

CHAPTER 1: GEODETIC CONTROL



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Theme Description:⁷

A geodetic control network is the wire-frame or the skeleton on which continuous and consistent mapping, Geographic Information Systems (GIS), and surveys are based. To understand the function of geodetic control, we have to realize that a map or a plane survey is a flat representation of the curved world. If we want the maps to become an authentic representation of the real world, we have to be able to "paste" small pieces of (flat) map contents onto a curved world. The Geodetic Control is the mechanism that enables us to perform this "pasting" seamlessly, accurately and consistently.

Traditionally, geodetic control points are established as permanent physical monuments placed in the ground and precisely marked, located, and documented. Locating spatial features with respect to geodetic control enables the accuracy assessment of these features. Interest and activity regarding geodetic control has dramatically increased at all government levels because of the need for accurate maps and surveys used in geographic and land information systems.

With the advent of the Global Positioning System (GPS), the framework of the geodetic control network for Hawai'i should preferably be based on CORS (Continuously Operating Reference Stations). CORS stations provide an active geodetic control network, which enable GPS users to tie their positioning observations to the geodetic network without physically having to occupy a geodetic control point. Spatial data is georeferenced to the geodetic network by processing roving GPS receiver data with data from CORS stations. Hence, CORS stations offer lower cost, efficient and accurate positioning necessary to support National Spatial Data Infrastructure (NSDI) needs.

Status:

The state of Hawai'i has a highly accurate traditional geodetic network in place. New NAD83 (North American Datum of 1983) coordinates for a statewide network of 1,830 horizontal monuments were published in August 1993 (project 17624). These 1,830 new coordinates include 49 GPS monuments whose GPS-derived elevations also were published at that time. Statistics indicate that the NAD83 (1993) coordinates for most of the nearly 49 Hawai'i GPS monuments, in particular, are compatible with the coordinates for the existing CORS to within 2 centimeters (1 inch) horizontal accuracy and 6 centimeters (3 inches) vertical accuracy. Information for these monuments, which are all

⁷ The source for much of this chapter is the State of New Jersey Spatial Data Infrastructure Implementation: I-Team Strategic Plan, March 2002. (<http://njgeodata.state.nj.us/>)

part of the National Spatial Reference System, are available in FGDC Spatial Data Transfer Standard (SDTS) point profile format, used for the transfer of data into a GIS. In addition six CORS stations are already operating in Hawai'i to support GIS and surveying activities.

Data Sources:

The primary source for geodetic data is the National Geodetic Survey (NGS). NGS, known by other agency names in the past, has been responsible for establishing and maintaining a nation-wide geodetic control network since 1807. This network, currently called the National Spatial Reference System (NSRS), contains monumented survey stations whose horizontal and/or vertical coordinates are precisely surveyed and computed. In the past NGS was the only agency establishing, maintaining, and publishing high accuracy geodetic control. Due to the nature of the surveying technologies most horizontal control was on mountain peaks, and vertical control followed roads. To support mapping efforts state agencies such as the Department of Transportation (HI-DOT) would come off the NGS control and survey down to the area of interest using lower accuracy procedures and instruments, but adequate for their mapping projects. Therefore, many geodetic survey stations established with that technology are considered inaccessible by today's surveyors or inappropriate for using GPS technology. The control network continues to diminish in size as stations are destroyed due to construction and vandalism.

With the advent of modern technologies such as GIS, GPS and other electronic instruments, many state, county and local government agencies have undertaken the task of establishing geodetic control. Some of them elected to submit the data to NGS. Data submitted to NGS that comply with standards and specifications are incorporated into the NSRS. Many entities elect not to submit their data to the NGS but will provide those data upon request, while some entities will not provide those data outside the agency. The NSRS is made available free of charge by NGS through direct Internet access (<http://www.ngs.noaa.gov/datasheet.html>); other methods (CDs, paper products, etc.) incur a cost of dissemination.

Professional licensed surveyors in Hawai'i, who to establish geodetic control are encouraged to publish geodetic control coordinates within their own jurisdictions and in conjunction with the NGS.

Standards:

Standards for both the establishment of geodetic control and for data transfers are well documented. See FGDC (Federal Geographic Data Committee) Geospatial Positioning Accuracy Standards, Part 2:Standards for Geodetic Networks (FGDC-STD-007.2-1998), and the FGDC Spatial Data Transfer Standard (SDTS), Part 6:Point Profile (FGDC-STD-002.6).

Priority:

The geodetic control layer is of very high priority for Professional surveyors, GIS developers and spatial data gatherers in Hawai'i. The rationale being that if geodetic control is readily available throughout the state, all geospatial data will be brought into a common coordinate system at the time the data are collected. This is especially important for the development of a seamless parcel map for the state.

Since geodetic control is a fundamental infrastructure for geo-spatial analysis activities, the higher the interest levels in a geographic area, the higher the priority for good geodetic control. Since much of the data collection for geospatial data in Hawai'i will be done with GPS receivers, using the existing CORS system for establishing the Federal Base Network (FBN) and the Cooperative Base Network (CBN) in the state is of the highest priority. NAD83 coordinates will be expressed as geographic (latitude, longitude, orthometric height) and projected onto Hawai'i State Plane coordinates whose units are meters. Without such a network, high accuracy data (1.0 ft. ground resolution or better) will be more expensive and time consuming to compile.

Estimated total investment in this theme:

NGS' mission since 1807 is to establish and maintain the geodetic and leveling networks for all the states and territories. The Hawai'i geodetic network was started in 1871 and the work has been done as part of NGS' budget over the years.

Estimated current state and local contributions:

Hawai'i is supporting the Geodetic State Advisor program (http://www.ngs.noaa.gov/INFO/OnePagers/One-Pager_State_Advisor.pdf) which is jointly funded between the state of Hawai'i and NGS.

What is needed:

A coordinated effort by the Federal Partners Team, the HI- DOT, Hawai'i Association of Land Surveyors (HALS) and Hawai'i Office of Planning to identify entities that are willing to assist in the establishment of the FBN and CBN (http://www.ngs.noaa.gov/INFO/OnePagers/One-Pager_FBN.pdf) and enhance the vertical component of the NSRS using NGS' Height Modernization program (http://www.ngs.noaa.gov:80/Slides/HTML_Ht_Mod/index.htm).

What is the likely source:

- Municipal Government
- County Government
- HI Department of Transportation
- U.S. National Geodetic Survey

- U.S. NOAA – National Weather Service

U.S. Geological Survey
HI Utilities such as Hawaiian Electric and Water companies
Hawai'i Association of Land Surveyors
University of Hawai'i

Estimated total investment needed to complete this theme:

Following the FBN guidelines to maintain the geodetic horizontal network.
Getting the support of Congress and the Administration for 500K per year for four years for the Height Modernization for Hawai'i.

Estimated current allocation of funding

See above.

Estimated budget shortfall:

Depends on support from Congress and the Administration for the Height Modernization for Hawai'i.

Possible ways to overcome this gap:

TBD

Most appropriate data steward:

National Geodetic Survey

Maintenance Process:

Following NGS' FBN guidelines for replacing destroyed control points.

Estimated Maintenance cost:

To be done by in kind labor by either County Governments, HI Department of Transportation, U.S. National Geodetic Survey, U.S. Geological Survey, HI Utilities such as Hawaiian Electric and Water companies, and Hawai'i Association of Land Surveyors