# POTENTIAL NATURAL VEGETATION
# OF THE
# MISSISSIPPI ALLUVIAL VALLEY:
# YAZOO BASIN, MISSISSIPPI

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# PREFACE

This report is one of a series describing the Potential Natural Vegetation of the Mississippi Alluvial Valley. Each report in the series is concerned with the vegetation of a specific sub-section of the valley—in this case, the Yazoo Basin in Mississippi. Each report is intended to be used to interpret and apply detailed digital maps available as GIS files, or to be used in conjunction with Field Atlases that can be downloaded and printed as hard-copy maps. The principal intended use of all of these products is to provide a template for ecosystem restoration on any scale and to meet a variety of potential objectives, including water quality improvement and replacement of critical habitat. They are designed specifically to be used in the modern, hydrologically altered environment of the Mississippi Alluvial Valley.

The Potential Natural Vegetation mapping project has had the support of various state and federal agency sponsors as well as private non-profit organizations. This report and the accompanying maps were developed with grants to the Oakleaf Foundation of Little Rock Arkansas and the Mississippi Chapter of the Nature Conservancy under the Freshwater Initiative in the Walton Family Foundation's Environment Program. Additional services and support were provided by the US Fish and Wildlife Service Joint Venture Office and the Engineer Research and Development Center, both of Vicksburg Mississippi, and by 5-Oaks Wildlife Services, L.L.C., of Stuttgart Arkansas.

# INTRODUCTION

Studies of wetland plant communities over the past decade in the Arkansas and Mississippi portions of the Mississippi Alluvial Valley (MAV) have produced a site classification approach based on hydrology and geomorphic setting (Klimas et al. 2005, Klimas et al. 2009). The approach is consistent with the "hydrogeomorphic" or HGM classification system proposed by Brinson (1993), but it has been adapted and refined specifically to support the development of detailed maps of the Potential Natural Vegetation (PNV) of the region. The purpose of PNV maps is to serve as a template for restoration planning and prioritization in a landscape that has been highly modified. Most of the bottomland hardwood forests and other native plant communities of the MAV were converted to agriculture during the 20th century, the remnants being largely those forest types adapted to the wettest sites where row cropping was infeasible. At the same time, tremendous local and federal effort has gone into drainage, flood control, and navigation projects that have permanently altered the hydrology of the floodplain and alluvial terraces in the region. Therefore, the PNV maps are not designed to represent the distribution of the original, pre-settlement vegetation, but rather they identify the natural communities that are appropriate to the altered site conditions─hence the "potential" designation. This means that persons interested in restoring particular tracts of land can identify the plant communities appropriate to the various site conditions present, or conversely, persons interested in restoring particular plant communities can identify parts of the landscape that could support those types. Because this information is available in GIS format, various other restoration scenarios can be explored, such as corridor reestablishment, and alternatives compared in terms of costs and ecological effectiveness.

This approach was developed and refined in Arkansas, where PNV mapping is underway or complete for all of the sub-basins within the Arkansas portion of the MAV. Mapping also has been completed for the Tensas Basin and Ouachita Basin portions of northern Louisiana (Foti et al. 2011, Pagan et al. 2011) and this report describes PNV mapping for the Yazoo Basin part of the MAV in Mississippi. It presents the methods used, descriptions of the site classification criteria and vegetation of the PNV community types, and metadata describing the content and structure of the accompanying shapefiles that comprise the PNV map. Readers are referred to the publications cited previously for details on the basic HGM classification approach and its application within the MAV. For additional information on HGM classification in the Yazoo Basin, as well as geomorphic features, their ages, origins, and characteristics, all of which are primary considerations in the PNV mapping process, see Autin et al. (1991), Saucier (1994), Smith and Klimas (2002) and Rittenour et al. (2007). All discussions of geomorphology in the following sections are based on those documents, particularly the comprehensive treatment published by Saucier. Much of the rest of the description of the study area is taken from Smith and Klimas (2002).

# STUDY AREA

## Location

The study area is the largest of six major lowland areas that comprise the MAV (Saucier 1994). It is located in northwestern Mississippi where it is bounded on the east by rolling uplands and on the west by the mainstem levee system along the Mississippi River. It is about 200 miles long, extending from Memphis to Vicksburg, about 60 miles at the widest, and has an area of about 7,600 square miles (Figure 1).

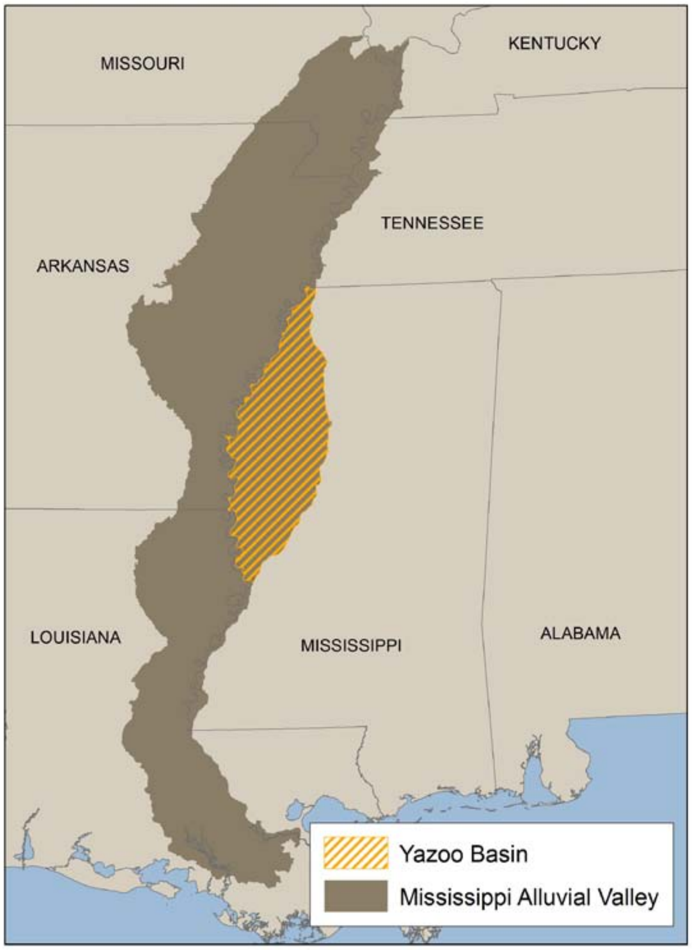

Figure 1. Location of the Yazoo Basin in northwestern Mississippi.

## Geomorphology

The Yazoo Basin consists entirely of sedimentary deposits of various ages, origins, and characteristics. It is divided into a number of smaller natural drainage basins by meander belt ridges formed by the abandoned paths of rivers. These meander belts generally flow in a north-south direction and are the principal topographic features of the basin. From east to west, the Yazoo River, the Sunflower River, and Deer Creek follow meander belts and the Tallahatchie River, Tippo Bayou, Bogue Phalia and Steel Bayou drain backswamp basins between the meander belts (Harrison 1961).

The oldest surfaces, in the western part of the study area along portions of Deer Creek, are of Late Pleistocene age, and consist of glacial outwash (known as "valley train" deposits) that coursed through the Mississippi Valley carried by meltwaters from continental glaciations. Most of this material was later eroded away to some depth by lateral migration of the Mississippi River during the Holocene, and replaced or buried by the resulting meander belt deposits that account for the majority of the landscape in the modern Yazoo Basin. Along the eastern valley wall there are extensive alluvial fans that overly both valley train and meander belt surfaces. Each of these settings has distinctive features that influence the natural vegetation they support.

### *a. Valley trains*

Glacial outwash was deposited in a braided-stream environment that left topography and substrates that are distinctly different from meandering-stream deposits. The former braided channels generally run down-valley in relatively narrow parallel or criss-crossing patterns, unlike the wide, curved channel segments left behind by a meandering stream. And unlike the clay-filled remnants of meandering channels, outwash channels tend to be filled with coarse, sandy materials. In the Yazoo Basin, all of the remnant valley train surfaces are blanketed by fine-grained deposits left during the waning glacial outwash flows, or by later loess deposition or flooding from the meandering Mississippi River. Saucier (1994) mapped valley train only where the surface deposits were thin enough that the distinctive braided channels are still apparent.

### *b. Meander belt features*

Following the melting of the last continental glacier, the Mississippi River switched from a braided stream to the single-channel meandering system that prevails today. Typically, as it moved laterally within a meander belt, it eroded the glacial outwash and replaced it with rolling ridge-and-swale point bar deposits. In many areas, these features are blanketed by a veneer of natural levee deposits formed during overbank flooding, such that the deposits nearest the current and former stream channels are high and well drained. As these natural levee and point bar "ridges" built up, they tended to impede the return of floodwaters to the channel and large slackwater basins called backswamps formed. Where sections of the meandering channel formed tight loops that were eventually cut off at the neck, the abandoned channel segments formed oxbow lakes that gradually filled with fine-grained sediments. Where entire long channel segments were abandoned and the stream began following a new course, the abandoned course tended to fill with coarse materials as stream flows waned. Over the past 10,000 years, these mechanisms have created a landscape that includes parts of at least six distinct meander belts, numerous abandoned channels and abandoned courses of the Mississippi River and various smaller streams, and several extensive backswamp areas.

### *c. Alluvial fans*

Alluvial fans form where streams exiting upland valleys onto the lowlands deposit eroded sediments in a partial cone shape. Like the stream channels of the Mississippi River, the stream that builds the fan changes course frequently as its own deposits cause it to divert to new paths, leaving behind numerous abandoned channel segments across the face of the fan. In the Yazoo Basin, the glacial outwash and meander belt deposits along the valley wall are relatively recent, therefore the fans that blanket them in places are smaller than those found elsewhere in the MAV. However, they are numerous, and tend to

> coalesce in places into continuous steep, narrow alluvial aprons that extend for miles. Because the hills that form the eastern flank of the basin are blanketed with loess, the fans also are composed largely of silty materials.

## Soils

The periodic influx of glacial outwash and subsequent development of multiple Mississippi River meander belts produced complex but characteristic landforms in the Yazoo Basin where sediments are sorted to varying degrees based on their mode and environment of deposition. The sorting process has produced textural and topographic gradients that are fairly consistent on a gross level and result in distinctive soils. Generally, within a meander belt, surface substrates grade from relatively coarse-textured, well-drained, higher elevation soils such as Commerce on natural levees directly adjacent to river channels through progressively finer-textured and less well-drained soils (e.g. Dundee) on levee backslopes and point bar deposits to very heavy clays (e.g. Alligator, Sharkey) in closed basins and backswamps. Soils of older meander belts are likely to show greater A soil horizon development than soils in equivalent positions within younger meander belts (Autin et al. 1991). Similarly, older soils are likely to be more acid and deeper, show less depositional stratification and more horizonation, and have other characteristics of more advanced soil development than soils of younger meander belts.

Soils cannot be used as a substitute for geomorphology in this PNV mapping process. Soil series as mapped in the study area are based on the physical and chemical parameters observed through the soil profile and follow accepted soil taxonomy conventions. In many cases these taxonomic differences may be of little importance in distinguishing plant communities at a useful level of distinctiveness, and in even more cases the specific relationships between a soil map unit and appropriate vegetation units may not be known. Geomorphic units are more general than soil series and more easily correlated with definable vegetation types; therefore they are often more useful for mapping PNV. The mapping criteria in this project are based primarily on geomorphology with specific soils of known significance to vegetation distribution used as secondary mapping criteria.

## Hydrology

Prior to construction of modern levees, major Mississippi River floods would have inundated most or all of the Yazoo Basin (Moore 1972). However, modern mainstem levees that prevent Mississippi River overbank flooding do not completely eliminate the influence of the river on hydrology of the Yazoo Basin. High stages on the Mississippi River cause impeded drainage of tributary streams, which results in backwater flooding. An analysis of the major flood of 1973 (USACE 1973) indicated that the event would have inundated the entire Yazoo Basin had flood protection works not been in place; however, even though no Federal levees failed in the Lower Mississippi Valley, approximately 40 percent of the Yazoo Basin was flooded anyway, mostly due to backwater effects.

Except during major floods, surface water entering the Yazoo Basin arrives as precipitation or as runoff from the hills along the eastern flank of the basin. The only surface outlet is through the Yazoo River, which enters the Mississippi River at the southern end of the basin near Vicksburg. Most surface water discharge in the Yazoo River originates in the uplands along the eastern flank of the basin and is carried to the Yazoo via the Coldwater, Yocona, Tallahatchie, and Yalobusha Rivers as well as several smaller streams. Interior drainage is provided by numerous small streams that discharge to Deer Creek, the Big Sunflower River, Steele Bayou, or Bogue Phalia, which flow to the lower Yazoo River. The pattern of drainage within the basin is generally southward, but can be quite convoluted, reflecting the influence of a complex topography dominated by abandoned meander belts of the Mississippi River (Saucier 1994). Groundwater also is a significant component of the hydrology of the Yazoo Basin. The geologic units that flank and underlie the alluvial valley include significant non-alluvial aquifers. In places, these are contiguous with the alluvial aquifer within the MAV, which occupies coarse-grained deposits that originated as glacial outwash and from more recent alluvial activity. Generally, the surface of the alluvial aquifer is within 30 ft of the land surface. It is essentially continuous throughout the MAV and constitutes one of the largest and most heavily used freshwater sources in the United States. Where the topstratum is made up of coarse sediments, the alluvial aquifer is recharged by surface waters and the aquifer subsequently contributes to stream baseflow during low-flow periods (Saucier 1994, O'Hara 1996).

## Vegetation

The Yazoo Basin is in the east-central portion of the Mississippi Alluvial Plain Ecoregion (Omernik 1987, Chapman et al. 2004). Most forests of the basin are referred to as bottomland hardwoods, a term which incorporates a wide range of species and community types, all of which can tolerate inundation or soil saturation for at least some portion of the growing season (Wharton et al. 1982). Bottomland hardwood forests are among the most productive and diverse ecosystems in North America. Within-stand diversity varies from dominance by one or a few species to forests with a dozen or more overstory species and diverse assemblages of understory, ground cover, and vine species (Putnam 1951, Wharton et al. 1982).

Most major overviews of bottomland hardwood forest ecology emphasize the relationship between plant community distribution and inundation, usually assuming that floodplain surfaces that occupy different elevations in relation to a river channel reflect different flood frequency, depth, and duration (e.g., Wharton and Brinson 1978, Brinson et al. 1981, Larson et al. 1981, Wharton et al. 1982). This leads to classification of forests in terms of hydrologic "zones," each zone having characteristic plant communities. However, zonal concepts have limited utility in the Yazoo Basin, where multiple meander belts of the Mississippi River dominate the landscape. All major stream systems that internally drain the basin are either captured by these meander belts or are constrained between them and have not formed a series of abandoned floodplains (terraces). In the Yazoo Basin, the term "terrace" generally refers to glacial outwash valley train deposits rather than abandoned floodplains of extant tributary streams. Geomorphic elements such as natural levees and abandoned channels, which may be rather minor components of some southeastern floodplains, are common major features in the Yazoo Basin. In much the same way, the general zonal models imply that the principal hydrologic controls on community composition are flood frequency, depth, and duration, as indicated by elevation relative to a stream channel. Stream flooding is just one of several important sources of water in the wetlands of the Yazoo Basin, and factors such as ponding of precipitation, as indicated by geomorphic setting, may be more important than flooding effects in some places.

The synthesis documents of Putnam (1951) and Putnam et al. (1960) adopt a perspective that recognizes the unique terrain of the MAV and summarize the principal combinations of landscape setting, drainage characteristics, and flood environment as they influence plant community composition. Table 1 is based on that approach.

**Table 1. Composition and Site Affinities of Common Forest Communities in the Yazoo Basin (after Putnam 1951)**

| **Forest Cover Type** | **Characteristic Species** | **Site Characteristics** |
|---|---|---|
| Sweetgum -<br>water oaks | *Liquidambar styraciflua*<br>*Quercus nigra*<br>*Quercus nuttallii*<br>*Quercus phellos*<br>*Ulmus americana*<br>*Celtis laevigata*<br>*Fraxinus pennsylvanica* | In first bottoms except for deep sloughs, swamps, fronts, and poorest flats. Also on terrace flats. |
| White oaks -<br>red oaks -<br>other hardwoods | *Quercus michauxii*<br>*Quercus stellata* var. *paludosa*<br>*Quercus falcata* var. *pagodifolia*<br>*Quercus shumardii*<br>*Quercus falcata* var. *falcata*<br>*Carya* spp.<br>*Nyssa sylvatica*<br>*Ulmus alata* | Fine, sandy loam and other well-drained soils on first bottom and terrace ridges. |
| Hackberry -<br>elm -<br>ash | *Celtis laevigata*<br>*Ulmus americana*<br>*Fraxinus pennsylvanica*<br>*Carya aquatica*<br>*Quercus phellos* | Low ridges, flats, and sloughs in first bottoms, terrace flats, and sloughs. Occasionally on new lands or fronts. |
| Overcup oak -<br>water hickory | *Quercus lyrata*<br>*Carya aquatica* | Poorly drained flats, low ridges, sloughs, and backwater basins with tight soils. |
| Cottonwood | *Populus deltoides*<br>*Carya illinoensis*<br>*Platanus occidentalis*<br>*Celtis laevigata* | Front land ridges and well-drained flats. |
| Willow | *Salix nigra* | Front land sloughs and low flats. |
| Riverfront<br>hardwoods | *Platanus occidentalis*<br>*Carya illinoensis*<br>*Fraxinus pennsylvanica*<br>*Ulmus americana*<br>*Celtis laevigata*<br>*Acer saccharinum* | All front lands except deep sloughs and swamps. |
| Cypress -<br>tupelo | *Taxodium distichum*<br>*Nyssa aquatica* | Low, poorly drained flats, deep sloughs, and swamps in first bottoms and terraces. |

Under natural conditions, forest stands within the Yazoo Basin undergo change at various temporal and spatial scales. Primary succession occurs on recently deposited substrates, which include abandoned stream channels, point bars, crevasse splays, and abandoned beaver ponds. One familiar example is the colonization of new bars adjacent to river channels by black willow, which is replaced over time by other species such as sugarberry and green ash and eventually by long-lived, heavy-seeded species such as oaks and hickories (Putnam et al.1960, Meadows and Nowacki 1996). Although this sequential replacement does occur, it is actually a complex process that includes changes in the elevation and composition of the substrate as colonizing plants and flood flows interact to induce sedimentation and, on a longer-term scale, as soils mature and river channels migrate away from the site and cease delivering large volumes of new sediments. In the Yazoo Basin, creation and colonization of new point bars is limited, because many of the internal streams are deeply entrenched within old Mississippi River channels or have been channelized and do not migrate significantly. Creation of other new substrates due to Mississippi River channel migration and overbank flows has been curtailed in the Yazoo Basin by levee construction and bank stabilization projects (Klimas 1991).

Typically, natural regeneration processes in established forest stands are initiated within small forest openings that occur due to windthrow, disease, lightning strikes, and similar influences that kill individual trees or small groups of trees (Dickson 1991) or in larger openings caused by fire, prolonged flooding (especially due to beaver), tornados, hurricanes, or ice storms. The resulting openings are rapidly colonized, but the composition of the colonizing trees may vary widely depending on factors such as existing advanced reproduction, seed rain from adjacent mature trees, and importation of seed by animals or floodwaters. Often, this pattern results in small, even-aged groves of trees, sometimes of a single species (Putnam et al. 1960).

Under presettlement conditions, fire may have been a significant factor in stand structure, but the evidence regarding the extent of this influence is unclear. Putnam (1951) stated that southern bottomland forests experience a “serious fire season” every 5-8 years and that fires typically destroy much of the understory and cause damage to some larger trees that eventually provides points of entry for insects and disease. Similarly, it is difficult to estimate the influence of beaver in the presettlement landscape, because they were largely removed very early in the settlement process. However, it is likely that widespread beaver activity resulted in extensive areas of dead timber, open water, marsh, moist soil, and shrub swamp at any given time.

### Alterations to Environmental Conditions

The physical and biological environment of the Yazoo Basin has been extensively altered by human activity. Isolation and stabilization of the Mississippi River have effectively halted the large-scale channel migration and overbank sediment deposition processes that have continually modified the Yazoo Basin over the past 10,000 years. At the same time, sediment input to depressions and sub-basins within the area has increased manyfold in historic times due to erosion of uplands and agricultural fields (Saucier 1994). The Mississippi River no longer overwhelms the landscape with floods that course through the basin, but it continues to influence large areas through backwater effects. Patterns of land use and resource exploitation have had differential effects on the distribution and quality of remaining forest communities.

a. *Land use and management*

   Natural levees, which commonly are the highest elevations in the landscape of the Yazoo Basin and form in direct proximity to water, have been the focus of human settlement during both prehistoric and historic times (Saucier 1994). At the time of European settlement, natural levees were extensively used for maize agriculture by Native Americans. By the time detailed surveys of the Mississippi River were made in the 1880s, there were extensive agricultural fields on the natural levees adjacent to the Mississippi River through the entire reach bordering the Yazoo Basin (Mississippi River Commission 1881-1897). Lower terrain had not been similarly developed, however, and in 1879 less than 10 percent of the Yazoo Basin had been cleared. With improved flood control and farming equipment, conversion of forested land to agriculture progressed to other sites. Levees along the Mississippi River were completed in Mississippi earlier than those across the river in Arkansas and Louisiana and therefore extensive clearing occurred earlier in the Yazoo basin. Approximately 2,040,000 acres or 37% of the original forested area remained in 1950, and from 1950 to 1959, an additional 206,000 acres were cleared (Harrison 1961). In a separate analysis, 334, 267 acres were cleared between 1957 and 1967, and a further 248,528 acres from 1967 to 1977 (MacDonald, et al. 1979). Today only about 10% of the original forest remains.

Much of the remaining forest is highly fragmented, with the greatest degree of fragmentation occurring on drier sites (such as natural levees) and the largest remaining forest tracts being in the wettest areas (Rudis 1995). The differential conversion of higher, drier sites to agriculture may be a major contributing factor in the near disappearance of the extensive stands of cane, which many early travelers remarked upon as common features of the natural levees (Remsen 1986, Dickson 1991).

Nearly all of the remaining forests within the basin have been harvested at least once, and many are in a degraded condition due to past high-grading practices (Putnam 1951, Rudis and Birdsey 1986). Limited old-growth areas are protected within the Research Natural Area system on Delta National Forest, but most of the remaining forests are in various stages of recovery from past harvests, and many of the current stands of mature forest date from a period of intensive harvest activity in the 1930s and 1940s. Clearly, many of these stands originated from high-graded stands, and many have been subjected to additional selective harvests, some with the objective of timber stand improvement. Not all of the current forests are in a managed condition by any means, and very few are in any condition that reflects the “natural” development of forested stands over many generations.

Forest management has shifted to an emphasis on wildlife habitat in recent decades on many of the remaining large tracts. Much of this has come about as an attempt to mitigate some of the impacts of flood control and navigation projects within the Yazoo Basin and elsewhere in the region. Parts of the Delta National Forest were converted to green-tree reservoirs in the 1980s in an attempt to provide habitat for wintering waterfowl. Management of these areas requires pumping water into shallow, forested impoundments during late fall. Water management systems have also been constructed within existing national wildlife refuge lands, and large forest tracts have been converted to wildlife management areas. In addition, considerable reforestation is underway on private lands, primarily under the auspices of the Wetland Reserve Program (WRP) administered by the Natural Resources Conservation Service of the U.S. Department of Agriculture.

The Lower Mississippi Valley Joint Venture, led by the U.S. Fish and Wildlife Service, has developed guidelines for restoration and management of forests in the MAV with an emphasis on enhancing wildlife habitat (LMVJV Forest Conservation Working Group 2007). The Joint Venture has also identified large blocks of forested habitat, both existing and potentially restorable, that can serve as focal areas for restoration and management of forest for wildlife species, particularly migratory birds (Twedt et al. 1999). Together, these efforts enhance the potential for future restoration and management of forests appropriate to the diversity of sites present.

### b. *Flood control and drainage projects*

At the time of European settlement, much of the Yazoo Basin was subject to prolonged, extensive ponding following the winter wet season in virtually all years; localized short-term ponding following rains at any time of year; and extensive inundation within tributary flood basins due to rainfall in headwater areas in most years. During major floods, large-scale backwater flooding influenced numerous tributary systems, and complete inundation of most, or all, of the basin occurred when Mississippi River stages were high enough to cause overbank flows. In the post-settlement era, the hydrology of the Yazoo Basin has been modified extensively and purposefully. Federal projects have largely protected the basin from the effects of major floods, allowing extensive land clearing and agricultural development. The water that enters or underlies the modern basin is rerouted, stored, and exported from the system in complex patterns that can result in more or less water available to remaining wetlands. For example, the uneven annual distribution of rainfall makes both supplemental irrigation and drainage common agricultural practices (Brown et al. 1971). Drainage may involve land leveling as well as ditching and can have various effects on wetlands, which may serve as sumps to which adjacent fields drain, and/or they may themselves be drained to streams or larger ditches. During periods of backwater flooding, these same artificial drainage networks may function in reverse and deliver water to low areas far from the source stream channels. Groundwater withdrawals, particularly for agricultural purposes, have caused depletion of the aquifer in some areas. However, the most dramatic influences on hydrology in the basin have been the flood control features of the Mississippi River and Tributaries Project (MR&T).

Efforts to control flooding on the lower Mississippi River began with the construction of small private levees in the early 19th century (Mississippi River Commission 1970). Corps of Engineers activities through most of the 1800s focused principally on survey and engineering efforts relating to navigation improvement. In 1879, Congress authorized the creation of the Mississippi River Commission to oversee a coordinated Federal effort, carried out by the Corps of Engineers, to provide reliable navigation throughout the entire Mississippi River (Moore 1972). Over the next 5 decades, the authority of the Commission was expanded to include flood control, and its jurisdiction gradually enveloped various tributary stream systems. Funding was appropriated to support basic studies and projects, including channel dredging and the construction of an extensive levee system (Moore 1972). During the first decades of this century, local drainage districts were formed throughout the region to improve interior drainage (Barham 1964, Sartain undated). By 1927, levee construction and related works were believed to be providing effective protection from Mississippi River floods, as well as effective drainage for communities and farmlands throughout the entire lower valley.

A devastating flood in 1927 showed that the flood protection works were inadequate, and the Flood Control Act of 1928 authorized the Corps of Engineers to implement a new and comprehensive plan for preventing flooding in the Lower Mississippi Valley. The approach included construction of larger and stronger levees as well as various channel improvements, bank protection works, and other features. The multiple elements of this plan and its subsequent modifications are collectively referred to as the MR&T Project (Moore 1972).

> A 1931 report on the Yazoo Basin portion of the project area identified three major sources of flooding: overflow from the Mississippi River, backwater due to high stages on the Mississippi River, and direct overflow of the Yazoo River and its tributaries. The mainstem levee solved the first of these problems, but the remaining flooding sources have been addressed by a complex series of projects that were incrementally developed, authorized, and constructed over the past six decades. These projects are described in detail by Moore (1972) and Smith and Klimas (2002).
>
> With the advent of the National Environmental Policy Act (NEPA) in 1969 and other environmental legislation, proposed modifications to the MR&T have been subject to more complex planning and coordination requirements than previously existed. Actions likely to adversely affect fish, wildlife, wetland ecosystems, and other natural resources have been re-evaluated to identify ways to avoid or minimize environmental impacts (Moore 1972, Bolton and Metzger 1998). Compensation for impacts deemed unavoidable has included acquisition and restoration of many thousands of acres of forest within the project area, as well as construction of additional water management facilities to benefit wildlife, particularly waterfowl (Young 1998).

## METHODS

The PNV map for the Yazoo basin was developed using spatial data layers in a Geographic Information System (GIS) and field studies. The purpose was to identify and characterize relatively stable assemblages of tree species that consistently occur on particular combinations of site factors. The plant communities were classified using the HGM approach to maintain consistency with other PNV mapping conducted in the Delta Region of Arkansas. The details of the Arkansas HGM classification system and criteria are summarized in Klimas et al. (2011) and the PNV mapping approach used there is described in Klimas et al. (2009). The data layers and procedures used in the Yazoo basin study are detailed below.

### Spatial Data Assembly and Preparation

This project uses a combination of three criteria (flooding, geomorphology, and soils) to classify the potential natural vegetation of an area. Spatially representing these three criteria required the use of several datasets that were collected from existing publicly available sources and assembled in a GIS. Some of these input data required significant preparation before modeling could begin. Primary inputs were geomorphology, soils, flood frequency and hydrography. Additional spatial data such as roads, political boundaries and aerial photography were used for orientation. All data were clipped to the study area and projected to UTM Zone 15 North (NAD83). Due to the relatively small study area for this project, the modeling was performed in a vector environment to preserve some of the detailed linework of some input datasets.

#### a. *Geomorphology*

The main source of spatial geomorphology data for this project was a digital version of the 1:250,000 scale map prepared by Saucier (1994). That map was generalized from a series of 1:64,000 scale maps (Krinitzsky et al. 1965).

Three of the geomorphology features needed for the HGM classification were originally included on the 1:64,000 scale maps but were not transferred to the 1:250,000 scale version.

These features were: surface natural levee deposits (designated as “veneer” on the maps); small abandoned channels and courses; and alluvial fans. They were digitized specifically for this project from scanned versions of the original 1:62,500 scale maps, which were geometrically corrected using ground control points from 1:24,000 DRGs. The geometric correction was completed using ERDAS Imagine 10 software. The RMS errors for most maps were below 3 meters, though in many areas it was challenging to find control points due to a lack of road infrastructure in parts of the study area. After the veneer, small abandoned channels and courses, and alluvial fans were digitized from the georeferenced 1:64,000 maps. Some additional editing was performed to correct edge mapping problems that arose from discrepancies in mapping of features between adjoining maps. These discrepancies were corrected using expert opinion, aerial photography, and soils maps.

### *b. Soils*

Soil data for this project were obtained from the 1:24,000 scale county-level Soil Survey Geographic (SSURGO) soils databases. For each individual county an attribute join was performed to add the soil name to the attribute table associated with the soil map. Then all of the SSURGO maps for each county in the study area were merged together and clipped to the project extent.

### *c. Hydrography*

Stream and waterbody features for this project were extracted from the National Hydrography Dataset (NHD). Streams were extracted by selecting feature types of “stream/river,” “artificial path,” and “connector” from the flowline file. These three feature types were necessary because some portions of the rivers in the study area have been ditched and modified and are therefore identified as artificial. Waterbodies were also extracted from the NHD dataset. They were used in the modeling process to identify the “Fringe” wetland types that occur within lakes and ponds and “Depression” wetland types that occur in swamps and marshes.

### *d. Hydrology*

The principal source of hydrologic information consisted of two datasets that had been assembled by the Southern Regional Office of Ducks Unlimited (DU) (http://www.ducks.org/conservation/southern-regional-office/southern-regional-office), which they designated as the Flood Frequency and Observed Flood Models. Typically, flood frequency models are created from a collection of both tabular river gauge data and spatial data showing the extent of flooding. DU created the spatial component by mapping the presence of water on numerous Landsat satellite images. In the model, the MAV is subset into watersheds that DU created specifically for this model. At the pour point, or the lowest point, of each watershed, a gauge height is recorded. This gauge data is used to calculate flood frequencies for each of the watersheds in monthly intervals from 6 to 60 months (5 years). The calculated flood frequencies were applied to each of the coded satellite scenes based upon the gauge height on the date the scene was created. Analysis of all the scenes and gauge data showed that there was insufficient data to precisely and consistently identify equivalent flood events across all of the watersheds in the basin, but for most sites we were able to create maps of the 2- and 5-year flood events that were sufficient for the purposes of this project. However, these are best viewed as only crude approximations of those frequency events, and are essentially depictions of “very wet” and “less wet” sites, and areas that do not fall into either category are considered to be flooded only rarely or not at all.

Several steps were taken to refine the flood frequency maps. Some images were discarded because they were taken at times when numerous catfish ponds where filled with water, causing large areas to be misclassified. Next the imagery was cleaned by performing a clump-and-eliminate procedure to remove isolated pixels most likely caused by classification errors before they were converted into a vector format. Then all polygons that did not intersect a NHD stream (as defined above) were removed to eliminate areas that were wet because of ponded precipitation rather than overbank or backwater flooding from streams. The shapefiles for each flood class were then merged together across watersheds to create the base for the 2- and 5-year floodplains.

A few watersheds had insufficient data to create the 5-year flood map so data from the DU Observed Flood Index was used instead. The flood index dataset also used a combination of gauge data and satellite imagery to characterize flooding; however, it did not calculate values in terms of flood frequency. The values in this dataset show the ratio of how many times a pixel was classified as wet to classified as dry for each scene. For instance, a pixel with a value of 20 was classified as water in 2 of the 10 Landsat scenes for that path and row. To use the flood index all pixels were reclassified as water/no water. All single pixel clumps were removed as above and then the image was converted to a vector. Again, all polygons that did not intersect a stream were removed. The resulting shapefiles were merged with the 5-year flood class created from the DU Flood Frequency Model, creating the combined DU model.

The incorporation of the Observed Flood Data was necessary to develop a basin-wide flood frequency map, but it likely overestimated the extent of the 5-year floodplain in some places. And it did not resolve another problem, which was that several of the watersheds in the lower part of the basin were not represented at all in the available flood scenes. To address these issues, we incorporated 2- and 5-year flood frequency maps that had been developed in 2010 by the Vicksburg District, U.S. Army Corps of Engineers. These were based on a 30 meter Digital Elevation Model and a period of record dating from 1948 for most gauges (Dave Johnson, USACE Vicksburg District, pers. comm.). Those model results also were uneven in their coverage in the basin, as less information was available for some of the upper basin than the lower, but together, the Corps and DU models provided full coverage and allowed us to compile a unified flood frequency map that resolved many of the shortcomings of each source model.

In general, the combined DU model and the Corps map were most similar in major flood basins subject to extensive backwater flooding; they tended to be most different in the upper part of the study area where the Corps map showed flooding only along major channels, while the combined DU model tended to include considerable off-channel sites and smaller floodplains along tributaries. Also, the two approaches dealt differently with the artificially ponded sites in agricultural fields and within aquaculture (catfish) ponds. Typically, the DU approach included such sites while the Corps’ model did not. For our purposes, we wanted to include only those parts of such areas as would be inundated if the sites were restored to a forested condition, therefore both flood maps contained information of interest. The approach that we adopted combined the results of both flood maps as follows:

- Because the combined DU model tended to include many potentially-restorable sites that were not mapped as floodplain by the Corps, it was adopted as the basic coverage. Where the combined DU model and the Corps map overlapped, the flood frequency designations represented on the combined DU model took precedence, in order to maintain consistency with adjacent sites where no Corps floodplains were mapped.
- The Corps map was the primary source for designating floodplains in those several watersheds in the lower basin where no useful DU coverage existed. Because these areas were among the most extensively-flooded in the basin, it is assumed that the differences between the DU and Corps approaches would have been relatively insignificant in those areas.
- In the few instances where the Corps map showed flooding and the combined DU model did not, the flooded area was added to the flood map and designated as 5-year floodplain. In some cases the affected area had originally been designated as 2-year floodplain, but was reassigned to maintain consistency with adjacent sites. In most such cases, the areas that were re-designated were clearly on the “dry end” of the 2-year flood zone, and had likely been mis-mapped by DU because they drained too rapidly to have been picked up in the flood scenes, meaning that the change was of minimal consequence for restoration planning purposes.

The composite DU and Corps flood map included numerous areas designated as floodplain that were clearly catfish ponds and ponded areas in farm fields. The initial automated editing process identified many such areas, but the remainder were identified and removed manually. In some cases, especially where large catfish operations were present, a variety of resources were used to recognize the approximate boundary of the “restorable” portion of the floodplain within a more extensive impounded area. These included aerial photos, the Corps flood map, geomorphic mapping, and topographic maps created prior to the construction of the pond complexes. Where they could be applied to recognize an approximate contour line or topographic break point, a new floodplain perimeter was digitized that cut across the pond complex. In other cases, where there was no basis for designating a probably boundary, the ponded areas remain designated as floodplain, resulting in some straight line floodplain boundaries. Other straight-line boundaries remain in the flood map due to the effects of roads and other structures.

Another anomaly in the hydrologic map caused by catfish ponds is that they tend to be mapped as 2-year floodplain, causing rectangular frequently-flooded areas to appear within expanses of 5-year floodplain. Where possible, these areas were re-classified to realistically reflect their restoration potential, but many remain where no clear appropriate designation is apparent.

## Field Studies

The field portion of this project involved stand-level characterizations of canopy composition and dominance. The objective was to locate and characterize as many stands as possible across a wide range of site conditions rather than to gather detailed structural data on a small number of stands, which would have precluded the kind of comprehensive overview required to assemble a complete PNV map coverage. Two field investigations were conducted; the first to develop the classification system and identify key site relationships for the major plant communities, and the second to fill in gaps, resolve discrepancies, and otherwise troubleshoot problems with the draft classification and map.

The field procedure involved locating mature forest stands on a wide range of site conditions, characterizing the dominance patterns and understory of each stand, and recording observations regarding the limits of distribution of the community and its adjacent communities. We identified specific sampling sites in the field using a laptop computer, linked to a Geographic Positioning System (GPS) that contained the GIS coverages for soils, geomorphology, flood frequency, and hydrography, as well as USGS topographic maps and recent aerial photography. The sampling strategy was to stratify the study area according to geomorphic setting, then by flood frequency, and identify mature forest tracts within each major combination of those categories. The GPS and GIS were used to select observation points in each target tract, and to identify variations in soils within those stands for additional observations. By this means, general conceptual models of community distribution relative to site conditions were developed and refined as the field surveys progressed, and recorded in a matrix format, where each HGM subclass designation was associated with a particular set of geomorphic and hydrologic conditions, as well as soils. The HGM community type was described in terms of dominant species and characteristic understory components.

## Classification

HGM classification divides all wetlands into one of five classes (riverine, fringe, flat, depression, and slope), according to their hydrologic and geomorphic setting. The term “geomorphic” in HGM terminology, however, is somewhat misleading, in that it is intended to reflect topography rather than the age and origin of landforms. Thus, a depression can occur in a point bar swale, an abandoned channel segment, an upland sinkhole, or other settings where a closed basin is formed. Similarly, a fringe wetland can occur on the margins of an oxbow lake in an abandoned channel, as well as on the margins of a man-made body of water. However, the geomorphic mapping available for the study area had great utility for recognizing fundamental differences among sites above the level of the HGM classification. Past experience and the initial field studies showed major differences in plant communities and site characteristics between the Pleistocene terraces and Holocene meander belts described previously, and between Holocene meander belts of different ages, and the classification system was stratified first on that basis. The HGM classes were superimposed below that level, based on topography and hydrology, and HGM subclasses and PNV communities were designated within those classes based primarily on hydrology, the presence of natural levee veneers, and soils.

Most PNV communities were associated with more than one soil, but not all possible unique combinations of soils and other site factors were observed in the field studies. Therefore, several soils with limited distribution within the study area and clear vegetation affinities were used in defining appropriate categories in the classification based on soil survey descriptions and our professional experience. The classification was revised and refined as the mapping process proceeded. The final classification system was structured to be consistent with the approach previously applied to the PNV maps developed for other basins within the MAV.

## Mapping

The classification system was constructed as a matrix of PNV community types and their associated site factors, and map assembly rules were developed that were designed to produce polygons that represented those specific combinations. Certain subclasses and communities were designated by only one or two site factors, and these were identified first and removed from further consideration. The remaining subclasses and community types were defined based on unique combinations of geomorphology, hydrology, and soils. The principal task in developing assembly rules was to specify a stepwise order of operations that produced a unique solution for each PNV community, and avoided conflicts or gaps. Details of the final assembly rules and order of operations are in the metadata that describe the final PNV shapefile.

## RESULTS

A total of 22 unique PNV community types were recognized in the Yazoo Basin portion of the PNV. Figure 2 provides an overview of the PNV map for the area and Table 2 contains the map legend, which describes the map units in terms of HGM subclasses, general site characteristics, and principal dominant species. Note that Figure 2 and Table 2 are provided only to illustrate the general character and complexity of the ecosystem if fully restored under the prevailing hydrologic regime; the original shapefiles or Field Atlas are needed to use the map for actual site-specific applications, along with Appendix A in this report, which presents the PNV community descriptions in more detail, and is intended to be used to develop site-specific restoration plans. Appendix A also presents the mapping criteria used to identify each community type, which allows the user to identify alternate community types appropriate for restoration where hydrology will be modified or where map features (soils, infrastructure, hydrologic zones) are found to be in error.

The classification in Appendix A is organized according to HGM class and subclass, but the mapping criteria used geomorphology as the fundamental level of organization, as explained above. After summarizing the field data according to geomorphic settings and examining the results, four broad geomorphic groupings were established for detailed classification based on hydrology, the presence of natural levee veneers, and soils.

- Abandoned channels and courses, large swales within point bar deposits, and water bodies.
- Holocene point bar and backswamp deposits of the Mississippi River and smaller streams.
- Pleistocene terraces
- Alluvial fans.

Within each of these four broad groupings, HGM classes and subclasses were recognized based on hydrology and topographic setting, as follows:

- Riverine and river-connected wetlands are restricted to the 5-year flood frequency zone.
- Fringe wetlands are associated only with bodies of water identified as lakes on the NHD Coverage. They are further classified as connected or unconnected depending on whether they intersect perennial streams.

- Depression wetlands are identified based on soils and areas identified as a swamp or marsh in the NHD waterbodies. They are classified as connected or unconnected depending on whether they intersect perennial streams.
- Flat wetlands are all remaining sites outside the 5-year floodplain, except those designated as upland types.
- Uplands, which are not an HGM class because they are not wetlands, are included in this classification to provide seamless coverage of the entire study area, and because they are likely to be considered when using this map to plan landscape-scale restoration. They are above the 5-year floodplain, and are distinguished from other communities based on geomorphology and soils. Uplands in the Yazoo Basin are mapped only on alluvial fans.

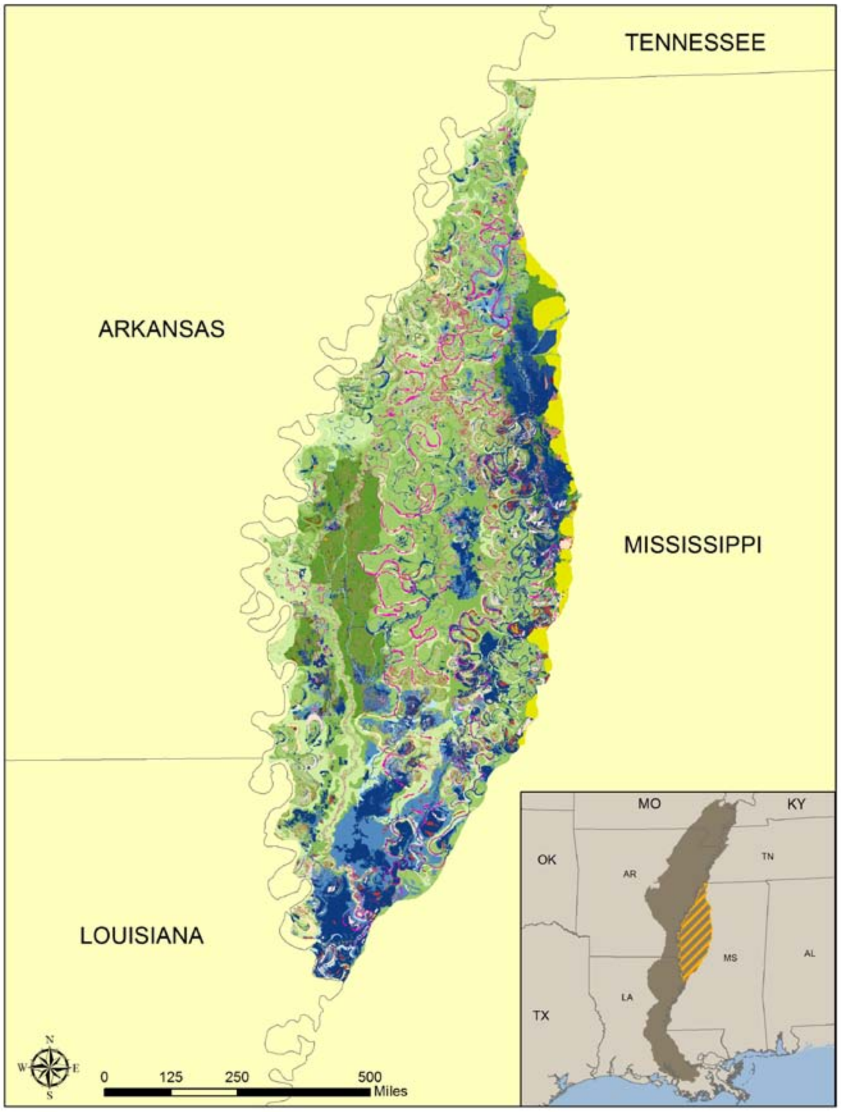

Figure 2. Overview of the Potential Natural Vegetation of the Yazoo Basin, Mississippi.

## TABLE 2: POTENTIAL NATURAL VEGETATION MAP KEY: YAZOO BASIN

| HGM Subclass | General Site Characteristics | Principal Dominant Species |
|---|---|---|
| **RIVERINE BACKWATER** | **WETLANDS MAINTAINED BY RIVERINE BACKWATER FLOODING** | |
| RB1 | Occasionally flooded well drained lowlands | Nuttall Oak– Willow Oak–Water Oak |
| RB2 | Occasionally flooded, moderately drained lowlands | Willow Oak–Water Oak–Sweetgum |
| RB3 | Occasionally flooded flats | Willow Oak–Sweetgum |
| RB4 | Occasionally flooded, poorly drained lowlands | Nuttall Oak–Sweetgum |
| RB5 | Occasionally flooded Pleistocene deposits | Willow Oak–Nuttall Oak |
| RB6 | Frequently flooded Pleistocene deposits | Overcup Oak–Bitter Pecan–Green Ash |
| RB7 | Frequently flooded lowlands | Overcup Oak–Bitter Pecan |
| **RIVERINE OVERBANK** | **WETLANDS MAINTAINED BY RIVERINE OVERBANK AND HEADWATER FLOODING** | |
| RO2 | River swamps in underfit channels | Baldcypress–Water Tupelo |
| **FLAT** | **WETLANDS MAINTAINED BY PRECIPITATION** | |
| F1 | High natural levees | Cottonwood–Water Oak–Sugarberry |
| F2 | Well drained recent alluvium in lowlands | Cherrybark Oak–Water Oak–Sweetgum |
| F3 | Well drained older alluvium in lowlands | Cherrybark Oak–Water Oak–Cow Oak |
| F4 | Moderately drained lowlands | Sugarberry–Green Ash–American Elm |
| F5 | Poorly drained Mississippi River sediments | Willow Oak–Cedar Elm |
| F7 | Poorly drained undulating topography on Pleistocene outwash terraces | Willow Oak–Water Oak–Cherrybark Oak |
| F11 | Alkali prairie/savanna | Three Awn–Little Bluestem–Delta Post Oak |
| **CONNECTED AND UNCONNECTED DEPRESSIONS** | **WETLANDS IN DEPRESSIONS** | |
| D1 | Stream-connected depressions in abandoned channels | Baldcypress–Water Tupelo |
| D2 | Stream-connected depressions on Pleistocene outwash terraces | Baldcypress–Water Tupelo |
| D3 | Unconnected depressions in abandoned channels | Baldcypress–Water Tupelo |
| D4 | Unconnected depressions on Pleistocene outwash terraces | Baldcypress–Water Tupelo |
| **CONNECTED AND UNCONNECTED FRINGE** | **WETLANDS FRINGING WATER BODIES** | |
| FR1 | Stream-connected lake and pond fringe wetlands | Baldcypress–Buttonbush–Emergents |
| FR2 | Unconnected lake and pond fringe wetlands | Baldcypress–Buttonbush–Emergents |
| **UPLAND** | **NON-WETLANDS/UPLANDS** | |
| U2 | Well-drained soils on alluvial fans | Mixed Hardwoods |

Within the HGM subclasses, community types were recognized where specific combinations of soils, geomorphic setting, and hydrologic criteria consistently supported particular plant communities. Plant communities were defined in terms of the typical composition and structure of mature systems that are likely to occupy a particular site type under the natural disturbance regime typical for the site. In complex and dynamic systems such as fringe wetlands, where subtle variations in water depth and fluctuation regimes can favor any of a wide range of structural and compositional combinations, we describe the most common variants but do not attempt to link them with specific site characteristics. However, the majority of the communities described in Appendix A are forested and we describe them consistently in terms of leading dominant trees in the canopy as well as characteristic secondary and understory species where those were consistently present.

This level of description is intended to support the primary objective of the study, which is to provide general guidance for planning and evaluating multiple alternative restoration options. The community types described here represent the predominant conditions that would be expected to exist indefinitely on the restored landscape, and to guide species selection and site preparation for establishing those communities. We recognize that under natural conditions there are multiple possible developmental stages and inclusions of earlier stages within canopy gaps in the community types we identify as “typical” of a site, but overall the composition and structure should be essentially stable over the long term and over large areas.

Appendix A is organized primarily in terms of the HGM classification described previously, therefore the same leading dominant species often appear in more than one community type. For example, communities dominated by baldcypress or co-dominated by baldcypress and water tupelo are identified in riverine overbank, riverine backwater, connected depression, unconnected depression, connected fringe and unconnected fringe HGM subclasses. These communities are all compositionally consistent with the descriptions of the Baldcypress (101) and Baldcypress-tupelo (102) types of the Society of American Foresters (SAF) (Eyre 1980), the Cypress-tupelo type of Putnam (1951), and the Bald-cypress Semipermanently Flooded Forest Alliance (A.346) and Water Tupelo - (Bald-cypress) Semipermanently Flooded Forest Alliance (A.345) of NatureServe (Grossman et al. 1998; Anderson et al. 1998). However, within the HGM classification these types all have different hydrologic regimes and varying degrees of connection to other aquatic systems, and therefore are identified as separate types reflecting their functional and structural differences. The other HGM community types listed in Appendix A can also be cross-referenced to the classifications of Putnam, SAF, and NatureServe if that is desirable for management recommendations or for more detailed listings of associated plants, but for specific site affinities and the functional insights provided by HGM classification, the community types identified in Appendix A are more useful.

In addition to listing dominant and secondary species, Appendix A presents the principal criteria used to separate the community types. Some key characteristics of the classification system and certain unique community types are described below.

### Riverine systems

The HGM classification distinguishes riverine overbank from riverine backwater systems based on the energy of the flowing waters during flood stages, and the related ability of the system to export organic material, deposit fine sediments, and similar functions. This distinction is reflected mostly in the separation of overbank community from backwater sites, and the further subdivision of backwater sites according to flood frequency, with frequently flooded areas (1 and 2-year floodplain) being dominated by species such as overcup oak, while less flooded sites (3-5-year floodplain) support a broader suite of species, usually including some combination of Nuttall oak, sweetgum and willow oak. However, the numerous abandoned courses of the Mississippi River and other streams that are currently occupied by smaller streams account for the widespread occurrence of a community type we refer to as the river swamp, a variant of the riverine overbank HGM subclass. The river swamp community type (RO2) usually consists of a baldcypress-dominated forest that is situated in the bottom of the former river channel, within and along the edges of the much smaller stream that now occupies it. Because the steep channel sides confine normal high flows, the river swamp is often flooded deeply and with high-velocity flows, but the trees may stand in nearly stagnant water at most times if the present stream is small. The sideslopes of the abandoned course also receive occasional high-velocity flows but are relatively well-drained and even drought-prone the rest of the time, so they tend to support a combination of somewhat resilient and broadly tolerant species such as sugarberry, box elder, and elms. Because most abandoned courses include this same combination of open water, baldcypress forest, and typical riverfront hardwoods, the entire complex is mapped as the river swamp type in this classification, and the margins of the mapped complex are approximate. Note that in some cases, the former large channel has been so completely filled that the river swamp community may be little more than a narrow band of trees in a shallow channel – nevertheless, the basic mechanism that maintains the type (sluggish, near-permanent flows) are usually present as long as a perennial stream occupies the abandoned river course.

Appendix A includes 7 riverine backwater types. RB1, RB2, RB3, and RB4 are occasionally-flooded (2-5 year floodplain) communities of the large stream bottoms, with willow oak as a characteristic dominant. They differ primarily in their drainage characteristics and topography and the effects of those factors on community composition. For example, the ridge-and-swale terrain and natural levee veneers of RB1 and RB2 sites account for a much greater importance of water oak (on veneered ridges) and more pronounced development of vernal pools (in swales) than are found in the other two community types. Vernal pools in the RB2 sites tend to be narrow, relatively deep, and typically have a variety of bottomland species (often including Nuttall oak) while those in the backswamp settings of RB4 are usually very shallow pools dominated by overcup oak. RB5 is also an occasionally-flooded, typically willow oak-dominated community, but it occupies a very different setting. It is found on the slightly elevated interfluves between the former outwash channels of the Pleistocene valley train terraces. The channels themselves, which are often long, interconnected, parallel-trending low areas, usually are flooded frequently (1-2 year floodplain) and like the most frequently-flooded sites in Holocene settings, they are classified as RB7. Less frequently flooded outwash channel sites (2-5 year floodplain) are classified as RB6, but are similar in composition to the RB7 type. Both of these sites most commonly support overcup oak-bitter pecan communities, but the RB7 type tends to include more cypress-tupelo, while the RB6 trends toward the Nuttall oak – green ash phase.

Although the riverine backwater community types are periodically flooded, much of their wetland character is dependent on the ridges, swales, and broad shallow basins (vernal pools) that collect and hold rainwater. Where those features have been leveled or drained, they should be restored before planting if the wetland communities described in Appendix A are to be successful and functional.

## Fringe

Fringe wetlands include a wide range of potential compositional and structural expressions, for the reasons noted above. Nearly all water bodies in the study area are either man-made or have water control structures on them, therefore the structure, composition and distribution of fringing plant communities cannot be regarded as “stable” in the long term, since water regimes often don’t follow natural fluctuation patterns and may be changed at any time. From a functional standpoint, the most important difference among fringe communities is whether they occur along a water body that is connected to a perennial stream or not. If the water body is connected to a perennial stream, the slowing of water passing through the water body and the associated fringe wetland removes sediments and alters downstream flood peaks and baseflow; the outflow exports organic carbon to downstream systems; and aquatic organisms can move into and out of the fringe wetland from the stream system. These are functions that unconnected wetlands do not perform.

There are two fringe types in the classification (Appendix A). FR1 occurs along water bodies connected to a perennial stream, and FR2 occurs along water bodies not connected to a perennial stream.

## Depression

Depression wetlands are relatively consistent in composition and structure. Most are some combination of cypress-tupelo or overcup oak–water hickory, depending on the depth and duration of standing water. By HGM convention, depressions are less than 6 ft deep, therefore they do not often have an open water zone like fringe wetlands, but may include a buttonbush zone at the deepest point. Along the margins, depressions also often include fairly dense understories of water privet and water elm. Depression wetlands are more commonly found in geomorphic settings that were created by meandering rivers, rather than valley train areas, because that is where large closed basins remain in the remnants of abandoned channels and swales. As with fringe wetlands, ecologoical functions of depressions are highly influenced by whether the depression is connected to a perennial stream or not. Connected depressions have functions (such as detention of floodwaters and export of organic carbon) that unconnected depressions do not have.

There are four depression types (Appendix A). D1 (connected) and D3 (unconnected) occur within all Holocene meander belts and Pleistocene terraces and are located in large swales and abandoned courses of rivers. D2 and D4 occur in the remnants of glacial outwash channels on Pleistocene valley train terraces. Appendix A describes the distinctive character and soils of these “valley train ponds.” Of note is that there may be subsurface flow in these ancient channels and areas of sandy soil may occur within them, leading to greater species diversity. Klimas et al. (2011) provide a more detailed discussion of these unique wetlands based on observations made in Arkansas.

## Flats

The term “flat” is sometimes misleading in that it does not necessarily imply flat topography. Rather, it is a category within the HGM classification system (Brinson 1993) that indicates that the predominant source of wetland hydrology is precipitation rather than flooding or groundwater discharge. In the MAV, flats are those wetlands that are flooded less frequently than every 5 years, or not at all. Despite their lack of regular inundation, flats in the Yazoo basin are on river-deposited sediments that are poorly-drained or pond rainwater and runoff sufficiently to sustain wetland characteristics and functions. Prior to construction of the current flood control and drainage projects, only the highest natural levee ridges and Pleistocene terraces in the basin would have been flooded infrequently enough to be considered flats, but that has changed dramatically. Now much of the basin, particularly in the northern half, is so effectively drained and flood-protected that vast acreages of former riverine wetlands are now classified as flats. On the higher natural levee crests of the most recent Mississippi River meander belts (F1) they commonly support riverfront species such as cottonwood, but on older and lower sites with natural levee veneers (F2, F3) cherrybark oak and water oak are characteristic dominants. Those same sites with less-well-drained soils (F4) are typically sugarberry-elm-ash communities. On poorly-drained flats of the Mississippi River meander belts (F5) willow oak is the usual dominant species. The forests of the unflooded interfluves on the Pleistocene terraces (F7) reflect their comparatively complex topography and sediments in that they share dominance among a variety of different species, including cherrybark oak, willow oak and water oak.

As with riverine backwater wetlands, restoration of wetlands on sites classified as flats is particularly dependent on assuring that subtle topographic variations that pond rainwater, and the larger vernal pools, have not been drained or filled via ditching and land-leveling. Where those changes have taken place, the original topography should be restored prior to planting, or the sites will not function as wetlands or support the tree species prescribed in Appendix A.

## Uplands

The plant communities that we have included in the HGM classes described above are designated as wetlands because they are prone to periodic flooding or they are on alluvial surfaces with topography and soils that promote prolonged soil saturation. They are in that sense ecological wetlands, regardless of whether they meet the current criteria for jurisdictional wetlands under the Clean Water Act or other wetland definitions. However, there are sites within the study area that are clearly non-wetland. These are on the alluvial fans that occur along the eastern valley wall. The source materials for those fans is primarily loess that has eroded from the thick deposits on the hills, and where the fans are steeply sloped, drainage and soil moisture conditions are essentially the same as on the adjacent hillslopes. In both settings, the woody flora is diverse and generally has a mesic character due to the deep soils and high water availability, with cherrybark oak being the typical dominant and a wide variety of other species present, commonly including Shumard oak, white oak, water oak, bitternut hickory, shagbark hickory, and southern red oak. Although the HGM classification system was designed specifically to be applied to wetlands, these upland types have been included in the classification in Appendix A (U2) in order to assure consistent and complete map coverage of the study area. Where the fan deposits tail out onto the lowlands, the shift to wetland communities is gradual, and the mapped community boundaries imply a more distinct and abrupt transition than usually exists.

## DISCUSSION

The PNV mapping process was conceived as a way to provide the best available representation of restoration potential for the natural plant communities of the Lower Mississippi Valley. The key aspect is that these maps reflect current hydrologic patterns rather than historic ones. This is particularly important in the Yazoo Basin where the hydrology of the system has been so thoroughly altered. The primary purpose is to support restoration planning and prioritization, and to help identify opportunities to address resource management and recovery objectives. There are many possible uses for the PNV maps, including the following:

### Replacement of critical habitat

The massive deforestation of the MAV has left a number of plant and animal species in precarious circumstances. PNV mapping can be used to target restoration of critical habitat. For example, the recent rediscovery of the Ivory-bill woodpecker (IBWO) in Arkansas prompted interest in restoring habitats that might support that animal. Until that rediscovery, it had been more than 60 years since a breeding population of the IBWO had last been known to exist in the MAV. The Tensas Basin PNV map (Foti et al. 2011) was developed specifically to address the loss of habitat for the Ivory-Billed Woodpecker (IBWO), and the Ouachita Basin PNV map (Pagan et al. 2011) was created as an extension of that effort. Foti et al. (2008) (included as an appendix in Foti et al. 2011) present a discussion of how PNV mapping can contribute to both understanding of the habitat conditions preferred by the IBWO as well as help identify where those habitats might be restored in the modern landscape.

### Site-specific restoration design

Because the PNV maps often recognize mapping units of a fraction of an acre, they can normally inform restoration design even on relatively small or diverse sites. The site descriptions and geomorphic settings in Appendix A indicate the extent to which a particular community tends to be affiliated with the ridges or swales of point bars, or the almost-imperceptible vernal pools in backswamps, and similar subtle variations in terrain that may have been moderated or eliminated by agricultural practices. Users should evaluate any particular site in light of these descriptions, and restore the appropriate topography prior to planting the area. The classification system in Appendix A also contains the information needed to modify the prescribed plant community if hydrologic restoration can be accomplished on a site. If filling a ditch or breaking a levee is part of the restoration plan, the expected change in flood frequency should be applied to the Appendix A matrix to identify the appropriate community for the wetter site conditions. While all of these features will help guide restoration design, users are encouraged to adjust their site preparation and planting plans as needed based on their local knowledge, experience, and observations of actual conditions in the field. In particular, it is important to recognize that the accuracy of the community boundaries on the PNV map are limited by the precision and resolution of the underlying geomorphic, soils, and hydrology mapping, and that actual transitions between communities are normally more gradual than community mapping implies. An example of applicability of the matrix and PNV maps to a current restoration project is presented in the final report on the Ouachita Basin PNV map (Pagan et al. 2011). That case study describes restoration underway on a large area within the Upper Ouachita National Wildlife Refuge that had been leveed, drained, cleared and farmed. The PNV map shows the diversity of plant communities that are appropriate to restore in the former cropland.

### Landscape-level restoration planning

PNV maps can be useful for identifying restoration needs and opportunities where resource objectives involve the distribution of particular habitats over large regions. In a GIS environment, it is relatively simple to identify sites that would support the maximum habitat diversity within a single large block of restored forest, or the appropriate forest communities for restoration within riparian corridors. PNV maps directly reflect flood frequency, therefore restoration projects can be designed to assure that flood refugia are included in projects intended to provide habitat for terrestrial wildlife. Because the PNV maps use the HGM classification system, they reflect other wetland characteristics of potential interest. For example, the PNV map distinguishes between sites suitable for establishing Connected Depressions and Unconnected Depressions. Though these sites support the same forest communities, the latter is far more suitable for restoring amphibian populations due to the lack of predatory fish. And because the PNV maps identify flood-connected areas, they can be used to prioritize restoration of agricultural lands based on their likely contribution to downstream water quality problems. There are numerous similar types of applications that can add flexibility and insight to the restoration planning process.

### Mitigation analyses

The PNV maps have some obvious applications in meeting regulatory or planning requirements, such as finding suitable locations for in-kind mitigation of project impacts, or planning mitigation in a watershed context, as is currently required in federal programs. However, because the PNV maps use the HGM classification system, they can also be used in conjunction with HGM Regional Guidebooks to help calculate the amount of restoration of particular wetland subclasses that is required under any particular impact scenario. The HGM guidebook for the Yazoo Basin (Smith and Klimas 2002) includes assessment models and recovery trajectories that can be used to estimate the degree to which restored wetlands perform certain functions over time. This means that restoration priorities can be adjusted to offset the loss of particular functions, or to favor restoration scenarios that will most quickly meet particular functional needs.

## AVAILABILTY OF PNV MAPS

Currently, there are PNV maps available or under development for all of the MAV in Mississippi and Arkansas, and in Louisiana north of the Red River. There are some fundamental and dramatic differences among the sub-basins across this large area. Pleistocene deposits are more extensive in Arkansas than Holocene deposits, while the opposite is true in Mississippi. Arkansas River deposits are more extensive than Mississippi River deposits across northeastern Louisiana and southeastern Arkansas, but are nonexistent east and north of that zone. These types of patterns account for some observed variation in the distribution of community types throughout the region, but the classification system used here, being based on physical site characteristics rather than biota, allows consistent labeling and characterization within and across all sub-basins. Those differences within communities that relate to the range limitations of particular species and climatic influences are handled as general comments in the classification matrix for each basin (Appendix A in this report) rather than by creating entirely new community types. This characteristic of the classification system–basing community designations on site conditions rather than species composition–also prevents misclassification of sites based on past management practices or other historic influences that we are unable to characterize with much certainty.

The Louisiana and Mississippi PNV maps are available in Field Atlas form where individual 1:24,000 quad sheets are reproduced in an 8.5x11 inch format suitable for printing in color and binding for identifying the restoration potential of specific sites in the field. Much more detail is observable in the original shapefiles which can be used for complex planning and research applications, such as the examples discussed in the previous section of this report. The downloadable files as well as other products related to PNV mapping in the MAV can be found at: http://www.lmvjv.org/PNV_of_MAV.htm

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# APPENDIX A

Characteristic dominant and associated plant species and landscape settings of the Potential Natural Vegetation communities of the Yazoo Basin portion of the Lower Mississippi Valley; also included are the principal mapping criteria used to establish the distribution of the community types. Geomorphic terminology and Soil Groups are defined following the classification section.

| HGM SUBCLASSES: CONNECTED AND UNCONNECTED DEPRESSION | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **D1**<br>Stream-connected depressions in abandoned channels | Dominants:<br>Baldcypress<br>Water tupelo<br>Overcup oak<br>Bitter pecan<br>Understory and associated species:<br>Water elm<br>Waterlocust<br>Swamp privet<br>Buttonbush | Topographic depressions with very poorly drained soils in former stream channels and large swales across most geomorphic surfaces other than valley train deposits. Species composition is restricted to the most water-tolerant plants, which distinguishes true depressions from vernal pools. Vines and ground cover species are uncommon. | Any flood zone;<br>D1 intersects a perennial stream<br>D2 has no connection to a perennial stream | Specific soils located in the following settings:<br>Mississippi River abandoned channels and abandoned courses<br>Mississippi River point bars<br>Small stream abandoned channels and courses | Soil Group A |
| **D3**<br>Unconnected depressions in abandoned channels | | | | | |
| **D2**<br>Stream-connected depressions on Pleistocene outwash terraces | Dominants:<br>Baldcypress<br>Water tupelo<br>Water elm<br>Associates:<br>Overcup oak<br>Bitter pecan<br>Drummond's red maple<br>Green ash<br>Swamp privet<br>Swamp cottonwood<br>Included Interfluves:<br>Nuttall oak<br>Willow oak<br>Delta post oak<br>Water oak<br>Cherrybark oak<br>Sweetgum | Depressions (valley train ponds) that occur in the remnants of glacial outwash channels on Pleistocene valley train terraces. The original coarse channel materials have mostly been veneered with fine-grained sediments and support swamp and floodplain species. Localized areas where the veneer is thin may be sandy and support individual trees or small groups of riverfront species such as river birch and sycamore. Small areas of higher ground (interfluves) not identified on soils maps are included in these units. | Any flood zone;<br>D2 intersects a perennial stream<br>D4 has no connection to a perennial stream | All Pleistocene Valley Train settings | Soil Group B |
| **D4**<br>Unconnected depressions on Pleistocene outwash terraces | | | | | |

| HGM SUBCLASSES: CONNECTED AND UNCONNECTED FRINGE | | | | | |
|---|---|---|---|---|---|
| COMMUNITY TYPE | CHARACTERISTICS | | MAPPING CRITERIA | | |
| | TYPICAL VEGETATION | DESCRIPTION | FLOOD ZONE | GEOMORPHIC SETTING | SOILS |
| **FR1**<br>Stream-connected lake and pond fringe wetlands | Common dominants in systems with natural fluctuation patterns:<br>Baldcypress<br>Water tupelo<br>Buttonbush<br>Numerous herbaceous species<br>Common dominants in systems with highly modified fluctuation patterns:<br>Black willow<br>Buttonbush<br>American lotus | Wetlands within permanent lakes and ponds, including borrow pits, but not aquaculture ponds. Natural systems typically support baldcypress and tupelo forests within the fluctuation zone and in the immediate lakefront zone where water tables remain near the surface. Buttonbush thickets may dominate in shallow, near-permanent water, and zones of emergent species are usually present, with erect rooted species in shallow water, floating-leaved species in deeper water, and submerged aquatics present throughout the open water area. Where water levels are manipulated, these patterns are usually altered in various ways. Because water depths and fluctuation patterns are unknown, the entire water body is mapped as fringe wetland. | FR1- Water body connected to a perennial stream<br>FR2 – Water body not connected to a perennial stream | Permanent water bodies (not streams) | Mapped as water bodies on NHD maps |
| **FR2**<br>Unconnected lake and pond fringe wetlands | | | | | |

| HGM SUBCLASS: PRECIPITATION-MAINTAINED FLAT | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **F1**<br>High natural levees | Dominants:<br>Cottonwood<br>Water oak<br>Sugarberry<br>Pecan<br>Associates:<br>Cow oak<br>Blackgum<br>Shagbark hickory<br>Sycamore<br>Sweetgum<br>Characteristic understory:<br>Numerous vines<br>Cane<br>Redbud<br>Red mulberry<br>Paw-paw | High, well drained linear features that were formed along the banks of the Mississippi River. In recent meander belts they may have a strong riverfront character, being dominated by cottonwood and sugarberry, and with abundant vines usually including poison ivy, trumpet creeper, and river grape. On older deposits dominance shifts to water oak and pecan. Cow oak, blackgum, and shagbark hickory increase in abundance with increasing site age, but rarely dominate. Cane and paw-paw are characteristic understory plants. | Outside 5 year floodplain | High natural levee crests (recognized by soils) on recent Mississippi point bar deposits | Soil Group C |
| **F2**<br>Ridge and swale topography in recent alluvium in lowlands | Dominants:<br>Water oak<br>Cherrybark oak<br>Sweetgum<br>Sugarberry<br>American elm<br>Associates:<br>Cedar elm<br>Pecan<br>Box elder<br>Blackgum<br>Cow oak<br>Cottonwood<br>Vernal pools:<br>Nuttall oak<br>Overcup oak<br>Green ash | Mixed oak communities on well-drained sites not subject to regular flooding. Water oak and cherry bark oak are characteristic, Large swales and other sites where persistent vernal pools occur may support Nuttall oak, overcup oak and green ash. | Outside 5 year floodplain | Veneered recent Mississippi River point bars and all backswamps veneered with natural levee deposits | All soils not defining levee crests or depressions |

| HGM SUBCLASS: PRECIPITATION-MAINTAINED FLAT | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **F3**<br>Ridge and swale topography in older alluvium in lowlands | Dominants on ridges and flats:<br>Cherrybark oak<br>Water oak<br>Associated species:<br>American elm<br>Box elder<br>Cow oak<br>Dominants in swales:<br>Overcup oak<br>Nuttall oak<br>Characteristic understory species:<br>Rough-leaf dogwood<br>Deciduous holly<br>Paw-paw<br>Cane | Older, well-drained ridge and swale point bar deposits and natural levee deposits over backswamps. Typical natural levee species such as cow oak occupy the higher sites while most of the undulating terrain is dominated by cherrybark and water oaks. Nuttall oak and overcup oak usually dominate in ponded sites, which are most commonly point bar swales. | Outside 5 year floodplain | Veneered older Mississippi River point bars | All soils not defining levee crests or depressions |
| **F4**<br>Moderately drained lowlands | Dominants:<br>Sugarberry<br>Green ash<br>American elm<br>Sweetgum<br>Associates:<br>Water oak<br>Willow oak<br>Persimmon<br>Cherrybark oak<br>Vernal Pools:<br>Overcup oak<br>Bitter pecan | Gently undulating, moderately drained point bars and veneered backswamps of various ages and origins. The characteristic community is sugarberry-elm-ash, but subtle site variations favor water oak on better drained ridges and Nuttall oak or willow oak on true topographic flats. Overcup oak usually dominates in swales. | Outside 5 year floodplain | Unveneered Mississippi River point bars | All soils not defining levee crests or depressions |
| **F5**<br>Poorly drained Mississippi River sediments | Dominants:<br>Willow oak<br>Cedar elm<br>Associates:<br>Nuttall oak<br>Sugarberry | Poorly drained, often ponded topographic flats, usually dominated by willow oak and with cedar elm consistently present. | Outside 5 year floodplain | Mississippi River abandoned courses, abandoned channels, and backswamps, unveneered | All soils not defining levee crests or depressions |

| HGM SUBCLASS: PRECIPITATION-MAINTAINED FLAT | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **F7**<br>Poorly drained undulating topography on Pleistocene outwash terraces | Dominants:<br>Willow oak<br>Water oak<br>Cherrybark oak<br>Associates:<br>Cedar elm<br>Sweetgum<br>Sugarberry<br>Shagbark hickory<br>Characteristic understory:<br>Cane<br>Palmetto | Complex topography on valley train deposits. Plant communities are variable, with dominance shifting among a suite of common species depending on subtle variations in soils and ponding. | Outside 5 year floodplain | Pleistocene outwash deposits, primarily on interfluves. | All soils other than those used to define D2 and D4 |
| **F11**<br>Alkali prairie/savanna | Herbaceous dominants:<br>Three-awn grass<br>Poorjo<br>Little bluestem<br>Shrubs:<br>Dwarf palmetto<br>Saltbush<br>Marginal woodland dominants:<br>Delta post oak<br>Post oak<br>Blackjack oak<br>Shortleaf pine<br>Loblolly pine | Limited areas within the study area may have historically supported Delta Post oak/three-awn savanna. These were periodically-burned saline flats with characteristic herbaceous and shrub species present, sometimes under a woodland canopy. Where terrain is somewhat dissected or in the long-term absence of fire, a hardwood forest replaces the savanna that also includes willow oak, cherrybark oak, and winged elm.<br>This community characteristically includes unique salt slicks with bare soil fringed with a cryptogamic lip of algae and lichens. This narrow cryptopgamic zone in other basins within the MAV supports the federally endangered plant,*Geocarpon minimum* | Outside 5 year floodplain | Pleistocene Valley Train terraces | Soil Group D |

| HGM SUBCLASS: RIVERINE BACKWATER | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **RB1**<br>Occasionally flooded well drained lowlands | Dominants:<br>Water oak<br>Willow oak<br>Nuttall oak<br>Pecan<br>Sugarberry<br>Sweetgum<br>American elm<br>Associates:<br>Box elder<br>Persimmon<br>Green ash<br>Cedar elm<br>Vernal pools:<br>Overcup oak<br>Bitter pecan | Diverse forest of gently rolling point bar complexes, adjacent backswamps,and filled channels where natural levee deposits blanket the surface. This type is distinguished primarily by the abundance of species characteristically found on natural levees, particularly pecan and sugarberry. Dominance shifts among water oak, willow oak, and Nuttall oak depending on site drainage conditions. Overcup oak and bitter pecan dominate in vernal pools that form within the largest point bar swales and sump areas within backswamps and old channels. Vernal pools are generally small and infrequent in veneered terrain as opposed to unveneered settings of similar origins. | 2-5 year floodplain | Natural levee veneers over recent Mississppi River point bars, backswamps, and abandoned channels and courses | All except depression, fringe, and levee crest soils |
| **RB2**<br>Occasionally flooded, moderately drained lowlands | Dominants:<br>Willow oak<br>Water oak<br>Sweetgum<br>Vernal pools:<br>Nuttall oak<br>Green ash<br>Swamp privet | Relatively subdued ridge-and-swale landscapes without the diversity of sites and species found on younger veneered deposits. Predominantly occupied by willow oak and water oak with sweetgum as the only other common co-dominant. Occasional swales are dominated by Nuttall oak. | 2-5 year floodplain | Veneered older Mississippi River point bars | All except depression, fringe, and levee crest soils |
| **RB3**<br>Occasionally flooded flats | Dominants:<br>Willow oak<br>Sweetgum<br>Associates:<br>Nuttall oak<br>Overcup oak<br>Green ash | Flat or gently undulating unveneered point bars strongly dominated by willow oak. Vernal pools typically not present but microsite variation maintains a consistent presence of associated wet-site species. | 2-5 year floodplain | Unveneered older Mississippi River point bars | All except depression, fringe, and levee crest soils |

| HGM SUBCLASS: RIVERINE BACKWATER | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **RB4**<br>Occasionally flooded, poorly drained lowlands | Dominants:<br>Sweetgum<br>Nuttall oak<br>Willow oak<br>Green ash<br>Overcup oak (on backswamp)<br>Associates:<br>Persimmon<br>American elm<br>Overcup oak<br>Characteristic understory species:<br>Styrax<br>Deciduous holly | Wetter sites of the 2-5 year flood zone with poorly-drained soils and extensive ponding of precipitation. Typically a relatively diverse mix of species except where surface drainage is impeded sufficiently to favor strong dominance by overcup oak. | 2-5 year floodplain | Unveneered recent point bars, unveneered backswamps, abandoned channels and abandoned courses | All except depression, fringe, and levee crest soils |
| **RB5**<br>Occasionally flooded Pleistocene deposits | Dominants:<br>Willow oak<br>Nuttall Oak<br>Sweetgum<br>Associated species:<br>Cherrybark oak<br>Delta post oak<br>Characteristic understory species:<br>Hawthorn<br>Palmetto | Interfluve areas of the Late Pleistocene outwash (valley train) deposits The better-drained interfluves are separated from the relict braided channels based on soils and veneer deposits. | 2-5 year floodplain | Late Pleistocene outwash deposits with veneer or specific soils | Soil Group E |

| HGM SUBCLASS: RIVERINE BACKWATER | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **RB6**<br>Frequently flooded Pleistocene deposits | Dominants:<br>Bitter pecan<br>Overcup oak<br>Green ash<br>Associates:<br>Baldcypress<br>Willow oak<br>American elm<br>Persimmon<br>Drummond red maple<br>Relict in-channel bars (buried sand deposits):<br>Sycamore<br>Swamp cottonwood<br>River birch | Relict braided channels within the Late Pleistocene outwash (valley train) deposits. Relict channels tend to stay wetter and have more connection to the water table than the adjacent interfluves. In places, channels substrates include thick lenses of sand (former in-channel bars) where small stands of riverfront species may occur. | 2-5 year floodplain | Late Pleistocene outwash deposits without veneer or specific soils. | All soils except Groups B and E |
| **RB7**<br>Frequently flooded lowlands | Dominants:<br>Overcup Oak<br>Bitter pecan<br>Understory:<br>Swamp privet<br>Associates on wetter sites:<br>Baldcypress<br>Water tupelo<br>Associates on drier sites:<br>Nuttall oak<br>Green ash<br>Drummond red maple<br>American elm<br>Persimmon | This community type occurs on a wide variety of geomorphic settings and soil types where forest composition is strongly controlled by extended periods of backwater flooding in most years. The characteristic community is dominated by overcup oak, bitter pecan, and a limited group of associated canopy and understory species. Vines and ground cover species also are less abundant and diverse than on less flooded sites. Additional species occur in all strata on the less-flooded sites and upslope margins of the overcup oak zone. Dominance may shift to baldcypress and water tupelo in the deepest parts of abandoned channels and stream courses, and in localized sumps and along minor interior drainageways in backswamps, point bars, and Pleistocene outwash channels. | 1-2 year floodplain | Abandoned channels and courses of the Mississippi and smaller rivers<br>Backswamps<br>Point bars<br>Pleistocene outwash channels | Any |

| HGM SUBCLASS: RIVERINE OVERBANK | | | | | |
|---|---|---|---|---|---|
| **COMMUNITY TYPE** | **CHARACTERISTICS** | | **MAPPING CRITERIA** | | |
| | **TYPICAL VEGETATION** | **DESCRIPTION** | **FLOOD ZONE** | **GEOMORPHIC SETTING** | **SOILS** |
| **RO2**<br>River swamps in underfit channels | Channel bottom zone:<br>Dominants:<br>Baldcypress<br>Water tupelo<br>Buttonbush<br>Lower bank or narrow terrace adjacent to stream:<br>Dominants:<br>Overcup oak<br>Water locust<br>Bitter pecan<br>Associated species:<br>Nuttall oak<br>Water elm<br>Swamp privet<br>Sideslopes of abandoned channel:<br>Mixed hardwoods and riverfront species | "River swamps" of slow-moving streams that have occupied large abandoned courses of the Arkansas River. Typically a swamp forest of baldcypress dominates the zone occupied by the modern stream at normal flows. The rest of the former channel sideslope supports a series of forest species reflecting flood frequency, from overcup oak adjacent to the cypress community through natural levee species such as cow oak along the channel rim. A wide variety of other species may occupy the intervening zones. A standard buffer along the center lines of the abandoned courses as mapped on 1:62.5K quad sheets was used to delimit this type, and therefore the boundaries are less precise than other mapped features. | Perennial stream present; usually near-permanent inundation in the active stream channel, grading to annual flooding in the adjacent zone through rarely flooded sites along the channel rim. | Abandoned courses of small streams (defined as 400m zone along mapped abandoned course line and indeterminate abandoned courses) | any |

| HGM SUBCLASS: UPLAND | | | | | |
|---|---|---|---|---|---|
| COMMUNITY TYPE | CHARACTERISTICS | | MAPPING CRITERIA | | |
| | TYPICAL VEGETATION | DESCRIPTION | FLOOD ZONE | GEOMORPHIC SETTING | SOILS |
| **U2**<br>Well-drained soils of alluvial fans | Dominant species:<br>Water oak<br>Cherrybark oak<br>Shumard oak<br>Associates species:<br>Box elder<br>Basswood<br>White oak<br>Southern red oak | Upland forests of alluvial fans along the eastern edge of the Yazoo Basin. Species composition can vary widely depending on local soils and drainage conditions, but generally is similar to forests of the adjacent loess hills. | No flooding | All alluvial fans | any |

Notes:

1. This Appendix describes the community types represented on the Potential Natural Vegetation map. It identifies groups of species–principally trees– adapted to specific combinations of soils and geomorphic settings within the hydrologic regimes that currently exist on the landscape. Species lists reflect principal dominants and associated species in mature, compositionally stable communities. The listed species do not necessarily occur together in a particular stand, but may be found on similar sites. In some instances, understory species or other characteristics strongly associated with the particular community type are noted. No early successional communities are described, although seral patches exist in all of the community types, and in some settings, such as point bars within and along active channels, they may be extensive. Similarly, the community descriptions do not necessarily reflect the current vegetation found on many sites, which may have established under a previous hydrologic regime or been extensively manipulated. Because the purpose of the classification is to support restoration design and planning, the focus of this map is on the predominant long-term equilibrium condition best adapted to persist on each site under the current hydrologic and climatic regime. Where reference is made to terrain characteristics (e.g. ridge-and-swale, rolling, vernal pools present, etc.) re-establishment of those conditions is a necessary part of the restoration plan, particularly where extensive land-leveling has occurred.
2. Site characterizations in this table list the primary conditions associated with the community type. Minor inclusions of other geomorphic settings may occur.
3. Flood frequency refers to the return interval of inundation originating within the stream channel (either overbank or backwater) but not inundation that occurs entirely as the result of ponding of precipitation. Flood zones are designated as 1-2, 2-5, or >5. The sources for these categories vary by sub-basin and involve correlation of imagery and gage data and are intended to be approximations of relative “wetness” rather than true depictions of flood frequency. Ponded sites are recognized by soils, geomorphology, and in some instances, the presence of standing water in particular satellite images. See report for further discussion of flood data sources and interpretation.
4. Geomorphic terminology reflects Saucier (1994), but has been modified for this application as follows:
   - “Recent” Mississippi River point bar deposits include Hpm 1, Hpm 2, and Hpm 3 as mapped by Saucier.
   - “Older” Mississippi River point bar deposits include Hpm 4, Hpm 5, and Hpm 6.
   - Abandoned channels and courses of “minor streams” are those labeled “S” on the Saucier basemaps and the associated point bars are labeled Hps.
   - The original 1:62.5K geomorphic maps for the region (Saucier 1967) included a symbol for the presence of a natural levee veneer on top of the major geomorphic surfaces such as point bars and backswamps. The natural levee symbol was omitted when Saucier consolidated those quad sheets into a 1:250K coverage. For this study, the natural levee veneer deposits were digitized from the original source maps and are used as modifiers (“veneered”) to the geomorphic setting. Additional details such as abandoned courses of small streams also were digitized and added to the geomorphic basemap.
   - The Pleistocene Valley Train Terraces are glacial outwash deposits of various ages and relative elevations. In the Yazoo Basin only one level is present – the late Wisconsin Pvl 2 terrace.

5. Soils are used here as modifiers to geomorphic setting in those instances where they indicate the presence of depressions, the high crests of natural levees, alkali flats, and interfluves areas on glacial outwash deposits. The soil groups referenced in the classification matrix are defined below.

| SOIL GROUP | COUNTY | CODE | SERIES |
|---|---|---|---|
| **A**<br>(Holocene depressions) | DeSoto | Da<br>Db | Dowling clay<br>Dowling soils |
| | Tunica | MU 125<br>MU 372<br>MU272 | Dowling clay 0-1 ponded<br>Sharkey sicl, occ fl, ponded<br>Sharkey clay, ponded |
| | Coahoma | Da<br>Db | Dowling clay<br>Dowling soils |
| | Bolivar | Dc<br>MR | Dowling clay<br>Marsh |
| | Sunflower | Db<br>Sn (or Sw?) | Dowling clay<br>Swamp |
| | Tallahatchie | Ad<br>Fo | Alligator clay, depressional<br>Forestdale silo depressional |
| | Washington | Da<br>Db<br>Sw | Dowling clay 0-2 occ fl<br>Dowling soils 0-2 occ fl<br>Swamp |
| | Leflore | MU 6<br>MU 23 | Alligator clay, depressional<br>Dowling muck |
| | Carroll | MU 300 | Sharkey clay, ponded |
| | Grenada | Ad | Alligator clay, depressional |
| | Issaquena | Da<br>Db | Dowling clay<br>Dowling soils |
| | Sharkey | Da<br>Db | Dowling clay<br>Dowling soils |
| | Humphreys | Da<br>Db<br>Dc<br>Dd<br>Ma | Dowling clay<br>Dowling clay overflow phase<br>Dowling soils<br>Dowling soils overflow phase<br>Marsh |
| | Warren | Do | Dowling clay |
| **B**<br>(Pleistocene depressions) | Quitman | Wa | Waverly soils, depressional phase |
| | Tallahatchie | Cb | Calhoun-Bonn complex |
| | Carroll | MU 300 | Sharkey clay, ponded |
| | Grenada | Ad<br>LSI | Alligator clay, depressional<br>Land subject to inundation |
| | Bolivar | Dc | Dowling clay |
| | Washington | Da<br>Db | Dowling clay 0-2 occ. fl.<br>Dowling soils 0-2 occ. fl. |

| | | | |
|---|---|---|---|
| **C**<br>(Natural levee crest) | DeSoto | Dm | Dundee vfsl, nearly level phase |
| | Tunica | MU 80 | Commerce silo 0-2 |
| | | MU 73 | Bruno loamy fs freq fl |
| | Coahoma | Bb | Beulah vfsl, nearly level phase |
| | | Bd | Bosket vfsl, nearly level phase |
| | | Cb | Commerce silo, nearly level phase |
| | Bolivar | Bb | Bosket vfsl, nearly level phase |
| | | Cc | Commerce silo |
| | | De | Dubbs vfsl, nearly level phase |
| | Sunflower | Dg | Dubbs very fine sandy loam, nearly level phase |
| | Tallahatchie | DtA | Dundee and Tensas silos, 0-3% slopes |
| | Washington | Ca | Commerce silo, 0-2 |
| | Warren | Cn | Commerce silo |
| **D**<br>(Alkali flat) | Carroll | MU 80 | Bonn silo |
| **E**<br>(Pleistocene interfluves) | Bolivar | Sb | Sharkey clay, nearly level phase |
| | Washington | Ae<br>Ab<br>Aa<br>Ac<br>Ad | Alligator, various |