

## **Aquatic Ecology**

### **Additional References**

**Requested Aquatic Documents - Provide the following references which are cited in the Environmental Report (ER).**

**ER Chapter 2 (other references are in AQ-3)**

- 4. Article: The Red-Cockaded Woodpecker: Notes on Life History and Management. March 1980. (Hooper, et. al. 1980) Request for Information on Groundwater, July 26, 2006 (Johnson 2006)**
- 7. Calculation Package for Population Density and Environmental Justice, included in ER Section 2.6 Regional Demograph, August 17, 2006 (TtNUS 2006)**

# THE RED-COCKADED WOODPECKER: NOTES ON LIFE HISTORY AND MANAGEMENT

By  
Robert G. Hooper, Andrew F. Robinson, Jr. and Jerome A. Jackson\*

U.S. Department of Agriculture, Forest Service, Southeastern Area, State and Private Forestry, 1720 Peachtree Road, N.W., Atlanta, Ga. 30309

## INTRODUCTION

The red-cockaded woodpecker was once a common bird in the mature pine forests of the Southeast. It lived from east Texas to Florida and north to Missouri, Kentucky and Maryland. Today, its range and population have been reduced through loss of habitat.

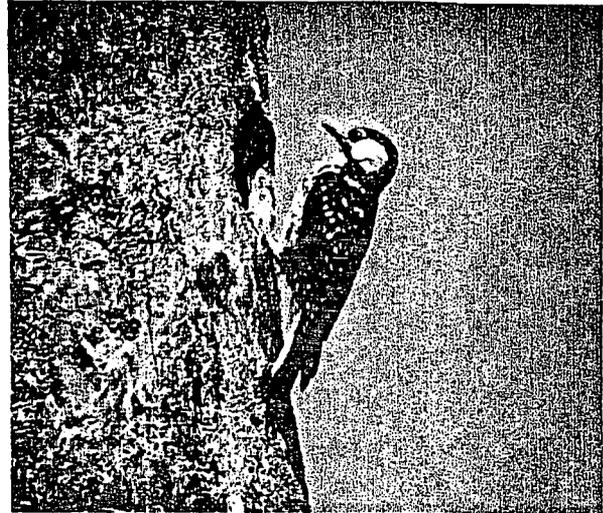
Unlike other woodpeckers, the red-cockaded roosts in cavities in live southern pines. It needs older pine trees for its cavities, and extensive pine and pine-hardwood forests to meet its foraging requirements. Much of the South has been cleared for agriculture or other incompatible uses. Much of the remaining pine forests are not suitable for the red-cockaded. Each year, more areas become unsuitable. Because of the drastic loss and continued decline of habitat, the bird is considered in danger of extinction.

In 1970, the red-cockaded was declared an endangered species. It now has the same protection given the better-known bald eagle and whooping crane. But protection alone is not enough. On Federal and State lands, forestry practices are giving the bird a better chance for survival by creating a favorable habitat. Other landowners can take positive steps to enhance its survival, especially if the red-cockaded already lives on their land. This publication describes the needs of the red-cockaded and outlines steps to aid the bird.

## DESCRIPTION

The red-cockaded is slightly larger than a bluebird, about 7¼ inches (18.3 cm) long (figure 1). The back and top of the head are black. Numerous, small white spots arranged in horizontal rows on the back give a ladder-back appearance. The cheek is white. The chest is dull white with small black spots on the side. Males and females look almost alike, except males have a small red streak above the cheek. The red streak is rarely seen and then only with a powerful binocular in bright sunlight. Juvenile males have a small red patch on the very top of the head until fall.

All other southern woodpeckers of similar size have one or more of the following characteristics: conspicuous red on the head, a prominent white vertical streak on the back, a prominent white patch on the wing, or brown feathers.



## LIFE HISTORY

**Social Organization.** - Among woodpeckers, the red-cockaded has an advanced social system. These birds live in a group called a clan. The clan may have from two to nine birds, but there is never more than one breeding pair. Young birds frequently stay with their parents for several months. The other adults are usually males called helpers. Some clans have no helpers, but others have as many as three. The helpers are typically the sons of the breeding male and can be from 1 to 3 years old. Young birds hatched in the spring disappear from the clan throughout the year, but a male sometimes remains with the clan to become a helper. The helpers assist in incubating eggs, feeding young, making new cavities, and defending the clan's area from other red-cockaded woodpeckers. A breeding male may live for several years. When he dies, one of his helper sons may inherit the status of breeding male.

**The Colony.** - A clan nests and roosts in a group of cavity trees called a colony. The colony may have one or two cavity trees to more than 12, but it is used only by one clan (figure 2). Cavities are made in live pines. Typically, within any colony, some cavities are still under construction (figures 3-5), some are finished and in use (figures 6, 7), and some have been abandoned (figures 9-13). In most colonies, all the cavity trees are within a circle about 1,500 feet (457 m) wide. In some colonies, all the trees are within 300 feet (9 m), but in others they may be ½ mile (.8 km) apart.

\*See page 6

Each clan member tries to have a cavity for roosting. Only one bird roosts in a cavity. Birds without cavities in live trees often roost in scars on pine trees, in crotches between limbs or in cavities in dead trees. Red-cockaded birds with cavities defend them from other red-cockaded birds and other animals. Only the red-cockaded typically makes cavities in live pines, but 11 other birds, 5 mammals, 2 reptiles, and bees are known to use the cavities. Some animals use the cavity after it is no longer suitable for the red-cockaded. But others compete vigorously with the red-cockaded for its cavity. Some of the major competitors are the bluebird, red-bellied woodpecker, red-headed woodpecker, pileated woodpecker, and flying squirrel.

**Nesting Behavior.** - The red-cockaded woodpecker nests between late April and July. Only the breeding male courts and mates with the female. The female usually lays two to four eggs in the breeding male's roost cavity. Clan members take turns incubating the eggs during the day, but the breeding male stays with the eggs at night. The eggs hatch in 10 to 12 days. Nestlings are fed by the breeding pair and helpers. Adults bring food to the nest from up to 700 yards (640 m) away. Young birds leave the nest in about 26 days. Adults continue to feed the young after they leave the nest, but less so as summer progresses.

**Feeding Behavior.** - The clan spends much of its time looking for food as it travels about its territory. Most of the searching is concentrated on the trunks and limbs of live pine trees. There the birds scale the bark and dig into dead limbs for spiders, ants, cockroaches, centipedes, and the eggs and larvae of various insects. Repeated feeding visits are sometimes made to lightning-struck pines that are infested with beetles. The birds also spend time on cypress and hardwoods. Near farmland, they will feed on corn earworms. On occasion, they will eat fruits such as blueberry, sweetbay magnolia, wild cherry, poison ivy, and wax myrtle. They drink water from flooded holes in trees and from the ground.

**The Territory.** - The clan defends year round a territory surrounding the colony. Territories range from less than 100 acres (40.5 ha) to more than 250 acres (101 ha). The total area used by a clan can be as large as 1,000 acres (404.7 ha). A clan tries to keep other red-cockaded woodpeckers out of its territory, but will frequently trespass on its neighbors' territories. Defense can be mild encounters between clans, but at times fighting erupts with two opposing birds grasping each other's beak and falling to the ground.

**Cavity Construction.** - The red-cockaded woodpecker is the only bird that makes nesting and roosting cavities in live southern pines. Most other woodpeckers select dead trees or dead parts of live trees to make their cavities. These other birds

generally make new cavities each year and many do so in less than 2 weeks. The red-cockaded takes months and even years to excavate a cavity. Compared to dead wood, the sapwood and heartwood of the living pine is indeed tough. The abundant resin or pitch flow that occurs once the sapwood is penetrated creates another barrier. Seldom is a cavity completed in 1 year and most take several years of work. Generally, clans have several cavities under construction at the same time with some closer to completion than others. Many cavities that are started are never completed. Once completed, a cavity is used for several years.

The most intensive work on cavities occurs in summer after the young leave the nest. A bird may spend an hour or more excavating. Although work occurs any time during the day, most is in the morning. As fall progresses the birds spend less time working on cavities, and work essentially stops in winter. Spring sees a renewed interest in cavity construction. At this time, some clans show more interest than others and some defer cavity work altogether until the young leave the nest. Most cavities are between 20 and 50 feet (6.1 and 15.2 m) above ground. A few have been found over 60 feet (18 m) and some as low as 4 feet (1.2 m). Generally, the cavity is below any live limbs. It is common to find a tree with several cavities, but the birds may not use all the cavities at a given time.

Before a cavity is completed it is called a start hole (figures 3-5). A start hole progresses from a thumbnail size area where the bark has been removed, to a tunnel 6 inches (15.2 cm) or more into the tree. The tunnel is excavated at an upward slope so the resin or pitch will drain from the hole. The heartwood doesn't have flowing resin. Once the birds have tunneled through the sapwood and into the heartwood a sufficient distance, they excavate downward forming a gourd-shaped chamber about 6 to 10 inches (15.2 to 25.4 cm) deep and 3 to 5 inches (7.6 to 12.7 cm) wide. A bird sometimes roosts in a start hole before the chamber is fully developed.

**Cavity Maintenance.** - Before the cavity is completed, the birds flake away the bark several feet above and below the cavity entrance. The smoother surface possibly makes it harder for snakes to reach the cavity. Scattered about the trunk near the cavity entrance, numerous small holes called resin wells are chipped through the bark (figures 5-8). Resin flow from these holes eventually coats the trunk with pitch. Birds regularly peck at resin wells to stimulate resin flow.

The cavity entrance would grow shut if the birds did not remove the growing tissue from around the hole. In time, the birds expose the sapwood for several inches around the entrance. This exposed area is called the plate (figure 7). Pitch from the plate and resin wells thoroughly coats the trunk. From a distance, the cavity tree looks like a candle

(figure 2). Some observers think these so-called candles help the woodpeckers find their cavities. Others think the conspicuous trees serve as a territorial warning to alien red-cockaded. Another theory is that the resin deters predators - especially rat snakes. In one study, captive snakes actively avoided fresh resin and it appeared to be poisonous to them.

As long as a clan uses a cavity tree, the birds continue to scale the bark, chip the bark at the edge of the resin wells and plate, and enlarge the plate. On trees actively used for roosting and nesting, the pitch is clear and sticky, the freshly chipped bark around the resin wells and plate is reddish and the plate is light-colored. Once the birds stop using the cavity tree, the resin dries to a gray color, the plate becomes dull and weathered, and the bark at the edge of the resin wells and plate appears the same brownish color as the rest of the trunk (figures 9-13).

## HABITAT REQUIREMENTS

**Cavity Tree.** - Red-cockaded woodpecker cavities have been found in longleaf, loblolly, shortleaf, pond, slash, pitch, and Virginia pines. Two cavities have been reported in cypress. Cavities are rarely found in trees as young as 30 to 40 years old and most cavity trees are twice that old. Studies from different parts of the South found the average cavity tree age ranged from 63 to 126 years for longleaf, 70 to 90 years for loblolly, 75 to 149 years for shortleaf, 62 to 130 years for pond and 70 years for slash pine.

The tree must have enough heartwood to contain the roosting chamber. A chamber in sapwood would fill with resin. Heartwood is quite hard, but a high percentage of cavities is found in pines infected with a heart rot fungus called red heart. This fungus weakens the heartwood and makes cavity excavation easier. Some cavity trees apparently do not have red heart, but these trees may have softer than

average heartwood. It is not certain if the red-cockaded needs red heart in order to make a cavity in the average pine.

**Colony Site.** - The colony site is the stand of trees containing and surrounding the cavity trees. A good colony site is a mature, park-like, pine stand with 50 to 80 square feet (4.6 to 7.4 m<sup>2</sup>) of basal area per acre (figure 2). Few or no hardwood trees should be above 15 feet (4.57m) high. When the hardwood mid-story grows to the level of the cavities a high rate of cavity abandonment occurs, leading eventually to loss of the colony. Likewise sapling pines growing near the cavity trees can also cause abandonment. A few widely scattered hardwood trees, and shrubs below 15 feet (4.6 m) do not harm the red-cockaded and are beneficial to other wildlife. However, hardwood understories rapidly grow into hardwood mid-stories unless control measures are taken.

An important function of the colony site is to provide a source of new cavity trees. Cavity trees are generally used for several years, but on the average, from 4 to 9 percent die each year. In addition, other cavities become unusable by the red-cockaded. The colony site should be at least 5 to 10 acres (2 to 4 ha) to ensure cavity trees for the future.

The red-cockaded does not always have the chance to select good colony sites. Some sites that appear normal to the inexperienced eye are actually close to being abandoned. In seeking trees suitable for excavation, the bird often uses relict trees that were left as seed trees, or as culls, or to mark property boundaries. Often, such sites lack a supply of future cavity trees. At other sites, the uncontrolled hardwoods rapidly crowd out the birds.

**Foraging Habitat.** - The best colony site is no good if an adequate foraging habitat is unavailable. Good foraging habitat consists of pine stands with trees 9 inches (22.9 cm) and larger in diameter at breast height (d.b.h.). The red-cockaded also forages in pole stands (4 to 9 inches d.b.h.), but little use is made of sapling stands (less than 4 inches d.b.h.). Clans regularly forage on pines scattered through hardwood stands, but pure hardwood stands are of little value to the woodpecker. The acreage of foraging habitat needed by a clan varies with the quality of the habitat. While 100 acres (40.5 ha) of mature pine is sufficient for some clans, where habitat conditions are not ideal, clans commonly forage over several hundred acres.

Clans sometimes continue to use a colony site when their territory has less than 100 acres (40.5 ha) of suitable foraging area. But, study suggests these clans have considerable difficulty raising young. It is not uncommon to find abandoned colonies surrounded by a lack of adequate foraging habitat. Control of mid-story hardwoods is essential in colony sites, but the red-cockaded commonly forages in pine stands with a well-developed hardwood mid-story.



Active cavity with plate and resin wells.

Nonetheless, the highest populations of the bird are on areas with active, prescribed burning programs for the control of hardwoods in pine stands. Also, territories tend to be smaller in areas with hardwood control.

## MANAGEMENT SUGGESTIONS<sup>1</sup>

**Governing Factors.** - The potential for managing privately-owned forests to provide a favorable habitat for the red-cockaded woodpecker depends on (1) goals of the owner (2) current condition and natural capabilities of the land (3) size of the forest (4) forest conditions on adjacent land (5) occurrence of the red-cockaded on the owner's land and adjacent lands.

Landowners who have a red-cockaded colony can do much to enhance its survival regardless of the size of their property. But, because the birds forage over large areas, forest conditions on adjacent land may ultimately determine the fate of a colony. On larger forests, particularly those 200 acres (80.9 ha) or bigger, the bird can be maintained with greater assurance. Each individual colony is important to the survival of the species, but large ownerships of several hundred or thousand acres have the potential of sustaining significant populations of this endangered species. Land that has little or no pine forests has little potential as a red-cockaded woodpecker habitat. On areas without red-cockaded woodpeckers, but with pine forests, improvement of the habitat may encourage the red-cockaded to move into the area.

**Objectives.** - A successful management plan for the red-cockaded woodpecker must do five things: (1) retain existing cavity trees (2) provide trees for new cavities (3) provide adequate foraging habitat (4) control hardwoods in the colony site (5) provide future colony sites.

**Colony Site.** - Defer harvesting of existing colony sites. If the colony is in a larger stand that will be harvested, designate an uncut 200-foot (61 m) buffer zone around each cavity tree. Leaving only the cavity trees is not adequate, as the buffer is needed to provide replacement cavity trees. Do not isolate colony sites from foraging stands of pole size and larger pines. The colony site should be surrounded by or directly adjacent to foraging stands.

Control of hardwoods in the colony site is vital. Do not allow hardwoods to exceed 15 feet (4.6 m) or so in height, especially within 50 feet (15.2 m) of cavity trees. In colony sites lacking past hardwood control, it may be necessary to remove hardwoods by cutting. Prescribe burning, when properly applied, is an effective means of controlling small hardwoods. When using fire, rake around the base of the cavity trees to remove litter and resin, otherwise the tree may catch fire and destroy the cavity.

Thin stands containing colony sites back to 50 to 80 square feet (4.6 to 7.4 m<sup>2</sup>) of basal area per acre. Leave the older trees for future cavity trees. Unless a safety hazard, do not remove dead or abandoned cavity trees as other animals may use them instead of the good cavity trees.

In colony sites infested with southern pine beetles, the infested trees, except cavity trees, may be cut and removed, burned or sprayed with an approved pesticide. Do not use pesticides (such as organophosphates) toxic to vertebrates.

**Foraging Areas.** - Manage the available acreage as a foraging habitat. Favor pine stands on suitable sites. Plant pines at a 10x10 foot or 12x12 foot (3x3 m or 3.7x3.7 m) spacing to aid rapid stand development. Birds continue to use seed tree areas for foraging until seed tree removal. Regeneration areas of 10 to 30 acres (4 to 12 ha) have less impact on the bird than larger ones. Avoid isolating colony sites from foraging areas when regenerating stands. Thinning of sapling and pole stands improves diameter growth and opens up stands to a condition more suitable to the woodpecker. Control hardwoods by prescribed burning.

**Rotation Age.** - In general, the longer the rotation age, the greater the opportunity the red-cockaded has to maintain existing colonies and to create new ones. The minimum rotation age necessary to provide an adequate number of cavity trees to sustain a viable population of Red-cockaded is not known. As a safe minimum, the National Recovery Team recommends 100-year rotations for longleaf and 80-year rotations for other pines. Some opportunity for cavity replacement is provided by shorter rotations of 80 years for longleaf and 70 years for other pines, but it is not certain if these rotations can supply an adequate number of cavity trees. When it is not feasible to have long rotations over the entire ownership, leaving small, scattered stands of older pines will benefit the bird.

## THE AUTHORS

**Robert G. Hooper** is a wildlife biologist, Southeastern Forest Experiment Station, USDA Forest Service, 2730 Savannah Highway, Charleston, S.C. 29704. **Andrew F. Robinson, Jr.**, was an endangered species specialist, Southeastern Area, State and Private Forestry, USDA Forest Service, when this report was first published; he is now with the U.S. Fish and Wildlife Service, 75 Spring St., Atlanta, Ga. 30303. **Jerome A. Jackson** is professor of biological sciences, Mississippi State University, Mississippi State, Miss. 39762.

<sup>1</sup>The suggestions are based upon those recommended by the National Recovery Team for the Red-cockaded Wood-

### SELECTED READING

Carter, J. H.  
1974. Habitat utilization and population status of the red-cockaded woodpecker in south-central North Carolina. M.S. Thesis. N.C. State Univ. 31 p.

Jackson J. A.  
1977. Determination of the status of red-cockaded woodpecker colonies. *J. Wildl. Manage.* 41:448-452.

Jackson, J. A.  
1977. Red-cockaded woodpeckers and pine red heart disease. *Auk* 94:160-163.

Jackson, J. A.  
1978. An analysis of the distribution and population status of the red-cockaded woodpecker. *In Proceedings of the rare and endangered wildlife symposium.* Tech. Bull. no. WL 4. p. 101-111. Ga. Dep. Nat. Resources, Game and Fish Div., Atlanta, Ga.

Jackson, J. A., M. R. Lennartz and R. G. Hooper.  
1979. Tree age and cavity initiation by red-cockaded woodpeckers. *J. For.* 77:102-103.

Jones, H. K. and F. T. Ott.  
1973. Some characteristics of red-cockaded woodpecker cavity trees in Georgia. *Oriole* 38:33-39.

Lay, D. W. and D. N. Russell.  
1970. Notes on the red-cockaded woodpecker in Texas. *Auk* 87:781-786.

Lennartz, M. R. and R. F. Harlow.  
1979. The role of parent and helper red-cockaded woodpeckers at the nest. *Wilson bull.* 91(2):331-335.

Ligon, J. D.  
1970. Behavior and breeding biology of the red-cockaded woodpecker. *Auk* 87:255-278.

Nesbitt, S. A., D. T. Gilbert and D. B. Barbour.  
1978. Red-cockaded woodpecker fall movements in a Florida flatwoods community. *Auk* 95:145-151.

Nicholson, C. P.  
1977. The red-cockaded woodpecker in Tennessee. *Migrant* 48:54-62.

Skorupa, J. P. and R. W. McFarlane.  
1976. Seasonal variation in foraging territory of red-cockaded woodpeckers. *Wilson Bull.* 88:662-665.

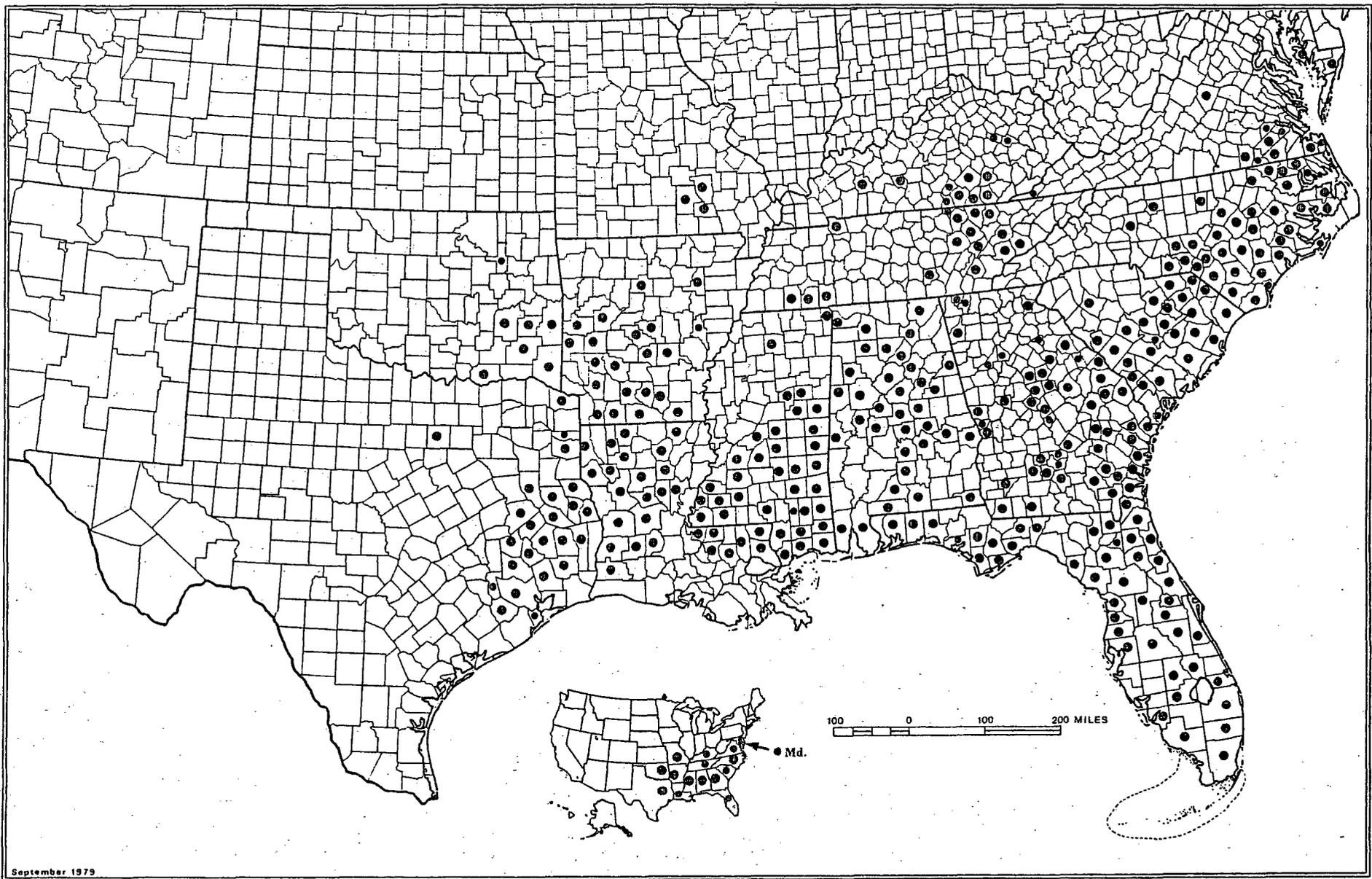
Steirly, C. C.  
1957. Nesting ecology of the red-cockaded woodpecker in Virginia. *Atlantic Naturalist* 12:280-292.

Thompson, R. L. (Ed.)  
1971. The ecology and management of the red-cockaded woodpecker. U.S. Dep. Interior, Bureau of Sport Fisheries and Wildlife, and Tall Timbers Research Station. 188 p.

Wood, A. D.  
1977. Status, habitat, home range, and notes on the behavior of the red-cockaded woodpecker in Oklahoma. M.S. Thesis. Oklahoma State Univ. 60 p.

---

*Historical distribution of red-cockaded woodpecker, by county and state.*



September 1979

Date: July 26, 2006

To: Jan S. Kozyra  
Licensing Lead  
License Renewal Section  
Robinson Nuclear Plant

From: Ron Johnson  
Sr. Environmental Specialist  
Crystal River Fossil Plant

Re: Request for Information on groundwater from Gary Gunter, TETRA TECH NUS, Inc.; for Crystal River Unit Re-Licensing Effort

Below are a list of questions provide by Mr. Gunter in an email dated June 21, 2006 along with responses. In some cases additional information is attached as a separate document. Since this was a combined effort of several people, the source person for the information is also shown.

**1. Where does the Crystal River Plant get its water for process and domestic (potable) use?**

Source: Ron Johnson

The Crystal River Energy Complex (CREC) maintains 7 active production ground water wells located linearly away from the complex toward the East. The nearest well is approximately 3 miles to the East while the farthest well is approximately 4 miles to the East. The eastern most four (4) wells supply water to the North coal fired units (Units 4 and 5). The western most three (3) wells supply water to the South coal fired plants (Units 1 and 2) as well as to the nuclear plant (Unit 3).

Well water is treated by cold lime softener, sand filter, and chlorination technology to produce potable water. There are two water treatment plants (north and south) both with Public Water System ID numbers. Each water system is considered a Non-Transient Non-community water system by the Florida Department of Environmental Protection.

A large portion of the potable water is further treated by de-mineralization for use in the boilers and steam generators.

The north and south plant water systems are interconnected and have the ability to interchange both potable water and de-mineralized water, but not well water.

The facility does not maintain a separate, non-potable, "service water" system. All

well water is initially treated to potable standards.

In addition to the 4 active wells for the North plant, there are 3 additional, inactive wells further to the East.. These wells are completed to the surface, but are not currently equipped with pumps, motors, power, or well house. These wells, plus some additional wells are anticipated to become operational to support the pollution control projects for the fossil plants in the next few years.

- 2. How much water do they use for the various operations? This data can be in virtually any form (weekly, monthly, or annual) as long as we can manipulate it and present monthly/annual use versus permit limit. Monthly data are preferred, but annual data are acceptable. The NRC likes to see 5 years of data, so as to establish "trends."**

Source: Ron Johnson

The attached spreadsheet contains monthly consumptive water use data for the two separate water systems and for the Energy Complex in total, for the years 2001 through June 2006. See Excel spreadsheet "CREC Consumptive Use.XLS", under the "Totals" tab.

Background: Consumptive use of groundwater is regulated by the Southwest Florida Water Management District through the issuance of Water Use Permits. The CREC has been issued two separate water use permits. Each permit currently has a daily limit of 1 MGD averaged over the calendar year. This average amount may be exceeded periodically; however, any month cannot exceed a daily average of 1.5 MGD for the south system; while any day cannot exceed 3 MGD for the north system. In addition each production well has associated average limits and peak monthly limits which are tracked in the management of consumptive use at the facility.

The amount of water provided to CR Unit 3 is measured by flow meter. This information is also provided in the Excel spreadsheet (Well Detail Tab).

- 3. If their process/potable water is from another of Progress Energy's facilities located nearby (coal-fired plants) and this facility uses groundwater wells as a source, we still need to obtain the data and evaluate it just as though the wells were part of Crystal River 3. NRC will almost certainly contend that because all of these units are owned by the same company and are in close proximity to one another, an evaluation is required. Let's be on the safe side and get it!**

Source: Ron Johnson

This is definitely the case, and hopefully the information provided above will be sufficient to complete the evaluation.

4. **Are there any dewatering wells associated with the Crystal River 3 plant itself? If so how much do they pump from below-grade sumps/structures? If there are dewatering operations, where is the water pumped?**

Source: Mike Shrader/Ron Johnson

No.

5. **If groundwater wells are used onsite or if well water from the coal-fired area is used at CR3 we need a scaled site map showing location of wells and the site's property boundary (include nuclear facility property and site where wells located. Also will need the closest off-site well location (marked on scaled map that shows well locations). We will also need basic well data (year installed, depth, aquifer, designed pumping rate, pump test data, etc.). [Mike] We would also need well production data for each pumping well for at least the past 5 years along with any permits they have regarding these wells.[Ron]**

Scaled Site Map: To be provided by Mike Shrader.

Source: Ron Johnson

Production well data is contained in the attached spreadsheet "CREC Consumptive Use.XLS" under the "Well Detail" tab.

Consumptive water use for the south plant is governed by a SWFWMD permit, while north plant usage is governed by a "Conditions of Certification" document issued pursuant to the Florida Site Certification regulations. A copy of Water Use Permit No. 204695 is attached as a "pdf" file named "South Water Use Permit.pdf". A copy of the most recent order modifying conditions of certification, relative to consumptive use conditions, is attached as a "pdf" file named "North Water Use Permit.pdf".

6. **Progress Energy has already provided 5 years of groundwater quality data for CR. We need to get 5 years of Rad Environmental Monitoring Reports as well so we can include data on radionuclides (tritium etc.) in groundwater. NRC is beginning to consider these in their evaluation for local impacts.[Carolyn, Rudy]**

Source: Rudy Pinner

Copies of the annual radiation reports for 2000 through 2005 are attached as pdf format files.

See "CR3 Rad Report 200X.pdf"

**Calculation Package  
for Population Density and Environmental Justice**

**included in**

**ER Section 2.6 Regional Demography**

**August 17, 2006**

**Prepared for:  
Progress Energy**

**Prepared by:  
Emily H. McRee  
Tetra Tech NUS  
Aiken, South Carolina**

**Author:**

\_\_\_\_\_

**Reviewed By:**

\_\_\_\_\_

**Project Manager:**

\_\_\_\_\_

**Date:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Supporting Information for Section 2.6 Regional Demography

This discussion supports the determination of population density within 20 and 50 miles of Crystal River Unit 3 (CR3) and the identification of minority and low income populations within 50 miles of the plant.

#### Population Density

Total populations and densities were calculated for areas within 20 and 50 miles of CR 3 for Section 2.6 of the License Renewal Environmental Report. Population data for Florida was obtained from USCB Summary File 1 (USCB 2000a). Two factors, "sparseness" and "proximity", were used to characterize population in the vicinity of the CR 3. "Sparseness" measures population density and city size within 20 miles of a site and categorizes the demographic information based on these numbers. "Proximity" measures population density and city size within 50 miles of a site and categorizes the demographic information based on these factors. Therefore, it was necessary to calculate the population densities within 20 and 50 miles of CR 3.

ArcGIS® 9.1 Geographic Information System (GIS) was used to query block groups within 20 and 50 miles of CR 3. The total land area of each block group was then calculated. If a block group was not contained completely within the 20 or 50-mile radius, the block group was then "clipped". New areas were calculated for the "clipped" block groups, and new populations were calculated based on the ratio between the total area of the block group and the "clipped" area. To obtain population densities, the populations for the "clipped" block groups were totaled, and divided by the total area of the "clipped" block groups. Table 1 contains calculations of total area and clipped area for the block groups in the 50-mile radius. Table 2 contains the calculation of population density for the 20-mile radius.

For CR 3, the 50-mile population density was 169.63 (170) persons per square mile and the 20-mile population density was 124.79 (125) persons per square mile. These calculations are shown at the ends of Tables 1 and 2, respectively.

#### Minority and Low-Income Populations (Section 2.5.4, Environmental Justice)

Procedures for the determination of minority and low-income populations found in Section 2.6 of the Environmental Report are discussed in this section. Appendix D of the "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" released by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation, May 24, 2004, is the current regulatory guide for identifying minority and low-income populations for an Environmental Justice review. TtNUS has used this guidance in identifying minority and low-income populations in the License Renewal Environmental Report.

Typically, the potential area impacted by environmental issues is within a 50-mile radius of the site (NRC 2004). TtNUS decided to determine the minority populations and low-income populations for all census block groups within 50 miles of CR 3. Block groups are used because the block group geographic area is small enough so as to not dilute a potential minority or low-income populations within the larger general population (NRC 2004). U.S. Census Bureau Summary File 1 (USCB 2000a) containing race data and Summary File 3 containing low-income household poverty data (USCB 2000b) were obtained for all block groups in Florida. For each minority category (Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Other Race, and Two or More Races), the percentage of the total population was calculated for each block group. The Aggregate category was also analyzed. The Aggregate of the minorities represents the total population of the minority races (Black or African American, American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander, Other Race, and Two or More Races). The Hispanic Ethnicity category is NOT included

in the aggregate of minorities because the U. S Census Bureau treats race and Hispanic origin (ethnicity) as two separate and distinct concepts. People who are Hispanic may be of any race. People in each race group may be either Hispanic or Not Hispanic. Each person has two attributes, their race (or races) and whether or not they are Hispanic. Because each person is counted in a race category and in either the Hispanic or not Hispanic category, including the Hispanic ethnicity in the "aggregate race" category would double count a number of individuals. As such, the race categories and the Hispanic Ethnicity categories are considered separately. The percentage of low-income households was also calculated for each block group.

The minority demographic data and low-income data were then attributed to block group spatial data in ArcGIS® 9.1 to become a shapefile coverage containing demographic and low-income data for every block group. This allowed the demographic and low-income data to be queried spatially and by attribute.

In order to identify whether a minority or low-income population exists, an area larger and that encompasses the entire area of potential impact must be identified for comparative analysis (NRC 2004). This area is called a geographic area. TtNUS defines the geographic area to be the state of Florida.

A minority population is considered to be present if: 1) the minority population in the census block group exceeds 50 percent or 2) the minority population percentage of the block group is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area (NRC 2004). A low-income population is considered to be present if: 1) the low-income population in the census block group exceeds 50 percent or 2) the percentage of households below the poverty level in an environmental impact area is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area (NRC 2004). State percentages for race and low income were obtained from the USCB (USCB 2000c, 2000d). Queries were performed on the block groups within 50 miles of the CR 3. Any block group falling wholly or partially within the 50-mile radius was identified if that block group contained a "minority population".

Table 3 presents minority and low-income data for all block groups within 50 miles of the CR 3 site. For each minority category, Table 3 identifies for each block group, whether the minority or low-income percentage exceeds the state percentage by at least 20%, and/or is greater than 50%. Table 4 presents a summary, by county, of block groups containing significant minority or low-income populations for the "20% greater than the state percentage" and the "greater than 50%" categories. A total of 483 block groups fall within 50 miles of CR 3 (Table 4). Minority populations exist within 50 miles of the CR 3 site for the Black, Other Races, Aggregate of Races, Hispanic Ethnicity, and Low-Income categories. Figures 2.6-1 through 2.6-5 (from Section 2.6 of the Environmental Report) are also included to identify locations of the minority and low-income block groups.

**References:**

**(NRC 2004)** *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues, Rev. 1.* NRR Office Instruction No. LIC-203, May 24.

**(USCB 2000a)** *Summary File 1: Census 2000.* Available at <http://www.census.gov/Press-Release/www/2001/sumfile1.html>. Accessed June 26, 2006.

**(USCB 2000b)** *Summary File 3: Census 2000.* Available at <http://www.census.gov/Press-Release/www/2002/sumfile3.html>. Accessed June 26, 2006.

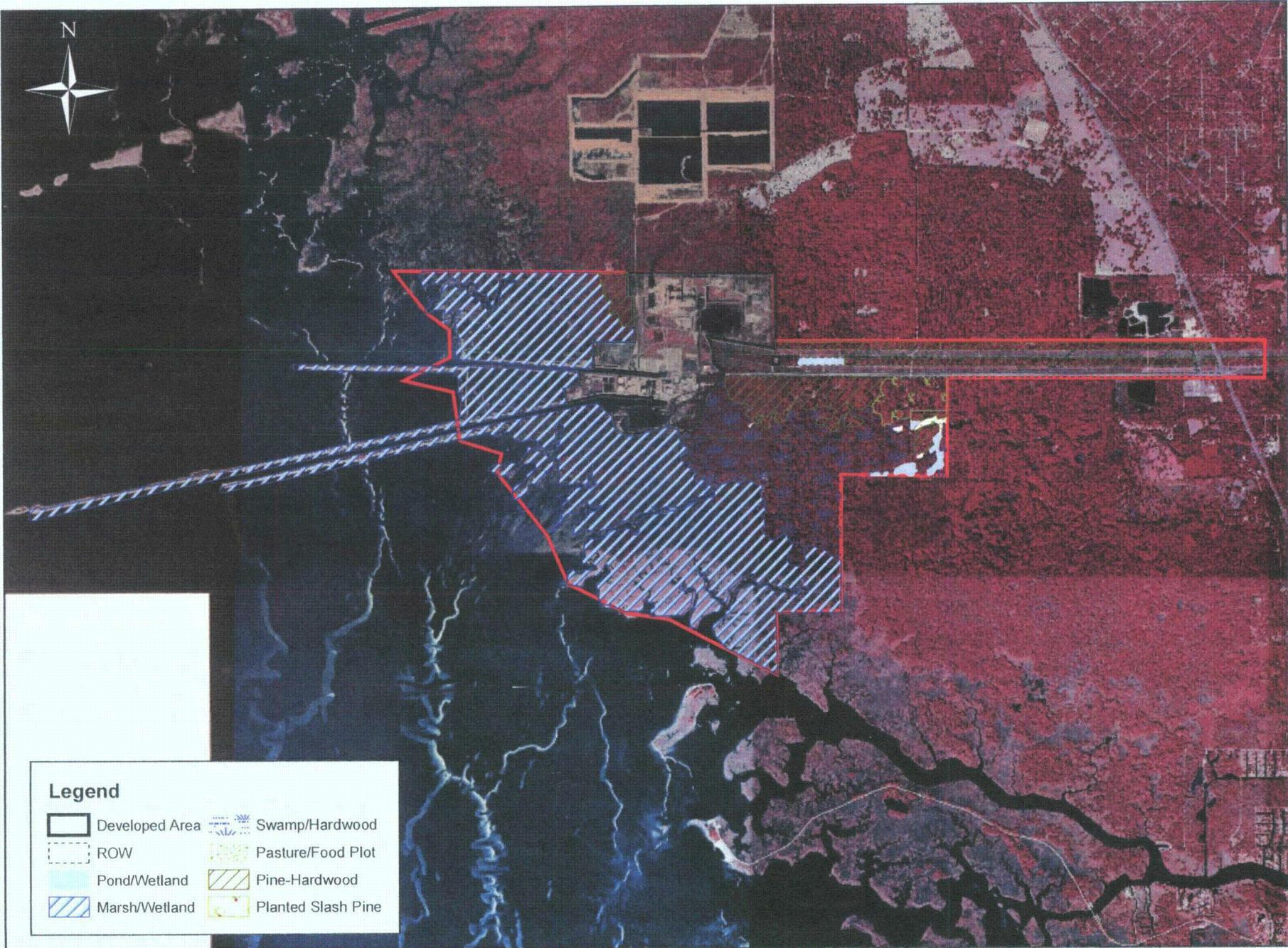
**(USCB 2000c)** *P3: Race [71] – Universe: Total Population. Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data,* Available at <http://factfinder.census.gov>.

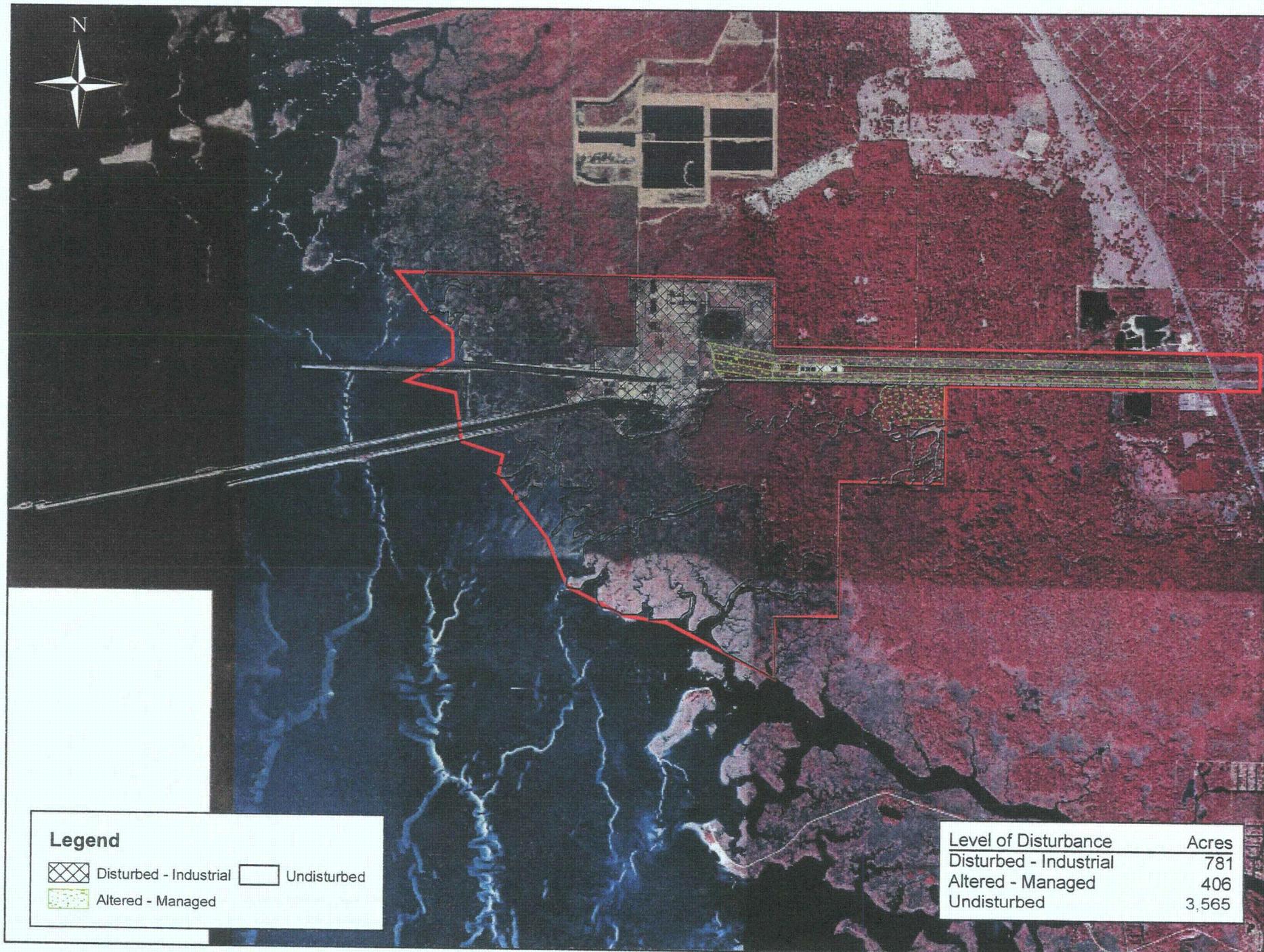
**(USCB 2000d)** *P92: Poverty Status in 1999 of Households by Household Type by Age of Householder [59] – Universe: Households. Data Set: Census 2000 Summary File 3 (SF 3) – Sample Data,* Available at <http://factfinder.census.gov>.

## **Archeology**

### **AR-1**

- 1. CRC Developed Area Map**
- 2. CRC Disturbed Area Map**





**Legend**

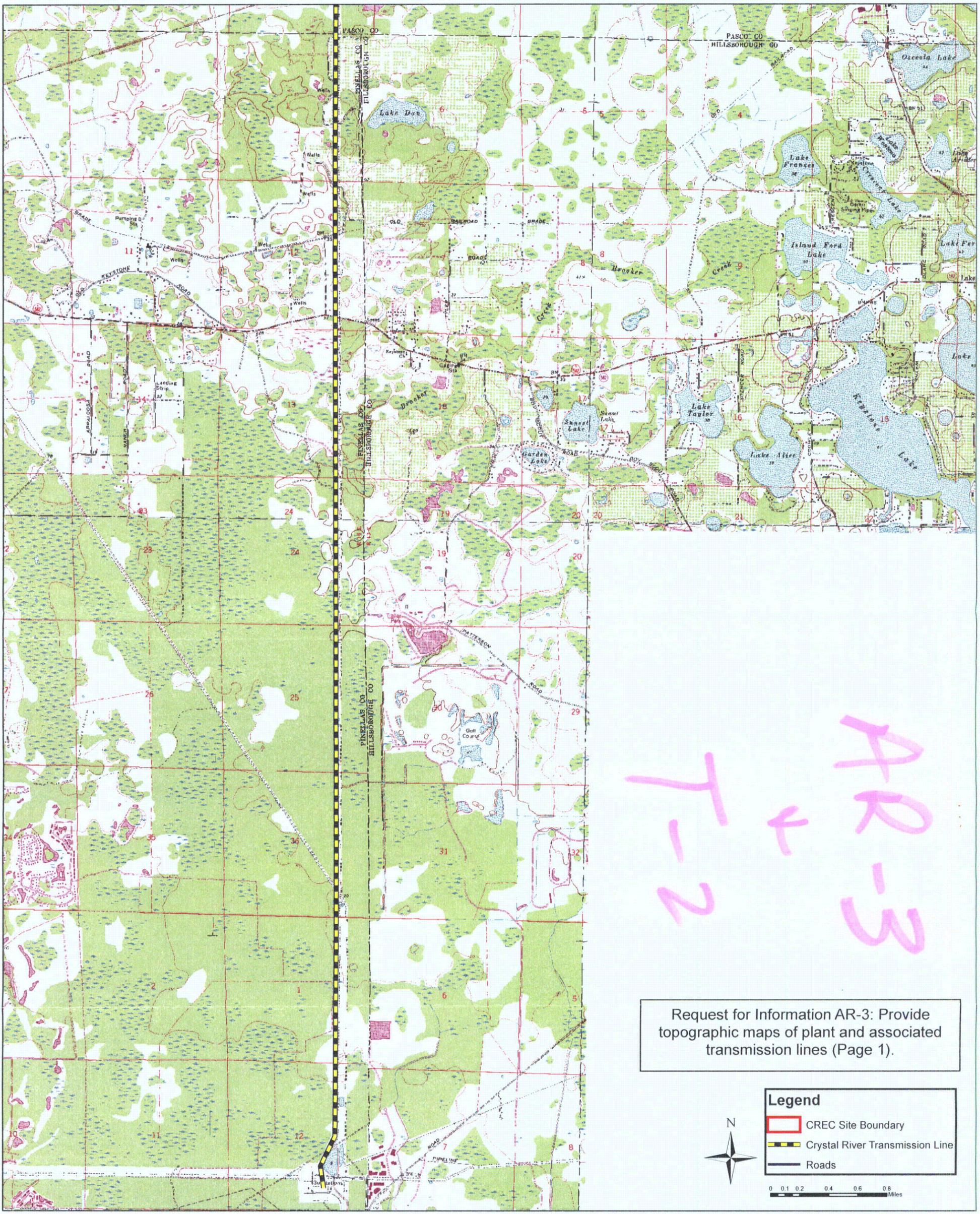
-  Disturbed - Industrial
-  Undisturbed
-  Altered - Managed

Level of Disturbance	Acres
Disturbed - Industrial	781
Altered - Managed	406
Undisturbed	3,565

**Archeology**

**AR-3**

- 1. Topographic Maps of Plant Site and Transmission Lines (15 sheets)**



AR-3

Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 1).

**Legend**

- CREC Site Boundary
- Crystal River Transmission Line
- Roads

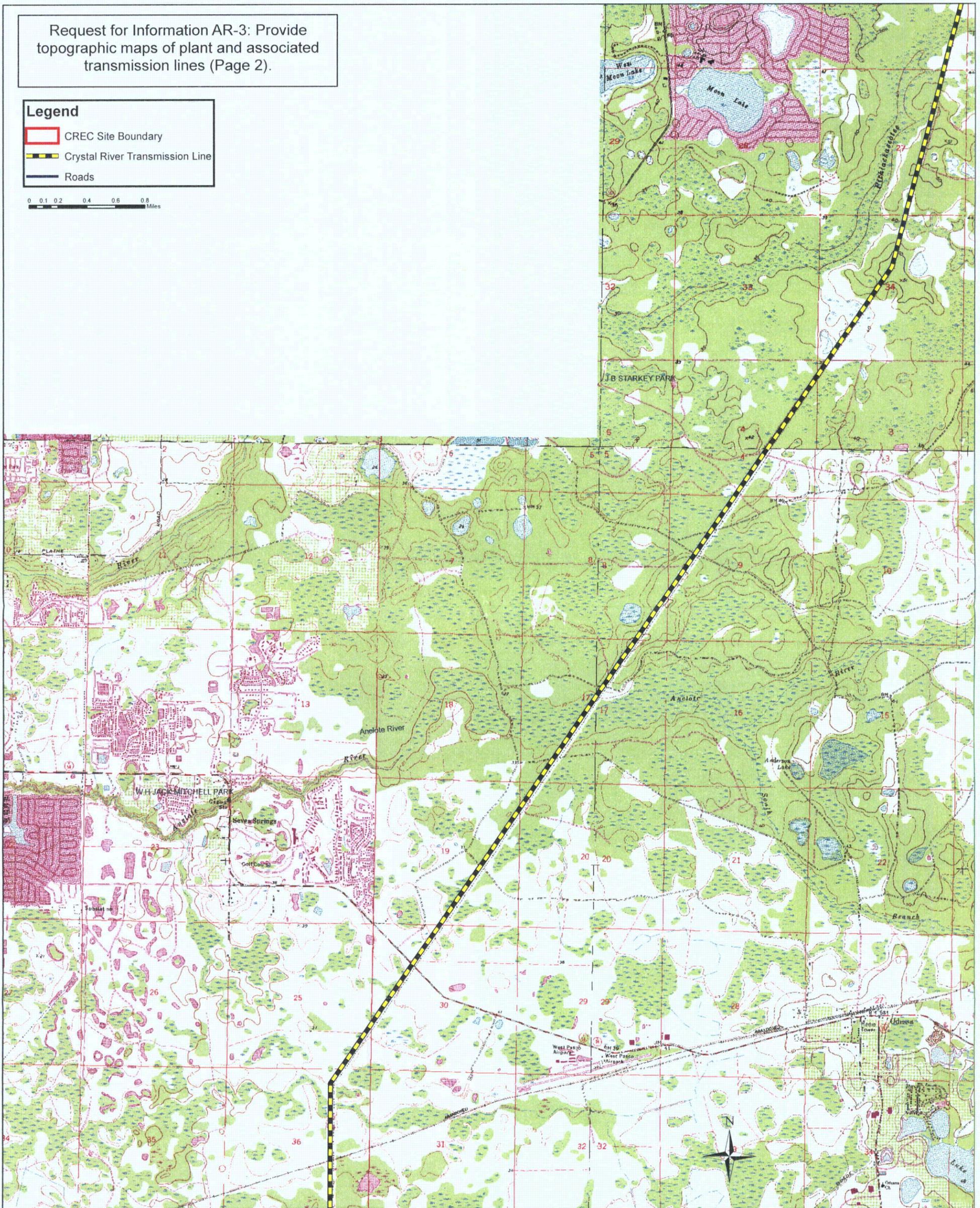
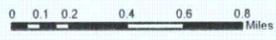


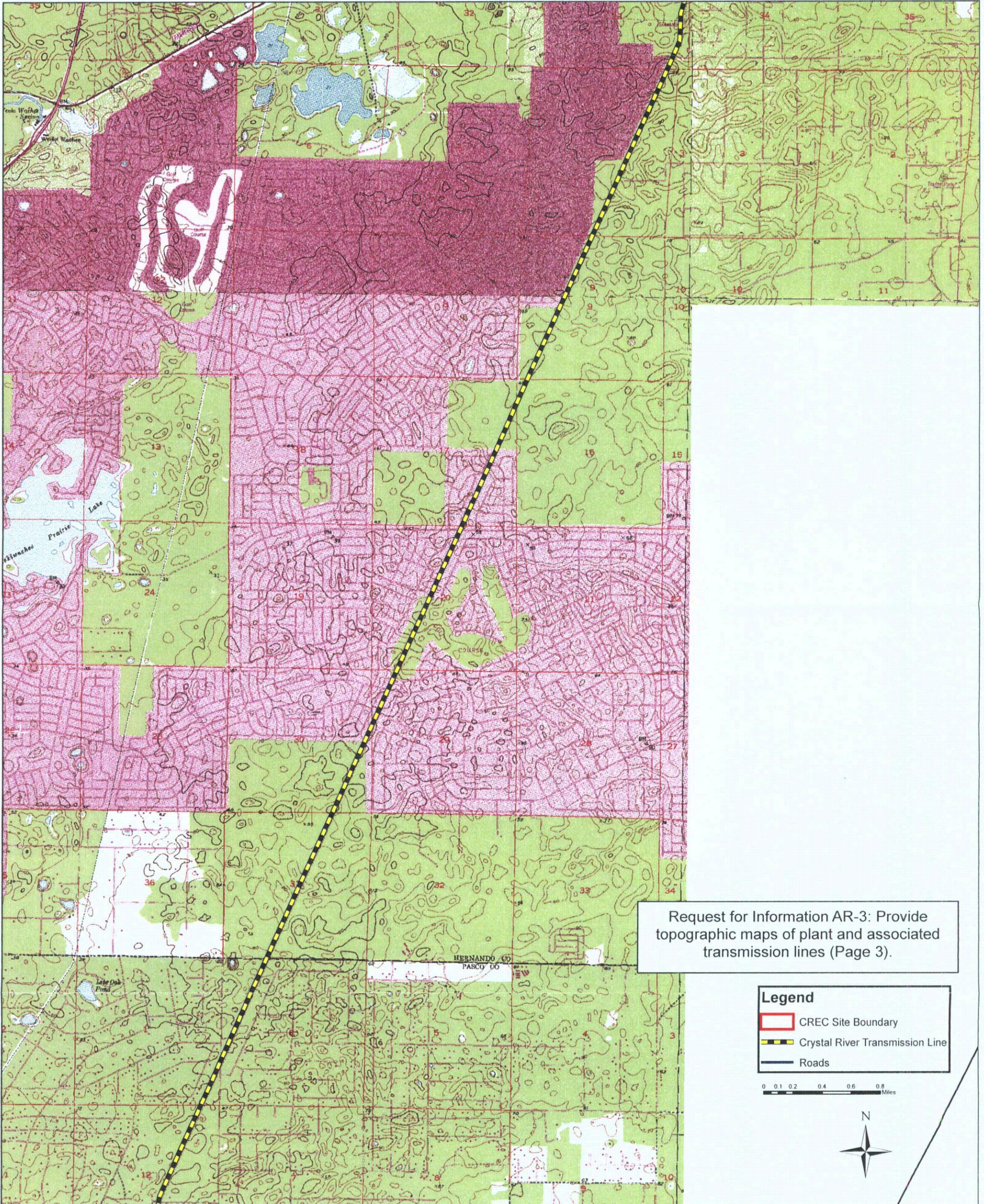
0 0.1 0.2 0.4 0.6 0.8 Miles

Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 2).

**Legend**

-  CREC Site Boundary
-  Crystal River Transmission Line
-  Roads

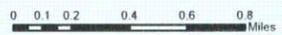


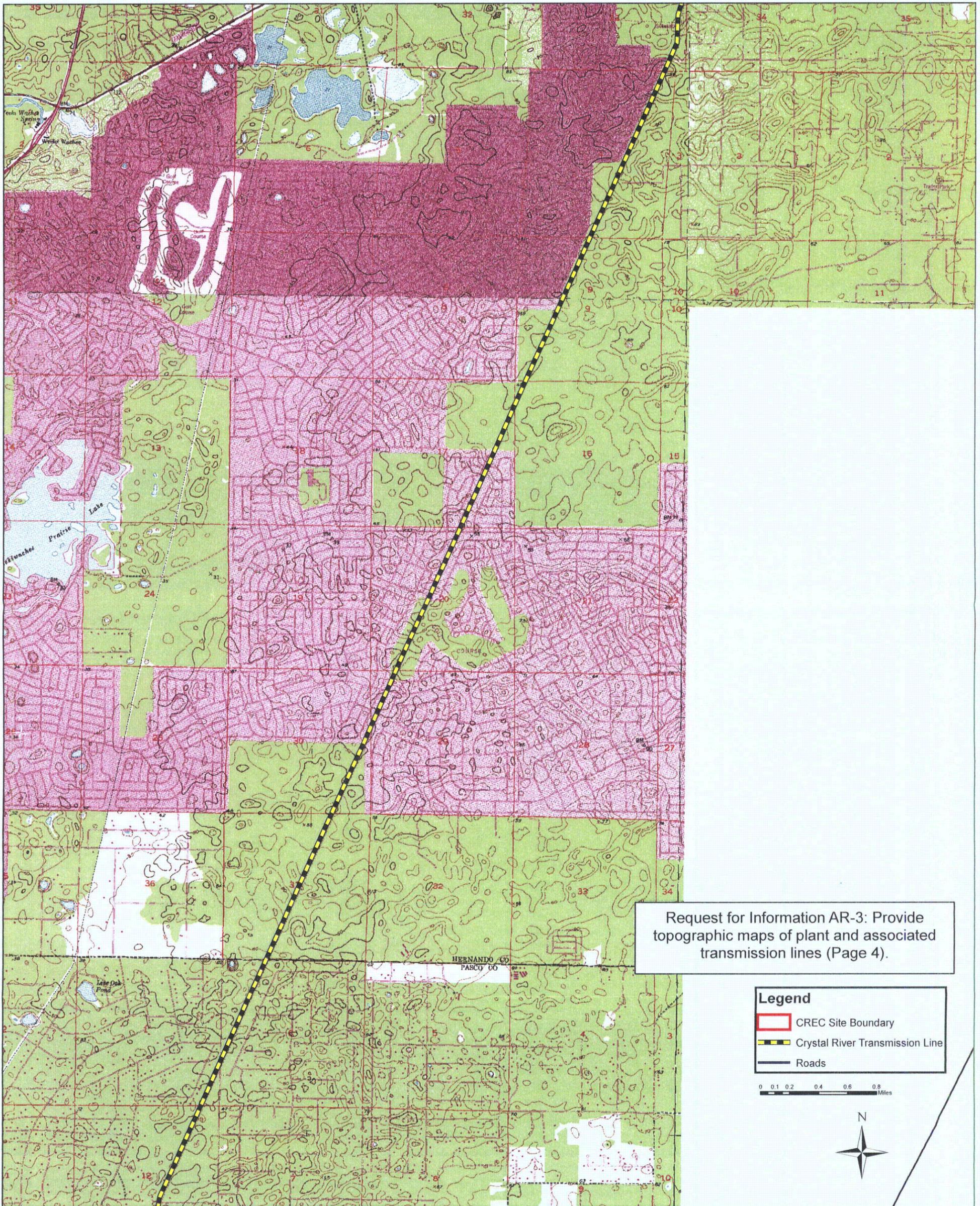


Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 3).

**Legend**

- CREC Site Boundary
- Crystal River Transmission Line
- Roads



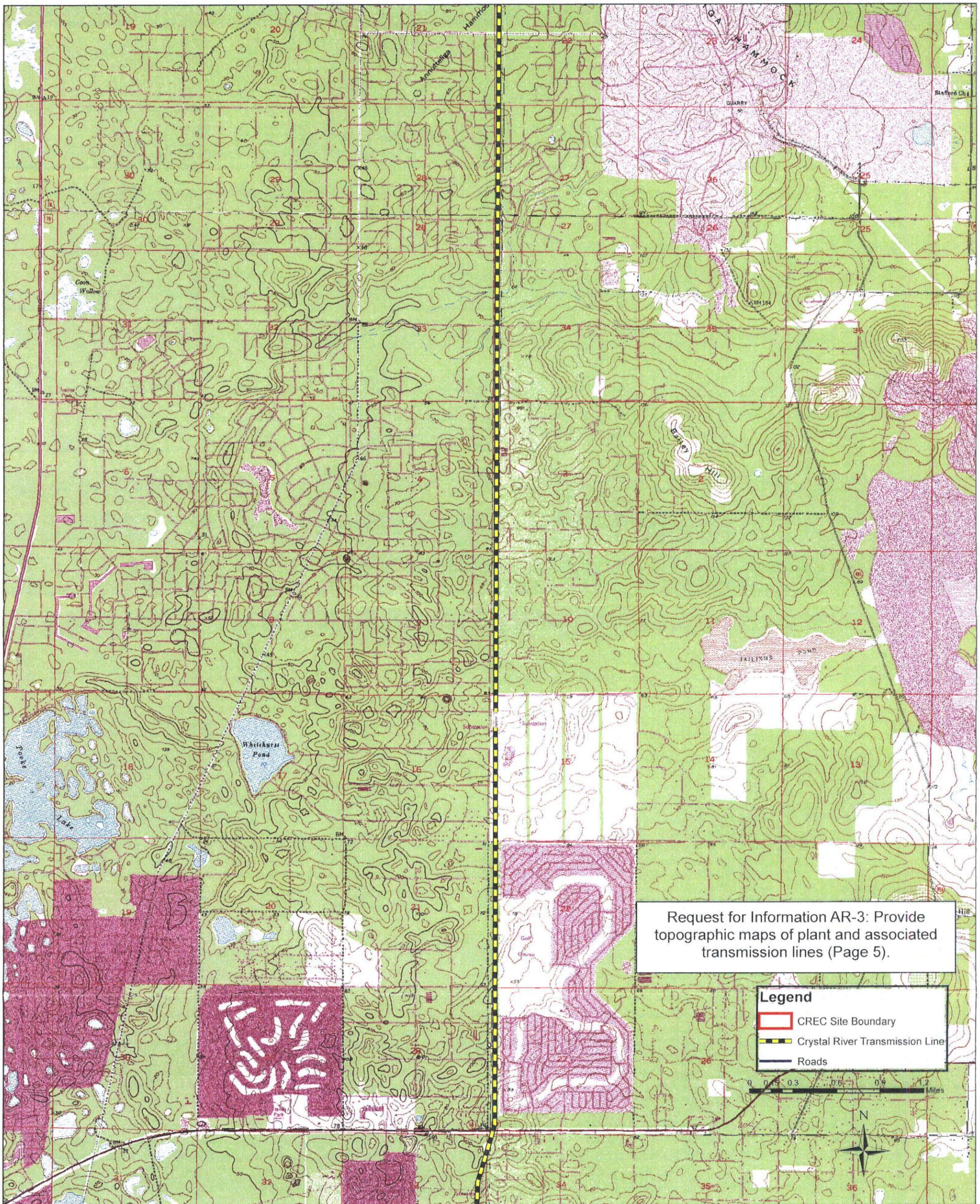


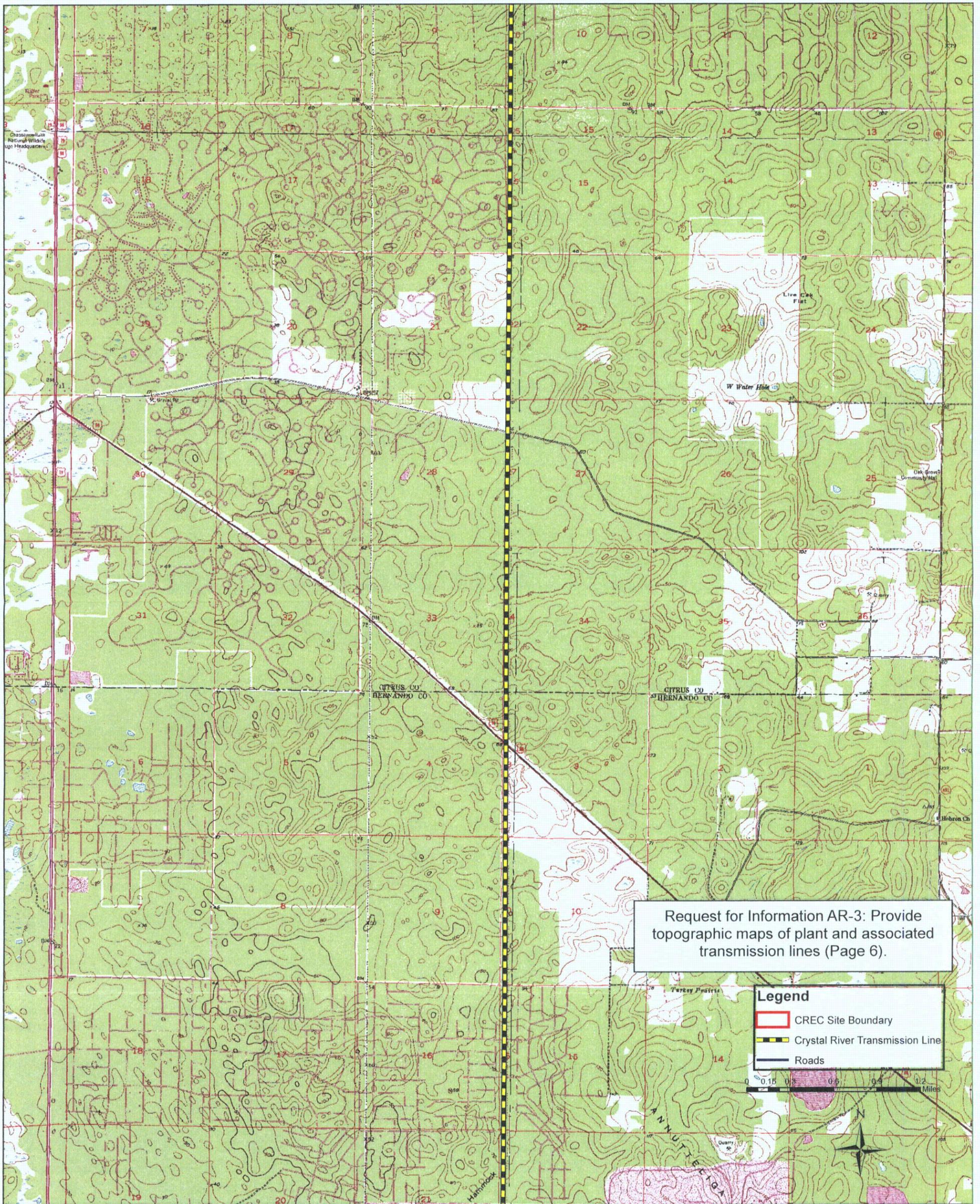
Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 4).

**Legend**

-  CREC Site Boundary
-  Crystal River Transmission Line
-  Roads





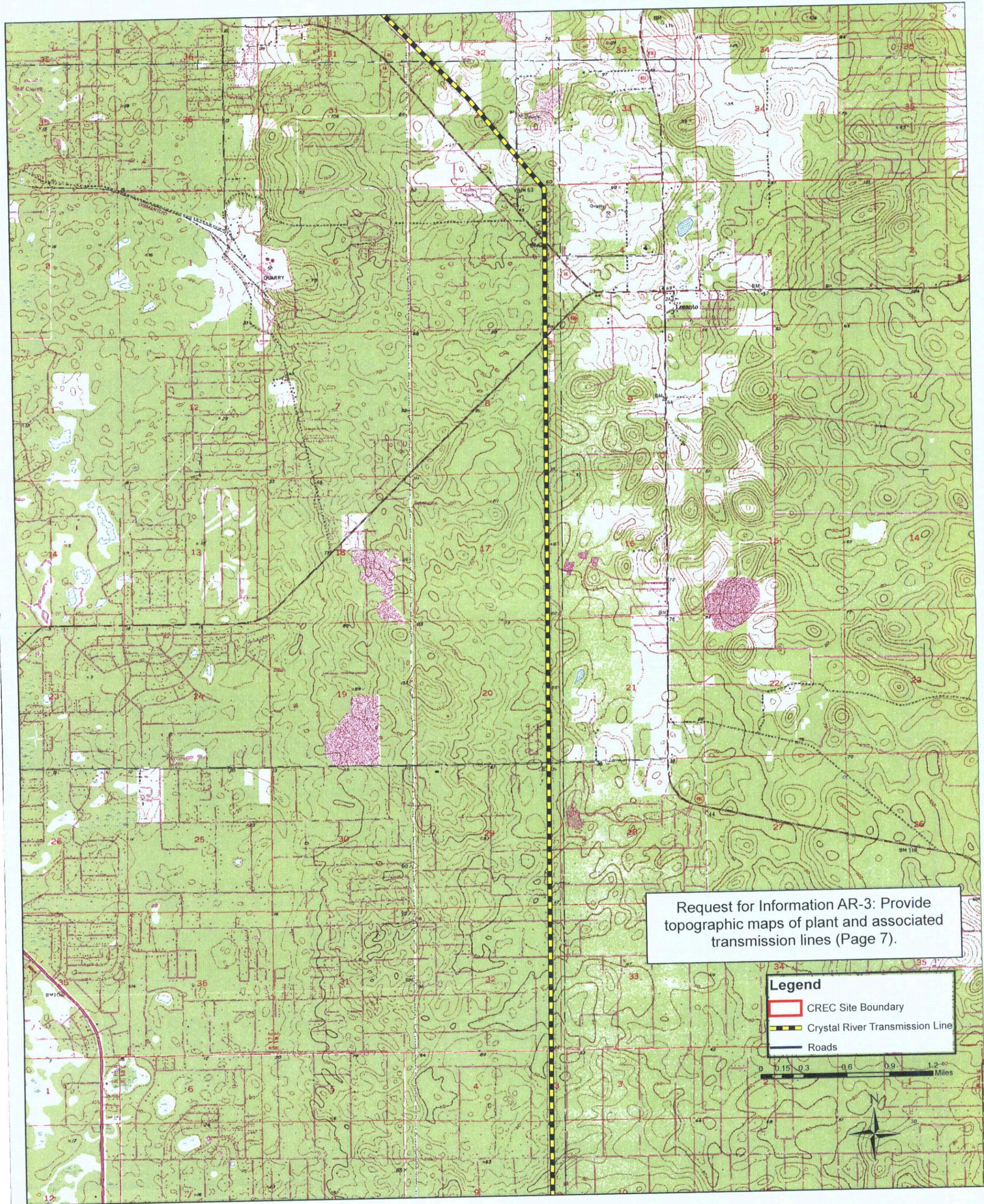


Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 6).

**Legend**

-  CREC Site Boundary
-  Crystal River Transmission Line
-  Roads





Request for Information AR-3: Provide topographic maps of plant and associated transmission lines (Page 7).

**Legend**

-  CREC Site Boundary
-  Crystal River Transmission Line
-  Roads

0 0.15 0.3 0.6 0.9 1.2 Miles

