Practice Advisory Department and the Surveyor General Division

Showing Coordinates on Legal Plans in Integrated Survey Areas

It has come to the attention of the Practice Advisory Department and the Surveyor General Division that in some Integrated Survey Areas (ISA's), an accurate GNSS survey of a Geodetic Control Monument (GCM) can result in coordinate values which substantially differ from the official published coordinate values for that GCM. This can occur where the GCM has a poor horizontal positional accuracy (HPA).

The purpose of this bulletin is to provide recommendations to land surveyors who find themselves in the situation where they are unsure whether to show official published coordinates on their plans (and to submit them in their ParcelMap BC Dataset submission), or to show their own coordinate realization as derived from an accurate GNSS survey.

Definitions

Horizontal Positional Accuracy (HPA) is defined by the General Survey Instruction Rules (GSIR) as "the network horizontal accuracy of all the georeferenced points in the survey."

Network Horizontal Accuracy (as defined by the GSIR) means "the absolute accuracy of the coordinates for a point with respect to the adopted British Columbia Geo-Spatial Reference to a 95% confidence level, which is dependent on the network accuracy of the known point(s) used to derive the coordinates of the legal survey and the relative accuracy of the connection(s) to the known point(s)."

Horizontal Precision as defined by the MASCOT website refers to the "statistically derived standard level confidence in the coordinates with respect to the NAD83 Datum". Keep in mind that Standard Deviation given for MASCOT points is at 68% confidence and not the 95% required by the GSIR.

Reliability is determined by the number of connections a GCM has to other GCM's and the precision of those connections.

Monument Class is a MASCOT GCM designation which considers the Horizontal Precision, Reliability and accuracy of a GCM to determine if the GCM should or should not be used or retired.

For more information about these topics, visit the MASCOT news page: *http://a100.gov.bc.ca/pub/mascotw/public/mascot_news.html* ; scroll 2/3 of the way down the page to sub-heading 4 "Classification and retirement of Geodetic Control Markers".

Problematic Situations

The situation where an ISA monument might have a poor HPA can be categorized into three scenarios.

1. The following Integrated Survey Areas have been identified as being poorly integrated and therefore their monuments have poor horizontal positional accuracies. (MASCOT categorizes GCM's in these ISA's as 'D Class').

- Integrated Survey Area Number 5- Village of Elkford
- Integrated Survey Area Number 6- Village of Granisle
- Integrated Survey Area Number 33- District of Tumbler Ridge

MASCOT refers to the stations in these ISA's as "high standard deviation markers" and does not publish coordinates for these monuments. Coordinates for these stations can be obtained on the LTSA website- however, members must understand that the HPA requirements for georeferencing will not be met if these coordinates are used.

2. Other Integrated Survey Areas contain GCM's which have poor horizontal positional accuracies. MASCOT will generally categorize these monuments as 'C Class'. Again, the concern is that the minimum HPA requirements for georeferencing as set out by the General Survey Instruction Rules will not be met if these coordinates are used for georeferencing.

For example, GCM 811166 (ISA Number 9- Cranbrook) is 'C Class', and has published standard deviations for the Northing and Easting of 0.127 m and 0.104 m respectively. The HPA is calculated as 0.33 m- well in excess of the requirements of the Rules. ISA Number 8 – Mackenzie is another example of an ISA with C class monuments.

3. Some ISA's have been identified in which the published standard deviations would seem to indicate good quality coordinates are available but when compared to a high

precision GNSS surveyed coordinate there is a discrepancy larger than expected.

Users have reported this situation in

- Integrated Survey Area Number 26 – Wildwood Heights (Powell River)
- Integrated Survey Area Number 19 – Vernon

All cases can create a situation of uncertainty for land surveyors, especially when they are establishing their coordinates using GNSS in conjunction with a real time network, active control, or the Precise Point Positioning service.

In regards to what to show on the plan and what to include in the ParcelMap BC Dataset submission, the question is; should the land surveyor show and submit the coordinates as realized by their accurate GNSS survey, or show and submit the official published coordinates?

Recommended Practice

In the situations described above, it is recommended practice to show on the plan (and submit in the ParcelMap BC Dataset) the coordinates from the accurate GNSS survey and not show the official published values.

Showing Coordinates at ISA Monuments

If the observed coordinates are shown at the ISA monuments, then it is recommended that the following note be placed on the plan in an appropriate location;

Note: The coordinates and horizontal positional accuracies shown on this plan are a result of an independent and accurate GNSS survey and do not represent official published coordinates.

When submitting ParcelMap BC CSV file, these points should be tagged with an S for Survey instead of a G for Geodetic since the surveyed position and not the published position is being used to locate the data.

The purpose of this bulletin is to provide recommendations to land surveyors who find themselves in the situation where they are unsure whether to show official published coordinates on their plans (and to submit them in their ParcelMap BC Dataset submission), or to show their own coordinate realization as derived from an accurate GNSS survey.

Showing coordinates at Traverse Hubs in an ISA

In some cases, practitioners will choose to georeference their project using accurate GNSS, in conjunction with a Real-time network, PPP, or Active Control. In these cases they will show coordinates on traverse hubs closer to their project area, and show ties to the Geodetic Control Monuments, but not show coordinates at the GCM's.

While this is good practice, this approach can create uncertainty for the ParcelMap BC team, in that the ParcelMap BC Dataset submitted in support of the plan will contain coordinate values for the Geodetic Control Monuments which may differ substantially from the published GCM coordinate values. In these instances, it is recommended practice to add the following note to the face of the plan in an appropriate location:

Note: The coordinates and horizontal positional accuracies shown on this plan are a result of an independent and accurate GNSS survey. Positions for Geodetic Control Monuments which are calculated from information on this plan may not agree with official published coordinates.

Tips on How to Avoid Coordinate Discrepancies

In some instances, coordinate discrepancies can be avoided by selecting the GCM's which are best suited to a GNSS survey. This may be achieved by a review of the MASCOT long form. The following tips may contribute to better agreement between your GNSS survey and the published coordinates.

- The 'Survey Connections' link on the MASCOT long form will provide indicators of a monument's reliability (monument reliability contributes to monument accuracy). In particular;
- Monuments with several "GPS" ties in the "Surv. Meth." Column will result in the best agreement with GNSS surveys
- A higher number of survey connections (terrestrial or GPS connections) will generally indicate higher reliability (and therefore result in higher accuracy)
- Monuments of classes A and B are most suitable for georeferencing. Monuments of class C may not meet the HPA requirements prescribed by the GSI Rules. D Class monuments should not be used for georeferencing. For visualization purposes the MASCOT layer on Google Earth provides a quick at a glance

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classification by using different symbols for the different classes

- The MASCOT published standard deviations for a monument are a good indicator of a monument's HPA- but this information needs to be considered in concert with the previous points in this section.

Proposed Future State

The Surveyor General Division is working with GeoBC and has commissioned new control surveys using GNSS in a number of lower quality ISA's in order that the quality class of the some of the monuments in question can be improved. This is a project that is currently underway with data processing and integration into MASCOT by GeoBC to follow in 2018. As such, we will still have to deal with the current situation for some time and hence the need for this bulletin to provide guidance in the interim. ✣