Resources Inventory Committee

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Standard for the Use of Map Projections in British Columbia for Resource, Cultural and Heritage Inventories

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and Ministry of Forests
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Resources Inventory Committee

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report "The Future of our Forests".

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at: http://www.for.gov.bc.ca/ric.

Digital Data Working Group

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Scope

The following is a British Columbia Resources Inventory Committee (RIC) standard for the use of Map Projections. The scope for use of the standard includes all natural and cultural resources inventories, including; collection, storage, analysis, interpretation and reporting of the inventory data.

A map projection is a representation of the earth's surface on a flat plane using one of many orderly planar grids to transform the geographic grid (latitude and longitude) from its actual spherical form to a flat surface. Obviously, this cannot be done without distortion of the geographic grid and the planar grid is only an approximation of the earth's surface. The geographic grid (or Geographics) are the lines of latitude and longitude used to fix the location of features on the earth's surface.

It would be preferable to work with geographic or map data which is stored in Geographics (i.e. Latitude/Longitude coordinates). However, current mapping and Geographic Information System software is severely limited in its ability to do analysis with data in Geographics. Most GIS software calculates area, distance and angles only from data which is stored in a map projection.

In anticipation of future software, which may be capable of doing these calculations directly from data stored in latitude and longitude, Geographics are included as part of this standard.

The map projection standard attempts to consider the following concerns:

- there is a need for a Government wide standard
- data custodians establish operational standards
- no single projection is "best" for all uses
- all map projections introduce distortion
- for the sake of consistency the fewer the projection choices the better
- current tools have limitations when dealing with projections
- the current and anticipated use of projections in the BC Government.

This standard does NOT address future needs or uses for data which may require greater accuracy's or less distortion than is currently the case for natural or cultural resources data (for example, very large map scale operational/municipal or cadastral applications).

Map Projection Standard

General Standard

Three Corporate standard map projections are recognized, including:

i) Geographics (Latitude and Longitude)
ii) Universal Transverse Mercator (UTM)
iii) BC Albers Equal Area, with parameters of:

Central meridian:	126:00:00 West longitude
First Standard Parallel	50:00:00 North latitude
Second Standard Parallel	58:30:00 North latitude
Latitude of projection origin	45:00:00 North latitude
False northing	0.0
False easting	1000000.0 (one million meters)

Except for Geographics, all map projections (including both UTM and BC Albers) introduce distortion when representing features from the curved surface of the earth onto a flat map. This distortion introduces errors when analysis is done on the map features.

BC Albers preserves area, but distorts shape and distance. UTM preserves shape and direction, but distorts area and distance. Appendix A quantifies some of the distortions associated with both UTM and Albers as compared to Geographics. Selection of a map projection for use should take both the type and degree of distortion into consideration.

Although UTM has better positional accuracy and is the most commonly accepted mapping standard world-wide, it divides the earth into six-degree zones of longitude. BC includes five of these zones, or separated projections. Handling the separated projections using current GIS tools for analysis of areas which span the zone boundaries presents technical difficulties and has prompted the need for a seamless map projection for the Province; BC Albers. Note that extending the UTM projection zones beyond their defined six-degrees of latitude will introduce errors greater than those stated in Appendix A..

Specific Standards and Guidelines

Below are specific standards for using map projections in various situations. The situations include the use of map projections for local or operational storage in support of mapping operations, for archive of published maps as a source for data exchange (commonly in a warehouse), for original data capture, for analysis of map data, and for presentation of map information. In the case of analysis, interim guidelines are provided because most current analysis tools (i.e. GIS's) are not able to work effectively in the standard, namely Geographics.

Standard for Local Working or Operational Storage (Internal Use)

For mapping operations the map projection is defined by the data custodian based on local (i.e. ministry) needs. A move to Geographics as analytical software becomes available is recommended. The standard does not address concerns that might relate to having more than one standard map projection and its impact on mapping operations. As example, moving from one projection to another involves a transformation. Transformation tools can introduce systematic errors when moving from one projection to another, that is, effectively changing the data. In an operational mapping environment involving updates to existing maps this could cause problems.

Standard for Archive/Exchange (Published/Warehouse)

The Corporate standard is Geographics for Exchange. It is recommended the local projection also be made available as a client option. The latter should be accompanied by "user beware" statements as necessary (e.g. transforming distances associated with dynamic segmentation in BC Albers will lead to errors in another projection; or areas associated with UTM are in error).

Standard for Original Data Capture

For all original data capture, involving line or polygon features being georeferenced to either the TRIM or Provincial 1:250,000 topographic base maps, compile using UTM to maintain consistency with Provincial topographic base mapping standards, thus ensuring data can be overlaid.

Standard for Analysis

The Corporate standard for analysis is Geographics. It is recognized that most current tools are unable to support analysis in Geographics. Thus an interim set of guidelines for use of map projections is required.

Interim Guidelines for Analysis

It is generally accepted that analysis for planning purposes, involving large areas, and where the key data involved is in a small scale (1:50:000 and greater), errors introduced by using either the UTM or BC Albers map projections is not of consequence. The guideline for practical purposes is to use the projection most convenient for your immediate analysis.

For larger scales, or operational analysis where accuracy, as influenced by map projection (see Appendix A), is a concern the following additional guidelines are provided:

i) When concerned with shape of features, spatial accuracy of features within an area (including direction or distance), or with analyses involving geometric

constructs (e.g. buffers defined around points, lines or areas; analysis involving point or area grids, use of bounding boxes) and the required accuracy is supported by the data, use UTM.

ii) When concerned with the accuracy of area summaries of mapped polygon features and the required accuracy's are supported by the data, use BC Albers.

Summary of Interim Map Projection Guidelines for Analysis[1]

Table 1 - Summary of Interim Map Projection Guidelines for Analysis[1]

Scale \ Use	Area Summaries of mapped polygons	Area Summaries of mapped polygons involving overlays	Area Analysis using geometric constructs (with or without overlays)	Intersection Analysis involving overlays	Linear Analysis	Coordinate Geometry
Key Sources are small scale (≤1:50,000) / focus is regional planning	BC Albers (UTM)	BC Albers (UTM)	UTM (BC Albers)	UTM (BC Albers)	UTM	UTM
Key Sources are large scale (<1:50,000) / focus is operational planning	BC Albers[2]	BC Albers[2]	UTM	UTM	UTM	UTM

[1]The less preferable projection is shown in brackets.

[2]Where area measurements are better than .08ha in 100ha

Standard for Presentation

The map projection is to be defined by analyst based on presentation objectives.

1996/09/09

Appendix A: Comparison of BC Albers and UTM with Geographics

The following identifies the maximum distortion for both BC Albers and UTM that was found when 393 1000-meter squares were constructed in Geographics, spaced uniformly across the Province and projected into each projection.

UTM Distortions (within each UTM zone within BC)

The maximum north/south linear distortion is 0.040%
The maximum east/west linear distortion is 0.040%
The maximum area distortion is 0.08%

BC Albers Distortions (within all of BC)

The maximum north/south linear distortion is 0.36%
The maximum east/west linear distortion is 0.36%
The maximum area distortion is 0.00%

Following are three examples showing the distortion in both UTM and BC Albers when drawing a 10,000 meter circle around a point at three locations in BC. The two locations, Terrace and Victoria are both near the top end for distortion in both BC Albers and UTM. Note that in the case of UTM the distortion is constant making the circle slightly larger (to a maximum of about 4 meters larger, depending on where you are in the Province). In the case of BC Albers, the magnitude of the distortion varies transforming the circle into an ellipse (with a maximum distortion of about 40 meters). For both UTM and BC Albers, this would approximate the range in distortion across a single TRIM sheet. Generally, total distortion increases as the area increases.

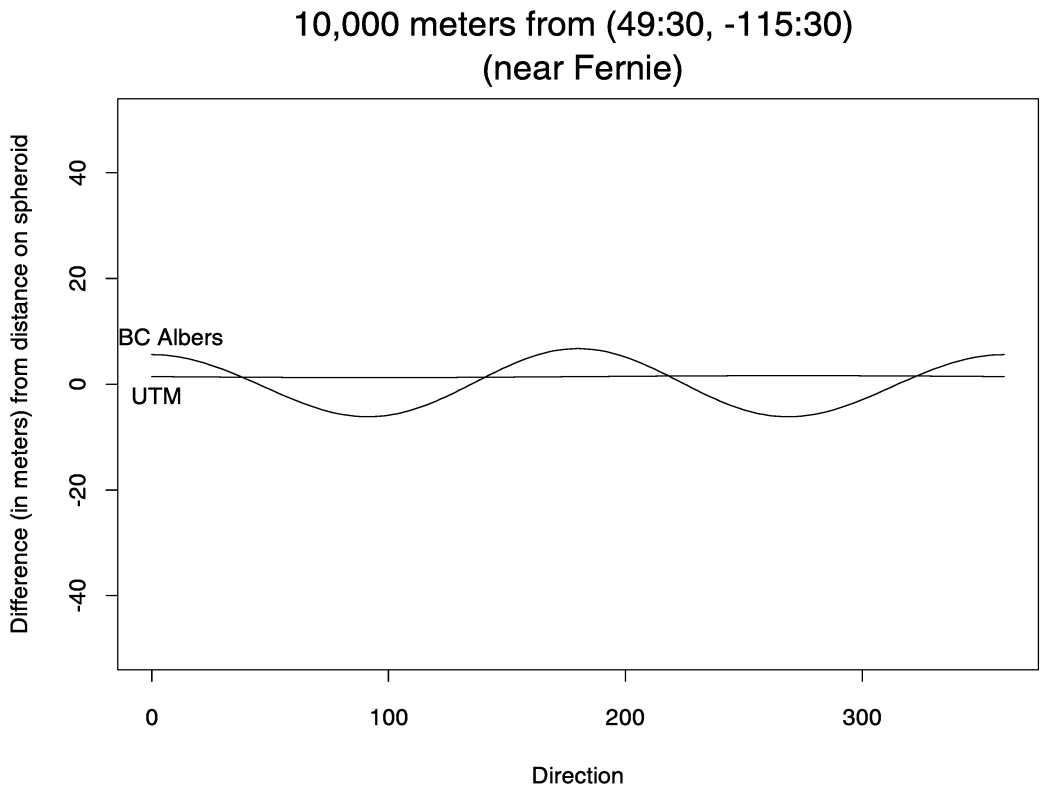

Figure 1 - Near Fernie

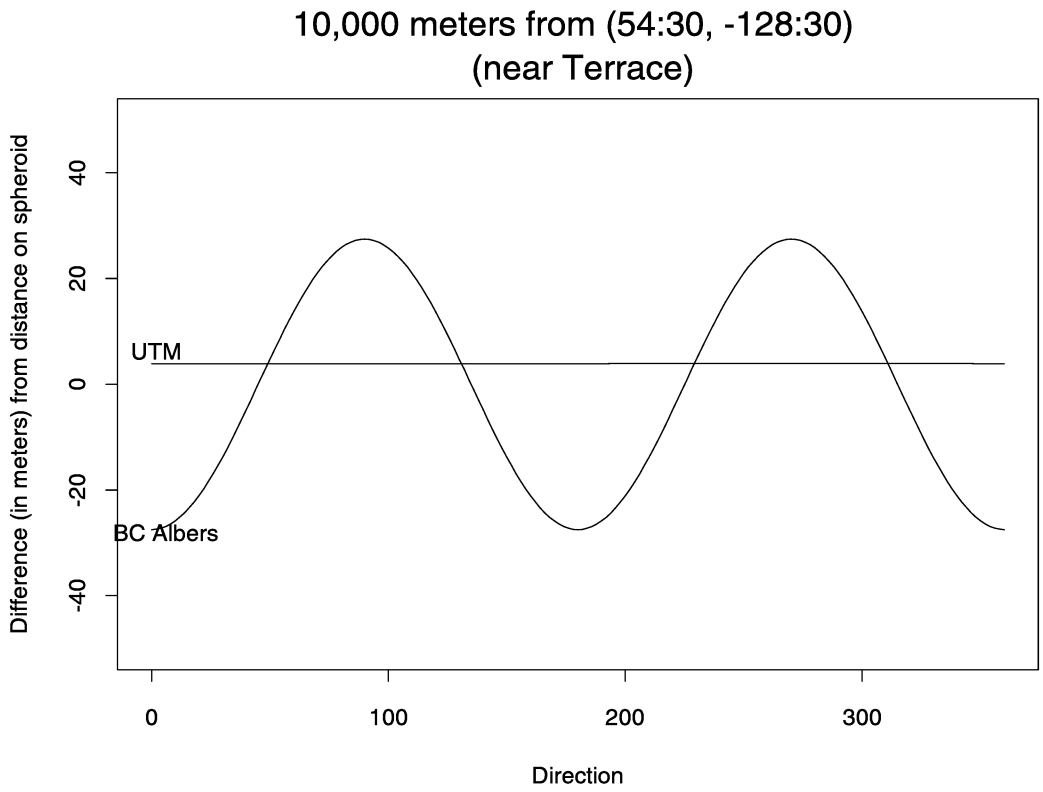

Figure 2 - Near Terrace

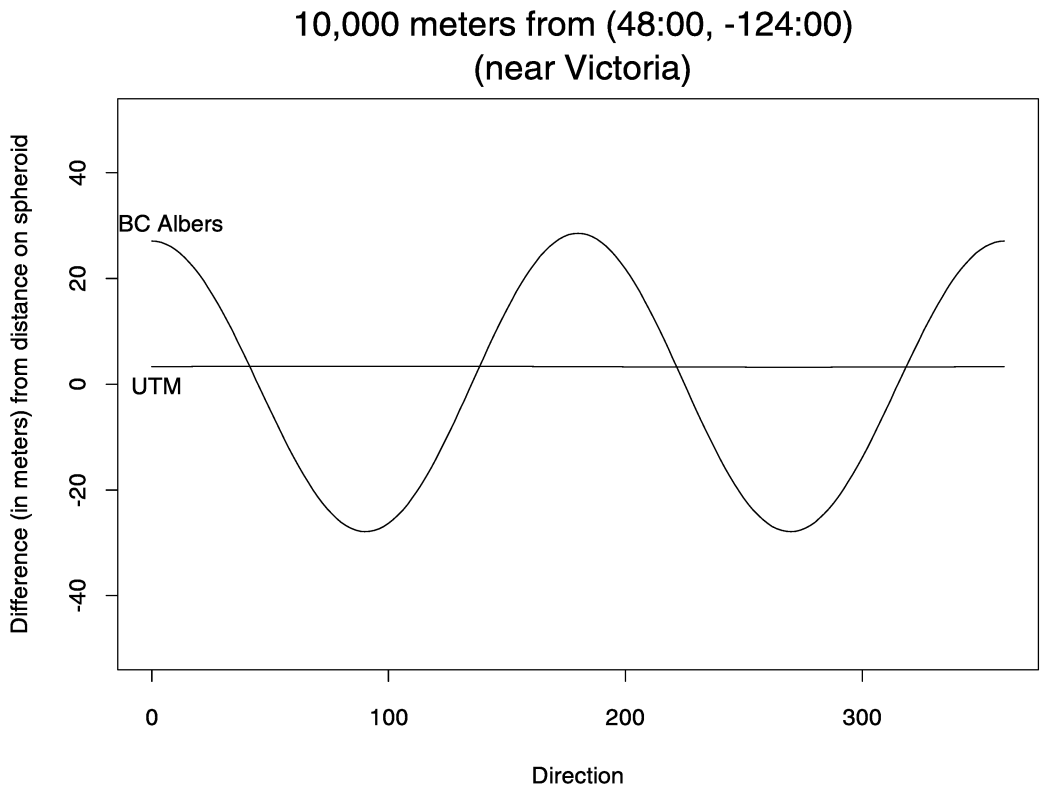

Figure 3 - Near Victoria

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