Geospatial Data Standards

Considerations for the delivery of 2D and 3D spatial data

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Version	Date	Summary of Changes	Changes Made By:
1.00	March 16, 2018	Version 1.0 published	
1.01	October 2, 2018	CSRS Epoch 2010 v7 changed to v6	Z.Green

Purpose

This document is intended to provide GRCA project managers and technical staff with a summary of best practices and **GRCA standards related to geospatial data** (e.g. GIS, GNSS, LiDAR). Refer to this document when defining project requirements and deliverables to ensure appropriate terms are included in contracts, agreements, and other collaborative arrangements involving spatial data.

The quality, reliability and usability of data outcomes are directly impacted by parameters contained herein and warrant consideration in early stages of project planning. Acronyms used in this document are described in the Glossary.

Speak with GRCA Geomatics staff in advance of a project for support defining project requirements.

Highlights

- **Ensure data deliverables meet GRCA standards**
- **Metadata must accompany any data product provided to GRCA**
- **Intellectual property rights must be clearly communicated and/or or data license included**
- **Provide data capture specifications in advance (precision, attributes, spatial reference, etc.)**

GIS Data Standards

All data need a geographic coordinate reference system[1],[2]. Building on that, there are two common approaches to storing horizontal position information: projected (e.g. UTM with northing, easting coordinates) or unprojected (aka. geographic, with latitude/longitude coords). A horizontal datum is the foundation for both. When elevation data is captured, a vertical reference system is also required.

GIS data delivered to GRCA as part of project deliverables needs to meet the standards outlined below in Table 1 and Table 2.

For clarity, EPSG Geodetic Parameter Registry[3] identifiers are specified and need to be referenced. Alternately, WKIDs used by Esri, which are largely based on EPSG numbers[4], can be referenced.

[1] Older reference frames (2D) include NAD83 and WGS84. Modern reference frames (3D) includes NAD83(CSRS), WGS84 "G" series and ITRF.
[2] When using ArcGIS, care is needed when transforming between coordinate systems. For NAD83<--->WGS84 transformations use the geographic transformation known as NAD_1983_to_WGS_1984_5
[3] See http://www.epsg-registry.org/ for details. Version 9.2.2.
[4] https://support.esri.com/en/technical-article/000011199

Table 1: Horizontal Reference System

Option	EPSG ID	Description	Underlying Datum	P or G
1 - Preferred	26917	NAD83 UTM Zone 17	NAD83	P
2 - Alternate A	2958	NAD83 CSRS UTM Zone 17N	NAD83 CSRS	P
3 - Alternate B	4326	WGS84	WGS84	G

P = Projected
G = Geographic

Table 2: Vertical Reference System

Option	EPSG ID	Description	Underlying Geoid
1 - Preferred	6647	CGVD2013	CGG2013
2 - Alternate	5713	CGVD28	CGG2000 Htv2

Data Format

Vector	Esri file geodatabase or Esri shapefile
Raster	.geoTIFF or other Esri compatible format

Unit of measurement Metric

Data Capture Standards

Spatial data can be collected and created in a variety of ways. Knowledge and experience of an external service provider to generate GIS data that meets GRCA standards is an important consideration.

Digitizing

Digitizing from mylar maps or heads-up from digital imagery on-screen are common data capture methods. Ensure the following details are documented:

- Source
- Description
- Date on source
- Scale or resolution of source
- Horizontal Reference System
- Media type
- Conversion method

Note: Respect copyright when digitizing from existing map or data products. See page 5 for information regarding Intellectual Property.

GNSS

GNSS/GPS receivers need to be configured in advance of data collection to ensure the best possible way to achieve the desired accuracy. There are various factors to consider when determining which settings are most appropriate.

Unless post-processing is employed, RTK GNSS is a common "survey-grade" solution. Access to a Network RTK subscription service[5] provides high quality real-time GNSS corrections while out in the field. GRCA's survey-grade GNSS receivers use this method.

GRCA has a need for both survey-grade data and general mapping level of detail. The following tables provide spatial reference system standards for both.

For GNSS data capture using a non-survey grade receiver, refer to Table 1 for spatial reference system preferences.

Table 3A: Survey-grade Reference System -- Horizontal

Option	Geographic Coordinate System [6]	Projected (optional)
1 - Preferred	NAD83 CSRS v6 epoch 2010	UTM Zone 17N
2 - Alternate	NAD83 CSRS v3 epoch 1997	UTM Zone 17N

Table 3B: Survey-grade Reference System -- Vertical

Option	EPSG ID	Description *	Underlying Geoid
1 - Preferred	6647	CGVD2013	CGG2013
2 - Alternate	5713	CGVD28	CGG2000 Htv2

* Heights in terms of CGVD2013 are orthometric. Heights in terms of CGVD28 are normal-orthometric. [7]

Additional

For LiDAR, UAV and Total Station which inherently use GNSS, refer to Tables 3A and 3B.

Deliverables

Clearly specify project deliverables to include:

- Metadata
- GIS data that meets GRCA GIS Data Standards
- Where GNSS is used, also request the tabular data from the receiver, i.e. original source data
- Data license to accompany data and/or intellectual property rights outlined in project contract. The latter is strongly advised particularly when GRCA is hiring external professional services.
- Comply with MFIPPA

[5] Trimble's RTK network is called Can-Net. Topcon's network is TopNET*live*. Both of these private RTK networks are compliant with and broadcast the NAD83(CSRS) national standard.
[6] ArcGIS uses versioning to distinguish between different realizations of NAD83 (CSRS).
[7] See Figure 1 in Height Reference System Modernization published by Natural Resources Canada

Additional Specifications

GNSS Precision / Accuracy – In the early stages of project planning, identify the required level of relative positioning precision. Communicate this requirement clearly to the Contractor; data collection settings on the GNSS receiver must be set accordingly. Note that the term "accuracy" is frequently used interchangeably for "precision".

"Survey grade" is generally considered decimetre precision but should be able to achieve relative positioning with centimetre precision depending on how long observations are recorded at a given location. For general mapping purposes (i.e. non-survey grade), precision is typically in the 2-5m range. Note that it is more difficult to achieve vertical precision than horizontal.

With survey grade GNSS data, you may want to request that PDOP and number of satellites be recorded and uploaded from the receiver as feature level metadata in the GNSS data table.

GIS Data Accuracy – Accuracy is often reported as + /– X metres or an RMSE value should be provided.

Metadata - GRCA template should be used. Minimum required information includes:

- Abstract
- Description of attributes and possible values
- Horizontal coordinate system including datum
- Horizontal projection as applicable
- Vertical coordinate system, as applicable for 3D data
- Terms of use
- Spatial precision / accuracy
- Data capture (or creation) date
- See also Data Capture Standards – Digitizing on page 3

Intellectual Property

For GRCA projects, the main contract with the service provider should address intellectual property (IP) rights. For incoming and outgoing IP, e.g. data, a data license needs to exist or accompany the data.

For most GRCA projects, the requirement will be that GRCA holds full IPR to project deliverables. There can be exceptions to this, especially where third party rights come into play.

Be cognisant of pre-existing data, i.e. IP that existed pre-project and will be used for the project. Use of or incorporating such data into a deliverable warrants close consideration of third-party rights. It may not be possible for the service provider to assign full IPR to GRCA. Respect third party rights.

If GRCA cannot hold full IPR to deliverables of a GRCA project, ensure full licensed rights. See Geomatics (Zoë Green) for details.

Glossary

CGG	Canadian Gravimetric Geoid, e.g. CGG2013
CGVD	Canadian Geodetic Vertical Datum, including CGVD1928 (tidal), CGVD2013 (gravimetric)
CSRS	Canadian Spatial Reference System, a 3D grid maintained by Natural Resources Canada
EPSG	European Petroleum Survey Group. The EPSG Geodetic Parameter Registry contains a dataset of Coordinate Reference Systems and Coordinate Transformations. The dataset is maintained by the Geodesy Subcommittee of IOGP's Geomatics Committee
Galileo	European Union GNSS
GLONASS	Russian GNSS
GNSS	Global Navigation Satellite System
GPS	Global Positioning System, the American GNSS
IOGP	International Association of Oil and Gas Producers
IPR	Intellectual property rights
MFIPPA	Ontario *Municipal Freedom of Information and Protection of Privacy* Act
NAD83	North American Datum 1983
PDOP	Position Dilution of Precision; recorded by GNSS receivers. The greater the value, the lower the accuracy of the GNSS data. Receiver settings typically set to a maximum acceptable PDOP value; data capture prevented in conditions where PDOP reading is above that limit.
RMSE	Root Mean Square Error
RTK	Real Time Kinematic
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984
WKID	Well-known ID

At time of publication, national standard for horizontal is NAD83CSRS v6 epoch 2010.
CGVD2013 is the height reference standard across Canada.
GRCA GIS data warehouse is referenced to NAD83 Original.