

# LAKE ONTARIO – ST. LAWRENCE RIVER STUDY GIS GUIDELINES

## Introduction:

The Information Management Technical Working Group (IM TWG) (formerly the Common Data Needs Technical Work Group) was tasked by the Study Board with establishing a GIS and Information Management Strategy for the Lake Ontario-St. Lawrence River Study. In April 2001, the TWG met and identified a number of issues that needed to be addressed by such a strategy. As they worked through the list of issues, it became clear that some of the items needed to be addressed right away to facilitate compilation, use, and distribution of geo-spatial data within the study. As a result, the TWG decided to break down the issues into short and long-term issues. The short-term issues were those items that needed attention and agreement right away while the longer-term issues were those that would form the basis of a full information management strategy for the study. The purpose of this document is to address the short-term issues identified by the TWG.

The short-term issues include:

1. What base map data are we going to use, what scale is the data and who is going to put it together?
2. What projections are we going to use for geospatial data?
3. What datum will we use for geospatial data?
4. What unit of measurement are we using?
5. Do we need metadata and if so, what format are we using?
6. Is there a common geographic nomenclature that should be used?
7. What about data schema and data dictionaries?
8. How will data be distributed and accessed in the short-term?
9. Is there any GIS technical support available for the TWGs?

The purpose of this report is to go through each of these items and provide some general guidelines for the Study. If any of the decisions made by the IM TWG are going to cause problems for any of the other TWGs, the IM TWG must be informed as soon as possible, so an alternative arrangement can be worked out. Please contact either Ian Gillespie or Roger Gauthier if you have any questions or concerns with any of the guidelines presented (addressed listed at the bottom of this report.)

## 1. Common Data Layers (Base Map Data)

Base layers include standard topographic and planimetric information usually portrayed on a map. Topographic data include elevation contours and spot heights. Planimetric data include roads and streams as well as administrative and political boundaries. It is important in this study that we have a common set of GIS base layers which can be made available to all groups. This will ensure consistency in mapping and will allow all data to be referenced to the same base layers. The following data were identified as base layers. They include:

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### Common GIS Base Layers

| Base Layer                       | Coverage   | Ontario  | Quebec   | U.S.  |
|----------------------------------|--|--|--|---|
| 1. Shoreline                     | Lake Ontario and St. Lawrence R. to Trois Riviere.                       | 1:10:000 OBM upstream to single line format 5km buffer | 1:10,000 from MSC Modeleur (not always 5km upland)       | 1:24,000-scale IJC and possible USGS feature  |
| 2. Political Units               | Municipal/county boundaries  | From Ontario NRVIS database 1:10,000                   | Need to check with province                              | From USGS 1:24,000                            |
| 3. Transportation Feature        | Roads within 5 km buffer of shoreline.                                   | From Ontario NRVIS database 1:10,000                   | From NRCAN 1:50,000 NTDB                                 | From USGS 1:24,000                            |
| 4. Watersheds                    | All sub-watersheds within the Lake Ontario and St. Lawrence River basins | Derived from Ontario 25m DEM                           | From EC 1:1M national watershed coverage                 | Need to check with USGS/State of New York     |
| 5. Tributaries                   | All tributaries within the above watersheds                              | From Ontario NRVIS database 1:10,000                   | From NRCAN 1:50,000 NTDB                                 | From USGS 1:24,000                            |
| 6. Half metre elevation contours | CDN 1 and 7 and U.S. 2, 4 and 7  | DEM created from SHOALS mapping and FDRP maps          | DEM created from acoustic sounding and topographic LIDAR | DEM created from SHOALS and topographic LIDAR |

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### 2. Projections:

Map projections are attempts to portray the surface of the earth or a portion of the earth on a flat surface. Some distortions of conformity, distance, direction, scale, and area always result from this process. Some projections minimize distortions in some of these properties at the expense of maximizing errors in others. Some projections are attempts to only moderately distort all of these properties. Different map projections result in different spatial relationships between regions.

Raster data, which is gridded or cell data such as that produced for a Digital Elevation model is not well suited to be stored as lat/long since this creates considerable distortion in grid size. (refer to Moore, 1997). The transformation of a discrete, raster structure is very different from the transformation of vector data. Vector data employs the time tested point-to-point method, is very flexible in terms of transformation, and standard cartographic theory regarding map projection transformation applies. The transformation of less flexible, global raster data sets is more complex. Given current implementations of projection transformation, data changes at the pixel level are inevitable (Mulcahy, 2001). A raster cannot be easily re-projected since the square grids of a raster file are affected when re-projected. Therefore, it is important to try to maintain the projection the data was originally compiled in. For the Study it has been decided that raster data will be stored as Lambert Conformal Conic. With this projection, area, and shape are distorted away from standard parallels. Directions are true in limited areas. Lambert Conformal Conic is commonly used for maps of North America. The following projection parameters should be used.

|                             |   |
|-----------------------------|---|
| Projection:                 | Lambert Conformal Conic                           |
| 1 <sup>st</sup> parallel    | 49.0  |
| 2 <sup>nd</sup> parallel    | 77.0  |
| Central meridian            | -91.8666  |
| Lat. Of projection's origin | 63.0  |
| False Easting               | 6200000   |
| False Northing              | 2958000   |
| Scaling Factor              | 1.0 (required by some GIS packages e.g. ArcInfo8) |

Since all raster data will be stored in Lambert Conformal Conic, it makes sense to also store all vector (line) data in the same projection. Vector data is easily transferable between projections, so any existing vector data which may not be in this projection can be easily changed.

### 3. Datums:

Geodetic datum's, define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth. Referencing geodetic coordinates to the wrong datum can result in position errors of hundreds of meters. Different nations and agencies use different datums as the basis for coordinate systems used to identify positions in geographic information systems, precise positioning systems, and navigation systems

#### 3.1 Horizontal Datums

In North America, two horizontal datum's are most commonly used, the North American Datum of 1983 and the World Geodetic System of 1984 (WGS 84) of the U.S. Defense Mapping Agency (DMA). Both NAD 83 and WGS 84 were defined (in words) to be geocentric, and oriented as the BIH Terrestrial System. In principle, the three-dimensional coordinates of a single physical point should therefore be the same in both systems; in practice, small differences are sometimes found. The original intent was that both systems would also use the Geodetic Reference System of 1980 (GRS 80) as a reference ellipsoid. As it happened, the WGS 84 ellipsoid differs very slightly from GRS 80. The Global Positioning system is based on the World Geodetic System 1984 (WGS 84), while the National topographic series of both Canada and the U.S. are based on NAD 83 (Schwarz, 1989). The study will use a horizontal datum of NAD 83 with an ellipsoid of GRS 80 as the horizontal datum. For live GPS WGS 84 will be used, and transformed out to NAD 83.

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### 3.2 Vertical Datums

Two common vertical datums for North America have been identified for this Study; these being: the North American Vertical Datum of 1988 (NAVD 88) and the International Great Lakes Datum of 1985 (IGLD 85). For a new general adjustment of the North American Vertical Datum of 1988 (NAVD 88), a minimum-constraint adjustment of Canadian-Mexican-U.S. leveling observations was performed holding fixed the height of the primary tidal benchmark, referenced to the new International Great Lakes Datum of 1985 (IGLD 85) local mean sea level height value, at Pointe-au-Père /Rimouski, Quebec, Canada. IGLD 85 and NAVD 88 are now one and the same. Pointe-au-Père /Rimouski is an IGLD water-level station located at the mouth of the St. Lawrence River, and is the reference station used for IGLD 85. This constraint satisfies the requirements of shifting the datum vertically to minimize the impact of NAVD 88 on U.S. Geological Survey mapping products, and provides the datum point desired by the IGLD Coordinating Committee for IGLD 85. The only difference between IGLD 85 and NAVD 88 is that IGLD 85 benchmark values are given in dynamic height units, and NAVD 88 values are given in Helmert orthometric height units. The geopotential numbers of benchmarks are the same in both systems. (Zilkoski, et al., 1992)

### **4. Measurement Units and Precision**

Since Canada and the U.S. use different measurement systems (the U.S. uses the imperial system and Canada uses the metric system), it is important to standardize the measurement units to ensure consistency and avoid confusion. For this study it has been decided that all data will be gathered and stored using metric units. Data produced in the study will also use metric units.

Precision refers to the level of coordinate accuracy based on the possible number of significant digits that can be stored for any coordinate. Within ArcInfo, for example, datasets can be stored in either single or double precision coordinates. Single precision coverages can store up to 7 significant digits retaining a precision of 1-metre in an extent of 1,000,000-metres. Double precision coverages store up to 15 significant digits per coordinate, retaining a sub-metre precision at a global extent. If no precision option (single/double) is specified when copying datasets, the new coverage will inherit the same precision as its predecessor. The default for the study will be double precision accuracy.

### **5. Metadata**

Metadata is "data about data". It is used to describe the content, quality, condition, and other characteristics of data. The Federal Geographic Data Committee coordinates the development of the National Spatial Data Infrastructure. The Federal Geographic Data Committee (FGDC) is tasked by Executive Order 12906 to develop procedures and assist in the implementation of a distributed discovery mechanism for digital geospatial data. The Content Standard for Digital Geospatial Metadata was adopted by the Federal Geographic Data Committee (FGDC) to label geospatial datasets. The metadata standard documents characteristics of data so that consumers can determine the data's fitness for their purpose.

The major uses of metadata are to:

- help organize and maintain an organization's internal investment in spatial data;
- provide information about an organization's data holdings to data catalogues, clearinghouses, and brokerages; and,
- provide information to process and interpret data received through a transfer from an external source.

The U.S has adopted the FGDC metadata standard and most Canadian agencies also adhere to FGDC. As such, it has been agreed that for this Study, the FGDC Content Standard for Digital Geospatial Metadata is to be employed. All produced or derived data must have metadata generated before dissemination. Contracts let for the collection or development of data will require metadata development.

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The software tool used to create the metadata is up to the TWG. Some common metadata generators that conform to these standards are Corpsmet, Blueangel, SMMS, ArcCatalogue, MetaMaker etc. Information on metadata software tools can be found at:  
<http://badger.state.wi.us/agencies/wlib/sco/metatool/mtools.htm>

The standard and other metadata information and materials are available from the FGDC Secretariat at:  
<http://www.fgdc.gov/metadata/metadata.html>. The FGDC Web Server can be found at:  
<http://www.fgdc.gov/>.

## 6. Common Geographic Nomenclature

The purpose of common geographic nomenclature is to ensure that there is consistency within the study for what geospatial entities are called. For example a shoreline reach may mean one thing to the Coastal TWG and something else to the Commercial Navigation TWG.

The IM TWG will cease calling the sections of shorelines defined for bathymetric and topographic data collection “reaches”. Rather they will use the term shoreline unit. The term “reach” has a unique definition to several of the TWGs, so to avoid confusion, the IM TWG will not use this term. The example signifies the requirement for a common geographic nomenclature to be used by all TWGs in the study. Each TWG will have their own terminology and naming conventions they use to perform their studies, but a common, consistent naming convention and terminology will be required if all work produced by the TWGs is to be assembled into a final database/document.

It was agreed that all data gathered, within the study area, should be referenced by shore unit and county in the United States. This will allow data to be displayed both by physical and political boundaries.

## 7. Data Dictionary/Catalogue/Schema

These items are included in the long-term issues as part of the overall information management strategy for the study. How they are to be considered and dealt with in the strategy is still to be determined. Some discrepancies on the use of the terms do exist. In the short-term, we have tried to identify a common definition of what is meant by these terms. The definitions discussed to date by the IM TWG are:

Data Glossary – a definition of words and terms appropriate to that engineering/GIS field.

Data Dictionary – defines the basic organization of a database, it contains a list of all the files within the database, the number of records in each file and the names and types of each field.

Data Catalogue - a document describing all available data and where it resides and is stored in the Data Dictionary.

Data Schema - a database laying out the file structure for the data and is stored in the Data Dictionary.

These will be refined and considered in the development of an information strategy.

## 8. Data Dissemination & Access

In the long-term and as part of the information management strategy, a method for disseminating data will be developed. However, in the short-term data needs to be distributed and exchanged among TWGs. To facilitate this exchange of data, a FTP site has been established for the study. The FTP site is password protected. All interested parties who seek access to data from the FTP site should contact the IM TWG chairs listed herein.

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The FTP site contains folders for each of the TWGs in the study. Folders have been created for databases, GIS, imagery, maps, meetings, presentations, and reports. Ian Gillespie, Environment Canada manages the FTP site for the time being, with funding from an ongoing GIS support contract for the IJC project. Additional funding, or other arrangement may be required if the site becomes excessively large. However, for now this will be the primary method of data exchange.

In addition to the FTP site, the IM TWG will develop a TWG web-site in coordination with the study web-site. The site will be password protected to limit access to the data. To summarize,

- In the short term email and FTP sites will be used to distribute reports, presentations, minutes etc.
- A bi-national mirrored FTP/Internet system is the objective
- The IM TWG will develop a password-protected web site for limited access to data
- Interactive web mapping may need to be addressed in near-term for Public Information Advisory Group (PIAG) member access
- Long-term dissemination and data access will be deferred for the long-term information management strategy which will deal with the archiving of the generated supporting data

## 9. GIS Technical Support

The development of GIS databases within each of the TWGs is the responsibility of that TWG. However, the IM TWG recognizes that the TWGs may require some GIS assistance and advice from time to time. To assist with this, the IM TWG has put aside a small amount of funds to provide some GIS technical support to the TWGs. The IT Division of Environment Canada-Ontario Region and the United States Army Corps of Engineers - Detroit District will use their available suite of GIS software, hardware and expertise to provide the Common Data Needs TWG with miscellaneous geomatics support and services on an "as required" basis throughout the current fiscal period or until funding allocated under this contract is exhausted (whichever is reached first).

These are short-term items and can be in the form of digital data acquisition, data processing, data dissemination, cartographic design and production, plotting services, etc., that require GIS staff time and effort to complete.

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