New Geodetic Datums

New State Plane Coordinates for Iowa

August 2022 Lunch & Learn

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What Are Geodetic Datums?

1. Background of Geodetic Datums.

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What's Next for Geodetic Datums?

2. What's Next for Geodetic Datums?

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Datums and Reference Frames

- A **geodetic datum** or reference frame is an abstract coordinate system with a reference surface (such as sea level) that serves to provide known locations to begin surveys and create maps.
- National Geodetic Survey (NGS) defines the official geodetic datums for all federal mapping activities in the U.S.

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NGS Geodetic Datums

- Horizontal
  - North American Datum of 1927 (NAD27)
    - Best fit the North American Continent
  - North American Datum of 1983 (NAD83)
    - Better fit for the whole world.
- Vertical
  - North American Vertical Datum of 1929 (NAVD29)
  - North American Vertical Datum of 1988 (NAVD88)

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NAD83 "Realizations" (or re-adjustments)

- "Original" NAD83
- NAD83(1996)
  - Ia High Accuracy Network (IaHARN)
- NAD83(Cors96)
- NAD83(NSRS2007)
- NAD83(NA2011)

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New Datums Are Coming!

NOAA is Replacing NAD 83 and NAVD 88. NOAA's National Geodetic Survey (NGS) will be replacing the datums of the National Spatial Reference System (NSRS), including **the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88)**. NGS will provide the tools to easily transform between the new and old datums. Read the NGS Ten-Year Plan and visit the **New Datums Web page** on our site to learn more.

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National Geodetic Survey

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Background: Why is NGS replacing NAD 83 and NAVD 88?

NAD 83 and NAVD 88, although still the official horizontal and vertical datums of the National Spatial Reference System (NSRS), have been identified as having shortcomings that are best addressed through defining new horizontal and vertical datums. Specifically:

- NAD 83 is non-geocentric by about 2.2 meters.
- NAVD 88 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.

These issues derive from the fact that both datums were defined primarily using terrestrial surveying techniques at passive geodetic survey marks. This network of survey marks deteriorates over time (both through unchecked physical movement and simple removal), and resources are not available to maintain them.

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NAD83 will be replaced by:

Four Terrestrial Reference Frames

Replacing the three existing NAD 83 reference frames will be four plate-fixed ***terrestrial reference frames.*** The tectonic plate for each frame may be inferred from their names, which are:

North American Terrestrial Reference Frame of 2022 (NATRF2022)

Pacific Terrestrial Reference Frame of 2022 (PTRF2022)

Mariana Terrestrial Reference Frame of 2022 (MTRF2022)

Caribbean Terrestrial Reference Frame of 2022 (CTRF2022)

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NAVD88 will be replaced by:

Heights and Other Physical Coordinates

A ***geopotential datum*** will be created which will contain all of the necessary information to provide mutually consistent orthometric heights, geoid undulations, gravity anomalies, deflections of the vertical, and all other geodetic coordinates related to the gravity field. This geopotential datum will be called:

North American-Pacific Geopotential Datum of 2022 (NAPGD2022)

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State Plane Coordinate Systems (SPCS)

- Spherical Coordinates (latitude and longitude) are used to locate positions on the earth.
- Using latitude and longitude to define positions on a map can be involved and/or difficult.
- Rectangular grids (State Plane Coordinate Systems) were developed in 1934 for use by surveyors and engineers.

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Iowa State Plane Coordinate System

- The Iowa SPCS is based on the two-parallel Lambert Conformal Conic Projection with two zones, **North** and **South**.
- By using two zones, the north-south width of each zone could be kept within 115 miles and minimize linear distortion.
  - (typical state plane zone width is 158 miles).

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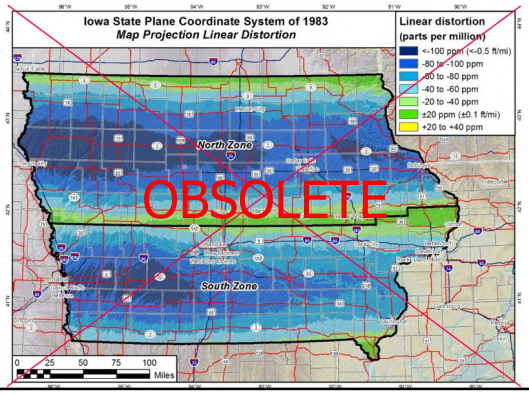
North Zone(1401) – South Zone(1402)



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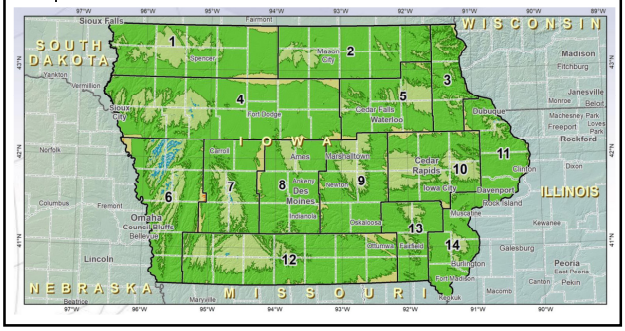
New Iowa State Plane Coordinate System 14 Low Distortion Zones (2022)



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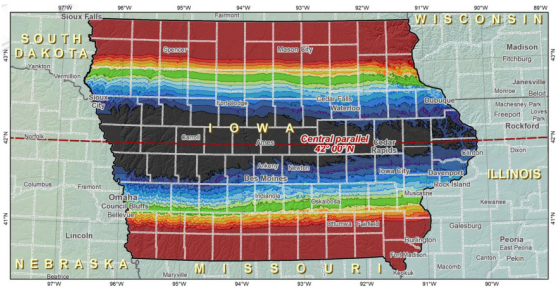
New Single Iowa Zone (2022)



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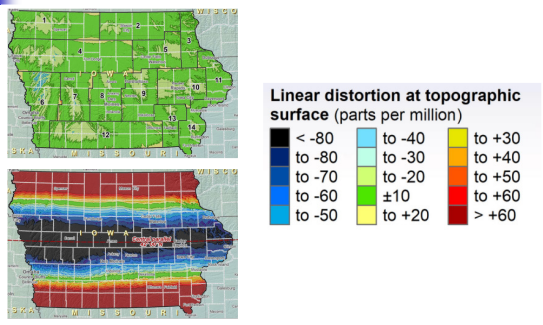
Linear Distortion 14 Zones versus 1 Zone



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How do we prepare for 2022?

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Best ways to determine coordinates in Modernized NSRS

1. **Resurvey**: Return to the field and collect new observations, relying upon geodetic control that has coordinates in the new datum
2. **Readjust**: Using existing observations, re-compute new coordinates based upon geodetic control that has been defined in the new datum
3. **Transform**: Take finished products which have coordinates in the old datum and use transformation software to estimate coordinates in the new datum

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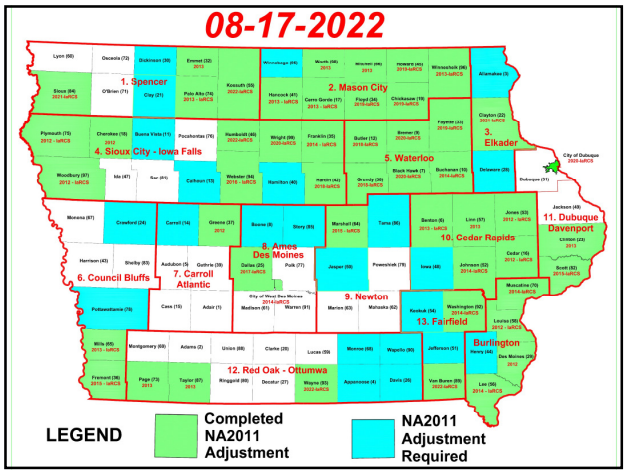

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Delayed Release

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

Issue 29 July 2022

NSRS Modernization News

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

Decisions and Timelines

NGS has recently begun to re-stack the priorities for NSRS modernization. The following decisions were recently approved for public release:

- NGS will release all *data* for the modernized NSRS before all *tools* are built.
- NGS will focus on *updating* tools like OPUS-S and OPUS-Projects to work with the modernized NSRS before *building* new tools.
- NGS will adopt TRANS4D (v0.3.3 or later) as IFDM2022 version 1.0.
- The new estimated timeline for release of the modernized NSRS (data + limited tools) is **mid-2025.**

endpoint. This effort will lead to an input set of vectors, all in ITRF2014, all at epoch 2020.00, which will yield the "alpha" set of geometric RECs. Future work will look at using the adjusted ellipsoid heights as control for a similar "alpha" adjustment of orthometric RECs. All of this work will lead to the formal "2020 REC projects" that will ultimately rely on ITRF2020, GFOID2022, EPP2022, IFDM2022 and LASER to create the final 2020.00 RECs on passive control that will be part of the release of the modernized NSRS.

SPCS2022 (Project Manager: Dr. Michael Dennis)

NGS is reviewing designs of 806 SPCS2022 zones submitted by stakeholders in 28 states, and completing an additional 162 zones designed by NGS. Review of stakeholder designs should be done in September, and we plan to provide com-

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What Next??

- **Say GOODBYE to the U.S. Survey Foot.**

  - September 28, 2020 - Final determination FRN is anticipated to be published on or before this date and will present the public comments analysis and describe recommended actions to facilitate the deprecation of the U.S. survey foot.
  - December 31, 2022 - The last day U.S. survey foot should be used.
  - January 1, 2023 - The U.S. survey foot will be deemed obsolete and superseded by the International foot (also known as the foot) equal to 0.304 8 meter exactly for all applications.

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Two "Right" Feet?

4. US Survey Foot vs. International Foot

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Ending the Era of the U.S. Survey Foot (1959 to 2022)

- One US Survey Foot is equal to 0.3048006096 meters
- One International Foot is exactly 0.3048 meters
- The International Foot is shorter than the US Survey foot by two parts per million (0.01ft in 5280ft).
- 2 parts per million is very significant when working with large coordinate values typical for plane coordinate systems.

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Webster County Passive Control Network

Webster County, Iowa
Horizontal Datum: **NAD 83(NA2011)** - Vertical Datum: **NAVD 1988**
Iowa State Plane North Zone (1401)
Iowa Regional Coordinate System, Zone 4, Sioux City-Iowa Falls LCC
US Survey Feet
2016

Point Name: **6024**
Designation: 902703 4 (Set by Deni Associates in 1996)

NAD 83(NA2011) Latitude: **N42°38'40.50947"** Longitude: **W94°01'48.80332"**
NAVD 88 Ortho Height: **1141.950**sft Ellip. Ht: **1049.328**sft **Geoid12B**

Iowa North Zone (1401) Northing: **3698394.324**sft Easting: **4778597.371**sft
Mapping Angle: **-0°21'34"** Combination Scale Factor: **0.9998953852**

IaRCS Zone 4 Northing: **8641571.741**sft Easting: **14716090.977**sft
Mapping Angle: **0°32'35"** Combination Scale Factor: **0.9999968111**

Monument Type: Berntsen Top Security Rod monument with 3-1/4" aluminum cap set inside aluminum access cover.

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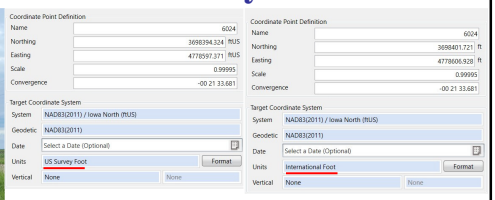
Webster County #6024



The difference between the **iFT** coordinate and the **sFT** coordinate is:
12.085 feet.

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Senate File 2233

signed by Governor Kim Reynolds May 2, 2022

AN ACT
RELATING TO TERMS USED IN THE CONTEXT OF LAND SURVEYING.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:

Section 1. Section 355.5, subsection 4, Code 2022, is amended to read as follows:

4. Distances shall be shown in decimal feet in accordance with the federal definition of ~~the U.S. survey~~ a foot at the time the survey is performed. ~~Distance measurements shall refer to the horizontal plane.~~

Sec. 2. Section 355.16, Code 2022, is amended to read as follows:

355.16 Iowa plane coordinate system defined.

The Iowa plane coordinate system may be used for the purpose of conducting official surveys, as defined by the United States national geodetic survey or a successor agency. As used in this ~~subchapter, unless the context otherwise requires~~ section, ~~"Iowa plane coordinate system" or "coordinate system"~~ means the system ~~of plane coordinates~~ established by the ~~United States national ocean survey, or the~~ United States national geodetic survey, or a successor agency, for defining and stating the geographic positions or locations of points on the surface of the earth within the state of Iowa that is in use at the time the survey is performed.

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Summary

- NGS is replacing NAD83 and NAVD88.
- The geo-centric reference frame for the new datum will be shifted 2.2 meters (**7.21ft**).
- NAVD 88 is biased and tilted about 1 meter coast to coast. (**0.75 meter shift in Iowa**)
- Active vs. Passive Control Monuments

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Summary Continued

- With the 2022 datums Iowa will have:
  - **14 Low Distortion Regional Zones.**
  - **Also a Single "Statewide" Zone.**
- New Horizontal Datum
  - **NATRF 2022**
- New Vertical Datum
  - **NAPGD 2022**
- New Units
  - **International Foot**

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Conclusion

- 2 Big Changes on the Horizon!
  - **New Datums are Coming!**
    - NOAA is replacing NAD83 and NAVD88
  - **New Units of Measure!**
    - International Foot replaces US sft.

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Questions??

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