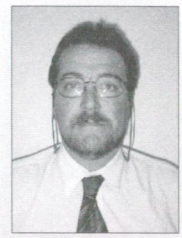

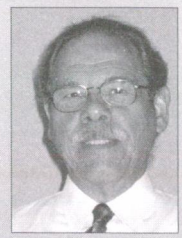

Delivering Marine Geospatial Data on the Web

The Canadian Department of Fisheries and Oceans' GeoPortal

By Don Vachon, Canadian Hydrographic Service, Pierre Lafond, Holonics Data Management Group Ltd and Timothy V. Evangelatos, Terraqueous Technologies, Canada

In the early 1990s, Canada like many other nations was trying to overcome barriers to the wider and more effective use of geospatial data [IACG 1996]. To deal with this complex issue, a national initiative to build a Canadian Geospatial Data Infrastructure (CGDI) was funded in 1998. The mission of CGDI is to make Canada's geospatial data available on the Internet. Led by Natural Resources Canada, the development of CGDI or GeoConnections, is founded upon the following five basic thrusts:

- **Access** to government information
- A national **data framework**
- International **standards**
- Cost-efficient **partnerships**
- Providing seamless data to users within a supportive **policy** environment

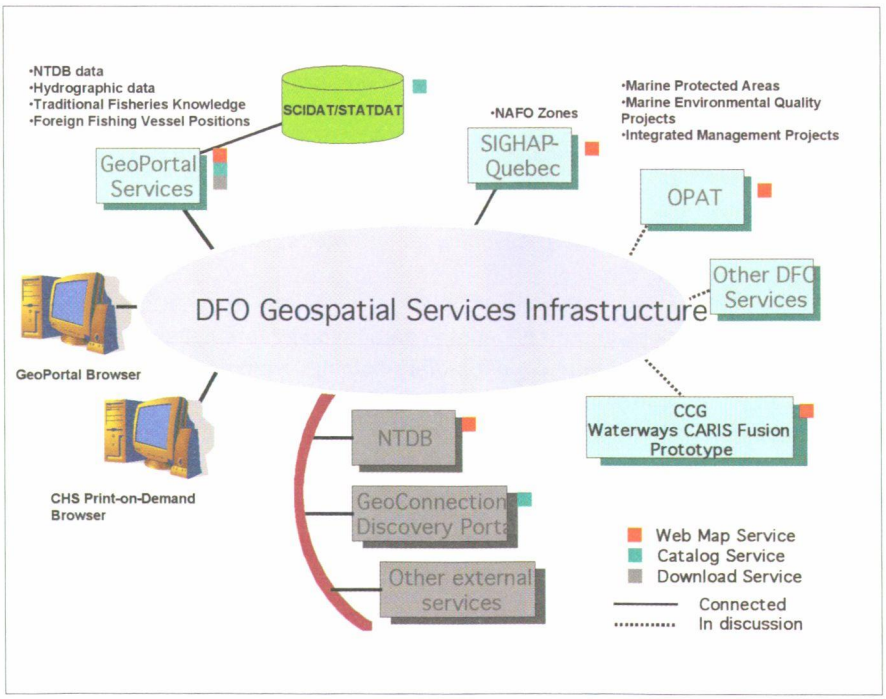

Figure 1: Phase I GeoPortal delivery

GeoConnections coordinates and leads the initiative that involves all levels of government, industry, and others interested in sharing geospatial data. This federally funded partnership programme is designed to:

- Co-ordinate Canada's numerous databases of geographic information and make them accessible through a common window on the internet
- Enable partnerships between provincial and federal governments, the private sector and the academic community

A Program Advisory Network for GeoConnections consists of twelve committees or nodes and one of these nodes is a Marine Advisory Node established to ensure that the marine sector is adequately represented. GeoConnections has also led the development of a technical vision and implementation plan for the data infrastructure [CAWG 2001] and a standards-based architecture [CAWG 2002] that forms the technical basis for the construction of the Department of Fisheries and Oceans' (DFO) GeoPortal.
The Canadian Hydrographic Service (CHS) has been an active participant in the development of the CGDI through its role as Co-chair of the Marine Advisory Node of GeoConnections. The DFO GeoPortal is the first national effort on the marine component and will help establish a foundation for aa Marine Geospatial Data Infrastructure (MGDI). GeoConnections is a sponsor of the GeoPortal Project.

GeoPortal Mission and Objectives

In many organisations including DFO, geospatial information is difficult to share for a variety of reasons, technological and organisational. This results in a substantial duplication of effort in having to re-acquire and re-convert the same data for different technology platforms. The GeoPortal aims to address these problems and positions DFO so that it can make *strategic* and *tactical* use of geospatial information to better achieve its mandate. The DFO GeoPortal is comprised of two major components: a geospatial infrastructure for information discovery and integration, and a common user interface to enable access to services provided via the infrastructure and spatial display capabilities.
The GeoPortal is built on an open standards-based and Web services architecture [Evangelatos 2002] so that users can access a variety of data-related services through the Portal. These services are distributed, in that they can run on different machines and access data from different data sources. The architecture is based on international specifications, allowing for interoperability of data formats and data processes through standard interfaces.
The GeoPortal is also aiming to be an *enabling agent* to facilitate the inclusion of geospatial contents and geospatial services in community (or discipline) portals. A community portal can be defined as a portal addressing the information requirements of a specific target community (habitat management, marine services, etc.). Community portal developers will use The GeoPortal to target specific geospatial contents and services to include in their own portals.
As indicated in Figure 1 the purpose of this project is to develop a set of web-based geoservices that will allow departmental staff to catalogue and publish their geospatial data holdings through standards-based interfaces and also to discover, view, and download geospatial data holdings from various sources.
As a complement to other departmental information portals, the GeoPortal provides an open geospatial portal capability that enables the integration of various information holdings within the Department through their georeference. The GeoPortal does not provide a centralised data warehouse, but rather integrates information at the source. Furthermore, the GeoPortal is built on an open standards-based architecture to provide access to a wide range of data sources, managed by stakeholders at the source to allow a variety of standards-based services.

CGDI/MGDI Web Service-based Architecture

The DFO GeoPortal is built upon a Web-Service architecture [CAWG 2002] that uses specifications devel-

OGC Web Map Service (WMS)
OGC Web Feature Service (WFS)
OGC Geodata Discovery Service
OGC Geographic Markup Language (GML)
ISO Metadata Specification
IHO S57

Table 1: International specifications used in the GeoPortal

oped by the ISO Technical Committee for Geographic Information (TC211 - www.isotc211.org) and the Open GIS Consortium (www.opengis.org). Table 1 shows the international standards currently endorsed for CGDI and supported by the GeoPortal. Many software vendors now support these specifications thus making it much easier for users to access geospatial data and the variety of data-related services available through Internet sites such as the GeoPortal.

These services are distributed, in that they can run on different machines and are able to discover and access data from different data sources. Since the architecture is based on international specifications, this allows for interoperability of data formats and data processes through standard interfaces. The GeoServices provided include:

1. A Data Catalogue Service, using the M3Cat system [Intélec 2001] to provide a web data entry capability for metadata into an Oracle database and also a schema to manage the metadata. The mandatory metadata recommended for the GeoPortal is shown in Appendix A
2. A Cascading Web Mapping Service, using the CARIS Cascading Map Server and CARIS Spatial Fusion to allow for the inclusion of proprietary data sources such as ENC S-57 chart data, BSB raster charts and data stored in Oracle Spatial, as well as the inclusion of Web Maps coming from other OGC-compliant Web Map Servers
3. A Web Feature Service, using the CARIS Web Feature Server, that provides the capability to perform data manipulation (insert, update, delete, select) transactions on geospatial data, on the Web
4. A translation and download service, using Safe Software's Spatial Direct, to allow users to download data, that has been identified as 'downloadable', from a user-specified geographical area, and translate it into one of many formats supported by Spatial Direct®. Table 2 shows some of the popular formats that are supported. The following data are currently available through this service:

FORMAT	READ	WRITE
Arc/Info (Generate,E00, Coverage)	✗	✓
AutoCAD DWG R12, R14, 2000	✗	✓
AutoCAD DXF R12, R14	✗	✓
CubeWerx IIIOGDI	✓	✗
EPS (Encapsulated Postscript) image	✗	✓
ESRI SDE 3.x	✓	✗
ESRI Shape	✓	✓
IBM DB2 GeoTask	✓	✗
MapGuide SDL (ascii)	✗	✓
MapInfo (MIF/TAB)	✓	✓
MapInfo Spatialware	✓	✗
MDF (Cubewerx)*	✗	✓
NTX (Caris)	✗	✓
Oracle 8i	✓	✗
RASTER Image (GIF)	✗	✓

Table 2: Input/Output formats with Spatial Direct®

- Topographic data from the National Topographic Database (NTDB). All layers from the 1:50K and 1:250K datasets are available for download from the GeoPortal Oracle Spatial database
- Hydrographic data, in the form of S-57 chart data, raster charts in BSB format, and Natural Resource Maps (NRM) in BSB format set up as common layers to be accessed by all Portal users. S-57 layers were organised around S-57 object codes as well as S-57 data was for direct download through the GeoPortal

5. A common GeoPortal user interface application was designed and developed, to allow access to all GeoPortal services. The application is Web-based and comprises a catalogue query interface, a Web Map Viewer interface as well as an interface to the download service
6. A prototype Print-On-Demand (POD) web-based application was developed, using the underlying GeoPortal interface components. This application was designed to support CHS paper chart suppliers wanting a capability to print charts on-demand

The 3-tier architecture and the software components selected for the GeoPortal are shown in Figure 2. At the bottom, the Database Tier is built upon the Oracle relational database system; the Application Tier employs the CARIS Web Mapping and Web Feature Servers supplemented with a Catalogue and download servers; and at the top the Client Tier is based upon thin client Web browsers such as Internet Explorer and Netscape.

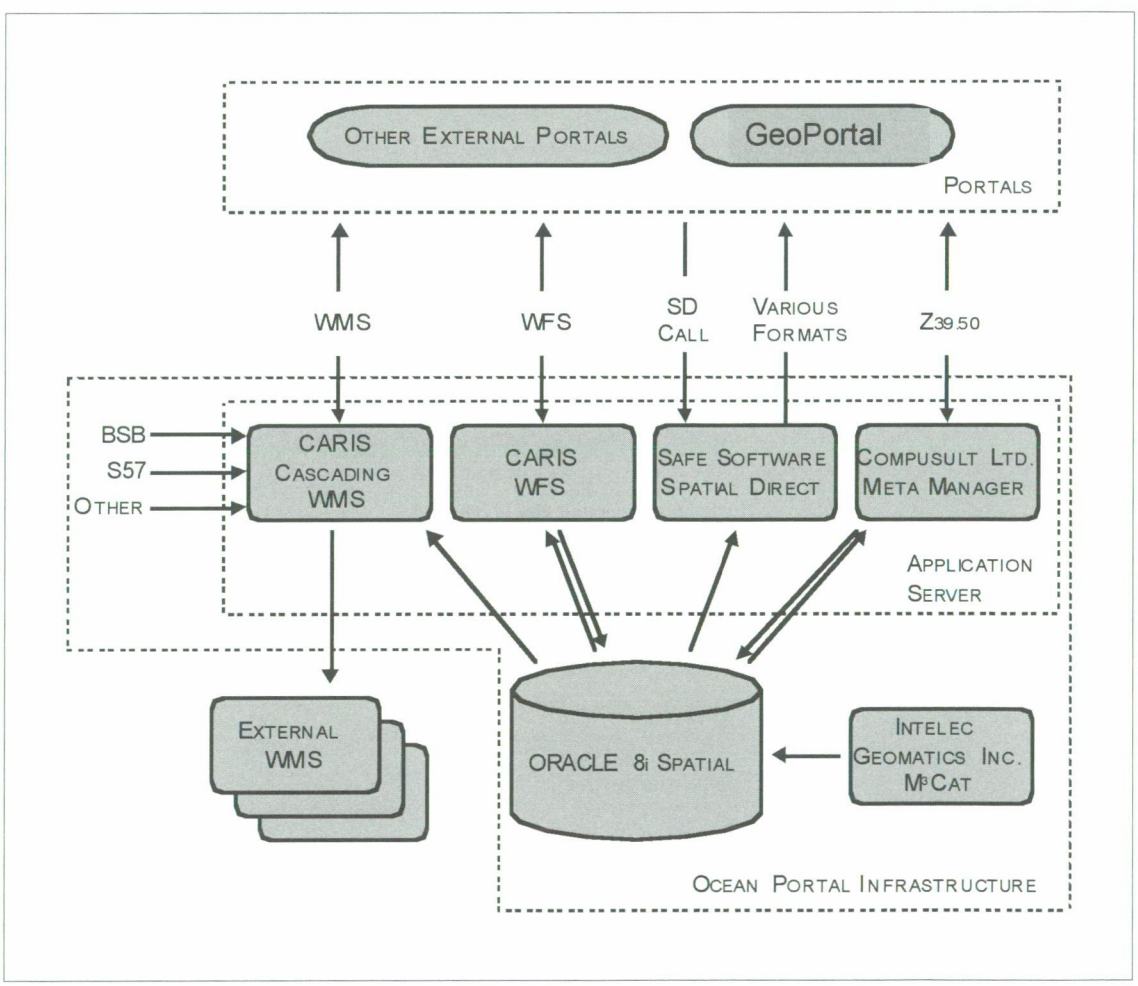

Figure 2: GeoPortal software components

Community Portals

Efforts are underway to determine how the various 'Community Portals' will use and evolve with the GeoPortal. Some of the community systems use proprietary non-CGDI compliant software and require special interfaces. A high-level, strategic, 'roadmap' of the existing DFO information infrastructure is being prepared that will help the infrastructure developers determine priorities as they move forward.
The GeoPortal is particularly interesting because it is an important catalyst for improving the information infrastructure in the Department. Further, there are many links between the various sectors and regions with other agencies at all levels of government across Canada, and there are many requirements for sharing data. Figure 3 illustrates the variety of other community portals accessing both internal and external data sources using the common geospatial services connected through standard interfaces. A gateway to other MGDI and CGDI data sources is also shown.
If all these data providers/users adopt the CGDI approach, it is believed that a lot of the current chaos and duplication of effort can be eliminated. As the new infrastructure is implemented, costs can be reduced, information can be found much faster, and timely decisions may be made. Figure 4 is one of many examples where data from seven different sites have been accessed and integrated in a common view. It is a good example of how information and knowledge needed for decision-making can be created by bringing together data from independent data sources.

Plans for the Next Phase of the GeoPortal Project

Plans for the coming year cover a number of areas, but working with the different sectors and regions of the Department located across Canada will be stressed. The plans to enhance various aspects of the infrastructure are as follows:

Discovery and Catalogue Service: A focus of the next phase of the project will be to make more data content available through the GeoPortal. This will include adding and improving the metadata to enhance the discovery and catalogue services that are available.

Cascading Web Map Service: Plans are to work with other sectors of the Department to make more data content available, connect additional map servers and to integrate the GeoPortal into community portals. The option to add support for Styled Layer Descriptors will be assessed when that specification matures.

Download Service: More data contents will be made available and the Geographic Markup Language (GML) (XML) capability will be promoted as well as functionality to enable impact analysis of updates.

Web Feature Server: The web transaction capability will be integrated into community portals.

GeoPortal Application: A number of enhancements including the integration of the catalogue search and the map server, enhancement of the metadata of both the server and layer capabilities and the enhancements recommended by users.

Conclusions

The Internet has become a key driver for reducing major barriers to the sharing of geospatial data. The efforts of the ISO and OGC to produce public domain specifications and the commitment by software vendors, primarily through OGC, to market products based upon these specifications has made it possible to build open-standards based data infrastructures. Even though only a small part of the potential for the development of additional tools and services has been done, the basic components exist from a variety of suppliers and are affordable.

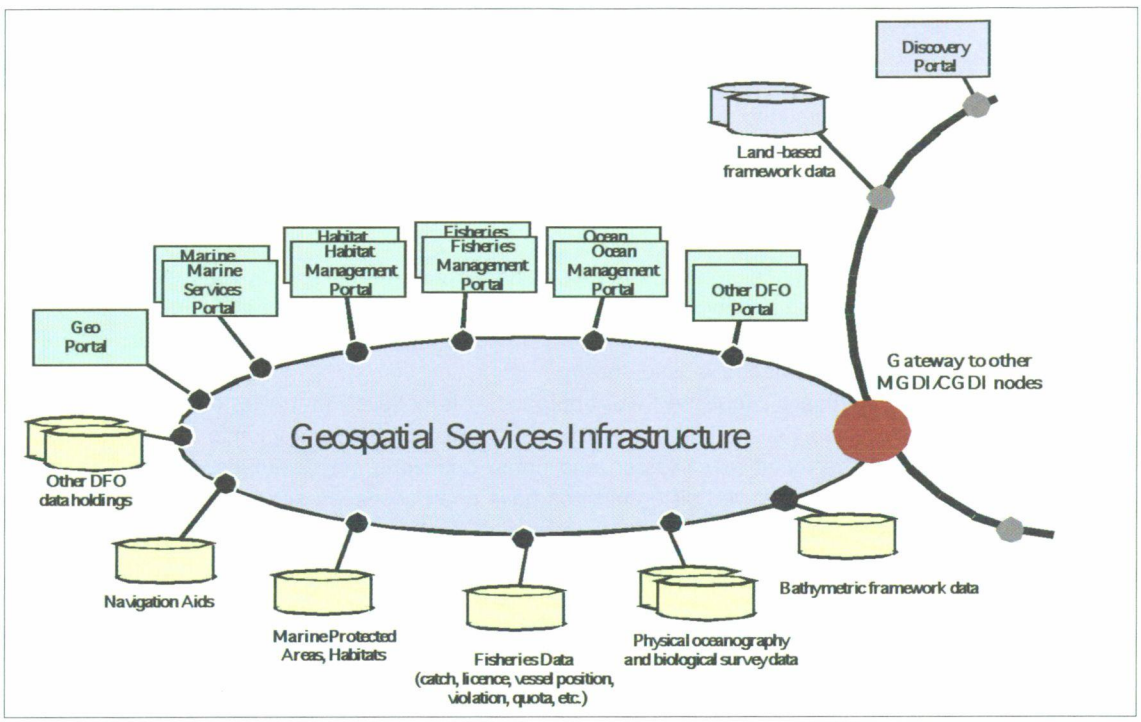

Figure 3: Proposed DFO geospatial architecture

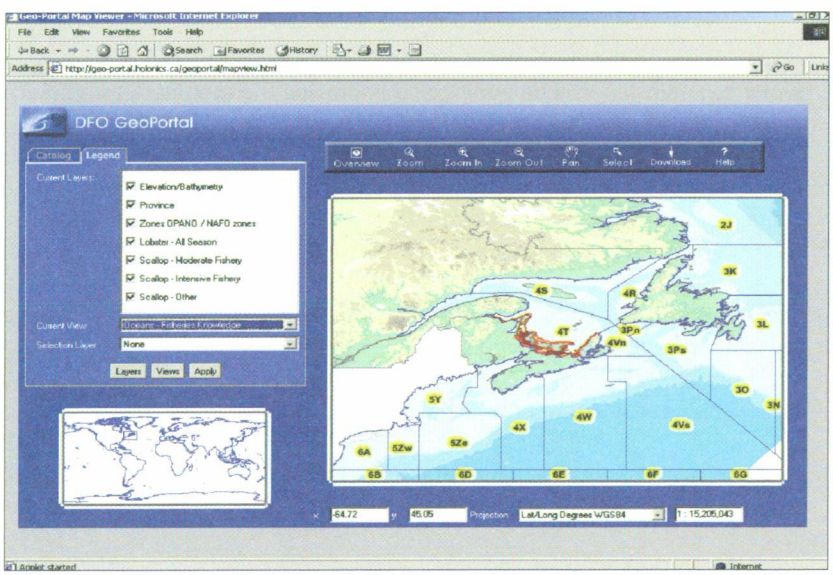

Figure 4: Snapshot of browser showing the 200 mile limit, traditional fisheries knowledge and NAFO zones

Many in the hydrographic community have been leaders in the development of some aspects of the technology, particularly those associated with digital data collection, data management, data distribution and international standards for hydrographic data. Activities in the IHO are now underway to bring these efforts in line with the work of ISO and OGC and this will ease the efforts needed by Hydrographic Offices to become active participants in the new global geospatial data infrastructure. The DFO-GeoPortal is one example of how that can be done.

Appendix A: Mandatory Attributes Recommended for Data Collections

The metadata fields are numbered and the category of the metadata is given in italics

1.) Name of the Product Collection
Identification Information
Citation
Citation Information
2.) Originator
3.) Title
4.) Geospatial Data Presentation Form (Product type)
Description
5.) Description
6.) Purpose
Time Period of Content
Time Period Information
7.) Beginning Date (YYYY-MM-DD)
8.) Ending Date (YYYY-MM-DD)
Spatial Domain
9.) Bounding Coordinates
Keyword
Theme
10). Theme Keywords
Place
11). Place Keywords
Point of Contact
Contact Information
Contact Person Primary
12.) Contact Person
13.) Contact Organisation
Contact Address
14.) Address Type
15.) Address
16.) City
17.) Province or State
18.) Postal Code/ZIP Code
19.) Country
20.) Contact's Telephone Number (+cc-aaa-nnnnn)
21.) Contact Facsimile Telephone (+cc-aaa-nnnnn)
22.) Contact Electronic Mail Address
Data Quality Information
Spatial Data Organisation Information
23.) Direct Spatial Reference Method
Spatial Reference Information
Entity and Attribute Information
Distribution Information
Distributor
Contact Information
Contact Person Primary
24.) Contact Person
25.) Contact Organisation
Contact Address

26.) Address Type
27.) Address
28.) City
29.) Province or State
30.) Postal Code/ZIP Code
31.) Country
32.) Contact's Telephone Number (+cc-aaa-nnnnn)
33.) Contact Facsimile Telephone (+cc-aaa-nnnnn)
34.) Contact Electronic Mail Address
35.) Fees

Metadata Reference Information

36.) Metadata Future Review Date (YYYY-MM-DD):

Metadata Contact

Contact Information

Contact Person Primary

37.) Contact Person
38.) Contact Organisation

Contact Address

39.) Address Type
40.) Address
41.) City
42.) Province or State
43.) Postal Code/ZIP Code
44.) Country
45.) Contact's Telephone Number (+cc-aaa-nnnnn)
46.) Contact Facsimile Telephone (+cc-aaa-nnnnn)
47.) Contact Electronic Mail Address

References

CAWG (CGDI Architecture Working Group, GeoConnections Programs) (2001). *The Canadian Geospatial Data Infrastructure* (CGDI) *Technical Vision and Implementation Plan*. Version 1, December 2001, http://www.geoconnections.org/architecture/, Ottawa, Canada

CAWG (CGDI Architecture Working Group, GeoConnections Programs) (2002). *The Canadian Geospatial Data Infrastructure (CGDI) Architecture*, http://www.geoconnections.org/architecture/, Ottawa, Canada

Evangelatos, T., O'Brien, C.D., Casey, M. J., Vachon, D. (2002). *Hydrographic Data Standards and Standards-based Geospatial Data Infrastructures*, The International Review, August, Vol. 3, No. 2, pp. 91-102

IACG (Inter-Agency Committee on Geomatics) (1996). *Barriers to the use of Geomatics Data.* Unpublished paper, Ottawa, Canada

Intélec Géomatique Inc. (2001). *Development of a New-Generation, Multilingual and Multi-Standards Cataloguing Tool*, GeoConnections Project Showcase Agenda, 24 January 2002, Ottawa, Canada

Lafond, P. (2002). *The Department of Fisheries and Oceans (DFO) GeoPortal – Final Report*, Version 1.1, 23 April 2002, Ottawa Canada

Poulin, M. and Gillespie, R. (2002). MGDI: *Information Infrastructure for the Marine Community*, Proceeding of the Canadian Hydrographic Conference, May 2002, Toronto, Canada

Biographies

Don Vachon, Chief, Engineering Development, Canadian Hydrographic Service, has been involved with the development of GIS and geospatial databases for over 23 years and is currently implementing OGC-based services in his department through the GeoPortal Project. He also chairs the Working Group on S57 extensions for Edition 4.0 which will integrate several of the TC211 components.

Pierre Lafond has over twenty years of experience in management and information systems in both the public and private sectors. He co-founded Holonics in 1996 to provide data management services in the areas of Oracle technology and spatial systems. He has been heavily involved in geospatial infrastructure projects based on OGC specifications for the last three years, including managing the delivery of the first phase of the DFO GeoPortal project.

Timothy V. Evangelatos retired from the Canadian Hydrographic Service in 1996 after three decades of involvement in developing hydrographic data processing systems, nautical chart production systems, geospatial standards, and electronic charts infrastructure. Now President of Terraqueous Technologies he has been active in establishing the national programme to build the Canadian Geospatial Data Infrastructure (CGDI).

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