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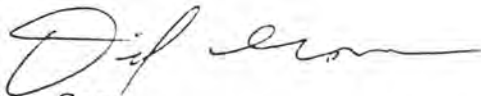
March 31, 2001

Dear Mr. Johnson:

In accordance with our Cooperative Agreement DACA87-00-H-0017 please find attached our deliverable draft final GIS analysis for the UWGCP Multi-Site Management Plan. The deliverable includes a summary of findings from the GIS analysis as well as relevant maps.

Please do not hesitate to contact me if you have questions or comments concerning this deliverable.

Sincerely,



Dave Gosse
Upper West Gulf Coast Plain Project Manager
501-614-5086
dgosse@tnc.org

cc: Mr. Peter Boice, Director of Conservation, Office of the Deputy Under Secretary of Defense for Environmental Security, Department of Defense
Mr. Charles M. Becker, Natural Resource Specialist, Pine Bluff Arsenal
Ms. Susan Hortenstine, Grants Specialist, TNC TXFO

Summary of GIS Analysis Findings
DoD Multi-Site Management Plan
Cooperative Agreement DACA87-00-H-0017

This document summarizes the preliminary findings of the GIS analysis conducted by The Nature Conservancy (TNC) for the U.S. Department of Defense (DoD) under Legacy Cooperative Agreement DACA87-00-H-0017. This summary is presented as a final draft; additional findings may be created from this analysis during the next phase of the Multi-Site Management Plan. Any additional analysis, findings, and maps will be provided as they occur.

Sources and Methods

TNC GIS analysts used data from various sources to complete this GIS analysis. Sources include: land cover and land use from enhanced satellite images and state GAP reports; state geology offices; TNC data records, state natural heritage agencies; U.S. Census data, USDA data; and where possible, data from individual DoD facilities in the ecoregion. Metadata for this project continues to be compiled as TNC enters into the next stage of ecoregional planning. Complete GIS metadata will be provided with the literature review, due to DoD in September, 2001.

Geospatial tools and data for this Multi-Site Management Plan were most useful when 1) biotic TNC and state heritage data were analyzed against nonbiotic geospatially represented datasets, and 2) the relationships between nonbiotic factors were analyzed. Analysis points included: target element occurrences; state tracked species occurrences; community and natural area occurrences; current and recent land use; geology; soil associations; digital elevation and slope modeling; remote sensing; landscape/natural area/community size, condition, and context; roads and roadless areas; digitized INRMP data; watershed, drainage, buffer, and stream reach context; surrounding ownership and ecoregional managed areas; and population, urban areas, and rurality context.

Summary of Findings

Element Occurrences and Tracked Species

Element occurrence requests for TNC ecoregional target species were compiled from Arkansas, Louisiana, Oklahoma, and Texas natural heritage and TNC data. Each resulting occurrence was plotted and is represented by a point. These element occurrence (EO) points were then analyzed and ranked according to their viability, or conservation priority and either ability to persist or candidacy for restoration. Viability was performed on a modified pass/fail system as follows: Preferably Viable (known occurrences that are irreplaceable or of outstanding quality); Viable (known occurrences able to persist or to be restored); Unknown (obsolete or unreliable data exists); or Not Viable (habitat has been destroyed, species extirpated, or no data exists). Viable and Preferably Viable element occurrences were plotted. Element occurrences that received a rank of Unknown were also plotted and will be analyzed on the basis of landscape size, condition, and context in an attempt to fill any data gaps during the portfolio site selection process.

Viable element occurrences of state tracked, ecologically significant, and TNC ecoregional target occurrences are known from Pine Bluff Arsenal (PBA), Barksdale Air Force Base (BAFB), and Louisiana Army Ammunition Plant (LAAP). These occurrences contribute significantly to the number, distribution, and overall viability of these target species and communities throughout the ecoregion. In many cases the natural areas and plant communities that occur on these facilities provide biologically diverse native habitat. Other natural areas on the facilities are shown to be capable of supporting diverse natural habitat with restoration. The viable and highly viable element occurrences on DoD facilities in the ecoregion will contribute to the cluster analysis and portfolio site selection as part of TNC's ecoregional planning. They will contribute significantly to the management recommendations in the final DoD Legacy Multi-Site Management Plan.

The condition, extent, and viability of state tracked, ecologically significant, or TNC ecoregional target occurrences at Red River Army Depot (RRAD) and Lone Star Army Ammunition Plant (LSAP) are currently unknown. There are no updated state heritage data referencing these bases. The base INRMPs are currently in production and the data unavailable for review. GIS analysis and some visual inspection provided additional and encouraging data towards the state of biological diversity occurrence and restoration capability at the RRAD and LSAP. A comprehensive ecological inventory and study of RRAD and LSAP would greatly contribute to current planning efforts and would be critical to future conservation management and action.

Though the Naval Space Command (NSC), Lewisville Unit lies within the UWGCP study area, it is not included in this GIS analysis as its mission and size preclude any landscape level conservation or occurrence protection. It should be noted that the base complies with its updated and comprehensive INRMP. Satellite analysis, visual inspection, and land use analysis reveal that the base provides quality foraging grounds for some wintering and breeding avian populations.

GIS analysis revealed several element occurrence trends across bases in the study area. Several bases contain active or previously active Red-cockaded woodpecker nesting sites. PBA, LAAP, and BAFB contain several occurrences of native plants and plant communities in sustainable locations. EO analysis in conjunction with satellite analysis shows many natural areas, as well as potential natural areas. Across their landscapes, LAAP, PBA, and BAFB contain known viable occurrences of TNC ecoregional target species and state tracked species that trend throughout the ecoregion.

A map illustrating species trends across the ecoregion with these bases highlighted is included in this deliverable. EO trends will be refined into cluster analysis and finally to priority management sites for the TNC ecoregional planning effort, which will be incorporated into the DoD Legacy Multi-Site Management Plan.

Satellite Data and Land Use

Enhanced 1999 satellite data for the entire ecoregion was analyzed as part of this effort. Satellite imagery included in this deliverable are only areas immediately surrounding the bases. Even though the initial mission of ammunition plants and depots prescribed location in remote areas near water bodies, the effect of population growth and landscape fragmentation around the bases is evident in the satellite analysis. Currently RRAD, LSAP, PBA, LAAP, and BAFB contain islands of forested and natural areas (often of high quality) in areas adjacent to fragmented landscape. Only PBA has forested lands in its immediate vicinity. The forested areas common to these bases are critical to the conservation of native species and communities across the ecoregion.

Satellite data and road coverages (digitized by TNC) contributed to a roadless areas analysis of the DoD facilities. Though divided into 40-acre plots to facilitate game management, many areas of RRAD and LSAP could be considered to contain roadless areas. Overall, DoD facilities showed portions of roadless areas greater than other non-industrial forest landowners. These roadless areas are important to several TNC ecoregional target species.

Satellite imagery and Arkansas GAP land use data show areas of dense forest growth on the bases. Interviews with base natural resource specialists confirm satellite imagery analyses that PBA, LAAP, BAFB, and RRAD support active sustainable forestry practices programs. Satellite imagery and hydrology were analyzed in conjunction towards the status of watershed health and aquatic species analysis in the ecoregion.

Hydrology

Hydrologic geospatial analysis was conducted with satellite imagery, EO data, and 8-digit hydrologic unit code (HUC) data. All bases are located in watersheds of critical management concern in the ecoregion. PBA and LAAP drain to higher order stream reaches where larger-river fish guilds occur. RRAD, LSAP, BAFB and LAAP contain lower order stream reaches with critical habitat to

small-stream species. The lower-order stream reaches on these bases may be candidates for mussel bed occurrences. Mussel communities are known from higher-order water bodies downstream from the bases. Each of these reaches drain into critical aquatic habitats targeted in the TNC ecoregional plan and contain some of the highest quality mussel beds in the ecoregion, which in turn contain state-rare and globally imperiled species. The DoD Multi-Site Management Plan will reflect the importance of base aquatic habitat and their contribution to the aquatic habitat management.

Digital elevation and slope modeling

Digital elevation modeling was used as a surrogate for updated topographic coverage. Digital elevation modeling allowed the analysis of certain areas to the applicability of certain types of vegetation and plant community coverage in the absence of on-the-ground data or obsolete element occurrence records. Examples included site candidates for stream seep locations, mesic hardwood communities, and xeric sandhill and blackland prairie communities. This data will be used in the upcoming cluster analysis and ecoregional priority site selection.

An attempt was made to identify candidate slopes for blackland prairie restoration in the North West section of the ecoregion. Given the overall low elevations, generally shallow gradient, gradual elevation changes throughout the ecoregion, and microtopographic nature of candidate slopes, slope modeling was inconclusive at the ecoregional scale. Slope modeling for blackland prairie types will be attempted on closer scale in the future once macrosites are identified.

Population and Demographics

Used in conjunction with satellite imagery, U.S. Census data and USDA rurality indices show the extent of population growth, urban expansion, and landscape fragmentation in the ecoregion. Bases that were built in semi-rural areas are now adjacent to urban areas or are surrounded by fragmented, developed, or farmed landscape. Census data and rurality indices illustrate population centers and their relation to natural areas in the ecoregion. Though low in population relative to the nation, UWGCP contains several areas of population density which have expanded outward into neighboring counties over the past decade. In some areas, such as the Houston metropolitan area, areas managed for conservation act as a barrier to urban expansion.

Geology and soils

Geology and soils were analyzed in conjunction with the digital elevation model for the ecoregion. Generally level to slightly rolling topography are common to areas on all bases within the ecoregion. As most bases are located near alluvial plains of higher-order stream or river reaches, bluff and ravine topography as well as well-drained and poorly-drained soils are present.

Unique geology and soils of the UWGCP ecoregion provide habitat native plants and equally unique communities. Across the ecoregion DoD facilities are located on similar soils and geology; most are underlain by Pleistocene and Upper Cretaceous formations.

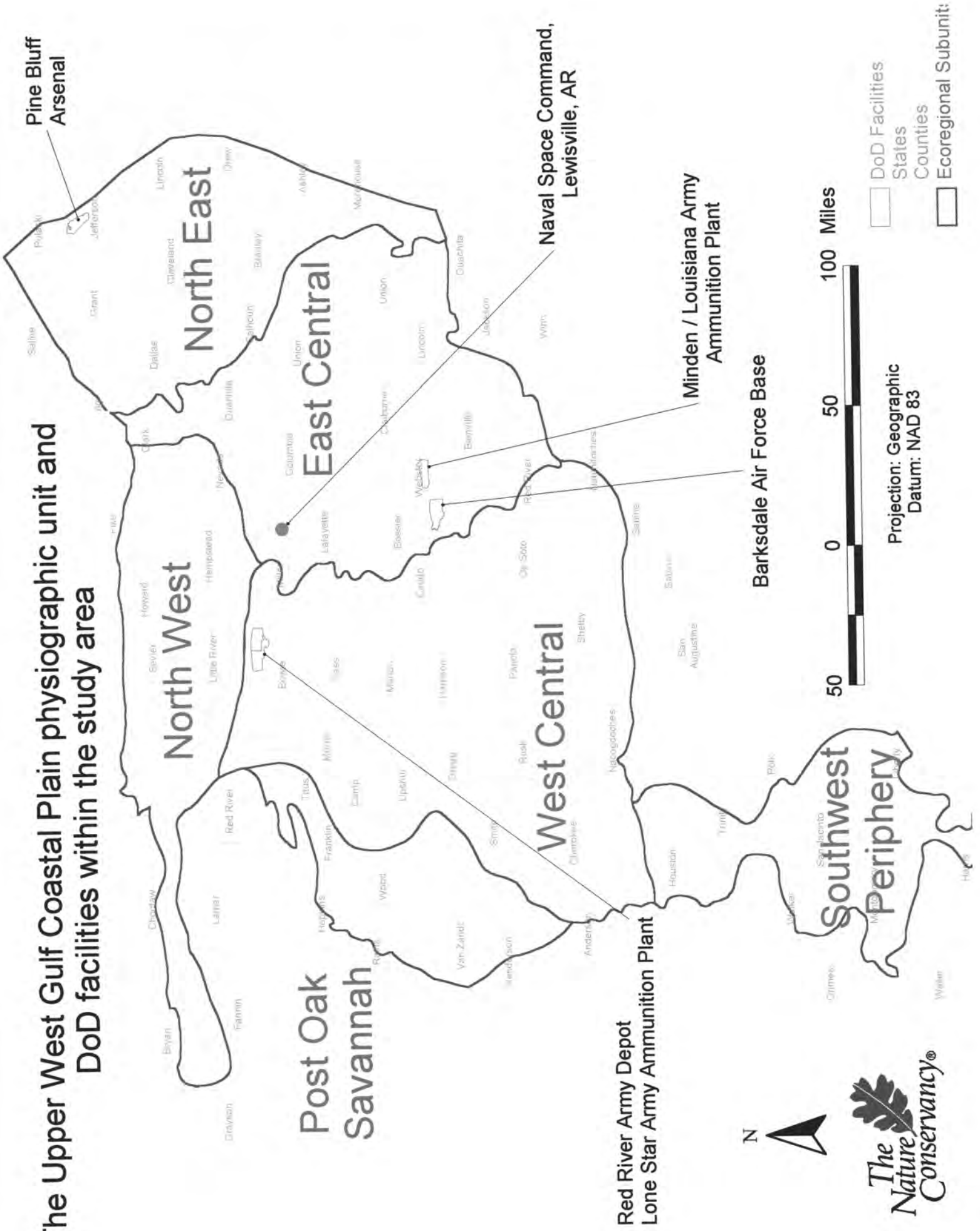
RRAD and LSAP lie at the southwestern end of a series of soils, underlain by Pleistocene and Cretaceous calcareous geology, that form blackland prairie conditions. Saline prairie conditions are also possible with certain soil associations present over this geology. It is conceivable that prairie areas on RRAD and LSAP could be restored to native prairie communities.

BAFB and LAAP contain loamy sandy soils and some sandy acidic soils similar to those at PBA. LAAP contains remnants of "pimple mounds," a geologic feature unique to the ecoregion.

Conclusion

Geospatial analysis of the DoD facilities and the surrounding ecoregion reveal that the DoD facilities are in many ways representative of natural areas, EOs, and conservation opportunities in the ecoregion. Existing management systems, geology and soils, and hydrology at the facilities contribute to opportunities for the conservation of rare and unique species and communities while also providing sustainable forestry activity and actively supporting DoD mission fulfillment. This GIS analysis has contributed significantly to generation and compilation of data towards completion of the DoD Legacy Multi-Site Management Plan and the TNC ecoregional plan. Upcoming cluster analysis and priority site selection for TNC's ecoregional planning effort will require additional GIS analysis; further analysis may also be necessary after ecoregional plan review. DoD will be provided any additional GIS analysis as it occurs as part of this deliverable.

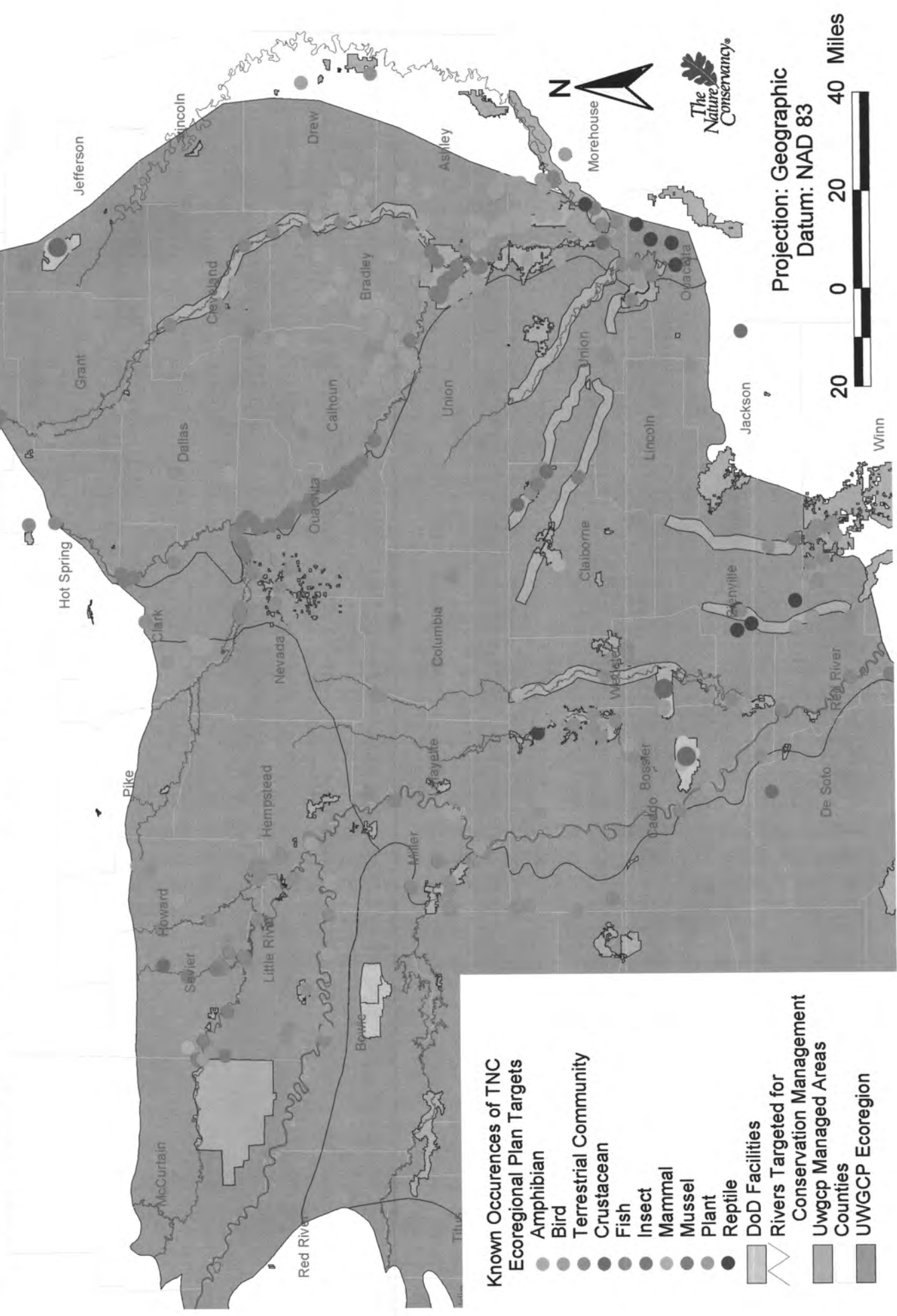
The Upper West Gulf Coastal Plain physiographic unit and DoD facilities within the study area



Red River Army Depot
Lone Star Army Ammunition Plant



Selected Managed Areas and TNC Target Element Occurrences in the UWGCP



Known Occurrences of TNC Ecoregional Plan Targets

- Amphibian
- Bird
- Terrestrial Community
- Crustacean
- Fish
- Insect
- Mammal
- Mussel
- Plant
- Reptile

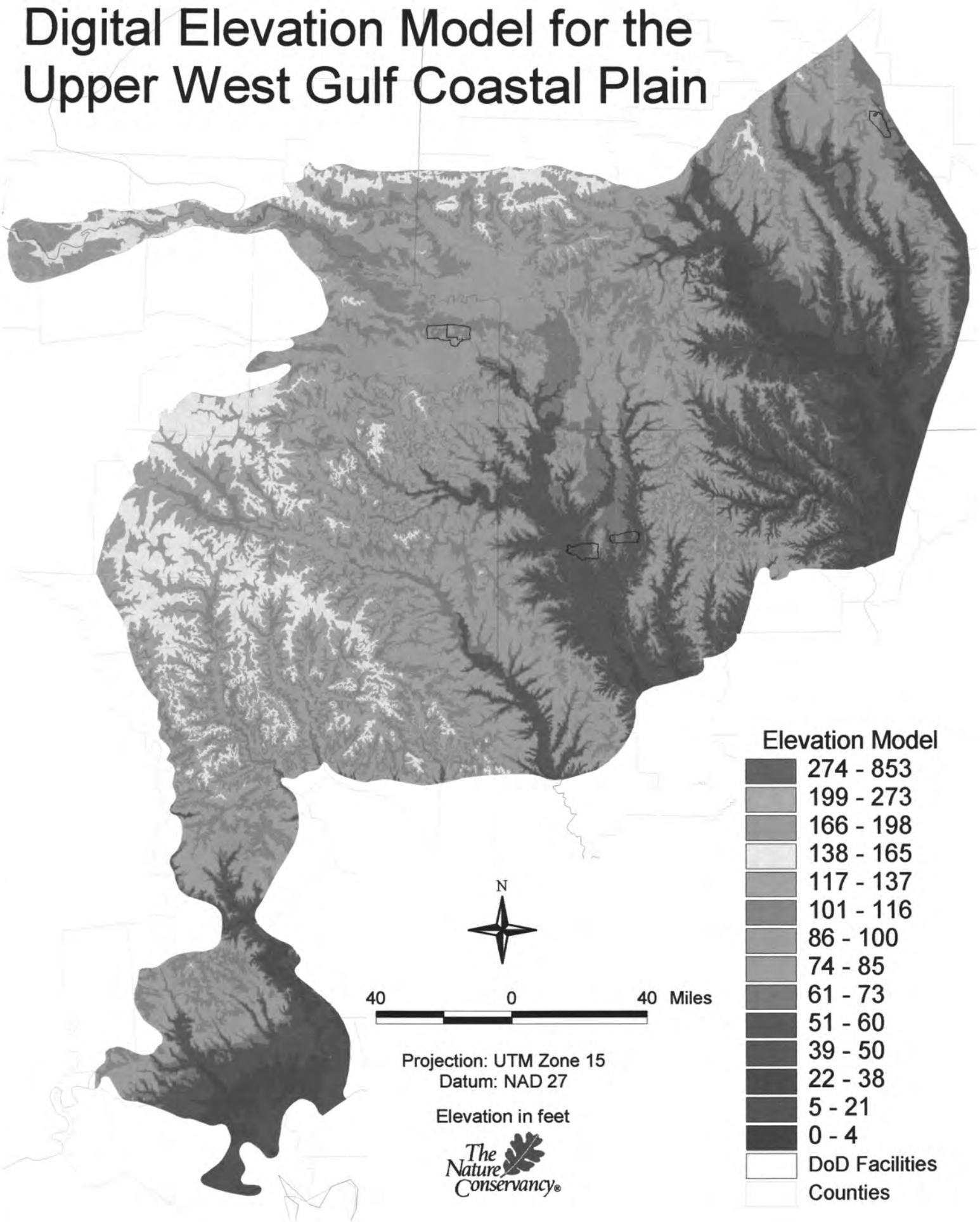
- ▭ DoD Facilities
- ▭ Rivers Targeted for Conservation Management
- ▭ Uwgc Managed Areas
- ▭ Counties
- ▭ UWGCP Ecoregion



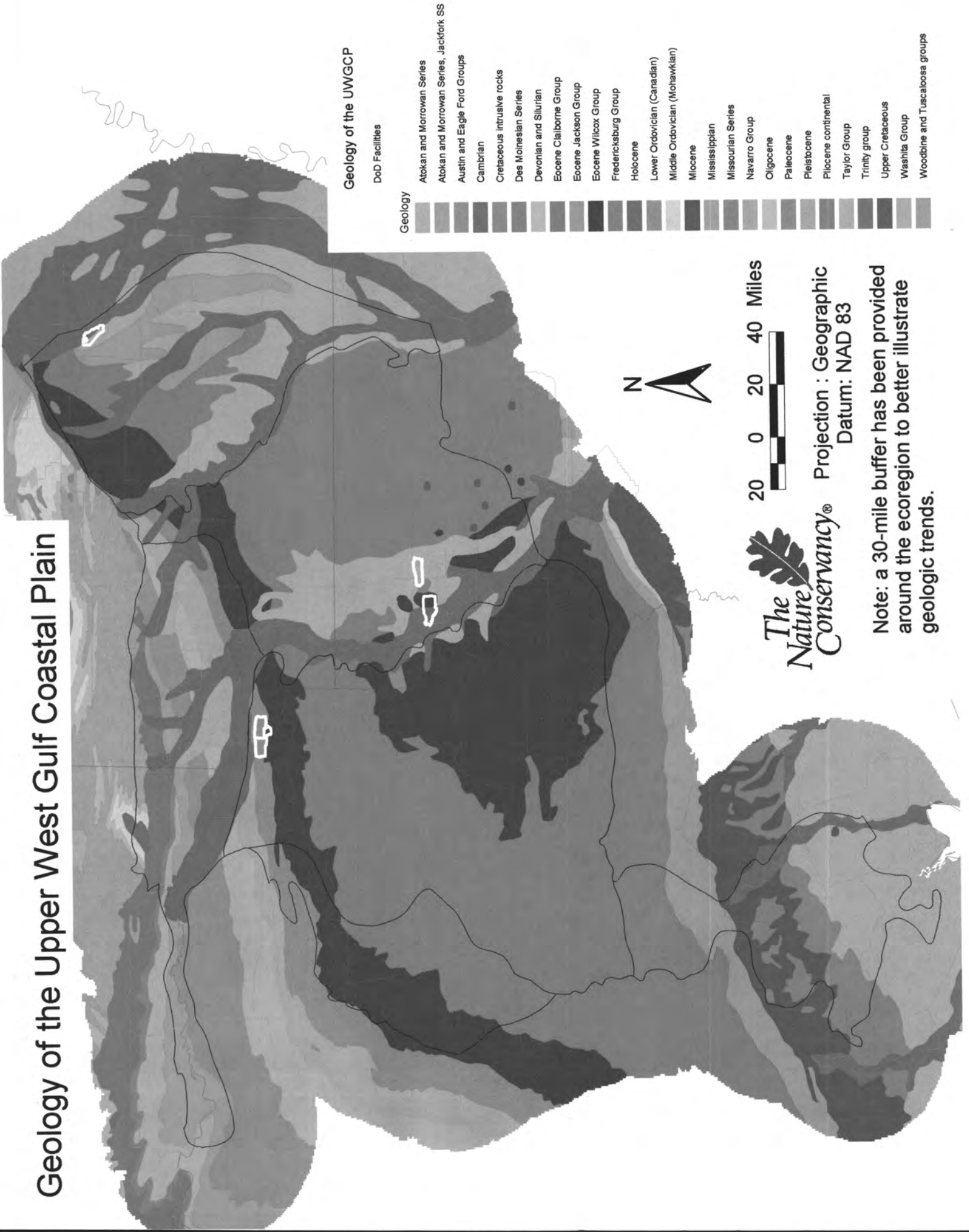
Projection: Geographic
Datum: NAD 83



Digital Elevation Model for the Upper West Gulf Coastal Plain



Geology of the Upper West Gulf Coastal Plain



Geology of the UWGCP

DoD Facilities

Geology

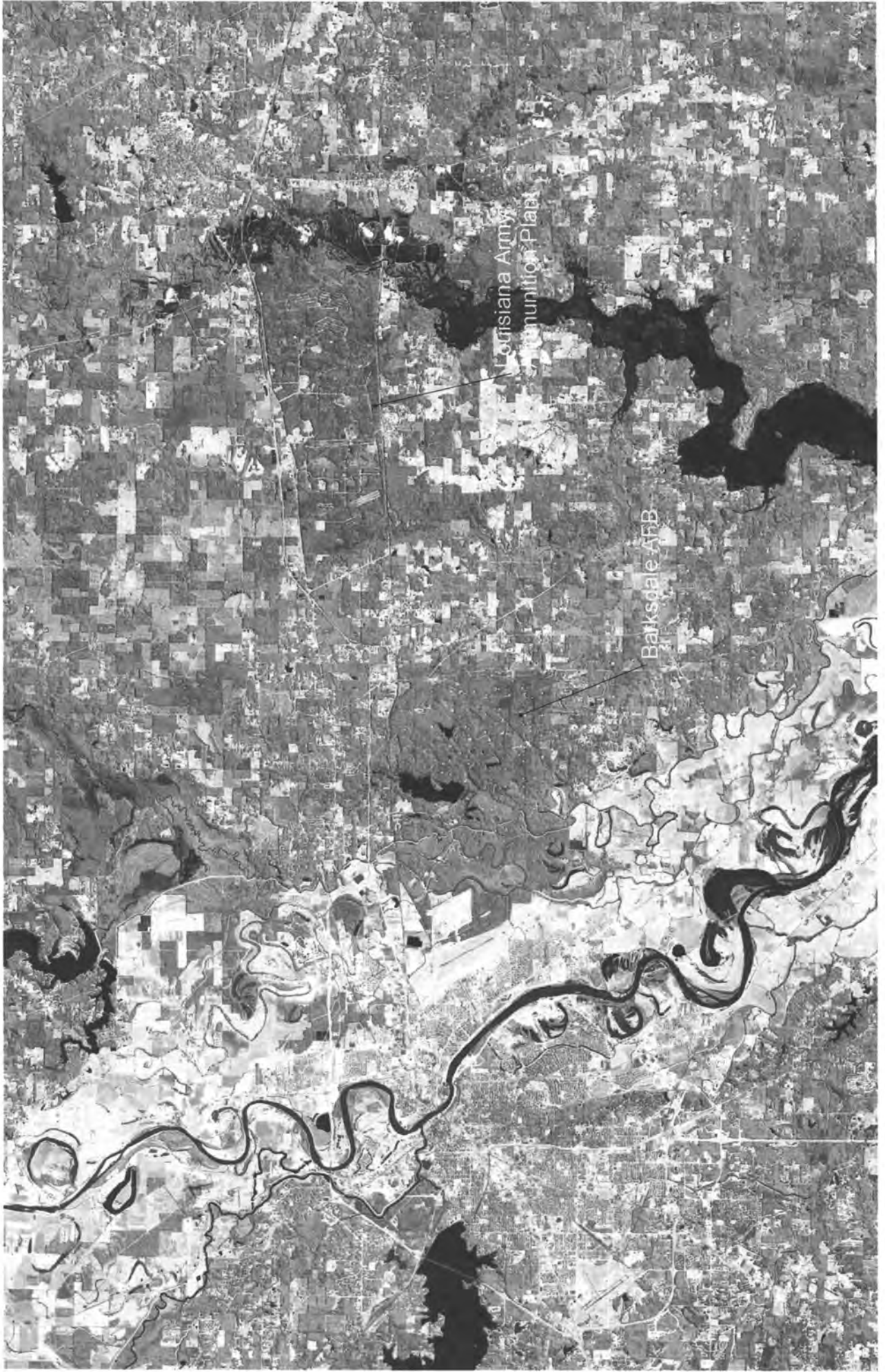


- Atokan and Morrowan Series
- Atokan and Morrowan Series, Jackfork SS
- Austin and Eagle Ford Groups
- Cambrian
- Cretaceous intrusive rocks
- Des Moines Series
- Devonian and Silurian
- Eocene Claiborne Group
- Eocene Jackson Group
- Eocene Wilcox Group
- Fredericksburg Group
- Holocene
- Lower Ordovician (Canadian)
- Middle Ordovician (Mohawkian)
- Miocene
- Mississippian
- Missourian Series
- Navarro Group
- Oligocene
- Paleocene
- Pleistocene
- Pliocene continental
- Taylor Group
- Trinity group
- Upper Cretaceous
- Washita Group
- Woodbine and Tuscaloosa groups

The Nature Conservancy® Projection : Geographic Datum: NAD 83

Note: a 30-mile buffer has been provided around the ecoregion to better illustrate geologic trends.

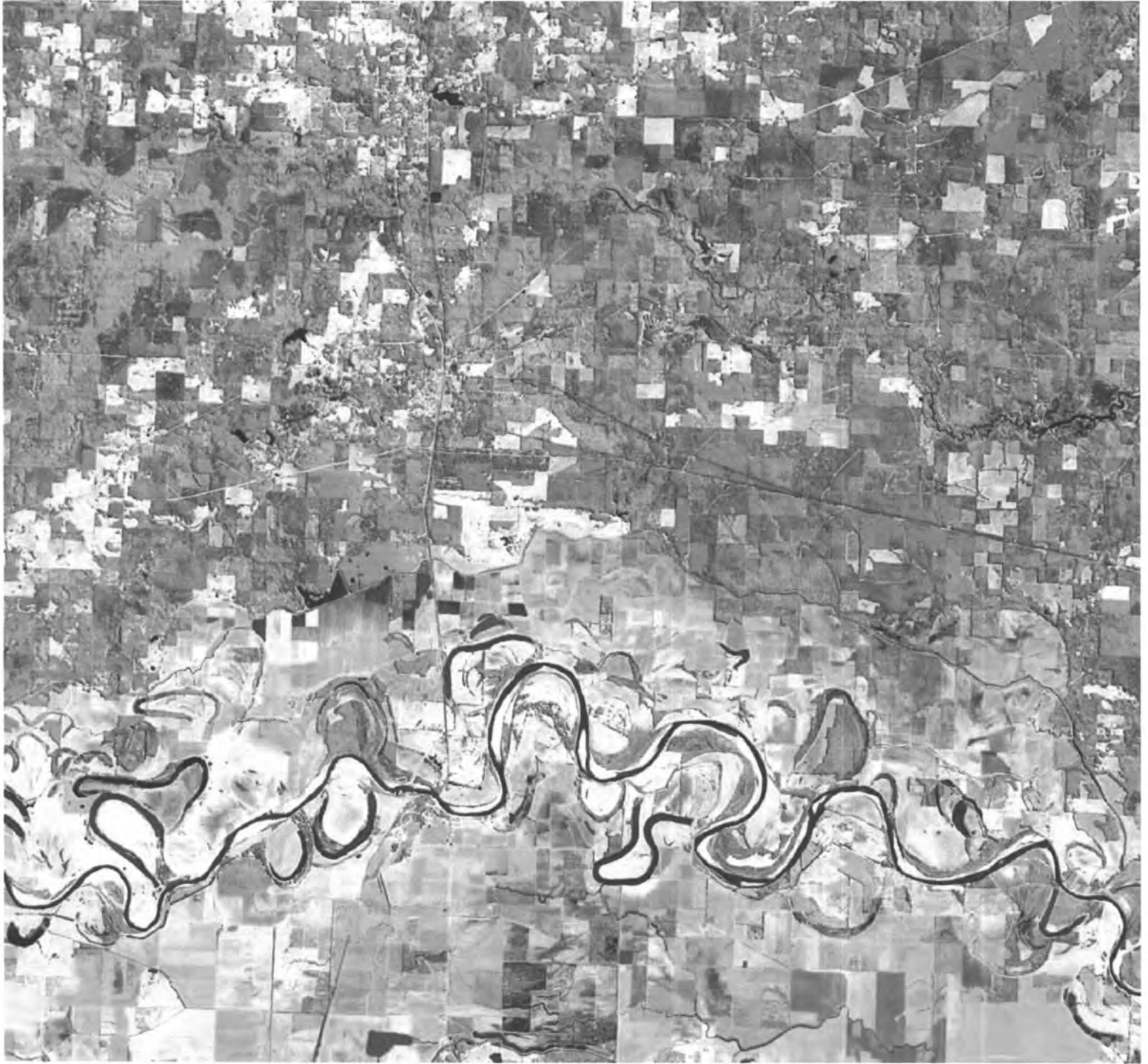
Barksdale Air Force Base and Louisiana Army Ammunition Plant 1999 Enhanced Satellite Imagery



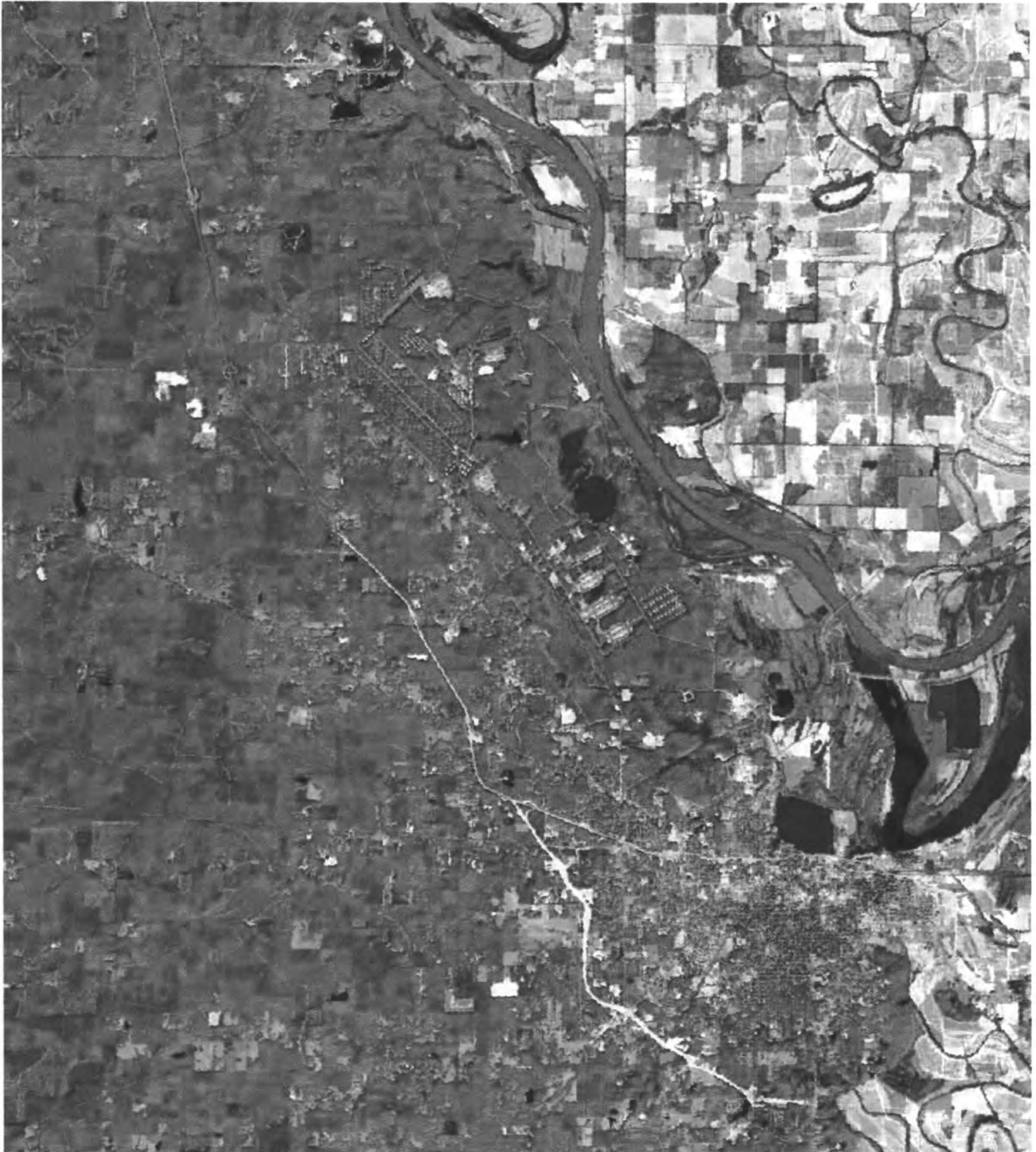
**Red River Army Depot and Lone Star Army Ammunition Plant
1999 Enhanced Satellite Imagery**



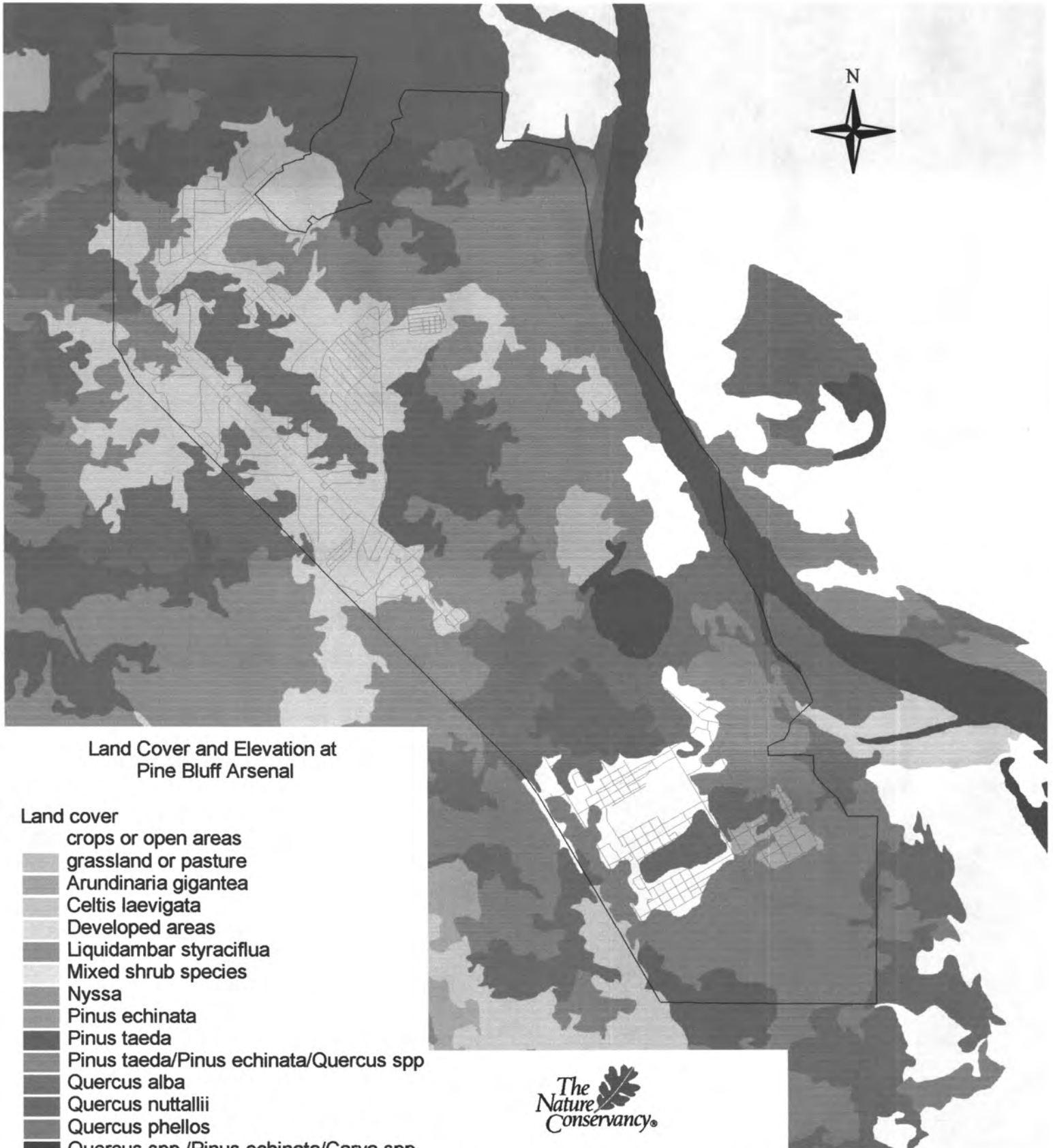
Naval Space
Command,
Lewisville
1999 Enhanced
Satellite Imagery



Pine Bluff Arsenal Area
1999 Enhanced Satellite Imagery




















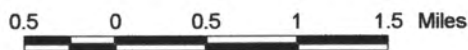
Land Cover at Pine Bluff Arsenal



Land Cover and Elevation at Pine Bluff Arsenal

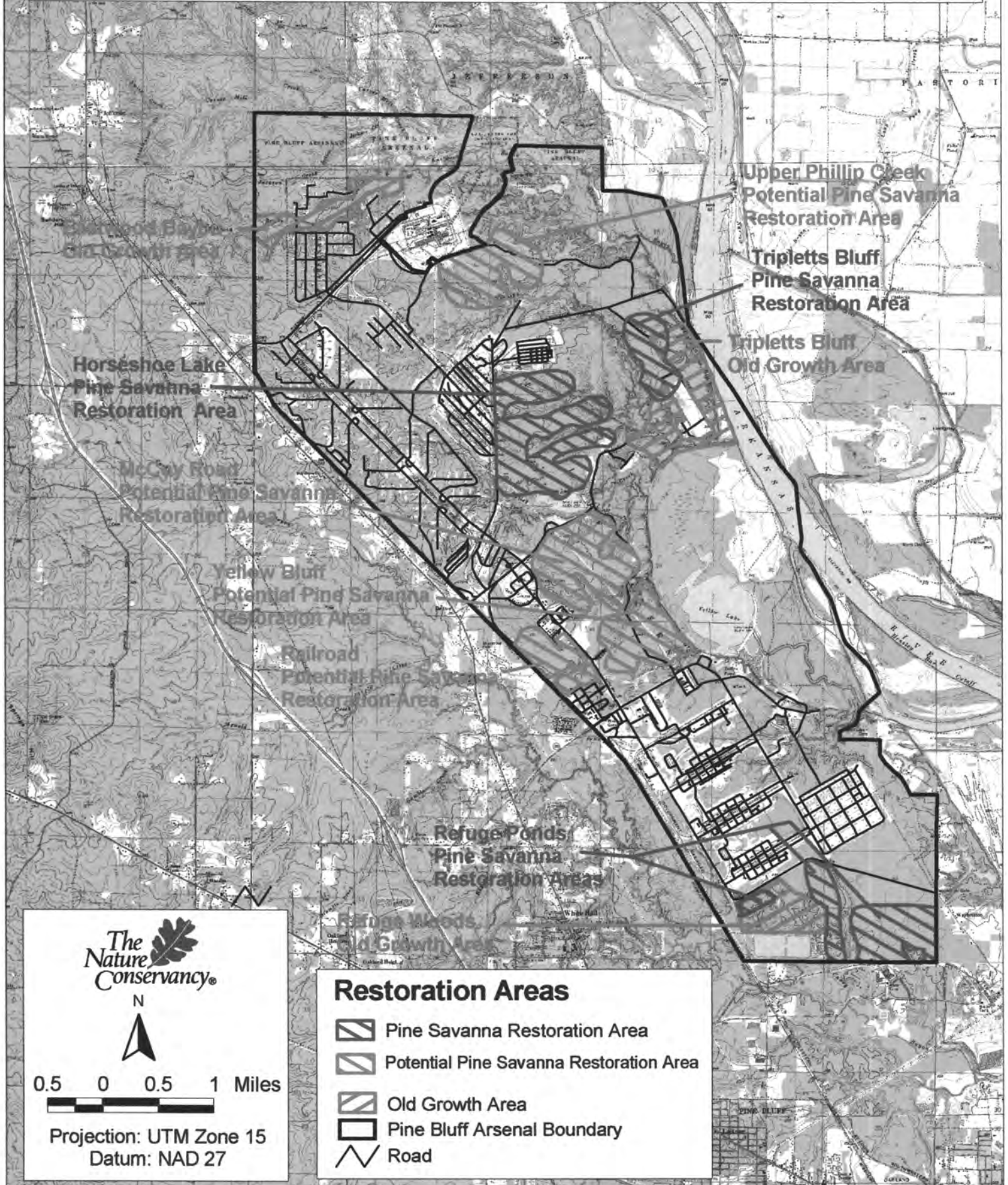
Land cover

-  crops or open areas
-  grassland or pasture
-  *Arundinaria gigantea*
-  *Celtis laevigata*
-  Developed areas
-  *Liquidambar styraciflua*
-  Mixed shrub species
-  *Nyssa*
-  *Pinus echinata*
-  *Pinus taeda*
-  *Pinus taeda*/*Pinus echinata*/*Quercus* spp
-  *Quercus alba*
-  *Quercus nuttallii*
-  *Quercus phellos*
-  *Quercus* spp./*Pinus echinata*/*Carya* spp.
-  *Taxodium distichum*
-  Water



Projection: UTM Zone 15
Datum: NAD 27

Pine Bluff Arsenal Pine Savanna Restoration Areas





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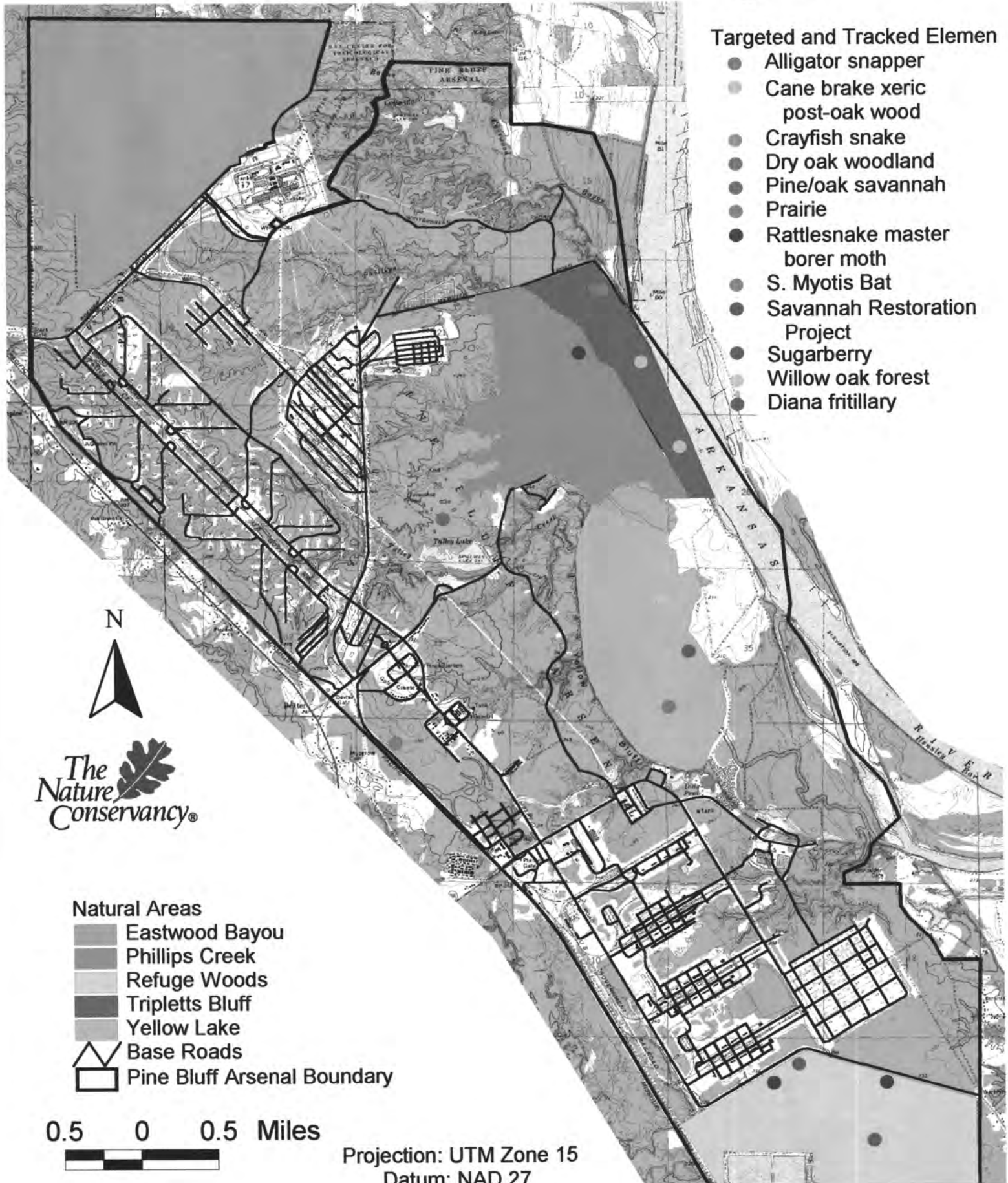
0.5 0 0.5 1 Miles

Projection: UTM Zone 15
Datum: NAD 27

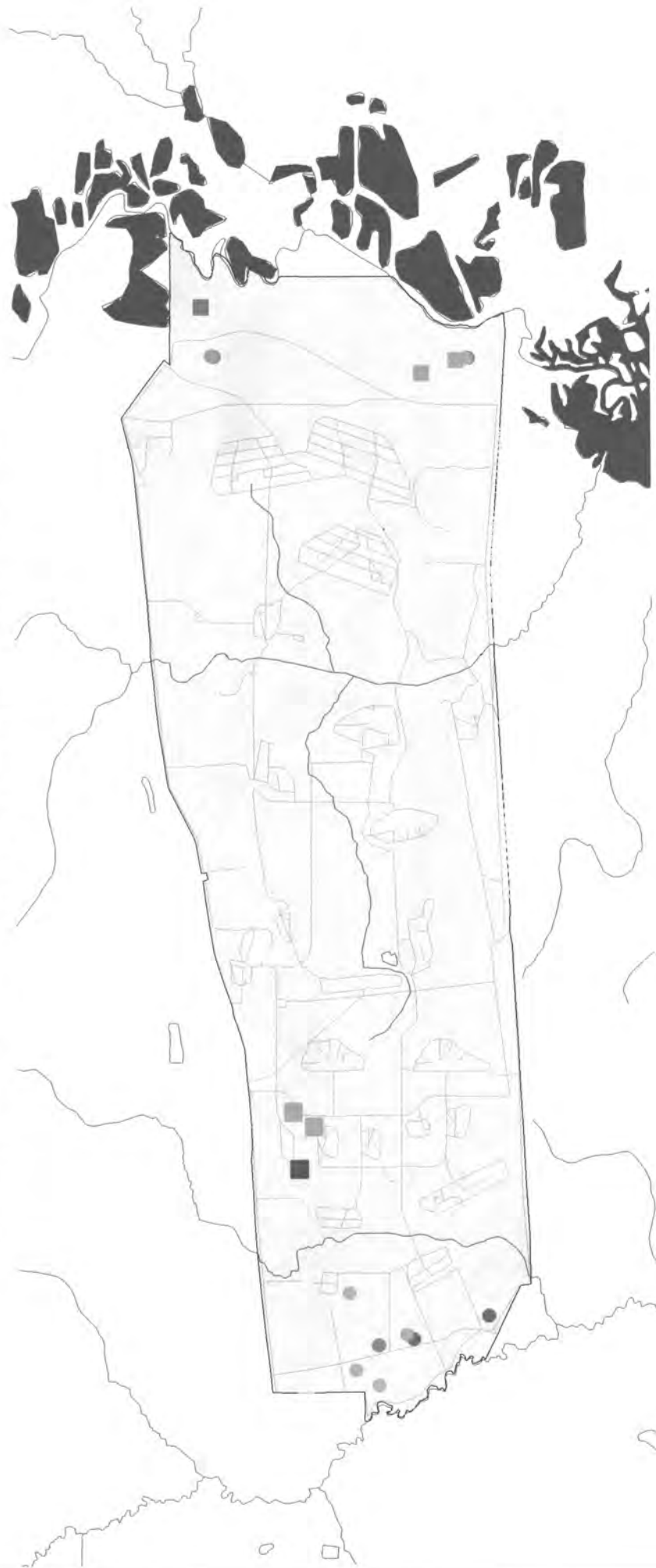
Restoration Areas

-  Pine Savanna Restoration Area
-  Potential Pine Savanna Restoration Area
-  Old Growth Area
-  Pine Bluff Arsenal Boundary
-  Road

Pine Bluff Arsenal Tracked Species, Natural Areas, and Ecoregional Targets



Tracked Species at Louisiana Army Ammunition Plant



Projection: Geographic
Datum: NAD 83

0.6 0 0.6 1.2 1.8 Miles



TNC Ecoregional Targets
known from Louisiana Army
Ammunition Plant

- Swainson's Warbler
- Red-cockaded woodpecker
- Bird-voiced treefrog

State Tracked Species at LAAP

- Celestial Lilly
- Large Whorled Pogonia
- Northern Burmannia
- Prairie Acacia
- Prairie Parsley
- Cougar

□ Barksdale AFB Boundary

~ Barksdale AFB base roads

















~ Stream Reaches

■ Water Bodies

Barksdale Air Force Base Natural Areas



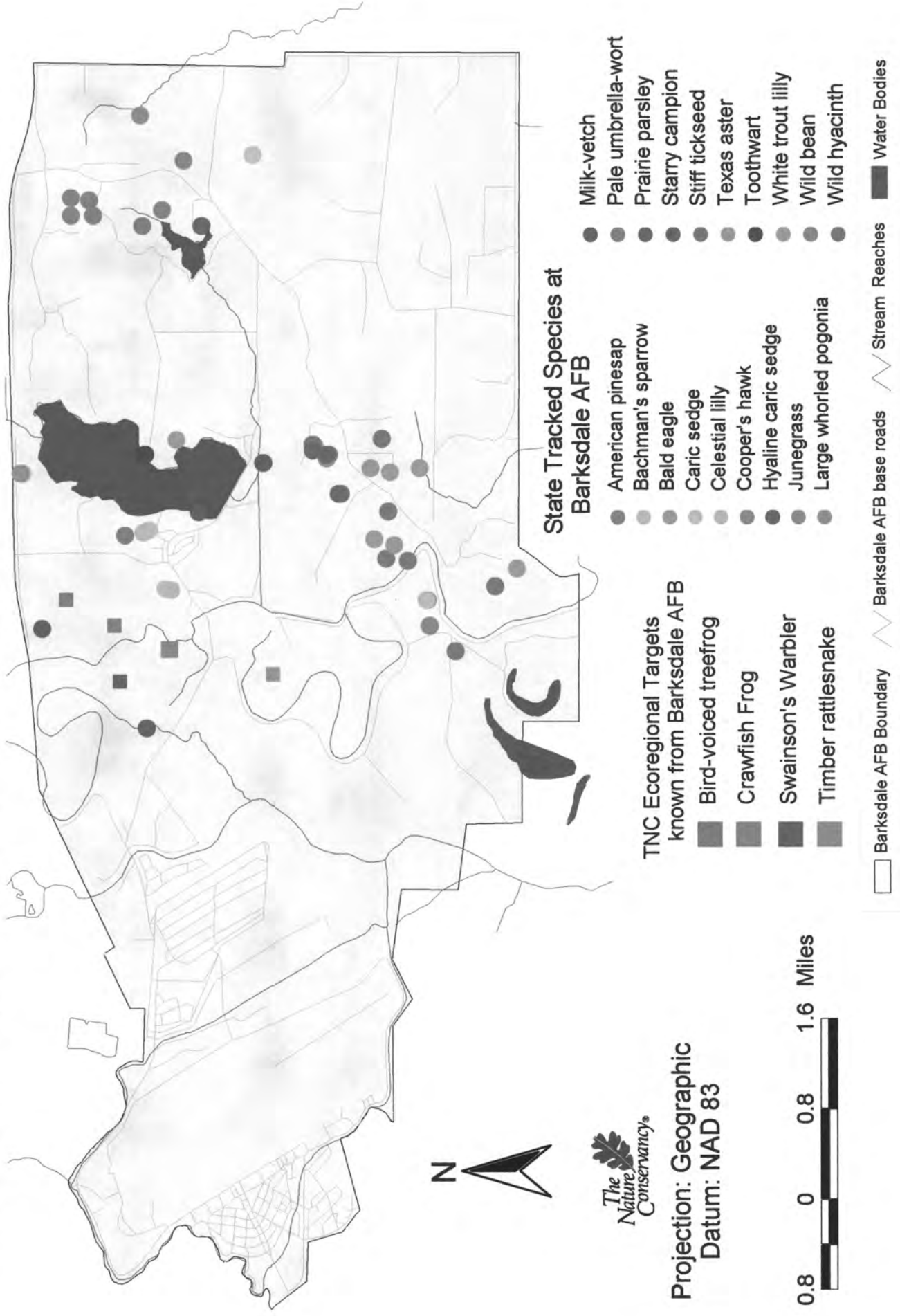
Natural Areas

-  Austin Pond Natural Area
-  East Reservation Housing Natural Area
-  Escarpment Natural Area
-  Firetower Seep Natural Area
-  Flag Lake Point Natural Area
-  Moon Lake Natural Area
-  North Harmon Lake Natural Area
-  North Red Chute Bluffs Natural Area
-  Nutmeg Woods Natural Area
-  Shortleaf Pine Demonstration Forest
-  The "Island" Natural Area
-  Willow Oak Flat Natural Area
-  Rivers and Lakes
-  Stream Reaches
-  Barksdale Air Force Base
-  Road



Projection: Geographic
Datum: NAD83

Tracked Species at Barksdale Air Force Base



Red River Army Depot and Lone Star Army Ammunition Plant Potential Natural Areas



Potential Natural Areas

-  Creek Bottom/Hardwood Bottomland
-  Mixed Pine/Hardwood
-  Open Grassland Prairie
-  Open Pine Woodland
-  Pine Plantation
-  Rivers and Lakes
-  Stream Reaches
-  Red River Army Depot and Lone Star Army Ammunition Plant
-  Road



Projection: Geographic
Datum: NAD83

Louisiana Army Ammunition Plant Natural Areas









Projection: Geographic

Datum: NAD 83 0.5 0 0.5 1 Miles

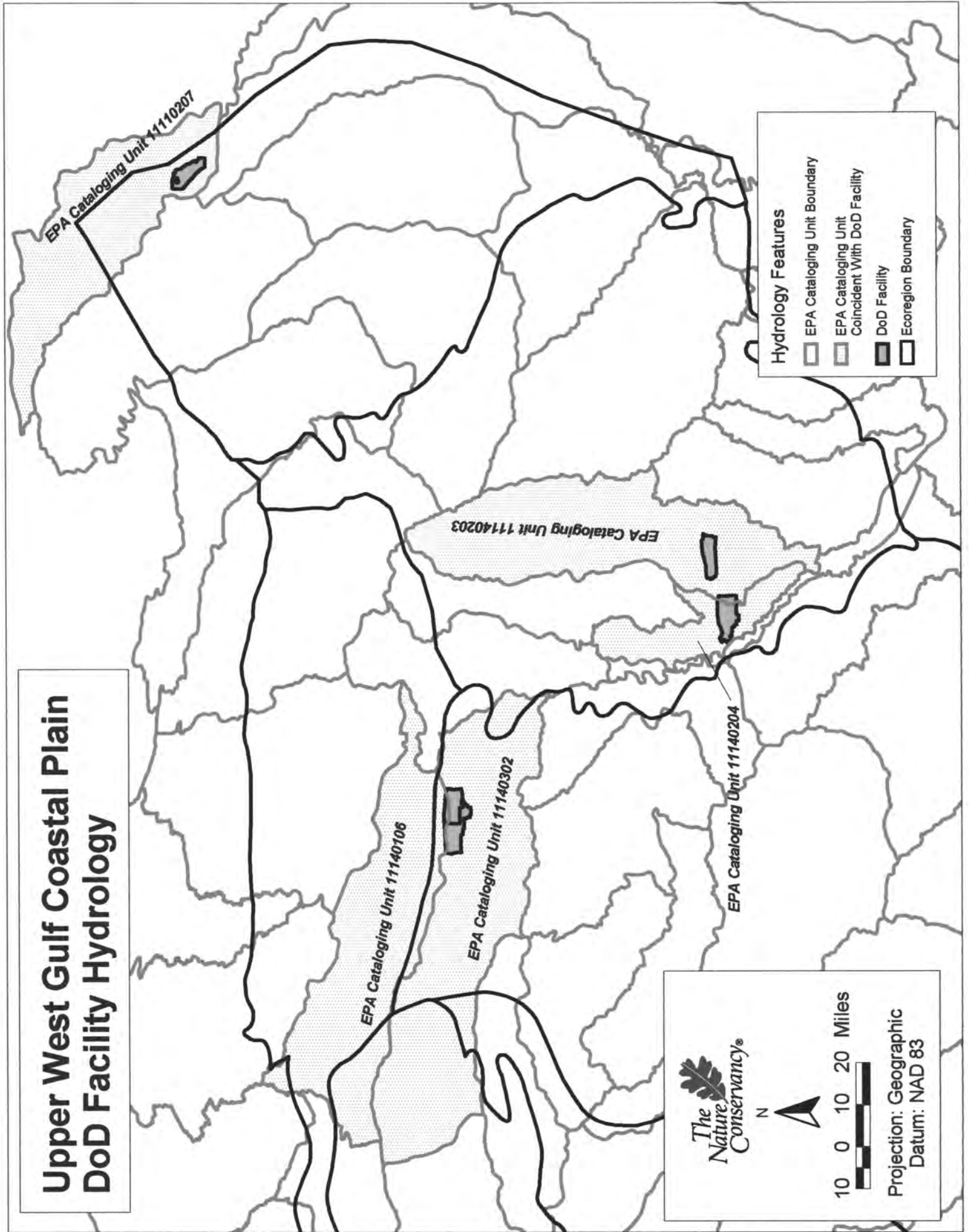


Natural Areas

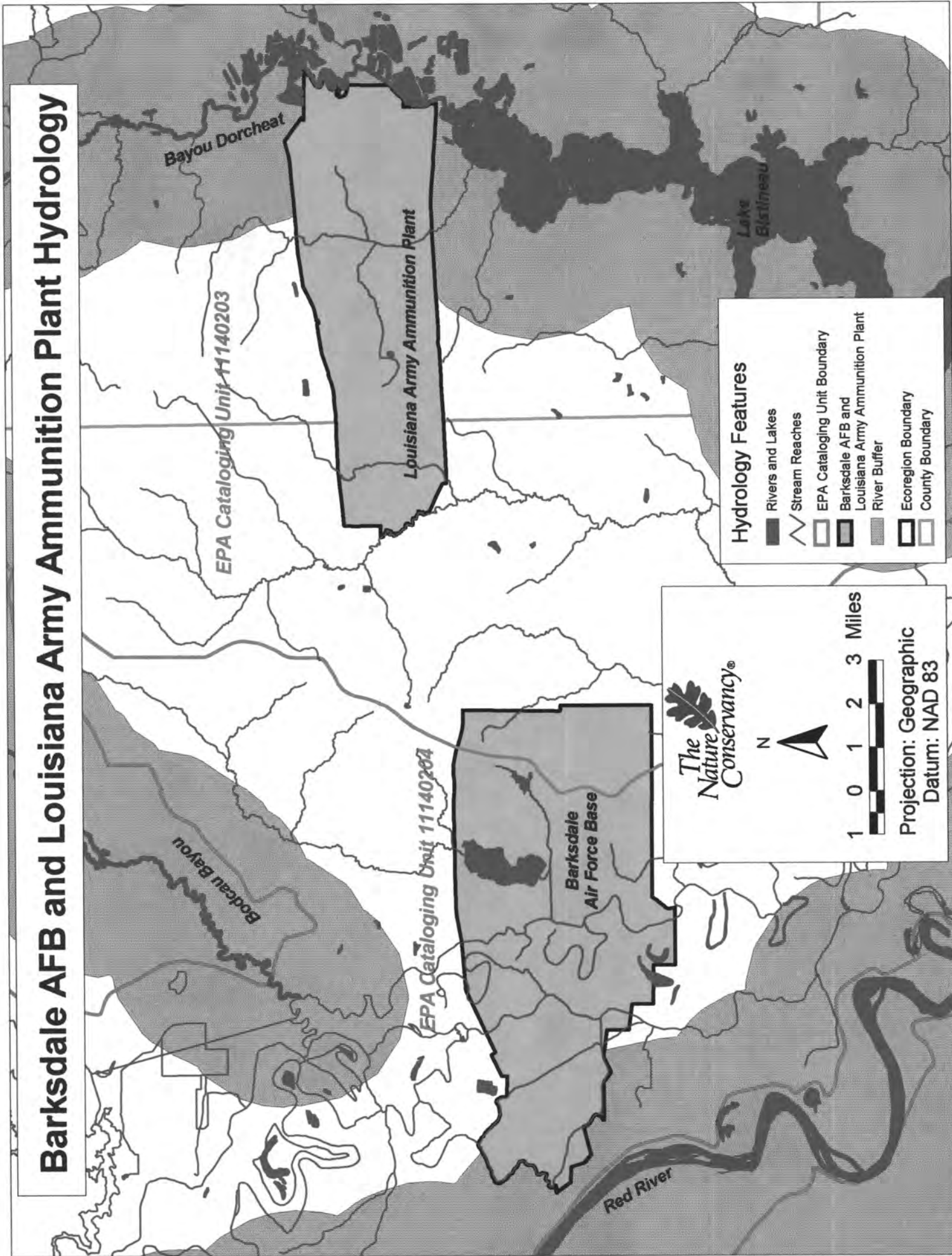
-  Bayou Dorcheat Natural Area
-  Boone Creek Natural Area
-  Hardwood Slope Natural Area
-  RCW Natural Area
-  Ridge and Swale Natural Area
-  Willow Oak Natural Area

-  Base Boundary
-  Base Roads
-  Water Bodies
-  Stream Reaches

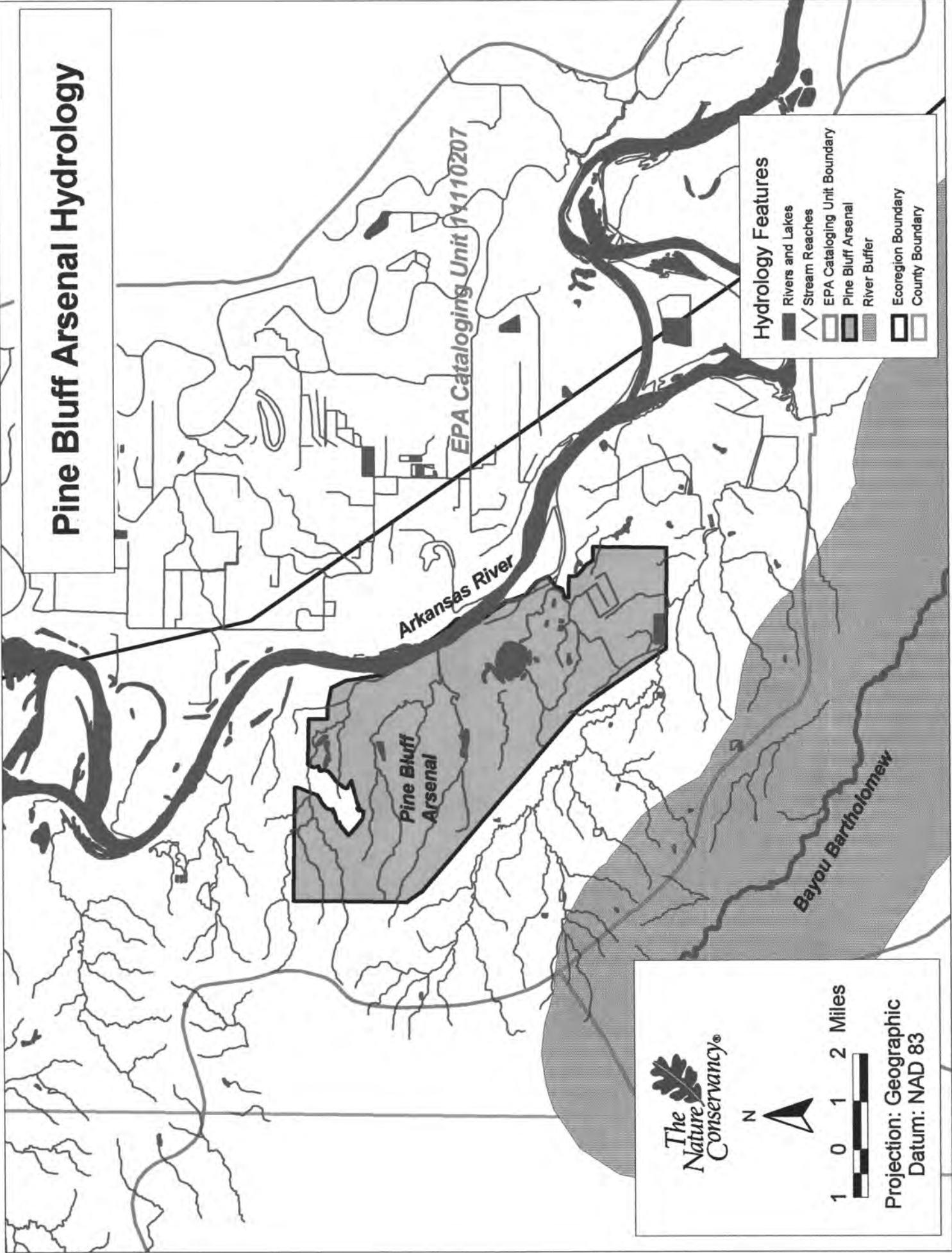
Upper West Gulf Coastal Plain DoD Facility Hydrology



Barksdale AFB and Louisiana Army Ammunition Plant Hydrology





Pine Bluff Arsenal Hydrology




Hydrology Features

- Rivers and Lakes
- Stream Reaches
- EPA Cataloging Unit Boundary
- Pine Bluff Arsenal
- River Buffer
- Ecoregion Boundary
- County Boundary

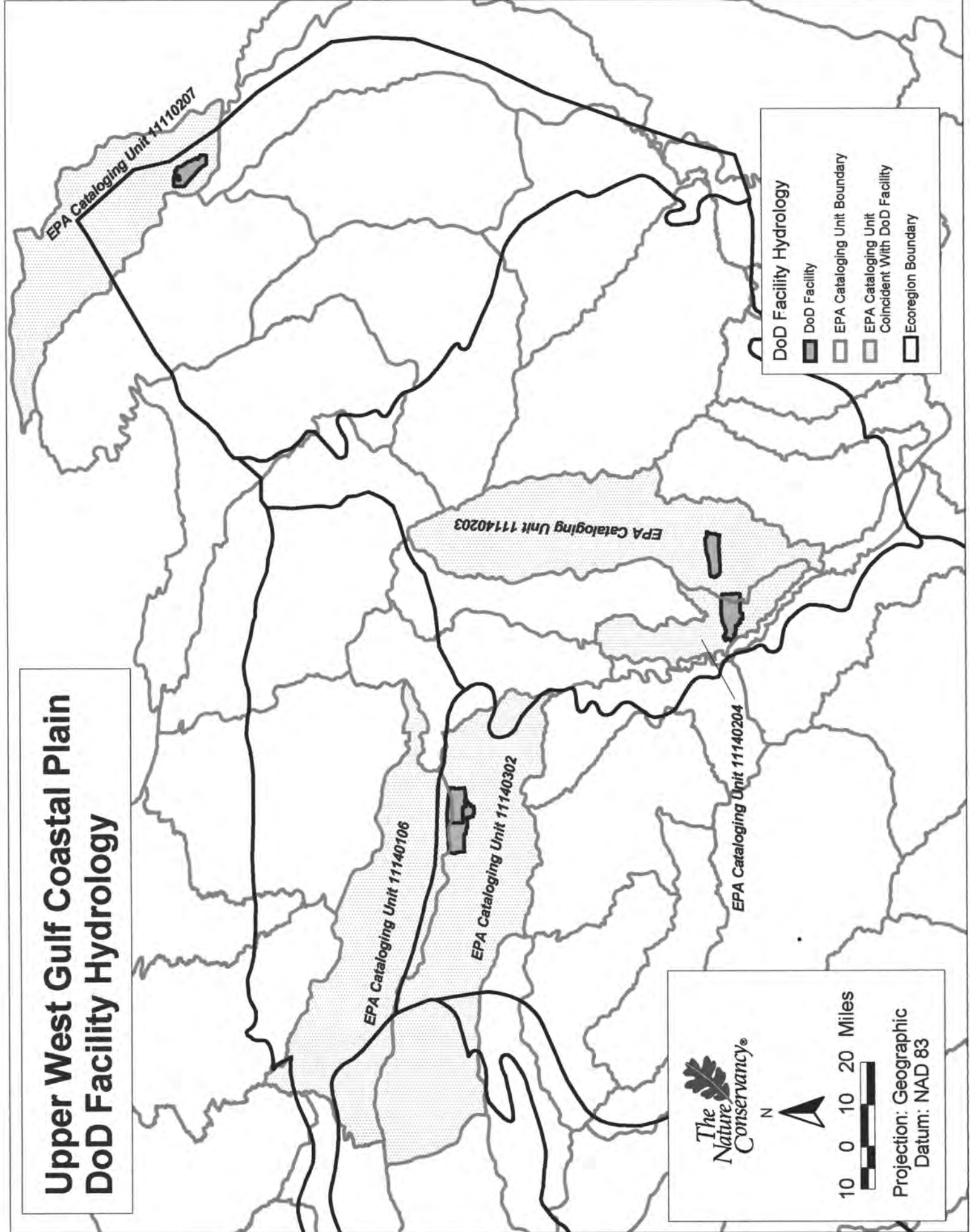
 The Nature Conservancy®

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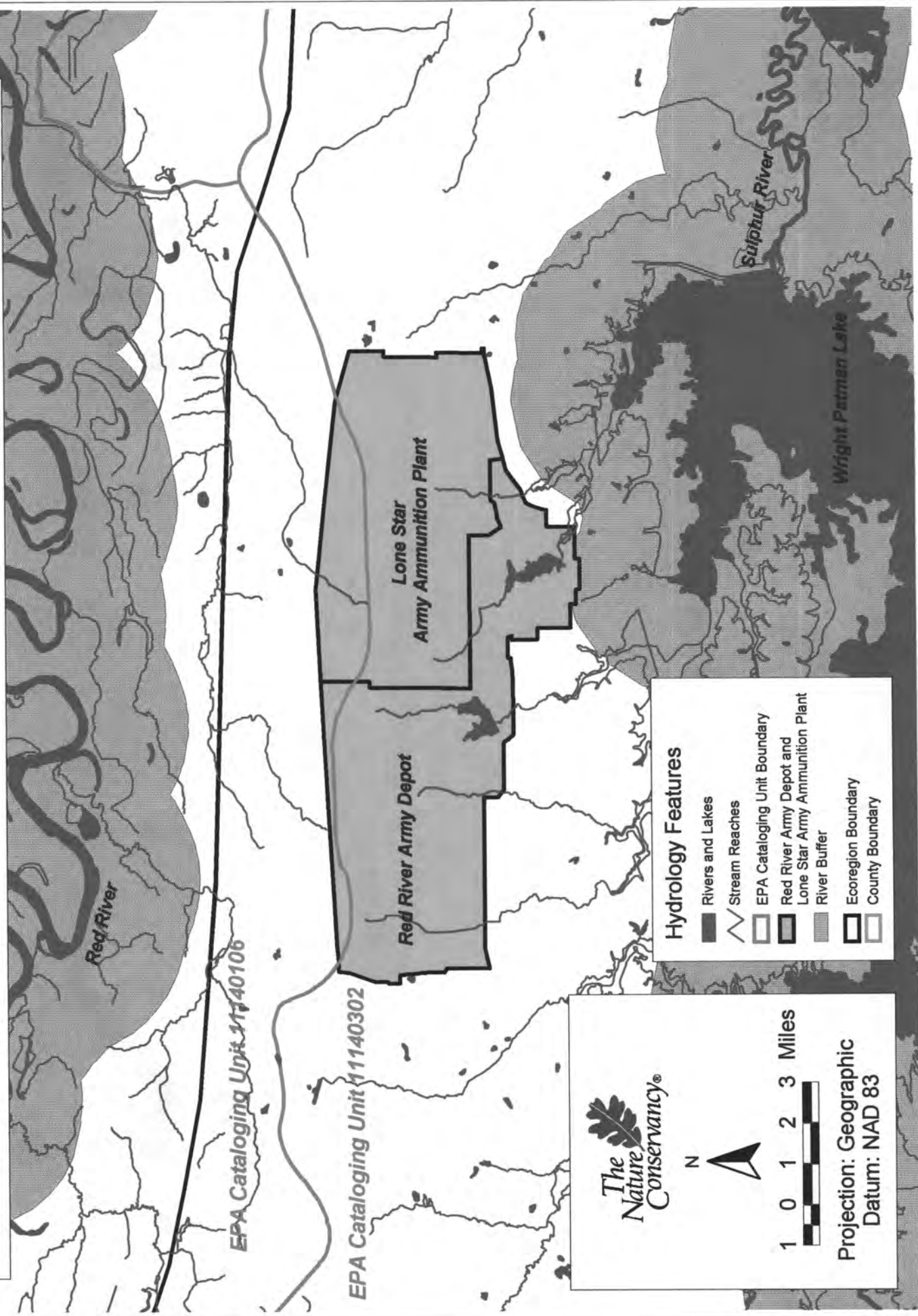
1 0 1 2 Miles 

Projection: Geographic
Datum: NAD 83

Upper West Gulf Coastal Plain DoD Facility Hydrology




Red River Army Depot and Lone Star Army Ammunition Plant Hydrology





Hydrology Features

-  Rivers and Lakes
-  Stream Reaches
-  EPA Cataloging Unit Boundary
-  Red River Army Depot and Lone Star Army Ammunition Plant
-  River Buffer
-  Ecoregion Boundary
-  County Boundary



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1 0 1 2 3 Miles

Projection: Geographic
Datum: NAD 83

EPA Cataloging Unit 11140106

EPA Cataloging Unit 11140302

Red River Army Depot

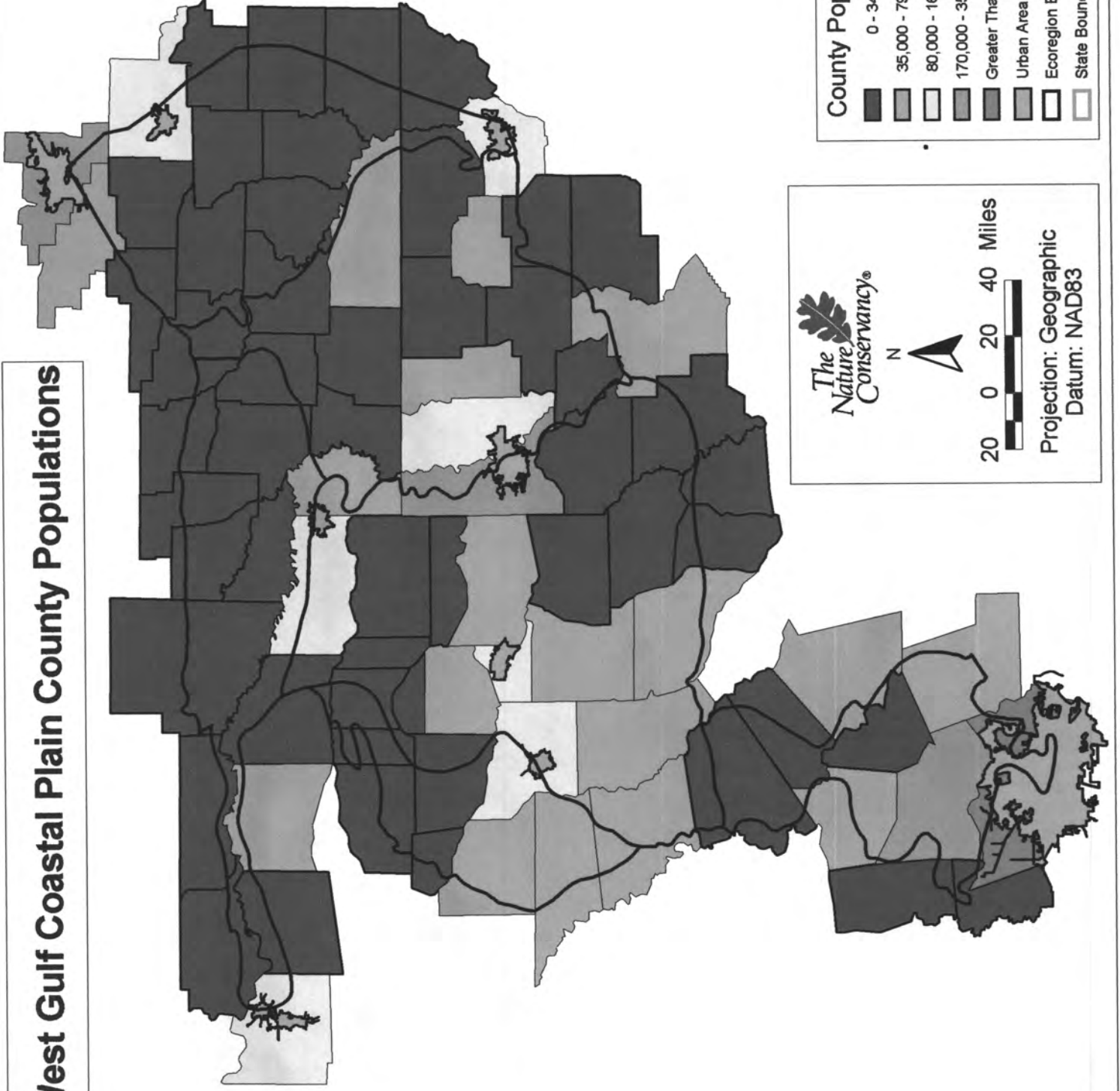
Lone Star Army Ammunition Plant

Red River

Sulphur River

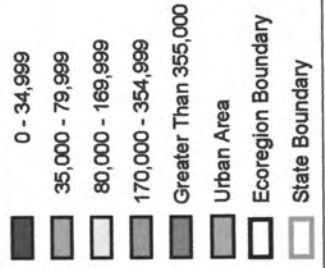
Wright Patman Lake

Upper West Gulf Coastal Plain County Populations

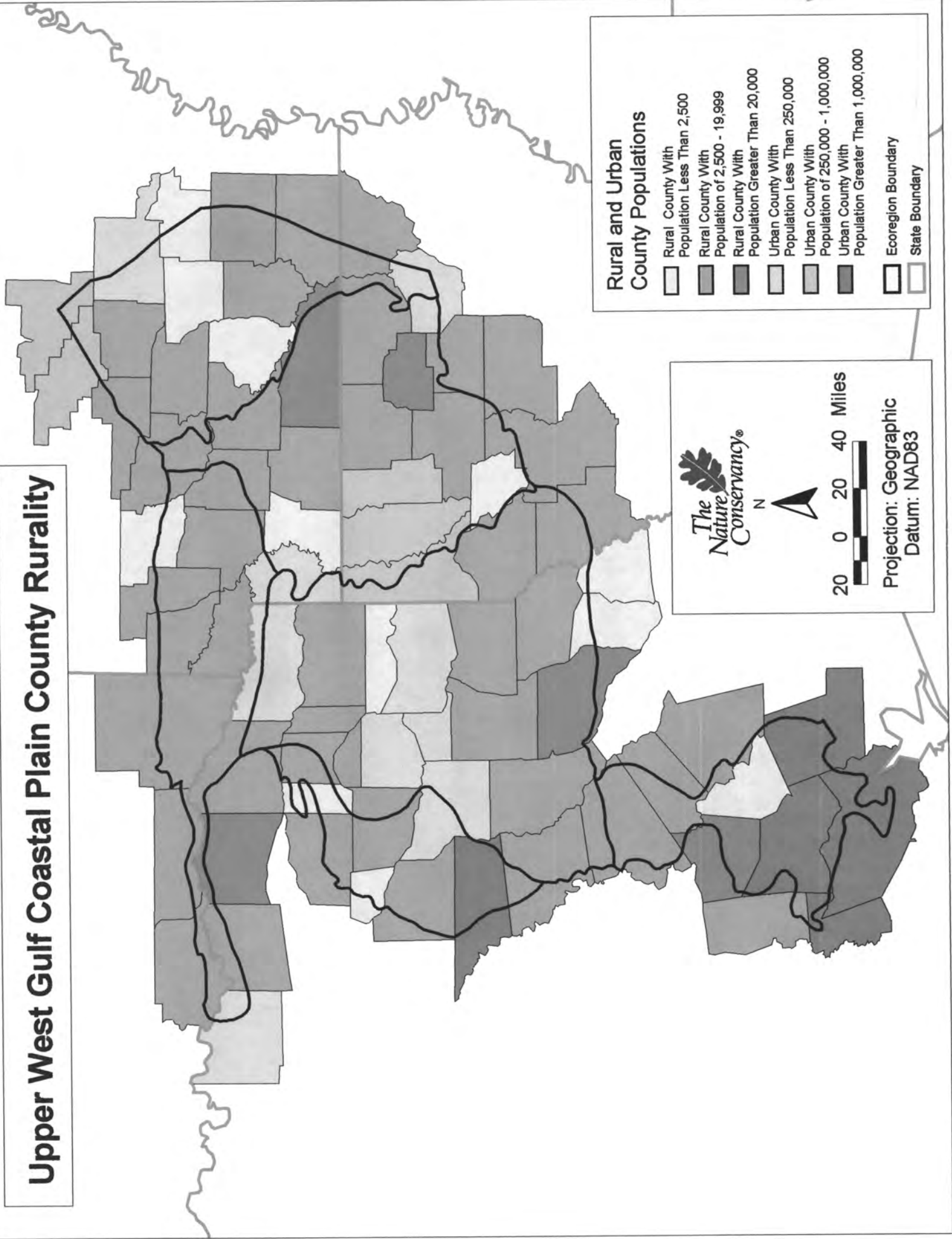


Projection: Geographic
Datum: NAD83

County Population



Upper West Gulf Coastal Plain County Rurality



Rural and Urban County Populations

- Rural County With Population Less Than 2,500
- Rural County With Population of 2,500 - 19,999
- Rural County With Population Greater Than 20,000
- Urban County With Population Less Than 250,000
- Urban County With Population of 250,000 - 1,000,000
- Urban County With Population Greater Than 1,000,000
- Ecoregion Boundary
- State Boundary



20 0 20 40 Miles



Projection: Geographic
Datum: NAD83

Upper West Gulf Coastal Plain County Poverty

