APPENDIX A

New Jersey Department of Environmental Protection
Geographic Information System Mapping and Digital
Data Standards prepared by:

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Overview

The New Jersey Department of Environmental Protection (NJDEP) maintains a Geographic Information System (GIS) for the storage and analysis of cartographic (mapped) and related environmental scientific and regulatory information for use by the Department. A GIS is a computer mapping system used to display and analyze geographic information and spatial databases.

Many Departmental programs require the submission of mapped data to a GIS standard. The submission of mapped data by all sectors based on this standard will facilitate data input into the Department's GIS and the integration of data with the New Jersey Environmental Management System (NJEMS). Much of these data can be shared back with the regulated community and public as appropriate. Important concepts regarding the creation, capture and delivery of digital mapped information are addressed in this document.

There are three basic concepts that must be followed.

The first concept addresses the need for all mapping to meet accepted accuracy standards. All digital data must meet or reference published standards such as those defined by the Federal Geographic Data Committee or a defined survey standard, regardless of scale. Testing against base maps 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.

Secondly, digital data provided to or produced for the Department are required to be in North American Datum 1983 (NAD83) horizontal geodetic datum and in the New Jersey State Plane Coordinate system (SPC). SPC is a geographic reference system in the horizontal plane describing the position of points or features with respect to other points in New Jersey. All coordinates of the system are expressed in meters. The Department, however, prefers to receive and maintain data in U.S. survey feet. The official survey base of the State is known as the New Jersey State Plane Coordinate System whose geodetic positions have been adjusted on the NAD83 as per Chapter 218, Laws of New Jersey 1989.

Lastly, GIS data must also be documented using the Federal Geographic Data Committee (FGDC) Metadata Standard or be compliant with the FGDC metadata standard. 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 was produced and the accuracy of the data being made available. The Federal Spatial Data Transfer Standard (SDTS) requires that a quality report accompany the data. This information should include a statement of the positional accuracy of the data and testing procedures used to determine positional accuracy. Geographic data must be delivered according to standard media and digital formats. Accepted formats and media currently used by the Department are presented in the body of this paper.

Programs within the Department may define additional technical mapping requirements to accommodate specific program needs.

MAPPING AND DIGITAL DATA STANDARDS GEOGRAPHIC INFORMATION SYSTEM NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

1.0 INTRODUCTION

Geographic Information System technology has become a tool for innovative efforts to protect the natural environment and the public health of citizens, nationally and within the State of New Jersey. To adequately address these and other issues, the Department must make decisions based on sound data of known and adequate accuracy. This document provides guidance for the basic standards for creating, describing and distributing spatial data on a GIS. Basic standards will ensure consistent data quality and documentation, provide for compatibility between data sets, facilitate interactive analysis within the Department and ensure the highest quality of results derived from the GIS.

The Department endorses the Federal Geospatial Standards (FGDC, 1998) for positional accuracy as the most comprehensive and current standard. The Department continues to support National Map Accuracy Standards.

2.0 GEOSPATIAL POSITIONING ACCURACY STANDARDS AND TESTING

There are two widely accepted standards for positioning accuracy for mapped data, the Federal Geographic Data Committee (FGDC) “Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy” (1998) and National Map Accuracy Standard (1947). The Department supports both these standards and either standard can be used for mapped data. The Department recommends the more current FGDC (1998) standard.

2.1 Federal Geographic Data Committee (FGDC)

The Federal Geographic Data Committee (FGDC) in 1998 released the endorsed version of "Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy" (NSSDA) (http://www.fgdc.gov/standards/standards.html). This standard is designed for digital spatial data. In spite of the title, it prescribes a testing methodology, rather than threshold accuracy values, and is described as a Data Usability Standard.

The NSSDA requires the following test (quoted from Sections 3.2.1, 3.2.2, and Appendix 3-A):

The NSSDA uses root-mean-square error (RMSE) to estimate positional accuracy. 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.

Accuracy is reported in ground distances at the 95% confidence level. Accuracy reported at the 95% confidence level means that 95% of the positions in the dataset will have an error with respect to true ground position that is equal to or smaller than the reported accuracy value. The reported accuracy value reflects all uncertainties, including those introduced by geodetic control coordinates, compilation, and final computation of ground coordinate values in the product.

Horizontal accuracy shall be tested by comparing the planimetric coordinates of well-defined points in the dataset with coordinates of the same points from an independent source of higher accuracy. Vertical accuracy shall be tested by comparing the elevations in the dataset with elevations of the same points as determined from an independent source of higher accuracy.

Errors in recording or processing data, such as reversing signs or inconsistencies between the dataset and independent source of higher accuracy in coordinate reference system definition, must be corrected before computing the accuracy value.

A minimum of 20 checkpoints shall be tested, distributed to reflect the geographic area of interest and the distribution of error in the dataset. When 20 points are tested, the 95% confidence level allows one point to fail the threshold given in product specifications.

Horizontal Root Mean Square Error is known as $RMSE_r$.

If error is normally distributed and independent in each the x- and y-component and error, the factor 2.4477 is used to compute horizontal accuracy at the 95% confidence level (Greenwalt and Schultz, 1968). When the preceding conditions apply, $Accuracy_r$, the accuracy value according to NSSDA, shall be computed by the formula:

$$Accuracy_r = 2.4477 * RMSE_x = 2.4477 * RMSE_y$$

$$= 2.4477 * RMSE_r/1.4142$$

$$Accuracy_r = 1.7308 * RMSE_r$$

Note that because this formula is based on statistical probabilities, the satisfaction of the underlying assumptions is important, and the formula also applies to a specific number of error measurements (20 points). The full FGDC document gives more information on what to do in cases where either of these requirements cannot be satisfied. It also gives direction on additional topics, and a worked example.

The NSSDA test described above has been embodied in the ArcView 3.x extension RMSEr2.avx, written by Gregory Herman of the New Jersey Geological Survey; the extension is available from the ESRI web site (http://gis.esri.com/arcscripts/scripts.cfm). Note that the extension does not provide a test of the validity of the assumptions.

A data set that has been tested for horizontal accuracy per the NSSDA standard should be reported in the metadata as *"Tested _____ (meters, feet) horizontal accuracy at 95% confidence level."* Tests and reporting statements for vertical accuracy are analogous, and are shown in the FGDC document.

If alternate means of evaluating accuracy are used, the data set should be reported in the metadata as *"Compiled to meet _____ (meters, feet) horizontal accuracy at 95% confidence level."*

In summary, there are seven steps in applying the NSSDA (from Positional Accuracy Handbook, 1999, Minnesota Planning Land Management Information Center):

1. Determine if the test involves horizontal accuracy, vertical accuracy, or both.

2. Select a set of test points from the data set being evaluated.

3. Select an independent data set of higher accuracy that corresponds to the data set being evaluated.

4. Collect measurements from identical points from each of those two sources.

5. Calculate a positional accuracy statistic using either the horizontal or vertical accuracy statistic worksheet.

6. Prepare an accuracy statement in a standardized report form.

7. Include that report in a comprehensive description of the data set called metadata.

The Positional Accuracy Handbook provides a very clear explanation of NSSDA and excellent examples of testing methods and non-testing assessments. It can be found at (http://www.mnplan.state.mn.us/press/accurate.html).

The NSSDA itself does not include threshold values, i.e. values of accuracy that are required for particular purposes. Sources for appropriate threshold values are discussed further below in Section 2.3.

2.2 National Map Accuracy Standard (NMAS)

The National Map Accuracy Standard, designed for paper maps, has been used since their adoption in 1941 to set accuracy requirements and to describe accuracy levels of maps. The 1947 revision is quoted in part below:

1. Horizontal accuracy for maps on publication scales larger than 1:20,000, not more than 10% of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50th of an inch. These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as benchmarks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is well defined will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus, while the intersection of two road or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. Examples of data in this class would be timberlines, soil boundaries, etc.

2. Vertical Accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

NMAS accuracy is described in map units (inches on the map), rather than ground units (feet or meters in the real world). Given a scale, one can translate the map units into ground units. For example, NMAS requires that a map of scale 1:12,000 shall have an accuracy of 1/30 inch; the corresponding ground unit accuracy is 33.3 ft. Although designed for paper maps, NMAS has been widely used to describe the accuracy level of digital data; for example, a digital data set is commonly described as meeting NMAS at a particular nominal scale.

As discussed above, NMAS is based on statistical testing; however the confidence level is set at 90 percent, in contrast to the 95 percent confidence level required by NSSDA. This means that the same map or data set will have a different accuracy level description (i.e. different numerical accuracy value in feet or meters) for NMAS vs. NSSDA. One can think of the horizontal accuracy as a circle of that radius around each well-defined position point: the confidence level expresses the likelihood that the actual location of the point falls within that circle. For a given "quality" of data, one needs a larger circle for a 95 percent confidence level than for a 90 percent confidence level. Appendix 3-D of the NSSDA document gives a fuller treatment of the relationship between NMAS and NSSDA.

The full text of National Map Accuracy Standards (1947) is shown in section 7.1.

2.3 Threshold Accuracy Values

The Department continues to support positioning data to meet the accuracy level of the NMAS, but using the testing methodology and reporting language of NSSDA. One approach to satisfying this requirement is to establish an appropriate nominal scale for the data/mapping in question, and use the NSSDA equivalent of NMAS values to establish threshold values for accuracy. The mathematical relationship is described in the NSSDA document (Appendix 3-D). Table 2.3.1 below shows the results of this calculation for a range of scales.

Table 2.3.1 Threshold accuracy values in ground units.
Derived from National Map Accuracy Standards (1947).

Scale	NMAS accuracy (feet)	NSSDA $Accuracy_r$ (feet)	NMAS accuracy (meters)	NSSDA $Accuracy_r$ (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
1:100,000	167	190	50.9	58
1:250,000	417	475	127	145
1:500,000	833	950	254	290

When the FGDC began work on the NSSDA, the sub-committee used Accuracy Standards for Large-Scale Maps (Interim, 1990) from the American Society for Photo-grammetry and Remote Sensing (ASPRS) as the basis for updating NMAS. The ASPRS standards use $RMSE_X$ and $RMSE_y$ as their base statistics, and state threshold values for various scales. (Note that $RMSE_X$ and $RMSE_y$ are NOT the same as $RMSE_r$.) Discussion of these standards can be found in the NSSDA document (section 3.1.5 and Appendix 3-D). Table 2.3.2 below shows the threshold values of the ASPRS

Class 1 mapping standards and their translation into $Accuracy_r$ of NSSDA (note that statistical assumptions are involved in making this calculation). As comparison of $Accuracy_r$ values between the two tables shows, the ASPRS standards are stricter than NMAS.

Should the map producer not be able to test the quality of the submitted data by either of these two tests, then the producer shall document this fact in the metadata submitted with the digital GIS data. The Department strongly recommends that when a producer of mapped information is not required to submit data to a quality standard by regulation or by contract, that an accuracy statement be submitted with the GIS data and referenced in the metadata.

Table 2.3.2 Threshold accuracy values in ground units.

Derived from American Society for Photogrammetry and Remote Sensing Class 1 Horizontal

Interim Accuracy Standards for Large-Scale maps (1990).

Scale	Class 1 Planimetric Accuracy, limiting RMSE (feet)	Equivalent $Accuracy_r$, NSSDA (feet)	Class 1 Planimetric Accuracy, limiting RMSE (meters)	Equivalent $Accuracy_r$, NSSDA (meters)
1:60	0.05	0.12		
1:1,200	1.0	2.4		
1:2,000			0.50	1.2
1:2,400	2.0	4.9		
1:5,000			1.25	3.1
1:6,000	5.0	12.2		
1:10,000			2.50	6.1
1:12,000	10.0	24.5		
1:20,000	16.7	40.9	5.00	12.2

The New Jersey Society of Professional Land Surveyors (NJSPLS, http://www.njspls.org/) has also produced a set of proposed threshold $Accuracy_r$ values for several specific types of GIS data. Because these standards have not yet been adopted, they are not shown here.

3.0 NEW JERSEY DEPARTMENT ENVIRONMENTAL PROTECTION GIS DATA STANDARDS

The remainder of this document describes standards adopted by the Department to facilitate data sharing and provide the basic standards for creating, describing and distributing spatial data on its GIS. The objective is to facilitate interactive analysis of data of the highest quality within the Department.

3.1 Datum and Projection

3.1.1 Horizontal Datum and Vertical Datum

The North American Datum of 1983 (NAD83) is required for mapping in the horizontal plane. The North American Vertical Datum of 1988 (NAVD 88) should be used when possible rather than the older National Geodetic Vertical Datum of 1929 (NGVD29).

3.1.2 Projection and Coordinate System

Based on the Chapter 218, Laws of New Jersey 1989, New Jersey State Plane is required in meters (the Department prefers feet), NAD83. The State of New Jersey is entirely contained within one state plane zone (2900). Special situations may require other projection systems for small-scale maps of regional (interstate) or national interest. The Department prefers to use feet as the units of measure and serves all of its data in the following Projected Coordinate System: NAD_1983_StatePlane_New_Jersey_FTPS_2900_Feet

3.2 Data Capture Methodology and Procedure

GIS information comes from a variety of sources, which can produce a wide range of positional accuracy. Consequently, each source must be evaluated to determine whether redrafting is necessary to prepare the data for entry into the GIS. Heads-up digitizing, Tablet digitizing, Scanning, and Global Positioning Systems (See Section 4.0) are all viable methods to input data to a GIS. Much of the data required for a GIS can be derived directly from the photointerpretation of aerial photos or from rectified photo basemaps. Whichever method is used it is important that the most accurate data source set be used whenever possible. For New Jersey the February-April, 2002 digital color infrared (CIR) orthophotography 1:2400 (1"=200') are currently the preferred reference for heads up digitizing. Only differentially corrected GPS coordinates may surpass this source in accuracy.

3.2.1 Heads-Up Digitizing

Heads-Up digitizing is a technique that is useful for capturing or updating data from digital imagery on screen. High-resolution digital imagery now allows GIS users to edit and delineate features directly on the screen using desktop GIS software. The following considerations should be carefully planned out in advance.

1. The user must document procedures when using this technique.

2. Scale used for data capture should be established & documented. Recommended scales for digitizing should be between 1:1200 to 1:4000 over DOQQ. Below 1:1200 the imagery becomes extremely blurred. Above 1:4000 accuracy could be compromised.

3. Digitizing tolerances should be established and documented.

4. Users should maintain clear definitions or classifications of features that are being interpreted and delineated.

5. Ground truth (field verification) remains an important step in establishing the quality of heads-up digitizing, particularly for land cover delineation.

6. Make sure appropriate entries concerning the quality of the data are documented in the metadata files.

Detailed classification systems and resolution of imagery may require that features be captured on the screen and then photo-interpreted from aerial photography to the digital image. Photo-interpreting and heads-up digitizing at the same time can be extremely difficult even for experienced users.

All attribute coding shall be 100 percent correctly coded. A full description of each code should be provided as part of the metadata. The coding of features should follow an approved classification system as adopted by State and Federal agencies. These codes follow specifications of organizations responsible for deriving and maintaining the data. For example, the Department uses the Cowardin et al. (1979) system for the Classification of Wetland and Subaqueous Lands in the United States as adopted by the National Wetlands Inventory of the U.S. Fish and Wildlife Service. In addition the Department supports a modified version of Anderson et al. (1976), USGS, for classifying land use/land cover. For prototype classification schemes, clear concise documentation describing the classes is required.

3.2.2 Tablet Digitizing

Tablet digitizing is a common method of getting data into a GIS. The procedure involves tracing lines or locating points with a computer mouse on a digitizer. The manuscript's lines should be clear and complete with no gaps or shortfalls. Operators should not interpret and digitize at the same time. The digitizer should concentrate solely on capturing the exact nature of the features. All maps shall be edge matched prior to digitization to eliminate cartographic errors and reduce digital problems. Digital accuracy shall be evaluated by proof plotting the digital data to the base at the same scale as the manuscript and overlaying the data to the original map. The line work should be digitized in such a way as to create a digital copy that is within +/- one line width of the original. Edits can be flagged and corrected such that the standard is met. Coverage TICS should be identified and RMS errors documented in the metadata.

3.2.3 Scanning and Recompilation

Scanning of features from hardcopy sources or the recompilation of existing digital data, involves the redrafting of features from one source to a more accurate, planimetric source based on identifiable features. This method is commonly used to improve the quality of data that has been delineated on sources of unknown or unspecified quality or paper manuscripts. It is also commonly used to transfer data or non-rectified photography to a rectified orthophoto basemap based on a series of local fits of common photo-identifiable features, such as roads.

Other data sources without photo-images may be recompiled to planimetric sources by using other coincident features. For instance, grids on source data may be generated and plotted to planimetric basemaps and used as a guide for the redrafting of information that would otherwise not be usable in a digital form. This has been used to draft historical purveyor boundaries from old atlas sheets to the photoquads, for instance. Whatever the technique, metadata must be completed describing the recompilation techniques employed.

4.0 GLOBAL POSITIONING SYSTEM (GPS)

The NAVSTAR Global Positioning System (GPS) has become a mainstream technology for data collection for GIS. In New Jersey, state, county and municipal government agencies, academic institutions, public utilities, non-profit organizations, and private firms are using the technology to collect positions of features associated with their activities. A GPS receiver is able to determine its 3D position (latitude, longitude, and elevation) on the surface of the earth, store location information and convert the coordinates into features for use in a GIS. Users can not only capture a feature's location, but also enter descriptive attribute data that significantly adds to the final data layer's value in GIS.

GPS is most effective when the GPS receiver's antenna has an unobstructed view of the sky. Buildings in urban areas and dense tree cover can create reception problems making GPS collection work difficult in these types of environments. The GPS receiver must be able to receive relatively clear signals from at least four satellites simultaneously to determine a 3D position or fix. Depending on the design of the GPS receiver, and the data collection/data processing techniques used, the horizontal range of accuracy can be 15 meters to sub-centimeter.

Positional data collected with GPS must, at a minimum, meet within a 5 meter, 95 percent confidence standard. This requires all GPS data to be differentially corrected. If accuracy requirements call for higher accuracy, parameter settings have to be adjusted accordingly in order to meet the higher standard.

The Department has adopted standards for the critical settings for rover (field data) receivers that are consistent regardless of which receiver model is being used. Users should not deviate from these standards. These settings include:

Table 4.0.1 Critical and Recommended Settings for Data Collection

Standard GPS Collection Parameter Settings

Position Mode	Manual 3D is the normal setting.
Elevation Mask	15 degrees above horizon.
PDOP Mask	6

Signal to Noise Ratio Mask (SNR)	6
Minimum Positions for Point Features	200 (100 for Trimble Pro XL, 60 for Pro XR)
Logging Intervals	Intervals for point features will be 1 second or faster. 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 a 5-second interval.
Logging of DOP	Turned On.

For detailed information on recommended GPS receiver settings and collection procedures, see the Department's *Standards for Using Code-Based Global Positioning Systems (GPS) for the Development of Accurate Location Data for Use with Arc/Info and ArcView Geographic Information Systems.* (http://www.state.nj.us/dep/gis/gpsoutstand.html)

5.0 METADATA STANDARDS

Metadata is required for all digital data layers created by the Department. Metadata is supporting information that describes the digital data layer and is critical for users to understand the key components of the data. Metadata describes how the data were created, who created and maintains the data, when the data were created and/or updated, item (attribute) descriptions, transfer standards, and more. The Federal Geographic Data Committee has defined the Federal metadata standard that all Federal agencies are required to follow for each digital data layer. The Department requires that metadata be provided with each digital data layer and that the metadata be FGDC compliant. Standard FGDC compliant metadata is a critical component of information management systems (clearinghouses) on the World Wide Web (WWW) and for any interactive mapping applications provided across the WWW.

The following is a statement from the FGDC on the metadata standard:

The objectives of the standard are to provide a common set of terminology and definitions for the documentation of digital geospatial data. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.

This standard is the data documentation standard referenced in the executive order (Executive Order 12906, "Coordinating Geographic Data Acquisition and Access: the National Spatial Data Infrastructure)." The standard was developed from the perspective of defining the information required by a prospective user to determine the availability of a set of geospatial data, to determine the fitness the set of geospatial data for an intended use, to determine the means of accessing the set of geospatial data, and to successfully transfer the set of geospatial data. As such, the standard establishes the names of data elements and compound elements to be used for these purposes, the definitions of these data elements and compound elements, and information about values that are to be provided for the data elements.

For more information on metadata, go to the Department's GIS Metadata page (http://www.state.nj.us/dep/gis/metastan.htm). For examples of metadata for GIS data layers go to the New Jersey Geographic Information Network (NJGIN) and "Search" for data (https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp).

Additional information can be found at (http://www.fgdc.gov/metadatalmetadata.html).

For examples of metadata please go to the New Jersey Geographic Information Network and search for GIS data (https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp). For additional resources go to the Department's GIS web site (http://www.state.nj.us/dep/gis/metastan.htm) for a description of metadata and additional examples.

6.0 DATA TRANSFER STANDARDS

In order to enhance data exchange, the following standards should be followed. Presented below are recommended exchange standards for ESRI's Arc suite of products.

6.1 Software

Digital Exchange Standards for GIS

Table 6.1.1 details the exchange standards recommended for the exchange with the Department's GIS software. For "relate," "join" or "link" databases, dbase IV, Access and Excel are preferred over INFO look up tables.

Table 6.1.1 NJDEP GIS Compatible Configurations

PLATFORM	*UNIX Workstation*	PC
OPERATING SYSTEM	*UNIX*	Windows 2000, XP
SOFTWARE/File Format	ArcGIS 9.x Workstation Geodatabase Coverage Shape Files ArcView 3.x Coverage Shape Files DXF	ArcGIS 9.x Geodatabase Personal Geodatabase Coverage Shape Files ArcView 3.x shape files DWG (AutoCad) DGN (Microstation) DXF

DATA TRANSFER	Arc/Info Interchange File (*.e00) Shapefile XML	Arc/Info Interchange File (*.e00) Shapefile XML Winzip (rename to *.abc) (*=name of file)
MEDIA	CD-ROM (CD-R) DVD 3½" HD 1.44MB	CD-ROM (CD-R) DVD 3½" HD 1.44MB Zip Disk (100 or 250MB)

6.2 Data Distribution

6.2.1 Digital Transfer Methods

Data are available in the following variety of formats from a variety of sources today. The formats, usually available in compressed Zip file format, should be compatible with Table 6.1. The New Jersey Geographic Information Network (NJGIN) (https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp) is the preferred centralized location and method for data distribution to users outside the Department.

6.2.2 Data Supplied by NJDEP

For data supplied by the Department the following Distribution Agreement (NJDEP) shall accompany all data transfers. The users agrees to abide by the terms and conditions of the following:

I. Description of Data to be provided

The data provided herein are distributed subject to the following conditions and restrictions.

For all data contained herein, (NJDEP) makes no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties to be implied with respect to the digital data layers furnished hereunder. NJDEP assumes no responsibility to maintain them in any manner or form.

II. Terms of Agreement

1. Digital data received from the NJDEP are to be used solely for internal purposes in the conduct of daily affairs.

2. The data are provided, as is, without warranty of any kind and the user is responsible for understanding the accuracy limitations of all digital data layers provided herein, as documented in the accompanying Metadata, Data Dictionary and Readme files. Any reproduction or manipulation of the above data must ensure that the coordinate reference system remains intact.

3. Digital data received from the NJDEP may not be reproduced or redistributed for use by anyone without first obtaining written permission from the NJDEP. This clause is not intended to restrict the distribution of printed mapped information produced from the digital data.

4. Any maps, publications, reports, or other documents produced as a result of this project that utilize the Department's digital data will credit the Department's Geographic Information System (GIS) as the source of the data with the following credit/disclaimer: "This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized."

5. Users shall require any independent contractor, hired to undertake work that will utilize digital data obtained from the Department, to agree not to use, reproduce, or redistribute NJDEP GIS data for any purpose other than the specified contractual work. All copies of the Department's GIS data utilized by an independent contractor will be required to be returned to the original user at the close of such contractual work.

Users hereby agree to abide by the use and reproduction conditions specified above and agree to hold any independent contractor to the same terms. By using data provided herein, the user acknowledges that terms and conditions have been read and that the user is bound by these criteria.

7.0 ADDITIONAL INFORMATION

7.1 National Map Accuracy Standard (NMAS)

NATIONAL MAP ACCURACY STANDARDS
United States National Map Accuracy Standards
U.S. Bureau of the Budget, Revised June 17, 1947

With a view to the utmost economy and expedition in producing maps, which fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, standards of accuracy for published maps are defined as follows.

1. Horizontal accuracy, for maps on publication scales larger than 1:20,000, not more than 10% of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50th of an inch. These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as benchmarks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is well defined will also be determined by what is plotable on the scale of the map within 1/100 inch. Thus, while the intersection of two road or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test

points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timberlines, soil boundaries, etc.

2. Vertical Accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

3. The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.

4. Published maps meeting these accuracy requirements shall note this fact on their legends, as follows: "This map complies with National Map Accuracy Standards."

5. Published maps whose errors exceed that aforestated shall omit from their legends all mention of standard accuracy.

6. When a published map is a considerable enlargement of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20000-scale map drawing," or "This map is an enlargement of a 1:24000-scale published map."

7. To facilitate ready interchange and use of basic information for map construction among all Federal mapmaking agencies, feasible and consistent with the uses to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7.5 minutes, or 3-3/4 minutes in size. (From Thompson, 1987).

7.2 Digital Imagery (Meets NMAS)

2002 Digital color infrared (CIR) orthophotography

Aerial photography of the entire State of New Jersey was captured during February-April, 2002. Digital color infrared (CW) orthophotography was produced at a scale of 1:2400 (1"=200') with a 1 foot pixel resolution for New Jersey in State Plane NAD83 Coordinates, U.S. Survey Feet. Digital orthophotography combines the image characteristics of a photograph with the geometric qualities of a map. Digital orthophotography is a process, which converts aerial photography from an original photonegative to a digital product that has been positionally corrected for camera lens distortion, vertical displacement and variations in aircraft altitude and orientation. The ortho-rectification process achieved a +/- 4.0 ft. horizontal accuracy at a 95% confidence level, National Standard for Spatial Data Accuracy (NSSDA).

This dataset consists of 5000' x 5000' files in MrSID format with a 15:1 compression ratio. The files, which can be selected and downloaded from the NJGIN site, were produced utilizing MrSID Geospatial Edition 1.4 and are approximately 5 MB in size.

State Resource: NJ Geographic Information Network (NJGIN)
(https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp)

The 2002 orthos are available for purchase in MrSID compressed format (on DVD media only) from the USGS-EROS Data Center.

A complete set of orthos for the State is available on 13 DVDs at a cost of $785.00. Note: If you are NOT purchasing a complete set of orthos on 13 DVDs, you need to include the DVD series number (i.e., DVD 1 of 13, DVD 2 of 13, etc.) with your order.

The MrSID Index with the series number for each DVD is provided as an ESRI shapefile from the NJGIN site.

Pricing Information: $60 per DVD + $5 handling fee per order (subject to change).

Payment, or obligation by way of a purchase order, must be received by the USGS-EROS Data Center before order processing may begin. All instruments of payment are to be made payable to Department of the Interior, USGS. The link for payment options is: http://edc.usgs.gov/about/customer/modes.html

To order: Send email to custserv@usgs.gov or contact Kim Brown at 1-800-252-4547, ext. 2061. USGS-EROS Data Center Business Hours: Monday through Friday, 8:00 a.m. to 4:00 p.m., Central Time.

1995-97 Digital color infrared (CIR) orthophotography

The imagery conforms to the standards of USGS "standard product" for digital orthophoto quarterquads (DOQQs). Many organizations including the Department use these high quality images as digital base maps for mapping applications.

The 1995/97 imagery is color infrared (CIR), has 3 bands, 1 meter resolution, and is NAD83 in UTM (meters). The standard product is available through the USGS EROS Data Center. The Department has made the data available on the GIS server in SPC feet, NAD83. The imagery is available from the following resources:

Federal Resource: http://edcwww.cr.usgs.gov/webglis
http://mapping.usgs.gov/
USGS (703) 648-5931

State Resource: NJ Geographic Information Network
(https://njgin.state.nj.us/NJ_NJGlNExplorer/index.jsp)

1991-92 Digital imagery

The 1991-92 digital imagery is available at 5-ft (quarter quad) resolution or 10 ft (quad) grayscale (1 band) digital files, NAD83. These images meet NMAS at the production scale (1:12000) and are the manuscript images from which the 1991-92 Mylar basemaps were made. The files are *.gis* (ERDAS) files and are 16mb each. These digital images are available only from MARKHURD.

Contractor Resource: MARKHURD, Minneapolis, MN (1-800-MAP- HURD).

7.3 New Jersey Basemaps (Meets NMAS)

The Department has created several source basemaps that are available for mapping initiatives that meet or exceed NMAS. Basemaps provide the foundation for many mapping projects and for the display of mapped information. As such, basemaps must meet uniform, rigorous standards for positional accuracy and cartographic integrity. Over the years, several series of quality basemaps that meet or exceed NMAS have been produced. Basemaps can be either hardcopy (Mylar or acetate) or digital (softcopy). A statewide synoptic set of hardcopy basemaps for New Jersey was made from aerial over-flights sponsored by the Department in 1991 and 1986. In both cases, both quadrangle (1:24000) and quarter quadrangle (1:12000) hardcopy Mylar basemaps were produced. Other basemaps cover specific areas only, such as the 1977-78 Tidelands photo basemaps. Two series of digital (softcopy) basemaps have also been produced, from the 1991 and 1995/97 over-flights. The digital images were produced at quarterquad scale (1:12000).

*** Hardcopy (Mylar) Basemaps**

Listed below in order of general overall quality is available New Jersey basemap series that were produced on stable base mylar and meet a definable mapping standard (NMAS). The first four series listed are photo basemaps, derived from aerial photography. The 1991/92 and the 1986 wetland series are both orthophoto basemaps compiled from a sophisticated aero-triangulation process. They should be used whenever possible to generate GIS compatible data and/or to use as a recompilation base.

All the hardcopy basemaps described herein with the exception of the 1991/92 products are referenced in NAD27. For this reason, the 1991/92 mylar basemap quads (1:24000) and quarterquads (1:12000) series, referenced in NAD83 are highly recommended by the Department over all other sources listed for mapping at these scales. Stable base site maps of large scale meeting NMAS, produced by surveying, mapping or photogrammetric firms may qualify as GIS compatible if they contain a minimum of four registration tics in the New Jersey State Plane Coordinate System, North American Datum 1983 (NAD83), the official survey base of New Jersey. The USGS topoquad series are not recommended as a delineation source because they are generally available only on paper and are not synoptic data sources. Rather, they represent variable data sources and dates.

***1991/92 Orthophoto Basemaps (Quadrangles and Quarter quadrangles)**

The most recent statewide set of hardcopy chronoflex quarterquad (1:12000) and photoquad (1:24000) photo basemaps were produced from the 1991/92 aerial overflight of the State. These basemaps meet or exceed NMAS. This series of maps is referenced in SPC feet in NAD83, but also has NAD27 tics in the margin. This series is the most current, highest quality basemaps of their scale available statewide, that are referenced in the new datum, NAD83. This basemap series is highly recommended by the Department for mapping efforts at these scales.

*** 1986 Freshwater Wetlands Orthophoto Quarterquad Basemaps (1:12000)**

The passage of the Freshwater Wetlands Act of 1987 required the State to produce a composite map of the freshwater wetlands (FWW) for the State. Subsequently, a set of 635 chronoflex photo quarterquads for the entire State from the March 1986 overflight was produced. The maps represent an excellent source for both photo-interpretation and recompilation at a county, municipal or site level. However, these maps are dated and are referenced in the old datum (NAD27). The 1991/92 series now supercedes these maps. There is also a set of composite hardcopy FWW maps with the delineation superimposed on the image.

*** 1986 Photoquad Basemaps (1:24000)**

A statewide overflight in March 1986 produced a complete set of stable base photoquads at 1:24000. The control for the production of these basemaps was the Mylar USGS 7.5-Minute topoquads. The photoquads have been widely used both to create data layers and to recompile other data sources from paper or non-planimetric sources. These basemaps did not follow rigorous orthophoto techniques and are referenced in the old datum. The 1991/92 basemaps supercedes these maps.

*** 1977/78 Tidelands Basemaps (1:2400)**

The tidelands maps are a series of 1:2400 base maps for the coastal zone that include all tidal areas in the State to delineate the State's claim to all tide-flowed lands. The series consists of 1628 photo basemaps. These maps are rectified products that meet NMAS below the ten-foot contour. The photo-image is late summer of 1977 and 1978. These maps cover the entire coastal zone up to the head-of-tide.

*** USGS 7.5-Minute Series Topoquad Basemaps (1:24000)**

The USGS has published an entire series of 172 topographic maps for the State at a scale of 1:24000. The base information ranged from the late 1940s to the 1980s with photo-updates into the mid 1990s. Because these maps vary in source date, and because more accurate and current basemaps (1991/92) are available, the USGS topoquads series *is not recommended* by the Department as a mapping base.

The topoquads do represent an excellent reference source, particularly for named places and features.

Basemap Resources

Mylar photo basemaps from 1991, 1986 and 1977/78 and the digital imagery from 1991 may be obtained from MARKHURD, Minneapolis, MN (1-800-MAP-HURD). There are several sets of the 1986 and 1991 chronoflex (Mylar) base maps in the Department. The GIS Unit has a set of each for reference.

Paper prints of 1986 and 1991 orthophoto basemap series, as well as paper prints of USGS topoquads, may be obtained from the Department's Maps and Publications; (609) 777-1038. Paper prints from the 1977/78 series are available from the Bureau of Tidelands Management: (609) 292-2573.

Topoquads and other USGS Federal maps (and aerial photos) may be ordered from 1-800-USA-MAPS or (703) 648-5931.

Aerial Photograph Resources

Historic aerial photography is available for inspection at the Department's Tidelands Management Program (TMP) by scheduled appointment. The 1986, 1991/92, 1995/97 and 2002 photo color infrared frames are also available for inspection at the TMP. Appointments are required. The 1991/92 and 1995/97 photos may also be purchased from the USGS EROS Data Center.

Federal Resource: http://mapping.usgsgov/
USGS (703) 648-5931
Department Resource: Tidelands Management Program (609) 633-7369

7.4 Internet Resources

NJDEP, BGIS: http://www.state.ni.us/dep/gis

NJ Geographic Information Network: https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp

GPS Resource: http://www.state.nj.us/dep/gis/newgps.htm

FGDC Resources: http://fgdc.er.usgs.gov/standards
http://geochange.er.usgs.gov/
http://www.fgdc.gov/
http://www.fgdc.gov/standards/standards.html
http://www.fgdc.gov/standards/documents/proposals/swathpr3.html

USGS Resource: http://edcwww.cr.usgs.gov/
(EROS) Data Center

ASPRS Resource:
http://www.asprs.org/asprs/resources/standards.html

NOAA Resource: http://www.csc.noaa. gov/crs/ccap_index.html
Coastal Change Analysis Program (C-CAP):
"Guidance for Regional Implementation"

Private Resource: http://www.spaceimaging.com/
Contains Landsat TM ortho-corrected processing procedures.

Surveyor Resource: http://www.njspls.org/
(NJ Society of Professional Land Surveyors)