



State Plane Coordinate System of 2022 Policy

Policy Document National Geodetic Survey National Ocean Service National Oceanic and Atmospheric Administration	
AUTHORIZED BY:	
<hr/>	
Director, National Geodetic Survey Juliana P. Blackwell	Date <hr/>
Tracking Number: NGS 2019-1214-02	
Effective Date: 10/25/2019	

Official Policy Title: State Plane Coordinate System of 2022 Policy

Tracking Number: NGS 2019-1214-02

Date Reviewed by NGS Director or Executive Steering Committee: October 25, 2019

Effective Date: October 25, 2019

Internal or External: External

Associated NGS Documents:

“Procedures for Design and Modification of the State Plane Coordinate System of 2022”

<<https://geodesy.noaa.gov/INFO/Policy/files/SPCS2022-Procedures.pdf>>

“The State Plane Coordinate System: History, Policy, and Future Directions,” *NOAA Special Publication NOS NGS 13*, National Oceanic and Atmospheric Administration, National Geodetic Survey, Silver Spring, Maryland.

<https://geodesy.noaa.gov/library/pdfs/SP_NOS_NGS_13.pdf>

Authority/Reference: As original creator of the State Plane Coordinate System and official steward of the National Spatial Reference System (NSRS), NGS has sole authority to define and establish this policy.

Supersedes:

“Policy on Changes to State Plane Coordinates,” *NGS Policy 08-2012*.

<https://geodesy.noaa.gov/INFO/Policy/files/082012_State_Plane_Coordinate_Policy.pdf>

“Policy of the National Geodetic Survey Concerning Units of Measure for the State Plane Coordinate System of 1983,” *NGS Policy 02-2006*.

<https://geodesy.noaa.gov/INFO/Policy/files/022006_Policy_on_Units_of_Measure_83.pdf>

Review Schedule: At least once every two years.

Responsible Office/Position: The Observation and Analysis Division (OAD) Chief is responsible for upholding and implementing this policy. The OAD Chief has the authority to review and approve procedures associated with this policy.

Purpose/Scope

This policy provides the framework for defining and maintaining the State Plane Coordinate System of 2022 (SPCS2022). It is divided into the following four sections:

- I. General SPCS2022 policy. Specifies overall policy for SPCS2022, including its official name, authority of NGS, scope, coordinate uniqueness, primacy, coordination with other federal agencies, and documentation.
- II. SPCS2022 technical characteristics and requirements. Fundamental technical attributes of SPCS2022 specified as *policy* (i.e., can only be modified with approval of the NGS Director or Executive Steering Committee). Technical details that can be approved by the NGS OAD Chief are in the SPCS2022 procedures associated with this policy.
- III. SPCS2022 zones and consistency with statute. Provides guidance on zone definitions and extents and addresses consistency with state and territory statute.

- IV. Default SPCS2022 definitions. Specifies characteristics of SPCS2022 defined in the absence of consensus input from stakeholders for a state or territory. This is necessary to ensure all zones are defined prior to release of the 2022 Terrestrial Reference Frames (TRFs). This section will be removed upon official release of SPCS2022.

SPCS2022 is established for states, the Federal District, and selected insular areas of the United States. For brevity, the term “state” represents all of these areas throughout this document, as in the associated procedures document.

Background

NGS will establish SPCS2022 as part of the transition from the North American Datum of 1983 (NAD 83) to the 2022 TRFs. SPCS2022 will replace SPCS 83, the version referenced to NAD 83. SPCS 83 consists of 125 zones based on three conformal map projections: Lambert Conformal Conic, Transverse Mercator, and Oblique Mercator. SPCS 83 is defined in all states and U.S. territories where the National Spatial Reference System (NSRS) is defined, except for the District of Columbia, American Samoa, and the Commonwealth of Northern Mariana Islands.

SPCS is a system of conformal map projections originally created in the 1930s to support surveying, engineering, and mapping activities throughout the United States. Since its inception, SPCS has served as a practical means for NGS customers to access the NSRS. The characteristics and usage of SPCS have varied considerably over its long history. Details of the history and evolution of SPCS are given in *NOAA Special Publication NOS NGS 13*, referenced as part of this policy document.

NGS recognizes that usage of SPCS varies greatly, and that there is significant interest within the geospatial community as to how SPCS2022 is defined. Many NGS customers also wish to have a voice in the development of SPCS2022. To that end, this policy and associated procedures were developed to facilitate stakeholder input for their state. Such input includes requests, proposals, and contributions of designs, for both the initial creation of SPCS2022 and later changes. Importantly, this policy and associated procedures also specifies the characteristics and requirements for SPCS2022. The intent is to define SPCS2022 such that it is a technically sound and practical projected coordinate system for the modernized NSRS.

Exceptions

The NGS Director may exercise discretion to approve or deny requests regarding initial design or subsequent changes of SPCS2022 that depart from this policy (and associated procedures), either in whole or in part.

Definitions of Terms

Not all technical terms are defined in this policy. For terms not defined and more detailed definitions, please refer to the associated procedures. Terms in *italics* in the definitions are also defined in this list.

- Conformal map projection. A projection where the *linear distortion* is unique (the same in every direction) at a point. The versions of this projection type used for SPCS are the Lambert Conformal Conic, Transverse Mercator, and Oblique Mercator.
- Linear distortion. For *conformal map projections*, it is the amount by which a distance or length in a projected coordinate system differs from the actual horizontal distance on or near the curved topographic surface of the Earth. Also known as “scale error” when evaluated with respect to distances on the *reference ellipsoid* surface.
- Reference ellipsoid. An oblate ellipsoid of revolution that approximates the size and shape of the entire Earth geoid (“mean sea level”) or a large portion of it. When oriented with respect to a geometric reference frame or datum, it defines the reference surface for projected coordinate systems. Also known as a reference “spheroid.”
- Stakeholders. NGS customers and users of SPCS within a state who have a substantial stake in how SPCS2022 is designed, and who interact with NGS through specific organizations. The types of recognized organizations are listed in the stakeholders definition of the procedures associated with this policy.
- Zone. A region on the surface of the Earth that defines the area where a projected coordinate system is used, with extents usually based on a specified maximum *linear distortion* magnitude.

Policy on the State Plane Coordinate System of 2022

SPCS2022 characteristics in this document include certain technical details that are approved at the *policy* level (by the NGS Director or Executive Steering Committee). To the extent possible, such details have been minimized within the policy and are addressed to greater depth in the associated procedures and NGS technical publications. It is important that the procedures be referenced along with the policy, to ensure that the full context of the policy and details of its implementation are understood.

I. General SPCS2022 policy

- A. Name. The official NGS projected coordinate system for the 2022 Terrestrial Reference Frames (TRFs) is designated as the **State Plane Coordinate System of 2022** (abbreviated **SPCS2022**).
- B. Authority. NGS has sole authority and discretion to approve or deny recommendations, requests, or proposed designs for any SPCS2022 zone or zone configuration.
- C. Scope. SPCS2022 zones are established such that appropriate SPCS2022 coordinates can be computed at every location within its designated zone.
- D. Uniqueness. SPCS2022 coordinates differ by at least 10,000 m horizontally from SPCS 83, SPCS 27, all versions of Universal Transverse Mercator (UTM), and other SPCS2022 zone layers covering the same geographic region.

- E. Primacy. This SPCS2022 policy and associated procedures supersede all previous NGS policies, procedures, and Federal Register notices for prior versions of SPCS.
- F. Coordination with other federal agencies. NGS will work cooperatively with other federal agencies to ensure SPCS2022 is appropriately defined and implemented.
- G. Documentation. NGS will document the characteristics of SPCS2022 and any changes to its definitions, policy, or procedures.

II. SPCS2022 technical characteristics and requirements. See §6 of the associated procedures for detailed specifications.

A. Map projection types

- 1. SPCS2022 is limited to the following three conformal projections: **Lambert Conformal Conic**, **Transverse Mercator**, and **Oblique Mercator**.
- 2. Only a single form of each projection type is used for the entire SPCS. The projection types correspond to specific computation algorithms used by NGS.

B. Ellipsoid and reference frames

- 1. All map projections are based on the **Geodetic Reference System of 1980** (GRS 80) ellipsoid, without modification.
- 2. For computing SPCS2022 coordinates, the input latitude and longitude must be from one of the four 2022 Terrestrial Reference Frames (TRFs), and the specific 2022 TRF must be identified for all zones.

C. Linear distortion design criteria

- 1. The criterion for maximum allowable linear distortion for designing a projection zone is evaluated at the **topographic surface**, *not* at the reference ellipsoid surface.
- 2. A **maximum allowable linear distortion design criterion** is specified for a map projection zone or area of interest within a zone. The design criterion is the magnitude of distortion that meets performance metrics as described in the procedures associated with this policy.

D. Numerical values of defining parameters

- 1. The **meter** is the unit of the defining linear parameters for SPCS2022.
- 2. Zones are defined such that SPCS2022 coordinates (northings and eastings) are positive at all locations within a zone.

E. Specifications for SPCS2022 input and output

- 1. SPCS2022 coordinates are published in meters. If coordinates in feet are provided, they will be labeled simply as “feet” and will be based on the definition 1 foot = 0.3048 meter *exactly* (i.e., numerically identical to the “international foot”). The “U.S. survey foot” will not be supported in SPCS2022 or any other component of the NSRS after December 31, 2022. For more information, see *Federal Register* notice 84 FR 55562 published on October 17, 2019, available at

<https://www.federalregister.gov/documents/2019/10/17/2019-22414/deprecation-of-the-united-states-us-survey-foot>.

2. Latitudes are positive in the northern and negative in the southern hemisphere. Longitudes are positive east from the prime meridian (0° to 360°).
3. In addition to coordinates, SPCS2022 output includes linear and angular distortion, as described in the associated procedures.

III. SPCS2022 zones and consistency with statute

A. Zone definitions and extents

1. Each zone of SPCS2022 is completely within a single state, except for two cases listed under §III.A.2.
 - a. Within the state, SPCS2022 may consist of one or more zones.
 - b. Zones must correspond to specific, well-defined geographic regions. The coverage area for zones must be unambiguously defined and comply with all other requirements herein and the procedures associated with this policy.
2. Exceptions for requirement of SPCS2022 zones entirely within a single state:
 - a. *Multiple states in one zone*. Requires consensus agreement among stakeholders within the affected states to use identical projection parameters.
 - b. *Special use zones*. Zones for well-defined geographic regions that fall within two or more states and therefore do not have contiguous coverage within the state zone scheme. These zones are for major urbanized areas, large American Indian reservations, or federal jurisdictions and applications that fall within more than one state. Requests for special use zones are evaluated on a case-by-case basis and must be individually approved by the NGS Director. Such zones must satisfy all other requirements of this policy and associated procedures. A special use zone does not count against the maximum limit of three zone layers for a state (see §III.B).

B. Zone layers. A state can have one, two, or three projection zone layers, where each layer has a distinct distortion design criterion and coverage scheme for its zones.

1. *Statewide zone layer*. NGS will design a single statewide SPCS2022 zone for every state (or group of states per the exception in §III.A.2.a). If a state has only one layer, it must be a statewide zone. Although designed by NGS, state stakeholders can request desired characteristics.
2. *Multiple-zone layers*. Along with a single statewide zone, a state can optionally have zero, one, or two additional layers. Each layer consists of two or more zones defined by closed polygons contained entirely within the state.
 - a. Only one multiple-zone layer can provide complete coverage of an entire state.
 - b. Only one multiple-zone layer can provide discontinuous (partial) coverage (i.e., gaps between zone polygons or holes within zone polygons that define areas of no

coverage for the layer). Discontinuous zones are permitted to allow desired performance for specific areas within a state, usually due to mountainous terrain. This layer can consist of a single zone that does not cover the entire state, and other zones can be added to the layer over time.

- c. Within a multiple-zone layer, the extents of each zone must be defined by a single, closed polygon that does not overlap any part of other zone polygons in that layer. A zone polygon can include holes, and there can be gaps between polygons for a layer with discontinuous coverage. Although holes are permitted in zone polygons, their use should be minimized, and any holes must themselves each be identified by a single closed polygon, without further holes.
- C. Consistency with statute. The preference of NGS is that SPCS2022 definitions be consistent with relevant state statutes, administrative rules, and/or applicable officially recognized documentation for jurisdictions that reference the 2022 TRFs.
 - 1. NGS will coordinate design and implementation of SPCS2022 with efforts to update legislation for changes to the NSRS associated with the 2022 TRFs.
 - 2. While NGS encourages such formal acceptance of SPCS2022, it does not imply that adoption of zone definitions by statute (or similar mechanism) can be used as a means of imposing SPCS2022 zone designs on NGS. All SPCS2022 zone designs must comply with NGS policies and procedures, and they must be reviewed and approved by NGS. SPCS2022 is part of the NSRS, and therefore acceptance or rejection of proposed SPCS2022 designs is at the sole discretion of NGS.

IV. Default SPCS2022 definitions. In the absence of consensus stakeholder input for designs, NGS will define default SPCS2022 zones as described below.

- A. Justification. A default is necessary to ensure all zones are defined upon release of the 2022 TRFs. All default designs will provide complete coverage of a state.
- B. Design. For most zones, the same projection type and the same zone configuration as SPCS 83 will be used. All default SPCS2022 zones will exhibit performance similar to existing SPCS 83 (but at the topographic surface rather than the ellipsoid surface), including the few zones where the projection type or zone extents have changed. Default designs are essentially a perpetuation of the SPCS 83 definitions, with overall minor modifications. SPCS2022 Procedures §6.i provides examples where the default projection type and zone configuration differ from SPCS 83.

RECORD OF REVIEW AND CHANGES

This policy is a living document that is reviewed at least once every two years. It will be updated, when appropriate, to reflect changes in controlling federal policies, organizational strategic goals/objectives, technology, or other matters that may have an impact on this policy. Modifications made to this document are recorded in the below table. This record will be maintained throughout the life of the document.

Version Number	Date	Section/Page Affected	Summary of Change or Annual Review	Author / Reviewer
1	4/23/2019	All	New policy document to replace all previous SPCS policy	Michael Dennis
2	10/25/2019	All	Mainly §II.E.1 on foot definition, plus various minor changes in wording, file names, and approval requirements	Michael Dennis