Technical Specifications for Cadastral
Base Digital Mapping

Land Records Management Division
North Carolina Department of
The Secretary of State

Spring 2007

PREFACE

The "Land Records Management Program" (LRMP) was established in 1977 by the North Carolina Legislature in order to provide technical and financial assistance to local governments for the modernization of their land records systems. The Technical Specifications for Base, Cadastral, and Digital Mapping (Orthophotos)" is thus prepared as an essential element of the LRMP and is applicable to all county or municipal mapping projects. To the maximum extent practicable, these specifications should also be utilized by state agencies involved in mapping operations. Section 6, "Digital Orthophotos", was adopted on August 18, 2004, by the North Carolina Geographic Information Coordinating Council (GICC).

The Orthophoto Standards were removed from this document and adopted as a stand alone standard on October 1, 2009.

Invaluable guidance and assistance have been provided by the Standards Committee of the North Carolina Property Mappers Association and by representatives of local governments. Assistance was also provided by the North Carolina Geodetic Survey (NCGS), the Center for Geographic Information and Analysis (CGIA), the North Carolina Department of Transportation, and the North Carolina Department of Revenue.

TECHNICAL SPECIFICATIONS FOR BASE, CADASTRAL, AND DIGITAL MAPPING (ORTHOPHOTOS)

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SECTION 1

GENERAL

1. **GENERAL**
   1.01 **Definitions:**
   a. The Contracting Officer is the officially designated representative of the local government obtaining the mapping products or other services. This individual's authority and responsibilities shall be as prescribed by the County Board of Commissioners or appropriate municipal authority.
   b. The Contractor is that firm, company, or organization to which the mapping or service contract has been let. References to the Contractor in these specifications shall also apply in full to any subcontractor working for the named Contractor.
   c. References to "the County" shall be construed to include not only county governments, but also municipal governments or any other agency or party wishing to enter into a mapping contract with a Contractor under the provisions of these specifications.

   1.02 **Work Statement:**
   The Contractor shall furnish all materials, superintendence, labor, equipment, and transportation and shall execute and complete all of the work required by the contract in conformance with these specifications and any contractual modifications to these specifications. Any deviation from these specifications, unless specifically authorized in writing by the Contracting Officer or his representative, shall be sufficient cause for rejection of any part or all of the work performed.

   1.03 **General Mapping Specifications:**
   a. The Contractor will supply the Contracting Officer with a sample format of each hardcopy map/overlay type and/or softcopy map/overlay mask type showing the placement and content of all border information for approval prior to final map and/or overlay production.
   b. All deliverable hardcopy maps/overlays and/or softcopy maps/overlays shall contain the following statement:
       This map/overlay is correlated to the North Carolina State Plane Coordinate System, NAD83(NSRS2007) North American Datum.
   c. All lettering on all deliverable hardcopy maps/overlays and/or softcopy maps/overlays shall be done by mechanical means only - freehand lettering will not be accepted.

1.04   Visits to Contractor's Site:
The Contract Officer or an officially designated representatives or agents of the County may visit the Vendor's site to inspect work in progress and verify that the procedures and equipment being used are in compliance with these Specifications and contract requirements. The Contractor agrees to allow access to its production facilities for periodic visits by the County representatives or agents. These visits may be unannounced and/or may be upon short notice.

1.05   Surveying Activities:
All surveying activities, as defined in NC GS 89C, undertaken by the Contractor shall be conducted by surveyors licensed by the North Carolina Board of Engineers and Land Surveyors. Photogrammetry services shall only be provided by licensed surveyors who are competent by virtue of education and experience in the discipline of photogrammetry. At the beginning of a project involving photogrammetric services, the Contractor shall identify the licensed surveyor who will sign and seal the completed project, and, as such, will have direct supervisory control of the project.

1.06   Traditional Cadastral Mapping Activities:
Traditional cadastral mapping activities as detailed in these Specifications are not surveying services as defined in NC GS 89C and, as such, do not need to be provided by surveyors licensed by the North Carolina Board of Engineers and Land Surveyors.

SECTION 7

CADASTRAL MAPS

7. CADASTRAL MAPS

7.01 Definitions:

a. Cadastral Map. A cadastral map or cadastre is a line-drawn-to scale depiction of the parcel boundaries within a governmental jurisdiction, as covered by the map's image area. It is normally a multi-purpose public record designed to show (1) real property ownership within the jurisdiction; (2) the basis for real property valuation and taxation; and (3) geographical information for use by planners and other governmental officials, as well as the general public.

b. Parcel. A parcel is that portion of land, commonly referred to as real estate or realty, which has been or may be legally conveyed to a new owner by deed in its existing configuration, and is continuous within its outer boundaries.

c. Deed Acreage. Deed acreage is the acreage stated in the recorded deed.

d. Computed Acreage. Computed acreage is the acreage calculated by the Contractor from the parcel as shown on the finished cadastral map.

e. Assessed Acreage. Assessed acreage is the acreage that the County Assessor uses for listing and appraising a parcel for tax purposes.

f. Exempt Parcels. Exempt parcels are those parcels that the County Assessor exempts from County property tax such as churches; schools; charitable properties; and state, County, and city properties.

g. Parcel Identifier Number (PIN). The parcel identifier number (PIN) is a number assigned to each parcel. See subsection 7.06 for the derivation of the parcel identifier number.

7.02 Project Area & County Contract Map:

The location, size, and boundaries of the areas to be mapped will be outlined on a county map and further subdivided and designated in a way to show the number and scales of the final cadastral maps to be prepared; the map shall be at a scale adequate for its purpose and shall be in hardcopy and electronic formats. The electronic version shall be geo-referenced and at the request of the County may contain the major county road network. This marked county map shall be entitled the "County

Contract Map" and shall become attached to and part of any contractual agreement. Priority areas to be incorporated in the contract delivery schedule will be shown on the County Contract Map.

7.03   <u>**General**</u>**:**

The cadastral map is primarily intended to depict property boundaries and related information and will be produced as described in Section 8. It should not be cluttered with symbols for such natural and man-made features as are normally found on planimetric base maps for the same area. Nevertheless, certain other descriptive and identifying features will be included on cadastral maps or associated overlays, namely:

a.   Names, boundaries, and identification of subdivisions and plats.

b.   State, County, township, municipality, special districts, and public land boundaries and names.

c.   Boundaries of all known rights-of-way and major easements.

d.   Delineation and identification of all streets, roads, highways, alleys, railroads, rivers, lakes, canals, seaports, and airports.

7.**04**   <u>**Content and Format for Hardcopy Maps**</u>**:**

a.   <u>Size</u>. The standard map size is 30 inches by 42 inches and will contain a neat image area of 25 inches by 25 inches. The sample cadastral maps cited in Appendix B are incorporated into these specifications by reference, and bear the same weight of authority as the written specifications.

b.   <u>Materials.</u> The map will be prepared on a stable polyester material suitable for overlay printing of the orthophoto base map. The material will be cronaflex or ultra-translucent Mylar film with a minimum thickness of .003 inch and having a matte surface on both sides.

c.   <u>Legend & Marginal Information.</u> Marginal information consisting of north arrow, disclaimer note, map index, bar scale, map number, map scale, map title, subdivision index, mapping Contractor, grid coordinate values (north coordinate values labeled across east side of map and east coordinate values labeled across south side of map), and border lines will appear in the 9 inch right-hand margin border of the map. The chart for record of revisions will be placed in the left hand

margin. All marginal information will be placed on the cadastral map in such a way that when this map is overprinted with its respective base map, all marginal information from both maps will be clearly legible. The map number on the cadastral map will be the same as the map number for its respective, or "matching," base map. The legend and marginal information may be created with a digital template. The following marginal information shall also appear on the map:

1. Map title. The map title will contain the County and State names. The Contracting Officer may require the County seal to be included in the map title.

2. Subdivision index. The subdivision index will contain the following information for each subdivision shown on the map: the index number, the main PIN number, the subdivision name, and plat book and page number.

3. Legend. The legend will contain as a minimum the following: state, county, city, township, Indian reservation (when appropriate), and national forest (when appropriate) boundary lines; property boundary lines; parcel hook; original lot number; original lot lines; interstate, US, NC, and secondary roads; road and railroad rights-of-way; streams and shorelines; block number; parcel identifier; computed acreage; scaled dimensions; acres in county; utilities easements; property corners with grid coordinates; and a note stating that dimensions are in feet.

4. Disclaimer note. The disclaimer note will read as follows: This map is prepared for the inventory of real property found within this jurisdiction and is compiled from recorded deeds, plats, and other public records and data. Users of this map are hereby notified that the aforementioned public primary information sources should be consulted for verification of the information contained on this map. The County and the mapping companies assume no legal responsibilities for the information contained on this map.

Located with the disclaimer note will be the following statement:

Grid based on the North Carolina State Plane Coordinate System, NAD83(NSRS2007), North American Datum.

5.   Map index. The map index will show the relationship of the map to all adjacent surrounding maps.

d.   Scale of Maps. The scales of the County's cadastral maps will be the same as the scales of the underlying base maps which are normally prepared at nominal scales of 1" = 400', 1" = 200', 1" = 100', and in special situations 1" = 50'.

e.   Block Lines and Block Numbers. On all scales of cadastral maps, the neat image area will be sub-divided into so-called "map blocks" for the purpose of building the parcel identifier number (PIN). The map block will be a 1,000-foot square whose boundaries will conform to the even thousand-foot divisions of the North Carolina State Plane Coordinate System and will be delineated by fine block/grid lines running north-south and east-west across the entire neat image area. The two-digit block number derived from the PIN system will be printed in the center of each block using "hollow" numbers. Details of the size and style of annotation will be determined by the County and Contractor.

f.   Grid Ticks. On all scales of cadastral maps, the 25 inch by 25 inch neat image area will be further subdivided with "grid ticks" (1/2 inch crosses) placed where north-south and east-west grid coordinate lines drawn every 5 inches on the image area would run or intersect. On 1" = 100' or larger scale maps, grid ticks will be shown on those points where intersecting block lines do not appear. Grid ticks will appear as black lines on the finished map.

g.   Adjoining County Maps. A county contracting for cadastral maps under these specifications shall determine if any of its adjoining counties have already been mapped in conformance with these state specifications. The contracting County shall obtain copies of all existing maps adjoining its County boundaries for delivery to and use by the Contractor as source materials.

7.05   **Project Procedures:**

a.   The Contractor will conduct all field investigations necessary to obtain property boundary and cadastral information. Such field

investigations may include visiting properties, contacting property owners, contacting neighboring property owners, etc.

b. The Contractor will prepare all property boundaries and cadastral information on the digital orthophoto base map. The location and plotting of the parcel boundaries shall be accomplished through the use of recorded source maps and plats and the deed descriptions in conjunction with photo images on the orthophoto base maps. In the event parcel ownership boundaries cannot be delineated or plotted through the use of deed descriptions, existing source maps, or recorded plats and surveys, the following priorities of calls shall be utilized:

1. Natural Boundaries
2. Natural Monuments
3. Man-made Boundaries
4. Adjacent Owners
5. Course (bearing or direction)
6. Distance
7. Area

Leaseholds, lessor estates, and mineral interests will not be included in this location and plotting process. Major cross-country utility easements as agreed upon between the Contracting Officer and the Contractor are included in this location and plotting process.

c. The Contractor shall submit a working file with corresponding source material for each cadastral data layer. The source material shall include but not be limited to deed(s) of each parcel, plats, etc. that were used in the compilation of the parcels and associated data layers. The County may require the scanning of all deeds, and surveys as well as link the property record cards to the GIS database. If hard copies are used, the deed(s) and plot shall be attached to a copy of the parcel's property record card. Any other documents used in the compilation of the checkplot of the cadastral map such as plats, wills and estates, surveys, etc. will be numbered with the corresponding subdivision index number or PIN number and will be included in the file as well as digitally linked to associated PIN. This working file may be scanned and delivered to the County in an electronic format consistent with the County's computer system. The

Contracting Officer will review the map and corresponding work files, note any corrections to be made, and return a narrative of the corrections to be made to the Contractor.

d.   The Contractor will deliver the finished cadastral maps to the Contracting Officer for review. All transfers, splits, and combinations of parcels will be included on the final deliverable cadastral map and will be current to within sixty (60) days of the final delivery schedule. The Contracting Officer will review the final cadastral maps for adherence to specifications including the location and correctness of PIN's, location and correctness of acreages, etc., note any corrections, and return a narrative of the corrections to be made to the Contractor.

7.06   Derivation of Parcel Identifier Number (PIN):
The parcel identifier number (PIN) is constructed from the North Carolina State Plane Coordinates of the visual center of a parcel. The following is the procedure for determining the PIN.

a.   Grid Coordinates of the visual center of the parcel are measured from the cadastral map:

    "x" coordinate (easting) - E 2,715,569
    "y" coordinate (northing) -N 0,756,737

b.   The digits in each coordinate value are paired by taking each digit separately from the east-coordinate and matching it with the corresponding digit of the north-coordinate.

    20 77   15 56 57 63 97
    EN EN EN EN EN EN EN

c.   With this arrangement, the above example of a parcel identifier may be sorted as follows:

20	7715	56	5763	97
Redundant	Number of	Block	Lot or	Utilized
lead number	basic map	number	parcel	only to

for any one	module	number	extend the
county	(1" = 400')		capacity of
			system

d. The North Carolina "Parcel Identifier Number" or "PIN" is obtained by recording the <u>middle</u> three sets of numbers (ten digits), and is written with dashes as follows:

7715 - 56 - 5763

e. Records of condominiums, townhouses or other cases of diverse ownership on one parcel of land will be further identified by the use of a decimal at the end of the PIN with three (3) digits to the right of the decimal. The records for a condominium unit or units built on the above-described hypothetical parcel could be assigned a suffix number to the Pin of .001 through .999. For example, a condominium unit could have the following PIN number:
7715 - 56 - 5763.008

7.07   **Mapping of Subdivisions:**

a. Subdivision plats or maps on file in the Register of Deeds Office will be mapped by the Contractor according to one of the following two options:

Option #1 - All Inclusive– The subdivision will be mapped as recorded with all interior lot boundary lines shown by <u>solid</u> lines. A PIN will be assigned and depicted on the map for each of the interior lots (parcels).

Option #2 - Status Dependent Subdivision – Subdivisions will be mapped in stages directly related to activity as shown in the following categories:

A. <u>Undeveloped subdivision.</u> The owner of a particular tract or combination of tracts or parcels has designated his property as a "subdivision" by filing a plat or map showing that property as a subdivision. However, the owner has made no physical improvements, as defined below, to this "subdivision" <u>and</u> no

lot or lots have been sold from this "subdivision." No interior lot lines will be shown in the mapping.

B.   <u>Improved subdivision.</u> The owner has taken the step described in (A) above and, in addition, has made some physical improvement to the property in preparation for development. This "improvement" may take the form of one or more of the following: land clearing or grading operations; construction of roads or streets, whether paved or unpaved; installation of utility services of any kind; or the building of any new structures on the property. No lot or lots have been sold. Interior lot lines will be shown as <u>dashed</u> lines and all interior boundary dimensions will be shown. No PIN's will be placed on the map for any of the interior lots.

C.   <u>Active subdivision.</u> The owner has taken the step described in (A) above and has also sold one or more of the lots of the "subdivision". The owner may or may not have made any "improvements" to the subdivision property; improvements are not a criterion for subdivision category C. All interior lot boundary lines will be shown by <u>solid</u> lines. A PIN will be assigned and depicted on the map for each of the interior lots (parcels).

b.   The following mapping requirements will apply to all subdivision categories described in subsection 7.07 a. The entire outer boundary of the subdivision will be shown by a **<u>bold</u>** solid line. Numerals placed inside the corners will be keyed to an index of subdivision names in the margin. When a subdivision is plotted on more than one map, the subdivision's index number will be the same on all maps. An index number may not be duplicated on any map. When a subdivision is plotted on more than one map, the main PIN will be placed on the map that contains the largest area of the subdivision, or on the map that contains the majority of the common-user property. All parcels should get their own unique identifier as per common mapping standards, however, if specified in writing by the County, one main PIN can be determined and can be utilized as the land records system's link to all common-user property (playgrounds, pools, clubhouses, greenways, wells, maintenance facilities,

sanitation facilities, parks, etc.) within the subdivision or to subdivision documents such as the subdivision plat or maps, restrictive covenants, association by-laws, etc. The last four digits of the main PIN will be shown on the map by an enclosing oval. Main PIN's will be assigned to those subdivisions that are recorded and have been given a public name such as McGregor Downs Subdivision or Sunset Hills. See Appendix H for drafting specifications.

7.08   **Drafting Specifications:**

a.   Method. It is desirable for state, county, municipality, and all special districts and their annotations; block lines; block numbers; and grid ticks to be drafted or plotted on separate layers.

b.   Symbols. All symbols, numbers, letters, and lines will be shown, insofar as possible. Cross-country utility easements as agreed upon between the Contracting Officer and the Contractor are to be shown by dashed lines at the boundaries of the easement's limits and annotated with the width of the easement and the kind of utility. All special district lines will be shown by dashed lines, and labels identifying the district will be placed in the breaks of the dashed lines. The Contracting Officer will supply the Contractor with proper source material that will permit the Contractor to accurately locate and identify the special district lines on the cadastral maps.

c.   Parcels.

1.   General. All parcel boundaries will be delineated with solid lines. When a parcel is made up of a combination of two or more previously separate tracts or parcels, the interior tract boundaries will be delineated with dashed lines. A black dot marking the visual center of the parcel, the parcel identifier number (last four digits), and the acreage of the parcel will be entered inside the parcel's boundaries. If the parcel identifier number and/or acreage cannot be entered inside the parcel boundaries, they will be placed on an adjoining space and arrowed into the parcel. All parcels having corners tied to the North Carolina State Plane Coordinate System in conformance with North Carolina General Statute # 47-30 (f) (9) shall have

such corners depicted on the cadastral map. All parcels that are exempt from taxation shall have their common names labeled inside their boundaries or arrowed in if necessary. The labeling of bearings along parcel boundaries is an <u>optional</u> feature (see Appendix H). See Appendix B for illustrations of the proper entry of parcel information.

2.   <u>Dimensions.</u> All dimensions will be shown for parcels five (5) acres or less in size. The County and the Contractor may agree to the option that all dimensions be placed on all parcels regardless of acreage. Regardless of parcel acreage, dimensions will be shown for all parcel boundaries that front on roads. Dimensions of parcel boundaries that front road rights-of-way will be measured to the limits of the rights-of-way, thereby indicating that the area covered by the entire road right-of-way is excluded from the parcel's acreage calculation. Deed dimensions will be shown except where the discrepancies between deed and scaled dimensions exceed two (2) feet at 1" = 100', four (4) feet at 1" = 200' and eight (8) feet at 1" = 400', in which cases the scaled dimension will be shown.

3.   <u>Acreages.</u> All parcels one (1) acre and larger in size will show their computed acreage on the final cadastral map. Acreages will be shown to the nearest one-hundredth (0.01) of an acre on all scales of maps. A county can request in writing to the contractor to supply deeded acreage instead of the computed acreage.

4.   <u>Hydrographic features.</u> Lakes, ponds, streams, rivers, and large bodies of water will be labeled with their names inside or along their boundaries.

5.   <u>Roads.</u> All roads, streets, and highways will be labeled with their names or numbers inside or along their boundaries.

6.   <u>Inter - county parcels.</u> All boundaries of a parcel that extend into another county will be shown on the map whenever it is possible. The parcel's acreage within the County and the parcel's total acreage will be indicated on the map. Unless otherwise noted, the assessed acreage and the computed

acreage required in subsection 7.11 refer to a parcel's assessed and computed acreage within the County.

7.09   Delivery Schedule:
The Contracting Officer and the Contractor shall develop a delivery schedule, with cut-off dates for map updates (e.g., property lines, subdivision lines), for all the deliverable products of the project. Prior to preparation of the contract, the cut off dates will be determined and included in the contract delivery schedule.

7.10   Cadastral Database Maintenance:
The Contractor shall maintain all digital cadastral data until all deliverable products are received and accepted by the Contracting Officer in accordance with the contract delivery schedule and subsection 7.05 c. and 7.05 d.

7.11   Deliverable Items by the Contractor for Cadastral Maps:
At the completion of the mapping project, the Contractor shall deliver to the Contracting Officer for his acceptance the following items:

a.   An index map as described in subsection 7.02.

b.   A computer-generated database consistent with the County's computer system for all parcels in the County, including the following information at a minimum:

   (1)   Full name(s) of parcel owner(s)

   (2)   Parcel identifier number (PIN)

   (3)   Parcel dimensions (deed or scaled)

   (4)   Parcel acreage (as shown on the map)

   (5)   Conveyance records (book and page of deeds and/or will abstract)

   (6)   Date of recordation

   (7)   Any prior identification (tax number, etc.)

   (8)   Subdivision name (if applicable)

   (9)   Plat book and page (if applicable)

   (10)   Map Number

(11) Township code or name

The Contractor will submit a sample format of the database to the Contracting Officer for written approval prior to any data entry activities.

c. Computer generated "Property Index Files" consistent with the County's computer system. There shall be a digital file of the "Property Indexes" for each cadastral map in use. In the headings of the Indexes will be the complete description of the cadastral map to which each Index is keyed. The property Indexes will list all parcels by parcel identifier numbers in numerical sequence. The second set of Property Indexes will list the parcel owner(s) name(s) in alphabetical sequence. Exempt properties will also be included in these "Property Index Sheets" and will be identified by their common names. Column headings on each sheet will be as follows:

1. Property index by PIN

	OWNER(S)	CONVEYANCE		
PIN	NAMES(S)	INFORMATION (BK/PG)	DATE RECORDED

2. Property index by owner(s) names(s)

OWNER(S)		CONVEYANCE	
NAMES(S)	PIN	INFORMATION (BK/PG)	DATE RECORDED

A sample of the "Property Indexes" format will be submitted by the Contractor to the Contracting Officer for approval.

d. The working file for each map as described in subsection 7.05 c.

e. Errata or reconciliation lists. All errata or reconciliation lists will be computer printout pages with all lines double-spaced. These lists will be delivered in accordance with the contract delivery schedule. Master files of these lists will be kept current during the entire project and a composite listing in alphabetical or numerical order will be delivered to the Contracting Officer at the end of the project. A sample of the format of each list will be submitted to the Contracting Officer for approval prior to the development of the lists. For quality control purposes an "in process" copy of Errata Lists will be made

available upon request by the Contracting Officer and may be in digital or hardcopy form.

1. Unlocatable Parcels. Unlocatable parcels are all parcels that are assessed or on the tax scrolls but are not locatable by the mapping Contractor. A list will be prepared that shows the names of owners as found on the Assessor's Roll and the assessed acreages; the list shall also show the total acreage of all such properties in the County. The total number of parcels on this list shall not be greater than one percent (1%) of the total number of parcels in the County without the written approval of the Contracting Officer.

2. Parcel Discoveries/Owner Known. Parcel Discoveries/Owner Known are those parcels found and mapped by the Contractor for which the owner name are known but are not on the Assessor's Roll. A list will be prepared that will show the name(s) of owner(s), PIN, deed acreage, and computed acreage for each parcel; the list shall also show the total deed acreages and computed acreage of all such properties in the County.

3. Parcel Discoveries/Owner Unknown or Doubtful. Parcel Discoveries/owner Unknown or Doubtful are all parcels found and mapped by the Contractor for which the true owner cannot be satisfactorily determined and which are not on the Assessor's Rolls. A list will be prepared which shows the PIN, deed acreages, and computed acreages; the list shall also show the total acreage of all such properties in the County. The total number of parcels on this list shall not be greater than one percent (1%) of the total parcels in the County without the written approval of the Contracting Officer.

4. List of Acreages (Deed, Computed, and Assessed.) A list will be prepared that shows the deed acreage, computed acreage, and assessed acreage for each parcel in the County. There shall be one separate List of Acreages for each cadastral map in use, and in the heading of the List will be the complete description of the cadastral map to which the List is keyed. Column headings on each List will be as follows:

Old Parcel Number	PIN	Owner(s) Name(s)	Assessed Acreage	Deed Acreage	Computed Acreage

The Contractor will also provide the total assessed acreage, deed acreage, and computed acreage for the entire County.

5. <u>List of Divergent Parcel Acreages.</u> A list will be prepared for all parcels where the computed acreage varies from the assessed acreage by at least the percent shown in the following chart:

Parcel Acreage	Percent of Divergence
1.01 - 5.00	10%
5.01 - 20.00	8%
20.01 - 50.00	6%
50.01 & Greater	4% to a maximum of 5 acres

The County may require a different Parcel Acreage/Percent of Divergence if agreed in writing with the Contractor. There shall be one separate List of Divergent Parcel Acreages for each cadastral map in use, and in the heading of the List will be the complete description of the cadastral map to which the list is keyed. The column heading on each list will be as follows:

PIN	Owner(s) Name(s)	Assessed Acreage	Deed Acreage	Computed Acreage	Amount of Divergence Assessed/Computed (in acres)

f. Two sets of exempt parcel lists. One set will contain lists of exempt parcels and will be delivered in accordance with the contract delivery schedule. The second set will contain a list of all exempt parcels in the County and shall be delivered at the end of the project. Both sets of lists will be digital as well as computer printout pages with all lines double-spaced. Column headings for both sets of lists will be as follows:

<pre>
          Owner(s)   Computed
     Common Name   PIN   Name(s)_   Acreage
</pre>

g. Media for storing the data generated in the preparation of the database and maps described in subsections 7.11 b., c., e., and f. shall be in compliance with section 8.05. All base maps and associated materials, including microfilm provided to the Contractor by the County, and/or all other materials used by the Contractor in the completion of the project. All such returned materials shall be organized according to their respective maps. Microfilm will be boxed and identified by microfilm reel number.

7.12   Materials/Information/Assistance to be Provided or Made Available by the County:

In addition to all necessary base maps for the cadastral mapping project, the County shall be responsible for providing the Contractor with the following:

a. Copies of assessment rolls and/or tax scrolls for each year during the duration of the project. These may be provided in a digital format consistent with the computer system of the contractor.

b. Access to all existing photography, maps, deeds, and records necessary for cadastral mapping within the County government's jurisdiction. The Contractor shall be responsible for the cost of making copies of these materials and records.

c. Assistance in gaining access to all available information regarding the location of state highway rights-of-way and other public lands such as parks.

d. A listing, as complete as possible, of all "exempt" parcels in the County (e.g., churches, schools, other charitable or non-profit owners) including the parcel's common name and street address or other locational information.

e. All adjoining counties' cadastral maps along the County's boundary lines.

SECTION 8

DIGITAL MAPPING

8.01 <u>Introduction</u>:

>The purpose of this section is to provide the Contracting Officer and Contractor with a set of standards for digital mapping. This section also provides descriptions of terminology, data structure, accuracy, and data exchange specifications.

>Information to be used in a digital mapping system will be stored in X and Y North Carolina State Plane Coordinates.   The process of capturing the coordinate points and storing them in a computer or computer-readable format is called digitizing. The digitization of cadastral, soils, land use, and topographic information should be based on existing maps, GPS, Orthophotography, stereo models, etc..

>The product of digital mapping must be topologically structured digital data sets.

8.02 <u>Data Definitions</u>:

The following definitions of map data are presented to clarify their usage and meaning in these

specifications.

>a.   <u>Layer.</u> (Layers are described by one of the following): Vector data such as roads, rivers, or political boundaries which is organized by subject matter. Vector can be described as digital transparencies that can be overlaid for viewing or spatial analysis; a raster data set represents a particular geographic area, such as an aerial photograph or a remotely sensed image. Raster and vector data, covering the same geographical space, are registered to one another by means for a common coordinate system; a file that stores and displays symbology and information for a given vector or raster data set. The layer points to it's physical location but does not actually contain the data.

>b.   <u>Component.</u> A component is a discrete type of data that, in combination with other components, creates a layer. Examples of components include soil lines, soil labels, PIN numbers, and right-of-way lines. Each component is composed of objects (see definition below) that graphically represent a component's extent (lines or area) or that present information (symbols or text). Subsection 8.10 contains a listing of components by layer.

c. Objects. Objects are the basic graphic elements that are the "building blocks" of geographic data files. The primary objects used to create components are points, nodes, lines, and areas. Objects are interrelated in a "topological" structure that defines the relationships of the objects to each other. Topological data structures are defined below.

1. Points: Points are used to represent the location of objects defined by a single set of X and Y coordinates (see Figure 8.02.1). In some cases, these are feature points that can be identified on the surface of the earth (e.g., benchmarks). In other cases, they are arbitrarily placed label points (e.g., locations for the placement of text). In other cases, they are attribute points for areas or lines (e.g., PIN's). The locations of attribute points may be digitized or may be calculated by computer software, GPS, etc.

2. Nodes: Nodes represent the ends or intersections of lines (linear objects). Nodes exist at the first (beginning point) and last (ending point) set of X and Y coordinates of a line. Each node may also reflect an intersection with one or more additional lines (see Figure 8.02.1). A node plays an important role in topological definition and, as such, should reference each line that intersects it.

3. Lines: Lines are strings of coordinates that run between nodes. Each line has a minimum of two X and Y State Plane Coordinate pairs (straight line). Lines also include references to attribute points, the beginning and ending node numbers, and identifiers of areas (when applicable) on the right and left of the line (see Figure 8.02.1).

4. Areas: Areas are polygons which are defined by a series of lines. These lines must, in combination, totally encircle or close the area they represent. Areas also include references to attribute points and other associated data. The boundary of an area is defined by a listing of the lines that comprise the area's border (see Figure 8.02.1).

Figure 8.02.1 Graphic and Coordinate Depictions of Objects.

d. Topological Data Structure. Topology is the study of the mathematical properties of geometric figures; it is a means of mathematically describing the relationship among points, lines, and areas used to define geographic entities. The use of a topological data structure is important for the effective creation and manipulation of geographic data. Topology allows the interrelationships of graphic objects to be specified. It also prevents the necessity of storing repetitive data. Thus, one line can represent a stream and the boundary of each of two adjacent areas or parcels. This structure allows the computer to generate areas based on node and line information. Topological structures allow the efficient analysis of lines or areas. Thus, road networks stored in a format with topological structure can be used for school bus routing, garbage truck routing, or emergency service routing. Topology requires that several data items be maintained with relation to each node, line, and area. Figure 8.02.2 illustrates these relationships.
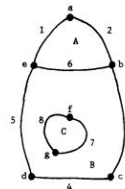

Figure 8.02.2 Diagram illustrates topological relationships of areas, lines, and nodes in both graphic and tabular form.

e. Digital Data Sets: Digital data sets are computer files that store geographic data. Each data set may contain components from one or

more layers. For example, a data set may contain the hydrographic names component associated with the hydrographic layer and the road names component from the cadastral layer. Or a data set containing soils lines components would also contain soil labels. A roads data set could contain pavement width, right-of-way limits, and road labels. The Contracting Officer should define the components that will be contained in each digital data set before requesting proposals for digital mapping.

f. <u>Digital Labeling</u>: There are two methods of digital labeling: (1) attaching attribute data to points, lines, and areas, and (2) attaching text labels to points.

Attribute data may be stored and linked to each line, area, or feature point to allow users to select the specific objects that they wish to plot, report on, or analyze. Thus, all of the lines that are State Road 1010 could be extracted and plotted because they each have State Road 1010 as an attribute.

Text label points are used to locate labels for an object or a series of objects on a map. Thus, two different text label points may be used to graphically label State Road 1010 as it crosses a map. Thirteen lines, each with data associated with its attribute points, are used to draw State Road 1010 on the map. Figure 8.02.3 illustrates the utility of text label points as opposed to attribute points in producing a readable map.

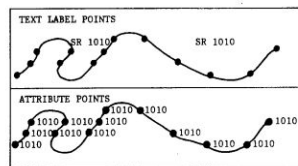Figure 8.02.3 Illustration of State Road 1010 identified by text label points and by attribute points.

g. <u>Edge Matching</u>: Edge matching is the matching of lines and areas between adjoining maps. With digital data, the match implies that each line ends with a node that has the same coordinates as the end point or node of the line that continues on the adjoining map (see Figure 8.02.4).

Figure 8.02.4 Illustration of edge matching.

h.   Digital Mapping Product: The product of digital mapping must be topologically structured digital data sets that store map objects using North Carolina State Plane Coordinates and associated attribute information with each object. Each object (e.g., point, line, area) of a component must have associated attributes. These attributes will be agreed to by both the Contracting Officer and the Contractor before digitizing begins. The digital mapping product that a County receives may include a number of a individual data sets (computer files), or all data may be integrated in a single database for use in a Database Management System.

Attribute data may be stored as part of the geographic data set or in an associated database. Each graphic object must be assigned attributes according to a labeling scheme agreed on by the Contracting Officer and the Contractor. Thus, a road could have only the road name stored as an attribute of a road line (e.g., SR 1010) or it could have road name, road number, type of road, road width, road owner, etc. stored for each line that represents a road. Similarly, an area representing a parcel might only have the PIN associated with it, or it might have all information that the County maintains on that property associated with it. Associated information may be keyed in or merged into a data set from information that has already been stored in a computer-readable format.

8.03 Digital Accuracy:

A number of issues must be addressed to ensure the accuracy of the digital product. Each map to be digitized should have been created using a Lambert conformal conic projection. The North Carolina State Plane Coordinate System is based on the Lambert conformal conic projection. If the map to be

digitized uses another projection, it should be digitized using the map's projection and then converted to the Lambert conformal conic projection. The following digital accuracy requirements must be fully met to ensure product acceptability:

a. Scaling Accuracy: Scaling refers to the initial setup of a map on a digitizing table. A minimum of three corner points (e.g., lower left, lower right, and upper right) of the map will be used to scale or tie the map to the surface of the earth through coordinate transformation algorithms. After a map is scaled, the accuracy of the transformation must be tested by digitizing a minimum of three points that were not used in setting up the map but have known X and Y North Carolina State Plane Coordinates. The digitized coordinates will be checked against known coordinates to verify that they are within the acceptable tolerance. The maximum tolerance will be one-fiftieth (1/50) of an inch (.02 inch). The maximum tolerance at map scale is listed by scale in Table 8.03.1.

    TABLE 8.03.1 MAXIMUM ALLOWABLE SCALING ERRORS

Maximum Error	Scale of Map	Scaling (at map scale)
1:4800 or 1" = 400'		$\pm$ 8.0'
1:2400 or 1" = 200'		$\pm$ 4.0'
1:1200 or 1" = 100'		$\pm$ 2.0'
1:600 or 1" = 50'		$\pm$ 1.0'

b. Digitizing Accuracy: Digitizing accuracy refers to the results of comparing a check plot of a digitized line to the same line on the source map. This is accomplished by making a check plot of the digitized data at the same scale as the source map. The line width used for the check plot will not exceed .010 inch. The resulting plot is laid on the digitized source map, and the two are placed on a light table. If any light can be seen between the digitized line and the source map line, the line must be re-digitized.
    One special case exists with regard to line accuracy requirements. If the source map's lines are greater than 0.020 inches in width, the center of the lines must be digitized. The lines on the check plot of

the digital data must overlay and not extend beyond the width of the

original lines on the source map. Line smoothness and consistency

shall be evaluated when reviewing line accuracy. Digitized data will

form smooth lines and curves that are aesthetically pleasing and

follow the lines they represent.

    c.   <u>Attribute Accuracy</u>: After attributes are assigned to a source map

(file), the map will be checked for accuracy, and all errors will be

corrected.

    d.   <u>Edge Matching Accuracy</u>: No edge match tolerance will be allowed

in digital mapping. The Contractor and Contracting Officer shall

agree on methods and procedures to be used for accomplishing edge

matching.

8.04   <u>Data Format:</u>

The Contractor will provide digital data to the County in a format that can be used on the County's system

or in an acceptable standard data exchange format. The Contractor may produce data by any software

program or package so long as the final delivery of the data is delivered in the format specified by the

County. This data then must be linked to the County's existing database as specified by the County. Each

digital data set must be accompanied by reports that specify the labeling scheme used and provide summary

statistics on each type of data object (e.g., total label points, total attribute points, total number of lines,

total number of areas, total area, total length).

8.05   <u>Transfer Media</u>

The digital data will be transferred from the Contractor to the Contracting Officer in a format specified by

the County. The format and media of this transfer of digital data between the Contractor and the County

shall facilitate the efficient exchange of data. Some examples of media that can be used are: tapes, CD's or

DVD's, a hard drive, etc.

8.06   <u>Delivery Schedule:</u>

The Contracting Officer and the Contractor shall develop a delivery

schedule, with cut-off dates for map updates (e.g., property lines, subdivision

lines), for all the deliverable products of the project. Prior to preparation of the contract, the cut off dates will be determined and included in the contract delivery schedule.

8.07 Cadastral Database Maintenance:
The Contractor shall maintain all digital cadastral data until all deliverable products are received and accepted by the Contracting Officer in accordance with the contract delivery schedule and subsection "7.05 c" and "7.05 d".

8.08 Deliverable Products:
The final deliverable digital products shall include tapes or other media of digital data sets and documentation of the information contained on each data set. Documentation will include but not be limited to: (1) a listing of all data stored on a given data medium including file names and descriptions of the data stored on each file; (2) a summary of the format or formats of the data files; (3) a summary of the format of the digital labels used in each file, their type (e.g. character, Integer, real), and their length in characters; and (4) Metadata for each data layer to comply with the Content Standards for Geospatial Metadata as specified by the Federal Geographic Data Committee (FGDC)(for an example see Attachment 2). One copy of the digital data will be generated by the Contractor for delivery to the Contracting Officer. It is preferable that the digital data media be hand delivered to the Contracting Officer. If the digital data media must be commercially delivered, the digital media must be shipped in a protective container with tracking information readily available. Each media to be delivered shall contain a label that includes the following: County name, media contents (e. g. cadastral map, soil map), cadastral data base cut-off date, media specifications (see subsection 8.05), name of Contractor, and the date of delivery to County. If the County receives a computer mapping system as part of the contract, the Contracting Officer shall require that all computer hardware and software be installed and in working order before accepting any digital data set tapes or other media. The Contractor shall maintain a duplicate of all digital data sets until the project is satisfactorily completed.

8.09 Project Procedures:

The Contracting Officer will review data and associated material for line placement, line quality, and labeling accuracy. All lines will be examined for accuracy against the source maps as described in subsection 8.03 b. If more than five (5) percent of the lines are in error, review will stop and the maps will be returned to the Contractor. All maps that have line accuracy problems will be returned to and corrected by the Contractor.

Label points and attribute points will be reviewed for labeling accuracy. If the Contracting Officer identifies that more than one (1.0) percent of the attributes on a map are incorrect, the review will stop and the maps will be returned to the Contractor for correction. The resulting final attribute accuracy shall be less than three-tenths of one (1) percent (0.3%), or 3 errors in 1,000 attributes.

All data that has been returned to the Contractor for editing must be, after correction, resubmitted to the Contracting Officer for review.

After digital data have been reviewed and accepted by the Contracting Officer, the Contractor will prepare and transmit the digital data in the format specified with it's associated documentation to the Contracting Officer. The Contracting Officer will then load, review, and accept or reject the data.

8.10 Components Of Maps:

The following are components of various map layers. The same component may appear in more than one layer; however, in a digital mapping environment, the component need only be digitized once. Each map layer may include other components that may be identified by the Contracting Officer.

    a.   Cadastral Map Layer

        1.   Road and street rights-of-way

        2.   Property lines excluding rights-of-way

        3.   Interior lot lines (dashed)

        4.   Road-front and street-front dimensions

        5.   Property line dimensions excluding road-front and street-front dimensions

6. Parcel acreage
7. PIN including dot (PIN - 10 or 13 digits, last 4 or 7 to be plotted)
8. Private roads or streets
9. Private road or street names with annotation indicating that the road or street has not been dedicated to the city or state (private ownership)
10. Road or street names (e.g. Lake Wheeler Road or Main Street)
11. Road numbers (e.g. SR 1007, NC 98, US 64, I-40)
12. Hydrography
13. Hydrography names
14. Gas line easements (cross-country lines, ownership name, and easement width)
15. Power line easements (cross-country lines, ownership name, and easement width)
16. Telephone easements (cross-country lines, ownership name, and easement width)
17. Railroad rights-of-way
18. Railroad ownership name
19. Railroad right-of-way width
20. Subdivision limit lines (corners)
21. Subdivision index numbers (reference numbers)
22. Subdivision lot numbers (original lot numbers)
23. Subdivision names
24. Tied-in corners (North Carolina State Plane Coordinates of property corners established by field survey methods)
25. Parcel hooks
26. Exempt property names
27. City limit lines
28. City names
29. Township lines
30. Township names
31. County boundary lines
32. County names
33. Subdivision PIN's

b. Soil Map Layer

       1.   Soil lines

       2.   Soil labels

       3.   Border data - soils disclaimer note

c.   Topographic Map Layer

       1.   Index contour lines

       2.   Intermediate contour lines

       3.   Index contour line values

       4.   Spot elevations (includes "X" for location)

       5.   County boundary lines

d.   Hydrography

       1.   Hydrography

       2.   Hydrographic names

e.   County

       1.   County Boundary Lines

f.   Plot Layer Template/Program

       1.   Grid lines

       2.   North Carolina State Plane Coordinate values

       3.   Block Lines

       4.   Interior and exterior block numbers (exterior block numbers below and beside easting and northing grid coordinates, respectively)

       5.   Border data - topographic accuracy statement

       6.   Border data - contour information (contour interval, map scale)

       7.   Border data - County seal (optional)

       8.   Border data - County map/logo

       9.   Border data - title of map

   10.   Border data - legend

   11.   Border data - north arrow

   12.   Border data - bar graph (scale)

   13.   Border data - Contractor's name and address

   14.   Border data - border lines

   15.   Border data - map number

   16.   Border data - date of aerial photography

   17.   Border data - horizontal and vertical datum

   18.   Map index