NJDEP MAPPING AND DIGITAL DATA STANDARDS (February 7, 2021)

SECTION 1: SCOPE AND APPLICABILITY

(a) The New Jersey Department of Environmental Protection (the Department) maintains a Geographic Information System (GIS) for the storage and analysis of cartographic and related environmental, scientific, and regulatory data. A GIS is a computer system for generating, analyzing, displaying, and managing many forms of geographic and spatially enabled data. The GIS has become a critical tool in allowing the Department to fulfill its core mission of protecting the air, waters, land, and natural and historic resources of New Jersey, and the importance of the GIS in supporting this mission will continue to grow.

(b) The effectiveness of the GIS system rests in large part on the quality of the data that are available to the Department. These data are generated by the Department, other state and federal agencies, universities, environmental organizations, the regulated community, and the public, among others. The submittal of spatially enabled data by all these sectors will facilitate data input into the Department's GIS and the integration of data with the New Jersey Environmental Management System (NJEMS). As such, there can be a wide range in the types and quality of data that are generated and used by the Department and the wider New Jersey environmental community.

(c) In order to maximize utility of these disparate data sets, and facilitate data sharing, integration, and compatibility within the GIS System, the Department requires that all data generated for the Department adhere to the set of basic standards outlined in the present document. While all specific standards will not apply to every data set produced for the Department, there are three standards regarding the creation, capture and delivery of digital mapped information that do apply to all data produced for the Department.

1. All digital data must meet, or reference published accuracy standards regardless of scale. Testing against basemaps or photography of known accuracy determines the accuracy of data. This will ensure appropriate positional accuracy of the geographic data and, therefore, compatibility of digital information.

2. Digital data produced for the Department are required to be in the North American Datum 1983 (NAD83) horizontal geodetic datum and in the New Jersey State Plane Coordinate system (NJSPC). If elevation data are generated, those values will be referenced in NAVD88.

3. GIS data produced for the Department for utilization in its GIS must be documented in a metadata record that adheres to mandatory GIS elements in the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) (**Ref 1**). Metadata is information about the digital data being provided. It is important to know not only the positional coordinates of mapped information, but also how the data were produced, and the accuracy of the data being made available. FGDC metadata must be included with the distribution of any GIS data. Details of CSDGM elements required by the Department are described in Section 6: Metadata Standards

(d) The following standards defined in this document represent the minimum standards that all data generated for the Department must follow. Additional, more stringent standards and/or additional metadata documentation may be required for specific programs, and specific regulatory requirements. However, all data submitted must adhere, at least, to the core standards outlined in this document.

SECTION 2: SPATIAL REFERENCE INFORMATION

(a) Digital data produced for the Department are required to be in the North American Datum 1983 (NAD83) horizontal geodetic datum and referenced in the New Jersey State Plane Coordinate System (NJSPC); and in the North American Vertical Datum of 1988 (NAVD 88). The NJSPC is the official survey base for the State of New Jersey, as set in the New Jersey Statutes Annotated (N.J.S.A), 51:3-7 (**Ref. 2**).

(b) The specifics of the referencing system requirements are as follows:

1. Projection: Transverse Mercator
2. Geographic Coordinate System: New Jersey State Plane
3. FIPS Zone: 2900
4. False Easting: 492125
5. False Northing: 0
6. Central Meridian: -74.5
7. Scale Factor: 0.9999
8. Latitude of Origin: 38.833333
9. Linear Unit: Foot US (0.304801)
10. Angular Unit: Degree (0.017453292519943299)
11. Horizontal Datum: North American Datum of 1983
12. Vertical Datum NAVD 88
13. Spheroid GRS1980
14. Semi Major Axis: 6378137
15. Semi Minor Axis 6356752.3141403561
16. Inverse Flattening 298.25722210100002

Note that 51:3-7 sets meters as the official units for reporting NJSPC values. The Department would prefer that all coordinate values be reported in units of feet. However, both feet and meter values shall be accepted, with the units clearly defined in the metadata document submitted with the digital data. This requirement applies to all ground survey data as well, which must be submitted with equivalent NJSPC values for all points if the points were not captured in NJSPC

SECTION 3: DATA CREATION AND CAPTURE

(a) Data for the Department can be generated from base sources, such as digital imagery or basemaps.

1. For data created from base sources, the Department requires the following sources be used, listed in order of preference:

i. 2020 digital ortho-imagery: produced by the Office of GIS, Office of Information Technology and the Bureau of GIS, Department of Environmental Protection. This imagery was produced at a scale of 1:2400, has a pixel resolution of 1 foot and meets a +/- 4 ft. ground sample distance (GSD) at the 95% confidence limits as tested according to the National Standards for Spatial Data Accuracy (NSSDA) procedures (**Ref 3**). This imagery is available free of charge from the New Jersey Office of GIS (OGIS), NJ Geographic Information Network (NJGIN), (**Ref 4**). It is also viewable on several online mapping applications available through the Department website.

ii. 2015 digital ortho-imagery: produced by the Office of GIS, Office of Information Technology and the Bureau of GIS, Department of Environmental Protection. This imagery was produced at a scale of 1:2400, has a pixel resolution of 1 foot and meets a +/- 4 ft. ground sample distance GSD at the 95% confidence limits as tested according to the NSSDA procedures (**Ref 3**). This imagery is available free of charge from NJGIN (**Ref 4**). It is also viewable on several online mapping applications available through the Department website.

iii. 2012 digital ortho-imagery: produced by the Office of GIS, Office of Information Technology and the Bureau of GIS, Department of Environmental Protection. This imagery was produced at a scale of 1:2400, has a pixel resolution of 1 foot and meets a +/- 4 ft. GSD at the 95% confidence limits as tested according to the NSSDA procedures (**Ref 3**). This imagery is available free of charge from NJGIN, (**Ref 4**). It is also viewable on several online mapping applications available through the Department website.

iv. **Any other more recent digital ortho-imagery**: at larger scales than the above imagery that has been tested and reported according to the NSSDA procedures (**Ref 3**), or as defined in the American Society for Photogrammetry and Remote Sensing (ASPRS) Accuracy Standards for Digital Geospatial Data, (**Ref 5**).

v. Any other more recent digital ortho-imagery: at smaller scales than the above imagery that has been tested and reported according to the NSSDA procedures (**Ref 3**), or ASPRS standards (**Ref 5**).

vi. 2007 digital ortho-imagery: produced by the Office of GIS, Office of Information Technology and the Bureau of GIS, Department of Environmental Protection. This imagery was produced at a scale of 1:24 00, has a pixel resolution of 1 foot and meets a +/- 4 ft GSD at the 95% confidence limits as tested according to the NSSDA procedures (**Ref 3**). . This imagery is available free of charge from NJGIN) (**Ref 4**). It is also viewable on several online mapping applications available through the Department website.

vii. 2002 digital ortho-photography: produced by the Office of GIS, Office of Information Technology, and the Bureau of GIS, Department of Environmental Protection. This imagery was produced at a scale of 1:2400, has a pixel resolution of 1 foot and meets a +/- 4 ft ground sample distance (GSD) at the 95% confidence limits as tested according to the NSSDA procedures (**Ref 3**). This imagery is available free of charge from NJGIN (**Ref 4**). It is also viewable on several online mapping applications available through the Department website

viii. Pre-2002 historical digital ortho-imagery: Since most historical base image sources were created prior to the development of the NSSDA testing methodology, accuracies for historical digital imagery may be reported using the ASPRS standards (**Ref 5**), or National Map Accuracy Standards (NMAS) (**Ref 6**).

ix. Non-digital (hard copy) photo-basemaps: Data generated to represent historical conditions may have to be developed from non-digital sources. Those sources must meet or exceed the accuracy thresholds for the appropriate scale as defined in the NMAS (**REF. 6**).

x. User georeferenced digital imagery: Georeferencing is the process of defining a coordinate system and a projection for an undefined data source, such as a historic map or image. In those cases, in which the data submitted to the Department were generated from a source georeferenced by the data provider, the source material shall be identified and its accuracy characteristics described, along with a full description of the georeferencing process used by the data provider. Control point files detailing the root mean square errors calculated for the control point links shall also be provided

xi. Vector data sets: Data submitted to the Department may be based on existing vector data sets. In these cases, a full description of the accuracy of the base vector data sets, including the accuracy of the source layer used to create the data shall be fully documented

In those cases where the data are generated on base sources not referenced in NJSPC, all data will be projected to NJSPC before submittal to the Department

2. When data are created from digital base layers using on-screen digital editing techniques, the predominant viewing scales for data creation must be indicated in the metadata. Examples of acceptable scale ranges for data creation from several digital base sources available through State or Federal sources are given in Table 1. For digital bases not included in this table, acceptable scale ranges will be similar to those given for digital bases of similar source type and pixel size.

Table 1. Acceptable Scale Ranges for On-Screen Data Generation from Common New Jersey Digital Base Layers

Source	Type	Pixel Size of Digital Base Layer	Acceptable Scale Range for Data Generation
Historical Atlas Sheets	Georeferenced basemaps	Approx. 17 FT.	1:5000 to 1:15000
1930 Pan Imagery	Georeferenced photography	Approx. 6.5 FT.	1:2400 to 1:10000
1970 Wetlands Basemaps	Georeferenced photo-basemaps	Approx. 1 FT.	1:1000 to 1:5000
1977 Tidelands Basemaps	Georeferenced photo-basemaps	Approx. 1 FT.	1:1000 to 1:5000
1991 Pan Imagery	Ortho rectified imagery	5 FT.	1:2400 to 1:10000
1995 CIR Imagery	Ortho rectified imagery	1 Meter	1:1000 to 1:5000
2002 CIR Imagery	Ortho rectified imagery	1 FT.	1:250 to 1:2400
2007 CIR and Color Imagery	Ortho rectified imagery	1 FT.	1:250 to 1:2400
2010 Color Imagery (NAIP)	Ortho rectified imagery	1 Meter	1:1000 to 1:5000
2012 CIR and Color Imagery	Ortho rectified imagery	1 FT.	1:250 to 1:2400
2013 Color Imagery (NAIP)	Ortho rectified imagery	1 Meter	1:1000 to 1:5000
2015 CIR and Color Imagery	Ortho rectified imagery	1 FT.	1:250 to 1:2400
2017 Color Imagery (NAIP)	Ortho rectified imagery	1 Meter	1:1000 to 1:5000
2017 Color Imagery (NAIP)	Ortho rectified imagery	1 Meter	1:1000 to 1:5000
2020 CIR and Color Imagery	Ortho rectified imagery	1 FT.	1:250 to 1:2400

(b) Data can be generated from field investigations using surveying instruments, or GPS devices,

1. Surveyed Map Data: The Department requires that all submitted surveys (digital or on paper), and the surveyors who perform them, follow the standards for performance and documentation established in the New Jersey Administrative Code (N.J.A.C.), Title 13, Chapter 40, State Board of Professional Engineers and Land Surveyors (**Ref 7**). These standards apply to any boundary information required or depicted in the process of completing any type of survey work requested. Additionally, all property surveys submitted to the Department shall meet the latest Minimum Standard Detail Requirements for relative positional precision as described by the American Land Title Association/American Congress on Surveying and Mapping (ALTA/ACSM), Section 3, paragraph E (**Ref. 8**). Lastly, there are services that may only be provided by a New Jersey professional land surveyor for inclusion on a cadastral survey, as outlined by the New Jersey Society of Professional Land Surveyors.

i. Specific requirements for all surveyed data include:

(1). For all cadastral surveys submitted to NJDEP, the basis of bearings or north reference and the beginning point coordinate values (stated in US Survey Feet to two decimal places) shall be New Jersey State Plane Coordinate System, North American Datum 1983 Adjustment (NJSPCS NAD83). The Grid Factor shall be applied to the Northing and Easting values in US Survey Feet of the parcel's description point of beginning, but not to horizontal survey distances in US Survey Feet. The Grid Factor applied to the Northing and Easting values shall be noted on the survey. The north arrow shown on the plan must indicate the Bearing Base or reference north.

(2). All property lines of the surveyed parcel must form closed polygons: All sides must be defined by mathematical survey expressions with angular units being degrees, minutes, and whole seconds of arc. Horizontal distances, vertical elevations, radii of curves, lengths of arc, and New Jersey State Plane Coordinate values of Northing and Easting shall be stated in horizontal ground US Survey feet stated to two decimal places

(3) A separate plan of survey of property shall be prepared for each tax lot or group of contiguous tax lots in common ownership. Lots that are in common ownership in the general vicinity but are not contiguous may be grouped onto a single plan only if detail and clarity of information is not compromised when the scale of the plan is reduced.

(4) When a property description is required, a metes and bounds deed description of the property surveyed shall be prepared for each lot and all descriptions shall have a common basis of bearing and point of beginning. Groups of contiguous tax lots in common ownership may be combined into a single description at the discretion of the owner and requesting agency. The description shall be a separate document apart from the plan of survey and shall be prepared on company letterhead that includes the survey contract vendor's name and certificate of authorization number (if applicable), street and mailing addresses, telephone and fax numbers, company email address, and company web page (if any), and shall be signed, sealed and dated by the surveyor responsible for the preparation of the survey.

ii. Specific Minimum Standard Detail Requirements for Relative Positional Precision in Property Surveys:

(1) "Relative Positional Precision" means the length of the semi-major axis, expressed in feet or meters, of the error ellipse representing the uncertainty due to random errors in measurements in the location of the monument, or witness, marking any corner of the surveyed property relative to the monument, or witness, marking any other corner of the surveyed property at the 95 percent confidence level (two standard deviations). Relative Positional Precision is estimated by the results of a correctly weighted least squares adjustment of the survey.

(2) Any boundary lines and corners established or retraced may have uncertainties in location resulting from:

a. The availability, condition, history and integrity of reference or controlling monuments.
b. Ambiguities in the record descriptions or plats of the surveyed property or its adjoiners.
c. Occupation or possession lines as they may differ from the written title lines.
d. Relative Positional Precision.

Of these four sources of uncertainty, only Relative Positional Precision is controllable, although due to the inherent errors in any measurement, it cannot be eliminated. The magnitude of the first three uncertainties can be projected based on evidence; Relative Positional Precision is estimated using statistical means (see (1) above and (5) below).

(3) The first three of these sources of uncertainty must be weighed as part of the evidence in the determination of where, in the surveyor's opinion, the boundary lines and corners of the surveyed property should be located per the Minimum Standard Detail Requirements, Section 3.D. (**Ref 8**). Relative Positional Precision is a measure of how precisely the surveyor is able to monument and report those positions; it is not a substitute for the application of proper boundary law principles. A boundary corner or line may have a small Relative Positional Precision because the survey measurements were precise, yet still be in the wrong position (i.e. inaccurate) if it was established or retraced using faulty or improper application of boundary law principles.

(4) For any measurement technology or procedure used on an ALTA/ACSM Land Title Survey, the surveyor shall:

a. Use appropriately trained personnel.
b. Compensate for systematic errors, including those associated with instrument calibration.
c. Use appropriate error propagation and measurement design theory (selecting the proper instruments, geometric layouts, and field and computational procedures) to control random errors such that the maximum allowable Relative Positional Precision outlined in 5 below is not exceeded.

(5) The maximum allowable Relative Positional Precision for an ALTA/ACSM Land Title Survey is 2 cm (0.07 feet) plus 50 parts per million (based on the direct distance between the two corners being tested). It is recognized that in certain circumstances, the size or configuration of the surveyed property, or the relief, vegetation or improvements on the surveyed property will result in survey measurements for which the maximum allowable Relative Positional Precision may be exceeded. If the maximum allowable Relative Positional Precision is exceeded, the surveyor shall note the reason as explained in Section 6.B.ix of the ALTA/ACSM Minimum Standard Detail Requirements (**Ref 8**).

iii. Services that may only be performed by a New Jersey Professional Land Surveyor, as defined in the New Jersey Statutes Annotated (N.J.S.A) Title 45:8-2B, Professions and Occupations, (**Ref 9**) for inclusion on a cadastral survey:

(1) Any map or plan that shows the following: (per N.J.A.C, Title 13, Chapter 40 (**Ref 7**), or the N.J.S.A , Title 45:8 (**Ref 9**.).

a. Property lines (N.J.S.A. 45:8(e), N.J.A.C. 13:40-1.3 and N.J.A.C. 13:40-5.1)
b. Locations of existing buildings and/or physical features and/or improvements (N.J.S.A. 45:8-28(e)
c. Locations of existing utilities (N.J.S.A. 45:8-28(e), N.J.A.C. 13:40-1.3 and N.J.A.C. 13:40-5.1(g)4)
d. Locations of easements (N.J.A.C. 13:40-5.1(a) and N.J.A.C. 13:40-5.2 (f)9)
e. Existing elevations, contours, or topography (N.J.S.A. 45:8-2(e) and N.J.A.C. 13:40-5.1 (a)(n))
f. Hydrographic or bathymetric information
g. Post-construction conditions-horizontal and vertical (N.J.A.C. 13:40-7.2(a))
h. Wetlands delineation by metes and bounds or coordinate location (N.J.A.C 13:40-7.2(2))

(2) FEMA Elevation Certificates (N.J.S.A. 45:8-28(e) and N.J.A.C. 13:40-1.3)
(3) Major and minor subdivision plans (N.J.S.A. 46:26B-1, N.J.A.C. 13:40-1.3, N.J.A.C. 13:40-5.1(m) and N.J.A.C. 13:40-7.4)

(4) Determination of areas and volumes included as part of a land survey (N.J.S.A. 45:8(e) and N.J.A.C. 13:40-1.3)
(5) Preparation and annual maintenance of tax maps (N.J.S.A. 19:23A-1.7 and N.J.A.C. 13:40-5.1(k))
(6) Preparation and maintenance of base mapping for Land Information Systems (N.J.S.A. 45:8-28(e) and N.J.A.C. 13:40-1.3)
(7) Foundation location surveys (N.J.A.C. 5:23-2.18(b)1.ii (1) and N.J.A.C. 13:40-72(a))
(8) Survey information may be transferred to another plan that is submitted to the Department if the following information is provided:

a. The surveyor who prepared the survey
b. The date of the survey
c. Who the survey was prepared for
d. A signed and sealed copy of the Survey attached to the submitted plan. (N.J.A.C. 13:40-7.2(a)1 and N.J.A.C. 13:40-5.1(n))

2. Data generated using GPS devices:

i. Hand-held GPS:

(1). The Department has adopted standards for the critical settings for rover (field data) GPS receivers that are consistent regardless of which receiver model is being used. . Any mapping-grade GPS receiver will allow the setting of data collection parameters.

(2). These settings should enable the results of the data collected to achieve the better than 5-meter accuracy standard. These settings are detailed in Table 2. A full discussion of the required GPS receiver settings and collection procedures are included in the NJDEP GPS Data Collection Standards for GIS Data Development (**Ref 10**).

(3). In the case of data collected using either GPS or standard survey techniques, complete data collection documentation will be submitted and will include coordinate offsets when applicable.

(4). Note that recreational GPS receivers usually do not provide the capability to adjust critical settings for data collection, nor do they typically offer post-processed differential correction solutions (needed when real time differential correction services are not available) and are therefore not appropriate for accurate field data collection.

Table 2. Critical GPS Collection Parameter Settings

Position Mode	All position fixes must be determined with 4 or more satellites. 2D fixes (using only 3 satellites) are not acceptable. 3D positions generated from 2D fixes supplemented with user entered elevations are also not acceptable.
Elevation Mask	15 degrees above horizon.
PDOP Mask	If this parameter setting exists, set it to the manufacturer's recommendation that would, at a minimum, allow the GPS data collected to achieve NJDEP's 5-meter standard.
Signal to Noise Ratio Mask (SNR)	If this parameter setting exists, set it to the manufacturer's recommendation that would, at a minimum, allow the GPS data collected to achieve NJDEP's 5-meter standard
Minimum Positions for Point Features	If this parameter setting exists, set it to the manufacturer's recommendation that would, at a minimum, allow the GPS data collected to achieve NJDEP's 5-meter standard. Solutions based on a single fix are not acceptable.
Logging Intervals	Intervals for point features will be 1 or 5 seconds. Intervals for line and area features depend on the velocity at which the receiver will be traveling and the nature of the feature and the operating environment. Under normal circumstances (i.e., when the user is walking with the receiver) the interval for line and area features will be set to 5 seconds.
Logging of DOP	If the receiver allows, this parameter setting will be set to allow the logging of DOP data along with position fixes.

ii. Mobile Assisted GPS:

(1). Mobile-assisted GPS has emerged in recent years as an alternative to traditional handheld GPS units. "Mobile-assisted GPS" refers to a tablet or smart phone paired with a GNSS receiver to record high accuracy locational data. The mobile device is paired via Bluetooth to the GNSS receiver to override the onboard cellular GPS of the device. Mobile-assisted GPS must abide by all NJDEP GPS standards for handheld GPS units, except the need for post-processing software because of its unavailability.

(2). The NJDEP supports GIS applications that can support this data collection method. Applications such as Esri's Collector or Survey123 can submit data to ArcGIS Online. Specific data schema must be setup and added to these applications, with the correct permissions, in order to record the necessary satellite and accuracy information from the GNSS receiver. Once collected, this data can be synced with the published feature class. Multiple collection groups can collect data at a time to update the hosted data in a web map in real-time. This is in contrast of the data collection of a typical handheld GPS unit where additional data editing will need to be done to combine multiple collections of data.

(3). Mobile-assisted GPS has been proven through testing to consistently fall within the NJDEP's accuracy standard of 5 meters. Although this can act as a reliable alternative to handheld GPS, there are reasons to use a handheld GPS when available:

a. Mobile-assisted GPS collected data do not currently have access to post-processing software. Because of this, the accuracy of the data will depend on the accuracy of the unit out in the field with no available adjustments. Collecting near buildings or under tree canopy can introduce error to the data that will not be corrected if not done manually.

b. Handheld GPS units can have consistently higher accuracy in both raw (uncorrected) and post-processed (corrected) forms.

c. All information that is recorded by the paired GNSS receiver will be added to the data layer if that data layer matches a certain data schema.

d. The onboard cellular GPS of the mobile device does not consistently fall within 5 meters of the truth. A high accuracy GNSS receiver must be paired with the mobile device to be a viable option.

(c). UAS Data Creation: Data may also be collected or generated using unmanned aircraft systems (UAS), commonly referred to as drones. UAS can be extremely useful for conducting site inspections, monitoring environmental site conditions, responding to environmental emergencies, and unobtrusively collecting data on endangered species populations and habitats, among others. It is anticipated that the use of UAS to collect both imagery and other remotely sensed data that serve as the basis for generating many other types of digital data, will increase greatly in the coming years. So, there is a need for NJDEP standards to address proper mission protocols and flight operations, collection of imagery or other remotely sensed products, accuracy requirements, mission planning, and documentation for UAS data creation.

1. Project intent: UASs can be used to capture imagery/data for a variety of uses including: general image display, creating a video covering an area or feature of interest, generating ortho imagery for use as a mapping base or input into GIS mapping applications, and developing 3D data of a coverage area, among others. Each of these uses may not be applicable to all camera and drone systems. In addition, each of the uses will require different flight planning considerations, different collection techniques, different accuracy requirements, and different documentation among other things. It is therefore critical to define the intended use of the data to be collected before the mission is undertaken so that all critical issues needed to ensure the usability of the data for the intended purpose will be met. The project intent and all critical flight and data specifics will be recorded in the project documentation and metadata.

2. Specific UAS data types supporting the above listed uses include:

i. General unreferenced resource photography and videos to be used primarily for informational purposes, and not intended for generating GIS compatible data.
ii. Geo-referenced but non-ortho-rectified photography (individual or mosaiced) suitable for preforming some mapping functions. May be used for some GIS data development operations. Geo-referencing will normally be done as a separate GIS processing step.
iii. Ortho-rectified single images and image mosaics that have a defined accuracy specification and can be used for generating enterprise level digital data. Generally captured as 3 band R-G-B imagery. May be used as a photo-base map product for generating GIS compatible data, as well as an input source for data generated through automated image processing. Rectification process will be done using UAS mapping software.
iv. Multi-spectral and hyperspectral imagery consisting of more than the standard 3 R-G-B bands. This imagery can be both used as a base for generating digital vector datasets as well as inputs into a variety of imagery processing applications to generate spatial environmental data through automated image classification. Hyperspectral sensors and bands captured will vary based on the environmental factor being sensed.
v. Elevation data (This is different than elevation points generated through image matching as part of standard UAS processing.)
vi. 3D models generated using the above referenced elevation data. These can be both spatially enabled models that can be used in a GIS with other spatially enabled data, and non-spatially enabled models to be used in stand-alone analysis and display.
vii. Thermal data.

3. All UAS data submitted from non-NJDEP organizations for use by the Department must be collected by a current Certified Remote Pilot and conform to the requirements of Section 4.4 Non-Department Drone Data Collection of the NJDEP -UAS Flight Operations Manual (FOM) **(Ref 11)**.

4. All UAS flight operations undertaken by NJDEP staff will be conducted in accordance with the NJDEP UAV Standard Operating Procedure (SOP) (**Ref 12**), and the FOM (**Ref 11**). These outline the necessary requirements for UAV flight operations conducted by NJDEP staff. The guidelines include education and training, flight maneuvers, best practices, flight records, flight planning, reporting, and maintenance among other things.

5. UAS data collected to provide ortho-rectified data products for use in the NJDEP GIS, shall be batch processed using a UAS mapping software or service. The batch processing should incorporate ground control points (GCPs) collected as part of the flight operations. The total number and distribution of GCPs will vary based on the project specifics and topography in the area of coverage. However, at a minimum, 5 GPCs are required for all projects collecting data for use in the NJDEP GIS.

6. Where possible, additional QA/QC GCPs should be collected to independently assess the accuracy of the ortho-rectification process. These points are not used in the batch processing of the UAS imagery but will be used to verify the optional accuracy of the processed imagery. The tested RMSE of the UAS products referenced using the QA/QC GCPs will be +/- four feet or less.

7. Where it is not possible to collect additional QA/QC points, the locational accuracy of the imagery will be verified by testing the UAS imagery against approved ortho-rectified image layers maintained by the NJDEP and listed in Table 1, or other image sources that have been tested to have a higher horizontal accuracy than the ortho-imagery base layers (which is +/- 4 feet). At least 4 link points will be used, and the link point file and RMSE will be reported as part of the data documentation. The tested RMSE of UAV ortho products will be +/- four feet or less.

8. UAS data collected to provide geo-referenced data products for use in the NJDEP GIS and not post processed using UAS software will be referenced using approved ortho-rectified image layers maintained by the NJDEP and listed in Table 1, or other image sources that have been tested to have a higher horizontal accuracy than the ortho-imagery base layers (which is +/- 4 feet). Geo-referencing will be accomplished using a minimum of 4 photo-identifiable link points located across the image extent. Where possible, more link points should be used. The link file and the calculated RMSE of the referencing will be provided as part of the data documentation. The tested RMSE of the UAV geo-referenced products will be +/- four feet or less.

9. All UAS data generated for use in the NJDEP GIS will be accompanied by the processing report generated by the UAS mapping software. Processing reports may vary in different software products. However, at a minimum, the submitted processing information will include all items included in Table 3. Those items in Table 3 not included in the software processing report, will be determined by the data provider through other methods and be provided as part of the processing documentation. In addition, the make and model of the UAS and the specifications of the camera/sensor shall be submitted.

Table3. UAS Processing Information

Date Collected

Date Processed
Camera Model Name
Average Ground Sample Distance (GSD)
Amount of Area Original Data Product Covered
Amount of Area Current Data Product Covered
Amount of Ground Control Points (GCPs)
RMSE of GCPs
Original Input Horizontal Datum (Drone)
Original Input Vertical Datum (Drone)
Output Horizontal Datum (Data Product)
Output Vertical Datum (Data Product)
Error Introduced by Reprojection
Relative Geolocation Error

(d). Data may also be submitted to the Department that were generated using specialized techniques such as laser scanners for collecting LiDAR elevation data, or image scanners for digital ortho-imagery. Since the creation of data from these sources involves specialized and highly technical processes, the Department relies on industry standards that have been developed by federal agencies such as the United States Geological Survey (USGS) and the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) in conjunction with professional associations such as the American Society for Photogrammetry and Remote Sensing (ASPRS). These standards are defined in the USGS LiDAR Base Specifications 2020 Rev A. (**Ref 13**).

SECTION 4: ACCURACY REQUIREMENTS

(a) As will be discussed in Section 6: Data Formats, data generated for submittal to the Department can be in one of several formats depending on the specifics of the project being supported.

(b) Regardless of the data format, all data submitted to the Department must be accompanied by a full description of the processing steps used to create the data, and of the accuracy of the data set. This accuracy statement should include information on both the positional accuracy of the data, as well as on the accuracy of any attribute information submitted.

1. Positional Accuracy

i. Positional accuracy is a measurement of how closely the mapped features are to their true positions on earth, and awareness of the positional accuracy of any digital data set is critical to evaluating the results of any GIS analyses using the data. There are several components that contribute to the overall positional accuracy of digital data.

ii. The first component determining the accuracy of the data is the inherent accuracy of any base data sets on which the digital data layer is created. Base data sets, often georeferenced digital imagery or hard copy photo-basemaps, need to meet some clearly defined accuracy specifications since the accuracy of the base layer sets the upper limits on the accuracy of the derived data. A derived data set cannot be of higher acracy than the base that it is created from. There are three common accuracy standards or accuracy testing methods that are used to verify and describe the accuracy of basemap layers.

(1). National Map Accuracy Standards (NMAS) (**Ref 6**): The NMAS uses measurements from hard copy maps at the publication scales to set accuracy thresholds. It was developed in 1941 before digital mapping applications were developed, so has limited usefulness for accuracy analysis of commonly used digital data products. But it is still used for analysis of older base map data. Common NMAS accuracy targets are included in Table 4.

Table 4. **Threshold accuracy values in ground units**

Scale	NMAS Accuracy (feet)	NSSDA Accuracy (feet)	NMAS Accuracy (meters)	NSSDA Accuracy (meters)
Large scale	1/30 inch (map)			
1:1,200	3.3	3.8	1.0	1.2
1:2,400	6.7	7.7	2.0	2.3
1:6,000	16.7	19	5.1	5.8
1:12,000	33.3	38	10.1	12
Small scale	1/50 inch (map)			
1:24,000	40	46	12.2	14
1:63,360	106	120	32.3	37

(2). The American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data (**Ref 5**): The ASPRS standards differ from the NMAS in that they assess accuracy at ground scales of the base data instead of at the scale of the published hard copy maps. Accuracy levels are defined using the calculation of root mean square errors (RMSE) between the measured position of features on the base data set and the positions of those features measured from sources of known higher accuracy. An allowable RMSE is calculated for a source data set, to determine the highest accuracy class for the data, called Class I, with lower Class II and Class III accuracies defined as having RMSEs of 2 or 3 times the Class I value respectively. Examples of ASPRS accuracy levels are included in Table 5.

(3). The National Standard for Spatial Data Accuracy (NSSDA) (**Ref 3**): The NSSDA is not a true standard but defines a testing methodology and statistical basis for assessing map accuracies. It is based on calculating the 95% confidence limits of the base data using an equation assessing the combined RMSEs of the X and Y coordinates of map test points and the coordinates of those points measured from a source of higher known accuracy, for horizontal accuracies, or of the Z values for elevation data. For most current digital imagery base maps used by NJDEP (refenced in Table 1), the higher accuracy sources are surveyed ground points collected for each project. However, existing tested data sets of known accuracy can be used to test other base products. While separate from the ASPRS standards, the calculation of the 95% limits is connected to accuracy thresholds arising out of the APSRS accuracy targets for base data of different resolutions.

Table 5. ASPRS Accuracy Classes

Map Scale	Approximate Source Imagery GSD	Horizontal Data Accuracy Class	RMSEx or RMSEy (cm)	RMSEr (cm)	Horizontal Accuracy at the 95% Confidence Level (cm)
1:100	1-2 cm	I	1.3	1.8	3.1
		II	2.5	3.5	6.1
		III	3.8	5.3	9.2
1:200	2-3 cm	I	2.5	3.5	6.1
		II	5.0	7.1	12.2
		III	7.5	10.6	18.4
1:250	3-4 cm	I	3.1	4.4	7.6
		II	6.3	8.8	15.3
		III	9.4	17.7	22.9
1:500	4-10 cm	I.	6.3	8.8	15.3
		II	12.5	17.7	30.6
		III	18.8	26.5	45.9
1:1000	10-20 cm	I	12.5	17.7	30.6
		II	25.0	35.4	61.2
		III	37.5	53.0	91.9
1:2000	20-30 cm	I	25.0	35.4	61.2
		II	50.0	70.7	122.4
		III	75.0	100.1	183.6
1:2500	30-40 cm	I	31.3	44.2	76.5
		II	62.5	88.4	153.0
		III	93.8	132.6	229.5
1:5000	40-100 cm	I	62.5	88.4	153.0
		II	125.0	176.8	306.0
		III	187.5	265.2	458.9
1:10000	1-2 m	I	125.0	176.8	306.0
		II	250.0	353.6	611.9
		III	375.0	530.3	917.9
1:25000	3-4 m	I	312.5	441.9	764.9
		II	625.0	853.9	1529.8
		III	937.5	1325.8	2294.7

iii. The second component of the accuracy of a digital data set is the accuracy with which the data creators generate their data from the source layer. Data generated from a highly accurate base may not always reflect that accuracy, depending on the intended uses of the data created. Locations of points mapped on a basemap that has a +/- 4 ft accuracy may only have been mapped to +/- 100 ft of their true surveyed positions because of the scale at which the data points were located and the intended use of the data layer. These kinds of accuracy details must be fully documented with the submitted data.

iv. The third component of the final positional accuracy of a digital data set is the accuracy of any equipment used to capture the data. Global Positioning Systems, for example, vary in the maximum positional accuracies at which they can collect data. Some units may be able to collect positional data that is within a foot of the true position on the earth, while other units can do no better than 10 feet. Further, the actual accuracies of the collections will be affected by the different settings used at the time of data collection, such as the number of satellites used to fix the locations, the length of time the receiver is left at a particular location, and whether or not the data are differentially corrected. All of these factors must be fully documented so that the accuracy of data generated using GPS, and other equipment, can be evaluated.

v. Because of the many different data types and many different uses of data submitted to the Department, the Department does not set absolute accuracy standards for all data. The Department does require that base sources used to create data submitted to the Department must at least meet the minimum threshold accuracy levels given in Table 4 above. Preferably, data should be created on a base source that has been tested using the NSSDA testing methodology, and which meets accuracy targets set forth in the ASPRS standards provided in Table 5. In all cases, the accuracy specifications of the data set are to be fully described, as are the procedures used to verify these accuracies. In the case of data that are generated through on-screen digital editing, the accuracy description must include the predominant view scale or scales at which the data were created.

2. Attribute Accuracy:

i. The Department requires that all mandatory attribute data be 100% correctly coded.
ii. A description of the procedures used to assure 100% coding shall be included in the data set documentation. For example, "frequency procedures have been run to assure that there are no invalid codes or duplicate values.

SECTION 5: DATA FORMATS

(a) The Department GIS is built on the Environmental Systems Research Institute (Esri) suite of products. All digital data submitted to the Department must be in formats compatible with the ArcGIS version being used by the Department at the time of data submission. Acceptable formats are listed below in order of preference, with any specific requirements applicable to each:

1. Geodatabase:

i. Digital data developed and submitted to the Department in a geodatabase shall be in an ArcGIS file geodatabase or personal geodatabase. The geodatabase is currently the common data storage and management framework for ArcGIS. It combines spatial data with a data repository to create an intelligent structure for spatial data storage and management. In addition, the geodatabase format allows the user to define and apply a wide set of integrity rules and constraints to ensure that data are created and delivered with correct topology. Topology allows data users to answer questions about adjacency, connectivity, proximity and coincidence. Topology is crucial and all data submitted to the Department must be topologically correct. Both file and personal geodatabases are acceptable, with the file geodatabase preferable where complex data sets are being submitted.

ii. Geodatabases will adhere to at least the following standards:

(1) All feature classes included in the geodatabase will exist in one or more feature data sets.

(2) The XY coordinate system for all feature datasets and feature classes will be NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet

(3) The Z coordinate system will be NAVD_1988

(4) The XY tolerance will be at least 0.003280833333333 ft. A closer tolerance may be used where the accuracy of the data, such as that collected with survey grade GPS, supports it

(5) The XY resolution will be at least 0.003280833333333 ft.

(6) The domain limits will be set at (Foot US): Max X: 2955094000892.94 Max Y: 2955065037392.94

(7) Topologies will be created for all feature datasets and feature classes and all data will be submitted with no topologic errors

(8) For topologies that involve more than one layer, the most accurate layer will be given the highest rank

(9) The minimum topologic rules are:

a. Features will not be duplicated
b. Linear features will not overlap; i.e., all line intersections will require a node
c. Linear features will maintain correct arc directionality for any data set with flow directions.
d. Linear features will not have pseudo-nodes unless they are required to maintain a change in arc attribution
e. Polygons must close
f. Polygons will have no overshoots or dangles
h. Polygons will not overlap
i. Polygons sharing edges will not have gaps
j. Polygons will have one and only one label point
k. Coincident features shared by different feature classes within the geodatabase will match without any topologic errors.

(10) Any additional topologic rules enforced during the creation of the data will be fully described in the metadata.

(11) The topologies should be submitted as part of the geodatabase delivered to the Department so that adherence to the topologic rules can be verified.

(12) In some cases, specific Department programs may develop project-oriented geodatabase templates for data submittal consistency. Data providers shall discuss with the program whether geodatabase templates have been created and posted for download before developing a geodatabase for a program specific data submittal.

2. Coverages

i. Coverages are vector datasets depicting points, lines, polygons, regions, or routes, and are an original data format developed by ESRI. As with geodatabases, coverages allow topologic rules to be defined and enforced so that data sets can be created without topologic errors. In addition, data tolerances can be set during data creation that ensure that data created meet minimum standards. All coverages delivered in the native format will have an info directory submitted, and be created using the following standards:

(1) Double Precision

(2) Fuzzy Tolerance 0.0001
(3) Dangle Tolerance 0.0
(4) Tic Match 0.0
(5) Edit 0.5
(6) NodeSnap 0.0001
(7) Weed 0.5
(8) Grain 0.5
(9) Snap 0.5
(10) Projection State Plane
(11) Zone 4701
(12) Units Feet
(13) Datum NAD83
(14) Correct arc directionality must be maintained on streets and any dataset with flow directions
(15) Polygons must close without overshoots or undershoots
(16) Pseudo nodes must only exist where:
    (a) a line closes on itself
    (b) only two lines intersect
    (c) there is a change in attribution along a line
    (d) a node is needed to maintain the shape and measurements of an arc

(17) Lines, polygons, points and annotation must not be duplicated
(18) Streets and facility data do not break at overpasses and underpasses
(19) The maximum of 500 vertices per arc limit with ArcInfo software must be observed
(20) Polygons must edge match without slivers
(21) Polygons must not overlap
(22) Polygons will have one and only one label point, except for the background polygon, which will have none
(23) There will be no node errors and no dangles

ii. The Department will accept coverage export files (*.E00).

3. Shapefiles

i. The shapefile is a simple vector data format that stores non-topological geometry and attribute information for each of the features in a data set. The features can be points, lines or polygons. The format was developed as part of the Esri product suite, but shapefiles can be used and created by many other GIS software applications.

ii. Shapefiles are a set of separate files that define the vector features and attributes. Unlike geodatabases and coverages, shapefiles do not adhere to any formal topological rules, and as such data creators need to be aware that extra care must be taken when creating shapefiles for submittal to the Department.

iii. Shapefiles submitted to the Department must include at a minimum the following files:

(1) **.shp** (the file that stores the geometry)
(2) **.shx** (the file that stores the feature geometry index)
(3) **.dbf** (the file that stores the feature attribute information)
(4) **.prj** (the file that stores the coordinate information)

iv. When applicable, the following files should also be submitted:

(1) **.sbx**, **.sbn** (the files that store the spatial index of the features)
(2) **.ain**, **.aih** (the files that store the attribute index of active fields in the attribute table)

v. Shapefiles must be created so that the following basic topologic rules are not violated:

(1) Features will not be duplicated

(2) Linear features will not overlap, i.e., all line intersections will require a node
(2) Linear features will maintain correct arc directionality for any data set with flow directions
(3) Linear features will not have pseudo-nodes unless they are required to maintain a change in arc attribution
(4) Polygons must close
(5) Polygons will have no overshoots or dangles
(6) Polygons will not overlap or self-intersect
(7) Polygons sharing edges will not have gaps
(8) Each polygon will have one and only record in the attribute table

4. Geodatabase XML

i. The ESRI Geodatabase XML is a mechanism for interchanging geospatial information to and from a geodatabase. While geodatabases can be simply copied and loaded into a new directory or folder, the geodatabase XML workspace export preserves the schema developed for the geodatabase and includes all simple and custom features data, participation in networks and topologies, network connectivity and topology rules, simple and composite relationships, and any other information associated with the geodatabase datasets. Therefore, all behaviors created within the original geodatabase will be recreated when the XML document is imported into the receiving system.

ii. For an XML extract, both the data and the schema shall be exported.

5. Raster data sets

i. Rasters are spatial data models that define space as an array of equally sized cells arranged in rows and columns and composed of single or multiple bands. Each cell contains an attribute value and location coordinates. Unlike a vector structure, which stores coordinates explicitly, raster coordinates are contained in the ordering of the matrix. Groups of cells that share the same value represent the same type of geographic feature. The Department will accept the following raster formats:

(1) ArcInfo grids (integer or floating point)
(2) Triangular Irregular Networks (TINs)
(3) MrSid (version 2, 3 or 4) with world file
(4) Tiff, Geotiff, with world file
(5) Jpeg, jpeg2000 with world file
(6) ERDAS Imagine
(7) ASCII

ii. All raster data sets must have the projections defined with the following parameters:

(1) Projection New Jersey State Plane
(2) Units Feet
(3) Datum NAD83

iii. All raster data submitted to the Department must meet minimum positional accuracy standards as described in 4. (b).1.v. Submissions must also include the full description of procedures used to assure accuracy.

6. CAD Drawing Files

i. CAD drawing files are digital representations of a design or an object. The files are composed of various objects including graphical objects such as points, lines and polygons, and non-graphical items such as text, labels, legend blocks, etc. The various objects are grouped into drawing layers with objects that share similar physical characteristics grouped into the same layer. Three major formats of CAD drawing files will be accepted by the Department:

(1) AutoCAD DWG (**Ref 14**)
(2) AutoCAD DXF (**Ref 14**)
(3) Bentley MicroStation DGN (**Ref 15**)

ii. All CAD data submitted will comply with the following minimum specifications:

(1) For all formats, the CAD files reference is NJSPC US Feet, NAD83. Unreferenced files will not be accepted

(2) All data will be exported using a 16 decimal places option, so that double precision accuracy will be maintained

(3) In addition, a text file listing individual layer names and descriptions shall be submitted with each CAD data set

(4) All CAD files regardless of software version used to create the files will follow the structure outlined in the New Jersey Tax Maps- CAD Layer Template 2011 (**Ref 16**)

(5) Annotation for each layer shall be placed in separate annotation layers

(6) At least three separate digital files are required for each submission:

a. One file shall be the exact text of each metes and bounds description prepared for the site-specific engagement. The format shall be MS Word .doc format or other text file extension format that is acceptable to the Using Agency

b. One file shall be a digital file in format containing the full survey drawing. This drawing must be created at its real New Jersey State Plane Coordinates, NAD83, NORTH position and the view shall be un-rotated from the coordinate system so that the NJPCS NORTH points orthographically vertical in the screen

c. One file shall be a single layer digital drawing containing the closed line polygon of the perimeter survey lines and certain other lines that are internal to the survey

(7) Additional separate layer files may be requested by specific programs accepting CAD submissions to facilitate review of data for individual regulatory requirements. These specific layers will be listed in supporting documents for each program

7. LiDAR data.

i. While still a relatively new technology, LiDAR collections are becoming increasingly Important sources of data for the Department. LIDAR is an acronym for ***Li**ght **D**etection and **R**anging* and is a technology that uses laser light pulses to generate information about earth surface features. The Department relies on technical industry standards that have been developed by federal agencies such as the United States Geological Survey (USGS), the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) in conjunction with professional associations such as the American Society for Photogrammetry and Remote Sensing (ASPRS). These standards are defined in detail in the USGS LiDAR Base Specifications 2020 Rev A. (**Ref 13**).

ii. The primary specifications for LIDAR data produced for or submitted to NJDEP include: .

(1) All LiDAR collections for NJDEP use will meet at a minimum the specifications for QL2 level data as defined in the USGS LiDAR Base Specifications 2020 Rev A (Ref 13)
(2) Raw and classified point clouds delivered in LAS file format, version 1.4 or higher

(3) Minimum classification scheme will follow that included in the USGS LiDAR Base Specifications 2020 Rev A (**Ref 13**).
(3) Horizontal coordinates expressed in New Jersey State Plane Feet, NAD83
(4) Vertical elevation values referenced to the North American vertical Datum of 1988 (NAVD88) and expressed in feet
(5) Classified point clouds, and bare earth digital elevation models will be tiled.
(6) Tiles will be based on a regular, standard grid, preferably the "New Jersey 2007-2008 High Resolution 5000-foot Tile Index (rev 2009)" (**Ref 18**).

8. Naming Conventions

i, Dataset naming conventions

(1) Dataset names will contain only alphanumeric characters (i.e. letters, numbers)
(2 Dataset names will start with a letter
(3) Dataset names will be entirely in lowercase
(4) No spaces, dashes, special characters other than an underscore will be used
(5) Dataset names will be 10 characters or less
(6) Common abbreviations will be used where applicable

ii. Attribute field naming

(1) Attribute field names will contain only alphanumeric characters (letters and numbers) and underscores
(2) Attribute field must start with a letter
(3) No spaces, dashes, or special characters other than an underscore will be used
(4) Attribute field names will be 10 characters or less

b). Other data formats may be accepted by the Department based on program requirements. Data providers will consult with the using program before any additional data formats are submitted.

SECTION 6: METADATA STANDARDS

(a) Metadata, or 'data about data', document the content, quality, condition, and other characteristics of data. The Department recognizes metadata as a critical and mandatory component of a data set. Metadata records preserve the usefulness of all types of environmental data over time by detailing methods for data collection and data set creation. Metadata can reduce the chance of duplication of effort among Department programs, a serious issue when dealing with the collection of expensive environmental digital data. Metadata supports local data asset management such as local inventory and data catalogs, and the sharing of spatial data on external user communities (clearinghouses) such as the New Jersey Geospatial Information Network (NJGIN). Metadata provides adequate guidance for end-use application of data such as detailed lineage and context. Metadata makes it possible for data users to search, retrieve, and evaluate many different issues associated with the data set.

(b) The Department requires that all spatial data created for the Department be documented with metadata that adheres to the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) (Ref 1), except in those situations as described in section (c) below. Metadata items are listed below in section (d).

(c) For data that is developed and submitted to the Department as part of an on-going long term data development project which involves the periodic submittal of new or edited data, and for which a fully FGDC compliant metadata document has already been received by the Department at the initiation of the project., data creators may be able submit metadata records including only a subset of the full template items as part of the periodic data submittals The items to be submitted will be defined by the specific Department program contract manager, based on the types of data being submitted and specific program requirements.

(d). Metadata items:

1. Section 1: Identification Information

    i. Abstract
    ii. Purpose
    iii. Supplemental Information
    iv. Access Constraints
    v. Use Constraints
    vi. Native Data Set Environment
    vii. Title
    viii. Originator
    ix. Publication Date
    x. Edition
    xi. Geospatial Data Presentation Form
    xii. Online Linkage
    xiii. Publication Place
    xiv. Publisher
    xv. Currentness Reference
    xvi. Calendar Date
    xvii. Progress
    xviii. Update Frequency
    xix. North, South, East, and West Bounding Coordinates
    xx. Theme Keyword & Thesaurus
    xxi. Place Keyword & Thesaurus
    xxii. Temporal Keyword & Thesaurus

2. Section 2: Data Quality Information

    i. Logical Consistency Report
    ii. Completeness Report
    iii. Accuracy Report
    iv. Horizontal Accuracy (Accuracy Report)
    v. Vertical Accuracy (Accuracy Report)
    vi. Source Scale Denominator
    vii. Type of Source Media
    viii. Source Citation Abbreviation
    ix. Source Contribution
    x. Source Title
    xi. Source Originator
    xii. Source Date
    xiii. Source Edition
    xiv. Source Geospatial Presentation Form
    xv. Source Publication Place
    xvi. Source Publisher
    xvii. Source Currentness Reference
    xviii. Source Calendar Date
    xix. Process Description
    xx. Process Date

3. Section 3: Spatial Data Organization

    i. Direct Spatial Reference Method
    ii. SDTS Terms
    iii. SDTS Point & Vector Object Type
    iv. SDTS Point & Vector Object Count

4. Section 4: Spatial Reference Information (Based on NAD83)

i. Geographic Coordinate System Name
ii. Projected Coordinate System Name
iii. Horizontal Data Name
iv. Ellipsoid Name
v. Semi-major axis
vi. Denominator of Flattening Ratio
vii. Planar Coordinate Information
viii. Coordinate Pair
ix. Abscissa and Ordinate Resolution
x. Planar Distance Units
xi. Encoding Type
xii. Transverse Mercator Selection
xiii. SPCS Zone Identifier
xiv. Scale Factor at Central Meridian
xv. Longitude of Central Meridian
xvi. Latitude of Projected Origin
xvii. False Easting
xviii. False Northing

5. Section 5: Entity and Attribute Information

i. Entity Label Entity Definition
ii. Entity Definition Source
iii. Attribute Label
iv. Attribute Definition
v. Attribute Definition Source

6. Section 6 : Distribution Information

i. Resource Description
ii. Distribution Liability
iii. Distributor Organization
iv. Distributor Contact Voice Telephone
v. Distributor Contact Fax Number
vi. Distributor Contact Instructions
vii. Distributor Address Type
viii. Distributor Address
ix. Distributor City
x. Distributor State or Province
xi. Distributor Postal Code
xii. Fees
xiii. Ordering Instructions
xiv. Format Name
xv. Format Version
xvi. File Decompression Technique
xvii. Network Resource Name
xviii. Offline Media
xix. Recording Format

7. Section 7: Metadata Reference

i. Metadata Date
ii. Language of Metadata

iii. Metadata Standard Name
iv. Metadata Standard Version
v. Metadata Time Convention
vi. Metadata Contact Person
vii. Metadata Contact Organization
viii. Metadata Contact Position
ix. Metadata Contact Voice Telephone
x. Metadata Contact Fax Number
xi. Metadata Contact Email Address
xii. Metadata Contact Address Type
xiii. Metadata Contact Address
xiv. Metadata Contact City
xv. Metadata Contact State or Province
xvi. Metadata Contact Postal Code

SECTION 7: DEFINITIONS

95% Confidence Limits" or "95% Confidence Level" means a statistical statement on the probability that results found (or the hypothesis proposed) is correct. At the 95% confidence interval it would be expected that the test result would be correct 95 percent of the time, and there is a 5 percent risk that the result is incorrect. Stating a result at the 95% confidence level indicates a very high probability that the results are correct.

"Accuracy" means a measure or statement of correctness or the degree to which measured or collected data agree with what are considered true or accepted values. Spatial or locational accuracy reflects the degree to which a reported coordinate value conforms to the true position on the earth. Attribute accuracy refers to the degree to which the information in an attribute field correlates with the true value.

"Angular Unit" means the unit of measurement on a sphere or a spheroid, measured in degrees, minutes and seconds. The latitude- longitude geographic reference system uses an angular unit of measurement.

"Annotation" means text, labeling or graphics, (but not geographic features) that presents information on a map. Common examples include street names, tax parcel numbers, lot dimensions, etc. In CAD and GIS software annotation is stored as a separate layer and individual text strings or graphics can be placed on the map, and selected, moved, sized, and edited separately from geographic data layers.

"Arc" means a linear feature on a map in a geospatial data set. Arcs may be line features or form the boundaries of polygons.

"Arc/Info" or " ArcInfo" means a GIS software product developed and marketed by Environmental Systems Research Institute (Esri), Inc. that has been superseded by the ArcGIS suite of products. The ArcInfo name is still used to denote the ArcGIS license level, that features the most numerous and most powerful data management and geoprocessing features.

"ArcGIS" means a GIS software product suite developed and marketed by Environmental Systems Research Institute (Esri), Inc.

"ArcView" means a GIS software product of Esri, Inc. ArcView is the lowest level license in a three-tier desktop GIS product group.

"ASCII" means American Standard Code for Information Interchange. ASCII is the de facto format standard for text files in computer systems and is limited to 128 different characters. ASCII text is often informally referred to as "plain text."

"Attribute" or "attributes" means non-spatial information about the characteristics of geographic features in a geospatial dataset. Attribute information is linked to geographic features and is generally stored in tabular format. For example, attributes of a river would include its name, length, stream order, hydrologic unit code, the watershed in which it exists, etc.

“Attribute Information” or “Attribute Data” means Tabular or textual data describing the characteristics of geographic features (see Attribute(s).

“Attribution” means the process of assigning attributes to features in a geospatial data layer.

“AutoCAD” means software developed and marketed by the AutoDesk Corporation. It is one of the leading drawing, drafting and design software packages, for both 2-dimentional and 3-dimentional CAD design work. The software is often used for creating maps for surveying, planning, and engineering work, and now has many features in common with advanced GIS software. CAD files created with AutoCAD have the DWG or DXF file extensions (see entries for DWG and DXF).

“Background Polygon” means the universe polygon in the Esri Coverage format. This is a characteristic of a polygon coverage, where the first record in the attribute table of the layer, represents the area beyond the outer boundary of the coverage. The background polygon is unique in that it has not label point and no attributes are assigned to it.

“Base Data Set” means the source data used in the compilation or development of mapped data (for example digital aerial photography, satellite imagery, USGS topographic quadrangle digital raster graphic files).

“Basemap” means a map of background reference information (e.g., roads, rivers and streams, buildings, political boundaries, geodetic control) that serves as the basis for the mapping of another data layer. A basemap could be digital data or a hard copy map on paper or Mylar.

“Base Sources” means the fundamental sources used for data development. Common examples are digital aerial ortho-imagery, or hardcopy Mylar aerial ortho-imagery.

“CAD” means Computer Aided Design, sometimes also denoted as CADD for computer-aided drafting and design. CAD is a computer-based system for creating drawings, plans, maps, and designs. It can be differentiated from GIS in its primary focus on the graphical drawing rather than on spatial data management, spatial analysis or geoprocessing. However, contemporary CAD software contains many of the same features as GIS software, and also uses an approach that uses layers of digital information.

“CAD File” means the digital drawing, plan, map, figure, or schematic created using a CAD system. GIS software can often import and use CAD data files. Important CAD file formats include DWG (AutoCAD drawing file), DXF (AutoDesk Drawing Exchange Format), and DGN (the file format used by the Bentley MicroStation CAD software.

“Central Meridian” means the line of longitude that defines the center and often the x-origin of a projected coordinate system.

“Control Point(s)” means the point(s)s used to register (georeference) map sheets and transform map sheet drawing coordinates into real world geographic coordinates. Control points can be points generated through surveyed geographic features, or points extracted from base sources which are already georeferenced.

“Control Point File” means the data file that contains information on the control points used to register or georeference a mapped data, spatial data layer, feature class or raster image.

“Coordinate Offsets” means the offsets, using distance and direction, to place coordinates in a different position from which they were measured or indicated. Coordinate offsets are commonly used in cases where actual coordinates could not be accurately measured (e.g., using a GPS receiver under dense tree canopy). By use of the offset values coordinates are moved from one location to another.

“Coordinates” or “Coordinate Values” means a set of values that define a position within a spatial reference or coordinate system indicating horizontal and/or vertical positions. Coordinate values are associated with a coordinate system that sets the appropriate measurement parameters (datum, units, etc.) used by that system.

“Coordinate System” or “Coordinate Reference Systems” means a set of rules for specifying how coordinates are to be assigned to points or locations. The rules usually specify an origin of coordinates and of axes (for example, x and y for Cartesian systems) from which distances or angles are measured to yield locations.

“Coverage” means a specific vector data format, created by Esri, Inc., for storing geographic features. The term is often synonymously used to mean a “layer” or “feature data set”, which are also common Esri data formats.

“Critical Settings” means the hardware and software settings that are necessary for the collection or creation of accurate Global Positioning Systems (GPS) data. Usually, these settings are made in a GPS receiver prior to collecting data.

“Dangle Tolerance” means, for ArcInfo coverages, the minimum length allowed for dangling arcs by the clean process, which removes dangling arcs shorter than the dangle tolerance.

“Dangle” or “Dangling Arc” means a feature created where a digital line extends past the intended boundary line or end point. The extension past the intended juncture point is called a dangle. A dangling arc is not always an error (e.g., dead end street, cul-de-sac), but is a common data editing oversight. It is sometimes referred to as an overshoot.

“Data Layer” means a geographic data set in any digital map environment that can be registered and overlaid with other georeferenced data. The layer concept derives from the way in which a data set representing different thematic data types (parcels, roads, hydrography, land use, etc.) can be stacked up in layers.

“Datum” means a set of parameters and control points used to accurately define the three-dimensional shape of the Earth (e.g., as a spheroid). The datum is the basis for a planar coordinate system. For example, the North American Datum for 1983 (NAD83) is the datum for map projections and coordinates within the United States and throughout North America (Kansas Association of Mappers).

“Decimal Degrees” or “DD” means values of latitude and longitude expressed in decimal format rather than in degrees, minutes, and seconds. Latitude-longitude values are converted to decimal degrees mainly for ease of use. Decimal degrees can be calculated by adding the value for degrees to the result of degrees divided by 60 plus seconds divided by 3,600. Using this formula the longitude 74° 44' 35" is equal to 74.7430 in decimal degrees.

“Degree” means a unit of angular measure represented by the symbol °. The earth is divided into 360 degrees of longitude and 180 degrees of latitude. A degree is 1/360th of a circle. A degree is further divided into 60 minutes, and a minute is divided into 60 seconds. In New Jersey, on average, a degree of longitude measuring east-west is roughly 280,200 feet, and a degree of latitude measuring north-south is roughly 364,200 feet. A degree of longitude is roughly 8,500 feet wider in areas in the southern part of the state (Cape May County), compared to areas in the northern part of the state (Sussex County). The width of a degree of latitude is approximately the same throughout the state.

“Derived Data” means information that is created using another source as its basis. For example, land use polygon data can be considered as derived from aerial imagery.

“Differential Correction” means the process of correcting GPS data collected using a rover (GPS receiver collecting data in the field) with data collected simultaneously at a base or reference station. Because it is collecting GPS measurements at a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real time, or after the data has been collected by post processing (NY State GPS Glossary).

“DGN” means a CAD file format used in Micro Station software. Micro Station is a prevalent CAD software package developed and marketed by Bentley. DGN files are denoted by the .DGN file extension.

“Digital Data” means electronic machine-readable data stored in a computer data system. Digital data is most often categorized in GIS as spatial (georeferenced vector or raster information) or non-spatial (tabular or attribute data linked to georeferenced features).

“Digital Imagery” means a computer compatible version of an aerial photograph, satellite photo or other map image. It is a raster data layer, composed of a matrix or grid of individual picture elements (pixels).

“Digital Ortho-imagery” means a digital image for which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map (USGS, 2001). Digital ortho-imagery is often referred to as an orthophoto, orthophotograph or orthoimage.

“Domain” means the universe of values permitted in a database field in an attribute table or database table. Using domains to populate data attributes is a mechanism for enforcing data integrity in a database by limiting data input to accepted values.

“Domain Limits” means the range of permissible values for a database field in an attribute table or database table.

“DOP” or “Dilution of Precision” means the indicator of the quality of a GPS position, which takes account each satellite's location relative to the other satellites in the constellation, and their geometry in relation to the GPS receiver. A low DOP value indicates a higher level of accuracy.

“Double Precision” or “Double Precision Accuracy” means the coordinate values defining feature geometry of a digital layer are stored as numbers with up to 15 significant digits. Double-precision geometries retain positional accuracy of much less than 1 meter at a global extent.

“DWG” means a widely used file format and specification for CAD drawing files. It is the main file format of output from AutoCAD software, and the source of a great deal of mapping data imported and used by GIS software users. These files are identified by the .DWG file extension.

“DXF” means a standard data exchange file format for AutoCAD drawing files that enables the export and import of AutoCAD data for use with software other than AutoCAD. DXF files have a .DXF file extension. As noted in “AutoDesk 2012 DXF Reference” (AutoDesk 2011, p.1.), the “DXF™ format is a data representation of all the information contained in an AutoCAD drawing file. Furthermore, almost “all user-specified information in a drawing file can be represented in DXF format.” Therefore, the import of DXF formatted files is a common function for GIS users.

“Easting” means the east-west, X, coordinate in a rectangular coordinate system, the equivalent of longitude in a geographic reference system (Kansas Association of Mappers).

“Elevation data” or “Elevation Layer” means a geospatial data layer containing information about the vertical distance of a point or object above or below a reference surface or datum. Generally, elevation data is referenced to mean sea level, in which case elevation data would be given as height above sea level. (Univ. of Texas Libraries).

“Elevation Mask” means the angle above and relative to the horizon, below which your GPS rover will not track satellites. It is normally set to 15° to avoid interference problems caused by buildings and trees and multipath errors (New York State GPS Glossary).

“ERDAS Imagine Image file” means an image file format native to the ERDAS IMAGINE software products. This format is now an industry wide standard and is supported by most GIS and geospatial software.

"Esri" means Environmental Systems Research Institute. The company that develops and markets GIS software, including the ArcGIS system of software.

“False Easting” means the linear value added to all x-coordinates of a map projection so that none of the values in the geographic region being mapped are negative

“False Northing” means the linear value added to all y-coordinates of a map projection so that none of the values in the geographic region being mapped are negative

“Feature Class” means a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes can be stored in geodatabases, shapefiles, coverages, or other data formats

“Feature Dataset” means a collection of feature classes stored together that share the same spatial reference; that is, they share a coordinate system, and their features fall within a common geographic area. Feature classes with different geometry types may be stored in a feature dataset.

“Feature” means a representation of a real-world object on a map, or in a spatial database. Features are usually represented in a vector dataset graphically as a point, a line, or a polygon.

“FEMA” means the Federal Emergency Management Agency.

“Field Collection” means the collection of raw data through measurements and observations conducted on site, in the field (out in the environment).

“Field Data” means data generated through field collection.

“File Geodatabase” means a geodatabase stored as a folder of files. (See Geodatabase)

“FIPS Code” means the Federal Information Processing Standards code. This is a standardized set of numeric or alphabetic codes issued by the National Institute of Standards and Technology (NIST) to ensure uniform identification of geographic entities through all federal government agencies. The entities covered include: states and statistically equivalent entities, counties and statistically equivalent entities, named populated and related location entities (such as, places and county subdivisions), and American Indian and Alaska Native areas.

“Flow” means the movement or transport, and direction of movement from one point to another along a linear network. Flow direction along a linear network in important in hydrologic modeling, traffic analysis or any other network layer where information on the direction of transport is necessary.

Foot (US)

The U.S. Survey Foot is the unit of measure used in the New Jersey State Plane coordinate system (NJSPC), NAD 83 (feet). It is defined in reference to a meter and differs slightly from the International Foot. The US Survey Foot is defined as: 1 meter = 39.37 inches. If you divide 39.37 by 12 (12 inches per foot), you get the conversion factor: 1 meter = 3.280833333.

“Fuzzy Tolerance” means the distance within which coordinates of nearby features are adjusted to coincide with each other when topology is being constructed or polygon overlay is performed. Nodes and vertices within the fuzzy tolerance are merged into a single coordinate location. Fuzzy tolerance is a very small distance, usually from 1/1,000,000 to 1/10,000 times the width of the coverage extent and is generally used to correct inexact intersections.

“Geodatabase” means a database or file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data. The geodatabase is the standard data management and storage framework of ArcGIS. Both file and personal geodatabases will be accepted.

“Geodatabase XML” means a software language or encoding system for information stored in a geodatabase. XML is an acronym for Extensible Markup Language, which is a set of rules for creating standard information formats using customized tags and sharing both the format and the data across applications.

“Geographic Coordinate System” means a reference system that uses latitude and longitude to define the locations of points on the surface of a sphere or spheroid. A geographic coordinate system definition includes a datum, prime meridian, and angular unit.

“Geometry” means the measures and properties of points, lines, and surfaces. In a GIS, geometry is used to represent the spatial component of geographic features.

“Georeference” means the process of aligning geographic data to a known coordinate system so it can be viewed, queried, and analyzed with other geographic data. Georeferencing may involve shifting, rotating, scaling, skewing, and in some cases warping, rubber sheeting, or orthorectifying the data.

“GeoTiff” means a TIFF based interchange format for georeferenced raster imagery that was developed as an open standard. TIFF is an acronym for Tagged Image File Format.

“GIS” means Geographic Information System(s).

“Global Positioning Systems”, or “GPS” means a satellite-based navigation system commonly used by GIS data creators, mappers and surveyors.

“GPS Receiver” means the device used in the field to collect geographic locations by receiving transmissions from Global Positioning Systems satellites.

“Grid” (cartography) means any network of parallel and perpendicular lines superimposed on a map and used for reference. These grids are usually referred to by the map projection or coordinate system they represent, such as universal transverse Mercator grid.

“Grid” (raster) means an Esri data format for storing raster data.

“GRS” means Geodetic Reference System. This denotes a standard measurement system for mapping, for example, GRS 80, the standard measurements of the earth's shape and size adopted by the International Union of Geodesy and Geophysics in 1979.

“GSD” means Ground Sample Distance, which are distances or measurements taken on the ground rather than from a map or aerial photograph.

“Hard Copy” means a non-digital map source on paper or mylar.

“Horizontal Geodetic Datum” means a geodetic datum specifying the coordinate system in which horizontal control points are located.

“JPEG” means the Joint Photographic Experts Group image file format. This is a standard image compression mechanism which can obtain high compression ratios but may cause some data loss. Pixel values will be slightly different after decompression.

“Label Point” means an Esri feature class used to represent points or identify polygons. When representing points, the x,y location of the point describes the location of the feature. When identifying polygons, the point can be located anywhere within the polygon.

“Large Scale” means a description of the relative scale at which a map is created. For example, a map at a scale of 1:2,400 is large scale when compared with a map of 1:24,000 scale.

“Latitude” means the first component of a spherical coordinate system used to record positions on the earth’s surface. Latitude indicates the angular distance north or south of the earth’s equator measured through 90 degrees.

“Latitude of origin” means the latitude value that defines the origin of the y-coordinate values for a projection.

“Latitude/Longitude” means a spherical coordinate system used to record positions on the earth’s surface with reference to a grid composed of lines of latitude and meridians of longitude. Latitude is indicated as north or south of the equator from 0 degrees at the equator to 90 degrees at the poles. Longitude is measured east or west from 0 degrees at the prime meridian to the 180-degree longitude line which is opposite the Prime Meridian on the globe.

“LiDAR” means Light Detection and Ranging, It is a remote-sensing technology that uses lasers to measure elevations and terrain features.

“Logging interval” means the interval, or amount of time, between position fixes taken by the GPS receiver. The interval set in the receiver can be short, such as one fix per second, or longer, such as one fix every 10 seconds.

“Longitude” means the second component of a spherical coordinate system used to record east-west positions on the earth's surface, measured in degrees as the arc or position of the earth's equator intersected between the meridian of a given place and the prime meridian, which runs through Greenwich, England.

“Metadata” means information that characterizes data. Metadata are used to provide documentation for data products. Metadata is often referred to as “the data about the data.”

“MicroStation” means the CAD Software product of Bentley Microsystems. Also see entry DGN.

“MrSid” means Multiresolution Seamless Image Database. MrSid is a file compression technology and format for storage of geospatial imagery such as digital aerial and satellite photography.

“NAD” means North American Datum (see entry for Datum).

“National Map Accuracy Standards” or “NMAS” means the set of standards developed by the USGS for indicating the spatial accuracy of mapped data. The United States National Map Accuracy Standards defines accuracy standards for published maps, including horizontal and vertical accuracy, accuracy testing method, accuracy labeling on published maps, labeling when a map is an enlargement of another map, and basic information for map construction as to latitude and longitude boundaries (USGS, NMAS).

“National Standard for Spatial Data Accuracy” or “NSSDA” means the statistical and testing methodology developed by the Federal Geographic Data Committee for evaluating the positional accuracy of points on maps and in digital geospatial data, with respect to georeferenced ground positions of higher accuracy.

“NAVD” means the North American Vertical Datum. Denotes the vertical datum used for data development, such as The North American Vertical Datum of 1988 (NAVD 88). See entry for Datum.

“New Jersey State Plane Coordinate System”, or “NJSPC” means the designated planar coordinate system used for mapping in New Jersey, measured in either feet (US foot) or meters, using the North American Datum of 1983 (NAD 83). Unlike many other states, New Jersey has only one state plan zone. The State Plane Coordinate system provides coordinates on a flat grid for easy computation. The State Plane Coordinate system divides the U.S. into a hundred or more distinct grid surfaces (Zones).

NJSPC
See New Jersey State Plane Coordinate System.

NMAS
See National Map Accuracy Standards.

“Node” means a point at the beginning, ending or intersection of a line in a geospatial data set.

“Node errors” means types of topology errors within a geospatial data set. A common node error is a “dangle” where a line goes beyond an arc to which is was intended to snap (see Dangle). Another node error often encountered is when polygon features are not completely enclosed by a boundary line, leaving a gap in the feature intended to be a polygon.

“North American Datum”, or “NAD” means the horizontal control datum for the United States, Canada, Mexico, and Central America.

“North American Vertical Datum”, or “NAVD” means the vertical (elevation) control datum for the United States, Canada, Mexico, and Central America.

“Northing” means the north-south, or Y, coordinate in a rectangular coordinate system, The equivalent of a latitude value in a geographic coordinate system (Kansas Association of Mappers).

“NRCS” means the US National Resources Conservation Service.

“NSSDA”

See entry for National Standard for Spatial Data Accuracy.

“NSSDA testing methodology”

A defined process for testing the spatial accuracy of a digital geospatial data set against data of a higher accuracy.

“OGIS, Office of GIS “

The New Jersey Office of GIS that is part of the New Jersey Office of Information Technology (NJ OIT).

“OIT” Office of Information Technology”

The New Jersey State government agency that serves oversees and coordinates Information Technology/Information Systems for State entities.

“Offsets”

See entry for Coordinate offsets.

“Overshoots” means a digital line which extends past the intended boundary line. This extension past the intended juncture point is called a dangle.

“Ortho-imagery”, or “ortho-images” means aerial photography in digital format that has been digitally processed and transformed from image coordinates to real-world coordinates. Orthogonal (ortho) rectification makes corrections within a photograph so that the scale is uniform throughout the resulting image. Ortho-images combine the image characteristics of a photograph with the geometric qualities of a map. Distances and locations from these images can be accurately measured since ortho-images are produced to meet threshold accuracy specifications.

“PDOP” means Position Dilution of Precision. It is a unit-less figure of merit expressing the relationship between the error in user position and the error in satellite position, when making GPS measurements. Values considered good for positioning are small, such as 3. Values greater than 7 are considered poor.

“Personal Geodatabases” means a geodatabase format of Esri Inc. that is stored in Microsoft Access database format.

“Photo-Basemaps” means a hard copy mapping base which has an aerial photograph or satellite image printed on it. The photo-basemap normally has a coordinate grid superimposed on it so that data mapped from the gridded image has real world coordinate locations associated with them.

“Pixel” means a Picture Element, the smallest non-divisible image-forming unit of a digital image. Each pixel can have assigned attributes, in addition to color. In raster processing, pixels refer to a single cell within a matrix of grid cells.

“Pixel Resolution” means the size of a single pixel in an image file (aerial or satellite).
“Point Features” means features in a geospatial data set stored as point locations (see entry for Point).

“Point” means a single X,Y (optionally Z) location in space. Dimensionless geometric feature having no other spatial properties except location. Many natural and man-made features are modeled as points in a geospatial database including trees, hydrants, poles, buildings, etc.

“Polygon” means a closed plane figure bounded by three or more line segments, used to represent area features in a geospatial data set.

“Position Mode” means the settings made on a GPS receiver that puts it in a state to records positions (locations).

“Positional Accuracy” means the accuracy (correctness) of the locations associated with digital data.

“Post-processed” means the manipulation of GPS data after it has been recorded in the field. Generally, the raw positions recorded by the receiver must be transferred to a computer for additional processing to improve accuracy of positions through differential correction and to export to a geospatial file.

“Projection” means a mathematical method for representing the shape of the earth on a flat plane; a formula that converts latitude-longitude locations on the earth’s spherical surface to X, Y locations on a map’s flat surface.

“Pseudo-nodes” means a node connecting only two edges or arcs, or the endpoint of an edge or arc that connects to itself, in a geodatabase topology or ArcInfo coverage.

“Raster Data Sets” means spatial data that are stored using the raster data model. This model stores data in an evenly spaced grid, where each grid square (pixel) stores a data value. Raster datasets are commonly used to store imagery (aerial and satellite) or continuous data, such as elevation values, for examples. Types of data file formats for raster data sets include JPEG, JPEG 2000, Esri Grid, MrSid, TIFF, and GeoTiff.

“Root Mean Square Error (RMSE)” means a calculated value that measures the error of a point measurement. RMSE is the square root of the average of the set of squared differences between dataset coordinate values and coordinate values from an independent source of higher accuracy for identical points.

“Rover” means any mobile GPS receiver and data collector used for determining location in the field. A roving’s position can be differentially corrected relative to a stationary base GPS receiver

“Satellites” means the orbiting space vehicles (SVs) that make up the space-based portion of the GPS system. Satellites send the radio transmissions that are the basis for the calculation of location using GPS receivers.

“Scale” means the relationship between the dimensions of features on a map and the geographic features represented on the earth, commonly expressed as a fraction. For example, a map scale of 1:24000 means that one unit of measure on the map equals 24,000 of the same unit on the earth (1 inch would equal 24,000 inches, or 2000 feet). Also, scale often refers to a calibrated line, as on a map or an architectural plan, indicating such a proportion.

“Schema” means the structure or design of a database or database object, such as a table, view, index, stored procedure, or trigger. In a relational database, the schema defines the tables, the fields in each table, the relationships between fields and tables, and the grouping of objects within the database. Schemas are generally documented in a data dictionary. A database schema provides a logical classification of database objects. Schema files are often coded in XML (Extensible Markup Language).

“Signal to Noise Ratio”, or “SNR" means a measure of the signal strength of a GPS satellite signal relative to the background noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz. The quality of a GPS position is degraded if the SNR of one or more satellites in the constellation falls below 39. This value is used to determine whether the signal strength of a satellite is sufficient for that satellite to be used by the GPS receiver. If a satellite’s SNR is below the configured minimum SNR, that satellite is not used to compute positions.

“Significant Digits” means the number of digits in a measurement that are known with some degree of reliability. This is indication of the accuracy and precision of a number, especially related to coordinate location values.

“Sliver”, or “Sliver Polygon” means an area feature formed when two adjacent polygons do not abut along an intended single common boundary line.

“Small Scale” means a description of the relative scale at which a map is created. For example, a map at a scale of 1:24,000 is at a small scale when compared with a map at a 1:2,400 scale.

“Snap”, or “Snapping” means an automatic editing operation in which points or features within a specified distance (tolerance) of other points or features are moved to match or coincide exactly with each other.

SNR

See entry for Signal to Noise Ratio.

“Spatial Reference” means the coordinate reference system characterizing the data, including specifics of the datum and projection.

“Spheroid” means any surface differing slightly from a true sphere. A spheroid model of the shape of the Earth is a basic component of many geographic and coordinate reference systems.

“State Plane” means a plane rectangular coordinate system. Each State in the United States of America has its own state plane coordinate system (or state coordinate system). When necessary, the coordinates in the coordinate system of a particular state are referred to by the name of the state, e.g., New Jersey State Plane Coordinates. State plane coordinates are used extensively for calculating and recording the results of land surveys

“Survey”, or “Surveying” means the orderly process of determining data relating to any physical, chemical, or geometric characteristic of the Earth. Surveying, in New Jersey is conducted by licensed land surveyors and produces highly spatially accurate locational information.

“Survey Grade” means geospatial data created by a licensed land surveyor, or that was collected in accordance with, and has the positional accuracy of a survey. Survey grade data or data collection methods and instruments are considered highly accurate.

“Threshold Value” means a value that serves as an indicator when it is reached or surpassed, or a value that should not be breached. An example from GPS data collection is a PDOP greater than 6 (the threshold). Data collected with a PDOP greater than the threshold is unacceptable, and the GPS receiver can be prevented from collecting data when PDOP exceeds that value.

“Tic“ means a registration or geographic control point for a coverage representing a known location on the earth's surface. Tics allow all coverage features to be recorded in a common coordinate system. Tics are used to register map sheets when they are mounted on a digitizer. They are also used to transform the coordinates of a coverage, for example, from digitizer units (inches) to the appropriate values for a particular coordinate system.

“Tic Match” means Identifying or matching a tic in a coverage layer with its related point on a map or geospatial data layer, for the purpose of georeferencing.

“TIFF” means Tagged Image File Format. It is a format that is commonly used to store geospatial imagery (see entry for Geotiff).

“TIN” means Triangulated Irregular Network. A TIN is a format for representing a continuous surface (such as elevation) in a vector rather than a raster format.

“Topology”, or “Topologic Rules” means the rules and requirements relating to and describing the spatial relationships of features (points, lines, polygons) within a geospatial data set and among various related datasets. Topologic rules in a GIS enforce the ways in which points connect to lines, and lines connect to form polygons, and the way in which these features should or should not overlap. A geospatial data set must have accurate topology if it is to be used for analysis and geoprocessing with other data sets.

“Transverse Mercator” means a map projection that is the basis of the New Jersey State Plane Coordinate System. On a Transverse Mercator projection, the central meridian (the central north-south straight line) is the line of true scale. This makes the projection appropriate for areas with long north-south extent and narrow east-west extent.

“USGS” means the United States Geological Survey.

“Vector Data” or means geospatial data composed of discrete features represented by points, lines, and polygons.

“Vector Data Sets” Geo-spatial data sets in vector format (see vector data)

“Vertex”, or “Vertices” means one, or more, of a set of ordered x, y coordinate pairs that defines the shape of a line or polygon feature.

“View Scale“ means the scale at which digital geospatial data are displayed on a computer screen. In GIS the view scale can change dynamically as the GIS user zooms in or zooms out on the map view.

“Weed”, means the process of removing unneeded vertices from line work stored in a geospatial data set. A vertex is needed to define a change in the position or shape of a line. If a vertex, or vertices, does not indicate a change in the geometry of the line, then it is superfluous and can be “weeded” out or deleted. Weeding is useful because many extra vertices needlessly increase the complexity and file size of a vector data set.

“Weed Tolerance” means the minimum distance that can exist between vertices in a digital vector layer.

“World File” means a file, used in conjunction with a raster layer, such as aerial or satellite imagery that provides geospatial information for the corresponding layer. In the case of a TIFF file, a world file would be a small text file with the same name as the raster layer, but with a .TWF file extension.

“XML” means Extensible Markup Language. XML was developed by the W3C, a standardized general purpose markup language for designing text formats that facilitates the interchange of data between computer applications. XML is a set of rules for creating standard information formats using customized tags and sharing both the format and the data across applications.

“XY Coordinate System” means a geographic reference system for indicating locations on the surface of the earth as a measurement from an origin along two axes-- a horizontal axis (x), and a vertical axis (y). On a map, x, y coordinates are used to represent features at the location they are found on the earth's spherical surface.

“XY Tolerance” means a setting for data creation or editing that sets the minimum distance that is possible between coordinates before they would collapse into one single coordinate feature. Usually, the XY tolerance is a very small distance to prevent features from moving when editing or during geoprocessing tasks.

“Z Coordinate System” means the reference system in which locational in a third dimension, usually elevation or depth, is record

SECTION 8: REFERENCES

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