

# REPLACING NAVD88: THE EFFECTS OF VERTICAL DATUM MODERNIZATION ON COASTAL ENGINEERING

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## VERTICAL CHANGES ARE COMING

The United States (US) National Geodetic Survey (NGS) will be replacing the North American Vertical Datum of 1988 (NAVD88) with the North American-Pacific Geopotential Datum of 2022 (NAPGD2022).

NAVD88 is still the official vertical datum of the NSRS at this time, but it is in need of improvement; it is both biased (by about one-half meter) and tilted (about 1 meter coast to coast) relative to the best global geoid models available today. This issue stems from the fact that NAVD88 was defined primarily using terrestrial surveying techniques at passive geodetic survey marks. For access, users must often collect hours of Global Navigation Satellite System (GNSS) data, or rely on our nation's network of passive survey marks, which is not fully stable (consider areas of subsidence such as the Mississippi River delta) and is deteriorating over time. Maintenance of these marks requires significant resources and vertical motion of marks is not tracked in a systematic way.

A modernized vertical reference frame will primarily rely on GNSS such as the Global Positioning System (GPS) in combination with an updated and time-tracked geoid model. This paradigm shift will result in improvements to the National Spatial Reference System (NSRS) that will provide users with enhanced access, easier maintenance, and more consistent coordinates for precise positioning activities nationwide.

## DEFINING THE NEW GEOPOTENTIAL DATUM

In 2022, the NSRS will contain one time-dependent geopotential datum: NAPGD2022. NGS has produced a document, the *Blueprint for 2022, Part 2: Geopotential Coordinates*, which describes the current state of plans for the definition of NAPGD2022, including related NSRS geopotential quantities. The document also describes the continued maintenance of the datum, and defines the relationship between the official zero-height reference surface for new orthometric heights (GEOID2022) and other height reference surfaces such as Global Mean Sea Level, local tidal datums, and NAVD88.

Gravity for the Redefinition of the American Vertical Datum (GRAV-D) is an NGS project that supports the redefinition of the US vertical datum that is accurate at the 2 cm level, where possible, by 2022. The project is currently underway with an airborne campaign to collect a new high-resolution "snapshot" of gravity data across the US and its territories.

In addition to the GRAV-D data-collection efforts, NGS is annually releasing an experimental gravimetric geoid (xGeoid; see Figure 1) for evaluation purposes, and has

launched a Geoid Monitoring Service Project to build the time-dependent component of GEOID2022 from satellite data and terrestrial tracking stations.

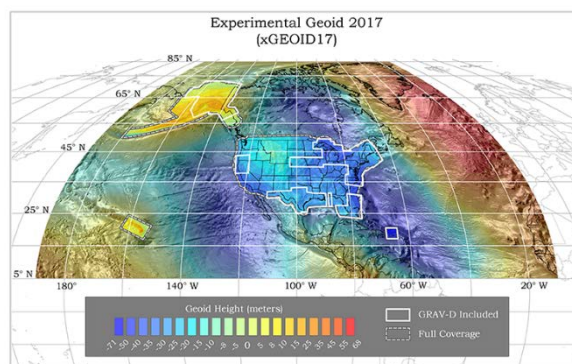


Figure 1 - Map of the experimental geoid model of 2017 (xGEOID17), an annual gravimetric geoid product that incorporates all best-available gravity sources, including new airborne gravity collected through the GRAV-D project.

## IMPROVEMENTS FOR COASTAL ENGINEERING

Coastal engineers routinely rely on the NSRS for consistency in coordinates and heights pertaining to activities such as obstruction design and floodplain mapping. The time-dependent nature of the modernized NSRS, combined with more systematic ties between NAPGD2022 and tidal datums, will significantly improve the quality of geospatial data in coastal environments by increasing confidence in the definition of heights in areas experiencing relative sea level change. Furthermore, primary access to the NSRS with GNSS will create new efficiencies and create an easier spatial framework for GNSS-based technology, such as unmanned infrastructure monitoring systems or precision navigation.

## PREPARING FOR THE TRANSITION

Updates to the NSRS will result in a critical adjustment to orthometric heights of up to 2 meters (over 6 feet) in the vertical and have significant impact on many federal agencies, coordination with Federal partners and the Federal Geographic Data Committee (FGDC) is underway. New tools are also in development that will support users in the transition to NAPGD2022 from NAVD 88.

## REFERENCES

National Geodetic Survey (2017): *Blueprint for 2022, Part 2: Geopotential Coordinates*, National Oceanic and Atmospheric Association Technical Report NOS NGS 64, 41 p.

Youngman, Monica; Dru Smith; Scott Lokken; and Tom Langan (2011): *The Effect of Modernizing the National Datums on Floodplain Mapping*, 41 p.