

# Wetland Environmental Database: Meeting the Challenge of Federal Geographic Data Acquisition and Access Requirements

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**PURPOSE:** This technical note describes the organization and content of a digital wetland environmental database developed for a portion of the Cache River drainage basin in eastern Arkansas. The database is one of the first DoD environmental databases to conform to several new Federal regulations addressing geographic data acquisition and access which are discussed in this technical note.

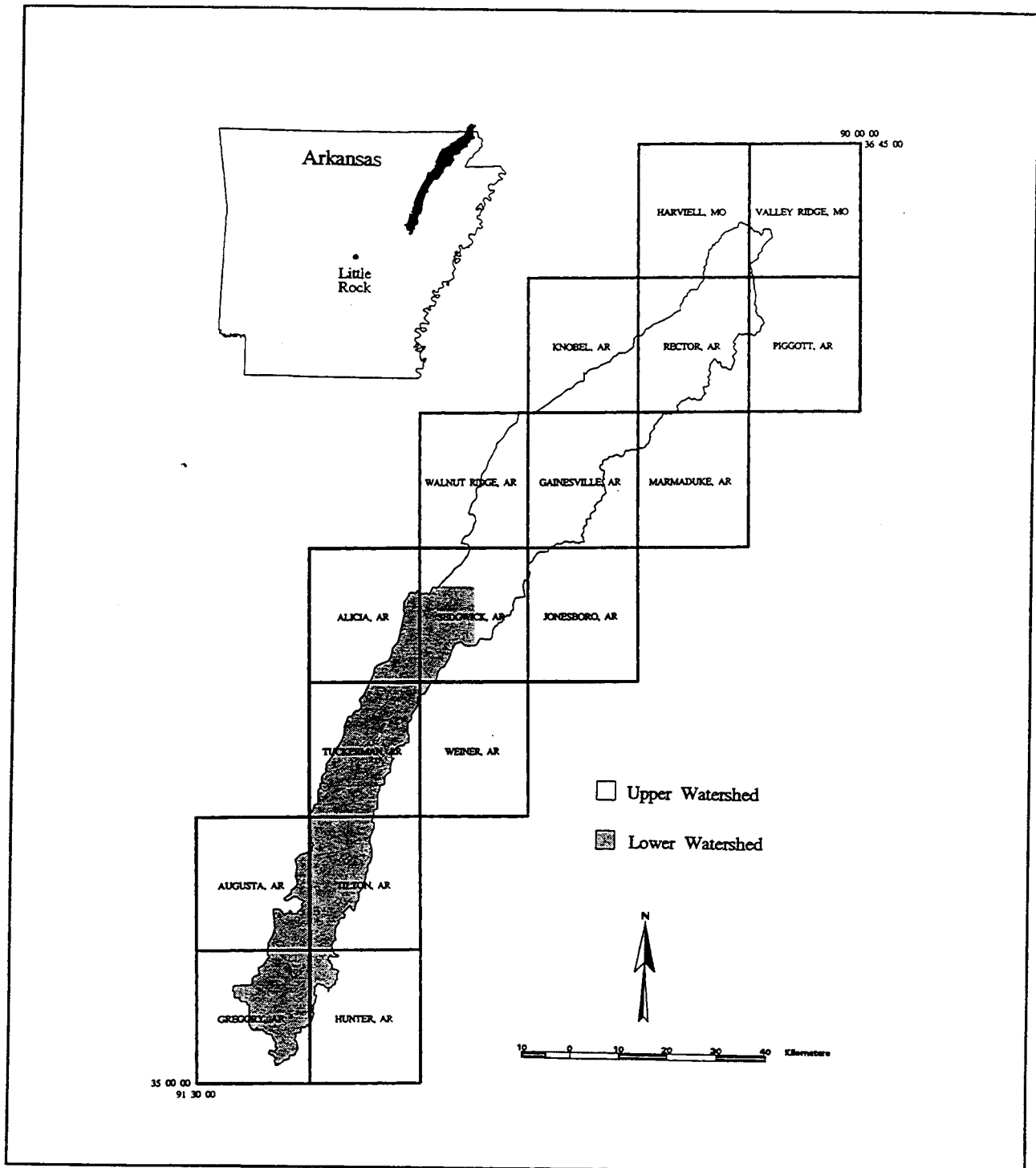
**BACKGROUND:** Technological advances in automated measuring, monitoring, and testing equipment have led to a tremendous increase in the volume of environmental data collected by researchers worldwide. This is especially the case for sensitive environmental resources such as wetlands. In many cases the ability to collect environmental data has exceeded the ability to integrate and analyze the data. Locating, evaluating, and accessing existing data are still widespread problems. Data that are poorly organized, undocumented, or difficult to access are of little use in solving environmental problems. Scientists, engineers, and managers need quick access to well-structured, integrated environmental information to support analysis, modeling, and decision-making.

Recent advances in the ability to electronically locate and access existing environmental data will improve our wetland stewardship capabilities by fostering the exchange of information, avoiding duplication, and stimulating creative problem-solving. In addition, several new Federal regulations include the use of these electronic access technologies as part of their implementation guidance.

**WETLAND ENVIRONMENTAL DATABASE:** As part of the Corps of Engineers' Wetland Research Program (WRP), the Waterways Experiment Station (WES) investigated methods for compiling, organizing, and accessing digital wetland databases. These investigations addressed technical issues of database design, storage formats, documentation, archive requirements, and electronic data transfer. A prototype database was developed for a portion of the Cache River watershed in eastern Arkansas (Figure 1). The database is archived on compact disk-read only memory (CD-ROM) and distributed as part of a WRP technical report (Kress and Bourne 1995).

Scientific investigations of the Cache River bottomland hardwood forest and the associated watershed have generated a wide variety of environmental data. Included among the types of data that have been acquired to characterize and understand the wetland system are field measurements of physical features, laboratory test results of water samples, numerical modeling output for basin hydrologic conditions, mapped data such as soil type and forest cover, remotely sensed images from satellites, land survey data containing the locations of sample sites, and narrative accounts of previous investigations.

The data included on the CD-ROM (Kress and Bourne 1995) are listed in Table 1. Derived from a variety of sources, each file has an associated text file describing its content, origin, and format. These data are archived in vector, raster, or tabular format as appropriate.



**Figure 1.** Location and geographic extent of the WRP Cache River Wetland Environmental Database. Grids represent 15- by 15-min blocks used to subset large files for the data archive

Vector data include digital maps of elevation contours, surface hydrology, wetland types, forest cover, and soil types. The vector data are available in three exchange formats. Satellite images and a digital elevation model are stored as raster data in a band interleaved by line format. The Landsat multispectral

Table 1. Content of the WRP Cache River Wetland Environmental Database	
Data Type	Source
State boundaries	USGS 1:2M Digital Line Graphs
County boundaries	USGS 1:2M Digital Line Graphs
Surface hydrology	USGS 7.5' topographic maps
Topographic elevation contours	USGS 7.5' topographic maps
Digital elevation model	Interpolated from elevation contours
Forested areas - 1935	USGS 15' topographic maps dated 1930-1940
Forested areas - 1975	USGS 7.5' topographic maps dated 1960-1970
USDA soil series	USDA/SCS county soil surveys
Wetland type - 1990	USFWS/National Wetland Inventory
Satellite images - 1972, 1974, 1976, 1980	Landsat MSS, 4 channel
Forested areas - 1972, 1974, 1976, 1980, 1987	Interpreted from satellite images
Map Index - 1:24,000, 1:62,500	USGS 7.5' and 15' topographic maps
Bird counts by species	Field measurements
Reptile counts by species	Field measurements
Mammal counts by species	Field measurements
Logs - count and length	Field measurements
Snags - counts and length	Field measurements
Saplings - count by species	Field measurements
Seedlings - count by species	Field measurements
Subcanopy - count by species	Field measurements
Ground cover - percent cover by species	Field measurements
Tree diameter breast height by species	Field measurements
Tree density by species	Field measurements
Weather data - daily amount	Field measurements
Stream gauge readings - daily	Field measurements
Water quality test results - weekly	Field measurements

scanner images provided on the CD-ROM are not copyrighted. Tabular data include field measurements and observations, results of laboratory tests, and numerical model output. They were collected or generated by various scientists using established and experimental methods. A simple, portable storage format is used for tabular data. The format is a row major, comma delimited ASCII format. Data in this format can be imported by most commercially available statistical, spreadsheet, database, and graphic softwares.

The Cache River database is organized on the CD-ROM in a series of directories and subdirectories. The structure is based primarily on data theme (subject). All data related to a basic theme (such as hydrology or vegetation) are stored together. For large files, a further subdivision based on geographic extent was used to store the data in smaller, manageable files. These geographic subdivisions correspond to the boundaries of the USGS 1:62,500 topographic maps as shown in Figure 1.

**EXECUTIVE ORDER 12906:** Recognizing that “geographic information is critical to promote economic development, improve our stewardship of natural resources, and protect the environment...” on April 11, 1994, President Clinton signed Executive Order (EO) 12906, “Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure.” Of central importance in the EO is the documentation and sharing of geospatial data. Geospatial data are defined in the EO as “information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth...derived from, among other things, remote sensing, mapping, and surveying technologies.” The definition brings to mind various types of map information, but statistical data may be included as well. All data in the WRP Cache River database can be considered geospatial data. The

digital database conforms to all current Federal regulations and standards related to geospatial data acquisition, documentation, and access. Three of these new Federal requirements--metadata documentation, electronic clearinghouse access, and spatial data transfer standard--are discussed below.

**METADATA:** The EO requires that all geospatial data produced with Federal funds be documented in standardized manner. This standardized documentation is referred to as metadata. The prefix "meta-" means beyond or transcending. In the current context, "metadata" are supporting information used to document important characteristics of a file and the data contained in the file. Metadata document the content, quality, condition, and source of the geospatial data. They document who, how, when, and sometimes why the data were collected or produced.

In the WRP Cache River database, every geospatial data file has an associated metadata file. The metadata are stored as ASCII text and follow guidance found in "Content Standards for Digital Geospatial Metadata," issued by the Federal Geographic Data Committee (FGDC) on June 8, 1994.

Figure 2 illustrates part of a metadata text file. These metadata document digital geospatial data depicting the extent of forested area as shown on the 1:62,500-scale Tuckerman, AR, topographic map dated 1935. The keyword entries are important. Just as a user may search library holdings for books on a certain subject, digital data holdings may be searched by theme keyword (subject) or place keyword (geographic location) through the geospatial data clearinghouse.

**CLEARINGHOUSE:** The EO also requires that the availability of geospatial data be made known through the National Geospatial Data Clearinghouse. The Clearinghouse is an electronically connected network of geospatial data producers, managers, and users, established in 1994 by the Federal Geographic Data Committee. The goal of the clearinghouse is to improve access to Federal geospatial data by Federal users and the general public. Agencies must check the Clearinghouse for existing data prior to expending Federal funds to produce geospatial data. Beginning with the FY97 budget cycle, Commanders must certify in writing that the Clearinghouse has been checked for possible duplicate data acquisition efforts.

WES has prepared approximately 100 metadata files for the Clearinghouse informing the public of the availability of the WRP Cache River database. These metadata will allow potential users to determine if the data are applicable for their work and inform them how copies of the database may be obtained. Information about the Clearinghouse is available electronically via Internet mail ([gdc@usgs.gov](mailto:gdc@usgs.gov)) or via the FGDC server, Universal Resource Locator (URL <ftp://fgdc.er.usgs.gov/>). Metadata can be accessed via the World Wide Web at the U.S. Army Corps of Engineers' Geospatial Data Infrastructure (URL [http://corps\\_geol.usace.army.mil](http://corps_geol.usace.army.mil)).

**SPATIAL DATA TRANSFER STANDARD (SDTS):** Federal Information Processing Standard 173 specifies the Spatial Data Transfer Standard (SDTS) as the format for official data exchange between Federal agencies (Department of Commerce 1992). The SDTS is a large but flexible set of rules for encoding geospatial data for transfer between dissimilar computer systems. In response to this Federal regulation, commercial vendors are providing import/export capabilities for SDTS.

WES used the topological vector profile of the SDTS to export all vector data for archiving on the CD-ROM. The SDTS translators are just beginning to appear in the commercial market. For this reason, the Cache River data are archived in two additional formats. These are ArcInfo uncompressed export format

and ArcInfo ungenerate format. The uncompressed export format can be used by UNIX and DOS versions of ArcInfo and by Intergraph Microstation. The ungenerate format is a simple polygon vector ASCII listing. Complete documentation of the three archive data formats is provided on the CD-ROM (Kress and Bourne 1995).

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FOREST30.MET
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IDENTIFICATION INFORMATION

Citation Information
Originator:                US Army Corps of Engineers
                           Waterways Experiment Station
                           Environmental Laboratory

Publication Date:          10/1/94
Title:                     forest30

Publication Information
Publication Place:         Vicksburg, Mississippi
Publisher:                US Army Corps of Engineers
                           Waterways Experiment Station
                           Environmental Laboratory

Description
Abstract:  These data represent forested areas inside the Cache River
AR watershed as depicted on the Army Map Service 1:62,500 scale
Tuckerman AR topographic map dated 1935. The data were manually
digitized from non-stable base materials in ArcInfo. The data are stored
in topological vector format. The coordinate system is UTM. Similar
data for adjoining map sheets are also available.

Purpose:  These data were produced as part of a comprehensive study of
the bottomland hardwood wetlands in the watershed of the Cache River AR.
The study was conducted under the US Army, Corps of Engineers, Wetland
Research Program. The data are used to characterize the historical
extent of bottomland hardwood forest during the 1930's.

Status
Progress:                  complete
Maintenance and Update Frequency:  none planned

Spatial Domain
Bounding Coordinates
West Bounding Coordinate:  -91.250
East Bounding Coordinate:  -91.000
North Bounding Coordinate:  35.750
South Bounding Coordinate:  35.500

Keywords
Theme
Theme Keyword:            forest cover
Theme Keyword:            vegetation
Theme Keyword:            landcover
Place
Place Keyword:            Arkansas
Place Keyword:            Cache River
Place Keyword:            Tuckerman
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Figure 2. Part of the metadata documentation for a vector file in the WRP Cache River Wetland Environmental Database

The WRP Cache River Database is available through Interlibrary Loan Service by contacting the U.S. Army Engineer Waterways Experiment Station Library, telephone (601) 634-2355 or FAX (601) 634-2542.

**REFERENCES:**

Department of Commerce. (1992). "Spatial data transfer standard (SDTS) (Federal Information Processing Standard 173)," National Institute of Standards and Technology, Washington, DC.

Executive Order 12906. (13 Apr 94). "Coordinating geographic data acquisition and access: The national spatial data infrastructure," *Federal Register* 59(71), 17671-74.

Kress, R., and Bourne, S. (1995). "Cache River Basin, Arkansas: Environmental database, compact disk data archive, and metadata documentation," Technical Report WRP-SM-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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