identifies the datasets that are available at the four mapping scales (Figure 2).

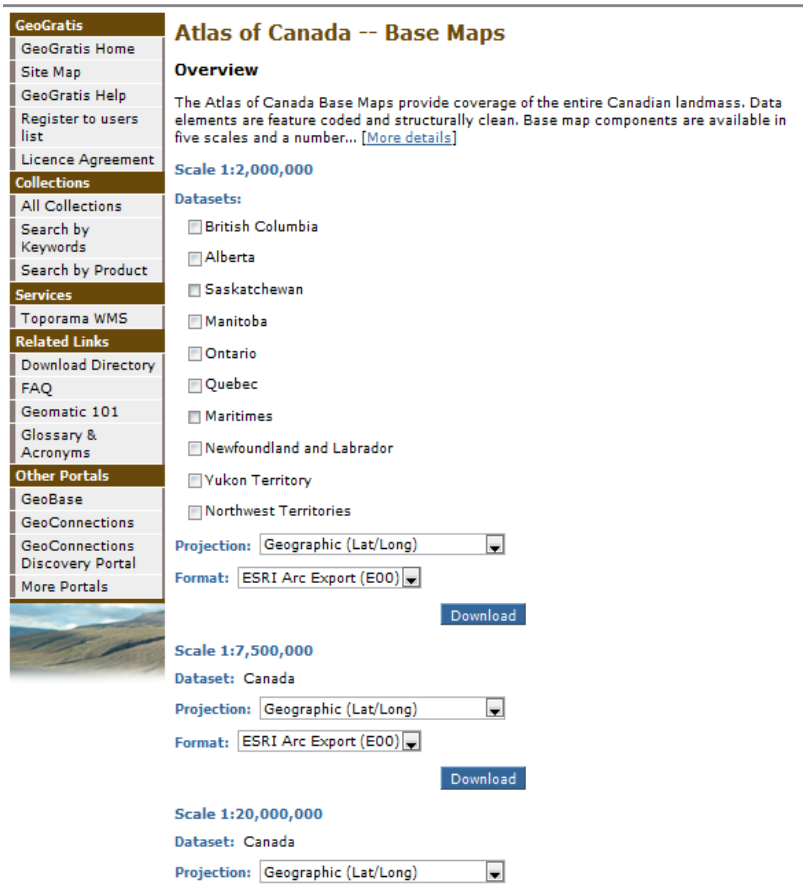


Figure 2

3.4.6 Downloading Data

Once you have discoverd the available data files as described above, you can download them using the following steps.

1. Identify which files are to be downloaded by placing a check mark in the box beside the files. You also need to select the map projection and the format for the data to be downloaded. The two projection options are Geographic (Lat/Long) and Lambert Conformal Conic, and the two format options are ESRI Arc Export and AutoCAD DXF.

2. Click **Download** and the browser will open the Download Page, where the selected file(s) will be identified. Click on the file to be downloaded and a download prompt will appear. In the example shown in Figure 3, the 1:2,000,000 scale dataset for the Maritimes, with Geographic projection and in ESRI Arc Export format, has been selected.

Figure 3

In the download prompt that appears, you are presented with the option of either opening the compressed file that contains the dataset directly, or saving the file to a chosen directory and extracting the dataset(s) later. For this example, the .zip file will be opened and the data saved immediately.

3. Click **Open**. If your computer has a file compression application installed (such as WinZip or WinRAR), it will appear as the default in the dropdown list to the right. If not, you must install a compression application to view and remove the files that have been compressed within the downloaded file. Click **OK**. When the download completes and the compressed file has been opened, the list of files making up the requested dataset(s) is shown. The files shown in Figure 4 represent the geodata at the 1:2,000,000 scale for the Maritimes.

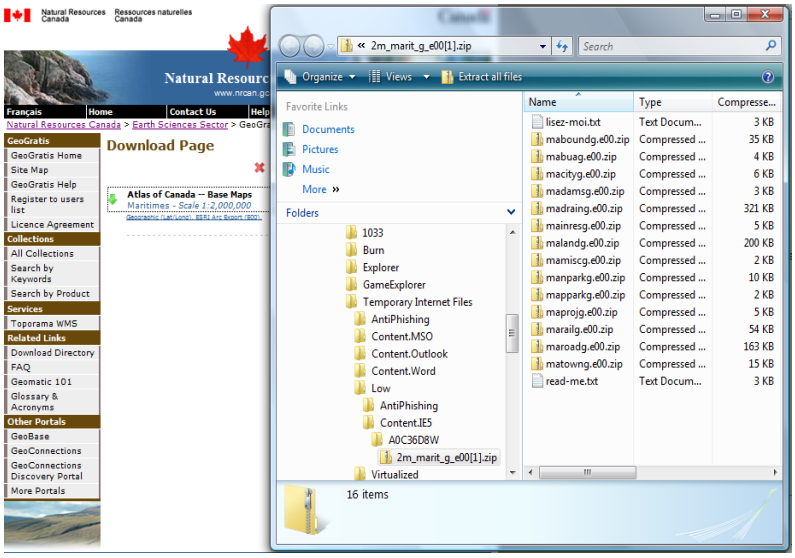


Figure 4

4. **Save (extract)** all the compressed files to an appropriate directory. Make sure all files are saved in the same location. If your GIS or Web application does not see all file extensions relevant to an opened file, an error may result.

3.4.7 Atlas of Canada Web Mapping Service (WMS)

If you are a more experienced geospatial information user, you can use the Atlas of Canada's Web Map Service (WMS), an Internet-based service designed to provide developers of on-line OGC (Open GIS Consortium) WMS compliant mapping tools access to the Atlas of Canada's base layers. To access a WMS, you must have GIS software or a Web application compatible with OGC standards that supports the service. This will allow your GIS or Web application to communicate directly with the GIS database on the map server. The Atlas of Canada WMS allows fast access to show requested geodata layers in a map or workspace directly from the server. If you have some experience with WMS services, you can obtain detailed information on accessing Atlas of Canada framework data through their service at the Web Map Service page on the portal.

3.5 Provincial Portals

Provincial and Territorial Governments play an important role in the creation and dissemination of framework data as well. Most of these jurisdictions have counterpart agencies to the national mapping group at Natural Resources Canada, which are responsible for base or framework mapping of their territories typically at scales in the range of 1:10,000 to 1:20,000. The majority of those agencies are partnering with Natural Resources Canada on GeoBase, to contribute their framework data to this national initiative.

A number of Canadian Provinces and Territories have their own portals providing access to geospatial data. Llinks to these provincial portals are available through the Discovery Portal. While there are some differences between jurisdictions on what they include in the category of framework data (often referred to as base mapping data on their portals) and in the methods for discovering and accessing that data, the links to provincial portals below provide you with other valuable sources of data that you may wish to consider in deciding on the best framework data to meet your needs.

British Columbia
Alberta
Saskatchewan
Manitoba
Ontario
Quebec
New Brunswick
Nova Scotia
Prince Edward Island
Newfoundland and Labrador
Northwest Territories
Yukon

4. Chapter 4: Example Applications of Framework Data

The following sections provide some examples of how framework data has been used in a variety of applications. These examples are intended to illustrate and inspire.

4.1 Chapter Highlights

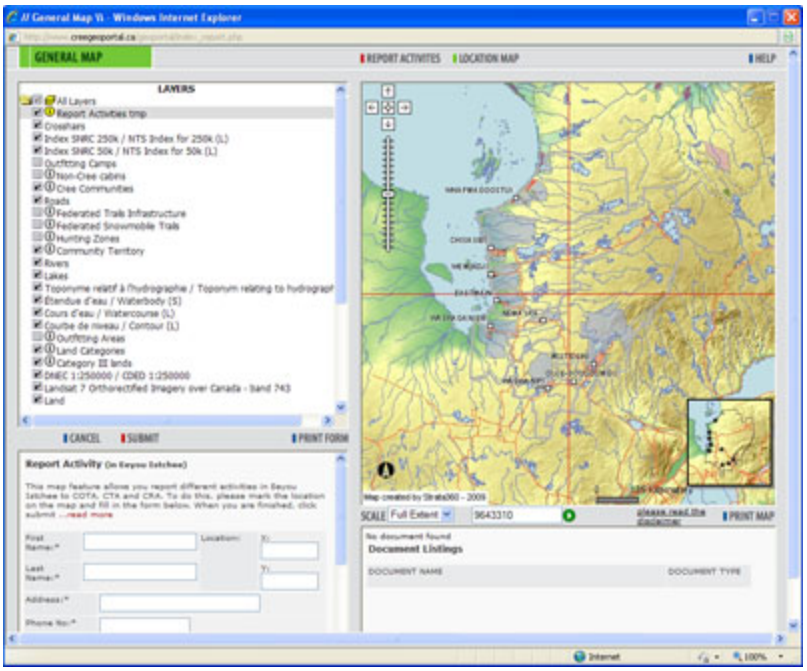
In this Chapter, you will learn about several examples of the application of framework data that illustrate its potential use:

- **Geo Portal for Eeyou Istchee**, an Internet portal to help an Aboriginal community to manage tourism and land use harmoniously.
- **MapSherpa**, an on-line mapping service that allows users to make maps for their personal, organizational or customer needs.
- **Radio Mobile**, freeware that was developed for amateur radio users to help predict radio frequency patterns and the performance of radio systems.
- **National Forestry Information System**, an information infrastructure to provide answers on matters relating to sustainable forest management in Canada.
- **Online Injury Atlas for Ontario,** a password protected Web site that allows health care workers to view the distributions of injuries by type and age ranges, according to census subdivisions or local health integration network (LHIN) areas.

4.2 Aboriginal Matters: Geo Portal for Eeyou Istchee

Geospatial framework data helps to connect Aboriginal people and their communities, enabling them to map their futures, manage resources, and capitalize on opportunities. A good example of the use of such information is the Geo Portal for Eeyou Istchee, an internet portal for Cree communities in northern Quebec using GeoBase layers as framework data to manage tourism and land use harmoniously.

Creegeoportal.ca delivers geospatial information to Cree communities to support research, discussion, planning and decision making related to resource management and tourism development. The Portal incorporates Cree traditional knowledge datasets in combination with information and base maps (vector and satellite images) from other distributed data sources. It conforms to CGDI standards and specifications, and supports applications based on visualization of map data.



The main objective of the Portal is to provide Cree users with a wide range of geographic information on:

- The lands and resources of Eeyou Istchee
- The Cree use, management and protection of these resources
- The threats to these resources from non-Cree activities
- The Cree and non-Cree infrastructures

Numbers of visitors to Eeyou Istchee are on the rise, as are competing land uses, such as forestry, mining and hydro-electric development. These pressures have led to complaints from communities about the use of their land. In response to the land use issues, COTA partnered with the CTA and started a project to organize information and make it available online. GeoConnections provided funding to support the development of a geospatial portal.

The portal provides web mapping services that allow users to access a wide variety of maps and geo-information of interest through use of the following interactive maps:

- Outfitting map and database keeps track of outfitting operations and includes a permit monitoring system. It also facilitates permit renewal and new outfitting applications
- CTA cabins map and database includes a Web-based form used to populate and maintain the cabin database remotely. The cabins map also enables users to submit applications for new projects
- Trapline atlas - The main purpose of this map was to update and finalize the present trapline boundaries on the Cree territory and to keep them up to date in the future
- General map is a public map containing detailed base maps and other geospatial layers relevant to land management and planning. It also facilitates reporting of non-Cree activities in Eeyou Istchee

- Tourism map is accessed through the Portal application as well as through the COTA web site. The map displays the following main topics: Cree outfitters, points of interest, suggested itineraries and tourism related infrastructure

- Community maps - nine maps, one for each community showing tourism infrastructure data.

In the past, data for the Eeyou Istchee was collected using traditional means - pencil and paper - and then it was transferred to various databases managed by Cree and non-Cree organizations. It was very difficult for users to access the information, and a community member would have to approach each individual organization to try and piece together the complete land-use picture for their community or trapline.

Through the portal, users can combine different pieces of information with framework data accessed through GeoBase to produce dynamic views of areas of interest. The use of the framework data facilitates the combination and integration of these other data sets.

On a practical level, the web mapping services built into creegeoportal.ca allow a range of community needs to be met. For example, a tourism planner can determine the locations of cabins and/or details of outfitting permits, a local fur officer can find the locations of trap lines, and note where snowmobile trails impact the trap lines. Any registered member of the Cree communities can access the information through a secure interface that facilitates access privileges. In addition, members of the public can access the tourism information, leading to heightened interest in visits to the region and the resulting economic benefits.

4.2.1 How Framework Data was Accessed and Used

Several layers of data were needed to meet the functional requirements of the portal, including framework data from GeoBase and other base map layers. The layers being used and their sources are identified in the table below.

Data Layer	Data Source
Framework Data	
Landsat 7 Orthorectified Imagery	GeoBase Web Map Service (WMS)
Other Base Map Data	
1:250,000 water bodies	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)
1:250,000 water courses	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)
1:250,000 contours	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)
1:250,000 shaded relief	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)
1:250,000 geographical names	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)
1:250,000 index	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)

1:50,000 index	Centre for Topographic Information – Sherbrooke Web Map Service (WMS)

These data layers were chosen for the General Maps section of the portal, which is a publicly available area of the Web site. In addition to an interactive map, this section contains an application that allows users to report different activities that may be of interest or specific problems which they have identified throughout the Cree territory by clicking on a specific location on the map and filling in a form. It also provides access to important documents relevant to the geospatial layers shown on the map.

The same data layers are also used for the COTA Maps and CTA Maps sections, the use of which is restricted to community members via password protection. The COTA Maps section provides access to the CTA Cabins Map Application and the Trapline Atlas. Community members can also use this section to access the cabins insurance form and the trapline transfer form. The CTA Maps section provides access to the Outfitting Map and database, Tourism Map and Community Maps. It also facilitates access to new outfitting applications, license renewal and the new non-Cree applications subject to the right of first refusal.

The chosen data layers were selected because they provided the kind and level of detail required for the portal application. To these layers have been added several additional layers of locally produced thematic data including, for example, outfitting areas and camps, hunting zones, protected areas, land categories and snowmobile trails. As the user zooms in or out on the interactive map, the system automatically switches between common base provided by the 1:250,000 topographic data and the Landsat imagery.

The WMS option was chosen over data downloading to the portal server to avoid the challenges of keeping these layers up to date. The advantage of accessing the data directly on the Federal Government servers is that the most current versions of the layers are always available to the application. The disadvantage is that response time may not be as good as if the data were downloaded to and accessed from the local server.

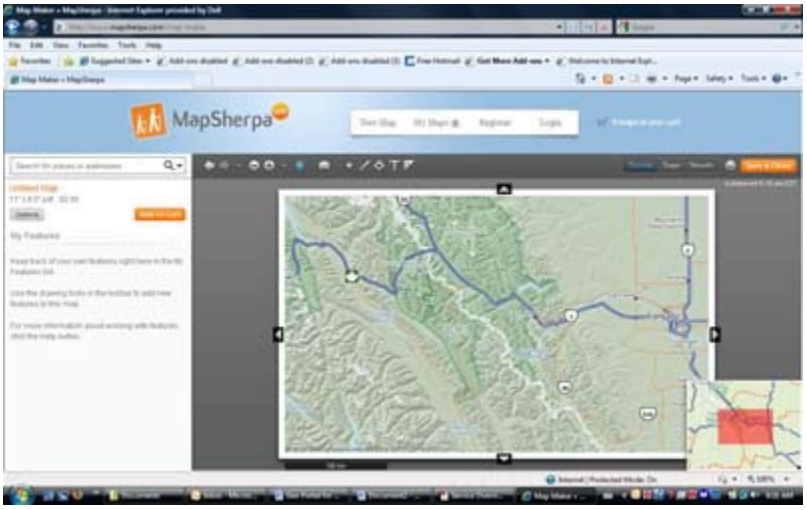
A number of challenges were addressed during the development of the Geo Portal for Eeyou Istchee, including the following:

- WMS was not working properly because the parameter "Image memory limit" in the commercial GIS product used for portal implementation was set too small by default. This problem was corrected with an increase in the memory allocation.
- Map display speed was a problem when multiple users were accessing the portal at the same time. This challenge was overcome by upgrading the ISP connection to a higher speed.
- An important function of the CTA Maps section of the portal is the ability to print large scale maps for trappers. The WMS services were limited in their output size to a resolution of 800x800 pixels which resulted in data layers not appearing on larger-size print layouts used by the application. An interim solution was to download the necessary portion of the data for this application until the resolution of the WMS services is increased.

4.3 Developers: MapSherpa

CGDI provides developers of commercial software products with access to the information they need to create applications. Companies like DM Solutions Group are taking advantage of this powerful resource to create new product offerings.

Recognizing that some users may not have the GIS skills to create and access custom digital, print and interactive maps, DM Solutions Group (DMSG) decided to create a new on-line mapping service called MapSherpa. Users of all kinds can use MapSherpa to take control of the maps required for their personal, organization or customer needs: web designers, real estate agents, or paper map consumers for example. Benefitting from the use of geospatial framework data, MapSherpa uses GeoBase data as the core of the application.



As a service hosted by DMSG, the only software needed to interact and work with MapSherpa is a web browser. In addition, users don't need to work with any GIS data as this is fully integrated behind the scenes within the hosted service.

"Today's Web technologies, in particular AJAX and Web 2.0 technologies, can enable a modern mapping company to empower users with the tools to make their map of choice, and access it in a manner that best suits their needs," said Dave McIlhagga, President of DMSG. "This is the primary objective of MapSherpa."

MapSherpa provides the user with most of the functions outlined below and plans to extend the service to meet all of the following:

- **Create your map** – With minimal effort users can cookie-cut from a number of pre-styled maps to meet their needs. Users can also integrate their own information, such as business address, a customer list, or GPS data collected from the field.
- **Access your maps** – MapSherpa provides many options (or combinations) for users to access their created maps in the way they need them.
- **Mapping as an ongoing tool** – MapSherpa allows users to save their maps and custom data for ongoing use by them or others in their organization.

4.3.1 How Framework Data was Accessed and Used

The primary objective of the MapSherpa service is to allow users and subscribers to create custom maps of the highest quality for use in paper and digital forms. This fundamental requirement impacted the mechanisms chosen by DMSG to manage and access various data sources in accordance with key factors including:

- Size of dataset

- Frequency of updates or changes to data
- Frequency of access by users
- Data types including raster, vector types
- Cartographic requirements including symbology, print resolution, labeling and others

The layers being used and their sources are identified in the table below.

Data Layer	**Data Source**
Framework Data	
Canadian digital elevation data (CDED) – source for hillshading	GeoBase Download
Canadian Geographical Names	CGDI Gazetteer Service
Other Base Map Data	
1:50,000 CANVEC data	Centre for Topographic Information – Sherbrooke Download
Atlas of Canada framework data	Atlas of Canada Web Map Service (WMS)/ Web Feature Service (WFS)
High resolution imagery data	DigitalGlobe Web Map Service (WMS) (Not currently enabled live)
Road network data	NAVTEQ Download

One of the main objectives in designing MapSherpa was to maintain data closest to source and through maximum leverage of standards-based Web services. In order to achieve the dual goals of highest quality maps and performance efficiencies while achieving maximum leverage of standards-based services, the following approaches have been adopted:

- Where available, MapSherpa accesses raster imagery sources via WMS services (e.g., the DigitalGlobe imagery data layer).
- Sources of vector data that do not change frequently are accessed via WFS services and downloaded into the local MapSherpa environment (e.g., CDED, CANVEC and Atlas of Canada data layers). Local access allows for higher quality map production by retaining broader control of cartographic representation.
- In the case of vector data that changes frequently, all access is through WFS or WMS directly into the rendering process, dependent on the volume of data (e.g., road network data). This

results in some loss in map quality but is the only practical means of accessing this data that has frequent changes.

Two other CGDI services are also being leveraged for functions required by the MapSherpa system. According to Dave McIlhagga, "DMSG's long term vision for MapSherpa is to enable third parties to manage an instance of the service that will incorporate data of their choosing, both their own and standards based data services that would be discovered through the GeoConnections Discovery Portal Catalog API." Consequently, DMSG staff leverage the GeoConnections Discovery Portal in order to discover relevant CGDI assets for incorporation into the MapSherpa service. This ensures that users of MapSherpa have access to the most current map services available within the CGDI. Secondly, the GeoConnections Gazetteer Services API is accessed and exposed to users in the MapSherpa search function, to assist users with finding a location within the interactive map.

A number of data challenges were encountered during the development of the MapSherpa application, including the following:

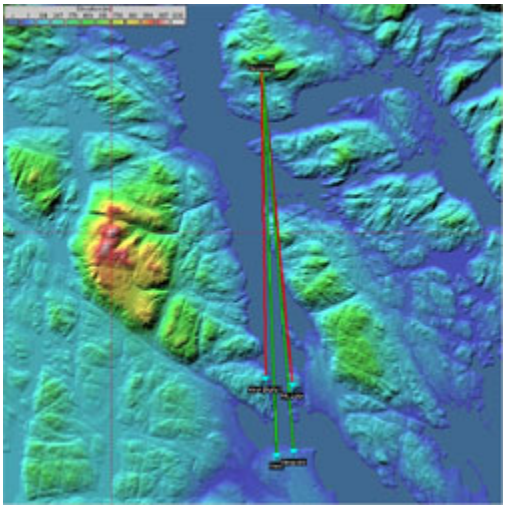
- Since CANVEC data was originally developed on a sheet by sheet basis, this does not always align well with a seamless interactive online experience. Some of the issues encountered included:
    - Lake and other polygons clipped at borders – modified cartographic representation was required to address this.
    - Contours in both metric and imperial units – this could not be addressed in the first release and DMSG is considering interpolation of metric contours on imperial sheets.
- Contour intervals vary across Canada, making consistency in the mapping application challenging – DMSG is considering modifying the full contour layers for the country to create a more consistent approach.
- Use of WMS services for data sources was mostly impractical due to high-end cartographic styling requirements including print production, and reliability issues for the service – to address this, all source data other than imagery and geographical names was downloaded and processed locally in the MapSherpa infrastructure.

4.4 Public Safety & Security: Radio Mobile

Using geospatial framework data, public safety and security organizations can increase their situational awareness by better understanding incidents – and their management options. Radio Mobile freeware was developed for amateur radio users, and uses the GeoBase data layers as framework data to help predict radio frequency patterns and the performance of radio systems.

The GeoBase CDED data layer is used to automatically extract a path profile between an emitter and a receiver. CDED data is added to system, environmental and statistical parameters to feed the Irregular Terrain Model radio propagation model, in order that strength of a radio signal can be modeled as a function of distance, time and space. Elevation data is also used to produce background maps - illustrating the terrain. Radio Mobile has supplied 10,000 copies of the Radio Mobile freeware to members and has had 600,000 hits on its Web site since 1997.

The software also provides 3D views, stereoscopic views, and animation. Background pictures can be merged with scanned maps such as Toporama and Landsat 7 satellite orthoimagery.



Using Radio Mobile software and the GeoBase CDED data layer, the Canadian Coast Guard (CCG), Pacific Region Integrated Technical Services, is able to find optimal locations for mountaintop radio communication sites. The image above shows the predicted paths to several proposed sites for remote equipment locations. The profiles in red indicate that the path is obstructed, where the profiles in green indicate an unobstructed path.

"Access to this high quality data is essential to this part of my job," says Cameron Bremner, of Integrated Technical Services. Bremner explains that the free, unrestricted GeoBase data allows him "to predict the point-to-point propagation path between two sites. Even though there may be good line-of-sight between two sites, there may be peaks that extend into the radio diffraction paths." This would indicate that the ground coverage between the potential sites is inadequate for the Coast Guard's needs.

Once the remote radio sites have been placed, they can be used for a variety of functions. Some sites have VHF repeaters that allow users, such as Fisheries and Oceans Canada, to communicate over great distances using portable radios. Other CCG sites are networked together via microwave broadband links and are outfitted with Marine VHF FM radio equipment that allows watercraft to communicate with the CCG's Maritime Communications and Traffic Services. According to Bremner, this has greatly increased the amount and quality of information being passed back and forth as well as improving occupational health and safety conditions.

4.4.1 How Framework Data was Accessed and Used

Two key layers of data were needed to meet the CCG functional requirements, including framework data from GeoBase and another map layer. The layers being used and their sources are identified in the table below.

Data Layer	Data Source
Framework Data	
Canadian digital elevation data (CDED)	GeoBase Download
Other Base Map Data	
Shuttle Radar Topography Mission (SRTM)	United States Geological Survey (USGS) Download

In addition to the Radio Mobile software package, CCG uses another package called Pathloss, a comprehensive path design tool for radio links operating in the frequency range from 30 MHz to 100 GHz. Pathloss employs the elevation data provided by the CDED and SRTM data layers to create a vertical profile along a potential path and then to determine vertical obstructions and loss of the radio frequency (RF) signal resulting from those obstructions.

The GeoBase CDED data was chosen for this application because it is the best available digital elevation data set available for Canada, and is complementary to the SRTM data set, which provides a coarser depiction of the terrain elevation. Since this data set is updated infrequently and contains a very large volume of data, the best choice for CCG's application was to download the data to their servers, rather than access it in real time through the GeoBase WMS service.

4.5 Sustainable Development & Environment: National Forest Information System

Canada's forests cover some 500 million hectares and stretch across the entire country. Many jurisdictions and management agencies are responsible for these forests, including governments, industry and other organizations, which are gathering forestry information in different ways and for different uses, and storing it in different locations. As a result, accessing and integrating this information is extremely complex.

In August 2000 the Canadian Council of Forest Ministers (CCFM) decided to establish an information infrastructure, called the National Forest Information System (NFIS), to provide answers on matters relating to sustainable forest management in Canada. The vision was to implement the necessary information technology framework to demonstrate sustainable forest management practices in Canada. The framework was designed to:

- Provide ready access to the most current, consistent and reliable forest resources information;
- Provide the transparent integration of information across jurisdictional boundaries;
- Provide consistency in reporting to avoid different answers being given to the same question;

- Reduce costs through the sharing of information technology; and
- Eliminate duplication in reporting, resulting in greater efficiency and reduced costs.

The NFIS technical infrastructure is made up of the following four distinct components:

- The data and information held by the partners that is made available for access;
- Generalized data models which allow diverse data representations to be mapped into a common representation;
- The Web-based data and information access and delivery tools and services; and
- The Web Portal.

The NFIS architecture consists of a network of content servers working within a common information and services framework. This allows NFIS member organizations to attach attributes to the shared representations of the landscape and to carry out independent, off-line analyses and compilations for subsequent Web-based delivery through the common framework. "This is a distributed architecture," says Brian Low, Manager of the National Forest Information System, Pacific Forestry Centre, Canadian Forest Service, of Natural Resources Canada, "that allows responsibility for the management of information and the definition and implementation of services to reside with the custodian, closest to the data source." This approach ensures that the data are authoritative and current and it also provides the custodial agency with full control of access to the data.

In order to facilitate the collection and portrayal of different themes of data and to implement access control to the data sets, a number of Web portals have been developed. The Public Portal, which does not have any access restrictions, contains base mapping, forest cover, vegetation, ecological classification, and imagery data layers. The Provincal and Territorial Portals, also without access restrictions, provide access to data published by partners. Themed Portals provide views of a range of thematic data, such as Canada's protected areas, forest cover and others, some of which are restricted to different groups of users. Scientific Portal provide users that have obtained a valid NFIS user account with access to partners' published data holdings. Finally, CFSNet Portals provide access to a number of Canadian Forest Service portals that have been developed for research and operational purposes (e.g., Canadian Wildland Fire Information System, Canadian Forest Genetic Resources Information System, the Mountain Pine Beetle Internet Tool, etc.)

Framework data provides the important geographic foundation for many of the national portals that are part of the National Forest Information System. The only exceptions to the use of the common framework data layers are the Provincial and Territorial Portals, which usually build their information on provincial/territorial government framework data, in which there is some variation.

4.5.1 How Framework Data was Accessed and Used

Several layers of data were needed to meet the functional requirements of NFIS, including framework data from GeoBase and other base map data. The common layers available on the NFIS Public Portal are identified in the table below.

Data Layer	**Data Source**
Framework Data	
Landsat 7 Orthorectified Imagery	NRCan-CCRS http://ceoware2.ccrs.nrcan.gc.ca (WMS)
Road Network	NRCan-CTI http://www.cits.rncan.gc.ca (WMS)
Inland Water Bodies	GeoBase Web Map Service http://wms.geobase.ca (WMS)
Water Courses	GeoBase Web Map Service http://wms.geobase.ca (WMS)
Built-up Areas	GeoBase Web Map Service http://wms.geobase.ca(WMS)
Toponomy	NRCan-CTI http://www.cits.rncan.gc.ca (WMS)
Elevation	GeoBase Web Map Service http://wms.geobase.ca (WMS)
Other Base Map Data	
Provincial Boundaries	Centre for Topographic Information – Sherbrooke Download
Provincial Base Mapping	Provided by provincial partners
Provincial Forestry Data	Provided by provincial and territorial partners
Federal Forestry Data	Provided by Canadian Forest Service

These data layers were chosen for NFIS because they provide the kind and level of map detail required to support the different portal applications within the overall system. The WMS option was chosen for the majority of data layers over data downloading to the NFIS server to avoid the challenges of keeping

these layers up to date. The advantage of accessing the data directly through the GeoBase WMS service is that the most current versions of the layers are always available to the application. The disadvantage is that response time may not be as good as if the data were downloaded to and accessed from the local server. The provincial boundaries layer was downloaded to the NFIS server because this information is static.

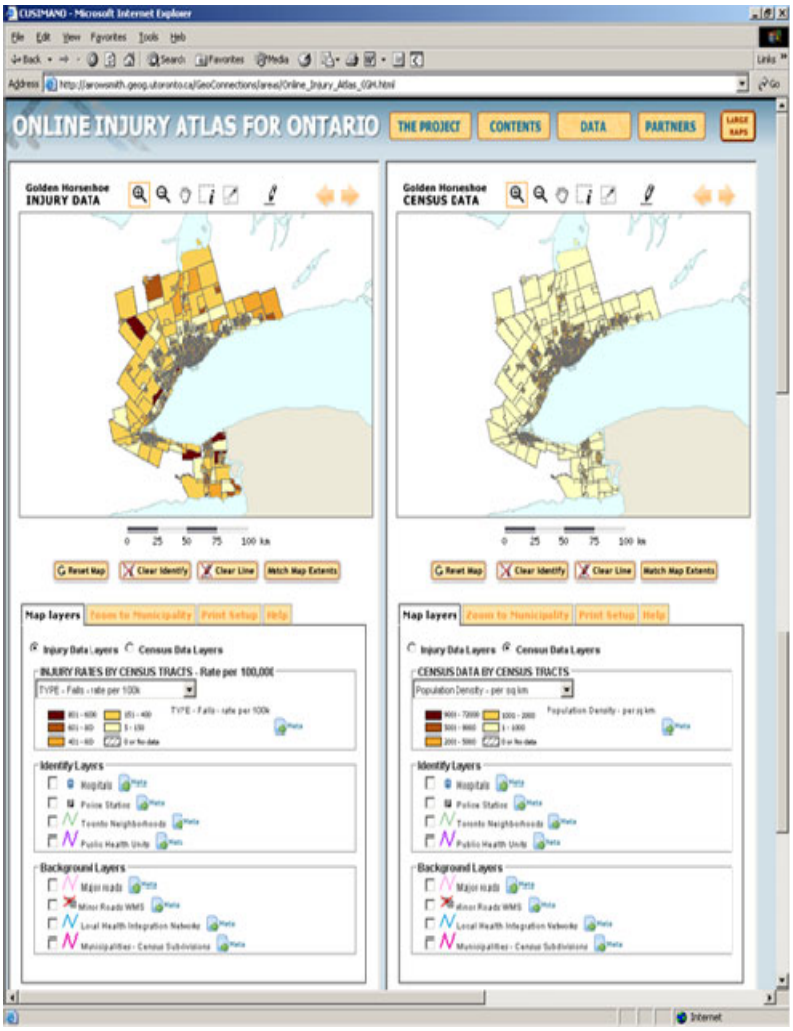
A number of framework data access and integration challenges that still need to be addressed including the following:

- service availability – down time
- redundant data sources
- performance (response time from servers must be within reasonable time)
- metadata – quality of data missing
- service level agreements
- multiple version of CGDI data even within NRCan WMS servers
- version control - authoritative

4.6 Public Health: Online Injury Atlas for Ontario

In Canada, injuries are the greatest single contributor to potential years of life lost before age 65 and remain a major health problem in the country. As the largest province by population, Ontario represents a significant proportion of the national injury burden, with thousands of lives lost, and hundreds of thousands of injuries sustained annually. To increase public awareness about the threat of injury, the Injury Prevention Research Office of St. Michael's Hospital in Toronto, Ontario, collaborated with GeoConnections to develop a web-based injury atlas for the province.

St. Michael's worked with The University of Toronto, Ryerson University, and a group of end users throughout the province, including health care providers, public health agencies, non-governmental organizations, and provincial ministries. The datasets used include hospitalization rates for injury, census data from Statistics Canada, and map data layers from Natural Resources Canada. Public health units can use the atlas to determine areas and populations at risk, enabling them to provide appropriate injury prevention programs and make informed decisions about policies and programming.



Some of the datasets used in the online atlas are served with Web Map Services (WMSs) coming from a number of sources. For example, a public road map layer from the CGDI (WMS) and injury rates from a protected, high-security server at the Centre for the Study of Commercial Activity at Ryerson University (WMS) are overlaid with household income data from a protected Census map server at the Cartography Office, University of Toronto. Users can view the distributions of injuries by type (e.g., falls, motor vehicle, assault, self-inflicted) and by age ranges, according to census subdivisions or local health integration network (LHIN) areas. The application provides the ability to display census or injury data on either of two side-by-side maps. A top-level selection tool was incorporated based on end-users consultations during the development of the online atlas, and provides a useful means for displaying more data (such as emergency room visits) in future versions of the web-atlas.

The Online Injury Atlas for Ontario has made significant contributions to the Canadian Geospatial Data Infrastructure by combining a number of existing WMSs with health, injury, and demographic data published as new WMSs for this project. As expected, injury data (and health data in general) cannot easily be published and integrated in the CGDI due to their confidentiality. In order to protect the confidential datasets, access to the entire web-atlas is limited to authorized users with a user name/password log-in process. The user name and password were frequently altered to maximize data privacy and security. The online atlas demonstrates the combination of public and protected datasets within one web mapping application, and the need to provide levels of access within spatial data infrastructure that includes password-protected sections. Thus, while this project can only contribute new

services to the CGDI if the data providers agree to share their data, the atlas demonstrates the use of certain public WMS in combination with protected WMS to support decision-making in public health.

4.6.1 How Framework Data was Accessed and Used

Several layers of geographic data were needed to meet the functional requirements of the online atlas, including framework data from the Atlas of Canada and other base map layers. The layers being used and their sources are identified in the table below.

Data Layer	Data Source
Framework Data	
1:2,000.000 major highways and roads	Atlas of Canada WMS
Other Base Map Layers	
LHIN boundaries	Statistics Canada, Health Region Boundaries Download
Public health unit boundaries	Statistics Canada, Health Region Boundaries Download
Municipal boundaries	Statistics Canada, Cartographic Boundaries Download
Acute care hospitals	Ontario Ministry of Health and Long-Term Care files Download
Police Stations	Internet sites of police services Download

A number of challenges were encountered and addressed during the development of the online atlas, including:

- Reaching agreement with the owner of the injury data took longer than anticipated, and this limitation needs to be taken into consideration when developing timelines for projects involving data privacy concerns.
- The open source web mapping software used for the online atlas, CartoWeb, proved successful in achieving the goals of the project, but the resources required for customization were significantly higher than originally planned and there were many gaps in the documentation provided.
- It was more difficult than expected to find useful general base data layers that would serve up efficiently and could be relied upon. For example, one of the planned WMS services was not a dependable data source. It may be necessary to test services for reliability in particular applications (a guide for service testing can be found here).

5. Chapter 5: The Context for Framework Data

5.1 Chapter Highlights

In this Chapter, you will learn about:

- The major components and benefits of the Canadian Geospatial Data Infrastructure (CGDI)
- The role played in framework data by the following key Canadian and international geospatial organizations:
- GeoConnections
- Canadian Council on Geomatics (CCOG)
- Inter-Agency Committee on Geomatics (IACG)
- Open Geospatial Consortium (OGC)
- International Organization for Standardization (ISO)

5.2 The Canadian Geospatial Data Infrastructure

Spatial data infrastructures formalize the structure and process for organizing, using and sharing geospatial data and services common to a broad spectrum of applications and users within a country and between countries. Like Canada, countries such as Australia, Sweden and the United States have established their own national spatial data infrastructures, and many others are following suit.

More information about the CGDI can be found at: http://www.geoconnections.org/en/aboutcgdi.html
A complete CGDI training course can be found at:
http://www.geoconnections.org/publications/training_manual/e/index.htm

The Canadian Geospatial Data Infrastructure (CGDI) is the name for Canada's national spatial data infrastructure. It consists of the technology, standards, access systems and protocols necessary to harmonize all of Canada's geospatial databases, and make them available on the Internet. Geospatial databases are very diverse and examples include: topographic maps, air photos, satellite images, nautical and aeronautical charts, census and electoral areas, forestry, soil, marine and biodiversity inventories. Framework data is a subset of such geospatial data.

Five major components of the CGDI, which are common to any SDI, are access to data and services, data policy, framework data, technology, and standards.

5.2.1 Benefits of the CGDI

Canadians are benefiting from the Canadian Geospatial Data Infrastructure through:

- Universal access to geospatial information, anywhere, anytime;
- The development of applications to discover and access distributed online information;
- The integration of different geospatial information to provide seamless views;
- Seamless chaining of applications, data and services or combinations of these;
- Geospatial update and exchange capabilities, which enable collaborative activities;
- The sharing of geospatial semantics, allowing easier integration of information;
- Wide-scale interoperability, by adhering to common and open information standards and specifications; and
- The development of effective partnerships with regional and sector-specific spatial data infrastructures and linkages with other national spatial data infrastructures to form a global spatial data infrastructure.

Those developing business applications that include geospatial data benefit from the infrastructure through:

- Reduced costs: Applications can be built by reusing existing services.
- Reduced complexity: Service interfaces hide the underlying complexity.
- Less costly integration and interoperability: Standard interfaces simplify interconnection and integration.
- Direct access to current, authoritative source data.

In sum, the CGDI and the new applications it spawns lead to:

- Informed decision-making: The CGDI provides easy access to current information, knowledge and expertise.
- Efficiency: National standards and specifications, as well as access to services, reduce duplication of effort.
- Usability: The CGDI provides reliable access to geospatial information for Canadian governments, businesses and individuals.
- Economic growth: The CGDI encourages the profitable export of Canadian technology, products and services and internal growth with increased sales.

5.2.2 CGDI and Framework Data

As mentioned previously, the Canadian Geospatial Data Infrastructure facilitates the access to and use of the geospatial framework data in Canada that is being developed through partnerships between federal, provincial and territorial governments. This framework data generally falls into two categories,

characterized by different resolutions of geospatial data. Each category of CGDI framework data has a specified resolution (normally the resolution at which it was acquired) and a range of scales to which it is suited. Although eventually it might be possible to maintain just a single representation of any particular feature, for ease of use the CGDI framework data is currently stored and maintained at national and regional resolutions.

National resolution

The standard reference layers available at this resolution cover all of Canada and are based on the 1:1M product maintained by the National Atlas of Canada. Much of this data was either derived from or aligned to the Canadian portion of the VMAP level 0 data set (originally Digital Chart of the World) as adjusted and distributed by the National Atlas of Canada. The nominal scale of this data is 1:1,000,000, and the accuracy is approximately 1 km.

Regional resolution

Framework data at a regional resolution consists of data produced by and available from a wide variety of organizations from federal, provincial, and in some cases, municipal levels. These data sets are maintained at a variety of accuracies, typically ranging from 250m down to around 1m. Normally the resolution used as the standard is the most detailed resolution of mapping available for that area. Regional resolution data may not be available for all of Canada. Horizontal integration is a requirement between adjacent regional data sets.

5.3 Canadian Organizations

GeoConnections, the Canadian Council on Geomatics, and the Inter-Agency Committee on Geomatics are domestic groups involved in the provision of framework data.

5.3.1 GeoConnections

GeoConnections is a national partnership program (federal, provincial and territorial governments, industry and academia) led by Natural Resources Canada. It has five major thrusts:

- Implementation of the CGDI;
- Development of a common national geospatial data framework;
- Development and adoption of common international geospatial standards;
- Improved federal-provincial-territorial partnerships; and
- The development of a policy environment to encourage the broadest possible use of geospatial information.

Now in its second phase, which will run from 2005 to 2011, GeoConnections is working to ensure that decision-makers in key areas benefit from the Canadian Geospatial Data Infrastructure (CGDI). Co-funded projects encourage key decision-making audiences in four priority areas (public health, public safety and security, the environment and sustainable development, and Aboriginal matters) to work with the Canadian geomatics sector in developing technologies and decision support systems that meet their specific needs.

Although GeoConnections acts as a catalyst in creating solutions for decision-makers in the four priority areas, the program also relies heavily on its partners. These partners can be private companies, government agencies at all levels, non-government organizations, academic institutions, or sometimes a combination of the above.

GeoConnections also brings Canada's geospatial information community together to agree on policies that simplify data licensing, access, and sharing. By fulfilling this role of coordinator, GeoConnections assists Canada's geospatial information community to pull in the same direction and thereby do more in less time at less cost.

GeoConnections also strongly advocates the use of national standards based on internationally recognized open geospatial specifications. By encouraging technology developers, solutions developers, and data suppliers to adhere to such standards and specifications endorsed for the Canadian Geospatial Data Infrastructure (CGDI), GeoConnections greatly enhances the CGDI's value to Canadians. That is because standardized data or applications accessible via the CGDI from one provider can then easily be layered or used with those from another. This interoperability will often produce richer and more useful information than a single data set or application can provide.

GeoConnections is active in the negotiation and development of data standards and policies with the government agencies at the federal and provincial/territorial levels domestically and with the international standards bodies described in the following sections. Since the standards that GeoConnections endorses for the CGDI are internationally recognized, Canadian applications developers and data suppliers can easily export their technologies, data, and expertise to other countries adhering to the same international standards.

GeoConnections is governed by a management board, operated by a secretariat, and guided by numerous advisory committees, four of which represent the interests of GeoConnections' key audiences. By thoroughly understanding the information needs and challenges of decision-makers in our four key areas, the program is well positioned to request and fund independent project proposals that deliver the most sought-after solutions for end-users in those areas. These linkages with the user communities have also ensured that the CGDI framework data sets are appropriate for most users' needs and that future framework data layers will be added as those needs continue to change and evolve.

An important role has been played by GeoConnections in the development of the primary framework data set, GeoBase. Through its Policy Committee, the organization was instrumental in the change in policy at federal and provincial government levels, from sale of base map (or framework) data to provision of data access at no cost and with no restrictions on reuse. This policy change led to the agreement to create GeoBase. In addition, GeoConnections provided funding support to the GeoBase partners to bring the contributed data to a common format and standard, and to develop/update key data layers (e.g., road network and satellite orthoimagery).

Recognized around the world for its prominent role in building the Canadian Geospatial Data Infrastructure and establishing a solid foundation of framework data, GeoConnections is serving as a model for other countries to emulate in creating their own national geospatial data infrastructure. As such, GeoConnections' influence extends well beyond Canada's borders, furthering the country's reputation as an international geospatial information leader and innovator, and helping other nations around the globe.

5.3.2 Canadian Council on Geomatics

The Canadian Council on Geomatics (CCOG), created in 1972, is 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. The Council:

- Provides a consultative forum of federal, provincial and territorial government representatives for such purposes as:
    - the consideration and discussion of important common issues and concerns;
    - the exchange of information on current and future programs;
    - the discussion of proposed legislation of general interest;
    - the presentation and discussion of reports on achievements, organizational changes, new ideas, technology and procedures developed during the preceding year or to be developed in future;
- Develops, promotes and promulgates national and international geomatics standards;
- Works together to support a Canadian geospatial data infrastructure;
- Promotes cooperation and the exchange of geomatics data to reduce duplication of effort and to facilitate easy access to and use of geographical information by all Canadians; and
- Formulates recommendations and resolutions as are from time to time deemed appropriate.

The members of the Council are delegates of the governments of Canada, the provinces and the territories representing their government's major geomatics organizations (responsible for the provision, standardization and co-ordination of geospatially referenced data). CCOG has been instrumental in the establishment of the partnership arrangements for development and maintenance of GeoBase.

CCOG sub-committees exist to deal with the Canadian Geodetic Reference System, GeoBase, and the National Mapping Strategy, and the Council is represented on the GeoConnections Management Board.

5.3.3 Inter-Agency Committee on Geomatics

The Inter-Agency Committee on Geomatics (IACG) is an inter-departmental federal co-ordinating body for the effective and efficient utilization of geomatics within the Canadian government. The IACG is directed by an Assistant Deputy Minister (ADM) Steering Committee supported by a Director General/Director Working Group and a secretariat.

The objectives of IACG are to develop and implement a federal government geomatics strategy, complementary with provincial and territorial approaches, that promotes the maintenance and widespread use of a data infrastructure having common standards and up-to-date data that are collected once and used by many agencies. It does this by:

- Establishing cooperation and recognising the lead roles for the collection, maintenance, analysis, integration and sharing of geospatial data and information to eliminate overlap and duplication by;

  - ensuring best efforts to reduce or eliminate federal inter-agency charges for access and use of common geospatial data;
  - encouraging and furthering the interoperability of geospatial and other information systems developed by agencies and their partners;

- Promoting the use of common geomatics standards that comply with international standards;
- Facilitating easy access to and use of geographical information by all Canadians though, for example, the use of common data licenses; and
- Providing a consultative forum for the federal geomatics community.

The IACG played a lead role in the development of the GeoConnections program and in gaining funding for the program, and is represented on the GeoConnections Management Board. It continues to play a strong role in ensuring that all federal government information systems that use geospatial information are linked to the CGDI and use the framework data, and provides input to decisions on the priorities for new data layers to be added to GeoBase.

5.4 International Organizations

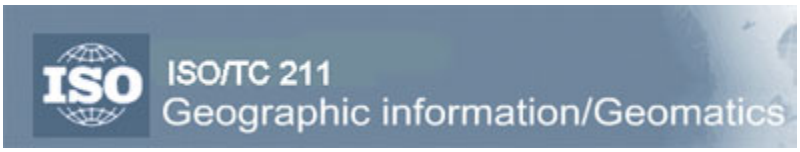
Canadian framework data standards meet international norms, making the data compatible with both commercial and custom geospatial information applications. The Open Geospatial Consortium (OGC) and the International Organization for Standardization are two groups involved in the establishment of international standards governing framework data.

5.4.1 Open Geospatial Consortium

The Open Geospatial Consortium (OGC) is a consortium of over 387 companies, agencies and universities working toward a world in which everyone benefits from geographic information and services made available across any network, application, or platform. The mission of the OGC is to promote the development and use of advanced open systems standards and techniques in the area of geoprocessing and related information technologies.

OGC manages a global consensus process that results in approved interface and encoding specifications that enable interoperability among and between diverse geospatial data stores, services, and applications. Its membership is international and includes universities, federal government agencies, local government agencies, earth imaging vendors, content providers, database software vendors, integrators, computing platform vendors and other technology providers. OGC facilitates their reaching agreement on OpenGIS specifications for interfaces, schemas and architectures. Systems implementing OpenGIS standards can interoperate, whether those systems are running on the same computer or the same network. OGC standards provide essential infrastructure for the Spatial Web, a network of geospatial resources that is thoroughly integrated into the Web, such as the Canadian Geospatial Data Infrastructure.

5.4.2 International Organization for Standardization



The International Organization for Standardization Geographic Information/Geomatics Technical Committee 211 (ISO/TC 211) is responsible for the ISO geographic information series of standards. Many bodies are actively engaged in the work of ISO/TC 211. These include national standardization bodies, the OGC, international professional bodies such as the International Federation of Surveyors (FIG) and the International Cartographic Association (ICA), UN agencies, and sectoral bodies. The CGDI interest in the work of ISO/TC 211 is represented through the membership of Natural Resources Canada.

This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. For geographic information, these standards may specify methods, tools and services for data management (including definition and description), and for acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations.

The work links to appropriate standards for information technology and data where possible, and provides a framework for the development of sector-specific applications using geographic data. For example, a number of the OGC standards have been adopted by ISO and others are being considered for adoption.

Annex A: More Information

The preceeding Framework Data Guide has provided links to additional information at various points. The most generally useful of those links have been assembled here for convenience in accessing other information sources relevant to framework data:

Data Portals and Other Information

Discovery Portal: http://geodiscover.cgdi.ca/gdp/

Discovery Portal User Guide: http://geodiscover.cgdi.ca/gdp/help?request=helpConsumersGuide

GeoBase: http://www.geobase.ca/geobase/en/index.html

CGDI: http://www.geoconnections.org/en/aboutcgdi.html

CGDI User Guide: http://www.geoconnections.org/publications/training_manual/e/

Canadian Spatial Reference System: http://www.geod.nrcan.gc.ca/index_e.php

Canadian Geographic Names Database: http://geonames.nrcan.gc.ca/index_e.php

Organizations

GeoConnections: http://www.geoconnections.org/en/index.html

Canadian Council on Geomatics: http://www.ccog-cocg.ca/index_e.html

Inter-Agency Committee on Geomatics: http://www.iacg-cmoig.org/index_e.php

Open Geospatial Consortium: http://www.opengeospatial.org/

International Organization for Standardization: http://www.iso.org/iso/home.htm

Free Data Viewers

ArcExplorer distributed by ESRI: http://www.esri.com/software/arcexplorer/explorer.html

Geomatica 10 FreeView provided by PCI Geomatics:
http://www.pcigeomatics.com/Forms/RequestFreeView.php

Map Maker Gratis provided by Map Maker: http://www.mapmaker.com/

Quantum GIS: http://www.qgis.org

Udig: http://udig.refractions.net/confluence/display/UDIG/Home

gvSig: http://www.gvsig.gva.es/index.php?id=gvsig&L=2

dlgv32 Pro provided by U. S. Geological Survey (USGS):
http://mcmcweb.er.usgs.gov/drc/dlgv32pro/index.html

3DEM provided by Simtel: http://www.simtel.net/product.php?url_fb_product_page=6700

Caris Easy View: http://www.caris.com/products/easy-view/

Google Earth: http://earth.google.com/download-earth.html

JUMP: http://jump-project.org/project.php?PID=JUMP&SID=OVER

MapWindow: http://www.mapwindow.org/

ALTAVU provided by Groupe ALTA: http://www.geomatheque.com/altaviewer/Altavu.aspx

Annex B: Glossary

Term	Definition
American National Standards Institute	ANSI is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. ANSI provides consensus standards for products, processes and services that are at the foundation of the American economy and society.
Applet	A program designed to be executed from within another application. Unlike an application, an applet cannot be executed directly from the operating system. A well-designed applet can be invoked from many different operations.
Application	A program that performs a specific function directly for a user. Applications can make use of CGDI services.
Application Program Interface (API)	The interface (calling conventions) by which an application program accesses operating systems and other services. An API provides a means for developing custom user interfaces. The web API provides a programmable interface to the GeoConnections Discovery Portal.
Architecture	The organizational structure and operating environment of the CGDI, including the relationships between its parts, and the principles and guidelines governing their design and evolution.
Boolean	In programming, Boolean refers to a combinatorial system devised by George Boole that combines propositions with the logical operators AND and OR and IF THEN and EXCEPT and NOT.
Cadastre	A public record, survey, or map of the value, extent, and ownership of land as a basis of taxation.
Canadian Geospatial Data Infrastructure	An Internet/web infrastructure comprised of the developments of the federal, provincial, territorial and private sector partners who are creating the technology, standards, access systems and protocols necessary to harmonize all of Canada's geospatial databases, and make them available on the Internet.
Catalogue	A complete list of things, usually arranged systematically. Most databases are comprised of catalogues and inventories.

Term	Definition
Client	A software component or an application that accesses a service. The Guide to the CGDI distinguishes between a client (an inanimate part of the process) and a user (an individual who uses a computer, program, network or related service.)
Community of Practice	An organized group of users who share common interests about a topic or common sets of problems, or who have common needs that can be met by an infrastructure. In this case, a community of practice has common user requirements of the CGDI.
Component	Software that packages the client or server implementation of a service and can provide the realization of a set of interfaces. A component consists of software code (source, binary or executable) or other equivalents such as scripts or command files.
Content Standard for Digital Geospatial	The objectives of the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) are to provide a common set of terminology and definitions for the documentation of digital geospatial data. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.
Control Widget	A control widget provides the means to adjust the speed of a simulation, as well as to stop, restart and quit a simulation.
Coverage	A continuous representation of a portion of the earth's surfaces. A coverage may be a collection of features (like a vector dataset) or it may be a raster or gridded surface representing one or more attributes.
Data	Distinct pieces of factual information, especially information organized for analysis or used to reason or make decisions. Data are usually formatted in a special way, and exists in a variety of forms: as numbers or text on paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. Data in the CGDI comprises maps, satellite images, publications and other geospatial data provided by Canadian and international organizations.
Data Collection/ Product Collection	Data which has one or several common elements, and which has been assembled by these common elements to form a grouping. For instance, the National Air Photo Collection is comprised of several thousand air photos of the

Term	Definition
	Canadian landscape taken over different dates.
Data Product	Data product and data collection are used to describe data available on the GeoConnections Discovery Portal web site. However, a data product is distinct from a data collection because the data collection groups several data products; for example the following four data products could be grouped together as one data collection by removing reference to the resolution: RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 250 Metres; RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 500 Metres; RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 750 Metres; RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 1,000 Metres becomes: RADARSAT Ortho-rectified Mosaic of Canada, Lambert Conformal Conic.
Data Warehouse	A repository for data designed to support management decision-making. Creation of a data warehouse includes development of systems to extract data from operating systems plus installation of a warehouse database system that provides managers flexible access to the data.
Dataset	A grouping of data by subject topic or type.
Directory	A type of catalogue in which data collections are described through metadata. In the GeoConnections Discovery Portal, the directory contains descriptions of geospatial data, services (including web services) and the organizations that provide them. Users can search for content using spatial, temporal, keyword and textual constraints or browse the directory contents.
Discovery Mechanism	An online service that allows users to find, evaluate and access resources (data, services and organizations). Discovery mechanisms bring together suppliers (those providing resources) and users (those using the resources).
Federal Geographic Data Committee (FGDC)	An American government department that coordinates the development of its national spatial data infrastructure. The FGDC developed the Content Standard for Digital Geospatial Metadata.
Framework Data	The set of geospatial data that provides the reference framework for all other CGDI-compliant geodata.
GeoConnections	A national partnership initiative among federal, provincial and territorial governments, the private and academic sectors that is developing the CGDI, to

Term	Definition
	make Canada's geographic data, tools and services readily accessible on the Internet.
GeoConnections Discovery Portal	A free online service that allows individuals and organizations to find geospatial data products and services from around the world. The GeoConnections Discovery Portal enables organizations to register and promote their data, services, resources and organization. The GeoConnections Discovery Portal is part of the CGDI and links to other parts of both the CGDI and other spatial data infrastructures.
Geographic Information System (GIS)	A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the earth's surface. A GIS can be used for handling various types of maps. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image of a map, and layers of data are organized to be studied and to perform statistical analysis.
Geographic Mark-up Language (GML)	A vendor-neutral, XML grammar that transfers geographic features through the Internet.
Geomatics	Through 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.
Geometric Identifier	Each geometric representation has its unique identifier, which is a number that is used for maintenance (revision) purposes. It is also used to ensure that all users' applications refer to the same feature. The identifier is unique per data theme and per scale.
Geospatial Data	Geo-info or geodata with explicit geographic positioning information included, such as a road network from a GIS, or a geo-referenced satellite image. Geospatial data may include attribute data that describes the features found in the dataset.
Geospatial Information (Geo-info)	Includes legal surveys, property cadastre, aerial photography, satellite imagery, aeronautical and nautical charts as well as various types of maps such as topographic maps, and geological, agriculture and forestry maps.

Term	Definition
Global Change Master Directory (GCMD)	NASA's GCMD is a comprehensive directory of descriptions of datasets of relevance to global change research. The GCMD database includes a description of datasets covering climate change, agriculture, the atmosphere, biosphere, hydrosphere and oceans, geology, geography and human dimensions of global change.
Global Spatial Data Infrastructure (GSDI	A global and open organization coordinating the organization, management and use of geospatial data and related activities. GSDI is being advanced through the leadership of many nations and organizations represented by a GSDI Steering Committee. This multinational Steering Committee includes representatives from all continents, and all sectors - government, academia, and the private sector. The "GSDI encompasses the policies, organizational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the global and regional scale are not impeded in meeting their objectives". (http://www.gsdi.org/)
Infrastructure	A reliable, supporting environment, analogous to a road or telecommunications network, which facilitates the access to geographically-related information using a minimum set of standard practices, protocols and specifications.
International Organization for Standard	A worldwide federation of national standards bodies from 130 countries. The International Organization for Standardization (ISO) mission is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. The ISO's work results in international agreements that are published as international standards.
Inventory	A catalogue that lists individual data products. Most databases are comprised of inventories and catalogues.
Location Commerce (l-commerce)	A new and growing economic sector that exploits the commercial uses of geospatial data and services.
Metadata	Information about data. Metadata describes how and when and by whom a particular set of data was collected, and how the data are formatted. Metadata is essential for understanding information stored in data warehouses.
National Information	NISO (U.S.) is a non-profit association that develops and promotes technical standards used in a wide variety of information services. NISO has developed

Term	Definition
Standards Organization	standards for information retrieval such as the Z39.50 search protocol.
Open Geospatial Consortium, Inc. (OGC)	OGC is a non-profit organization founded to address the lack of interoperability among systems that process geospatial data. The Open Geospatial Consortium, Inc (OGC) is an international industry consortium of 253 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications. OpenGIS® Specifications support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT.
Operation	An interaction between a client and a server, resulting in a transfer of information or an action. An operation can be either an interrogation (e.g. request-response) or an announcement (e.g. notification).
Organization	In the GeoConnections Discovery Portal, an organization includes federal, provincial and municipal departments, non-profit organizations, academic organizations (universities, colleges) as well as commercial organizations that offer data, services and resources of a geospatial nature.
Profile	For a search protocol, a profile identifies a set of base standards, together with appropriate options and parameters necessary for purposes including interoperability and methodology for referencing the various uses of the base standards, so as to be meaningful for both users and suppliers. For a data standard: a profile specifies elements to be used by a particular group e.g. North American profile of ISO 19115 is the International standard adapted to address North American's needs (attributes are added).
Registry	A listing of the individual datasets, services or other things made available by an organization to CGDI users. There are two kinds of registries: a type registry (a listing of the different types or classes of things, such as services, components or events, which are recognized by CGDI services or applications), and an instance registry (a listing of the individual services, components, datasets or other things that comprise the CGDI or are relevant to its users. Instance registries are used to identify, locate and describe individual instances.)
Relational Database Management Software	A system for database management of a relational database, i.e. a database in the form of tables which have rows and columns to show the relationships between items, and in which information can be cross-referenced between two or more items to generate a third table.

Term	Definition
Resource	Within the CGDI, a resource refers to services, including web services and tools, data products and organizations.
Reusable Component (RUC)	A free online mapping tool that can be embedded into an organization's web pages from the GeoConnections Discovery Portal. RUCs allow users to quickly add interactive maps and locators to their web site, and to coordinate entry tools to the site. Standardized interfaces (wizards) are provided so that developers can embed the tools into their own applications. Each of the mapping tools automatically interacts with each other when embedded into the same page.
Scale	A map scale is a ratio representing the relationship between a specified distance on a map and the actual distance on the ground. For example, at the scale of 1:50,000, 1 unit of measurement on the map equals 50,000 units of the same measurement on the ground. Map scale is frequently expressed as a representative fraction and graphically as a bar scale. To change the size of an object while maintaining its shape, most graphics software, particularly vector-based packages, allows you to scale objects freely.
Schema	XML and GML schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content and semantics of XML and GML documents.
Server	A computer on a network that is dedicated to a particular purpose and which stores all information and performs the critical functions for that purpose (http://www.congressonlineproject.org/glossary.html#S). A search server is a program on a computer that is connected to the Internet. It accepts search queries through the Internet, then queries a database connected to the same local area network as its host computer. The database returns the result to the search server, and the search server returns the result to the Internet client that originated the request.
Service	A collection of operations, accessible through one or more interfaces, that allows a user to evoke a behaviour of value to that user. A service is delivered by a server. A "service instance" is another name for a server. In the GeoConnections Discovery Portal, a service is a description of professional services, online services and software provided by registered organizations or individuals. See 8.2, What Can You Register and Promote with the Discovery Portal?, for a listing of Discovery Portal services.

Term	Definition
Site	A location (e.g. URL) at which a system is accessed.
Spatial (Geospatial) Data Infrastructure	The relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. A spatial data infrastructure provides a basis for spatial data discovery, evaluation and application for users and suppliers within all levels of government, the commercial sector, the non-profit sector, academia and citizens in general.
Stateful Search Protocol	With a stateful search protocol, a discovery mechanism opens a connection with a search server and keeps it open for the entire duration of the search session.
Stateless Search Protocol	With a stateless search protocol, a discovery mechanism opens a connection with a search server, sends a bit of information, receives a bit of information, and then closes the connection. The search session consists of a series of such open-send-receive-close interactions between it and the search server, where each open-send-receive-close interaction is independent of the others.
Styled Layer Descriptor (SLD)	A companion specification to the Web Map Server Interface (WMS) specification, the SLD is a means for controlling the portrayal of data rendered from a WMS server.
Topology	In the geospatial information context, topology is a set of rules and behaviours that model how geospatial objects (i.e., points, lines and polygons) share common geometry. For example, adjacent features such as two lots or parcels of land share a common edge, the boundary between the two parcels. Further geometrical relationships could also be defined; for example lot boundaries in a particular block must completely cover the block and share edges along the block boundaries. Topology can also be sued to enforce data integrity rules (e.g., no gaps or overlaps can should exist between lot features, lot boundary lines must meet at the corners with no gaps or overshoots, etc.).
User	In the Guide to the CGDI, "user" refers to an individual who uses a computer, program, network or related service. The Guide to the CGDI distinguishes between a user (person) and a client (a software component or application that access a service.)
Web Coverage Service (WCS)	An emerging specification for a coverage, i.e. an irregular multi-dimensional grid that describes many types of Earth phenomena at every point in the grid.

Term	Definition
Web Feature Service (WFS)	A specification that defines data manipulation operations on geographic features, allowing for querying, retrieval and transactional (i.e. add, update or delete) operations.
Web Map Service (WMS)	An Internet-based service that allows clients to display maps and/or images with a geographic component and whose raw spatial data files reside on one or more remote WMS servers. The WMS conforms to the OpenGIS Web Map Server Interface specification.
Z39.50 Search Protocol	The ANSI/NISO Z39.50 search protocol is a computer-to-computer communications protocol designed to support searching and retrieving of information, full-text documents, bibliographic data, images and multimedia in a distributed network environment. The Z39.50 is currently supported by the GeoConnections Discovery Portal.