

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Spatial Characteristics.....	1
1.2	Classification System.....	2
2.0	SCENE CO-REGISTRATION	5
3.0	IMAGE MAP PRODUCTION	5
4.0	COMPILATION OF DATA.....	7
4.1	CGIA-Coordinated Ancillary Data.....	7
4.1.1	Southern Appalachian Assessment Land Cover Classification.....	7
4.1.2	University of North Carolina - Greensboro	9
4.1.3	Natural Heritage Program.....	9
4.1.4	State Parks	11
4.1.5	Eastwide Forest Inventory Assessment.....	11
4.1.6	Division of Coastal Management.....	12
4.2	Other Ancillary Data Sources	12
4.2.1	National Wetlands Inventory	12
4.2.2	Dismal Swamp National Wildlife Refuge.....	13
4.2.3	Fort Bragg	15
4.3	Combining Ancillary Data.....	15
4.4	Ground Truth Collection.....	19
4.4.1	EarthSat’s Ground Truth Collection Forms	19
4.4.2	Ground Truth Collection Procedures	20
4.5	Digital Format of Data.....	23

5.0	IMAGE CLASSIFICATION	25
5.1	Classification Procedures	25
5.2	Assignment of Information Classes	27
5.3	Quality Assurance During Processing	29
5.4	Obstructed Areas	29
5.5	Raster Editing	32
5.6	Spectral Confusion	33
	5.6.1 Agriculture-Managed Herbaceous	33
	5.6.2 Developed-Sand-Agriculture	33
	5.6.3 Developed-Water	34
	5.6.4 Similar Class Confusion	34
	5.6.5 Mountain Effects	35
	5.6.6 Shrub-Agriculture	35
5.7	Aerial Photograph Interpretation	38
5.8	Scene Accuracy Appraisals	43
5.9	Filtering to Reach Minimum Mapping Unit	45
5.10	Neuse-Tar/Pamlico Watershed Land Cover	49
5.11	Mosaicking and Municipal Area Deduct	49
5.12	Statewide Land Cover	50
	5.12.1 Statewide Accuracy Evaluation	51
6.0	PROVISION OF METADATA	51
7.0	ACKNOWLEDGMENTS	54
8.0	REFERENCES	55

APPENDICES

- A. LAND COVER CLASSIFICATION SYSTEM
- B. CO-REGISTRATION PARAMETERS
- C. 1:250,000-SCALE IMAGE MAPS
- D. ANCILLARY DATA COLLECTION SHEET
- E. FIELD DATA COLLECTION SHEET
- F. DATA COLLECTION INSTRUCTION SHEET
- G. PHOTO LOG
- H. PATH/ROW DATA POINTS
- I. DENDROGRAM
- J. IMAGE PROCESSING QUALITY ASSURANCE TABLE
- K. SCENE ACCURACY MATRICES
- L. NEUSE-TAR/PAMLICO CLASSIFICATION SUMMARY REPORT
- M. FINAL DATABASE ACCURACY MATRICES
- N. METADATA FOR LAND COVER DATABASE
- O. METADATA FOR DATA POINTS DATABASE

LIST OF FIGURES

1.1	Statewide TM Coverage with Municipal Areas	4
4.1	Great Dismal Swamp SPOT Classification.....	14
4.2	Ancillary Data Points	17
4.2.1	Natural Heritage Program Data Points (CL/NHP/NHP_NEW)	17
4.2.2	Dismal Swamp Data Points.....	17
4.2.3	SAA Data Points	17
4.2.4	NWI and FIA Points.....	18
4.2.5	State Park and UNCG Points	18
4.3	Forest Classification Chart	21
4.4	GPS Points Captured.....	24
4.5	EarthSat Field Data Points	24
5.1	Assignment of Land Cover Information Classes.....	28
5.2	Approximate Leaf-on Cloud-Obstructed Areas.....	30
5.3	Cloud Effects on Classification, Northwest of Wilmington.....	30
5.4	Southeast Path 16 Row 35	31
5.5	Comparison of Point-Buffered and Full Scene Classifications	36
5.6	Point-Buffered and Full-Scene Matrix.....	37
5.7	Path 15 Row 35 NDVI (4,5,3 RGB).....	39
5.8	Path 15 Row 35 NDVI Spectral Confusion.....	39
5.9	Portion of Path 15 Row 35 NDVI Dendrogram.....	40

5.10	Path 15 Row 35 NDVI Spectral Class Manipulation.....	41
5.11	7.5' Quadrangles Identified for Black-and-White Photo Acquisition	43
5.12	Examples of Filtering, Lake Norman Area.....	47
5.13	Examples of Filtering Water, East of Charlotte	48
5.14	Scene Mosaicking Hierarchy	50

LIST OF TABLES

1.1	Multi-temporal TM Data.....	1
1.2	Projection Parameters for Data.....	2
1.3	Study Area Bounding Box.....	2
1.4	Land Cover Classification System.....	2
2.1	Co-registration Error Analysis Parameters.....	6
4.1	SAA Classification.....	8
4.2	Data Points From SAA.....	8
4.3	Data Points From UNCG.....	9
4.4	Data Points From NHP.....	10
4.5	Data Points From State Parks.....	11
4.6	Data Points From FIA.....	12
4.7	Data Points From NWI.....	13
4.8	NWI-NC Land Cover Class Correlation.....	13
4.9	Data Points From Dismal Swamp Database.....	15
4.10	All Ancillary Data Points.....	16
4.11	Ancillary Data Source Prefixes.....	16
4.12	Field Data Collection Teams.....	19
4.13	Data Points Collected by EarthSat.....	22

4.14	Database Attribute Items	25
5.1	Comparison of ISODATA Routines.....	26
5.2	Error Matrix for Landsat TM Classification.....	44
5.3	Collapsed Accuracy Land Cover Classes.....	45
5.4	Database Raster Attributes	52
5.5	Seamless MMU Database Land Cover Class Content.....	53

1.0 INTRODUCTION

The North Carolina Center for Geographic Information and Analysis (CGIA), with funding support from the United States Environmental Protection Agency Region IV Wetlands Division and the North Carolina Department of Transportation, initiated a project to generate comprehensive land cover data for the entire state. Earth Satellite Corporation (EarthSat) was contracted in January 1996, under CGIA's base/municipal area deduct proposal, to provide a seamless statewide land cover database for all areas outside municipal boundaries and within a 1-kilometer buffer around the state border.

In support of this initiative, CGIA acquired recent (1993-1995) multi-temporal Landsat Thematic Mapper (TM) satellite data (Table 1.1). The raw 7-band data, geocoded by EOSAT in North Carolina State Plane Coordinate System meters, NAD83 datum and GRS1980 ellipsoid, was at a pixel resolution of 28.5 meters (93.5 feet). Data provided to EarthSat was terrain-corrected and resampled using the cubic convolution method. Several leaf-on scenes contained scattered cloud and haze cover; in all cases such obstructions were less than 10% of any TM Path/Row.

Table 1.1 Multi-temporal TM Data

Path/Row	Leaf-on (Summer) Date	Leaf-off (Winter) Date
14/35	07/15/94	11/04/94
14/36	06/10/93	11/20/94
15/35	05/16/93	12/26/93
15/36	05/16/93	12/26/93
16/35	07/10/93	01/05/95
16/36	07/10/93	01/05/95
17/35	05/20/95	02/26/94
17/36	05/17/94	02/26/94
18/35	06/06/93	11/29/93
18/36	06/06/93	11/29/93
19/35	07/31/93	11/07/94

1.1 Spatial Characteristics

The study area for the land cover database included the entire state with a 1.0 km buffer around the state boundary. All data used for the study was either provided in or projected to the parameters shown in Table 1.2. Given these parameters, the bounding box for the study area was as indicated below (Table 1.3). At 28.5 meter cell (pixel) size the study area was 28,376 elements (columns) by 10,861 lines (rows). Municipal areas, as provided to EarthSat by CGIA, were excluded in the final database and coded as land cover class 10. Figure 1.1 shows the state with a 1-km buffer, municipal

areas deducted from the final database, and TM footprints (note that image borders vary slightly due to normal fluctuations in satellite position).

Table 1.2 Projection Parameters for Data

Projection Type: North Carolina State Plane Coordinate System
 Projection Units: meters
 Zone: 4901
 FIPS Zone: 3200 (-3200 for Imagine use)
 Standard Parallels: none
 Central Meridian: none
 Origin: none
 False Easting: none
 False Northing: none
 Datum: NAD83
 Spheroid: GRS1980

Table 1.3 Study Area Bounding Box

XMIN = 122,800
 XMAX = 931,630
 YMIN = 9,700
 YMAX = 319,267

1.2 Classification System

The target classification system for this mapping initiative was in accordance with the state’s A Standard Classification System for the Mapping of Land Use and Land Cover. Upon EarthSat’s recommendation endpoint class 312, unmanaged herbaceous cover, was split to map unmanaged wetland (3122) and unmanaged upland (3121) cover. Table 1.4 shows the classification system and endpoint class land cover codes; the final classification system with full class descriptions is provided in Appendix A.

Table 1.4 Land Cover Classification System

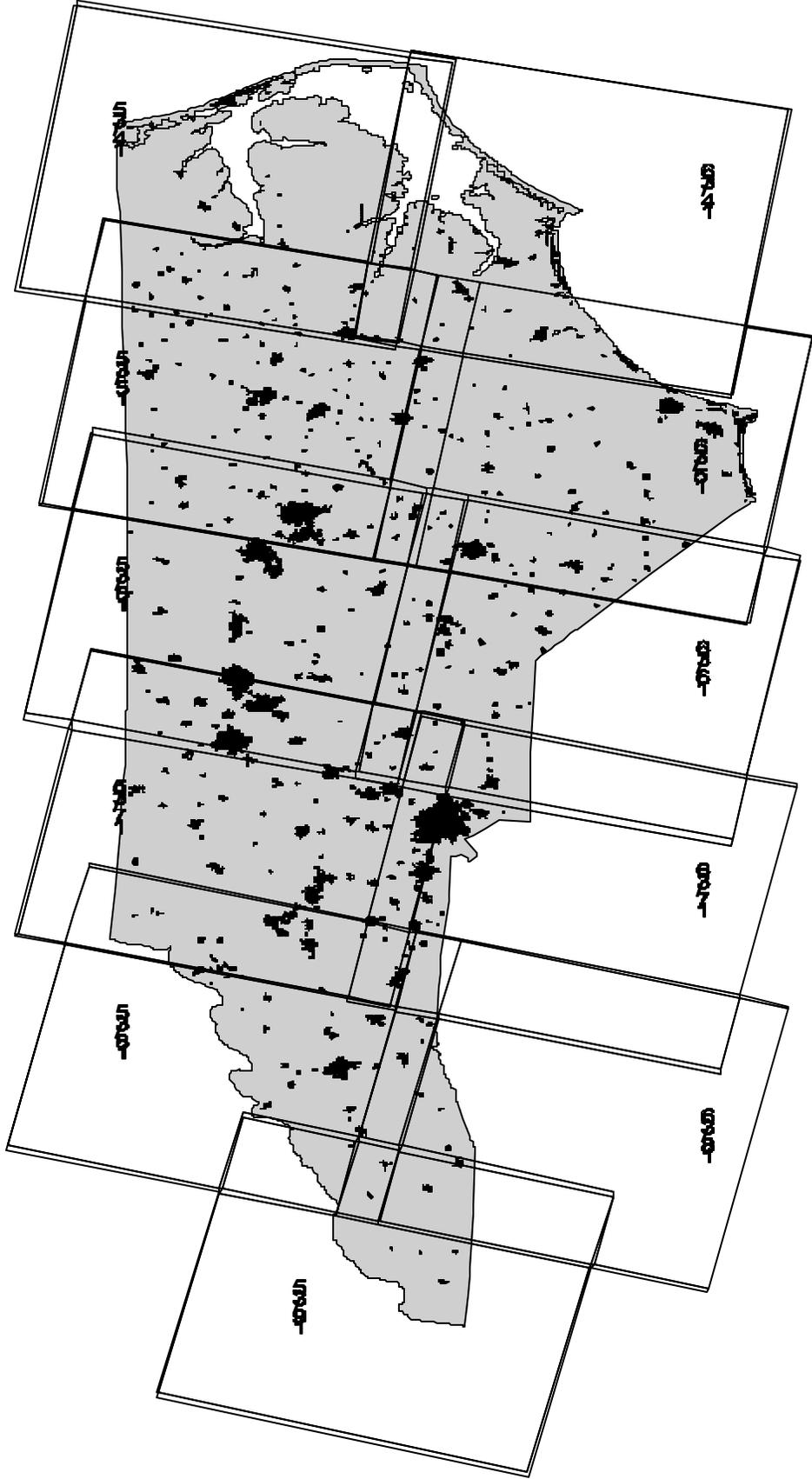
Endpoint Class	Class Number	Class Name
	1	DEVELOPED
1	11	High Intensity
2	12	Low Intensity
3	2	CULTIVATED

Table 1.4 Land Cover Classification System (continued)

Endpoint Class	Class Number	Class Name
	3	HERBACEOUS COVER AND SHRUBLANDS
	31	Herbaceous Cover
4	311	Managed Herbaceous Cover
5	312	Unmanaged Herbaceous Cover
	32	SHRUBLAND
6	323	Evergreen Shrubland
7	324	Deciduous Shrubland
8	325	Mixed Shrubland
	4	FOREST LAND
	4A	Deciduous Forests
	41	Broadleaf Deciduous Forest
9	411	Mixed Hardwoods
10	414	Hardwood Swamps
11	419	Other Broadleaf Deciduous Forests
12	45	Needleleaf Deciduous
	4B	Evergreen Forests
	42	Needleleaf Evergreen Forest
13	421	Mountain Conifers
14	422	Southern Yellow Pine
15	429	Other Needleleaf Evergreen Forests
16	43	Broadleaf Evergreen Forest
	4C	Mixed Deciduous/Evergreen Forests
	44	Mixed Deciduous-Evergreen Forest
17	441	Mixed Hardwoods/Conifers
18	442	Oak/Gum/Cypress
19	5	WATER BODIES

Endpoint Class	Class Number	Class Name
	6	BARREN LAND
20	61	Unconsolidated Sediment
21	62	Exposed Rock
22	9	INDETERMINATE LAND COVER

Figure 1.1 Statewide TM Coverage with Municipal Areas



2.0 SCENE CO-REGISTRATION

Original Level 1A TM scenes were not available. EarthSat, consequently, evaluated the co-registration error to determine whether any inter- or intra-scene co-registration correction would be required before initiating image processing or ground truth collection activities. Any scenes with large root mean square (RMS) co-registration errors would have to be resampled for proper geometric alignment.

EarthSat's proprietary X-Display software was used for control point identification and coordinate recording. Control points were collected primarily on scene edges for analyzing inter-scene (between different Path/Rows) as well as intra-scene (same Path/Row) error. Each control point's x,y coordinate was recorded for each scene on which it occurred (Appendix B). Control point 1, for example, had a location identified only on Path 14 Row 35 leaf-off and leaf-on, with an X -RMS error of 3 meters and Y -RMS error of 11 meters. Control point 28, with an X -RMS error of 0 meters and Y -RMS error of 24 meters, was identified on both Path 15 Row 35 and Path 16 Row 35 leaf-off and leaf-on.

Inter-scene and intra-scene RMS errors were, with very few exceptions, within one pixel (28.5 meters). With inter-scene and intra-scene average RMS errors less than a pixel and average RMS error among all scenes significantly less than one pixel (Table 2.1) it was determined that scene geocoding was acceptable and geometric correction would not be necessary.

3.0 IMAGE MAP PRODUCTION

Bands 4, 5, and 3 (RGB) of both the leaf-off and leaf-on scenes were used for the creation of TM image maps for each of the scenes required. Vector data provided by CGIA, including the state border, 1-kilometer and 10-kilometer buffers of the state border, county boundaries, municipal boundaries, primary roads, and USGS 1:24,000 quad sheet boundaries, were overlaid on the imagery, along with a state plane grid and latitude/longitude tick marks.

EarthSat's proprietary IPS software combined the raster and vector data; a 10" x 10" negative for each of the scenes was created using a Cirrus Film Recorder. From this negative, 1:250,000 scale (Appendix C) and 1:100,000-scale prints were created for each scene, with each 1:100,000-scale image map approximately 1/4th of a full 1:250,000-scale image map (hence 4 1:100,000-scale image maps were created for each 1:250,000-scale image map). Complete image map production for all scenes included 22 1:250,000-scale and 88 1:100,000-scale prints.

Table 2.1 Co-registration Error Analysis Parameters

Scene	Average X-RMS Error (meters)	Average Y-RMS Error (meters)
All Scenes	10	1
Path 14 Row 35	9	5
Path 14 Row 36	22	14
Path 15 Row 35	19	12
Path 15 Row 36	18	5
Path 16 Row 35	9	9
Path 16 Row 36	3	3
Path 17 Row 35	11	7
Path 17 Row 36	5	7
Path 18 Row 35	6	11
Path 18 Row 36	2	4
Path 19 Row 35	0	11
Path 14 Row 35 and Path 14 Row 36	18	15
Path 14 Row 35 and Path 14 Row 35	6	10
Path 14 Row 36 and Path 15 Row 35	10	14
Path 14 Row 36 and Path 15 Row 36	24	16
Path 15 Row 35 and Path 15 Row 36	0	0
Path 15 Row 35 and Path 16 Row 35	14	16
Path 15 Row 36 and Path 16 Row 36	11	21
Path 16 Row 36 and Path 17 Row 35	18	11
Path 16 Row 35 and Path 16 Row 36	16	8
Path 17 Row 35 and Path 17 Row 36	6	12
Path 17 Row 35 and Path 18 Row 35	9	26
Path 17 Row 36 and Path 18 Row 36	6	8
Path 18 Row 35 and Path 18 Row 36	4	8
Path 18 Row 35 and Path 19 Row 35	18	24
Path 18 Row 36 and Path 19 Row 35	4	16

4.0 COMPILATION OF DATA

Two sets of ground truth data were required for this mapping initiative. One set of ground truth data were used to develop spectral signatures and assign information (land cover) classes to spectral classes. The other set of ground truth data were reserved for evaluation of the derived classification. Both sets included ground truth data collected by EarthSat and ancillary reference data available from other sources.

Each data site was assigned a unique code with a character prefix and numeric sequence suffix. The character prefix corresponded to the data source while the sequential number corresponded to the report number for the site. (EarthSat's Ancillary Data Collection sheet can be found in Appendix D.)

4.1 CGIA-Coordinated Ancillary Data

The CGIA worked closely with many state agencies and other entities to gather a variety of data sources available. Many of these data sources were very useful as supplemental data. Some data sources, however, were less useful because of difference in classification systems, difficulty in interpreting appropriate land cover class, or mapping at mismatched scales.

4.1.1 Southern Appalachian Assessment Land Cover Classification

The Southern Appalachian Assessment (SAA) classification was generally a good source of data for western scenes. Classifying land cover into 17 classes, the SAA GRID used for area identification (*saa_lc_p*) had a minimum mapping unit of two acres. ARC/INFO® GRID was used to collect data points; the resultant coverage was projected from UTM and attributed.

From the 17-land cover classes, it was determined that the best areas to use were established forests, pasture, and cropland. No classes were available to delineate full forest from shrubland, while developed cover was included in only one class (Table 4.1). Metadata was not available for the dataset; some classes, therefore, were difficult to interpret for their suitability for classification in this mapping initiative. For example, whether a developed area should be classified as high or low intensity, a barren area as unconsolidated sediment or exposed rock, or what percentage threshold constituted a mixed forest under SAA classification.

Despite classification differences, 84 data points were collected from SAA (Table 4.2). During raster editing it was discovered that one agriculture point fell within a shrub area. Interpretation of the raw imagery, spectral values, and land cover surrounding the point confirmed the area was a recent (as

of imagery date) clear-cut. The only other difficulty in classification was among mixed forests where provision of metadata would have helped with interpretation.

Table 4.1 SAA Classification

SAA Class Number	SAA Class Description	EarthSat Class Interpretation
1	Northern Hardwood Forests	411
2	Mixed Mesophytic Hardwood Forests	411
3	Oak Forests	411
4	Bottomland Hardwood Forests	414
5	White Pine/Hemlock Forests	421
6	Montane Spruce-Fir Forests	421
7	Southern Yellow Pine Forests	422
8	White Pine/Hemlock/Hardwood Forests	441
9	Mixed Pine/Hardwood Forests	441
10	Herbaceous	311/3121
11	Barren	61/62
12	Agriculture - Pasture	311
13	Agriculture - Crop	2
14	Wetlands	3122
15	Developed	11/12
16	Water	5
17	Indeterminate - Clouds, Shadows	9

Table 4.2 Data Points From SAA

Land Cover Class	Number of Points
2	6
311	2
411	28
421	12
422	8

441	16
5	4
62	8

4.1.2 University of North Carolina - Greensboro

The CGIA sponsored a ground truth field trip with University of North Carolina, Greensboro (UNCG) students. Students identified areas on USGS 1:24,000 quadrangles for which ground truth data were completed. The classification system used was comparable to the classification system used for this initiative and data points, therefore, were largely considered good, depending upon descriptions provided and spatial coverage. For example, areas classed as 312 with no description would likely be difficult to interpret and developed classes that were a small group of buildings would be beyond the minimum mapping unit. From the database, quad sheets, and field data forms provided to EarthSat, 68 data points were used (Table 4.3). The two indeterminate field points were both lumber yards, areas which would not logically fit into the classification scheme (but generally were classified as either indeterminate or developed).

Table 4.3 Data Points From UNCG

Land Cover Class	Number of Points
11	6
12	2
2	6
311	14
323	2
411	20
421	2
422	2
442	2
5	10
9	2

4.1.3 Natural Heritage Program

Data from the Natural Heritage Program (NHP), under the Natural Resources Section of the Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, was extremely valuable in both digital and analog forms provided. Provision of a classification report greatly assisted with interpretation of digital data provided to EarthSat (Shafale and Weakley 1990).

Digital data for requested counties required processing time to alter the data in a form to generate *x,y* coordinates and join attribute data in ARC/INFO. Once projected and attributed, determination of appropriate classification was fairly effortless because of good descriptions and similar classification schemes. The two most significant difficulties in usefulness of data were positional error and incompatible scale mapping. During raster editing a number of points were discovered with obvious positional error; *e.g.*, several 3121 points appeared well off the coast of Cape Lookout. Also during raster editing some points were clearly valid data points but the scale at which the data were identified was significantly larger than TM data would identify even before filtering to the minimum mapping unit. Quite frequently sandhills mapped in the CL database would be encompassed by bottomland forests or exposed rock and would be too small an area to be represented by one or more pixels on TM imagery.

Staff from NHP worked with CGIA to identify areas and provide classification data on particular scenes. Areas clearly delineated on the 1:100,000-scale TM image maps and descriptions provided the basis for categorizing the areas into the appropriate land cover class if it was not already provided. In some cases where exact classification was not provided, descriptions were not clear enough to fit the identified areas into the appropriate land cover class. The linguistic scale did, however, provide sufficient additional classification information for such areas. Data provided in this form were the most valuable of any ancillary data sets used.

A significant number of data points from NHP were extracted for use in this mapping initiative (Table 4.4). Of 1,252 points in both digital and analog form, 63 points from digital data could not be appropriately interpreted; 1,189 were maintained and appended to the ancillary database.

Table 4.4 Data Points From NHP

Land Cover Class	Number of Points
11	2
311	4
3121	43
3122	96
323	28
324	11
325	21
411	18
414	21

421	21
422	19
429	21
43	30
441	25
442	75
45	21
5	40
61	11
62	45

4.1.4 State Parks

Similar to the effort with NHP staff, personnel from the Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, worked with CGIA to provide classification data primarily on areas identified by EarthSat in and near selected state parks. Parks targeted were primarily in areas of TM scene overlap (so that maximum benefit could be gained from the points). Areas of interest were loosely delineated on 1:24,000-scale USGS quadrangles and provided with the corresponding 1:100,000-scale TM image maps and general descriptions of the area.

As was the case with NHP data, areas were delineated more exactly on the TM image map with corresponding descriptions provided to fit the areas into the appropriate land cover class. Where exact classification was not provided and descriptions were not clear enough to fit the identified areas into the appropriate land cover class, the linguistic scale provided sufficient additional classification information. Data provided were invaluable to mapping in and around parks; 59 data points were collected (Table 4.5).

Table 4.5 Data Points From State Parks

Land Cover Class	Number of Points
11	1
12	2
2	5
311	8
3121	3
3122	2
323	1

325	3
411	12
414	1
421	6
422	4
441	8
5	1
61	2

4.1.5 Eastwide Forest Inventory Assessment

The Eastwide Forest Inventory and Analysis (FIA) for North Carolina, South Carolina, and Georgia was provided to EarthSat during early field data collection. After evaluation of the data set, EarthSat deemed it was not useful because of both processing time to identify useful points and difference in both classification scheme and mapping scale. FIA classed trees of various species into 28 broad groups and four core groups (pine, other softwoods, soft hardwoods, and hard hardwoods; Hansen *et al*). The database also contained site-specific information that significantly exceeded the minimum mapping unit. Twelve points were identified from the database (Table 4.6) that likely did not meet minimum mapping unit specifications and/or conform to the classification scheme used in this mapping initiative.

Table 4.6 Data Points From FIA

Land Cover Class	Number of Points
414	4
422	2
429	4
442	2

4.1.6 Division of Coastal Management

Data from the Division of Coastal Management’s (DCM) collection of field data were provided on-disk to EarthSat but significant processing time would have been required to alter the data in an appropriate form for use. Given data conversion difficulties and limited database provision (at the time DCM’s field data collection was suspended because of their difficulty to estimate canopy closure in leaf-off conditions), unsuccessful effort was put into working with DCM data.

4.2 Other Ancillary Data Sources

Aside from CGIA’s coordination, several other ancillary data sources were identified and used. Numerous individuals encountered during field trips provided information about local areas and environments which proved very useful for obtaining field data or access to otherwise limited-access areas. State parks personnel were consistently helpful, providing invaluable information about local conditions affecting land cover and assistance whenever possible. Forest rangers were also very helpful for identifying recent burns, land cover, and conditions affecting land cover.

4.2.1 National Wetlands Inventory

EarthSat acquired from the U.S. Fish and Wildlife Service a data tape containing all National Wetlands Inventory (NWI) data available through December 1995. Data for North Carolina was extracted and processed to use as polygonal vector data. Point data were then extracted for areas likely to fit within the classification system for this mapping initiative. Two problems were present in using NWI data, however: 1) exclusion of data for upland areas, and 2) difference in classification systems. Given these difficulties and sensitive to not over sample data in wetland areas, only 140 data points were identified using NWI (Table 4.7). Because NWI data were only used as a supplemental source and because of classification correlation difficulty, both remapping and frequency tables were not necessary (and hence not created).

Table 4.7 Data Points From NWI

Land Cover Class	Number of Points
3122	6
442	60
45	74

In using NWI as an ancillary data source, the general NWI-NC land cover classification correlation was used as shown in Table 4.8. These NWI classes are, however, not necessarily as rigid in their classification of land cover as the system used for this mapping initiative so corresponding NC land cover class is the most likely appropriate class for the given NWI classed areas. NWI data for many areas is also dated and may not be a good source for use with more recent TM data.

Table 4.8 NWI-NC Land Cover Class Correlation

NWI Wetland (Cowardin) Class	NC Land Cover Class
E2EM, R1EM, R2EM, L2EM, PEM	3122
E2SS3, E2SS4, E2SS7, PSS3, PSS4, PSS7	323
	324

E2SS1, E2SS2, E2SS6, PSS1, PSS2, PSS6	
EFO1, EFO6, PFO1, EFO6	414
EFO2, PFO2	45

4.2.2 Dismal Swamp National Wildlife Refuge

Based on 1989 SPOT data, the Great Dismal Swamp National Wildlife Refuge had land cover within the Refuge's boundary classified. This database was made available to EarthSat during ground truth field work, along with a comprehensive biological inventory (LeGrand 1994) and previous land cover map (Carter and Gammon 1976).

Although the database did not include thresholds for mixed forests, aligning areas into the classification system used for this mapping initiative was generally effortless (Figure 4.1). Homogeneous forests were classed as a single letter (*e.g.*, C for bald cypress, P for pine, M for maple-dominated mixed hardwoods) while mixed forests were identified as letter groups (*e.g.*, CGM for cypress, water and black tupelo, and maple-dominated mixed hardwoods). In letter grouping mixed forests, dominant species and approximate content were listed in order (*e.g.*, CGM meant cypress had the largest content in the delineated area; MGC meant maple-dominated mixed hardwoods were prevalent with cypress having a noteworthy presence but less dominant).

Figure 4.1

than other species).

The database was valuable for obtaining ground truth samples throughout the swamp, as well as identifying infrequently occurring classes in North Carolina such as Atlantic White Cedar. Sixty data points were obtained from the database (Table 4.9). Points retained for use in classification were identified in ArcView®; the resultant shapefile was converted into an ARC/INFO coverage and projected to the required parameters.

Table 4.9 Data Points From Dismal Swamp Database

Land Cover Class	Number of Points
411	10
414	2
419	4
422	6
429	14
43	8
441	2
442	12
45	2

4.2.3 Fort Bragg

The GIS Coordinator of the Directorate of Public Works and Environment, Engineering Systems Division, XVIII Airborne Corps and Fort Bragg provided to EarthSat a data tape containing, in GRASS format, various data sets for Fort Bragg and Camp Mackall. Several hard copy maps were also provided. Given data conversion difficulties (several unsuccessful attempts to read the digital data in GRASS and convert it to ARC/INFO) and limited spatial extent, unsuccessful minimal effort was put into working with the digital data provided. Hard copy maps were, however, used during raster editing to confirm and/or edit areas.

4.3 Combining Ancillary Data

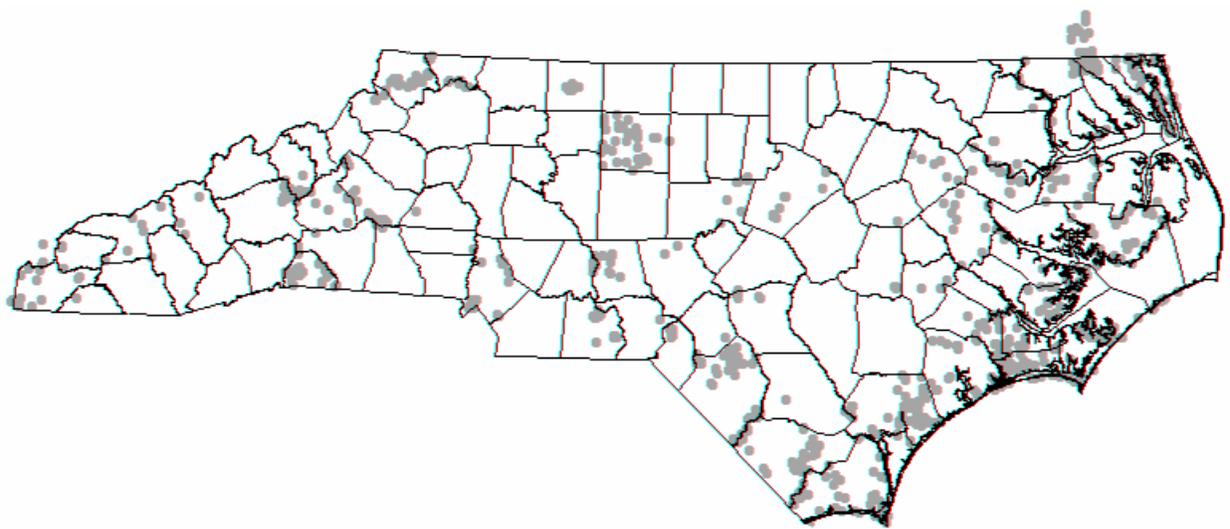
From the sources outlined above, 1,612 data points (Table 4.10) were gathered for use during classification and accuracy assessment. Points were assigned unique character prefixes that identified the data source (Table 4.11) and had descriptions completed in the Ancillary Data Collection Sheet. Each database had linguistic information completed where applicable and/or appropriate. The several point coverages were appended into one dataset (*Ancillary*, Figure 4.2) and then appended into a coverage of all data points (*Allpoint*). (Section 4.3.2 contains additional information regarding digital formatting of the data.)

Table 4.10 All Ancillary Data Points

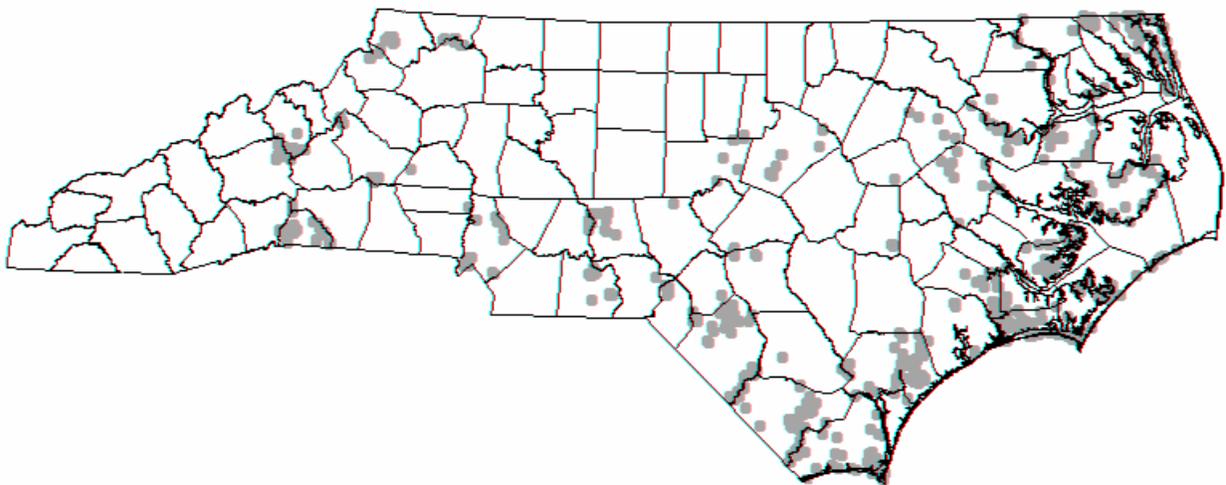
Land Cover Class	Number of Points
11	9
12	4
2	17
311	28
3121	46
3122	104
323	31
324	11
325	24
411	258
414	217
419	4
421	41
422	220
429	39
43	38
441	51
442	151
45	97
5	55
61	12
62	53
9	2

Table 4.11 Ancillary Data Source Prefixes

Site Prefix	Data Source
CL/NHP_NEW	Natural Communities Database (Natural Heritage Program)
DS	Dismal Swamp SPOT Classification Database
FIA	Eastwide Forest Inventory & Analysis Database



NHP	Natural Heritage Program
-----	--------------------------



NWI	National Wetlands Inventory
PK	Division of Parks and Recreation (State Parks)
SAA	Southern Appalachian Assessment
UNCG	University of North Carolina - Greensboro

Figure 4.2 Ancillary Data Points

Figure 4.2.1 Natural Heritage Program Data Points (CL/NHP/NHP_NEW)

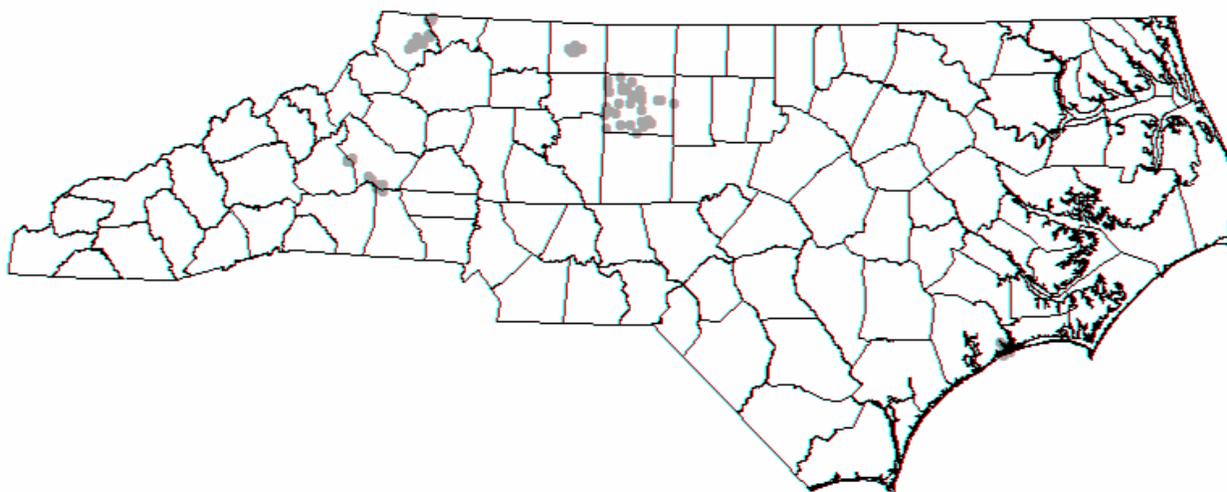
Figure 4.2.2 Dismal Swamp Data Points

Figure 4.2.3 SAA Data Points

Figure 4.2.4 NWI and FIA Points



Figure 4.2.5 State Park and UNGC Points



4.4 Ground Truth Collection

EarthSat's initial strategy for ground truth collection was to concentrate in overlap areas between TM paths; overlap area between paths covered approximately 45% of the state. The advantage to collecting data in this manner was to use the same ground truth point for developing spectral signatures in two or more scenes. Fifty-eight 7.5' USGS quadrangles were selected using a stratified random sampling approach for which extensive ground truth data were to be collected: 50 quads within scene overlap areas and 8 quads in the coastal region of the two Path 14 scenes. Aerial photos for these 58 quads and areas adjacent to them were to be acquired by the state and provided to EarthSat for interpretation.

During the first ground truth field trip in February 1996, EarthSat determined that collecting data only for those quadrangles would not necessarily provide sufficient numbers of points per endpoint class and would leave too many areas across the state unvisited. A statistical random sample approach was considered but rejected because of potential cost of getting to selected sites and for fear of over sampling agriculture and pine forests. EarthSat adopted a strategic sampling approach, whereby field teams were given flexibility to gather field data based on spectral responses found on image maps and relative ease of accessibility to selected sites. Strategic sampling was also chosen for representativeness of data based on land cover; infrequent reporting of some classes corresponded to infrequent occurrences of the corresponding land cover type. One hundred-twenty-seven quad sheets were provided to EarthSat for use in field work.

4.4.1 EarthSat's Ground Truth Collection Forms

Each data site was assigned a unique code with a two-character prefix and numeric sequence suffix. The character prefix corresponded to the team head (Table 4.9) while the sequential number corresponded to the report number for the site (*e.g.*, 1 was the first site reported by the team, 2 was the second, and so on). The site identification corresponds to the *SITE-#* field in the field point database and the hard copy Field Data Collection Sheet (Appendix E).

Table 4.12 Field Data Collection Teams

Site Prefix	Team Head	Affiliation
DH	David Hughes	Appalachian State University
JM	Jeffrey Miller	EarthSat
TP	Todd Patterson	EarthSat

Location of the site was recorded by state, county, USGS quad name, Path/Row or J/K for SPOT data, and/or approximate (coordinate) location. Approximate location was obtained from either the 1:100,000-scale TM image map (grid coordinate) or GPS report. Actual coordinate was obtained during digital entry of the point by placing the computer cursor on the exact location on the TM scene

and reading the coordinates at the cursor. The land cover code (*e.g.*, 61) and land cover description (*e.g.*, Unconsolidated Sediment) were recorded with a complete description of the site, including estimation of canopy closure, vegetation species present, and topographic/disturbance regime data. Many agricultural field points had no crop type listed; because of the time of year field data were collected, areas were easily identified as cultivated but crops were either not in growth or at a growth stage that crop type could not be identified.

The linguistic scale allowed the reporting team to indicate the site's likelihood to be classified in each land cover class. A clear-cut regrowth area, for example, may have been reported as a 323 but deciduous content may have been close to the threshold for 325. In such a case, 323 might be a 4 (absolutely correct) or 3 (good interpretation) with 325 and/or 324 reported as 3, 2, or 1. Land cover codes interpreted as 0 on the linguistic scale were generally left blank (0 was not circled). EarthSat completed a one-page instruction sheet to guide field teams with form completion information (Appendix F), as well as a flow chart (Figure 4.3) to assist with decision making in classing forests.

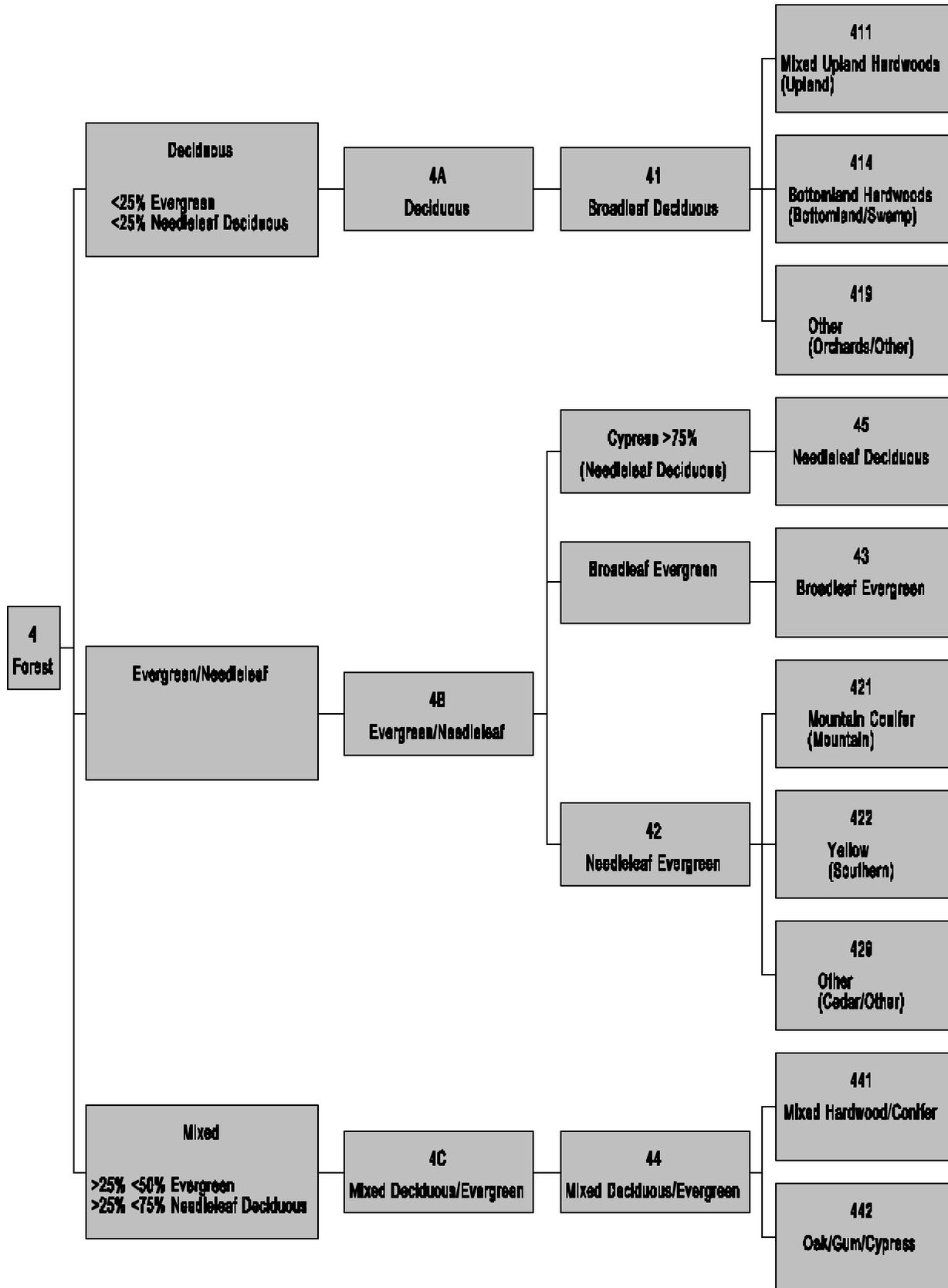
Numerous sites were selected to be cataloged by photograph. Sites were generally selected because of their unique vegetation or spectral response. A number of typical vegetative or spectral classes were also photographed, however. When photos of sites were taken, the roll number, frame number, and look azimuth were recorded on the field data collection form and cross-referenced on the Ground Truth Photo Log (Appendix G). EarthSat field teams took more than 500 photographs across the state.

4.4.2 Ground Truth Collection Procedures

For ground truth collection throughout most of the state, EarthSat loaded data sets onto a laptop computer for use in the field. Primary roads and municipal boundaries, as provided by the state and printed on image maps, TIGER line files provided by the state and projected to adhere to the project's parameters, and county boundaries, along with appropriate ancillary data sets available during any given field trip, were loaded onto the PC to use as overlays on the raw imagery (LANs of each image were created and printed onto CD). EarthSat used Direct GPS for ArcView with these data to allow for real-time tracking and data collection. The 1:100,000-scale image maps were used for point identification and corresponding data were reported on ground truth collection forms.

EarthSat hired a graduate student intern from Appalachian State University (ASU) to collect field data in western scenes. ASU's Department of Geography and Planning lent their Trimble GeoExplorer GPS unit in support of field data collection activities. Sixty sample points were typically gathered at each site but that number depended upon environmental conditions (ease of defining area; for example, more than 120 sample points might be gathered for small rock outcrops). Basic attribute data, such as site number and land cover class, were input digitally during point collection. Points were differentially corrected using files downloaded from base stations in either Raleigh (Monday through Friday) or Asheville (weekends or weekdays after 8:00 PM) using P-Finder 3.0 software.

Figure 4.3 Forest Classification Chart
(endpoint classes on right side of chart)



EarthSat’s goal was to collect 125 samples per endpoint land cover class, reserving 40% (50 points) for accuracy evaluation. Ancillary data were to supplement classes where 125 samples were not collected by EarthSat during field work and provide additional data for accuracy assessment. EarthSat collected a significant number of ground truth (Table 4.13) but was unable to obtain 125 points for certain classes; after addition of ancillary data, only six land cover classes did not attain the 125 point goal: 325 (105 points), 419 (51 points), 429 (74 points), 43 (70 points), 62 (86 points), and 9 (7 points). Forty percent of the points for each of these classes were reserved for accuracy assessment, however.

Table 4.13 Data Points Collected by EarthSat

Land Cover Class	Number of Points
11	297
12	145
2	493
311	594
3121	156
3122	95
323	182
324	125
325	81
411	228
414	229
419	47
421	105
422	565
429	35
43	32
441	132
442	60
45	47
5	86
61	88
62	33
9	5

Using Direct GPS for ArcView for real-time mapping allowed EarthSat field teams to collect a significant number of field points representative of the land cover found across North Carolina, while also sampling infrequently occurring classes (such as broadleaf evergreen forests). Even though accuracy of the GPS was within 100 meters with selective availability off, very few x,y locations obtained from the GPS unit were maintained in the final database because the methodology used did not allow for differential correction (Trimble's Direct GPS for ArcView currently does not support post-processing differential correction). Hardware problems were also frequently encountered meaning data storage was not always reliable. The GPS was therefore used for on-screen positional reporting with the user marking the exact site x,y location on the 1:100,000-scale image map with the site identifier. (It should be noted, however, that the GPS accuracy was well within 100 meters in nearly every instance; in some cases error amounted to the wrong side of the street.)

EarthSat field teams were able to provide 2,808 GPS points (Figure 4.4) used for site and positional identification. This number was only a fraction of all GPS points collected, however, because of frequent equipment failures or overheats. (Entire GPS points from the northeast and central North Carolina were lost because of such problems. West-Northwest North Carolina ground truth was collected by the second methodology, therefore GPS points are reflected in the field points database and not GPS database.) Using the two separate GPS methodologies explained above, 3,860 field points (Figure 4.5) were collected for all scenes. (Note that some points were collected in Virginia, South Carolina, Tennessee, and Georgia for use in classification.)

4.5 Digital Format of Data

Because few GPS x,y locations were retained for site identification using the Direct GPS for ArcView collection method, field teams marked on the 1:100,000-scale image maps the precise location and site number of each field point. After each field trip the exact x,y location was entered digitally along with attribute information. Using Erdas Imagine, raw imagery was displayed with vector data provided on image maps. This allowed for ease of locating points marked on the 1:100,000-scale image maps. The point's location identified on the image map was found on-screen and a new point added to the database. Attribute information, such as site number and land cover code, was entered digitally and the state plane x,y coordinate recorded on the field form. Points collected in the western part of North Carolina using the Trimble PathFinder had x,y and primary attribute information entered in the field. After each field trip the points were differentially corrected and complete attribute information entered.

After field work was complete and ancillary data had been compiled, both datasets were appended into a single coverage. Separate coverages were also maintained containing only field and ancillary data points, respectively. The databases contained the essential information found on data collection sheets (Table 4.14). Using ArcPlot an AML was run on the coverage of all field points to randomly select 40% for each land cover class to be reserved for accuracy assessment; an attribute of 'Y' was assigned to the AA field for those points. Two coverages were created based on the AA

attribute to separate points to be reserved and those to be used for classification.

Some data were received after this process was complete. The points were added to the ancillary database and used both during raster editing and for final accuracy assessment.

Figure 4.4 GPS Points Captured

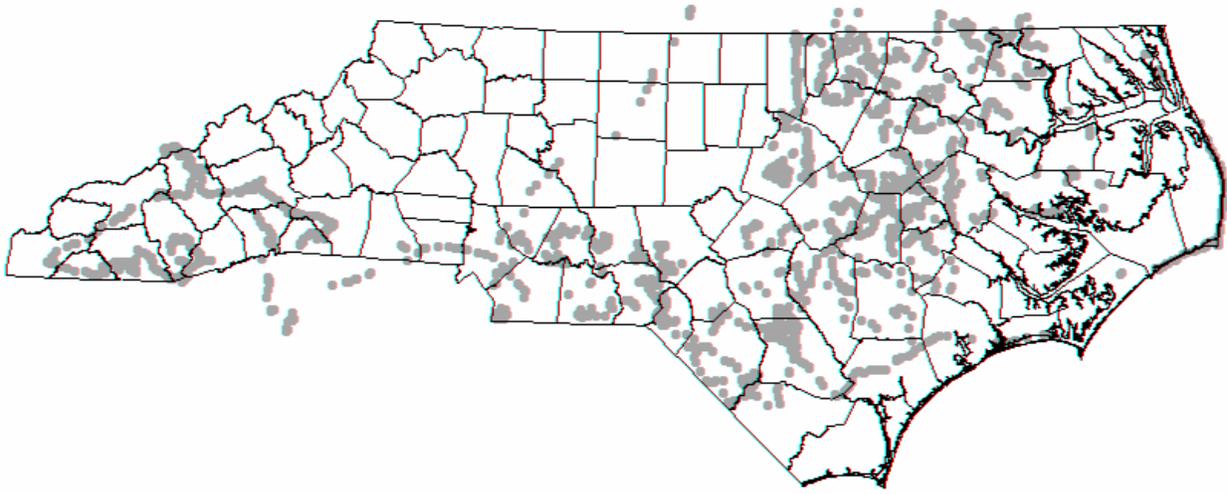


Figure 4.5 EarthSat Field Data Points

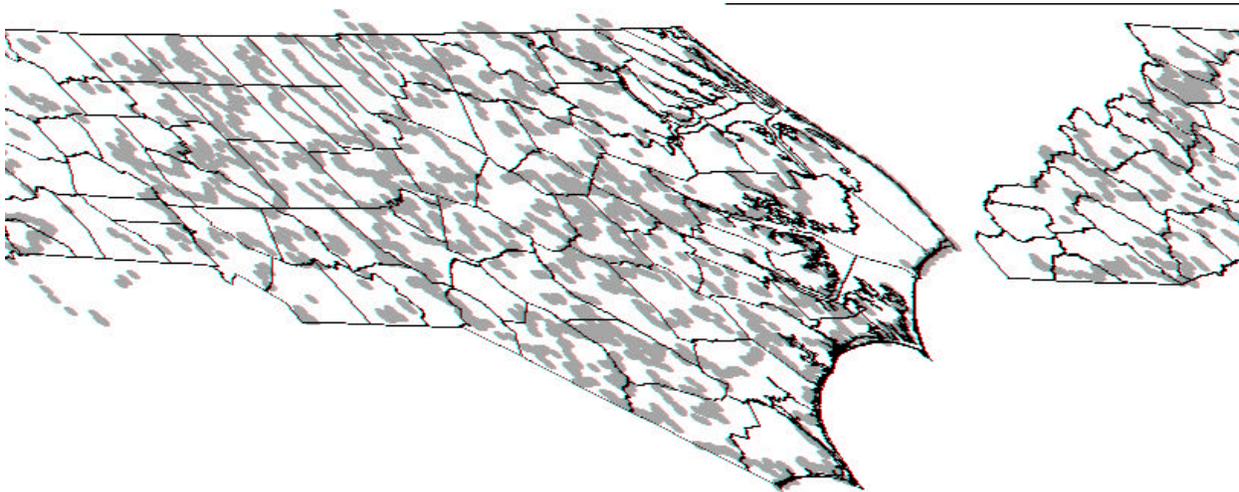


Table 4.14 Database Attribute Items

Field	Type	Width	Description
SITE-#	CHARACTER	7	Site identification number
CODE	CHARACTER	5	Land cover classification code Assigned
L4	CHARACTER	5	Linguistic scale 4: land cover code
L3-1	CHARACTER	5	Linguistic scale 3: land cover code
L3-2	CHARACTER	5	Linguistic scale 3: land cover code
L2-1	CHARACTER	5	Linguistic scale 2: land cover code
L2-2	CHARACTER	5	Linguistic scale 2: land cover code
L1-1	CHARACTER	5	Linguistic scale 1: land cover code
L1-2	CHARACTER	5	Linguistic scale 1: land cover code
DESCRIPT	CHARACTER	20	Brief site description (<i>e.g.</i> , primary vegetation type(s) found at the location)
PHOTO	CHARACTER	1	Y/N - whether a photo was taken of the site
AA	CHARACTER	1	Y/N - whether point was reserved for accuracy assessment (N meant the point was used during classification)

5.0 IMAGE CLASSIFICATION

In traditional image processing, the procedure of image classification is frequently used to improve the interpretability of multispectral imagery. In essence, classification may be viewed as a data reduction technique, reducing from many (typically three to six or more) “raw” data bands to a one-band classified image. An image classification may be supervised or unsupervised or a combination of both. In a supervised classification, training statistics are collected prior to the classification, resolving the image into information classes so that the resulting classified image is directly meaningful. This normally requires extensive collection of ground truth to define the training statistics. In an unsupervised classification, an automated statistics collection process is substituted for the collection of training statistics. A variety of different procedures are available to perform this function, and which one is used will affect the characteristics of the resulting classified image. When using an unsupervised approach, it is necessary after the classification to group or assign the resulting spectral classes into the required information (land cover) classes. EarthSat’s approach for this mapping initiative was a combined supervised-unsupervised classification.

5.1 Classification Procedures

A 12-band image for each pair of TM scenes was created, with bands 1-6 from the leaf-off

scene and bands 7-12 from the leaf-on scene. Thermal data (band 6) from both leaf-off and leaf-on scenes were not used. Initially EarthSat intended to use Imagine’s seed grow routine to develop signatures near points and assign information classes. This process is rather timely and user intensive, however, because it spans the euclidian distance of all bands of data within a specified neighborhood. With 2,607 points not retained for accuracy assessment, this process was quickly rejected.

Two separate methodologies were explored to determine which unsupervised process would yield the best results to assign information classes to spectral classes. Path 15 Row 35 was selected as the test scene.

ISODATA (iterative self-organizing data analysis technique), the first method, was performed on the full 12-band image into 240 spectral classes with a maximum of 10 iterations. A supervised classification was then performed on the full 12-band image using the signature file created from the unsupervised ISODATA process. The second method attempted to use data points for signature development. Points falling within the path/row were selected and buffered by 200-meters. The point buffers were then converted into a one-band image. The single band image was used to create a new 12-band image; the new 12-band image contained data only within the 200-meter buffers. A more stringent ISODATA was performed on the 12-band buffered image into 240 spectral classes with a maximum of 12 iterations. (Table 5.1 shows the complete parameters for the two different ISODATA routines performed.) A supervised classification was performed on the full 12-band image using the signature file created from the unsupervised 12-band point buffer ISODATA.

Table 5.1 Comparison of ISODATA Routines

ISODATA Parameters	Full Scene	Buffered Scene
Spectral classes	240	240
Standard deviations	2	2
XY skip	30	1
Convergence Threshold	0.95	0.99
Maximum iterations	10	12

Based on points not reserved for accuracy assessment, information classes were assigned to spectral classes for both supervised images. Analysis of both spectral confusion (different land cover classes falling within same spectral classes, *e.g.*, separate field points assigned land cover class 323 and 2 falling within spectral class 127) and visual consistency and quality made apparent that the second methodology, using areas from the 12-band image within 200-meters of points to produce a classified image, produced less spectral confusion and better database quality. ISODATA was then performed on all 11 12-band images using the buffered scene methodology.

After completion of the ISODATA routine for each scene, the resultant signature file was edited

to approximate a 4,5,3 (RGB) image. A supervised classification was performed in Imagine using the signature file with the corresponding 12-band scene. For each classification the parallelepiped rule was used as the non-parametric rule, parametric rule was used for both the overlap and unclassified rules, and maximum likelihood as the parametric rule. The maximum likelihood rule classifies a pixel based on the probability that the pixel belongs to a particular spectral class; the other rules correspond to pixels at overlaps and edges (and essentially leave a pixel an unassigned spectral value if it does not fall into a parallelepiped).

5.2 Assignment of Information Classes

Reports listing the total number of data points and number of points reserved for accuracy assessment for each land cover class were generated for each path/row (Appendix H). Points not reserved for accuracy assessment were separated into coverages based on their path/row location (*e.g.*, all points not reserved for accuracy assessment and completely within the maximal geographic extent of Path 17 Row 36 were put into a coverage called *p17r36_pts*). Separate coverages for each of the TM path/rows were created and ArcView's *Select By Theme* operation created shapefiles for each set of points within each path/row. Shapefiles were then converted into ARC/INFO coverages. Each point coverage was rasterized so that information classes could be assigned.

ARC/INFO Grid's dendrogram function was used to show the pairing of spectral classes and the euclidian distance separating their means. Dendrogram allows the user to visually analyze spectral relationship through a "spectral tree," whereby the length of the branch illustrates the magnitude of the euclidian distance of the spectral class. Using Imagine's *Signature Editor*, the spectral class and euclidian mean for each of the 12 bands were exported to a data file. The data file was processed in order to be read correctly by dendrogram; the dendrogram output was saved to a file and a hard copy printed.

A summary operation in Imagine matched each point (input zone) to its spectral class (input class), effectively reporting the spectral class falling at an input's *x,y* location. Point land cover codes falling on each spectral class were recorded on the hard copy dendrogram; information classes were assigned based on majority of points within a spectral class and/or spectral similarity (Appendix I). Visual analysis was also used in areas of extreme confusion or difficulty in interpreting spectral response. Approaching supervised classification in this manner allowed the user to thoroughly understand where spectral confusion was strongest and how land cover classes were related spectrally.

Figure 5.1 illustrates the general process of matching spectral class with land cover class and assigning the information class. Using Path 15 Row 35, field point images were split into groups of 255 (to coincide with 8-bit classified imagery) and summaries were run for each group. The field point corresponding to zone 30 fell within spectral class 93 (upper left). Points rasterized maintained 28.5 meter pixel resolution, hence only one zone pixel was within the spectral class. Zone 30 corresponded to field point TP1227 (upper right), classed as land cover code 323. The color of the spectral class was changed so the user could see where the spectral class occurred on the classified scene. During

classification three color attributes were present: one that maintained the original 4,5,3 classification, one that assigned the color viewed by the user, and one that maintained the color assigned to specific land cover classes.

Figure 5.1

5.3 Quality Assurance During Processing

To ensure consistent and systematic image processing, EarthSat developed a quality assurance chart (Appendix J). Use of the chart avoided processing overlaps and daily progress/status reporting. It also ensured that file naming conventions were comparable for respective scene and process stage; the first line of the chart was the processing step and the the file extension added to the path/row. For example, thematic recoding for each scene was *pathrow_recode.img*, or *p16r36_recode.img*, *p17r36_recode.img*, and so on. The chart listed each processing step's parameters to further ensure parallel processing for each scene.

5.4 Obstructed Areas

Several scenes contained areas of cloud and haze content. The provision of both leaf-off and leaf-on scenes, however, alleviated classification of such areas as land cover class 9, indeterminate land cover. Where possible cloud and haze cover were disregarded by scene mosaicking (section 5.10). The eastern portion of Path 16 Row 35 leaf-on, for example, was largely covered by haze and clouds. The western portion of Path 15 Row 35 had no cloud effects during either leaf-on or leaf-off, however. Path 15 Row 35 overlap was therefore maintained in the mosaic process, thus largely eliminating haze and cloud obstruction.

All leaf-off scenes contained virtually no clouds or haze within the state boundary. Thus, in areas where scene overlap did not eliminate clouds or haze obstructions, only the leaf-off scene was used for classification. Areas of interest (AOIs) were drawn loosely around clouded areas of the appropriate leaf-on scene. Less stringent parameters of ISODATA were used to generate a full-scene classified image; the AOI file was used to clip out only obstructed areas.

Because such areas contained little to no field points for classification, less stringent criteria for ISODATA was used to create classified images on the full 6-band scene (not point buffers). Assignment of land cover class to spectral class was based on available field points and areas from the 12-band classified image not obstructed by clouds or haze. If spectral classes remained unassigned information classes after both processes, the user made assignment based on neighborhood information class assignment. Black areas in figure 5.2 show approximate¹ areas where leaf-off 6-band imagery was used for classification.

Path 15 Row 36 and Path 16 (both Row 35 and Row 36) had the largest amount of cloud

¹ Shaded areas are not to scale and are not indicative of true geographic extent of created AOI. These approximations are shown only for general reference information.

coverage affecting classification. An example near Wilmington (Figure 5.3) demonstrates the effects clouds had on classification and why leaf-off areas were used to correct the problem. Similarly, an example from southeast Path 16 Row 35 (Figure 5.4) demonstrates cloud effects on classification (bottom) while also showing the leaf-on (upper left) and leaf-off (upper right) scenes of the same region.

Figure 5.2/5.3

Figure 5.4

5.5 Raster Editing

Satellite imagery inherently generalizes land cover characteristics which makes obtaining a pure, true classification nearly impossible. The use of substantial numbers of data points for classification in this mapping initiative vastly improved the classification process and results achieved. Inevitably, however, spectral confusion and mixed pixels will always be a problem.

Interactive raster editing was performed on areas based on available data points and/or visual and spectral interpretation of general neighborhood/proximity. Some mixed and confused pixels were relatively simple to identify and correct. For example, a narrow road dividing a pine forest might reflect an evergreen shrub (land cover class 323) spectral signature. The linear nature of the shrub is easily identified visually, the spectral class confirmed by referencing the dendrogram, and ancillary data (such as on-line TIGER or analog maps) further confirms a road's presence. The user draws an AOI around the shrub and selects the spectral class or spectral classes² to be recoded to developed land cover.

Recoding could not necessarily use the corresponding information class, however, because 8-bit data limits the user to 255 classes. For example, land cover class 3122 exceeds 255. Based on the example provided above, spectral class 11 may have been inadvertently assigned land cover class 5; recoding 323 to spectral class 11 would not provide the desired results (the road would be a river instead). Therefore either unassigned spectral classes or spectral classes with appropriately assigned information classes had to be identified for recoding pixel values. Since all ISODATA parameters allowed for a maximum of 240 spectral classes, 15 unassigned spectral classes were guaranteed for every scene. Generally more than 15 empty classes were available since most processing did not use all 240 classes. Therefore every effort was made to keep pixels classified separate from those recoded.

Using the 323 to 11 example above, assume the classified image has 235 spectral classes resulting from the combined unsupervised/supervised approach described earlier; spectral classes 236-255 are empty. During raster editing the pixels incorrectly classified as land cover class 323 could be reassigned any value. The user takes previously empty spectral class 236 and assigns it land cover class 11. All spectral classes assigned land cover class 323 would then be recoded to spectral class 236. Spectral class 236 is no longer an empty class; subsequent editing requiring pixels be changed to land cover class 11 would be recoded to spectral class 236. Through this process, maintaining separation of classified from recoded pixels is also achieved; the user can easily identify those pixels recoded because their spectral value would exceed 235.

² Several different spectral classes could potentially fall in the same area and require recoding. In such a case, recoding was more efficient by selecting all spectral classes based on assigned information class. In the example provided, all spectral classes assigned land cover class 323 would be recoded to land cover class 11.

With 28.5 pixel resolution, roads often did not classify well. In many instances roads were enveloped by surrounding cover, such as agriculture or forests with heavy closure over the road surface, but recoding where mixed pixels were roads (such as above) was achieved.

5.6 Spectral Confusion

It became evident during dendrogram completion and subsequent product reviews that several land cover classes had significant spectral confusion. When possible the information class assigned to a spectral class was changed to reduce spectral confusion. Instances where that yielded favorable results were extremely rare, however, because so doing normally changed the direction and vicinity of the spectral confusion. For example, changing a spectral class assigned as evergreen shrub to agriculture might correct pixels obviously in the middle of a large cultivated field but in another part of the scene the spectral change might turn an entire clear-cut area erroneously into agriculture. While much of the spectral confusion occurred in eastern scenes, confusion tended to be concentrated among several specific land cover classes.

5.6.1 Agriculture-Managed Herbaceous

Confusion between agriculture (land cover class 2) and managed herbaceous (land cover class 311) was more prevalent among scenes without good temporal spacing. Agriculture and managed herbaceous spectral signatures were very similar in Path 17 Row 35, for example, because effectively only three months³ separated the scenes. Most agriculture was not at a sufficient growth stage to reflect a spectral signature very different from managed areas such as hay fields. Sand (land cover class 61) and agriculture were often confused in scenes with fairly early leaf-off dates; this confusion reflected the sandy soil in eastern portions of the state and agriculture, such as tobacco or corn, having limited early crown density.

To attempt resolution of the problem, users relied on data points and dominant class identification during raster editing. Use of image maps and digital raw data throughout the editing process helped users identify fairly homogeneous areas, thus reducing instances of eradicating small areas of different land cover types occurring in the same local area. For example, using only dominant class identification in an area where managed herbaceous and agriculture were widely confused, a small managed field of 14 pixels in between or at the edge of large agricultural fields might be recoded to agriculture. With the image map, raw digital scene, and field point database readily available, the user

³ Although the scenes were taken in 1994 and 1995 for leaf-off and leaf-on, respectively, the difference for growing seasons is effectively only three months because crop rotation and fallow cultivation were generally insignificant factors.

would have potentially identified the field and ensured it was not filtered.

5.6.2 Developed-Sand-Agriculture

Largely in eastern scenes, high intensity developed (land cover class 11), sand, and agriculture were frequently spectrally similar. In such instances error was favored for developed classes so as to avoid not classing local rural developments. It was also generally easier to identify mis-placed developed than agriculture -- developed signatures appearing along forest edges because of shadow effect, for example. Availability of image maps, raw digital scenes, and field points again assisted the user in decision making during raster editing.

5.6.3 Developed-Water

Both Path 18 Row 35 and Path 19 Row 35 had minor confusion between developed and water (land cover class 5). This was primarily because of mountain shadows where roads followed a river. Again error was favored for developed classes because of ease of identifying mis-classed pixels. Such confusion was not widespread, however, and availability of TIGER line files and other sources largely resolved the problem.

5.6.4 Similar Class Confusion

Throughout the state confusion between “mixed” and “pure” classes was observed, largely because of forests at or near the class content threshold (*e.g.*, land cover class 411 versus 441). Several closely-related land cover classes, mostly in physiographic transition zones, were difficult to differentiate, however.

In central North Carolina (Coastal Plain to Piedmont transition) the confusion was between bottomland hardwood (land cover class 414) and mixed upland hardwoods (land cover class 411). Interactive alteration of spectral classes was attempted and yielded positive results. The user shaded a particular confused spectral class and moved around the image to identify what potential reclassification of the spectral class would render. A number of single spectral classes that were clearly bottomland in eastern but upland in western Path 16 (both Rows 35 and 36) were recoded as appropriate.

In western North Carolina (Piedmont to Mountain transition) the confusion was between mountain conifer (land cover class 421) and southern yellow pine (land cover class 422). Interactive alteration of spectral classes as performed for Path 16 was attempted but yielded limited positive results. Confusion was not as commonplace as 411-414 confusion, however; forests identified during field work as 421 or 422 and occurring in close proximity very often were differentiated well. Raster editing of such confusion was limited to what appeared to be obviously homogeneous forests, such as higher elevations, and was therefore not very extensive.

Across the state managed herbaceous (land cover class 311) and low intensity developed (land cover class 12) were oftentimes difficult to differentiate. The land cover classes had frequent spectral

confusion because of their similar spectral response and spatial proximity. Classification often unintentionally favored 311 because of limited 12 cover outside municipal boundaries and much of 12 eliminated in achieving the minimum mapping unit.

Among eastern scenes in general and most notably in Path 14 Row 36, unmanaged herbaceous wetland (land cover class 3122) and water (land cover class 5) were also difficult to differentiate. Some 3122 may be under-represented, especially near barrier islands, because of environmental factors such as tides and flooding. Every effort was made to separate spectral classes and resolve this problem; part of Path 14 Row 36 leaf-on near the southern barrier islands was used to minimize spectral confusion for 3122 classing.

5.6.5 Mountain Effects

Similar to forest edge effects found in eastern scenes, developed classes appeared in shadow areas in western scenes. The spectral confusion was not as broad-scale because of smaller spatial extent and number of data points collected specifically to minimize mountain shadow effects. Shadow areas were readily identified and resolved using both on-line raw imagery and image maps.

Spectral confusion because of sun illumination was prominent in Path 18 Row 35 and Path 19 Row 35, and minor in Path 18 Row 36. It became apparent through further analysis of Path 19 Row 35 that additional processing was needed to enhance classification results. The problem was largely confusion of mixed hardwood forests from the leaf-off image because of sun illumination; the spectral signature on illuminated slopes was very similar to managed herbaceous fields. Using the less stringent ISODATA parameters a classification was performed (not using the point buffer methodology) on both the full 12-band scene and 6-band leaf-on scene. While 411-311 conflict was virtually eradicated on the leaf-on classification, conflict among shrub, cultivated, and managed classes increased. The full 12-band classification was subsequently used since 411-311 conflict was considerably less prevalent and additional confusion was not introduced. Since most of the 411-311 confusion occurring in Path 18 Row 35 was in the southwestern portion of the scene, overlap from Path 19 Row 35 was used.

5.6.6 Shrub-Agriculture

The most wide-spread and difficult to resolve spectral confusion encountered throughout the entire classification process was among shrub classes and agriculture. Early-on in processing Path 15 Row 35 had the largest incidence of shrub-agriculture conflict and was selected for additional processing to determine whether any other methodologies could be implemented to resolve and/or reduce the spectral confusion.

The scene used for preliminary classification was a result of the point-buffer methodology. Using the less stringent ISODATA parameters, a classification was performed on the full 12-band scene without the point-buffer methodology. Figure 5.5⁴ illustrates that shrub confusion remained a significant

⁴ On the figure, yellow corresponds to land cover class 2; brown, 422 (top middle); dark

problem but shifted geometrically in some areas. A matrix was produced to compare classification results (Figure 5.6) with the point-buffer scene as primary input and full scene as secondary input. Staff were thus able analyze cultivation and shrub agreement as well as cultivation-to-shrub and shrub-to-cultivation difference. Both visual and histogram comparisons suggested that, of the two approaches, the point-buffered methodology achieved better results.

Extending the matrix methodology, 12-bands of data were clipped from the full scene using areas in conflict or agreement. (Essentially areas in black as in Figure 5.6 were ignored

green, 411; light green, 324; grey, 311; deep grey, 325; purple, 323; red, 11; blue, 5; light brown (upper left), 414; white, 61; other classes present do not have significant representation.

Figure 5.5

Figure 5.6

during the process.) ISODATA was performed using the more stringent criteria but not point-buffer procedure. Both visual and spectral analysis, confirmed by histogram comparisons, concluded that spectral confusion largely increased throughout the scene.

A normalized difference vegetation index (NDVI) was performed to determine whether the NDVI (computed as **band 4 - band 3 / band 4 + band 3**) would provide better classification results (Figure 5.7). Similar spectral confusion problems persisted, however, made evident by visual (Figure 5.8) and spectral (Figure 5.9) analysis. Further spectral analysis was performed to ascertain if any confused spectral classes could reliably be assigned a particular information class. Figure 5.10 illustrates the process of information class assignment based on dendrogram summary and interactive class alterations. The figure highlights (a) shrub *vs.* agriculture in spectral class 108 in blue where information class 325 falls in both cultivated (near or in yellow patches) and clear cut (dark blue, upper middle) areas; (b) developed *vs.* agriculture in spectral class 85 in red where information class 11 falls in cultivated areas; and (c) additional developed *vs.* agriculture in spectral class 79. Although some classes were identified as potential candidates for information class reassignment, throughout the scene such detection was not reliable and consistent; NDVI was therefore rejected as an acceptable process for spectral conflict resolution.

Several other procedures were considered but rejected. Other vegetative indices were deemed futile because of limited success with previous methods implemented, especially when factored with budgetary and deadline constraints. Because of dates of both leaf-on and leaf-off, classification of only 6 bands was rejected because of insufficient growth stage for much of the spectrally confused land cover classes. Seed grow was also rejected because several test areas suggested that the timely process would not provide considerably different results from the point buffer classification methodology. After careful consideration and interpretation of all results, the point buffer classification was retained. In performing comprehensive tests using Path 15 Row 35 additional processing time was not lost on other scenes as improved results would largely not be expected.

5.7 Aerial Photograph Interpretation

The State Department of Transportation (DOT) maintains an extensive library of aerial photographs for the entire state. DOT's facilities were made available to EarthSat staff on several occasions for photo interpretation and acquisition. Initially black-and-white photos were considered to be of minor value in ancillary data point collection primarily because of photos centering around roads. Color photographs were more valuable for both information and spatial content; color photos were available for the entire northeast portion of the state. With budgetary and access constraints (color photographs were only available at DOT's facility) little opportunity was available early-on to use photos for ancillary data point collection.

As processing of imagery began and spectral confusion was realized, particularly in the case of shrub-agriculture, use of aerial photographs was reconsidered. Hardcopy maps of classified scenes for Paths 14 and 15 were plotted and brought to Raleigh for color photo interpretation. EarthSat staff

compared photos with classification results and marked areas of both agreement and conflict on the maps. Areas pinpointed as conflict were subsequently
Figure 5.7/5.8

Figure 5.9

Figure 5.10a

Figure 5.10b/c

recoded. Use of aerial photos was also considered of limited overall value, however, as several data points fell within areas interpreted as mis-classed. For example, several areas near Lake Gaston and Kerr Reservoir were interpreted as agriculture mis-classed as shrub but the presence of data points confirmed correct classification.

While in Raleigh, EarthSat identified alternate 7.5' quadrangles for which quad-centered black-and-white photos would be acquired (Figure 5.11; the northeast portion of the state was not acquired because of availability and use of color photos). An attempt was made to obtain color infrared photography (CIR) for western quadrangles but DOT was relied upon for all photos when it was discovered both NAPP and CIR photography had no availability for desired areas. Photos were provided to EarthSat for use during raster editing of western scenes and classification confirmation comparable to work performed in Raleigh.

Several black-and-white digital orthophoto quarter quadrangles (DOQQ) were provided to EarthSat to determine whether their use would be beneficial. With each quad approximately 40-MB of disk space, requiring significant levels of processing to reproject and resample data and covering only limited spatial extent, it was determined that their use would be of minimal value.

Figure 5.11 7.5' Quadrangles Identified for Black-and-White Photo Acquisition

5.8 Scene Accuracy Appraisals

The creation of a matrix that describes the accuracy of the land cover classification is referred to as the confusion matrix or error matrix. The matrix (Table 5.2) lists the land cover classes across the columns and down the rows. The rows describe the land cover classes as observed from the detailed classification of the TM scenes and the columns describe the land cover classes observed from the detailed ground truth. Each cell of the matrix lists the number of ground truth points that were classified as land cover class *i* and, based upon the detailed ground truth, found to actually be in land cover class *j*. A perfect classification would have only values along the diagonal (black boxes) of the matrix.

Table 5.2 Error Matrix for Landsat TM Classification

		Ground Truth Derived Classes										User's Accuracy
	<i>i</i> <i>j</i>	1	2	3	4A	4B	4C	5	6	9	Row Total	
TM Deri ved Clas ses	1	■										
	2		■									
	3			■								
	4A				■							
	4B					■						
	4C						■					
	5							■				
	6								■			
	9									■		
Column Total											Total	
Producer's Accuracy												Overall Accuracy

Overall accuracy assessment is calculated by summing the diagonal elements and dividing by the total pixels analyzed. The probability of a reference pixel being correctly calculated is termed the producer's accuracy and is calculated for each class by dividing the number pixels properly classified by the total number of pixels of the class derived from the reference data (column total). The producer's accuracy is a measure of omission error. The measure of commission error, or user's accuracy, is calculated by taking the correct pixels by class and dividing this number by the total number of pixels classified as that class (row total).

Classification was evaluated after collapsing the 23 endpoint land cover classes to 9 collapsed land cover classes (Table 5.3). As classification was completed, separate error matrices for all data points and only data points reserved for accuracy assessment were created (Appendix K). To appraise classification, the classified scene was recoded to the appropriate thematic accuracy class. Data points were rasterized also using the appropriate thematic accuracy class so that the assessment could be performed on similarly-coded images. Using a process similar to information class assignment, a summary matrix was processed with rasterized points as the input zone and the recoded classified image as input class. Reported numbers were transferred to the summary matrix table and calculated.

Table 5.3 Collapsed Accuracy Land Cover Classes

Collapsed Land Cover Class	Thematic Accuracy Class	Description
1	1	Developed (classes 11 & 12)
2	2	Agriculture (class 2)
3	3	Herbaceous (classes 311 & 312)
4A	4	Woody/Deciduous (classes 324, 41, & 45)
4B	7	Woody/Evergreen (classes 323, 42, & 43)
4C	8	Woody/Mixed (classes 325 & 44)
5	5	Water (class 5)
6	6	Barren (classes 61 & 62)
9	9	Indeterminate (class 9)

In cases where accuracy was below the 85% requirement, additional analyses were undertaken. Oftentimes the nature of low accuracy was identified by either the linguistic scale, where points were understandably close to land cover class content thresholds, or positional error. If additional analyses undertaken did not yield acceptable explanation of low accuracy, additional raster editing was performed to bring the scene and/or problematic land cover class within the accuracy requirements. If additional analyses undertaken did yield acceptable explanation of low accuracy and accuracy was close to requirements, *i.e.*, just under 85% and/or low accuracy limited to specific classes, the scene was accepted. For example, on Path 16 Row 35, for land cover class 61 only 50% user and 33% producer accuracy was obtained for points reserved for accuracy assessment while 80% (both user and producer) was obtained for all points. The scene was accepted because of a combination of higher accuracy with more points and overall accuracy of 89%. Data points classed as indeterminate were extremely limited⁵ and results accepted within reason. Overall accuracy for all scenes of data points reserved for accuracy assessment was 88.5%; 88.4% overall accuracy for all scenes was obtained for all data points.

⁵ Only two points classified as land cover class 9 were mis-classed; one that was a quarry and one that was clear-cut. Five points classed as 9 were lumber yards, which met criteria for that land cover class.

5.9 Filtering to Reach Minimum Mapping Unit

Once an image was classified into the desired information classes and results were within acceptable accuracy specifications, scenes were filtered to achieve the minimum mapping units (MMU) of 12 pixels for land cover and 6 pixels for water. The image was recoded to sequential thematic classes for filtering to group same information classes and collapse attributes from 255 to 23 classes. In scenes where parts of the 6-band leaf-off classified scene were used because of clouds, the winter classified scene was also recoded to the appropriate thematic class then mosaicked with the cloud-obstructed classified scene. In such cases filtering was performed on the combined 12-band and 6-band classified scene.

Imagine's clump algorithm was used to identify neighborhood pixels within contiguous groups of 8 pixels. In the clumping process, single or limited numbers of pixels were considered insignificant data if they were not part of eight neighboring pixels. Because the clump process is extremely processing and hardware intensive, clumping of each classified scene except for Path 14 was split into ninths⁶. Clumping for Path 14 was completed for entire scenes because of the presence of a large area of homogeneous data (*i.e.*, the Atlantic Ocean). (Path 14 Row 36 took approximately 42 hours to complete, even with nearly 75% cover water.) To ensure that small areas in overlap of inter-scene clumps were not erroneously deleted, each clump had a 30-pixel overlap.

As clumping was complete, Imagine's eliminate algorithm was used to bring the clumped scene to the MMU. Eliminate was chosen over Imagine's sieve operation because the eliminate algorithm contains a focal majority filter that assigns a class value to pixels targeted by clump, while sieve maintains zero-values for areas not meeting the MMU. Two separate eliminates were performed for each clump — one with a 6 pixel minimum class size and one with a 12 pixel minimum class size. When all respective eliminates were complete, the scene parts were mosaicked to produce two full-scene classified images, one with a MMU of 6 pixels and one with a MMU of 12 pixels.

The 6-pixel MMU scene values were recoded to class 0 except for water, which maintained thematic class value 20. The recoded 6-pixel MMU scene was mosaicked over the 12-pixel MMU scene to achieve the dual MMU. Figure 5.12 illustrates the steps followed to reach the MMU from an area near Lake Norman; figure (a) illustrates the thematic recode scene (upper left), 6-pixel eliminate (upper right), 12-pixel eliminate (lower left), and mosaic of 6-pixel and 12-pixel images (lower right) and figure (b) illustrates the same steps for a windowed area with cross-hairs provided for reference. Figure 5.13 illustrates the steps followed to reach the MMU with emphasis on water class from an area east of Charlotte; figure (a) illustrates the four-step process as in Figure 5.12(a) and figure (b) emphasizes a windowed area demonstrating the difference between 6-pixel (left) and 12-pixel (right)

⁶ Some scenes were adjusted to maximize processing based on areas to be used in the final land cover surface. The lower left third of Path 16 Row 36, for example, was not clumped because no part of the region was in North Carolina.

filtering.

Figure 5.12

Figure 5.13

5.10 Neuse-Tar/Pamlico Watershed Land Cover

EarthSat received a change order in April 1996 to accelerate land cover development for the Neuse and Tar/Pamlico watersheds. Because the change order came early in the image processing methodology development (much of spectral confusion hadn't been realized by that point in time), vast improvements were made to various areas within the watersheds as different methodologies were explored. A separate, brief summary report (Appendix L) accompanied delivery of the database, which contained parts of 5 classified scenes, in August 1996. The report also provided information about the classification methodology; the point buffer methodology was implemented for land cover classification.

Accuracy assessment was not required but preliminary analyses suggested the database accuracy was between 60% and 70%. This was primarily due to lack of sufficient time for interactive error checking and extensive raster editing, incomplete ancillary data points, and filtering of some points that did not meet the MMU threshold. Some processing errors, mostly incorrectly recoded spectral classes (land cover classes 61 to 422 and 422 to 421), were also discovered well past delivery of the database.

5.11 Mosaicking and Municipal Area Deduct

All areas contained in the municipal ARC/INFO coverage were not classified for land cover; the vector coverage was rasterized with pixel values of 24 and subsequently mosaicked during statewide scene mosaicking. Initially the state provided the Powell (1983) municipal boundary dataset for use in the project and image maps were created using this coverage. The state later changed the municipal boundary to use; the 1989 municipal boundary coverage was used in the final mosaicking (hence municipal boundaries on the final land cover surface and the image maps do not necessarily correspond).

Reviews of data quality in and among scenes was performed early in the processing methodology development to establish a mosaicking hierarchy. This was to identify parts of scenes that would not be used because of either cloud cover or classification results. Once all scenes were classified, review of overlap areas refined the hierarchy to determine final statewide mosaicking. Figure 5.14 shows the TM boundaries with numbers corresponding to mosaic order. The larger number took preference over smaller numbers; hence, Path 19 Row 35 was the base scene (number 1) and areas of the scene overlapping with Path 18 Row 36 were essentially non-existent. There were a few other

alterations, as indicated on the figure by letters⁷, because of

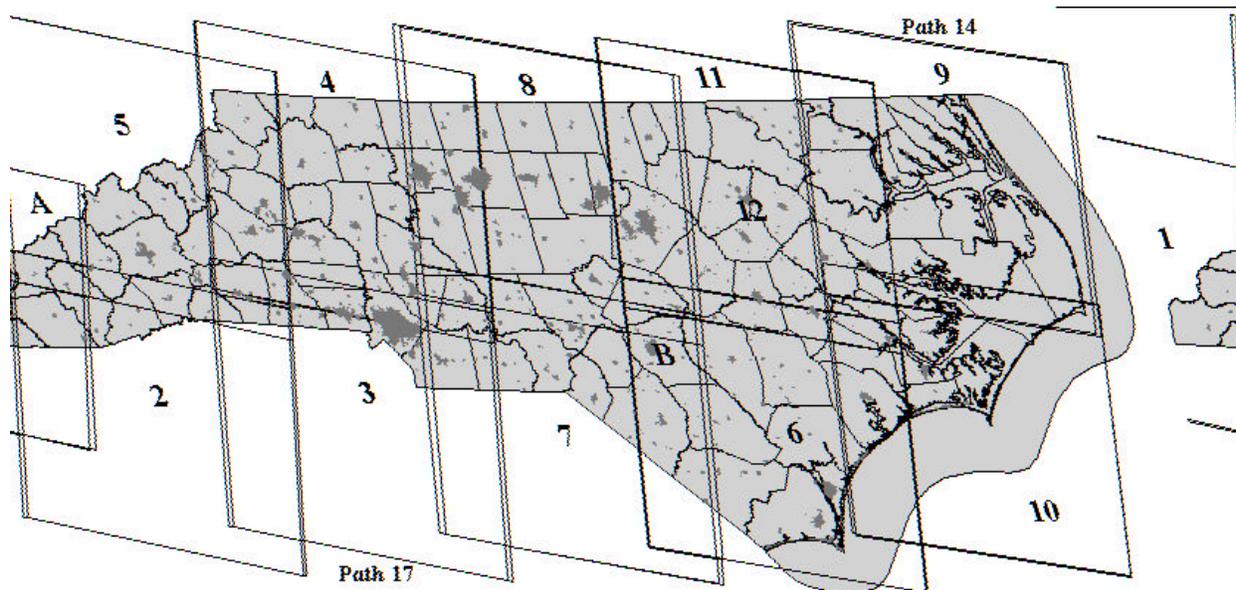


Figure 5.14 Scene Mosaicking Hierarchy

classification differences and/or limited area obstructions.

After all scenes were mosaicked, the statewide database underwent additional raster editing for interactive error checking to ensure scene overlap was consistent and any remaining errors were averted. Aerial photographs were re-used for further error checking and classification confirmation.

5.12 Statewide Land Cover

⁷ Number 12 corresponds to the Neuse-Tar/Pamlico database; darker areas are municipal boundaries (land cover class 10) deducted from final database. Letter A refers to Path 19 Row 35 overlap used instead of Path 18 Row 35. Letter B refers to an AOI extended from the top of scene boundary to the south and west of Fayetteville where overlap from Path 15 Row 36 was used in place of Path 16 Row 36. Path 16 Row 36 had precedence over Path 15 Row 36 in all other areas of overlap.

In compliance with the change order contract, the Neuse-Tar/Pamlico database was included in the final statewide land cover database. But advances in classification methodology and spectral confusion resolution, aerial photograph interpretation, extensive raster editing, recode error correction, and addition of data points all helped to significantly improve the quality of the entire database, including areas within the watershed boundaries. For this reason, four statewide land cover databases were provided to the state in place of the contracted two (filtered and unfiltered): two (one each, unfiltered and MMU) databases with the previously delivered Neuse-Tar/Pamlico classification and two (one each, unfiltered and MMU) without the delivered Neuse-Tar/Pamlico classification. EarthSat recommends that the latter database be used as the final statewide land cover database included in the corporate geographic database because of significant improvements.

Mixed pixels are a serious, continual problem with 28.5 meter resolution because land cover rarely conforms to pixel size and is rarely homogeneous within the pixel. Roads in particular were problematic because many roads do not have large spatial extent. Especially in reaching the MMU, segments often were enveloped by surrounding cover. While mixed classes representing roads were recoded to developed where possible, many roads remained unclassified or were eliminated in reaching the MMU. EarthSat considered rasterizing TIGER or other road networks and mosaicking them onto the final database. But with significant positional error and data inaccuracies in TIGER in particular, and other data sources in general, this option was rejected. Hence road networks will not necessarily appear in the database.

There were some limitations of multi-temporal imagery because of changes to land cover between dates. Changes were most notable among scenes with greater temporal spacing (*i.e.*, scene acquisition not in the same year). Eastern scenes also had greater occurrences of change because of higher variability of environmental conditions and likelihood for change. Although multi-temporal data created some spectral class confusion, availability was essential to producing a complete and accurate database. The completed land cover database contained nearly 164,225,800 classified pixels. Table 5.5 reports the number of pixels and total hectares for each land cover class for the two MMU databases.

5.12.1 Statewide Accuracy Evaluation

Final statewide accuracy evaluation was to be completed by CGIA but, to facilitate use of the database, EarthSat completed evaluation at no extension to the contract. Accuracy assessments were performed for the filtered (MMU) databases, both with and without the previously delivered Neuse-Tar/Pamlico database. Appraisals were reported for data points originally reserved for accuracy assessment, a new set of accuracy points (40% of all final compiled points), all final compiled points, and only field points (no ancillary data). The eight final appraisals can be found in Appendix M.

Analysis of the final accuracy reports indicate that accuracy on the more recent database, without the Neuse-Tar/Pamlico mosaicked, had much higher accuracy in all cases. Further, accuracy was higher on only field-collected data (without ancillary data). These accuracy assessments may

under-estimate overall accuracy because of incompatible ancillary data classification schemes, positional error, and potential changes in land cover between scene dates. Using only the original 40% reserved points, accuracy for the database with the Neuse-Tar/Pamlico classification was 78% and accuracy without the Neuse-Tar/Pamlico was 86%.

6.0 PROVISION OF METADATA

Metadata was provided to the state in both hard copy and digital (ASCII and WordPerfect text) format. Federal Geographic Data Committee (FGDC) compliant metadata was completed using the template provided by the CGIA and using their document, *North Carolina GIS Technical Advisory Committee Annotated Metadata Example*. Metadata for the seamless land cover surfaces complies to federal standards and maintains consistency for inclusion in the state geographic database. Metadata was provided for the land cover databases (Appendix N) and ARC/INFO coverage final point data compilation (Appendix O).

Table 5.4 Database Raster Attributes

Thematic Class	R	G	B	Land Cover Class	Land Cover Description	Accuracy Class
1	1	0	0	11	High Intensity Developed	1
2	1	0.2	0.3	12	Low Intensity Developed	1
3	1	1	0	2	Cultivated	2
4	0.9	0.9	0.8	311	Managed Herbaceous Cover	3
5	0.7	0.6	0.4	3121	Unmanaged Herbaceous Upland	3
6	0.2	0.7	0.8	3122	Unmanaged Herbaceous Wetland	3
7	0.5	0.1	0.4	323	Evergreen Shrubland	7
8	0.5	0.8	0.5	324	Deciduous Shrubland	4
9	0.6	0.7	0.6	325	Mixed Shrubland	8
10	0.4	0.8	0.1	411	Mixed Hardwoods	4
11	0.6	0.5	0.5	414	Hardwood Swamps	4
12	0.6	0.2	0.3	419	Other Broadleaf Deciduous Forests	4
13	0.2	0.9	0.9	45	Needleleaf Deciduous	4
14	0.8	0.3	0.2	421	Mountain Conifers	7
15	0.6	0.4	0.4	422	Southern Yellow Pine	7
16	0.8	0.1	0.5	429	Other Needleleaf Evergreen Forests	7
17	0.6	0.3	0.3	43	Broadleaf Evergreen Forest	7
18	0.2	0.7	0.4	441	Mixed Hardwoods/Conifers	8
19	0.2	0.4	0.7	442	Oak/Gum/Cypress	8
20	0	0	1	5	Water Bodies	5
21	1	1	1	61	Unconsolidated Sediment	6
22	0.5	0.5	0.5	62	Exposed Rock	6
23	0	0	0	9	Indeterminate Land Cover	9
24	1	0	0	10	Municipal Area	

Table 5.5 Seamless MMU Database Land Cover Class Content

Thematic Class	Land Cover Class	With Neuse-Tar/Pamlico		Without Neuse-Tar/Pamlico	
		Histogram	Total Hectares	Histogram	Total Hectares
1	11	1057137	85865.95	1072266.00	87094.81
2	12	446532	36269.56	450373.00	36581.55
3	2	23153202	1880618.83	23386783.00	1899591.45
4	311	17236110	1400003.03	17369335.00	1410824.23
5	3121	482325	39176.85	502240.00	40794.44
6	3122	864664	70232.33	919246.00	74665.76
7	323	5676887	461105.15	5112077.00	415228.45
8	324	1271214	103254.36	1256282.00	102041.51
9	325	1646647	133748.90	1683468.00	136739.69
10	411	36538828	2967866.30	36664961.00	2978111.46
11	414	17675859	1435721.65	17283219.00	1403829.46
12	419	9529	773.99	9557.00	776.27
13	45	68928	5598.68	73004.00	5929.75
14	421	2760622	224231.52	2767387.00	224781.01
15	422	29946846	2432432.57	30200563.00	2453040.73
16	429	102252	8305.42	121027.00	9830.42
17	43	69384	5635.72	94262.00	7656.43
18	441	9807360	796602.82	9939439.00	807330.93
19	442	1026679	83392.00	1007041.00	81796.91
20	5	13874283	1126938.64	13820985.00	1122609.51
21	61	322842	26222.84	310736.00	25239.53
22	62	181281	14724.55	181475.00	14740.31
23	9	6356	516.27	63.00	5.12

7.0 ACKNOWLEDGMENTS

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8.0 REFERENCES

Carter, Virginia, and Patricia Gammon. 1976. *Great Dismal Swamp Inventory*. U.S. Geological Survey Open-File Map 76-615. Suffolk, VA: U.S. Fish and Wildlife Service, U.S. Department of the Interior.

Comprehensive Land Cover Mapping for the State of North Carolina: Detailed Study Design. 1996. Rockville, MD: Earth Satellite Corporation. February.

Federal Geographic Data Committee. 1994. *Content Standards for Digital Spatial Metadata. June 8 Draft*. Washington, DC: Federal Geographic Data Committee.

Hansen, Mark H., Thomas Frieswyk, Joseph F. Glover, and John F. Kelly. Unknown. *The Eastwide Forest Inventory Data Base: Data Base Description and User's Manual*. Asheville, NC: Southeastern Forest Experiment Station.

LeGrand, Harry E. 1994. *Biological Inventory of Dismal Swamp Natural Area, North Carolina*. Raleigh: North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health and Natural Resources.

North Carolina GIS Technical Advisory Committee Annotated Metadata Example: State-Owned Complexes. Unknown. Raleigh: State of North Carolina Center for Geographic Information and Analysis.

Shafale, Michael P., and Alan S. Weakley. 1990. *Classification of the Natural Communities of North Carolina*. Third Approximation. Raleigh: North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health and Natural Resources.

A Standard Classification System for the Mapping of Land Use and Land Cover. 1994. Raleigh: State of North Carolina Center for Geographic Information and Analysis. January.

APPENDIX A

LAND COVER CLASSIFICATION SYSTEM

This document describes and details the classification system implemented as part of the statewide land cover mapping project under development by the North Carolina Center for Geographic Information and Analysis (CGIA). This classification system is largely based on the document entitled A Standard Classification System for the Mapping of Land Use and Land Cover (hereafter referred to as the standard classification system), produced by the CGIA in February 1994. The standard classification system was developed as the result of a series of forums, workshops, and reviews by more than sixty public and private sector organizations representing the land cover data user community from mid-1992 through the end of 1993.

Specific class definitions below are taken directly from the standard classification system. Both the descriptions and definition rules of a number of classes have been modified from the standard classification system, if necessary, to meet the following requirements:

1. generalize the classification from 43 classes to 22 classes for the final land cover surface;
2. enhance the thematic consistency of the statewide land cover surface with the regional or statewide products of other agencies mapping land cover or vegetation in the State;
3. increase the consistency of the standard classification system for mapping land cover in the State with the most recent draft vegetation classification standards under consideration by the Federal Geographic Data Committee, Vegetation Subcommittee.

In making these modifications, the CGIA retained the basic information content and structure that was cooperatively developed by the user community and described in the standard classification system. Underlined classes in this document represent the endpoint classes included on the final statewide land cover surface.

1 DEVELOPED

Description:

This category includes all land covered by urban development, including residential, commercial, industrial, transportation and utility infrastructure, and other developed land exclusive of agricultural land. In general, this category includes all areas where the land is covered predominantly by human structures, including buildings and pavement with minimal vegetation. This category includes densely populated urban and suburban areas as well as developed lands

in more rural areas (*e.g.*, paved runways at airports or industrial complexes surrounded by rural land). Isolated structures such as farmsteads and low density residential areas are generally not included in this category but are included within the surrounding land cover category (*e.g.*, 2, 3, or 4).

Decision Rule: More than 50% coverage by synthetic land cover, including asphalt, concrete, and other building materials.

11 HIGH INTENSITY

Decision Rule: More than 80% coverage by synthetic land cover.

12 LOW INTENSITY

Decision Rule: Between 50% and 80% coverage by synthetic land cover.

2 CULTIVATED

Description:

While this land cover category has an implied "use," it is included here to account for areas of land that are occupied by row and root crops that are cultivated in distinguishable rows and patterns, such as corn, soybeans, tobacco, peanuts, potatoes, and beets cultivated on a permanent basis or in rotation. This category also includes non-row grain crops such as wheat or oats. Barren or non-vegetated land that represents fallow cultivated land is also included in this class. Land used for orchards and tree plantations that meets the definition of Forest is generally included in Class 4. Pasture Land and significant coverage of bush crops (*e.g.*, berries) are normally included in Class 3.

Decision Rule: More than 50% coverage by seasonally harvested row and root crops and non-row grain crops, as well as barren or non-vegetated land that represents fallow fields that are generally cultivated.

3 HERBACEOUS COVER AND SHRUBLANDS

Description:

This category includes land predominantly covered by communities of grasses, grasslike plants, and forbs, including small flowering and nonflowering plants, and mixtures thereof, or shrubs and low woody plants. It includes unmanaged land as well as managed areas such as pasture, golf courses, cemeteries, and cultivated berries and vineyards.

31 HERBACEOUS COVER

Description:

This category includes areas dominated by native or introduced grasses and forbs, including grasslike plants such as sedges and rushes, and small flowering and nonflowering plants occurring on upland and lowland areas. This subcategory includes agricultural pasture land and land used for the production of grass. Non-row grain crops are included in Class 2. Also

included are areas of intensive human use such as golf courses and cemeteries which exhibit a predominantly herbaceous cover. Herbaceous cover areas may be maintained in this state by natural conditions, or they may be subjected to continuous management practices and disturbances such as mowing, grazing, or burning to maintain the herbaceous character. Areas of herbaceous cover sometimes occur on the upland margins of inland or coastal wetlands and may be periodically inundated by water after storm events.

Decision Rule: Land that is not classified as either Developed, Cultivated, Water, or Barren, with vegetation dominated by herbaceous species, and closure by either forest or shrub cover not to exceed 25% of either.

311 Managed Herbaceous Cover

Description:

This subclass includes pastures, land used for the production of grass and other forage crops, and other actively managed areas of herbaceous cover, including golf courses, cemeteries, etc. Although this category has an implied "use," it is included because it represents important information in the Herbaceous Cover class.

312 Unmanaged Herbaceous Cover

Description:

This subcategory includes all unmanaged herbaceous vegetation; areas that were formerly managed, such as abandoned croplands and pastures, that are reverting to natural vegetation; and areas that are managed on multiple-year cycles, through prescribed burns or other forms of vegetation control, to maintain herbaceous cover.

3121 Upland Herbaceous

Description:

This subclass includes areas covered by herbaceous vegetation that is not characteristic of riverine and estuarine environments. These areas include dry meadows, grassy balds, and herbaceous-dominated glades in the Piedmont and Mountains and areas of dune grass in the coastal region.

3122 Riverine/Estuarine Herbaceous

Description:

This subclass includes areas of herbaceous cover in salt, brackish, and freshwater marshes in riverine and estuarine environments. This subclass includes areas that are in transition to shrubland or forest. Typical plants which dominate these areas include sea oats, beach grass, panic grass, sand grass, black rush, cord grass and rice grass. These areas may be permanently or periodically inundated with water, or may represent permanent wetlands.

32 SHRUBLAND

Description:

Shrublands are dominated by shrubs and low woody plants generally below 3 meters in height. Included are areas of immature trees that may be in transition to forest. Cultivated areas with shrub crops, including berries and vine crops, are part of this subcategory. Also included are areas that are occasionally managed, through prescribed burns or other forms of clearing, to maintain shrub growth for wildlife habitat and other purposes. Low-lying shrub and brushlands may be periodically inundated by water following storm events.

Decision Rule: Land that is not classified as either Developed, Cultivated, Forest, Water, or Barren, with more than 25% closure by shrubs.

323 Evergreen Shrubland

Description:

This category includes areas dominated by evergreen shrubs and low woody vegetation including:

- (a) pocosins in the coastal plain (characterized by fetterbush, ti-ti, inkberry and scattered pond pine and loblolly bay);
- (b) mountain bogs (characterized by long stalked holly, mountain laurel, and rhododendron, with some tag alder);
- (c) mountain heath balds;
- (d) heath-dominated bluffs in the Piedmont; and
- (e) maritime scrublands.

Young pine plantations and clear-cut areas that are at an immature growth level with tree heights below 3 meters are also included in this category, as are areas of evergreen cultivated shrubs or vines.

Decision Rule: Evergreen shrub species comprise more than 75% of shrub cover.

324 Deciduous Shrubland

Description:

The category includes areas dominated by deciduous shrubs and low woody vegetation that lose their leaves seasonally, including:

- (a) low pocosins, dominated by honeycup;
- (b) deciduous shrubland on river bars, river banks and other poorly drained areas;
- (c) shrubby glades;
- (d) clear-cut areas dominated by deciduous shrubs and small trees, such as blackberry, blueberry, huckleberry, sumac, and hawthorns;
- (e) and areas of deciduous cultivated shrubs or vines.

Decision Rule: Deciduous shrub species comprise more than 75% of shrub cover.

325 Mixed Shrubland

Description:

This category includes areas of shrubs and low woody vegetation where neither evergreen nor deciduous species dominate. Examples include mixed pocosins in the Coastal Plain and oak-pine heaths in mountains.

Decision Rule: At least 25% intermixture deciduous and evergreen species.

4 FOREST LAND

Description:

Forest lands are covered with deciduous or evergreen woody vegetation about 3 meters or more in height. Forest lands exhibit a tree crown density of at least 25%. Lands from which trees have been removed to less than 25% crown density should be included in another land cover category as appropriate. This category includes upland forests and forest land on seasonally or permanently wet or inundated areas often called "forested wetlands" in other classification schemes. For land on which there is forest rotation involving clear cutting and block planting, the clear-cut or plantation areas are not included in this subcategory until planted trees reach a growth stage to meet the height and crown density criteria. This category includes managed areas of tree growth such as orchards or Christmas tree farms that meet the basic criteria for forest areas.

Decision Rule: Land that is not classified as either Developed, Cultivated, Water, or Barren, with more than 25% closure by trees.

4A DECIDUOUS FORESTS

Description:

Forested areas covered predominantly by deciduous trees that lose their leaves at the end of the growing season. This category includes both upland and lowland hardwood stands, including such species as oak, hickory, elm, poplar, maple, beech, cottonwood and other deciduous species, as well as areas dominated by cypress.

41 BROADLEAF DECIDUOUS FOREST

Forested areas covered predominantly by broadleaf deciduous trees, including subclasses for upland and lowland hardwood stands.

411 Mixed Hardwoods

Description:

This category includes Classes 411 and 412 in the standard classification system, including (a) oak-hickory and oak-chestnut forests (forests occurring in Piedmont and mountain areas in which oaks, hickory, or chestnut, singly or in combination, constitute a plurality of the stocking; in many areas of the state, these areas are dominated by oak with minor amounts of hickory or chestnut; common associates include yellow poplar and maple); and (b) mixed mesophytic upland hardwoods (mixed forests occurring in mountain coves, and moist mountain slopes on the Piedmont and coastal plain; in the Piedmont and coastal

plain, these areas are small in extent and are dominated by a mixture of beech, oaks, and other hardwoods; mountain examples include both the extensive northern hardwood forests of beech, birch, maple and buckeye; and the lower elevation cove forests consisting of these species plus yellow poplar, basswood, hemlock, and other species).

414 Bottomland Hardwoods/Hardwood Swamps

Description:

This category includes Classes 413 and 414 in the standard classification system, including:

- (a) bottomland and wet hardwood forests (forests with a predominance of hardwoods commonly occurring in lowland and wet areas; it includes elm-ash-cottonwood in which these species, either singly or in combination, constitute a plurality of the stocking; in some bottomland areas, oaks may dominate, but ash, sweetgum, elm and pine may dominate or co-dominate; natural levees tend to be dominated by ash, elm, box elder, sycamore, birch, or oaks; along small streams, cypress and gum and mesic species such as beech may be mixed in as well; this forest category also includes non-riverine wet hardwood forests on the coastal plain and in the Piedmont that are dominated by wetland oaks, cottonwood, and other hardwood species, and upland depression swamp forests not associated with streams that are dominated by water oak or overcup oak); and
- (b) hardwood swamps (including riverine cypress-gum swamps with less than 25% cypress; hardwood forests in swamps and bogs of the mountains and Piedmont that are dominated by maple or birch; gum and maple swamps on the coastal plain, maritime swamp forests on barrier islands dominated by hardwoods such as ash, sweetgum, and blackgum, and maritime shrub swamps dominated by swamp dogwood or red bay greater than 3 meters in height).

419 Other Broadleaf Deciduous Forests

Description:

This category includes other forest areas dominated by deciduous species that cannot be classified under either 411 or 412.

45 NEEDLELEAF DECIDUOUS

Description:

Forest class including cypress stands or strands, mixed gum/cypress forests, and maritime swamp forests dominated by cypress.

Decision Rule: Forested land with bald cypress constituting more than 75% closure of the stocking.

4B EVERGREEN FORESTS

Description:

Forested areas predominantly covered by needleleaf or broadleaf evergreen species.

Decision Rule: Forest land with more than 75% stocking by either needleleaf or broadleaf evergreen species.

42 NEEDLELEAF EVERGREEN FOREST

Description:

Forested lands covered predominantly by needleleaf evergreen species. This category includes upland and lowland species of pine, spruce, hemlock, and fir.

Decision Rule: Forest land with more than 75% stocking by needleleaf evergreen species.

421 Mountain Conifers

Description:

This category includes Classes 421, 422, and 423 in the standard classification system, including:

- (a) white pine forests (forests commonly occurring in mountain areas in which eastern white pine, red pine, or hack pine, singly or in combination, constitute a plurality of the stocking; common associates include hemlock, birch, or maple);
- (b) hemlock forests (forests commonly occurring in mountain areas in which eastern Canada hemlock and Carolina hemlock constitute a plurality of the stocking; common associates include birch, maple, or white pine); and
- (c) spruce-fir forests (forests commonly occurring in high elevation mountain areas in which spruce or true firs, singly or in combination, constitute a plurality of the stocking; common associates include hemlock, birch, or maple).

422 Southern Yellow Pine

Description:

This category includes Classes 424, 425, 426, and 427 in the standard classification system, including:

- (a) longleaf pine forest (forests commonly occurring on the Coastal Plain in which longleaf pine constitutes a plurality of the stocking);
- (b) loblolly-slash pine forests (forests that may occur throughout the state from the Coastal Plain to mountain areas in which loblolly pine and slash pine, singly or in combination, constitute a plurality of the stocking);
- (c) other yellow pine forests (forests that occur mainly on ridgetops and other upland areas within which shortleaf, Virginia, pitch and Table Mountain pines, singly or in combination, constitute a plurality of the stocking; common associates include oak, hickory, and gum); and
- (d) pond pine forests (forests commonly occurring on the Coastal Plain in which pond pine constitutes a plurality of the stocking).

429 Other Needleleaf Evergreen Forests

Description:

This category includes Classes 428 and 429 in the standard classification system, including:

- (a) Atlantic White Cedar forests (forest stands rarely occurring on the Coastal Plain in which Atlantic White Cedar constitutes the plurality of the stocking);
- (b) other needleleaf evergreen forest land, including red cedar stands; and
- (c) other forest areas dominated by evergreen species that cannot be classified as under either 421 or 422.

43 BROADLEAF EVERGREEN FOREST

Description:

This category includes forest stands characteristic of Carolina Bays and pocosins, as well as maritime evergreen broadleaf forests and bay forests, stocked predominantly by broadleaf trees that do not seasonally lose their leaves. Dominant trees in these stands normally include sweetbay, holly, red bay, wax myrtle, live oak, and laurel oak. Also included in this category are significant areas, mainly in low density residential areas, where non-deciduous broadleaf species have been planted.

Decision Rule: Forest land with more than 75% stocking by broadleaf evergreen species.

4C MIXED DECIDUOUS/EVERGREEN FORESTS

44 MIXED DECIDUOUS-EVERGREEN FOREST

Description:

Forested areas which exhibit mixtures of deciduous and evergreen species where neither predominate. Generally, where there is at least a 25% intermixture of deciduous and evergreen species, it will be placed in this category.

Decision Rule: Forested land with at least a 25% intermixture of deciduous and evergreen species.

441 Mixed Hardwoods/Conifers

Description:

Forests commonly occurring in Piedmont and mountain areas in which hardwoods (mainly oak) constitute a plurality of stocking but pines also account for 25 to 50% of the stocking. Additionally includes mixed stands of mesophytic hardwood species and evergreen species, including pines or mountain conifers.

442 Oak/Gum/Cypress

Description:

Bottomland forests in which tupelo, blackgum, sweetgum, or cypress, singly or in combination,

constitute a plurality of the stocking. These stands are classified in this subcategory when cypress constitutes at least 25% of the stocking but less than 75%. Common associates include willow, sycamore, beech, and maple.

5 WATER BODIES

Description:

This category includes all areas of surface water with no, or minimal, emergent vegetation. Areas with significant tree, shrub, or herbaceous cover that are permanently, seasonally, or periodically flooded should be included in Categories 3 or 4. Water bodies that include floating and submerged aquatic plants are included in this category.

Decision Rule: More than 50% coverage by open water.

6 BARREN LAND (named BARE LAND in the standard classification system)

Description:

This category includes non-forested and nonagricultural land that has less than 10 percent vegetation cover, including natural areas (such as sand dunes, river bars and banks, exposed bedrock) and managed areas (such as active or abandoned mines, quarries, and spoil piles). Land that is in transition to a non-barren or developed state, such as land being scraped for construction, is also included in this class. Excluded from this category is developed land (Category 1) and fallow cultivated land (Category 2).

Decision Rule: Land that is not classified as Developed, Cultivated, or Water with less than 10% coverage by vegetation.

61 UNCONSOLIDATED SEDIMENT (includes Classes 61 and 62 in the standard classification system;)

Description:

This category includes sandy or silty areas abutting tidal areas, and inland lakes and upland sand areas that little or no established vegetation. Beaches, active dunes, dune fields, tidal flats, sand hills, and similar coastal features are included. Also, sandy, silty, or gravel banks and bars along rivers and inside the river channel that support little or no vegetation are included, as are areas that have been scraped bare or excavated, abandoned mines, quarries, and spoil piles.

62 EXPOSED ROCK

Description:

Any area where bedrock is exposed at the surface or where a layer of soil exists that is not thick enough to support significant vegetation. Non-vegetated or poorly vegetated mountain balds and cliffs are examples of areas that fall in this category.

9 INDETERMINATE LAND COVER

Description:

Land will be assigned to this category in cases where the cover type does not logically fall into a

previously defined land cover class. This category also includes areas where clouds, shadows, snow and ice, or other obstructions preclude the identification of land cover.

APPENDIX B

CO-REGISTRATION PARAMETERS

Control Point Number	Root Mean Square Error X	Root Mean Square Error Y	Sum of the Square of the Difference X	Sum of the Square of the Difference Y	Mean X	Mean Y	N of X	N of Y	Sum X	Sum Y
1	3	11	12.5	242	869765.5	327875	2	2	1739531	655750
2	17	0	578	0	854378	190357	2	2	1708756	380714
3	14	0	392	0	827882	171228	2	2	1655764	342456
4	0	15	0	420.5	790020	106176.5	2	2	1580040	212353
5	12	20	588	1624.75	802410	315808.25	4	4	3209640	1263233
6	31	24	3822.75	2226.75	794059.75	295338.25	4	4	3176239	1181353
7	13	15	630.75	841	778484.25	273300.5	4	4	3113937	1093202
8	13	15	630.75	841	781291.75	243261.5	4	4	3125167	973046
9	31	13	3822.75	630.75	786364.75	204038.25	4	4	3145459	816153
10	14	15	784	841	788153	189624.5	4	4	3152612	758498
11	12	7	536.75	214	813306.75	178417	4	4	3253227	713668
12	24	12	2241	588	771587.5	193194	4	4	3086350	772776
13	10	14	651.5	1121.333333	787134.5	184841.3333	6	6	4722807	1109048
14	12	12	588	588	753048	92475	4	4	3012192	369900
15	15	13	841	630.75	774501.5	130978.75	4	4	3098006	523915
16	24	14	2241	784	753575.5	124502	4	4	3014302	498008
17	5	7	72	152.6666667	735938	76461.33333	3	3	2207814	229384
18	59	24	13698	2241	772528	108292.5	4	4	3090112	433170
19	32	24	4033	2226.75	756717.5	157269.75	4	4	3026870	629079
20	14	0	392	0	646451	64638	2	2	1292902	129276
21	0	14	0	392	626458	125357	2	2	1252916	250714
22	17	6	578	72	648283	12021	2	2	1296566	24042
23	0	15	0	420.5	719254	303453.5	2	2	1438508	606907
24	0	0	0	0	672657	186475	2	2	1345314	372950
25	43	22	3612.5	924.5	708236.5	248156.5	2	2	1416473	496313
26	13	0	630.75	0	673148.25	316806	4	4	2692593	1267224
27	13	12	630.75	588	659197.75	285477	4	4	2636791	1141908
28	0	24	0	2226.75	635892	250806.75	4	4	2543568	1003227
29	14	29	784	3249	641321	222185.5	4	4	2565284	888742
30	24	12	2226.75	588	630996.75	178431	4	4	2523987	713724
31	20	20	1568	1624.75	683886	314354.75	4	4	2735544	1257419
32	37	9	5433	313	539990.5	179962.5	4	4	2159962	719850
33	17	7	1107	214	500066.5	178864	4	4	2000266	715456
34	13	10	714.75	418	532194.25	178653	4	4	2128777	714612
35	15	6	872.75	157	608909.25	158593.5	4	4	2435637	634374
36	13	5	694	99	609975	156565.5	4	4	2439900	626262

Control Point Number	Root Mean Square Error X	Root Mean Square Error Y	Sum of the Square of the Difference X	Sum of the Square of the Difference Y	Mean X	Mean Y	N of X	N of Y	Sum X	Sum Y
37	20	14	1589	734.75	628767.5	159965.75	4	4	2515070	639863
38	0	3	0	18	636547	159500	2	2	1273094	319000
39	15	12	420.5	264.5	636481.5	159394.5	2	2	1272963	318789
40	14	8	811	288.75	639623.5	159526.75	4	4	2558494	638107
41	30	0	1800	0	627602	143303	2	2	1255204	286606
42	12	11	612.75	484	537338.75	171655	4	4	2149355	686620
43	7	13	192.75	722	539276.75	188396	4	4	2157107	753584
44	3	20	18	800	516434	283902	2	2	1032868	567804
45	31	6	3804.75	162.75	527595.75	321887.25	4	4	2110383	1287549
46	15	20	420.5	800	408903.5	185258	2	2	817807	370516
47	14	12	392	264.5	410659	175964.5	2	2	821318	351929
48	6	14	72	392	421047	178441	2	2	842094	356882
49	7	15	193	867	394667.5	184448.5	4	4	1578670	737794
50	3	20	18	800	377821	181234	2	2	755642	362468
51	0	11	0	242	340404	191759	2	2	680808	383518
52	14	20	392	760.5	327929	187663.5	2	2	655858	375327
53	3	9	18	144.5	430518	180686.5	2	2	861036	361373
54	0	3	0	18	409071	183993	2	2	818142	367986
55	3	6	12.5	72	386576.5	178039	2	2	773153	356078
56	0	9	0	144.5	376399	180840.5	2	2	752798	361681
57	3	0	18	0	386571	178039	2	2	773142	356078
58	2	12	18.75	529	415818.75	172840.5	4	4	1663275	691362
59	0	16	0	1004.75	508103	170051.75	4	4	2032412	680207
60	12	6	288	60.5	438221	325566.5	2	2	876442	651133
61	15	0	420.5	0	450279.5	333501	2	2	900559	667002
62	9	3	162	18	408168	172023	2	2	816336	344046
63	5	10	108	410	391923	182790	4	4	1567692	731160
64	6	15	150.75	867	386423.75	179506.5	4	4	1545695	718026
65	7	14	192.75	744.75	394542.25	183471.25	4	4	1578169	733885
66	7	8	222.75	281	387187.75	175754.5	4	4	1548751	703018
67	8	17	233	1142.75	501983.5	168099.75	4	4	2007934	672399
68	6	16	144	1085	503720	165329.5	4	4	2014880	661318
69	14	16	800.75	1051	508452.25	159612.5	4	4	2033809	638450
70	41	25	6666.75	2436.75	207077.25	194782.75	4	4	828309	779131
71	11	19	473	1510.75	194476.5	196155.25	4	4	777906	784621
72	19	26	1066.666667	1962	209586.6667	262834	3	3	628760	788502
73	9	9	144.5	144.5	218437.5	263199.5	2	2	436875	526399

Control Point Number	Root Mean Square Error X	Root Mean Square Error Y	Sum of the Square of the Difference X	Sum of the Square of the Difference Y	Mean X	Mean Y	N of X	N of Y	Sum X	Sum Y
74	13	40	662.75	6314	218724.25	262920	4	4	874897	1051680
75	0	0	0	0	364309	168184	2	2	728618	336368
76	12	13	536.75	699	367093.75	168434.5	4	4	1468375	673738
77	10	11	366.75	456	370986.75	166102	4	4	1483947	664408
78	0	3	0	18	357184	175950	2	2	714368	351900
79	0	14	0	392	327579	178937	2	2	655158	357874
80	3	6	18	72	319425	180222	2	2	638850	360444
81	3	9	18	162	320485	180225	2	2	640970	360450
82	0	11	0	242	320556	180188	2	2	641112	360376
83	0	0	0	0	194871	190750	2	2	389742	381500
84	6	3	60.5	18	192351.5	191203	2	2	384703	382406
85	6	9	72	144.5	192899	192006.5	2	2	385798	384013
86	9	20	289	1614.75	200100.5	196967.25	4	4	800402	787869
87	0	6	0	60.5	221331	261207.5	2	2	442662	522415
88	0	0	0	0	259578	70081	2	2	519156	140162
89	0	15	0	420.5	258267	74313.5	2	2	516534	148627
90	0	14	0	392	70252	196664	2	2	140504	393328
91	0	15	0	420.5	192375	134163.5	2	2	384750	268327
92	0	28	0	1568	194712	129875	2	2	389424	259750
93	0	0	0	0	192603	125001	2	2	385206	250002
94	0	0	0	0	193885	131527	2	2	387770	263054
95	0	6	0	72	162609	201278	2	2	325218	402556
96	0	14	0	392	167352	199229	2	2	334704	398458
97	0	15	0	420.5	186013	168152.5	2	2	372026	336305
98	16	11	800.6666667	352.6666667	178515.3333	151161.3333	3	3	535546	453484
99	3	35	18	2380.5	179005	151978.5	2	2	358010	303957
100	16	39	962	5960	192041	131946	4	4	768164	527784
101	0	12	0	264.5	213083	197943.5	2	2	426166	395887
102	6	9	156.75	358	210556.25	196648	4	4	842225	786592
103	9	6	144.5	60.5	471569.5	136463.5	2	2	943139	272927
104	0	12	0	264.5	467166	140225.5	2	2	934332	280451
105	6	3	60.5	12.5	466179.5	142177.5	2	2	932359	284355
106	9	12	144.5	264.5	467921.5	136845.5	2	2	935843	273691
107	3	3	18	18	469905	138638	2	2	939810	277276
108	0	6	0	60.5	476976	137523.5	2	2	953952	275047
109	12	9	264.5	144.5	471982.5	136705.5	2	2	943965	273411

Control Point Number	Root Mean Square Error X	Root Mean Square Error Y	Sum of the Square of the Difference X	Sum of the Square of the Difference Y	Mean X	Mean Y	N of X	N of Y	Sum X	Sum Y
110	5	8	90.75	238	348825.25	158145	4	4	1395301	632580
111	2	7	18.75	216.75	348402.25	151176.75	4	4	1393609	604707
112	5	3	90.75	27	348808.25	157221.5	4	4	1395233	628886
113	5	3	108	25	530592	163763.5	4	4	2122368	655054
114	5	13	90.75	662.75	352222.75	131716.75	4	4	1408891	526867
115	3	12	36	566.75	364899	150314.25	4	4	1459596	601257
116	17	11	1136.75	469	364991.75	152229.5	4	4	1459967	608918
117	17	6	1166	150.75	511965	283641.75	4	4	2047860	1134567
118	18	16	1272	974.75	516931	283802.25	4	4	2067724	1135209
119	29	21	3290.75	1818.75	525183.25	281390.25	4	4	2100733	1125561
120	9	16	264.6666667	806	525522.3333	283276	3	3	1576567	849828
121	15	5	872.75	99	503687.25	281418.5	4	4	2014749	1125674
122	22	6	1850	144	504246	271194	4	4	2016984	1084776
123	18	11	1250.75	446	517320.25	242164	4	4	2069281	968656
124	11	10	490	366.75	520445	244127.75	4	4	2081780	976511
125	12	13	566.75	709	523823.75	238980.5	4	4	2095295	955922
126	6	6	72	60.5	351906	224864.5	2	2	703812	449729
127	17	1	578	0.5	629610	237848.5	2	2	1259220	475697
128	6	17	72	578	627028	231454	2	2	1254056	462908
129	12	0	264.5	0	623026.5	240522	2	2	1246053	481044
130	3	3	12.5	18	301338.5	117998	2	2	602677	235996
131	6	0	60.5	0	305525.5	122743	2	2	611051	245486
132	12	31	264.5	1922	435228.5	194931	2	2	870457	389862
133	6	3	60.5	18	431780.5	188644	2	2	863561	377288
134	22	4	924.5	32	438541.5	202756	2	2	877083	405512
135	4	29	60.75	3274	381631.75	223072	4	4	1526527	892288
136	11	28	446	3166	380748	223303	4	4	1522992	893212
137	6	22	150.75	1965	376910.75	187248.5	4	4	1507643	748994
138	12	23	614	2165	364124	225753.5	4	4	1456496	903014
139	7	34	192.75	4490	364451.75	222348	4	4	1457807	889392
140	10	428	361	733989	380745.5	223048.5	4	4	1522982	892194
141	12	21	565	1792.75	364950.5	219385.25	4	4	1459802	877541
142	3	17	18	578	232243	247454	2	2	464486	494908
143	17	17	578	578	232582	250047	2	2	465164	500094
144	3	3	18	18	228840	255146	2	2	457680	510292
145	49	23	4704.5	1012.5	804278.5	255473.5	2	2	1608557	510947
146	5	7	84.75	216.75	799326.25	220887.75	4	4	3197305	883551

Control Point Number	14/35 Winter	14/35 Summer	14/36 Winter	14/36 Summer	15/35 Winter	15/35 Summer
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Control Point Number	14/35 Winter	14/35 Summer	14/36 Winter	14/36 Summer	15/35 Winter	15/35 Summer
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Control Point Number	14/35 Winter		14/35 Summer		14/36 Winter		14/36 Summer		15/35 Winter		15/35 Summer	
111												
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141												
142												
143												
144												
145												
146									804230	255496	804327	255451
147	799328	220892	799322	220892					799322	220875	799333	220892

Control Point Number	15/36 Winter		15/36 Summer		16/35 Winter		16/35 Summer		16/36 Winter		16/36 Summer	
	x-Meters	y- Meters										
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14	753027	92454	753055	92482								
15	774487	130986	774487	130986								
16	753597	124516	753540	124516								
17	735932	76454	735938	76471								
18	772435	108271	772578	108328								
19	756732	157263	756703	157291								
20	646437	64638	646465	64638								
21	626458	125371	626458	125343								
22	648266	12015	648300	12027								
23												
24												
25												
26					673141	316806	673141	316806				
27					659205	285484	659205	285484				
28					635892	250828	635892	250828				
29					641307	222214	641307	222157				
30					631018	178438	630990	178438				
31					683886	314355	683858	314383				
32					539955	179954	540012	179962	539955	179977	540040	179957
33					500055	178860	500055	178871	500061	178871	500095	178854
34					532174	178643	532209	178666	532191	178660	532203	178643
35					608891	158596	608902	158585	608913	158591	608931	158602
36					609985	156561	609962	156567	609991	156561	609962	156573

Control Point Number	15/36 Winter	15/36 Summer	16/35 Winter	16/35 Summer	16/36 Winter	16/36 Summer
37			628748	159947	628749	159959
38			636547	159497		
39					636467	159406
40			639614	159531	639618	159514
41					627572	143303
42			537339	171644	537321	171666
44			539271	188390	539271	188419
45			516431	283882	516437	283922
46			527580	321884	527580	321890
47						
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Control Point Number	15/36 Winter	15/36 Summer	16/35 Winter	16/35 Summer	16/36 Winter	16/36 Summer
75						
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Control Point Number	15/36 Winter	15/36 Summer	16/35 Winter	16/35 Summer	16/36 Winter	16/36 Summer
111						
112						
113						
114						
115						
116						
117						
118			511939	283632	511974	283643
119			516915	283785	516927	283808
120			525192	281369	525226	281369
121			525511	283295	525534	283255
122			503680	281414	503669	281420
123			504250	271200	504222	271188
124			517320	242158	517309	242164
125			520432	244119	520438	244131
126			523835	238966	523807	238983
127						
128			629627	237849	629593	237848
129			627022	231437	627034	231471
130			623038	240522	623015	240522
131						
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Control Point Number	17/35 Winter		17/35 Summer		17/36 Winter		17/36 Summer		18/35 Winter		18/35 Summer	
37												
38												
39												
40												
41												
42												
44												
45												
46	527649	321879	527574	321896								
47			408918	185238			408889	185278				
48			410645	175953			410673	175976				
49			421041	178427			421053	178455				
50	394668	184440	394673	184440	394656	184440	394673	184474				
51			377818	181214			377824	181254				
52			340404	191748			340404	191770				
53			327915	187644			327943	187683				
54	430515	180678			430521	180695						
55	409071	183990			409071	183996						
56	386574	178033			386579	178045						
57	376399	180832			376399	180849						
58	386574	178039			386568	178039						
59	415820	172829	415820	172829	415820	172852	415815	172852				
60	508103	170036	508103	170036	508103	170065	508103	170070				
61	438233	325572	438209	325561								
62	450265	333501	450294	333501								
63	408177	172026	408159	172020								
64	391926	182793	391914	182776	391926	182804	391926	182787				
65	386431	179515	386414	179481	386425	179515	386425	179515				
66	394548	183477	394531	183448	394548	183483	394542	183477				
67	387195	175758	387183	175742	387195	175753	387178	175765				
68	501993	168081	501976	168093	501989	168098	501976	168127				
69	503726	165305	503714	165334	503726	165328	503714	165351				
70	508457	159594	508428	159600	508462	159622	508462	159634				
71									207052	194797	207024	194740
72									194472	196148	194461	196137
73											209600	262798
74											218429	263191

Control Point Number	17/35 Winter		17/35 Summer		17/36 Winter		17/36 Summer		18/35 Winter		18/35 Summer	
75									218731	262935	218703	262941
76											364309	168184
77									367080	168457	367108	168429
78									370978	166120	371001	166098
79											357184	175953
80									327579	178951		
81											319422	180216
82											320482	180216
83									320556	180199		
84									194871	190750		
85											192357	191200
86											192893	191998
87									200109	196952	200092	196974
88									221331	261213	221331	261202
89												
90												
91												
92												
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102												
103												
104					471578	136458	471561	136469				
105					467166	140214	467166	140237				
106					466185	142175	466174	142180				
107					467930	136834	467913	136857				
108					469908	138635	469902	138641				
109					476976	137518	476976	137529				
110					471994	136697	471971	136714				

Control Point Number	17/35 Winter	17/35 Summer	17/36 Winter	17/36 Summer	18/35 Winter	18/35 Summer
148						
149						
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Control Point Number	18/36 Winter	18/36 Summer	19/35 Winter	19/35 Summer		
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70						
71			207109	194797	207124	194797
72			194484	196148	194489	196188
73			209560	262855	209600	262849
74					218446	263208

Control Point Number	18/36 Winter	18/36 Summer	19/35 Winter	19/35 Summer
148				
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APPENDIX C

1:250,000-SCALE IMAGE MAPS

An example of one 8.5x11" 1:250,000-scale image map is provided here for reference only. Complete set of prints is available under separate cover entitled *Landsat TM Scenes*.

APPENDIX D

ANCILLARY DATA COLLECTION SHEET

APPENDIX E

FIELD DATA COLLECTION SHEET

Earth Satellite Corporation Field Data Collection Sheet

Page 1

Project #: 2134

Site #: _____

Date: _____

Time: _____

Reported By: _____

Organization: _____

Other Party Members and Affiliations:

USGS Quad: _____

State: NC **County:** _____

Image (path/row, J/K, date): _____

Aerial Photo (proj., flight line, frame, scale): _____

Ancillary Data Source:

Ground Truth Photo

Roll #: _____ **Frame #:** _____

Azimuth: _____

Approximate Coordinate: _____ **W** _____ **N**

Actual Coordinate: _____ **W** _____ **N**

Projection: _____ **Zone:** _____ **Datum:** _____

Spheroid: _____

Units: _____

Land Cover (code/description): _____ /

Land Use (code/description): _____ /

Field Verified (Y or N): _____ **Date/Time** (if different from above): _____

Description

of

Site: _____

Earth Satellite Corporation Field Data Collection Sheet

Page 2

Project #: 2134

Site #:

LANDCOVER CHARACTERIZATION

select the landcover class (circle the underlined number) and provide corresponding information

- 1 **DEVELOPED** (>50% synthetic cover; i.e., asphalt, concrete, structures)
- 11 **DEVELOPED - High Intensity** (>80% synthetic cover; i.e., asphalt, concrete, structure)
- 12 **DEVELOPED - Low Intensity** (>50% and <80% synthetic cover; i.e., asphalt, concrete, structure)

Type of synthetic material (check all that apply):

asphalt
concrete
structure

Describe type of facility:

- 2 **CULTIVATED LAND**
Crop type:

- 3 **HERBACEOUS COVER AND SHRUBLAND**

- 31 **HERBACEOUS COVER**

- 311 **MANAGED HERBACEOUS COVER** (closely cropped grass, lawn, golf course, pastures)

- 312 **UNMANAGED HERBACEOUS COVER**

- 3121 **UNMANAGED HERBACEOUS COVER - Upland**

- 3122 **UNMANAGED HERBACEOUS COVER - Wetland**

- 32 **SHRUBLAND**

- 323 **EVERGREEN SHRUBLAND** (>10% vegetated with >25% woody stem, average stem height <3 meters, >70% evergreen cover; check type of cover below)

broadleaf evergreen cover
needleleaf evergreen cover

- 324 **DECIDUOUS SHRUBLAND** (>10% vegetated with >25% woody stem, average stem height <3 meters, >70% deciduous cover)

- 325 **MIXED SHRUBLAND** (>10% vegetated with >25% woody stem, average stem height <3 meters, neither evergreen nor deciduous shrubs dominate)

Approximate height of canopy: _____ meters _____ feet

Earth Satellite Corporation Field Data Collection Sheet

Page 3

Project #: 2134

Site #:

Canopy closure class (circle): 11-25% 26-50% 51-75% 75-100%

Identify dominant species:

LANDCOVER CHARACTERIZATION (continued)

select the landcover class (circle the underlined number) and provide corresponding information

4 FOREST LAND

4A DECIDUOUS FOREST

41 BROADLEAF DECIDUOUS FOREST

411 MIXED UPLAND HARDWOODS (oak, hickory, or chestnut with <25% pines)

414 BOTTOMLAND FORESTS (<25% cypress, riverine swamps, bottomland forest)

419 OTHER BROADLEAF DECIDUOUS FOREST (forests dominated by deciduous species but not classified as 411 or 414)

45 NEEDLELEAF DECIDUOUS (>75% cypress)

4B EVERGREEN FORESTS

42 NEEDLELEAF EVERGREEN FOREST

421 MOUNTAIN CONIFERS (white pine, hemlocks, and spruce fir forests in the mountains)

422 SOUTHERN YELLOW PINE (all longleaf, loblolly, and slash pines predominantly found in the Piedmont and coastal plain)

429 OTHER NEEDLELEAF EVERGREEN FOREST (forests dominated by Atlantic White Cedar or Red Cedar but not classified as 421 or 422)

43 BROADLEAF EVERGREEN FOREST (loblolly bay, red bay, wax myrtle, magnolia, live oak, and laurels of bays and pocosins)

4C MIXED DECIDUOUS/EVERGREEN FORESTS

44 MIXED DECIDUOUS-EVERGREEN FORESTS

441 MIXED HARDWOOD/CONIFERS (hardwoods with 25% to 50% pines)

442 OAK/GUM/CYPRESS (tupelo, blackgum, sweetgum, oaks, and cypress >25% and <75%)

Approximate height of canopy: _____ meters _____ fet

Canopy closure class (circle): 11-25% 26-50% 51-75% 75-100%

Dominant species in upper canopy:

Dominant species in subcanopy (<3 meters):

Dominant species in shrubstory (1 to 3 meters):

Earth Satellite Corporation Field Data Collection Sheet

Page 4

Project #: 2134

Site #:

Dominant species in groundstory (<1 meter):

If forest coverage <100% describe non-forest inclusions:

LANDCOVER CHARACTERIZATION (continued)

select the landcover class (circle the underlined number) and provide corresponding information

5 WATER (open water)

Check appropriate type:

river/stream

lake/pond

artificial _____ identify type:

6 BARREN LAND (<90% vegetated, except urban areas)

Nature of material (check appropriate type):

61 UNCONSOLIDATED _____ (Type (circle): Gravel Sand lay/Silt Mud Other)

62 EXPOSED ROCK

Is barren area a construction site or other transitional area? (circle) Y N

9 INDETERMINANT LANDCOVER (type doesn't logically fall into previously defined category)

Earth Satellite Corporation Field Data Collection Sheet

Page 5

Project #: 2134

Site #:

TOPOGRAPHY/DISTURBANCE REGIME

record topographic information (required) and disturbance regime (if appropriate)

TOPOGRAPHY

Topographic Position (check appropriate category):

Ridge top/Upper slope

Midslope

Midslope bench

Lower slope

Flatland

Bottomland/wet bottomland

Topographic Slope Class (check appropriate class), in degrees:

0-5

6-10

10-20

20-30

>30

Topographic Aspect Class (circle appropriate class):

N

NE

E

SE

S

SW

W

NW

DISTURBANCE REGIME

Check all disturbance regimes that apply:

Fire

Clearcutting

Selective cutting/thinning

Earth Satellite Corporation Field Data Collection Sheet

Page 6

Project #: 2134

Site #: _____

Windfall

Natural reversion from nonforest

Active livestock grazing

Disease or insect defoliation

Other _____ **specify:** _____

Other _____ **specify:** _____

LINGUISTIC SCALE

For each of the following landcover classes, circle a number corresponding to the likelihood of the site belonging to that class per the following rules:

- 0 absolutely incorrect interpretation of site
- 1 incorrect interpretation of the site but there is something about the site which suggests membership in this class may be understandable
- 2 an acceptable interpretation of the site but not the best interpretation; more than one other possible interpretation seems reasonable
- 3 a good interpretation of the site but there is something about the site suggesting that membership in this class is not absolutely correct
- 4 absolutely correct interpretation of the site

CLASS	DESCRIPTION	SCALE				
1	DEVELOPED					
<u>11</u>	High Intensity	0	1	2	3	4
<u>12</u>	Low Intensity	0	1	2	3	4
<u>2</u>	CULTIVATED	0	1	2	3	4
3	HERBACEOUS COVER AND SHRUBLANDS					
31	HERBACEOUS COVER					
<u>311</u>	Managed Herbaceous Cover	0	1	2	3	
4						
312	UNMANAGED HERBACEOUS COVER					
<u>3121</u>	Unmanaged Herbaceous Cover - Upland	0	1	2	3	
	4					
<u>3122</u>	Unmanaged Herbaceous Cover - Wetland	0	1	2		
	3 4					
32	SHRUBLAND					
<u>323</u>	Evergreen Shrubland	0	1	2	3	
4						
<u>324</u>	Deciduous Shrubland	0	1	2	3	
		4				
<u>325</u>	Mixed Shrubland	0	1	2	3	4
4	FOREST LAND					
4A	DECIDUOUS FOREST					
41	BROADLEAF DECIDUOUS FOREST					

Earth Satellite Corporation Field Data Collection Sheet

Page 7

Project #: 2134

Site #:

<u>411</u>	Mixed Hardwoods	0	1	2	3	4
<u>414</u>	Hardwood Swamps	0	1	2	3	4
<u>419</u>	Other Broadleaf Deciduous Forests		0	1	2	3
4						
<u>45</u>	Needleleaf Deciduous	0	1	2	3	4
<u>4B</u>	EVERGREEN FORESTS					
<u>42</u>	NEEDLELEAF EVERGREEN FOREST					
<u>421</u>	Mountain Conifers	0	1	2	3	4
<u>422</u>	Southern Yellow Pine	0	1	2	3	4
<u>429</u>	Other Needleleaf Evergreen Forests		0	1	2	3
4						
<u>43</u>	Broadleaf Evergreen Forest		0	1	2	3
4						
<u>4C</u>	MIXED DECIDUOUS/EVERGREEN FORESTS					
<u>44</u>	Mixed Deciduous-Evergreen Forests					
<u>441</u>	Mixed Hardwoods/Conifers	0	1	2	3	4
<u>442</u>	Oak/Gum/Cypress	0	1	2	3	4
<u>5</u>	WATER BODIES	0	1	2	3	4
<u>6</u>	BARREN LAND					
<u>61</u>	Unconsolidated Sediment	0	1	2	3	4
<u>62</u>	Exposed Rock	0	1	2	3	4
<u>9</u>	INDETERMINATE LANDCOVER	0	1	2	3	4

APPENDIX F

DATA COLLECTION INSTRUCTION SHEET

Earth Satellite Corporation Field Data Collection Sheet Instructions for Form Completion

Project #: 2134

Imagery Data Collection Sheet

1. It is not necessary to complete the entire field data collection form unless the site information is field verified.
2. Record the image path, row, season, and site number (site number recorded as recorder's initials-site number, e.g. **TP-01**, **TP-02**, etc.).
3. Record the landcover classification number and provide a brief description of the site. Use as many lines to describe the site as necessary.

Field Data Collection Sheet

1. Report the site identification number (site number recorded as recorder's initials-site number, e.g. **TP-01**, **TP-02**, etc.), date and time of field observation along with your name and affiliation, as well as the name(s) and affiliation(s) of other individuals present for data collection.
2. Record U.S. Geological Survey 7.5 minute quadrangle (if known), county, TM image path, row, and season (fall/winter scene), and ancillary data sources used for field checking (if any).
3. If photos are taken of the site, record the roll number, frame number(s), and azimuth (whether picture was taken facing north, south, etc.). (NOTE: If photo is taken be sure to complete the ground truth photo log form.)
4. Record approximate coordinates using imagery tic marks. Provide easting and northing information.
5. Write the number of the land cover code and a brief description applicable for the site. Describe land use for the site as well.
6. Check whether the site was field verified and the time/date verified (if different from date recorded earlier) and describe the site in more detail.
7. Circle the landcover number corresponding to the site. Note that **ONLY** the numbers underlined should be used. (Numbers not underlined are general headings; the numbers underline are actual landcover classifications.) If indicated, complete additional information. (Note that general information is to be completed for any landcover classified in category 3 or 4 follows; this information follows the landcover classification listings for the category.)
8. Describe the topographic and disturbance regimes by checking the appropriate category and, for topography, provide slope and aspect information by circling the correct category.
9. Complete the linguistic scale for the site. Rate on a scale of 0 (incorrect) to 4 (absolutely correct) the likelihood of the site's landcover classification. (Note that any lines not circled are interpreted as 0, incorrect.)

APPENDIX G

PHOTO LOG

Earth Satellite Corporation Ground Truth Photo Log

Project #: 2134

Roll #: _____

Photographer: _____

Frame	Site #	Date	Description
1			
2			
3			
4			
5			
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8			
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10			
11			
12			
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14			
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17			
18			
19			

20			
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Earth Satellite Corporation
Ground Truth Photo Log
 (continued)

Project #: 2134

Roll #: _____

Photographer: _____

Frame	Site #	Date	Description
21			
22			
23			
24			
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26			
27			
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APPENDIX H

PATH/ROW DATA POINTS

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 14 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	10	5
2	12	Low Intensity	6	3
3	2	CULTIVATED	22	28
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	28	8
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	6	4
6	3122	Unmanaged Herbaceous Cover - Wetland	23	13
	32	SHRUBLAND		
7	323	Evergreen Shrubland	25	15
8	324	Deciduous Shrubland	8	4
9	325	Mixed Shrubland	14	6
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	17	12
11	414	Bottomland Forest/Hardwood Swamps	37	33
12	419	Other Broadleaf Deciduous Forests	0	2

13	45	Needleleaf Deciduous	12	6
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	0	0
15	422	Southern Yellow Pine	73	44
16	429	Other Needleleaf Evergreen Forests	16	11
17	43	Broadleaf Evergreen Forest	4	4
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	5	5
19	442	Oak/Gum/Cypress	27	12
20	5	Water Bodies	7	5
	6	BARREN LAND		
21	61	Unconsolidated Sediment	10	6
22	62	Exposed Rock	0	0
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			350	226

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 14 Row 36

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	21	10
2	12	Low Intensity	7	1
3	2	CULTIVATED	29	26
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	29	16
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	8	3
6	3122	Unmanaged Herbaceous Cover - Wetland	22	17
	32	SHRUBLAND		
7	323	Evergreen Shrubland	9	10
8	324	Deciduous Shrubland	5	3
9	325	Mixed Shrubland	16	12
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	9	5
11	414	Bottomland Forest/Hardwood Swamps	18	6
12	419	Other Broadleaf Deciduous Forests	0	0

13	45	Needleleaf Deciduous	12	13
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	0	0
15	422	Southern Yellow Pine	62	32
16	429	Other Needleleaf Evergreen Forests	4	1
17	43	Broadleaf Evergreen Forest	6	2
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	2	4
19	442	Oak/Gum/Cypress	16	14
20	5	Water Bodies	3	3
	6	BARREN LAND		
21	61	Unconsolidated Sediment	13	5
22	62	Exposed Rock	0	0
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			291	183

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 15 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	42	27
2	12	Low Intensity	16	6
3	2	CULTIVATED	103	74
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	70	36
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	9	9
6	3122	Unmanaged Herbaceous Cover - Wetland	5	7
	32	SHRUBLAND		
7	323	Evergreen Shrubland	50	27
8	324	Deciduous Shrubland	28	14
9	325	Mixed Shrubland	9	7
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	31	18
11	414	Bottomland Forest/Hardwood Swamps	49	28
12	419	Other Broadleaf Deciduous Forests	0	0

13	45	Needleleaf Deciduous	14	4
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	0	0
15	422	Southern Yellow Pine	103	58
16	429	Other Needleleaf Evergreen Forests	1	1
17	43	Broadleaf Evergreen Forest	2	4
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	8	3
19	442	Oak/Gum/Cypress	18	18
20	5	Water Bodies	31	16
	6	BARREN LAND		
21	61	Unconsolidated Sediment	7	9
22	62	Exposed Rock	1	1
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			597	367

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 15 Row 36

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	42	30
2	12	Low Intensity	8	3
3	2	CULTIVATED	114	64
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	71	35
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	17	16
6	3122	Unmanaged Herbaceous Cover - Wetland	34	16
	32	SHRUBLAND		
7	323	Evergreen Shrubland	26	17
8	324	Deciduous Shrubland	12	9
9	325	Mixed Shrubland	23	14
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	14	1
11	414	Bottomland Forest/Hardwood Swamps	53	35
12	419	Other Broadleaf Deciduous Forests	2	2

13	45	Needleleaf Deciduous	37	30
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	0	0
15	422	Southern Yellow Pine	136	110
16	429	Other Needleleaf Evergreen Forests	5	2
17	43	Broadleaf Evergreen Forest	15	4
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	12	7
19	442	Oak/Gum/Cypress	29	20
20	5	Water Bodies	9	9
	6	BARREN LAND		
21	61	Unconsolidated Sediment	16	15
22	62	Exposed Rock	1	0
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			676	439

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 16 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	60	36
2	12	Low Intensity	30	14
3	2	CULTIVATED	52	29
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	96	67
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	34	24
6	3122	Unmanaged Herbaceous Cover - Wetland	4	4
	32	SHRUBLAND		
7	323	Evergreen Shrubland	20	18
8	324	Deciduous Shrubland	22	15
9	325	Mixed Shrubland	9	4
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	67	39
11	414	Bottomland Forest/Hardwood Swamps	24	19
12	419	Other Broadleaf Deciduous Forests	12	6

13	45	Needleleaf Deciduous	3	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	5	3
15	422	Southern Yellow Pine	61	34
16	429	Other Needleleaf Evergreen Forests	5	6
17	43	Broadleaf Evergreen Forest	3	1
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	20	8
19	442	Oak/Gum/Cypress	2	0
20	5	Water Bodies	19	13
	6	BARREN LAND		
21	61	Unconsolidated Sediment	11	7
22	62	Exposed Rock	3	3
23	9	INDETERMINATE LAND COVER	0	2
24	20	MUNICIPAL AREAS		
TOTAL			562	352

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 16 Row 36

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	13	12
2	12	Low Intensity	6	5
3	2	CULTIVATED	52	23
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	35	27
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	29	14
6	3122	Unmanaged Herbaceous Cover - Wetland	1	1
	32	SHRUBLAND		
7	323	Evergreen Shrubland	11	9
8	324	Deciduous Shrubland	19	11
9	325	Mixed Shrubland	5	3
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	29	15
11	414	Bottomland Forest/Hardwood Swamps	43	27
12	419	Other Broadleaf Deciduous Forests	8	8

13	45	Needleleaf Deciduous	9	4
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	0	1
15	422	Southern Yellow Pine	77	57
16	429	Other Needleleaf Evergreen Forests	1	0
17	43	Broadleaf Evergreen Forest	4	2
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	21	14
19	442	Oak/Gum/Cypress	8	3
20	5	Water Bodies	11	9
	6	BARREN LAND		
21	61	Unconsolidated Sediment	17	7
22	62	Exposed Rock	1	0
23	9	INDETERMINATE LAND COVER	1	0
24	20	MUNICIPAL AREAS		
TOTAL			401	252

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 17 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	39	32
2	12	Low Intensity	30	18
3	2	CULTIVATED	41	32
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	117	99
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	29	24
6	3122	Unmanaged Herbaceous Cover - Wetland	2	0
	32	SHRUBLAND		
7	323	Evergreen Shrubland	13	9
8	324	Deciduous Shrubland	11	13
9	325	Mixed Shrubland	2	4
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	65	40
11	414	Bottomland Forest/Hardwood Swamps	7	7
12	419	Other Broadleaf Deciduous Forests	11	3

13	45	Needleleaf Deciduous	0	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	35	18
15	422	Southern Yellow Pine	22	18
16	429	Other Needleleaf Evergreen Forests	5	5
17	43	Broadleaf Evergreen Forest	3	2
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	29	9
19	442	Oak/Gum/Cypress	1	0
20	5	Water Bodies	5	5
	6	BARREN LAND		
21	61	Unconsolidated Sediment	9	3
22	62	Exposed Rock	15	8
23	9	INDETERMINATE LAND COVER	2	1
24	20	MUNICIPAL AREAS		
TOTAL			493	350

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 17 Row 36

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	7	6
2	12	Low Intensity	9	11
3	2	CULTIVATED	5	1
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	10	16
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	6	3
6	3122	Unmanaged Herbaceous Cover - Wetland	0	0
	32	SHRUBLAND		
7	323	Evergreen Shrubland	2	0
8	324	Deciduous Shrubland	5	3
9	325	Mixed Shrubland	2	1
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	5	8
11	414	Bottomland Forest/Hardwood Swamps	1	1
12	419	Other Broadleaf Deciduous Forests	4	4

13	45	Needleleaf Deciduous	0	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	4	0
15	422	Southern Yellow Pine	5	8
16	429	Other Needleleaf Evergreen Forests	0	0
17	43	Broadleaf Evergreen Forest	0	0
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	6	2
19	442	Oak/Gum/Cypress	0	0
20	5	Water Bodies	0	0
	6	BARREN LAND		
21	61	Unconsolidated Sediment	2	0
22	62	Exposed Rock	0	0
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			73	64

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 18 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	24	8
2	12	Low Intensity	13	16
3	2	CULTIVATED	19	10
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	68	58
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	13	8
6	3122	Unmanaged Herbaceous Cover - Wetland	1	0
	32	SHRUBLAND		
7	323	Evergreen Shrubland	14	7
8	324	Deciduous Shrubland	7	4
9	325	Mixed Shrubland	1	2
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	46	40
11	414	Bottomland Forest/Hardwood Swamps	0	0
12	419	Other Broadleaf Deciduous Forests	6	1

13	45	Needleleaf Deciduous	0	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	54	28
15	422	Southern Yellow Pine	6	8
16	429	Other Needleleaf Evergreen Forests	0	0
17	43	Broadleaf Evergreen Forest	0	1
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	25	19
19	442	Oak/Gum/Cypress	0	0
20	5	Water Bodies	0	2
	6	BARREN LAND		
21	61	Unconsolidated Sediment	9	5
22	62	Exposed Rock	15	42
23	9	INDETERMINATE LAND COVER		
24	20	MUNICIPAL AREAS		
TOTAL			321	259

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 18 Row 36

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	8	0
2	12	Low Intensity	0	7
3	2	CULTIVATED	2	1
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	17	14
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	4	0
6	3122	Unmanaged Herbaceous Cover - Wetland	0	0
	32	SHRUBLAND		
7	323	Evergreen Shrubland	2	3
8	324	Deciduous Shrubland	2	0
9	325	Mixed Shrubland	4	1
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	12	13
11	414	Bottomland Forest/Hardwood Swamps	0	0
12	419	Other Broadleaf Deciduous Forests	4	2

13	45	Needleleaf Deciduous	0	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	12	9
15	422	Southern Yellow Pine	2	5
16	429	Other Needleleaf Evergreen Forests	0	0
17	43	Broadleaf Evergreen Forest	0	0
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	6	4
19	442	Oak/Gum/Cypress	0	0
20	5	Water Bodies	1	1
	6	BARREN LAND		
21	61	Unconsolidated Sediment	3	2
22	62	Exposed Rock	7	2
23	9	INDETERMINATE LAND COVER	2	0
24	20	MUNICIPAL AREAS		
TOTAL			88	64

North Carolina Land Cover Classes

Image Classification Ground Truth Data

Path 19 Row 35

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	3	1
2	12	Low Intensity	0	2
3	2	CULTIVATED	7	3
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	12	11
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	2	1
6	3122	Unmanaged Herbaceous Cover - Wetland	0	0
	32	SHRUBLAND		
7	323	Evergreen Shrubland	0	2
8	324	Deciduous Shrubland	0	0
9	325	Mixed Shrubland	0	0
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	16	21
11	414	Bottomland Forest/Hardwood Swamps	0	0
12	419	Other Broadleaf Deciduous Forests	2	2

13	45	Needleleaf Deciduous	0	0
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	14	16
15	422	Southern Yellow Pine	3	3
16	429	Other Needleleaf Evergreen Forests	0	0
17	43	Broadleaf Evergreen Forest	0	0
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	9	8
19	442	Oak/Gum/Cypress	0	0
20	5	Water Bodies	2	0
	6	BARREN LAND		
21	61	Unconsolidated Sediment	1	0
22	62	Exposed Rock	2	2
23	9	INDETERMINATE LAND COVER	0	0
24	20	MUNICIPAL AREAS		
TOTAL			73	72

North Carolina Land Cover Classes
Image Classification Ground Truth Data
All Scenes

ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	1	DEVELOPED		
1	11	High Intensity	181	120
2	12	Low Intensity	89	58
3	2	CULTIVATED	300	199
	3	HERBACEOUS COVER AND SHRUBLANDS		
	31	HERBACEOUS COVER		
4	311	Managed Herbaceous Cover	357	238
	312	Unmanaged Herbaceous Cover		
5	3121	Unmanaged Herbaceous Cover - Upland	108	71
6	3122	Unmanaged Herbaceous Cover - Wetland	70	46
	32	SHRUBLAND		
7	323	Evergreen Shrubland	119	78
8	324	Deciduous Shrubland	78	52
9	325	Mixed Shrubland	55	36
	4	FOREST LAND		
	4A	Deciduous Forest		
	41	Broadleaf Deciduous Forest		
10	411	Mixed Upland Hardwoods	186	124
11	414	Bottomland Forest/Hardwood Swamps	161	107
12	419	Other Broadleaf Deciduous Forests	30	19

13	45	Needleleaf Deciduous	54	36
ENDPOINT CLASSES	CLASS NUMBER	CLASS NAME	TALLY	ACCUR. ASSESS.
	4B	Evergreen Forests		
	42	Needleleaf Evergreen Forest		
14	421	Mountain Conifers	70	46
15	422	Southern Yellow Pine	370	246
16	429	Other Needleleaf Evergreen Forests	32	20
17	43	Broadleaf Evergreen Forest	24	15
	4C	Mixed Deciduous/Evergreen Forests		
	44	Mixed Deciduous-Evergreen Forest		
18	441	Mixed Hardwoods/Conifers	91	60
19	442	Oak/Gum/Cypress	66	43
20	5	Water Bodies	62	41
	6	BARREN LAND		
21	61	Unconsolidated Sediment	68	45
22	62	Exposed Rock	31	20
23	9	INDETERMINATE LAND COVER	5	3
24	20	MUNICIPAL AREAS		
TOTAL			2607	1723

APPENDIX I

DENDROGRAM

The first few pages of the dendrogram list the pairing of classes and the euclidian distance separating the means of the spectral classes. The first pairing are spectrally the most similar, with a small euclidian distance. This distance is calculated by summing for all 12 bands the differences in the means for each of the 12 bands. For example, in the hypothetical example below, the euclidian distance would be calculated as 10.

Band	Class X	Class Y	Difference
1	23	24	1
2	14	15	1
3	10	11	1
4	88	89	1
5	44	45	1
6	89	90	1
7	27	28	1
8	201	200	1
9	196	197	1
10	208	207	1
11	112	112	0
12	241	241	0
SUM			10

Below is an example of a completed dendrogram for Path 18 Row 35. After the class pairings is the spectral tree showing the magnitude of the euclidian distance and spectral relationship of each class. The first number on the left is the land cover class assigned to the spectral class; second number is the spectral class. Numbers to the right of the branch of the tree correspond to field point land cover

classes falling within the spectral class.

Path 18 Row 35 Buffered Image
 Distances between Pairs of Combined Classes
 (in the sequence of merging)

Remaining Class	Merged Class	Between-Class Distance
15	18	5.744563
15	21	5.987252
10	11	7.071068
19	27	7.810250
12	13	8.366600
19	24	8.598758
19	31	8.591869
64	68	9.055385
12	16	9.289493
25	35	9.327379
57	61	9.327379
82	85	9.643651
51	54	10.049876
44	51	10.126362
32	40	10.198039
25	42	10.216179
44	47	10.516044
96	103	10.630146
30	32	10.699776
10	15	10.723475
43	53	10.816654
64	67	10.868514
12	17	10.971515
19	39	11.251101
19	20	10.908661
44	57	11.374756
71	80	11.661904
45	55	11.747340
73	76	11.958261
64	73	10.793074
105	115	12.124356
100	104	12.165525
93	100	11.219374
33	43	12.227452
30	38	12.568771
82	86	12.623860
93	110	12.634820
59	62	12.767145
44	59	12.607549
44	50	12.463960
52	69	13.114877
19	28	13.180920
116	127	13.304135

71	79	13.321042
52	72	13.513611
10	23	13.600238
30	46	13.615068
82	89	13.810558

Path 18 Row 35 Buffered Image

Distances between Pairs of Combined Classes
(in the sequence of merging)
(continued)

Remaining Merged Between-Class

Class	Class	Distance
30	48	14.007610
120	136	14.177447
91	107	14.247807
52	77	14.276618
70	74	14.282857
96	112	14.390660
36	58	14.456832
63	88	14.491377
96	114	14.763146
93	96	14.919720
10	12	15.044721
137	142	15.132746
33	60	15.136405
82	97	15.213895
102	108	15.524175
105	123	15.663072
25	45	15.679949
25	44	14.645480
121	128	15.716234
116	122	15.900062
83	113	16.031220
134	139	16.031220
134	147	15.454383
70	71	16.072158
70	82	15.903076
64	70	14.287410
133	137	16.075179
81	98	16.278821
151	168	16.401219
158	160	16.552945
124	131	16.673332
63	92	16.793902
119	120	16.817747
25	30	16.893620
56	75	16.970563
179	181	17.058722
140	155	17.262677
10	19	17.270568
134	153	17.358162
143	149	17.435596
119	126	17.578575

141	143	17.593313
150	158	17.681895
66	78	17.804494
81	106	18.031133
94	99	18.110770
151	174	18.177912

Path 18 Row 35 Buffered Image

Distances between Pairs of Combined Classes
(in the sequence of merging)
(continued)

Remaining Merged Between-Class

Class	Class	Distance	
	199	201	18.220867
87	94	18.328421	
102	105	18.361238	
102	130	17.457613	
150	167	18.675224	
141	159	18.818450	
84	101	18.947295	
83	102	19.060780	
162	169	19.157244	
93	116	19.241777	
134	146	19.400375	
121	124	19.451894	
175	179	19.463954	
84	91	19.524804	
175	190	19.610666	
118	165	19.697716	
111	118	19.106224	
33	34	19.783802	
170	177	20.174241	
132	170	19.625789	
203	208	20.174241	
152	164	20.248457	
109	129	20.420578	
93	119	20.568741	
203	212	20.569691	
56	65	20.701916	
10	29	20.751930	
138	148	21.118712	
162	183	21.151191	
162	176	20.190793	
26	49	21.283797	
156	172	21.400935	
156	157	20.682958	
132	151	21.468303	
204	211	21.540659	
140	150	21.603444	
140	141	20.569029	
41	56	21.730156	
4	6	21.817424	
52	64	21.858945	

138	145	21.997831
133	138	21.409745
63	83	22.121285
25	36	22.174671
84	87	22.298914
133	134	22.369362
175	186	22.577966

Path 18 Row 35 Buffered Image

Distances between Pairs of Combined Classes
(in the sequence of merging)
(continued)

Remaining Merged Between-Class

Class	Class	Distance
173	188	22.803509
194	200	22.912878
194	199	21.858979
90	125	22.978251
3	4	23.026986
196	209	23.345235
194	204	23.591491
196	202	23.635083
180	189	23.811762
192	193	24.248711
156	171	24.323883
156	163	23.357861
132	140	24.379821
81	121	24.431378
81	117	22.822670
81	93	25.078957
26	180	25.080478
185	187	25.534291
52	84	25.581931
133	161	25.726043
220	221	25.961510
215	216	26.172505
191	196	26.370487
10	25	26.456629
66	90	26.471445
166	173	26.658595
41	95	26.776502
215	220	27.046357
213	214	27.073973
162	175	27.268586
10	33	27.355383
218	223	27.531800
218	226	24.398601
26	111	27.811430
182	184	29.034462
26	185	29.654281
133	156	29.846263
194	203	30.292928
191	194	28.769210

191	198	30.061372
63	81	30.418039
1	8	30.594117
162	166	30.850362
132	162	30.421419
213	222	31.993929
52	63	32.361332

Path 18 Row 35 Buffered Image
Distances between Pairs of Combined Classes
(in the sequence of merging)
(continued)

Remaining Merged Between-Class

Class	Class	Distance
52	66	32.137179
205	210	32.388269
22	41	32.518778
14	37	32.741411
213	215	33.609192
152	154	34.066761
205	206	34.590012
109	133	34.655251
109	135	36.717798
191	192	37.485025
10	14	37.888620
7	9	37.894591
22	182	38.624781
109	152	39.416961
5	144	39.887341
205	207	42.070410
205	217	39.318845
213	218	43.092921
10	52	43.290798
22	26	43.590173
22	132	41.525835
1	7	43.947358
191	213	47.769803
2	3	50.221771
10	22	50.469878
5	10	49.920130
5	109	49.909109
191	205	50.926892
191	195	64.153089
191	224	73.922121
225	227	82.957821
219	225	74.045217
178	197	84.332675
178	191	81.757602
1	2	86.897585
5	178	103.537435
1	5	129.894198
219	228	166.678604

1 219 266.778064

Dendrogram of

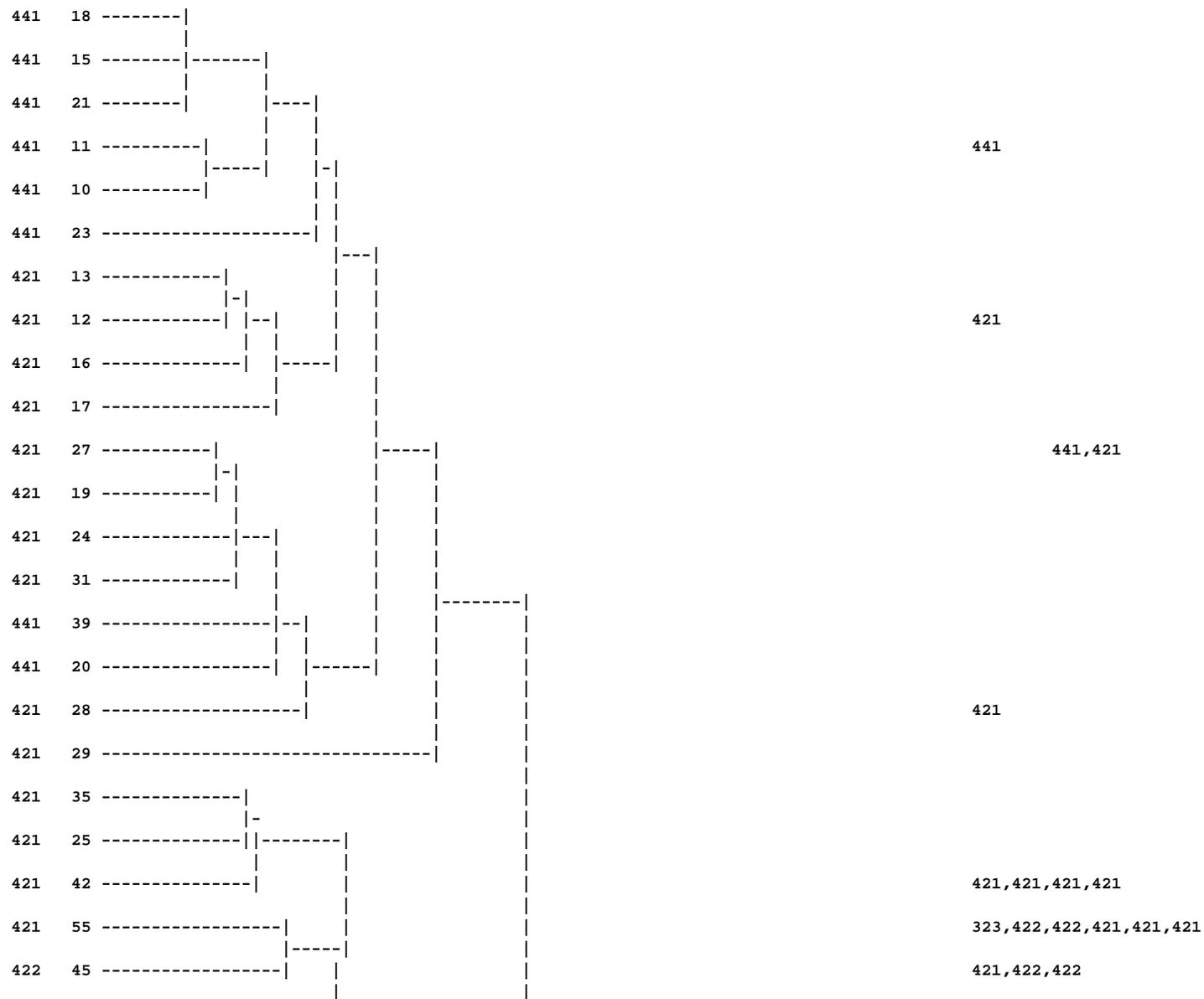
C DISTANCE

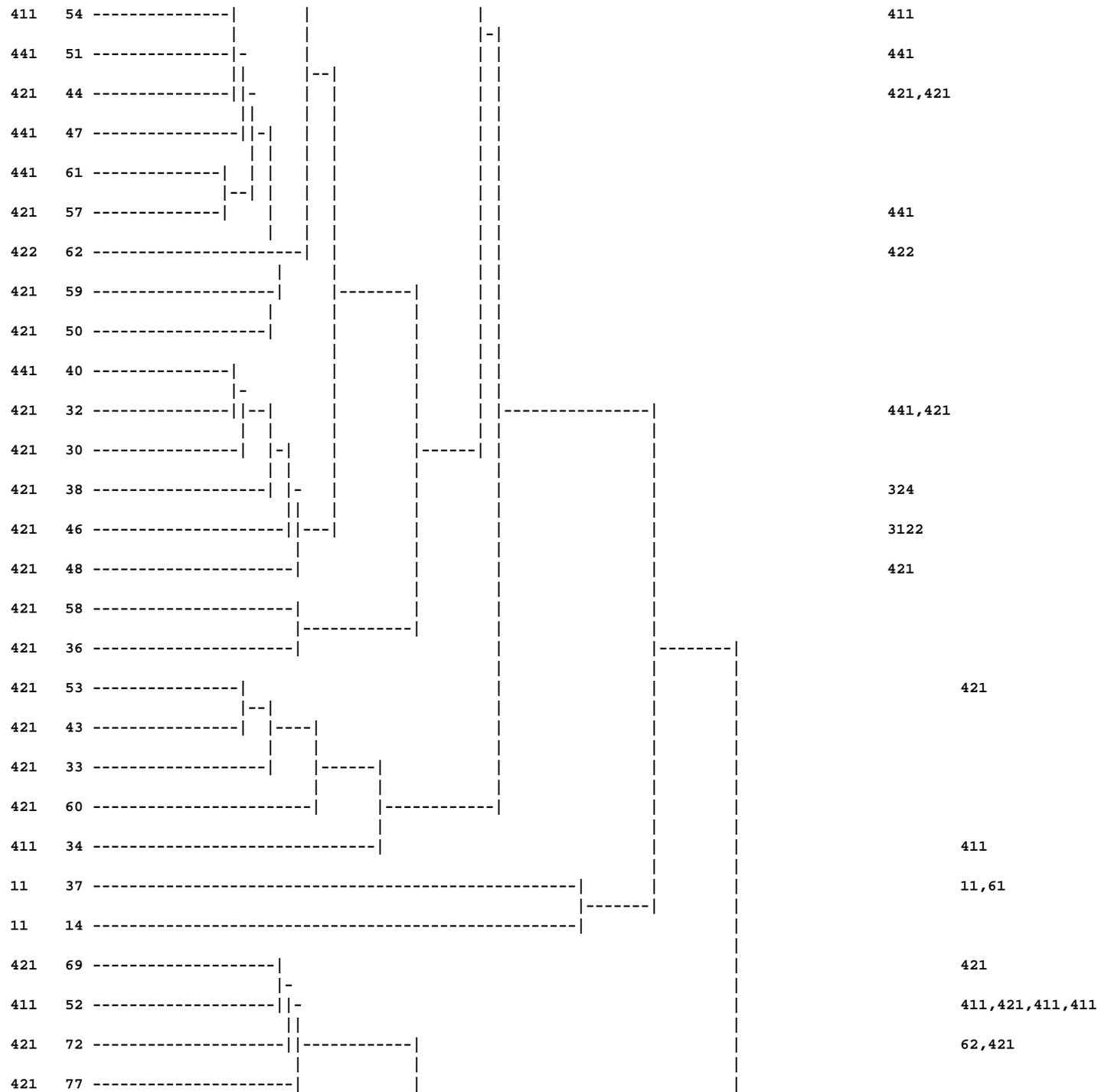
L

A

S 0

S |-----|-----|----->

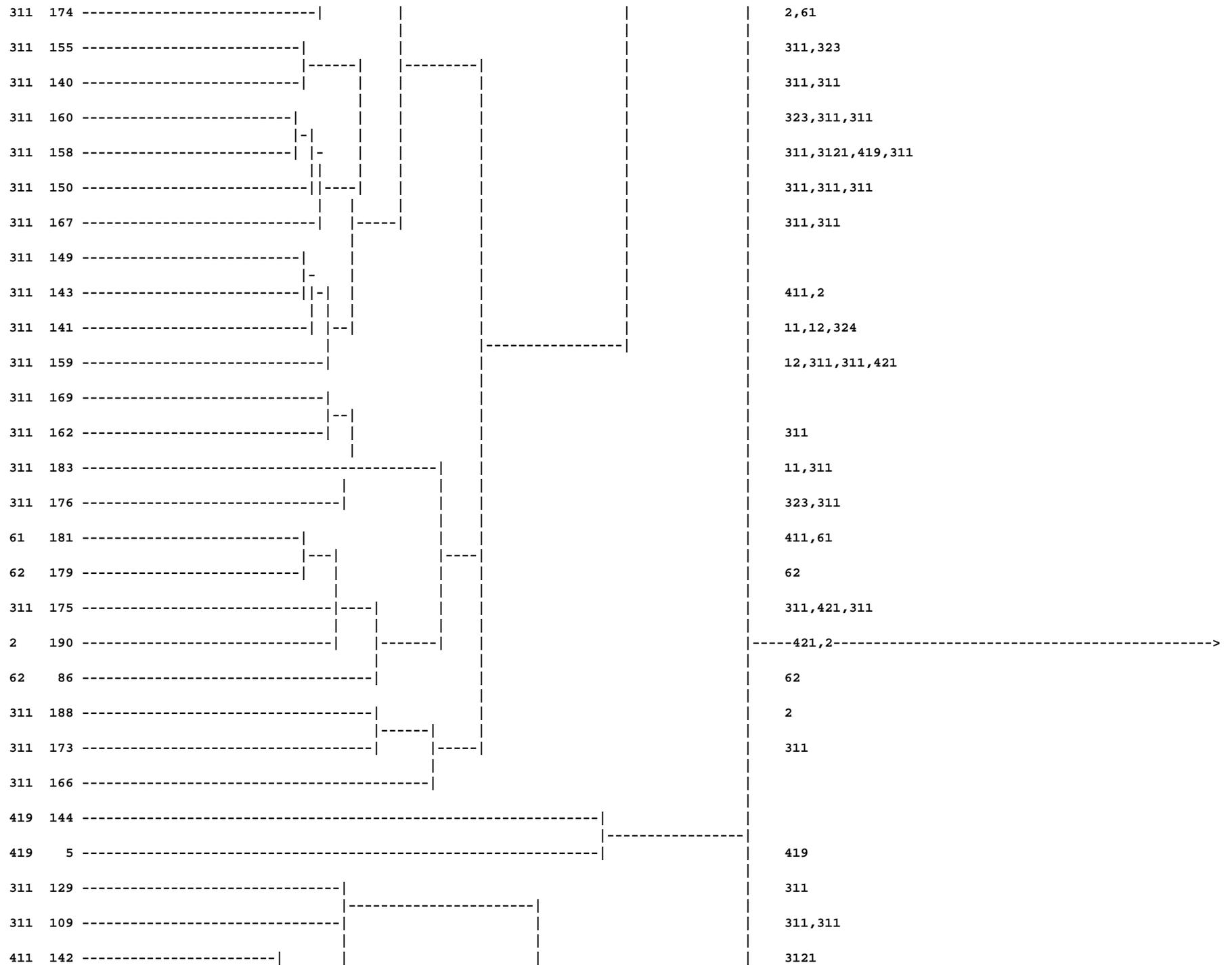


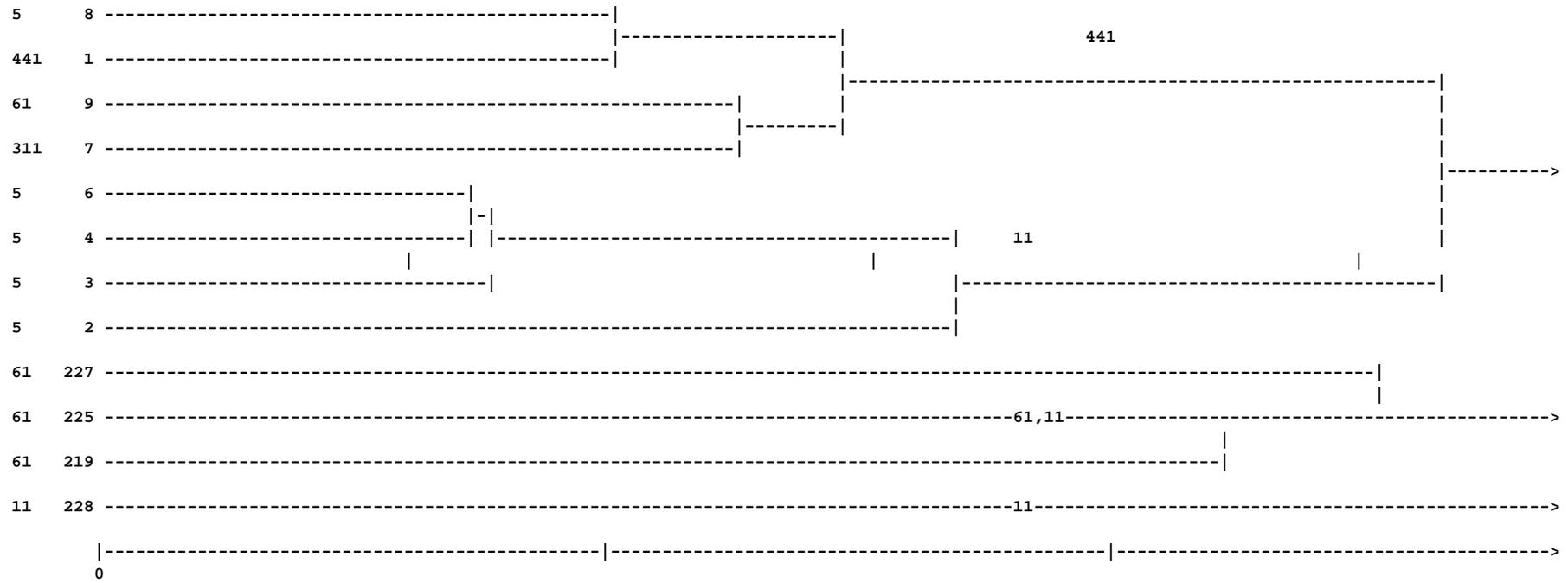


421	68	-----				62
441	64	-----	---			441
441	67	-----	-----			441
411	76	-----				411,411,411,411
411	73	-----				
323	74	-----				323
421	70	-----	-----			421
441	80	-----				
441	71	-----	---			323,441
441	79	-----				411
441	85	-----				441
411	82	-----	-----			61,411
441	86	-----	---			441
441	89	-----				411,411
441	97	-----				421,311,411,421
411	101	-----				411
411	84	-----				421,411,411
441	107	-----	-----			421
422	91	-----				421,441
441	99	-----				441
411	94	-----	---			421,411,411,421
411	87	-----				411,419
421	88	-----				
421	63	-----	---			62,421,421,324,421
421	92	-----				11
441	113	-----	-----			421,441,2
441	83	-----	---			441,421

441	108	-----				441
421	102	-----	-----			441,421
441	115	-----				441,419
411	105	-----	-----			11,411
12	123	-----				12,62
325	130	-----				62
411	98	-----				
411	81	-----	-----			411
411	106	-----				
3121	128	-----				323,3121,411
441	121	-----	-----			441
421	131	-----				311,421,421,311
62	124	-----				
441	117	-----				
411	104	-----				411,411
421	100	-----				421,421
411	93	-----	-----			311,62,(3)411,12
411	110	-----				411,311,411
411	103	-----	-----			
12	96	-----				61
411	112	-----				411,323
441	114	-----				323,3121,441
62	127	-----				62,411
62	116	-----	-----			411,62,311,411
411	122	-----				411,311
311	136	-----				311
325	120	-----				323,441,3121,411,411
411	119	-----				411,311

311	126	-----				311
421	78	-----				421
421	66	-----	-----			324,421,421
421	125	-----	-----	-----		421,421,11
421	90	-----	-----			(8)421
421	75	-----	-----			421
411	56	-----	-----			411
421	65	-----	-----			422
441	41	-----	-----			441
441	95	-----	-----	-----		
11	22	-----	-----	-----		11
62	184	-----	-----	-----		324
62	182	-----	-----			
12	49	-----	-----			12,11
62	26	-----	-----			62
11	189	-----	-----	-----		11,11
11	180	-----	-----	-----		411,11,11,11,11
12	165	-----	-----			12,12
11	118	-----	-----	-----		12,11
11	111	-----	-----			441
12	187	-----	-----			12
12	185	-----	-----			12,11
12	177	-----	-----			
12	170	-----	-----			12
421	132	-----	-----			421
323	168	-----	-----	-----		323
311	151	-----	-----	-----		311,323,2





APPENDIX J

IMAGE PROCESSING QUALITY ASSURANCE TABLE

Path/ Row	tar	Pyramid Layers	re- tar	Isodata	siged	Buffer/ Additem/ Calc/ buff	polygrid/ grid- image _grid buff.img	grid- image project buff.img	Buffer Modeler buf1.img	Buffer Isodata buf11.si g	siged buffer buf1.sig	Dendro Isodata .dendro	Dendro Buffer Isodata buf1. dendro	Super. Isodata _cls.img	Super. Isodata Buffer _cls_buf .img	Classify _cls.img	Classify Buffer _cls_buf .img
P14R35																	
P14R36																	
P15R35																	
P15R36																	
P16R35																	
P16R36																	
P17R35																	
P17R36																	
P18R35																	
P18R36																	
P19R35																	

BUFFERS CREATED:

200 meters

ADDITEM/GRID:

ADDITEM "ONES" AND MAKE GRID BASED ON VALUE

GRIDIMAGE: USE "ONES" FOR ONE BAND IMAGE

ISODATA:

2 standard deviations, 10 iterations, 30 xy skip, 240 classes, .950 convergence threshold

BUFFER ISODATA:

INTERPRETER/UTILITIES/OPERATOR: file 1 = 12 band image; file 2 = file of 1's for the buffer; output = p__r__buf1.img

intersection; operator = times (*); output = 8-bit unsigned

BUFFER ISODATA:

2 standard deviations, 12 iterations, 1 xy skip, 240 classes, .990 convergence threshold

SUPERVISED CLASSIFIER:

PARALLELPIPED rule

SIGNATURE EDITOR:

reset values, image association, approximate to true colors (4/5/3 bands), save, export (value/count/means) to **.dat/buff.dat** (third button exports)

DENDROGRAM:

```
awk -f doer.awk p__r__.dat > p__r__.gsg
vi p__r__.gsg and add header information to file
dendrogram p__r__.gsg p__r__d1 NOSTD 455
vi p__r__d2 ---> add 100 blank lines
cat p__r__d1 p__r__d2 > p__r__.dendro
lpr -P8900 p__r__.dendro
```

Path/ Row	Raster edit	Recode overlap to 0	Accuracy Assessme nt PTS	Thematic recode ATTRIB	Clump	Eliminate 6 pixel	Eliminate 12 pixel	Recode 6 Eliminate	Mosaic 6/12 eliminates & thematic	Aerial photo correlation	Mosaic scenes, muni boundary	Clip 1-km state buffer, add descriptors
<i>p_r</i>	<i>_cls_buf.im g</i>	<i>_cls_buf.im g</i>	<i>_aarcd.im g</i>	<i>_recode.im g</i>	<i>_clmp.img</i>	<i>_elm6.img</i>	<i>_elm12.img</i>	<i>_elmrcd.im g</i>	<i>_elim.img _elm_mosaic.i mg</i>	<i>_elim.img</i>	<i>_mosaic.img _nofilt_clip.im g</i>	<i>.img _nofilter.img</i>
P14R35												
P14R36												
P15R35												
P15R36												
P16R35												
P16R36												
P17R35												
P17R36												
P18R35												
P18R36												
P19R35												

- ACCURACY ASSESSMENT:** Perform accuracy assessment to ensure classification meets minimum reported accuracy
- THEMATIC RECODE:** Collapse 255-class image into 23-class image
- CLUMP:** Cluster data to nearest 8 pixels
- ELIMINATE 6/12:** Bring areas to MMU (eliminate naming and process depends on geographic extent of areas for eliminates and appropriate MMU)
- ELIMINATE RECODE:** Recode all landcover values on 6 pixel eliminate image to 0 except water; maintain water as class 20
Mosaic recoded 6 pixel eliminate image on top of 12 pixel eliminate image to achieve dual MMUs
Check land cover and spectral classes for correct assignment
- MOSAIC/CHECK OVERLAP:** Mosaic all completed eliminate scenes and municipal areas and check overlap areas for error
Mosaic all unfiltered scenes and check overlap areas for error
- CLIP NC BOUNDARY:** Mask 1-km state boundary (no recode needed) on final eliminate mosaic
Mask 1-km state boundary (no recode needed) on final unfiltered mosaic
- DESCRIPTORS:** Check class assignments and descriptions (Accuracy Class I=5, LC Class I=5, Description S=36) on final eliminate mosaic
Check class assignments and descriptions (Accuracy Class I=5, LC Class I=5, Description S=36) on final unfiltered mosaic

APPENDIX K

SCENE ACCURACY MATRICES

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 14/35

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	7	0	0	0	0	0	0	0	0	7	100
2	0	23	2	0	0	0	0	0	0	25	92
3	0	0	22	0	0	0	0	0	0	22	100
4	0	0	0	45	0	0	7	1	0	53	84.9
5	0	0	0	0	5	0	0	0	0	5	100
6	0	1	0	0	0	6	0	0	0	7	85.7
7	0	0	1	5	0	0	63	3	0	72	87.5
8	0	0	0	3	0	0	2	19	0	24	79.2
9	0	0	0	0	0	0	0	0	0	0	100
Total	7	24	25	53	5	6	72	23	0	215	
Prod. Acc	100	96	88	85	100	100	88	83	100		
Total Correct										190	88.4

TP17 corrected (classed as 2 but positional error --> AA = 7)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 14/35

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	22	0	1	0	1	1	1	0	0	26	84.6
2	0	45	3	3	0	0	0	1	0	52	86.5
3	1	0	101	3	1	0	2	0	0	108	93.5
4	0	0	1	152	0	0	15	12	0	180	84.4
5	0	0	3	1	12	2	0	0	0	18	66.7
6	0	1	1	0	0	15	0	0	0	17	88.2
7	0	0	2	10	0	2	193	9	0	216	89.4
8	0	0	3	9	0	0	4	66	0	82	80.5
9	0	0	0	0	0	0	0	0	0	0	100
Total	23	46	115	178	14	20	215	88	100	699	
Prod. Acc	96	98	88	85	86	75	90	75	100		
Total Correct										606	86.7

TP17 corrected (classed as 2 but positional error --> AA = 7)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 14/36

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	9	0	0	0	0	0	0	0	0	9	100
2	0	24	0	0	0	0	0	0	0	24	100
3	0	1	33	0	0	0	2	2	0	38	86.8
4	0	1	0	26	0	0	0	3	0	30	86.7
5	0	0	0	0	2	0	0	0	0	2	100
6	0	0	0	0	0	4	0	0	0	4	100
7	1	0	0	0	0	0	37	0	0	38	97.4
8	0	0	0	0	0	0	1	21	0	22	95.5
9	0	0	0	0	0	0	0	0	0	0	100
Total	10	26	33	26	2	4	40	26	100	167	
Prod. Acc	90	92	100	100	100	100	93	81	100		
Total Correct										156	93.4

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 14/36

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	34	1	0	0	0	0	0	0	0	35	97.1
2	1	50	0	0	0	0	0	0	0	51	98
3	0	1	114	0	2	0	2	2	0	121	94.2
4	0	1	0	84	0	1	2	11	0	99	84.8
5	0	0	7	1	9	3	2	0	0	22	40.9
6	0	0	6	1	1	25	0	0	0	33	75.8
7	1	0	1	1	3	3	158	1	0	168	94
8	0	0	2	1	0	3	5	47	0	58	81
9	0	0	0	0	0	0	0	0	0	0	100
Total	36	53	130	88	15	35	169	61	100	587	
Prod. Acc	94	94	88	95	60	71	93	77	100		
Total Correct										521	88.8

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 15/35

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	28	0	0	0	0	0	0	0	0	28	100
2	3	66	5	0	0	2	4	1	0	81	81.5
3	0	6	41	0	0	0	3	1	0	51	80.4
4	0	0	0	48	1	1	4	4	0	58	82.8
5	0	0	0	0	15	0	0	0	0	15	100
6	0	1	0	0	0	7	0	0	0	8	87.5
7	1	0	6	9	0	0	76	4	0	96	79.2
8	0	1	0	4	0	0	3	18	0	26	69.2
9	0	0	0	0	0	0	0	0	0	0	100
Total	32	74	52	61	16	10	90	28	0	363	
Prod. Acc	88	89	79	79	94	70	84	64	100		
Total Correct										299	82.4

TP997 corrected (classed as 11 but positional error --> AA = 2)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 15/35

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	75	0	0	0	2	0	0	0	0	77	97.4
2	7	157	11	3	0	4	6	1	0	189	83.1
3	2	11	112	2	0	0	5	1	0	133	84.2
4	1	1	2	164	3	2	19	16	0	208	78.8
5	0	0	0	0	43	0	0	0	0	43	100
6	0	1	0	0	0	12	0	0	0	13	92.3
7	4	3	10	15	0	0	207	8	0	247	83.8
8	1	1	1	18	0	2	8	42	0	73	57.5
9	0	0	0	0	0	0	0	0	0	0	100
Total	90	174	136	202	48	20	245	68	0	983	
Prod. Acc	83	90	82	81	90	60	84	62	100		
Total Correct										812	82.6

TP997 corrected (classed as 11 but positional error --> AA = 2)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 15/36

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	25	2	1	0	0	0	1	1	0	30	83.3
2	4	56	2	1	0	0	0	0	0	63	88.9
3	1	2	55	2	1	0	1	1	0	63	87.3
4	1	1	1	64	0	1	5	2	0	75	85.3
5	0	0	2	0	8	0	0	0	0	10	80
6	1	1	3	1	0	9	0	1	0	16	56.3
7	0	1	1	2	0	4	122	4	0	134	91
8	0	1	0	7	0	1	4	32	0	45	71.1
9	0	0	0	0	0	0	0	0	0	0	0
Total	32	64	65	77	9	15	133	41	0	436	
Prod. Acc	78	88	85	83	89	60	92	78	0		
Total Correct										371	85.1

TP997 corrected (classed as 11 but positional error --> AA = 2)

CL23 removed (xy error; 3121 over ocean)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 15/36

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	71	2	3	0	1	1	3	1	0	82	86.6
2	6	159	6	4	0	0	4	2	0	181	87.8
3	2	7	166	9	0	1	1	2	0	188	88.3
4	0	0	6	180	0	10	10	12	0	218	82.6
5	0	0	2	1	19	1	0	0	0	23	82.6
6	1	2	4	2	0	22	1	2	0	34	64.7
7	0	2	2	12	1	15	333	6	0	371	89.8
8	1	4	2	17	3	7	14	94	0	142	66.2
9	0	0	0	0	0	0	0	0	0	0	0
Total	81	176	191	225	24	57	366	119	0	1239	
Prod. Acc	88	90	87	80	79	39	91	79	0		
Total Correct										1044	84.3

TP997 corrected (classed as 11 but positional error --> AA = 2)

CL23 removed (xy error; 3121 over ocean)

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 16/35

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	35	0	1	1	0	2	0	0	1	40	87.5
2	0	14	1	0	0	0	0	0	0	15	93.3
3	1	2	69	1	0	0	1	0	0	74	93.2
4	0	0	1	60	0	0	2	1	0	64	93.8
5	1	0	0	0	6	0	4	0	0	11	54.5
6	0	1	0	0	0	1	0	0	0	2	50
7	0	0	0	1	0	0	28	0	0	29	96.6
8	1	0	1	2	0	0	2	8	0	14	57.1
9	0	0	0	0	0	0	0	0	1	1	100
Total	38	17	73	65	6	3	37	9	2	250	
Prod. Acc	92	82	95	92	100	33	76	89	50		
Total Correct										222	88.8

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 16/35

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	92	0	2	1	0	2	0	0	1	98	93.9
2	0	40	2	0	0	0	0	0	0	42	95.2
3	8	5	162	3	0	0	2	1	0	181	89.5
4	2	1	4	156	0	0	4	2	0	169	92.3
5	1	0	0	0	20	0	10	0	0	31	64.5
6	0	1	1	0	0	8	0	0	0	10	80
7	3	1	1	2	0	0	76	0	0	83	91.6
8	1	0	1	3	0	0	4	24	0	33	72.7
9	0	0	0	0	0	0	0	0	1	1	100
Total	107	48	173	165	20	10	96	27	2	648	
Prod. Acc	86	83	94	95	100	80	79	89	50		
Total Correct										579	89.4

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 16/36

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	9	0	0	0	0	0	0	0	0	9	100
2	0	14	5	2	0	1	0	0	0	22	63.6
3	2	2	35	1	0	0	0	0	0	40	87.5
4	0	2	1	49	1	0	4	4	0	61	80.3
5	0	0	0	0	6	0	0	0	0	6	100
6	1	0	0	0	0	4	0	0	0	5	80
7	0	0	0	0	0	0	52	2	0	54	96.3
8	1	0	0	8	0	1	2	13	0	25	52
9	0	0	0	0	0	0	0	0	0	0	100
Total	13	18	41	60	7	6	58	19	0	222	
Prod. Acc	69	78	85	82	86	67	90	68	100		
Total Correct										182	82

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 16/36

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	18	0	0	0	0	0	1	0	0	19	94.7
2	1	53	19	7	0	3	2	1	0	86	61.6
3	4	4	74	1	0	1	0	0	0	84	88.1
4	0	2	4	149	2	4	6	10	1	178	83.7
5	0	0	0	1	15	1	0	0	0	17	88.2
6	1	1	1	0	0	18	0	0	0	21	85.7
7	1	0	0	5	1	2	138	4	0	151	91.4
8	2	1	1	16	1	2	5	39	0	67	58.2
9	0	0	0	0	0	0	0	0	0	0	100
Total	27	61	99	179	19	31	152	54	1	623	
Prod. Acc	67	87	75	83	79	58	91	72	0		
Total Correct										504	80.9

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 17/35

Points Description: All points reserved for accuracy assessment (only for portion of scene used for inclusion in final database)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	21	0	0	0	0	0	0	0	0	21	100
2	1	14	1	0	0	0	0	0	0	16	87.5
3	1	5	36	0	0	0	0	0	0	42	85.7
4	0	0	1	15	0	0	3	2	0	21	71.4
5	0	0	0	0	0	0	0	0	0	0	100
6	0	0	0	0	0	4	0	0	1	5	80
7	0	0	1	0	0	0	13	0	0	14	92.9
8	1	0	0	0	0	0	0	5	0	6	83.3
9	0	0	0	0	0	0	0	0	0	0	100
Total	24	19	39	15	0	4	16	7	1	125	
Prod. Acc	88	74	92	100	100	100	81	71	0		
Total Correct										108	86.4

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 17/35

Points Description: All points (only for portion of scene used for inclusion in final database)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	47	0	0	1	0	0	0	0	0	48	97.9
2	1	34	2	0	0	0	1	0	0	38	89.5
3	1	6	78	1	0	0	0	0	0	86	90.7
4	0	0	2	48	0	0	6	4	0	60	80
5	0	0	0	0	2	0	1	0	0	3	66.7
6	0	0	0	0	0	16	0	0	1	17	94.1
7	0	0	1	0	0	0	26	1	0	28	92.9
8	2	0	0	0	0	0	1	14	0	17	82.4
9	0	0	0	0	0	0	0	0	2	2	100
Total	51	40	83	50	2	16	35	19	3	299	
Prod. Acc	92	85	94	96	100	100	74	74	67		
Total Correct										267	89.3

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 17/36

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	16	0	0	1	0	0	0	0	0	17	94.1
2	0	1	0	0	0	0	0	0	0	1	100
3	0	0	16	0	0	0	0	0	0	16	100
4	1	0	0	15	0	0	0	0	0	16	93.8
5	0	0	0	0	0	0	0	0	0	0	100
6	0	0	0	0	0	0	0	0	0	0	100
7	0	0	0	0	0	0	7	0	0	7	100
8	0	0	0	0	0	0	0	3	0	3	100
9	0	0	0	0	0	0	0	0	0	0	100
Total	17	1	16	16	0	0	7	3	0	60	
Prod. Acc	94	100	100	94	100	100	100	100	100		
Total Correct										58	96.7

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 17/36

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	32	0	0	2	0	0	0	0	0	34	94.1
2	0	5	0	0	0	0	0	0	0	5	100
3	0	0	31	1	0	0	0	0	0	32	96.9
4	1	0	0	56	0	0	0	0	0	57	98.2
5	0	0	0	1	0	0	0	0	0	1	0
6	0	0	0	0	0	2	0	0	0	2	100
7	0	0	0	2	0	0	18	0	0	20	90
8	0	0	0	1	0	0	0	10	0	11	90.9
9	0	0	0	0	0	0	0	0	0	0	100
Total	33	5	31	63	0	2	18	10	0	162	
Prod. Acc	97	100	100	89	100	100	100	100	100		
Total Correct										154	95.1

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 18/35

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	22	1	0	0	0	0	0	0	0	23	95.7
2	0	9	0	0	0	1	0	0	0	10	90
3	0	0	53	3	0	0	0	1	0	57	93
4	0	0	3	25	0	0	1	1	0	30	83.3
5	0	0	0	0	2	0	0	0	0	2	100
6	0	0	1	1	0	14	0	0	0	16	87.5
7	0	0	1	1	0	0	32	0	0	34	94.1
8	1	0	3	5	0	1	3	14	0	27	51.9
9	0	0	0	0	0	0	0	0	0	0	100
Total	23	10	61	35	2	16	36	16	0	199	
Prod. Acc	96	90	87	71	100	88	89	88	100		
Total Correct										171	85.9

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 18/35

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	55	0	0	1	0	2	0	1	0	59	93.2
2	0	27	1	0	0	2	0	0	0	30	90
3	0	2	139	2	0	1	3	2	0	149	93.3
4	2	0	5	94	0	0	2	0	0	103	91.3
5	0	0	0	0	3	0	0	0	0	3	100
6	2	1	1	2	0	38	0	0	0	44	86.4
7	1	0	4	3	0	1	103	1	0	113	91.2
8	0	0	3	12	0	2	5	39	0	61	63.9
9			0	0		0	0	0	0	0	100
Total	60	30	153	114	3	46	113	43	0	562	
Prod. Acc	92	90	91	82	100	83	91	91	100		
Total Correct										498	88.6

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 18/36

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	5	0	0	0	0	0	0	0	0	5	100
2	0	1	0	0	0	0	0	0	0	1	100
3	0	0	13	0	0	0	0	0	0	13	100
4	0	0	1	14	0	0	2	0	0	17	82.4
5	1	0	0	0	1	0	0	0	0	2	50
6	1	0	0	0	0	4	0	0	0	5	80
7	0	0	0	0	0	0	14	0	0	14	100
8	0	0	0	0	0	0	0	4	0	4	100
9	0	0	0	0	0	0	0	0	0	0	100
Total	7	1	14	14	1	4	16	4	0	61	
Prod. Acc	71	100	93	100	100	100	88	100	100		
Total Correct										56	91.8

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 18/36

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	12	0	0	0	0	0	0	0	0	12	100
2	0	3	0	0	0	1	0	0	0	4	75
3	0	0	32	0	0	1	0	0	0	33	97
4	1	0	3	45	0	5	3	1	0	58	77.6
5	1	0	0	0	2	0	0	0	0	3	66.7
6	1	0	0	0	0	15	1	0	0	17	88.2
7	0	0	0	1	0	0	29	0	0	30	96.7
8	0	0	0	0	0	0	0	12	0	12	100
9	0	0	0	0	0	0	0	0	0	0	100
Total	15	3	35	46	2	22	33	13	0	169	
Prod. Acc	80	100	91	98	100	68	88	92	100		
Total Correct										150	88.8

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 19/35

Points Description: All points reserved for accuracy assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	2	0	0	0	0	0	0	1	0	3	66.7
2	0	1	0	0	0	0	0	0	0	1	100
3	0	0	10	0	0	0	1	0	0	11	90.9
4	0	0	1	20	0	0	0	0	0	21	95.2
5	0	0	0	0	0	0	0	0	0	0	100
6	0	0	0	0	0	2	0	1	0	3	66.7
7	0	0	0	0	0	0	15	0	0	15	100
8	0	0	0	0	0	0	1	6	0	7	85.7
9	0	0	0	0	0	0	0	0	0	0	100
Total	2	1	11	20	0	2	17	8	0	61	
Prod. Acc	100	100	91	100	100	100	88	75	100		
Total Correct										56	91.8

SUMMARY MATRIX
Unfiltered classified scene

Path/Row: 19/35

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	4	0	0	0	0	0	0	0	0	4	100
2	0	7	0	0	0	0	0	0	0	7	100
3	0	0	24	0	0	0	0	0	0	24	100
4	0	0	0	38	0	1	0	0	0	39	97.4
5	0	0	0	0	2	0	0	0	0	2	100
6	0	0	0	0	0	3	0	0	0	3	100
7	0	0	0	0	0	0	32	1	0	33	97
8	0	0	0	0	0	0	1	16	0	17	94.1
9	0	0	0	0	0	0	0	0	0	0	100
Total	4	7	24	38	2	4	33	17	0	129	
Prod. Acc	100	100	100	100	100	75	97	94	100		
Total Correct										126	97.7

APPENDIX L

NEUSE-TAR/PAMLICO CLASSIFICATION SUMMARY REPORT

**Comprehensive Land Cover Mapping
for the State of North Carolina**

**Change Order No. 1
Acceleration of Landcover Development
in the Neuse and Tar/Pamlico River Basins**

EarthSat's Summary Report

August 1996

Section 1. Current Status

May through June 1996, Earth Satellite Corporation's (EarthSat's) personnel logged 157.0 hours to charge to the change order. The period cost for direct labor is \$11,460.00, with no costs for Other Direct Costs or G&A on ODCs. The project has been completed within the available funds and delivered on-schedule.

Landcover database development for the Neuse and Tar/Pamlico river basins is complete, covering parts of five (5) Landsat TM path/row scenes. The raster database is clipped to the hydrologic unit boundaries with municipal areas excluded.

Section 2. Product Development

All field and ancillary data points obtained under the Comprehensive Landcover Mapping for the State of North Carolina contract were compiled and, pursuant to the contract, 40% were reserved for accuracy assessment. Point coverages, consisting only of points not reserved for accuracy assessment, were generated for each TM path/row. A 200-meter buffer was generated around each point; the resultant buffer polygon was used to produce a 240-class isodata signature file (with the following parameters: 2 standard deviations, 1 xy skip, 12 iterations on a .990 convergence threshold) for each of the five 12-band images (winter and summer scenes combined minus thermal bands) covered by the basins. Using parallelepiped rule, a supervised classification was then produced.

The image produced from the supervised classification was used to assign landcover types. An Arc/INFO Grid dendrogram was produced by exporting the means of the 240 spectral classes found in each of the 12-band scenes. A summary report indicated the spectral class associated with each reference point; the landcover type was marked on the dendrogram until all reference points were used. In this way, all spectral clusters had a landcover type assigned either by an actual reference point or by spectral similarity. Both spectral confusion and potential mis-classed reference points were easily identified in cases where several landcover types were recorded for the same spectral cluster. Raster edits helped to improve the database consistency and accuracy.

After one iteration of raster edits, all scenes were filtered to the minimum mapping unit using clump and eliminate. Filtered images were produced for each of the MMUs, with all of class 5 (water) from the 6-pixel filter burned onto the 12-pixel filter to achieve the different MMUs on a single database. The five scenes were then mosaicked (in the following order: path 15 row 36, path 16 row 35, path 14 row 35, path 14 row 36, path 15 row 35) and an additional iteration of raster edits performed to improve the quality, consistency, and accuracy of the database. The database was clipped to the hydrologic and municipal boundary datasets.

Final landcover database for the Neuse and Tar/Pamlico river basins was provided in general binary (BIL, BIP, and BSQ) and Imagine (IMG) formats with data items listing each landcover code and brief description, along with readme files containing similar information. Files in those formats were provided for the unfiltered images as well as images filtered to the minimum mapping units.

Section 3. Classification Difficulties

Some classes may appear to be under-represented in the final landcover database. As discovered in field data collection, southern yellow pines often dominate upper canopy even with significant mixed deciduous/evergreen understory. Although such areas may be spectrally unique, use of the dendrogram and reference points helped to ensure proper classification (largely 422, southern yellow pine). Classification is also dependent upon growth stage for the classification; in some areas fairly recent clearcuts were classed as 3121, unmanaged herbaceous upland, because of either lack of closure and/or small height. Again, dendrogram and field reference data helped to retain appropriate classification.

During landcover class assignment, when spectral confusion was identified on the dendrogram landcover class for the spectral class was assigned based on majority of landcover type and/or spectral similarity of adjacent spectral clusters. Classes 11, 2, and 61 (high intensity developed, cultivated, unconsolidated sediment) had the largest frequency of confusion on all scenes; in such instances error was favored for developed classes. The reason for this was to avoid not classing local rural developments and allow for easier identification during raster editing (*e.g.*, it was easier to identify where developed areas wouldn't be than where they might be amongst large agricultural groups). Classes 11, 12, and 311 (high intensity developed, low intensity developed, managed herbaceous) also had confusion; again error was made in favor of developed areas for similar reasons cited above.

Especially in path 15 row 35, significant spectral confusion was encountered between classes 311 and 2 (managed herbaceous and cultivated). Because the summer scene was early in the year (May) and vegetation was not at a mature growth stage, it was difficult to spectrally ascertain whether some areas were cultivated or managed herbaceous. Classification using the dendrogram and reliance on field points during raster editing helped alleviate some of this problem, however.

One other problem encountered in classification was between classes 411 and 414, mixed upland hardwoods and bottomland forests/hardwood swamps. Classification using the dendrogram, reliance on field points during raster editing, spatial location (*i.e.*, location of forests in relation to river and/or wetland classes) also helped alleviate some of this problem.

In filtering the images to produce a database at the minimum mapping unit, some classes were unavoidably absorbed into surrounding landcover types. This was most noticeable among linear features such as roads and rivers. (Water features were generally maintained better, however, because separate filters were performed for 6 and 12 pixels with all of class 5 (water) from the 6-pixel filter burned onto the full 12-pixel filter to achieve the different MMUs.)

In some areas, a "salt and pepper" effect may be noticeable, indicating spectral dissimilarities in landcover types. Raster editing helped to correct for some areas where filtering did not compensate thoroughly. An additional modal filter may make the database more appealing but would also bring it beyond the MMU. Areas where this effect occurs could help in identifying places in need of additional field reference data.

Co-registration of the summer and winter scenes indicated that geocoding was sufficient for mosaicking. Overlap of intra-scene boundaries was reclassified as 0 before final mosaic. Once mosaicked, image boundaries were checked to identify areas in need of raster edits. Because geocoding was good, minimal editing was required for the seamless database.

Section 4. Thematic Organization

Readme files and database fields for both the filtered and unfiltered databases link the thematic class number with the landcover classification code and landcover description:

THEMATIC CLASS NO.	LANDCOVER CODE	LANDCOVER DESCRIPTION
1	11	High Intensity Developed
2	12	Low Intensity Developed
3	2	Cultivated
4	311	Managed Herbaceous
5	3121	Unmanaged Herbaceous - Upland
6	3122	Unmanaged Herbaceous - Wetland
7	323	Evergreen Shrubland
8	324	Deciduous Shrubland
9	325	Mixed Shrubland
10	411	Mixed Hardwoods
11	414	Bottomland Hardwoods/Hardwood Swamps
12	419	Other Broadleaf Deciduous Forests
13	45	Needleleaf Deciduous
14	421	Mountain Conifers
15	422	Southern Yellow Pine
16	429	Other Needleleaf Evergreen Forests
17	43	Broadleaf Evergreen Forest
18	441	Mixed Hardwoods/Conifers
19	442	Oak/Gum/Cypress
20	5	Water
21	61	Unconsolidated Sediment
22	62	Exposed Rock
23	9	Indeterminate Landcover

Section 5. Spatial Characteristics

Images provided are in the following projection:

Projection:	State Plane
FIPS Zone:	3200
Datum:	NAD83
Spheroid:	GRS 1980
Units:	meters

The spatial extent of the databases covers the hydrologic unit boundaries of both the Neuse and Tar/Pamlico River Basins (with municipal boundaries excluded from the database) with a pixel resolution of 28.5 meters. Based on the coordinate projection the approximate spatial extent is:

Upper left X: 589054	Upper left Y: 299734
Lower right X: 920309	Lower right Y: 94648

APPENDIX M

FINAL DATABASE ACCURACY MATRICES

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, with Neuse-Tar/Pamlico

Points Description: All points reserved for accuracy
assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	78	3	6	3	0	2	1	2	1	96	81.25
2	19	167	24	6	1	8	6	0	0	231	72.29
3	6	16	253	5	0	1	10	5	0	296	85.47
4	3	4	12	270	1	2	29	32	0	353	76.49
5	2	0	3	0	37	1	1	0	0	44	84.09
6	4	1	0	0	0	36	1	0	0	42	85.71
7	9	4	16	19	0	5	328	22	0	403	81.39
8	4	4	3	19	0	5	15	75	0	125	60
9	0	0	0	0	0	0	0	0	1	1	100
Total	125	199	317	322	39	60	391	136	2	1591	
Prod. Acc	62	84	80	84	95	60	84	55	50		
Total Correct										1245	78.25

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, with Neuse-Tar/Pamlico

Points Description: All points reserved for accuracy
assessment (40% of all points)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	82	1	4	0	0	1	2	2	1	93	88.17
2	23	178	33	8	1	7	8	2	0	260	68.46
3	7	10	295	4	0	3	12	3	0	334	88.32
4	2	0	6	373	2	16	34	42	0	475	78.53
5	0	1	6	3	40	4	3	1	0	58	68.97
6	3	1	3	0	1	38	1	0	0	47	80.85
7	9	4	12	24	5	19	410	22	0	505	81.19
8	2	3	4	32	0	7	16	105	0	169	62.13
9	0	0	0	0	0	0	0	0	1	1	100
Total	128	198	363	444	49	95	486	177	2	1942	
Prod. Acc	64	90	81	84	82	40	84	59	50		
Total Correct										1522	78.37

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, with Neuse-Tar/Pamlico

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	372	4	5	6	7	8	9	Total	User Acc
1	197	5	11	6	1	3	2	4	1	230	85.65
2	48	423	72	20	4	15	19	5	0	606	69.8
3	23	32	709	16	4	4	24	9	0	821	86.36
4	6	6	25	822	5	27	86	100	1	1078	76.25
5	3	1	18	4	93	11	5	2	0	137	67.88
6	7	2	11	0	1	105	2	1	0	129	81.4
7	23	12	39	67	7	34	953	58	0	1193	79.88
8	6	10	10	57	1	9	44	214	0	351	60.97
9	0	0	0	0	0	0	0	0	3	3	100
Total	313	491	895	992	116	208	1135	393	5	4548	
Prod. Acc	63	86	79	83	80	50	84	54	60		
Total Correct										3519	77.37

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, with Neuse-Tar/Pamlico

Points Description: All field points (all ancillary
data removed)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	194	5	8	5	1	3	3	3	0	222	87.39
2	47	414	70	15	3	14	19	3	0	585	70.77
3	20	32	621	12	2	2	22	8	0	719	86.37
4	5	6	22	530	2	10	70	55	1	701	75.61
5	3	1	6	0	77	4	2	2	0	95	81.05
6	6	2	1	0	0	76	2	0	0	87	87.36
7	24	10	35	38	0	4	740	41	0	892	82.96
8	6	10	10	40	0	2	40	154	0	262	58.78
9	1	0	0	0	0	0	0	0	3	4	75
Total	306	480	773	640	85	115	898	266	4	3567	
Prod. Acc	63	86	80	83	91	66	82	58	75		
Total Correct										2809	78.75

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, no Neuse-Tar/Pamlico

Points Description: All points reserved for accuracy
assessment

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	100	2	5	2	0	2	1	1	1	114	87.72
2	8	178	8	4	0	3	4	0	0	205	86.83
3	5	13	284	5	0	1	9	3	0	320	88.75
4	2	1	9	290	1	2	18	18	0	341	85.04
5	0	0	2	0	38	1	1	0	0	42	90.48
6	3	1	0	0	0	41	0	0	0	45	91.11
7	4	2	6	7	0	5	347	14	0	385	90.13
8	3	2	3	14	0	5	11	100	0	138	72.46
9	0	0	0	0	0	0	0	0	1	1	100
Total	125	199	317	322	39	60	391	136	2	1591	
Prod. Acc	80	89	90	90	97	68	89	74	50		
Total Correct										1379	86.68

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, no Neuse-Tar/Pamlico

Points Description: All points reserved for accuracy
assessment (40% of all points)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	109	0	2	0	0	1	1	1	1	115	94.78
2	5	184	16	4	0	3	6	2	0	220	83.64
3	7	8	329	4	0	2	9	1	0	360	91.39
4	1	0	5	397	2	15	23	25	0	468	84.83
5	1	0	3	2	42	2	2	1	0	53	79.25
6	2	1	1	0	1	51	1	0	0	57	89.47
7	1	3	4	16	4	14	431	12	0	485	88.87
8	2	2	3	21	0	7	13	135	0	183	73.77
9	0	0	0	0	0	0	0	0	1	1	100
Total	128	198	363	444	49	95	486	177	2	1942	
Prod. Acc	85	93	91	89	86	54	89	76	50		
Total Correct										1679	86.46

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, no Neuse-Tar/Pamlico

Points Description: All points

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	258	2	9	5	1	2	2	3	1	283	91.17
2	17	447	28	11	0	8	11	5	0	527	84.82
3	16	26	801	15	1	3	20	5	0	887	90.3
4	3	2	16	879	4	27	57	68	1	1057	83.16
5	1	0	10	3	101	5	3	1	0	124	81.45
6	4	2	6	0	1	130	1	1	0	145	89.66
7	9	6	17	37	6	24	1007	37	0	1143	88.1
8	5	6	8	42	2	9	34	273	0	379	72.03
9	0	0	0	0	0	0	0	0	3	3	100
Total	313	491	895	992	116	208	1135	393	5	4548	
Prod. Acc	82	91	89	89	87	63	88.7	69	60		
Total Correct										3899	85.73

SUMMARY MATRIX
Filtered classified scene

Path/Row: Statewide, no Neuse-Tar/Pamlico

Points Description: All field points (all ancillary data removed)

Field/ancillary reference data points ---->

Row	1	2	3	4	5	6	7	8	9	Total	User Acc
1	253	2	7	4	1	2	2	3	0	274	92.34
2	17	437	28	9	0	7	11	3	0	512	85.35
3	14	26	695	10	1	2	18	4	0	770	90.26
4	3	2	17	564	1	9	43	38	1	678	83.19
5	1	0	3	0	82	1	1	1	0	89	92.13
6	4	2	1	0	0	90	1	0	0	98	91.84
7	9	5	14	22	0	2	791	24	0	867	91.23
8	5	6	8	31	0	2	31	193	0	276	69.93
9	0	0	0	0	0	0	0	0	3	3	100
Total	306	480	773	640	85	115	898	266	4	3567	
Prod. Acc	83	91	90	88	96	78	88	73	75		
Total Correct										3108	87.13

APPENDIX N

METADATA FOR LAND COVER DATABASE

1.0 Identification Information

1.1 Citation

- 8.1 *Originator:* Earth Satellite Corporation (EarthSat)
- 8.2 *Publication Date:* 199703
- 8.4 *Title:* Comprehensive Land Cover Mapping for the State of North Carolina
- 8.6 *Geospatial Data Presentation Form:* Map
- 8.8 *Publication Information*
 - 8.8.1 *Publication Place:* Rockville, Maryland
 - 8.8.2 *Publisher:* EarthSat
- 8.9 *Other Citation Details:* NCCGIA distributes this dataset
- 8.10 *Online Linkage:* Metadata --<http://cgia.cgia.state.nc.us/corpmeta.dir/>

1.2 Description

1.2.1 Abstract:

The North Carolina Center for Geographic Information and Analysis, in cooperation with the NC Department of Transportation and United States Environmental Protection Agency Region IV Wetlands Division, contracted Earth Satellite Corporation (EarthSat) of Rockville, Maryland to generate comprehensive land cover data for the entire state of North Carolina. EarthSat was awarded the base/municipal area deduct contract in response to request for proposal (RFP) number 503768, issued 12 July 1995.

1.2.2 Purpose:

These data were created to assist governmental agencies and others in making resource management decisions through the use of a geographic information system (GIS).

1.2.3 Supplemental Information:

Twenty-two TM scenes were acquired from EOSAT Landsat Thematic Mapper (TM) and used by EarthSat to produce land cover classification. See full documentation for this data layer in report, "Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Rockville, Maryland: Earth Satellite Corporation.

1.3 Time Period of Content

9.3 Range of Dates/Times

9.3.1 *Beginning Date:* 19930516

9.3.3 *Ending Date:* 19960631

1.3.1 Currentness Reference:

Land cover database reflects conditions at imagery dates and field data collection activities through 31 June 1996.

1.4 Status

1.4.1 *Progress:* Complete

1.4.2 *Maintenance and Update Frequency:* As needed

1.5 Spatial Domain

1.5.1 Bounding Coordinates

- 1.5.1.1 West Bounding Coordinate: -84.435748
- 1.5.1.2 East Bounding Coordinate: -75.523956
- 1.5.1.3 North Bounding Coordinate: 36.507731
- 1.5.1.4 South Bounding Coordinate: 33.787184

1.6 Keywords

1.6.1 Theme

- 1.6.1.1 Theme Keyword Thesaurus: None
- 1.6.1.2 Theme Keyword: Land cover
- 1.6.1.3 Theme Keyword: Satellite
- 1.6.1.4 Theme Keyword: Classification
- 1.6.1.5 Theme Keyword: Thematic Mapper
- 1.6.1.6 Theme Keyword: Comprehensive
- 1.6.1.7 Theme Keyword: Mapping
- 1.6.1.8 Theme Keyword: Land use

1.6.2 Place

- 1.6.2.1 Place Keyword Thesaurus: None
- 1.6.2.2 Place Keyword: North Carolina
- 1.6.2.3 Place Keyword: Statewide
- 1.6.2.4 Place Keyword: Neuse
- 1.6.2.5 Place Keyword: Tar/Pamlico

1.7 Access Constraints: None

1.8 Use Constraints:

Acknowledgment of products derived from this data set should cite the following:
The source of the Land Cover - TM data is the North Carolina Corporate Geographic Database. Earlier versions of these data may exist. The user must be sure to use the appropriate data set for the time period of interest. While efforts have been made to ensure that these data are accurate and reliable within the state of the art, CGIA (and its cooperators and contractor EarthSat) cannot assume liability for any damages or misrepresentation caused by any inaccuracies in the data or as a result of changes to the data caused by system transfer.

1.9 Point of Contact

10.2 Contact Organization Primary

10.2.1 Contact Organization:

NC Center for Geographic Information and Analysis

10.2.2 Contact Person: Zsolt Nagy

10.3 Contact Position: Database Administrator

10.4 Contact Address

- 10.4.1 Address Type: Mailing and physical address
- 10.4.2 Address: 115 Hillsborough Street
- 10.4.3 City: Raleigh
- 10.4.4 State or Province: North Carolina
- 10.4.5 Postal Code: 27603
- 10.4.6 Country: U.S.A.

10.5 Contact Voice Telephone: (919) 733-2090

10.7 Contact Facsimile Telephone: (919) 715-0725

10.8 Contact Electronic Mail Address: dataq@cgia.state.nc.us

10.9 Hours of Service: 8:30 am to 5:30 pm

10.10 Contact Instructions: Preferred contact is by phone or e-mail

1.11 Data Set Credit

NCCGIA Director, Karen Siderelis

Database Administrator, Zsolt Nagy

Remote Sensing Project Manager, Thaddeus Bara

NC Center for Geographic Information and Analysis
115 Hillsborough Street
Raleigh, North Carolina 27603

EarthSat Vice President of Environmental and GIS Services, Dr. Greg T. Koeln
Project Manager, Todd C. Patterson
Assistant Project Manager, Todd F. Helt
Earth Satellite Corporation (EarthSat)
6011 Executive Boulevard, Suite 400
Rockville, Maryland 20852

1.13 Native Data Set Environment:

Present version is in Erdas's Imagine (IMG) format, version 8.2, with file naming convention conforming to unix (descriptive) format. All data was projected to North Carolina State Plane, zone 4901 (FIPS Zone 3200), NAD83 datum, GRS1980 spheroid, meters as units. Land cover classification was performed using Erdas Imagine 8.2 algorithms for unsupervised and supervised classification and information classes assigned using Arc/INFO Grid's (version 7.0.3) dendrogram function.

Individual classified scenes were filtered and mosaicked using Erdas Imagine 8.2. Full 12-band (combined leaf-off and leaf-on) scenes were used for the entire state; where clouds obstructed classification only leaf-off 6-band images were used.

2.0 Data Quality Information

2.1 Attribute Accuracy

2.1.1 Attribute Accuracy Report:

Raster pixels were assigned information (land cover) classes by undergoing an unsupervised classification in Erdas Imagine 8.2. The resultant single-band image signature file was exported and formatted to use with Arc/INFO Grid's dendrogram function. A summary function in Erdas Imagine 8.2 corresponded land cover class with pixel value at which the land cover data point was located. The land cover class was recorded on the dendrogram until all data points were assigned a spectral class. Information class was assigned to spectral class by majority of points within the spectral class and/or by spectral similarity. Full process description can be found in EarthSat's final report to NCCGIA, "Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997.

After processing each scene was raster edited to alleviate errors and provide for a consistent land cover surface. After an initial accuracy appraisal the scene was filtered to reach the minimum mapping unit (MMU) of 6 pixels for water and 12 pixels for other land cover types.

2.1.2 Quantitative Attribute Accuracy Assessment

2.1.2.1 Attribute Accuracy Value:

2.1.2.1.1 Filtered Database with Neuse-Tar/Pamlico: 78.25

2.1.2.1.2 Filtered Database without Neuse-Tar/Pamlico: 86.68

2.1.2.2 Attribute Accuracy Explanation:

The land cover surface was recoded to collapse the 23-land cover classes into the 9-accuracy classes. A summary matrix was recorded to list the user and producer accuracy for the entire scene, for both filtered and unfiltered databases.

2.2 Logical Consistency Report:

Using ESRI's Arc/INFO and ArcView software, and Trimble Navigation's Direct GPS for ArcView and PathFinder 3.0, data points were attributed with land cover class and

rasterized for use in the classification procedure. Pseudo-color single-band images (4,5,3 RGB) were created in an unsupervised classification and information classes assigned based on majority of field data points within the spectral class and/or euclidian relationship of the means of each spectral class.

2.3 Completeness Report:

These data represent areas within a 1-kilometer buffer of the state's borders, showing human uses of the land, vegetation, water, natural surface, and construction.

2.4 Positional Accuracy

2.4.1 Horizontal Positional Accuracy

2.4.1.1 Horizontal Positional Accuracy Report:

Analysis of inter- and intra-scene co-registration suggested all scenes were accurate to within one pixel (28.5 meters).

2.4.1.2 Quantitative Horizontal Positional Accuracy Assessment

2.4.1.2.1 Horizontal Positional Accuracy Value: 10 meters

2.4.1.2.2 Horizontal Positional Accuracy Explanation:

Average root mean square (RMS) error of co-registration of all scenes.

2.4.2 Vertical Positional Accuracy

2.4.2.1 Vertical Positional Accuracy Report: N/A

2.5 Lineage

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: Earth Satellite Corporation (EarthSat)

8.2 Publication Date: 199703

- 8.4 *Title:*
 - Comprehensive Land Cover Mapping for the State of North Carolina
- 8.6 *Geospatial Data Presentation Form:* Map
- 8.8.1 *Publication Place:* Rockville, Maryland
- 8.8.2 *Publisher:* EarthSat
- 8.9 *Other Citation Details:* NCCGIA distributes this data set
- 2.5.1.2 *Source Scale Denominator:*
- 2.5.1.3 *Type of Source Media:* 8-mm digital tape
- 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 19930516
 - 9.3.3 *Ending Date:* 19960631
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Land cover database reflect conditions at imagery dates and field data collection activities through 31 June 1996.
- 2.5.1.5 *Source Citation Abbreviation:* TM
- 2.5.1.6 *Source Contribution:* Raw satellite image data - Landsat Thematic Mapper (TM), and ancillary data points, aerial photograph interpretation.
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* EOSAT/Landsat Thematic Mapper (TM)
 - 8.2 *Publication Date:* 1996
 - 8.4 *Title:* Landsat Thematic Mapper (TM) data
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Lanham, Maryland
 - 8.8.2 *Publisher:* EOSAT
 - 8.9 *Other Citation Details:* NCCGIA distributes this dataset
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 19930516
 - 9.3.3 *Ending Date:* 19950520
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Earliest and latest dates of 22 TM scenes acquired to cover the entire state for both leaf-off and leaf-on conditions.
 - 2.5.1.5 *Source Citation Abbreviation:* TM
 - 2.5.1.6 *Source Contribution:* Raw satellite image data - Landsat Thematic Mapper (TM)
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Earth Satellite Corporation (EarthSat)
 - 8.2 *Publication Date:* 199607

- 8.4 *Title:*
 - Comprehensive Land Cover Mapping for the State of North Carolina Field Data Points
- 8.6 *Geospatial Data Presentation Form:* Map
- 8.8.1 *Publication Place:* Rockville, Maryland
- 8.8.2 *Publisher:* EarthSat
- 8.9 *Other Citation Details:* NCCGIA distributes this dataset
- 2.5.1.2 *Source Scale Denominator:*
- 2.5.1.3 *Type of Source Media:* 8-mm digital tape
- 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 199602
 - 9.3.3 *Ending Date:* 199606
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Field data collection activities for use in assigning information classes to spectral classes of raw imagery.
- 2.5.1.5 *Source Citation Abbreviation:* TP, JM, DH
- 2.5.1.6 *Source Contribution:*
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Pacific Meridian Resources
 - 8.2 *Publication Date:* 1995
 - 8.4 *Title:* Southern Appalachian Assessment classification
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Portland, Oregon
 - 8.8.2 *Publisher:* Pacific Meridian Resources
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* unknown
 - 9.3.3 *Ending Date:* 1995
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Land cover classification of Appalachia.
 - 2.5.1.5 *Source Citation Abbreviation:* SAA
 - 2.5.1.6 *Source Contribution:* Raw satellite image data
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* University of North Carolina at Greensboro
 - 8.2 *Publication Date:* 1995
 - 8.4 *Title:* Field data collection
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Raleigh, NC
 - 8.8.2 *Publisher:* NCCGIA
 - 8.9 *Other Citation Details:* NCCGIA distributed this dataset

- 2.5.1.2 *Source Scale Denominator:*
- 2.5.1.3 *Type of Source Media:* 8-mm digital tape, USGS 7.5' quad map
- 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* varies
 - 9.3.3 *Ending Date:* 1995
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Field data collection with Department of Geography students based on USGS 7.5' topographic quadrangle maps.
- 2.5.1.5 *Source Citation Abbreviation:* UNCG
- 2.5.1.6 *Source Contribution:* Digital point data
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Natural Heritage Program
 - 8.2 *Publication Date:* 1996
 - 8.4 *Title:* Ancillary data collection
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Rockville, Maryland
 - 8.8.2 *Publisher:* EarthSat
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:*
 - 8-mm digital tape, 3.5" diskette, hardcopy image map
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 19930516
 - 9.3.3 *Ending Date:* 199611
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Earliest and latest dates of TM scenes acquired based on biologist(s) knowledge of area and imagery.
 - 2.5.1.5 *Source Citation Abbreviation:* NHP, NHP_NEW, CL
 - 2.5.1.6 *Source Contribution:*
 - Raw satellite image map markings entered into point database, projected points from digitally-provided database.
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Division of Parks and Recreation
 - 8.2 *Publication Date:* 1996
 - 8.4 *Title:* Ancillary and field data collection
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Rockville, Maryland
 - 8.8.2 *Publisher:* EarthSat
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* hardcopy image map
 - 2.5.1.4 *Source Time Period of Content*

- 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date*: 19930516
 - 9.3.3 *Ending Date*: 199611
- 2.5.1.4.2 *Source Currentness Reference*:
 - Earliest and latest dates TM scenes acquired based on park staff knowledge of area, imagery, and location of requested sites on USGS 7.5' topographic quadrangle maps.
- 2.5.1.5 *Source Citation Abbreviation*: PK
- 2.5.1.6 *Source Contribution*: Raw satellite image map markings
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator*: Southeastern Forest Experiment Station
 - 8.2 *Publication Date*: unknown
 - 8.4 *Title*: The Eastwide Forest Inventory Database
 - 8.6 *Geospatial Data Presentation Form*: Map
 - 8.8.1 *Publication Place*: Asheville, North Carolina
 - 8.8.2 *Publisher*: Southeastern Forest Experiment Station
 - 2.5.1.2 *Source Scale Denominator*:
 - 2.5.1.3 *Type of Source Media*: 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date*: unknown
 - 9.3.3 *Ending Date*: unknown
 - 2.5.1.4.2 *Source Currentness Reference*: unknown
 - 2.5.1.5 *Source Citation Abbreviation*: FIA
 - 2.5.1.6 *Source Contribution*: Ancillary data points from digital dataset
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator*: U.S. Fish and Wildlife Service
 - 8.2 *Publication Date*: 19951204
 - 8.4 *Title*: NWI Digital Data, Complete Set
 - 8.6 *Geospatial Data Presentation Form*: Map
 - 8.8.1 *Publication Place*: Washington, D.C.
 - 8.8.2 *Publisher*: U.S. Fish and Wildlife Service
 - 8.9 *Other Citation Details*:
 - U.S. Fish and Wildlife Service distributes this dataset
 - 2.5.1.2 *Source Scale Denominator*:
 - 2.5.1.3 *Type of Source Media*: 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date*: 197102
 - 9.3.3 *Ending Date*: 199212
 - 2.5.1.4.2 *Source Currentness Reference*: Varies
 - 2.5.1.5 *Source Citation Abbreviation*: NWI
 - 2.5.1.6 *Source Contribution*: Ancillary data points from digital dataset

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: Dismal Swamp National Wildlife Refuge

8.2 Publication Date: 1989

8.4 Title: SPOT classification

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Suffolk, Virginia

8.8.2 Publisher: U.S. Fish and Wildlife Service

2.5.1.2 Source Scale Denominator:

2.5.1.3 Type of Source Media: 3.5' diskette

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: 1989

9.3.3 Ending Date: 1989

2.5.1.4.2 Source Currentness Reference:

SPOT land cover classification reflecting conditions at the Great Dismal Swamp in 1988-1989.

2.5.1.5 Source Citation Abbreviation: DS

2.5.1.6 Source Contribution: Ancillary data points from digital dataset

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: XVIII Airborne Corps and Fort Bragg

Directorate of Public Works and Environment, Engineering Systems Division

8.2 Publication Date: unknown

8.4 Title: Digital and analog forest inventory data

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Fayetteville, North Carolina

8.8.2 Publisher: XVIII Airborne Corps and Fort Bragg

Directorate of Public Works and Environment, Engineering Systems Division

2.5.1.2 Source Scale Denominator:

2.5.1.3 Type of Source Media: 8-mm digital tape, hardcopy maps

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: unknown

9.3.3 Ending Date: unknown

2.5.1.4.2 Source Currentness Reference: mid-1990s

2.5.1.5 Source Citation Abbreviation:

2.5.1.6 Source Contribution: Classification confirmation with maps

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: U.S. Geological Survey

8.2 Publication Date: varies

8.4 Title: USGS 7.5' Topographic Quadrangle Maps

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Reston, Virginia

8.8.2 Publisher: U.S. Geological Survey

8.9 Other Citation Details: Published map series

2.5.1.2 Source Scale Denominator: 24000

2.5.1.3 Type of Source Media: Paper

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: varies

9.3.3 *Ending Date*: varies

2.5.1.4.2 *Source Currentness Reference*:

Publication dates of quadrangles

2.5.1.5 *Source Citation Abbreviation*: None

2.5.1.6 *Source Contribution*:

Assistance with location during field data collection; identification of areas for ancillary data collection.

2.5.1 *Source Information*

2.5.1.1 *Source Citation*

8.1 *Originator*: Department of Transportation

8.2 *Publication Date*: varies

8.4 *Title*: Aerial photograph interpretation

8.6 *Geospatial Data Presentation Form*: Aerial photographs

8.8.1 *Publication Place*: Raleigh, North Carolina

8.8.2 *Publisher*: Department of Transportation

8.9 *Other Citation Details*:

Department of Transportation maintains and distributes these data

2.5.1.2 *Source Scale Denominator*: varies

2.5.1.3 *Type of Source Media*: Aerial photographs

2.5.1.4 *Source Time Period of Content*

2.5.1.4.1 *Time Period Information*

9.3.1 *Beginning Date*: 1988

9.3.3 *Ending Date*: 1995

2.5.1.4.2 *Source Currentness Reference*: Date(s) of mission(s)

2.5.1.5 *Source Citation Abbreviation*: DOT

2.5.1.6 *Source Contribution*:

Confirmation of classification; collection of ancillary data

2.5.2 *Process Step*

2.5.2.1 *Process Description*:

Land cover database derived from two co-registered multi spectral Landsat 5 TM pairs, leaf-off and leaf-on, and classified using field and ancillary data. Six bands (1-5 and 7) were stacked to produce a single 12-band raster image (bands 1-6 leaf-off). The Erdas Imagine ISODATA algorithm was applied to the 12-band image to generate 240 spectral class signatures. The Imagine maximum likelihood classifier was then applied using the resulting signatures to assign information (land cover) classes to the spectral classes. Arc/INFO Grid 7.0.4 dendrogram function was used to produce a paper spectral tree showing the euclidian relationship of spectral classes; land cover classes based on field data collection activities and available ancillary data (both of which not reserved for final accuracy appraisal, 40% of each class for each scene) falling at each spectral class were recorded and information class assigned based on majority and/or spectral relationship. Raster editing was interactively performed to correct for spectral confusion and misclassification.

A change order was delivered to EarthSat in April 1996 to accelerate classification for the Neuse-Tar/Pamlico watershed. This dataset was incorporated into the final statewide land cover but because of enhancement to processing techniques and correction of some errors a separate, enhanced statewide database was also provided (that did not have the earlier provided Neuse-Tar/Pamlico watershed land cover classification database).

Each scene underwent accuracy appraisal before being accepted for use

in the final statewide database. Once accepted, scenes were filtered to reach the minimum mapping unit (MMU) of 6 pixels for water and 12 pixels for all other classes. Imagine clump and eliminate routines were used to reduce insignificant data and filter information class assignment.

A hierarchy of scenes was determined based on obstructed areas, scene dates, and classification results. Additional raster editing was performed to enhance data quality and interactively correct any remaining inconsistencies or spectrally confused areas. The municipal vector was rasterized and mosaicked with the final scenes and recoded to land cover class 10 (thematic class 24).

2.5.2.2 Source Used Citation Abbreviation:

All data identified previously

2.5.2.3 Process Date: 199602 to 199702

2.5.2.5 Source Produced Citation Abbreviation:

“Comprehensive Land Cover Mapping for the State of North Carolina: Final Report,” March 1997, Rockville, Maryland: Earth Satellite Corporation. Provides detailed descriptions of field and ancillary data collection activities, classification procedures, and procedures attempted to resolve spectral confusion.

2.5.2.6 Process Contact

10.2 Contact Organization Primary

10.2.1 Contact Organization:

Earth Satellite Corporation (EarthSat)

10.2.2 Contact Person: Dr. Gregory T. Koeln

10.2.2 Contact Person: Mr. Todd C. Patterson

10.2.2 Contact Person: Mr. Todd F. Helt

10.3 Contact Position: Environmental and GIS Services Group

10.4 Contact Address

10.4.1 Address Type: Mailing and physical address

10.4.2 Address: 6011 Executive Boulevard, Suite 400

10.4.3 City: Rockville

10.4.4 State or Province: Maryland

10.4.5 Postal Code: 20852-3801

10.4.6 Country: U.S.A.

10.5 Contact Voice Telephone: (301) 231-0660

10.7 Contact Facsimile Telephone: (301) 231-5020

10.8 Contact Electronic Mail Address: userid@earthsat.com

10.9 Hours of Service: 8:00 am to 5:30 pm Eastern time

10.10 Contact Instructions:

Prefer primary contact through NCCGIA

2.6 Cloud Cover:

No obstructed areas; leaf-off scenes only (6-bands) were used for processing of all cloud-obstructed areas and incorporated into the full scene before filtering and accuracy appraisal.

3.0 Spatial Data Organization Information

3.1 Indirect Spatial Reference:

North Carolina State Plane Zone, FIPS state plane projection zone.

3.2 Direct Spatial Reference Method: Raster

3.4 Raster Object Information

3.4.1 Raster Object Type: Pixel

3.4.2 Row Count: 10,861

3.4.3 Column Count: 28,376

3.4.4 Vertical Count: N/A

4.0 Spatial Reference Information

4.1 Horizontal Coordinate System Definition

4.1.2 Planar

4.1.2.2 Grid Coordinate System

4.1.2.2.1 Grid Coordinate System Name:

State Plane Coordinate System 1983

4.1.2.2.4 State Plane Coordinate System

4.1.2.2.4.1 SPCS Zone Identifier: 4901

4.1.2.4 Planar Coordinate Information

4.1.2.4.1 Planar Coordinate Encoding Method: coordinate pair

4.1.2.4.2 Coordinate Representation

4.1.2.4.2.1 Abscissa Resolution: 28.5

4.1.2.4.2.2 Ordinate Resolution: 28.5

4.1.2.4.4 Planar Distance Units: meters

5.0 Entity and Attribute Information

5.1 Detailed Description

5.1.1 Entity Type

5.1.1.1 Entity Type Label: Land cover classification

5.1.1.2 Entity Type Definition:

Statewide land cover classification based on human uses of land, vegetation, water, natural surface, and construction.

5.1.1.3 Entity Type Definition Source:

Earth Satellite Corporation (EarthSat)

5.1.2 Attribute

5.1.2.1 Attribute Label: Row

5.1.2.2 Attribute Definition: Sequential thematic class

5.1.2.3 Attribute Definition Source:

Assigned based on sequential land cover class and collapsed 255-spectral class mosaicked classified scenes

5.1.2.4 Attribute Domain Values

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 0

5.1.2.4.1.2 Enumerated Domain Value Definition:

Not within statewide land cover database

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Computed by software

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 1

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to land cover class 11, High Intensity Developed

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 2

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to land cover class 12, Low Intensity Developed

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 3

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to land cover class 2, Cultivated

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 4

- 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 311, Managed Herbaceous Cover
- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 5
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 3121, Upland Herbaceous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 6
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 3122, Riverine/Estuarine Herbaceous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 7
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 323, Evergreen Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 8
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 324, Deciduous Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 9
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 325, Mixed Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 10
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 411, Mixed Hardwoods

- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 11
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 414, Bottomland Hardwoods/Hardwood Swamps
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 12
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 419, Other Broadleaf Deciduous Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 13
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 45, Needleleaf Deciduous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 14
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 421, Mountain Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 15
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 422, Southern Yellow Pine
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 16
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 429, Other Needleleaf Evergreen Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 17
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 43, Broadleaf Evergreen Forest
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 18
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Pixel corresponds to land cover class 441, Mixed Hardwoods/Conifers

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 19

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 442,
Oak/Gum/Cypress

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 20

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 5, Water Bodies

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 21

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 61, Unconsolidated
Sediment

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 22

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 62, Exposed Rock

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 23

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 9, Indeterminate

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 24

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 10, Municipal Areas

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* Histogram

5.1.2.2 *Attribute Definition:*

Number of pixels for each enumerated domain (described above)

5.1.2.3 *Attribute Definition Source:* Software computed

5.1.2.4 *Attribute Domain Values*

5.1.2.4.2 *Range Domain (with Neuse-Tar/Pamlico)*

5.1.2.4.2.1 *Range Domain Minimum:* 6356

5.1.2.4.2.2 *Range Domain Maximum:* 154464299

5.1.2.4.2 *Range Domain (no Neuse-Tar/Pamlico)*

5.1.2.4.2.1 *Range Domain Minimum:* 63

5.1.2.4.2.2 Range Domain Maximum: 154464329

5.1.2 Attribute

5.1.2.1 Attribute Label: Color

5.1.2.2 Attribute Definition:

Color assigned to view pixel values for each enumerated domain (described above)

5.1.2.3 Attribute Definition Source:

Color assigned by Earth Satellite Corporation

5.1.2.4 Attribute Domain Values

5.1.2.4.4 Unrepresentable Domain:

Color is arbitrary assignment to view pixel values for each enumerated domain (or land cover class, described above)

5.1.2 Attribute

5.1.2.1 Attribute Label: Landcover Class

5.1.2.2 Attribute Definition:

Classification number, relates to classification name and thematic sequence number (enumerated domain describe above)

5.1.2.3 Attribute Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4 Attribute Domain Values

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 0

5.1.2.4.1.2 Enumerated Domain Value Definition:

Not within statewide land cover database

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Computed by software

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 11

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to High Intensity Developed

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 12

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to Low Intensity Developed

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 2

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to Cultivated

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 311

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to Managed Herbaceous Cover

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 3121

5.1.2.4.1.2 Enumerated Domain Value Definition:

Pixel corresponds to Upland Herbaceous

- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 3122
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Riverine/Estuarine Herbaceous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 323
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Evergreen Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 324
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Deciduous Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 325
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Mixed Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 411
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Mixed Hardwoods
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 414
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Bottomland Hardwoods/Hardwood Swamps
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 419
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Other Broadleaf Deciduous Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 45
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Needleleaf Deciduous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 421
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*

- Pixel corresponds to Mountain Conifers
- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 422
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Southern Yellow Pine
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 429
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to land cover class 429, Other
Needleleaf Evergreen Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 43
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Broadleaf Evergreen Forest
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 441
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Mixed Hardwoods/Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 442
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Oak/Gum/Cypress
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 5
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Water Bodies
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 61
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Unconsolidated Sediment
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 62
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Exposed Rock
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 9

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Indeterminate

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 10

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Pixel corresponds to Municipal Areas

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* Landcover Description

5.1.2.2 *Attribute Definition:*

Descriptive title of land cover (relates to classification name and thematic sequence number (enumerated domain describe above))

5.1.2.3 *Attribute Definition Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4 *Attribute Domain Values*

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:*

blank (not within statewide land cover database)

5.1.2.4.3.2 *Codeset Source:* Computed by software

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* High Intensity Developed

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* Low Intensity Developed

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* Cultivated

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* Managed Herbaceous Cover

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* Upland Herbaceous

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:*

Riverine/Estuarine Herbaceous

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name:* Evergreen Shrubland

5.1.2.4.3.2 *Codeset Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.3 *Codeset Domain*

- 5.1.2.4.3.1 *Codeset Name:* Deciduous Shrubland
- 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Mixed Shrubland
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Mixed Hardwoods
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:*
Bottomland Hardwoods/Hardwood Swamps
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:*
Other Broadleaf Deciduous Forests
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Needleleaf Deciduous
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Mountain Conifers
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Southern Yellow Pine
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:*
Other Needleleaf Evergreen Forests
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Broadleaf Evergreen Forest
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Mixed Hardwoods/Conifers
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Oak/Gum/Cypress
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Water Bodies
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)

- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Unconsolidated Sediment
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Exposed Rock
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Indeterminate
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.3 *Codeset Domain*
 - 5.1.2.4.3.1 *Codeset Name:* Municipal Areas
 - 5.1.2.4.3.2 *Codeset Source:*
Land Cover Classification System (NCCGIA); North Carolina Corporate Geographic Database vector municipal dataset
- 5.1.2 *Attribute*
 - 5.1.2.1 *Attribute Label:* Accuracy Class
 - 5.1.2.2 *Attribute Definition:* Sequential collapsed accuracy class
 - 5.1.2.3 *Attribute Definition Source:*
Earth Satellite Corporation (sequential assignment); NCCGIA Request for Proposal 503768
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 0
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Not within statewide land cover database
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Computed by software
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 1
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Developed (land cover classes 11 and 12)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 2
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Agriculture (land cover class 2)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 3
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Herbaceous (land cover classes 311 and 312)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*

- 5.1.2.4.1.1 *Enumerated Domain Value:* 4
- 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Deciduous (land cover classes 324, 41, 45)
- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4A from
NCCGIA Request for Proposal 503768
- 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 5
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Water (land cover class 5)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 6
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Barren (land cover classes 61 and 62)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 7
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Evergreen (land cover classes 323, 42, 43)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4B from
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 8
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Mixed (land cover classes 325, 44)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4C from
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 9
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Indeterminate (land cover class 9)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 10
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Municipal Areas (land cover class 10)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on North Carolina
Corporate Geographic Database vector municipal dataset
- 5.1.2 *Attribute*
 - 5.1.2.1 *Attribute Label:* Opacity
 - 5.1.2.2 *Attribute Label Definition:* Determines solid fill of color

5.1.2.3 *Attribute Definition Source:* Erdas Imagine software

5.1.2.4 *Attribute Domain Values*

5.1.2.4.2 *Range Domain*

5.1.2.4.1 *Range Domain Minimum:* 0

5.1.2.4.2 *Range Domain Maximum:* 1

5.2 *Overview Description*

5.2.1 *Entity and Attribute Overview.*

A raster data set depicting land cover found across North Carolina and within 1-kilometer of the state's borders. Attribute table contains descriptive data, including thematic class (row, sequentially corresponds to land cover class), number of pixels (histogram) for each row, land cover class, land cover description, accuracy class, and opacity. The attribute table is represented as follows:

<u>ITEM</u>	<u>WIDTH</u>	<u>TYPE</u>	<u>DESCRIPTION</u>
Row	3	Integer	Sequential thematic class
Histogram	9	Real	Number of pixels
Color	5	Color	Arbitrary color assignment
Landcover Class	15	Integer	Land cover class number
Landcover Description	32	Character	Description of land cover
Accuracy Class	5	Integer	Sequential accuracy class
Opacity	7	Integer	Display fill value

5.2.2 *Entity and Attribute Detail Citation:*

"Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Earth Satellite Corporation.

5.2.2 *Entity and Attribute Detail Citation:*

"Comprehensive Land Cover Mapping for the State of North Carolina: Detailed Study Design," February 1996, Earth Satellite Corporation.

5.2.2 *Entity and Attribute Detail Citation:*

"Land Cover Classification System," November 1996, NCCGIA. (Also available as Appendix A in "Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Earth Satellite Corporation.

5.2.2 *Entity and Attribute Detail Citation:*

"A Standard Classification System for the Mapping of Land Use and Land Cover," January 1994, NCCGIA.

6.0 **Distributor Information**

6.1 *Distributor*

10.2 *Contact Organization Primary*

10.2.1 *Contact Organization:*

NC Center for Geographic Information and Analysis

10.3 *Contact Position:* Production Services

10.4 *Contact Address*

10.4.1 *Address Type:* Mailing and physical address

10.4.2 *Address:* 115 Hillsborough Street

10.4.3 *City:* Raleigh

10.4.4 *State or Province:* North Carolina

10.4.5 *Postal Code:* 27603

10.4.6 *Country:* U.S.A.

10.5 *Contact Voice Telephone:* (919) 733-2090

10.7 *Contact Facsimile Telephone:* (919) 715-0725

10.8 *Contact Electronic Mail Address:* data@cgia.state.nc.us

10.9 *Hours of Service:* 8:30 am to 5:30 pm

10.10 *Contact Instructions*: Preferred contact is by phone or e-mail
6.2 *Resource Description*: Land Cover - TM (Statewide)

6.3 *Distribution Liability*:

NCCGIA is charged with the development and maintenance of the State's corporate geographic database and, in cooperation with other mapping organizations, is committed to offering its users accurate, useful, and current information about the state. Although every effort has been made to ensure the accuracy of information, errors and conditions originating from physical sources used to develop the corporate database may be reflected in the data supplied. The client must be aware of data conditions and bear responsibility for the appropriate use of the information with respect to possible errors, original map scale, collection methodology, currency of data, and other conditions specific to certain data. NCCGIA does not support secondary distribution of these data. The use of trade names or commercial products does not constitute their endorsement by the NCCGIA or North Carolina State Government.

6.4 *Standard Order Process*

6.4.2 *Digital Form*

6.4.2.1 *Digital Transfer Information*

6.4.2.1.1 *Format Name*: Erdas Imagine IMG raster format

6.4.2.1.2 *Format Version Number*: Imagine 8.2

6.4.2.1.5 *Format Information Content*: Single file IMG format

6.4.2.1.6 *File Decompression Technique*:

No compression applied

6.4.2.1.7 *Transfer Size*: Approximately 412

6.4.2.2 *Digital Transfer Options*

6.4.2.2.1 *Online Option*

6.4.2.2.1.1 *Computer Contact Information*

6.4.2.2.1.1.1 *Network Resource Name*:

Metadata only -

<http://cgia.cgia.state.nc.us/corpmeta.dir/corplaye.html>

6.4.2.2.1.1.2 *Dialup Instructions*: N/A

6.4.2.2.1.2 *Access Instructions*:

Metadata accessible using a World Wide Web (WWW) application

6.4.2.2.1.3 *Online Computer and Operating System*:

Unix, Sun Server, SunOS, Mosaic

6.4.2.2.2 *Offline Option*

6.4.2.2.2.1 *Offline Media*: 8mm data tape

6.4.2.2.2.2 *Recording Capacity*

6.4.2.2.2.2.1 *Recording Density*: 2.3

6.4.2.2.2.2.2 *Recording Density Units*: Gigabytes

6.4.2.2.2.3 *Recording Format*: tar or dd

6.4.2.2.2.4 *Compatibility Information*:

tar for UNIX

platforms blocking factor is 20 blocks, dd for other platforms

6.4.3 *Fees*:

Costs determined on a per-order basis. Basic costs, \$50.00 each, first three data sets per order, \$20.00 each additional file per order. Media: 8mm - \$25.00, 150mb cartridge - \$25.00, 9-track - \$25.00, 3.5 inch ds hd diskette - \$5.00 each. Client

may supply new media. Format, datum, units of measure, projection changes, other custom processing Erdas Imagine raster IMG image, NAD83, stateplane, meters, have additional hourly processing fees applied at a rate of \$54.00 per hour.

6.4.4 Ordering Instructions:

Contact Production Services, phone (919) 733-2090

6.4.5 Turnaround: Order dependent, standard 3 weeks

6.5 Custom Order Process:

For data creation and large analysis jobs contact Database Administration, phone (919) 733-2090. All data is available through standard ordering procedures on a cost recovery basis.

6.6 Technical Prerequisites:

All formats supplied are created using Erdas Imagine version 8.2. Users must be sure their system is compatible with the above format(s). Format compatibility is the user's responsibility.

7.0 Metadata Reference Information

7.1 Metadata Date: 19970311

7.2 Metadata Review Date:

7.3 Metadata Future Review Date:

7.4 Metadata Contact:

10.2 Contact Organization Primary

10.2.1 Contact Organization:

NC Center for Geographic Information and Analysis

10.3 Contact Position: Database Management

10.4 Contact Address

10.4.1 Address Type: Mailing and physical address

10.4.2 Address: 115 Hillsborough Street

10.4.3 City: Raleigh

10.4.4 State or Province: North Carolina

10.4.5 Postal Code: 27603

10.4.6 Country: U.S.A.

10.5 Contact Voice Telephone: (919) 733-2090

10.7 Contact Facsimile Telephone: (919) 715-0725

10.8 Contact Electronic Mail Address: data@cgia.state.nc.us

10.9 Hours of Service: 8:30 am to 5:30 pm

10.10 Contact Instructions: Preferred contact is by phone or e-mail

7.5 Metadata Standard Name:

FGDC Content Standards for Digital Geospatial Metadata

7.6 Metadata Standard Version: 19940608

7.7 Metadata Time Convention: Local time

7.8 Metadata Access Constraints: None

7.9 Metadata Use Constraints:

This metadata file is to accompany the data set identified and received from NCCGIA. NCCGIA does not support secondary distribution. If this data file was received from anyone besides NCCGIA, this metadata file and the data set it describes may contain discrepancies.

7.10 Metadata Security Information

7.10.1 Metadata Security Classification System: N/A

7.10.2 Metadata Security Classification: Unclassified

7.10.3 Metadata Security Handling Description: N/A

APPENDIX O

METADATA FOR DATA POINTS

1.0 Identification Information

1.1 Citation

8.1 *Originator*: Earth Satellite Corporation (EarthSat)

8.2 *Publication Date*: 199703

8.4 *Title*:

Comprehensive Land Cover Mapping for the State of North Carolina
Data Points

8.6 *Geospatial Data Presentation Form*: Map

8.8 *Publication Information*

8.8.1 *Publication Place*: Rockville, Maryland

8.8.2 *Publisher*: EarthSat

8.9 *Other Citation Details*: NCCGIA distributes this dataset

8.10 *Online Linkage*: Metadata --<http://cgia.cgia.state.nc.us/corpmeta.dir/>

1.2 Description

1.2.1 Abstract:

The North Carolina Center for Geographic Information and Analysis, in cooperation with the NC Department of Transportation and United States Environmental Protection Agency Region IV Wetlands Division, contracted Earth Satellite Corporation (EarthSat) of Rockville, Maryland to generate comprehensive land cover data for the entire state of North Carolina. EarthSat was awarded the base/municipal area deduct contract in response to request for proposal (RFP) number 503768, issued 12 July 1995.

1.2.2 Purpose:

These data were created for use with classification of 22 Landsat Thematic Mapper (TM) images and subsequent accuracy assessment of the resultant classification.

The classification was created to assist governmental agencies and others in making resource management decisions through the use of a geographic information system (GIS).

1.2.3 Supplemental Information:

Twenty-two TM scenes were acquired from EOSAT Landsat Thematic Mapper (TM) and used by EarthSat to produce land cover classification. Field and ancillary data were compiled for use as training sites to assign information classes to spectral classes and perform an accuracy appraisal. See full documentation for this data layer in report, "Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Rockville, Maryland: Earth Satellite Corporation.

1.3 Time Period of Content

9.3 Range of Dates/Times

9.3.1 *Beginning Date*: 197102

9.3.3 *Ending Date*: 19960631

1.3.1 Currentness Reference:

Data points database reflects conditions during field data collection activities conducted by EarthSat and consultants to EarthSat between 1 February 1996 and 31 June 1996 and ancillary data compiled for use with the land cover classification initiative; dates of ancillary data range from

1971 to 1996 interpretations. Data points are generally current from May 1993 to June 1996.

1.4 Status

1.4.1 *Progress*: Complete

1.4.2 *Maintenance and Update Frequency*: As needed

1.5 Spatial Domain

1.5.1 Bounding Coordinates

1.5.1.1 *West Bounding Coordinate*: -84.253068

1.5.1.2 *East Bounding Coordinate*: -75.413683

1.5.1.3 *North Bounding Coordinate*: 36.777205

1.5.1.4 *South Bounding Coordinate*: 33.733342

1.6 *Keywords*

1.6.1 *Theme*

1.6.1.1 *Theme Keyword Thesaurus*: None

1.6.1.2 *Theme Keyword*: Land cover

1.6.1.3 *Theme Keyword*: Satellite

1.6.1.4 *Theme Keyword*: Classification

1.6.1.5 *Theme Keyword*: Thematic Mapper

1.6.1.6 *Theme Keyword*: Comprehensive

1.6.1.7 *Theme Keyword*: Mapping

1.6.1.8 *Theme Keyword*: Land use

1.6.1.9 *Theme Keyword*: Global Positioning System

1.6.1.10 *Theme Keyword*: Ground truth

1.6.1.11 *Theme Keyword*: Field data

1.6.2 *Place*

1.6.2.1 *Place Keyword Thesaurus*: None

1.6.2.2 *Place Keyword*: North Carolina

1.6.2.3 *Place Keyword*: Statewide

1.7 *Access Constraints*: None

1.8 *Use Constraints*:

Acknowledgment of products derived from this data set should cite the following:
The source of the Land Cover - TM data is the North Carolina Corporate Geographic Database. Earlier versions of these data may exist. The user must be sure to use the appropriate data set for the time period of interest. While efforts have been made to ensure that these data are accurate and reliable within the state of the art, CGIA (and its cooperators and contractor EarthSat) cannot assume liability for any damages or misrepresentation caused by any inaccuracies in the data or as a result of changes to the data caused by system transfer.

1.9 *Point of Contact*

10.2 *Contact Organization Primary*

10.2.1 *Contact Organization*:

NC Center for Geographic Information and Analysis

10.2.2 *Contact Person*: Zsolt Nagy

10.3 *Contact Position*: Database Administrator

10.4 *Contact Address*

10.4.1 *Address Type*: Mailing and physical address

10.4.2 *Address*: 115 Hillsborough Street

10.4.3 *City*: Raleigh

10.4.4 *State or Province*: North Carolina

10.4.5 *Postal Code*: 27603

10.4.6 *Country*: U.S.A.

10.5 *Contact Voice Telephone*: (919) 733-2090

10.7 *Contact Facsimile Telephone*: (919) 715-0725

10.8 *Contact Electronic Mail Address*: dataq@cgia.state.nc.us

10.9 *Hours of Service*: 8:30 am to 5:30 pm

10.10 *Contact Instructions*: Preferred contact is by phone or e-mail

1.11 *Data Set Credit*

NCCGIA Director, Karen Siderelis

Database Administrator, Zsolt Nagy

Remote Sensing Project Manager, Thaddeus Bara

NC Center for Geographic Information and Analysis

115 Hillsborough Street

Raleigh, North Carolina 27603

EarthSat Vice President of Environmental and GIS Services, Dr. Greg T. Koeln
Project Manager, Todd C. Patterson
Assistant Project Manager, Todd F. Helt
Field Staff, Jeffrey B. Miller
Field Staff, Jacques Piou
Field Staff, Andy Waxman
Field Staff Consultant, Nancy A. Clusen
Field Staff Consultant, David Hughes
Earth Satellite Corporation (EarthSat)
6011 Executive Boulevard, Suite 400
Rockville, Maryland 20852

Natural Heritage Program
Division of Parks and Recreation
Department of Environment, Health and Natural Resources
Raleigh, North Carolina

Division of Parks and Recreation
Department of Environment, Health and Natural Resources
Raleigh, North Carolina

Department of Transportation
Raleigh, North Carolina

Department of Geography
University of North Carolina at Greensboro
Greensboro, North Carolina

Forester, Mr. Dave Brownlie
Great Dismal Swamp National Wildlife Refuge
Suffolk, Virginia

GIS Coordinator, Mr. John Shaw
XVIII Airborne Corps and Fort Bragg Directorate of Public Works and
Environment, Engineering Systems Division
Fayetteville, North Carolina

1.13 Native Data Set Environment:

Field data was either captured or referenced using Trimble Navigation's Direct GPS for ArcView /hardware software or Trimble's GeoExplorer hardware. For GPS points captured and maintained in the database, the positional location with attribute(s) entered during field data collection were saved in latitude longitude coordinates and projected to the mapping initiative parameters. For points referenced and maintained in the database, the GPS was used for navigation purposes with the point location marked on paper image maps and located and attributed using Erdas Imagine 8.2. All points were appended into a field points Arc/INFO 7.0.3 coverage.

Ancillary data was either provided digitally with points selected on-line for use in the classification process or marked on paper image maps and located and attributed using Erdas Imagine 8.2.

2.0 Data Quality Information

2.1 Attribute Accuracy

2.1.1 Attribute Accuracy Report:

Field data points using Direct GPS for ArcView were within 100 meters of accuracy. Field data points using GeoExplorer were differentially corrected and were within 5 meters of accuracy. Field data points using Direct GPS for ArcView for navigational purposes only were within 2 pixels of accuracy. Ancillary point accuracy varied dependent upon data source.

2.1.2 Quantitative Attribute Accuracy Assessment

2.1.2.1 Attribute Accuracy Value: varies (see above)

2.1.2.2 Attribute Accuracy Explanation: varies (see above)

2.2 Logical Consistency Report:

Using ESRI's Arc/INFO and ArcView software, and Trimble Navigation's Direct GPS for ArcView and PathFinder 3.0, data points were attributed with land cover class and rasterized for use in the classification procedure. Pseudo-color single-band images (4,5,3 RGB) were created in an unsupervised classification and information classes assigned based on majority of field and ancillary data points within the spectral class and/or euclidian relationship of the means of each spectral class. Before information class assignment, 40% of all points (combined field and ancillary) for each land cover class were reserved for accuracy assessment and not used in information class assignment.

2.3 Completeness Report:

These data represent areas in and near North Carolina for which TM coverage was available. Attributes useful for the classification and editing process were maintained in the database; the site identification number corresponds to hardcopy ground truth collection forms archived at NCCGIA.

2.4 Positional Accuracy

- 2.4.1 *Horizontal Positional Accuracy*
 - 2.4.1.1 *Horizontal Positional Accuracy Report:*
varies (see section 2.1.1)
 - 2.4.1.2 *Quantitative Horizontal Positional Accuracy Assessment*
 - 2.4.1.2.1 *Horizontal Positional Accuracy Value:*
varies (see section 2.1.1)
 - 2.4.1.2.2 *Horizontal Positional Accuracy Explanation:*
varies (see section 2.1.1)
 - 2.4.2 *Vertical Positional Accuracy*
 - 2.4.2.1 *Vertical Positional Accuracy Report:* N/A

2.5 *Lineage*

- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Earth Satellite Corporation (EarthSat)
 - 8.2 *Publication Date:* 199703
 - 8.4 *Title:*
Comprehensive Land Cover Mapping for the State of North Carolina Field Data Points
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Rockville, Maryland
 - 8.8.2 *Publisher:* EarthSat
 - 8.9 *Other Citation Details:* NCCGIA distributes this data set
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 199602
 - 9.3.3 *Ending Date:* 19960631
 - 2.5.1.4.2 *Source Currentness Reference:*
Field data points database reflects conditions during field data collection activities conducted by EarthSat and consultants to EarthSat between 1 February 1996 and 31 June 1996.
 - 2.5.1.5 *Source Citation Abbreviation:* TP, JM, DH
 - 2.5.1.6 *Source Contribution:* Field and ancillary data points

- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* EOSAT/Landsat Thematic Mapper (TM)
 - 8.2 *Publication Date:* 1996
 - 8.4 *Title:* Landsat Thematic Mapper (TM) data
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Lanham, Maryland
 - 8.8.2 *Publisher:* EOSAT
 - 8.9 *Other Citation Details:* NCCGIA distributes this dataset
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 19930516
 - 9.3.3 *Ending Date:* 19950520
 - 2.5.1.4.2 *Source Currentness Reference:*
Earliest and latest dates of 22 TM scenes acquired to cover the entire state for both leaf-off and leaf-on conditions.
 - 2.5.1.5 *Source Citation Abbreviation:* TM
 - 2.5.1.6 *Source Contribution:* Raw satellite image data -

Landsat Thematic Mapper (TM)

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: Pacific Meridian Resources

8.2 Publication Date: 1995

8.4 Title: Southern Appalachian Assessment classification

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Portland, Oregon

8.8.2 Publisher: Pacific Meridian Resources

2.5.1.2 Source Scale Denominator:

2.5.1.3 Type of Source Media: 8-mm digital tape

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: unknown

9.3.3 Ending Date: 1995

2.5.1.4.2 Source Currentness Reference:

Land cover classification of Appalachia

2.5.1.5 Source Citation Abbreviation: SAA

2.5.1.6 Source Contribution: Raw satellite image data

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: University of North Carolina at Greensboro

8.2 Publication Date: 1995

8.4 Title: Field data collection

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Raleigh, NC

8.8.2 Publisher: NCCGIA

8.9 Other Citation Details: NCCGIA distributed this dataset

2.5.1.2 Source Scale Denominator:

2.5.1.3 Type of Source Media: 8-mm digital tape, USGS 7.5' quad map

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: varies

9.3.3 Ending Date: 1995

2.5.1.4.2 Source Currentness Reference:

Field data collection with Department of Geography students based on USGS 7.5' topographic quadrangle maps.

2.5.1.5 Source Citation Abbreviation: UNCG

2.5.1.6 Source Contribution: Digital point data

2.5.1 Source Information

2.5.1.1 Source Citation

8.1 Originator: Natural Heritage Program

8.2 Publication Date: 1996

8.4 Title: Ancillary data collection

8.6 Geospatial Data Presentation Form: Map

8.8.1 Publication Place: Rockville, Maryland

8.8.2 Publisher: EarthSat

2.5.1.2 Source Scale Denominator:

2.5.1.3 Type of Source Media:

8-mm digital tape, 3.5" diskette, hardcopy image map

2.5.1.4 Source Time Period of Content

2.5.1.4.1 Time Period Information

9.3.1 Beginning Date: 19930516

9.3.3 Ending Date: 199611

- 2.5.1.4.2 *Source Currentness Reference:*
Earliest and latest dates of TM scenes acquired based on biologist(s) knowledge of area and imagery.
- 2.5.1.5 *Source Citation Abbreviation:* NHP, NHP_NEW, CL
- 2.5.1.6 *Source Contribution:*
Raw satellite image map markings entered into point database, projected points from digitally-provided database.
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Division of Parks and Recreation
 - 8.2 *Publication Date:* 1996
 - 8.4 *Title:* Ancillary and field data collection
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Rockville, Maryland
 - 8.8.2 *Publisher:* EarthSat
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* hardcopy image map
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 19930516
 - 9.3.3 *Ending Date:* 199611
 - 2.5.1.4.2 *Source Currentness Reference:*
Earliest and latest dates TM scenes acquired based on park staff knowledge of area, imagery, and location of requested sites on USGS 7.5' topographic quadrangle maps.
 - 2.5.1.5 *Source Citation Abbreviation:* PK
 - 2.5.1.6 *Source Contribution:* Raw satellite image map markings
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Southeastern Forest Experiment Station
 - 8.2 *Publication Date:* unknown
 - 8.4 *Title:* The Eastwide Forest Inventory Database
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Asheville, North Carolina
 - 8.8.2 *Publisher:* Southeastern Forest Experiment Station
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* unknown
 - 9.3.3 *Ending Date:* unknown
 - 2.5.1.4.2 *Source Currentness Reference:* unknown
 - 2.5.1.5 *Source Citation Abbreviation:* FIA
 - 2.5.1.6 *Source Contribution:* Ancillary data points from digital dataset
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* U.S. Fish and Wildlife Service
 - 8.2 *Publication Date:* 19951204
 - 8.4 *Title:* NWI Digital Data, Complete Set
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Washington, D.C.
 - 8.8.2 *Publisher:* U.S. Fish and Wildlife Service
 - 8.9 *Other Citation Details:*

U.S. Fish and Wildlife Service distributes this dataset

- 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 197102
 - 9.3.3 *Ending Date:* 199212
 - 2.5.1.4.2 *Source Currentness Reference:* Varies
 - 2.5.1.5 *Source Citation Abbreviation:* NWI
 - 2.5.1.6 *Source Contribution:* Ancillary data points from digital dataset
- 2.5.1 *Source Information*
- 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Dismal Swamp National Wildlife Refuge
 - 8.2 *Publication Date:* 1989
 - 8.4 *Title:* SPOT classification
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Suffolk, Virginia
 - 8.8.2 *Publisher:* U.S. Fish and Wildlife Service
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 3.5' diskette
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 1989
 - 9.3.3 *Ending Date:* 1989
 - 2.5.1.4.2 *Source Currentness Reference:*
SPOT land cover classification reflecting conditions at the Great Dismal Swamp in 1988-1989.
 - 2.5.1.5 *Source Citation Abbreviation:* DS
 - 2.5.1.6 *Source Contribution:* Ancillary data points from digital dataset
- 2.5.1 *Source Information*
- 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* XVIII Airborne Corps and Fort Bragg
Directorate of Public Works and Environment, Engineering Systems Division
 - 8.2 *Publication Date:* unknown
 - 8.4 *Title:* Digital and analog forest inventory data
 - 8.6 *Geospatial Data Presentation Form:* Map
 - 8.8.1 *Publication Place:* Fayetteville, North Carolina
 - 8.8.2 *Publisher:* XVIII Airborne Corps and Fort Bragg
Directorate of Public Works and Environment, Engineering Systems Division
 - 2.5.1.2 *Source Scale Denominator:*
 - 2.5.1.3 *Type of Source Media:* 8-mm digital tape, hardcopy maps
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* unknown
 - 9.3.3 *Ending Date:* unknown
 - 2.5.1.4.2 *Source Currentness Reference:* mid-1990s
 - 2.5.1.5 *Source Citation Abbreviation:*
 - 2.5.1.6 *Source Contribution:* Classification confirmation with maps
- 2.5.1 *Source Information*
- 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* U.S. Geological Survey
 - 8.2 *Publication Date:* varies

- 8.4 *Title:* USGS 7.5' Topographic Quadrangle Maps
- 8.6 *Geospatial Data Presentation Form:* Map
- 8.8.1 *Publication Place:* Reston, Virginia
- 8.8.2 *Publisher:* U.S. Geological Survey
- 8.9 *Other Citation Details:* Published map series
- 2.5.1.2 *Source Scale Denominator:* 24000
- 2.5.1.3 *Type of Source Media:* Paper
- 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* varies
 - 9.3.3 *Ending Date:* varies
 - 2.5.1.4.2 *Source Currentness Reference:*
 - Publication dates of quadrangles
- 2.5.1.5 *Source Citation Abbreviation:* None
- 2.5.1.6 *Source Contribution:*
 - Assistance with location during field data collection; identification of areas for ancillary data collection.
- 2.5.1 *Source Information*
 - 2.5.1.1 *Source Citation*
 - 8.1 *Originator:* Department of Transportation
 - 8.2 *Publication Date:* varies
 - 8.4 *Title:* Aerial photograph interpretation
 - 8.6 *Geospatial Data Presentation Form:* Aerial photographs
 - 8.8.1 *Publication Place:* Raleigh, North Carolina
 - 8.8.2 *Publisher:* Department of Transportation
 - 8.9 *Other Citation Details:*
 - Department of Transportation maintains and distributes these data
 - 2.5.1.2 *Source Scale Denominator:* varies
 - 2.5.1.3 *Type of Source Media:* Aerial photographs
 - 2.5.1.4 *Source Time Period of Content*
 - 2.5.1.4.1 *Time Period Information*
 - 9.3.1 *Beginning Date:* 1988
 - 9.3.3 *Ending Date:* 1995
 - 2.5.1.4.2 *Source Currentness Reference:* Date(s) of mission(s)
 - 2.5.1.5 *Source Citation Abbreviation:* DOT
 - 2.5.1.6 *Source Contribution:*
 - Confirmation of classification; collection of ancillary data
- 2.5.2 *Process Step*
 - 2.5.2.1 *Process Description:*
 - Field data was either captured or referenced using Trimble Navigation's Direct GPS for ArcView /hardware software or Trimble's GeoExplorer hardware. For GPS points captured and maintained in the database, the positional location with attribute(s) entered during field data collection were saved in latitude longitude coordinates and projected to the mapping initiative parameters. For points referenced and maintained in the database, the GPS was used for navigation purposes with the point location marked on paper image maps and located and attributed using Erdas Imagine 8.2. All points were appended into a field points Arc/INFO 7.0.3 coverage.
 - Ancillary data was either provided digitally with points selected on-line for use in the classification process or marked on paper image maps and located and attributed using Erdas Imagine 8.2.

Land cover database derived from two co-registered multispectral Landsat 5 TM pairs, leaf-off and leaf-on, and classified using field and ancillary data. Six bands (1-5 and 7) were stacked to produce a single 12-band raster image (bands 1-6 leaf-off). The Erdas Imagine ISODATA algorithm was applied to the 12-band image to generate 240 spectral class signatures. The Imagine maximum likelihood classifier was then applied using the resulting signatures to assign information (land cover) classes to the spectral classes. Arc/INFO Grid 7.0.4 dendrogram function was used to produce a paper spectral tree showing the euclidian relationship of spectral classes; land cover classes based on field data collection activities and available ancillary data (both of which not reserved for final accuracy appraisal, 40% of each class for each scene) falling at each spectral class were recorded and information class assigned based on majority and/or spectral relationship. Raster editing was interactively performed to correct for spectral confusion and misclassification.

2.5.2.2 Source Used Citation Abbreviation:

All data identified previously

2.5.2.3 Process Date: 199602 to 199702

2.5.2.5 Source Produced Citation Abbreviation:

"Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Rockville, Maryland: Earth Satellite Corporation. Provides detailed descriptions of field and ancillary data collection activities, classification procedures, and procedures attempted to resolve spectral confusion.

2.5.2.6 Process Contact

10.2 Contact Organization Primary

10.2.1 Contact Organization:

Earth Satellite Corporation (EarthSat)

10.2.2 Contact Person: Dr. Gregory T. Koeln

10.2.2 Contact Person: Mr. Todd C. Patterson

10.2.2 Contact Person: Mr. Todd F. Helt

10.3 Contact Position: Environmental and GIS Services Group

10.4 Contact Address

10.4.1 Address Type: Mailing and physical address

10.4.2 Address: 6011 Executive Boulevard, Suite 400

10.4.3 City: Rockville

10.4.4 State or Province: Maryland

10.4.5 Postal Code: 20852-3801

10.4.6 Country: U.S.A.

10.5 Contact Voice Telephone: (301) 231-0660

10.7 Contact Facsimile Telephone: (301) 231-5020

10.8 Contact Electronic Mail Address: userid@earthsat.com

10.9 Hours of Service: 8:00 am to 5:30 pm Eastern time

10.10 Contact Instructions:

Prefer primary contact through NCCGIA

2.6 Cloud Cover: N/A

3.0 Spatial Data Organization Information

3.1 Indirect Spatial Reference:

North Carolina State Plane Zone, FIPS state plane projection zone.

3.2 Direct Spatial Reference Method: Vector

4.0 Spatial Reference Information

4.1 Horizontal Coordinate System Definition

4.1.2 Planar

4.1.2.2 Grid Coordinate System

4.1.2.2.1 Grid Coordinate System Name:

State Plane Coordinate System 1983

4.1.2.2.4 State Plane Coordinate System

4.1.2.2.4.1 SPCS Zone Identifier: 4901

4.1.2.4 Planar Coordinate Information

4.1.2.4.1 Planar Coordinate Encoding Method: coordinate pair

4.1.2.4.2 Coordinate Representation

4.1.2.4.2.1 Abscissa Resolution: 1.00

4.1.2.4.2.2 Ordinate Resolution: 1.00

4.1.2.4.4 Planar Distance Units: meters

5.0 Entity and Attribute Information

5.1 Detailed Description

5.1.1 Entity Type

5.1.1.1 Entity Type Label: Data point database

5.1.1.2 Entity Type Definition:

Field and ancillary data points gathered in support of land cover classification efforts for the entire State of North Carolina.

5.1.1.3 Entity Type Definition Source:

Earth Satellite Corporation (EarthSat)

5.1.2 Attribute

5.1.2.1 Attribute Label: AREA

5.1.2.2 Attribute Definition: Total area in coverage units

5.1.2.3 Attribute Definition Source: Software computed

5.1.2.4 Attribute Domain Value

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 0

5.1.2.4.1.2 Enumerated Domain Value Definition: Area

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Software (Arc/INFO 7.0.4)

5.1.2 Attribute

5.1.2.1 Attribute Label: PERIMETER

5.1.2.2 Attribute Definition: Total perimeter in coverage units

5.1.2.3 Attribute Definition Source: Software computed

5.1.2.4 Attribute Domain Value

5.1.2.4.1 Enumerated Domain

5.1.2.4.1.1 Enumerated Domain Value: 0

5.1.2.4.1.2 Enumerated Domain Value Definition:

Perimeter

5.1.2.4.1.3 Enumerated Domain Value Definition Source:

Software (Arc/INFO 7.0.4)

5.1.2 Attribute

5.1.2.1 Attribute Label: ALLPOINTS#

5.1.2.2 Attribute Definition: Point internal identification number

5.1.2.3 Attribute Definition Source: Software computed

5.1.2.4 Attribute Domain Value

5.1.2.4.2 Range Domain

5.1.2.4.2.1 Range Domain Minimum: 1

5.1.2.4.2.2 Range Domain Maximum: 5543

5.1.2 Attribute

5.1.2.1 Attribute Label: ALLPOINTS-ID

5.1.2.2 *Attribute Definition*: Point internal identification number

5.1.2.3 *Attribute Definition Source*: Software computed

5.1.2.4 *Attribute Domain Value*

5.1.2.4.2 *Range Domain*

5.1.2.4.2.1 *Range Domain Minimum*: 1

5.1.2.4.2.2 *Range Domain Maximum*: 643

5.1.2 *Attribute*

5.1.2.1 *Attribute Label*: SITE-#

5.1.2.2 *Attribute Definition*: Unique site identification number

5.1.2.3 *Attribute Definition Source*: EarthSat

5.1.2.4 *Attribute Domain Value*

5.1.2.4.3 *Codeset Domain*

5.1.2.4.3.1 *Codeset Name*:

Name varies by data source and sequential number assigned to data point. Character prefix corresponds to data source identified above (citation abbreviation) and number corresponds to sequential number assigned (general sequence is order entered into database). For more thorough explanation refer to report, "Comprehensive Land Cover Mapping for the State of North Carolina: Final Report," March 1997, Rockville, Maryland: Earth Satellite Corporation.

5.1.2.4.3.2 *Codeset Source*: EarthSat

5.1.2 *Attribute*

5.1.2.1 *Attribute Label*: CODE

5.1.2.2 *Attribute Definition*: Land cover class type

5.1.2.3 *Attribute Definition Source*:

Land Cover Classification System (NCCGIA)

5.1.2.4 *Attribute Domain Value*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value*: 11

5.1.2.4.1.2 *Enumerated Domain Value Definition*:

Point corresponds to High Intensity Developed

5.1.2.4.1.3 *Enumerated Domain Value Definition Source*:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value*: 12

5.1.2.4.1.2 *Enumerated Domain Value Definition*:

Point corresponds to Low Intensity Developed

5.1.2.4.1.3 *Enumerated Domain Value Definition Source*:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value*: 2

5.1.2.4.1.2 *Enumerated Domain Value Definition*:

Point corresponds to Cultivated

5.1.2.4.1.3 *Enumerated Domain Value Definition Source*:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value*: 311

5.1.2.4.1.2 *Enumerated Domain Value Definition*:

Point corresponds to Managed Herbaceous Cover

5.1.2.4.1.3 *Enumerated Domain Value Definition Source*:

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

- 5.1.2.4.1.1 *Enumerated Domain Value:* 3121
- 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Upland Herbaceous
- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 3122
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Riverine/Estuarine Herbaceous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 323
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Evergreen Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 324
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Deciduous Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 325
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Mixed Shrubland
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 411
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Mixed Hardwoods
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 414
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Bottomland Hardwoods/Hardwood Swamps
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 419
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Other Broadleaf Deciduous Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 45
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Needleleaf Deciduous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 421
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Mountain Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 422
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Southern Yellow Pine
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 429
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 429, Other Needleleaf Evergreen Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 43
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Broadleaf Evergreen Forest
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 441
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Mixed Hardwoods/Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 442
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Oak/Gum/Cypress
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 5
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Water Bodies
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 61
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Unconsolidated Sediment
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 62
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Exposed Rock

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 9

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to Indeterminate

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L4

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "4" on linguistic scale, corresponding to "Absolutely correct interpretation of site."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L3-1

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "3" on linguistic scale, corresponding to "A good interpretation of the site but there is something about the site suggesting that membership in this class is not absolutely correct."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L3-2

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "3" on linguistic scale, corresponding to "A good interpretation of the site but there is something about the site suggesting that membership in this class is not absolutely correct."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L2-1

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "2" on linguistic scale, corresponding to "An acceptable interpretation of the site but not the best interpretation; more than one other possible interpretation seems reasonable."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L2-2

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "2" on linguistic scale, corresponding to "An acceptable interpretation of the site but not the best interpretation; more than one other possible interpretation seems reasonable."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L1-1

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "1" on linguistic scale, corresponding to "Incorrect interpretation of the site but there is something about the site which suggests membership in this class may be understandable."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* L1-2

5.1.2.2 *Attribute Definition:*

Land cover classification assigned as "1" on linguistic scale, corresponding to "Incorrect interpretation of the site but there is something about the site which suggests membership in this class may be understandable."

5.1.2.3 *Attribute Definition Source:* EarthSat/NCCGIA

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0 or blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Absolutely incorrect interpretation of site

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat/NCCGIA

5.1.2.4.1 *Enumerated Domain*

Enumerated domain corresponds to land cover code type; see above definitions for value definitions.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* DESCRIPT

5.1.2.2 *Attribute Definition:*

Brief description of land cover or land use associated with the site, including applicable building or vegetation content(s).

5.1.2.3 *Attribute Definition Source:* varies by data source

5.1.2.4 *Attribute Domain*

5.1.2.4.4 *Unrepresentable Domain:*

Descriptions vary in length and number of words dependent upon land cover found at respective site.

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* PHOTO

5.1.2.2 *Attribute Definition:* Whether photo of site exists

5.1.2.3 *Attribute Definition Source:* EarthSat

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0, N, blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

No photo of the site exists from field data collection activities

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* Y

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Photo of the site exists from field data collection activities

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* AA

5.1.2.2 *Attribute Definition:*

Whether point was reserved for initial accuracy assessment; 40% of points per land cover class were not used for information class assignment/classification. Additional ancillary points were added to the database after classification of all scenes and a second set of 40% of all points was used for a secondary accuracy appraisal (but not reflected in any attribute of this database).

5.1.2.3 *Attribute Definition Source:* EarthSat

5.1.2.4 *Attribute Domain*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 0, N, blank

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Not reserved for accuracy assessment (hence used for classification/information class assignment)

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* Y

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Reserved for accuracy assessment (hence not used for classification/information class assignment)

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

EarthSat

5.1.2 *Attribute*

5.1.2.1 *Attribute Label:* THEME

5.1.2.2 *Attribute Definition:* Sequential thematic class

5.1.2.3 *Attribute Definition Source:*

Assigned based on sequential land cover class

5.1.2.4 *Attribute Domain Values*

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 1

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Point corresponds to land cover class 11, High Intensity Developed

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 2

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Point corresponds to land cover class 12, Low Intensity Developed

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 3

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Point corresponds to land cover class 2, Cultivated

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*

Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 4

5.1.2.4.1.2 *Enumerated Domain Value Definition:*

Point corresponds to land cover class 311, Managed Herbaceous Cover

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 5

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 3121, Upland Herbaceous

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 6

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 3122, Riverine/Estuarine Herbaceous

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 7

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 323, Evergreen Shrubland

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 8

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 324, Deciduous Shrubland

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 9

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 325, Mixed Shrubland

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 10

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 411, Mixed Hardwoods

5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)

5.1.2.4.1 *Enumerated Domain*

5.1.2.4.1.1 *Enumerated Domain Value:* 11

5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 414, Bottomland Hardwoods/Hardwood Swamps

- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 12
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 419, Other Broadleaf Deciduous Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 13
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 45, Needleleaf Deciduous
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 14
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 421, Mountain Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 15
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 422, Southern Yellow Pine
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 16
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 429, Other Needleleaf Evergreen Forests
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 17
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 43, Broadleaf Evergreen Forest
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 18
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 441, Mixed Hardwoods/Conifers
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 19

- 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 442, Oak/Gum/Cypress
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 20
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 5, Water Bodies
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 21
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 61, Unconsolidated Sediment
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 22
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 62, Exposed Rock
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 23
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Point corresponds to land cover class 9, Indeterminate
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Land Cover Classification System (NCCGIA)
- 5.1.2 *Attribute*
 - 5.1.2.1 *Attribute Label:* THEME_AA
 - 5.1.2.2 *Attribute Definition:* Sequential collapsed accuracy class
 - 5.1.2.3 *Attribute Definition Source:*
Earth Satellite Corporation (sequential assignment); NCCGIA Request for Proposal 503768
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 1
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Developed (land cover classes 11 and 12)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 2
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Agriculture (land cover class 2)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 3

- 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Herbaceous (land cover classes 311 and 312)
- 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
- 5.1.2.4 *Attribute Domain Values*
 - 5.1.2.4.1 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 4
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Deciduous (land cover classes 324, 41, 45)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4A from
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1.2 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 5
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Water (land cover class 5)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1.3 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 6
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Barren (land cover classes 61 and 62)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1.4 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 7
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Evergreen (land cover classes 323, 42, 43)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4B from
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1.5 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 8
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Woody/Mixed (land cover classes 325, 44)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
Earth Satellite Corporation; based on value 4C from
NCCGIA Request for Proposal 503768
 - 5.1.2.4.1.6 *Enumerated Domain*
 - 5.1.2.4.1.1 *Enumerated Domain Value:* 9
 - 5.1.2.4.1.2 *Enumerated Domain Value Definition:*
Indeterminate (land cover class 9)
 - 5.1.2.4.1.3 *Enumerated Domain Value Definition Source:*
NCCGIA Request for Proposal 503768
 - 5.1.2.4.2 *Range Domain Maximum:* 1

5.2.1 Entity and Attribute Overview.

A vector data set of points assigned land cover class used for land cover classification and accuracy appraisal of the resultant classifications. Points were a combination of field

collected ground truth data and ancillary data from a variety of data sources. Attribute table contains descriptive data for each points and is represented as follows:

<u>ITEM</u>	<u>WIDTH</u>	<u>TYPE</u>	<u>DESCRIPTION</u>
AREA	4	Floating	Area of point
PERIMETER	4	Floating	Perimeter of point
ALLPOINTS#	4	Binary	Internal identification
ALLPOINTS-ID	4	Binary	Internal identification
SITE-#	7	Character	Unique site/data identifier
CODE	5	Character	Land cover class
L4	5	Character	Linguistic scale assignment
L3-1	5	Character	Linguistic scale assignment
L3-2	5	Character	Linguistic scale assignment
L2-1	5	Character	Linguistic scale assignment
L2-2	5	Character	Linguistic scale assignment
L1-1	5	Character	Linguistic scale assignment
L1-2	5	Character	Linguistic scale assignment
DESCRIPT	20	Character	Brief site description
PHOTO	1	Character	Whether photo exists
AA	1	Character	Whether reserved for accuracy assessment
THEME	5	Integer	Sequential thematic class
THEME_AA	5	Integer	Sequential accuracy class

5.2.2 Entity and Attribute Detail Citation:

“Comprehensive Land Cover Mapping for the State of North Carolina: Final Report,” March 1997, Earth Satellite Corporation.

5.2.2 Entity and Attribute Detail Citation:

“Comprehensive Land Cover Mapping for the State of North Carolina: Detailed Study Design,” February 1996, Earth Satellite Corporation.

5.2.2 Entity and Attribute Detail Citation:

“Land Cover Classification System,” November 1996, NCCGIA. (Also available as Appendix A in “Comprehensive Land Cover Mapping for the State of North Carolina: Final Report,” March 1997, Earth Satellite Corporation.

5.2.2 Entity and Attribute Detail Citation:

“A Standard Classification System for the Mapping of Land Use and Land Cover,” January 1994, NCCGIA.

6.0 Distributor Information

6.1 Distributor

10.2 Contact Organization Primary

10.2.1 Contact Organization:

NC Center for Geographic Information and Analysis

10.3 Contact Position: Production Services

10.4 Contact Address

10.4.1 Address Type: Mailing and physical address

10.4.2 Address: 115 Hillsborough Street

10.4.3 City: Raleigh

10.4.4 State or Province: North Carolina

10.4.5 Postal Code: 27603

10.4.6 Country: U.S.A.

10.5 Contact Voice Telephone: (919) 733-2090

10.7 Contact Facsimile Telephone: (919) 715-0725

10.8 Contact Electronic Mail Address: dataq@cgia.state.nc.us

10.9 Hours of Service: 8:30 am to 5:30 pm

10.10 Contact Instructions: Preferred contact is by phone or e-mail

6.2 Resource Description: Land Cover Data Points (Statewide)

6.3 Distribution Liability:

NCCGIA is charged with the development and maintenance of the State's corporate geographic database and, in cooperation with other mapping organizations, is committed to offering its users accurate, useful, and current information about the state. Although every effort has been made to ensure the accuracy of information, errors and conditions originating from physical sources used to develop the corporate database may be reflected in the data supplied. The client must be aware of data conditions and bear responsibility for the appropriate use of the information with respect to possible errors, original map scale, collection methodology, currency of data, and other conditions specific to certain data. NCCGIA does not support secondary distribution of these data. The use of trade names or commercial products does not constitute their endorsement by the NCCGIA or North Carolina State Government.

6.4 Standard Order Process

6.4.2 Digital Form

6.4.2.1 Digital Transfer Information

6.4.2.1.1 *Format Name:* Arc/INFO coverage format

6.4.2.1.2 *Format Version Number:* Arc/INFO version 7.0.4

6.4.2.1.5 *Format Information Content:*

Directory format, not transferable over the internet, usable on Arc/INFO, unix, workstation platforms

6.4.2.1.6 *File Decompression Technique:*

No compression applied

6.4.2.1.7 *Transfer Size:* approximately 1.3

6.4.2.2 Digital Transfer Options

6.4.2.2.1 Online Option

6.4.2.2.1.1 Computer Contact Information

6.4.2.2.1.1.1 Network Resource Name:

Metadata only -

<http://cgia.cgia.state.nc.us/corpmeta.dir/corplaye.html>

6.4.2.2.1.1.2 Dialup Instructions: N/A

6.4.2.2.1.2 Access Instructions:

Metadata accessible using a World Wide Web (WWW) application

6.4.2.2.1.3 Online Computer and Operating System:

Unix, Sun Server, SunOS, Mosaic

6.4.2.2.2 Offline Option

6.4.2.2.2.1 Offline Media: File Transfer Protocol (ftp)

6.4.2.2.2.3 Recording Format:

compressed or uncompressed

6.4.2.2.2.4 Compatibility Information:

FTP transfers are used on a per-order basis where NCCGIA connects to the client's system temporarily to transfer data files

6.4.2.2.2 Offline Option

6.4.2.2.2.1 Offline Media: 8mm data tape

6.4.2.2.2.2 Recording Capacity

6.4.2.2.2.2.1 Recording Density: 2.3

6.4.2.2.2.2.2 Recording Density Units: Gigabytes

6.4.2.2.2.3 Recording Format: tar or dd

6.4.2.2.2.4 Compatibility format:

tar for UNIX platforms blocking factor is 20 blocks, dd for other platforms

6.4.2.2.2 Offline Option

- 6.4.2.2.2.1 *Offline Media:* 1/4 inch data tape
- 6.4.2.2.2.2 *Recording Capacity*
 - 6.4.2.2.2.2.1 *Recording Density:* 150
 - 6.4.2.2.2.2.2 *Recording Density Units:* Megabytes
- 6.4.2.2.2.3 *Recording Format:* tar
- 6.4.2.2.2.4 *Compatibility Information:*

Only usable on
tape drives able to read unix, tar from a QIC150 tape drive

6.4.2.2.2 *Offline Option*

- 6.4.2.2.2.1 *Offline Media:* 9-track magtape
- 6.4.2.2.2.2 *Recording Capacity*
 - 6.4.2.2.2.2.1 *Recording Density:* 800
 - 6.4.2.2.2.2.1 *Recording Density:* 1600
 - 6.4.2.2.2.2.1 *Recording Density:* 6250
 - 6.4.2.2.2.2.2 *Recording Density Units:* bpi
- 6.4.2.2.2.3 *Recording Format:* tar or dd
- 6.4.2.2.2.4 *Compatibility Information:*

tar for UNIX

platforms, dd for other platforms

6.4.3 *Fees:*

Costs determined on a per-order basis. Basic costs, \$50.00 each, first three data sets per order, \$20.00 each additional file per order. Media: 8mm - \$25.00, 150mb cartridge - \$25.00, 9-track - \$25.00, 3.5 inch ds hd diskette - \$5.00 each. Client may supply new media. Format, datum, units of measure, projection changes, other custom processing Erdas Imagine raster IMG image, NAD83, stateplane, meters, have additional hourly processing fees applied at a rate of \$54.00 per hour.

6.4.4 *Ordering Instructions:*

Contact Production Services, phone (919) 733-2090

6.4.5 *Turnaround:* Order dependent, standard 3 weeks

6.5 *Custom Order Process:*

For data creation and large analysis jobs contact Database Administration, phone (919) 733-2090. All data is available through standard ordering procedures on a cost recovery basis.

6.6 *Technical Prerequisites:*

All formats supplied are created using Arc/INFO version 7.0.4. Users must be sure their system is compatible with the above format(s). Format compatibility is the user's responsibility.

7.0 Metadata Reference Information

7.1 *Metadata Date:* 19970312

7.2 *Metadata Review Date:*

7.3 *Metadata Future Review Date:*

7.4 *Metadata Contact:*

10.2 *Contact Organization Primary*

10.2.1 *Contact Organization:*

NC Center for Geographic Information and Analysis

10.3 *Contact Position:* Database Management

10.4 *Contact Address*

10.4.1 *Address Type:* Mailing and physical address

10.4.2 *Address:* 115 Hillsborough Street

10.4.3 *City:* Raleigh

10.4.4 *State or Province:* North Carolina

10.4.5 *Postal Code:* 27603

10.4.6 *Country:* U.S.A.

- 10.5 *Contact Voice Telephone:* (919) 733-2090
- 10.7 *Contact Facsimile Telephone:* (919) 715-0725
- 10.8 *Contact Electronic Mail Address:* dataq@cgia.state.nc.us
- 10.9 *Hours of Service:* 8:30 am to 5:30 pm
- 10.10 *Contact Instructions:* Preferred contact is by phone or e-mail

7.5 Metadata Standard Name:

FGDC Content Standards for Digital Geospatial Metadata

7.6 Metadata Standard Version: 19940608

7.7 Metadata Time Convention: Local time

7.8 Metadata Access Constraints: None

7.9 Metadata Use Constraints:

This metadata file is to accompany the data set identified and received from NCCGIA. NCCGIA does not support secondary distribution. If this data file was received from anyone besides NCCGIA, this metadata file and the data set it describes may contain discrepancies.

7.10 Metadata Security Information

7.10.1 Metadata Security Classification System: N/A

7.10.2 Metadata Security Classification: Unclassified

7.10.3 Metadata Security Handling Description: N/A