ENVIRONMENTAL INVESTIGATIONS AT THE PADUCAH GASEOUS DIFFUSION PLANT AND SURROUNDING AREA McCRACKEN COUNTY, KENTUCKY

VOLUME III

THREATENED AND ENDANGERED SPECIES INVESTIGATION

Prepared by

Department of the Army
Waterways Experiment Station, Corps of Engineers
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and

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Engineer District Nashville
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Volume 3 of 5

May 1994
Final Report

Prepared for

Department of Energy
Oak Ridge Operations
Paducah Site Office
P.O. Box 1410
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Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	0.405	hectares
feet	0.3048	meters
inches	2.540	centimeters
miles	1.609347	kilometers
square feet	0.093	square meters

Contents

Preface

This document provides results of one of four studies conducted to describe environmentally sensitive areas near the Paducah Gaseous Diffusion Plant properties at Paducah, Kentucky. This report presents the methods and results of the identification and evaluation of threatened and endangered species habitat on the Department of Energy and Tennessee Valley Authority reservations and selected areas not included as part of either reservation. A planning level threatened and endangered species characterization is discussed.

This work was performed by the U.S. Army Engineer Waterways Experiment Station (WES). The report was prepared by Drs. Wilma Mitchell and M. R. Kress of the Environmental Laboratory (EL). Dr. Kress was the WES Project Coordinator.

The work was conducted under the direct supervision of Mr. Hollis Allen, Acting Chief of the Stewardship Branch. General supervision for the study was provided by Mr. Roger Hamilton, Acting Chief, Natural Resources Division, EL, and Dr. John Harrison, Director, EL.

The purpose of the WES environmental investigations was to support PGDP's National Environmental Policy Act (NEPA) compliance program. These investigations provide current information about environmentally sensitive areas on the PGDP reservation and support the development of environmental impact statements planned for the PGDP site. These investigations also support current DOE regulations (10 CFR 1022) which implement Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands), and support DOE to comply with Section 106 of the National Historic Preservation Act and the Endangered Species Act of 1973.

The results of the environmental investigation are presented in five volumes as follows:

Volume I: Executive Summary
Volume II: Wetlands Investigation
Volume III: Threatened and Endangered Species Investigation
Volume IV: Cultural Resources Investigation
Volume V: Floodplain Investigation

Director of WES during the preparation of this document was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard.

1 Introduction

The objective of this task area is to provide information on threatened and endangered (T/E) plant and animal species on the Paducah Gaseous Diffusion Plant (PGDP). The area covered by this study is shown in Figure 1. The area inside the security fence was excluded from the study.

Lists of Federal and state T/E species known to be on or in the vicinity of PGDP were used to determine potential species for investigation on the study area. The Kentucky State Nature Preserve Commission (KSNPC) Natural Heritage Program provided a list of plant and animal species that it considers to be endangered, threatened, and of special concern in Kentucky; this list also denotes which species are Federally listed. Reliable sitings of T/E species are maintained in a current data base from which information can be extracted for county and other unit locations. Two listings of Federal and state T/E species were requested and received from the KSNPC: (1) Those reported from McCracken County and Ballard County (Appendix A, Table A1); and (2) Those reported from the PGDP (Appendix A, Table A2). The KSNPC also provided geographic coordinates of sitings on the PGDP. Figure 2, developed using information provided by the KSNPC, shows T/E siting locations as of 15 Dec 1992. Upon request, the Region 3 field office of the U.S. Fish and Wildlife Service sent a letter suggesting Federally listed species that could occur on PGDP; these were also investigated.

A copy of "Endangered and Threatened Wildlife and Plants" (50 CFR 17.11 & 17.12), published 29 August 1992, was requested from the U.S. Fish and Wildlife Service Reference Service. Although this listing is worldwide in scope, it is frequently referred to as the "Federal List" because Federal agencies must fulfill compliance requirements under the Endangered Species Act of 1973 (ESA) for those listed species within United States boundaries. This list was used to check the latest Federal status of each species from PGDP and the vicinity. A summary of Federally and state listed species reported from PGDP is given in Table 1.

Several Federally listed species were selected for in-depth study because they have been cited from the PGDP or immediate vicinity, and agency action involving these species requires compliance with the ESA. The Indiana myotis (*Myotis sodalis*), listed as Federally endangered (LE), and the copperbelly water snake (*Nerodia erythrogaster neglecta*), Proposed Threatened (PT), have

been cited from the PGDP. Detailed species accounts and management recommendations were developed for these 2 species (Chapter 3). The same information is provided for the orange-footed pearly mussel (*Plethobasus cooperianus*) because of its recent siting in the Ohio River just outside the study area boundary (Chapter 4) and for the bald eagle (*Haliaeetus leucocehpalus*) because of the increasing potential for its nesting on the WKWMA (Chapter 4).

Species accounts were compiled and management recommendations were developed for 17 other Federally listed or candidate species reported from Ballard or McCracken Counties outside the PGDP (Chapter 4) and for 16 state-listed species sited on the PGDP (Chapter 5). Information is also provided for 59 state-listed species occurring off-site in Ballard and McCracken Counties (Chapter 6). Knowledge was sought from experts on agency compliance with the ESA, the determination of species occurrence potential at PGDP, and management recommendations. Specialists and their areas of expertise are listed in Table 2. All points of contact are listed in Table 3.

2 Compliance with the Endangered Species Act of 1973

The Endangered Species Act of 1973 requires Federal agencies to protect Federally listed threatened and endangered species and to establish a conservation program to preserve any of these species found on its lands. The most current Federal list, entitled Endangered and Threatened Wildlife and Plants, was published 23 August 1993 (50 CFR 17.11 & 17.12). Compliance with the Endangered Species Act (ESA) is required for all species on the Federal list.

Under the provisions of the ESA, each Federal agency is required to insure that agency actions are not likely to jeopardize Federally listed species or result in destruction or adverse modification of critical habitat (Section 7, PL 93-205) (16 U.S.C. §1536(a)(2) 1988). Although one of the stated purposes of the ESA is to protect ecosystems upon which listed species depend, Section 7 requirements apply only to officially designated critical habitats (50 CFR Section 17.95 and Section 17.96). However, the U.S. Fish and Wildlife Service does consider impacts to species' habitats during consultation.

"Agency action" is defined broadly as "any action authorized, funded, or carried out by" a Federal agency (16 U.S.C. §1536(a)(2) 1988). Typical agency actions that are covered by Section 7 include:

- Actions intended to conserve listed species or their habitats;
- The promulgation of regulations;
- The granting of licenses, contracts, leases, easements, rights-of-way permits, or grants-in-aid; and
- Actions directly or indirectly causing modifications to the land, water, or air (50 C.F.R. §402.02 1990).

State agencies are subject to compliance with Section 7 when they conduct activities with Federal funding or when Federal permits are required. State agencies may conduct informal consultation and prepare biological

assessments, but only Federal agencies can initiate formal consultation. It is ultimately the responsibility of the Federal agency to comply with Section 7 provisions.

To "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02 1990). Section 7 formerly stated that the actions of Federal agencies "do not" jeopardize species. In 1979 Congress changed the wording to read "not likely to jeopardize"; therefore, the regulation is less restricting, and the Secretary of the Interior is permitted to frame his decision on the best available evidence (Littell 1992).

When Congress enacted the ESA of 1973, it was aware that the greatest threat to species survival was the destruction of natural habitat (Littell 1992). Therefore, the statute forbids agency action that is likely to result in either direct or indirect alteration that appreciably diminishes the value of critical habitat for the survival and recovery of a listed species (50 CFR §402.02 1990).

Consultation

In order to avoid practices that may jeopardize the continued existence of threatened and endangered species, all Federal agencies are required to consult with the U.S. Fish and Wildlife Service (referred to as the Service). Consultation involves a "three-step process"; the first two steps serve a screening function to determine whether formal consultation is required (Littell 1992).

Step one: Informal consultation

Whenever a Federal agency plans any action, it must inquire of the Service whether a protected species "may be present" in the action area (16 U.S.C. §1536(c)(1)). This includes both listed species and those proposed to be listed.

A Federal agency (or designated non-Federal representative) may request a species list from the Service. However, the ESA does not require them to obtain a list from the Service; species lists may be obtained from any source. However, lists obtained from non-Service sources may need to be verified by the Service if the consultation proceeds to the biological assessment stage. Lists provided by the Service include candidate species; however, these species have no legal protection under the ESA, and Section 7 requirements do not apply to them. The Service asks that agencies try to avoid impacts to candidate species because they are being considered for possible listing.

Step two: Determination of effect

In accordance with the new Section 7 regulations, a Federal agency is only required to make a determination of effect on those projects not considered "major Federal actions" as defined by the ESA (i.e., those projects significantly affecting the quality of the human environment). If a project is not a major Federal action and an agency makes a "no effect" determination, their obligations under the ESA are fulfilled and the project may proceed. For projects that are not major Federal actions and for which a "may affect" determination is made, the agency may initiate formal consultation, or it may prepare a biological assessment and make a determination of "likely to adversely affect" or "not likely to adversely affect." If the Service concurs, in writing, with the latter finding, the project may proceed. Otherwise, formal consultation is required.

If a proposed project is a major Federal action, the Federal agency (or non-Federal designee) must prepare a biological assessment. The assessment may be incorporated into other environmental documents or may be completed separately. If a "no effect" determination is made and the Service concurs in writing, the project may proceed. If a "may effect" finding is made, the agency must initiate formal consultation.

The content of a biological assessment is at the discretion of the agency preparing it. However, the Service recommends that any assessment contain the results of onsite surveys by qualified biologists, literature reviews, interviews with species specialists, and any other studies needed to adequately assess potential project impacts (Dr. Lee Barclay, pers. comm., U.S. Fish and Wildlife Service, 22 March 1994).

Step three: Formal consultation

If the biological assessment shows that the proposed action may likely affect an endangered or threatened species or its habitat, the Federal Agency must enter into formal consultation with the Service (50 C.F.R. §402.14 1990). If the species has been officially proposed for listing (but is not yet listed), the agency is not required to enter into formal consultation but only to confer with the Service (16 U.S.C §1536(a)(4)(1985)).

It is the responsibility of the Federal agency to initiate the consultation by submitting a written request to the Service. The requesting agency must also provide a copy of the agency's biological assessment as well as detailed data (Littell 1992). The formal consultation involves discussion between the Federal Agency and the Service to identify the impacts of agency action on the species or its habitat, to study possible modifications to the proposed action, and to determine whether there are any reasonable and prudent alternatives to the action that would be in compliance with Section 7(a)(2) and at least partially fulfill the Federal Agency's objectives (Hunter 1991). During consultation (including informal consultation), the Federal agency, State agency, or

permit applicant may not make any irreversible or irretrievable commitments of resources (e.g., acquisition of land, letting of contracts, purchase of equipment) that would preclude the implementation of reasonable and prudent alternatives to avoid jeopardy (Section 7(d)).

After completion of formal consultation, the Service issues a biological opinion, which is based upon the best scientific and commercial data available. The issuance of the biological opinion terminates the formal consultation (16 U.S.C §1536(b)(1988). The Service tries to complete formal consultation within 90 days, but the ESA provides up to 90 days for "consultation" and another 45 days for issuance of a biological opinion, for a maximum total formal consultation period of 135 days.

Informal consultation

Because formal consultation can be a long and arduous process, an informal consultation is useful for proposed actions that may benefit the species or not adversely affect it (Hunter 1991). In this case, the Federal Agency has already determined that the species is present and may have reason to believe that the proposed action can be accomplished without adversely impacting the species. Therefore, the agency chooses to involve the Service very early in the planning stages to make sure that all factors have been considered. There is no time limit for informal consultation, and the Federal Agency and the Service may actually be in continual informal consultation on long-term proposed actions.

The Service recommends that informal consultation be initiated as early as possible in the project planning stages (Dr. Lee Barclay, pers. comm., U.S. Fish and Wildlife Service, 22 March 1994). The more time it has to work with an agency, the easier it is to resolve potential conflicts. Most controversies and conflicts between projects and the ESA occur as the result of an agency waiting until late in the planning stages or until final plans have been approved before initiating consultation.

The Biological Opinion

The Service is required to provide a biological opinion to the Federal Agency within 45 days after the formal consultation period has ended (Hunter 1991). If the Service finds that the requesting agency's action is likely to jeopardize a listed species or to degrade its critical habitat, the Service issues a "jeopardy" biological opinion. However, if the Service finds that the proposed action is not likely to jeopardize or degrade, the Service issues a "no jeopardy" biological opinion (50 C.F.R. §402.14(h)(1990). In this case, the agency may proceed with its program or project.

Whenever the Service issues a "jeopardy" biological opinion, it also recommends "reasonable and prudent alternatives" to the action that would be

in compliance with Section 7(a)(2) and at least partially fulfill the Federal Agency's objectives (Hunter 1991). Measures to "minimize and mitigate" the impact of the action on the endangered species may allow the agency to proceed with the project. Strong conservation plans to protect the listed species may also provide the alternatives that the Service suggests. If "jeopardy" cannot be avoided, the Federal Agency must apply for an exemption from the Committee before the agency can undertake its proposed action. However, adherence to the recommended alternatives should preclude the need for exemption. Since the ESA was passed in 1973, tens of thousands of projects have undergone informal Section 7 consultation; only a small percentage have proceeded to formal consultation, and only three have resulted in application for exemption (Dr. Lee Barclay, pers. comm., U.S. Fish and Service, 22 March 1994). The Service has an excellent record of working with agencies to see that project objectives are met and listed species are protected.

Application to the PGDP

The information provided in this report describes the Federally listed species that have been reported from the PGDP area or have strong potential for existing there, defines their habitat requirements, and shows maps of their known and potential habitats. It also addresses Federal species reported from Ballard and McCracken Counties that have potential for inhabiting the PGDP area. Recommendations have been made for protecting these habitats.

If agency actions are planned in habitats or potential habitats of these Federally listed species, compliance with the ESA is required. The candidate species presented in this report may be listed within a few years; therefore, the same information has been given for candidate species as for those that are currently on the Federal list. If any activities are planned in the areas mapped for the endangered or threatened species now known to exist on the PGDP area or for which there is potential habitat, the Service must be contacted and the process of compliance must be put into effect. If the species that would be affected are candidate species, the Service should be contacted to confer on an informal basis.

The information furnished in this report is pertinent to and should be included in future biological assessments. It is not a biological assessment in itself. The biological assessment is conducted to determine the effects of a specific agency action on a Federally endangered or threatened species.

Literature Cited

Hunter, W. (1991). Managing for RCW on Federal lands. Report accompanying panel presentation at DoD Red-cockaded Woodpecker Management Workshop, Marine Corps Base Camp Lejeune, N. C., 3-5 April. 14 pp.

Littell, R. (1992). Endangered and Other Protected Species: Federal Law and Regulation. The Bureau of National Affairs, Inc., Washington, D.C. 185 pp. and appendices.

3 Federally Listed or Candidate Species Reported from the PGDP

The two species discussed in this chapter are the only Federally listed or candidate species that have been reported from the PGDP. For each of these is provided a species account, management recommendations, siting map, and potential habitat map. Compliance with the Endangered Species Act of 1973 (ESA) is required if any project activity is planned that could affect one of these species or its potential habitat.

Indiana Myotis

The Indiana bat (*Myotis sodalis*) is a Federally listed endangered species (Federal Register 32 FR 4001). A single male myotis was found west of Bayou Creek Ridge State Natural Area (SNA). It was netted about 0.1 air mile southeast of the end of the road in Bayou Creek Woods, which consists of approximately 400 hectares (1,000 acres) of bottomland hardwoods and includes the SNA. (See #17 - Fig. 2, Table A2.)

Description

The Indiana bat is a medium-sized myotis that was first described as a new species by Miller and Allen (1928). Its dorsal fur is usually a dull grayish chestnut color, whereas the ventral fur is pinkish to cinnamon with the basal portions appearing slaty. The length of the forearm is 3.6 cm to 4.1 cm (1.4 in. to 1.6 in.), the wingspread is 24 cm to 27 cm (9.4 in. to 10.6 in.), and the heel of the foot is approximately 1.6 cm (0.6 in.) long with a definite keel. The wing membrane is attached at the base of the toes (Mississippi Museum of Natural Science, Undated). This myotis weighs from 7 g to 9 g (0.2 oz to 0.3 oz)(Burt and Grossenheider 1976).

The Indiana bat closely resembles the little brown myotis (*Myotis lucifugus*) and is difficult to distinguish from it in the field. The best distinguishing

characteristics are coloration and the heel of the foot. The brown fur of the latter has long glossy tips that produce a characteristic glossy sheen, and the heel has no definite keel (Burt and Grossenheider 1976).

Distribution

The distribution of the Indiana myotis is associated with the major cavernous limestone areas and areas just north of cave regions in the midwestern and eastern United States (Hall 1962). It occurs from the western edge of the Ozark Plateau in Oklahoma, north to Iowa and southwestern Wisconsin, east to New Hampshire, and south to northern Alabama with disjunct records from northwestern Florida (Fig. 3). In summer the Indiana myotis is apparently absent south of Tennessee; in winter it is apparently absent from Michigan, Ohio and northern Indiana where suitable caves and mines for hibernation sites are unknown (Barbour and Davis 1969).

Behavior

Indiana bats hibernate in caves and mines (hibernacula) during the fall and winter months. In spring they migrate to more northern habitats, where they forage throughout the summer; during this time the young are born and develop into volant (flying) juveniles.

Hibernation. Migration to the hibernacula usually begins in August, and individuals tend to return to the same cave to hibernate each year (Griffin 1940, Hall 1962, LaVal and LaVal 1980). Bats enter the warm parts of the caves in early fall and forage each night to replenish the fat reserves depleted by migration (Hassell 1967). They move to cooler parts of the caves during winter and form large, dense aggregations on the flat surfaces of ceilings and walls (Guthrie 1933). The bats hang by their feet in these clusters, which are irregular in shape and one tier deep. Because of this behavior, the Indiana myotis is sometimes referred to as the "cluster bat," its specific name *sodalis* meaning "comrade or companion." Every 8 to 10 days hibernating individuals awaken to spend an hour or more flying about or to join a small cluster of active bats elsewhere in the cave before returning to hibernation. Movement between hibernation sites has also been reported (Hall 1962, Fenton 1966, Hardin and Hassell 1970).

Reproduction. The Indiana myotis breeds during the first 10 days of October (U.S. Fish and Wildlife Service 1991). Mating occurs at night on the ceilings of hibernation caves, but ovulation, fertilization, and implantation probably do not occur until females leave hibernation (Thomson 1982). Males and females segregate as the hibernating colonies disperse in March and migrate to the northern part of their range. Females live in maternity colonies consisting of 25 or more females and their young, which are born in late June and early July (Easterla and Watkins 1969, Humphrey et al. 1977). Females

give birth to only 1 offspring, which is weaned in 25 to 37 days, and the first young begin flying by mid-July (Humphrey et al. 1977).

Foraging. The diet of reproductive females consists chiefly of soft-bodied insects and moths, but post-lactating females and juveniles also consume beetles and flies (Thomson 1982). Females and juveniles forage in the airspace near the foliage of riparian and floodplain trees, while males forage the densely wooded area at tree top height (LaVal et al. 1977). The female and her young fly in tandem to forage as the young become volant (Humphrey et al. 1977).

Habitat requirements

Winter habitat. Indiana bats hibernate in limestone caves and mines with cool, stable temperatures throughout the winter (Humphrey 1978). The preferred sites have temperatures ranging from 4 ° to 8 °C in midwinter (U.S. Fish and Wildlife Service 1983) and an average relative humidity of 87 percent (Hassell 1967). These bats are very specific about the hibernaculum characteristics and tend to occupy the same caves year after year.

Summer habitat. Floodplains provide significant summer habitat for populations of the Indiana bat (Humphrey et al. 1977, Cope et al. 1978, U.S. Fish and Wildlife Service 1983). A recent study in Illinois showed that upland habitats are also used extensively by maternity populations (Garner and Gardner 1992). Seventy-five percent of the roost trees were located near intermittent streams in upland situations. Roost trees were found in other habitat types that were wooded or contained dead trees but were not found in old fields, residential areas, or agriculturally cleared lands other than pastures with scattered trees.

Adult female bats establish maternity roosts in hollow trees and under the loose bark of various species of trees (Humphrey et al. 1977, Cope et al. 1978). Typical roosts are located beneath the exfoliating bark of dead trees, but other roost sites have been found beneath the bark of living trees (Garner and Gardner 1992). Species selected as roost trees include slippery elm (*Ulmus rubra*), American elm (*U. americana*), white oak (*Quercus alba*), shingle oak (*Q. imbricaria*), shagbark hickory (*Carya ovata*), bitternut hickory (*C. cordiformis*), pignut hickory (*C. ovalis*), silver maple (*Acer saccharinum*), sugar maple (*A. saccharum*), cottonwood (*Populus deltoides*), and sassafras (*Sassafras albidum*). Green ash (*Fraxinus pennsylvanica*) was used extensively by Indiana bats in Michigan, where it is an abundant tree (Kurta et al. 1993).

Optimal roost sites occur beneath the bark of dead trees with adequate spaces to allow for air circulation and for bats to change position on the trunk (Garner and Gardner 1992). Species such as cottonwood, northern red oak (*Quercus rubra*), post oak (*Q. stellata*), shagbark hickory, bitternut hickory, and slippery elm are highly suitable for roosts. Senescent, severely injured, or

dead portions of these trees possess bark that is tenacious and springs away from the trunk upon drying. Living shagbark hickory produces long strips of loose persistent bark that also provides adequate shelter.

It has been assumed that shade is necessary to protect roost sites against the intense solar radiation of midsummer. The study in Illinois showed that 68% of the roost trees in forested habitats had >80% canopy cover (Garner and Gardner 1992). In Michigan, however, roost trees without any shade were used by bats throughout the summer even though other suitable trees were nearby (Kurta et al. 1993). The cooler climate in Michigan probably prevents roost temperatures from rising high enough to be lethal to the bats.

Roost trees are located at various distances from foraging habitat. Humphrey et al. (1977) suggested that the optimal foraging habitat is the foliage of riparian and floodplain trees, and Garner and Gardner (1992) found that pregnant females would travel distances >1 km (0.6 mile) to reach these preferred ecotypes. Foraging areas ranged from 28 ha to 37 ha (69 acres to 91 acres) for juveniles to 52 ha (128 acres) for pregnant females and 94 ha (232 acres) for lactating females.

Essential summer habitat described by Garner and Gardner (1992) includes any site within the currently delineated summer range of the species that meets the following criteria:

a. Foraging areas consisting of deciduous forest cover equal to or greater than 30% and permanent water available within a 1-km (0.6-mile) circle, and

b. Suitable roost trees located within 0.4 km (0.25 mile) of the foraging area.

Suitable summer habitat is determined by the same criteria except that forest cover is equal to or greater than 5%.

Streams without riparian vegetation do not appear to be suitable habitat for the Indiana bat (Cope et al. 1978). Optimum foraging habitat consists of streams lined on both sides with mature trees that overhang the water by more than 3 m (918 ft)(U.S. Fish and Wildlife Service 1983). Humphrey et al. (1977) found that bats forage at a height of 2 m to 30 m (6.5 ft to 98 ft) under riparian and floodplain trees.

Critical habitat. The U.S. Fish and Wildlife Service (1991) has designated the following caves as Critical Habitat within the Southeast Region:

Tennessee:	White Oak Blowhole Cave, Blount County
Kentucky:	Bat Cave, Carter County Coach Cave, Edmonson County

Populations

Population decline. The Indiana myotis is nearly extinct over most of its former range in the northeastern states, and the major winter colonies in caves of West Virginia, Indiana, and Illinois have disappeared since 1950 (U.S. Fish and Wildlife Service 1991). The population decreased by 28% over its total range between 1960 and 1975 with declines in individual states of 8% to 73% (Engel et al. 1976, Humphrey 1978). Since 1960 Kentucky has had a greater population decline than any other state (U.S. Fish and Wildlife Service 1983). Populations in the two largest hibernacula dropped approximately 75% because of microclimate changes in hibernacula subjected to poorly designed gates (Humphrey 1978). These structures interfered with cave thermodynamic processes and made roosts too warm for bat survival.

During the winter approximately 87% of the entire population hibernates in 7 caves (IUCN 1978). The U.S. Fish and Wildlife Service (1991) estimates that only 500,000 individuals of this species still exist, and about 20 per cent of them are found in Kentucky.

Causes of decline. Declining populations over the past three decades are attributed to natural hazards, human disturbance, and altered microclimate in hibernation caves (Thomson 1982). A high degree of aggregation during hibernation makes this species vulnerable to alterations in its roosting caves (U.S. Fish and Wildlife Service 1991). Flooding, ceiling collapses, and freezing are natural disasters that have contributed to population declines in hibernacula (Hall 1962, Humphrey 1978, Brady 1982, Clawson 1987). However, human disturbance has probably been the dominant factor contributing to the population decline. Roosting caves have been disturbed by commercialization, vandalism, and spelunking; some have been rendered unsuitable as a result of blocking or impeding air flow into the caves, thus changing the cave's microclimate (U.S. Fish and Wildlife Service 1991). Other types of habitat alteration include stream channelization, deforestation for agriculture, surface strip-mining, road and utility construction, and urban expansion (Garner and Gardner 1992).

Potential habitat mapping

The PGDP area has potential summer habitat for nursery colonies of the Indiana bat. There are no limestone caves on the PGDP to serve as winter hibernacula for Indiana myotis. Therefore, the vegetation of this area was mapped and evaluated for potential summer habitat.

Based on the work of Garner and Gardner (1992), the major criteria for vegetation to compose suitable summer habitat included the following:

a. Forested land at least 500 m from paved and well-traveled gravel roads;

b. Forested land containing tree species with loose bark for maternity roosts (riparian bottomland hardwoods or oak-hickory upland forests);

c. Roosting habitat generally within 0.4 km (0.25 mile) of a potential foraging area;

d. Minimum foraging area of 4.5 hectares (11 acres) within a distance of 1 km (.6 mile) from water; and

e. Canopy cover of 30% to 80%

Using the digital database provided by DOE, buffers 500 m (1,640 feet) wide on either side of paved roads were generated. Although the area inside the buffer may have been, in all other ways, potential bat habitat, they were eliminated from consideration because of their proximity to roads (Garner and Gardner, 1992). The 500 m buffers were superimposed onto the forested area map included in the DOE digital database which identified forested and non-forested land at PGDP. The remainder of the study area, outside the buffers, was then evaluated as bat habitat.

Non-forested land was not rated. Only forested land was considered bat habitat. Non-forested land is land without trees or woody vegetation. It includes land under cultivation and in pastures, lands which have been removed from agricultural or other uses so recently that they have not yet become populated with woody vegetation, and natural prairie land which is prescribed burned to prevent invasion by woody plants.

For forestland evaluation for bat habitat quality, information was required such as that provided by a forest stand[1] map and its accompanying stand information. As an example, trees with loose bark under which bats can roost generally are either dead or are living individuals of species which produce loose bark, e.g., shagbark hickory or white oak (Garner and Gardner, 1992). Those species which naturally produce loose bark generally do so only as the tree becomes mature. Therefore, age of the trees (or in this case relative age of the trees), which would ordinarily be available from stand records, was needed to evaluate habitat quality.

Some forest stand information was available from a forest management plan written for the Western Kentucky Wildlife Management Area (WKWMA), but additional stand sub-delineation was needed to reflect subtle differences which might be significant to use by Indiana bats. In addition, no such forest information was available for some parts of the study area. Since stand information was not directly available, it had to be inferred through interpretation of aerial photographs.

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[1] A "stand" is an area of trees which are approximately the same age, species, size, and spacing, or which are a relatively uniform mixture of these characteristics.

Black and white aerial photographs (9" x 9" format) of the study area were supplied by DOE. The 1:9000 scale photographs were dated 20 March 1990. All stereoscopic pairs of aerial photographs of forestland were examined using a stereoscope[1].

Species of trees could not be determined from these photographs, but species was implied by texture, shading, crown shape, and branching patterns. Relative age was inferred from the spacing of the tree stems and the size and physiognomy of the tree crowns. For example, young stands of trees are generally densely spaced with short stems and narrow crowns. They also tend to be interspersed with other vegetation (trees and shrubs) of various heights and spacings. Older trees generally are less densely spaced, stand taller, and have wider crowns than younger trees. By such interpretations, vegetated areas were aggregated into the approximate equivalent of forest stands, and the stand boundaries were marked on the aerial photographs. During a subsequent field survey, species composition and physical measurements (diameter at breast height (DBH), total tree height, and crown diameter) of trees of some of the stands were made to verify photographic interpretations.

Stand boundaries were digitized as a layer of information in the digital database. Island stands, within non-forested land, which were less than 4.5 hectares (11 acres) and farther than 1 km (.6 mile) from water were incorporated into the non-forested area and eliminated from consideration as bat habitat. The only exception was if several small island stands occurred in close proximity (less than 30 meters) to each other and their total area was equal to, or greater than, 4.5 hectares (11 acres), they were treated as a single stand.

Habitat ratings. After habitat suitability was determined, each stand was rated as good, fair, or poor based on the potential of the vegetation to provide bat habitat. Good habitat most closely met these criteria: a) it contained large trees, b) it provided dense canopy cover, and c) it was located within 0.4 km (.25 mile) of potential foraging areas, i.e., bodies of water (this distance was measured on the map or on the aerial photographs). Habitat was rated as poor if trees were much less mature than those in habitat rated as good, if it provided minimal amounts of canopy cover, and if it was greater than 0.4 km (.25 mile) from potential foraging areas. Habitat was rated fair if it provided some, but not all the requirements to be rated good. Fair was often the most difficult rating to assign since it required assessment of borderline stands. Two examples of the judgments required are: a) if the stand were an older stand with dense crown coverage but located 0.4 km (.25 mile) from water, or b) if the stand were 0.4 km (.25 mile) from permanent water, but it contained a mixture of large and small trees of moderate density spacing.

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[1] John Tingle, Ecologist, USA Waterways Experiment Station, Mississippi Board of Registration for Foresters: Registration Number 413.

The study area consists of approximately 4,746 hectares (11,719 acres). 944 hectares (2,330 acres) were evaluated as potential summer habitat for Indiana bats. The areas evaluated were rated as follows:

	hectares	acres
Poor	255	631
Fair	382	944
Good	231	571

This habitat, including quality ratings, is shown in Figure 4 and in Appendix B, plates 1-13.

The best habitat for maternity colonies is found in the riparian forest on the Ohio River floodplain (Plates 1, 2). It is old growth bottomland forest that contains dead trees with exfoliating bark and living trees with characteristically shaggy bark. The WKWMA forest management plan indicates that species composition in this 370-acre forest is 3% white oaks and 20% hickories; 30% of the stand is medium sawtimber (dbh = 18 to 24 in.), and 11% is large sawtimber (dbh = 26+ in.). There is also excellent habitat further south in the Little Bayou Creek drainage (Plate 6) and a substantial amount of fair habitat along Bayou and Little Bayou Creeks (Plates 3, 4, 6). That forests are more fragmented, less dense, and younger in the southern part of the target area suggests less potential for the presence of maternity roosts there (Plates 7, 9, 11, 12).

Mr. Bill Hendricks, who is investigating Indiana bats in Kentucky, refers to the old growth forest as "significant bat habitat." In addition to its potential for maternity roosts, it may also serve as a staging area for bats; aerial photos show it as an "island of habitat" with much larger areas of potential habitat in surrounding counties (Hendricks, pers. commun., Dec. 1992). Mr. Hendricks is doing research on a maternity roost in southwest Ballard County, where 6 females and 1 male have been tagged.

Management

Recovery Plan. The primary objective of the Indiana Bat Recovery Plan is to remove the bat from endangered status (U.S. Fish and Wildlife Service 1983). The major emphasis is on controlling the hibernacula and protecting them from human disturbance. However, the maintenance, protection, and restoration of foraging and nursery habitat is also a major consideration. Methods suggested to help protect and maintain this summer habitat are as follows:

a. Avoid forest destruction and stream alteration whenever possible;

b. Determine bat habitat requirements and conduct summer surveys to locate potential nursery habitat;

c. Maintain large, dead trees that are potential nursery sites;

d. Preserve or restore forest cover along rivers and streams;

e. Preserve water quality for the insect fauna that serve as food for the Indiana bat; and

f. Monitor the habitat for foraging areas and nursery roosts.

Local management. These methods should be applied to management of the Indiana bat on the PGDP target area. The Kentucky Department of Fish and Wildlife Resources is responsible for managing most of the potential bat habitat; therefore, commercial destruction of forests and stream alterations should be well controlled and of no immediate concern.

Bat habitat requirements have been determined, and mist-netting has produced evidence of the presence of the Indiana bat in the riparian forest on the Ohio River floodplain. The oaks and hickories in this forest are approaching or at maturity, which is an excellent growth stage for nursery colonies. The living trees should be maintained, and snags should be retained as potential roost sites. Retention of snags will also benefit cavity nesting birds and mammals and thus help to maintain the biodiversity of this area, part of which comprises the Bayou Ridge State Natural Area. Trees removed along streams for the purpose of forest management should be restored to maintain habitat quality in future years. The recovery plan suggests planting bands of riparian vegetation 30 meters (98 feet) wide on each side of a stream to restore forest vegetation.

Water pollution adversely affects the insect fauna that composes the food base of the Indiana bat (U.S. Fish and Wildlife Service 1983). If activities are planned that would impact the Ohio River or nearby streams outside the WKWMA, water quality should be monitored in Bayou Creek, Little Bayou Creek, and their tributaries to insure that water quality standards are met.

If bat mortality occurs on the PGDP area, insect samples from known foraging areas should be collected and analyzed for toxic chemical residues (U.S. Fish and Wildlife Service 1983). The recovery plan suggests that bats (Indiana and others) be examined for cause of death according to methods described by Clark (1981).

Known and potential Indiana bat habitat should be monitored each summer to evaluate its quality and to search for nursery colonies. Any new occurrences should be reported to the Regional Director, Region 3 U.S. Fish and Wildlife Service Office. Survey data collected by state and federal agencies is maintained in this office, and guidelines for summer habitat surveys may also be obtained. The Kentucky State Nature Preserve Commission also needs this information as it keeps records of T/E species within the state.

Planned activity that could negatively impact potential summer habitat requires a mist net survey to determine whether the habitat is being used by the Indiana bat. Its presence would indicate that the project must be appropriately altered or perhaps terminated. The U.S. Fish and Wildlife Service should be contacted for guidance on the correct legal procedures for endangered species.

Significance of summer habitat. Recovery began in the early 1980s to protect the winter hibernacula of the Indiana bat. According to an information survey conducted by The Nature Conservancy, the overall population of Indiana bats has continued to decline despite strict conservation efforts at winter caves (Evans et al., 1992). Expert respondents felt that the loss of summer habitat may be the primary factor in continuing population declines. Therefore, it appears that summer habitat is essential for recovery and should be maintained wherever it is found. The PGDP area provides adequate amounts of good summer habitat for Indiana bats. Habitat quality should be maintained to aid in the recovery of this endangered species.

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Copperbelly Water Snake

The copperbelly water snake (*Nerodia erythrogaster neglecta*) is a candidate species that was proposed for listing as threatened in August 1993. A public hearing has been held, and it should be assumed that the copperbelly will be listed, probably in 1994 (Ron Refsnider, USFSW, pers. commun., April 1994). One individual was reported from Metropolis Lake State Nature Preserve at the boat launching ramp of the Lake. (See #1 - Fig. 2, Table A2) Metropolis Lake consists of 20 hectares (50 acres) of water surrounded by a ring of baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) trees and is characteristic habitat for the copperbelly water snake.

Description

The copperbelly water snake is from 76 cm to 122 cm (30 in. to 48 in.) in length (Conant 1975). The color of the dorsum ranges from gray or olive to dark brown or black, and the belly is bright yellow to orange with lateral invasions of the dorsal ground color (Smith 1961, Conant 1975). Ventral coloration is usually reduced posteriorly to a median series of narrow, orange, semilunar markings (Smith 1961). Parietal spots and a post-parietal streak are common (Ernst and Barbour 1989). The young have a lighter dorsum with irregular spots that merge to form a blotched pattern (Conant 1975). Subadults become uniformly dark above and orange below but occasionally retain traces of the blotched pattern (Smith 1961). The scales are keeled, and the anal plate is divided in about 90% of individuals (Conant 1975).

Reproduction. The copperbelly is viviparous (Ernst and Barbour 1989). Mating probably occurs from April to June, as it has been observed during this period in the closely related plainbelly water snake (*Nerodia erythrogaster*)

N O T I C E

THE STATUS OF THE COPPERBELLY WATER SNAKE IS NOW **PROPOSED THREATENED (PT).**

The PT status affords the species temporary but full protection under the Endangered Species Act until such time as official action by the USFWS may alter this status.

Species status listings are dynamic. All listings must be periodically verified. Users of this report are advised to check the official status of all species in this report on a regular basis.

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(Conant 1951, Wright and Wright 1957). The young are born from August to October (Ernst and Barbour 1989). Although broods of 5 to 37 young may be produced (Fitch 1970, Minton 1972), 10 to 20 young are most common (Ernst and Barbour 1989). Females may store active sperm for almost two years after mating (Conant 1965).

Distribution

The copperbelly water snake has a limited natural distribution. It occupies a disjunct northern range in south-central Michigan and adjacent Indiana and Ohio, southwestern Indiana, southern Illinois, and western Kentucky and adjacent Tennessee (Ernst and Barbour 1989) (Fig. 5). Isolated colonies are also found in west-central Ohio and south-central Indiana.

The current distribution of the copperbelly water snake is best described as regional endemic (Wilsmann and Soule 1992). Its range is concentrated in southern Indiana, Illinois, and western Kentucky, with only a few relict populations in northern Indiana and southern Michigan. There is also a broad intergrade zone between the copperbelly and the yellow-bellied water snake (*Nerodia erythrogaster flavigaster*) in southern Illinois, Kentucky, and Tennessee where both subspecies and hybrids are found.

Behavior

Copperbelly water snakes are usually first active in April and remain active until October or November (Ernst and Barbour 1989). They may be intermittently active throughout the winter in the southern portion of their range (Guidry 1953, Kofron 1979). They hibernate in rock piles, muskrat and beaver burrows, earth and rock dams, and hollow logs and stumps along banks.

These water snakes forage mostly at night (Mushinsky et al. 1980). The daytime is spent basking (on the bank, in overhanging branches, on partially submerged logs) or being submerged for as much as an hour at a time (Baeyens et al. 1980).

Most copperbellies actively pursue their prey (Ernst and Barbour 1989), but they have been observed to anchor their tails to rocks and face into the current with gaping mouths (Gillingham and Rush 1974). The diet consists chiefly of fish (Ernst and Barbour 1989) and amphibians such as tadpoles, adult frogs and toads, ambystomid salamanders, and sirens (Minton 1972, Mushinsky and Hebrard 1977). Other prey items include crayfish and aquatic invertebrates (Clark 1949, Ashton and Ashton 1981).

Habitat requirements

The copperbelly water snake is a lowland species that prefers the quiet waters in cool, moist areas (Smith 1961, Ernst and Barbour 1989). Its colonies are usually located in or near swampy or river bottom woodlands (Conant 1975). Typical habitats consist of slow moving waterways with mud bottoms, abundant emergent vegetation, and brushy shorelines located in bottomland hardwoods (Ernst and Barbour 1989). Specimens have been taken from bayous, swampy woodlands, lowland swamps, cypress swamps, river bottoms, rivers, streams, sloughs, ditches, lakes, and mill ponds. It has also been found in brushy seasonal and permanent ponds in wooded wetlands, oxbows, and vegetation canals adjacent to swamps (Sellers 1987, 1988, 1991).

The copperbelly is more terrestrial than other water snakes and may be found in more open, drier habitat (Conant 1951, Minton 1972, Sellers 1987, Winn and Gillingham 1987). However, it probably uses upland areas as corridors for moving among aquatic habitats (Weatherby and Sellers 1992). The copperbelly also uses upland corridors to move between hibernacula and breeding areas, as it is presumed to hibernate in rocky, upland areas (Brandon 1992). It occupies wetlands during spring and early summer and moves to hibernation sites in late summer and fall. Therefore, corridors linking these seasonal habitats are important.

Populations

Population decline. The copperbelly water snake now occurs in only half of the counties from which it was once known (Wilsmann and Soule 1992). Approximately 75 occurrences with observations since 1980 are known from Michigan, Ohio, Kentucky, Indiana, and Illinois where field work has been quite thorough. However, less than half of these records include evidence of reproduction, which suggests that many may represent relict populations. From 13 Kentucky records in Sellers (1991), only 2 included evidence of reproduction. The total number of reproducing populations throughout the copperbelly's range probably falls well below 50 (Wilmsmann and Soule 1992).

Causes of decline. Although the copperbelly water snake is subject to many natural predators, it has been most vulnerable to human threats such as habitat destruction, shooting, and insecticide poisoning (Ernst and Barbour 1989). The destruction of wetlands and fragmentation of intervening upland has been a major factor in its population decline; unfortunately, this continues regionally (Wilsmann and Soule 1992). The removal of fence rows, woodlots, and small wetlands in agricultural areas reduces corridor habitat, which is vital to its movements among wetlands and hibernacula. Collecting adds to the problem in some areas, and even scientific collection should be discouraged except for research that is vital to the recovery of the species.

Potential habitat

The PGDP provides potential habitat for the copperbelly water snake. It is composed of swamps, sloughs, and wetlands associated with the bottomland forests in the Bayou Creek drainages. Metropolis Lake, from which a siting was reported, is also typical copperbelly habitat, a natural oxbow lake with baldcypress and water tupelo. Other forested wetlands in the target area also provide potential habitat for this species. Figure 6 depicts the distribution of potential copperbelly water snake habitat.

Management

Because the copperbelly water snake is still a candidate species, a recovery plan has not been developed and no legalities are involved in its management. The potential for its occurrence in the target area falls within the habitat boundaries of several known endangered species; therefore, measures to protect Indiana bat and bald eagle habitat will benefit the copperbelly. This species is likely to be on the Federal list of threatened species in 1994 or 1995. Therefore, its protection should be considered now. Any sitings should be reported to the KSNPC and U.S. Fish and Wildlife Service. If agency action is planned in the old growth forest of the WKWMA, PGDP should confer with the Service as required for compliance concerning a candidate species (see compliance procedures at the end of Chapter 2).

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4 Federally Listed or Candidate Species Reported from McCracken or Ballard Counties

This chapter discusses 15 Federally listed or Candidate species reported from McCracken or Ballard Counties but not from the PGDP.

Orange-Footed Pearly Mussel

The orange-footed pearly mussel, or pimpleback (*Plethobasus cooperianus*), is a Federally listed endangered freshwater mussel (Federal Register 41 FR 24064) that has been collected from the Ohio River in the vicinity of the West Kentucky Wildlife Management Area. One individual was taken from the mussel beds at RM 949.5, only 0.5 mile downriver from the WKWMA, during dredging operations of the Louisville District (Fig. 7) (Siemsen, pers. commun., Dec. 1992). Because of its presence in the vicinity of the WKWMA, this mussel has the potential to be affected by activities in the Paducah Gaseous Diffusion Plant area and vicinity.

Description

The shell of the orange-footed pearly mussel is almost circular; it attains a length of 8.7 cm to 10.2 cm (3.4 in. to 4 in.) (Miller et al. 1986, Cummings and Mayer 1992). The shell is approximately 7.5 cm (3 in.) in height and 4.5 cm (1.8 in.) wide (Miller et al. 1986). The anterior end is rounded; the posterior end is rounded to bluntly pointed and covered with raised knobs called tubercles (Cummings and Mayer 1992). The umbos are low and directed forward. The pseudocardinal teeth are well developed with two in the left valve and one in the right valve. Lateral teeth are short, straight or slightly curved; two are present in the left valve and one in the right valve.

The periostracum (outer shell surface) is light brown in small shells but becomes chestnut or dark brown in larger individuals (Cummings and Mayer 1992) and is marked by concentric, irregular growth lines (World Wildlife Fund 1990). The nacre (inner shell surface) is white, usually with pink or salmon coloration near the beak (umbo) cavity and iridescence posteriorly (Cummings and Mayer 1992). The most definitive characteristic of this mussel is the bright orange foot and viscera that can be seen in live specimens by gently prying the valves apart (Clarke and Fuller 1983).

Reproduction. The life history of the orange-footed pearly mussel is unknown but probably similar to that of most naiads (Grace and Buchanan 1981). Sperm is discharged into the water and dispersed downstream by water currents. Females obtain the sperm during the normal process of siphoning water for feeding and respiration. Fertilization occurs within the gills of the female, and the eggs are retained there to develop into glochidia (larvae). The glochidia are released and attach to a fish host where they develop into juvenile naiads. The orange-footed pearly mussel is probably a short term breeder, which mates in spring and releases glochidia by late summer (Wilson and Clark 1914, Yokley 1972). The host fish is unknown (Miller et al. 1986).

Distribution

Historic range. The orange-footed pearly mussel is an Interior Basin species with distribution in the Ohio, Cumberland, and Tennessee River drainages (Ortmann 1919). Its historic range included the Ohio River from western Pennsylvania to southern Indiana; the Wabash River below Mt. Carmel, Illinois; the Cumberland River from Cumberland County, Kentucky, to the vicinity of Nashville, Tennessee; and the Tennessee River from near Knoxville, Tennessee, to Kentucky Lake in Benton County, Tennessee (Miller et al. 1986). This species was locally abundant in the Ohio River between St. Marys, West Virginia, and Marietta, Ohio, and around the confluence of the Wabash River in Indiana (World Wildlife Fund 1990). It has been recorded from the Caney Fork, Holston, Duck, Clinch, and French Rivers in Tennessee; from the Green and Rough Rivers in Kentucky; and from the Kanawha River in West Virginia.

Current distribution. The range of the orange-footed pearly mussel has been greatly reduced, and the mussel survives chiefly in the Tennessee and Ohio Rivers (Miller et al. 1986, World Wildlife Fund 1990). This species has been found in the Tennessee River below the Fort Loudoun and Pickwick Dams (Tennessee) and Guntersville Dam (Alabama); it survives in the Cumberland River only below Cordell Hull Dam (Tennessee) and in the lower Ohio River between Metropolis and Mound City (Illinois).

Habitat Requirements

The habitat of the orange-footed pearly mussel consists of sand and gravel substrates in shoals and riffles of medium to large rivers (Miller et al. 1986, World Wildlife Fund 1990). The mussel is usually found in depths of 3 m to 9 m (9.8 ft to 29.5 ft) and buries itself in the sand with only the margin of the shell and feeding siphons exposed to the water. The Olmsted mussel bed (RM 966.4-969.4), a site from which the mussel has been collected in the lower Ohio River, is a gravel bar about 3 miles long that follows the Illinois shoreline; the substrate is composed of densely packed coarse sand and gravel with particle sizes that range from <1.0 cm to >10.0 cm (<0.4 in. to >3.9 in) (Miller et al. 1986). This habitat differs very little from that of 25 other unionids that have been collected from the Olmsted bed and indicates that the orange-footed pearly mussel may occur in the Ohio River in beds with other more common mussels.

Populations

The orange-footed pearly mussel had a relatively restricted distribution but has become increasingly rare throughout its range (Ahlstedt 1984). The reasons for its decline are not totally understood other than those factors attributed to the decline of all freshwater mussels. Since mussels are sedentary and live up to 50 years, they are especially vulnerable to situations resulting from stream alterations.

Causes of decline. The single most important factor contributing to mussel decline is probably the alteration and destruction of river habitat produced by impoundments for flood control, navigation, hydroelectric power production, and recreation (Ahlstedt 1984). Impoundments produce changes such as reduced flows, altered temperature regimes, extreme water level fluctuations, reduced turbidity, and anoxic conditions to which some species are unable to adapt for continued survival. Biological responses to these environmental changes can cause reductions in the benthic and fish communities, which in turn affect foraging quality for mussels and loss of larval vectors (Isom 1971). Miller et al. (1986) suggest that the orange-footed pearly mussel may be more sensitive to altered habitats than other mussels, so that prevailing conditions reduce the energy reserves required for producing adequate numbers of glochidia.

Siltation has greatly altered the habitat of freshwater mussel communities. The greatest diversity and abundance of mussels in rivers and streams are usually found in habitats with gravel and/or sand substrates, which are most common in running water (Hynes 1970). Human activities have introduced increasingly large quantities of silt into American waterways. Two major effects of inorganic sediments introduced into aquatic ecosystems are an increase in turbidity, causing a reduction in light penetration, and a blanketing effect on the substrate (Hynes 1974). Suspended solids in the water column produce an abrasive action that can irritate, damage, or cause clogging of the

gills (feeding structures) of mollusks (Loar et al. 1980). This can result in reduced or inhibited feeding by mussels and cause nutritional stress and mortality (Loosanoff 1961). Because mussels require clean, flowing water over silt-free substrates, the smothering action of silt can be severe; many species are unable to survive a layer of silt greater than 0.6 cm (0.2 in.) (Ellis 1936). Mussel life cycles can also be affected from siltation by impacting the host-fish populations, reducing food availability, and filling interstitial spaces in gravel and rubble substrate to eliminate spawning beds and habitat critical for the survival of young fishes (Loar et al. 1980).

Pollution is a third factor that affects freshwater mussel populations. The impacts may be difficult to ascertain, as the damage suffered results from a complex of interrelated factors, which include the characteristics of the receiving river and the nature, magnitude, and frequency of the stresses being applied (Ahlstedt 1984).

Potential habitat

The orange-footed pearly mussel is considered to be extremely rare in the Tennessee, Cumberland, and Ohio Rivers (Ahlstedt 1984). However, collections in recent years indicate that the species is still present in the lower Ohio River. Specimens have been collected from the Olmsted mussel bed (RM 966.4-969.4), approximately 15 miles downriver from the WKWMA. Williams and Schuster (1989) found 1 live specimen, and Miller et. al (1986) obtained 3 live individuals at this location. Two specimens were later collected at RM 967.2 and upriver from Lock and Dam 53 at RM 957.8 (Miller and Payne 1991). In August 1992, another specimen was found at the latter location (Dr. Drew Miller, pers. commun., Dec. 1992).

In recent years the orange-footed pearly mussel has been found in the Ohio River adjacent to the PGDP area. A map of the Ohio River showing river mile (RM) designations is shown in Figure 7. Collections in 1982 contained specimens at RM 944 near Metropolis, Illinois (Ahlstedt 1984), which is only 1 mile upriver of the PGDP target area. The specimen found in 1992 at Ohio RM 949.5 is downriver 0.5 mile the western boundary of the WKWMA. These data indicate that the stretch of the Ohio River bordering on PGDP lands is potential habitat for the Federally endangered orange-footed pearly mussel. Bayou Creek, Little Bayou Creek and their tributaries are not deep enough or contain the appropriate substrate to serve as habitat for this riverine species.

Mussel beds. Although not sampled extensively, mussel beds are known to occur in the Ohio River adjacent to the PGDP target area. Neff (1980) sampled the Ohio River from RM 916.3 to 981.0 and collected mussels from beds located on the Illinois side of the river at RM 944.2-945.0 (east of Flagpond Bridge to Metropolis Lake) and at RM 946.0-946.5 (across from Shawnee Steam Plant intake). Some beds were also located on the Kentucky side of the

river upstream of the PGDP area (RM 940.5-940.7 and 941.5-942.0) and downstream at RM 950-951.

The most recent samples were collected during dredging operations by the Louisville District Corps of Engineers. Beds were located at RM 946.2-RM 949.5. Although the orange-footed pearly mussel was the only endangered mussel species found in this survey, the potential also exists for other endangered mussels to inhabit these beds, which are located on solid substrate that is good mussel habitat (Mr. Terry Siemsen, pers. commun, April 1993).

Management

Recovery Plan. The ultimate objective of the Orange-footed Pearly Mussel Recovery Plan is to maintain and restore viable populations to a significant portion of the mussel's historic range and thereby remove this species from its endangered status (Ahlstedt 1984). Recovery can be accomplished by (1) protecting and enhancing habitats containing this mussel; and (2) by establishing populations in rivers and river corridors in its historic range. The step-down procedures emphasize the detection of existing populations and suitable habitat, determination and elimination of potential threats to the species and its host fish, and identification of appropriate transplant sites.

Local management. The only local potential habitat for this species is found in the main channel of the Ohio River. The primary concern for management of the orange-footed pearly mussel in the PGDP area is strict protection of this species and its habitat (Fig. 7). It must be given the highest priority in the planning of any activity that could impact its habitat in the Ohio River adjacent to and downstream of the PGDP area (e.g., road construction, dredging, release of chlorinated effluents into the river). Compliance with the ESA will be required for any environmental action planned in the vicinity of the Ohio River or to waters emptying into the River. A formal consultation must be initiated with the U.S. Fish and Wildlife Service; this agency will advise of the legal implications of disturbing the mussel's habitat and provide guidance in the event of impact activity. A step-by-step outline of compliance procedures is provided at the end of this chapter.

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Pink Mucket

The pink mucket (*Lampsilis abrupta*) was listed as a Federally endangered species in June 1976 (Federal Register 41(115):24062-24067) under the species name of *L. orbiculata* (Hildreth 1828). It was first described by Say (1931) as *Unio abruptus*.

Description

The round to elliptical shell reaches a size of 105 mm in length, 82 mm (3.2 in.) in height, and 61 mm (2.4 in.) in width (Ahlstedt 1985a). The valves are inflated, thick, heavy, unsculptured, and gaping at the anterior-ventral base. The anterior margin of the shell is rounded in both sexes; the posterior end is bluntly pointed in males and truncated in females (Cummings and Mayer 1992). The dorsal margin is straight, but the ventral margin may be slightly curved. The umbos are broad, inclined forward, and elevated above the hinge line. The beaks (umbos) are located in the anterior part of the shell, and sculpture, if visible, consists of several double-looped ridges. The surface of the shell is smooth, and the periostracum is yellow to yellowish green or greenish brown with no rays or faint green rays (Ahlstedt 1984, Cummings and Mayer 1992).

The left valve contains two large, thick, triangular, divergent pseudocardinal teeth separated by two curved lateral teeth with a short flat interdentum (Ahlstedt 1984, Williams and Schuster 1989). The right valve has one thick, triangular, divergent pseudocardinal tooth and occasionally a smaller tubercular tooth in front (Cummings and Mayer 1992). The lateral teeth are short, heavy, and thick, and the beak cavity is deep. The nacre is pink or white; it is iridescent along the hinge line and posteriorly and is usually tinged with pink or salmon in the beak cavity and center area (Parmalee 1967).

Reproduction. The pink mucket becomes gravid in August; the embryos develop into the larvae (glochidia) during September and are released into the water the following year in June (Ortmann 1912, 1919). The glochidia consist

of two tiny valves that are bean-shaped and hookless and are frequently parasitic on the gill filaments of fish (Lefevre and Curtis 1910, Coker and Surber 1911). Although fish hosts are little known, the sauger (*Stizostedion canadense*) has been reported to serve as host for glochidia of the pink mucket (Coker et al. 1921, Surber 1913, Wilson 1916).

Distribution

Historical records for the pink mucket indicate that it is an Interior Basin species found chiefly in the Tennessee, Cumberland, and Ohio River drainages, with a few records from the Mississippi River drainage (Ahlstedt 1985a). Although it occurred in 25 river systems and was widespread in distribution, this species has never been collected in large numbers from any one site or drainage and has usually been considered rare.

The pink mucket is presently known from 16 rivers and smaller tributaries in Tennessee, Kentucky, Alabama, West Virginia, Missouri, and Arkansas (Ahlstedt 1985a). The largest concentrations have been reported from the Tennessee River (Yokley 1972, Tennessee Valley Authority 1976, Pardue 1981), Cumberland River (Tennessee Valley Authority 1976, Parmalee et al. 1980), Osage River (Grace and Buchanan 1981), and Meramec River (Buchanan 1980). This species was also found in the lower Ohio River by Leroy Koch and Jeffrey Pardue in July 1980 (Ahlstedt 1985a). One specimen was found at RM 940.7 (I-24 bridge), and two specimens were found at RM 944.2. However, an investigation conducted by Neff and Pearson to identify the presence of this species from Ohio RM 918.2 to RM 981.0 produced negative results (Turner 1993). Investigations in the lower Ohio River that failed to find the pink mucket include those of Williams (1969), Williams and Schuster (1989), and Miller and Payne (1984, 1991).

Habitat

The pink mucket occurs in medium to large rivers (i.e., at least 20 m (65 feet) wide) in a variety of substrates that include silt, sand, gravel, rubble, and boulders (Hickman 1937, Yokley 1972, Buchanan 1980, Clarke 1982). However, this species is most commonly found in larger rivers in moderate to fast-flowing water at depths ranging from 0.5 m to 8.0 m (1.6 ft to 26.2ft). It has also been found in standing water at depths of only 2.5 cm (1 in.) (Buchanan 1980) and in riffles with strong currents (Bogan and Parmalee 1983).

Population

No single factor causing population declines of the pink mucket can be distinguished from those factors attributable to population declines of communities of freshwater mussels. Because mussels are sedentary and long-lived (up

to 50 years), they are vulnerable to long-term stream perturbations such as impoundments, siltation, and pollution (Ahlstedt 1985a).

The greatest factor contributing to mussel decline is probably the alteration and destruction of stream habitat produced by impoundments for flood control, navigation, hydroelectric power production, and recreation (Ahlstedt 1985a). Stream impoundments produce changes such as reduced flows, altered temperature regimes, extreme water level fluctuations, reduced turbidity, and anoxic conditions to which some species are unable to adapt for continued survival. Biological responses to these environmental changes can cause reductions in the benthic and fish communities, which in turn affect foraging quality for mussels and loss of larval vectors (Isom 1971).

Siltation has greatly altered the habitat of freshwater mussel communities. The greatest diversity and abundance of mussels in rivers and streams are usually found in habitats with gravel and/or sand substrates, which are most common in running water (Hynes 1970). Human activities have introduced increasingly large quantities of silt into American waterways. Two major effects of inorganic sediments introduced into aquatic ecosystems are an increase in turbidity, causing a reduction in light penetration, and a blanketing effect on the substrate (Hynes 1974). Suspended solids in the water column produce an abrasive action that can irritate, damage, or cause clogging of the gills (feeding structures) of mollusks (Loar et al. 1980). This can result in reduced or inhibited feeding and cause nutritional stress and mortality (Loosanoff 1961). Because mussels require clean, flowing water over silt-free substrates, the smothering action of silt can be severe; many species are unable to survive a layer of silt greater than 0.6 cm (0.2 in.) (Ellis 1936). Mussel life cycles can also be affected by siltation impacting the host-fish populations, reducing food availability, and filling interstitial spaces in gravel and rubble substrate to eliminate spawning beds and habitat critical for the survival of young fishes (Loar et al. 1980).

Pollution is a third factor that affects freshwater mussel populations. The impacts may be difficult to ascertain, as the damage suffered results from a complex of interrelated factors, which include the characteristics of the receiving stream and the nature, magnitude, and frequency of the stresses being applied (Ahlstedt 1985a).

Potential habitat and management

Potential habitat and management recommendations for the pink mucket are the same as those for the orange-footed pearly mussel (Fig. 7).

Ring Pink

The ring pink mussel (*Obovaria retusa*) was listed as a Federally endangered species without critical habitat in September 1989 (Federal Register 54 (188):40109-10112). It is likely to become extinct in the foreseeable future unless reproducing populations are found or methods are developed to maintain existing populations (Biggins 1991).

Description

The thick solid shell is somewhat inflated with an unusual dorso-ventrally elongated recurved shape and may be up to 76 mm (3 in.) in length (Cummings and Mayer 1992). The margins are rounded, and the umbos are high, full, and directed forward. The shell surface is smooth, and the female has a distinct groove on the posterior ridge. The periostracum is commonly reddish brown but may be dark brown or black in older individuals. The pseudocardinal teeth are large, elevated, heavy, and serrated; two are in the left valve, and a large one is in the right valve. The lateral teeth are short and separated by a moderately wide interdentum. The nacre is pink or purple inside the pallial line with white around the margins.

Reproduction. Little is known of the reproductive biology of the ring pink mussel, but it probably reproduces like other freshwater mussels (Biggins 1991). Gravid ring pink mussels have been observed in August (Ortmann 1909, 1912). The glochidia were reported by Ortmann (1912) to be large and hookless. The fish host utilized by the ring pink is unknown (Biggins 1991).

Distribution

The historic range of the ring pink mussel was the Ohio River and its larger tributaries in Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, Tennessee, and Alabama (Gordon and Layzer 1989, Bogan and Parmalee 1983, Kentucky State Nature Preserves Commission 1980, Parmalee and Klippel 1982, Lauritsen 1987, Stansbery 1970). This species has been found in none of the recent molluscan surveys of the Ohio River beginning with Williams (1969) and is believed to be extirpated from this River (Biggins 1991).

Currently, the ring pink mussel is known to occur in only two river reaches in Kentucky, two reaches in Tennessee, and one reach in West Virginia (Biggins 1991). In Kentucky waters, this species has been collected in recent years only from the Tennessee River in McCracken, Livingston, and Marshall Counties, and from the Green River in Hart and Edmonson Counties. Only two live individuals have been collected in recent years from the Tennessee River population in Kentucky; these specimens were taken in by Sickel in 1985 and by Moore in 1986.

Habitat

The ring pink mussel inhabits the gravel and sandy bottoms of large rivers (Bogan and Parmalee 1983, Bates and Dennis 1985, Cummings and Mayer 1992). However, it has also been found in these same substrates in waters only 0.6 m (2 ft) deep (Hickman 1937, Neel and Allen 1964). Although the specific food habits of this species are unknown, it probably feeds on detritus, diatoms, and plankton as do other freshwater mussels (Churchill and Lewis 1924).

Population

The major factor responsible for reduction of ring pink populations is probably the conversion of many sections of the big rivers in the Interior Basin to a series of large impoundments (Biggins 1991). This produced alterations in the aquatic environment, which probably affected the distribution and availability of its fish host and dietary components, and reduced the availability of gravel and sand substrates. The populations of this mussel have declined, and its distribution has been greatly reduced. Threatening factors for remaining populations include gravel dredging, channel maintenance, and commercial mussel fishing (incidental take).

None of the five existing populations show evidence of reproduction (Biggins 1991). The three populations in the Tennessee and Cumberland Rivers may contain only individuals that have passed their reproductive age.

Potential habitat and management

Potential habitat and management recommendations for the ring pink are the same as those for the orange-footed pearly mussel (Fig. 7).

Fat Pocketbook

The fat pocketbook (*Potamilus capax*) was described by Green in 1832 as *Unio capax* and by Lea that same year as *Symphynota globosa* (Dennis and Stewart 1989). The specific name *capax* was accepted for this species, but the generic name underwent several changes until Turgeon et al. (1988) used *Potamilus* in an effort to bring consistency to mollusk nomenclature. The fat pocketbook mussel was listed as Federally endangered in 1976 (41 FR 24604).

Description

The shell is round to somewhat oblong, greatly inflated, and thin in young mussels to moderately thick in adults (Cummings and Mayer 1992). It may

grow to a length of 127 mm (5 in.). Both ends of the shell are rounded; the anterior end is broad and slightly angular near the hinge, whereas the posterior margin is very narrow (Green 1832). The valves do not close perfectly upon each other but gape at the opposite margins. The umbos are greatly inflated, elevated, and turned inward; beak sculpture of a few faint ridges is visible only in young shells (Cummings and Mayer 1992). The surface of the shell is smooth and shiny. The rayless periostracum is yellow, yellowish tan, or olive but becomes dark brown in older mussels.

Two pseudocardinal teeth are present in each valve; these are thin, compressed, and elevated (Cummings and Mayer 1992). The lateral teeth are thin and greatly curved; two are present in the left valve, and one is present in the right valve. The hinge line is S-shaped, and the beak cavity is very deep. The nacre is white and may be tinged with pink or salmon.

Reproduction. The life cycle of the fat pocketbook mussel is not known but is probably similar to that of other members of the Unionidae (Dennis and Stewart 1989). It is probably a long-term breeder and is reported to be gravid during the summer months and October (Surber 1912, Ortmann 1914). The glochidium is described as "axe-head" (Coker and Surber 1911). The fish host is unknown but is probably a large river species, as other members of the genus utilize the freshwater drum (*Aplodinotes grunniens*) and white crappie (*Pomoxis annularis*) (Coker and Surber 1911; Surber 1912, 1913; Howard 1913; Wilson 1916).

Distribution

The past distribution of the fat pocketbook is known chiefly from museum records, which indicated that this species occurred in the upper Mississippi River above St. Louis, Missouri; the Wabash River in Indiana; and the St. Francis River in Arkansas (Dennis and Stewart 1989). There are a few historic records of the fat pocketbook from the Illinois River (Calkins 1874, Danglade 1914).

The largest known viable population of this species is in the St. Francis River, Arkansas (Turner 1993). Since 1980 live specimens have been collected from the lower Wabash River in Indiana (Cummings et al. 1987) and the Cumberland River near its confluence with the Ohio River (Sickel 1987). The fat pocketbook mussel has not been collected from the Ohio River even though field surveys have been conducted from River Mile (RM) 317 through RM 918 by Williams and Schuster (1989) and in the vicinity of Smithland Lock and Dam and Lock and Dam 53 on the Ohio River (Miller and Payne 1991).

Habitat

Although conflict exists about the exact nature of its habitat, museum records indicate that the fat pocketbook mussel is a large river species that requires flowing water and stable substrate (Dennis and Stewart 1989). It has been found inhabiting a variety of substrates, but the most common are sand, mud, and fine gravel (Parmalee 1967, Bates and Dennis 1983, Clarke 1985, Jenkinson and Ahlstedt 1988). The fat pocketbook has also been found on hard clay and gravel substrates by Jenkinson and Ahlstedt (1988); their findings indicate that its preferred habitat is most likely a mixture of sand, silt, and clay.

Population

As with other freshwater mussels, channelization and impoundment have produced major impacts on the habitat of the fat pocketbook mussel (Dennis and Stewart 1989). Channel maintenance dredging is particularly destructive, as this riverine species is sensitive to changes caused by alteration of the bottom substrate. The most obvious impact is removal of mussels and their habitat by the cutter head of the dredge. Long-term dredging usually produces shifting sand substrate over large reaches of river bottom. This results in continuous erosion and deposition of fine materials in accumulations of loose, unstable material downstream of the dredging; few freshwater mussels can adapt to this altered environment. Reproductive success may also be impacted by the effects that dredging has on fish host species, such as altering flow patterns that may change the distribution or behavior patterns of fishes.

Siltation is usually cited as a factor that impacts the habitat of freshwater mussels, but there is little supporting data to show its actual effects. The smothering effect of heavy silt deposition, such as that occurring behind riverine impoundments, has been demonstrated (Scruggs 1960, Bates 1962, Isom 1969), but the effects of suspended silt are not well documented. It has been observed that suspended silt, resulting from erosion, appears to be increasing as mussel populations decline in the Mississippi River drainage (Ellis 1936, Thiel 1981) and the Tennessee River system (Isom 1969, Bates and Dennis 1978, Dennis 1981). Ellis (1936) showed that 0.1 cm to 2.5 cm (0.25 in. to 1 in.) of deposited silt caused high mussel mortality; he suggested that silt interfered with feeding by causing mussels to remain closed much of the time.

The primary effects of pollution on the fat pocketbook mussel within its present range is from agricultural run-off (Dennis and Stewart 1989). Most work on the effects of pollution has centered on heavy metals and pesticides. The effects of non-point source pollutants have been poorly addressed because of the complexity and magnitude of this problem.

Potential habitat and management

Potential habitat and management recommendations for the fat pocketbook are the same as for the orange-footed pearly mussel (Fig. 7).

Tubercled-Blossom Pearly Mussel

The tubercled-blossom pearly mussel (*Epioblasma torulosa torulosa*) was first described as *Amblema torulosa* (Rafinesque 1820). Of the 23 freshwater mussels listed as endangered by the U.S. Fish and Wildlife Service, eight are species of *Epioblasma*. Along with two of these, the tubercled blossom was listed as Federally endangered in June 1976 (Federal Register 41(115):24062-24067).

Description

The following description of the tubercled-blossom mussel is provided by Cummings and Mayer (1992). The shell is thick anteriorly but much thinner posteriorly, elongated, and inflated. The anterior margin is rounded, whereas the posterior-ventral margin is broadly rounded or slightly truncated in females but indented in males. The umbos are low and turned slightly forward. The beak sculpture of two or three indistinct ridges is evident only in very young shells. A row of large turbercles (knobs) runs from the beaks to the posterior-ventral margin. A wide, shallow depression is located between the row of knobs and the posterior ridge. The periostracum is yellowish brown with numerous fine green rays that are obscure in older shells. The length of shells may reach 76 mm (3 in.).

The pseudocardinal teeth are triangular, divergent, and roughened; two are present in the left valve, and one is located in the right valve with two smaller teeth on either side. There are two short lateral teeth in the left valve and one in the right valve with a much smaller tooth below. The beak cavity is shallow to moderately deep. The nacre is generally white but may appear iridescent posteriorly.

Reproduction. Data based on other species of *Epioblasma* suggest that the tubercled-blossom mussel is a long-term breeder with the female becoming gravid during the summer and releasing the eggs the following spring or summer (Ahlsted 1985b). The glochidia are probably similar to those of most species in this genus, i.e., bean-shaped and hookless. The fish host is unknown.

Distribution

Records for the tubercled-blossom pearly mussel indicate that it was widespread in the larger rivers of the eastern United States and southern Ontario,

Canada, especially in the Tennessee, Cumberland, Ohio, and St. Lawrence Rivers (Ahlstedt 1985b). Studies of Indian shell middens indicate that this mussel was a relatively common species in the Tennessee River (Stansbery 1976a, Bogan and Parmalee 1983). A number of historical records show that it was present in the Ohio River (Rafinesque 1820, Call 1900, Ortmann and Walker 1922, Ortmann 1925, Parmalee 1960, La Roque 1967, Parmalee 1967, Stansbery 1970, Johnson 1978). The lack of recent information on the tubercled-blossom pearly mussel allows no conclusions to be drawn about its current distribution.

Habitat

The characteristic habitat for species of *Epioblasma* is composed of riffles and shoals with sandy gravel substrates and rapid currents (Stansbery 1971). These typically occur in medium to large rivers.

Population

Eight species of *Epioblasma* are presumed to be extinct (Ahlstedt 1985b). The exact causes for this dramatic decline are not well understood. These mussels are influenced by the same negative factors of stream impoundment, siltation, and pollution that affect other mussel species, but the impacts on species of *Epioblasma* seem to be more exaggerated. Perhaps a greater portion of their habitat has been eliminated by alterations associated with the impoundment of large rivers. These changes have been discussed above (pink mucket account) and include reduced water flows, altered temperature regimes, anoxic conditions, extreme water level fluctuations, reduced turbidity, and concentration of heavy metals (Tennessee Valley Authority 1980). The fish host(s) may also be reacting to levels or types of impacts that are not affecting other fish species in the same habitat (Ahlstedt 1985b).

Potential habitat and management

Potential habitat and management recommendations for the tubercled-blossom pearly mussel are the same as those for the orange-footed pearly mussel (Fig. 7).

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Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was protected under the Eagle Protection Act (16 U.S.C. 668-668d) of June 8, 1940, as amended on October 23, 1972. It is now endangered in the conterminous United States except for the populations in Washington, Oregon, Minnesota, Wisconsin, and Michigan, which are listed as threatened (Federal Register 32 FR 4001; 43 FR 6233). In February 1990 the U.S. Fish and Wildlife Service published advance notice of a proposal to reclassify or delist the bald eagle in some portions of its range (U.S. Fish and Wildlife Service 1991); however, its current status remains unchanged.

The bald eagle is a spring and fall transient in the vicinity of Paducah but winters at some places along the Ohio River. Records of the Kentucky State Nature Preserve Commission (KSNPC) Natural Heritage Program indicate that the eagle is an occasional winter visitor to the Metropolis Lake area. There are no known reports of bald eagles nesting on the PGDP.

Description

The adult bald eagle is easily identified by its large size, massive yellow bill, pale yellow eyes, and white head and tail on a dark brown body (National Geographic Society 1983). Its legs are feathered halfway down the tarsus, and its orange-yellow feet have large black talons (Peterson 1980). Males are about 0.9 m (3 ft) in length, weigh 3.6 kg to 4.5 kg (8 lb to 10 lb), and have a wingspread of approximately 2 m (6.5 ft) (U.S. Fish and Wildlife Service

1983). Females are larger than males, with some weighing as much as 6.5 kg (14 lb) and having a wingspan of 2.4 m (8 ft). Northern birds are larger than southern birds (Clark and Wheeler 1987).

The immature bald eagle has a dark bill, dusky head and tail, and brown eyes (Peterson 1980). First-year birds are often chocolate to blackish brown and may have some white mottling on the underwings, tail, and belly (U.S. Fish and Wildlife Service 1991). Older juveniles are irregularly mottled with white in their outer plumage as well (Robbins et al. 1966). The head and tail become increasingly white with age until full adult plumage is reached in the fifth or sixth year (U.S. Fish and Wildlife Service 1991). Sexes are alike in all plumages, and there are no plumage differences between northern and southern bald eagles (Clark and Wheeler 1987).

Similar species. First-year bald eagles can be distinguished from immature golden eagles by comparing coloration on the underwings and tails. The white on the immature bald eagle assumes a blotchy pattern, whereas that on the immature golden eagle is more sharply defined (National Geographic Society 1983). The head and bill of the bald eagle are also proportionately larger, and the tail is longer. The legs of the immature golden eagle are feathered all the way to the toes (Robbins et al. 1966).

Immature bald eagles may also be confused with turkey vultures (*Cathartes aura*) in flight. However, eagles soar in a flat plane, whereas vultures soar with wings held in a shallow V that tilts unsteadily in flight (National Geographic Society 1983).

Distribution

The bald eagle is distributed throughout North America from northern Alaska and Canada to southern California and Florida (National Geographic Society 1983, U.S. Fish and Wildlife Service 1991). In the East, the breeding range extends from the Great Lakes Region to northern Maine, down the east coast to southern Florida, and north along the Gulf Coast of Florida (Fig. 8) (Peterson 1980, National Geographic Society 1983). Small local breeding populations exist along the Gulf Coast of Texas and Louisiana and along the Mississippi River, with a few widely scattered pairs in other states (Clark and Wheeler 1987). In winter most individuals leave northern inland breeding sites and concentrate in areas that offer abundant food resources. The winter range of the bald eagle extends from the Alaskan Pacific Coast southward into the western states and across the United States to the east coast. A large winter concentration of bald eagles in the eastern United States is found along the upper Mississippi River, especially in association with navigational locks and dams.

Behavior

Foraging. Fish is the preferred dietary item; however, bald eagles are efficient predators and feed on almost any available prey (U.S. Fish and Wildlife Service 1983, Bortolotti and Gerrand 1988). They catch ducks, coots, other waterfowl, small birds and mammals, and snakes (U.S. Fish and Wildlife Service 1983, Dugoni et al. 1986, Clark and Wheeler 1987, Bortolotti and Gerrand 1988). Bald eagles are opportunists and will find food in the easiest possible way, including pirating food from other raptors and scavenging carrion, roadside kills, and garbage (U.S. Fish and Wildlife Service 1983, Clark and Wheeler 1987). They have even been known to consume carcasses of big mammals such as deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and bison (*Bison bison*) (Stalmaster 1987).

Breeding and nesting. The breeding season varies with latitude in the United States (U.S. Fish and Wildlife Service 1991). Winter breeding begins as early as September in the deep South and shifts gradually to spring breeding/nesting time in Kentucky with northward latitudinal progression. Eagles tend to return to their native site to breed, which is usually within 100 miles of where they were hatched (U.S. Fish and Wildlife Service 1983). The female performs most of the nest construction and lays from one to three eggs, more commonly two, in the nest (U.S. Fish and Wildlife Service 1991). The eggs are dull white or pale bluish white, unmarked, rounded-ovate to ovate, approximately 5.1 cm to 7.6 cm (2 in. to 3 in.) in length, 5.1 cm (2 in.) in width, and have rough or coarsely granulated shells (Bent 1961). Incubation requires approximately 35 days, and fledging occurs at 9 to 14 weeks (McEwan and Hirth 1979, U.S. Fish and Wildlife Service 1991). Both parents care for the young until the eaglets leave the nest but continue to provide some parental care for 4 to 6 more weeks (Bent 1961, McEwan and Hirth 1979). Only 50% of eaglets survive their first year (Murphy et al. 1989).

Roosting. The bald eagle is highly social and frequently forms communal night roosts in winter (Clark and Wheeler 1987). Roosts usually contain 2 to 3 eagles per tree but occasionally harbor as many as 100 birds; some eagles perch in nocturnal roosts for one to two days (Clark and Wheeler 1987, U.S. Fish and Wildlife Service 1991).

Habitat Requirements

Nesting habitat. Nests are invariably located near water, the chief component of bald eagle foraging habitat (Bent 1961, Clark and Wheeler 1987, Stalmaster 1987, Bortolotti and Gerrand 1988, Bull and Farrand 1990). In the Southeast, nest sites are usually within 3 km (1.9 miles) of water (McEwan and Hirth 1979). Old-growth timber provides the best sites as the large trees can support the weight of massive nests (Stalmaster 1987). Nests are usually located in the tallest trees, as these offer adequate nest support, an open flight path, and a good view of the surrounding area (Bent 1961, Stalmaster 1987). Pine (*Pinus* spp.) and baldcypress (*Taxodium distichum*) trees are preferred for

nesting in the South (Bent 1961), but large dominant deciduous trees may also be used (Stalmaster 1987).

The cone-shaped nest is a large, conspicuous mass of sticks that is lined with Spanish moss, grasses, cornstalks, dead weeds, and sod (McEwan and Hirth 1979, Murphy et al. 1989). It is usually placed in the upper 30 ft of a tree with canopy cover above and a clear view of open water below (McEwan and Hirth 1979). A typical nest is approximately 1.8 m (6 ft) wide and 1.8 m to 2.4 m (6 to 8 ft) high. However, nests are added to and reused each year, and some actually reach 3 m (10 ft) across and weigh as much as 1814 kg (4000 lbs) (U.S. Fish and Wildlife Service 1983).

Foraging habitat. The most important component of bald eagle habitat is a foraging area that provides abundant fish and adequate perches (Stalmaster 1987). Suitable foraging habitat consists of large bodies of open water, primarily sea coasts, lakes, rivers, and marshes (Peterson 1980, Bull and Ferrand 1990). Bald eagles prefer a wide visual field for hunting; therefore, foraging habitat needs to include large open areas for killing and eating prey (Stalmaster 1987).

An essential characteristic of foraging habitat is the availability of perches, which are sites for locating prey. Bald eagles prefer tree perches but also use cliffs, ice, partially submerged logs, and the ground (Steenhof et al. 1980). The characteristics of preferred perch sites are discussed below.

Perching habitat. Proximity to a food source is often the most important criterion for perch selection (Steenhof et al. 1980). Perches are usually located near shallow water; those at several Montana lakes were associated with water less than 6 m (20 ft) deep at 50 m to 100 m (165 ft to 330 ft) from shore (Caton et al. 1992). A perch site usually has good visibility of the surrounding terrain, accessible landing and departing areas, and isolation from disturbance (Stalmaster 1987).

The selection of foraging perches is influenced by tree characteristics as well as by site factors (Caton et al. 1992). Caton et al. (1992) found the mean dbh (diameter at breast height) of selected perch trees in Montana to be 67.1 cm (26.4 in.) and the mean tree height to be 23.8 m (78 ft). However, as mean dbh and height of available trees increase, the selection for size becomes less important.

Bald eagles prefer snags and partly dead trees but also perch in live trees with dead or broken tops (Stalmaster and Newman 1979, Hansen and Bartelme 1980, Steenhof et al. 1980, Grubb and Kennedy 1982, Fielder and Starkey 1986, Caton et al. 1992). The preferred species of live trees in Montana were Douglas-fir, black cottonwood, and lodgepole pine (Caton et al. 1992); loblolly pine and trees with leafless crowns were most important in North Carolina (Chester et al. 1990). These trees are probably desirable because of their large size and open structure, which affords better visibility for foraging. Chester et al. (1990) reported that eagle perch trees had more accessible perch limbs than

did neighboring trees. Although live trees exhibit greater structural variability, perch selection in living trees may also be determined by the open branching structure (Stalmaster and Newman 1979, Steenhof et al. 1980, Caton et al. 1992).

Perches are extremely important during the breeding season, as foraging areas need to be near the nest site. In Glacier National Park the median distance from perch to nest site was 220 m (524 ft) (Caton et al. 1992). On the Columbia River Estuary in Oregon and Washington, nesting eagles concentrated their foraging activity in a few areas that were centered around one or more key perches (McGarigal et al. 1991). These perches provided a commanding view of the surrounding foraging habitat and included trees on prominent points along the shoreline, isolated trees on the shorelines of natural, shrub-dominated islands, and pilings on tidal mud flats. During the nesting season when food demands are high, availability of preferred perch types at favored foraging sites may influence territory and nest-site selection as well as nesting success (Steenhof et al. 1980).

Wintering habitat. Bald eagle wintering areas possess many of the same characteristics as nest sites (U.S. Fish and Wildlife Service 1991). However, eagles are not so closely limited to shores during the winter since both adults and immatures gather food where it is most readily available. Dead trees and living deciduous trees are preferred daytime perches and tend to be the tallest trees in the foraging area (Stalmaster and Newman 1979). Snags and deciduous trees are probably selected because these trees lack foliage during winter, thus allowing the greatest range of vision from perch sites and providing relatively unobstructed flight paths through crowns.

The distribution of bald eagles at a winter site is apparently influenced most by location of food and areas protected from wind (Steenhof et al. 1980). Habitat use by wintering eagles along a section of the Missouri River floodplain in South Dakota showed that main centers of eagle use were associated with a communal roost and food source. During severe windchill conditions and high winds, eagles move to protected areas.

Roost sites are an important component of wintering areas (U.S. Fish and Wildlife Service 1991). Protection from the climate is the most important aspect in the selection of roost sites (Bortolotti and Gerrand 1988). Deciduous trees are preferred, but large pines are readily used (Stalmaster 1987), and dense stands of live conifers are preferred for night roosts in the Northwest (Stalmaster and Newman 1979). The selection of conifers may have a thermoregulatory function, providing a more thermally favorable microenvironment than dead or deciduous trees that lack foliage in winter. Roost trees tend to be higher than the surrounding canopy or close to forest edges where flight paths are unrestricted (Stalmaster and Newman 1979, Chester et al. 1990).

Communal roosts are sometimes established but are not essential (Stalmaster 1987). Communal roost sites for bald eagles may range in size from 0.32 ha (0.8 acre) to 254 ha (628 acres) (Steenhof 1976, Griffin 1978, Hansen

et al. 1980, Keister and Anthony 1983). Distances of roosts to food sources are more highly variable than those of foraging perches and have been reported to range from 0.25 km (0.15 mile) to 24 km (14.9 miles) (Edwards 1969, Stalmaster et al. 1979, Hansen et al. 1980, Keister and Anthony 1983).

Populations

It has been estimated that from 25,000 to 75,000 bald eagles were nesting in the conterminous United States in 1782, when this bird was adopted as the national symbol (U.S. Fish and Wildlife Service 1983). By the early 1970s that number had been reduced to 3,000 birds with approximately 400 known active nests.

Reasons for decline. A number of factors have been responsible for population declines in the bald eagle. These include habitat destruction and degradation, illegal shooting, environmental contamination with pesticides, and human recreational activities (U.S. Fish and Wildlife Service 1983, Murphy et al. 1989, U.S. Fish and Wildlife Service 1991).

The major factor involved in population declines has been the lowered reproductive success resulting from environmental contaminants, chiefly DDT and its metabolites. These compounds inhibit calcium deposition, which results in eggshell thinning and the ultimate loss of chicks (U.S. Fish and Wildlife Service 1983, Murphy et al. 1989, U.S. Fish and Wildlife Service 1991).

Although habitat alterations and human encroachment resulted in a slowly declining eagle population over many decades, it is the accelerated pace of human development of eagle habitat and the extensive area involved that are the most significant limiting factors in the Southeast today (Murphy et al. 1989). Human populations exhibited rapid growth in southeastern states between 1980 and 1986, ranging from 2% in Kentucky to 23% in Florida (U.S. Bureau of the Census 1987). Immigration to this region has resulted in extensive alterations in land use, which has destroyed much of the eagle's original habitat (Murphy et al. 1989). Exacerbating this situation is the preference of both eagles and humans for waterfront locations (Harris et al. 1987). Flood control projects may interfere with nesting (Shapiro et al. 1982), but man-made reservoirs create a significant amount of eagle habitat (Murphy et al. 1989). Although primarily providing wintering habitat, reservoirs are gradually receiving increased use by nesting eagles.

Illegal shooting has long been a factor in bald eagle population declines (Murphy et al. 1989). From 1961 to 1982, 25% of documented eagle mortality was caused by shooting. Although there is a downward trend in shooting mortality, the current level is unacceptable and may be limiting in areas of remnant nesting populations.

Recovery. The recovery goal is based on occupied territories of bald eagles. An occupied territory indicates activity in a nesting area by a pair of eagles but does not necessarily mean that the activity resulted in offspring. During 1990, occupied bald eagle territories in the conterminous United States were estimated at 2,933 (U.S. Fish and Wildlife Service 1991). In the Southeast, the number of occupied territories was 722 with 466 nests fledging young. This represents a substantial increase over southeastern populations of 1981, when the number of eagle territories was estimated at 396.

Current Kentucky status. It was estimated that only 5 to 10 pairs of bald eagles nested in Kentucky by the 1950's (Mengel 1965). A pair of nesting eagles was discovered at the Ballard County Wildlife Management Area (BCWMA) in 1986, the first such nest in Kentucky since 1946 (Turner 1993). The BCWMA currently has 5 nests, and several eaglets have been fledged each year since 1990.

Potential breeding habitat for bald eagle

Bald eagles are not currently known to be nesting on the PGDP, but there is potential breeding habitat near the Ohio River. The old growth bottomland hardwoods on the WKWMA and around Metropolis Lake SNP are potential habitat for the bald eagle (Fig. 9), because the 65 ha (160 acres) of forest provide tall trees capable of supporting eagle nests. Baldcypress trees, preferred by eagles in the Southeast, and old cottonwoods are abundant along lower Bayou Creek and around Metropolis Lake. These sites are located within the optimal distance to water, and the Ohio River and Metropolis Lake provide good foraging habitat.

Management

Recovery Plan. The primary objective of the Southeastern States Bald Eagle Recovery Plan is to remove the species from endangered and threatened status (Murphy et al. 1989). The step-down procedures focus on 3 aspects of recovery:

a. Protection and management of bald eagle habitat;

b. Protection and management of eagle populations;

c. Improvement and maintenance of awareness, concern, and support for the recovery of the species.

Local management. Wintering bald eagles are transient, not resident, in western Kentucky. Therefore, it is unlikely that PGDP activities would impact wintering eagles, since the surrounding area affords adequate foraging habitat. However, the WKWMA offers good nesting habitat for bald eagles. The lower Bayou Creek area designated as potential nesting habitat (Fig. 9) should

be monitored for nests each year, and any evidence of eagle nesting should be reported to the U.S. Fish and Wildlife Service in Region 3 (Appendix C). Measures should then be taken to protect and maintain eagle nests and foraging habitat. Specific management information is provided in "Habitat Management Guidelines for the Bald Eagle in the Southeast Region," published by the Service (1987) and included as Appendix C of this report. In the event of eagle nesting, compliance with the ESA would be required if agency action is planned in the old growth forest of the WKWMA (see compliance procedures at the end of Chapter 2).

Significance of potential habitat. It is reasonable to expect expansion of eagles from the Ballard County WMA, because the WKWMA may offer the nearest available habitat for young breeding eagles. The BCWMA is only 10 miles downriver from the PGDP area, and much of the land is being cleared along the Ohio River. Kentucky Lake also hosts nesting eagles, and several sites upriver are reported to have nests (Michael Turner, pers. commun., April 1993). Therefore, it is important to maintain the quality of this potential nesting habitat to aid in recovery of the bald eagle in Kentucky.

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Interior Population of the Least Tern

The least tern (*Sterna antillarum*) is a Federally listed endangered species (Federal Register 50 FR 21792). The interior least tern (*S. a. athalassos*) was recognized as a subspecies in 1983 (American Ornithologists' Union 1983). However, no consistently distinctive differences in morphology, behavior, or biochemistry have been found to separate it from other subspecies (Massey 1976, McCament and Thompson 1987, McCament-Locknane 1988). Although the interior least tern was proposed for endangered status, the U.S. Fish and Wildlife Service did not list the subspecies but instead designated as endangered those populations of least terns occurring in interior North America (Sidle and Harrison 1990).

It is possible that the interior least tern could occur on beaches of the PGDP lands adjacent to the Ohio River, but no sitings have been reported to the KSNPC. The nearest known interior least tern nests are in Carlisle County on sandbars and dike fields in the Mississippi River; the Ohio River at the PGDP is devoid of these potential least tern nesting sites (Michael Turner, personal com.). During summer months least terns might forage along this stretch of the Ohio River but are unlikely to nest on the narrow beaches, which are subject to frequent inundation.

Description

The least tern is the smallest North American tern, with a body length of approximately 23 cm (9 in.) and a wingspread of 51 cm (20 in.) (National Geographic Society 1983). The sexes are similar in appearance. The breeding adult has a black crown and nape, white forehead, black-tipped bill, gray back and dorsal wing surfaces, and snowy white undersurfaces. In flight, the black wedge on the outer primaries and the short, deeply forked tail are conspicuous. The color of the legs and bill vary according to sex (Boyd and Thompson 1985). The male's feet and legs are bright orange, while those of the female are pale to bright yellow. The male's bill is bright yellow to orange; the female's bill is light yellow or straw-colored.

Immature birds have darker plumage than adults, black eye stripes, white foreheads, and dark bills (National Geographic Society 1983). The juvenile is pinkish-buff above with brownish U-shaped markings on the feathers; it has a dusky crown, black eyestripe, and dark shoulder bar on the wings. The first-summer bird is similar to adults but retains the eye stripe and shoulder bar; it also has a dark bill and legs and dusky primaries.

Distribution

Historic range. The interior least tern is a migratory species that historically bred along the Mississippi, Missouri, Arkansas, Ohio, Red and

Rio Grande River systems and rivers of central Texas (Sidle and Harrison 1990). The breeding range extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana with incidental occurrences in Michigan, Minnesota, Wisconsin, Ohio and Arizona.

Current distribution. The interior least tern continues to breed in the river systems named above, but its distribution is generally restricted to less altered river segments, reservoirs, and refuges (Fig. 10) (Sidle and Harrison 1990). On the Mississippi River, it occurs almost entirely in the lower valley from south of Cairo, Illinois, to Vicksburg, Mississippi (Sidle et al. 1988). On the Ohio River, the interior least tern occurs just above the confluence of the Tennessee and Ohio Rivers and at one artificial site on the Wabash River in Indiana (Sidle and Harrison 1990). Known breeding areas in Kentucky are along the Mississippi River in Fulton, Hickman, and Carlisle Counties.

Breeding behavior

Interior least terns nest in colonies (terneries) on sandbars, beaches, or manmade structures. They arrive at breeding areas from late April to early June and remain for 4 to 5 months (Youngworth 1930, Hardy 1957, Wycoff 1960, Faanes 1983, Wilson 1984). Courtship occurs at or near the nest site (Tomkins 1959) and includes nest scraping, postures, vocalizations, an aerial display referred to as the fish flight, and copulation (Hardy 1957, Wolk 1974, Ducey 1981).

The nest is a shallow depression that holds 2 or 3 eggs (Hardy 1957, Anderson 1983, Faanes 1983, Smith 1985, Sweet 1985, Kirsch 1987-1989). The eggs are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-gray markings (Hardy 1957, Whitman 1988). Egg-laying begins by late May; incubation is shared by both sexes and usually lasts 20 to 25 days (Moser 1940, Hardy 1957, Faanes 1983, Schwalbach 1988). The young are precocial; fledging occurs at 3 weeks but parental care continues until migration (Hardy 1957, Tomkins 1959, Massey 1972, 1974). Interior least terns usually leave the nesting colony by early September (Bent 1921, Stiles 1939, Hardy 1957).

Habitat requirements

Meandering rivers on a broad floodplain offer the most suitable habitat for the interior least tern. These rivers have high sedimentation rates and slow currents that allow for the formation of sandbars and shallow water areas suitable for nesting and feeding (Whitman 1988).

Nesting habitat. Riverine nesting habitat consists of sparsely vegetated sand and gravel bars within a wide unobstructed river channel (Sidle and Harrison 1990). The nest is placed in an open, sandy area, gravelly patch, or exposed flat with small stones, twigs, or pieces of wood and debris lying near

the nest. Nesting areas are usually located on higher elevations away from the edge of the water, as nesting begins when river flows are high with only small amounts of sand exposed.

The size of nesting areas and the number of nests within a colony depend on water levels and the extent of associated sandbars. Along the Lower Mississippi River with its many large sandbars, nesting areas are often several hundred hectares in size and several hundred meters from the water (Rumancik 1987, 1988). However, variations in river flow may alter the sizes of nesting areas and the number of nests per colony. Along a stretch of the Missouri River, the average size of nesting sandbars was 12 ha (29.6 acres) in 1986 and 31 ha (76.6 acres) in 1987; nest elevation and nest-to-water distance differed by a factor of three in both years. Smith and Renken (1990) found Mississippi River colonies that averaged 100 nests/colony when habitat was restricted by high water early in the nesting period, but which averaged only 19.3 nests/colony during a year of more moderate river levels.

Foraging habitat. The interior least tern requires the shallow water of lakes, ponds, rivers, and streams with an abundance of small fishes, primarily minnows (Fisk 1978, Whitman 1988, Bull and Farrand 1990). The most important prey includes species of *Fundulus*, *Notropis*, *Campostoma*, *Pimephales*, *Gambusia*, *Blonesox*, *Morone*, *Dorosoma*, *Lepomis*, and *Carpoides* (Hardy 1957, Schulenberg et al. 1980, Rumancik 1988, Wilson et al. 1989, Smith and Renken 1990). However, size may be more important than species preference, as terns tend to feed on any fish between 2.5 cm and 7.5 cm (1 in. and 3 in.) in length. Riverine terns forage near the colony, usually within 100 m to 200 m (55 ft to 109 ft) of the nesting area (Whitman 1988).

Populations

Population decline. The transitory habitat of the interior least tern makes it susceptible to nest and chick loss. Therefore, annual reproductive success may vary greatly along a particular river or shoreline (Hill 1987; Kirsch 1987, 1988, 1989; Mayer and Dryer 1989; Dirks 1990). Surveys from major inland waterways showed a total of 4800 least terns in 1987 (Sidle and Harrison 1990), whereas a partial survey by Downing (1980) in 1975 had produced an estimate of only 1200 least terns. Although there are no historic data with which to compare these numbers, early descriptions indicate that the interior least tern was more common than it is today (Hardy 1957, Burroughs 1961).

Causes for decline. The decline in interior least tern populations is apparently the result of habitat alteration and destruction. Channelization, irrigation, and the construction of reservoirs and pools have contributed to the elimination of much sandbar nesting habitat in the Missouri, Arkansas, and Red River systems (Funk and Robinson 1974, Hallberg et al. 1979, Sandheinrich and Atchison 1986). Along the Lower Mississippi River, dike construction has created many sandbars on which nesting colonies are located (Landin et al. 1985; Smith 1985, 1986, 1987; Rumancik 1986, 1987, 1988, 1989). However,

dike field terrestrialization, which reduces tern habitat, is occurring at some nesting sites (Smith and Stucky 1988).

Changes in river flow to accommodate reservoir functions create problems for terns nesting in remaining habitats. For example, regulation of dam discharges on the Missouri River changes the seasonal river flow patterns and may reduce the available nesting habitat (Nebraska Game and Parks Commission 1985, Schwalbach et al. 1988). Historically, peak flows occurred in spring and early summer; then sandbars became available for nesting as water levels decreased in summer (Stiles 1939, Hardy 1957). Currently the demand for reservoir functions is unpredictable; therefore, when high flow periods extend into the normal nesting period, interior least terns are forced to nest in poor quality locations, thus reducing their potential for reproductive success.

Reservoir storage of flows responsible for scouring sandbars has resulted in the encroachment of vegetation and greatly reduced channel width along rivers such as the Platte River, Nebraska (Eschner et al. 1981, Currier et al. 1985, O'Brien and Currier 1987, Stinnett et al. 1987, Lyons and Randle 1988, Sidle et al. 1989). River main stem reservoirs now trap much of the sediment load, thereby resulting in less aggradation and more degradation of the river bed and less formation of suitable sandbars for nesting.

Human disturbance also reduces reproductive success and thus contributes to population decline (Mayer and Dryer 1988, Smith and Renken 1990). Many of the larger rivers have become centers for recreational activities, especially those in mid-America with sandbars large enough to serve as beaches. Sand and gravel pits and other artificial nesting sites are subjected to a high level of human disturbance.

Potential habitat

Although its historical range includes the Ohio River system, the interior least tern would not be expected to nest on the narrow beaches of the PGDP target area as these do not provide suitable nesting habitat. Least tern nesting habitat has been eliminated by the construction and operation of hydroelectric dams; the river no longer meanders and creates sandbars for nesting (Marc Evans, KSNPC, pers. comm., 5 May 1993). The beaches are very narrow, have almost no vegetation, and are frequently subject to total inundation (Michael Turner, USACE Louisville District, pers. comm., 27 April 1993). Any nest sites in the Ohio River drainage would probably be found on artificial substrates, such as those further north in the Wabash River (Brainard Palmer-Ball, KSNPC, pers. comm., 5 March 1993). Least terns would not be expected to forage along the stretch of Ohio River bordering PGDP because they usually feed near their nest sites.

Management

Each June or July the beaches should be monitored for interior least terns nesting along the Ohio River beaches on the PGDP. The U.S. Fish and Wildlife Service should be notified if the species is found to nest on any of these sites so that appropriate measures can be taken to protect it and its habitat. Compliance with the ESA would become effective if planned agency actions would occur in the least tern's nesting habitat.

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Southeastern Myotis

Description

The southeastern myotis (*Myotis austroriparius*) (Federal candidate; state endangered) is a medium-sized bat with a forearm length of 36 mm to 41 mm (1.4 in. to 1.6 in.) and a wingspread of 238 mm to 270 mm (9.5 in. to 10.8 in.) (Barbour and Davis 1969). The globose skull has a slight sagital crest, and the strong hind foot has no keel on the calcar (Hamilton and Whitaker 1979). Adult males weigh from 5 g to 7 g, but nursing females are heavier. The fur is distinctive in its thick, woolly appearance (Miller and Allen 1928). It is dull, yellowish brown with little contrast in color between the bases and tips of the hairs (Barbour and Davis 1969, Burt and Grossenheider 1976). Long hairs on the toes extend well beyond the tips of the claws (Barbour and Davis 1969). The southeastern myotis is most similar to the little brown myotis (*Myotis lucifugus*), but the latter is smaller and has smooth glossy fur.

Distribution

This species is distributed throughout the deep South from Georgia and Florida to extreme northeast Texas and southeastern Oklahoma (Fig. 11) (Barbour and Davis 1969, Hamilton and Whitaker 1979). Disjunct, isolated populations occur in coastal North Carolina, southern Indiana, southern Illinois, and northwest Kentucky. The summer and winter range is identical.

Habitat

During summer months, the southeastern myotis roosts in caves where these are available (Barbour and Davis 1969, Hamilton and Whitaker 1979). Maternity colonies containing thousands of bats are found in the cavernous regions of central Florida. In areas where caves are absent, the bats roost in buildings

foraging habitat, such as ponds and streams, and the bats fly just above the surface of the water to feed. In winter most bats leave the maternity caves of Florida for roosts that are exposed to cooler temperatures and protected from climatic extremes. These are usually found over water in places such as crevices between bridge timbers, storm sewers, road culverts, vertical drain pipes of concrete bridges, boat houses and other buildings, and hollow trees (Rice 1957).

Behavior and reproduction

Maternity colonies in Florida begin forming in mid-March and build to large numbers by early April (Barbour and Davis 1969, Hamilton and Whitaker 1979). The bats hang in large dense clusters of 150 bats per square foot. Adult males roost in other caves or shelters until after the young mature, at which time they join the colony. The majority of young are born from late April through mid-May in the deep South and in June in the more northern states (Burt and Grossenheider 1976). Ninety per cent of females give birth to twins, a unique trait among the *Myotis* of the United States (Barbour and Davis 1969). The young hang in separate clusters from the adults except when nursing (Sherman 1930) and begin flying within 5 to 6 weeks (Rice 1957). Nursery colonies disperse to winter quarters during October (Barbour and Davis 1969).

Population decline

The southeastern myotis has been abundant in Florida with estimates of 77 bats per square mile in central Florida in May (Rice 1957). The population in the lower Ohio River Valley is isolated from populations in the deep South and is known only from a few caves in Indiana, Illinois, and Kentucky (Barbour and Davis 1969). This species has been steadily declining in numbers and is apparently nearing extinction in the Ohio River Valley.

Potential habitat

The southeastern myotis was reported from McCracken County. This was the same site in the old growth forest at which the Indiana bat was netted (#17 - Fig. 2). This forest offers excellent foraging habitat for this species which is usually found in mature forests near permanent water. This species prefers roosting in buildings and other manmade structures but will roost in hollow trees or behind loose bark.

Management

Although not yet Federally listed, the southeastern myotis is endangered in Kentucky. The species needs protection if found on the PGDP. Abandoned buildings at the old Kentucky Ordnance Works and others in the area should be annually surveyed for these bats. Sitings should be reported to the KSNPC, and measures should be taken to protect any buildings where they are found.

Rafinesque's Big-eared Bat

Rafinesque's big-eared bat (*Plecotus rafinesquii*) (Federal candidate; state threatened) is a resident throughout its range and has been called the least known of the bats in the Southeast (Soule 1992). Much that has been written about it is based upon inferences from what is known of other species (Barbour and Davis 1969).

Description

The big-eared bat is a medium-sized bat with a forearm length of 40 mm to 46 mm (1.6 in. to 1.8 in.), a total length of 99.5 mm (3.9 in.), a wingspread of 265 mm to 301 mm (10.4 in. to 11.9 in.), and a weight of 7 g to 12 g (Barbour and Davis 1969, Burt and Grossenheider 1976, Hamilton and Whitaker 1979). Males are smaller than females. The most characteristic features of this bat are two prominent lumps on the dorso-lateral surface of the snout and tremendous ears that are more than 25 mm (1 in.) long and join at the base. When the bat is at rest, the ears are coiled around the neck like the horns of a ram (Hamilton and Whitaker 1979). The fur is pale brown or gray above and nearly white below; the individual hairs are black at the bases with strongly contrasting white tips (Barbour and Davis 1969). The only similar species is the western big-eared bat (*Plecotus townsendii*), from which Rafinesque's bat can be easily distinguished by its whitish underparts, strongly bicolored fur, long hairs that project beyond the toes, and the bicuspidate upper incisor.

Distribution

Rafinesque's bat is widely distributed over the southeastern United States (Burt and Grossenheider 1976, Hamilton and Whitaker 1979). Its range extends from the Dismal Swamp in Virginia south and west through the coastal states to extreme eastern Texas and southeastern Oklahoma (Fig. 12) (Barbour and Davis 1969). It is found from western and southern Arkansas up the Mississippi River Valley to southern Illinois, southern Indiana, and western Kentucky. Isolated populations also occur in southern Ohio, eastern Kentucky, and central West Virginia.

Habitat

Rafinesque's bat is associated with mature southern forests near permanent water (Soule 1992). It roosts in abandoned man-made structures and hollow trees in the Coastal Plain. In summer females most frequently form nursery colonies in buildings, and males roost solitarily in buildings, crevices behind loose bark, and hollow trees (Barbour and Davis 1969). This species prefers dilapidated buildings with partially lighted rooms. In the northern parts of its range, Rafinesque's bat hibernates in caves, mines, and similar artificial habitats such as cisterns and wells (Soule 1992). It sometimes hibernates in silica mines in Illinois (Hamilton and Whitaker 1979). An abandoned open cistern near Reelfoot Lake, Tennessee, has been known to house as many as 64 Rafinesque's bats at one time (Hoffmeister and Goodpaster 1962). These bats can occasionally be found in limestone caves in Indiana, Ohio, Kentucky, Tennessee, and Alabama (Barbour and Davis 1969).

The foraging habitat is primarily forested floodplains and swamps (Soule 1992). Preferred sites are usually those with mature forests along permanent bodies of water, especially rivers (Clark 1987). Bats emerge after dark (Barbour and Davis 1969) and probably forage chiefly on moths (Hamilton and Whitaker 1979). Studies indicate that they forage below the canopy along the forest edge or in moist wooded areas rather than over a stream (Soule 1992).

Behavior and reproduction

Rafinesque's bat has been considered unsociable, as it often roosts singly or in small colonies (Handley 1959). Summer colonies are composed mostly of females and young and rarely include males, whereas winter colonies are larger than summer colonies and include both sexes. Typical summer colonies have been found to contain from 4 to 25 individuals (Handley 1959), but some colonies have been reported with as many as 75 to 200 bats (Soule 1992).

Little is known about the reproductive biology of Rafinesque's bat, but breeding probably occurs in fall and winter (Barbour and Davis 1969, England el al. 1992). Nursery colonies form in the spring, and the young are born from mid-May in Louisiana to late May and early June in the northern portion of the range. The female produces a single pup each year. Juveniles reach full size and acquire adult pelage by August or early September (Handley 1959).

Population decline

Rafinesque's bat is not abundant anywhere (Barbour and Davis 1969, Harvey 1992) and is known or suspected to be declining in more than half its range (Soule 1992). It is thought to be fairly secure only in the southern Coastal Plain where extensive mature wetland forests occur. It is difficult to determine population sizes, however, because bat surveys are likely to miss

this species. It is locally common in eastern Kentucky along the western edge of the Cumberland Plateau and around Mammoth Caves, and there are two records from far western Kentucky that are not associated with caves. John MacGregor, USDA Forest Service, estimated the state population at 2000 individuals.

Because so little is known about Rafinesque's bat, it is difficult to assess impacts (Soule 1992). However, present threats include forest destruction, den tree removal, decreasing availability of abandoned buildings, vandalism of caves and mines, and closing or blasting mines shut. Cave visitation in the summer disturbs maternity colonies, and disturbance in the winter causes bats to awaken and fly, using stored body fat needed to survive the winter.

Potential habitat and management

Mr. Bill Hendricks (Murray State University, pers. comm., Dec 1992) saw a Rafinesque's big-eared bat on the WKWMA while conducting a mist-net survey in 1991. Rafinesques big-eared bat is threatened in Kentucky. Its potential habitat and management is the same as for the Southeastern myotis.

Alligator Snapping Turtle

The alligator snapping turtle (*Macroclemys temminckii*) (Federal candidate; state threatened) is the only living species in its genus. It is a large, long-lived aquatic turtle of the southeastern United States that is harvested commercially in Louisiana and is apparently declining over its range.

Description

The alligator snapping turtle is the largest freshwater turtle in North America. Its carapace ranges in length from 38 cm to 66 cm (15 in. to 26 in.), and it usually weighs from 15.9 kg to 68 kg (35 lb to 150 lb) with the record being 99.3 kg (219 lb) (Conant 1975).

This snapper can be easily identified by its rough, ridged carapace (dorsal shell), large head, and long tail. The carapace has 3 prominent dorsal keels (ridges), one extending along the center line and the other two lateral to it (Johnson 1987). Knobs on the keels are elevated and curved posteriorly (Ernst and Barbour 1989). The anterior margin of the carapace is smooth, whereas the posterior margin is deeply serrate (Carr 1952), and an extra row of small scutes is located just above the margin (Conant 1975). The plastron (ventral shell) is small and leaves most of the soft parts exposed.

The huge head terminates in a sharp, stongly hooked beak, which gives the turtle the appearance of having a pointed, triangular-shaped head (Johnson 1987). The skin on the head, neck, and front legs is covered with numerous

fleshy projections called tubercles. The muscular tail is as long as the carapace, and males have longer tails than females (Ernst and Barbour 1989). The carapace is dark brown or dark gray, and the skin of the head, neck and legs is dark brown to gray above but lighter below.

The only species with which the alligator snapping turtle might be confused is the common snapping turtle (*Chelydra serpentina*). However, it has a saw-toothed tail and smaller head and lacks the extra row of scutes above the carapace margin (Conant 1975).

Distribution

The historic range of the alligator snapping turtle extends westward from southwest Georgia and north Florida to central Texas and northward in the Mississippi Valley through eastern Oklahoma and Kansas to southern Iowa, central Illinois, and southeastern Indiana (Fig. 13) (Carr 1952, Conant 1975, Ernst and Barbour 1989, Soule 1992). The eastern edge of its range includes the extreme western parts of Kentucky and Tennessee, and the Suwannee River in central Florida appears to be the southern limit of its range (Carr 1952). The current distribution probably falls within a narrower range, as this species is most likely extirpated from Indiana and Iowa and records show no evidence of a viable breeding population in Kansas (Soule 1992).

Habitat

The alligator snapping turtle most frequently occurs in the deep water of rivers, canals, lakes, oxbows, and sloughs; but it is also found in swamps and marshes near running water and occasionally in the brackish waters of the Coastal Plain (Ernst and Barbour 1989). In a recent radiotracking study in Tennessee, Dr. Floyd Scott most often found these turtles in less than 3 m (9.8 ft) of water (Soule 1992). They are also occasionally seen in the clear, shallow water of west Florida creeks but appear to be moving between deep holes when thus observed (Carr 1952).

The preferred living and foraging habitat of alligator snappers is stream bottoms with mud substrate and abundant aquatic vegetation (Ernst and Barbour 1989). However, in an inventory of Florida Natural Areas, Jackson found them in sand substrate without aquatic vegetation (Soule 1992). Sloan and Taylor (1987) reported that alligator snappers in northeast Louisiana preferred flotant (dense floating vegetation mat) with cypress (*Taxodium distichum*) or buttonbush (*Cephalanthus occidentalis*) and that use was three times greater than availability.

Few studies have been done on nesting habitat preferences. Ewert observed nests along several rivers in Florida and found that alligator snappers selected a variety of sites for nesting (Soule 1992). These included sand mounds along river banks, sandbars within streams, and a steep cut bank. Site conditions

varied from exposed xeric situations to more mesic sites with partial or deep shade. The nests on the Apalachicola River averaged 12 m (39 ft) from the nearest water, whereas the one on an island in Lake Iamonia was 72 m (236 ft) away. Allen and Neill (1950) reported that nests in Florida were up to 50 m (164 ft) from water.

Behavior

The alligator snapper is almost totally aquatic and seldom emerges onto land except for nesting; it does little basking as do other aquatic turtles (Johnson 1987). The snapper walks along the stream bottom and seldom swims. This turtle is highly secretive, hiding during daylight hours and becoming active at night. Adult turtles forage on a variety of animals, including small fish and turtles, frogs, snails, mussels, worms, and crayfish (Ernst and Barbour 1989); the young also feed on aquatic insects and small mollusks (Johnson 1987). The end of the tongue forms a double-ended movable process that resembles a stout worm when it is distended with blood (Ernst and Barbour 1989). It has been assumed that this appendage, which can be moved at will by the turtle, is used to attract prey as the turtle rests on the bottom of the stream with its mouth open.

Reproduction. Individuals become sexually mature between 11 and 13 years of age (Dobie 1971). Courtship and mating take place in the water (Johnson 1987). Breeding occurs from February through April in Florida but probably later in the spring in the Mississippi Valley (Ernst and Barbour 1989). Nesting occurs about two months later, when the female emerges from the water and deposits eggs in a cavity she has dug with her hind feet (Allen and Neill 1950). After oviposition the eggs are covered, and the nest is smoothed over by the female. The clutch consists of 16 to 52 eggs that are round, white, and hard-shelled (Dobie 1971) with a diameter of 30 mm to 44 mm (1.2 in. to 1.7 in.) (Ernst and Barbour 1972). Larger females produce more eggs than smaller females; one clutch is usually laid per season, but some females lay every other year (Dobie 1971). Incubation requires from 100 to 140 days, and the young turtles emerge in September or October. The hatchling has a very long tail, a rough brown or black carapace that is about 44 mm (1.75 in.) in length, and dark gray skin.

Population decline

The alligator snapping turtle has declined in the northern part of its range and in Louisiana but is still relatively abundant in Florida and probably in other areas of the deep South (Soule 1992). Data is lacking to document the population size of this species over its range and reliably quantify its apparent decline. However, it has been harvested commercially in Louisiana, and the decline in size and number of these turtles in the alligator snapper industry indicates that the species will not continue to sustain prolonged heavy harvest in this area. It is considered extirpated in Indiana, is listed as rare and

unlawful to take in Missouri, and is listed as threatened without protection in Kentucky, where it is known only from the western one-fourth of the state.

Reasons for decline of the alligator snapping turtle are not always clear. However, Louisiana populations have been greatly reduced by overharvesting for food (Soule 1992). Other reasons given for its decline are habitat alteration, water pollution, and reduction in nesting sites (Johnson 1987). Dams have blocked passage on many rivers, which may isolate populations and prevent gene exchange, and water pollution may have negatively altered the food chain in some areas (Soule 1992). These factors continue to be threats, as well as deliberate harvest for human consumption.

Potential habitat and management

The alligator snapping turtle has been reported from McCracken County outside the PGDP. Metropolis Lake and the swamps and sloughs adjacent to the Ohio River provide excellent habitat for this species, especially in the area designated as bald eagle habitat (Fig. 9). Although the alligator snapping turtle is not yet Federally listed, it is threatened in Kentucky. Management or protection for the Federally endangered Indiana bat or bald eagle in this area would benefit this turtle. Any sitings should be reported to the KSPNC.

Lake Sturgeon

Description

The lake sturgeon (*Acipenser fulvescens*) (Federal candidate; state endangered) is one of 3 sturgeons known from Kentucky (Burr and Warren 1986). The distinctive body is mostly covered with longitudinal rows of bony plates. The long snout is conical and sharp with 4 large barbels in front of the ventral mouth. This fish averages 50.8 cm to 140 cm (20 in. to 25 in.) in length and 1 kg to 27 kg (2 lb to 60 lb) in weight (Trautman 1981). The body coloration is olive-yellow, gray or bluish dorsally and milky- or yellow-white ventrally; many individuals are sharply bicolored. The fins are similar in color to the adjacent parts of the body (Pflieger 1975). This species may be distinguished from the shovelnose sturgeon (*Scaphirynchus platorynchus*) by the snout, which is flattened rather than conical in the latter (Trautman 1981). The paddlefish (*Polyodon spathula*) has a longer, thinner snout, and gars are completely scaled.

Distribution

Historically, the lake sturgeon was widely distributed from eastern and central Canada south through the Great Lakes region (particularly Lake Erie) to Missouri, Kentucky, Tennessee, and northern Alabama (Pflieger 1975,

Trautman 1981, Burr and Warren 1986). Before 1900 this species was present in the main channels of the Mississippi, Ohio, Tennessee, and Cumberland Rivers (Woolman 1892, Call 1896, Evermann 1902). However, the lake sturgeon underwent a dramatic decline after 1900 (Pflieger 1975). Today there are only a few twentieth century records for Kentucky waters, and most of the specimens have been caught in the Mississippi River (Burr and Warren 1986).

Habitat

Potential habitat and management for large river fish species is discussed on page 77.

The lake sturgeon is a benthic omnivore that primarily inhabits large, moderately clear rivers and lakes (Trautman 1981). In Kentucky it is restricted to large, free flowing rivers with firm sand/gravel bottoms (Burr and Warren 1986). It forages chiefly over clean bottoms with substrates of cobble, pebble, gravel, and sand but avoids soft, muddy bottoms with few benthic organisms (Trautman 1981). With its protrusible mouth the sturgeon sucks up bottom materials and selectively removes snails, small clams, insect larvae, and crustaceans (Pflieger 1975).

Reproduction. The lake sturgeon migrates upstream to spawn in late May and early June (Trautman 1981). Females deposit the eggs on shallow, gravelly riffles of streams or rocky shoals of lakes (Pflieger 1975). One female may produce more than 500,000 eggs, but females do not spawn every year. Since growth is slow in this long-lived species, individuals do not reproduce until they are about 20 years old. They have a long reproductive life, however, as many live to be 40 years of age.

Population decline

The decline in abundance of the lake sturgeon is attributed chiefly to destruction of habitat and construction of dams that block migratory movements to spawning grounds (Pflieger 1975, Trautman 1981). Siltation and pollution have taken a toll on both spawning and foraging habitat. Great quantities of mussels and gastropods have been destroyed in Lake Erie and streams of its natural range (Clark and Wilson 1912). Overfishing may have been a contributing factor to its decline since it was an economically important fish before 1900 (Pflieger 1975, Trautman 1981). Because of its late maturity, many sturgeons were caught before having an opportunity to spawn.

Sturgeon Chub

The sturgeon chub (*Macrhybopsis gelida*) (Federal candidate; state historic) is one of 61 native species of the carp and minnow family (Cyprinidae) that

occur, or did occur, in Kentucky (Burr and Warren 1986). It was formerly placed in the genus *Hybopsis*.

Description

The following physical description of the sturgeon chub is from Pflieger (1975). This chub is a slender minnow with small eyes, a small horizontal mouth, and keeled scales on the back and sides. The snout is long, somewhat flattened, and projects far beyond the upper lip to give the minnow a rounded face. The front of the dorsal fin is closer to the tip of the snout than to the base of the tail fin. There are from 39 to 45 scales on the lateral line. The back is light brown with numerous fine dark specks. The sides are silvery without definite markings, and the belly is silvery-white. Breeding males do not have special colors, as do males of some minnow species, but have small tubercles along the rays of the pectoral fin. The sturgeon chub grows to a length of 2.8 cm to 3.6 cm (1.1 in. to 1.4 in.) by the end of its first summer.

Distribution

The sturgeon chub occurs in the Missouri River and the lower Mississippi River at least as far downstream as the mouth of the Ohio River (Pflieger 1975). It is not found in tributary streams and does not ascend the Mississippi River above the mouth of the Missouri River. The species is known from one locality in western Kentucky; it has been collected from Ballard County in the Mississippi River near Cairo, Illinois (Burr and Warren 1986). The chub is reported to occur in the Mississippi River as far south as Mississippi and Louisiana (Jenkins 1980).

Habitat

Potential habitat and management for large river fish species is discussed on page 77.

Adults occur in the open channels of large, turbid rivers over substrates of gravel, sand, or mud where the water is swift and shallow, i.e., 10 cm to 60 cm (3.9 in. to 23.6 in.) deep (Burr and Warren 1986). The young and subadults inhabit silty backwater areas or waters with sluggish current and sandy or silty bottoms. The physical traits of the sturgeon chub have been adapted for this habitat; its eyes are reduced in size, and external taste buds are abundant over the head, body, and fins (Pflieger 1975).

Population decline

Little information is available on the decline of the sturgeon chub. However, impoundments may have impacted it since the species prefers flowing

water. The nature of the diet and manner of spawning are not known (Pflieger 1975).

Sicklefin Chub

The sicklefin chub (*Macrhybopsis meeki*) (Federal candidate; state historic) is also a cyprinid native to Kentucky (Burr and Warren 1986). It was formerly placed in the genus *Hybopsis*.

Description

The following physical description of the sicklefin chub is from Pflieger (1975). This chub is a slender minnow with very small eyes and a small horizontal mouth with a small, conical barbel at the corner. The sickle-shaped (falcate) pectoral fins are longer than in other barbeled minnows, reaching far past the base of the pelvic fins. The blount, rounded snout projects slightly beyond the upper lip, but not nearly so far as that of the sturgeon chub. The lateral line has from 43 to 48 scales. The back and upper sides are pale yellowish-brown, and the lower sides and belly are silvery-white. Breeding males do not have special colors. Adults are typically from 6.1 cm to 9.4 cm (2.4 in. to 3.7 in.) in length.

Distribution

The distribution of this chub is similar to that of the sturgeon chub, but the sicklefin chub is more abundant (Pflieger 1975). It occurs in the Missouri River and in the Mississippi River downstream at least to the mouth of the Ohio River. This species is known from two localities in western Kentucky; it has been collected from Ballard County in the Mississippi and Ohio Rivers at Cairo, Illinois (Forbes and Richardson 1920). It has been reported to occur further south in the Mississippi River (Bailey and Allum 1962). There is an unsubstantiated record for the Ohio River at river mile 952 (Pearson and Krumholz 1984).

Habitat

Potential habitat and management for large river fish species is discussed on page 77.

The sicklefin chub is restricted to the open channels of large turbid rivers with strong current and firm sand or fine gravel bottoms (Burr and Warren 1986). The young and subadults inhabit silty backwaters or side channels. This chub is also adapted for living in fast-flowing turbid rivers. The eyes are small and partly covered with skin, and the large falcate fins aid in body control in swift water.

Population decline

Little information is available on decline of the sturgeon chub. It may have been impacted by impoundments which alter water flow and currents, an apparently critical element for the habitat of this species.

Blue Sucker

The blue sucker (*Cycleptus elongatus*) (Federal candidate) is one of 21 species of suckers native to Kentucky (Burr and Warren 1986). It belongs to a monotypic genus, the name of which means "small round mouth."

Description

The following description is taken from Pflieger (1975) and Trautman (1981). The blue sucker has a slender body with smooth cycloid scales, a small head, and a long sickle-shaped dorsal fin. The mouth is small, horizontal, and distinctly overhung by the snout. The lips are covered with numerous wart-like papillae. The dorsal fin contains from 28 to 37 rays, and the lateral line has more than 50 scales. The back and sides are blue-black or dark olive with brassy reflections, and the belly is bluish-white to white. All fins are dark slate-blue. Breeding males become very dark and have small tubercles over most of the head, body, and fins. The length of most adults falls within a range of 40 cm to 72 cm (16 in. to 30 in.) and weight ranges from 0.6 kg to 4.5 kg (1.5 lb to 10 lb).

Distribution

The blue sucker is rare but widespread in the Missouri and Mississippi Rivers and the lower sections of their larger tributaries (Pflieger 1975). Its historical range included the Ohio River from the Indiana to the Pennsylvania state lines (Trautman 1981). In recent times the species has occurred throughout the waters of Kentucky (Burr and Warren 1986). It is occasional and locally common at the Falls of the Ohio and sporadic in the Ohio River (Pearson and Krumholz 1984) and the lower Tennessee River below Kentucky Dam (Sickel et al. 1980).

Habitat

Potential habitat and management for large river fish species is discussed on page 77.

The blue sucker inhabits deep, swift, main channels of large rivers and big river subsystems (Burr and Warren 1986). It prefers clearer water but will

tolerate high turbidity if the current is sufficient to prevent silt deposition (Pflieger 1975). The bottom substrate usually consists of sand, gravel, or cobble. This sucker probably forages insect larvae and other small benthic invertebrates.

Population decline

The blue sucker has decreased in abundance since 1900 (Pflieger 1975). It was present throughout the nineteenth century in the Ohio River and was considered a common and highly-valued food fish (Trautman 1981). Construction of dams, which results in decreased current velocity and siltation, has probably imposed a major impact on blue sucker populations.

Potential habitat and management for fish

The lake sturgeon has been reported from both McCracken and Ballard Counties; the sturgeon chub and sicklefin chub were reported from Ballard County. The blue sucker has been reported from neither county but was suggested for investigation by personnel of the U.S. Fish and Wildlife Service. In recent times, most collections of these species have been from the Mississippi River. They are all large river or lake species, whose habitats have been affected by impoundments. The Ohio River may offer suitable habitat for these fishes, but there is little evidence to indicate the presence of viable populations in waters adjacent to the PGDP. Occurrences of the lake sturgeon should be reported to the KSNPC, as it is endangered in Kentucky. The chubs are considered of historic interest (not reliably observed since 1970), and the blue sucker is not monitored by the KSNPC because it is not considered rare in Kentucky. Neither Bayou Creek nor Little Bayou Creek provides suitable habitat for these large river fish species.

Rocksnails

Three species of rocksnails (Federal candidate; state special concern) that have been reported from McCracken County are the armored rocksnail (*Lithasia armigera*), ornate rocksnail (*L. geniculata*), and varicose rocksnail (*L. verrucosa*). Little has been published on the ecology of these gastropods; therefore, most of the information below has been obtained from Goodrich (1940) and Burch (1982) and through personal communication.

Description

Rocksnails belong to the family Pleuroceridae. General characteristics of this family include: (1) a multispiral operculum that seals the shell aperture when the snail's body is withdrawn; (2) respiration by gills; (3) adult shells of medium to large size (usually more than 15 mm long); and (4) dioecious

reproduction (requires 2 sexes) with egg-laying females (Burch 1982). These species of *Lithasia* have heavy, solid shells that are elongately conic, i.e., the angle formed by the sides with the tip of the spiral is about 30 degrees. (Several subspecies of the ornate rocksnail may be considered more broadly conic, i.e., the angle approaches 60 degrees.). The surface of the shell is sculptured with nodules; the most prominent spiral row is along the shoulder of the whorls in the ornate and varicose rocksnails, but it is along the median periphery in the armored rocksnail.

Distribution

The following distribution information is that given by Goodrich (1940). These rocksnails are chiefly known from the Ohio and Tennessee Rivers and their tributaries. The armored rocksnail is found in the Lower Ohio River, lower Wabash River, and the Cumberland River in Kentucky from above Burnside in Pulaski County to branches in Trigg County. It has also been recorded from the Tennessee River in the vicinity of Florence, Alabama. The varicose rock snail is distributed from the branch of the Ohio River near Cincinnati to the lower part of the river and from lower parts of East Tennessee headstreams of the Tennessee River to Marshall County, Kentucky. It has been recorded from the lower Wabash River in Indiana and the Black and Spring Rivers of Arkansas. Most of the distribution records for the ornate rocksnail are from Tennessee, but it has been found in the Cumberland River above Burnside in Pulaski County, Kentucky.

Habitat

These 3 rocksnails occur in riverine habitats in water depths up to 15 or 20 feet; depth distribution is probably not limiting if the water permits light penetration (Dr. Barry Payne, pers. commun., Feb. 1993). These snails are lotic (need flowing water) so would inhabit the channel bed rather than exposed rocks at the shoreline. They need rocky or pebbly substrates for foraging and would not be found on sandy or muddy bottoms. Their heavy shells protect them from the abrasiveness of their environment.

Populations

Although these rocksnails are in Category 2 of Federal candidate species, they are listed in Kentucky only as special concern species. It is difficult to ascertain the status of populations because of the paucity of published information. The 3 species co-exist, and the relative abundance in which they are now found may be a reflection of their natural frequency patterns (Dr. Barry Payne, pers. comm., Feb. 1993).

Potential habitat and management

The 3 species of *Lithasia* reported from McCracken County have Special Concern status in Kentucky. They primarily inhabit large rivers with flowing waters and rocky or pebbly substrates. The Ohio River adjacent to the PGDP area may provide suitable habitat for these snails. Any management for the orange-footed pearly mussel would benefit the rocksnails. Bayou Creek and Little Bayou Creek do not provide good habitat for these snails.

Other Species

Bachman's sparrow (*Aimophila aestivalis*) is a C2 species but has not been reported from the PGDP. The U.S. Fish and Wildlife Service (USFWS) at USFWS Region III Field Office have no records of this sparrow nesting in the Paducah area. One sighting in the area is an old record. Mr. Jim Widlak, Endangered Species Coordinator, said that Paducah is on the margin of the sparrow's range. This species prefers dry open woods, especially pine with scrub palmetto (National Geographic Society Field Guide 1983), which is not typical of the study area.

Arctic peregrine falcon (*Falco peregrinus tundrius*) is a Federally threatened species. One sighting occurred at Grahamville in 1980. This is an incidental migrant that should not be impacted by work at PGDP (Jim Widlak, USFWS, pers. commun., Dec. 1992).

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5 State Listed or Special Concern Species Reported from PGDP

There is no official listing of threatened and endangered species for Kentucky. However, the Kentucky State Nature Preserve Commission (KSNPC) Natural Heritage Program has a list of animal and plant species that it considers to be endangered, threatened, or of special concern in Kentucky. Reliable sitings of these species are maintained in a data base from which current information can be obtained for county and other unit locations. The following accounts are for species on the KSNPC list that have been sited on the PGDP.

There are no compliance requirements for state-listed species in Kentucky. However, it is recommended that the KSNPC and the Department of Fish and Wildlife Resources (DFWR) be notified if any planned project activities will be conducted in areas where these species are known to occur or have potential habitat (Mr. Gary Sherman, DFWR, pers. comm., 17 February 1994; Mr. Tom Bloom, KSNPC, pers. comm., 1 March 1994). Staff personnel of the DFWR and KSNPC are very supportive of efforts to protect state-listed species and will advise the most effective measures for protecting them in impact areas.

The KSNPC should also be notified if any other state-listed species is sited on the PGDP, even if there is no disturbance to its habitat. This aids in keeping the Natural Heritage data base updated so that timely information can be provided to users. Managers should request and retain the most current listing.

Prairie Plants and Communities

Most of the prairie plants in the study area are common in prairie communities and are not on the Federal or Kentucky lists of endangered species. However, two state-listed prairie wildflowers are found on the WKWMA. These are prairie compass plant (*Silphium l. laciniatum*), which is state-threatened, and cream wild indigo (*Baptisia bracteata* var. *leucophaea*), a special concern species. These plants are components of the prairie

communities that are being restored and maintained on the WKWMA. Sweet coneflower (*Rudbeckia subtomentosa*), a state-endangered prairie species, has not been reported from the PGDP.

Prairie plant communities. Remnant prairie is one of the unique features of the WKWMA, as this ecotype is part of the natural vegetative succession of western Kentucky. At the time of settlement, Kentucky had 3 million acres of eastern tall grass prairie (Mr. Marc Evans, pers. commun., 5 May 1993). It was a disjunct, U-shaped area that followed the Mississippi outcropping of limestone and extended from the Jackson Purchase Area in West Kentucky down through Bowling Green and up through Hardin and Meade Counties, just west of Louisville. These grasslands supported large herds of bison on the typical prairie vegetation.

The dominant grasses of these plant communities are those typical of tall grass prairie ecosystems. Indian grass (*Sorghastrum nutans*), eastern gamma grass (*Tripsacum dactyloides*), big bluestem (*Andropogon gerardii*), prairie cordgrass (*Spartina pectinata*), and little bluestem (*Schizachayrium scoparium*) are present throughout the WKWMA (Mr. Charles Logsdon, pers. commun., Mar. 1993). Silver broomsedge (*A. ternarius*) and common broomsedge (*A. virginicus*) are members of this assemblage but also occur extensively in areas outside the WMA. Dominant forbs include prairie compass plant, cream wild indigo, prairie blazing star (*Liatris* sp.), and black-eyed susan (*Rudbeckia hirta*).

The restoration of prairie plant communities is important in the maintenance of biological diversity within the region. The WKWMA has excellent potential for this effort, as it provides the largest tracts of remaining prairie in the state. These were formerly degraded by the absence of fire but are now being restored with prairie plant species and are being maintained with fire (Mr. Charles Logsdon, WKWMA supervisor, pers. commun., 6 May 1993). The prairie communities shown in Figure 14 were taken from a map of the WKWMA provided by Mr. Logsdon. The existing prairie plant communities consist of typical prairie species and are being actively managed as units of the native prairie ecosystem. The areas being considered for restoration and management as prairie communities are also shown in Figure 14. Mr. Logsdon also maintains an updated map showing new sitings of prairie compass plant and cream wild indigo outside the typical communities (Fig. 15).

Prairie compass plant. This species is a deep-rooted, long-lived herbaceous perennial that can have one or more stems (Pleasants and Jurik 1992). Each stem is hairy and leafy throughout its length with simple alternate leaves that are deeply dissected (Jones 1963, Mohlenbrock 1975). Nonflowering stems consist of a basal rosette of 1 to 5 vertical leaves approximately 20 cm (7.9 in.) wide and 40 cm (15.7 in.) tall; the leaves are aligned in a north-south direction, so the leaf surfaces face east and west (Zhang et al. 1991). Leaf size is progressively reduced up the stem until the uppermost leaf is entire and less than 10 cm (4 in.) long (Gleason 1952a). Flowering stems grow approximately 1.5 m (4.9 ft) tall and have several basal leaves (Pleasants

and Jurik 1992). Several heads are present in a narrow racemiform inflorescence; the disk is 2 cm to 3 cm (0.8 in. to 1.2 in.) wide with 15 to 30 rays that are 2 cm to 5 cm (0.8 in. to 2 in.) long (Gleason 1952a). This species flowers from July through September (Steyermark 1963). The seeds are winged achenes approximately 1.2 cm (0.5 in.) in length; seedlings appear in late spring and early summer from seeds deposited the previous year (Pleasants and Jurik 1992).

The prairie compass plant is distributed from Ohio and Michigan to Minnesota and North Dakota and south to Oklahoma, Texas, and Alabama (Steyermark 1963). It occurs in prairies, glades, and open areas such as disturbed sites along roadsides and railroads. It has been reported to the KSNPC from several sites on the WKWMA (# 3,4 - Fig. 2, Table A2) and is a forb component of the managed prairie communities (Fig. 14).

Cream wild indigo. This legume has cream-colored flowers that are borne in racemes with conspicuous bracts (Steyermark 1963). The entire plant is softly pubescent and grows from 3 dm to 6 dm (11.8 in. to 23.6 in.) tall (Radford et al. 1968). The trifoliate leaves are composed of membranous, oblanceolate to obovate leaflets that are from 2 cm to 4 cm (0.8 in. to 1.8 in.) in length. The ovoid seed pods have thick walls that are 4 cm to 5 cm (1.6 in. to 2 in.) long at maturity (Jones 1963). Cream wild indigo blooms from late April or May through June (Jones 1963, Mohlenbrock 1975).

This species occurs in prairies and open upland woods from Michigan to Minnesota and Nebraska and south to Kentucky, Arkansas, and Texas (Gleason 1952b). It also grows in sandhills and open woods of the southeastern Piedmont region (Radford et al. 1968). Locations on the WKWMA are shown in Figure 15.

Fishes

Metropolis Lake provides the only potential habitat for the four species of fish discussed below.

Chain pickerel. The chain pickerel (*Esox niger*) is a member of the pike family (Esocidae) and is listed as a species of special concern in Kentucky. It has an elongated body, a duck-bill shaped snout, and one dorsal fin similar in size and shape to the anal fin (Pflieger 1975). The dorsal fin is placed just above the anal fin, and both are located posteriorly near the forked caudal fin. The dorsal surface of the body is olive or yellow-green, whereas the sides are lighter with greenish hues and dark chain-like reticulations (Trautman 1981). There is a dark vertical bar under the eye. Adults are from 30.5 cm to 67.1 cm (12.0 in. to 26.4 in.) long and weigh from 198 g to 1.4 kg (7 oz to 3 lb).

The original range of the chain pickerel extended from extreme eastern Canada and the United States south through the eastern Coastal Plain to Florida, west to eastern Texas, north through the Ozarks in southeastern

Missouri, and east to western Kentucky (Trautman 1981, Burr and Warren 1986). The distribution of this species is sporadic in oxbow lakes along the lower Ohio and Mississippi Rivers (Burr and Warren 1986). The chain pickerel is locally common in Murphy Pond, Hickman County. It has also been taken from Bayou du Chien in Hickman County (Rice et al. 1983) and is recorded by the KSNPC from Metropolis Lake (#5 - Fig. 2, Table A2).

This species inhabits wetlands, sluggish lowland streams, and vegetated shorelines of cypress-bordered oxbow lakes and some reservoir and floodplain lakes (Burr and Warren 1986). It prefers substrates of sand, mud, and organic debris with submerged brush and aquatic vegetation (Trautman 1981).

Cypress minnow. The cypress minnow (*Hybognathus hayi*) is listed as endangered in Kentucky. This silvery minnow has a large eye and is from 7.6 cm to 15.2 cm (3 in. to 6 in.) long (Pflieger 1975). The back is yellowish-olive with emerald reflections and a broad dusky or greenish-golden strip along its midline. The scales on the forward part of the side have prominent dark edges that form a distinct diamond-shaped pattern and give the appearance of a lengthwise stripe.

The historic distribution of the cypress minnow is the lower Mississippi River and its tributaries (Pflieger 1975). However, it is now sporadic and rare in the direct Mississippi River tributaries of the Coastal Plain of extreme western Kentucky and oxbow lakes of the Ohio River (Burr et al. 1980). This minnow has been recorded from West Fork Clarks River in Graves County (Warren and Cicerello 1983), and records of the Kentucky State Nature Preserve Commission show that it has been found in Metropolis Lake (#5 - Fig. 2, Table A2).

The cypress minnow inhabits small sluggish streams, sloughs, ditches, and oxbow lakes where it occurs predominantly in open water over a mud or sand bottom (Burr and Warren 1986). It is occasionally associated with submerged aquatic vegetation or other cover.

Spotted sunfish. The spotted sunfish (*Lepomis punctatus*) is listed as threatened in Kentucky. It is slab-sided and has a moderated-sized mouth with the upper jaw reaching past the front of the eye (Pflieger 1975). The dorsal fin has 10 spines and is connected to a soft dorsal fin without a black spot, which is characteristic of some sunfishes. The back and sides are dark blue with a yellowish hue, and the belly is yellowish or dusky white. The scales on the sides form lengthwise rows that are marked by yellowish-orange spots in adult females and red spots in adult males. The ear flap is black and sometimes edged with white or pale yellow. This species reaches a length of approximately 20 cm (8 in.) and a weight of 198 gm (7 oz).

The spotted sunfish occurs throughout the southeastern United States from the eastern Coastal Plain and Florida west through Alabama and Mississippi to Texas and north to southeastern Missouri, southern Illinois, and western Kentucky (Burr and Warren 1986). It is known from 10 localities in extreme

western Kentucky (Burr and Mayden 1979), one of these being Metropolis Lake (#5 - Fig. 2, Table A2). Other locations in western Kentucky where this sunfish is known to occur are the Pond River in Muhlenberg County and the Mud River in Butler County (Warren and Cicerello 1982).

Typical habitats of the spotted sunfish are sluggish waters found in oxbow lakes, wetlands, vegetated shorelines of lakes, and backwaters and pools of streams (Burr and Warren 1986). The most common types of substrate used by this sunfish are sand and mud overlain with organic debris, particularly in areas with cypress knees and submerged aquatic vegetation.

Taillight shiner. The taillight shiner (*Notropis maculatus*), listed as threatened in Kentucky, is a very slender minnow with moderately large eyes and a small oblique mouth (Pflieger 1975). It has a dark stripe along the entire length of its body from the tip of the snout to the base of the tail fin, where a very prominent black spot is located. The back is pale olive-yellow with prominently dark-edged scales, and the sides are silvery-white. The dorsal fin is almost completely black in breeding males. Adults are commonly 4.8 cm to 6.1 cm (1.9 in. to 2.4 in.) long.

This minnow occurs in drainages of the Ohio and Mississippi Rivers, in Florida, and along the lower southeastern Coastal Plain (Burr and Warren 1986). It is occasionally found in oxbow lakes of the lower Ohio and Mississippi Rivers in extreme western Kentucky, especially those that border these rivers on the Mississippi Alluvial Plain (Burr and Page 1975). The Kentucky State Nature Preserves Commission has documented it from Metropolis Lake (#5 - Fig. 2, Table A2).

The taillight shiner is restricted to low-gradient streams, oxbow lakes, and sloughs (Burr and Warren 1986). It is usually found around cypress knees near the shallow margins of lakes or in backwaters over soft substrates of mud or detritus near or among aquatic vegetation.

Mammals

Evening bat. The evening bat (*Nycticeius humeralis*) is a southern bat that is listed as threatened in Kentucky. It has short, sparse, dull brown fur that is closely confined to the body and does not extend onto the wing or tail membranes (Hamilton and Whitaker 1979). The small ears are thick and leathery, and the short skull is low and broad with a nearly straight dorsal profile. It closely resembles the myotis, but the tragus is blunt rather than pointed (Burt and Grossenheider 1976). This bat averages 9.3 cm (3.6 in.) in total body length, 3.6 cm (1.4 in.) forearm length, and 5 g to 6 g (0.17 oz to 0.21 oz) in weight (Hamilton and Whitaker 1979). The evening bat usually has two young, which are born in May or June.

This species is distributed from the eastern Coastal Plain south to Florida and west to southcentral Texas and eastern Oklahoma and Kansas (Burt and

Grossenheider 1976). In the northern part of its range, the evening bat occurs occasionally from Pennsylvania to southern Michigan and Illinois (Hamilton and Whitaker 1979). It roosts in hollow trees and old buildings and almost never in caves. Two specimens were mist-netted on the WKWMA during a KSPNC survey in 1991 (#17 & 18 - Fig. 2, Table A2).

Northern long-eared bat. Five specimens of the northern long-eared bat (*Myotis septentrionalis*), a species of Special Concern, have been netted from the WKWMA at siting locations #17 and #18. Since three of these bats were netted in July 1993, information for them is not included in Table A2. The northern long-eared bat is dark brown with ears that extend slightly beyond the nose (Burt and Grossenheider 1976). Its forearm is 1.4 in. to 1.6 in. (36 mm to 41 mm) in length, and it weighs 0.25 oz to 0.33 oz (7 g to 9 g). Summer habitat for this species consists of mine tunnels, caves, buildings, hollow trees, storm sewers, and forested areas. Habitat is present for this species in the Bayou Creek Ridge SNA, where it has been netted.

Birds

The great blue heron (*Ardea herodias*) is a species of Special Concern in Kentucky. Although it is very common, it has not been officially reported from the PGDP area. It is a large slate blue heron with a white head and black stripe that extends above the eye; the white foreneck is streaked with black. The breeding adult has a yellowish bill and plumes on its head, neck, and back (National Geographic Society 1983). It breeds throughout the United States and parts of Canada and is a year-round resident in the Southeast and Southwest to the California coast. Marshes, swamps, tideflats, wet fields and meadows, and shores of lakes, rivers, lagoons, and seacoasts are typical habitats of the great blue heron (Peterson 1980). It walks slowly through the shallows searching for small fishes, which are its main source of prey (Robbins et al. 1966).

Species on the Margin of Natural Range

The KSNPC has records for the occurrences of other State-listed species on the PGDP, but none are candidates for Federal listing. They are uncommon in Kentucky chiefly because the western part of the state is located at the margin of their natural ranges. The significance of a marginal population is its contribution to the maintenance of heterogeneity in the gene pool of the larger population. This ensures the perpetuation of healthy populations and helps to maintain the biodiversity of an area. Therefore, it is important to be aware of the presence of any of these species and to take measures to protect them.

Sitings for each of these species have been plotted on Fig. 2. The information provided below indicates the following for each species: (1) Kentucky

status; and (2) location in Table A2 of its siting and map coordinates; (3) brief species description; and (4) typical habitat and range.

Water hickory. Water hickory (*Carya aquatica*) (state special concern) has alternate, pinnately compound leaves, whose leaflets are toothed and long-pointed (Petrides 1972). The bark separates into long thin plates or scales (Steyermark 1963). This species is similar to pecan (*Carya illinoensis*) but has a smaller fruit with a four-ribbed nut containing a bitter seed (Harlow et al. 1979). Water hickory is common in swamps and other low wet sites throughout the Coastal Plains from Virginia to Florida, west to eastern Texas, and north in the Mississippi Valley to southern Illinois (Fig. 2, #1). Potential habitat is Metropolis Lake and the bottomland forest near the Ohio River.

Carolina silverbell. Carolina silverbell (*Halesia carolina*) (state endangered) is a small tree with alternate, simple, obovate, finely toothed leaves and snowy, white bell-shaped flowers (Preston 1961). Typical habitats are bottomlands and rich woods, and its range extends from Virginia and southern West Virginia through southern Ohio, Indiana, and Illinois to southeastern Missouri and Oklahoma and throughout the Southeast to Florida and east Texas (Petrides 1972) (Fig. 2, #1). Potential habitat is Metropolis Lake and the bottomland forest near the Ohio River.

Hair grass. Hair grass (*Muhlenbergia glabrifloris*) (state special concern) is a perennial grass that stands erect from a scaly rhizome and grows approximately 16 in. to 31 in. (4 dm to 8 dm) tall (Gleason 1952a). It grows on moist or dry soils, in open woods and prairies and ranges from Indiana to Iowa and southwest to Texas.

The restored prairies may offer habitat for hair grass to become established on the area (Fig. 2, #2).

Green treefrog. The green treefrog (*Hyla cinerea*) (state special concern) is usually bright green with a white or yellowish strip along each side of its body; however, coloration is highly variable (Conant 1975). This species is approximately 1.25 in. to 2.25 in. (3.2 cm to 5.7 cm) long. The voice has a bell-like quality, and the call may be repeated as many as 75 times per minute. Typical habitats include swamps, borders of lakes and streams, floating vegetation, and almost any other wet or damp place. The range of the green treefrog extends from the Delmarva Peninsula to the southern tip of Florida and some of the Keys, west through the Gulf Coastal Plain to eastern and southern Texas, and north to extreme southern Illinois; isolated colonies are also in Kentucky and Tennessee. On the WKWMA, swamps and marshes in the bottomland forest near the Ohio River offer excellent habitat for the green treefrog (Fig. 2, #6, 7).

Northern crawfish frog. The northern crawfish frog (*Rana areolata circulosa*) (state special concern) has a stubby body, rounded dark spots with light borders on its dorsal surface, and an unmarked ventral surface (Conant 1975). It grows from 2.25 in. to 4.5 in. (5.7 cm to 11.4 cm) in length. This

species is often found in crawfish holes that have lost the chimneys and contain water. Other habitats include mammal burrows, holes in roadside banks, and storm or drainage sewers. Its limited range extends from southwestern Indiana across southern Illinois and north-central Missouri south to northeastern Oklahoma and south from Indiana to south-central Mississippi. Although the PGDP area is at the eastern margin of the frog's range, the WKWMA apparently offers habitat for this species as a number of sitings have been reported on the south end of the WKWMA (Fig. 2, #8, 9, 10, 11, 12).

Fish crow. The fish crow (*Corvus ossifragus*) (state special concern) closely resembles the American crow (*Corvus brachyrhynchos*) but is about 2 in. (5 cm) shorter at its average length of 15.5 in. (39 cm) (National Geographic Society 1983). It is best identified by its call, which is a high, nasal, single- or double-note "cah." The fish crow favors tidewater marshes and low valleys along large eastern river systems; it is less frequent inland except along rivers. Its range is mostly coastal from New England south to Florida and east Texas and up the Mississippi River Valley (Peterson 1980). The WKWMA provides good habitat in the swamps and bottomland forests along the Ohio River and at Metropolis Lake (Fig. 2, #13).

Hooded merganser. The hooded merganser (*Lophodytes cucullatus*) (state endangered) is a diving duck with a spikelike bill, a fan-shaped crest, and black and white secondary wing feathers (Peterson 1980, National Geographic Society 1983). The male's vertical crest may be raised and lowered; the white patches are conspicuous when it is raised. The male has a white breast with 2 black bars on each side, while the female is brownish all over with a tawny crest. Breeding habitat consists of wooded lakes, ponds, and rivers; winter range consists of freshwater estuaries and sheltered backwaters. The breeding range extends from southeastern Alaska and Canada to the eastern United States and the California coast. The part of the WKWMA that borders the Ohio River offers breeding habitat with its freshwater streams, swamps, and marshes (Fig. 2, #14).

Bell's vireo. Bell's vireo (*Vireo belli*) (state special concern) is approximately 4.75 in. (12 cm) long; it is dull grayish-olive above and whitish below, with yellow sides, indistinct white eye rings, and two faint white wing bars, the lower bar being more prominent (Peterson 1980, National Geographic Society 1983). This vireo is common in moist woodlands, bottomlands, and mesquite. It feeds in dense brush and occasionally in treetops. The breeding range of Bell's vireo is central and southwestern United States and northern Mexico, but it is expanding slightly into the northeastern United States. Breeding habitat on the PGDP area includes streamside thickets along the Bayou Creek system and dense brush around the KOW and other fairly open sites (Fig. 2, #15, 16).

A Crayfish. *Orconectes lancifer* (state endangered) has no common name. It was described by Hagen in 1870 as *Cambarus lancifer* (Hobbs 1989). This crayfish is a highly distinctive species with no close relatives (Page 1985). The rostrum is deeply excavated with convex margins that diverge anteriorly

and terminate in spines. The carapace is slightly flattened dorsoventrally and has large cervical spines. The chela are long and narrow, covered with bristles, and free of tubercles. *O. lancifer* is mottled in shades of red, brown, and green.

The range of *O. lancifer* is the Mississippi Gulf Coastal Plain from eastern Texas through Arkansas, Louisiana, Mississippi, and Tennessee to extreme southern Illinois (Page 1985). The crayfish inhabits the deep water of oxbows, bayous, and large streams. One specimen *O. lancifer* was collected at Metropolis Lake (#1 - Fig. 2, Table A2). Neither Big Bayou nor little Bayou Creek offer suitable habit for this species.

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6 State Listed or Special Concern Species Reported from McCracken or Ballard Counties

Potential Species on the PGDP

The KSNPC list of T/E species reported from Ballard and McCracken Counties included many state-listed species that have not been sited on the PGDP (Table 1). Managers should be aware that these species have the potential to occur on the PGDP in habitats similar to those in which they were sited in the surrounding counties.

Plants

The Bayou Creek System and the marshes and sloughs associated with Metropolis Lake offer potential habitat for 16 state-endangered, threatened, or special concern wetland species. Aquatic plants found in swamps, ponds, and quiet streams are Carolina fanwort (*Cabomba caroliniana*) and American frog's-bit (*Limnobium spongia*),threatened, and Illinois pondweed (*Potamogeton illinoensis*), endangered. The shallow waters, margins, and mud flats of sloughs and swamps are potential habitat for lake cress (*Armoracia lacustris*), threatened; blue mud-plantain (*Heteranthera limosa*), special concern; and pale manna grass (*Torreyochloa pallida var pallida*), endangered. Swamps, wet meadows, swales, and shores are potential habitat for blue-joint reedgrass (*Calamagrostis canadensis var macouniana*), endangered; brown bog sedge (*Carex buxbaumii*), endangered; woolly sedge (*Carex lanuginosa*), endangered; creeping St. John's-wort (*Hypericum adpressum*), historic interest; vetchling peavine (*Lathyrus palustris*), threatened; and narrow-leaved meadow-sweet (*Spiraea alba*), endangered. River bulrush (*Scirpus fluviatilis*), threatened, may be found in marshes and shallow water, especially along riverbanks. Large sedge (*Carex gigantea*), threatened, is an inhabitant of bottomland forests and floodplain swamps; swamp candles, also known as yellow loosestrife (*Lysimachia terrestris*), endangered, is found in open swamps and other wet

soils; and bog rush (*Juncus elliottii var elliottii*), endangered, occurs on damp or wet sandy or peaty soils.

Several potential species occur in drier habitats. Broad-leaf golden-aster (*Heterotheca subaxillaris var latifolia*), threatened, and pale umbrella-wort (*Mirabilis albida*), endangered, inhabit sandy sites, particularly disturbed places such as roadsides. Woods and edges offer potential habitat for southern crab-apple (*Malus angustifolia var angustifolia*), special concern; nannyberry (*Viburnum lentago*), endangered; Bush's muhly (*Muhlenbergia bushii*), endangered; blue scorpion-weed (*Phacelia ranunculacea*), special concern; and Buckley's goldenrod (*Solidago buckleyi*), special concern. Sweet coneflower (*Rudbeckia subtomentosa*) and rough rattlesnake-root (*Prenanthes aspera*) are two endangered prairie species that have potential for occurring in the prairie communities on the PGDP.

Aquatic animals

Mussels. Four potential species of mussels that inhabit gravel and sand substrates of large rivers are the long-solid (*Fusconaia s. subrotunda*), threatened; pocketbook (*Lampsilis ovata*), endangered; sheepnose (*Plethobasus cyphyus*), special concern (*Parmalee 1967*); the rabbitsfoot (*Quadrula c. cylindrica*), threatened, is found in the same type of habitats but also occur in small rivers. The bleufer (*Potamilus purpuratus*), endangered, occurs in deep streams with deep mud and fairly quiet pools.

Crayfish. Sluggish streams, sloughs, and standing water provide potential habitat for the cajun dwarf crayfish (*Cambarellus shufeldtii*), special concern; C. puer, endangered; and Procambarus viaeviridis, threatened. These crayfish will burrow during dry periods and may be found in roadside ditches once water has returned.

Central mudminnow. In Kentucky the mudminnow family (Umbridae) is represented by only one native species, the central mudminnow (*Umbra limi*), which is listed as a State threatened species. The cheeks, opercles, and top of the head are scaled; the tail is rounded; the fins have no spines; and a lateral line is lacking (Trautman 1981). The dorsal half of the head and body are dark olive-green or brown and mottled with dark brown, whereas the sides are lighter and mottling is more distinct; the ventral half of the body is dull yellow-white. The fins are brownish, and a prominent dark bar is located just anterior to the caudal fin. Adults are usually from 5.1 cm to 10 cm (2 in. to 4 in.) long.

The historic distribution of the central mudminnow covered the Great Lakes region of the United States and extended into northeast and northcentral Canada; however, the northern and northwestern limits of its range are indefinite (Trautman 1981). The species is at the southernmost edge of its range in western Kentucky. It is occasional and locally common in several drainages in

the extreme western part of the state (Burr and Warren 1986) and has been recorded by the KSNPC from McCracken County.

This species occurred in abundance only in undisturbed clear waters with low gradients where the bottom components were sand, mud, organic debris, and aquatic vegetation (Trautman 1981). A soft substrate is required because the mudminnow burrows tail first into the bottom to hide, rest, or estivate during droughts. In this region, it is usually found in dense beds of submergent plants or piles of organic debris in spring-fed wetlands, ditches, or shallow margins of lowland lakes (Burr and Warren 1986). This species tends to be isolated from other fishes by vegetation or land barriers, but it occasionally moves into small creeks and streams.

Habitat alteration and degradation of rivers and streams has apparently been responsible for the decrease in populations of the central mudminnow (Trautman 1981). Some populations in northern Ohio have been extirpated in recent years (White et al. 1975).

Other fishes. Eight of the potential fish species are associated with large rivers. These are the endangered alligator gar (*Atractosteus spatula*) and 7 species of special concern: the chestnut lamprey (*Ichthyomyzon castaneus*), black buffalo (*Ictiobus niger*), burbot (*Lota lota*), spottail shiner (*Notropis hudsonius*), northern madtom (*Noturus stigmosus*), flathead chub (*Platygobio gracilis*), and plains minnow (*Hybognathus placitus*). Of these, the chestnut lamprey and flathead chub (Pflieger 1975), plains minnow and northern madtom (Burr and Warren 1986), and black buffalo inhabit rivers with swift current over sand and gravel substrates. The latter species and alligator gar also occur in sloughs, silty backwaters, and oxbow lakes; the chestnut lamprey may also occur in moderate-sized creeks (Pflieger 1975); and the spottail shiner inhabits the shoreline over sandy substrate (Burr and Warren 1986). Lowland lentic habitats, such as wetlands, floodplain lakes, oxbows, and small to medium-sized streams offer potential habitat for the threatened lake chubsucker (*Erimyzon sucetta*), cypress darter (*Etheostoma proeliare*), inland silverside (*Menidia beryllina*), and special concern blacktail shiner (*Cyprinella venusta*) (Burr 1980, Burr and Warren 1986).

Amphibians and reptiles

The bird-voiced treefrog (*Hyla avivoca*), threatened, is an amphibian that could potentially occur on the PGDP. It inhabits permanent wooded swamps bordering rivers and streams.

The midland smooth softshell (*Apalone m. mutica*), special concern, is a turtle that occurs in large rivers and streams but may also be found in lakes, impoundments, and shallow bogs. It is usually in water with a sandy or mud bottom and few aquatic plants and often basks on sand bars and mudflats.

Three snake species that have potential for occurring on the PGDP are the western mud snake (*Farancia abacura reinwardti*), special concern; western ribbon snake (*Thamnophis p. proximus*) and eastern ribbon snake (*T. s. sauritus*), threatened. These snakes are usually found in the vegetative cover of slow streams, lakes, ponds, swamps, sloughs, bogs, lake margins, and marshes.

Birds

Two endangered bird species found in habitats similar to the great blue heron (Chapter 5) are the great egret (*Casmerodius albus*) and double-crested cormorant (*Phalacrocorax auritus*). The least bittern (*Ixobrychus exilis*), threatened, inhabits the tall vegetation of freshwater marshes.

Raptor species with potential for the PGDP are the common barn owl (*Tyto alba*) and the Mississippi kite (*Ictinia mississippiensis*), both special concern. The barn owl roosts and nests in dark cavities in city and farm buildings, cliffs, and trees; in winter it often roosts in dense conifers. The Mississippi kite is found in tall forests, open woodlands, prairies, semiarid rangelands, shelterbelts, and wooded areas bordering lakes and streams in more open regions.

The brown creeper (*Certhia americana*), endangered, is a small bird with streaked brown plumage that occurs in forests, woodlands, and swamps. The bank swallow (*Riparia riparia*), special concern, inhabits open and partly open lands; it nests in large colonies, excavating nest burrows in steep riverbank cliffs, gravel pits, and highway cuts.

Management

The management for these species would be the same as for the other state-listed species discussed in Chapter 5. The KSNPC should be notified if any of the above species is sited on the PGDP. The KSNPC and Department of Fish and Wildlife Resources should be notified if any planned project activities will be conducted in areas where these species have been sited. (See Management section in Chapter 5.)

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Table 1
Summary of Threatened, Endangered, Candidate and Special Concern Species Reported from PGDP as of 15 Dec 92

Common Name	Scientific Name	Federal Listing	State Listing
Indiana Bat	*Myotis sodalis*	E	E
Copperbelly Water Snake	*Nerodia erythrogaster neglecta*	C2	
Compass Plant	*Silphium l. laciniatum*		T
Cream Wild Indigo	*Baptisia bracteata var leucophaea*		S
Chain Pickerel	*Esox niger*		S
Cypress Minnow	*Hybognathus hayi*		E
Spotted Sunfish	*Lepomis punctatus*		T
Taillight Shiner	*Notropis maculatus*		T
Evening Bat	*Nycticeius humeralis*		T
Northern Long-eared Bat	*Myotls septentrionalis*		S
Water Hickory	*Carya aquatica*		S
Carolina Silverbell	*Halesia carolina*		E
Hair Grass	*Muhlenbergia glabriflora*		S
Green Treefrog	*Hyla cinerea*		S
Northern Crawfish Frog	*Rana areolata circulosa*		S
Great Blue Heron	*Ardea herodias*		S
Fish Crow	*Corvus ossifragus*		S
Hooded Merganser	*Lophodytes cucullatus*		E
Bell's Vireo	*Vireo billii*		S
A Crayfish	*Orconectes lancifer*		E

Table 2
Species Specialists

Species	Specialist	Agency/Organization	Phone Numbers
Indiana Bat	Hal Bryan Wayne Davis James Gardner Bill Hendricks Joyce Hofmann Cindy Rebar B. Palmer-Ball	Ecotech, Inc. Ky. Dep. Fish/ Wildl. Resour. Missouri Dep. Highways Murray State University Ill. Natural History Survey Murray State University KSNPC	502-223-8136 502-564-5448 314-526-5644 502-762-2786 217-244-2366 502-762-2786 502-573-2886
Bald Eagle	B. Palmer-Ball Michael Turner Jim Widlak	KSNPC USACE, Louisville District U.S. Fish and Wildl. Service	502-573-2886 502-582-6475 615-528-6481
Interior Least Tern	Mary Landin B. Palmer-Ball Jim Widlak	USACE Waterways Exp. Station KSNPC U.S. Fish and Wildl. Service	601-634-2942 502-573-2886 615-528-6481
Copperbelly Water Snake	John MacGregor Ron Refsnider	USDA Forest Service U.S. Fish and Wildl. Service	606-986-8434 612-725-3536
Fish	Brooks Burr Ron Cicerello Bill Pearson	Southern Illinois University KSNPC University of Louisville	618-453-4112 502-573-2886 502-588-8152
Mussels	Kevin Cummings Andrew Miller Barry Payne Ron Cicerello	Ill. Nat. History Survey USACE Waterways Exp. Station USACW Waterways Exp. Station KSNPC	217-333-1623 601-634-2141 601-634-3837 502-573-2886
Snails	J. B. Burch	Univ. Mich. Mus. of Zoology	313-747-2189
Crustaceans	Ron Cicerello	KSNPC	502-573-2886
Plants	Tom Bloom Deborah White Sidney McDaniel Robert Lichvar Charles Logsdon	KSNPC KSNPC Mississippi State University USACE Waterways Exp. Station West Ky. Wildl. Manage. Area	502-573-2886 502-573-2886 601-325-7570 601-634-2983 502-488-3233
Endangered Species Act	Lee Barclay	U.S. Fish and Wildl. Service	615-528-6481

Table 3
Points of Contact

Agency and university personnel who provided assistance with information are listed below.

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Laurel J. McNeil
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Tom Bloom
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Deborah White
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James (Gene) Gardner
Endangered Species

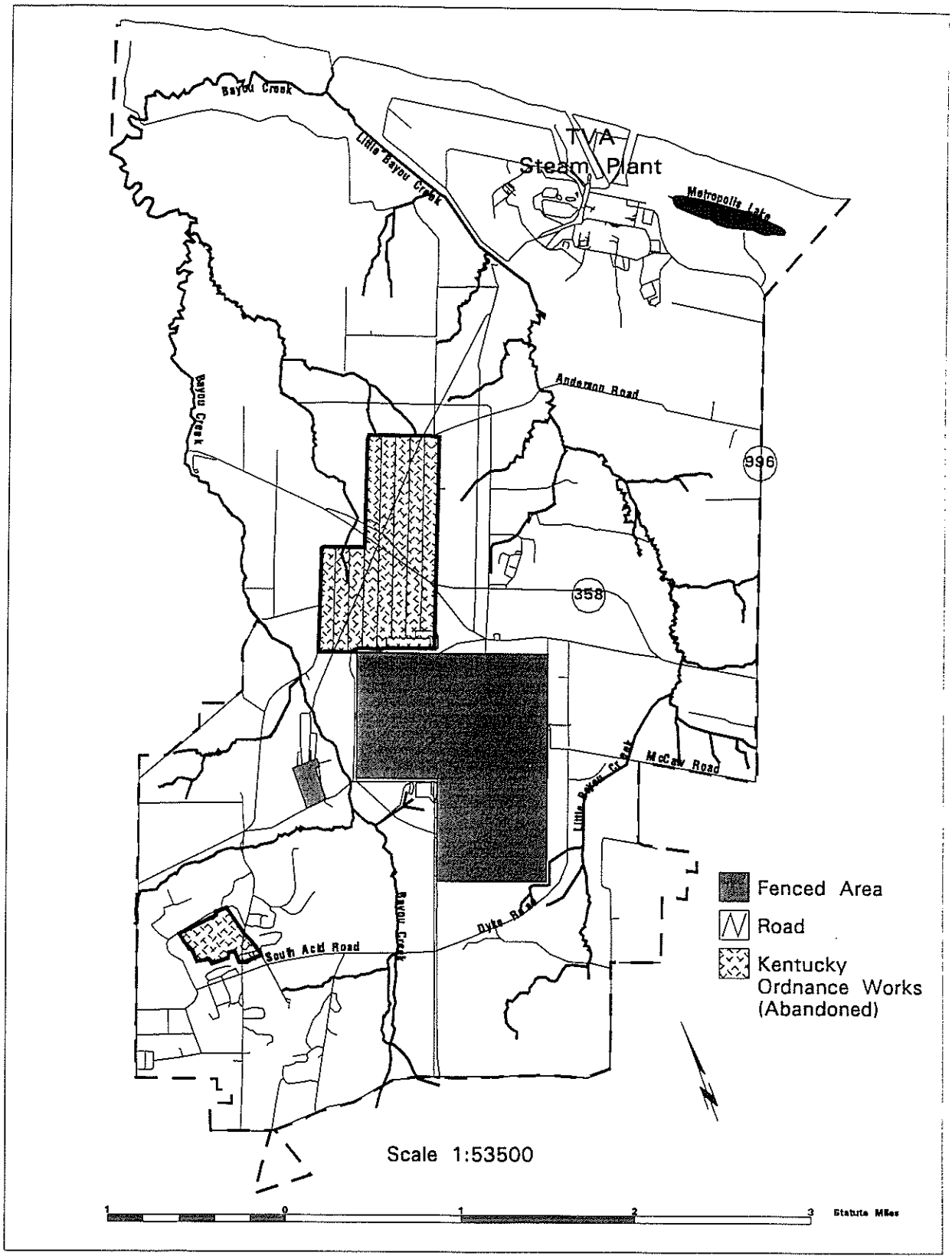


Figure 1. Location of threatened and endangered species investigation

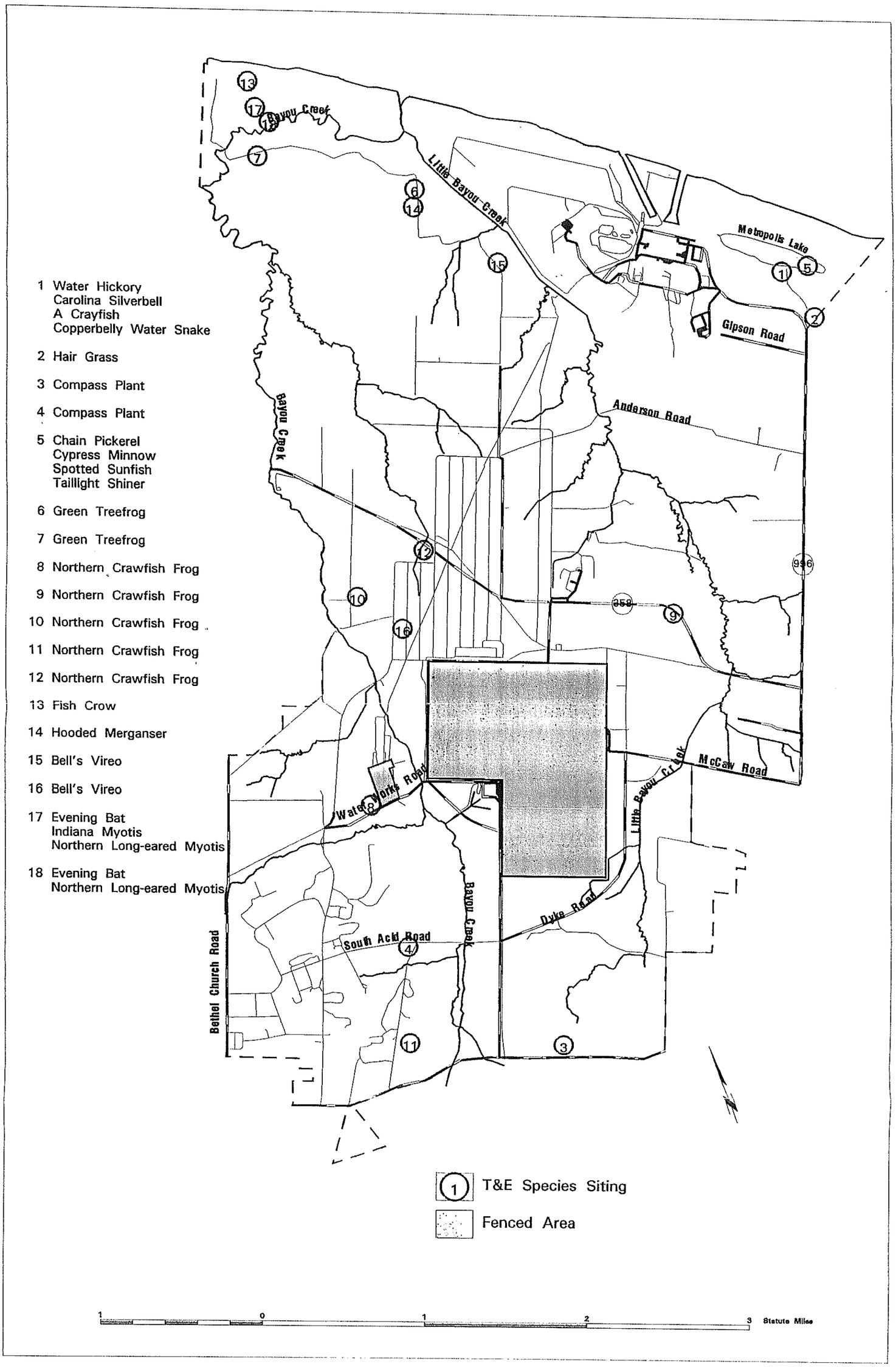


Figure 2. Location of threatened, endangered, candidate and special concern species sitings on the PGDP. This map is based on information provided by the KSNPC and shows officially reported sitings as of 15 Dec 1992.

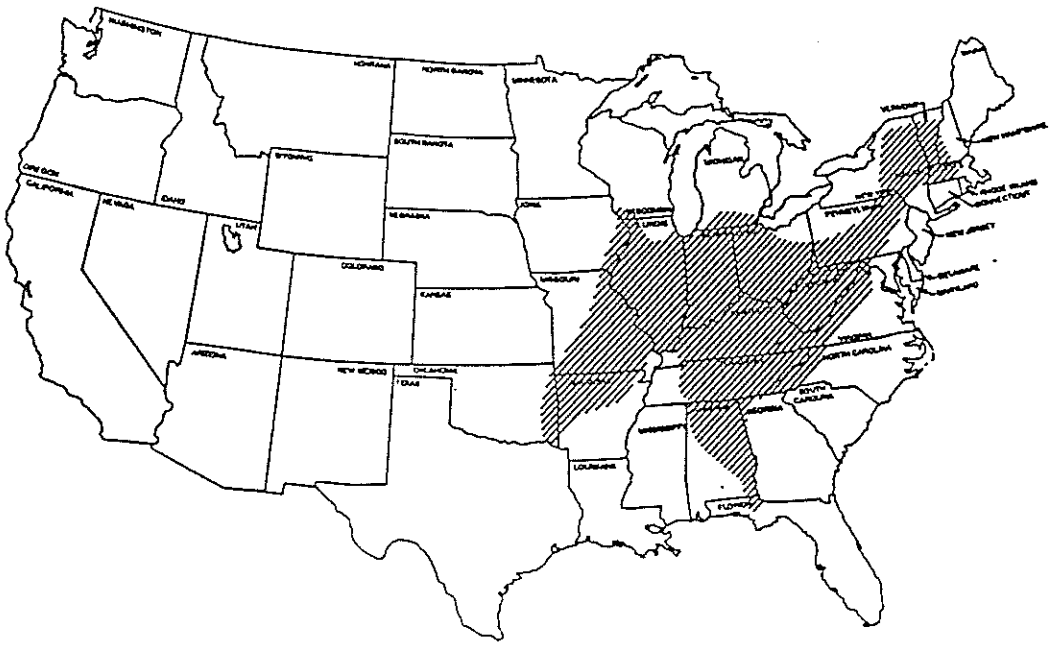


Figure 3. Distribution of the Indiana bat (composited from Miller and Allen 1928, Barbour and Davis 1969, Burt and Grossenheider 1976)

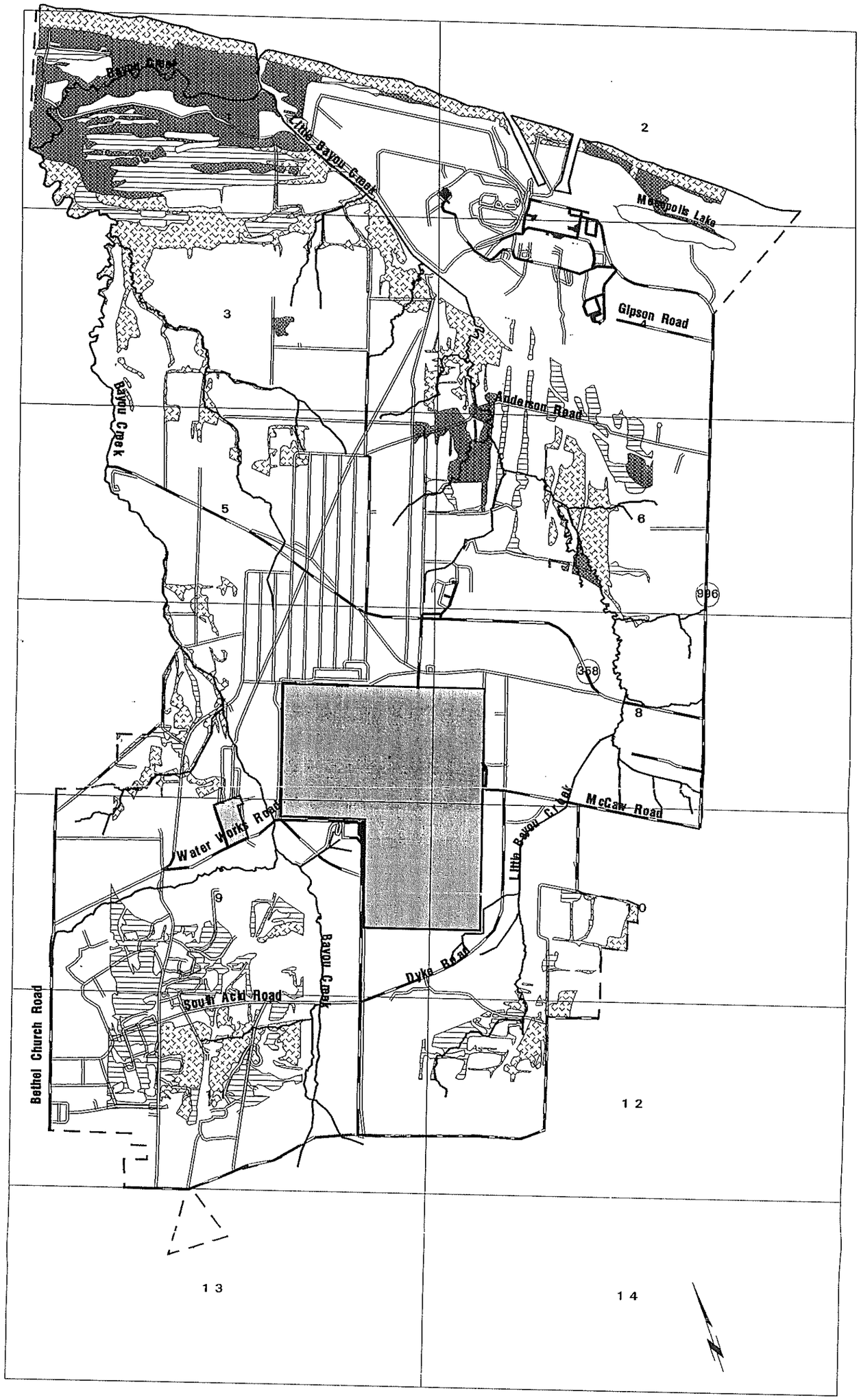


Figure 4. Indiana bat potential habitat quality on the PGDP

Figure 5. Distribution of the copperbelly water snake (composited from Minton 1972, Conant 1975, Ernst and Barbour 1989)

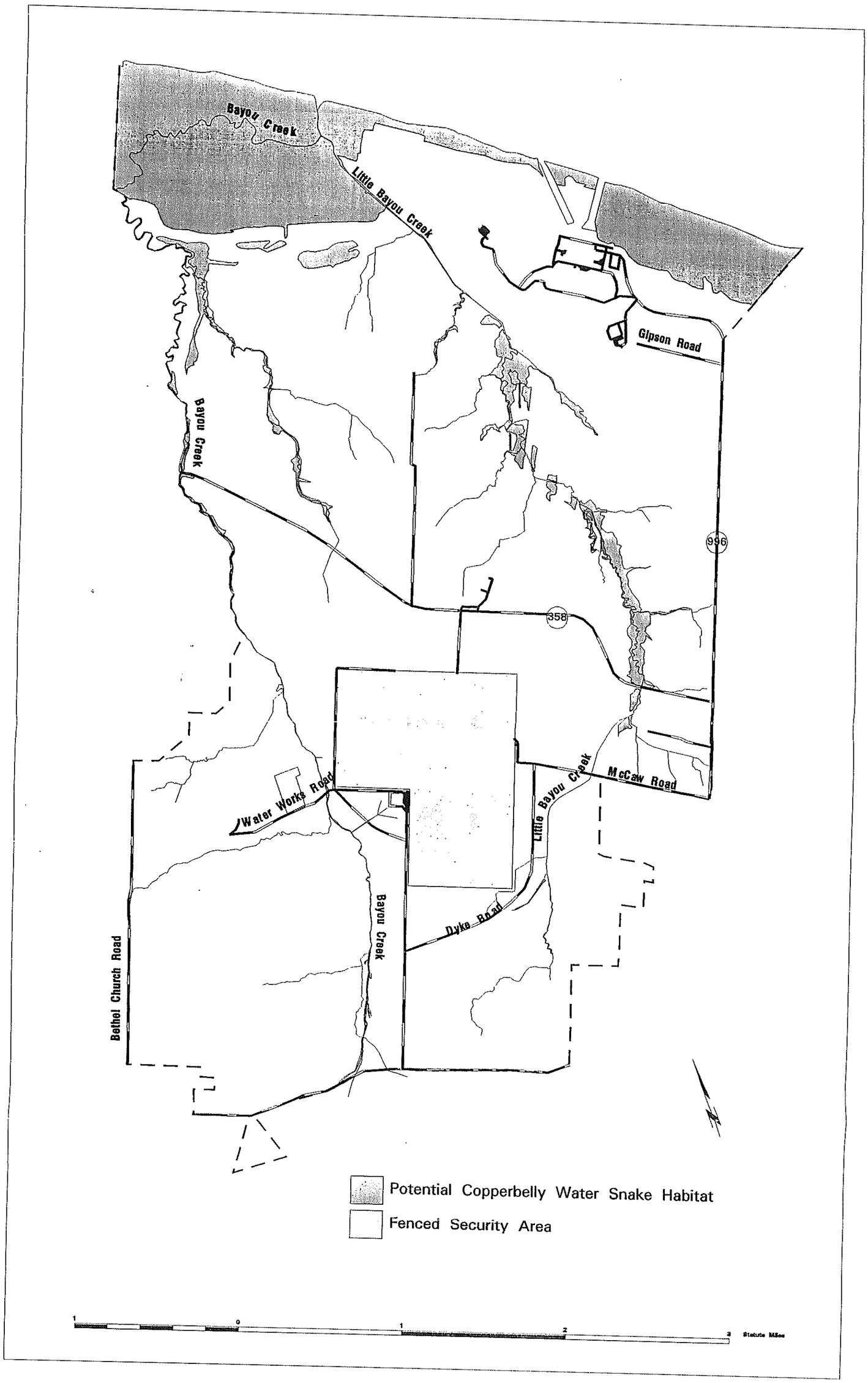


Figure 6. Potential copperbelly water snake habitat on the PGDP

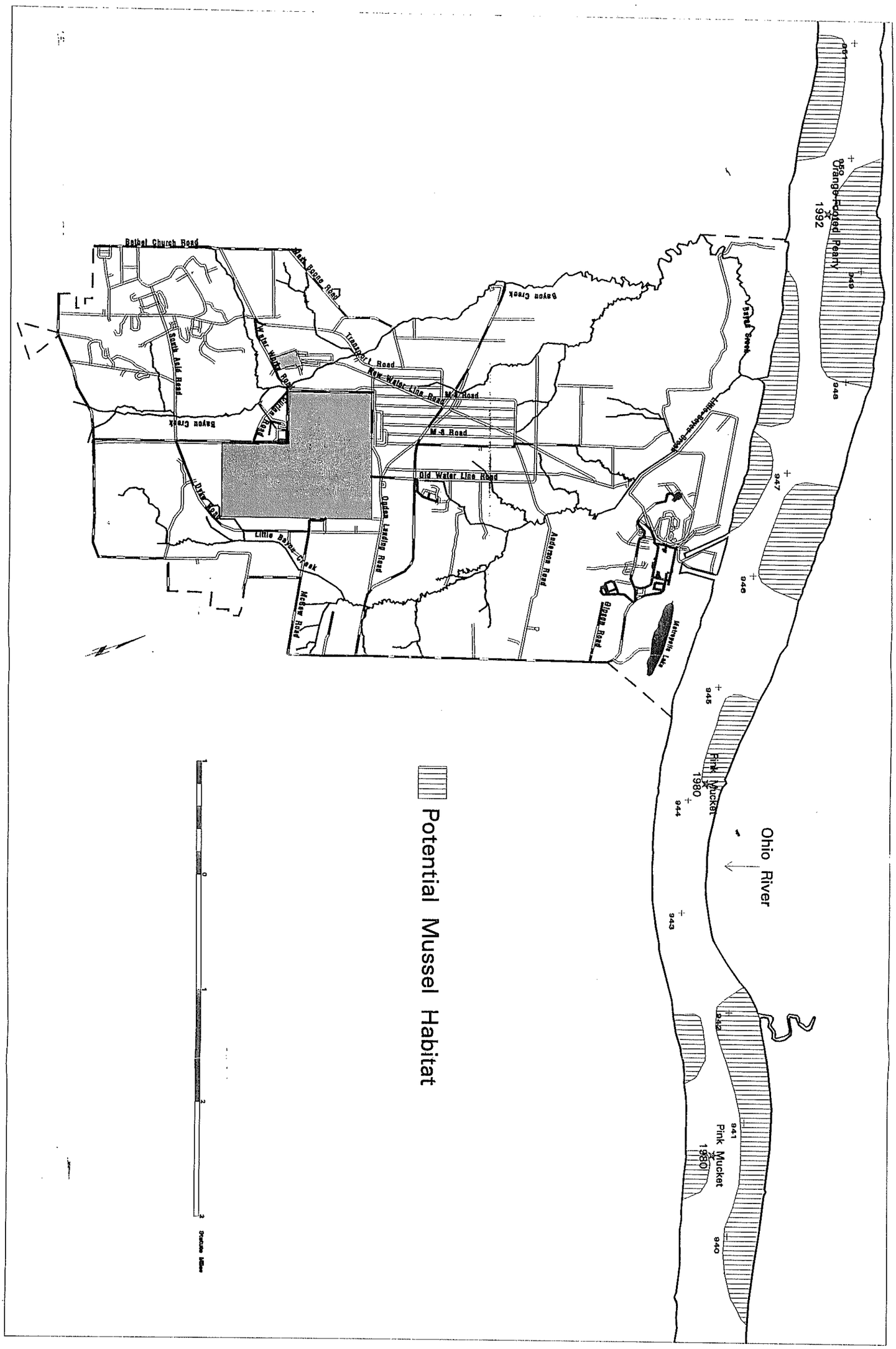


Figure 7. The Ohio River adjacent to the PGDP showing the river mile designations and recent collection sites of the orange-footed pearly mussel and the pink mucket

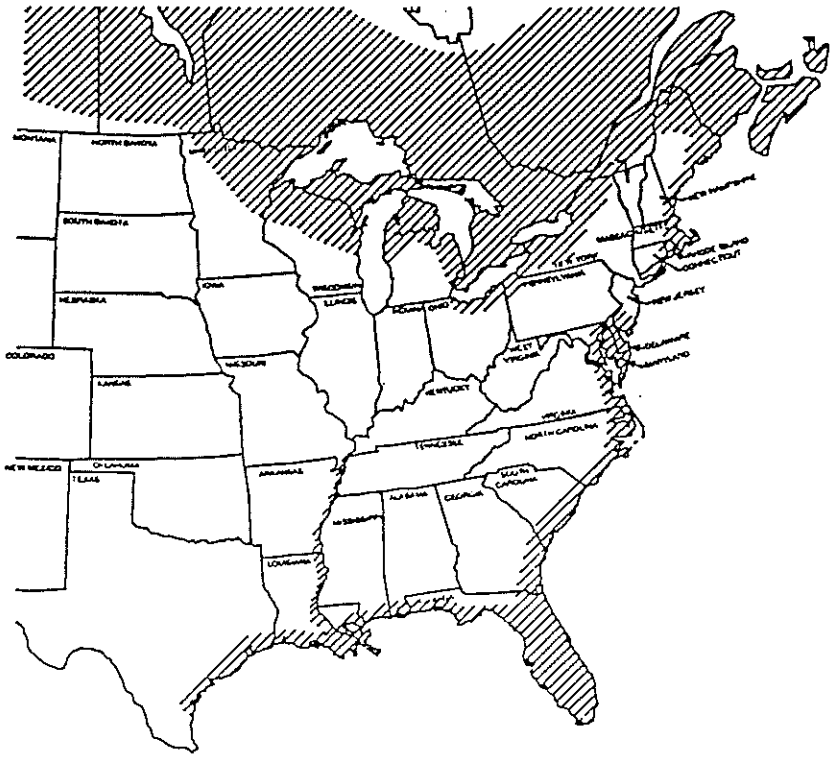


Figure 8. Distribution of breeding bald eagles in the eastern United States (composited from Peterson 1980, National Geographic Society 1983, Clark and Wheeler 1987)

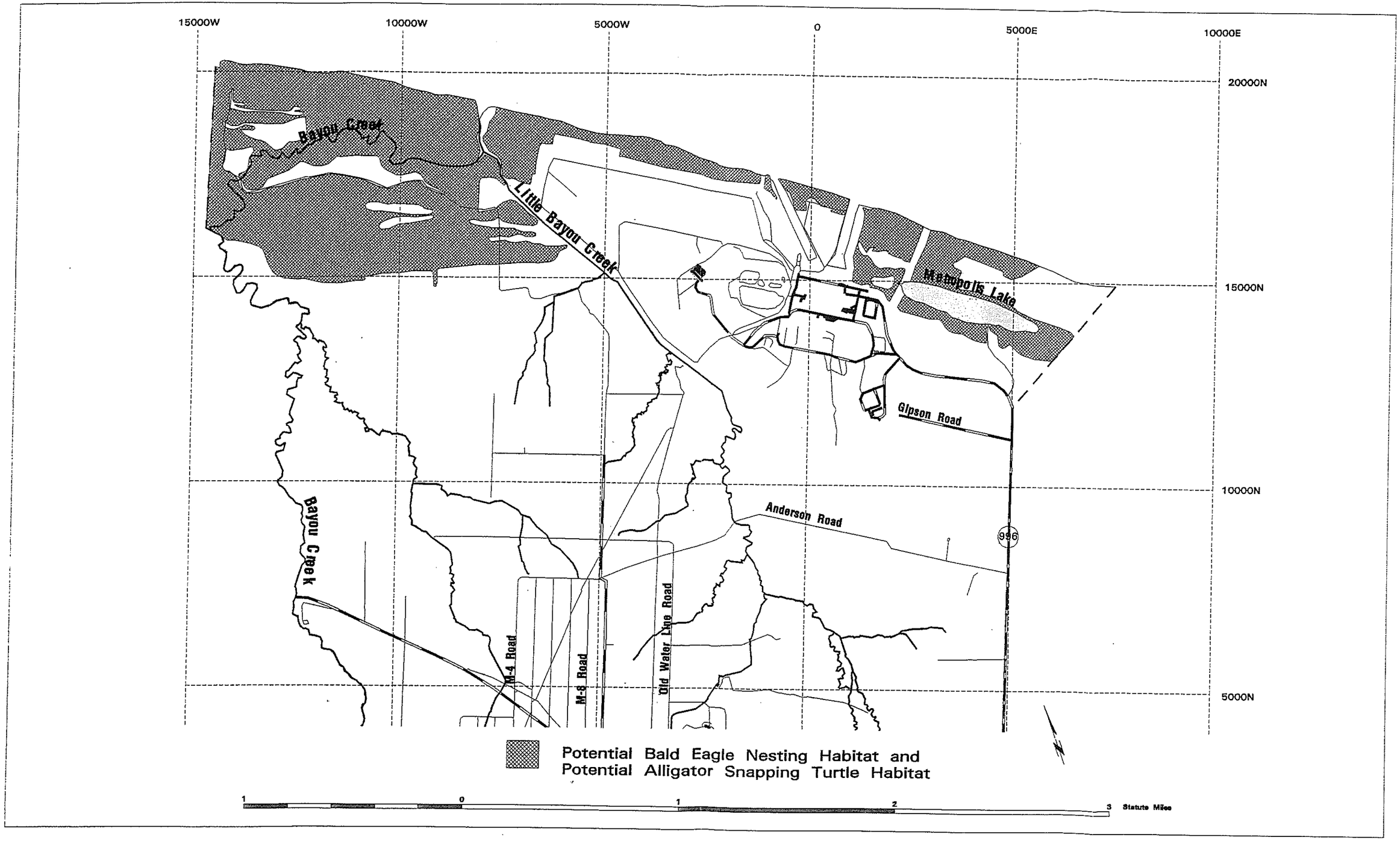


Figure 9. Potential bald eagle nesting habitat and potential alligator snapping turtle habitat on the PGDP

Figure 10. Distribution of the interior least tern in waterways of the United States (Sidle and Harrison 1990)

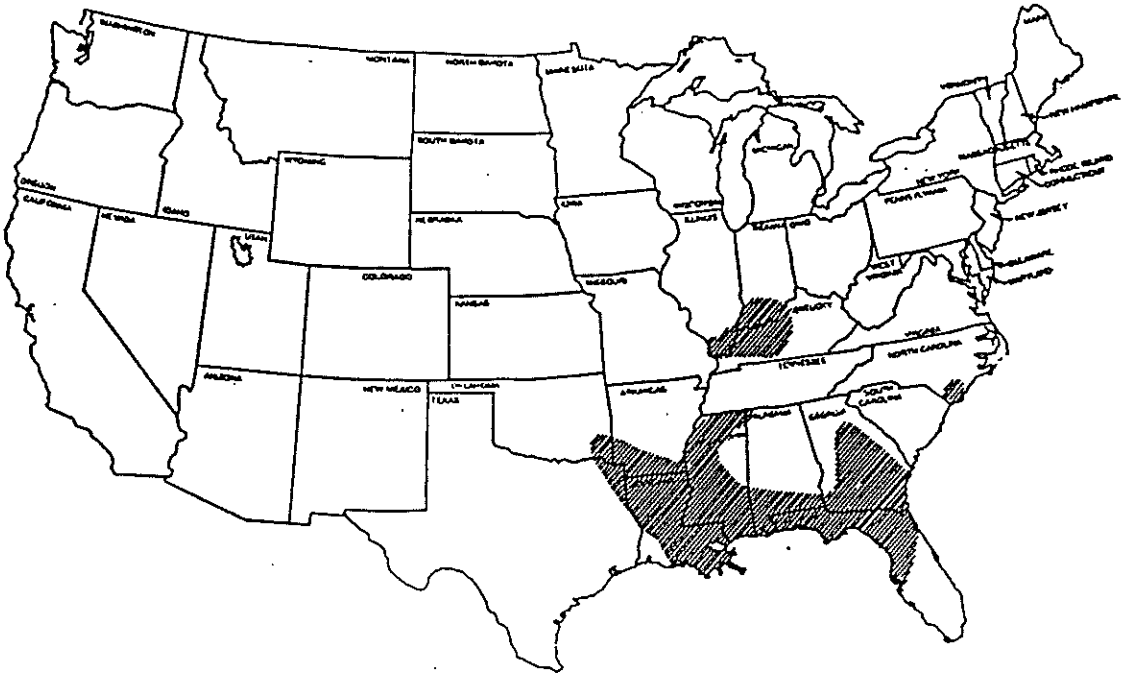


Figure 11. Distribution of the southeastern myotis (Barbour and Davis 1969)

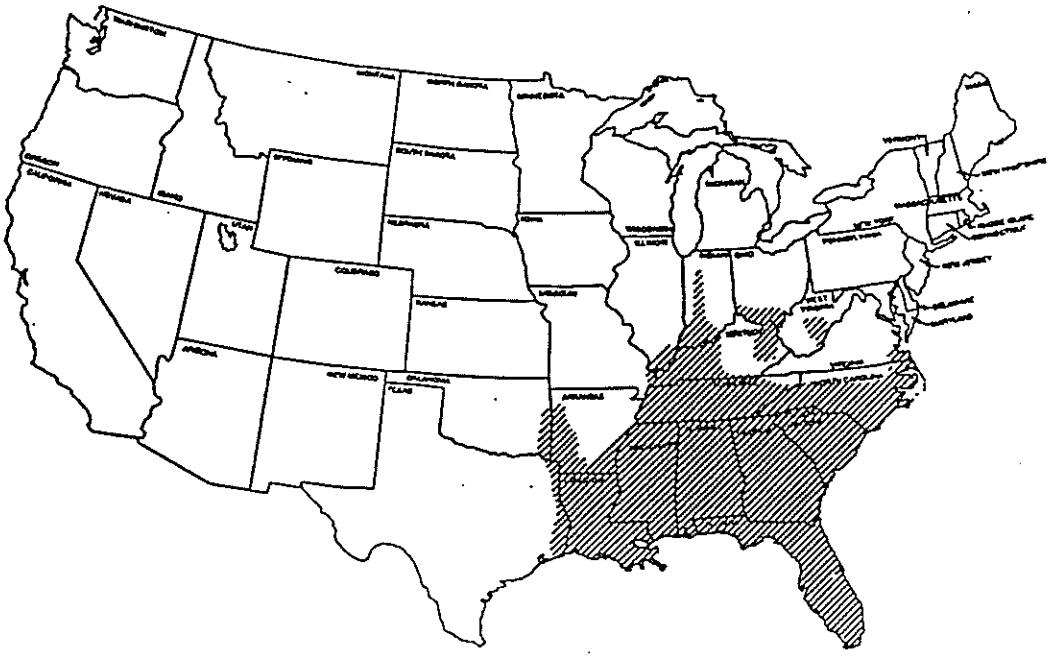


Figure 12. Distribution of Rafinesque's big-eared bat (composited from Barbour and Davis 1969, Hamilton and Whitaker 1979, Soule 1992)

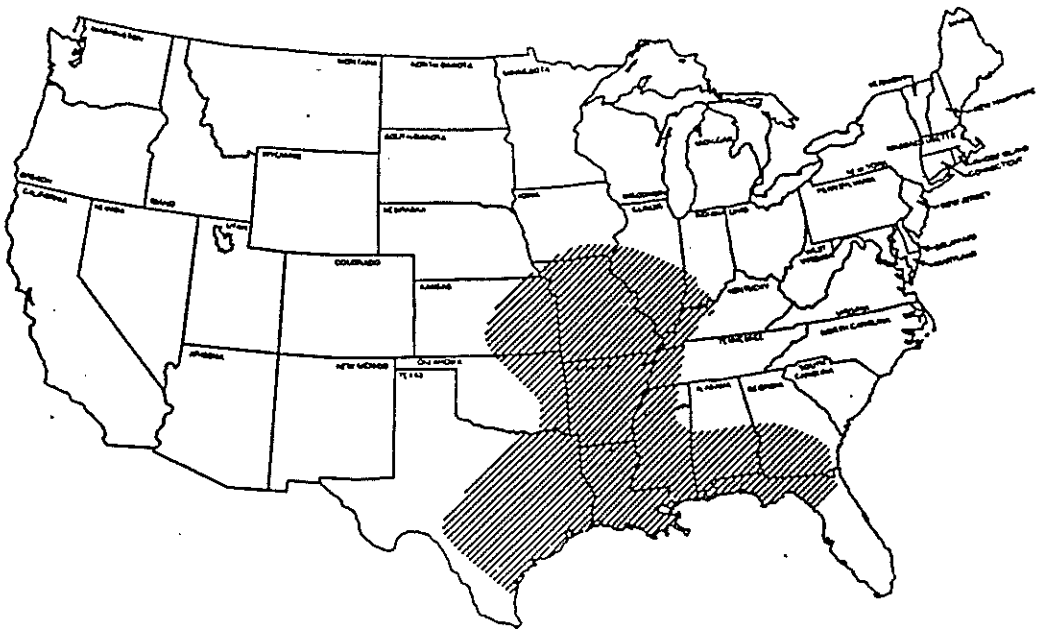


Figure 13. Distribution of the alligator snapping turtle (composited from Carr 1952, Ernst and Barbour 1989, Soule 1992)

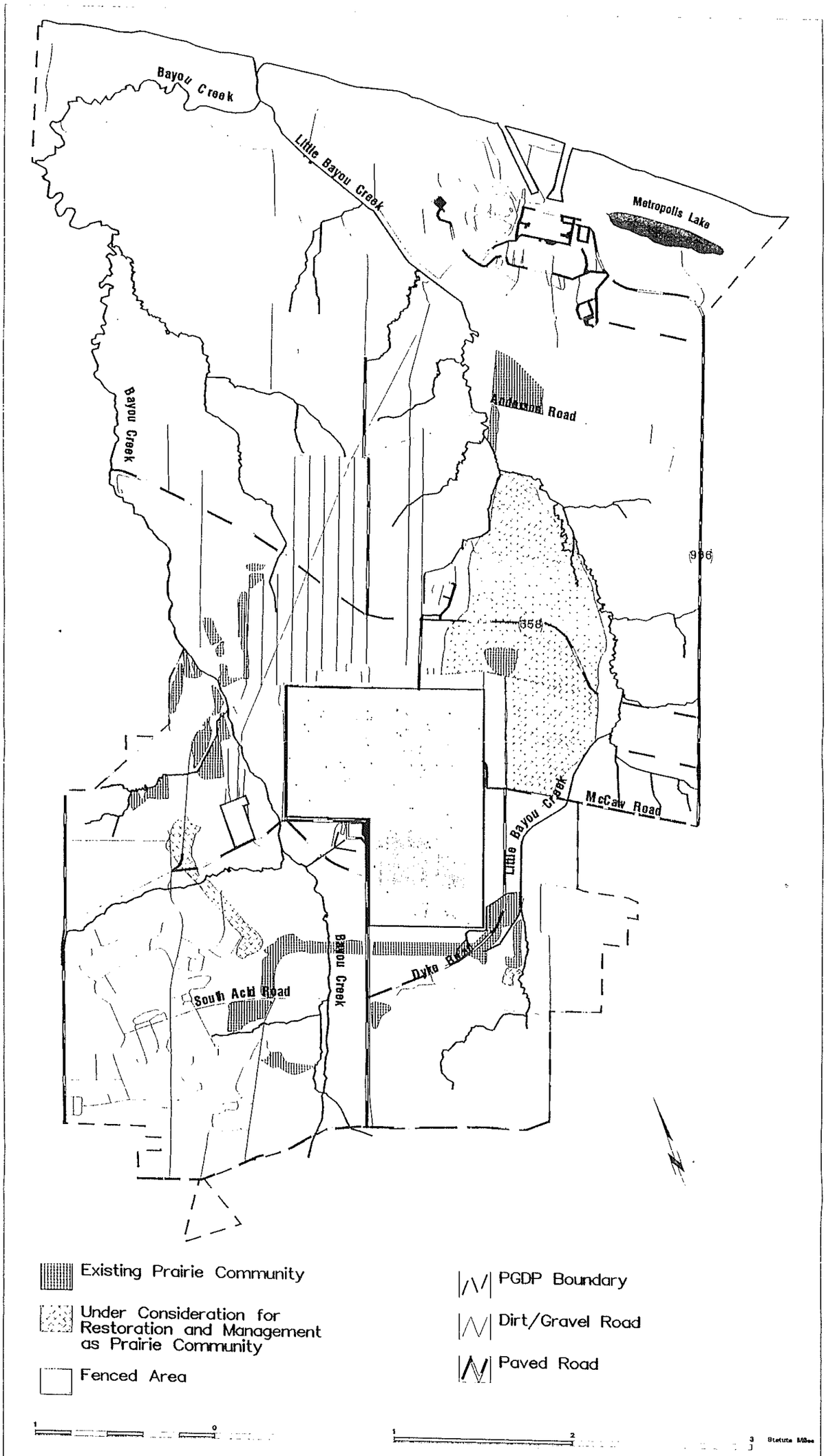


Figure 14. Existing and potential prairie plant communities on the PGDP

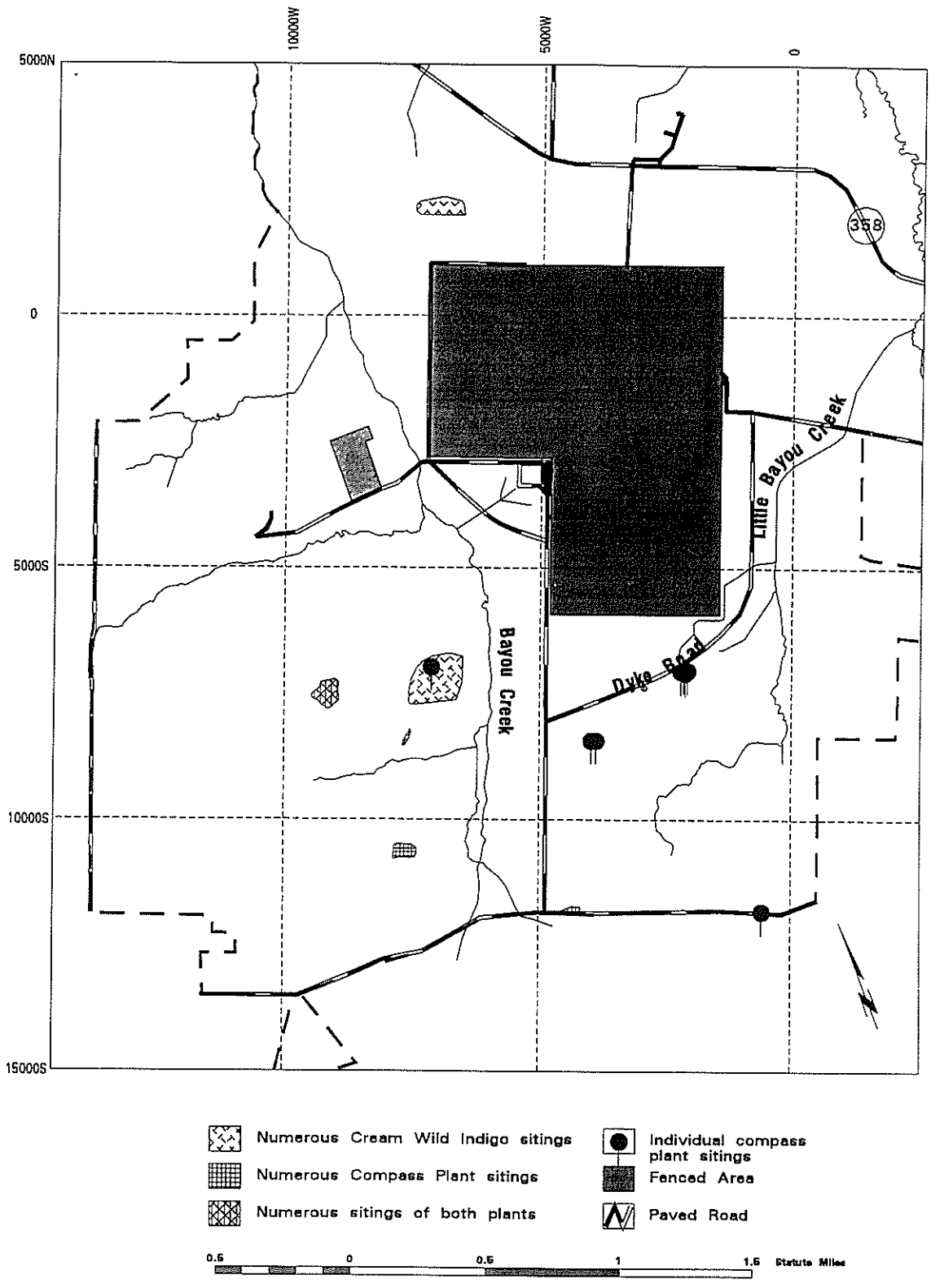


Figure 15. Sitings of native prairie plants outside of prairie communities

N O T I C E

THE STATUS OF THE COPPERBELLY WATER SNAKE IS NOW **PROPOSED THREATENED (PT).**

The PT status affords the species temporary but full protection under the Endangered Species Act until such time as official action by the USFWS may alter this status.

Species status listings are dynamic. All listings must be periodically verified. Users of this report are advised to check the official status of all species in this report on a regular basis.

30 June 1994

Appendix A
Tables of Endangered, Threatened, and Special Concern Species

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
		Vascular Plants		
Carolina Silverbell	*Halesia carolina*	Rich woods and edges of sloughs and oxbow lakes.		E
Blue Mud-plantain	*Heteranthera limosa*	Sloughs, pond margins and mud flats.		S
Broad-leaf Golden-aster	*Heterotheca subaxillaris var latifolia*	Dry, often sandy places, particularly disturbed sites.		T
Creeping St. John's-wort	*Hypericum adpressum*	Marshes, shores, wet meadows, swales and ditches.		H
Bog Rush	*Juncus elliottii var elliottii*	Damp or wet, sandy or peaty soil, particularly in pine barrens.		E
Vetchling Peavine	*Lathyrus palustris*	Wet meadows, swamps, wet woods, boulder-cobble bars along creek and river, and known from a roadside near a railroad (medley).		T
American Frog's-bit	*Limnobium spongia*	Ponds, bayous, stagnant water.		T
Swamp Candles	*Lysimachia terrestris*	Open swamps and wet soils.		E
Southern Crabapple	*Malus angustifolia var angustifolia*	Open dry - mesic woods and thickets.		S
Pale Umbrella-wort	*Mirabilis albida*	Meadows grassy openings and in KY sandy banks of Miss. R. and roadsides.		E
Bush's Muhly	*Muhlenbergia bushii*	Moist open woods and riverbanks at base of bluffs.		E

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
Gastropods				
Onyx Rocksnail	*Leptoxis praerosa*	Found on algae-covered rocks in strong current (Goodrich & Van Der Schalie, 1944).	C2	S
Armored Rocksnail	*Lithasia armigera*	According to sickel (1988), C. Armigera was found in the Cumber-land River in the following habitats: In partially buried logs, on gravel, and the species was found at its highest densities on submerged rock outcrops.	C2	S
Ornate Rocksnail	*Lithasia geniculata*	Habitat not available	C2	S
Varicose Rocksnail	*Lithasia verrucosa*	Inhabits rocky shoals and riffles in moderate current velocities in depths from near the water surface to several feet (approximately 3 ft).	C2	S
Rugged Hornsnail	*Pleurocera alveare*	Habitat not available.	C2	S
Bivalves				
Long-solid	*Fusconaia subrotunda subrotunda*	Occurs in large rivers and large to medium-size streams where it inhabits gravel bars and deep pools (Ahlstedt 1984, Goodrich and Van Der Schalie 1944, Neel and Allen 1964, Parmalee 1967).		T
Pink Mucket	*Lampsilis abrupta*	Large rivers in habitats ranging from silt to boulders, but apparently more commonly from gravel and cobble. Collected from shallow and deep water with current velocity ranging from zero to swift (Ahlstedt 1983, Bogan and Parmalee 1983, Buchanan 1980).	LE	E

(Sheet 4 of 15)

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
		Bivalves		
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Small to large rivers with sand, gravel, and cobble and moderate to swift current. Also occurs in deep water with sand bottoms and moderate flow.		T
Tubercled-blossom Pearly mussell	*Epioblasma torulosa torulosa*		LE	
		Crustaceans		
A Dwarf Crayfish	*Cambarellus puer*	Found commonly in sluggish streams, sloughs, roadside ditches; will burrow during dry periods.		E
Cajun Dwarf Crayfish	*Cambarellus shufeldtii*	Prefers sluggish to standing water; tolerant of elevated temperatures. Will burrow during dry periods.		S
A Crayfish	*Orconectes lancifer*	Generally found in deep water of stiller sections of large streams or lakes; nevertheless, often encountered in roadside ditches.		E
A Crayfish	*Procambarus viaeviridis*	Sluggish streams and lentic situations; tolerant of heat and of low oxygen levels.		T
		Fishes		
Lake Sturgeon	*Acipenser fulvescens*	Lakes and large rivers with a firm sand/gravel bottom (Burr and Warren 1986).	C2	E

(Sheet 6 of 15)

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
		Fishes		
Chestnut Lamprey	*Ichthyomyzon castaneus*	Moderate-size creeks, large rivers, and reservoirs. Substrate consists of gravel and rubble with areas of sand and silt. Larvae require clear streams with stable bars of silt, sand and organic detritis (Becker 1983, Case 1970, Pflieger 1975, Rohde and Lanteigne-Courchere 1980, Scott and Crossman 1973, Smith 1979).		S
Black Buffalo	*Ictiobus niger*	Usually in strong currents of large rivers; also in sloughs, silty backwaters, river-margin lakes, and impoundments.		S
Spotted Sunfish	*Lepomis punctatus*	Occurs in well-vegetated swamps, sloughs, bottomland lakes, and low gradient streams (Burr 1980, Burr and Mayden 1979, Lee 1980, Pflieger 1975, Smith 1979).		T
Burbot	*Lota lota*	Cool-water species preferring large deep rivers and northern lakes (Becker 1983, Lee and Gilbert 1980, Pflieger 1975, Scott and Crossman 1973, Smith 1979, Trautman 1981).		S
Sturgeon Chub	*Macrhybopsis gelida*	Continuously and heavily turbid, warm, medium to large rivers: in shallow areas of strong current with coarse sand or gravel bottom.	C2	H
Sicklefin Chub	*Macrhybopsis meeki*	Continuously and heavily turbid, warm waters: in shallows in strong current over fine gravel or sand.	C2	H

(Sheet 8 of 15)

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
Amphibians				
Bird-voiced Treefrog	*Hyla avivoca*	Permanent wooded swamps (Tupelo, Cypress, Birch, Buttonbush, and vine tangles) bordering rivers and streams. May climb high into trees.		T
Green Treefrog	*Hyla cinerea*	Swamps, marshes, and the edges of ponds, lakes, and streams, particularly where there is abundant floating and emergent vegetation. During daytime, rests among cattail blades or other leaves or shaded branches.		S
Northern Crawfish Frog	*Rana areolata circulosa*	Habitat not available		S
Reptiles				
Midland Smooth Softshell	*Apalone mutica mutica*	Large rivers and streams; in some areas also found in lakes, impoundments, and shallow bogs (B72ERN01NA). Usually in water with sandy or mud bottom and few aquatic plants. Often basks on sand bars and mudflats at edge of water.		S
Western Mud Snake	*Farancia abacura reinwardtii*	Swampy weedy lake margins, slow mud-bottomed streams, shallow sloughs with rotting logs, floodplains. Fossorial and semiaquatic; burrows in soft soil and among wet debris and mats of vegetation along water's edge.		S

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
		Birds		
Brown Creeper	*Certhia americana*	Forest, Woodland, swamps; also scrub and parks in winter and migration.		E
Fish Crow	*Corvus ossifragus*	Beaches, bays, lagoons, inlets, swamps, near marshes, and, less frequently, deciduous or coniferous woodland, in inland situations primarily in baldcypress swamps and along major watercourses. Also garbarge dumps.		S
Bald Eagle	*Haliaeetus leucocephalus*	Primarily near seacoasts, rivers, and large lakes. Preferentially roosts in conifers in winter in some areas. In winter, may associate with waterfowl concentrations or congregate in areas with abundant dead fish (B82GRI01NA).	LELT	E
Mississippi Kite	*Ictinia mississippiensis*	Tall forest, open woodland, prairie. Semiarid rangeland, shelter-belts, wooded areas bordering lakes and streams in more open regions, scrubby oaks and mesquite.		S
Least Bittern	*Ixobrychus exilis*	Tall vegetation in marshes, primarily freshwater, less commonly in coastal brackish marshes and mangrove swamps, preference for marshes with scattered bushes or other woody growth, infrequently in marshes <5 HA in 1A (A86BRO02NA).		T
Hooded Merganser	*Lophodytes cucullatus*	Streams, lakes, swamps, marshes, and estuaries; winters mostly in freshwater but also regularly in estuaries and sheltered bays (B83COM01NA).		E

Table A1 (Continued)

Common Name	Scientific Name	Habitat	USESA	KSNPC
		Mammals		
Northern Long-eared	*Myotis septentrionalis*	Closely associated with deciduous/coniferous forests. Occurs in Myotis in buildings or under loose treebark (summer) or caves/mines/tunnels (winter); may also roost in hollow trees or rock crevices. Commonly uses caves as night roosts in summer. Hibernation: Protected areas with high relative humidity, calm air flow, temperatures near 4 C (9-10 C at mid-winter, sometimes upto 14 C, according to B78LAY01NA).		S
Indiana Myotis	*Myotis sodalis*	Hibernation: Prefers limestone caves with pools; usually in coldest part of cave, avg. air temp. 3-6 C (preferred sites have midwinter air temperatures of 4-8 C, but tolerates much broader range); may shift site within cave during winter. In wooded or semiwooded areas along streams in summer.	LE	E
Evening Bat	*Nycticeius humeralis*	Prefers deciduous and mixed forest interspersed with cultivated areas. Commonly found along Waterways (B91SCH02NA). Summer roosts include attics of buildings, tree cavities, and spaces behind loose tree bark. May also use spanish moss for summer roosting, and cave mouths in fall. Hibernation site not known.		T

Table A2
Federally Listed or Candidate and State Listed or Special Concern Plants and Animals Reported as Occurring on the Paducah Gaseous Diffusion Plant as of 15 Dec 1992

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Vascular Plants									
Cream Wild Indigo	*Baptisia bracteata var leucophaea*		Numerous locations, see Figures 14 and 15	Prairies and open woods on sandy soil					S
Water Hickory	*Carya aquatica*	1	Metropolis Lake. Circa 1.0 air MI MNW of settling ponds for Shawnee Steam Plant along ridge above Ohio River	Bottomlands and flood-plain swamps, rich woods and edges of sloughs and oxbow lakes.	370848N	0884554W	M		S
Carolina Silverbell	*Halesia carolina*	1	Metropolis Lake. Circa 1.0 air MI WNW of settling ponds for Shawnee Steam Plant along ridge above Ohio River.	Bottomlands and flood-plain swamps, rich woods and edges of sloughs and oxbow lakes.	371026N	0884837W	S		E

(Sheet 1 of 16)

Note: PREC: Precision of the plotted location: S = location accurate to within one second of latitude-longitude but not confirmed by KSNPC staff; M = location accurate to within one minute of longitude-latitude. USESA = United States Endangered Species Act: LE = Listed endangered; LT = Listed threatened; C1 = Candidate species in category 1 status review; C2 = Candidate species in category 2 status review; 3C = Considered to be more abundant than previously thought. KSNPC = Kentucky State Nature Preserves Commission status: E = endangered (Ky); T = threatened (Ky); S = special concern (Ky); PE = Proposed endangered; PT = Proposed threatened; H = historic - not observed since 1970.
Data provided by the Kentucky State Nature Preserves Commission Natural Heritage Program, 15 Dec 1992 and other sources.

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Crustaceans									
A Crayfish	*Orconectes lancifer*	1	Metropolis Lake 4.8 KM N Grahamville near end of Hwy 305 (actually end of Hwy 996 and driveway to lake).	Habitat not available	370848N	0884554W	S		E
Fishes									
Chain Pickerel	*Esox niger*	5	Metropolis Lake 4.8 KM N Grahamville.	Coastal plain wetlands, streams, and vegetated oxbow lake shorelines, also tolerates reservoir conditions (Burr and Warren 1986).	370842N	0884540W	M		S

(Sheet 3 of 16)

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Fishes									
Taillight Shiner	*Notropis maculatus*	5	Metropolis Lake, 5 KM N Grahamville.	Marginal vegetation and accumulations of sticks and detritus in shallow water of swamps, ditches, and oxbow lakes (Burr and Page 1975, Pflieger 1975, Gilbert 1980, Sisk 1973).	370842N	0884540W	S		T
Amphibians									
Green Treefrog	*Hyla cinerea*	6	Circa 0.3 air MI SW of W tip of Shawnee Steam Plant settling ponds.	Swamps, marshes, and the edges of ponds, lakes, and streams, particularly where there is abundant floating and emergent vegetation. During Day-time, rests among cattail blades or other leaves or shaded branches.	370946N	0884805W	S		S

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Amphibians									
Northern Crawfish Frog	*Rana areolata circulosa*	9	West Kentucky Wildlife Management Area, CA 0.3 RD MI NNW JCT KY 358 and Ogden Landing RD (MARGNUM 14). West KY WMA, CA 1.3 RD MI W JCT KY 996 and KY 358 on N side KY 358 (MARGNUM 15, 370723N, 884736W). West KY WMA, 1.5 RD MI W of JCT KY 996 and KY 358, 0.15 air MI S of KY 358 (MARGNUM 16, 370718N, 884755W). West KY WMA, CA 1.7 RD MI W of JCT KY 358 and KY 996, CA 0.10 air MI S of KY 358 (MARGNUM 17, 370725N, 884805W).	Habitat not available	370710N	0884728	S		S

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Amphibians									
Northern Crawfish Frog	*Rana areolata circulosa*	12	West Kentucky Wildlife Management Area, CA 0.1 RD MI NW of JCT KY 358 and KY 995, down road just SE of lodge.	Habitat not available	370757N	0884845W	S		S
Reptiles									
Copperbelly Water Snake	*Nerodia erythrogaster neglecta*	1	Metropolis Lake at boat launching ramp.	Habitat not available	370848N	0884554W	S	C2	S

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Birds									
Bell's Vireo	*Vireo bellii*	15	Along Little Bayou Creek adjacent to the W side of the ash settling pond at the Shawnee Steam Plant, 6 Mi NNW of Grahamville.	Dense brush, mesquite, streamside thickets, and scrub oak, in arid regions but often near water (B83COM01NA); moist woodland, bottom-lands, woodland edge, scattered cover and hedgerows in cultivated areas. Open woodland brush in wint.	370916N	0884741W	M		S
Bell's Vireo	*Vireo bellii*	16	West Kentucky WMA, about 1.0 Mi S of entrance on SR-358.	Dense brush, mesquite, streamside thickets, and scrub oak, in arid regions but often near water (B83COM01NA); moist woodland, bottom-lands, woodland edge, scattered cover and hedge-rows in cultivated areas. Open woodland, brush in wint.	370735N	0884905W	M		S

(Sheet 11 of 16)

Table A2 (Continued)

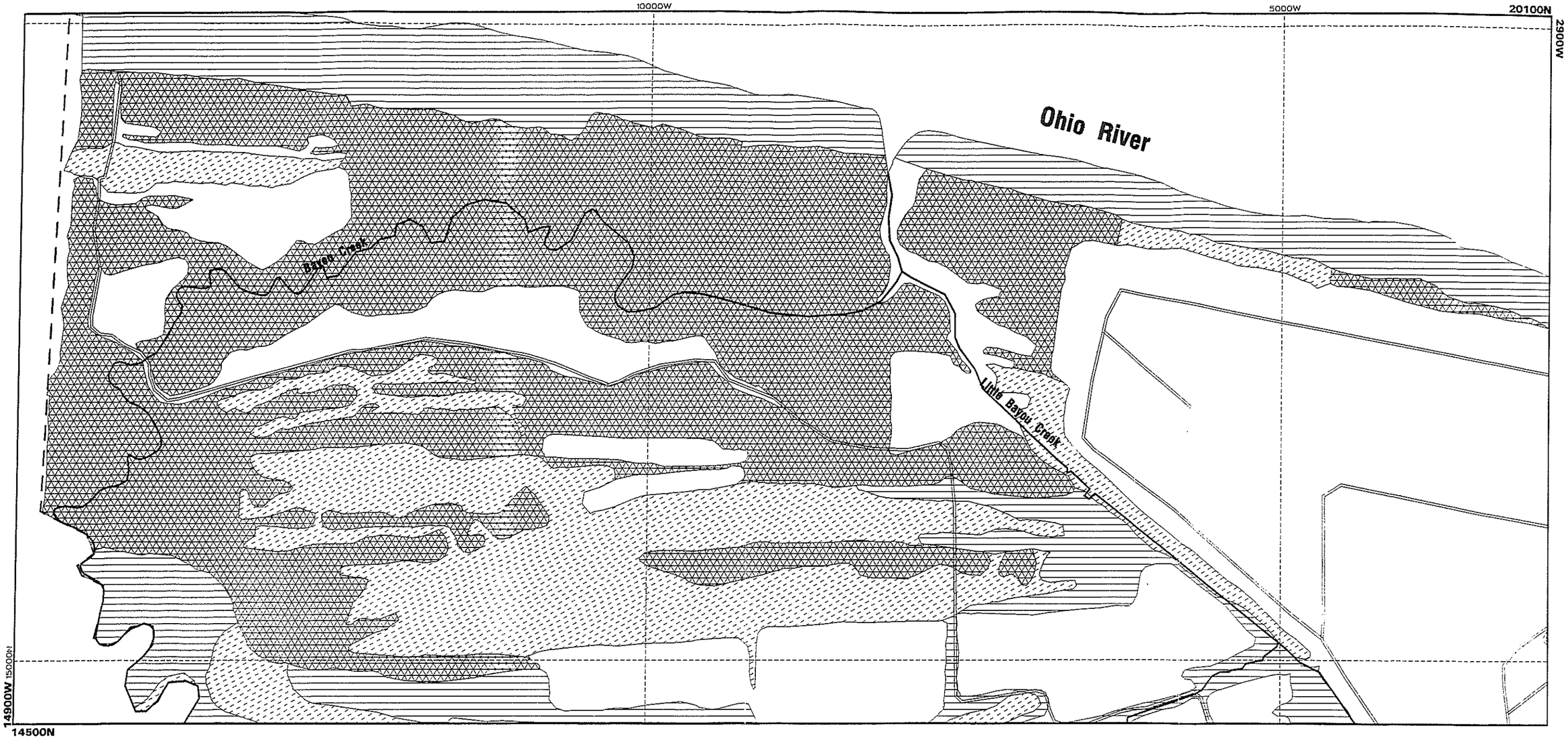
Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Northern Long-eared Myotis	*Myotis septentrionalis*	18	West Kentucky Wildlife Management Area, W end of Bayou Creek Ridge SNA, N side of creek, CA 0.4 air MI SSE of end of RD to Ohio River.	Closely associated with Deciduous/Coniferous Forests. Occurs in buildings or under loose treebark (summer) or caves/mines/tunnels (winter); may also roost in hollow trees or rock crevices. Commonly uses caves as night roots in summer. Hibernation: protected areas with high relative humidity, calm air flow, temperatures near 4 C (9-10 C at mid-winter sometimes up to 14 C according to (B78LAY01NA).	371025N	0884856W	S		S

(Sheet 13 of 16)

Table A2 (Continued)

Common Name	Scientific Name	Siting	Directions	Habitat	LAT	LONG	PREC	USESA	KSNPC
Mammals									
Evening Bat	*Nycticeius humeralis*	18	Bayou Creek Ridge SNA, W end on N side of creek, CA0.4 air MI SSE of end of road to Ohio River.	Prefers deciduous and mixed forest interspersed with cultivated areas. Commonly found along Waterways (B91SCH02NA). Summer roosts include attics of buildings, tree cavities, and spaces behind loose tree bark. May also use spanish moss for summer roosting, and cave mouths in fall. Hibernation site not known.	371025N	0884856W	S		T

Appendix B
Potential Indiana Bat Habitat on the PGDP



- Paved Roads
- Gravel/Dirt Roads
- PGDP Boundary
- Poor Habitat Conditions
- Fair Habitat Conditions
- Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

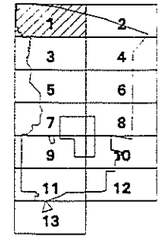
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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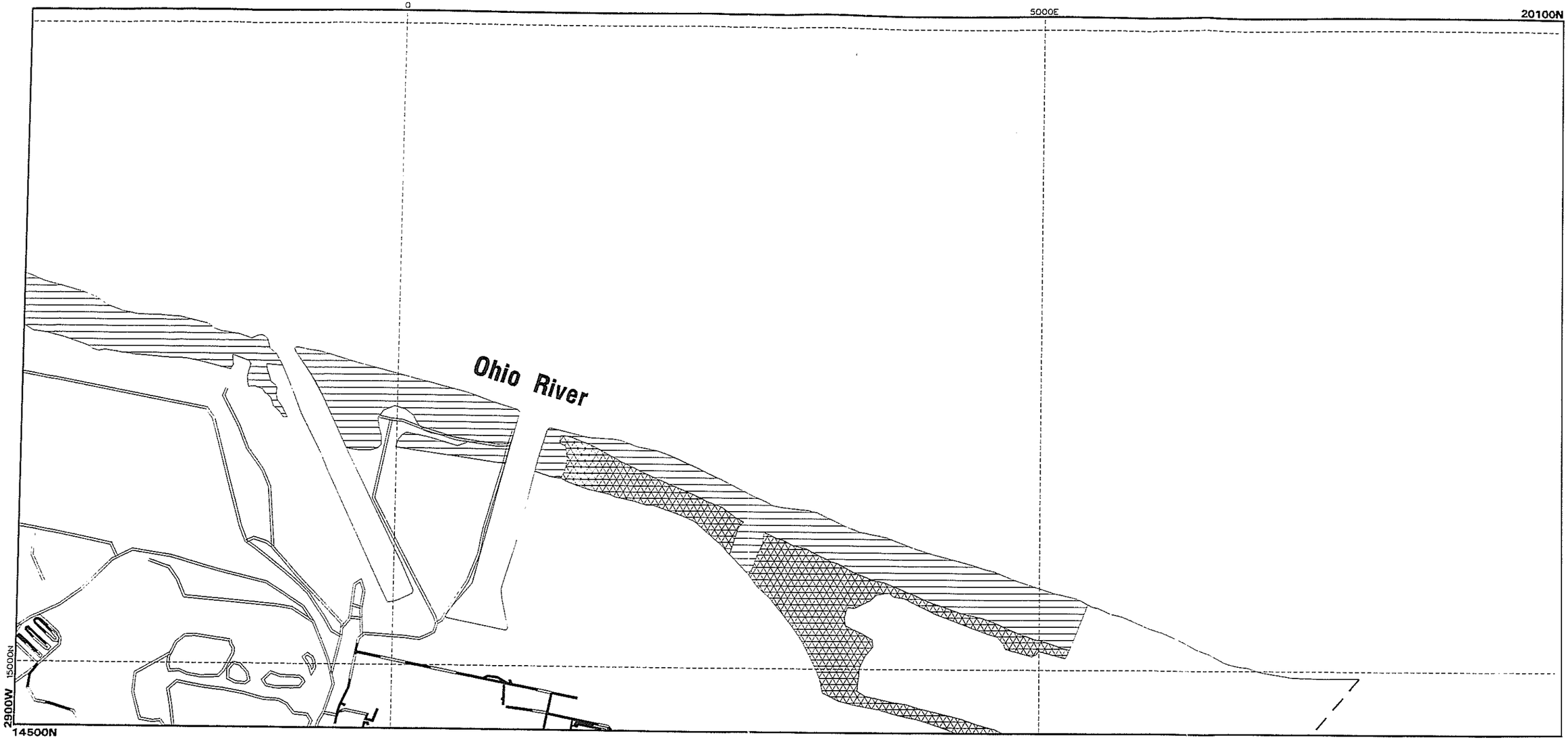

- Paved Roads
- Gravel/Dirt Roads
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- Poor Habitat Conditions
- Fair Habitat Conditions
- Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

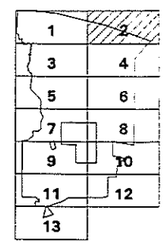
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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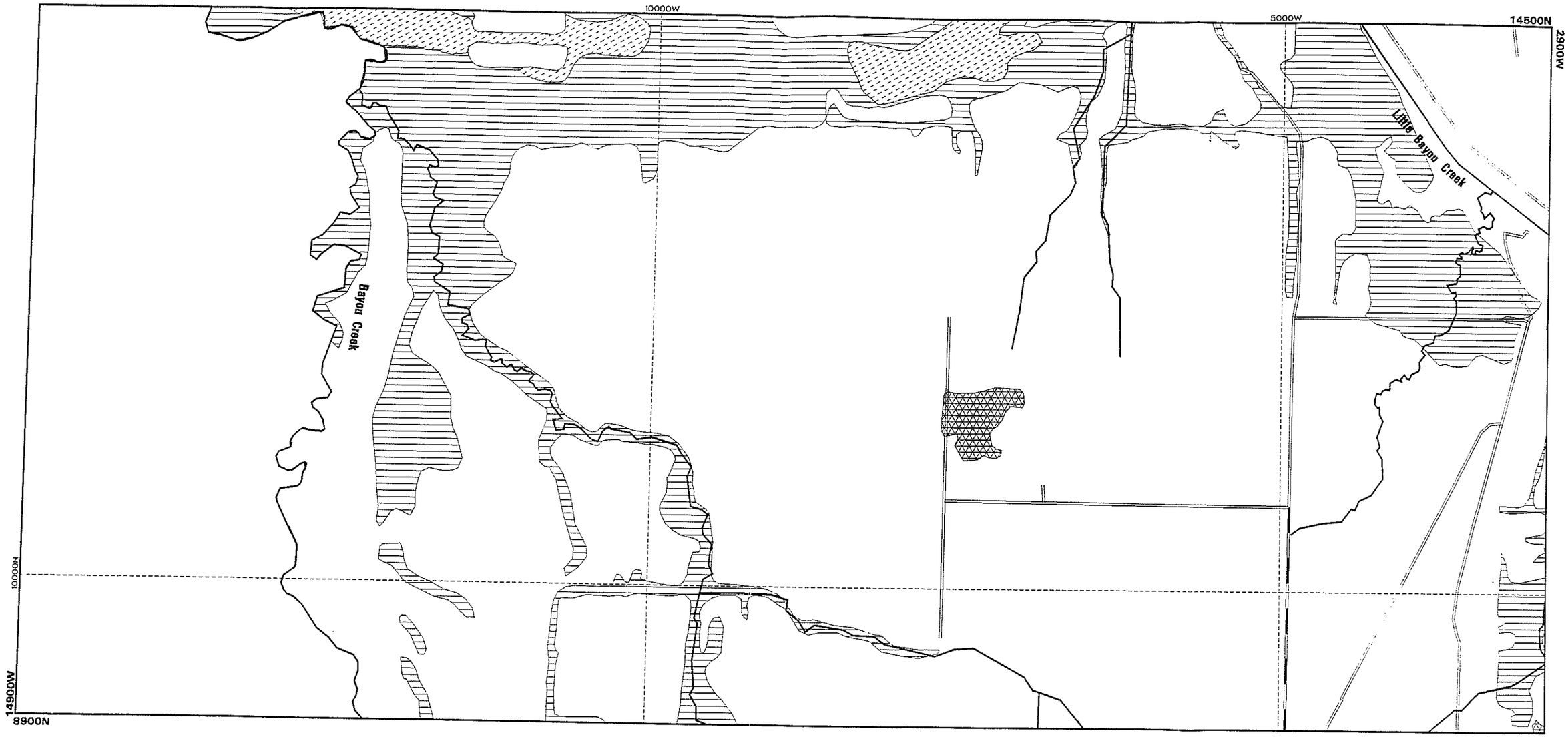

- Paved Roads
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Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

500 0 500 1000 1500

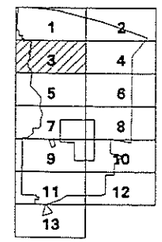
FEET

U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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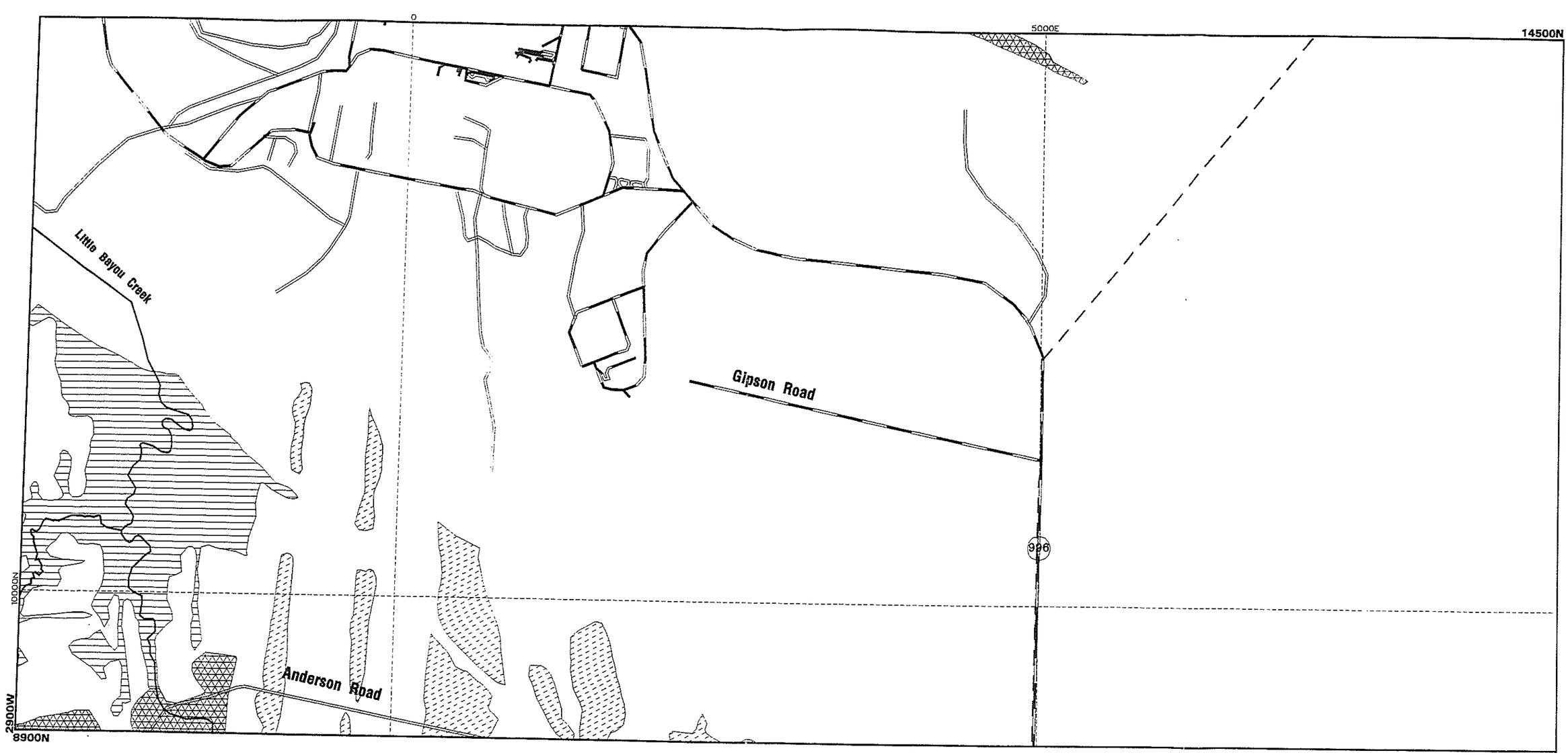


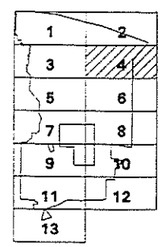
Paved Roads
Gravel/Dirt Roads
PGDP Boundary
Poor Habitat Conditions
Fair Habitat Conditions
Good Habitat Conditions
Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

500 0 500 1000 1500
FEET

Paducah Gaseous Diffusion Plant
Environmental Investigation
PGDP Local Coordinates (Feet)



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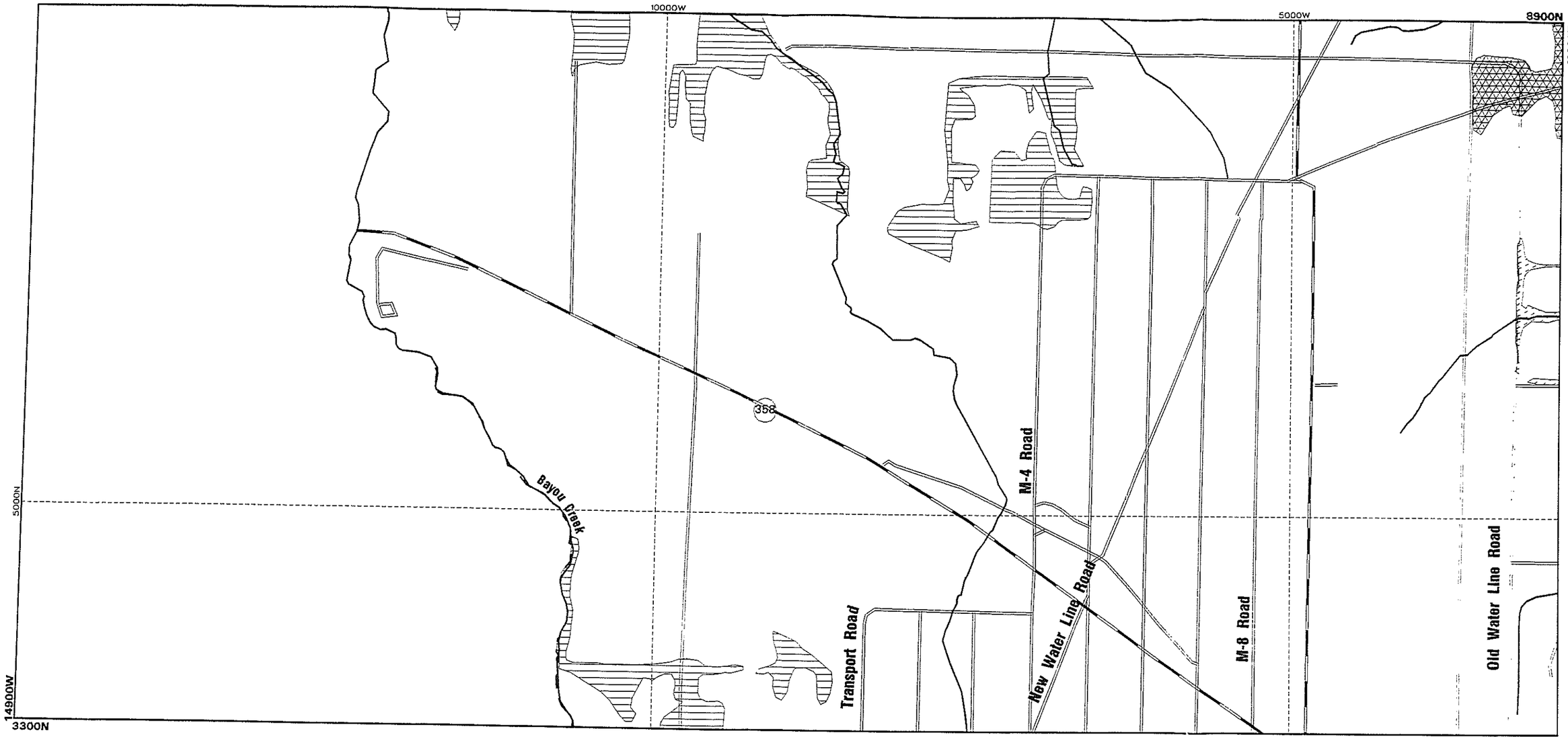


Paved Roads

Gravel/Dirt Roads

PGDP Boundary

Poor Habitat Conditions

Fair Habitat Conditions

Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

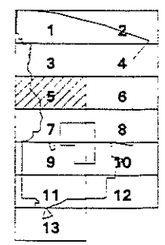
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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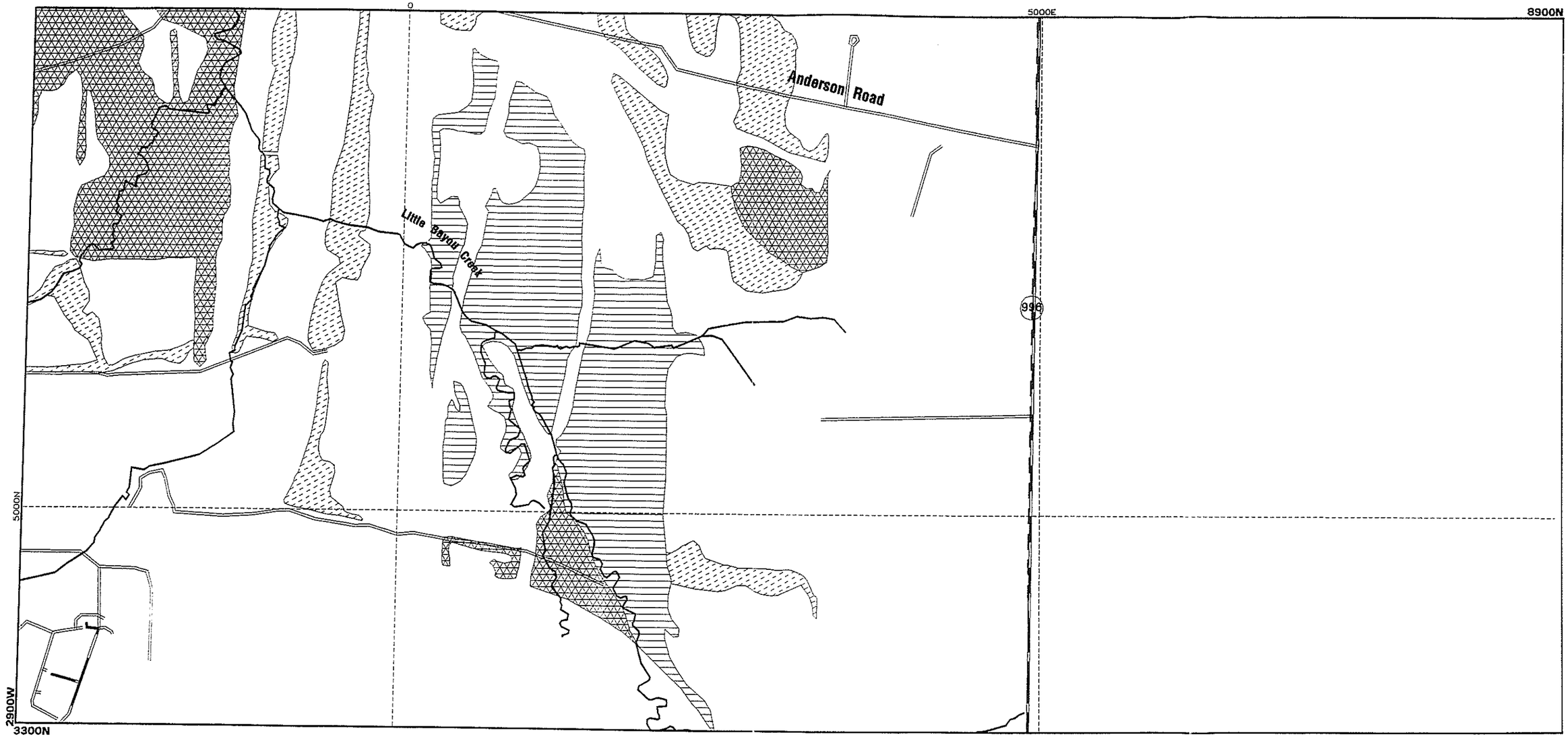


- Paved Roads
- Gravel/Dirt Roads
- PGDP Boundary
- Poor Habitat Conditions
- Fair Habitat Conditions
- Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation

Potential Habitat

Indiana Bat

(Myotis sodalis)

1:9600

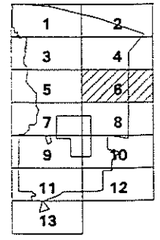
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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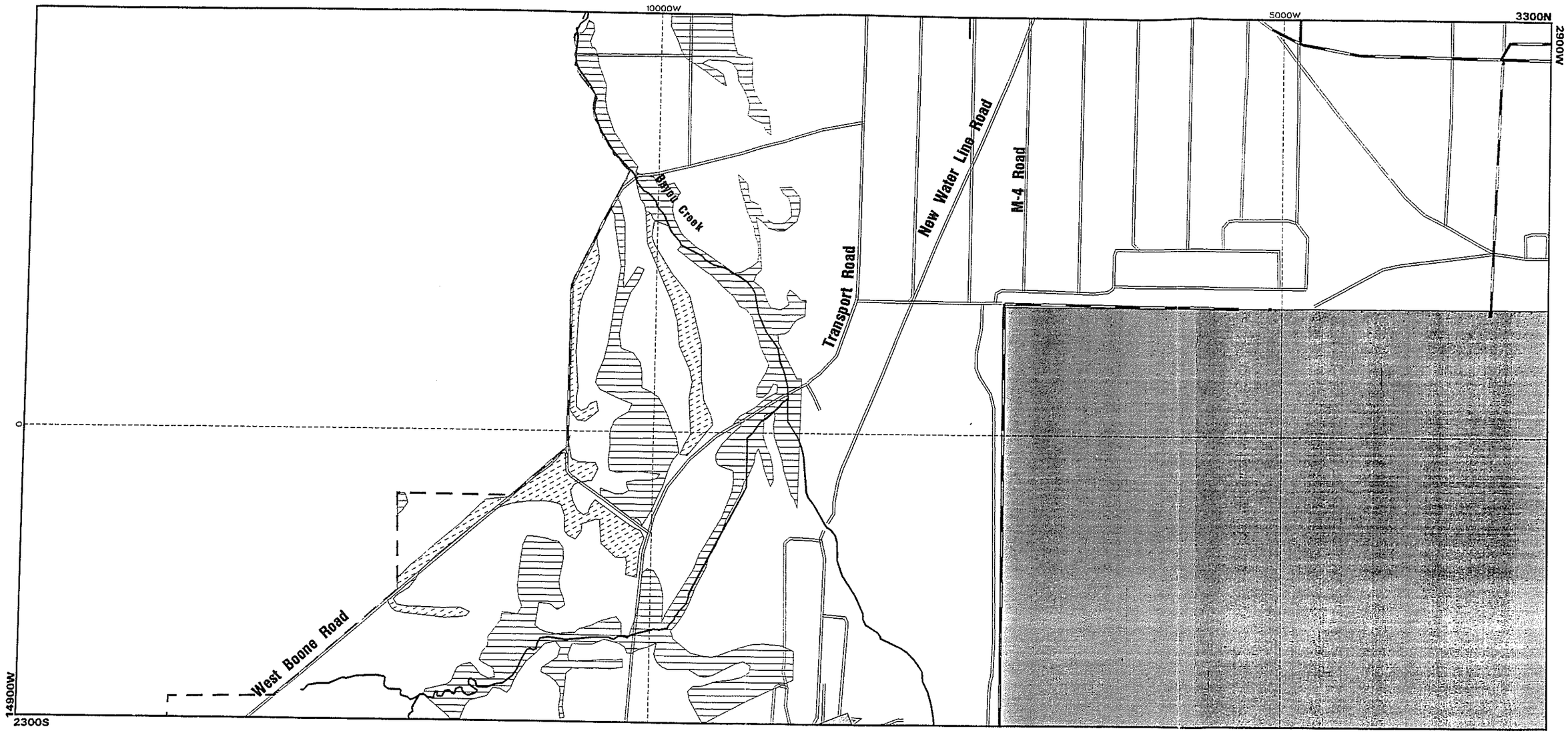

- Paved Roads
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Unshaded Areas Not Potential Habitat

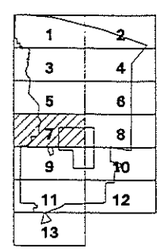
Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

500 0 500 1000 1500
FEET

U.S. ARMY ENGINEER WATERWAYS EXPERIMENTATION

Paducah Gaseous Diffusion Plant
Environmental Investigation
PGDP Local Coordinates (Feet)



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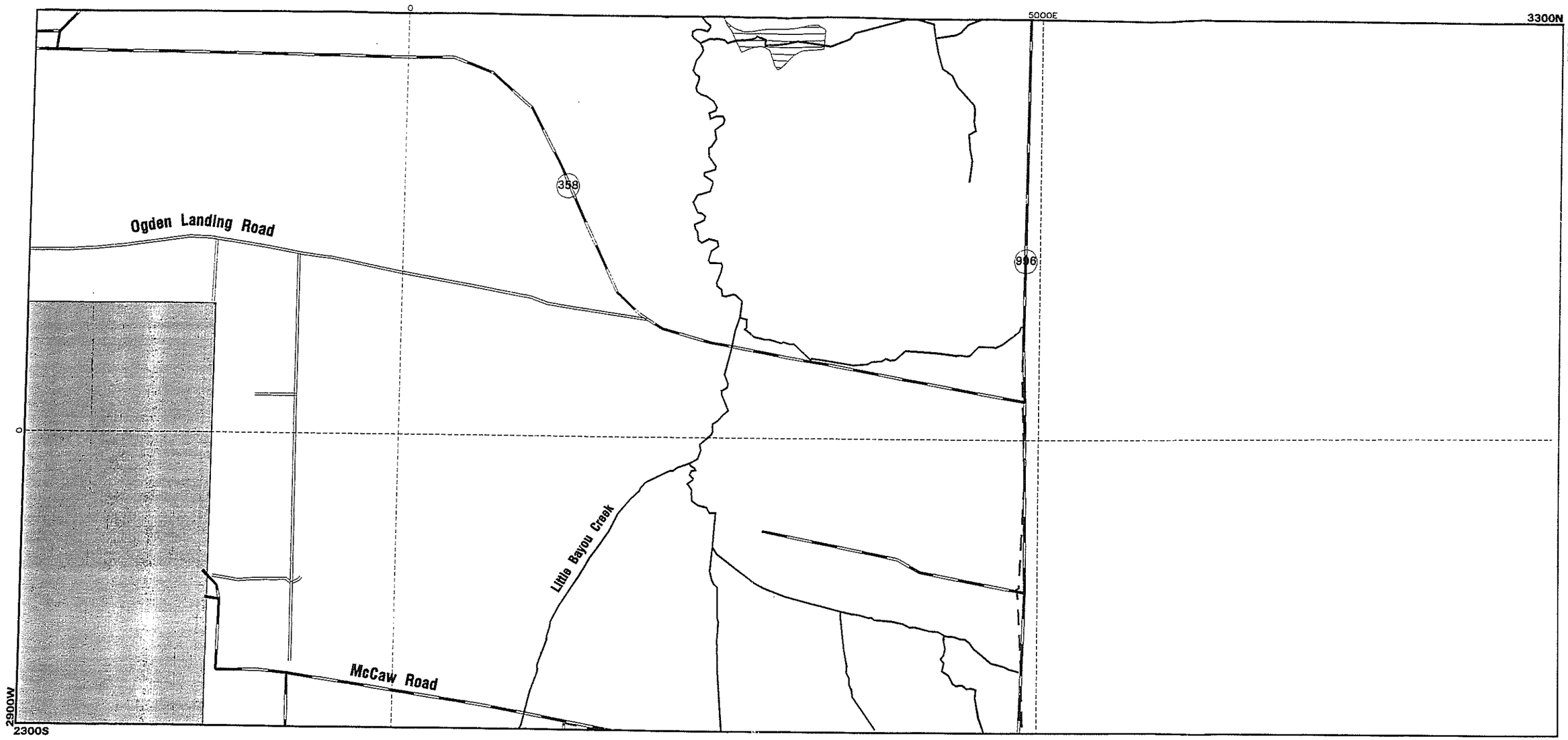

- Paved Roads
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- PGDP Boundary
- Poor Habitat Conditions
- Fair Habitat Conditions
- Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

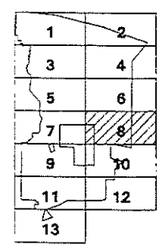
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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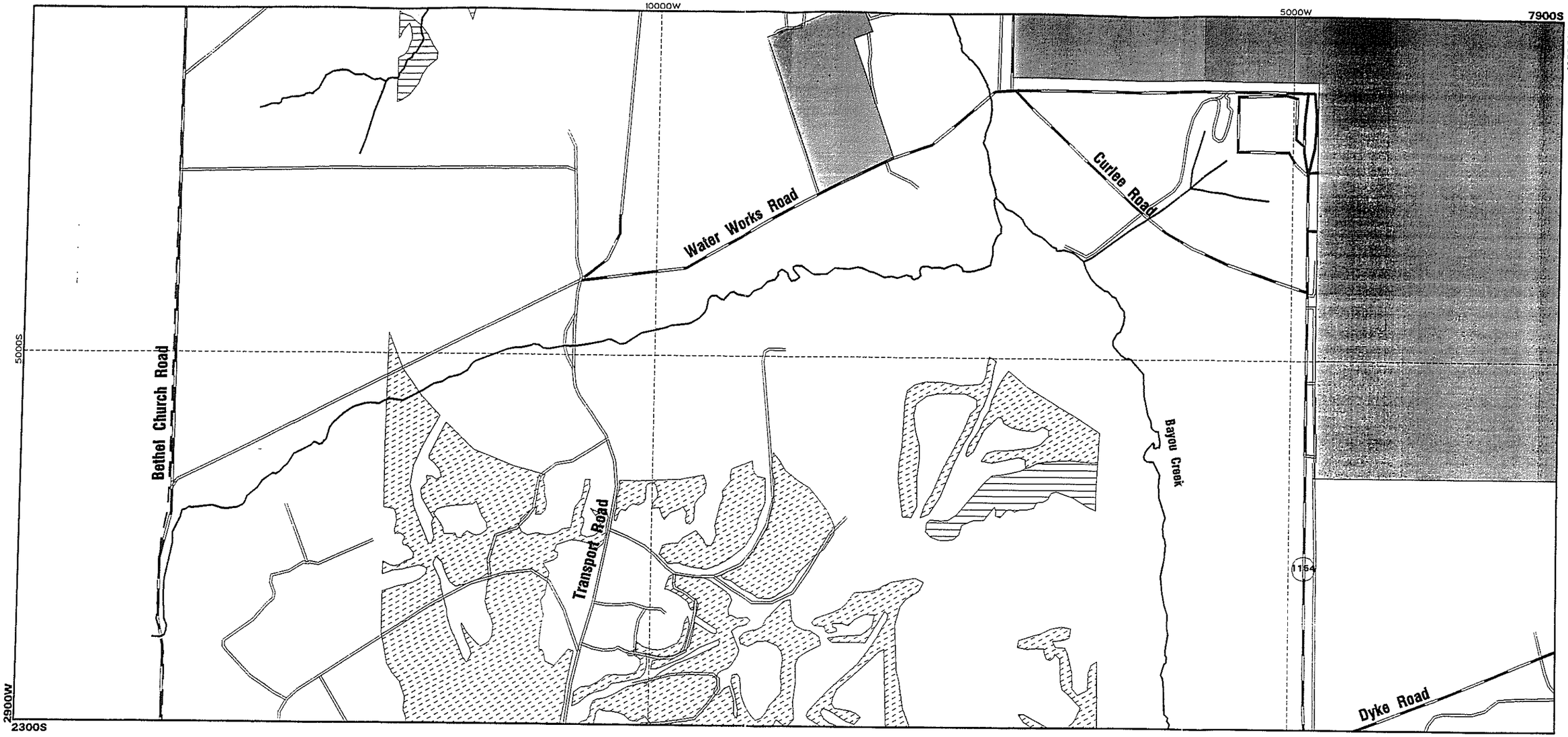

- Paved Roads
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- PGDP Boundary
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Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

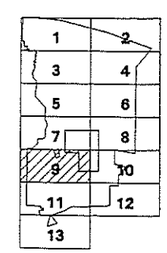
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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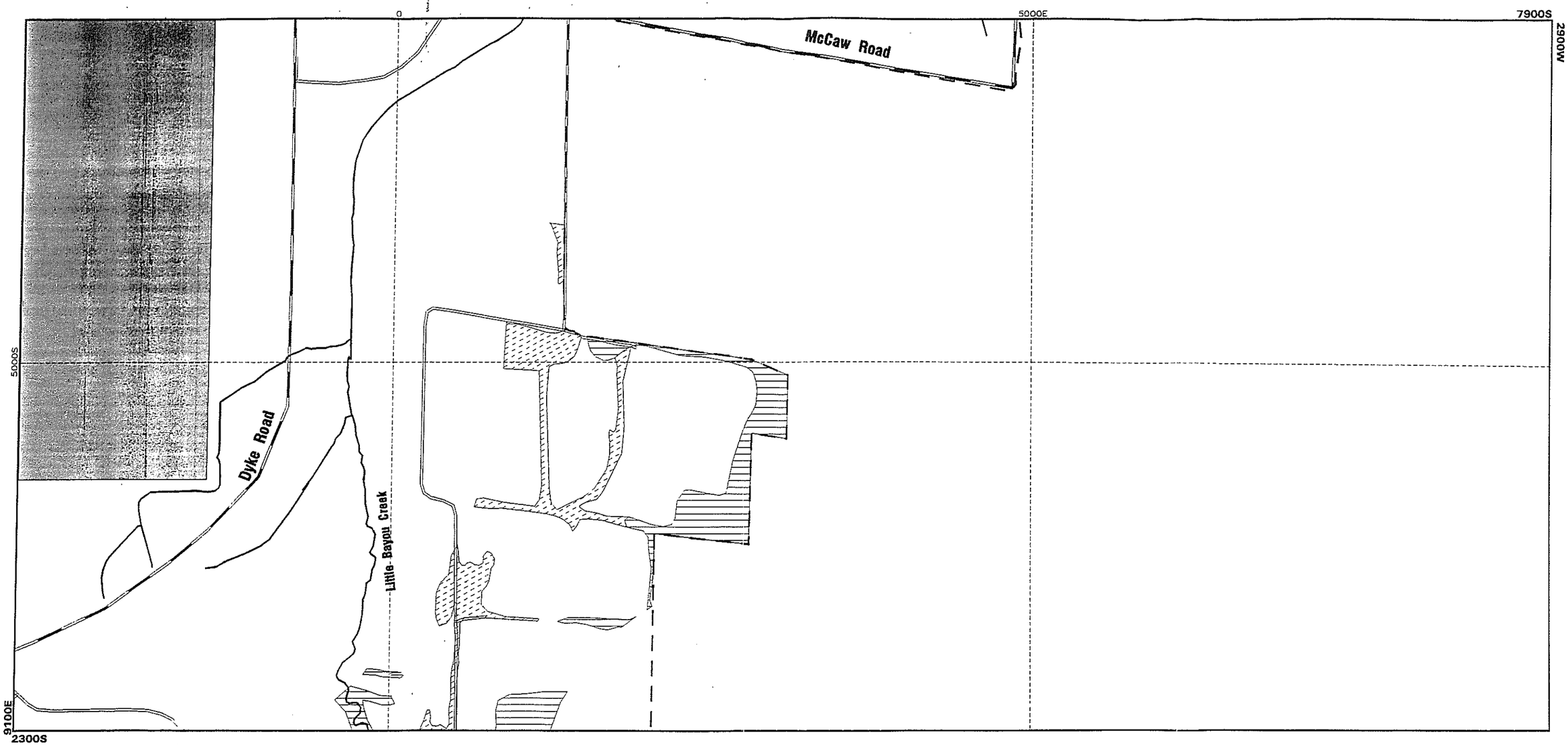

- Paved Roads
- Gravel/Dirt Roads
- PGDP Boundary
- Poor Habitat Conditions
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Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

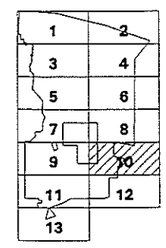
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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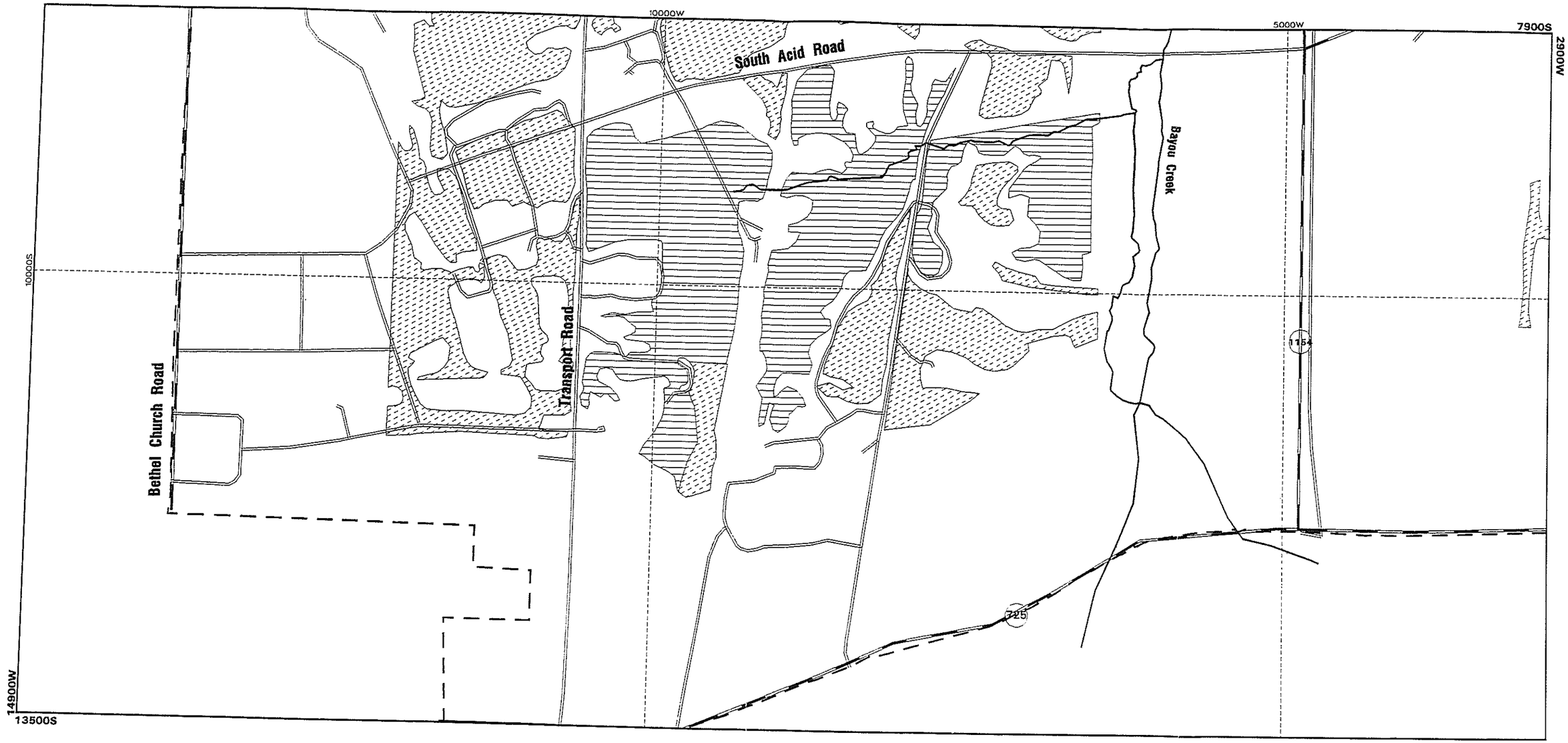

- Paved Roads
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Threatened & Endangered Species Investigation
Potential Habitat
Indiana Bat
(Myotis sodalis)

1:9600

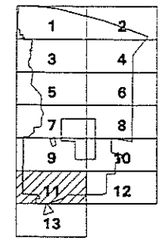
500 0 500 1000 1500

FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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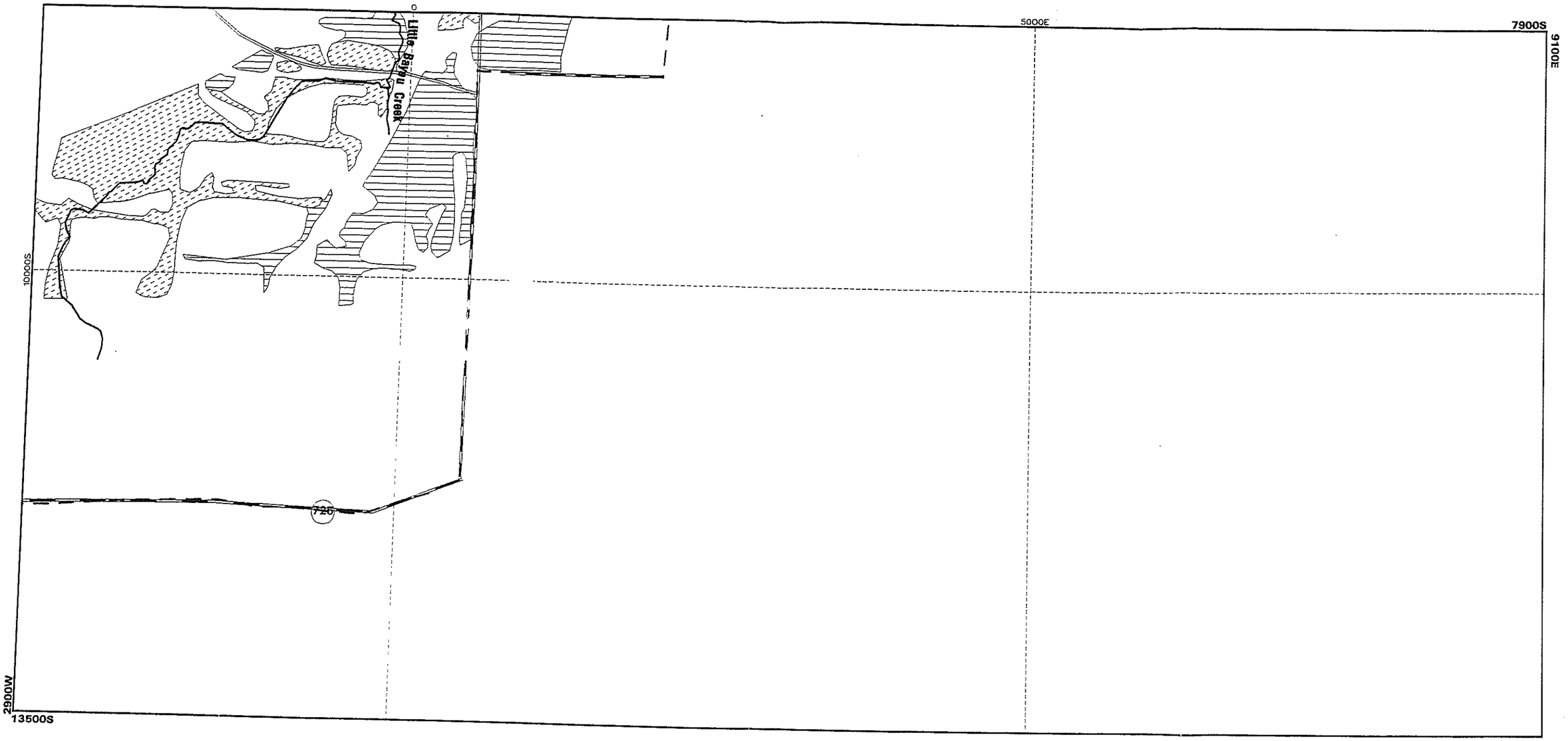

- Paved Roads
- Gravel/Dirt Roads
- PGDP Boundary
- Poor Habitat Conditions
- Fair Habitat Conditions
- Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation

Potential Habitat

Indiana Bat

(Myotis sodalis)

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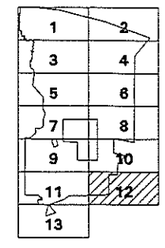
FEET

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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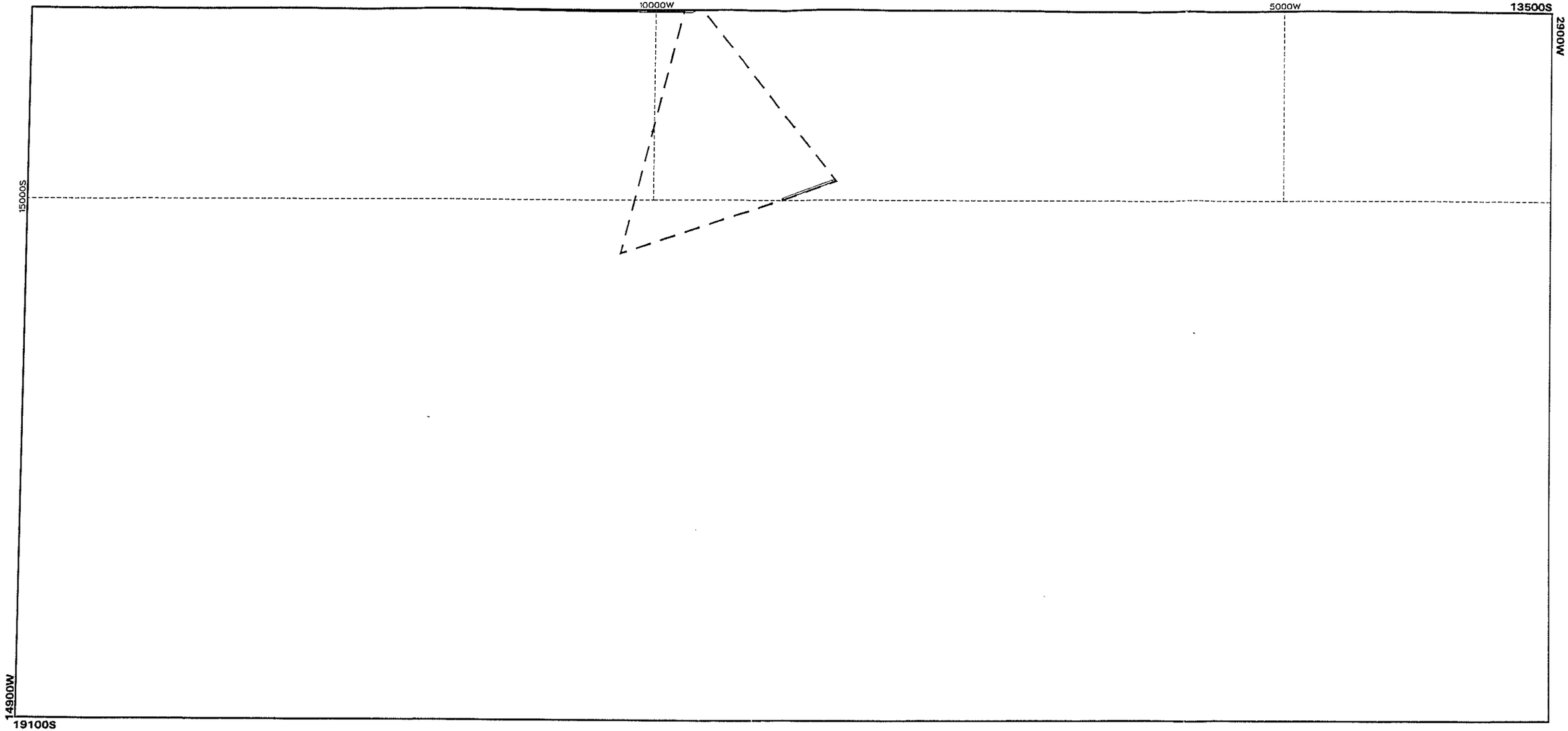


Paved Roads

Gravel/Dirt Roads

PGDP Boundary

Poor Habitat Conditions

Fair Habitat Conditions

Good Habitat Conditions

Unshaded Areas Not Potential Habitat

Threatened & Endangered Species Investigation

Potential Habitat

Indiana Bat

(Myotis sodalis)

1:9600

500 0 500 1000 1500

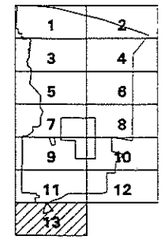
FEET

U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

Paducah Gaseous Diffusion Plant

Environmental Investigation

PGDP Local Coordinates (Feet)



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Appendix C
Habitat Management Guidelines for the Bald Eagle in the Southeast Region

HABITAT MANAGEMENT GUIDELINES FOR THE BALD EAGLE IN THE SOUTHEAST REGION

THIRD REVISION - JANUARY 1987

Introduction

These guidelines are published and issued by the U.S. Fish and Wildlife Service, Southeast Region, but were prepared in consultation with all the Southeastern State wildlife agencies and a number of bald eagle experts, with assistance from FWS solicitors. A number of Federal and State laws and/or regulations prohibit, cumulatively, such acts as harassing, disturbing, harming, molesting, pursuing, etc., bald eagles, or destroying their nests, (see Section IV); although advisory in nature, these guidelines represent a biological interpretation of what would constitute violations of one or more of such prohibited acts. Their purpose is to maintain and/or improve the environmental conditions that are required for the survival and well-being of bald eagles in the Southeastern United States, and are designated essentially for application in bald eagle/human activity (principally land development) conflicts. The emphasis is to avoid or minimize detrimental human-related impacts on bald eagles, particularly during the nesting season.

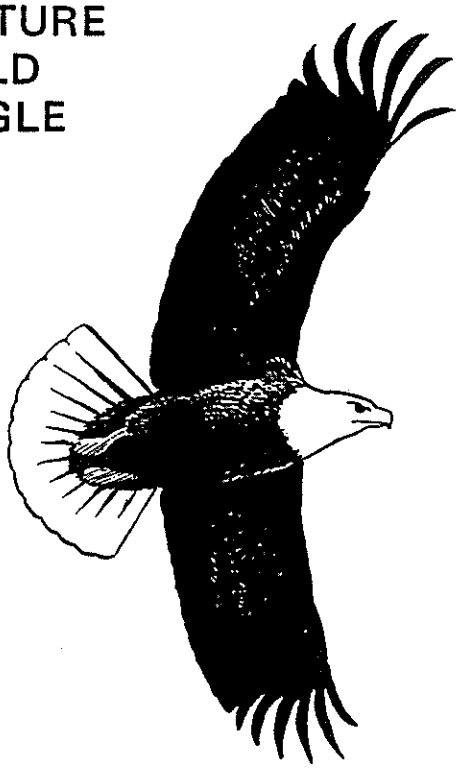
General

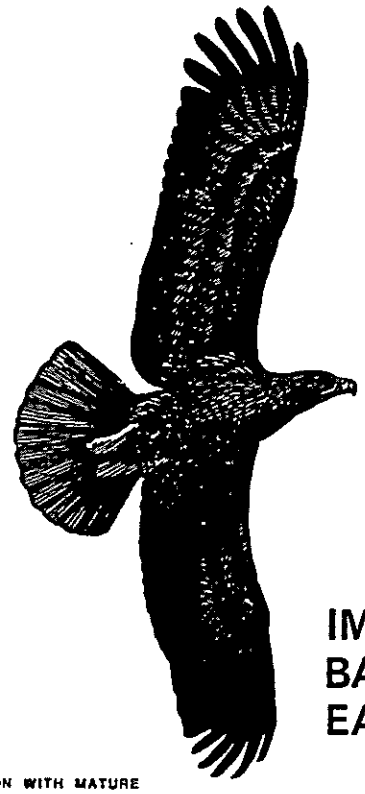
Individual bald eagle pairs exhibit considerable variation in response to human activity, depending in part upon the type, frequency, and duration of activity; extent of modification of the environment; time in the bird's reproductive cycle; and various other factors not well understood. Therefore, it cannot be predicted with absolute certainty the effects a given disturbance might have on a particular pair of bald eagles. Certain human activities are, however, known to disturb bald eagles more than others, and are addressed in the following sections as recommended restrictions. The guidelines are divided into sections on nesting, feeding, roosting, and legal considerations.

I. **NESTING:** In the Southeast, the bald eagle nesting period is usually from October 1 to May 15. However, in the northern portion of the range, nesting has occurred as late as August. Individual pairs return to their same territories year after year, and often territories are inherited by subsequent generations. Eagles are most vulnerable to disturbance early in the nesting period, i.e. during courtship, nest building, egg laying, incubation, and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment and/or chilled or overheated eggs or young. Human activity near a nest later in the nesting cycle may cause premature fledging, thereby lessening the chance of survival.

Loss of Nests or Nest Trees: Although bald eagle nests are legally protected, a nest in and of itself, from a biological perspective, is relatively inconsequential to a given pair of eagles (a pair can construct a nest in less than a week). It is the nest site that originally attracted the pair that is of critical importance. It is not uncommon for nests to be blown from trees by storms, after which the resident pairs typically renest on the same sites, often in the same trees. Therefore, in instances where nests, and even nest trees, are lost, these guidelines should continue to apply in their absence for a period extending through at least two complete breeding seasons subsequent to the loss.

MATURE
BALD
EAGLE





IMMATURE
BALD
EAGLE

TO AVOID CONFUSION WITH MATURE GOLDEN EAGLE REMEMBER:

- IMMATURE BALD EAGLES HAVE WHITE ON WING LININGS
- AND DO NOT HAVE FEATHERS EXTENDING TO TOES

"Abandoned" Nests: Bald eagles often use alternate nests in different years. Although all nests used by a given pair are situated in the same general vicinity, some nests go unused for several consecutive years and thereby may appear abandoned. Even a solitary nest can go unused for several years, often due to the death of one member of the resident pair, and then be reoccupied by either the original pair or one member of the original pair with a new mate. Even in instances where both members of a pair have died, the site would likely be taken over by another pair if no habitat degradation occurs. For these reasons, these guidelines should apply to apparently "abandoned" nests for a period extending at least through five consecutive breeding seasons of non-use.

Management Zones:

A. **Primary Zone:** This is the most critical area and must be maintained to promote acceptable conditions for eagles.

1. **Size:** Except under unusual circumstances, the primary zone should encompass an area extending from 750 to 1,500 feet outward from the nest tree. The precise radius distance between these two extremes would be dependent upon the proximal and spatial configuration of the critical elements (nest tree(s), feeding area, roost trees, etc.) within a particular nesting area, or other compelling factors.

2. **Recommended Restrictions:**

a. Close proximity of the following activities to bald eagle nests are likely to have detrimental impacts on eagle nesting and, therefore, should not occur within the primary management zone at any time:

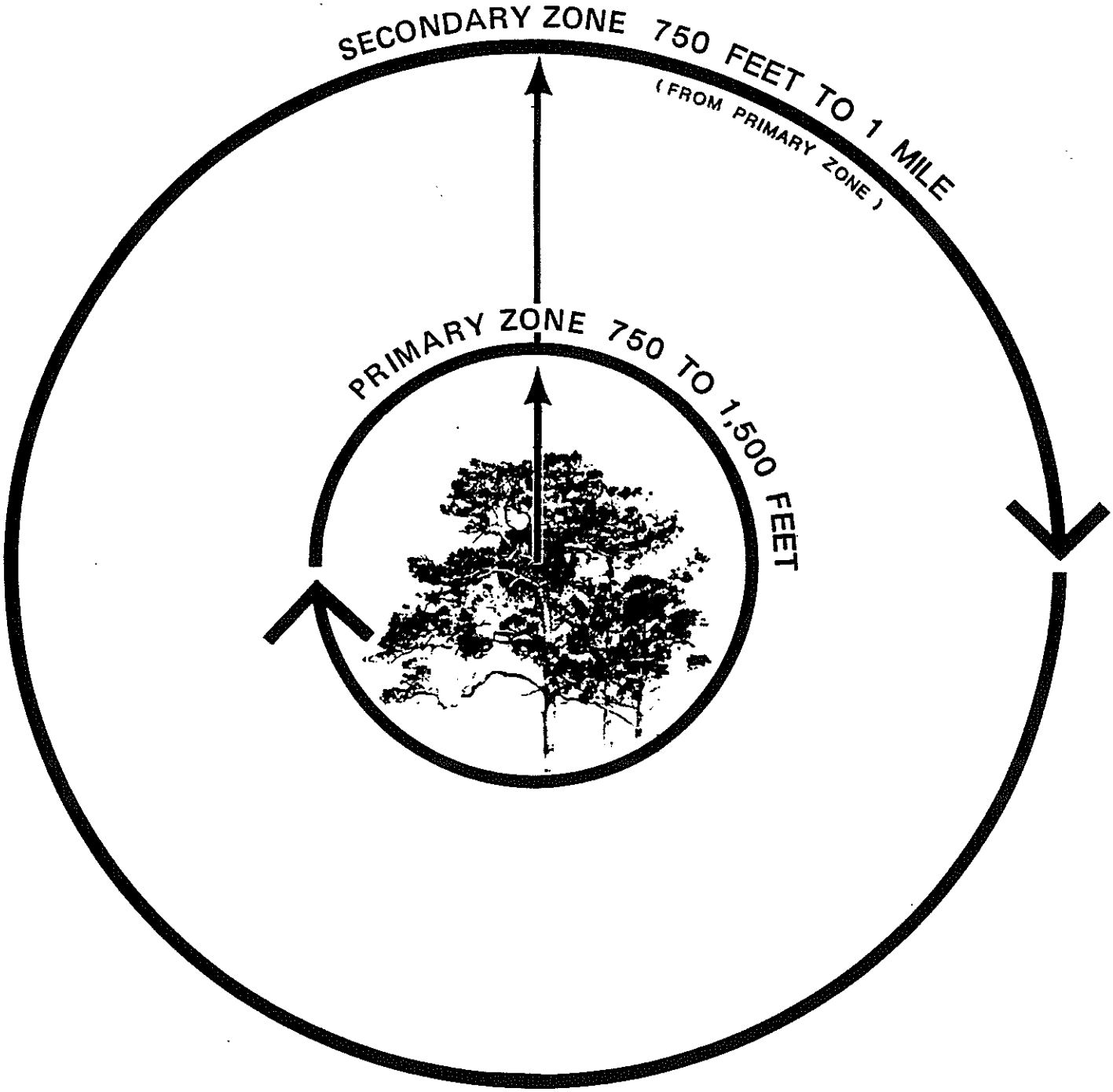
(1) Residential, commercial or industrial development, tree cutting, logging, construction and mining; and

(2) Use of chemicals toxic to wildlife.

b. The following activities would likely be detrimental while eagles are present and, therefore, should be restricted in the primary zone during the nesting period, but not necessarily during the non-nesting season:

(1) Unauthorized human entry; and

(2) Helicopter or fixed-wing aircraft operation within 500 feet vertical distance or 1,000 feet horizontal distance from a nest.


SECONDARY ZONE 750 FEET TO 1 MILE
(FROM PRIMARY ZONE)
PRIMARY ZONE 750 TO 1,500 FEET

B. **Secondary Zone:** Restrictions in this zone are needed to minimize disturbance that might compromise the integrity of the primary zone and to protect important areas outside the primary zone. The secondary zone should be arranged so as to be contiguous with feeding areas and provide a protected access between nests and the feeding area. In some cases that would involve extending a corridor from the primary zone to a particular feeding area, with that corridor requiring the same restrictions as the secondary zone.

1. **Size:** The secondary zone should encompass an area extending outward from the boundary of the primary zone, a distance of 750 feet to 1 mile. The precise distance will be dependent upon site-specific circumstances.

2. **Recommended Restrictions:**

a. Certain activities within the secondary zone are likely to be detrimental to bald eagles and in most cases should be restricted. These activities include, but are not necessarily limited, to:

(1) Development of new commercial and industrial sites;

(2) Construction of multi-story buildings and high density housing developments between the nest and the eagles' feeding area;

(3) Construction of new roads, trails, and canals which would tend to facilitate access to the nest; and

(4) Use of chemicals toxic to wildlife, such as herbicides or pesticides.

b. Other activities may take place in the secondary zone, but only during the non-nesting period. Even intermittent use or activities of short duration during nesting are likely to constitute disturbance. Examples are logging, land clearing, construction, seismographic activities employing explosives, mining, oil well drilling, and low-level aircraft operations. Minor activities such as hiking, bird watching, fishing, camping, picnicking, hunting, and recreational off-road vehicle use may be permitted in the secondary zone at any time.

II. **FEEDING:** These guidelines are designed to enhance the quality of bald eagle feeding areas and eliminate or minimize human disturbance.

A. The use of toxic chemicals in watersheds and rivers where bald eagles feed should be prohibited.

B. Alteration of natural shorelines where bald eagles feed should be prevented or limited. Degraded shorelines should be rehabilitated where possible.

C. Water quality in eagle feeding areas should be monitored and remedial steps taken when needed.

III. **ROOSTING:** These guidelines are designed to help preserve present roosting sites and provide future habitat.

A. Roosts within and adjacent to nesting territories

1. Within the primary management zone, no trees, living or dead, should be removed.

2. Within the secondary management zone, as many large trees as possible, living or dead, should be retained as roost and perch trees. Characteristically, these should be the larger trees in the stand. Trees with open crowns and stout lateral limbs are preferable.

B. Communal Roosts

1. There should be no significant logging, land clearing, or disruptive human activity within 1,500 feet of traditional roost sites.

2. Bald eagle roosting concentrations should be brought to the attention of the Fish and Wildlife Service or State wildlife agency so that a public or private agency can consider preservation of the roost by purchase, easement, or land exchange.

IV. **LEGAL CONSIDERATIONS:**

A. **Federal Statutes:**

1. The Bald Eagle Protection Act (16 U.S.C. 668-668d), and the regulations derived therefrom (50 CFR 22), state, in part, that no person ". . . shall take . . . any bald eagle . . . or any golden eagle, alive or dead, or any part, nest, or egg thereof . . .," with 'take' meaning ". . . to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb . . . ." Whoever violates any part of the BEPA may be fined from $5,000 to $10,000 or imprisoned from 1 to 2 years or both.

2. Section 9 of the Endangered Species Act of 1973 (16 U.S.C. 1531), as amended, makes it unlawful to 'take' any listed species with 'take' meaning to ". . . harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct . . . ."

For persons who violate the provisions of Section 9, the penalties can be civil or criminal with fines of from $5,000 to $20,000 and/or imprisonment from 6 months to 1 year. Section 7 of the ESA requires that all Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitat.

3. The Migratory Bird Treaty Act (16 U.S.C. 703-711) makes it unlawful ". . . to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, . . . offer for sale, sell, . . ., any migratory bird, any part, nest or eggs of any such bird . . . ." Violators may be fined from $500 to $2,000 and/or imprisoned from 6 months to 2 years.

B. State Statutes

1. State of Alabama:

Section 9-11-232 of Alabama's Fish, Game and Wildlife regulations curtails the possession, sale, and purchase of wild birds. "Any person, firm, association, or corporation who takes, catches, kills or has in possession at any time, living or dead, any protected wild bird not a game bird or who sells or offers for sale, buys, purchases or offers to buy or purchase any such bird or exchange same for anything of value or who shall sell or expose for sale or buy any part of the plumage, skin or body of any bird protected by the laws of this state or who shall take or willfully destroy the nests of any wild bird or who shall have such nests or eggs of such birds in his possession, except as otherwise provided by law, shall be guilty of a misdemeanor. . . ." Section 9-11-236, which prohibits the hunting of or posession of protected birds during closed season and carries a fine of up to $500, also protects eagles.

2. State of Arkansas:

Section 14.01 of the Official Codebook of Arkansas Game and Fish Commission Regulations states, "It shall be unlawful to take or attempt to take wild birds or bird eggs." A violation of this code carries a $100 to $500 fine.

3. State of Florida:

Rule 39-27.011 of the State of Florida Wildlife Code (Chapter 39, Florida Administrative Code) reads, "No person shall kill, attempt to kill, or wound any endangered or threatened species," and Rule 39-27.002(1) states, in part, "No person shall pursue, molest, harm, harass, capture or possess any endangered or threatened species or parts thereof or their nests or eggs . . . ." (The bald eagle is listed as a threatened species by the State of

State of Florida (cont'd):

Florida.) Violation of those regulations constitutes a second degree misdemeanor punishable by a $500 fine and/or up to 60 days in jail.

4. **State of Georgia:**

State law 27-3-22, referring to wildlife, states, in part, "It shall be unlawful for any person to hunt, trap, take, possess, sell, purchase, ship, or transport any hawk, eagle, owl, or any other bird or any part, nest, or egg thereof . . . ."

5. **State of Kentucky:**

Chapter 150, Section 330, of the Kentucky Fish and Wildlife Codes, revised in 1986, reads ". . . No person shall take, pursue, possess, purchase or sell or attempt to do so, any migratory birds, except as authorized by the migratory bird treaty act (40 stat. 755) as amended and regulations under it . . . ." Section 183 prohibits the importing, transporting, or possessing of endangered wildlife.

6. **State of Louisiana**

Chapter 9, Section 1901.C., which was amended in 1981, prohibits or carefully regulates ". . . the taking, possession, transportation, exportation from the state, processing, sale, or offer for sale or shipment within the state of . . . endangered species." (Endangered or threatened species are defined as those covered under the Federal Endangered Species Act, as concurred in by the Louisiana Wildlife and Fisheries Commission.) The bald eagle is recognized as an endangered species in Louisiana.

7. **State of Mississippi:**

Section 49-5-7 of the Mississippi Code of 1972 reads, "No wild bird other than a game bird shall be pursued, taken, wounded, killed, captured, possessed, or exported at any time, dead or alive. No part of the plumage, skin, or body of any bird . . . shall be sold or had in possession for sale in this state. No person shall molest, take or destroy the nests or eggs of any wild bird, or have such nests in his possession . . . ." Section 49-5-109 states, " . . . it shall be unlawful for any person to take, possess, transport, export, process, sell or offer for sale or ship, and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on the following lists: (1) the list of wildlife indigenous to the state determined to be endangered within the State . . . ." (The bald eagle is listed as endangered in Mississippi.) Any person who violates these regulations will face a $1,000 fine and/or imprisonment for up to 1 year.

8. **State of North Carolina:**

In 1985 North Carolina law G. S. 113-294 was amended to include subsection(1) which refers specifically to eagles. It reads: ". . . any person who unlawfully takes, possesses, transports, sells or buys any bald eagle or golden eagle, alive or dead, or any part, nest or egg of a bald eagle or golden eagle is guilty of a misdemeanor. Unless a greater penalty is prescribed for the offense in question, any person convicted under this subsection is punishable by a fine of not more than $1,000, or imprisonment of not more than 1 year, or both."

9. **State of South Carolina:**

Regulation 123-160, derived from the Nongame and Endangered Species Conservation Act, and adopted in December 1976, protects eagles and other wildlife of the Orders Falconiformes and Strigiformes. "It shall be unlawful for any person to take, possess, transport, export, process, sell or offer for sale or ship, and for any contract carrier knowingly to transport or receive for shipment any such species or products or parts thereof except by permit for scientific, educational or falconry purposes issued by the South Carolina Wildlife and Marine Resources Department."

10. **State of Tennessee:**

Section 70-8-105(c) of the Tennessee Nongame and Endangered or Threatened Wildlife Conservation Act of 1974 states, " . . . it shall be unlawful for any person to take, possess, transport, export, process, sell or offer for sale or ship, and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on any of the following lists: (1) The list of wildlife indigenous to the state determined to be endangered or threatened within the state pursuant to subsection (a); (2) The United States' List of Endangered Native Fish and Wildlife as it appears on April 5, 1974 (Part 17 of Title 50, Code of Federal Regulations, Appendix D); and (3) The United States' List of Endangered Foreign Fish and Wildlife (Part 17 of Title 50, Code of Federal Regulations, Apendix A) . . . ." A violation of this code constitutes a $25 to $1,000 fine and/or imprisonment for up to 1 year.