National Geodetic Survey

geodesy.noaa.gov

Positioning America for the Future

Learn about the planned modernization of the National Spatial Reference System (NSRS).

Join us to learn more about the National Geodetic Survey's (NGS) planned modernization of the National Spatial Reference System (NSRS).

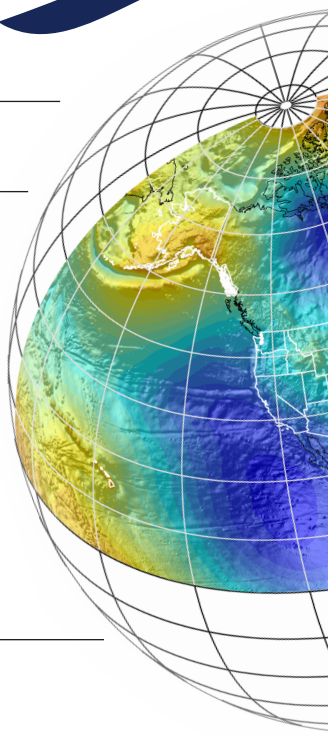
Geospatial Summit

Agenda

Day 1: Monday, May 6, 2019

Time: 9:30 am - 5:00 pm

Location: Silver Spring Civic Building, 1 Veterans Plaza
Silver Spring, MD 20910



Time	Description
9:30 – 10:00	**Arrival / Registration** *Ellsworth Room*
10:00 – 10:30	**Opening Session**
	Geospatial Summit Overview Juliana Blackwell Director, NGS
	Keynote RDML Timothy Gallaudet, Ph.D., USN Ret. Assistant Secretary of Commerce for Oceans and Atmosphere and Deputy NOAA Administrator
	General Announcements Brad Kearse Deputy Director, NGS
10:30 – 12:00	**NSRS Modernization Overview**
	Blueprint for 2022 Part 1: Geometric Coordinates Dan Roman, Ph.D. Chief Geodesist, NGS
	Blueprint for 2022 Part 2: Geopotential Coordinates Dan Roman, Ph.D. Chief Geodesist, NGS
	Blueprint for 2022 Part 3: Working in a Modernized NSRS Dru Smith, Ph.D. NSRS Modernization Manager, NGS
	Designing a Data Delivery System for the Future Boris Kanazir Geodesist, NGS

(Day 1 Itinerary continues on next page)

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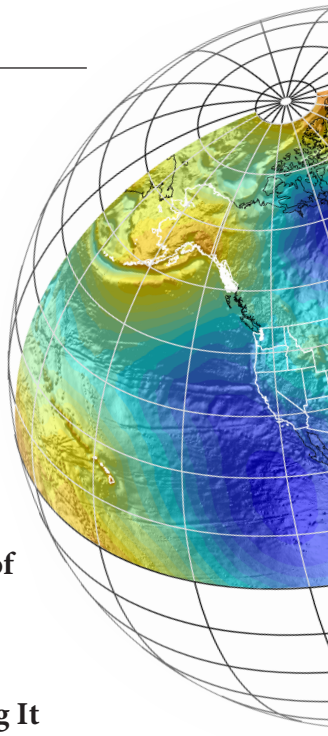
Time	Description
12:00 – 1:30	**Lunch on your own**
12:30 – 1:15	**Informal Meet and Greet** *Spring Room* State Geodetic Coordinators are welcome to come meet each other as well as the full team of NGS Regional Geodetic Advisors.
1:30 – 3:00	**NSRS Modernization Outreach and User Engagement Efforts** **Session Overview** Galen Scott Acting Constituent Resource Manager, NGS **Recap 2018 Industry Workshop and Introduction of Alpha Products** Dru Smith, Ph.D. NSRS Modernization Manager, NGS **The State Plane Coordinate System of 2022: Making It Your Way** Michael Dennis, Ph.D. Geodesist, NGS **National Society of Professional Surveyors (NSPS) Coordinated Efforts to Change State Legislation** Curtis Sumner Executive Director, National Society of Professional Surveyors **Keeping Coordinates Moving: Working in Dynamic California** Scott Martin California Geodetic Coordinator, California Department of Transportation



(Day 1 Itinerary continues on next page)

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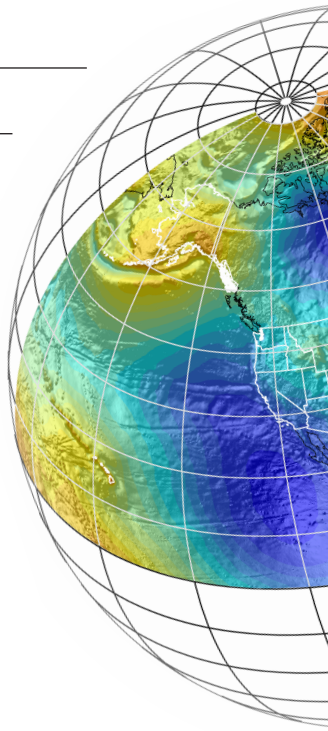
Day 1: Monday, May 6, 2019 (cont.)

Time: 9:30 am - 5:00 pm

Location: Silver Spring Civic Building, 1 Veterans Plaza
Silver Spring, MD 20910

Time	Description
3:00 – 3:30	**Break**
3:30 – 5:00	**Education and Training to Prepare Surveyors for NSRS Modernization** **Session Overview** Jacob Heck, Ph.D. Geodesist, NGS **NGS Educational Offerings** Erika Little Training Coordinator, NGS **NOAA-University of Puerto Rico at Mayagüez Memorandum of Understanding: An Overview of 20 Years of Partnership** Linda L. Velez - Rodriguez Professor, University of Puerto Rico **Mastery Paths Learning in Geosciences** Stacey D. Lyle , Ph.D. Professor of Practice, College of Geosciences, Texas A&M University College Station **Engaging the Unengaged - How to Reach the Professional** Patrick Tami Immediate Past President, National Council of Examiners for Engineering and Surveying
5:00 – 7:00	*Optional Social Gathering* *McGinty's Public House* *911 Ellsworth Dr., Silver Spring , MD 20910*



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Positioning America for the Future

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Geospatial Summit

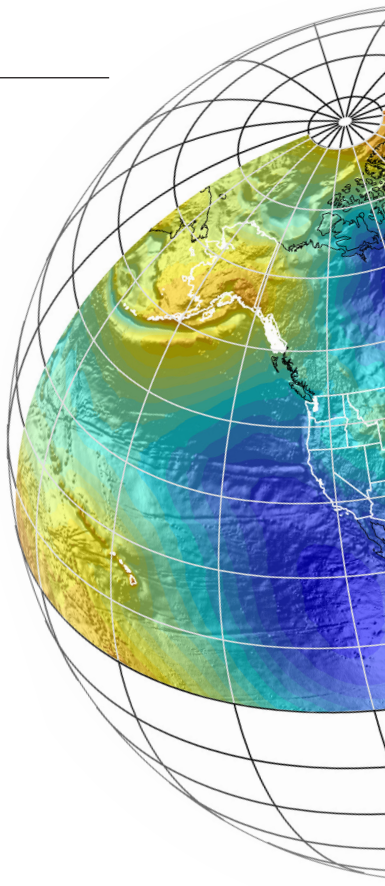
Agenda

Day 2: Tuesday, May 7, 2019

Time: 8:30 am - 5:00 pm

Location: Silver Spring Civic Building, 1 Veterans Plaza
Silver Spring, MD 20910

Time	Description
8:30 – 9:00	**Arrival/Registration**
9:00 – 9:05	**General Announcements** Brad Kearse Deputy Director, NGS
9:05 – 10:20	**NGS Ongoing Efforts / Interim Products (Part 1 of 2)** **Gravity for the Redefinition of the American Vertical Datum (GRAV-D)** Jeffery Johnson Acting GRAV-D Project Manager, NGS **Experimental GEOID Modeling (xGEOID19)** Yan Wang, Ph.D Geodesist, NGS **Geoid Montoring Service (GeMS)** Kevin Ahlgren, Ph.D. Geodesist, NGS **Hybrid Geoid Models (GEOID18)** Kevin Ahlgren, Ph.D. Geodesist, NGS **Modernizing Continuously Operating Reference Stations (CORS)** Theresa Damiani, Ph.D. Spatial Reference System Division Chief, NGS **Foundation CORS** Theresa Damiani, Ph.D. Spatial Reference System Division Chief, NGS



(Day 2 Itinerary continues on next page)

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Geospatial Summit

Agenda

Day 2: Tuesday, May 7, 2019 (cont.)

Time: 8:30 am - 5:00 pm

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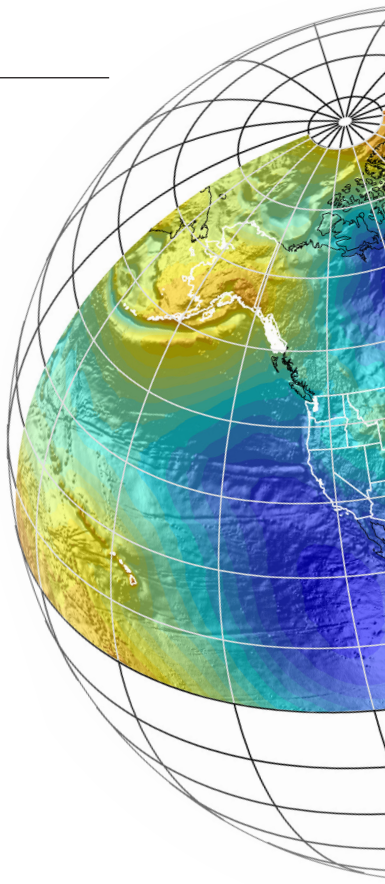
Silver Spring, MD 20910



Time	Description
9:05 – 10:20	**Turning the Page on PAGES: NGS's Next Generation, Multi-Global Navigation Satellite System (GNSS) Software** Bryan Stressler Geodesist, NGS
10:20 – 10:50	**Break**
10:50 – 12:00	**NGS Ongoing Efforts / Interim Products (Part 2 of 2)** **OPUS Projects Improvements** Mark Schenewerk, Ph.D Geodesist, NGS **OPUS-Projects for Uploading Real-Time Kinematic GNSS Vectors** Dan Gillins, Ph.D. Geodesist, NGS **OPUS Projects for Everything** Krishna Tadepalli Geodetic Applications Branch Chief **NGS Coordinate Conversion and Transformation Tool (NCAT)** Krishna Tadepalli Geodetic Applications Branch Chief **"GPS on Bench Marks" Efforts** Galen Scott Acting Constituent Resource Manager, NGS

(Day 2 Itinerary continues on next page)

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Geospatial Summit

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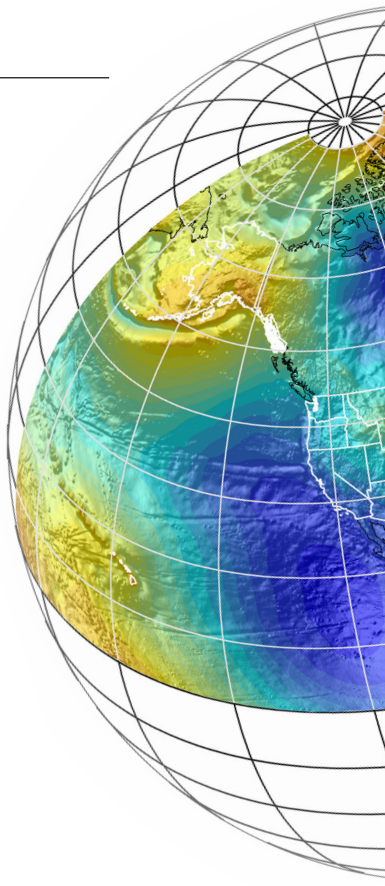
Time: 8:30 am - 5:00 pm

Location: Silver Spring Civic Building, 1 Veterans Plaza
Silver Spring, MD 20910

Time	Description
12:00 – 1:30	**Lunch on your own**
12:30 – 1:15	**Informal Meet and Greet** *Ellsworth Room* Industry partners, particularly software developers and equipment manufacturers, are welcome to meet NGS employees and discuss NSRS Modernization "alpha products."
1:30 – 2:45	**Panel Discussion** **Chair:** Andria Bilich, Ph.D. Geodesist, NGS **Panelists:** Kevin Ahlgren, Ph.D. Geodesist, NGS Theresa Damiani, Ph.D. Spatial Reference System Division Chief, NGS Dan Roman, Ph.D. Chief Geodesist, NGS Mark Schenewerk, Ph.D Geodesist, NGS Dru Smith, Ph.D. NSRS Modernization Manager, NGS
2:45 – 3:15	**Break**



(Day 2 Itinerary continues on next page)

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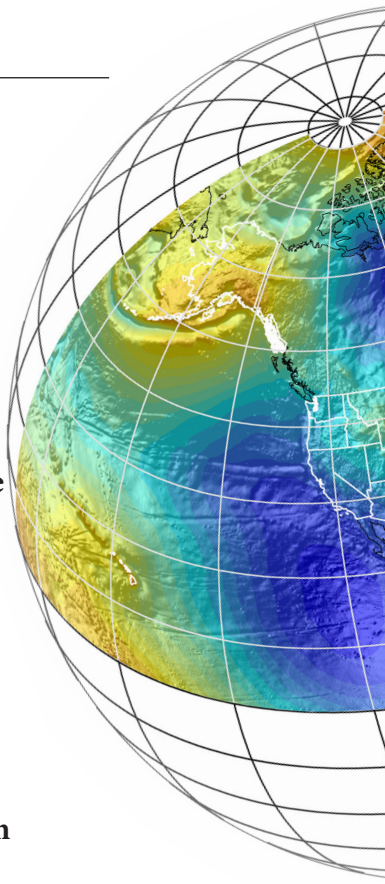


Time	Description
3:15 – 4:50	**NSRS Modernization Case Studies and User Perspectives** **Session Overview** Galen Scott Acting Constituent Resource Manager, NGS **Lidar Case Study - Alaska Geoid** Nicole Kinsman, Ph.D. Alaska Regional Geodetic Advisor, NGS **National Park Service Case Study – Assateague Island National Seashore** Neil Winn GIS Specialist, National Park Service **U.S. Geological Survey Case Study – Impacts to 3D Elevation Program (3DEP)** Barry Y. Miller GIS Applied Researcher, U.S. Geological Survey **North Carolina's Floodplain Mapping Program** Gary Thompson Chief, North Carolina Geodetic Survey
4:50 – 5:00	**Closing** Brad Kearse Deputy Director, NGS

National Geodetic Survey *Positioning America for the Future* geodesy.noaa.gov

Issue 15, April 2019

NSRS Modernization News

For all issues of **NSRS Modernization News**, visit:
geodesy.noaa.gov/datums/newdatums/TrackOurProgress.shtml

Geospatial Summit 2019

The Geospatial Summit on NSRS Modernization will take place May 6-7, 2019 in Silver Spring, MD. Mark your calendars and check the 2019 NGS Geospatial Summit page for more information when it becomes available.

Blueprint for 2022, Part 3

Blueprint for 2022, Part 3: Working in the Modernized NSRS has just been released! Find it on the NGS website at: https://geodesy.noaa.gov/PUBS_LIB/NOAA_TR_NOS_NGS_0067.pdf

What Will "2022" Entail?

NGS is working on a Technical Memorandum which outlines every product and service which is currently slated for the 2022 roll-out of the NSRS Modernization, as well as a status report on each project related to those products and services. Look for this TM later this year.

Contingency Plans

All projects for the NSRS Modernization are currently on track (though some just barely.) However, a number of resource difficulties have disrupted things significantly enough that NGS is working on contingency plans should any projects for the NSRS modernization not be completed by the end of 2022. Foremost among these concerns are delays caused by three government shutdowns last year. For now, 2022 remains the target!

Progress in Ongoing Projects

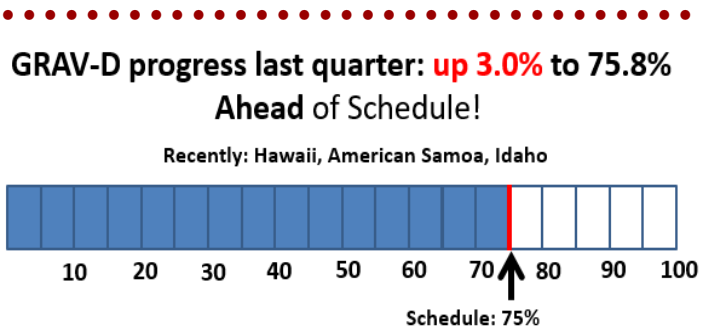
There are currently 18 ongoing projects directly related to NSRS modernization around NGS. Here are highlights from a select few:

- **GRAV-D**
  Project Manager: Jeffery Johnson

  GRAV-D reached an important milestone, collecting 75% of our target area by the end of March 2019. The survey that pushed GRAV-D over 75% was in Hawaii! GRAV-D has begun data collection in Hawaii and American Samoa. At this point we are about 58% done with Hawaii and about 40% done with American Samoa. We hope to return to Hawaii and complete data collection there in May-June of this year. American Samoa and Guam are likely to be completed in 2021 or 2022.

- **State Plane Coordinates**
  Project Manager: Dr. Michael Dennis

  NGS has finalized SPCS2022 Policy and Procedures, based largely on public comments received in response to an April 2018 Federal Register Notice. The official release, delayed due to government shutdowns, is expected this month (April 2019). Fillable forms included with the release will enable stakeholders to easily make requests and proposals regarding their state, and to submit their own designs for SPCS2022 zones. The policy, procedures, and forms will be available through the SPCS home page.



Executive Summary

NOAA Technical Report NOS NGS 67
Blueprint for 2022, Part 3: Working in the Modernized NSRS

In year 2022, the National Spatial Reference System (NSRS) will be modernized. This document addresses how geospatial professionals can expect to work within the newly-modernized NSRS.

At the forefront of these NSRS changes, we will embrace time-dependency, an issue NGS has not completely implemented as of yet. Beginning in 2022, points in the NSRS with defined coordinates will have epochs associated with them, based upon the time actual data were collected at those points. Such coordinates will be known as "Final Discrete" coordinates (if associated with finite timespans of data collection) or "Final Running" coordinates (if associated with continuous data collection). Consequently, passive control will have less reliability than active control, and NGS will treat the NOAA CORS Network as having the definitive, up-to-date coordinates within the NSRS. A change of business will result: both leveling and classical surveys will require Global Navigation Satellite System (GNSS) components to ensure coordinates computed in those surveys are up-to-date and are connected to the NSRS through the NOAA CORS Network.

In order to bridge users into a time-dependent NSRS, NGS will also be estimating, and providing to the public, coordinates on points at five-year reference epochs. While such *estimates* will mimic the current status quo [the 2010.00 epoch of NAD 83(2011), for example], they will not be considered the "definitive" NSRS coordinates. Whereas users will have the option, via an updated OPUS, to take any campaign survey at any date and adjust their surveys to such reference epochs, we at NGS will not do this. Rather, if your survey data is submitted to NGS, we will compute Final Discrete coordinates at the epoch of your survey. Then, in the future, those Final Discrete coordinates will be used to estimate Reference Epoch coordinates.

We will be providing tools to users, under the catch-all name "OPUS," for uploading, processing, analyzing, and submitting survey data of all types, such as: GNSS, RTK (Real Time Kinematic), RTN (Real Time Network), leveling, gravity, or classical. Additionally, OPUS will have tools for ingesting and analyzing continuous data (e.g. GNSS, gravity). The tool will be browser-based and will fully integrate all data types, whereby a single project, containing both GNSS and leveling could be uploaded and processed under the same project name. Users processing their data in OPUS will always receive "Preliminary" coordinates from OPUS. We hope to encourage users to submit that data so that NGS can provide quality control, internal national processing, and creation of Final Discrete coordinates from their data. Only data submitted to NGS will make it into the NSRS database and be processed and re-distributed to the public using an updated Data Delivery System, previously known as "datasheets."

Please find this entire report here:
https://geodesy.noaa.gov/PUBS_LIB/NOAA_TR_NOS_NGS_0067.pdf

Terminology Guide (Excerpt from Blueprint from 2022, Part 3)

Throughout this document, many of the following terms are used. For purposes of definition consistency, we shall adhere to the usages found in this guide. Readers are strongly encouraged to familiarize themselves with the definitions described below before reading the remainder of the document. Additionally, these terms are defined in consideration of their *geodetic* usage, not within their *broader* usage within the English language.

Antenna Reference Point (or ARP): The antenna reference point (ARP) is the **point** on a GNSS antenna from where antenna calibration values are referenced. The **ARP** is preferably, but not always, an easily accessible **point** on the plane that contains the antenna's lowest non-removable horizontal surface. The ARP could be physically identifiable on that (above-mentioned) surface of the antenna; or it may be the center of a mounting axis, and thus co-planar with that surface, without being on the surface itself. The **ARP** can, but is not required to, coincide (in space) with the geometric reference point (**GRP**) when the antenna is mounted as part of a **CORS**. For this reason, NGS has for decades erroneously described the coordinates at a **CORS** as referring to the **ARP**, and not the **GRP**, a practice we ceased in 2019. Note that the **ARP** is a **point** that is part of an antenna, but it is *not* a point on a **mark**. Therefore, a **CORS** only has an **ARP** at those times when an antenna is mounted at it, whereas a **CORS** always has a **GRP**.

Bluebooking: A phrase used to describe how geodetic survey data were formatted and submitted to NGS using *Input Formats and Specifications of the National Geodetic Survey Data Base* (FGCS, 2016) so they could be checked and included in the National Geodetic Survey's Integrated Database **(NGS IDB)**. The term **Bluebooking** was derived from the original document that had been distributed with a blue cover.

Continuously Operating Reference Station (CORS): A **station**, composed of a variety of equipment, but usually including at least one **mark** (containing one **geometric reference point**, or **GRP**), as well as a GNSS antenna and receiver, as well as some source of power and communications. The purpose of a CORS is to continuously collect and distribute GNSS data so as to monitor the coordinates of the **GRP**. The term **CORS,** however, has grown to acquire a general use worldwide, therefore, there is no guarantee a station being referred to as a **CORS** is actually part of **the NOAA CORS Network** (plural: CORSs).

Also referred to as: *Continuously Operating GPS Reference Station, Continuously Operating GNSS Reference Station, Active Control Station*

Coordinate Function: A set of three piecewise continuous functions (one for each of the X, Y or Z coordinates with respect to time), fit to the daily or weekly coordinates implied by analyzing daily or weekly data collected at a **CORS**. Serves as the official time-dependent NSRS

coordinates of the **GRP** of each **CORS**. Specific to **CORS** only, the coordinate function is identical to Final Running Coordinates (see Section 2.5).

Geometric Reference Point (or GRP): A unique **point** that is part of a particular **station**. The **GRP** is the **point** to which any coordinates of the **station** refer. The operator of each **station** identifies the **GRP** of that **station**. The GRP is sometimes independent of equipment, such when it is contained within a **mark** at a **CORS** (and thus it exists even when the antenna is removed). In other cases, such as with very long baseline interferometry (VLBI) and satellite laser ranging (SLR), the GRP is a **point** in space defined by the motion of the telescope, typically the intersection of the azimuth axis with the common perpendicular of the azimuth and elevation axis, and thus it only exists when that particular set of equipment is at that **station**.

Local Site Survey: A survey—often consisting of GNSS, leveling, and classical observations using survey-grade instruments—at one **site.** High-precision local tie vectors are determined between the **site marker** and the **geometric reference points** of co-located space geodetic technique (SGT) **stations** on that **site** so as to contribute to realizations of the International Terrestrial Reference Frame (ITRF).

GPS Month: Four consecutive GPS weeks, with the first week in the **GPS month** having a GPS week number that is a multiple of four. Thus, **GPS month** 'zero' is the consecutive period spanning GPS weeks zero, one, two, and three; **GPS month** 'one' is the consecutive period spanning GPS weeks four, five, six, and seven, etc.

Mark (or Marker): A physical structure of varying size or construction, attached to Earth's crust in some way that is presumed to be stable throughout years (or decades) and whose function is to contain a single, unique, identifiable **point** in a stable location. Such **points** are often a small divot or cross on the top of the **mark** (though even the smallest divot is not zero-dimensional, so for highest accuracy, one must clearly identify which part of the divot is the **point**. For example, the **point** on the **mark** might be the bottom of such a conical divot). Common forms of a **mark** include:

> A metal (often brass or aluminum) disk (often about 3 inches in diameter but varying from 0.5 inches to more than 12) with a stem underneath which keeps it mounted in stone, masonry or concrete.
>
> A metal rod (usually 1-2 centimeters in diameter) driven into the ground and rounded on the top.

When NGS refers to the "coordinates of a **mark**," we are referring to "the coordinates of the **point** on the **mark**."[2]

[2] To that end, NGS plans to change our official policy (from an unofficial practice that has been in place for approximately 10 years) that all surveying to a mark, and all coordinates of a mark, should refer to one uniquely identifiable point on that mark. This policy will be necessary to

Also called: *Bench Mark, Control Mark(er), Disk, Geodetic Control Mark(er), Monument, Passive Mark(er), Physical Mark(er), Rod, Survey Mark(er)*

See Figure 1 below.

NGS IDB (or IDB): The National Geodetic Survey Integrated Database. Prior to the modernization of the NSRS, the NGS IDB was the definitive storage place for all NSRS data. Datasheets were generated only from this database. It was "Integrated," because two separate databases (one for horizontal and one for vertical) were combined into the **NGS IDB** in the 1990s.

The NOAA CORS Network: The name of the collection of **CORSs** whose data are collected and processed by the National Geodetic Survey. Note that many other countries and agencies around the world refer to their individual **stations** as being **CORSs**. This generic use of the term **CORS** does not, however, mean their **stations** are in **the NOAA CORS Network**.

NSRS Database (or NSRS DB): The official database built to house the modernized NSRS. Some information from the **NGS IDB** will be converted directly into the **NSRS DB**. For example, the Permanent Identifier **(PID),** of a **mark**. Other information, such as coordinates, will be re-computed from raw measurements using the modernized NSRS as their foundation.

PID: Abbreviation for 'Permanent Identifier,' the unique six-character alphanumeric code assigned to each **point** included in the **NGS IDB** or **NSRS DB** and residing on a **mark.**[3]

Point: A zero-dimensional location. Two **points** cannot exist in the same space at the same time. A **point** might be physically "touchable" (such as the bottom of a small conical divot on top of a **mark**) or it may not be (such as the location of an airborne gravimeter's sensor at any given moment during a flight). *See Figure 1 below.*

Redundancy: Taking the same measurement more than once, where each measurement is taken separately and independently of the other. Strictly speaking, this is impossible, as anything measurable in the universe changes to some degree or another from one moment to the next. However, in the context of this document, **redundancy** will generally mean "collecting GNSS data at a **point** during two different occupations within the same **GPS month**."

Site: The smallest civil location name of the area where (one or more) **stations** are located. (Legal, i.e., recognizable by deed; national- or state-recognized city, town, village, or hamlet; or geographic feature). Multiple **stations** can be on one **site**. (Example: "MacDill Air Force

undo the official policy from the NOAA leveling manual (Schomaker and Berry, 2001) that states, "Place the rod so that the exact center of the base plate rests on the highest point of the turning point or control marker." Such a practice meant that, on any sort of tilted mark, the "highest point" might not be the same as the point at the center of the disk to which, say, a classical or GNSS survey might refer. Furthermore, as "depth of dimple" becomes an issue (particularly with using pointed fixed-height poles in GNSS surveys), the unique point of any given mark may need to be identified as the bottom of the dimple (or cross mark).

[3] Recall, **points** exist in the **NSRS DB** that are not on **marks**, such as the **points** an airborne gravimeter's sensor may have occupied during a flight. As each **mark** should hold only one unique **point**, the **PID** of a **point** may equally be considered to be the **PID** of the **mark** upon which that **point** resides.

Base" is a **site**, and it happens to contain two **stations**, which are the **CORSs** known as MCD5 and MCD6). *See Figure 1 below.*

***Site Mark(er)*:** A single, unique **mark**, installed one per **site**. All vectors from the **geometric reference points** of every **station** on that **site** are tied to that single mark within a **local site survey**. Note that **local site surveys** often use *many* **marks,** and all may be located at a **site** (for the purpose of **redundancy** and to provide a backup of the **site marker**), but only one can be (and must be) designated as the **site marker**. *See Figure 1 below.*

Station: A collection of equipment located at one **site** to collect one specific type of data for a particular geodetic purpose. Within the geodetic community there are many types of **stations**, and most common are:

Continuously Operating GNSS Reference Station (**CORS**)

Satellite Laser Ranging (SLR) Station

Very Long Baseline Interferometry (VLBI) Station

Doppler Orbitography and Radiopositioning Integrated by Satellite DORIS) Station

Continuously Operating Relative Gravimeter Station

Two or more **stations** located on the same **site** may share some pieces of common equipment, but at least one unique thing should distinguish one **station** from another. *See Figure 1 below.*

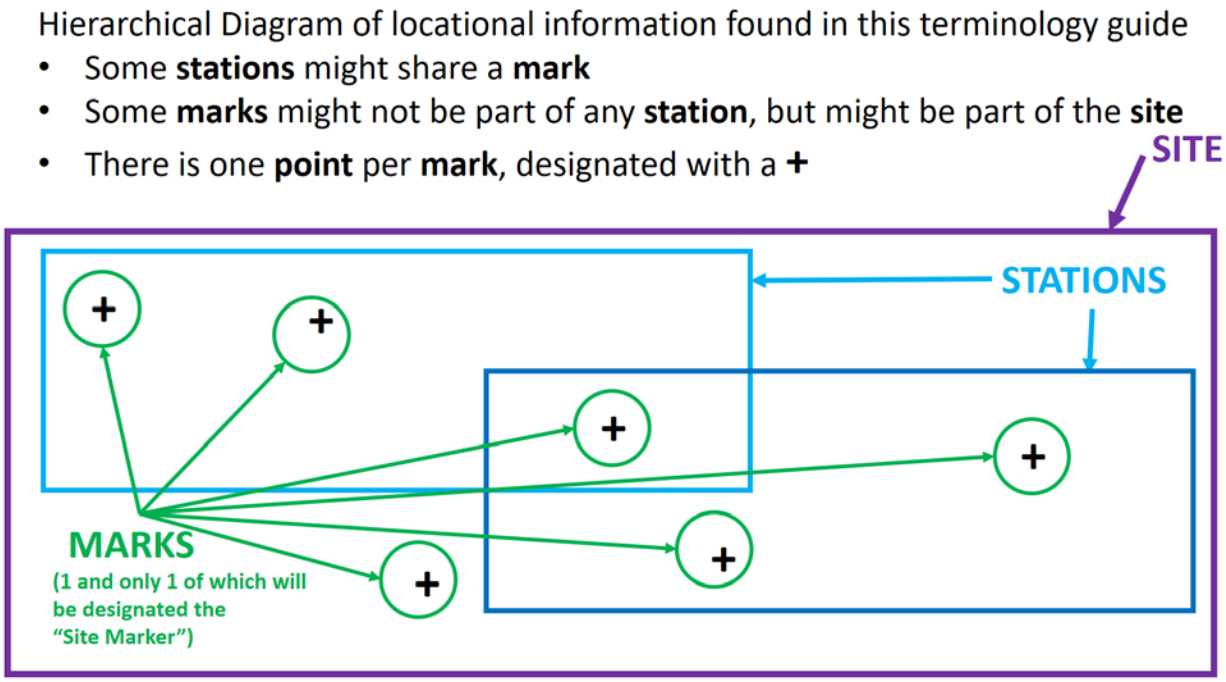


Figure 1: Site, Station, Mark, Site Marker, and Point Hierarchy

How to Send Your Response to Live Polls

Option 1: Web

Using a Web browser on your smart phone, tablet, or computer, visit www.PollEv.com/noaaNGS and submit your responses.

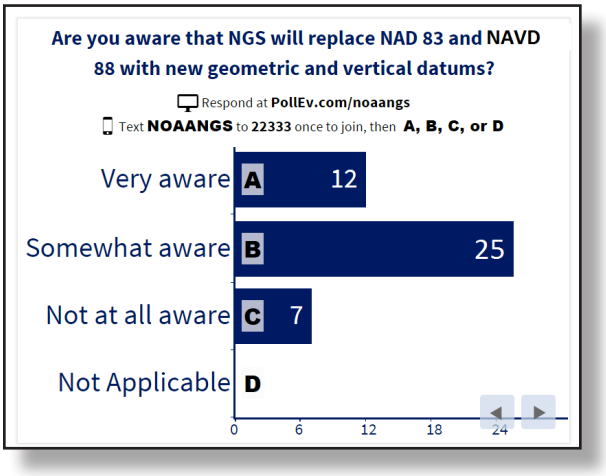
or

Option 2: Text

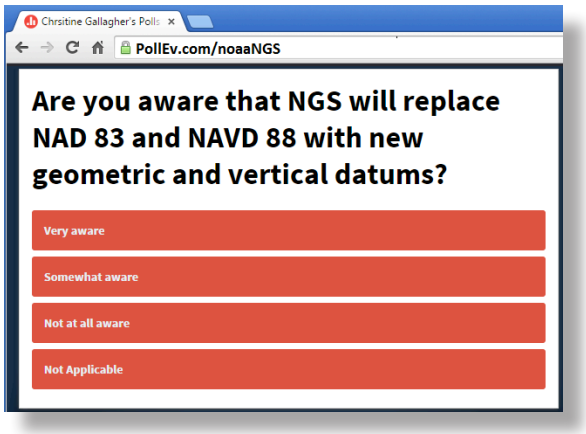
Using your cell phone, text noaaNGS to 22333 once to join.
Then, text your responses (e.g., A, B, C, etc., or open-ended response).

Examples:

Big Screen/ Webinar View



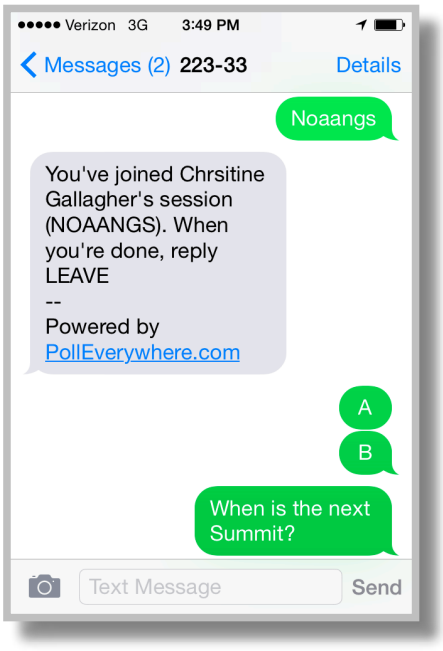
Via Web



Via Text

Note:

1. When texting, see the poll questions on the big screen or in webinar view.
2. Your normal texting fees will apply.



ATTENDEE FEEDBACK EVALUATION
2019 Geospatial Summit
Silver Spring, Maryland

Please circle your answer for the questions below.
NOTE: page 1 evaluates full event, and page 2 evaluates each session.

MEETING EVALUATION

1. **Which day of the Summit are you evaluating?**

   A) Only Mon., May 6 B) Only Tues., May 7 C) Both days

2. **Do you work for NOAA's National Geodetic Survey (NGS)?**

   A) Yes B) No

3. **How did you primarily attend this event?**

   A) In-person B) Webinar

4. **How clear were the objectives of the event?**

   A) Extremely B) Very C) Moderately D) Slightly E) Not at all

5. **How organized was the event?**

   A) Extremely B) Very C) Moderately D) Slightly E) Not at all

6. **Overall, how satisfied were you with the event?**

   A) Extremely B) Very C) Moderately D) Slightly E) Not at all

7. **Do you have any other questions, comments, or suggestions?**

---MORE QUESTIONS ON REVERSE---

SESSION EVALUATION

8. **Please evaluate each session by circling your responses in the table below:**

Session	How beneficial was the information?	How technical was the content?	Other comments
Opening Session / Keynote	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
NSRS Modernization Overview	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
NSRS Modernization Outreach and User Engagement Efforts	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
Education and Training to Prepare Surveyors for NSRS Modernization	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
NGS Ongoing Efforts / Interim Products	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
Panel Discussion	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	
NSRS Modernization Case Studies and User Perspectives	Very beneficial Beneficial Slightly beneficial	Too technical About right Not tech. enough	

9. **What sessions did you find most useful? (circle as many as you like)**
   A. Opening Session / Keynote
   B. NSRS Modernization Overview
   C. NSRS Modernization Outreach and User Engagement Efforts
   D. Education and Training to Prepare Surveyors for NSRS Modernization
   E. NGS Ongoing Efforts / Interim Products
   F. Panel Discussion
   G. NSRS Modernization Case Studies and User Perspectives

NAME (optional): _____

Thank you for our feedback! It will be used to help inform and improve future events.