Fact Sheet No.11

The Evolution of Alberta Survey Control

Land Surveys Unit, Geodetic Control

Introduction

This fact sheet discusses the history of the survey control in Alberta including the development of the Alberta Survey Control (ASC) network, surveying infrastructure, the Spatial Reference Design Alternatives initiative, development of the provincial High Precision Network, and the future of survey control in Alberta.

Primary Network Control in Alberta

The existing ASC network got its start when the original Dominion Land surveys came into Alberta in the late 1800's. While this framework worked well (and continues to work well) for land conveyance, it was not a suitable reference for land related information. The first formal survey (geodetic) control network was brought into Alberta in the 1920's in the form of triangulation networks (the Primary Network) established by the forerunner of the Canadian Geodetic Survey (Natural Resources Canada). These control markers were typically established on hill tops and other high points where it was convenient to see long distances and they typically consist of a bronze tablet embedded in a 0.4 m by 0.4 m by 0.96 m concrete block (typically a "stove pipe" design) with a 2nd bronze tablet embedded in the concrete block as a subsurface mark. There are approximately 1070 Primary Network control markers formally integrated within the ASC network with most located in southern and central Alberta.

The need for a more accurate framework

In the 1950's and 1960's, a desire for higher accuracy and denser coverage came hand-in-hand with improved surveying techniques that drove the need for the Cities of Edmonton and Calgary to establish their own control networks to meet engineering and land development requirements. Similarly, industrial development in the rest of Alberta drove the need for improved geodetic positioning. In 1976 a 10-year program was initiated to establish Alberta Survey Control Markers (ASCMs) on a provincial-wide basis in urban and rural areas of Alberta. In urban cadastral areas (under the *Municipal Integrated Surveying and Mapping* (MISAM) program), ASCMs were established at a 300 m to 800 m spacing primarily using triangulation and trilateration surveying techniques. For rural areas (i.e., everywhere else in Alberta not part of the MISAM program), ASCMs were established on a 10 km by 20 km grid primarily using inertial survey system surveying techniques. Typical urban accuracies ranged between 1st and 2nd order surveys while in the non-urban areas the accuracy was (and remains) typically 3rd order. The Government of Alberta (GOA) entered into agreements with all 73 municipalities (see Fact Sheet No.10 for names of municipalities) in the MISAM program to establish and maintain ASCMs at the municipal level. Within the rural areas, the GOA was responsible for establishment and maintenance of the ASC network. In addition, in support of the PARCEL mapping program for smaller municipalities not part of the MISAM program, ASCMs (typically up to four per municipality) were established by the GOA in/around these municipalities in the 1980's and early 1990's. All through the establishment and expansion of the ASC network, the network itself was derived via a 2-dimensional/1-dimensional adjustment process where the horizontal component was determined independently of the vertical component. As result, the ASC network was built with separate horizontal and vertical datums in mind; NAD27/NAD83(Original) for the horizontal and CGVD28 for the vertical. Further information on these datums and the ASC network is found on Fact Sheets No.2 and No.4.

https://www.alberta.ca/geodetic-control-unit.aspx

Alberta

The Alberta Survey Control Network

Overall, the ASC network consists of some 43,000 ASCMs that includes control markers with horizontal and vertical coordinates, benchmarks, temporary marks, and markers outside of Alberta but are included in the network. Of these, approximately 25, 000 ASCMs are available publicly and are considered to be usable and accessible. The typical ASCM is a brass cap affixed to a 2.5m to 3 m steel post with a helix shaped base that allows the ASCM to be screwed into the ground to provide for stability and longevity. Other ASCM types include pounded 3 inch pipe with brass cap, concrete-filled 30 cm pipe driven to refusal (i.e., the 21 Canadian Base Network (CBN) pillars), brass caps affixed to sidewalks, and other designs that have been used over the years. Coordinate and non-coordinate information is published on ASCM ID cards that allow users to obtain the coordinates, the physical location, and integration quality to surrounding ASCMs as well as other useful information. Further information on ASCM ID cards, see the Alberta Survey Control Products Manual on the GOA open data portal at https://open.alberta.ca/publications/0773212981. ASCM ID cards are obtained for free via the Spatial Information (SPIN) system from Alberta Land Titles at http://www.spin.gov.ab.ca. Here users can search by individual ASCM number, area or by map.

EDM Baselines and Validation Basenets

In Alberta there are four Electronic Distance Measurement (EDM) Calibration baselines and two Global Navigation Satellite System (GNSS) Validation basenets, established in the 1970's to the early 1990's. This infrastructure is used by Land Surveyors and others to test their surveying system (i.e., conventional and GNSS surveying equipment, field methodology, and data processing) to see if it meets their surveying requirements. The EDM baselines are located near the cities of Grande Prairie, Edmonton, Calgary and Lethbridge. The GNSS validation basenets make use of the EDM calibration baselines at Edmonton and Calgary along with other forced-centring concrete filled pillars and datum-type ASCMs. Detailed information on the EDM calibration baselines and the GNSS validation basenets can be obtained from the GOA open portal at https://open.alberta.ca/dataset?tags=calibration+baselines, https://open.alberta.ca/publications/edmonton-gps-validation-network , and https://open.alberta.ca/publications/calgary-gps-validation-network.

Spatial Reference Design Alternatives

In 1995, the GOA started to look at moving toward a GNSS, or space-based, spatial referencing system with a view to move from a dense passive ASC network to an active control network with reduced density for passive control. In 1998 this effort culminated in the release of the Spatial Reference Design Alternatives (SRDA) initiative that defined the various issues, roles and strategies to be employed in developing the future spatial referencing system in Alberta. In short, the SRDA looks to the GOA to have a role in: Coordination with Canada and the Canadian Spatial Referencing System (CSRS); standards development/maintenance for ASC; migration to NAD83(CSRS); mathematical maintenance and distribution of coordinate/non-coordinate data for ASCMs; and maintenance of EDM calibration baselines and GNSS validation networks. Conversely, development and maintenance of active control system networks and real-time kinematic networks is left to non-GOA entities, and development of High Precision Networks (HPNs) at the municipal level is left to municipalities. In particular, municipalities were given the role establishing and physically maintaining the ASC network via HPN development with technical support as need from Geodetic Control. Further information on the SRDA can be obtained by contacting Geodetic Control to obtain a copy of the SRDA initiative report.

Provincial HPN

In concert with the SRDA initiative, Geodetic Control established the provincial HPN which is made up of ASCMs that are physically and mathematically able to support GNSS observational techniques. As a consequence, Geodetic Control publishes a listing of 1120 ASCMs located across Alberta. The provincial HPN consists of the 21 Canadian CBN markers in Alberta, municipal HPNs, municipalities with CBN fiducial ASCMs in them, and other ASCMs established and/or reintegrated using GNSS surveying methodologies. The provincial HPN forms the backbone of the maintained passive survey control markers in Alberta. As other markers are

damaged and/or destroyed, they are not replaced. However, those within the HPN framework are typically physically and mathematically maintained. A copy of the listing is available from the GOA open data portal at https://open.alberta.ca/publications/nad83-csrsv7_e2010_cgvd2013_provincial_hpn_data-xlsx.

The Future

The future of survey control in Alberta is a combination of high accuracy GNSS capable passive control with non-GOA Real-time networks and the Natural Resources Canada (NRCan) Precise Point Positioning service. In particular, the non-GOA Real-time networks will be supported through the NRCan compliance program where Real-time network service providers provide base station data to NRCan who then derive accurate coordinates that are spatially consistent with the CSRS. In addition, Geodetic Control continues to actively work with the Canadian Geodetic Survey (NRCan) (and other provinces/territories) to maintain the provincial spatial reference system in concert with the CSRS. This includes actively working towards implementation of the North America Terrestrial Reference Frame of 2022 (NTARF2022). Of note, as the NATRF2022 project moves forward, further information including timing of implementation, availability of tools and data products will be released as it becomes available.

Need more information?

This fact sheet is one of a series published by Lands Division, Land Surveys Unit, Geodetic Control. For more information, please visit our web site or contact us at (780) 422-1291.