



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
National Geodetic Survey
Silver Spring, Maryland 20910-3282

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Mr. Michael H. Schoder, PLS
Alaska Cadastral Survey Chief
Division of Lands and Cadastral Survey
Bureau of Land Management, Alaska State Office
222 W. 7th Avenue, #13
Anchorage, Alaska 99513

Re: Applied use of the National Spatial Reference System (NSRS) in DPPS Methodology

Dear Mr. Schoder:

The National Oceanic and Atmospheric Administration's National Geodetic Survey (NGS) has been contacted by personnel from the Department of Interior's Bureau Land Management (BLM), the Alaska Department of Natural Resources (DNR), and others regarding BLM's proposal to use Direct Point Positioning Survey (DPPS) methods for preparing survey plats and defining Public Land Survey System (PLSS) corners with limited installation of physical survey markers. Due to the diverse and numerous independent requests for information on this topic, we provide the following response to all known parties with an interest in the geodetic aspects of the DPPS method:

"NGS's mission is to define, maintain, and provide access to the National Spatial Reference System (NSRS)," the foundation for all surveying, mapping, charting, and positioning activities in the United States and its territories. All civilian Federal geospatial agencies (including the BLM) are required to work within the NSRS. As such, it is imperative that NGS, as stewards of the NSRS, provide information about the capabilities and limitations of applied NSRS use with respect to BLM's proposal.

The NSRS is defined and accessed through a combination of active stations and passive control marks set by NGS, its predecessor agencies, and other surveying professionals for the purposes of mapping and charting our Nation. NGS maintains an official Integrated Database (IDB) that supports access to published NSRS coordinates of physical marks in the ground. Each passive control mark in the IDB has an official NSRS coordinate; however, coordinates may change over time for a variety of reasons:

- (a) a mark may physically move due to some geophysical phenomenon (scales vary in time and/or space),
- (b) the software used to compute the coordinate from original observations may have changed,
- (c) a new survey may have been performed, providing updated positional information,
- (d) an error in a previous computation could have been detected and corrected, or



(e) the datum to which all coordinates refer may have been updated.

Because each passive control mark in the IDB has an official NSRS coordinate, a 1-to-1 correlation exists temporarily between a passive control mark or physical location on the ground and some particular coordinate, but this 1-to-1 correlation could be broken if any of the above issues occur and are poorly modeled, documented, or understood.

Movement of the North American plate in Alaska and other tectonics are geophysical processes that are not well characterized. In lieu of models, direct measurement of crustal motion may be accomplished using GNSS in one of two ways—by re-observing passive control monuments or at Continuously Operating Reference Station (CORS) sites. CORS are present but sparse throughout parts of Alaska; and, few have existed long enough to provide computed velocities. The NGS software program, Horizontal Time-Dependent Positioning (HTDP), estimates crustal velocities and shifts horizontal coordinates between epochs. However, in many parts of Alaska these estimates are of limited accuracy for applying discrete motion adjustments to the coordinates of survey monuments. Please note that as this product presently is available, there is no guarantee that HTDP will remain an available NGS product.

With the upcoming modernization, the NSRS will rely on semi-dynamic datums where surveys will be time-tagged but not explicitly tied to older surveys using geophysical models. In a practical sense, this means that a 5 cm network accuracy is achievable at the time of a given survey, but that accuracy may not be maintained if repeat surveys are not performed over time on the same passive control network. To re-establish an NSRS coordinate from a past epoch in an area that has undergone tectonic motion, an adequate number of passive control marks must exist and remain available for re-observation. NGS consistently has recommended that surveyors re-observe existing passive control marks to obtain accurate coordinates in the NSRS, now and in the future.

For adoption of the proposed DPPS methodology, NGS recommends an acknowledgement that GNSS survey techniques that do not employ passive survey control monuments have accuracy limitations at the decimeters to meter level. Consequently, for GNSS to be used reliably as a tool to identify a unique point on the dynamic crust of the Earth, adequate local marks must be established to allow dependent surveys that follow to align with the original intent. This provides a representative dataset that characterizes the net crustal motion in the survey area platted. We therefore advise that BLM and Patentee review each survey plan and mutually agree on a minimum quantity and/or spacing of passive control, and acknowledge that there is a dependency on these passive control marks to re-establish ground positions tied to the NSRS at a future date. Additionally, both parties should understand that a certain percentage of passive controlling marks will be disturbed or destroyed (lost) over time. NGS personnel are able to assist in these discussions, but such agreements will require an understanding of additional factors beyond the scope of NGS purview in this topic, including assessments of risk tolerance and resource levels necessary to establish new passive monuments (including PLSS corners) if densification is required for subsequent purposes.

To facilitate any GNSS survey efforts, NGS recommends the use of our OPUS-Projects tool for network baseline processing and adjustments. OPUS-Projects may be used, in combination with data from CORS or other active GNSS control stations, to produce final control networks with

GNSS observation data on passive control marks. Unless specifically deleted by the creator, an OPUS-Projects network (including observation data) will remain permanently archived at NGS by project ID. Control network processing results, including mark uncertainties and other critical metadata, should be recorded on any plat such that future surveyors may understand and follow the intent of the original survey. The ability to add OPUS-Projects control network marks directly to the IDB is under development.

As a convenience, NGS provides a basic OPUS Database (OPUS-DB) to “share” GNSS observations on passive control marks. Within OPUS-DB, NGS retains mark coordinates from the time of observation, and automatically perpetuates these coordinates into future reference frame/datum realizations. In addition to the geodetic NSRS coordinate, OPUS-generated datasheets include the UTM and State Plane Coordinates, photos of the mark, an interactive map, observer record, PID, and mark designation. NGS further recommends that any GNSS observation data collected on passive control marks in support of DPPS be submitted to OPUS-DB for ease of access by any interested parties.

As a science-based technical authority on precise positioning, NGS is committed to providing timely and informative responses to all future inquiries about applied use of the NSRS within the proposed DPPS method. To facilitate a coordinated response to any additional questions, we request that all future inquiries on this topic be directed to the NGS Alaska Regional Geodetic Advisor, Dr. Nicole Kinsman at nicole.kinsman@noaa.gov or 202-306-5736. She will be able to identify an appropriate subject matter expert at our agency and ensure a response in the shortest time possible.

NGS looks forward to providing additional geodetic resources or guidance, as needed, and we are eager to support all parties in seeking a viable solution that will be in the best interest of the Nation.

Sincerely,



Juliana P. Blackwell
Director

cc: Gerald Jennings, Alaska Department of Natural Resources, Chief, Survey Section
Dr. Nicole Kinsman, National Geodetic Survey, Alaska Regional Geodetic Advisor