

### 3. SITE-SPECIFIC RBES DESCRIPTION

This chapter presents the site context risk-based end state description. This description presents information similar to that in Chap. 2, except at a greater level of detail. Generally, the maps presented here are similar to the site-wide maps that have appeared in the various RI documents (e.g., DOE 1996a, 1996b, 1997a, 1998a, 1999a, 1999b, 2000b, 2000c) and feasibility study reports (e.g., 2001a) prepared for PGDP.

The maps presented in this chapter are intended to show all areas and human and ecological receptors of concern near PGDP that might be affected by contamination originating on the site. The maps presented in this section depict the boundaries of all contiguous local and county governments and encompass site watersheds (i.e., Bayou and Little Bayou Creek), habitat and ecology areas, and other areas that could be affected by contamination migrating from the site. Site maps are presented for both current and RBES land use.

#### 3.1 PHYSICAL AND SURFACE INTERFACE

Material in this section discusses and depicts the local administrative boundaries, transportation and infrastructure features, and surface configuration features and their relationship with hazard areas of concern at PGDP under both the current state and RBES. Administrative boundaries included are those for local governments; federal and state properties, including the PGDP property boundary and fence lines; and legal ownership (i.e., private versus federal ownership.) Transportation and infrastructure features included are highways, roads, and railroads; utility lines; and power plants. Surface configuration features included are the Bayou Creek and Little Bayou Creek watersheds and major drainages leading from PGDP. Information presented about hazard areas of concern includes locations of contaminated surface water, sediment, and soil; waste cells (i.e., burial grounds); groundwater plumes; and contaminated buildings. Other information includes locations of monitoring wells, drinking water wells, and relevant institutional controls.

##### 3.1.1. Current State

Figure 3.1a depicts all physical and surface features under current conditions on a single map. The following narrative references this map.

Administrative Boundaries: As depicted in Fig. 3.1a, the DOE-owned PGDP is surrounded by the state-owned WKWMA, the TVA-owned steam plant, and private property. As noted in Chap 2, PGDP encompasses 3,556 acres, with the industrial portion of PGDP situated within a fenced security area that consists of approximately 748 acres. Within this area are the numerous buildings and offices, support facilities, equipment storage areas, and active and inactive waste management units that comprise PGDP. Outside the fenced security area are approximately 822 acres that are not surrounded by the main security fence but are controlled for security purposes. The remaining 1,986 acres is leased to the Commonwealth of Kentucky as part of the WKWMA. The entire WKWMA covers approximately 6,823 acres.

Another administrative boundary shown on Fig. 3.1a is that for the PGDP Water Policy. As discussed in Sect. 2.1, the PGDP Water Policy is a removal action completed under the ACO (DOE 1994), through which DOE offered municipal water to all existing private residences and businesses within the area affected by contaminated groundwater originating at PGDP. In return, the affected residences and businesses agreed to not drill new water supply wells or use existing water wells and to allow PGDP personnel property access to sample groundwater.

No incorporated towns or cities are visible on the site-context map; however, the unincorporated community of Heath borders the eastern and southeastern sides of PGDP. The nearest schools are Heath Elementary, Middle, and High Schools located about 1.86 miles southeast of PGDP in Heath.

Transportation and Infrastructure: As depicted in Fig. 3.1a, several state and county roads run near PGDP, with the main entrance road running from U.S. Highway 60 northeast into the plant. About 17.5 miles of paved roadway (concrete or asphalt) are in the industrialized portion of PGDP, and additional patrol roads and paved access roads branch to the plant's periphery. In addition, a railroad spur services PGDP and there are slightly more than 17 miles of track within the industrialized area. The spurs connect to the Illinois Central Gulf Railroad. No airports are visible on the site-context map. (The nearest airport is Barkley Regional Airport located approximately about 3.7 miles southeast of PGDP.

Surface Configuration: The PGDP region is characterized by low relief. Elevations vary from 290 ft amsl at the Ohio River, located approximately 3.5 miles to the north, to 380 ft amsl on the plant site. Two main topographic features dominate the landscape: a loess-covered terrace, at 350-380 ft amsl elevation, and the Ohio River floodplain zone, dominated by alluvial sediments, at 300-320 ft amsl.

The terrain of the PGDP area is modified slightly by the branching drainage systems associated with Bayou Creek and Little Bayou Creek. These northerly flowing streams, which meet 3.5 miles north of the site and discharge into the Ohio River, have eroded small valleys that are approximately 20 ft below the adjacent plain and ultimately discharge to the Ohio River. Bayou Creek is a perennial stream, and its drainage extends from approximately 2.5 miles south of PGDP to the Ohio River. Drainage flows toward the river along a 9-mile course that passes along the western boundary of the industrialized area of the plant. Little Bayou Creek, an intermittent stream south of PGDP, originates in the WKWMA and flows north toward the Ohio River along a 6.5-mile course that includes parts of the eastern boundary of the industrialized area of plant. Effluents from PGDP operations constitute ~85% of the normal flow in Bayou Creek and nearly 100% of the normal flow in Little Bayou Creek (Kornegay et al. 1991).

The average elevation at PGDP is 380 ft amsl, or about 80 ft above the average water level of the Ohio River near the plant. Storm water and effluent from the plant flow into a series of man-made ditches and storm sewers that direct flow off of plant property through outfall ditches. These outfall ditches, which contain a specific point that is monitored for compliance with regulatory discharge limits, carry storm water and/or effluent into Bayou and Little Bayou Creeks.

Hazard Areas of Concern: Several hazard areas are visible in Fig. 3.1a. These consist of the process buildings, landfills, and contaminated soils and sediments found on DOE-owned property and two major dissolved-phase solvent plumes found off DOE-owned property. In addition, contaminated sediments are found along Bayou and Little Bayou Creeks both on and off DOE property. Two groundwater pump-and-treat systems are also visible in Fig. 3.1a. These systems are located near the centers of the Northeast and Northwest Plumes and are used to control the migration of the high-concentration centroids of these plumes. The system for the Northwest Plume consists of two pumping areas, and that for the Northeast Plume consists of a single pumping area. (Note that these pump-and-treat systems do not hydraulically contain the plumes and are not intended to "remediate" the dissolved phase plumes.) The plumes also are monitored by several wells located within the plumes and along their peripheries.

### **3.1.2.RBES**

Fig. 3.1b depicts all physical and surface features under RBES conditions on a single map. The following narrative references this figure.

Administrative Boundaries: As depicted in Fig. 3.1b, DOE-owned property is not expected to increase under the RBES. However, the RBES includes enhanced institutional controls that would replace the existing PGDP Water Policy and be implemented on both DOE- and non-DOE-owned property. These controls could range from implementation of legal agreements with surrounding landowners to place enforceable restrictions on groundwater use to DOE's acquiring rights from surrounding property owners and directly implementing restrictions on groundwater and property use.

Transportation and Infrastructure: No significant transportation or infrastructure changes are visible on the site-context map. The changes in roads, railroads, and other infrastructure (e.g., utility lines) that may occur after GDP D&D are unknown, but these are expected to remain if PGDP is re-industrialized.

Surface Configuration: As depicted in Fig. 3.1b, no changes in surface configuration are expected by the end of the current planning horizon; however, Little Bayou Creek may become an intermittent stream if PGDP ceases discharging effluent to it.

Hazard Areas of Concern: As depicted in Fig. 3.1b, on a site-specific scale, the surface hazard areas found at PGDP will change significantly by the end of the current planning horizon under the RBES. As noted in Chap. 2, when the RBES is attained, all potentially contaminated sediments in Bayou and Little Bayou Creek will be addressed, all potentially contaminated surface soils and sediments in the industrialized area of PGDP will be addressed, and the GDP, including those facilities that currently are inactive and those that currently are operating, will undergo D&D. Hazard areas expected to remain are the permitted landfills (potentially including a newly constructed CERCLA Cell, which is assumed to be used for on-site disposal of materials from the D&D of the GDP), the subsurface sources of the groundwater plumes and the dissolved-phase plumes, and the capped burial grounds.

## **3.2 HUMAN AND ECOLOGICAL LAND USE**

Material in this section discusses and depicts the human activities, land cover, and ecological activities and their relationship to hazard areas of concern at PGDP under both the current state and RBES. Human activities included are land use and water supply information. Ecological activities included are conservation and ecological areas, watersheds, wetlands and floodplains, and biota habitat. Information presented about hazard areas of concern matches that in Sect. 3.1.

### **3.2.1. Current State**

#### Human Activities:

Several small communities are within 5 miles of PGDP. The closest communities, both unincorporated, are Grahamville, located 1 mile to the east, and Heath, located approximately 2 miles to the southeast. These areas support multiple private houses and lots, with the nearest residing approximately 3,000 ft from the industrial area. Areas south of PGDP are mainly rural and include a trailer park on Woodville Road. West of PGDP, the population density is low, and the setting is rural.

#### Land Cover:

Current human activities at and around PGDP are depicted on Figure 3.2a, and include the following land uses:

- Residential,
- Manufacturing/Industrial,
- Agricultural, and
- Open Space Ecological/Preservation

The immediate area of PGDP is identified as a manufacturing and industrial area and is surrounded by the WKWMA for a minimum of approximately 1 mile in all directions. The WKWMA is an open space ecological/preservation zone that is bordered on the west, east, and south by areas currently used for agricultural purposes. Residential areas are shown on the figure to the southeast of PGDP and across the Ohio River to the north.

#### Ecological Activities:

The area surrounding PGDP supports a variety of ecological resources including:

- Vegetation
- Wildlife
- Aquatic regions
- Wetlands
- Threatened and endangered species

Each of these categories is discussed in the following section (DOE 2001a and DOE 2003e).

The upland habitats in the PGDP area support a variety of plant and wildlife species. Because much of the DOE-owned property and WKWMA terrestrial habitat is managed for multiple uses, the diversity of habitat is excellent. Forest and shrub tracts alternate with fencerows and transitional edge habitats along roads and transmission-line corridors. Fencerow communities are dominated by elm, locust, oak, and maple, with an often thick understory of sumac, honeysuckle, blackberry, and grape. Herbaceous growth in these areas includes clover, plantain, and numerous grasses.

The terrestrial community is described by the dominant vegetation sites that characterize the community. The communities range from oak-hickory forest, in areas that have been relatively undisturbed, to managed fencerows and agricultural lands. Significant areas of the DOE-owned property and WKWMA include vegetation managed for consumption by wildlife, especially deer.

Most of the area in the vicinity of PGDP has been cleared of vegetation at some time. Approximately 2,000 acres in the WKWMA consist of old field grasslands. Approximately 800 acres within the WKWMA are in scrub or shrub habitat. The Kentucky Department of Fish and Wildlife Resources staff mows 600 to 700 acres; control burns 200 to 400 acres; plants 150 acres of food plots (for wildlife); and sprays, strip-discs, or otherwise actively manages an additional 100 to 500 acres annually on the WKWMA.

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thickets, and forest habitats. Observations by ecologists and WKWMA staff have provided a qualitative description of wildlife communities likely to inhabit the vegetation communities in the vicinity of PGDP. Open herbaceous areas are frequented by rabbits, mice, and a variety of other small mammals. Birds include red-winged blackbirds, quail, sparrows, and predators such as hawks and owls. In areas that include fencerows, low shrub, and young forests, a variety of wildlife is present including opossum, vole, mole, raccoon, and deer. Birds typically present include red-winged blackbird, loggerhead shrike, mourning dove, northern bobwhite quail, wild turkey, northern cardinal, and western meadowlark. Several groups of coyotes also reside in the vicinity of PGDP. In mature forests, squirrel, various songbirds, and great

horned owls may be present. The primary game species hunted for food in the area are deer, wild turkey, northern bobwhite, rabbit, and squirrel. Opossums and raccoons are hunted for dog training and pelts.

Both Bayou and Little Bayou Creeks and tributaries support a variety of aquatic life including several species of sunfish, as well as spotted and largemouth bass, bullheads, and creek chub. Inhabitants of shallow streams, characteristic of the two main area creeks, are dominantly bluegill, green and longear sunfish, and central stonerollers.

In addition to stream habitats, approximately 13 fishing ponds are located near PGDP, primarily in the WKWMA. Most of the ponds north of PGDP are used for public fishing. Ponds to the south of PGDP have been posted with consumption warnings, due to contamination from operations of an ordnance works that operated during World War II. Pond areas generally are dominated by largemouth bass, bluegill, and to a lesser extent, green sunfish.

Aquatic habitats are used by muskrat and beaver. Many species of water birds, including wood duck, geese, heron, and species of migratory birds, also use these areas. Numerous other smaller ponds and abandoned gravel pits usually contain water and may have functioning ecosystems.

Habitats that have soil and hydrology capable of supporting vegetation adapted for hydric environments are considered wetlands. These habitats include marshes (wetlands dominated by herbaceous species) and swamps (wetlands dominated by woody species), as well as variations between terrestrial and aquatic habitats. Near PGDP, there are numerous areas where these conditions prevail, particularly in the region adjacent to the Ohio River. Within the WKWMA, approximately 4,000 acres have been identified as having hydric soil capable of supporting wetlands. Some of these systems include a special-status species, the water hickory. Approximately 400 acres of this area are Tupelo Swamp, and another 600 acres are bottomland hardwood. The Tupelo Swamp, which is located near PGDP, is considered very unusual by state and federal land managers and is thought to be only one of three similar systems left in the United States. Most of the remainder of the wetlands in the PGDP vicinity is in agricultural use or is in some stage of succession to wetland scrub. Other wetland habitats are found associated with the shorelines of ditches and creeks (riparian vegetation), although many of these are incised and have only marginal areas of wetlands.

Eleven federally listed, proposed, or candidate species have been identified as potentially occurring at or near PGDP. None of the species has been reported as sighted on the DOE-owned property; however, potential summer habitat and suitable forage habitat exist on DOE-owned property for the Indiana bat, and Indiana bats have been captured in the PGDP vicinity.

Hazard Areas of Concern: Please see Section 3.1 for a depiction and discussion of hazard areas of concern under current conditions.

### **3.2.2.RBES**

#### Human Activities:

Figures 3.2b1 and 3.2b2 present the expected future land use and future zoning in the area, respectively. As shown in Fig. 3.2b2, the areas south of PGDP are anticipated to remain urban and rural residential. As discussed in Section 2.2.2, a gradual transition from agricultural use to low-density housing (i.e., residences on lots averaging from 1 to 5 acres) and recreational use is possible. Note that the change from agriculture use to low-density housing is not reflected in Fig. 3.2b1 because the areas where the transition from agricultural use to low-density housing may occur is unknown. However, this transition is consistent with the increasing subdivision of farmland for residential development along U.S. 60, west of Paducah, and the recent expansion of that road into a four-lane highway.

### Land Cover:

Land uses for the RBES are presented on Fig. 3.2b1 and include the following:

- Residential,
- Manufacturing/Industrial,
- Agricultural, and
- Open Space Ecological/Preservation.

The RBES land use is identical to the current state land uses, with the manufacturing/industrial PGDP area surrounded by the open/ecological/preservation area of the WKWMA, which is subsequently bordered by agricultural areas. Residential areas under the RBES are to the southeast of PGDP and across the Ohio River to the north.

The most significant differences between Figs. 3.2a and 3.2b1 are the removal of several hazard areas and the absence of the current extraction well system.

### Ecological Activities:

Ecological resources in the PGDP area for the RBES will be consistent with the current state. Changes in the size of the WKWMA in the future may result in changes to the areas inhabited by terrestrial and aquatic species.

### Hazard Areas of Concern:

Please see Sect. 3.2 for a depiction and discussion of hazard areas of concern under RBES conditions.

## **3.3 LEGAL OWNERSHIP**

Material in this section discusses and depicts the legal ownership of areas at and around PGDP under the current state and RBES. The ownership (surface and subsurface) classes considered are private and government (i.e., state, federal, and local).

### **3.3.1. Current State**

As depicted in Fig. 3.3a, the PGDP state government-owned property (i.e., the state-owned portion of the WKWMA) borders PGDP on the south, west, and north sides; federal government-owned property (i.e., the TVA Shawnee Steam Plant) borders the PGDP north side; and private property borders PGDP on the east and south side. Private property, in turn, surrounds the portion of the WKWMA bordering PGDP.

No incorporated communities are near enough to PGDP to appear on the site-context maps; however, the privately owned property to the east of PGDP does consist of homes located on relatively small lots (approximately 1 acre or less). This area is the unincorporated community of Heath.

The nearest schools also are located in Heath and are to the southwest of PGDP. These schools (i.e., Heath elementary, middle, and high schools) are approximately 1.86 miles from the boundary of DOE-owned property.

As noted earlier, portions of PGDP containing infrastructure needed for uranium enrichment are leased to USEC. Infrastructure leased to USEC includes the process buildings, electrical switchyards, an

administration building, and several maintenance and support buildings. In total, USEC leases 421 acres of the 748 acres within the secure area of PGDP.

An additional facility planned for PGDP is the depleted uranium hexafluoride conversion facility (DUF<sub>6</sub> Conversion Facility). This facility currently is under development and will be located in the southeast corner of the DOE-owned property. It will cover 9 acres.

### **3.3.2.RBES**

As depicted in Fig. 3.3b, DOE-owned property is not expected to increase under the RBES. However, the RBES includes enhanced institutional controls that would replace the existing PGDP Water Policy and be implemented on both DOE- and non-DOE-owned property. These controls could range from implementation of legal agreements with surrounding landowners to place enforceable restrictions on groundwater use to DOE's acquiring rights from surrounding property owners and directly implementing restrictions on groundwater and property use.

## **3.4 DEMOGRAPHICS**

Information presented in this section discusses and depicts the population density and other pertinent demographic information for the area near PGDP under the current state and RBES. Demographic data presented includes population data and housing and socioeconomic data.

### **3.4.1.Current State**

As depicted in Fig. 3.4a, the population density immediately around PGDP under current conditions is between 151 and 500 individuals per square mile. Specific demographic information from the 1980, 1990, and 2000 censuses about census tract 0315, block group 2, which is the block group for the area containing PGDP, is presented in Table 3.1.

As shown in Table 3.1, the area immediately around PGDP had a small net population gain from 1980 to 2000. The block group was over 90% white in the censuses and the percentage white has increased between censuses. There were slightly more elderly persons than children under age 10 in 1990, as the percentage of children declined, and the percentage of elderly people increased during that time.

For the 1990 census, there were 2.57 individuals per household, and nearly 90% of all households were owner-occupied, which is typical of rural areas. Over 71% of persons age 25 and older had at least a high school education, and median income was \$27,560. Under 13% lived below the poverty level, which is relatively low for western Kentucky. Over three-quarters of housing units in the area had water from sources other than a private well (ATSDR 2002).

For the 2000 census, there were 2.48 individuals per household (a -3.5% change) and an 87% rate of home ownership (a -2.2% change). Over 71% of persons age 25 and older had at least a high school education, and the median household income was \$37,308 (a 35% change). Under 8% lived below the poverty level (a change of -39%) compared to a state-wide average of 12.7%. The rate of private well use was similar to the 1990 census at 24%.

**Table 3.1. Demographic information for the area near the PGDP  
under current state (ATSDR 2002 and DOC 2003)<sup>a</sup>**

<b>Information</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Population</b>			
Total population	1,383	1,366	1,442
Percent change <sup>b</sup>		-1.2%	+5.6%
Density per square mile	46	45	47.5
Percent change		-2.2%	+5.6%
<b>Race</b>			
% Caucasian	91.4%	92.9%	94.4%
Percent change		+1.6%	+1.6%
<b>Age</b>			
Under Age 10	16.1%	12.4%	10.9%
Percent change		-23%	-12%
Age 65 and Over	11.5%	13.0%	14.7%
Percent change		+13%	+13%
<b>Socioeconomic Information</b>			
Total households	NA	531	581
Percent change			+9.4%
Individuals per household	NA	2.57	2.48
Percent change			-3.5%
% households owned	NA	88.5%	86.3%
Percent change			-2.5%
Individuals age 25 and older	NA	927	974
Percent change			+5.1%
% with at least high school diploma	NA	71.4%	71.4%
Percent change			None
Median income, \$	NA	\$27,560	\$37,308
Percent change			+35%
% below poverty level	NA	12.7%	7.7%
Percent change			-39%
Employed age 16 and older	NA	673	603
Percent change			10%
% in blue collar job	NA	38.6%	
Percent change			
% in white collar job	NA	61.4%	
Percent change			
<b>Water Source</b>			
Housing units	NA	580	631
Percent change			+8.8%
% with water from well	NA	24.3%	24.1%
Percent change			-0.8%
% with other water supply	NA	75.7%	75.9%
Percent change			+0.3%

“NA” indicates that the information was not available at the time this draft of the report was prepared.

a Information presented is for census tract 0315, block group 2.

b Percent change is relative to the previous census in all cases.



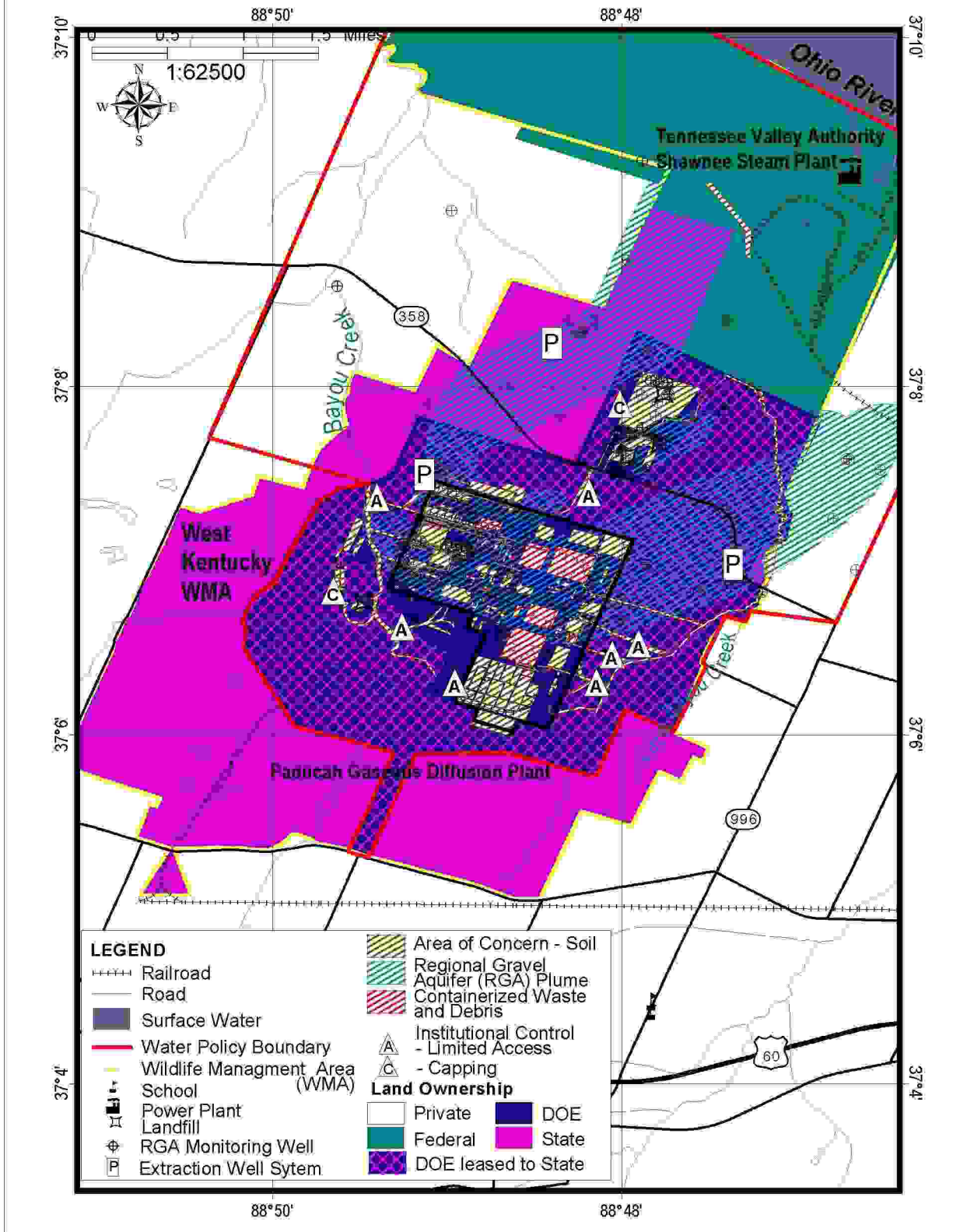
### **3.4.2.RBES**

By the end of the period considered, demographics are not expected to change markedly in areas near PGDP. As discussed in Chap. 2, the population size and the rate at which the population increases can be expected to become greater as the area around PGDP changes from agricultural use to low-density housing. However, the overall population density can be expected to remain below 500 individuals per square mile (Fig. 3.4b). Additionally, the socioeconomic status can be expected to remain stable as industry is recruited to replace any jobs lost as the PGDP mission changes. Note that there is a chance that the inflation-adjusted median household income could fall if the PGDP mission changes abruptly, because PGDP is a major regional employer that pays relatively high wages.

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003

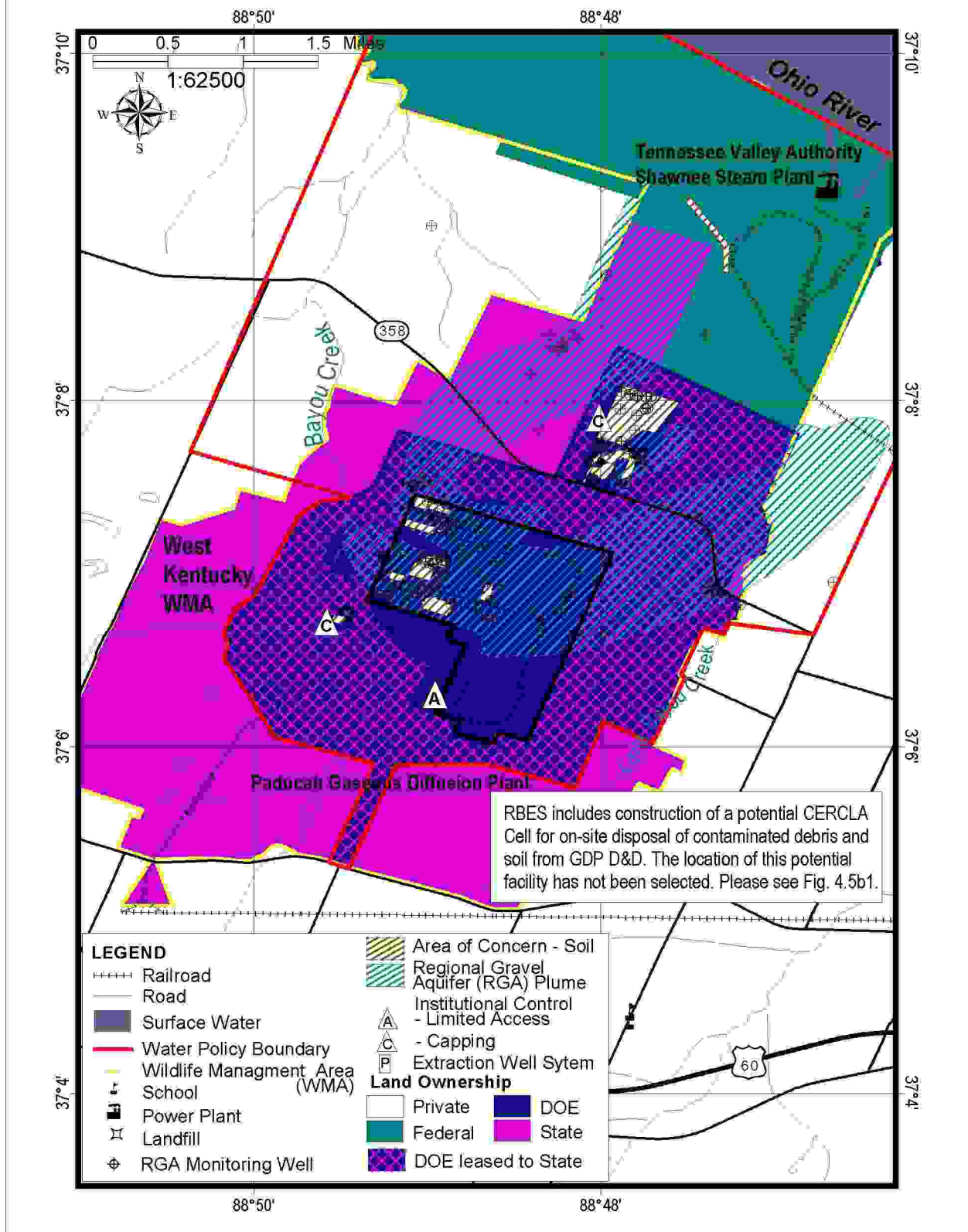


**Fig. 3.1a. Site physical and surface interface – current state.**

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003



**Fig. 3.1b. Site physical and surface interface – RBES.**

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003

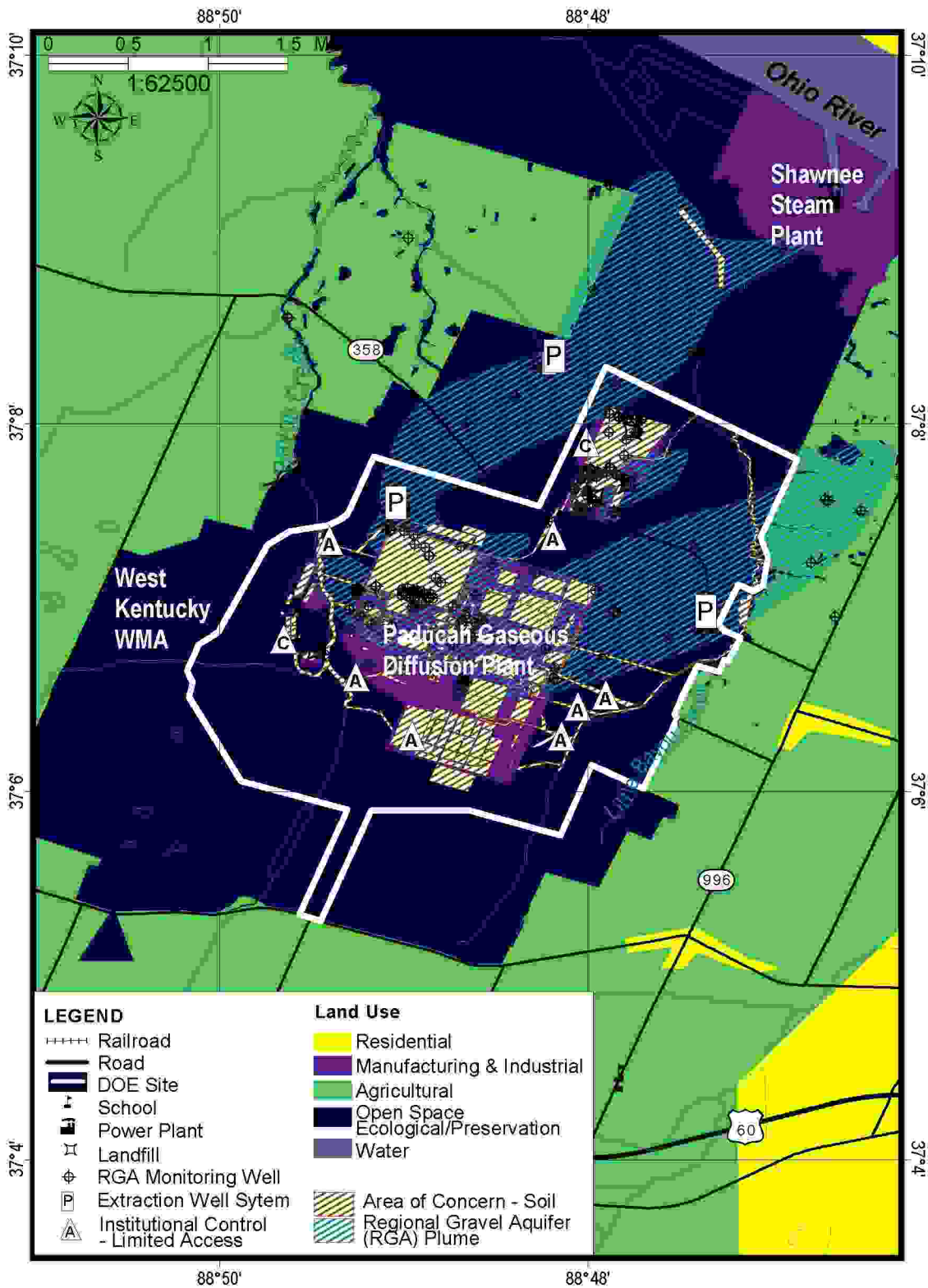


Fig. 3.2a. Site human and ecological land use – current state.

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003

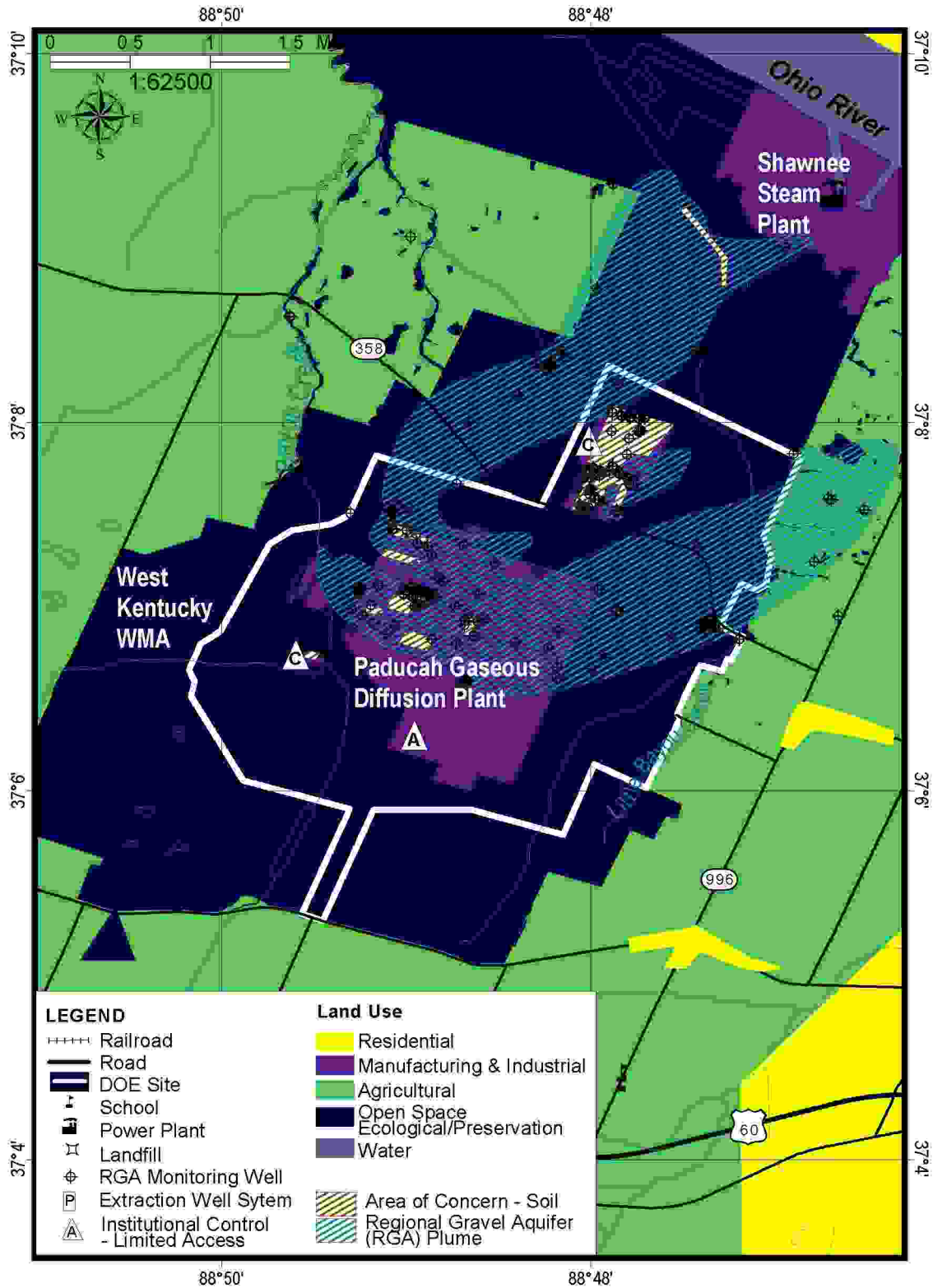
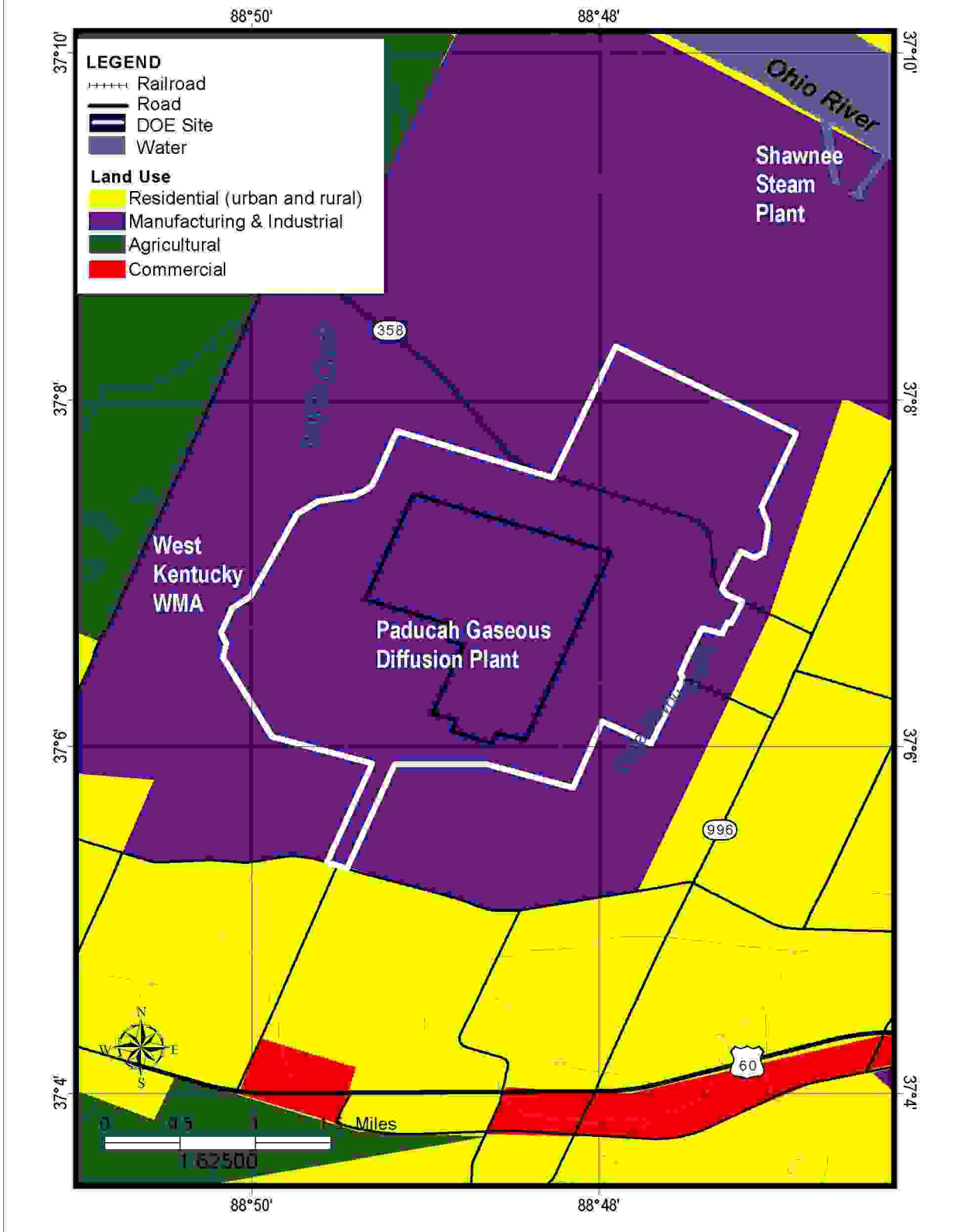


Fig. 3.2b. Site human and ecological land use – RBES.

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003; McCracken Co 2004



**Fig. 3.2b2. Site custom configuration – future zoning.**

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003

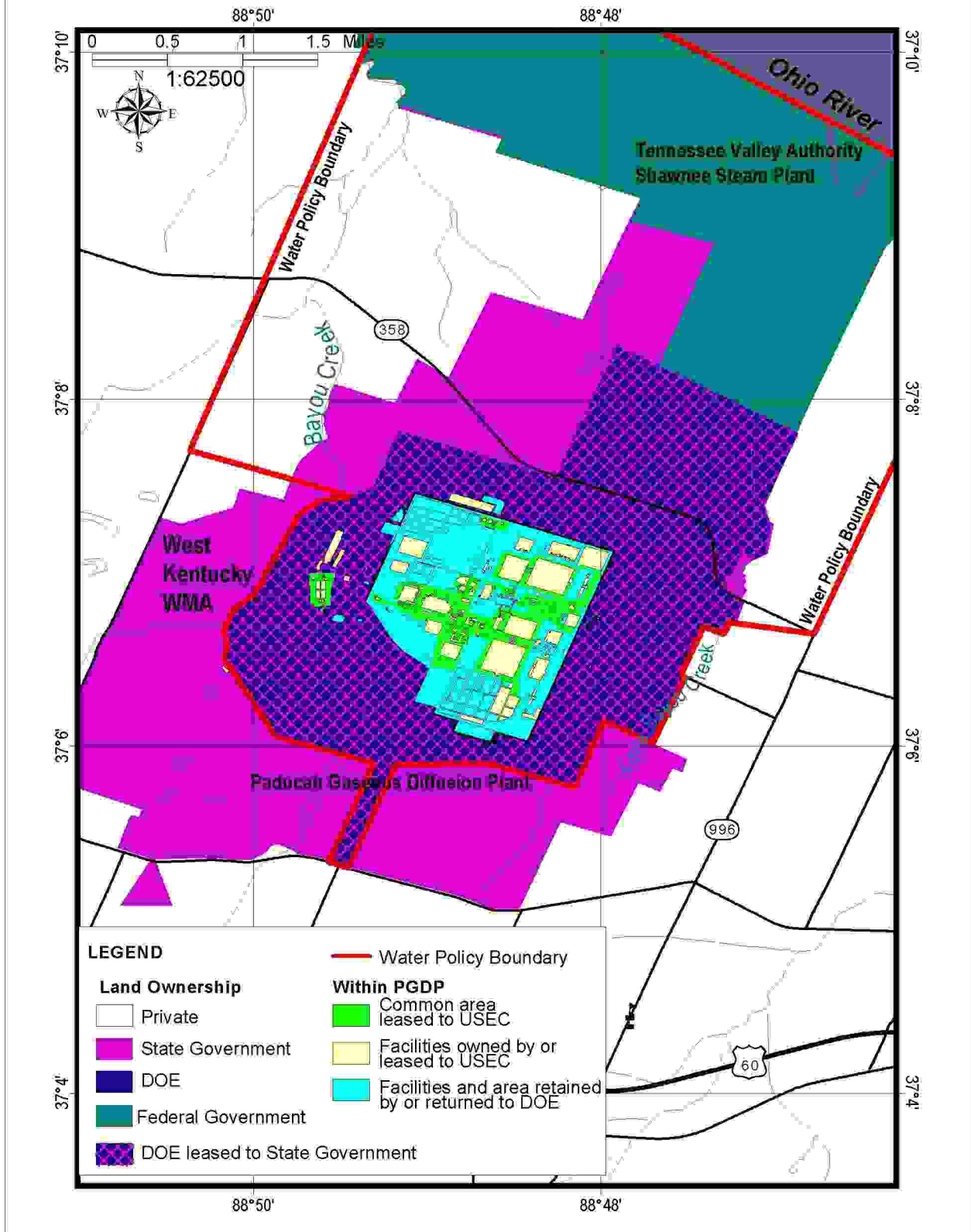


Fig. 3.3a. Site legal ownership – current state.

# Paducah Gaseous Diffusion Plant

Protection: NAD 1983 Lambert Conformal Conic  
 Map Date: 1/27/2004

References: ESRI 2003; Kentucky Geographic Explorer 2003; Illinois DNR 2003; BJC 2003

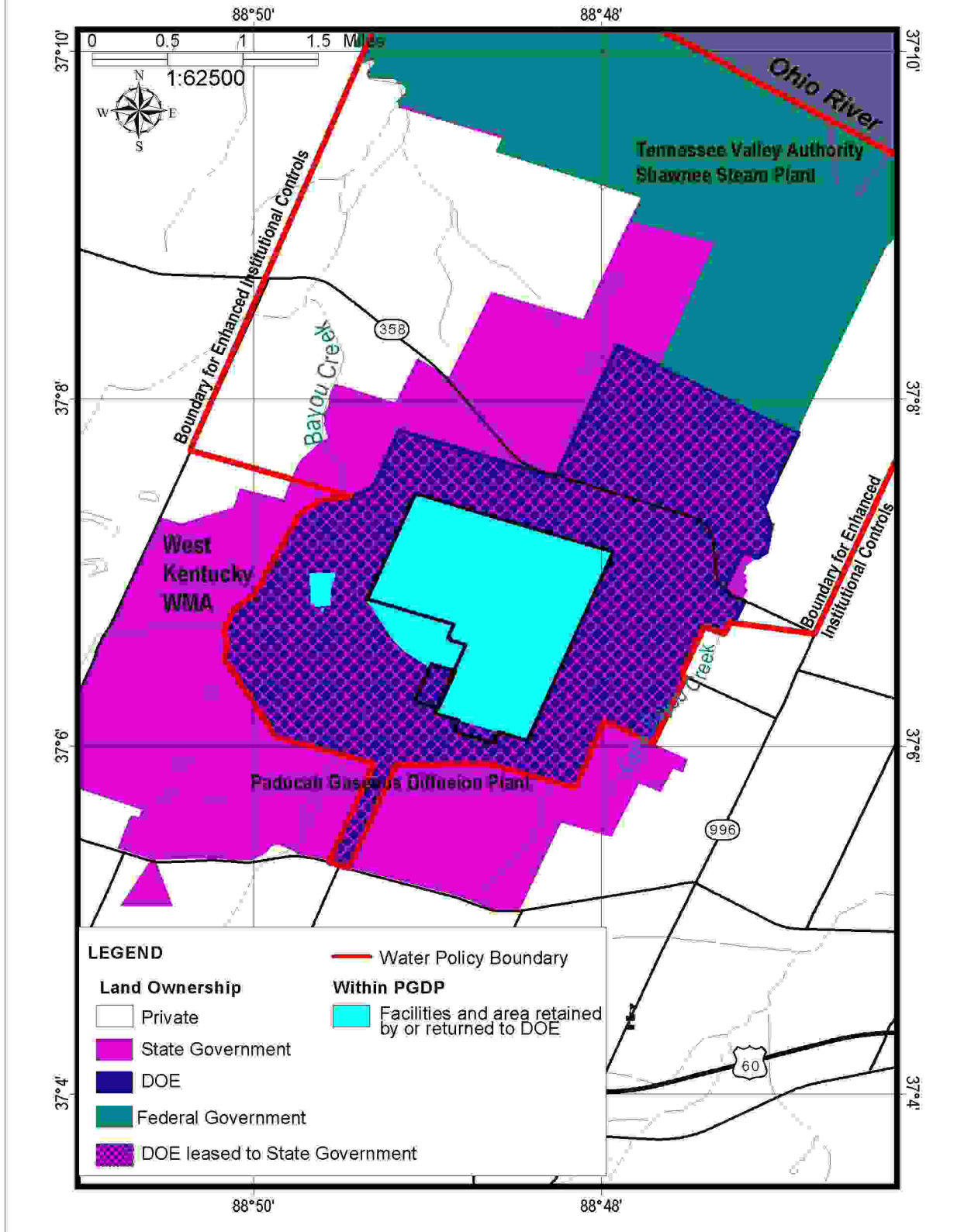


Fig. 3.3b. Site legal ownership – RBES.



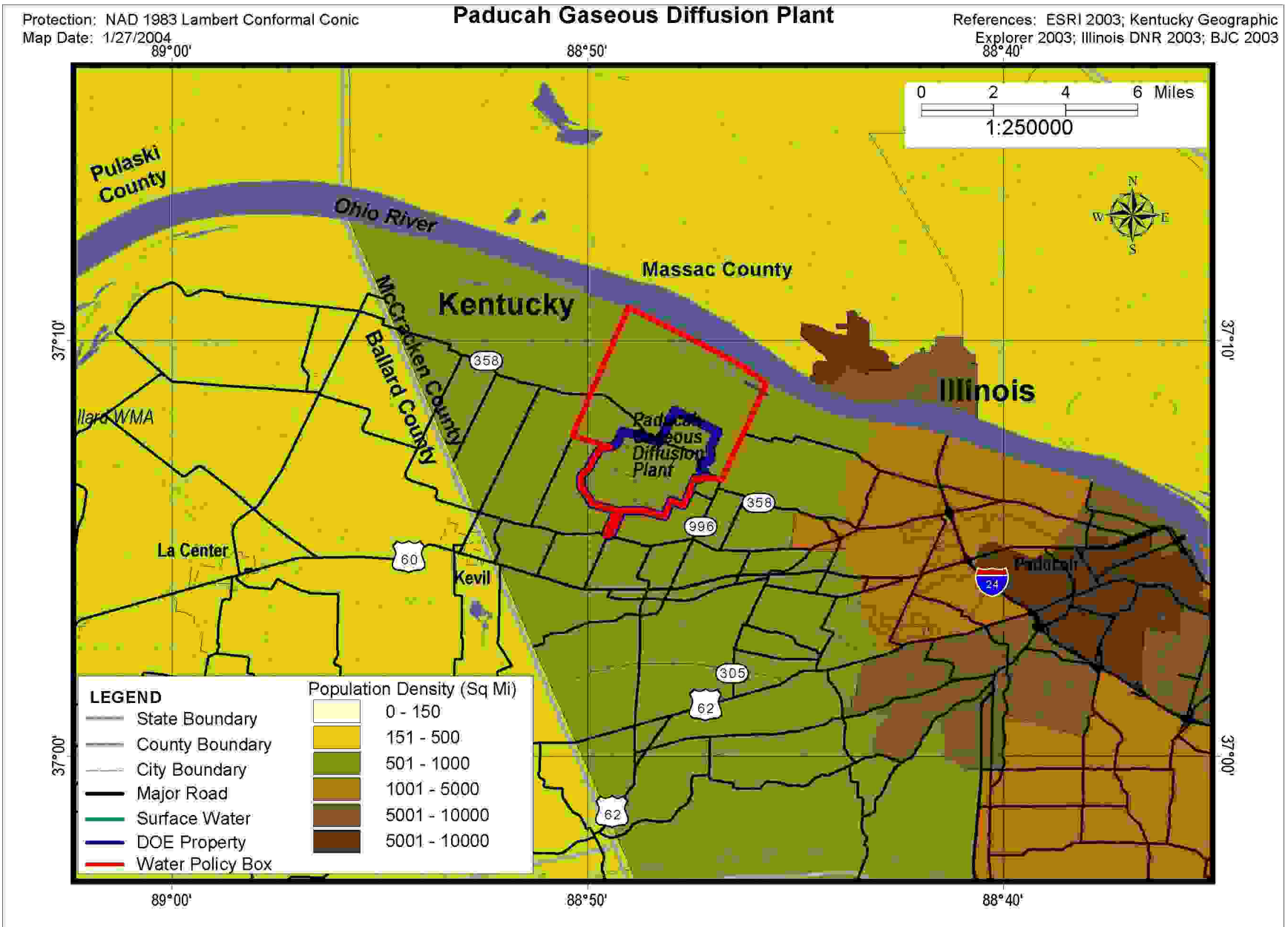


Fig. 3.4a. Site population density – current state.

