



Vegetation Mapping at Ocmulgee National Monument

Photointerpretation Key and Draft Vegetation Map

Natural Resource Report NPS/SECN/NRR—2014/860



ON THE COVER

Great Temple (right) and Lesser Temple Mounds (left) at Ocmulgee National Monument.
Photograph by: Nancy K. O'Hare, May 2014

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Executive Summary

The area now included in Ocmulgee National Monument (OCMU) has been used by humans for over 17,000 years. This region was heavily deforested in the early 1900s but has recovered in recent decades. The current vegetation of OCMU shows evidence of previous anthropogenic influences, with many early successional forest species such as sweet gum (*Liquidambar styraciflua*) and box elder (*Acer negundo*) and the presence of invasive species, especially Chinese privet (*Ligustrum sinense*) and Chinese tallow (*Triadica sebifera*).

Because of the extensive past land use history, using the National Vegetation Classification System (NVCS) to the association level was challenging. Determining community element global (CEGL) codes was particularly difficult because NVCS was designed for relatively undisturbed vegetation communities. Through the use of NatureServe vegetation plots, aerial photos, and data collected in the field, vegetation communities were delineated and assigned attributes. Using dominant vegetation classes and secondary vegetation classes, as well as modifiers to describe the diversity of species, detailed draft vegetation maps were created for OCMU, both inside the Monument and within a 500 meter buffer. The buffer polygons and attributes were created on a broader scale using a system based on the Anderson Level II classification scheme which includes anthropogenic and land use/land cover (LULC) classes. While within the Monument, the more detailed CEGL codes were used.

The products generated from this project include draft vegetation maps (Figure 6; Figure 7), a photointerpretation key (Appendix C), summary statistics of each vegetation class (Table 5; Table 6), and a detailed geodatabase with digital maps.

Acknowledgments

We would like to thank the OCMU staff for helping us with this project. They provided us with information regarding the historical context of the Monument, the presence of exotics, and current management practices.

Lonnie Davis, Cultural Resources, shared his extensive knowledge of the history of OCMU. Jim Brannon always welcomed us to OCMU and shared his perspective of OCMU from working there for over 14 years.

Alan Huckabee, a long-time volunteer in OCMU dedicated to exotic plant control, kindly spent a morning in the field with us discussing exotic plant removal and other aspects of OCMU vegetation.

Superintendent Jim David assured that park resources were available to us.

Introduction

As part of the National Park Service (NPS) Vegetation Inventory Program (Schmoldt, Peterson, and Silsbee 1994; Fancy, Gross, and Carter 2009), The University of Georgia Center for Geospatial Research (CGR) in the Department of Geography was asked to produce draft vegetation maps of eight park units in the NPS Inventory and Monitoring Program Southeast Coast Network (SECN) using mapping standards defined under the National Vegetation Classification System (NVCS) (Jennings et al. 2009). Under Task Agreement # P13AC01319, CGR agreed to analyze existing leaf-on color infrared (CIR) aerial photography to develop photointerpretation keys, accuracy assessment study plans, final digital maps of vegetation, geodatabases and associated metadata in accordance with NPS vegetation mapping standards, and field verification surveys in accordance with standard mapping practices.

The mapping work is divided into two phases according to location, available funding, and NPS priorities. Study areas (with associated parks and time frames) included in the entire mapping effort are:

Phase 1 – Georgia/Alabama (December 2013 to July 2014):

- Horseshoe Bend National Military Park (HOBE), Alabama
- Chattahoochee River National Recreation Area (CHAT), Georgia
- Ocmulgee National Monument (OCMU), Georgia

Phase 2 – Florida (August 2014 to July 2015):

- Canaveral National Seashore (CANA)
- Timucuan Ecological and Historic Preserve / Fort Caroline National Memorial (TIMU / FOCA)
- Castillo de San Marcos National Monument / Fort Matanzas National Monument (CASA / FOMA)

The contract for Phase 1 parks was signed on November 16, 2013. In compliance with the contract, the following tasks have been completed and delivered to Joe DeVivo, Program Manager for the SECN.

1. Draft overstory maps were delivered on August 22, 2014 and final deliverables (draft vegetation maps in digital ArcGIS geodatabase format) are included with this report. This report also includes PDF files of cartographic products depicting color-coded and labeled overstory vegetation, vegetation legend, Universal Transverse Mercator (UTM) grid, and NPS banner/logo (Figure 6; Figure 7). The associated spatial data includes vegetation community information in accordance with NVCS standards and Federal Geographic Data Committee (FGDC)–compliant metadata.

2. A photointerpretation key is included as Appendix C. The key contains a ground image and CIR image chip for each NCVS overstory vegetation class occurring in OCMU and a description of the CIR signature based on color, tone, texture, height, size, shape, location, and association.
3. Summary statistics of area coverage and number of polygons for each vegetation class within the boundaries of OCMU were generated. This information was then used to develop the study design for the accuracy assessment (Table 8).
4. This report provides written details on the photointerpretation and database/map generation procedures and on the field work. It also includes summary statistics of area coverage and number of polygons for each vegetation class (Table 5). Summary statistics were also developed for the general land use/land cover classes within the 500 meter buffer surrounding the Monument (Table 6).

Separate reports for HOBE and CHAT were also submitted in September 2014, completing Phase I of the Task Agreement.

Work for Phase II of the project started in July 2014.

Location of Ocmulgee National Monument

Ocmulgee National Monument (OCMU) is located on the banks of the Ocmulgee River adjacent to Macon, Georgia (Figure 1). It encompasses approximately 285 hectares (702 ac) and was established in 1936 to protect cultural resources. OCMU has been a site of human habitation for over 17,000 years (Kelly 1938; Kelly, Landers, and Fairbanks 1941). Artifacts from the early inhabitants, including Clovis points, tools, and pottery, have been found in the area. The site presently has one of the most extensive collections of archaeological artifacts in the United States (NPS 1991). The most visible features on the landscape are the ceremonial earthen mounds constructed by American Indians during the Mississippian Period between AD 900 and 1650. There are at least eight mounds, but perhaps as many as 12, within the boundaries of OCMU (Bigman 2012), including one mound with an unusual spiral ramp (NPS 1991). However, these mounds are not necessarily contemporaneous and likely represent different cultures (<http://www.nps.gov/ocmu/historyculture/index.htm>).

The Monument is located at the fork of the Ocmulgee River and Walnut Creek. The terrain is mostly flat bottomland with elevations ranging from 280 feet above mean sea level by the river to about 400 feet above mean sea level in the highest point of the uplands (Figure 2). OCMU is bounded on the north and west by the urban area of Macon, Georgia and on the south and east by forests and wetlands. The Monument consists of two distinct areas: the main unit and the Lamar Tract. The main portion is 267 hectares and is the only portion currently open to visitors. Not only does this portion of OCMU preserve the largest earthen mounds, it also contains evidence of a British trading post dating to the 17th century, a mid-19th century country residence (the Dunlap House), and both Confederate and Union earthen works from the American Civil War (NPS 1991). The smaller Lamar Tract is 18.7 hectares and is located about two miles southeast of the main portion.

NPS is in the process of potentially expanding OCMU (NPS 2014). The expansion would add approximately 2,100 acres, quadrupling the size of the Monument from about 280 to 1,133 hectares. The expansion would connect the two separate units of OCMU, expand the northern and eastern boundaries, and create a corridor along the Ocmulgee River connecting OCMU to Bond Swamp National Wildlife Refuge approximately six miles to the south. The proposed expansion is in accordance with the original vision to protect the Ocmulgee mounds (Marsh 1986), and its establishment would further protect the archaeological record of rich past cultures.

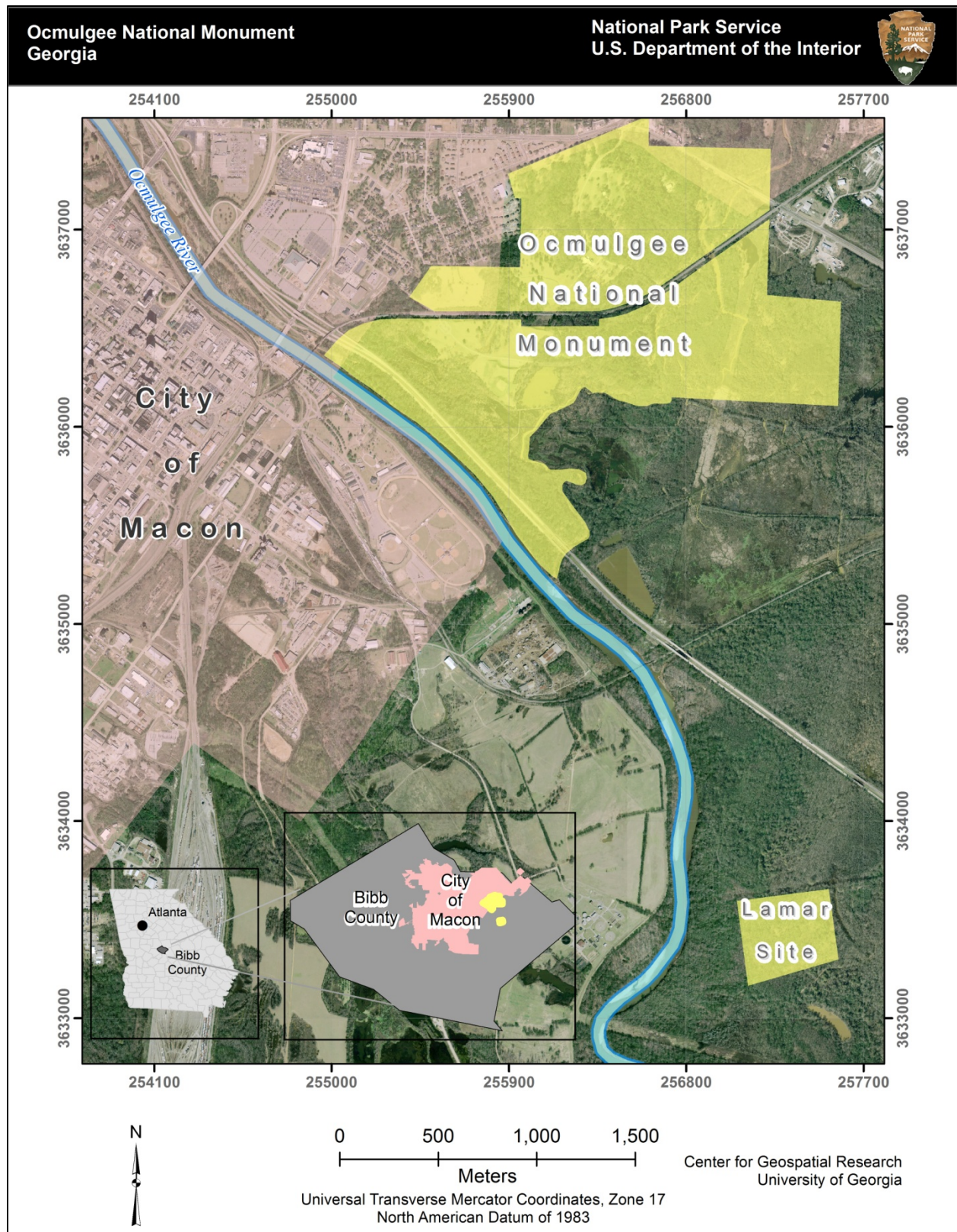
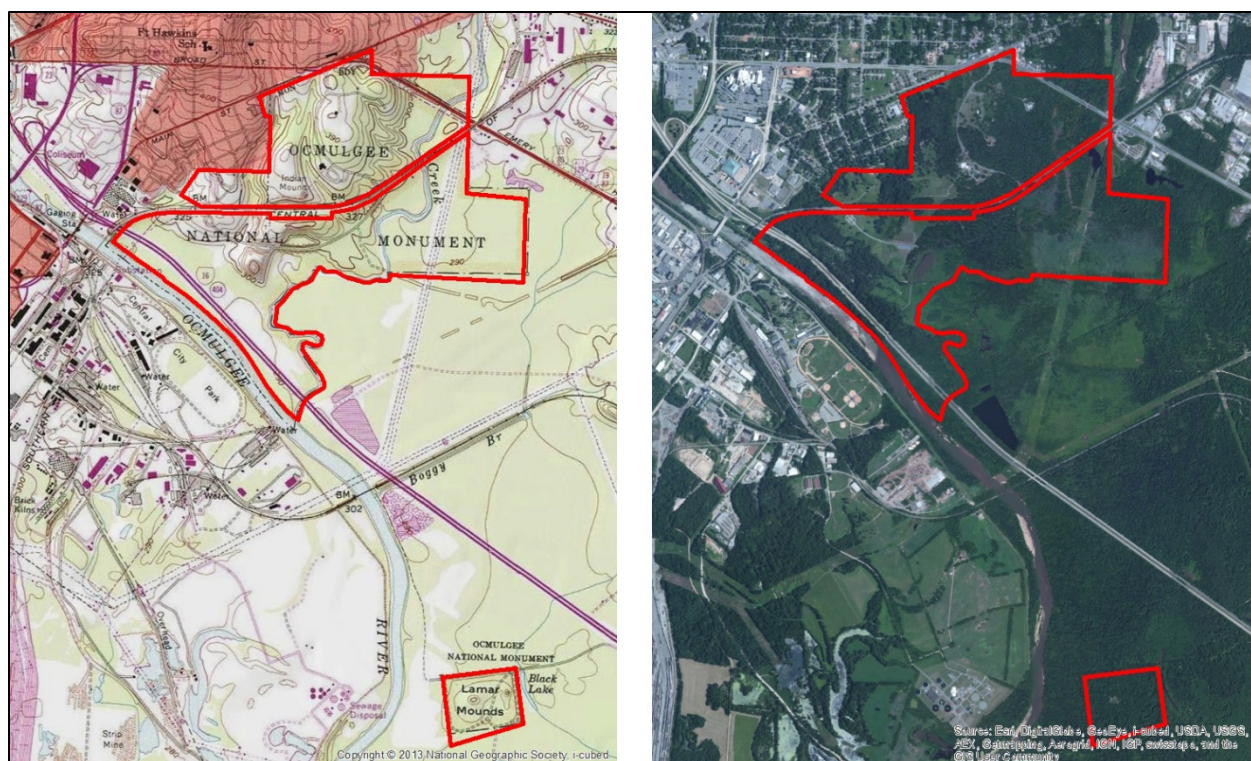


Figure 1. Location of Ocmulgee National Monument and its position relative to the State of Georgia, Bibb County, and the City of Macon.



Vegetation Classification System

The task agreement for mapping required that the National Vegetation Classification System (NVCS) be used for areas inside each park. The NVCS was developed by the Nature Conservancy (Grossman et al. 1998; Anderson et al. 1998). It is primarily based upon vegetation rather than climatic or edaphic factors. It emphasizes the existing natural vegetation and recognizes that vegetation communities form a continuum. The system has seven hierarchical levels so that vegetation can be described at multiple scales, depending upon the amount of information available. Higher levels can be broken down to lower levels as more information is available; conversely, lower levels can be aggregated to upper levels. The five upper levels (formation class, formation subclass, formation group, formation subgroup, and formation) describe vegetation physiognomy rather than actual species composition and are a modification of the UNESCO World Physiognomic Classification of Vegetation (UNESCO 1973). The two lowest levels (the alliance and association) are determined by floristic composition. The alliance level is determined by the species composition of the dominant or diagnostic species in the most prevalent stratum. A diagnostic species does not have to be dominant. For example, *Nyssa biflora* (swamp tupelo) is a characteristic species found in the Sweetgum–Tuliptree Brownwater Floodplain Forest but is not a dominant species. The association level is determined by diagnostic species in all strata (tree canopy, subcanopy, tall-shrub, short-shrub, herbaceous, non-vascular, vine/liana, and epiphyte), recognizing that each of these strata may not occur in every association. The tallest stratum may not be the diagnostic/dominant stratum. The association level is assigned a unique community element global code (CEGL). The CEGL code for the vegetation association is the target vegetation classification specified in the task agreement.

The dominant species in the tallest stratum are always visible in leaf-on aerial photographs. If the tallest stratum is dense, with a closed canopy, then the shorter subcanopy and understory layers are obstructed from the camera's view and are not visible. In vegetation communities where the tallest stratum is open, other strata will be visible in the aerial photograph. In some cases, a CEGL code can be determined solely by identifying its location (e.g., along a ridge or on the south slope) and viewing the uppermost stratum. In other cases, a lower stratum (or strata) not visible in the aerial photography must be used to determine CEGL code. In such cases, it is impossible to use only aerial photographs recorded during leaf-on conditions to accurately determine the NVCS code at the association level. If it was not possible to determine the association-level class due to similar overstory characteristics and lack of information on subcanopy vegetation, a second vegetation was assigned as a supplement to the dominant vegetation code.

Prior to CGR's photointerpretation, NatureServe conducted field surveys in accordance with standard practices (Jennings et al. 2009) to create a list of NVCS CEGL codes for OCMU (NatureServe 2009). Their detailed report includes a dichotomous key for separating the CEGL codes described for the Monument. Many of the couplets in the dichotomous key relied upon differences in the dominant vegetation in the tallest stratum or the presence/absence of diagnostic species. However, some couplets relied upon lower strata which may not be evident in the aerial photographs and/or edaphic

factors¹ (e.g. soil pH) which would not be evident in leaf-on CIR photographs. The NatureServe report also includes comprehensive descriptions of diagnostic species for each CEGl, and additional information on both the global and local expressions of the vegetation community type.

In general, the NVCS is best suited to natural or semi-natural vegetation communities that have been relatively undisturbed long enough for vegetation communities to develop in accordance with the environmental and climatic conditions of the site (Grossman et al. 1998; Anderson et al. 1998). Areas that are regularly or extensively disturbed by logging, fire, wind damage, exotic insects, exotic vegetation, and human activities are not easily classified with the NVCS. For this reason, CGR augmented the NVCS classes identified by NatureServe as occurring in OCMU to include additional disturbed, managed, successional, and modified classes, along with alphanumerical modifiers to provide detailed information to users of the vegetation databases and maps. Modifiers to the NVCS classes reflected variations of a particular NVCS class that are characteristic for the local site, but atypical of the global NVCS description.

The task agreement also required mapping a 500 meter buffer around each park. The buffer area contained extensive areas of human influence; consequently, the NVCS system was not applicable. Buffer areas were therefore mapped using guidelines derived from the Anderson Level II classification system, which includes human influences and water categories (Anderson et al. 1976). Modifiers were also greatly utilized within the buffer to increase the knowledge base about what LULC categories surround OCMU, though different modifiers were generally used in the buffer compared to in the Monument.

In summary, the Monument was mapped to the association (CEGL) level of the NVCS while the buffer area was more appropriately mapped using Anderson Level II guidelines. Modifiers to these classification systems were used, as appropriate, to ensure a meaningful classification system for this particular park. The complete vegetation classification system used for OCMU is provided in Table 3 and Table 4 of this report.

¹ Vegetation tends to reflect edaphic factors. Yet if the indicator vegetation is not visible in the aerial photograph, edaphic factors cannot be inferred.

Vegetation Mapping Workflow

The general workflow for this vegetation mapping project followed a series of steps, including:

1. Define CEGL codes within the study area based upon plot-level ground data (completed by NatureServe)
2. Contact park staff to discuss their needs and concerns as applicable to the final vegetation map, obtain any existing background information on management activities to include in a GIS database (see below), and arrange access
3. Collect base data and construct a GIS foundation geodatabase
 - a. Collect and inventory the aerial photographs
 - b. If needed, scan and orthorectify the aerial photographs
 - c. Obtain available GIS layers on exotic plant removal or prescribed burns that may affect vegetation communities
4. Create an initial photointerpretation key
 - a. Overlay NatureServe Vegetation Survey points on photos
 - b. Examine photos to understand signatures of vegetation communities as identified by ELCodes or CEGL number
5. Perform initial delineation of vegetation communities on CIR aerial photographs, supplemented by other leaf-off imagery (see Table 1) using photointerpretation from both stereo-pairs and 2D imagery by heads-up GIS methods
 - a. Identify spectral signatures dissimilar to the example spectral signatures around the NatureServe ground plots so that vegetation can be evaluated in field visits
6. Field visits
 - a. Schedule field trips to the site to visit specific areas where questions exist
 - b. Verify vegetation communities present
 - c. Reconcile photo signature with NatureServe CEGL code
 - d. Refine classification as necessary with reference to field work and ongoing communication with park staff regarding results
7. Refine and extend photointerpretation key and delineation of polygons
 - a. As needed, print photos and vegetation polygons for review and refinement

8. Prepare final deliverable products
 - a. Prepare final GIS files
 - b. Clean up line work and attribute tables
 - c. Compute statistics for vegetation polygons
 - d. Prepare metadata for vegetation polygon files
 - e. Finalize photointerpretation keys

Note that steps 4–7 reflect an iterative, rather than a linear, process. Steps 1, 2, and 3 are self-explanatory; the detailed workflow for the other steps, as pertains to the mapping of Ocmulgee National Monument, is described below.

Base Data and GIS Geodatabase Construction

Relevant publically available GIS datasets that cover the study area were downloaded and archived on a local server in CGR. Datasets include roads, hydrology, boundary files (political and NPS), digital elevation models (DEMs), and additional aerial photographs. These data are available from sources such as the NPS Datastore, the Georgia GIS Data Clearinghouse, the U.S. Geological Survey National Map, and the National Oceanic and Atmospheric Administration Digital Coast websites. Trail network and exotic plant removal² datasets were also obtained. These layers are not publicly available and were obtained through NPS contacts. The datasets used to populate the foundation GIS database were from different sources, compiled for different reasons, and may not be in the same map projection. The task agreement specified that the spatial data be projected to the Universal Transverse Mercator (UTM) Coordinate System, North American Datum of 1983 (NAD83). Where necessary, datasets were projected to UTM Zone 17. Finally, a geodatabase in ArcGIS 10.2 format was created as a container to store and organize the data. Details of this database are presented in Figure 3 and Table 1.

Color infrared (CIR) aerial photographs of the park at 1:12,000 scale were acquired by Aero-Metric, Inc. on May 11, 2011. These photos were scanned and converted to digital orthophotographs at 0.3 meter (1 ft) resolution before they were delivered to the NPS. Digital orthophotographs and hardcopy photographs in both film transparency and paper print formats were provided to CGR. A total of 12 photos in two flight lines were required to cover OCMU (Figure 4; Appendix A).

The mapping area was split in two sections: park and buffer. The park was defined as the area within the prescribed Monument boundaries while the buffer pertained to the region within 500 meters outside of the Monument boundary. Detailed vegetation mapping using CEGL codes was performed

² OCMU has an extensive exotic plant management program, some of which is performed in-house while some is performed by an SECN exotic pest plant management team. We spoke with Dr. Lauren Serra of the Southeast Coast Exotic Plant Management Team on May 20, 2014 regarding any available GIS/GPS data. While such information has been collected, it was not readily available.

within the park whereas more general mapping using a revised Anderson-type II hierarchical classification scheme was used in the buffer area.

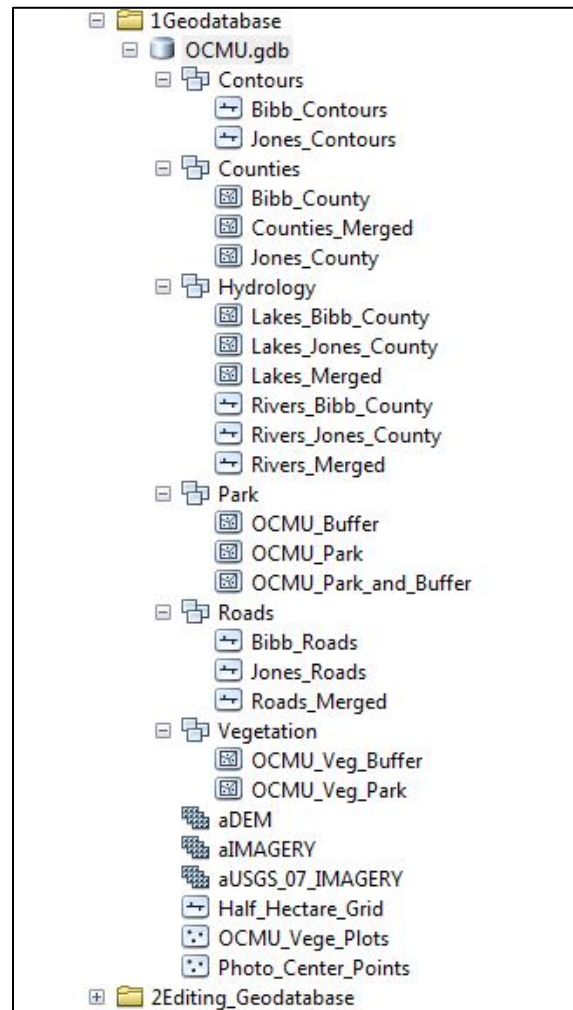


Figure 3. Foundation Geodatabase created for Ocmulgee National Monument.

Table 1. Datasets, descriptions, source, date, and scale imported into the Geodatabase.

Dataset	Description	Source	Date	Scale/Resolution
Contours	Statewide contours	Georgia GIS Clearinghouse	1996	1:100,000
Counties	County outlines for Bibb and Jones Counties	Georgia GIS Clearinghouse	2008	1:100,000
Park	Park and Buffer outlines	NPS Datastore and buffer analysis	2013	Unknown
Roads	Tiger Line Roads	Georgia GIS Clearinghouse	2006	1:12,000
Hydrology	Lakes and Rivers			
DEM	USGS Digital Elevation Model	USGS National Map Viewer	2010	1/9 arc second
USGS 07 Imagery	Natural color orthoimagery in three bands	U.S. Geological Survey	2011	0.5meters

Initial Photointerpretation Key and Vegetation Delineation

Classifying the different vegetation communities within the park was aided by the use of a photointerpretation key. The initial photointerpretation key was based upon the NCVS vegetation classes at the association level. These associates were determined by NatureServe through independent plot level vegetation surveys in accordance with standard NCVS field methods (Jennings et al. 2009). Plot sizes in OCMU ranged in size between 100 and 1,000 square meters. Plot level species presence/abundance was used to assign a four-digit Cegl number. The results of the survey are reported as a list of point locations and Cegl codes, as well as descriptions and field notes (Figure 3; Appendix B). The vegetation associations for OCMU were determined by NatureServe from 16 plots. CGR visited 130 points to interpret the CIR signatures of these vegetation associations to delineate vegetation. The future accuracy assessment of CGR's draft vegetation map will include 158 accuracy assessment points.

The NatureServe vegetation plot points were overlaid on the CIR aerial photographs and the photo signature was examined. Most Cegl codes were represented at least once in the park, however some were not sampled at all (Table 8). Still others were represented by multiple point locations. As a result, multiple signatures exist for these codes. The NCVS recognizes that vegetation communities form a continuum both within and between Cegl codes; spectral signatures are also likely to reflect this natural variation.

The photointerpretation key was developed to assist in the extension of the signatures at the plot level to the remainder of the park. The key noted color, tree crown shapes and sizes, texture, context, and any other characteristics that could help to differentiate one community from the others on the spectral signature of the leaf-on CIR aerial photography. The orthophotographs were examined on-screen in heads-up mode using the ArcGIS software. Where needed, the hardcopy photographs were viewed in stereo/3D using a light table and a mirror stereoscope. This method is excellent for using relative heights of the trees and terrain to assist in determining the vegetation community and to delineate the boundaries of the individual features.

This key was later expanded to include more detailed descriptions of each class. The final key for OCMU was expanded from nine classes provided by NatureServe to a total of 13 categories based on visual cues found in the CIR imagery and data collected in the field (Appendix C). The four additional classes (4048, 4692, 4732, and 7412), were found using the NCVS hierarchy and species information collected in the field. Color (varying from green to pink to purple), tone (light to dark), and texture (fine to coarse) were used to describe the strength and intensity. Other categories were based on canopy structure such as pattern (open to dense canopy) and height (short to tall). The remaining categories were used to express how the different codes are interrelated. These include shape (elongated to broad), size (based on total area, average size, and standard deviations of the polygons in a given class), location (relative to specific areas in the park), association (communities typically found near the specific class), and comments (to express any hints or issues that may arise). Also included are images taken from the field in order to provide a ground-level perspective that can be compared to the sample image chips taken from the airborne CIR images. The NatureServe

summary of the vegetation association and its distribution both globally and within OCMU are included for each class following the visual cue description.

The CEGL codes are listed in ascending numerical order in the key. While the NVCS itself is hierarchical, the numbering system for the codes is not hierarchical. Thus, it is impossible to determine physiognomy, species composition, or edaphic factors (e.g. soil saturation or inundation, soil pH, slope) from the CEGL code alone.

Using ArcGIS software, standard GIS methods, and a minimum mapping unit (MMU) of 0.5 hectares (ha), preliminary lines were drawn to delineate areas of uniform signature. Where the vegetation communities were clearly identifiable, polygons were tagged with the appropriate CEGL code. Where confusion existed, the polygons were tagged with an 'unknown' code until field visits could determine the appropriate CEGL.

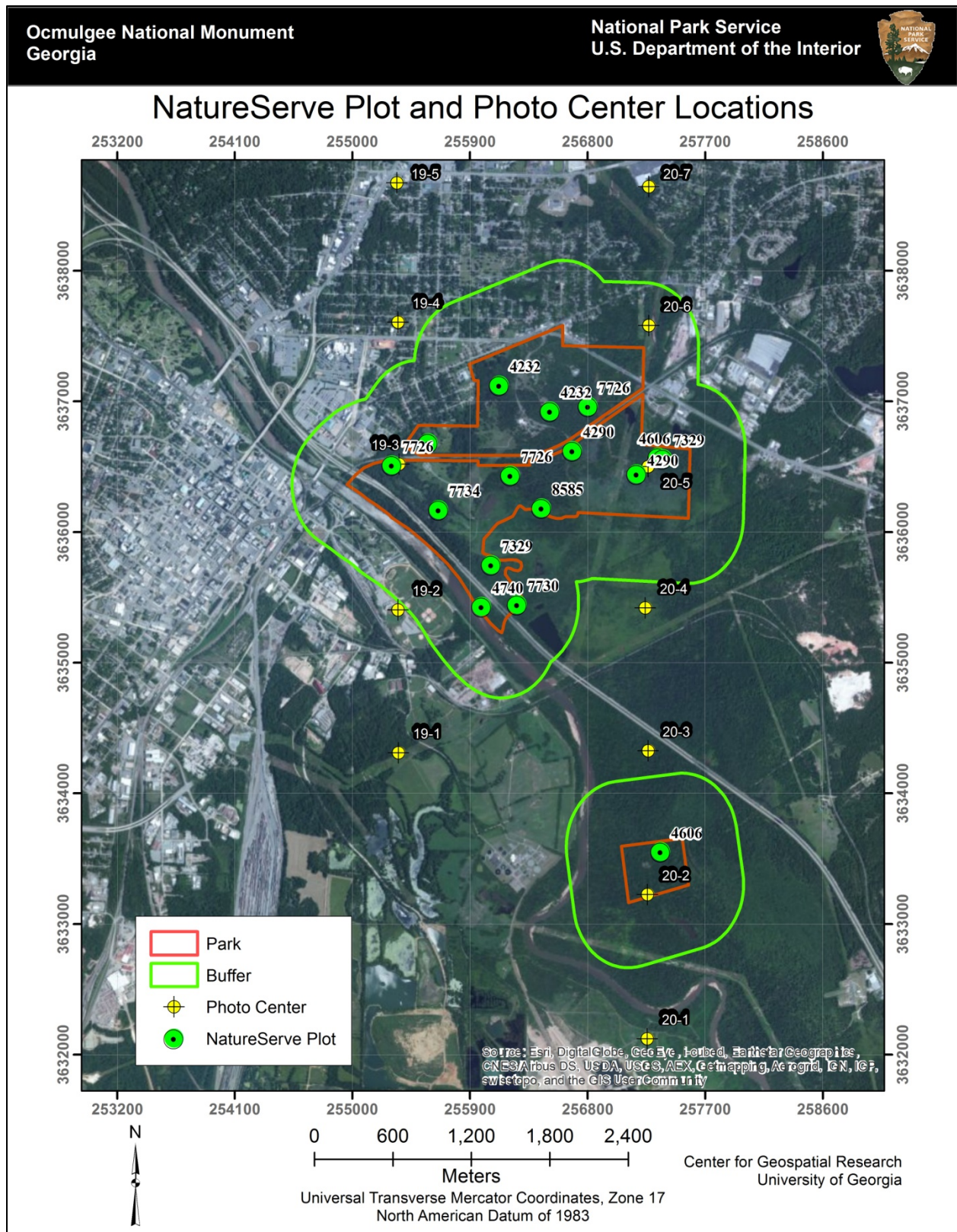


Figure 4. NatureServe vegetation plots and aerial photo center points for Ocmulgee National Monument.

Field Surveys and Ground Truth

In the course of developing the photointerpretation keys and delineating vegetation communities based upon their CIR signatures, a number of signatures were found that did not easily match the signatures from the NatureServe survey of 16 ground points. These areas required field visits to clarify vegetation communities+.

Field work and ground truthing for OCMU took place in May and June 2014. Field visits were aimed at giving specific attention to representative habitats, rare and important communities, areas that have been managed, disturbed, or invaded, and plots previously surveyed by NatureServe to collect data on canopy species composition, diagnostic species for NVCS, and terrain, similar to NatureServe's "Quick Plot" surveys.

Field crews carried paper field maps with the UTM grid coordinates, elevations, roads, rivers, initial vegetation polygons with CEGL codes, and points of interest superimposed on CIR photographs. They also used a Trimble Geo 6000 Xh Global Positioning System (GPS) handheld receiver loaded with similar GIS layers. On some trips, an Apple iPad 4 with a geoPDF (Wuthrich 2006, Pardue 2008) replaced paper field maps. The geoPDF gave the user both a higher level of detail of the original CIR compared paper maps, along with the ability to determine location in real-time using the device's internal GPS relative to the overlay of the line work.

The Trimble GPS was used to record the location of each site sampled. The coordinates were later post-processed by differential correction using Trimble's Pathfinder Office Software and base station data from sites in Macon. In some cases, base station data were only partially available, thereby necessitating use of multiple base stations in the Macon area for greater coverage. However, even when multiple base stations were used for a particular day, complete time coverage was not guaranteed. Some GPS locations could not be successfully differentially-corrected. Overall, post-processing produced a final accuracy of ± 1 to 5 meters. Accuracy was higher in open areas than in closed canopy forested areas.

At each sampling site, researchers recorded GPS position, species data, canopy cover, and topography (e.g. relative slope and aspect) inside an area between 250 and 1,000 square meters, based upon visual uniformity. Also noted were the presence of exotics, evidence of past or present human influence (e.g., agriculture, grazing, logging, mowing, exotic vegetation removal, old home sites), damage by insects, wild hogs, blow down, or fire. Prior to leaving a sampling location, researchers determined the primary association type, i.e. CEGL code (Anderson et al. 1998; Grossman, Goodin, and Reuss 1994; Grossman et al. 1998). Some sites were located in a mixed area indicative of an ecotone or an area of successional recovery. In such cases, secondary associations were determined in addition to dominant associations. Tertiary modifiers were often determined as well. In cases where researchers were unable to determine a clear match to a NVCS CEGL in the field, more detailed notes were taken in order to assign an appropriate CEGL or CGR-created class (e.g., a managed, damaged, human influence, or successional class) after further review of CIR signatures.

GPS points collected in the field were superimposed on CIR images in ArcMap. Field points were used in conjunction with the aerial photographs to refine vegetation delineation and assigned classification attributes (dominant CEG, secondary CEG, and modifiers, as appropriate). Additional field visits were conducted during the iterative interpretation process on an as-needed basis in order to refine interpretations, identify communities with unusual signatures, and resolve any questions. Maps were updated between field visits to reflect the ongoing process of photointerpretation of vegetation communities. Any areas visited that were already classified were checked for accuracy throughout the mapping process.

A total of five field visits/investigations and 130 discrete point locations were collected at OCMU (Table 2 and Figure 4). The number of sites visited in a single day ranged from 17 to 35 and was often influenced by terrain, weather, and point of interest density. Crossing some of the creeks and rivers traversing OCMU was a particular challenge. Usually, if more than two people were in the field, two independent field teams worked simultaneously to cover more area.

Table 2. Field visits and number of data points collected for Ocmulgee National Monument.

Date (2014)	Team Member(s)	Number of Data Points
May 13	N. K. O'Hare, D. L. Cotten, B. P. Adams	17
May 16	D. L. Cotten, B. P. Adams	35
May 26	N. K. O'Hare	23
June 5	N. K. O'Hare, D. L. Cotten, B. P. Adams	24
June 17	N. K. O'Hare, D. L. Cotten, B. P. Adams, M. Madden	31
Total		130



Field Data Collection Points

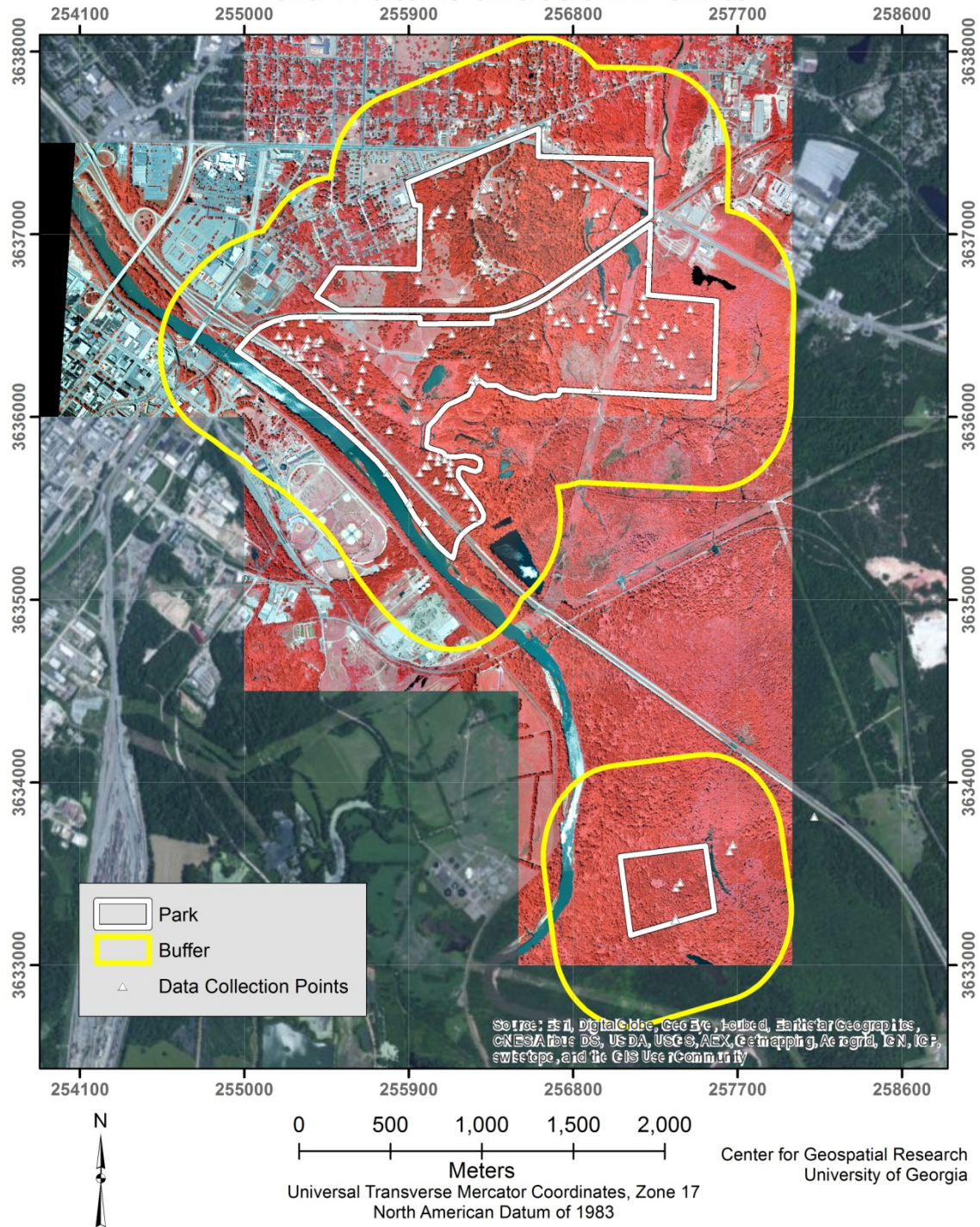


Figure 5. Field data collection locations from Ocmulgee National Monument overlaid on CIR imagery and visual imagery.

Photointerpretation and GIS Methods

The industry-standard GIS software, ArcGIS, offers a variety of methods and procedures to do most common mapping tasks. For the purposes of this project, photointerpretation was performed using heads-up digitizing methods in ArcGIS 10.2 using the CIR digital orthophotographs as the primary source material. Lines were drawn on-screen delineating the boundaries between different classes of vegetation. Where ecotones between features were broad, the line was drawn in the middle of the transition area. While the minimum mapping unit for this project was one half of a hectare, features smaller than this threshold that were distinct and could be easily mapped were delineated.

As vegetation areas were delineated with vector lines, points were digitized within each delineated area. These points were assigned attribute information such as the dominate vegetation (a CEGL value if located within the park or an Anderson-type code for the buffer), secondary vegetation, a modifier, the interpreter's initials, the date, the confidence of the classification, and other relevant information.

After the line work was completed and points attributed, the lines were converted to polygons and the attributes assigned to each polygon by joining the tables of the point features and polygons based on spatial location. In this operation, the attributes of the point closest to the polygon were assigned to that polygon. A 'distance' field was also assigned which indicates the distance of the point location from the polygon. If the distance was zero, the point was inside the polygon. Any other value greater than zero meant that the point used to populate the attribute fields was outside of the polygon. Consequently, the 'distance > 0' values were used as flags to select and examine polygons that were not properly attributed. Where necessary, additional points were added to the database to complete the map. The process was repeated until all polygons were properly attributed.

The initial draft maps were plotted at large scale on 'E-size' (34 x 4 in) paper such that the hollow polygons with their respective CEGL labels were overlaid on the original aerial photographs. Each polygon was individually inspected by a person not directly involved in the original mapping to make sure that the line work followed the vegetation feature properly, and that the CEGL codes were consistent with spectral signature. Edits were marked on the hardcopy maps and then applied to the database within ArcGIS. This review process was repeated to ensure completeness.

Additional editing and refinement was performed as necessary using information collected during the field surveys.

Draft Vegetation Mapping and Summary Statistics

A total of 13 distinct NVCS CEGLE association level vegetation communities were found in the park (Table 3). In the buffer zone, there were 14 distinct Anderson Level II codes (Table 4).

Table 3. Land cover classes found within the park area of Ocmulgee National Monument based on the National Vegetation Classification System.

Code	Description
4048	Cultivated Meadow
4232	Loblolly Pine (White Oak, Southern Red Oak, Post Oak) Southeastern Interior Forest
4290	Smartweed – Cutgrass Beaver Pond
4606	Loblolly Pine – Sweetgum – Swamp Tupelo Successional Swamp Forest
4692	Disturbed Herbaceous Vegetation
4732	Blackberry – Greenbriar Successional Shrubland Thicket
4740	Atlantic Coastal Plain Sugarberry – Green Ash Levee Forest
7329	Sweetgum – Tuliptree Brownwater Floodplain Forest
7412	Chinese Tallowtree Seasonally Flooded Forest
7726	Sweetgum – (Water Oak, Willow Oak) – Loblolly Pine / Elliott's Blueberry – Wax-myrtle Forest
7730	American Sycamore – Sugarberry – Green Ash / Northern Spicebush – Possumhaw / Reflexed Sedge Forest
7734	Atlantic Coastal Plain Black Willow – Green Ash Levee Forest
8585	Upper East Gulf Coastal Plain Cherrybark Oak – Sweetgum Terrace Forest
9998	Water
9999	Human Influence

Table 4. Land cover/land use classes found within the buffer of Ocmulgee National Monument.

Code	Description
11	Residential
12	Commercial and Services
13	Industrial
14	Transportation, Communications, and Utilities
17	Other Urban or Built-up Land
21	Cropland and Pasture
41	Deciduous Forest Land
42	Evergreen Forest Land
43	Mixed Forest Land
50	Major River
51	Streams and Canals
53	Reservoirs
61	Forested Wetland
62	Non-forested Wetlands

Table 5. Modifiers used throughout the park area and buffer of Ocmulgee National Monument.

Code	Description
BG3	Bare Ground — Greater than 75 percent
Exo	Exotics
FM1	Mixed Forest — Less than 25 percent
FM2	Mixed Forest — 25 to 75 percent
FM3	Mixed Forest — Greater than 75 percent
Gm3	Graminoids — Greater than 75 percent
GRC	Golf Course/Recreation Field
IS3	Impervious — Greater than 75 percent
PBB	Pine Bark Beetle
Sh3	Shrub — Greater than 75 percent
SS3	Shrub/Saplings — Greater than 75 percent
VG3	Vegetation — Greater than 75 percent
Wpl	Water — Greater than 75 percent
XLs	Exotics — Chinese Privet
XTs	Exotics — Chinese Tallow



Draft Vegetation Map - OCMU Main Area

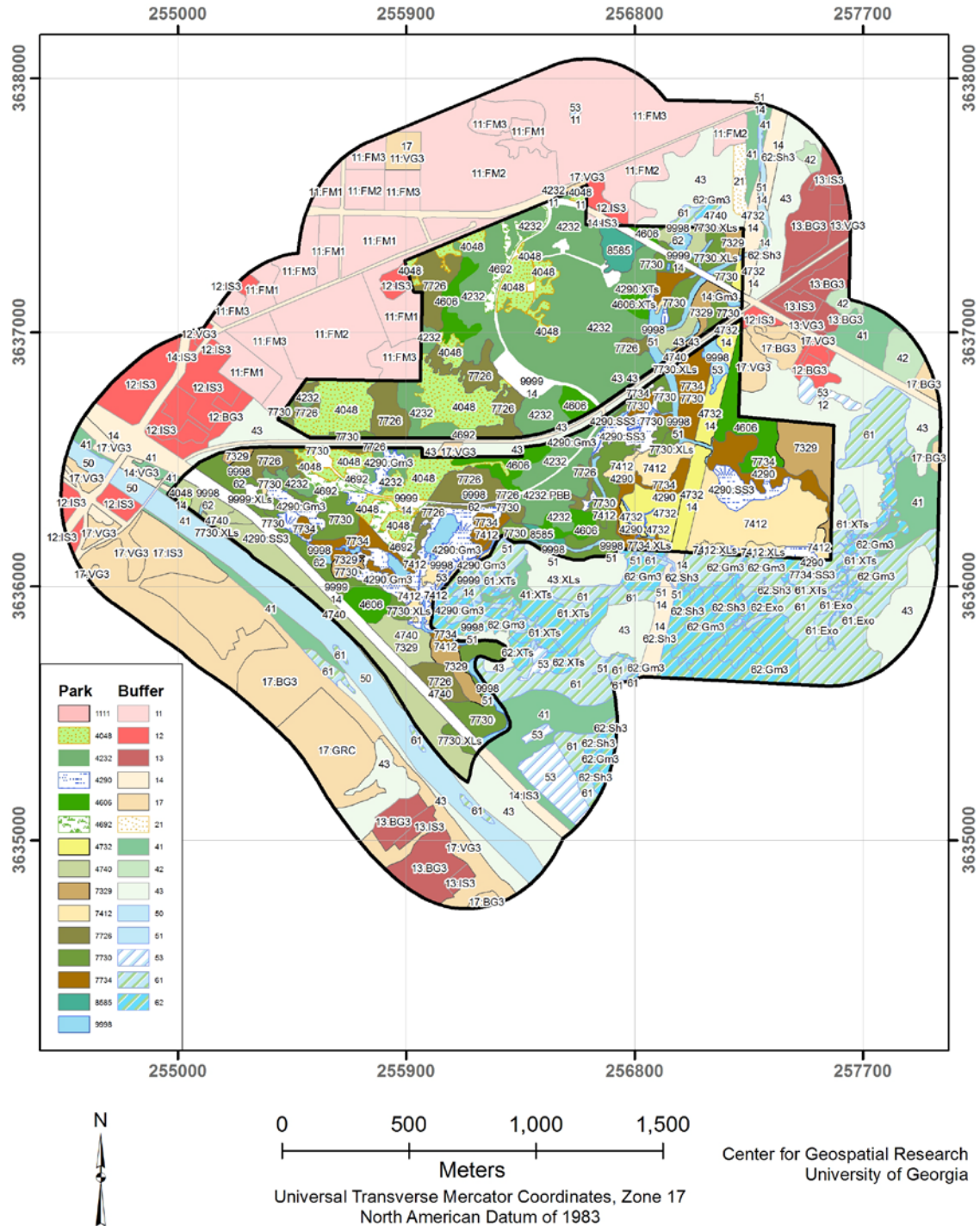


Figure 6. Draft vegetation map of the main section of Ocmulgee National Monument.



Draft Vegetation Map - OCMU Lamar Site

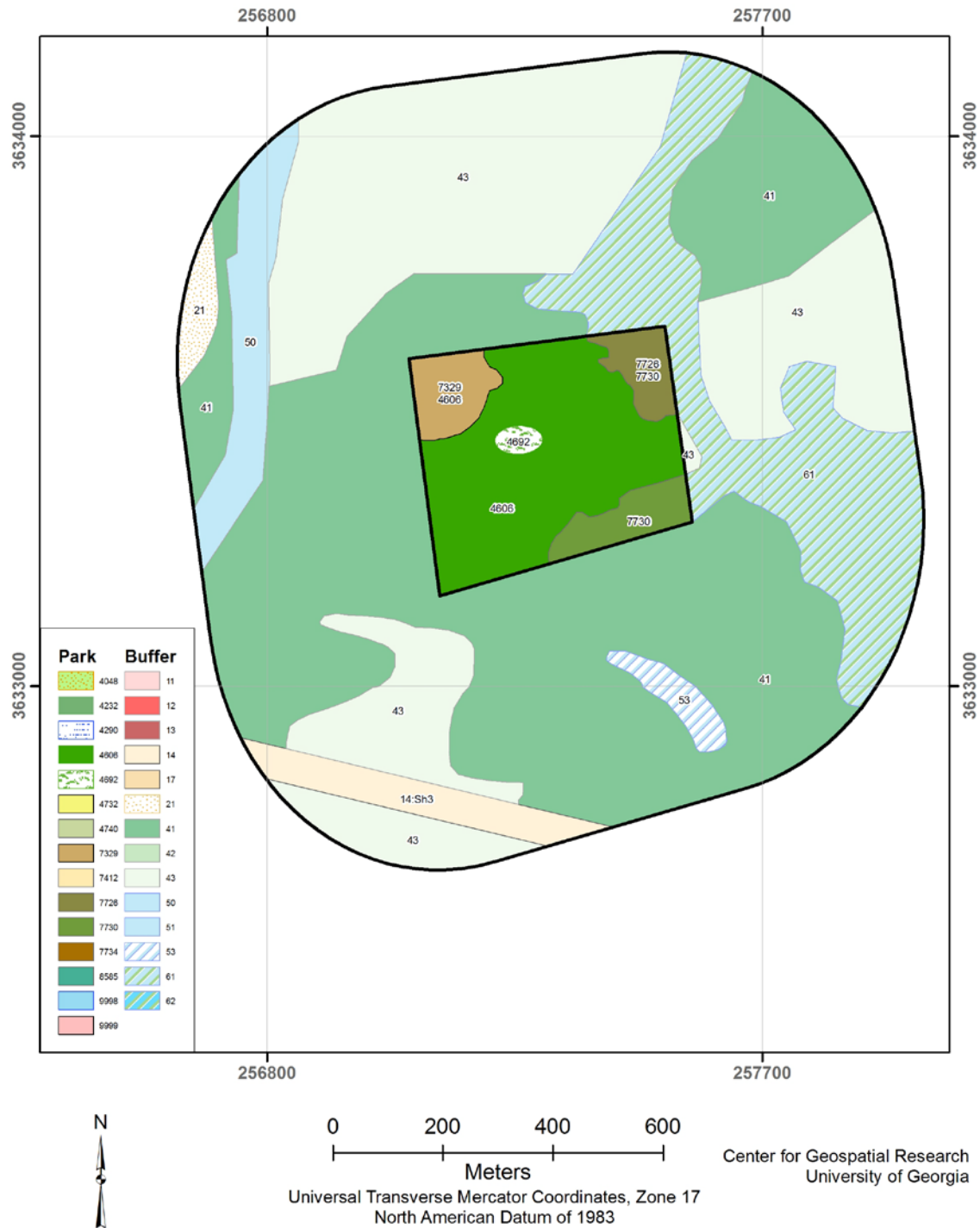


Figure 7. Draft vegetation map of the Lamar section of Ocmulgee National Monument.

The most common class found in OCMU was Loblolly Pine (White Oak, Southern Red Oak, Post Oak) Southeastern Interior Forest (4232), covering approximately 18% of the park. This was nearly twice as large as the second most common class, Loblolly Pine - Sweetgum - Swamp Tupelo Successional Swamp Forest (4606), at 10%. The smallest class was Upper East Gulf Coastal Plain Cherrybark Oak - Sweetgum Terrace Forest (8585) at less than 1%. The overall lack of a dominant class reflects the subtle topography and anthropogenic influences.

Within the buffer region of OCMU, Mixed Forests dominate the landscape, encompassing nearly 20% of the total buffer area. Residential and Deciduous Forest Land are the second and third most common classes with 16.7% and 15.2% of the area, respectively. Streams and Canals make up the smallest percentage of area at 0.3%.

Modifiers were utilized throughout the park and buffer regions to further enhance the classification system. The modifier system was based on insect infestation, the presence of exotic plants, or other classification system. This other class can include vegetation, mixed forest, or impervious surface coverage based on a scaling system. Where used, the scaling system is based on percent coverage of the specific modifier, with 1 for less than 25%, 2 for greater than 25% but less than 75%, and 3 for coverage greater than 75%.

Table 6. Community element global code (CEGL) classes, frequency of occurrence, mean area, total area, and percentage of total area within the park boundary of Ocmulgee National Monument.

CEGL	Frequency	Mean Area (ha)	Total Area (ha)	Percentage of Total Area
4048	17	0.7	24.3	8.5
4232	14	1.0	50.6	17.7
4290	24	1.0	16.6	5.8
4606	9	1.4	28.6	10.0
4692	6	1.8	5.9	2.0
4732	10	3.0	9.7	3.4
4740	6	3.2	17.8	6.2
7329	7	3.6	12.5	4.4
7412	14	1.2	17.0	5.9
7726	14	1.7	24.0	8.4
7730	24	1.2	28.0	9.8
7734	15	1.1	17.0	5.9
8585	2	1.2	2.5	0.9
9998	24	0.7	16.3	5.7
9999	7	2.2	15.2	5.3
Total	193		285.9	100.0

Percent Area of Classes within the Park

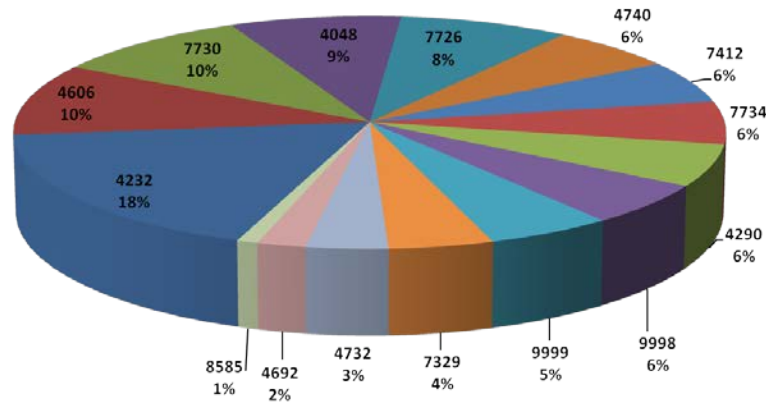


Figure 8. Park vegetation classes organized by relative size.

Table 7. Land use/land cover class, frequency of occurrence, mean area, total area, and percentage of total area within the buffer area of Ocmulgee National Monument.

Class	Frequency	Mean Area (ha)	Total Area (ha)	Percentage of Total Area
Residential	21	4.9	103.1	16.7
Commercial and Services	15	1.7	25.0	4.1
Industrial	11	2.1	23.4	3.8
Transportation, Communications, and Utilities	16	2.3	36.7	6.0
Other Urban or Built-up Land	18	3.6	64.0	10.4
Cropland and Pasture	2	1.4	2.7	0.4
Deciduous Forest Land	15	6.2	93.5	15.2
Evergreen Forest Land	3	1.4	4.2	0.7
Mixed Forest Land	23	5.2	120.1	19.5
Major River	3	7.3	22.0	3.6
Streams and Canals	10	0.2	1.7	0.3
Reservoirs	6	1.4	8.4	1.4
Forested Wetland	31	2.4	73.9	12.0
Nonforested Wetlands	25	1.5	37.4	6.1
Total	199		616.2	100.0

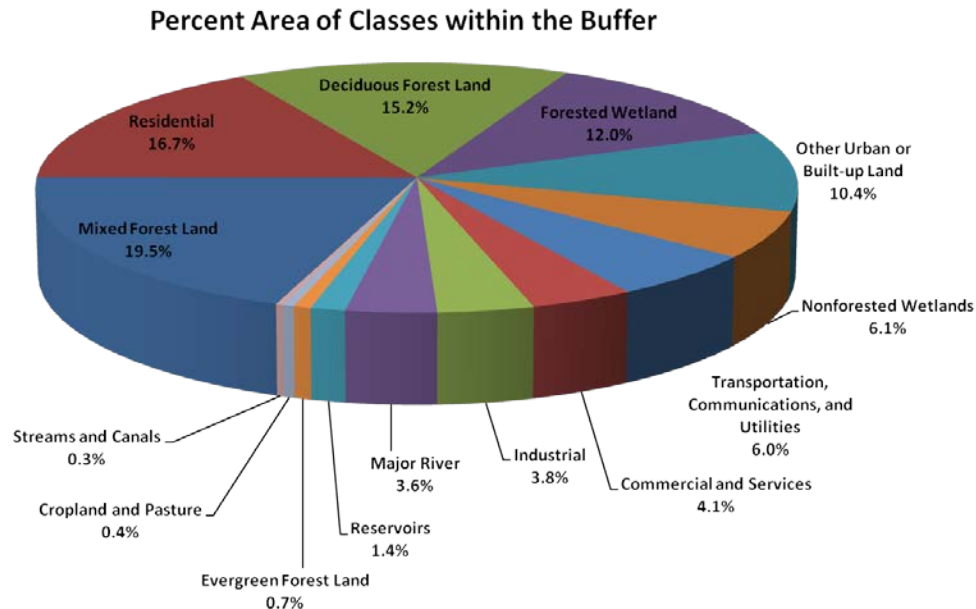


Figure 9. Buffer classes organized by relative size found in Ocmulgee National Monument.

Table 8. Modifiers used throughout the park and buffer areas, including frequency of occurrence, mean area, and total area.

Code	Description	Frequency	Mean Area (ha)	Total Area (ha)
BG3	Bare Ground — Greater than 75 percent	13	3.3	42.5
Exo	Exotics	4	0.5	2.1
FM1	Mixed Forest — Less than 25 percent	7	3.1	21.4
FM2	Mixed Forest — 25 to 75 percent	6	6.4	38.1
FM3	Mixed Forest — Greater than 75 percent	8	5.5	43.6
Gm3	Graminoids — Greater than 75 percent	30	1.2	36.1
GRC	Golf Course/Recreation Field	1	10.4	10.4
IS3	Impervious — Greater than 75 percent	20	3.1	63.0
PBB	Pine Bark Beetle	1	0.7	0.7
Sh3	Shrub — Greater than 75 percent	15	1.4	20.3
SS3	Shrub/Saplings — Greater than 75 percent	7	0.9	6.6
VG3	Vegetation — Greater than 75 percent	18	1.2	21.8
Wpl	Water — Greater than 75 percent	1	0.1	0.1
XLs	Exotics — Chinese Privet	14	0.9	13.2
XTs	Exotics — Chinese Tallow	16	0.9	14.4
Total		161		334.2

Accuracy Assessment Point Selection

As a part of the total mapping effort, a separate accuracy analysis (AA) of the thematic contents of the draft vegetation maps is required. Only classes with CEGL codes assigned and only polygons that fall within the prescribed park boundary are evaluated. To accomplish this, a set of points is selected to represent the distribution and rarity of the mapped vegetation classes. The number of AA sample points per class depends on the total area (in ha) of the particular vegetation class within the map area, according to the rule set established by the NPS for this purpose:

- Classes with < 8.33 ha 5 points per class
- Classes with ≥ 8.33 AND < 50 ha number of points is $0.6 \times$ the area in ha
- Classes with ≥ 50 ha 30 points per class

The task agreement requires determination of the number of accuracy assessment points. The actual distribution of the sample points will be determined under a separate task agreement, by another contractor. Protocol dictates that the points be randomly distributed and stratified by class. For example, if 30 points are required for a particular class, those 30 points should be randomly distributed within all of the polygons of that particular class. The distribution of classes, the number of polygons, and the areas of each class is given in Table 7.

Table 9. Community element global code (CEGL) classes, number of National Vegetation Classification System (NVCS) vegetation plots (NatureServe plots), total frequency of occurrence (number of polygons), mean area, total area, and number of accuracy assessment points for Ocmulgee National Monument.

CEGL	NatureServe Plots	Number of Polygons	Mean Area (ha)	Total Area (ha)	Accuracy Assessment Points
4048	0	17	0.7	24.3	15
4232	2	14	1.0	50.6	30
4290	2	24	1.0	16.6	10
4606	2	9	1.4	28.6	17
4692	0	6	1.8	5.9	5
4732	0	10	3.0	9.7	6
4740	1	6	3.2	17.8	11
7329	2	7	3.6	12.5	8
7412	0	14	1.2	17.0	10
7726	2	14	1.7	24.0	14
7730	1	24	1.2	28.0	17
7734	1	15	1.1	17.0	10
8585	1	2	1.2	2.5	5
9998	0	24	0.7	16.3	0
9999	0	7	2.2	15.2	0
Total	14	193		285.9	158

Conclusion

OCMU has a 17,000 year history of human use. Images from Froeschauer (1989) show that large areas adjacent to the railroad and mounds were completely deforested in the early 1900s; other areas were likely also deforested. Broad-scale vegetation maps from the 1970s (Froeschauer 1989) show a very different landscape pattern. The vegetation communities reflect this anthropogenic influence, since many of the forested areas are dominated by early successional species such as *Liquidambar styraciflua* (sweet gum) and *Acer negundo* (box elder).

This product is only one of four steps necessary to produce a final vegetation map based upon aerial photographs. Acquisition of aerial imagery and determination of the CEGL codes occur beforehand; accuracy assessment occurs afterwards. The entire process may take three to seven years to complete. While the NVCS classification system intends to capture stable vegetation categories, either man-made or natural disturbances may change some areas during the three to seven years required to produce a final vegetation map. For example, changes in non-tree dominated areas, which are typically wetlands in this region, may shift annually depending upon local weather, or cover by invasive exotics may change rapidly. More importantly, both of these natural and anthropogenic changes will likely continue in the future. Therefore, the vegetation map should be evaluated as a snapshot.

As a result of the extensive past land use history, applying the NVCS classification scheme to the association (CEGL) level was challenging. The present vegetation of OCMU likely reflects both direct and indirect influences of human habits and land use. The direct influences are related to land use during the past 100 to 200 years, including broad-scale land clearing, agriculture, and selective timbering. Indirect influences include: altered hydrology, which is particularly important in lowland areas such as OCMU; altered nutrient cycles; and colonization by exotic plant species. The indirect influences may shift the normal vegetative successional patterns (Davis et al. 2005; Thompson et al. 2013; Thompson et al. 2011). The wide-distribution of two invasive exotic pest plants are indicative of direct and indirect influence of land-use history on current vegetation. Chinese privet (*Ligustrum sinense*) is dominant in the understory of many forested areas, forming an impenetrable understory in some places. Chinese tallow (*Triadica sebifera*) is transforming open, graminoid wetlands typical of lowland areas to savannas. Because trees have higher evapotranspiration than graminoids, Chinese tallow invasion may alter the hydrology of invaded wetlands. As noted above, the NVCS classification system is not readily applicable to disturbed communities. There is no existing CEGL code for areas dominated by Chinese privet, although there is a CEGL code for Chinese tallow savannas. Overall, the extensive land use history of OCMU presented challenges in applying the NVCS classification system.

CGR will assist in the accuracy assessment, as needed, and will update the maps provided herein based upon the independent accuracy assessment as part of this task agreement.

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Appendix A. Flight Line Information

OCMU flight line and photo numbers and photo center coordinates (UTM Zone 17, NAD83). Photos were acquired by Aero-Metric at 1:12,000 scale on May 1, 2011.

Flight line	Photo	Easting	Northing
19	1	255355.8	3634312
19	2	255351.3	3635405
19	3	255359.6	3636521
19	4	255351.8	3637607
19	5	255342.8	3638673
20	1	257258.9	3632122
20	2	257260.7	3633226
20	3	257265.0	3634327
20	4	257243.2	3635420
20	5	257265.0	3636501
20	6	257270.5	3637582
20	7	257269.6	3638644

Appendix B. NatureServe Vegetation Plot Locations and Notes

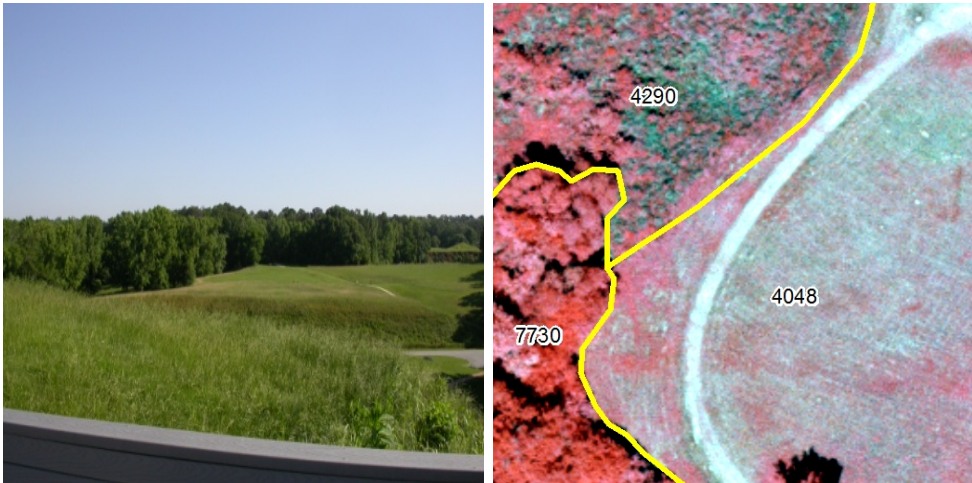
Field data acquired by L. Kruse and G. Burke in April and July, 2008.

Plot Code	Field X	Field Y	Provisional	Elcode	Environment	Leaf Type	Leaf Phenology	Physiological Class
OCMU001	32.8434	-83.6015	Loblolly – Sweetgum – Water Oak Forest	4232		Broad-leaved	Mixed evergreen/cold-deciduous	Forest
OCMU002	32.8438	-83.5984	Hardwood Mesic Drain Forest	7726		Broad-leaved	Cold-deciduous	Forest
OCMU003	32.8394	-83.6143	Water Willow Oak Lowland Terrace	7726		Broad-leaved	Cold-deciduous	Forest
OCMU004	32.8451	-83.6057	Loblolly Forest	4232		Needle-leaved	Evergreen	Forest
OCMU005	32.8410	-83.6114	Lawn/Meadow			Graminoid	Herb - perennial	Herbaceous
OCMU006	32.8367	-83.6020	Rich Sweetgum – Hornbeam-Slope Forest	8585		Broad-leaved	Cold-deciduous	Forest
OCMU007	32.8389	-83.6046	Lowland Deciduous Hardwood Forest	7726		Broad-leaved	Cold-deciduous	Forest
OCMU008	32.8298	-83.6067	Sugarberry, Water Oak Floodplain Terrace	4740		Broad-leaved	Cold-deciduous	Forest
OCMU009	32.8300	-83.6038	Lowland Deciduous Forest – Floodplain Terrace	7730	Trails/Roads, logging, beaver	Broad-leaved	Cold-deciduous	Forest
OCMU010	32.8327	-83.6060	Sweetgum – Poplar – Elm Floodplain Forest	7329	Erosion, exotic plants, area appears rooted as by hogs	Broad-leaved	Cold-deciduous	Forest
OCMU011	32.8132	-83.5916	Lowland Wet Pine – Hardwood	4606		Mixed	Cold-deciduous	Forest
OCMU012	32.8364	-83.6104	Bottomland Alluvial Terrace	7734	Hog rooting within plot	Broad-leaved	Cold-deciduous	Forest
OCMU013	32.8407	-83.5996	Floodplain Leersia Wetland	4290		Graminoid	Herb-perennial	Herbaceous
OCMU014	32.8392	-83.5943	Leersia Alluvial Wetland	4290		Graminoid	Herb-perennial	Herbaceous
OCMU015	32.8404	-83.5926	Mesic Pine – Sweetgum Forest	4606		Broad-leaved	Cold-deciduous	Forest
OCMU016	32.8403	-83.5922	Lowland Alluvial Hardwood Forest	7329		Broad-leaved	Cold-deciduous	Forest

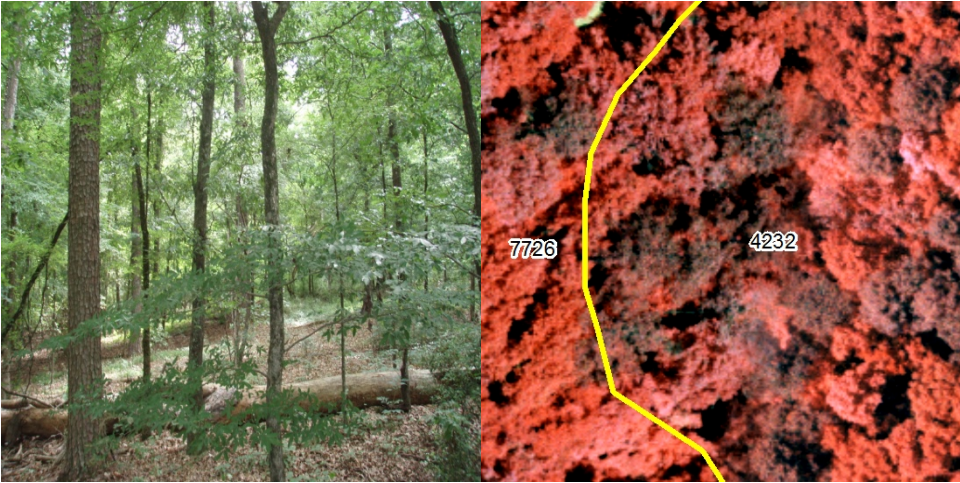
Appendix C. Photointerpretation Key

The photointerpretation key describes the attributes of the color infrared (CIR) images used to delineate the vegetation association CEGL codes found within the park. For each CEGL, a CIR image chip from within the park is included. For most CEGL codes, we also included a ground based digital photo of the vegetation, taken within the park. The standard visual cues to interpret and distinguish vegetation are described, including color, tone, texture, and pattern. When applicable, we also include comments on location within the park or topographic position. If there were other vegetation associations within the park that appeared similar on the CIR photographs, traits used to distinguish between similar vegetation associations are described.

The Vegetation Description for the CEGL within the park was copied directly from NatureServe (2009) to provide plot level information on species composition, dominance, characteristic species, and percent estimate of vegetation cover in understory, midstory, and/or canopy. It also includes the Global Description and geographic distribution. A separate literature cited section of the references from NatureServe (2009) text that was directly copied into the photointerpretation key is included at the end of this appendix.

Attribute	Description
CEGL Code	4048
Community Name	Cultivated Meadow Light
Pictures	
Color	Green/gray with pink
Tone	Light
Texture	Fine to medium
Pattern	Thin
Height	Very short
Shape	Some straight edges following roads and/or boundaries.
Size	Very common class; medium average size with large variations possible.
Location	Graminoid/Herbaceous (lacking any shrubs or trees) found near cultural sites and transportation.
Association	4692, 4290
Comments	Similar to 4692 but with less pink. Also similar to 4092 but contains mowing lines.

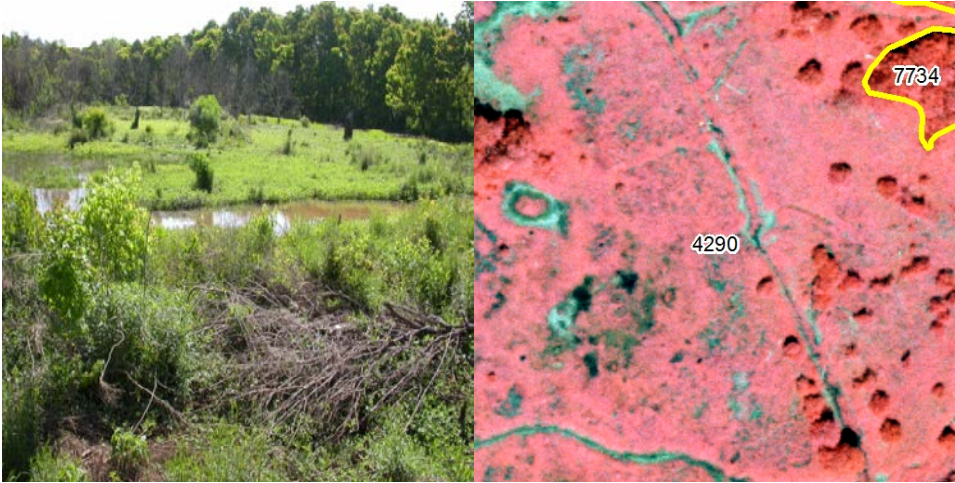
Summary: This association includes grassland pastures and hayfields, more-or-less cultural, though sometimes no longer actively maintained. It is currently defined for the Central and Southern Appalachians, Ozarks, Ouachita Mountains, and parts of the Piedmont and Interior Low Plateau, but it is possible throughout much of the eastern United States and southern Canada. The dominant species in this type are the European "tall or meadow fescues" of uncertain and controversial generic placement. Several other exotic grasses (*Agrostis gigantea*, *Dactylis glomerata*, *Holcus lanatus*, *Phleum pratense*, and *Poa pratensis*, for example) are common associates. These communities are sometimes nearly monospecific but can also be very diverse and contain many native as well as exotic species of grasses, sedges, and forbs. Exotic forbs include the legumes *Lespedeza cuneata*, *Trifolium campestre*, *Trifolium hybridum*, *Trifolium pratense*, and *Trifolium repens*, as well as *Achillea millefolium*, *Calystegia sepium*, *Daucus carota*, *Leucanthemum vulgare*, *Oxalis stricta*, and *Plantago lanceolata*. Common native herbs include *Apocynum cannabinum*, *Desmodium canescens*, *Dichanthelium clandestinum*, *Erigeron annuus*, *Fragaria virginiana*, *Potentilla simplex*, *Solanum carolinense*, *Solidago canadensis*, and *Verbesina occidentalis*.

Attribute	Description
CEGL Code	4232
Community Name	Loblolly Pine – (White Oak, Southern Red Oak, Post Oak) Southeastern Interior Forest
Pictures	
Color	Purple with red components
Tone	Medium to dark
Texture	Coarse
Pattern	Moderate to dense canopy
Height	Tall
Shape	Very expansive and broad.
Size	The most common class; the largest average size with very large variation possible.
Location	Pine dominated forest found on slopes or ridge tops that are never flooded.
Association	4606 and 7726
Comments	Easily distinguishable in OCMU because it is dominated by pines.

Ocmulgee National Monument Vegetation: The moderate (50-60% cover) tree canopy, 20-35 m tall, is dominated exclusively by *Pinus taeda* (loblolly pine), while the moderately sparse (20-40%) subcanopy (15-20 m) is made up of various combinations of *Quercus falcata* (southern red oak), *Quercus nigra* (water oak), *Quercus phellos* (willow oak), and *Ulmus alata* (winged elm). The sparse to moderate (20-60%) tall-shrub layer (5-10 m) and very sparse to moderately dense (5-70%) short-shrub layer (1-2 m) are dominated by *Liquidambar styraciflua* (sweetgum), *Magnolia grandiflora* (southern magnolia), *Quercus falcata* (southern red oak), *Quercus nigra* (water oak), and *Ulmus alata* (winged elm). Additional shrubs include *Asimina parviflora* (smallflower pawpaw), *Ilex vomitoria* (yaupon), *Prunus caroliniana* (Carolina laurelcherry), *Sassafras albidum* (sassafras), and others. Vines of *Vitis rotundifolia* (muscadine) are particularly prominent in the shrub and herb layers. The sparse (20-40%), generally species-poor herbaceous layer is made up of tree and shrub seedlings along with additional vines of *Lonicera japonica* (Japanese honeysuckle) (exotic), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax bona-nox* (saw greenbrier), and *Toxicodendron radicans* (eastern poison-ivy). Herbs found in small amounts include *Andropogon virginicus* (broomsedge bluestem), *Asplenium platyneuron* (ebony spleenwort), *Mitchella repens*

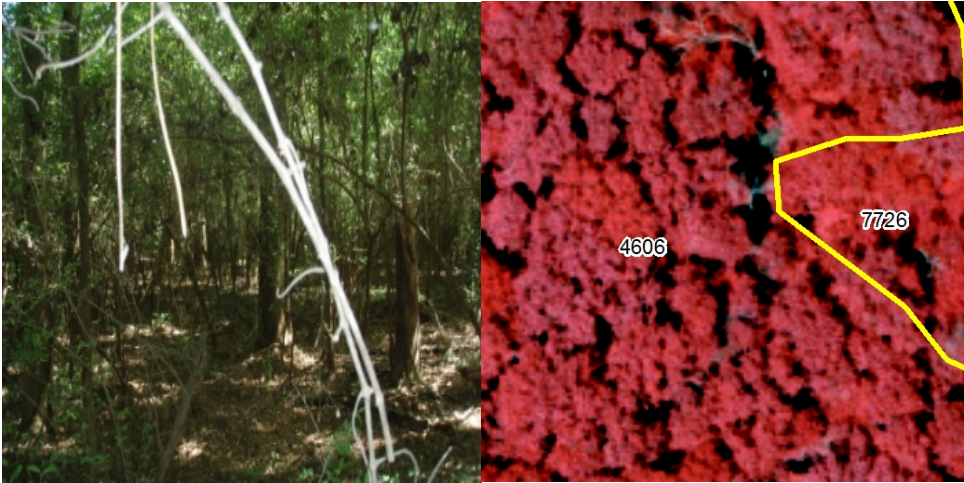
(partridgeberry), *Piptochaetium avenaceum* (blackseed speargrass), and *Rubus argutus* (sawtooth blackberry).

Global Vegetation: Stands of this mixed oak-pine upland forest association are dominated by a combination of various oaks and other hardwoods with *Pinus* (pine) spp. *Pinus taeda* (loblolly pine) or *Pinus virginiana* (Virginia pine) are usually present or codominant, being generally less abundant in more mature stands. *Quercus falcata* (southern red oak) is characteristic, but other oaks are also present, including *Quercus alba* (white oak), *Quercus stellata* (post oak), *Quercus velutina* (black oak), *Quercus coccinea* (scarlet oak), *Quercus marilandica* (blackjack oak), and *Quercus phellos* (willow oak), along with *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Pinus echinata* (shortleaf pine), and *Quercus nigra* (water oak). The subcanopy may include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Cornus florida* (flowering dogwood), *Oxydendrum arboreum* (sourwood), *Prunus serotina* (black cherry), and *Ulmus alata* (winged elm), as well as smaller oaks, particularly *Quercus velutina* (black oak). The shrub layers may include *Fagus grandifolia* (American beech), *Vaccinium arboreum* (farkleberry), and *Vaccinium pallidum* (Blue Ridge blueberry), with *Asimina parviflora* (smallflower pawpaw), *Cercis canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Diospyros virginiana* (common persimmon), *Euonymus americanus* (strawberry bush), *Sassafras albidum* (sassafras), *Toxicodendron radicans* (eastern poison-ivy), *Vaccinium pallidum* (Blue Ridge blueberry), and *Viburnum acerifolium* (mapleleaf viburnum). The herbaceous layer may include *Andropogon virginicus* (broomsedge bluestem), *Asplenium platyneuron* (ebony spleenwort), *Chimaphila maculata* (striped prince's pine), *Coreopsis major* (greater tickseed), *Dichanthelium* (rosette grass) spp., *Gaultheria procumbens* (eastern teaberry), *Mitchella repens* (partridgeberry), and *Polystichum acrostichoides* (Christmas fern). Typical vines include *Bignonia capreolata* (crossvine), *Decumaria barbara* (woodvamp), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax* (greenbrier) spp., *Toxicodendron radicans* (eastern poison-ivy), *Vitis aestivalis* (summer grape), and *Vitis rotundifolia* (muscadine). The presence of invasive exotics such as *Lonicera japonica* (Japanese honeysuckle) and *Ligustrum* (privet) *sinense* may be common.

Attribute	Description
CEGL Code	4290
Community Name	Smartweed – Cutgrass Beaver Pond
Pictures	
Color	Pink with green
Tone	Light
Texture	Very smooth
Pattern	Thin to scattered
Height	Very short
Shape	Irregular
Size	Uncommon class; very small average size with very little variation.
Location	Graminoid/Herbaceous (lacking many shrubs or trees); wet, low lying areas.
Association	7730,7712
Comments	Similar to 4048, 4692, and 4732, but does not contain mowing lines (4048 and 4092) and is smoother than 4732.

Ocmulgee National Monument Vegetation: This graminoid-dominated community is defined by the completely closed (100% cover) herbaceous layer, dominated exclusively by *Leersia oryzoides* (rice cutgrass). Additional important herbs include *Carex lupulina* (hop sedge), *Panicum hemitomom* (maidencane), *Polygonum setaceum* (bog smartweed), *Solidago altissima*, and the invasive exotics *Echinochloa crus-galli* (barnyardgrass), *Microstegium vimineum* (Nepalese browntop), *Murdannia keisak* (wartremoving herb), and *Paspalum urvillei* (Vasey's grass). There is also a very sparse (10-20%) emergent shrub layer (2-5 m tall) of *Salix nigra* (black willow) and *Sesbania punicea* (rattlebox). Other herbs include *Boehmeria cylindrica* (small-spike false nettle), *Cyperus pseudovegetus* (marsh flatsedge), *Eupatorium serotinum* (lateflowering thoroughwort), *Juncus effusus* (common rush), *Ludwigia decurrens* (wingleaf primrose-willow), *Mikania scandens* (climbing hempvine), *Polygonum sagittatum*, and many others. A total of nine exotic species were recorded from two plots, many of them found in significant numbers. Yearly flooding dynamics may shift the dominance of *Leersia oryzoides* (rice cutgrass) towards other species.

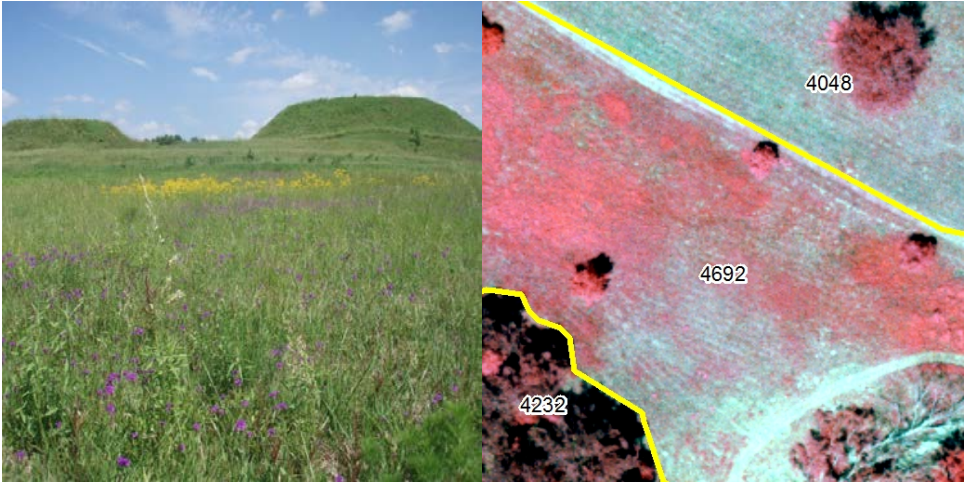
Global Vegetation: Stands of this vegetation are dominated by some combination of *Polygonum punctatum* (dotted smartweed), *Polygonum hydropiperoides* (swamp smartweed), *Leersia lenticularis* (catchfly grass), *Leersia oryzoides* (rice cutgrass), and/or *Leersia virginica* (whitegrass). Other herbaceous species which may be present include *Polygonum densiflorum* (denseflower knotweed), *Saururus cernuus* (lizard's-tail), *Proserpinaca* (mermaidweed) sp., *Sparganium americanum* (American bur-reed), *Typha latifolia* (broadleaf cattail), *Scirpus cyperinus* (woolgrass), *Lobelia cardinalis* (cardinalflower), *Onoclea sensibilis* (sensitive fern), *Penthorum sedoides* (ditch stonecrop), *Boehmeria cylindrica* (small-spike false nettle), *Sambucus canadensis* (common elderberry), *Bidens aristosa* (bearded beggarticks), and *Xanthium strumarium* (rough cocklebur). Scattered individuals of *Cephalanthus occidentalis* (common buttonbush) and *Acer saccharinum* (silver maple) or other woody plants may be present. Examples which have become dried-out (through drought and/or beaver dam failure) may exhibit greater dominance by *Leersia* (cutgrass) rather than *Polygonum* (knotweed). The combination of *Polygonum punctatum* - *Leersia virginica* was first noted, but the combination of *Polygonum hydropiperoides* (swamp smartweed) and *Leersia lenticularis* (catchfly grass) has also been observed in the Oconee National Forest. At Ocmulgee National Monument near Macon, Georgia, *Leersia oryzoides* (rice cutgrass) was the sole dominant at the time of sampling.

Attribute	Description
CEGL Code	4606
Community Name	Loblolly Pine – Sweetgum – Swamp Tupelo Successional Swamp Forest
Pictures	
Color	Red to purple
Tone	Medium to dark
Texture	Moderately coarse
Pattern	Moderate to dense
Height	Medium to tall
Shape	Very patchy
Size	One of the most common classes; very large patches with large variations possible.
Location	Mesic mixed forest found on or near lower slopes.
Association	4232, 7726
Comments	Usually found as a transition between 4232 and 7726, and located in more upland regions compared to 7726.

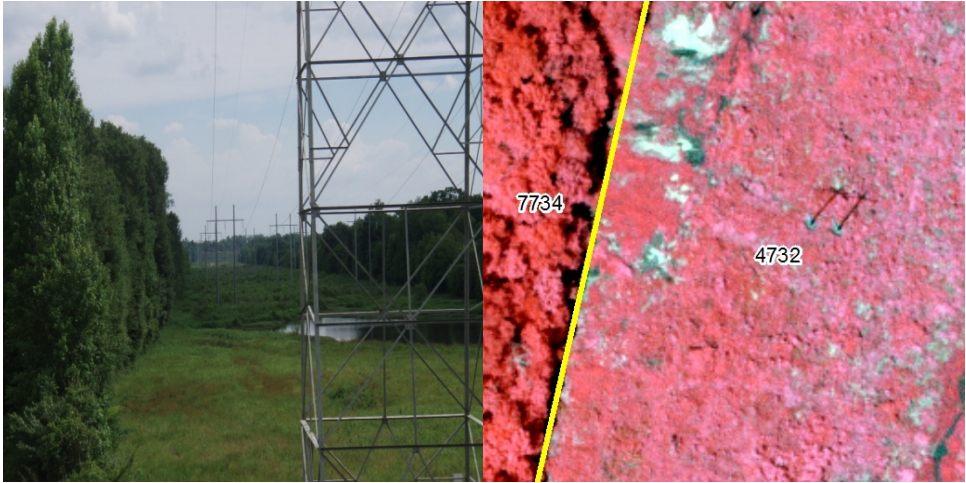
Ocmulgee National Monument Vegetation: The moderate (40-60% cover) tree canopy, 20-50 m tall, is codominated by *Liquidambar styraciflua* (sweetgum) and *Pinus taeda* (loblolly pine); *Fraxinus pennsylvanica* (green ash) and *Quercus nigra* (water oak) may also be present. The sparse (20%) subcanopy (10-20 m) includes canopy species and *Ulmus alata* (winged elm). The dense (70-90%) tall-shrub layer (5-10 m) is dominated by the invasive exotic *Ligustrum sinense* (Chinese privet); additional tall shrubs may include *Acer negundo* (box elder), *Arundinaria gigantea* (giant cane), *Carpinus caroliniana* (American hornbeam), and canopy tree saplings. Due to the dense tall-shrub layer, the short-shrub layer (1-2 m) and herbaceous layer are very sparse (5% and 10% cover, respectively). *Sabal minor* (dwarf palmetto) is a common short shrub, and herbs include *Arisaema triphyllum* (Jack in the pulpit), *Athyrium filix-femina* (common ladyfern), *Boehmeria cylindrica* (small-spike false nettle), *Carex* (sedge) spp., *Dioscorea quaternata* (fourleaf yam), *Mikania scandens* (climbing hempvine), *Onoclea sensibilis* (sensitive fern), and *Polygonum setaceum* (bog smartweed). Vines are abundant and may be found trailing along the ground or climbing into the upper layers. Common species include *Berchemia scandens* (Alabama supplejack), *Parthenocissus*

quinquefolia (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison-ivy), and *Vitis rotundifolia* (muscadine).

Global Vegetation: The canopy is dominated by some combination of *Pinus taeda* (loblolly pine), *Liquidambar styraciflua* (sweetgum), and *Nyssa biflora* (swamp tupelo). A mixture of other bottomland hardwood species may be present which includes *Diospyros virginiana* (common persimmon), *Quercus nigra* (water oak), *Acer rubrum* (red maple), *Quercus michauxii* (swamp chestnut oak), *Quercus laurifolia* (laurel oak), *Ulmus alata* (winged elm), *Carya cordiformis* (bitternut hickory), *Ulmus americana* (American elm), *Quercus pagoda* (cherrybark oak), *Celtis laevigata* (sugarberry), *Quercus phellos* (willow oak), *Fagus grandifolia* (American beech), *Carya alba* (mockernut hickory), and others. *Asimina triloba* (pawpaw) may be prominent in the understory with *Ilex decidua* (possumhaw), *Carpinus caroliniana* (American hornbeam), *Crataegus viridis* (green hawthorn), *Crataegus spathulata* (littlehip hawthorn), *Ilex opaca* (American holly), *Arundinaria gigantea* (giant cane), and other species. Vines such as *Vitis rotundifolia* (muscadine), *Vitis aestivalis* (summer grape), *Smilax* (greenbrier) spp., *Cocculus carolinus* (Carolina coralbead), and *Berchemia scandens* (Alabama supplejack) may be important, and the herbaceous layer likely includes *Boehmeria cylindrica* (small-spike false nettle), *Carex* (sedge) spp., and scattered ferns such as *Onoclea sensibilis* (sensitive fern). At Ocmulgee National Monument near Macon, Georgia, *Ligustrum sinense* (Chinese privet) can dominate the shrub layer.

Attribute	Description
CEGL Code	1692
Community Name	Disturbed Herbaceous Vegetation
Pictures	
Color	Pink with green/gray
Tone	Light
Texture	Smooth to medium
Pattern	Thin
Height	Very short
Shape	Patchy
Size	Rare class; small average size with very little variation.
Location	Graminoid/Herbaceous (lacking many shrubs or trees) found on or near cultural sites and transportation.
Association	4048, 4290
Comments	Similar to 4048 but contains more pink regions. Also similar to 4092 but generally not as smooth.

Summary: Some of the codominant plant species include *Panicum anceps* (beaked panicgrass), *Juncus effusus* (common rush), *Dichanthelium scoparium* (velvet panicum), *Solidago canadensis* (Canada goldenrod), *Symphyotrichum dumosum* (rice button aster), *Tripsacum dactyloides* (eastern gamagrass), and *Vernonia gigantea* (giant ironweed).

Attribute	Description
CEGL Code	4732
Community Name	Blackberry – Greenbriar Successional Shrubland Thicket
Pictures	
Color	Gray and pink
Tone	Medium
Texture	Medium to coarse
Pattern	Thin
Height	Short
Shape	Elongated, typically with straight edges.
Size	Uncommon class; very small average size with small variations.
Location	Shrub land found in wet areas near power lines.
Association	4290
Comments	Similar to 4048 and 4692 but does not have mowing lines and has a coarser texture. Also similar to 4092 but generally not as smooth.

Global Vegetation: Stands of this association are dominated by greenbrier species (*Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier)) and blackberries/dewberries (*Rubus argutus* (sawtooth blackberry), *Rubus trivialis* (southern dewberry)). They also contain a great variety of tree saplings and other woody species (e.g., *Quercus* (oak) spp., *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Rhus copallinum* (flameleaf sumac)). Some herbs in central Tennessee examples may include *Solidago* (goldenrod) spp., *Asteraceae* spp., *Helianthus* (sunflower) spp., *Hypericum* (St. Johnswort) spp., *Potentilla simplex* (common cinquefoil); grasses may include *Andropogon* (bluestem) spp., *Dichanthelium* (rosette grass) spp., *Panicum* (panicgrass) spp., *Schizachyrium scoparium* (little bluestem), *Lolium* (ryegrass) spp., and *Sorghastrum nutans* (Indiangrass). Communities that are surrounded by relatively intact ecosystems will tend to have more native species. Those surrounded by old fields or fragmented by development tend to have *Lonicera japonica* (Japanese honeysuckle) as a codominant vine overtopping much of the blackberry and greenbrier.

Attribute	Description
CEGL Code	4740
Community Name	Atlantic Coastal Plain Sugarberry – Green Ash Levee Forest
Pictures	
Color	Pink to red
Tone	Light to dark
Texture	Moderately coarse
Pattern	Medium to dense
Height	Medium to tall
Shape	Elongated with some patchy spots.
Size	Common class; large average area with very large variations possible.
Location	Mesic forest found near Ocmulgee River and other lowland areas.
Association	7730
Comments	Difficult to distinguish from 7726 in summer CIR. Understory exotics can cause confusion with 7730.

Ocmulgee National Monument Vegetation: The dense (80% cover) tree canopy, 20-35 m tall, is codominated by *Celtis laevigata* (sugarberry) and *Quercus nigra* (water oak), and the sparse (30%) subcanopy (15-20 m) is dominated by *Ulmus rubra* (slippery elm). The completely closed (100%) tall-shrub layer (2-5 m) is dominated by the exotic invasive *Ligustrum sinense* (Chinese privet). As a result of this dense shrub layer, the short-shrub and herbaceous layers are very sparse but include small amounts of *Cocculus carolinus* (Carolina coralbead), *Asplenium platyneuron* (ebony spleenwort), *Carex caroliniana* (Carolina sedge), *Myosotis macrosperma* (largeseed forget-me-not), and *Galium* (bedstraw) sp. Vines may be found trailing along the ground or climbing into the upper layers and include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Cocculus carolinus* (Carolina coralbead), and *Vitis rotundifolia* (muscadine).

Global Vegetation: This forest has been documented as occurring in two more-or-less distinct phases (Rice and Peet 1997). Both phases have closed canopies codominated by *Acer negundo* (box elder), *Celtis laevigata* (sugarberry), *Fraxinus pennsylvanica* (green ash), *Liquidambar styraciflua* (sweetgum), and *Ulmus americana* (American elm). Subcanopies range from dense to sparse and are

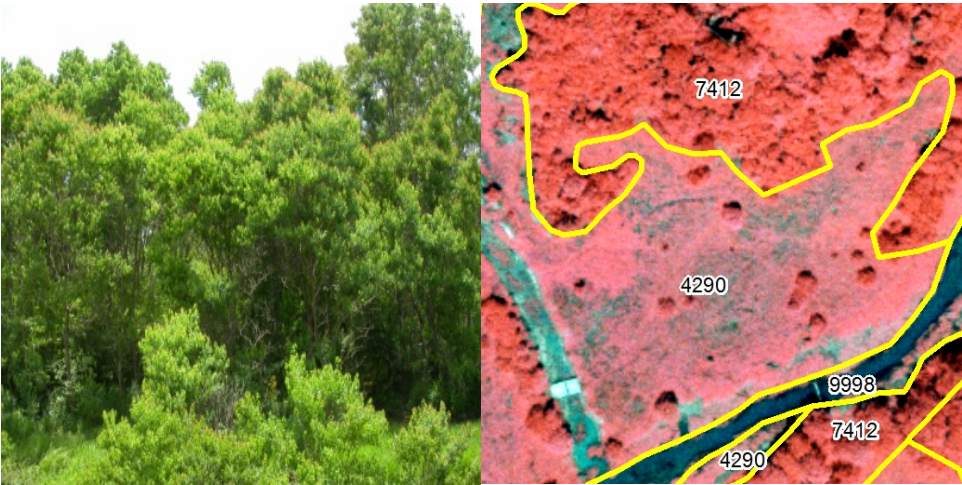
dominated by *Asimina triloba* (pawpaw). One of the phases (the *Asimina triloba* (pawpaw) phase) has a more well-developed understory stratum of *Asimina triloba* (pawpaw) than the other, although it is at least 'frequent' in the other, lower-density phase (Rice and Peet 1997). The other phase is called the *Carex grayi* - *Carex louisianica* Phase, and its understory is often a continuous, dense mixture of *Carex* (sedge) species. The relative abundance and diversity of understory herbs are inversely related to the abundance of *Asimina triloba* (pawpaw); however, *Arundinaria gigantea* (giant cane) often has a higher abundance under *Asimina* (pawpaw). Vines are also common, and important species include *Toxicodendron radicans* (eastern poison-ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax rotundifolia* (roundleaf greenbrier). In the Congaree Swamp National Monument, South Carolina, the mostly closed canopy of this community is dominated by *Celtis laevigata* (sugarberry), *Juglans nigra* (black walnut), *Acer negundo* (box elder), *Liquidambar styraciflua* (sweetgum), and *Ulmus americana* (American elm). These species are important in the well-developed subcanopy also. These occurrences differ from the Roanoke River occurrences by having a lesser amount of tree importance contributed by *Fraxinus pennsylvanica* (green ash) and by having substantial amounts of *Juglans nigra* (black walnut). A variety of other tree species are possible in these strata; these species include *Fraxinus pennsylvanica* (green ash), *Platanus occidentalis* (American sycamore), *Quercus laurifolia* (laurel oak), *Diospyros virginiana* (common persimmon), *Carya cordiformis* (bitternut hickory), *Quercus pagoda* (cherrybark oak), *Morus rubra* (red mulberry), and others. The shrub layer ranges from sparse to well-developed and is dominated by *Asimina triloba* (pawpaw) with *Lindera benzoin* (northern spicebush), *Ilex decidua* (possumhaw), and likely other species present as well. The moderately dense understory is dominated by *Elymus virginicus* (Virginia wildrye). Other typical species include *Carex grayi* (Gray's sedge), *Carex retroflexa* (reflexed sedge), *Chasmanthium latifolium* (Indian woodoats), *Elephantopus carolinianus* (Carolina elephantsfoot), *Leersia lenticularis* (catchfly grass), *Polygonum virginianum* (jumpseed), *Sanicula canadensis* (Canadian blacksnakeroot), *Carex bromoides* (bromelike sedge), *Glyceria striata* (fowl mannagrass), *Laportea canadensis* (Canadian woodnettle), and others. The vine stratum is moderate, and many species are possible. Among these are *Bignonia capreolata* (crossvine), *Berchemia scandens* (Alabama supplejack), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax bona-nox* (saw greenbrier), *Smilax tamnoides* (bristly greenbrier), *Vitis rotundifolia* (muscadine), *Matelea carolinensis* (maroon Carolina milkvine), *Cocculus carolinus* (Carolina coralbead), and *Vitis vulpina* (frost grape). The exotics *Ligustrum sinense* (Chinese privet), *Melia azedarach* (Chinaberrytree), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Nepalese browntop) are present in some occurrences of this community. At Ocmulgee National Monument near Macon, Georgia, this community is documented with nearly 100% cover of *Ligustrum sinense* (Chinese privet) in the shrub strata and thus a sparse, species poor herbaceous layer.

Attribute	Description
CEGL Code	7329
Community Name	Sweetgum – Tuliptree Brownwater Floodplain Forest
Pictures	
Color	Pink to red
Tone	Medium to dark
Texture	Moderately coarse
Pattern	Sparse to dense
Height	Medium to tall
Shape	Patchy and somewhat elongated
Size	Uncommon class; large sized patches with some variation.
Location	Mesic forest; Near water features in low lying areas.
Association	7730, 4740
Comments	Difficult to distinguish from 7726 in summer CIR but usually found in regions more susceptible to flooding.

Ocmulgee National Monument Vegetation: The sparse to dense (30-80% cover) tree canopy, 20-35 m tall, is dominated by *Liquidambar styraciflua* (sweetgum); one stand is codominated by *Populus deltoides* (eastern cottonwood). The sparse to moderate (30-50%) subcanopy (10-20 m) may include *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Platanus occidentalis* (American sycamore), *Ulmus alata* (winged elm), and/or *Ulmus rubra* (slippery elm). *Acer negundo* (box elder), *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Celtis laevigata* (sugarberry), and *Crataegus viridis* (green hawthorn) are dominants in the sparse to moderately dense (30-70%) tall-shrub layer (5-10 m), while *Sabal minor* (dwarf palmetto) may dominate the very sparse (10-20%) short-shrub layer (1-2 m). Additional shrubs include *Arundinaria gigantea* (giant cane), *Cornus foemina* (stiff dogwood), *Ilex ambigua* (Carolina holly), and the invasive exotic *Ligustrum sinense* (Chinese privet). The very sparse (10-20%) herbaceous layer may include *Arisaema dracontium* (green dragon), *Arisaema triphyllum* (Jack in the pulpit), *Boehmeria cylindrica* (small-spice false nettle), *Carex* (sedge) spp., *Dioscorea quaternata* (fourleaf yam), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern), *Polygonum virginianum* (jumpseed), and others. Vines may be found trailing along the ground or climbing into the upper layers. Common species

include *Ampelopsis arborea* (peppervine), *Berchemia scandens* (Alabama supplejack), *Mikania scandens* (climbing hempvine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison-ivy), and *Vitis rotundifolia* (muscadine).

Global Vegetation: In addition to *Liquidambar styraciflua* (sweetgum) and *Liriodendron tulipifera* (tuliptree), the canopy may contain *Nyssa biflora* (swamp tupelo) (which is a characteristic species of this type in the Coastal Plain (Jones et al. 1981b)) and *Acer rubrum* (red maple). An atypical example on the Ocmulgee River at the fall-line of Georgia (Ocmulgee National Monument) has a canopy codominated by *Populus deltoides* (eastern cottonwood). The subcanopy is well-developed and contains canopy species along with *Carpinus caroliniana* (American hornbeam), *Ilex opaca* var. *opaca* (American holly), *Persea palustris* (swamp bay), *Acer barbatum* (southern sugar maple), *Cornus florida* (flowering dogwood), *Diospyros virginiana* (common persimmon), *Frangula caroliniana* (Carolina buckthorn), *Quercus phellos* (willow oak), *Quercus nigra* (water oak), and *Viburnum nudum* var. *nudum* (possumhaw). Some examples may contain *Pinus taeda* (loblolly pine) or *Ulmus rubra* (slippery elm). Shrubs and vines may include *Arundinaria gigantea* (giant cane), *Berchemia scandens* (Alabama supplejack), *Crataegus viridis* (green hawthorn), *Decumaria barbara* (woodvamp), *Ilex ambigua* (Carolina holly), *Itea virginica* (Virginia sweetspire), *Leucothoe axillaris* (coastal doghobble), *Sabal minor* (dwarf palmetto), *Smilax laurifolia* (laurel greenbrier), *Toxicodendron radicans* (eastern poison-ivy), *Campsis radicans* (trumpet creeper), *Parthenocissus quinquefolia* (Virginia creeper), and *Vitis rotundifolia* (muscadine). Herbs may include *Boehmeria cylindrica* (small-spike false nettle), *Mitchella repens* (partridgeberry), *Carex* (sedge) spp., *Polystichum acrostichoides* (Christmas fern), *Onoclea sensibilis* (sensitive fern) and *Woodwardia areolata* (netted chainfern) (Jones et al. 1981b).

Attribute	Description
CEGL Code	7412
Community Name	Chinese Tallow Seasonally Flooded Forest
Pictures	
Color	Pink
Tone	Light
Texture	Very smooth
Pattern	Homogenous
Height	Short to medium
Shape	Various shapes
Size	Common class; medium sized patches with large variation.
Location	Mesic forest found near water, or seasonally flooded regions.
Association	7730,7734
Comments	Difficult to distinguish from 7734, but generally has more of a homogenous canopy.

Summary: This wetland forest type is broadly defined to cover a variety of sites strongly dominated by the exotic tree *Triadica sebifera* (= *Sapium sebiferum*) (Euphorbiaceae). Other wetland trees may be present including *Acer rubrum* var. *drummondii*, *Salix nigra*, and *Salix caroliniana*. Various wetland grasses, sedges, and forbs are present.

Attribute	Description
CEGL Code	7726
Community Name	Sweetgum – (Water Oak, Willow Oak) – Loblolly Pine / Elliott's Blueberry – Wax-myrtle Forest
Pictures	
Color	Red with some purple
Tone	Medium to dark
Texture	Medium to coarse
Pattern	Usually dense
Height	Medium to tall
Shape	Patchy, slightly elongated
Size	Very common class; large sized areas with little variation.
Location	Hardwood dominated forest found on slopes that are never flooded.
Association	Near pine dominated forests (4606, 4232)
Comments	Usually adjacent to pine dominated forests, but difficult to separate from 8585 in CIR because of the prevalence of oaks.

Ocmulgee National Monument Vegetation: At Ocmulgee National Monument, this forest tends to be rich with mixtures of high-quality site indicators, early-successional, and exotic species. The moderate to dense (60-80% cover) tree canopy, 20-35 m tall, is dominated by varying combinations of *Liquidambar styraciflua* (sweetgum), *Pinus taeda* (loblolly pine), *Quercus nigra* (water oak), and *Quercus phellos* (willow oak) and may also include *Fraxinus pennsylvanica* (green ash) and *Liriodendron tulipifera* (tuliptree). The sparse (10-30%) subcanopy (10-20 m) may include canopy species as well as *Carya cordiformis* (bitternut hickory), *Celtis laevigata* (sugarberry), and *Quercus pagoda* (cherrybark oak). Dominants in the moderate (40-50%) tall-shrub layer (2-10 m) may include *Arundinaria gigantea* (giant cane), *Carya cordiformis* (bitternut hickory), *Crataegus spathulata* (littlehip hawthorn), *Ostrya virginiana* (hophornbeam), and/or *Ulmus alata* (winged elm), frequently with *Aesculus pavia* (red buckeye). The sparse (10-20%) short-shrub layer (1-2 m) is generally made up of species from the upper layers. The sparse to moderately dense (20-70%) herbaceous layer is dominated by *Carex* (sedge) spp. (particularly *Carex abscondita* (thicket sedge), also *Carex oxylepis* (sharp-scale sedge) and *Carex blanda* (eastern woodland sedge)) and includes small amounts of many other taxa, including *Asplenium platyneuron* (ebony spleenwort), *Dichanthelium commutatum*

(variable panicgrass), *Euonymus americanus* (strawberry bush), *Galium aparine* (stickywilly), *Myosotis macrosperma* (largeseed forget-me-not), *Nothoscordum bivalve* (crowpoison), *Poa annua* (annual bluegrass), *Rubus trivialis* (southern dewberry), and *Verbesina occidentalis* (yellow crownbeard). Vines are abundant and may be found trailing along the ground or climbing into the upper layers. Common species include *Bignonia capreolata* (crossvine), *Campsis radicans* (trumpet creeper), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax* (greenbrier) spp., *Toxicodendron radicans* (eastern poison-ivy), and *Vitis rotundifolia* (muscadine). In addition, a total of 12 exotic species were recorded from three plots; *Lonicera japonica* (Japanese honeysuckle) is an herbaceous layer dominant.

Global Vegetation: The closed canopy is codominated by *Liquidambar styraciflua* (sweetgum) with *Quercus* (oak) spp., especially *Quercus nigra* (water oak) and *Quercus phellos* (willow oak), or possibly *Quercus pagoda* (cherrybark oak). *Nyssa sylvatica* (blackgum) is also typical in the canopy or subcanopy, along with *Liriodendron tulipifera* (tuliptree) in some cases. One phase has an emergent canopy of large *Pinus taeda* (loblolly pine). The moderately well-developed subcanopy is dominated by canopy species with *Ilex longipes* (Georgia holly), *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Prunus serotina* (black cherry), *Vaccinium arboreum* (farkleberry), *Carpinus caroliniana* (American hornbeam), and others. The shrub stratum is often sparse, and is primarily composed of canopy and subcanopy species. Occasionally a rather dense cover of *Morella cerifera* (wax-myrtle) may be present. Other species that may occur include *Euonymus americanus* (strawberry bush), *Rubus* (blackberry) sp., *Callicarpa americana* (American beautyberry), *Vaccinium elliotii* (Elliott's blueberry), *Gaylussacia frondosa* (blue huckleberry), and *Gaylussacia dumosa* (dwarf huckleberry). The vine/liana stratum is sparse to moderate and species present include *Bignonia capreolata* (crossvine), *Vitis rotundifolia* (muscadine), *Smilax bona-nox* (saw greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Wisteria frutescens* (American wisteria), *Gelsemium sempervirens* (evening trumpetflower), *Toxicodendron radicans* (eastern poison-ivy), *Ampelopsis arborea* (peppervine), and others. The herbaceous layer ranges from moderate to fairly dense. Typical species include *Chasmanthium sessiliflorum* (longleaf woodoats), *Scleria triglomerata* (whip nutrush), *Carex abscondita* (thicket sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Mitchella repens* (partridgeberry), *Juncus coriaceus* (leathery rush), *Chimaphila maculata* (striped prince's pine), *Asplenium platyneuron* (ebony spleenwort), *Malaxis unifolia* (green adder's-mouth orchid), and others. The exotic *Lonicera japonica* (Japanese honeysuckle) is common in occurrences of this community.

Attribute	Description
CEGL Code	7730
Community Name	American Sycamore – Sugarberry – Green Ash / Northern Spicebush –Possumhaw /Reflexed Sedge Forest
Pictures	
Color	Pink to red
Tone	Light to medium
Texture	Medium to coarse
Pattern	Moderate to dense
Height	Medium to tall
Shape	Elongated
Size	Very common class; small average size with some variation.
Location	Mesic forest found in wetland areas near water.
Association	7734,7412
Comments	Typically lightest tones on the map, but can get confused with nearly all other groups due to the wide range of species that can be found in this class.

Ocmulgee National Monument Vegetation: The moderate (50% cover) tree canopy, 20-35 m tall, is comprised of *Acer saccharinum* (silver maple), *Celtis laevigata* (sugarberry), *Fraxinus americana* (white ash), and *Platanus occidentalis* (American sycamore). The moderately sparse (30%) subcanopy (10-15 m) is dominated by *Acer negundo* (box elder), *Acer saccharinum* (silver maple), and *Ulmus rubra* (slippery elm). The completely closed (100%) tall-shrub layer (5-10 m) is dominated by the invasive exotic *Ligustrum sinense* (Chinese privet). As a result of this dense shrub layer, the short-shrub layer (1-2 m) and herbaceous layer are very sparse (5% and 20% cover, respectively). Herbs include *Chaerophyllum tainturieri* (hairyfruit chervil), *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium commutatum* (variable panicgrass), *Galium* (bedstraw) sp., and *Verbesina occidentalis* (yellow crownbeard). Vines are abundant and may be found trailing along the ground or climbing into the upper layers. Common species include *Brunnichia ovata* (American buckwheat vine), *Campsis radicans* (trumpet creeper), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison-ivy), and *Vitis rotundifolia* (muscadine).

Global Vegetation: The mostly closed canopy of this community is dominated by *Platanus occidentalis* (American sycamore), *Celtis laevigata* (sugarberry), and *Fraxinus pennsylvanica* (green ash). These species, along with *Acer negundo* (box elder), are also important in the well-developed subcanopy. Other tree species are possible in these strata and include *Crataegus viridis* (green hawthorn), *Juglans nigra* (black walnut), *Acer saccharinum* (silver maple), *Morus rubra* (red mulberry), *Ilex decidua* (possumhaw), *Ulmus americana* (American elm), *Planera aquatica* (planertree), *Quercus laurifolia* (laurel oak), *Liquidambar styraciflua* (sweetgum), *Carya aquatica* (water hickory), and others. The shrub layer generally is sparse and is dominated by *Lindera benzoin* (northern spicebush), *Ilex decidua* (possumhaw), *Asimina triloba* (pawpaw), and likely other species as well. *Acer barbatum* (southern sugar maple) may be an important shrub-layer component at the southern end of this community's range. Some examples of this community also have patches of *Arundinaria gigantea* (giant cane) in spots. The herbaceous layer is typically sparse; constant species are *Boehmeria cylindrica* (small-spike false nettle), *Carex grayi* (Gray's sedge), *Carex retroflexa* (reflexed sedge), and *Viola* (violet) spp. Other typical species include *Botrychium dissectum* (cutleaf grapefern), *Carex lupulina* (hop sedge), *Chasmanthium latifolium* (Indian woodoats), *Onoclea sensibilis* (sensitive fern), *Pilea pumila* (Canadian clearweed), *Polygonum hydropiperoides* (swamp smartweed), *Polygonum virginianum* (jumpseed), and others. The vine stratum is moderate and many species are possible. Among these are *Bignonia capreolata* (crossvine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax tamnoides* (bristly greenbrier), *Vitis rotundifolia* (muscadine), and *Toxicodendron radicans* (eastern poison-ivy). Exotic species such as *Ligustrum sinense* (Chinese privet), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Nepalese browntop) may invade stands of this association and increase following disturbance.

Attribute	Description
CEGL Code	7734
Community Name	Atlantic Coastal Plain Black Willow – Green Ash Levee Forest
Pictures	
Color	Pink to red
Tone	Light to medium
Texture	Medium to coarse
Pattern	Sparse to dense
Height	Short to tall
Shape	Elongated and patchy
Size	Common class; small sized patches.
Location	Mesic forest found near water and in low lying areas.
Association	7730, 7412, and 4290
Comments	Can be sparse like 4290, but it contains more trees. Similar to 7412 but less of a homogenous canopy. Found in similar hydrologic locations as 7730 but usually less dense.

Ocmulgee National Monument Vegetation: The moderately dense (70% cover) tree canopy, 20-35 m tall, is codominated by *Acer rubrum* (red maple) and *Salix nigra* (black willow), along with lesser amounts of *Platanus occidentalis* (American sycamore). The moderately sparse (40%) subcanopy (15-20 m) is made up of canopy species along with *Fraxinus pennsylvanica* (green ash). The sparse (30%) tall-shrub layer (5-10 m) and sparse (10%) short-shrub layer (1-2 m) are dominated by the invasive exotic *Ligustrum sinense* (Chinese privet) but also include significant amounts of *Cornus foemina* (stiff dogwood) and saplings of canopy species. The moderately sparse (40%) but rich herbaceous layer is dominated by *Glyceria striata* (fowl mannagrass); additional species found in lesser amounts include *Ageratina altissima* (white snakeroot), *Bidens discoidea* (small beggarticks), *Boehmeria cylindrica* (small-spike false nettle), *Brunnichia ovata* (American buckwheat vine), *Carex tribuloides* (blunt broom sedge), *Commelina virginica* (Virginia dayflower), *Juncus effusus* (common rush), *Leersia oryzoides* (rice cutgrass), *Ludwigia palustris* (marsh seedbox), *Onoclea sensibilis* (sensitive fern), *Panicum hemitomon* (maiden cane), *Pilea pumila*, *Polygonum setaceum* (bog smartweed), *Sagittaria latifolia* (broadleaf arrowhead), *Saururus cernuus*, *Triadenum walteri* (greater marsh St. Johnswort), and many others. Vines are abundant and may be found trailing along the

ground or climbing into the upper layers. Common species include *Ampelopsis arborea* (peppervine), *Berchemia scandens* (Alabama supplejack), *Brunnichia ovata* (American buckwheat vine), *Bignonia capreolata* (crossvine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison-ivy), *Vitis cinerea* var. *baileyana* (graybark grape), and *Vitis rotundifolia* (muscadine).

Global Vegetation: The mostly closed to closed canopy layer is strongly dominated by *Salix nigra* (black willow). Other typical species in the canopy include *Fraxinus pennsylvanica* (green ash), *Platanus occidentalis* (American sycamore), *Acer rubrum* (red maple), and likely others. The shrub layer is sparse, and species present include *Salix nigra* (black willow), *Taxodium distichum* (bald-cypress), *Planera aquatica* (planertree), *Celtis laevigata* (sugarberry), *Platanus occidentalis* (American sycamore), *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Acer negundo* (box elder), and likely others. The herbaceous stratum typically is sparse but can be species-rich. Species present in the herbaceous layer include *Boehmeria cylindrica* (small-spike false nettle), *Glyceria striata* (fowl mannagrass), *Saururus cernuus* (lizard's-tail), and others. The vine layer is absent to very sparse.

Attribute	Description
CEGL Code	8585
Community Name	Upper East Gulf Coastal Plain Cherrybark Oak – Sweetgum Terrace Forest
Pictures	
Color	Red with some purple
Tone	Medium to dark
Texture	Medium to coarse
Pattern	Usually dense
Height	Medium to tall
Shape	Patchy
Size	Rare class; medium sized patches.
Location	Hardwood dominated forest found in partially flooded regions.
Association	4232
Comments	Similar to 7726 but co dominated by Cherrybark Oak rather than Water Oak, therefore difficult to distinguish in summer CIR.

Ocmulgee National Monument Vegetation: The moderate (50% cover) tree canopy, 20-35 m tall, is codominated by *Liquidambar styraciflua* (sweetgum) and *Quercus pagoda* (cherrybark oak); additional species include *Carya ovata* (shagbark hickory) and *Quercus nigra* (water oak). The very sparse (10%) subcanopy (15-20 m) is made up of *Acer leucoderme* (chalk maple), *Carya ovata* (shagbark hickory), and *Ostrya virginiana* (hophornbeam). The moderately sparse (40%) tall-shrub layer (5-10 m) and short-shrub layer (1-2 m) contain sapling canopy species as well as *Aesculus pavia* (red buckeye), *Carpinus caroliniana* (American hornbeam), *Prunus caroliniana* (Carolina laurelcherry), *Ulmus alata* (winged elm), and *Vaccinium arboreum* (farkleberry). In addition, *Arundinaria gigantea* (giant cane) dominates the short-shrub layer. The moderately sparse (40%) herbaceous layer is dominated by the exotic vine *Lonicera japonica* (Japanese honeysuckle) but also includes *Asplenium platyneuron* (ebony spleenwort), *Carex blanda* (eastern woodland sedge), *Carex nigromarginata* (black edge sedge), *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium boscii* (Bosc's panicgrass), *Erythronium umbilicatum* (dimpled troutlily), *Melica mutica* (twoflower melicgrass), *Piptochaetium avenaceum* (blackseed speargrass), *Triodanis perfoliata* (clasping Venus' looking-glass), and others. Vines include *Gelsemium sempervirens* (evening trumpetflower),

Lonicera sempervirens (trumpet honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Vitis rotundifolia* (muscadine).

Global Vegetation: Stands are typically dominated by some combination of *Quercus pagoda* (cherrybark oak), *Quercus shumardii* (Shumard oak), and *Liquidambar styraciflua* (sweetgum). Other canopy trees include *Tilia americana* var. *caroliniana* (Carolina basswood), *Fraxinus americana* (white ash), *Quercus muehlenbergii* (chinkapin oak), *Acer barbatum* (southern sugar maple), *Quercus rubra* (northern red oak), *Ulmus rubra* (slippery elm), *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus phellos* (willow oak), *Liriodendron tulipifera* (tuliptree), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Carya carolinae-septentrionalis* (southern shagbark hickory), and *Juglans nigra* (black walnut). *Quercus shumardii* (Shumard oak) may be more important in the subcanopy than in the canopy. Other additional subcanopy and tall-shrub species include *Ulmus alata* (winged elm), *Ilex decidua* (possumhaw), *Halesia diptera* (two-wing silverbell), *Cercis canadensis* (eastern redbud), and *Ostrya virginiana* (hophornbeam). Important herbs are *Solidago auriculata* (eared goldenrod), *Verbesina virginica* (white crownbeard), *Spigelia marilandica* (woodland pinkroot), *Melica mutica* (twoflower melicgrass), *Trillium decipiens* (Chattahoochee River wakerobin), *Trepocarpus aethusae* (whitenymph), *Yeatesia viridiflora* (yellow bractspike), *Scutellaria ovata* (heartleaf skullcap), *Dichanthelium boscii* (Bosc's panicgrass), *Chasmanthium sessiliflorum* (longleaf woodoats), and *Sanicula canadensis* (Canadian blacksnakeroot). In a stand assigned here from Broken Arrow Creek (Russell County, Alabama, directly across the Chattahoochee River from Fort Benning, Georgia), the canopy is dominated by *Quercus muehlenbergii* (chinkapin oak) and *Quercus shumardii* (Shumard oak), and also contains *Quercus pagoda* (cherrybark oak), *Fagus grandifolia* (American beech), *Quercus rubra* (northern red oak), *Carya alba* (mockernut hickory), and *Fraxinus americana* (white ash). The subcanopy contains *Halesia tetraptera* (mountain silverbell), *Ulmus alata* (winged elm), *Acer leucoderme* (chalk maple), *Cercis canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), and *Ostrya virginiana* (hophornbeam). Shrubs include *Staphylea trifolia* (American bladdernut), *Acer leucoderme* (chalk maple), *Hydrangea quercifolia* (oakleaf hydrangea), *Ulmus alata* (winged elm), and *Aesculus pavia* (red buckeye). Herbs include *Polystichum acrostichoides* (Christmas fern), *Chasmanthium laxum* (slender woodoats), and *Solidago auriculata* (eared goldenrod). The diverse herbaceous layer may also include *Phlox divaricata* (wild blue phlox), *Amsonia tabernaemontana* (eastern bluestar), *Trillium decipiens* (Chattahoochee River wakerobin), *Cynoglossum virginianum* (wild comfrey), *Zephyranthes atamasca* (Atamasco lily), *Lithospermum tuberosum* (tuberous stoneseed), *Nothoscordum bivalve* (crowpoison), *Geranium maculatum* (spotted geranium), and *Hepatica nobilis* var. *obtusata* (roundlobe hepatica) (T. Govus pers. comm. 2001). A stand placed here from Ocmulgee National Monument exhibits a canopy codominated by *Liquidambar styraciflua* (sweetgum) and *Quercus pagoda* (cherrybark oak); additional species include *Carya ovata* (shagbark hickory) and *Quercus nigra* (water oak). The very sparse subcanopy is made up of *Acer leucoderme* (chalk maple), *Carya ovata* (shagbark hickory), and *Ostrya virginiana* (hophornbeam). The tall-shrub and short-shrub layers contain sapling canopy species as well as *Aesculus pavia* (red buckeye), *Carpinus caroliniana* (American hornbeam), *Prunus caroliniana* (Carolina laurelcherry), *Ulmus alata* (winged elm), and *Vaccinium arboreum* (farkleberry). In addition, *Arundinaria gigantea* (giant cane) dominates the short-shrub layer. The herbaceous layer includes *Asplenium platyneuron* (ebony

spleenwort), *Carex blanda* (eastern woodland sedge), *Carex nigromarginata* (black edge sedge), *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium boscii* (Bosc's panicgrass), *Erythronium umbilicatum* (dimpled troutlily), *Melica mutica* (twoflower melicgrass), *Piptochaetium avenaceum* (blackseed speargrass), *Triodanis perfoliata* (clasping Venus' looking-glass), and others. It is dominated by the exotic vine *Lonicera japonica* (Japanese honeysuckle). Other vines include *Gelsemium sempervirens* (evening trumpetflower), *Lonicera sempervirens* (trumpet honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Vitis rotundifolia* (muscadine). At Ocmulgee National Monument near Macon, Georgia, a disturbed representative of this association was documented with *Carya ovata* (shagbark hickory) and *Acer leucoderme* (chalk maple) dominant in the subcanopy, and *Aesculus pavia* (red buckeye), *Vaccinium arboreum* (farkleberry), and *Arundinaria gigantea* (giant cane) dominant in the shrub layer.

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