Response to RAI No. 1
Item 1

Nufarm

WEEDAR® 64 BROADLEAF HERBICIDE

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY DESCRIPTION

Product Name: Nufarm Weedar 64 Broadleaf Herbicide

Synonyms: 2,4-D DMA; 2,4-Dichlorophenoxyacetic acid, dimethylamine salt.

EPA Reg. No.: 71368-1

Company Name: Nufarm Americas, Inc.
Burr Ridge, IL 60521

Phone Numbers: **For Chemical Emergency, Spill, Leak, Fire, Exposure, Or Accident, Call CHEMTREC Day or Night: 1-800-424-9300.**
For Medical Emergencies Only, Call 877-325-1840.
For additional non-emergency information, call: 1-800-852-5234.

Date: March 12, 2002

Revisions: New or updated information in all sections.

Reasons for Revisions: General revision utilizing more specific data.

Supersedes: March 1, 2000

2. COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT	CAS REG. NO.	% BY WEIGHT
Acetic acid, (2,4-dichlorophenoxy)-, dimethylamine salt*	2008-39-1	46.8
Inert ingredients (trade secret)**		53.2

Note: The other major ingredient in this product is water.
*OSHA hazard
**Not OSHA hazard

3. HAZARDS IDENTIFICATION

Emergency Overview:

Appearance and Odor: Reddish brown liquid, phenolic-amine odor.
Warning Statements: DANGER. Keep out of reach of children. Corrosive. Causes irreversible eye damage. Harmful if swallowed. May be fatal if absorbed through the skin. Avoid breathing vapors or spray mist. Do not get in eyes, on skin or on clothing.

Potential Adverse Health Effects:

Likely Routes of Exposure: Inhalation, eye and skin contact.
Eye Contact: Causes corneal opacity, irreversible eye damage. Vapors and mist can cause irritation.
Skin Contact: May cause slight transient irritation. Overexposure by skin absorption may cause nausea, vomiting, abdominal pain, decreased blood pressure, muscle weakness, muscle spasms.
Inhalation: Harmful if inhaled. May cause upper respiratory tract irritation and symptoms similar to those from ingestion.
Ingestion: Harmful if swallowed. May cause nausea, vomiting, abdominal pain, decreased blood pressure, muscle weakness, muscle spasms.
Medical Conditions Possibly Aggravated By Exposure: Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.
Subchronic (Target Organ) Effects: (An adverse effect with symptoms that develop slowly over a long period of time): Repeated overexposure may cause effects to liver, kidneys, blood chemistry, and gross motor function. Rare cases of peripheral nerve damage have been reported, but extensive animal studies have failed to substantiate these observations, even at high doses for prolonged periods.
Chronic Effects/Carcinogenicity: Prolonged overexposure can cause liver, kidney and muscle damage. The International Agency for Research on Cancer (IARC) lists exposure to chlorophenoxy herbicides as a class 2B carcinogen, the category for limited evidence for carcinogenicity in humans. However, more current 2,4-D lifetime feeding studies in rats and mice did not show carcinogenic potential. The USEPA has given a class D classification (not classifiable as to human carcinogenicity).
Reproductive Toxicity: No impairment of reproductive function attributable to 2,4-D has been noted in laboratory animal studies.
Developmental Toxicity: Studies in laboratory animals with 2,4-D have shown decreased fetal body weights and delayed development in the offspring at doses toxic to mother animals.
Genotoxicity: There have been some positive and some negative studies, but the weight of evidence is that 2,4-D is not mutagenic.

4. FIRST AID MEASURES

If swallowed: If patient is conscious and alert, give 2 to 3 glasses of water or milk to drink. If available, give one tablespoon of Syrup of Ipecac to induce vomiting. Alternatively, induce vomiting by touching back of throat with finger. Do not make an unconscious person vomit. Get medical attention.
If on skin: Wash skin with plenty of soap and water. Remove contaminated clothing. Get medical attention.
If in eyes: Flush with water for at least 15 minutes. Get medical attention, PREFERABLY AN OPHTHALMOLOGIST.
If inhaled: Move to an uncontaminated area. Get medical attention.
Note to Physician: This product contains a phenoxy herbicidal chemical. There is no specific antidote. All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.
Myotonic effects may include muscle fibrillations, myotonia, and muscular weakness. Ingestion of massive doses may result in persistent fall of blood pressure. Myoglobin and hemoglobin may be found in urine. Elevations in lactate dehydrogenase (LDH), SGOT, SGPT and aldolase indicate the extent of muscle damage. It has been suggested that overexposure in humans may affect both the central and peripheral nervous systems. The acute effects on the central nervous system resemble those produced by alcohol or sedative drugs. In isolated cases, peripheral neuropathy and reduced nerve conduction velocities have been reported although these observations may be related to other factors. Gas-liquid chromatography for detecting and measuring chlorophenoxy compounds in blood and urine may be useful in confirming and assessing the magnitude of chlorophenoxy absorption.

5. FIRE FIGHTING MEASURES

Flash Point: >212° F (100° C) by Pensky-Martens closed cup method.
Autoignition Temperature: Not determined.
Flammability Limits: Not determined.
Extinguishing Media: Recommended (large fire): foam, water spray. Recommended (small fires): dry chemical, carbon dioxide.

Special Fire Fighting Procedures: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.
Unusual Fire and Explosion hazards: Under fire conditions, toxic, corrosive fumes are emitted. Containers will burst from internal pressure under extreme fire conditions.
Hazardous Decomposition Materials (Under Fire Conditions): Hydrogen chloride, oxides of nitrogen, and oxides of carbon.

6. ACCIDENTAL RELEASE MEASURES

Evacuation Procedures and Safety: Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.
Containment of Spill: Dike spill using absorbent or impervious materials such as earth, sand or clay. Collect and contain contaminated absorbent and dike material for disposal.
Cleanup and Disposal of Spill: Pump any free liquid into an appropriate closed container. Collect washings for disposal. Decontaminate tools and equipment following cleanup. (See Section 13.)
Environmental and Regulatory Reporting: Prevent material from entering public sewer system or any waterways. Do not flush to drain. Large spills to soil or similar surfaces may necessitate removal of top soil. The affected area should be removed and placed in an appropriate container for disposal. Spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

7. HANDLING AND STORAGE

Handling:
Handle containers carefully to avoid damage and spills.
Storage:
Store in original container in a dry secured storage area. Do not contaminate water, food or feed by storage or disposal. Avoid storage in close proximity to insecticides, fungicides, fertilizers and seeds. Keep container tightly closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

General:

These recommendations provide general guidance for handling this product. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended usage, including maintenance and repair of equipment. Contact personal protective equipment manufacturers for assistance with selection, use and maintenance of such equipment.

Personal Protective Equipment:

Respiratory Protection: When respirators are required, select NIOSH/MSHA approved equipment based on actual or potential airborne concentrations and in accordance with the appropriate regulatory standards and/or industrial recommendations. Under normal conditions, in the absence of other airborne contaminants, the following devices should provide protection from this material up to the conditions specified by the appropriate OSHA or ANSI standard(s): Air-purifying (half-mask/full-face) respirator with cartridges/canister approved for use against pesticides. Under conditions immediately dangerous to life or health, or emergency conditions with unknown concentrations, use a full-face positive pressure air-supplied respirator equipped with an emergency escape air supply unit or use a self-contained breathing apparatus unit.

Eye/Face Protection: Eye and face protection requirements will vary dependent upon work environment conditions and material handling practices. Appropriate ANSI Z87 approved equipment should be selected for the particular use intended for this material. Eye contact should be prevented through use of protective eyewear such as chemical safety glasses with side shields or splash proof goggles. An emergency eye wash should be readily accessible to the work area.

Skin Protection: Skin contact should be avoided through the use of permeation resistant clothing, gloves and footwear, selected with regard for use conditions and exposure potential. An emergency shower should be readily accessible to the work area. Consider both durability and permeation resistance of clothing.

Work Practice Controls: Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material: (1) Do not store, use, and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored. (2) Wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics, or using the toilet.

Exposure Guidelines:

Exposure Limits:	OSHA PEL*	ACGIH TLV®*	STEL	Units
Acetic acid, (2,4-Dichlorophenoxy)-, dimethylamine salt	10**	10**	ND	mg/m³

*8-hour TWA unless otherwise noted.
**Based on adopted limit for 2,4-D.

Ventilation:

Where engineering controls are indicated by specific use conditions or a potential for excessive exposure, use local exhaust ventilation at the point of generation.

9. PHYSICAL AND CHEMICAL PROPERTIES

NOTE: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

Physical Appearance:	Reddish brown to dark brown liquid.
Odor:	Characteristic organic amine and phenolic.
pH:	Approximately 7 to 9
Specific Gravity:	Approximately 1.155 @ 20°C
Water Solubility:	Soluble.
Melting Point Range:	Not Available.
Boiling Point Range:	Not Available. Expected to be similar to water: > 100°C
Vapor Pressure:	<1 x 10^{-7} mm Hg @ 26°C (data on 2,4-D dimethylamine salt)
Molecular Weight:	266.1 (data on 2,4-D dimethylamine salt)

10. STABILITY AND REACTIVITY

Chemical Stability: This material is stable under normal handling and storage conditions described in Section 7.
Conditions To Be Avoided: None known
Incompatibility With Other Materials: Strong oxidizing agents: bases, acids.
Hazardous Decomposition Products:
Decomposition Type: Thermal
Decomposition Products: Hydrogen chloride, oxides of carbon, nitrogen and sulfur.
Hazardous Polymerization: Does not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:
Except as noted, data from laboratory studies conducted on this product are summarized below.

Eye Irritation: Severely irritating (Rabbit).
Skin Irritation: Minimally irritating (Rabbit).
Dermal: Slightly toxic. (Rabbit LD_{50} 1544 mg/kg).
Inhalation: Slightly toxic. (Rat 4-hr LC_{50}: > 3.5 mg/L) (Data on similar product)
Oral: Slightly toxic. (Rat LD_{50} 1161 mg/kg).

This product contains substances that are considered to be probable or suspected human carcinogens as follows:

	Regulatory Agency Listing As Carcinogen			
Ingredients Name	**OSHA**	**IARC**	**NTP**	**ACGIH**
Chlorophenoxy herbicides	No	2B	No	No

(Also see Section 3.)

12. ECOLOGICAL INFORMATION

Aquatic Toxicity:
Data on 2,4-D dimethylamine salt:

96-hr LC_{50} Bluegill:	524 mg/l
96-hr LC_{50} Rainbow Trout:	250 mg/l
48-hr EC_{50} Daphnia:	184 mg/l

Avian Toxicity:
Data on 2,4-D dimethylamine salt:

Bobwhite Quail Oral LD_{50}:	500 mg/kg
Mallard Duck 8-day Dietary LC_{50}:	>5620 ppm

Environmental Fate:
In laboratory and field studies, 2,4-D DMA salt rapidly dissociated to parent acid in the environment. The typical half-life of the resultant 2,4-D acid ranged from a few days to a few weeks.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:
Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide is a violation of Federal Law and may contaminate ground water. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Handling and Disposal:
Do not reuse empty container. Triple rinse (or equivalent) adding rinsate to application equipment. Then offer empty container for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

14. TRANSPORTATION INFORMATION

NOTE: Information is for surface transportation of package sizes generally offered and does not address regulatory variations due to changes in package size, mode of shipment or other conditions.

Packages containing less than 26.3 gallons of this product are generally not regulated. For packages containing 26.3 gallons or higher:

DOT Proper Shipping Name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (2,4-D SALTS), RQ (2,4-D SALTS)
DOT Hazard Class / I.D. No.:	9 / UN3082
DOT Label:	Class 9
U.S. Surface Freight Classification:	Weed killing compound, N.O.I.B.N.

15. REGULATORY INFORMATION

Federal Regulations:

TSCA Inventory: This product is excepted from TSCA because it is solely for FIFRA regulated use.

SARA Hazard Notification:
Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370):

Fire:	Reactive:	Release of Pressure:	Acute Health:	Chronic Health:
No	No	No	Yes	Yes

Section 313 Toxic Chemical(s):
ACETIC ACID, (2,4-DICHLOROPHENOXY)-, CAS NO. 94-75-7 (38.9% equivalent by weight in product)

Reportable Quantity (RQ) under U.S. CERCLA:

Ingredient	RQ
ACETIC ACID, (2,4-DICHLOROPHENOXY) -	100 lbs (approximately 26.3 gallons of this product)

Selected State Regulations:

This product contains the following components that are regulated under California Proposition 65:

Ingredient Name	Cancer List	Reproductive List	Risk Level (ug/day)	
			California	Nufarm
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

16. OTHER INFORMATION

National Fire Protection Association (NFPA®) Hazard Ratings:

Ratings for This Product		Key to Ratings	
2	Health Hazard	0	Minimal
1	Flammability	1	Slight
0	Instability	2	Moderate
		3	Serious
		4	Severe

Abbreviations and Acronyms Not Defined Elsewhere:

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DOT	Department of Transportation
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
IARC	International Agency for Research on Cancer
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration

PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act of 1986
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
USEPA	U.S. Environmental Protection Agency

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of federal law to use a pesticide product in any manner not prescribed on the EPA-accepted label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Nufarm, Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Nufarm, Inc. be responsible for damages of any nature whatsoever resulting from the use or of reliance upon Information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Vegetation Management
2901-12 Rivendell
Knoxville, TN 37922
365-777-9505

"For Chemical Emergency"
Spill, Leak, Fire, Exposure or Accident, Call:
Chemtrec (24 Hours): (800) 424-9300
Outside U.S., call collect: (703) 527-3887

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT IDENTIFICATION

PRODUCT NAME: **VM Sulfometuron Methyl**	CHEMICAL FORMULA: **(METHYL 2-[[[[4,6-DIMETHYL-2-PYRIMIDINYL) AMINO]CARBONYL]AMINO]SULFONYL]BENZOATE**
CHEMICAL FAMILY: **Sulfonyl urea herbicide**	

SECTION 2 - HAZARDOUS INGREDIENT INFORMATION

Section 313 of SARA Title III: Ingredients subject to reporting are identified by asterisk (*)

CAS NO.	COMPONENT	%	ACGIH TLV	OSHA PEL	OTHER
74222-97-2	**Sulfometuron Methyl**	**75**	**5 mg/m3**	**N/E**	
	Inert Ingredients	**25**	**8 -hr TWA**		

SECTION 3 - PHYSICAL PROPERTIES

BOILING POINT:	MELTING POINT:	BULK DENSITY	VAPOR PRESSURE (mmHg)
NA	**N/A**	**36 LBS./CU. FT.**	**N/A**

VAPOR DENSITY (AIR=1):	% SOLUBILITY IN WATER:	% VOLATILE BY WEIGHT:
N/A	**Dispersible**	**N/A**
APPEARANCE:	ODOR:	EVAPORATION RATE (Butyl Acetate=1)
Off-White solid, dry flowable	**ODORLESS**	**N/A**

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT & METHOD:	FLAMMABLE LIMITS IN AIR - LEL: UEL:
NONE (CLOSED CUP)	**LEL - 0.092 g/L**

EXTINGUISHING MEDIA:
Water, Foam, CO_2, Dry Chemical

SPECIAL FIRE FIGHTING PROCEDURES:
In case of fire wear self-contained breathing apparatus. Runoff from fire fighting may be a pollution hazard. Control runoff.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Not an explosion hazard. Like most powders, under severe dusting conditions, this material may form explosive mixtures in air.

SECTION 5 - REACTIVITY DATA

STABILITY: **Stable under normal conditions**

HAZARDOUS POLYMERIZATION: **Will not occur**

HAZARDOUS DECOMPOSITION PRODUCTS: **Will Not Occur**

CONDITIONS & MATERIALS TO AVOID: **None**

SECTION 6 - PROTECTIVE EQUIPMENT & EXPOSURE CONTROL METHODS

RESPIRATORY PROTECTION:
Not Required – Use Normal Safety Precautions.

	LOCAL EXHAUST:	MECHANICAL:	SPECIAL:	OTHER:
VENTILATION	**ADEQUATE**	**ACCEPTABLE**	**NONE**	**NONE**

PROTECTIVE GLOVES:	EYE PROTECTION:
RUBBER GLOVES	**Not Required – Use Normal Safety Precautions**
OTHER PROTECTIVE CLOTHING OR EQUIPMENT:	WORK/HYGIENIC PRACTICES:
Long sleeved shirt; long pants; shoes plus socks	**AVOID SKIN AND EYE CONTACT**

PRODUCT NAME: Sulfometuron Methyl

SECTION 7 - HEALTH HAZARDS

PRIMARY ROUTES OF ENTRY:

SKIN AND EYES

CARCINOGEN:	NTP:	IARC MONOGRAPHS:	OSHA:
NONE KNOWN	**N/A**	**N/A**	**N/A**

INHALATION:

Inhalation LC 50 > 5.1 mg/L in rats (Very low toxicity)

EYE CONTACT:

Causes moderate eye injury (irritation) with tearing or blurring of vision. Avoid contact with eyes or clothing.

SKIN CONTACT:

LD50 > 2000 mg/kg. May cause slight skin irritation with repeated contact but is not a skin sensitizer.

INGESTION:

Based on animal studies, ingestion of high doses can cause red blood cell destruction.

SECTION 8 - EMERGENCY & FIRST AID PROCEDURES

EYE CONTACT:

IMMEDIATELY FLUSH EYES WITH WATER FOR AT LEAST 15 MINS. GET MEDICAL ATTENTION.

SKIN CONTACT:

Flush with soap and water. Get medical attention if irritation persists. Contaminated clothing – remove and launder.

INHALATION:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen, call a physician.

INGESTION:

Immediately give 2 glasses of water and induce vomiting. Never give anything by mouth to an unconscious person. Call a physician.

SECTION 9 - SPILL, LEAK & DISPOSAL INFORMATION

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

Dike spill. Prevent material from entering sewers, waterways, or low areas. Shovel or sweep up.

WASTE DISPOSAL METHOD:

DISPOSE OF IN APPROVED WASTE DISPOSAL FACILITY IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS. For container, triple rinse (or equivalent) and dispose of in a sanitary landfill.

SECTION 10 - SHIPPING DATA

DOT SHIPPING NAME:

Not regulated.

SECTION 11 - SPECIAL PRECAUTIONS & OTHER INFORMATION

SPECIAL INSTRUCTIONS:

Store below 140° C (284° F)

OTHER INFORMATION/PRECAUTIONS:

Read and follow all label instructions before use. Avoid contaminating water. Do not reuse containers. Open dumping is prohibited.

COMMON ABBREVIATIONS THAT MAY HAVE BEEN USED: N/A = NOT APPLICABLE N/E = NOT ESTABLISHED

DATE: *05/08/02*

BASF Corporation

BASF

MATERIAL SAFETY DATA SHEET

\gricultural Products Group
P.O.Box 13528,
Research Triangle Park, NC 27709
(919) 547-2000

EMERGENCY TELEPHONE NUMBERS:

BASF Corporation: 1 (800) 832-HELP

CHEMTREC: 1 (800) 424-9300

Product No.: 579666 **Sahara® DG herbicide**

Date Prepared: 7/25/2000 **Date Revised: 6/24/2002**

SECTION I

Trade Name: **Sahara® DG herbicide**

Chemical Name: **2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid; N'-(3,4-dichlorophenyl)-N,N-dimethylurea N'-(3,4-dichlorophenyl)-N,N-dimethylurea**

Synonyms: **Imazapyr; AC 243,997/ Diuron**

Formula: **C13 H15 N3 O3/ C9 H10 Cl2 N2 O**

Chemical Family: **Imidazolinone/Substituted Urea**

Mol Wt: **261.3/233.1**

SECTION II - INGREDIENTS

COMPONENT	CAS NO.	%	PEL/TLV - SOURCE
Imazapyr	81334-34-1	7.78	0.5 mg/m3 TWA BASF recommended
Diuron*	330-54-1	62.22	10 mg/m(3) TWA - ACGIH
Inerts	N/A	30.00	None established

SARA Title III Section 313: *Listed

SECTION III - PHYSICAL DATA

BOILING/MELTING POINT@760mm Hg: N/D **pH: 3.26 (2% dispersion)**

VAPOR PRESSURE mmHg @ 20°C: N/D

SPECIFIC GRAVITY OR BULK DENSITY: 37 - 43 lb/ft(3)

SOLUBILITY IN WATER: Disperses

APPEARANCE: Beige granules **ODOR: Odorless** **INTENSITY: N/A**

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD): N/D **AUTOIGNITION TEMP: N/D**

FLAMMABILITY LIMITS IN AIR (% BY VOL): LOWER: N/D UPPER: N/D

NFPA 704 HAZARD CODES

HEALTH: N/R FLAMMABLE: N/R INSTABILITY: N/R OTHER: N/R

NFPA 30 STORAGE CLASSIFICATION: N/R

EXTINGUISHING MEDIUM	**Use water fog, foam, CO(2), or dry chemical extinguishing media.**
SPECIAL FIREFIGHTING PROCEDURES	**Firefighters should be equipped with self-contained breathing apparatus and turnout gear.**
UNUSUAL FIRE EXPLOSION IAZARDS	**Organic dusts may form an explosive dust/air mixture. Combustion may result in toxic gases/vapors.**

SELECT ACRONYM KEY

N/A - Not available; N/D - Not determined; N/R - Not rated; N/E - Not established

SECTION V - HEALTH DATA

TOXICOLOGICAL TEST DATA:

Data for the formulated product:

Rat (female), Oral LD50 > 5359 mg/kg

Rat (male), Oral LD50 > 5000 mg/kg

Rat, Dermal LD50 > 2000 mg/kg

Rat, Inhalation LC50 (4 hr) - 3.7 mg/ L

Rat, Inhalation LC50 (1 hr calculated) - 14.8 mg/L

Rabbit, Eye Irritation - Moderately irritating

Rabbit, Skin Irritation - Slightly irritating

Guinea pig, Dermal Sensitizer - Not a sensitizer

OSHA, NTP, or IARC Carcinogen: None

EFFECTS OF OVEREXPOSURE:

See Product Label and Directions For Use for additional precautionary statements.

CAUTION: Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing spray mist.

Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

Existing medical conditions aggravated by this product: None known

FIRST AID PROCEDURES

If on skin:	Wash with plenty of soap and water. Get medical attention if irritation persists.
If in eyes:	Flush eyes with plenty of water. Call a physician if irritation persists.
If inhaled:	Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.
If swallowed:	Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Do not give anything to an unconscious person.
Note to physician:	Treat symptomatically. No specific antidote.
Note:	Have the product container or label with you when calling a poison control center or doctor or going for treatment.

SECTION VI - REACTIVITY DATA

STABILITY: Stable. Do not store below 32° F or above 100° F.

CONDITIONS TO AVOID: See Section X ADDITIONAL INFORMATION

CHEMICAL INCOMPATIBILITY: Oxidizing agents. Unlined steel.

HAZARDOUS DECOMPOSITION PRODUCTS: Combustion may result in toxic gases/vapors.

HAZARDOUS POLYMERIZATION: Does not occur.

CONDITIONS TO AVOID: Does not polymerize.

CORROSIVE TO METAL: No **OXIDIZER:** No

SECTION VII - PERSONAL PROTECTION

Users of a pesticidal end use product should refer to the product label for personal protective equipment requirements.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

Respiratory Protection:
Supplied air respirators should be worn if large quantities of mist/dust are generated or prolonged exposure possible.

Eye Protection:
Chemical goggles when respirator does not provide eye protection.

Protective Clothing:
Rubber gloves and protective clothing as necessary to prevent skin contact.

Ventilation:
Whenever possible, engineering controls should be used to minimize the need for personal protective equipment.

SECTION VIII - ENVIRONMENTAL DATA

ENVIRONMENTAL TOXICITY DATA

See the product label for information regarding environmental toxicity.

SARA 311/312 REPORTING

FIRE: N PRESSURE: N REACTIVITY: N ACUTE: Y CHRONIC: N TPQ(lbs): N/R

SPILL AND LEAK PROCEDURES:

In case of large scale spillage of this product, avoid contact, isolate area and keep out animals and unprotected persons. Call CHEMTREC (800 424-9300) or BASF Corporation (800 832-HELP). For a small spill, wear personal protective equipment as specified on the label. Eliminate all ignition sources.
FOR A LIQUID SPILL: Dike and contain the spill with inert material (sand, earth, etc.) and transfer the liquid and solid diking materials to separate containers for disposal. Remove personal protective equipment and decontaminate it prior to re-use.

HAZARDOUS SUBSTANCE SUPERFUND: Yes RQ(lbs): 100

WASTE DISPOSAL METHOD:

Pesticide wastes are acutely hazardous. Wastes resulting from this product may be disposed of on site or at an approved waste disposal facility. Improper disposal of excess pesticide, spray mix or rinsate is a violation of federal law. If these wastes cannot be disposed of according to label instructions, contact the state agency responsible for pesticide regulation or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

HAZARDOUS WASTE 40CFR261: No HAZARDOUS WASTE NUMBER: None

CONTAINER DISPOSAL:

FOR PLASTIC CONTAINERS: Triple rinse (or equivalent) and add rinsate to the spray tank. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.
FOR BULK CONTAINERS: Reusable containers should be returned to the point of purchase for cleaning and re-filling.
FOR MINIBULK CONTAINERS: Clean all tanks on an approved loading pad so rinsate can be collected and mixed into the spray solution or into a dedicated tank. Using a high pressure sprayer, rinse several times with small volumes of water to minimize rinsate.

SECTION IX - SHIPPING DATA - PACKAGE AND BULK

D.O.T. PROPER SHIPPING NAME (49CFR172.101-102):	HAZARDOUS SUBSTANCE (49CFR CERCLA LIST):
<161 lb pkg:: None In a pkg size of 161 lb or greater: Other regulated substances, solid, n.o.s.	Diuron (RQ as product = 161 lbs) **RQ(lbs):** 100

D.O.T. HAZARD CLASSIFICATION (CFR 172.101-102):

PRIMARY	SECONDARY
<161 lb pkg:: None In a pkg size of 161 lb or greater: Class 9	

D.O.T. LABELS REQUIRED (49CFR172.101-102):	D.O.T. PLACARDS REQUIRED (CFR172.504):	POISON CONSTITUENT (49CFR172.203(K)):
<161 lb pkg:: None In a pkg size of 161 lb or greater: Class 9	<161 lb pkg:: None In a pkg size of 161 lb or greater: Class 9	None

BILL OF LADING DESCRIPTION

Compounds, Tree or Weed killing, (Herbicide), NOIBN
This product is not regulated in the package size of less than 161 lb by the Department of Transportation.

In a package size of 161 lb or greater:
RQ, Other regulated substances, solid, n.o.s. (diuron); 9, NA 3077, PG III, ERG 171

CC NO.: Not applicable	UN/NA CODE: NA 3077

SECTION X - ADDITIONAL INFORMATION

Sahara® DG herbicide

PHYSICAL AND CHEMICAL HAZARDS

Store in original container in cool,dry, well ventilated place away from ignition sources, heat or flame.
Spray solutions of SAHARA® DG herbicide should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

EPA Reg. No. 241-372

KEEP OUT OF REACH OF CHILDREN

CAUTION

BASF Corporation

Agricultural Products Group
P.O.Box 13528,
Research Triangle Park, NC 27709
(919) 547-2000

DISCLAIMER

IMPORTANT: WHILE THE DESCRIPTIONS, DESIGNS, DATA AND INFORMATION CONTAINED HEREIN ARE PRESENTED IN GOOD FAITH AND BELIEVED TO BE ACCURATE, IT IS PROVIDED FOR YOUR GUIDANCE ONLY. BECAUSE MANY FACTORS MAY AFFECT PROCESSING OR APPLICATION/USE, WE RECOMMEND THAT YOU MAKE TESTS TO DETERMINE THE SUITABILITY OF A PRODUCT FOR YOUR PARTICULAR PURPOSE PRIOR TO USE. NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, DATA OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY BASF HEREUNDER ARE GIVEN GRATIS AND BASF ASSUMES NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.

.Vegetation Management
2901-12 Rivendell
Knoxville, TN 37922

)00-979-8994

"For Chemical Emergency"
Spill, Leak, Fire, Exposure or Accident, Call:
Chemtrec (24 Hours): (800) 424-9300
Outside U.S., call collect: (703) 527-3887

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT IDENTIFICATION

PRODUCT NAME:	CHEMICAL FORMULA:
Prodiamine 65 WDG	N3,N3-Di-n-propyl-2,4-dinitro-6-(trifluoromethyl)-m-phenylenediamine

CHEMICAL FAMILY:
Dinitroaniline Herbicide

SECTION 2 - HAZARDOUS INGREDIENT INFORMATION

Section 313 of SARA Title III: Ingredients subject to reporting are identified by asterisk (*)

CAS NO.	COMPONENT	%	ACGIH TLV	OSHA PEL (TWA)	OTHER
29091-21-2	**Prodiamine**	**65**	**N/E**	**N/E**	**10 mg/m³ TWA**
	Inert ingredients including:	**35**			
1332-58-7	**Kaolin Clay**		**2 mg/m³ TWA (respirable)**	**5 mg/m³ (respirable) 15 mg/m³ (total)**	
14808-60-7	**Crystalline Silica, Quartz**		**0.05 mg/m³ (respirable silica)**	**10 mg/m³/(%SiO2+2) (respirable dust)**	**IARC Group 2**
	Dispersing agent		**N/E**	**N/E**	**15 mg/m³ TWA**

SECTION 3 - PHYSICAL PROPERTIES

BOILING POINT:	FREEZING POINT:	BULK DENSITY	VAPOR PRESSURE (mmHg)
N/A	**N/A**	**39-41 LBS/CU. FT.**	**<5.6X10^{-6} @ 25°C (Prodiamine)**

VAPOR DENSITY (Air = 1):	% SOLUBILITY IN WATER:	pH OF 1% SOLUTION:
N/A	**Dispersible**	**7-9**
APPEARANCE:	ODOR:	% VOLATILE (BY WEIGHT)
Yellow Granules	**Odorless**	**N/A**

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT & METHOD:	FLAMMABLE LIMITS IN AIR - LFL: UFL:
N/A	**N/A**

EXTINGUISHING MEDIA:
When product is involved in a fire use carbon dioxide, dry chemical, or foam. Water runoff can cause environmental damage. If water used to fight fire, dike and collect runoff.

SPECIAL FIRE FIGHTING PROCEDURES:
During a fire, irritating and possibly toxic gases may be generated by thermal decomposition or combustion. Remain upwind. Use positive-pressure, self-contained breathing apparatus and full protective clothing. Evacuate nonessential personnel from area to prevent human exposure to fire, smoke, fumes or products of combustion.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
This product is considered electrically conductive. Static electricity, mechanical sparks, open flames and certain hot surfaces (greater than 680° F [360° C] can serve as ignition sources for this material. This material can energetically decompose at approximately 383° F (195° C).

SECTION 5 - REACTIVITY DATA

STABILITY: **Stable under normal use and storage conditions.**

HAZARDOUS POLYMERIZATION: **Will not occur.**

HAZARDOUS DECOMPOSITION PRODUCTS: **Can decompose at high temperatures forming toxic gases.**

CONDITIONS & MATERIALS TO AVOID: **Thermal, mechanical and electrical ignition sources. Oxidizing agents.**

SECTION 6 - PROTECTIVE EQUIPMENT & EXPOSURE CONTROL METHODS

RESPIRATORY PROTECTION:
In areas with inadequate ventilation a NIOSH approved chemical cartridge respirator with organic vapor cartridges and pesticide pre-cartridges or a self-contained breathing apparatus may be required when working with this product.

	LOCAL EXHAUST:	MECHANICAL:	SPECIAL:	OTHER:
VENTILATION	**ADEQUATE**	**ACCEPTABLE**	**NONE**	**NONE**

PRODUCT NAME: VM PRODIAMINE 65 WDG

PROTECTIVE GLOVES AND BOOTS:	EYE PROTECTION:
Use chemical resistant gloves made of nitrile- or butyl rubber, neoprene, PVC or Viton	**Use chemical splash goggles where eye contact is likely**
OTHER PROTECTIVE CLOTHING OR EQUIPMENT:	WORK/HYGIENIC PRACTICES:
A NIOSH-certified combination air-purifying respirator with an N, P or R 95 of HE class filter and an organic vapor cartridge may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. If spraying overhead, use chemical-resistant headgear.	**Avoid skin and eye contact. Wash thoroughly with soap and water after use. Remove and wash clothing contaminated with this product.**

SECTION 7 - HEALTH HAZARDS

PRIMARY ROUTES OF ENTRY:

Inhalation, skin, and eyes

CARCINOGEN:	NTP:	CHRONIC/SUBCHRONIC TOXICITY:	TERATOLOGY:
Benign thyroid tumors (rat). None observed in mouse.	**Not listed.**	**Liver (alteration and enlargement) and thyroid effects (hormone imbalances) at high dose levels (rats); decreased body weight gains.**	**Not a teratogen. Fetal toxicity at high dose levels where prodiamine also caused maternal toxicity (1 g/kg/day).**

INHALATION:

Slightly toxic. Long term exposure to high concentrations of kaolin dust may produce x-ray evidence of dust in the lungs. Continued long term overexposure may affect respiratory function in some individuals. Exposure to dispersant can cause upper respiratory tract irritation (nose and throat). Inhalation LC50 (Rat) 1.81 mg/l – 4 hours.

EYE CONTACT:

May cause mild eye irritation. Degree of irritation will depend on the speed and thoroughness of the first aid treatment.

SKIN CONTACT:

Practically non-irritating. The Dermal LD_{50} in rabbits is >2,000 mg/kg.

INGESTION:

Practically non-toxic. Oral LD_{50} (rat) – >5,000 mg/kg.

ALLERGIC SKIN REACTIONS (Dilute mix):

Sensitizing (Guinea Pig). Prolonged or repeated exposure may cause skin irritation in some individuals.

SECTION 8 - EMERGENCY & FIRST AID PROCEDURES

EYE CONTACT:

Flush eyes thoroughly with water for 15-20 minutes. Remove contact lenses after initial 5 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

SKIN CONTACT:

Rinse skin immediately by washing with soap and plenty of water. Remove contaminated clothing. Launder clothing before reuse. Seek medical attention if irritation develops. Discard items, which cannot be decontaminated, including leather articles such as shoes, belts, and watchbands.

INHALATION:

Remove person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration; if by mouth use rescuer protection (pocket mask etc.). If breathing is difficult, oxygen should be administered by qualified personnel.

INGESTION:

Have a person sip a glass of water if able to swallow. DO NOT induce vomiting unless told to do so by a physician or poison control center. Do not give anything by mouth to an unconscious person.

NOTES TO PHYSICIAN:

There is no specific antidote if this product is ingested. Treatment basis is the clinical symptoms presented by the patient.

SECTION 9 - SPILL, LEAK & DISPOSAL INFORMATION

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

Small spill: Observe precautions in Section 6. Clean up spills immediately by sweeping up and place in a chemical container. Scrub area with hard water detergent (e.g., commercial products such as Tide, Spic and Span). Pick up wash water with a neutral absorbent (pet litter and the like) and place into compatible disposal container. Seal the container and handle in an approved manner. Prevent use of contaminated area and equipment until decontaminated.
Large Spill: Contaminated water can cause environmental damage. Keep out of streams and domestic water supplies. If water used to fight fire, dike and collect runoff to prevent contamination of local water sources.

WASTE DISPOSAL METHOD:

Do not contaminate food, feed, or water by storage or disposal. Wastes are toxic. Improper disposal of excess waste, spray mixture, or rinsate is a violation of federal law. Spray mixture or rinse water that cannot be used according to label instructions must be disposed of in accordance with applicable local, state, and federal requirements.

SECTION 10 – HANDLING

PRECAUTIONS TO BE TAKEN IN HANDLING:

Prevent eating, drinking, tobacco use, and cosmetic application in areas where there is a potential for exposure to the material. Wash thoroughly with soap and water after handling.

Bulk bags (FIBC) used to contain this material should be either type B or type C. If type C bags are used, make sure they are electrically grounded before powder is discharged from the bag.

Handle this material only in electrically conductive equipment. Electrically ground and bond this equipment as well as any worker who could contact a dust cloud formed of this material. Eliminate the presence of mechanical sparks and other ignition sources where dust clouds of this material could form.

SECTION 11 – ECOLOGICAL INFORMATION

FISH TOXICITY (Technical)	**Not bioconcentratable in fish.**
96 hour LC_{50}, Rainbow Trout	**0.83 ppm**
96 hour LC_{50}, Bluegill Sunfish	**0.55 ppm**
INVERTEBRATE (Technical)	
48 hour LC_{50}, *Daphnia magna*	**0.66 ppm**
Bee LC_{50}/ EC_{50}	**>100 ug/Bee**
AVIAN (Technical)	
Bobwhite 8-Day Dietary LC_{50}	**>10,000 ppm**
Mallard 8-Day Dietary LC_{50}	**>10,000 ppm**
MOVEMENT & PARTITIONING	
Immobile in various soils. Stable in water.	**Solubility of technical in water is 0.013 ppm @ 77° F**

SECTION 12 - SHIPPING DATA

DOT SHIPPING DESCRIPTION:

DOT SHIPPING NAME:. Not regulated.
B/L FREIGHT CLASSIFICATION: Herbicides, NOI
INTERNATIONAL TRANSPORTATION:
IMO (vessel): Environmentally hazardous Substance, Solid, N.O.S. (Prodiamine 65%), Class 9, UN3077, PGIII (Marine Pollutant)
SHIPPING NAME: Quali-Pro Prodiamine 65 WDG
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

Health	**2**
Flammability	**2**
Reactivity	**1**

Additional Labeling: None

SECTION 13 – REGULATORY INFORMATION

OTHER INFORMATION/PRECAUTIONS:

TSCA STATUS: All components are listed on US EPA TSCA inventory or are not required to be listed.
SARA 311 and 312: This product is a hazardous chemical under 29CFR 1910.1200, and is categorized as an acute, chronic health hazard and reactive hazard.

SARA 313 (40CFR355.30): N/A

CALIFORNIA PROPOSITION 65: Not listed.

SECTION 14 - SPECIAL PRECAUTIONS & STORAGE INFORMATION

SPECIAL INSTRUCTIONS:

PRECAUTIONS TO BE TAKEN IN STORAGE: Do not store or process above 320° F (160° C). Store material in a well-ventilated, secure area out of reach of children and domestic animals. Do not store food, beverages or tobacco products in the storage area.

Read and follow all label instructions before use. Avoid contaminating water. Do not reuse containers. Dispose of product containers, waste containers, and residues according to local, state, and federal health and environmental regulations.

COMMON ABBREVIATIONS THAT MAY HAVE BEEN USED: N/A = NOT APPLICABLE N/E = NOT ESTABLISHED

DATE: *08/19/04*

Vegetation Management, LLC
P.O. Box 21365, Seattle, WA 98111
(800) 979-8994
Chemtrec (24 Hours): (800) 424-9300

"For Chemical Emergency"
Spill, Leak, Fire, Exposure or Accident, Call:
Chemtrec (24 Hours): (800) 424-9300
Outside U.S., call collect: (703) 527-3887

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT IDENTIFICATION

PRODUCT NAME:	CHEMICAL NAME (FORMULA):
Vegetation Manager Glyphosate 4	**Isopropylamine Salt of N-(phosphonomethyl) glycine (Isopropylamine Salt of Glyphosate)**

CHEMICAL CLASS:
Synthetic Amino Acid Herbicide

SECTION 2 - HAZARDOUS INGREDIENT INFORMATION

Section 313 of Sara Title III: Ingredients subject to reporting are identified by asterisk (*)

CAS NO.	COMPONENT	%	ACGIH TLV	OSHA PEL	OTHER
38641-94-0	**Isopropylamine Salt of Glyphosate**	**41**	**N/D**	**N/D**	**N/D**

SECTION 3 - PHYSICAL PROPERTIES

BOILING POINT:	MELTING POINT:	SPECIFIC GRAVITY:	VAPOR PRESSURE:
~212°F (~100°C)	**N/A**	**1.1655 @ 20 °C/15.6 °C**	**N/A**

VAPOR DENSITY (AIR=1):	% SOLUBILITY IN WATER:	% VOLATILE BY WEIGHT:
N/A	**100%**	**N/D**
APPEARANCE:	ODOR:	Ph:
Clear, viscous colorless-amber liquid	**Slight Amine-like Odor**	**4.4 – 5.0**

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT & METHOD:	FLAMMABLE LIMITS IN AIR (LFL - UFL):
Does not flash	**N/A**

EXTINGUISHING MEDIA:
Dry chemical, CO_2, water spray or foam may be used. Foam is preferred to avoid uncontrolled water that spreads contamination.

SPECIAL FIRE FIGHTING PROCEDURES:
Evacuate area and fight fire upwind from a safe distance to avoid hazardous vapors and decomposition products. Foam and/or dry chemical are preferred to minimize environmental contamination. If water is used, dike and collect water to prevent run off. Wear self-contained breathing apparatus and full fire-fighting turn-out gear (Bunker gear). Equipment should be thoroughly decontaminated after use.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
None.

SECTION 5 - REACTIVITY DATA

STABILITY: **Stable under normal conditions of handling and storage.**

HAZARDOUS POLYMERIZATION: **Does not occur.**

HAZARDOUS DECOMPOSITION PRODUCTS: **Oxides of carbon, nitrogen and phosphorus.**

CONDITIONS & MATERIALS TO AVOID:
Reacts with bases to liberate heat. Reacts with and corrodes galvanized steel or unlined steel to produce hydrogen, a highly flammable gas that could explode.

PRODUCT NAME: Vegetation Manager Glyphosate 4

SECTION 6 - PROTECTIVE EQUIPMENT & EXPOSURE CONTROL METHODS

RESPIRATORY PROTECTION:
No special requirement when used as recommended.

	LOCAL EXHAUST:	MECHANICAL:	SPECIAL:	OTHER:
VENTILATION	**Adequate**	**Acceptable**	**None**	**None**

PROTECTIVE GLOVES AND BOOTS:	EYE PROTECTION:
Chemical-resistant gloves made of any waterproof material.	**Protective eyewear (e.g., goggles or full-face shield).**
OTHER PROTECTIVE CLOTHING OR EQUIPMENT:	WORK/HYGIENIC PRACTICES:
Long-sleeved shirt, long pants, shoes plus socks.	**Do not get in eyes or on clothing. Avoid breathing vapor or spray mist.** **Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. DO NOT reuse them. Follow manufacturer's instructions for cleaning maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.**

SECTION 7 - HEALTH HAZARDS

PRIMARY ROUTES OF ENTRY:
Eyes, skin and inhalation.

CARCINOGEN:	NTP:	MUTAGENICITY:	TERATOLOGY (BIRTH DEFECTS):
Not a carcinogen	**Not listed.**	**Not mutagenic.**	**Not a teratogen.**

INHALATION:
Harmful if inhaled but not expected to produce significant adverse effects when used as recommended.

EYE CONTACT:
Causes substantial but temporary eye injury.

SKIN CONTACT:
Not expected to produce significant adverse effects when used as recommended.

INGESTION:
Harmful if swallowed. Causes gastrointestinal tract irritation. May cayse nausea/vomiting , diarrhea.

ALLERGIC SKIN REACTIONS (Dilute Mix):
Not a skin sensitizer.

SECTION 8 - EMERGENCY & FIRST AID PROCEDURES

EYE CONTACT:
Immediately hold eyelids open and flush with plenty of water for at least 15 minutes. Remove contact lenses, if present, after first 5 minutes then continue rinsing eyes. Get medical attention.

SKIN CONTACT:
Wash skin with plenty of water.

INHALATION:
Remove individual to fresh air. If not breathing, give artificial respiration, preferably mouth-to mouth. Get medical attention.

INGESTION:
This product will cause gastrointestinal tract irritation. Immediately dilute by swallowing water or milk. Get medical attention. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN:
This product is not an inhibitor of cholinesterase. Treatment with Atropine and Oximes is not indicated.

SECTION 9 - SPILL, LEAK & DISPOSAL INFORMATION

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Clean up spills immediately. Isolate hazard area. Keep unnecessary and unprotected personnel from entering.
Small Spill: Absorb small spills or sand, vermiculate or other inert absorbent. Place contaminated material in appropriate container for disposal.
Large Spill: Dike large spills using absorbent or impervious material such as clay or sand. Recover and contain as much free liquid as possible for reuse. Allow absorbed material to solidify, and scrape up for disposal. Pick up wash liquid with additional absorbent and place in a disposable container. After removal, flush contaminated area thoroughly with water. This material should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.

PRODUCT NAME: Vegetation Manager Glyphosate 4

WASTE DISPOSAL METHOD:
Dispose of as hazardous industrial waste. Recycle if appropriate facilities/equipment is available. Burn in special, controlled high temperature incinerator. Keep out of drains, sewers, ditches, and water ways. Pesticide Wastes are toxic. Improper disposal of excess pesticide spray mixture or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

SECTION 10 – ECOLOGICAL INFORMATION

SUMMARY OF EFFECTS:
Moderately toxic to fish and green algae, slightly toxic to aquatic invertebrates, practically non-toxic to birds and bees. No significant bioaccumulation.

FISH TOXICITY (Technical): **96 hour LC_{50}, Rainbow Trout**	**8.2 mg/L**
INVERTEBRATE (Technical): **48 hour EC_{50}, *Daphnia magna***	**12.9 mg/L**
MOVEMENT & PARTITIONING: **Low mobility to immobile in soil. Binds strongly to soil.**	**Partition coefficient: <0.000 (active ingredient)**

SECTION 11 - SHIPPING DATA

DOT PROPER SHIPPING NAME:
Not regulated.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:
Health N/A
Flammability N/A
Reactivity N/A
Additional Labeling: None

SECTION 12 - SPECIAL INSTRUCTIONS

SPECIAL INSTRUCTIONS:
Do not contaminate water, foodstuffs, feed or seed by storage or disposal. Store product in original container.

SECTION 13 - OTHER INFORMATION/PRECAUTIONS

TSCA STATUS:
Isopropylamine Salt of Glyphosate (CAS No. 38641-94-0)

SARA TITLE 3: SECTION 302 EXTREMEKY HAZARDOUS SUBSTANCE:
N/A

SARA TITLE 3: SECTION 311/312 CATEGORIZATIONS (40CFR 370):
Acute Hazard: Immediate

SARA TITLE 3: SECTION 313 INFORMATION (40CFR 372):
N/A

CALIFORNIA PROPOSITION 65:
Does not contain any substances known to the State of California to cause cancer or reproductive harm.

CERCLA REPORTABLE QUANTITY:
N/A

COMMON ABBREVIATIONS THAT MAY HAVE BEEN USED: **N/A = NOT APPLICABLE** **N/D = NOT DETERMINED**

The information provided on this Material Safety Data Sheet is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of Vegetation Management, LLC. The data on this sheet relates only to the specific material designated herein. Vegetation Management, LLC assumes no legal responsibility for the accuracy or completeness of this data, nor for use or reliance upon this data.

DATE: 010406 / SH3

FIRST AID

Call a poison control center or doctor immediately for treatment advice.

If Swallowed: Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

If on Skin or Clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes.

If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth to mouth if possible.

If in Eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses if present, after the first 5 minutes, then continue rinsing eye. Have the product container with you when calling a poison control center or doctor, or going for treatment.

STORAGE

Store in original container. Keep container tightly closed when not in use.

DISPOSAL

Do not contaminate water, food, or feed by storage or disposal. Triple rinse (or equivalent) add rinse water to spray tank. Offer container for recycling or dispose in an approved sanitary landfill, or by other procedures approved by appropriate authorities.

GENERAL INFORMATION

HY-END GlyphoBoost is a concentrated surfactant that is excellent in the forestry, rights of way, utility, aquatic, agriculture, and turf market.

APPLICATION RATES

APPLICATION	PER 100 GALLONS
Agriculture, Citrus, Turf	1/2 to 4 pints
Utility and Highway R.O.W.	1/2 pint to 2 quarts
Forest Site Preparation	1 to 2 quarts
Aquatic/Surface	1/2 pint to 2 quarts
Aquatic/Submerged	1 to 2 gallons

WARRANTY

Naturchem warrants that this product, when used as directed, is reasonably fit for use as designated on this label. Naturchem makes no warranty of fitness or merchantability. Naturchem's maximum liability for breach of this warranty shall not exceed the purchase price of this product. In no event shall Naturchem be liable for indirect or consequential damages. This warranty shall not be changed by oral or written agreement unless signed by a duly authorized officer of Naturchem.

Natur Chem

HY-END
GlyphoBoost

SPRAY ADJUVANT FOR PESTICIDES

PRINCIPLE FUNCTIONING AGENTS:
Alky Polyethoxy Ethers and other Ethoxylated Derivatives 92%
Constituents ineffective as spray adjuvants 8%
TOTAL **100%**
All ingredients are exempt from the requirement of a tolerance under 40 CFR 180.

CAUTION - KEEP OUT OF REACH OF CHILDREN
Do not take internally. Avoid skin contact.
May cause skin and eye irritation.
FIRST AID INSTRUCTIONS LOCATED ON INSIDE PAGE.

Manufactured For:
NaturChem
Lexington, SC
(803) 957-8989

NET CONTENTS

052206

PEEL BACK HERE AND RESEAL

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 9/9/99
Product Code: 38321
MSDS: 004422

GARLON* 3A HERBICIDE

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Garlon* 3A Herbicide

COMPANY IDENTIFICATION:
Dow AgroSciences
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Triclopyr ((3,5,6-trichloro-2-pyridinyl)oxy)acetic acid), triethylamine salt	CAS # 057213-69-1	44.4%
Inert Ingredients, Total, Including		55.6%
Ethanol	CAS # 000064-17-5	
Triethylamine (N,N-Diethylethanamine)	CAS # 000121-44-8	
Ethylenediaminetetraacetic Acid (EDTA)	CAS # 000060-00-4	

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW
Hazardous Chemical. Light purple-pink liquid, ammonia-like odor. May cause severe eye irritation with corneal injury, which may result in permanent impairment of vision, even blindness. Prolonged or repeated exposure may cause skin irritation, even a burn. LD_{50} for skin absorption in rabbits is >5000 mg/kg; oral LD_{50} for male rats is 2574 mg/kg and 1847 mg/kg for female rats. Toxic and irritating gases may be formed during fire conditions.
EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: May cause severe irritation with corneal injury, which may result in permanent impairment of vision, even blindness. Vapors of amines may cause swelling of the cornea resulting in visual disturbances such as blurred, smoky or halo vision. When tested on animals, dilutions of this material were less irritating to eyes than the undiluted product.

SKIN: Prolonged or repeated exposure may cause skin irritation, even a burn. When tested on animals, dilutions of this material were less irritating to skin than the undiluted product. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals. With the dilute mix, no allergic skin reaction is expected. A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts. The LD_{50} for skin absorption in rabbits is >5000 mg/kg.

INGESTION: Single dose oral toxicity is low. The oral LD_{50} was 2574 mg/kg for male rats and 1847 mg/kg for female rats. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Ingestion may cause gastrointestinal irritation or ulceration.

INHALATION: A single brief (minutes) inhalation exposure is not likely to cause adverse effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Excessive exposure may cause liver or kidney effects.

CANCER INFORMATION: Triclopyr did not cause cancer in laboratory animal studies. This material contains ethanol. Epidemiology studies provide evidence that drinking of alcoholic beverages (containing ethanol) is associated with cancer, and IARC has classified alcoholic beverages as carcinogenic to humans.

TERATOLOGY (BIRTH DEFECTS): For triclopyr, birth defects are unlikely. Even exposures having an adverse effect on the mother should have no effect on the fetus. Ethanol has been shown to cause birth defects and toxicity to the fetus in laboratory animal tests. It has also been shown to cause human fetotoxicity and/or birth defects when ingested during pregnancy.

*Trademark of Dow AgroSciences

REPRODUCTIVE EFFECTS: For triclopyr, in laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals. Ingestion of large amounts of ethanol has been shown to interfere with fertility in human males.

4. FIRST AID:

EYES: Immediate and continuous irrigation with flowing water for at least 30 minutes is imperative. Prompt medical consultation is essential.

SKIN: Wash off in flowing water or shower.

INGESTION: Do not induce vomiting. Give large amounts of water or milk if available and transport to medical facility. Do not give anything by mouth to an unconscious person.

INHALATION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

NOTE TO PHYSICIAN: Ingestion may cause tissue destruction leading to stricture. If lavage is performed, endotracheal and/or esophageal control is suggested. If burn is present, treat as any thermal burn, after decontamination. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

5. FIRE FIGHTING MEASURES:

FLASH POINT: 110°F (43°C)
METHOD USED: TCC
FLAMMABLE LIMITS
LFL: Not determined
UFL: Not determined

EXTINGUISHING MEDIA: Alcohol foam and CO_2.

FIRE & EXPLOSION HAZARDS: Toxic, irritating vapors may be formed or given off if product is involved in fire. Although product is water-based, it has a flash point due to the presence of small amounts of ethanol and triethylamine.

FIRE-FIGHTING EQUIPMENT: Use positive-pressure, self-contained breathing apparatus and full protective clothing.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Contain small spills and absorb with an inert material such as clay or dry sand. Report large spills to Dow AgroSciences at 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: **HANDLING:** Keep out of reach of children. Causes irreversible eye damage. Harmful if inhaled or absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic skin reaction in some individuals. Avoid contact with eyes, skin, clothing, breathing vapor, or spray mist. Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
STORAGE: Store above 28°F or agitate before use. Store in original container. See product label for handling/storage precautions relative to the end use of this product.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where the potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE(S):
Ethanol (ethyl alcohol): ACGIH TLV and OSHA PEL are 1000 ppm. ACGIH classification is A4.
3,5,6-Trichloro-2-pyridyloxyacetic acid (Triclopyr), triethylamine salt: Dow AgroSciences Industrial Hygiene Guideline is 2 mg/M^3 as acid equivalent; Skin.
Triethylamine: ACGIH TLV is 1 ppm TWA, 3 ppm STEL, Skin. OSHA PEL is 10 ppm TWA, 15 ppm STEL.

PELs are in accord with those recommended by OSHA, as in the 1989 revision of PELs.

A "skin" notation following the exposure guideline refers to the potential for dermal absorption of the material. It is intended to alert the reader that inhalation may not be the only route of exposure and that measures to minimize dermal exposures should be considered.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use a NIOSH approved air-purifying respirator.

SKIN PROTECTION: When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as faceshield, gloves, boots, apron or full-body suit will depend on operation.

EYE PROTECTION: Use chemical goggles. Eye wash fountain should be located in immediate work area. If vapor exposure causes eye discomfort, use a NIOSH approved full-face respirator.

APPLICATORS AND ALL OTHER HANDLERS: Please refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES:

BOILING POINT: Not determined
VAPOR PRESSURE: Not determined
VAPOR DENSITY: Not applicable
SOLUBILITY IN WATER: Miscible
SPECIFIC GRAVITY: 1.135 (68/68°F)
APPEARANCE: Light purple/pink liquid
ODOR: Ammonia-like odor

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Avoid sources of ignition if temperature is near or above flash point.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Any oxidizing agent. Consult manufacturer for specific cases.

HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen oxides and hydrogen chloride may be formed under fire conditions.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

MUTAGENICITY: For triclopyr and ethanol: in-vitro mutagenicity studies were negative. For triclopyr: animal mutagenicity studies were negative. For ethanol: animal mutagenicity studies were negative in some cases and positive in other cases.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE:

MOVEMENT & PARTITIONING: Based largely or completely on information for triclopyr. Bioconcentration potential is low (BCF <100 or Log Pow <3).

DEGRADATION & PERSISTENCE: Biodegradation under aerobic static laboratory conditions is high (BOD20 or BOD28/ThOD >40%). 20-Day biochemical oxygen demand (BOD20) is 0.30 p/p. Theoretical oxygen demand (ThOD) is calculated to be 0.75 p/p.

ECOTOXICOLOGY: Material is slightly toxic to aquatic organisms on an acute basis (LC_{50}/EC_{50} is between 10 and 100 mg/L in most sensitive species).
Acute EC50 for shell deposition inhibition in Eastern oyster *(Crassostrea virginica)* is 56-87 mg/L.
Acute LC_{50} for rainbow trout *(Oncorhynchus mykiss)* is 400 mg/L.
Acute LC_{50} for channel catfish *(Ictalurus punctatus)* is 446 mg/L.
Acute LC_{50} for pink shrimp *(Penaeus duorarum)* is 895 mg/L.
Growth inhibition EC_{50} for green alga *(Selenastrum capricornutum)* is 45 mg/L.

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MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

GARLON* 3A HERBICIDE

Effective Date: 9/9/99
Product Code: 38321
MSDS: 004422

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: Do not contaminate food, feed, or water by storage or disposal. Excess wastes are toxic. Improper disposal or excess wastes are a violation of federal law. If wastes resulting from the use of this product cannot be disposed of according to label instructions, dispose of these wastes at an approved facility. Contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance.

14. TRANSPORT INFORMATION:

For DOT regulatory information, if required, consult transportation regulations, product shipping papers, or contact your Dow AgroSciences representative.

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
N,N-Diethylethanamine	000121-44-8	3%

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A fire hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
Ethylenediamine Tetraacetic Acid	000060-00-4	NJ3 PA1 PA3
Ethanol	000064-17-5	NJ1 NJ3 PA1
N,N-Diethylethanamine	000121-44-8	NJ1 NJ3 PA1 PA3

NJ1=New Jersey Special Health Hazard Substance (present at > or = to 0.1%).
PA1=Pennsylvania Hazardous Substance (present at > or = to 1.0%).
PA3=Pennsylvania Environmental Hazardous Substance (present at > or = to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

CATEGORY	RATING
Health	3
Flammability	2
Reactivity	0

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MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 9/9/99
Product Code: 38321
MSDS: 004422

GARLON* 3A HERBICIDE

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): This product contains the following substance(s) listed as "Hazardous Substances" under CERCLA which may require reporting of releases:

Chemical Name	CAS Number	RQ	% in Product
Triethylamine	000121-44-8	5000	3%
Ethylenediaminetetra-acetic Acid (ETDA)	000060-00-4	5000	2.3%

RCRA Categorization Hazardous Code: Triethylamine = U404

16. OTHER INFORMATION:

MSDS STATUS: Revised Sections 3,4,6 & 8
Reference: DR-0121-6064
Replaces MSDS dated: 10/7/98
Document Code: D03-101-001
Replaces Document Code: D03-038-321

The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult Dow AgroSciences For Further Information.

*Trademark of Dow AgroSciences

1. IDENTIFICATION

Product name:	**Diuron 80 DF**
Chemical name of active ingredient(s):	Diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea)
Manufacturer/Registrant:	Makhteshim-Agan of North America 551 Fifth Avenue, Suite 1100 New York, NY 10176 Phone: 212-661-9800
For fire, spill, and/or leak emergencies, contact Infotrac:	Phone: 1-800-535-5053
For medical emergencies and health and safety inquiries, contact Prosar:	Phone: 1-877-250-9291

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS NUMBER	ACGIH (TLV)	OSHA (TWA)	PERCENT
Diuron	330-54-1	10 mg/m^3	NE	80%

3. HAZARDS IDENTIFICATIONS

SIGNS OF POISONING: Drowsiness, irritability, diarrhea
PRIMARY ROUTES OF ENTRY: Ingestion, skin/eye contact
SYMPTOMS OF SINGLE EXPOSURE:
Ingestion: Drowsiness, hyperreflexia, irritability, diarrhea, hyperthermia and weight loss
Skin Absorption: None known
Inhalation: Drowsiness, irritability, diarrhea, respiratory tract irritation
Eyes: May cause eye irritation
EFFECTS OF REPEATED OVEREXPOSURE: Prolonged or repeated overexposure may cause skin and/or eye irritation
OTHER EFFECTS OF OVEREXPOSURE: Extreme overexposure may cause glycosuria, proteinuria, and aciduria. Long term exposure may also cause enlargening of the liver and/or spleen
EXISTING MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE: Skin contact may aggravate preexisting skin conditions. Inhalation of mists may aggravate preexisting respiratory conditions.

4. FIRST AID

IF ON SKIN OR CLOTHING:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
IF IN EYES:	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
IF SWALLOWED:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.

Have the product container or label with you when calling a poison control center or doctor or going for treatment.

5. FIRE FIGHTING MEASURES

FLASHPOINT: Non-combustible
FLAMMABLE LIMITS (% in air): Not determined
AUTOIGNITION TEMPERATURE: Not determined
FLAMMABILITY: Not Applicable
UNUSUAL FIRE, EXPLOSION AND REACTIVITY HAZARDS: Noxious fumes may be emitted under fire conditions
EXTINGUISHING MEDIA: Use carbon dioxide or dry chemical for small fires and water fog or foam (alcohol, polymer or ordinary) for large fires. Water stream may spread flames

SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should use self contained breathing apparatus and full turnout gear. Prevent runoff of fire water. Avoid exposure to smoke.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILLS OR LEAKS: Dike the area using absorbent materials such as sand or clay. Recover and contain as much product as possible using absorbent. Clean spill area using a solution of water and detergent. Collect and contain wash water and all contaminated absorbent for disposal. If spilled on the ground, the affected area should be excavated to a depth of 1-2 inches. Prevent the spilled product or washing from reaching public sewers or waterways. Wear appropriate protective equipment during the cleanup. Ensure that tools and equipment are adequately decontaminated.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in a cool, dry, secure area away from sources of heat

7. HANDLING AND STORAGE

STORAGE: Store in a dry location away from children, animals, foods, feeds, seeds, fertilizers, or other agricultural chemicals. Handle in accordance with information given under PRECAUTIONARY STATEMENTS. In the event of spillage, scrape up spillage. If spillage is not suitable for use, dispose of in accordance with information given under DISPOSAL. Repackage and relabel useable product in a sound container. In case of fire σ other emergency, report at once by toll free telephone to Infotrac, 1-800-535-5053.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

THE FOLLOWING RECOMMENDATIONS FOR EXPOSURE CONTROLS/PERSONAL PROTECTION ARE INTENDED FOR THE MANUFACTURE, FORMULATION, AND PACKAGING OF THE PRODUCT.

FOR COMMERCIAL APPLICATIONS AND ON-FARM APPLICATIONS CONSULT THE PRODUCT LABEL.

Ingestion:	Prevent eating, drinking, tobacco usage and cosmetic application in areas where there is a potential for exposure to the material. Always wash thoroughly after handling.
Eye Contact:	To avoid eye contact, wear chemical safety glasses with side shields or chemical goggles.
Skin contact:	To avoid skin contact, wear rubber gloves, rubber boots, long-sleeved shirt, long pants and a head covering. Discard heavily contaminated articles, which cannot be washed.
Inhalation:	To avoid breathing vapors or spray mist, wear a NIOSH-approved chemical cartridge respirator with organic vapor cartridges and pesticide pre-cartridges or a supplied-air respirator.

PROTECTIVE EQUIPMENT SHOULD BE USED DURING THE FOLLOWING PROCEDURES:
- Manufacture or formulation of this product
- Repair and maintenance of contaminated equipment
- Clean up of leaks and spills
- Any other activity that may result in hazardous exposures
- Refer to product label for PPE required for labeled use

RESPIRATORY PROTECTION: Use NIOSH/MSHA approved respirator for organic vapors. Use positive pressure contained breathing apparatus where emergency conditions or where exposure limits are exceeded
VENTILATION: Local exhaust
PROTECTIVE CLOTHING: Chemical resistant gloves, coveralls, apron and foot coverings
EYE PROTECTION: Safety goggles
USER SAFETY RECOMMENDATIONS: Safety showers and eye wash should be easily accessible

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Off-white granules
ODOR: Slightly sweet
FORMULA: $C_9H_{10}Cl_2N_2O$
MOLECULAR WEIGHT (DIURON): 233.10
MELTING POINT (DIURON): 158-159°C

BOILING POINT: Not determined
SPECIFIC GRAVITY/DENSITY (BULK): 0.62 g/mL (5.17 lb/gal)
pH: 7.0-9.0
SOLUBILITY IN H2O (DIURON): 42 ppm AT 25°C
VAPOR PRESSURE (DIURON): 0.01 mPa at 25°C

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal conditions
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Excessive heat.
MATERIALS TO AVOID: None known
HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of nitrogen and carbon, hydrogen chlorides

11. TOXICOLOGICAL INFORMATION

ACUTE TOXICITY/IRRITATION STUDIES
Acute oral LD 50 (Rat): 1879 mg/kg
Acute Dermal LD 50 (Rabbit): >5000 mg/kg
Acute Inhalation: > 2.03 mg/L
Eye Irritation (rabbit): Mild irritant
Dermal Irritation (rabbit): Non irritating
Dermal Sensitization: Not a sensitizer
MUTAGENICITY, CARCINOGENICITY, TERATOGENICITY: Not listed as a carcinogen by NRC, IARC, or OSHA

12. ECOLOGICAL INFORMATION

Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of wastes. Do not apply when weather conditions favor drift from areas treated. Cover or incorporate spills.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of in accordance with federal, state and local regulations.
CONTAINER DISPOSAL: Dispose of in an approved manner according to federal, state and local regulations

14. TRANSPORT INFORMATION

DOT/IMO/IATA CLASSIFICATION: Not Regulated (<125 lbs./Package)
B/L FREIGHT CLASSIFICATION: Compounds, Tree or Weed Killing (Herbicides), NOI, other than poison

15. REGULATORY INFORMATION

SARA TITLE III CLASSIFICATION:
Section 302-304 (40 CFR 350): Not Listed
Extremely Hazardous Substance (EHS): Not listed
Section 312, Reporting (40 CFR 370):
SECTION 311/312: Acute Health Hazard
Chronic Health Hazard
SECTION 313 (chemicals): Diuron
Threshold Planning Quantity: 10,000 lbs.
Reportable Quantity (RQ): Diuron-100 lbs.
RCRA Classification: Not listed

16. OTHER INFORMATION

NFPA HAZARD RATINGS	NFPA	HMIS		
HEALTH:	2	2	0	LEAST
FLAMMABILITY:	0	0	1	SLIGHT
REACTIVITY:	0	0	2	MODERATE
			3	HIGH
			4	SEVERE

Issued 6-21-02

MSDS Revised Date: 6-21-02. Supercedes version dated 3-04-02. Changes made to Sections 2, 14, & 15. The information contained herein is given in good faith and is believed to be correct, but no warrant, express or implied, is made. Consult Makhteshim-Agan for further information.

MATERIAL SAFETY DATA SHEET

Product Name: Bifen I/T Insecticide/Termiticide

This product has been prepared to meet the requirements as defined by OSHA Hazard Comm. Std., 29 CFR 1910.1200: the EO Directive, 91/155/EEC and other regulatory requirements. The information contained herein is for the concentrate as packaged, unless otherwise nee

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **BIFEN I/T INSECTICIDE/TERMITICIDE**
ACTIVE INGREDIENT: **Bifenthrin**
CHEMICAL FAMILY: **Pyrethroid Pesticide**
MOLECULAR FORMULA: **$C_{23}H_{22}ClF_3O_2$ (bifenthrin)**
SYNONYMS: **FMC 54800; (2-methyl[1,1'-biphenyl]-3-yl)methyl 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropanecarboxylate; IUPAC: 2-methylbiphenyl-3-ylmethyl (Z)-(1RS)-cis-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate**

MANUFACTURER:
Control Solutions, Inc.
5903 Genoa-Red Bluff
Pasadena, TX 77507

EMERGENCY TELEPHONE NUMBERS:
Medical Emergency Phone: **(866) 897-8050**
Spill: CHEMTREC (U.S.): **(800) 424-9300**

SECTION 2 - COMPOSITION, INFORMATION OF INGREDIENTS COMPONENT

	PERCENTAGE	CAS NUMBER	PEL/TLV
Bifenthrin	7.9	82657-04-3	None
Glycerine	<1.0	56-81-5	10.0 mg/m^3

SECTION 3 - HAZARDS IDENTIFICATION SUMMARY

EMERGENCY OVERVIEW
IMMEDIATE CONCERNS:
- Eggshell white liquid with a mild odor.
- Thermal decomposition and burning may form toxic by-products.
- For large exposures or fire, wear personal protective equipment.
- Highly toxic to fish and aquatic organisms. Keep out of drains and watercourses.
- Moderately toxic if inhaled.

POTENTIAL HEALTH EFFECTS: Effects from overexposure may result from either swallowing, inhaling or coming into contact with the skin or eyes. Symptoms of overexposure include bleeding from the nose, tremors and convulsions. Contact with bifenthrin may occasionally produce skin sensations such as rashes, numbing, burning or tingling. These skin sensations are reversible and usually subside within 12 hours.
MEDICAL CONDITIONS AGGRAVATED: None presently known.

SECTION 4 - FIRST AID MEASURES

FIRST AID	
EYES	• Flush with plenty of water. • Get medical attention if irritation occurs and persists.
SKIN	• Wash with plenty of soap and water.
INGESTION	• Drink 1 or 2 glasses of water and induce vomiting by touching the back of throat with a finger or by giving syrup of ipecac. • Never induce vomiting or give anything by mouth to an unconscious person. • Contact a medical doctor.
INHALATION	• Remove to fresh air. • If breathing difficulty or discomfort occurs and persists, contact a medical doctor.
NOTES TO MEDICAL DOCTOR: This product has moderate inhalation, and low oral and dermal toxicity. It is practically non-irritating to the eyes and non-irritating to the skin. Reversible skin sensations (paresthesia) may occur and ordinary skin salves have been found useful in reducing discomfort. Treatment is otherwise controlled removal of exposure followed by symptomatic and supportive care.	

SECTION 5 - FIRE FIGHTING MEASURES

FLASH POINT AND METHOD: >100°C (>212°F) (TCC)
EXTINGUISHING MEDIA: Foam, CO2 or dry chemical. Soft stream water fog only if necessary. Contain all runoff.
FIRE / EXPLOSION HAZARDS: Slightly combustible. This material may support combustion at elevated temperatures.
FIRE FIGHTING PROCEDURES: Isolate fire area. Evacuate downwind. Wear full protective clothing and self-contained breathing apparatus. Do not breathe smoke, gases or vapors generated.
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide, chlorine, fluorine, hydrogen chloride and hydrogen fluoride.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Isolate and post spill area. Wear protective clothing and personal protective equipment as prescribed in Section 8, "Exposure Controls/Personal Protection". Keep unprotected persons and animals out of the area. Keep material out of lakes, streams, ponds and sewer drains. Dike to confine spill and absorb with a non-combustible absorbent such as clay, sand or soil. Vacuum, shovel or pump waste into a drum and label contents for disposal. To clean and neutralize spill area, tools and equipment, wash with a suitable solution of caustic or soda ash, and an appropriate alcohol (i.e., methanol, ethanol or isopropanol). Follow this by washing with a strong soap and water solution. Absorb, as above, any excess liquid and add to the drums of waste already collected. Repeat if necessary. Dispose of drummed waste according to the method outlined in Section 13, "Disposal Considerations".

SECTION 7 – HANDLING AND STORAGE

GENERAL PROCEDURES: Store in a cool, dry, well-ventilated place. Do not use or store near heat, open flame or hot surfaces. Store in original containers only. Keep out of reach of children and animals. Do not contaminate other pesticides, fertilizers, water, food or feed by storage or disposal.

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION

ENGINEERING CONTROLS: Use local exhaust at all process locations where vapor or mist may be emitted. Ventilate all transport vehicles prior to unloading.
PERSONAL PROTECTIVE EQUIPMENT
EYES AND FACE: For splash, mist or spray exposure, wear chemical protective goggles or a face shield.
RESPIRATORY: For splash, mist or spray exposure wear, as a minimum, a properly fitted air-purifying respirator with an organic vapor cartridge or canister with any R, P or HE pre-filter (approved by U.S. NIOSH/MSHA, EU CEN or comparable certification organization). Respirator use and selection must be based on airborne concentrations.
PROTECTIVE CLOTHING: Depending upon concentrations encountered, wear coveralls or long-sleeved uniform and head covering. For larger exposures as in the case of spills, wear full body cover barrier suit, such as a PVC suit. Leather items - such as shoes, belts and watchbands - that become contaminated should be removed and destroyed. Launder all work clothing before reuse (separately from household laundry).
WORK HYGIENIC PRACTICES: Clean water should be available for washing in case of eye or skin contamination. Wash skin prior to eating, drinking or using tobacco. Shower at the end of the workday.
GLOVES: Wear chemical protective gloves made of materials such as rubber, neoprene, or PVC. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.
COMMENTS: Personal protective recommendations for mixing or applying this product are prescribed on the product label. Information stated above provides useful, additional guidance for individuals whose use or handling of this product is not guided by the product label.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

ODOR: Mild chemical odor
APPEARANCE: Eggshell white liquid
pH: 5.8 – 6.2
SOLUBILITY IN WATER: Disperses
SPECIFIC GRAVITY: 1.038 @ 20°C (water =1)
MOLECULAR WEIGHT: 422.88 (bifenthrin)
WEIGHT PER VOLUME: 8.65 lb/gal. (1024 g/L)

SECTION 10 - STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
CONDITIONS TO AVOID: Excessive heat and fire.
POLYMERIZATION: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

DERMAL LD_{50}: >2000 mg/kg (rabbit)
ORAL LD_{50}: >500 mg/kg (rat)
INHALATION LC_{50}: >10 mg/L/1 hr (rat)
ACUTE EFFECTS FROM OVEREXPOSURE: This product has moderate inhalation, and low oral and dermal toxicity. It is practically non-irritating to the eyes and non-irritating to the skin. Large doses of bifenthrin ingested by laboratory animals produced signs of toxicity including convulsions, tremors and bloody nasal discharge. Bifenthrin does not cause acute delayed neurotoxicity. Experience to date indicates that contact with bifenthrin may occasionally produce skin sensations such as rashes, numbing, burning or tingling. These sensations are reversible and usually subside within 12 hours.
CHRONIC EFFECTS FROM OVEREXPOSURE: No data available for the formulation. In studies with laboratory animals, bifenthrin did not cause reproductive toxicity or teratogenicity. Tremors were associated with repeated exposure of laboratory animals to bifenthrin. In lifetime feeding studies conducted with rodents, a slight increase in the incidence of urinary bladder tumors at the highest dose in male mice was considered to be an equivocal response, not evidence of a clear compound-related effect. The overall absence of genotoxicity has been demonstrated in mutagenicity tests with bifenthrin.

CARCINOGENICITY:
IARC: Not listed
NTP: Not listed
OSHA: Not listed
OTHER: Not Listed (ACGIH)

SECTION 12 - ECOLOGICAL INFORMATION

Unless otherwise indicated, the data presented below are for the active ingredient.
ENVIRONMENTAL DATA: In soil, bifenthrin is stable over a wide pH range and degrades at a slow rate which is governed by soil characteristics. Bifenthrin will also persist in aquatic sediments. Bifenthrin has a high Log Pow (>6.0), a high affinity for organic matter, and is not mobile in soil. Therefore, there is little potential for movement into ground water. There is the potential for bifenthrin to bioconcentrate (BCF = 11, 750).
ECOTOXICOLOGICAL INFORMATION: Bifenthrin is highly toxic to fish and aquatic arthropods and LC50 values range from 0.0038 to 17.8 µg/L. In general, the aquatic arthropods are the most sensitive species. Care should be taken to avoid contamination of the aquatic environment. Bifenthrin had no effect on mollusks at its limit of water solubility. Bifenthrin is only slightly toxic to both waterfowl and upland game birds (LD50 values range from 1,800 mg/kg to >2,150 mg/kg).

SECTION 13 – DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Open dumping or burning of this material or its packaging is prohibited. If spilled material cannot be disposed of by use according to label instructions, an acceptable method of disposal is to incinerate in accordance with local, state and national environmental laws, rules, standards and regulations. However, because acceptable methods of disposal may vary by location and regulatory requirements may change, the appropriate agencies should be contacted prior to disposal.
EMPTY CONTAINER: Non-returnable containers which held this material should be cleaned, prior to disposal, by triple rinsing. Containers which held this material may be cleaned by being triple-rinsed, and recycled, with the rinsate being incinerated. Do not cut or weld metal containers. Vapors that form may create an explosion hazard.

SECTION 14 – TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)
REPORTABLE QUANTITY (RQ): None
U.S. SURFACE FREIGHT CLASS: Insecticides, NOI, other than Poison. NMFC Item 102120.

MARINE POLLUTANT #1: bifenthrin (Severe Marine Pollutant)
OTHER SHIPPING INFORMATION:
When shipped by highway, railroad or air, in packages <119 gallons/450 L in volume: Not regulated. Non-bulk packages by water and bulk packages by highway, railroad or water, the material is Class 9: Environmentally hazardous substances, liquid, n.o.s. (bifenthrin 7.9%), 9, UN3082, III. NAERG Guide 171.

SECTION 15 - REGULATORY INFORMATION

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355): Not listed

SECTION 311 HAZARD CATEGORIES (40 CFR 370): Immediate, Delayed

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370): The threshold planning quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs. This product contains the following ingredients with a TPQ of less than 10,000 lbs.: None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372): This product contains the following ingredients subject to Section 313 reporting requirements: (bifenthrin)

COMMENTS: U.S. EPA Signal Word : CAUTION

All information contained in this Material Safety Data Sheet is furnished free of charge and is intended for your evaluation. In our opinion the information is, as of the date of this Material Safety Data Sheet, reliable, however, it is your responsibility to determine the suitability of the information for your use. You are advised not to construe the information as absolutely complete since additional information may be necessary or desirable when particular, exceptional or variable conditions or circumstances exist or because of applicable or government regulations. Therefore, you should use this information only as a supplement to other information gathered by you, and you must make independent determinations of the suitability and completeness of the information from all sources to assure both proper use of the material described herein and the safety and health of employees. Accordingly, no guarantee expressed or implied is made by Control Solutions, Inc. as to the results to be obtained based upon your use of the information, nor does Control Solutions, Inc. assume any liability arising out of your use of the information.

Control Solutions, Inc.
5903 Genoa-Red Bluff
Pasadena, TX 77507-1041
(281) 892-2500

Date: 09-08-05

Herbicide Usage - Progress Energy Carolinas, Inc.

The goal of Progress Energy Carolinas Inc. is to provide safe, reliable and economical electrical service to all of our customers. An important part of keeping electricity reliable is maintaining transmission and distribution power line rights of way to prevent service interruptions from trees and other tall vegetation. A loss of service can be inconvenient, costly to our customers, and may disrupt vital services, such as electricity to hospitals, fire departments and individuals on life-support systems.

For this reason, Progress Energy uses a variety of methods to manage unwanted vegetation on rights of way. We evaluate methods for safety, environmental impact and costs. Because of the variety of terrain, differences in soils and land use and vegetation type, Progress Energy uses an Integrated Vegetation Management (IVM) approach, which includes both mechanical and chemical control methods.

Progress Energy right-of-way maintenance is performed by contractors using a variety of methods. Mechanical methods include pruning, felling, mowing and hand clearing. Chemical controls involve the use of herbicides, which are used to control woody vegetation that reseeds or resprouts after mowing. Without herbicide applications, these sprouts grow quickly and require repetitive mowing. Over time, the use of herbicides results in the growth of favorable low-growing, nonwoody plants, such as grasses and other native plants. These new plant communities do not interfere with power lines and the reliable flow of electricity to our customers. In addition, they provide a natural habitat that benefits many kinds of wildlife. As a result, there is a reduced need for future mowing and herbicide applications.

Progress Energy's IVM approach balances concerns for human safety, animals and pets, agricultural crops and overall environmental issues. The herbicides used at Progress Energy have been approved for use on power line rights of way by the U.S. Environmental Protection Agency (EPA). The EPA requires rigorous toxicological, environmental and chemical testing before the herbicides are registered for use. Also, the herbicides Progress Energy uses have the same chemical ingredients as those our customers can purchase in stores (such as Roundup™) for controlling weeds in gardens, yards and for agricultural practices. Most importantly, our applications are performed under the supervision of a licensed applicator.

Progress Energy evaluates its right-of-way management program throughout our service area to be certain that all segments of power lines are accessible for maintenance of facilities and restoration of power during emergencies. When herbicides are used, the program consists of low-volume foliar application from May through October, dormant-stem application from October through April and cut-stump/vine application throughout the year..

Progress Energy uses small amounts of eight herbicides for vegetation control on power line rights of way: Accord, EPA Registration # 62719-324; Arsenal, EPA Registration # 241-299; Garlon 3A, EPA Registration # 62719-37; Garlon 4, EPA Registration # 62719-40; Stalker/Chopper EPA Registration # 241-398; Krenite, EPA Registration #352-395; Sprakil S-5, EPA Registration # 34913-10; Topsite 2.5G, EPA Registration # 34913-22.

Progress Energy manages its power lines with concern for the environment. Natural vegetation serves as a source of food and shelter for many animals, such as song birds, quail, wild turkey, deer and rabbits. For these reasons, the herbicides selected are designed specifically to control vegetation and to minimize the risk to wildlife.

Mindful of our need to be good environmental stewards, Progress Energy works with federal, state and local governmental agencies and environmental organizations to identify and protect natural ecosystems and rare plants located within our rights of way, which we protect by selectively managing these sites. Progress Energy makes every effort to conserve compatible native plants within our rights of way that are valuable to wildlife and to control invasive exotic plants that threaten sensitive ecosystems.

We have found that many of our customers are pleased with this herbicide program. However, for organic farmers and others with concerns, we can provide other options. To discuss these options, contact Progress Energy Carolinas at 1-888-201-2229. If you desire a Material Safety Data Sheet or the manufacturer's label, please contact us at 1-888-201-2229, or access the manufacturer's Web site by selecting one of the links below:

- **Accord**
  EPA Reg No. 62719-00324
- **Arsenal**
  EPA Reg No. 00241-00299
- **Arsenal 5G**
  - **Material Safety Data Sheet**
  - **Label**
- **Garlon 3A**
  EPA Reg No. 62719-00037
- **Garlon 4**
  EPA Reg No. 62719-00040
- **Habitat**
  EPA Reg No. 241-246
  - **Material Safety Data Sheet**
  - **Label**
- **Stalker**
  EPA Reg No. 00241-00398
- **Krenite**
  EPA Reg No. 00352-00395
- **Sprakil S-5**
  EPA Reg. No. 34913-10
- **Topsite 2.5G**
  EPA Reg. No. 34913-22

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Response to RAI No. 1
Item 2

Document title

Transmission Vegetation Management Program

Document number

MNT-TRMX-00176

Applies to: Transmission Department (Progress Energy, Carolinas and Progress Energy, Florida)

Keywords: maintenance; transmission – maintenance line; vegetation management; clearances; r/w; row; r/w maintenance; transmission line maintenance

1.0 Introduction

Progress Energy Transmission employs an Integrated Vegetation Management Program (IVMP) that combines various components to manage the growth of vegetation on the electric transmission utility right of way (ROW). Through the use of different, integrated methods, the optimum results (reliability, etc.) occur reducing the need to employ reliability-based trimming/removal and danger tree cutting.

Progress Energy Transmission utilizes easements, permits and/or company owned lands for the right of way on which the transmission lines are constructed. The routine inspection and maintenance of the right of ways (ROW) are extremely important for the safety of the public and the personnel that are responsible for the operation/maintenance of the transmission lines. Maintaining right of ways in accordance with established procedures results in a high level of transmission line reliability.

2.0 Program Policies, Procedures, Components and Specifications (FAC-003 R1)

2.1 Program Objectives

Ensure the reliability of the transmission system by minimizing vegetation related interruptions, while maintaining compliance with regulatory, environmental and safety requirements/standards.

2.2 Philosophy

Our philosophy is based upon employing the proper, most economical vegetation management techniques to ensure the effectiveness of our program in a wide variety of environments. This is achieved through communication, continuous learning and assessing best management practices throughout the industry.

2.3 Program Scope

The visual inspection and appropriate maintenance of transmission line right of ways comprise the Transmission Vegetation Management Program.

Inspections (periodic aerial and as needed ground patrols) are performed to monitor vegetation growth, right of way contractor effectiveness and encroachments within the right of way. Maintenance activities may include any of the following: re-clearing vegetation (mechanical clearing, hand cutting and herbicide application), tree trimming/removal, danger tree cutting and encroachment licensing/removal.

All transmission lines at voltages of 200 KV and higher will maintain 100% compliance with the MNT-TRMX-00176 specifications and cycle frequencies. All transmission lines at voltages less than 200KV will utilize MNT- TRMX-00176 as a standard and apply appropriate IVM methods as required to ensure the reliability of the line.

This procedure shall be followed in accordance with Section 3 "Preventive Maintenance Program" requirements in the Transmission Maintenance Procedures Policy (MNT-TRMX-00000).

2.4 Program Work Components

All work performed shall be in accordance with ANSI, OSHA and other applicable safety requirements, laws and Progress Energy guidelines. The following describes the various components that are utilized in the Progress Energy Transmission's Integrated Vegetation Management Program.

Right of way re-clearing (using mechanical equipment – e.g., rotary mowers, Kershaw, Hydro-Ax, etc.) - All of the wooded sections of the right-of-way are to be re-cleared with mechanical equipment, where possible, to the full width as noted in a detail description. All undergrowth is to be cut within six (6) inches of the ground. All vines on poles and brush around poles in fields are to be cut and removed out of cropped areas. Cut all leaning trees that have been pulled into the right-of-way by storms. All brush cut from stream banks or drainage ditches must be removed from streams and ditches so as not to impede the flow of water. When run ways are cut through existing canals, the canal must be restored to original condition allowing drainage to continue as it did before our operation. The vista screens and trimmed trees are not to be cut without specific instructions from Company representative.

Right of way re-clearing (hand-cutting) - All of the wooded sections of the right-of way that cannot be re-cleared with mechanical equipment are to be hand cut to the full width as noted in a detail description. All undergrowth is to be cut within six (6) inches of the ground or current water level. All vines on poles and brush around poles in fields are to be cut and removed out of cropped areas. Cut all leaning trees that have been pulled into the right-of-way by storms. All brush cut from stream banks or drainage ditches must be removed from streams and ditches so as not to impede the flow of water. The vista screens and trimmed trees are not to be cut without specific instructions from a Progress Energy representative.

Right of way re-clearing (herbicides) – Where appropriate, the primary method of vegetation control on transmission right of ways may be established as, or converted to, the use of herbicides. Herbicides may also be applied on a case by case basis on areas of line right of ways that cannot be effectively, or efficiently, mowed or hand-cut. The application of herbicides on Transmission ROW shall be in accordance with procedure EVC-EDGC-00001 (Herbicide Usage on Rights-of-Way *Energy Delivery Carolinas only*) and all applicable TVM specifications.

Tree removal/trimming - All trees requiring removal/trimming should be removed or trimmed so as to obtain sufficient clearance to prevent a hazard to operations for the removal/trimming cycle.

Off right of way tree cutting – Off right of way trees are those trees located outside the defined right of way width. These trees, due to there height if they were to fall could make contact with the conductor or fall to within five feet of the outermost conductor, grow into the conductor or due to conductor blowout could make contact with the conductor. All trees cut are to be cut according to MNT-TRMX-00193 (TVM: Off Right of Way Tree Cutting Guidelines).

Danger tree cutting – Danger trees are those trees located inside or outside the designated right of way that are in decline/diseased, have structural defects, leaning towards the right of way or are dead. These trees, due to there height if they were to fall could make contact with the conductor or fall to within five feet of the outermost conductor. These trees should be inspected and assessed thoroughly for structural integrity before climbing is performed. When the safety of the crew is at risk if the tree is climbed, alternate mechanical or other methods shall be utilized to perform the removal safely.

2.4.1 Program Component Frequency Targets

The actual frequency for specific facilities may vary significantly from the target frequency based on the integrated program components that are being employed and on site/facility specific factors (such as - but not limited to: indigenous vegetation, easement/permit width and rights, construction type, voltage, pruning vs. removal philosophy, environmental restrictions, federal/state/local ordinances, etc.) Right of way maintenance frequency intervals for program component tasks are identified below.

	Task	PE Carolinas	PE Florida
2.4.1.1	Right of Way		
	1. Re-clearing (mechanical)	36 months	48-60 months
	2. Re-clearing (hand-cutting)	36 months	48-60 months
	3. Re-clearing (herbicides)	36 months	48 months
	4. Tree removal/trimming	24 to 36 months	48-60 months
	5. Off-R/W Tree Cutting	As Needed*	As Needed*

* Reliability-based danger tree cutting is performed as needed when danger trees are identified.

2.5 Work Specifications and Procedures

2.5.1 Work Specifications

Standards for specific work will be developed for all work practices and incorporated into contract documents for each project or work activity. These standards/specifications will incorporate ANSI-300 and ANSI-Z133 as appropriate.

2.5.2 Off Right-of-Way Tree Cutting

Standards found in MNT-TRMX-00193 (TVM: Off Right of Way Tree Cutting Guidelines).

3.0 Inspections (FAC-003 R1.1)

Aerial patrols will be conducted in accordance with all applicable Progress Energy Safety Rules, OSHA regulations, work practices, and Federal, State and local regulations & ordinances. Patrols will be conducted with qualified Progress Energy Transmission personnel to look for and document conditions of the following: ROW/Vegetation clearances - encroachments - line equipment - substation equipment.

The frequencies for inspections impact Right of way and line maintenance and are defined in procedure MNT-TRMX-00051 (Transmission Line Equipment Maintenance and Inspection Schedules).

4.0 TVM Clearance Requirements (FAC-003 R1.2)

Progress Energy Transmission vegetation clearance requirements for the TVM program have been established. These clearances comply with the program vegetation clearances requirements of FAC-003.

4.1 Vegetation Clearances Following VM Work (FA-003 R1.2.1)

The vegetation clearances to be achieved at the time of TVM work completion will comply with the following guidelines:

4.1.1 Clearances Achieved at the Time of TVM Work

4.1.1.1 Vegetation Clearance: Floor Growth

The vegetation to conductor clearances to be obtained at the time of TVM work completion will use the maximum operating sag of the conductor as the reference point for TVM work for vegetation clearances. The clearance to be obtained at the time of TVM work will use the following criteria to target the clearances at the time of TVM work:

- Clearances will include the appropriate 'minimum' conductor to vegetation clearances defined in Table 4 or Table 5 of MNT-TRMX-00191 (TVM Program: Vegetation Clearance Tables)
- Clearances will also include distances for vegetation re-growth as defined in Table 3 of MNT-TRMX-00191 (TVM Program: Vegetation Clearance Tables)
- These combined distances are to be obtained at the time of TVM work below the maximum operating sag point of the conductor

4.1.1.2 Vegetation Clearance: Side Growth

To ensure side growth and conductor side-swing impacts are limited, the TVM program targets providing vegetation side growth clearance based on the following criteria:

- Vegetation clearances will be maintained to provide for conductor blowout from less than 40 mph winds (sub-tropical storm winds)
- Clearances will include the appropriate 'minimum' conductor to vegetation clearances as defined in Table 4 or Table 5 of MNT-TRMX-00191 (TVM Program: Vegetation Clearance Tables)

4.1.2 Safe Working Clearances

For all vegetation work, the minimum safe working distances defined in Table 1 and Table 2 of MNT-TRMX-00191 (TVM Program: Vegetation Clearance Tables) will be observed.

The majority of all work is normally completed at normal operating (loading/temperature) conditions that ensure the safe working clearances can be observed with no special precautions. When operating conditions and vegetation growth reduce clearances to less than the minimum safe working distances, the work will be rescheduled under the appropriate operating conditions to ensure that safe working clearances can be observed.

4.2 Minimum Vegetation to Conductor Clearances (FA-003 R1.2.2)

The minimum conductor to vegetation clearances, Clearance 2 in FAC-003 (R1.2.2), will be maintained under all rated electrical operating conditions. These clearances are defined in Table 4 and Table 5 of MNT-TRMX-00191 (TVM Program: Vegetation Clearance Tables).

The clearances included in these tables were developed and based on Table 5, IEEE 516-2003, phase to ground distances with appropriate altitude correction factors applied.

5.0 Personnel Qualifications (FAC-003 R1.3)

The following qualifications represent the minimum level of experience and/or education to be hired for the following positions.

5.1 Field Inspector/Right of Way Specialist

Minimum Qualifications:

1. Bachelors Degree in Forestry or related field, or 2 year technical degree with 1 years experience, or 5 years experience in utility vegetation management
2. General understanding of Integrated Vegetation Management techniques
3. Understanding of ANSI Z-133 and A-300
4. Understanding of basic electrical systems and causes of vegetation related interruptions
5. General knowledge of proper herbicide uses and application methods
6. Must obtain state pesticide applicators license within 1 year
7. Must obtain ISA certification within 1 year

5.2 Lead Forester/Area Forester

Minimum Qualifications:

1. Bachelors degree in forestry or related field and 3 years utility vegetation management experience or 2 year technical degree and 5 years experience in utility vegetation management
2. Working knowledge of Integrated Vegetation Management techniques
3. Knowledge of NERC Standard FAC-003-1 and its requirements for the Transmission Vegetation Management Program
4. Working knowledge of ANSI Z-133 and A-300
5. Working knowledge of an Integrated Vegetation Management Program including practical applications of herbicides

6.0 Mitigation (FAC-003 R1.4)

For all locations (spans) on the transmission system where the minimum vegetation clearances cannot be obtained to meet the target frequency cycle for the program component activity, the location will be documented. The following will provide the documentation for all mitigation sites and reactive work:

Planned Mitigation – planned/documented vegetation management work that is scheduled more frequently than TVM program standard frequencies to mitigate vegetation-related clearance issues to ensure the reliability of the system.

- Every span that requires maintenance other than the Program Component Frequencies, in paragraph 2.4.1, will be documented and tracked, including the mitigation measures for that location (i.e., shorter frequencies, etc).

Reactive Work – vegetation related work identified in the field, not previously documented or planned, that requires action before scheduled cycle work to mitigate a potential reliability clearance issue.

- The TVM Program reactive work scheduling and tracking process will track all reactive work assigned and completed by TVM personnel.

7.0 Imminent Threat Communications (FAC-003 R1.5)

During the course of TVM work and inspections, any situation or condition that is observed and deemed to present an imminent threat to the Transmission System shall be reported in accordance with the MNT-TRMX-00192 (TVM: Imminent Threat Communication Procedure).

8.0 Annual Work Plan (FAC-003 R2)

An annual work plan for the year will be maintained for each area managed by an area forester. The plan will be developed for each component activity by line or complete line maintenance. The plan will be developed using previous work completion dates, cycle length and based on annual growth cycles. Changes to the annual plan shall be documented with criteria for any changes and mitigation plans. Each area forester shall maintain a file for reportable lines with work completion information and a line completion form for each activity or complete line maintenance.

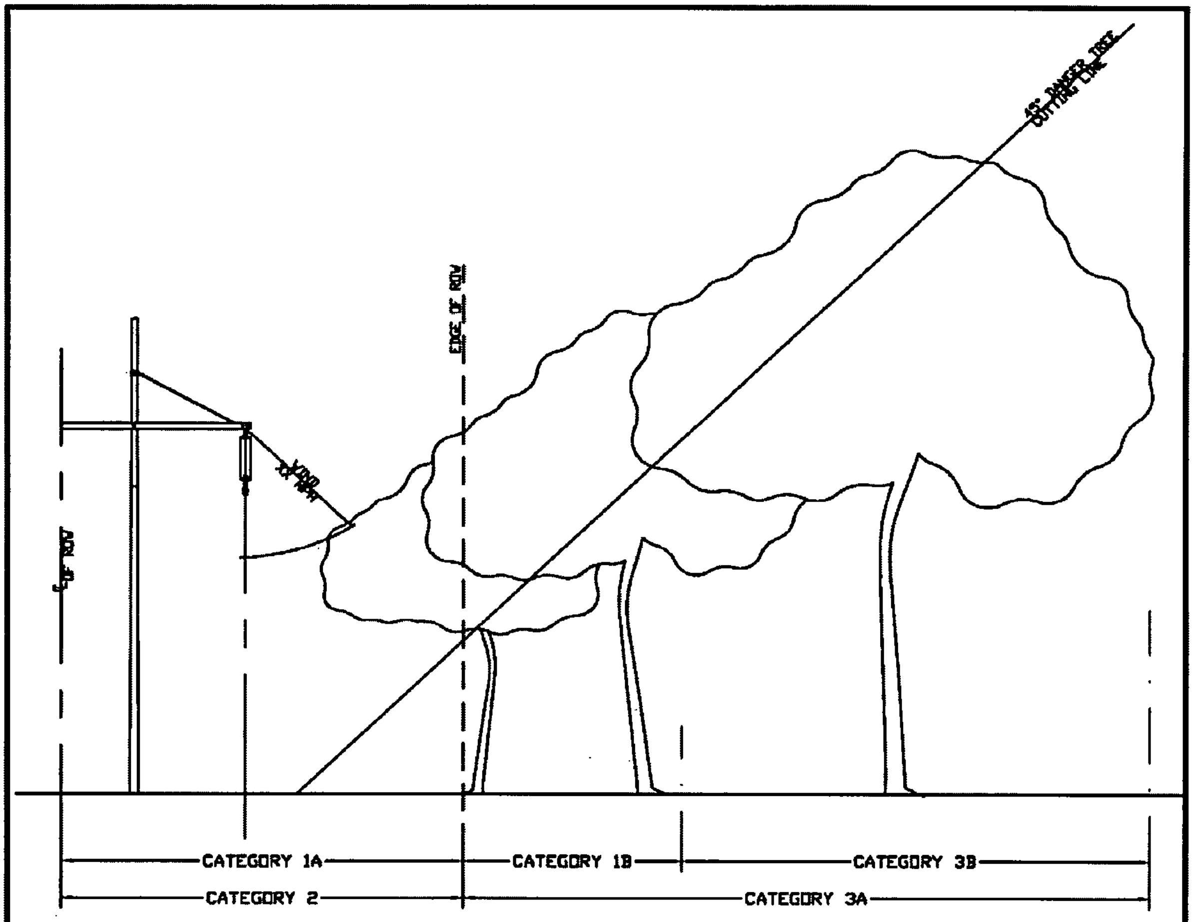
9.0 Transmission Vegetation Outage Reporting (FAC-003 R3)

On a periodic basis, as defined by the Region Reliability Organization, the TVM Program will report any outage that meets the criteria defined in FAC-003. In addition, the outage reporting will utilize the following criteria for meeting the FAC-003 reporting requirements:

- The general exclusion criteria in the MNT-TRMX-00194 (Transmission Outage Reporting Process)
- Side growth vegetation-related outages resulting from tropical storm or higher winds (40 mph or greater)

- Vegetation-related outages due to human or animal interference, such as: animal severing tree; vehicle contact with tree, removal or digging or moving of vegetation; logging; arboricultural or horticultural or agricultural activities; etc.)
- Vegetation related outages that result from vegetation falling into lines from outside the ROW that result from natural disasters shall not be considered reportable (examples of disasters that create non-reportable outages include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, major storms as defined either by MNT-TRMX-00194 --- the Transmission Outage Reporting Process, ice storms, and floods)
- Transmission vegetation categories (Attachment A, Attachment B, Attachment C & Attachment D)

Attachment A
Transmission Vegetation Categories



Vegetation categories.... Reliability compliance categories

NERC Category 1 - Code/Compliance Trees
PE A - Grow in trees located inside the right of way that could make contact with the conductor.
PE B - Trees located outside the right of way that could contact the conductor due to side growth into the right of way or conductor blow out.

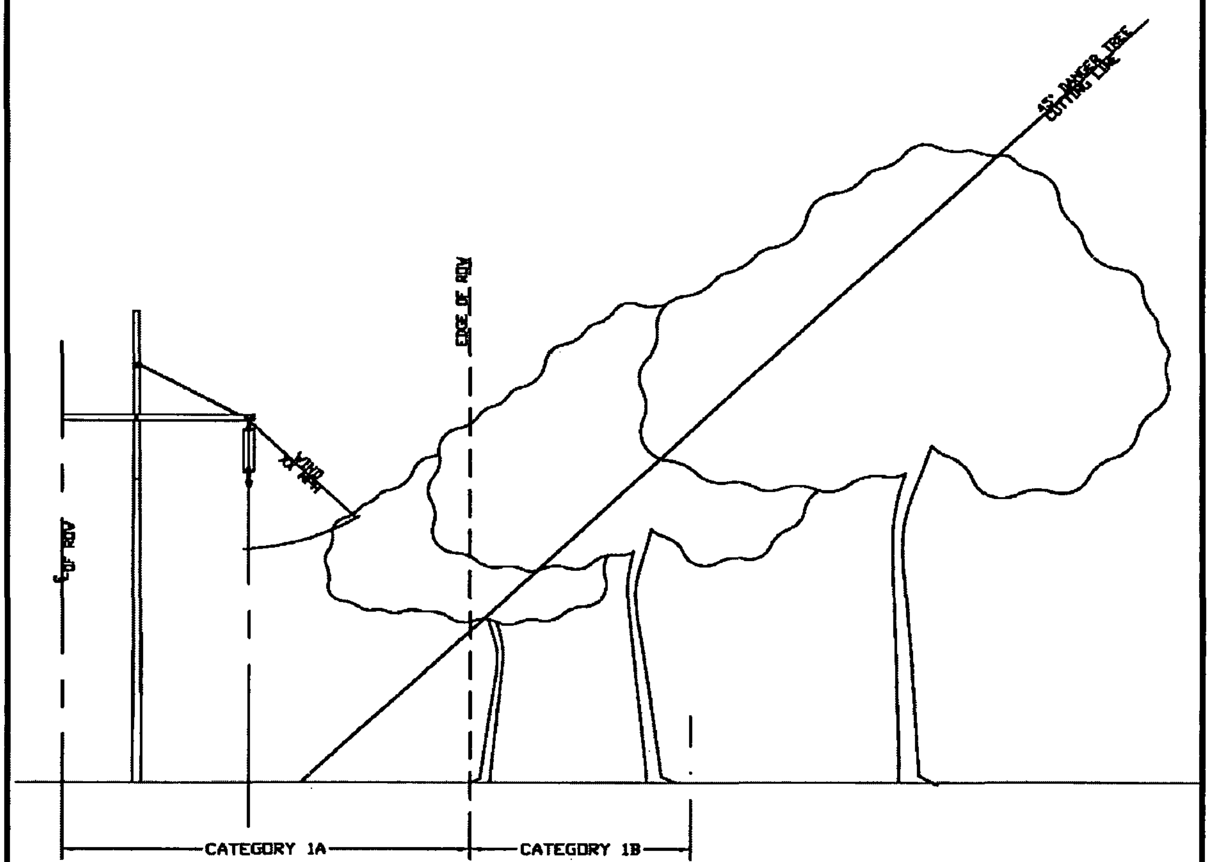
NERC Category 2 - Any tree that falls into the line from within the right of way.

NERC Category 3
PE A - Immediate Reliability Risk: Diseased, damaged, leaning, structurally unsound or dead trees located outside the right of way that would make contact with the conductor or fall to within 5 feet of a point on the ground directly beneath the outside conductor.
PE B - Long Term Reliability Risk: Trees that are outside of the right of way and could make contact with the conductor or fall to within 5 feet of a point on the ground directly beneath the outside conductor.

Progress Energy

10/06 DATE	V: NTS H: NTS SCALE	
JLW DRAWN	JLW TECH	TRANSMISSION VEGETATION MANAGEMENT
CHECK	ENGR	
1 OF 4 SHEET	DWG.	TVG

Attachment B
Category 1 Vegetation



NERC Category 1 - Code/Compliance Trees

PE A - Grow in trees located inside the right of way that could make contact with the conductor.

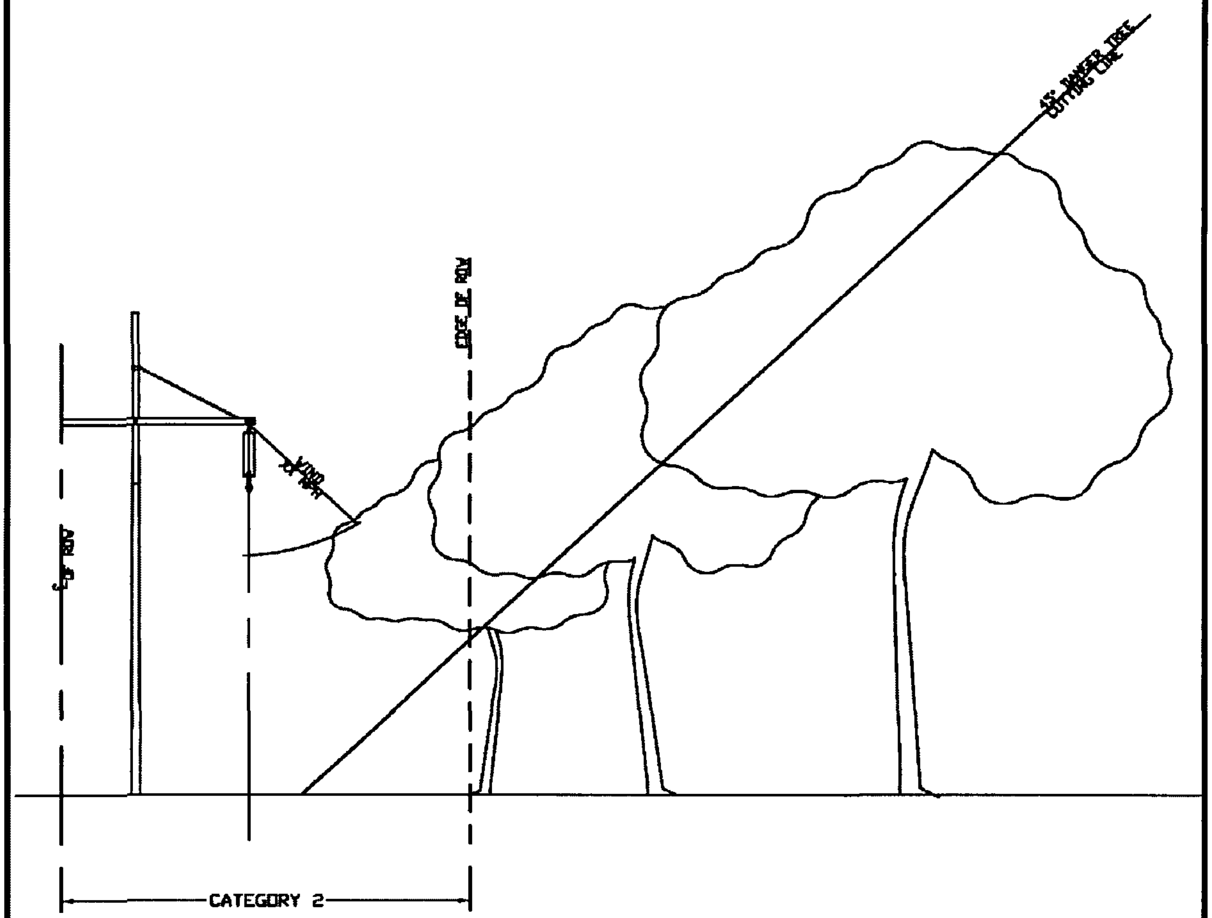
PE B - Trees located outside the right of way that could contact the conductor due to side growth into the right of way or conductor blow out.

Progress Energy

10/06 DATE	V: NTS H: NTS SCALE	
JLW DRAWN	JLW TECH	TRANSMISSION VEGETATION MANAGEMENT
CHECK	ENGR	
2 OF 4 SHEET	DWG. CATEGORY 1	

AUTHORIZED COPY

Attachment C
Category 2 Vegetation



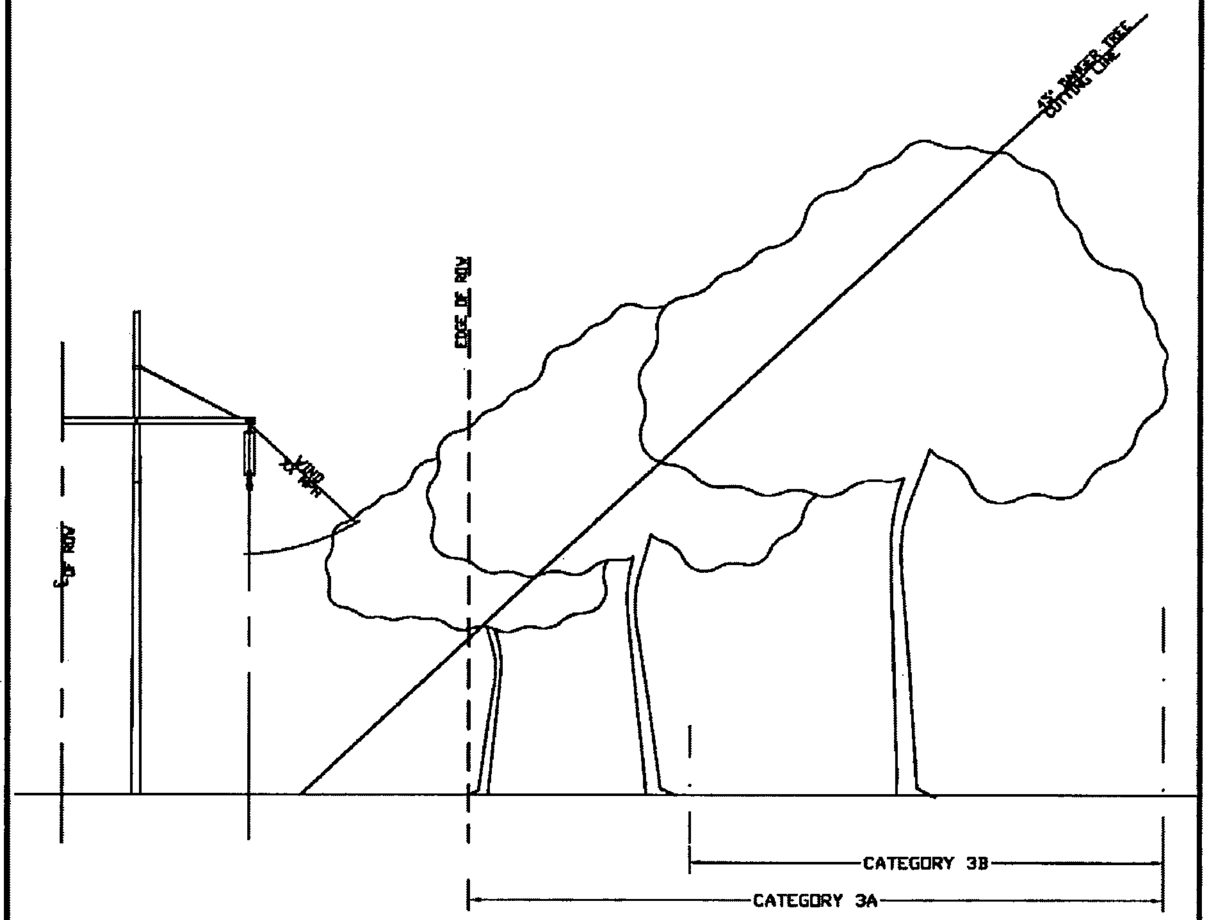
NERC Category 2 -
Any tree that falls into the line from within the right of way.

Progress Energy

10/06 DATE	V: NTS H: NTS SCALE	
JLW DRAWN	JLW TECH	TRANSMISSION VEGETATION MANAGEMENT
CHECK	ENGR	
3 OF 4 SHEET	DWG. CATEGORY 2	

AUTHORIZED COPY

Attachment D
Category 3 Vegetation



NERC Category 3

PE A - Immediate Reliability Risk: Diseased, damaged, leaning, structurally unsound or dead trees located outside the right of way that would make contact with the conductor or fall to within 5 feet of a point on the ground directly beneath the outside conductor.

PE B - Long Term Reliability Risk: Trees that are outside of the right of way and could make contact with the conductor or fall to within 5 feet of a point on the ground directly beneath the outside conductor.

Progress Energy

10/06 DATE	V: NTS H: NTS SCALE	
JLW DRAWN	JLW TECH	TRANSMISSION VEGETATION MANAGEMENT
CHECK	ENGR	
4 OF 4 SHEET	DWG. CATEGORY 3	

Document title

TVM Program: Vegetation Clearance Tables

Document number

MNT-TRMX-00191

Applies to: Transmission Department (Progress Energy, Carolinas and Progress Energy, Florida)

Keywords: maintenance; transmission – maintenance line; vegetation management; clearances; r/w; row; r/w maintenance; transmission line maintenance

1.0 Introduction

The following tables document the Transmission Vegetation Management Program clearance guidelines for Progress Energy, Inc.

2.0 Vegetation Clearances at Time of Work

The following tables provide the Progress Energy, Inc. TVM Program vegetation clearances to be observed at the time VM work is completed. They provide the clearance details to comply with Clearance 1 in FAC-003-1.

2.1 Table 1: Minimum Approach Distance Qualified Line-clearance Workers

These clearances represent safe working approach distances for the specified TVM maintenance personnel.

The following table identifies the minimum approach distance from energized conductors for qualified line-clearance arborists and qualified line-clearance arborist trainees. (For PE Transmission voltages)

Nominal Voltage kV phase-to-phase	**Includes 1910.269 elevation factor, sea level to 5000 ft***	
	Feet-Inches	Meters
46.1 – 72.5 (69kV)	3-09	1.14
72.6 – 121.0 (115kV)	4-06	1.37
138.0 – 145.0 (138kV)	5-02	1.58
161.0 – 169.0 (161kV)	6-00	1.83
230.0 – 242.0 (230kV)	7-11	2.41
500.0 – 550.0 (500kV)	19-00	5.80
* Exceeds phase-to-ground; elevation factor per 29 CFR 1910.269		

*Based on **ANSI Z133.1 Revision – October 2000, Section 5, Table 1, page 6***

2.2 Table 2: Minimum Approach Distance for Other Than Qualified Line-clearance Workers

These clearances represent safe working approach distances for the specified TVM maintenance personnel.

The following table identifies the minimum approach distance from energized conductors for persons other than qualified line-clearance tree trimmers and qualified line-clearance tree trimmer trainees. (For PE Transmission voltages)

Nominal Voltage kV phase-to-phase*	**Distance**	
	Feet-Inches	Meters
46.1 – 72.5 (69kV)	10-00	3.05
72.6 – 121.0 (115kV)	12-04	3.76
138.0 – 145.0 (138kV)	13-02	4.00
161.0 – 169.0 (161kV)	14-00	4.24
230.0 – 242.0 (230kV)	16-05	4.97
500.0 – 550.0 (500kV)	26-08	8.05
* Exceeds phase-to-ground.		

*Based on **ANSI Z133.1 Revision – October 2000, Section 5, Table 2, page 6***

2.3 Table 3: Vegetation Re-Growth Clearance

These clearances represent the target vegetation clearances to be obtained at the time of VM work to allow for re-growth of vegetation until the next trimming cycle.

The following table identifies the minimum re-growth clearance to be obtained at the time of trimming. (For PE Transmission voltages)

Operating Company	***Average Annual Re-growth Expected****	***Target Cycle for Trimming Activities***	***Minimum Vegetation Re-Growth Clearance Required***
PE Florida	5 feet	4 years	20 feet
	5 feet	5 years	25 feet
PE Carolinas	5 feet	2 years	10 feet
	5 feet	3 years	15 feet
* Site specific: Varies with local environmental conditions and vegetation species.			

3.0 Minimum Vegetation to Conductor Clearances

The following tables provide the Progress Energy, Inc. TVM Program minimum conductor to vegetation clearances to be observed under all rated electrical operating conditions. They provide the clearance details associated with Clearance 2 in FAC-003-1.

3.1 Table 4: Minimum Approach Distance: Vegetation to Conductor Clearance <u>(Up to Elevations of 3,000 ft)</u>

These clearances represent the minimum vegetation to conductor clearances that are to be maintained under all rated electrical operating conditions to prevent flashover to ground from occurring at elevations lower than 3,000 feet. This table primarily applies to facilities in Central & Eastern North Carolina, South Carolina and Florida.

The following table identifies the minimum distance between energized conductors and vegetation to be maintained under all rated electrical operating conditions (For PE Transmission voltages):

Voltage Range (Phase to Phase)	Minimum Clearance between Conductor and Vegetation to be Maintained ***(Elevations Up to 3,000 Feet)***
46.1 – 72.5 (69kV)	2.45'
72.6 – 121.0 (115kV)	2.45'
138.0 – 145.0 (138kV)	2.94'
161.0 – 169.0 (161kV)	3.42'
230.0 – 242.0 (230kV)	5.14'
500.0 – 550.0 (500kV)	14.68'

Progress Energy's Minimum Clearances between Conductor and Vegetation

3.2 Table 5: Minimum Approach Distance: Vegetation to Conductor Clearance (Elevations between 3,000 and 5,000 ft)

These clearances represent the minimum vegetation to conductor clearances that are to be maintained under all rated electrical operating conditions to prevent flashover to ground from occurring. This table applies primarily to facilities in Western North Carolina.

The following table identifies the minimum distance between energized conductors and vegetation to be maintained under all rated electrical operating conditions (For PE Transmission voltages):

Voltage Range (Phase to Phase)	Minimum Clearance between Conductor and Vegetation to be Maintained ***(Elevations between 3,000 to 5,000 Feet)***
72.6 – 121.0 (115kV)	2.57'
138.0 – 145.0 (138kV)	3.09'
161.0 – 169.0 (161kV)	3.59'
230.0 – 242.0 (230kV)	5.68'
500.0 – 550.0 (500kV)	15.43'

Progress Energy's Minimum Clearances between Conductor and Vegetation

AUTHORIZED COPY

Document title

Herbicide Usage on Rights-of-Way

Document number

EVC-EDGC-00001

Applies to: Energy Delivery Group - Carolinas

Keywords: environmental; energy delivery - environmental

1.0 Purpose/Use

The purpose of this procedure is to describe the actions to be followed when applying herbicides to power line rights-of-way in accordance with Memorandum of Agreement dated June 8, 1998 ("MOA"). Additionally herbicides will be applied in accordance with all applicable environmental and safety regulations.

2.0 Overview

Progress Energy Carolinas, Inc.'s goal is to provide safe, reliable and economical electrical service to all its customers. Power line rights-of-way are managed to control the growth of vegetation, therefore ensuring proper clearance and access. Herbicide use is an essential element of the overall management program.

Distribution and Transmission Foresters will be the program administrator for the herbicide program in their Regions/Areas. The program administrator will operate in accordance with all regulatory and contractual requirements and/or agreements.

3.0 Program Administrator Responsibility

The program administrator will employ a combination of control methods for right-of-way vegetation management in a process known as "Integrated Vegetation Management." "IVM" will utilize the best possible combination of mechanical and herbicide control of undesired vegetation on power line rights-of-way. When herbicide control is used for the method of "IVM" the administrator will:

3.1 Use established "Best Management Practices" (Attachment 1) in planning herbicide application.

3.2 Identify all customers/property owners who have Agreement to Avoid Herbicide Application on Progress Energy Carolinas, Inc. Right-of-Way (FRM-EDGC-00029) (Agreement). Appropriate maps using DIS/structure numbers and directions locating Agreements will be prepared and transmitted to contractors and Substation Maintenance Supervisor in the appropriate Area.

3.3 Identify all known rare plant sites that are marked with "Sensitive Area - Do Not Mow" signs or other restricted areas. Appropriate maps using DIS/structure numbers and directions locating such sites will be prepared and transmitted to contractors.

3.4 Select qualified contractor on the basis of experience, crew training, quality of work and competitive pricing for herbicide application.

3.5 Oversee the herbicide application to ensure compliance with contract provisions and MOA.

3.6 Assure that the appropriate internal organizations (operations centers) and community relations personnel have been informed of the herbicide application plans.

3.7 Provide a copy of MOA and review with Contractor.

4.0 Contractor Responsibility

The selected contractor will:

4.1 Ensure that all crew members are properly trained and working under the supervision of a licensed pesticide operator.

4.2 Abide by all terms of the contract.

4.3 Honor all customers' Agreements and ensure that crews know the location of properties where agreements exist.

4.4 Contact program administrator when contractor receives customer request for Agreement in the field.

4.5 Ensure that crews know the location of applicable rare plant sites and any other restricted areas so that no herbicides are applied to these sites.

5.0 Agreement to Avoid Herbicide Application

All customers/property owners have the option to choose non-herbicide methods for controlling vegetation on rights-of-way across their property as provided in the MOA.

For customers/property owners who request non herbicide methods for right-of-way maintenance, the program administrator will:

5.1 Contact customer and provide an Agreement for completion and compliance. If a form is not completed, the program administrator should contact the Legal Department to negotiate a mutually satisfactory compromise where possible.

5.2 Provide customer with "Cover Letter" (Attachment 2) and "Property Owner Posting Required to Comply with Non-herbicide Use Agreement: (Attachment 3) and non-herbicide use signs (Attachment 4).

5.3 Promptly notify contractor of any new "Agreements."

5.4 Original Agreements will be filed in the appropriate Region/Area by the program administrator. Copies of Agreements will be sent to contact person in Environmental Services Section (ESS). Agreements will be retained for seven (7) years after expiration date.

6.0 Herbicide Communications Plan

The functional area content of any communications to news media or other outside parties regarding herbicide issues should be coordinated through:

6.1 Primary Contact:
George Booth, Energy Delivery Group Environmental Coordinator
Work - 919-546-2624
Home - 919-363-5484
Cellular - 919-812-0950
Pager - 1-877-625-9077

6.2 Alternate Point of Contact:
Mike McDowell, Northern Region Environmental Coordinator
Work - 919-546-6764
Home - 919-639-1066
Cellular - 919-417-1167
Pager - 1-800-932-0442

6.3 Customer notice, including bill insert and Internet site, will be coordinated by ESS. Point of Contact: Roberta Blue 919-546-6702

Best Management Practices

Best Management Practices (BMPS) have been prepared to assist in the planning and implementation of ground application programs. They are intended to supplement and not replace the pesticide labels. The practices should be used when the Integrated Vegetation Management control option indicates that herbicide applications are appropriate. The BMPS will ensure that practical measures are being taken to reduce pesticide use and risk in order to meet the objectives of the pesticide stewardship strategy.

1. The following factors should be considered in the planning of any herbicide application:

- Brush species
- Height and density of brush
- Current and adjacent land use
- Label restrictions
- Natural and man-made restrictions

2. The following chart can be used to aid in planning an application program:

	Average Height		Density		
Technique	< 8 ft.	> 8 ft.	Lt.	Med.	Heavy
Low volume foliar	Yes	No	Yes	Yes	No
High volume foliar	No	Yes	No	Yes	Yes
Low volume basal	Yes	Yes	Yes	Yes	No
Cut surface	No	Yes	Yes	Yes	No
Cut stubble	No	Yes	No	Yes	Yes
Mechanical	Yes	Yes	No	Yes	Yes
Granular	Yes	Yes	Yes	Yes	Yes

3. Follow herbicide label directions and any other supplemental label information provided by the manufacturer.

4. Only herbicides registered by the U.S. Environmental Protection Agency and the designated responsible state agency shall be used.

5. Material Safety Data Sheets should be consulted prior to selecting the herbicide(s) for use. Factors such as toxicity, potential health effects, efficacy and cost should be considered for the proposed herbicide(s) to be applied.

6. All herbicide applications shall be performed by certified applicators or under the direct supervision of certified applicators.

7. Selective spray techniques should be used wherever practical so that compatible vegetation is not impacted.

8. Where possible, herbicides should be measured and mixed with diluent prior to transfer to application personnel.

9. Herbicide containers should be returned to manufacturers for recycling or other permitted uses.

10. Transfer of herbicide mixtures should be made directly from shipping containers to holding tank and/or to spray equipment through closed transfer systems, where possible.

11. Minimum operating pressures should be used. Coarse nozzle tips should be used to minimize drift.

12. These special precautions should be observed during periods of inclement weather:

    - No applications should be made in, immediately prior to or immediately following rain.

    - No applications should be made when wind and/or fog conditions are likely to cause drift.

    - No applications should be made when dew is heavy on vegetation.

13. When making applications near water, crops, and/or other restrictions, spray patterns should be directed away from the sensitive area.

Attachment 2

<<Date>>

<<First Name>> <<Last Name>>
<<Address>>
<<City>>,<<State>><<Postal Code>>

Dear <<Mr./Ms.>><<Last Name>>:

Thank you for your interest in Progress Energy Carolinas, Inc.'s right of way management program. The enclosed document, "Agreement to Avoid Herbicide Application on Progress Energy Carolinas Right of Way", should be completed, as instructed, and returned to Progress Energy Carolinas at the designated address.

The Agreement requires that the easement on your property be posted, with the appropriate signs, within 35 days after the Agreement has been dated and signed. As soon as the executed document is received by Progress Energy Carolinas and the property has been properly posted, Progress Energy Carolinas will abide by the terms of the Agreement, for the duration, to provide right of way reclearing, on your property, without the use of herbicides. Please recognize there are continuing obligations you will have to comply with in keeping the Agreement. If you desire to continue the Agreement beyond the current expiration date, you should contact Progress Energy Carolinas 30 days prior to the expiration date. A new Agreement will be sent to you at this time.

Progress Energy Carolinas, Inc. is committed to providing safe, reliable and economical electrical service.. If you have further questions about our management procedures, please call <<Name & Phone number of the forester for the property owner's area>>.

Sincerely yours,

<< Area/Region Forester>>

Property Owner Posting Required to Comply with Non-herbicide Use Agreement

- The property owner is responsible for purchasing the steel posts. The steel posts may be purchased at hardware or home improvement stores.

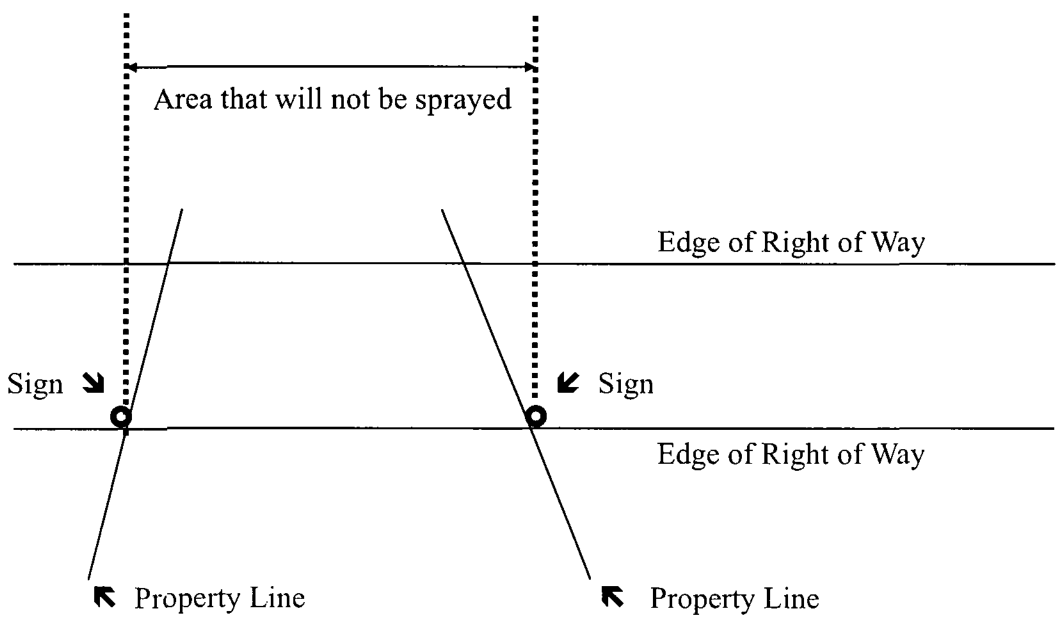
- Signs restricting the use of herbicides shall be mounted, by the property owner, approximately 2 inches from the top of steel posts that extend at least 6 feet out of the ground.

- Property owner is responsible for installing steel posts at the edge of the Progress Energy Carolinas right of way on your property. The total right of way on your property is ______ft. wide, or _____ft. each side of the centerline (middle) of the line.

- Two signs are required; one sign on the outer limits of property owner's property. Additional signs may be required if the easement area is not contiguous.

- The printed side of the signs must be maintained to ensure they face away from your property so that crews will see the sign as they approach your property.

- A three (3) foot radius, around the post, shall continually be cleared and maintained in such a manner that no brush obscures the visibility of the sign or post.



Response to RAI No. 1
Item 3

CP+L 1998b

CP&L

Memo

To: Mr. J. W. Johnson
Mr. J. C. Nuckles, Jr.
Mr. A. Eaddy

From: Cam Wheeler

Date: August 12, 1998

Subject: Threatened and Endangered Species
Self-Assessment Report

As earlier requested, attached are self assessment reports for compliance with threatened and endangered species at the three CP&L nuclear facilities. These assessments are in response to the NRC-issued report entitled "Threatened and Endangered Species for 75 Licensed Commercial Nuclear Power Generating Plants" (March 1997). The assessments have been prepared by the Biological Assessment Unit of the Environmental Services Section.

If there are questions, please let me know at Caronet 772-3288.

CCW/bjw

cc: Mr. G. B. Baird
Ms L. Cooper
Mr. W. R. Garrett
Mr. M. R. Greeson
Mr. R. S. Hobbs
Mr. K. T. Kirkland
[redacted]
Mr. T. E. Thompson
Mr. R. T. Wilson
Mr. R. C. Yates

CP&L

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Self Assessment of Carolina Power & Light Company's
Brunswick Steam Electric Plant for Compliance with
Threatened and Endangered Species
August 12, 1998

In March 1997, the Ecology Group of Pacific Northwest National Laboratory (PNNL) issued a report to the U.S. Nuclear Regulatory Commission entitled "Threatened and Endangered Species Evaluation for 75 Licensed Nuclear Power Generating Plants" (PNNL-11524). The purpose of the report was to evaluate the Nuclear Regulatory Commission's licensing of commercial nuclear generating facilities to determine compliance with the Endangered Species Act of 1973 (ESA). Such an evaluation was necessary because the ESA requires that federal agencies ensure that actions by one another do not jeopardize the species protected under the ESA.

The PNNL report included the Brunswick Steam Electric Plant and listed threatened and endangered species that might be impacted by plant activities. The PNNL assigned low, medium, or high priority for follow up regarding the potential for impacts to species at the nuclear facilities. Those facilities with a high-priority ranking were deemed, according to the PNNL report, in need of detailed follow-up evaluations before full ESA compliance can be assured. The Brunswick was given High Priority for sea turtles, manatees, terrestrial species, and other aquatic species.

The purpose of this CP&L self assessment is to evaluate the PNNL report to determine what activities by Brunswick personnel need to be considered for compliance with the ESA for any species actually or likely occurring on Company property at the site. Transmission rights-of-way were assessed only to the Company property boundary. Beyond the property boundary, CP&L has easements on power line corridors on land that is privately owned. However, any known locations on power line corridors in North Carolina of rare, threatened, or endangered species are protected by management agreement with the North Carolina Natural Heritage Program.

This self assessment was carried out by considering the species identified in the PNNL report, assessing the potential for their actual occurrence at the site, and what activities, if any, need to be considered to prevent such species impact. The CP&L self assessment compared the list of potential species from the PNNL report to the current federally protected species and any considered state threatened, endangered, and special concern species as listed by the North Carolina Natural Heritage Program.

The results of the self assessment for the Brunswick Steam Electric Plant are shown in Table 1. This table lists the species of animals and plants identified in the PNNL report, the current U.S. Fish & Wildlife Service list of protected species for North Carolina, and the species from the natural heritage program for North Carolina. The latter state list identifies species at the county level in which the nuclear facility is located. The status of each species (e.g., whether endangered, threatened, etc.) at the federal or state level is also identified in Table 1 showing their known occurrence in proximity to the nuclear plants (in some cases adjacent counties), and actions, if any, required to avoid impact to these species.

An evaluation was made of the species that reasonably could be impacted by plant activities. The results of the evaluation are provided in Exhibit 1. Recommended actions required of CP&L are also suggested.

A proposed modification addition to the Environmental Self-Assessment Program "Other Items" Compliance Checklist is included as Exhibit 2 as a means of continuing this assessment on an on-going basis.

Included as Exhibit 3 is the current federally listed plants and animals for North Carolina.

Attached as Exhibit 4 is a Literature Review and Sources Used for this self assessment.

<u>Summary</u>:

The report issued by the PNNL included species of plants and animals that were in part extracted from state natural heritage program lists, and were thus not federally endangered or threatened. For this reason, this CP&L self assessment was expanded to include reviews of currently listed endangered, threatened, special concern species, as well as other species designations made by heritage program staff of North Carolina. While this state list does not carry the same regulatory status as the federal U.S. Fish & Wildlife Service list, it is included in this self assessment to more accurately assess the species of concern. The state listed species have the potential for future federal listing and, hence, they are "candidate species."

The self-assessment evaluation of the Brunswick Steam Electric Plant shows there are six federally protected species that could be impacted by plant operations, facility expansion, or other activities. The results of the assessment show that the only known instances where nuclear plant operations are having an effect on a federally listed species are sea turtles at the Brunswick Steam Electric Plant. In that case, CP&L is currently cooperating with the Nuclear Regulatory Commission and the National Marine Fisheries under a Section 7 Consultation of the Endangered Species Act. Resolution is expected later in 1998.

Ongoing communication, regarding activities that potentially could affect threatened and endangered species, is recommended between plant personnel and personnel in CP&L's Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Exhibit 1. Federally Protected Species at or near CP&L's Brunswick Steam Electric Plant Requiring Action to Prevent Impact to Species

Species	Recommendations for Reducing Impact to Listed Species*
Red-cockaded woodpecker	Facility expansion or construction requiring removal of pine trees requires on-site assessment for occurrence.
Loggerhead sea turtle	Potential for impingement; blocker panel maintenance; canal patrols
Green sea turtle	Potential for impingement; blocker panel maintenance; canal patrols
Kemp's Ridley sea turtle	Potential for impingement; blocker panel maintenance; canal patrols
Rough-leaved loosestrife (plant)	Population is known on ROW off site and is protected and managed by CP&L in agreement with N.C. Natural Heritage Program.
Cooley's meadowrue (plant)	Population is known on ROW off site and is protected and managed by CP&L in agreement with N.C. Natural Heritage Program.

*Note: CP&L resources for consultation include personnel in the Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Under the Endangered Species Act, a Section 7 Consultation among federal agencies is required if a listed species is being impacted. One avenue for resolution includes an incidental take statement.

Exhibit 3. U.S. Fish & Wildlife Service List of Endangered and Threatened Species in North Carolina.

North Carolina--53 species

Animals--27 species

E - Bat, Indiana (*Myotis sodalis*)
E - Bat, Virginia big-eared (*Plecotus townsendii virginianus*)
E - Butterfly, Saint Francis' satyr (*Neonympha mitchellii francisci*)
T - Chub, spotfin (=turquoise shiner) (*Cyprinella (=Hybopsis) monacha*)
T - Eagle, bald (*Haliaeetus leucocephalus*)
E - Elktoe, Appalachian (*Alasmidonta raveneliana*)
E - Falcon, American peregrine (*Falco peregrinus anatum*)
E - Heelsplitter, Carolina (*Lasmigona decorata*)
E - Manatee, West Indian (=Florida) (*Trichechus manatus*)
E - Mussel, dwarf wedge (*Alasmidonta heterodon*)
E - Pearlymussel, little-wing (*Pegias fabula*)
E - Plover, piping (*Charadrius melodus*)
E - Shiner, Cape Fear (*Notropis mekistocholas*)
T - Shrew, Dismal Swamp southeastern (*Sorex longirostris fisheri*)
T - Silverside, Waccamaw (*Menidia extensa*)
T - Snail, noonday (*Mesodon clarki nantahala*)
E - Spider, spruce-fir moss (*Microhexura montivaga*)
E - Spinymussel, Tar River (*Elliptio steinstansana*)
E - Squirrel, Carolina northern flying (Glaucomys sabrinus coloratus)
E - Tern, roseate (*Sterna dougallii dougallii*)
E - Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)
T - Turtle, green sea (*Chelonia mydas*)
E - Turtle, hawksbill sea (*Eretmochelys imbricata*)
E - Turtle, leatherback sea (*Dermochelys coriacea*)
T - Turtle, loggerhead sea (*Caretta caretta*)
E - Wolf, red (*Canis rufus*)
E - Woodpecker, red-cockaded (*Picoides borealis*)

Plants--26 species

E - American chaffseed (*Schwalbea americana*)
T - Blue Ridge goldenrod (*Solidago spithamaea*)
E - Bunched arrowhead (*Sagittaria fasciculata*)
E - Canby's dropwort (*Oxypolis canbyi*)
E - Cooley's meadowrue (*Thalictrum cooleyi*)
T - Dwarf-flowered heartleaf (*Hexastylis naniflora*)
E - Green pitcher-plant (*Sarracenia oreophila*)
E - Harperella (*Ptilimnium nodosum (=fluviatile)*)
T - Heller's blazingstar (*Liatris helleri*)

E - Michaux's sumac (*Rhus michauxii*)
T - Mountain golden heather (*Hudsonia montana*)
E - Mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*)
E - Pondberry (*Lindera melissifolia*)
E - Roan Mountain bluet (*Hedyotis purpurea* var. *montana*)
E - Rock gnome lichen (*Gymnoderma lineare*)
E - Rough-leaved loosestrife (*Lysimachia asperulaefolia*)
E - Schweinitz's sunflower (*Helianthus schweinitzii*)
T - Seabeach amaranth (*Amaranthus pumilus*)
T - Sensitive joint-vetch (*Aeschynomene virginica*)
T - Small whorled pogonia (*Isotria medeoloides*)
E - Small-anthered bittercress (*Cardamine micranthera*)
E - Smooth coneflower (*Echinacea laevigata*)
E - Spreading avens (*Geum radiatum*)
T - Swamp pink (*Helonias bullata*)
T - Virginia spiraea (*Spiraea virginiana*)
E - White irisette (*Sisyrinchium dichotomum*)

Code:
E = Endangered
T = Threatened

Exhibit 4. Literature Review and Sources Used for Self Assessment.

Amoroso, Jame L. 1997. Natural Heritage Program List of the Rare Plant Species of North Carolina. N.C. Department of Environment, Health and Natural Resources, Raleigh, N.C.

Amoroso, Jame L. N.C. Department of Environment, Health and Natural Resources, Raleigh, N.C. Personal Communications. June 16, 1998, with Richard C. Yates (CP&L).

LeGrand, Harry E. N.C. Department of Environment, Health and Natural Resources, Raleigh, N.C. Personal Communications. June 16, 1998, with Richard C. Yates (CP&L).

LeBlond, Richard J. 1995. Inventory of the Natural Areas and Rare Species of Brunswick County North Carolina. N.C. Department of Environment, Health and Natural Resources, Raleigh.

LeGrand, Harry E., and Stephen P. Hall. 1997. Natural Heritage Program List of the Rare Animal Species of North Carolina. N.C. Department of Environment, Health and Natural Resources, Raleigh.

North Carolina Natural Heritage Program. 1995. Natural Heritage Areas Priority List. N.C. Department of Environment, Health and Natural Resources, Raleigh.

North Carolina Natural Heritage Program. 1997. County Species List. N.C. Department of Environment, Health and Natural Resources, Raleigh.

Sackschewsky, M. R. 1997. Threatened and Endangered Species Evaluation for 75 Licensed Commercial Nuclear Power Generating Plants. Pacific Northwest National Laboratory, Richland, WA.

United States Fish & Wildlife Service. 1998. Endangered Species Home Page [Internet Site]. http://www.fws.gov/r9endspp/endspp.html

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8/12/98

Table 1. Evaluation of Threatened and Endangered Species Reported at Carolina Power and Light Company's Brunswick Steam Electric Plant.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Birds					
Aimophila aestivalis	Bachman's sparrow	FSC/SC	Not known on site.	None known	Coastal plain and piedmont species; open longleaf pine forests and old fields Documented in the longleaf pine savannas of the Green Swamp in central Brunswick Co.
Ammodramus henslowii	Henslow's sparrow	FSC/SR	Transitory on site. Has been sighted in the surrounding Southport/Oak Island area during the annual Christmas bird count since 1987.	None known	Coastal plain species; clearcut pososins and other damp weedy fields
Charadrius melodus	piping plover	T/T	Transitory on site. One specimen has occasionally been sighted in the BSEP's return basin during the annual Christmas bird count since 1987.	None known	Tidewater areas: ocean beaches and island-end flats
Falco peregrinus	peregrine falcon	E/E	Transitory on site. Has been sighted in the surrounding Southport/Oak Island area during the annual Christmas bird count since 1987.	None known	Cliffs (for nesting); coastal ponds and mudflats
Haliaeetus leucocephalus	bald eagle	T/E	Transitory on site.	None known	Mature forests near large

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
			Has been sighted in the surrounding Southport/Oak Island area during the annual Christmas bird count since 1987.		bodies of water; lakes and sounds
Mycteria americana	wood stork	E/E	Not known on site as a regular visitor. Company biologist observed two specimens in the BSEP return basin for a period of 2-3 days during 1987.	None known	Tidewater areas: fresh or brackish ponds
Passerina ciris ciris	Eastern painted bunting	FSC/SR	Company biologist have routinely observed this species foraging along the intake canal road. Has also been observed along the discharge canal at Caswell Beach.	None known	Tidewater areas: maritime shrub thickets and forest edges
Picoides borealis	red-cockaded woodpecker	E/E	Historically known near site. Has been sighted in the surrounding Southport/Oak Island area during the annual Christmas bird count since 1987.	None known	Facility expansion involving removal of large, old long-leaf pine trees will need to be assessed for its occurrence
Sterna dougalii dougalii +	roseate tern	E/E	Not known on site.	None known	sand flats on maritime islands
Insects					
Agrotis nr. *buchholzi*	Buchholzi' dart moth	FSC/SR	Not known on site.	None known	Flatwoods with pixie moss in the coastal plain

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Problema bulenta	Rare skipper	FSC/SR	Not known on site.	None known	Fresh to brackish marshes in the Wilmington area. Host plant is southern wild rice.
Neonympha mitchellii francisci +	Saint Francis' satyr butterfly	E/SR	Not known on site	None known	Boggy areas, beaver ponds, and pocosin margins with sedges in sandhills. Host plant sedges.
Clams					
Elliptio waccamawensis	Waccamaw spike (mussel)	FSC/T	Not known on site	None known	Lake Waccamaw and vicinity
Snails					
*Planorbella magnifica *(N)*	magnificent rams-horn	FSC/E	Not known on site	None known	The only two remaining populations known are located at Orton Pond and on the Pleasant Oaks Plantation north of the BSEP.
*Helisoma eucosmium = Taphius eucosmius eucosmius *(N)*	Greenfield rams-horn	FSC/SR	Not known on site	None known	The only known remaining population is located in Town Creek, north of the BSEP.
*Triodopsis soelneri *(N)*	Cape Fear threetooth	FSC/T	Not known on site	None known	Swampy habitats in the extreme southeastern corner of the state. Endemic to North Carolina. Has been documented at Sunny Point Military Ocean Terminal (MOTSU).
Amphibians					
Rana areolata capito (=R. capito capito)	Carolina crawfish frog (= gopher frog)	FSC/SC	Not known on site	None known	Breeds in temporary fish-free pools; forages in sandy woods, especially pine-oak sandhills Species has been documented at MOTSU and the White Spring Ponds complex located along the MOTSU access road.
Reptiles					
Caretta caretta	loggerhead sea turtle	T/T	Has been collected in	Potential for entrapment	Nest on local beaches. Forages

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
			the intake canal	on the trash racks at the Plant. Intake modifications to reduce impingement of organisms including turtle blocker panels should minimize entry into the intake canal. Procedures are in place for the live capture, tagging, and release of sea turtles should one enter the canal.	in the middle and lower estuary. CP&L has participated in section 7 consultation with the NRC, USFWS, and the NMFS (January 1998).
Chelonia mydas	green sea turtle	T/T	Has occasionally been collected in the intake canal.	Same as for *Caretta caretta*.	Same as for *Caretta caretta*.
Dermochelys coriacea	leatherback sea turtle	E/E	None on site	None known	Remains in the ocean, rarely enters the estuary.
Eretmochelys imbricata	hawksbill sea turtle	E/E	None on site	None known	Remains in the ocean, rarely enters the estuary.
Lepidochelys kempii	Kemp's Ridley sea turtle	E/E	Has occasionally been collected in the intake canal.	Same as for *Caretta caretta*.	Same as for *Caretta caretta*.
Ophisaurus mimicus	mimic glass lizard	FSC/SC	Not known on site	None known	Habitat is pine flatwoods, pine/oak sandhills, other pine-oak forests
Pituophis melanoleucus melanoleucus	Northern pine snake	FSC/SC	Not known on site	None known	Habitat is dry and sandy woods, mainly pine-oak sandhills
*Alligator mississippiensis**	American alligator	T(SA)/T	Widespread distribution in the Walden Creek, Intake and Discharge canals	None known. No alligator has ever died as a result of operation of the BSEP. Construction and timbering activities may disturb nest sites.	The American alligator is listed as threatened solely due to similarity of appearance with other rare crocodilians. This species is not biologically endangered or threatened and is not subject to section 7 consultation.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
*Malaclemys terrapin centrata**	Carolina diamondback terrapin	/SC	Has occasionally been collected in Walden Crk. And the intake canal during biological sampling.	Potential for impingement of adults. Intake modifications designed to reduce impingement should minimize impact.	Salty or brackish marshes, southern half of the coast
Sistrurus miliarius	Pigmy rattlesnake *	/SR	Not known on site. Closest documented location was approximately 1-mile west of the Plant site adjacent to H.W. 133.	None known.	Pine flatwoods, pine/oak sandhills, other pine/oak forest Proposed for SC status but not adopted by NCWRC. Species is protected from taking.
Fishes					
Acipenser brevirostrum	shortnose sturgeon	E/E	Species is known from the lower Cape Fear river and thus the larvae and adults could be vulnerable to plant impact during spawning in late winter to early spring	None known; population is small and no individuals have ever been collected at BSEP.	Nine adults have been captured in the Cape Fear since 1987
Acipenser oxyrhynchus *	Atlantic sturgeon	/SC	Has occasionally been collected during biological sampling at the BSEP	Potential entrainment of larvae and impingement of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential impact.	Spawns in the upper Cape Fear River Estuary. Historically, this species was commercially fished in the Brunswick River.
Elassoma boehlkei	Carolina pigmy sunfish	FSC/T	Not known on site	None known	Unsuitable habitat; fresh water
Menidia extensa	Waccamaw silverside	T/T	Not known on site	None known	Unsuitable habitat; fresh water
Hypsoblennius ionthas *	freckled blenny	/SR	Has occasionally been collected during	potential entrainment of larvae and impingement	Prefers oyster reefs and hard substrates in the middle and

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
			biological sampling at the BSEP	of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential impact.	lower estuary. Ranges from North Carolina to the northern Gulf of Mexico.
Microphis brachyurus *	opposum pipefish	/SR	Has occasionally been collected during biological sampling at the BSEP	Potential entrainment of larvae and impingement of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential impact.	Ranges from North Carolina to the northern Gulf of Mexico. Species is rare throughout its entire range.
Eleotris pisonis *	spinycheek sleeper	/SR	Has occasionally been collected during biological sampling at the BSEP	Potential entrainment of larvae and impingement of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential impact.	Fresh to brackish ponds and estuaries; This species is at the extreme northern end of its range , thus this species is not abundant.
Evorthodus lyricus *	lyre goby	/SR	Has occasionally been collected during biological sampling at the BSEP	Potential entrainment of larvae and impingement of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential impact.	Shallow tidal water, salt marsh pools. This species is at the extreme northern end of its range, thus this species is not abundant.
Gobionellus stigmaticus *	marked goby	/SR	Has occasionally been collected during biological sampling at the BSEP.	Potential entrainment of larvae and impingement of adults. Intake modifications designed to reduce entrainment and impingement should minimize potential	Shallow salt and brackish water This species is at the extreme northern end of its range, thus this species is not abundant.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
				impact.	
Mammals					
Felis concolor cougar	eastern cougar	E/E	Unconfirmed sightings on property in last three years.	None known	Extensive forest, remote areas
Trichechus manatus	West Indian manatee	E/E	Not known on site	None known	Warm estuarine waters, river mouths
Sorex longirostris fisheri +	Dismal Swamp Southeastern shrew	T/T	Not known on site	None known	Woodlands and brushy fields, especially where damp, in lower coastal plain
Plants					
Asclepias pedicellata *	savanna milkweed	/C	Not known on site	None known	Known in Brunswick County; dry savannas and moist flatwoods
Amaranthus pumilus	seabeach amaranth	T/T	Not known on site	None known	Occurs on ocean beaches and island-end flats including Brunswick County
Amorpha georgiana confusa *	savanna indigo bush	FSC/T	Not known on site	None known	Known in Brunswick County; wet savannas
Amorpha georgiana georgiana	Georgia indigo bush = Georgia lead-plant	FSC/T	Not known on site	None known	Possible suitable habitat of wet savannas on site
Asplenium heteroresiliens	Carolina spleenwort	FSC/E	Not known on site	None known	Not known in Brunswick County.
Astragalus michauxii	Sandhills milkvetch	FSC/C-PT	Not known on site	None known	Not known in Brunswick County
Balduina atropupurea	honeycomb head	SC/C	Not known on site	None known	Known *only* in Brunswick County in savannas
Campylopus carolinae	savannah campylopus	SC/C	Not known on site	None known	Known in Brunswick County in sandhills and savannas
Carex chapmanii	Chapman's sedge	SC/W1	Not known on site	None known	Known in Brunswick County in moist bottomlands; associated with marl
Dichanthelium	erectleaf witch grass	/SR	Not known on site	None known	Known in Brunswick County;

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
erectifolium *					wet savannas
Dionaea muscipula	Venus flytrap	SC/C-SC	Known on power line ROWs from BSEP	None known	Expansion or construction activities need to consider possible presence of this species;
Eleocharis robbinsii *	Robbin's spikerush	/C	Not known on site	None known	Known in Brunswick County; limesink and beaver ponds and lakes
Eleocharis rostellata *	beaked spikerush	/C	Not known on site	None known	Known in Brunswick County; brackish marshes, limesink ponds
Eupatorium leptophyllum *	limesink dog fennel	/C	Not known on site	None known	Known in Brunswick County; limesink ponds and clay based Carolina bays
Fimbristylis perpusilla	Harper's fimbry	SC/T	Not known on site	None known	Known to exist in drawndown zones of blackwater rivers; occurs in Brunswick and Columbus counties
Helianthus schweinitzii	Schweinitz's sunflower	E/E	Not known on site	None known	Unsuitable habitat; nearest population is in the Piedmont N.C.
Kalmia cuneata	white-wicky	SC/E-SC-PC	Not known on site	None known	Unsuitable habitat; not known in Brunswick County
Lachnocaulon beyrichianum *	southern bogbutton	/SR	Not known on site	None known	Known in Brunswick County; sandhills, sandhill/pocosin ecotones
Lilaeopsis carolinensis *	Carolina grasswort	/T	Not known on site	None known	Known in Brunswick County; freshwater marshes and pools
Lindera melissifolia	pondberry (=Southern spicebush)	E/E	Not known on site	None known	Unsuitable habitat; not known in Brunswick County
Litsea aestivalis	pondspice	SC/C	Not known on site	None known	Species is known in Brunswick County; habitat is lime sinkponds and pools
Ludwigia linifolia *	flaxleaf seedbox	/SR	Not known on site	None known	Known in Brunswick County; limesink ponds
Ludwigia suffruticosa *	shrubby seedbox	/SR	Not known on site	None known	Limesink ponds, clay-based

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
					Carolina bays
Lysimachia asperulaefolia	rough-leaved loosestrife	E/E	Known on BSEP power line ROWs off site	On site: none known; the off-site population is registered and protected with the N.C. Natural Heritage Program	Known in Brunswick County pocosin/savanna ecotones
Macbridea caroliniana	Carolina birds-in-a-nest (=Carolina bogmint)	SC/C-PT	Not known on site	None known	Species is present in Brunswick County; habitat is possibly on the site
Myriophyllum laxum	loose watermilfoil	FSC/T	Not known on site	None known	Known in Brunswick County; habitat is limesink ponds and natural lakes
Oxypolis canbyi	Canby's dropwort (=Canby's cowbane)	E/E	Not known on site	None known	Nearest population is Scotland County; clay-based Carolina bays habitat
Oxypolis ternata	Savanna cowbane (= Piedmont cowbane = = Canby's cowbane)	SC/W	Not known on site	None known	Pine savannas/sandhills seeps
Panicum tenerum *	southeastern panic grass	/SR	Not known on site	None known	Known in Brunswick County; wet savannas and limesink ponds
Parnassia caroliniana	Carolina grass-of-parnassus	SC/E	Not known on site	None known	Known in Brunswick County in wet savannas
Peltandra saggitifolia *	spoonflower	/SR	Not known on site	None known	Known in Brunswick County; pocosins, other wet peaty sites
Plantago sparsiflora	pineland plantain	SC/E	Not known on site	None known	Known in Brunswick County in wet savannas
Polygonum hirsutum *	hairy smartweed	/SR	Not known on site	None known	Known in Brunswick County; limesink ponds, clay-based Carolina bays, drawdown zones of blackwater riverbanks
Rhexia aristosa	awned meadow-beauty	SC/T	Not known on site	None known	Known in Brunswick County; habitat is clay-based Carolina bays and limesink ponds
Rhexia cubensis *	West Indies meadow-beauty	/SR	Not known on site	None known	Known in Brunswick County; limesink ponds
Rhynchospora decurrens	swamp forest beaked-rush	SC/C	Not known on site	None known	Known in Brunswick County;

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
	(=beaksedge)				habitat is swamp forest
Rhynchospora pleiantha *	coastal beaksedge	/C	Not known on site	None known	Known in Brunswick County; limesink ponds
Rhynchospora scirpoides *	long-beak baldsedge	/SR	Not known on site	None known	Known in Brunswick County; limesink and beaver ponds, wet savannas
Rhynchospora thornei	Thorne's beaked-rush (=beaksedge)	SC/C-PE	Not known on site	None known	Known in Brunswick County; habitat wet savannas
Rhynchospora traceyi *	Tracy's beaksedge	/SR	Not known on site	None known	Known in Brunswick County; limesink ponds, clay-based Carolina bays
Rudbeckia heliopsidis	blackeyed Susan (=sun-facing coneflower)	SC/E	Not known on site	None known	Not known in Brunswick County; habitat is pine flatwoods and woodland borders in Moore and Harnett counties
Sagittaria isoetiformis *	quillwort arrowhead	/SR	Not known on site	None known	Known in Brunswick County; limesink and beaver ponds, clay-based Carolina bays, natural lakes
Schwalbea americana	American chaffseed	E/E	Not known on site	None known	Not know in Brunswick County; habitat is moist to dry pinelands with frequent fires
Scleria georgiana *	Georgia nutrush	/SR	Not known on site	None known	Known in Brunswick County; savannas
Solidago pulchra	Carolina goldenrod	SC/E	Not known on site	None known	Known in Brunswick County; savannas
Solidago verna	spring-flowering goldenrod	SC/E-PT	Not known on site	None known	Known in Brunswick County; habitat is mesic to moist pinelands and pocosin ecotones
Sporobolus teretifolius	wireleaf dropseed	FSC/T	Not known on site	None known	Known in only Brunswick and Columbus counties; habitat is wet savannas
Sphagnum fitzgeraldii *	Fitzgerald's peatmoss	/SR	Not known on site	None known	Known in Brunswick County; pocosins and savannas
Stylisma pickeringii (=Bonanmia)	Pickering's morning-glory (=dawnflower)	SC/E	Not known on site	None known	Unsuitable habitat; known in sandhills counties

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Thalictrum cooleyi	Cooley's meadowrue	E/E	Known power line ROWs off-site	Species is managed under ROWs in agreement with the N.C. Natural Heritage Program	Habitat is wet savannas; facilities expansion or additional power lines would require assessments
Tofieldia glabra	smooth bog-asphodel (= Carolina asphodel)	SC/C	Not known on site	None known	Known in Brunswick County; habitat is savannas, moist sandhills, and pocosin ecotones
Trichostema sp.1	blue curls (=dune bluecurls), undescribed species	SC/C	Not known on site	None known	Known in Brunswick County; habitat is dunes, openings in maritime forest and scrub.
*Utricularia olivacea**	dwarf bladderwort	/T	Not known on site	None known	Known in Brunswick County; limesink and beaver ponds
Xyris brevifolia *	shortleaf yellow-eyed grass	/SR	Not known on site	None known	Known in Brunswick County; savannas, other wet areas

Key:
C—Probable candidate for endangered or threatened status
C-PE—Candidate for proposed endangered status
C-PT—Candidate for proposed threatened status
C-SC—Candidate for Special Concern status
E—Endangered
E-PT—Currently endangered but a candidate for proposed threatened status
FSC—Federal Species of Concern
PC—Proposed candidate for listing status
SC—Special concern
SR—Significantly rare
T—Threatened
T(S/A)—Threatened due to Similarity of Appearance
W—State of N.C. "Watch" list

Species with no superscript designation are the species identified in the Pacific Northwest National Laboratory report for the NRC. A few species are dually listed on the PNNL report AND a state list; those are identified with an "N," meaning the PNNL report for the NRC.

Species noted with an asterisk (*) are listed by the State of N. C. Natural Heritage Program. No location data of these species is to be distributed to the general public (i.e., through newspapers, magazines, etc.) without the permission from the N. C. Natural Heritage Program of the North Carolina Department of Environment and Natural Resources. Species noted with a (+) are listed on the U. S. Fish and Wildlife Service, Region 4 endangered species list for North Carolina.

++CP&L resources for contact by plant personnel for updated information include personnel in the Environmental Services Section, Real Estate Management Section, and Transmission Department.

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Self Assessment of Carolina Power & Light Company's
Harris Nuclear Plant for Compliance with
Threatened and Endangered Species
August 12, 1998

In March 1997, the Ecology Group of Pacific Northwest National Laboratory (PNNL) issued a report to the U.S. Nuclear Regulatory Commission entitled "Threatened and Endangered Species Evaluation for 75 Licensed Nuclear Power Generating Plants" (PNNL-11524). The purpose of the report was to evaluate the Nuclear Regulatory Commission's licensing of commercial nuclear generating facilities to determine compliance with the Endangered Species Act of 1973 (ESA). Such an evaluation was necessary because the ESA requires that federal agencies ensure that actions by one another do not jeopardize the species protected under the ESA.

The PNNL report included the Harris Nuclear Plant and listed threatened and endangered species that might be impacted by plant activities. The PNNL assigned low, medium, or high priority for follow up regarding the potential for impacts to species at the nuclear facilities. Those facilities with a high-priority ranking were deemed, according to the PNNL report, in need of detailed follow-up evaluations before full ESA compliance can be assured. The Harris was given High Priority for the Cape Fear shiner (a fish), the red-cockaded woodpecker, rare plants, etc.

The purpose of this CP&L self assessment is to evaluate the PNNL report to determine what activities by Harris plant personnel need to be considered for compliance with the ESA for any species actually or likely occurring on Company property at the site. Transmission rights-of-way were assessed only to the Company property boundary. Beyond the property boundary, CP&L has easements on power line corridors on land that is privately owned. However, any known locations on power line corridors in North Carolina of rare, threatened, or endangered species are protected by management agreement with the North Carolina Natural Heritage Program.

This self assessment was carried out by considering the species identified in the PNNL report, assessing the potential for their actual occurrence at the site, and what activities, if any, need to be considered to prevent such species impact. The CP&L self assessment compared the list of potential species from the PNNL report to the current federally protected species and any considered state threatened, endangered, and special concern species as listed by the North Carolina Natural Heritage Program.

The results of the self assessment for the Harris Nuclear Plant are shown in Table 1. This table lists the species of animals and plants identified in the PNNL report, the current U.S. Fish & Wildlife Service list of protected species for North Carolina, and the species from the natural heritage program for North Carolina. The latter state list identifies species at the county level in which the nuclear facility is located. The status of each species (e.g., whether endangered, threatened, etc.) at the federal or state level is also identified in Table 1 showing their known occurrence in proximity to the nuclear plants (in some cases adjacent counties), and actions, if any, required to avoid impact to these species.

An evaluation was made of the species that reasonably could be impacted by plant activities. The results of the evaluation are provided in Exhibit 1. Recommended actions required of CP&L are also suggested.

A proposed modification addition to the Environmental Self-Assessment Program "Other Items" Compliance Checklist is included as Exhibit 2 as a means of continuing this assessment on an on-going basis.

Included as Exhibit 3 is the current federally listed plants and animals for North Carolina.

Attached as Exhibit 4 is a Literature Review and Sources Used for this self assessment.

<u>Summary</u>:

The report issued by the PNNL included species of plants and animals that were in part extracted from state natural heritage program lists, and were thus not federally endangered or threatened. For this reason, this CP&L self assessment was expanded to include reviews of currently listed endangered, threatened, special concern species, as well as other species designations made by heritage program staff of North Carolina. While this state list does not carry the same regulatory status as the federal U.S. Fish & Wildlife Service list, it is included in this self assessment to more accurately assess the species of concern. The state listed species have the potential for future federal listing and, hence, they are "candidate species."

The self-assessment evaluation of the Harris Nuclear Plant shows there is one federally protected species that could be impacted by plant operations, facility expansion, or other activities.

Ongoing communication, regarding activities that potentially could affect threatened and endangered species, is recommended between plant personnel and personnel in CP&L's Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Exhibit 1. Federally Protected Species at or near CP&L's Harris Nuclear Plant Requiring Action to Prevent Impact to Species

Species	Recommendations for Reducing Impact to Listed Species*
Red-cockaded woodpecker	Facility expansion or construction requiring removal of pine trees requires assessment for occurrence on site of this species.

*Note: CP&L resources for consultation include personnel in the Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Under the Endangered Species Act, a Section 7 Consultation among federal agencies is required if a listed species is being impacted. One avenue for resolution includes an incidental take satement.

Exhibit 2

ENVIRONMENTAL SELF-ASSESSMENT PROGRAM

OTHER ITEMS

COMPLIANCE CHECKLIST

Completed by ______________________ Date______________

ENDANGERED SPECIES

1. Has the Environmental Services Section identified any new endangered or threatened species which may be potentially impacted by plant operations, maintenance, or facility expansion? (Contact Environmental Services Section for update.) YES ( ) NO ( )

Comments:

If yes, describe:

2. Are any endangered or threatened species or endangered or threatened species habitats being impacted by operation (other than those addressed by existing Biological Opinions), by planned maintenance, or future modification or expansion of the nuclear facility? (Consult Environmental Services Section, Real Estate Management Section, and Transmission Department.) YES ( ) NO ( )

Comments:

If yes, describe:

3. If the answer to number 2 above is "yes," what actions have been taken by the nuclear plant personnel to eliminate impacts to endangered or threatened species, which are occurring on plant property?

   Comments:

   Describe actions taken:

   (For example, did you alter plans after contacting personnel in CP&L's Environmental Services Section, Real Estate Management Section, and the Transmission Department?)

Exhibit 3. U.S. Fish & Wildlife Service List of Endangered and Threatened Species in North Carolina.

North Carolina--53 species

Animals--27 species

E - Bat, Indiana (*Myotis sodalis*)
E - Bat, Virginia big-eared (*Plecotus townsendii virginianus*)
E - Butterfly, Saint Francis' satyr (*Neonympha mitchellii francisci*)
T - Chub, spotfin (=turquoise shiner) (*Cyprinella (=Hybopsis) monacha*)
T - Eagle, bald (*Haliaeetus leucocephalus*)
E - Elktoe, Appalachian (*Alasmidonta raveneliana*)
E - Falcon, American peregrine (*Falco peregrinus anatum*)
E - Heelsplitter, Carolina (*Lasmigona decorata*)
E - Manatee, West Indian (=Florida) (*Trichechus manatus*)
E - Mussel, dwarf wedge (*Alasmidonta heterodon*)
E - Pearlymussel, little-wing (*Pegias fabula*)
E - Plover, piping (*Charadrius melodus*)
E - Shiner, Cape Fear (*Notropis mekistocholas*)
T - Shrew, Dismal Swamp southeastern (*Sorex longirostris fisheri*)
T - Silverside, Waccamaw (*Menidia extensa*)
T - Snail, noonday (*Mesodon clarki nantahala*)
E - Spider, spruce-fir moss (*Microhexura montivaga*)
E - Spinymussel, Tar River (*Elliptio steinstansana*)
E - Squirrel, Carolina northern flying (Glaucomys sabrinus coloratus)
E - Tern, roseate (*Sterna dougallii dougallii*)
E - Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)
T - Turtle, green sea (*Chelonia mydas*)
E - Turtle, hawksbill sea (*Eretmochelys imbricata*)
E - Turtle, leatherback sea (*Dermochelys coriacea*)
T - Turtle, loggerhead sea (*Caretta caretta*)
E - Wolf, red (*Canis rufus*)
E - Woodpecker, red-cockaded (*Picoides borealis*)

Plants--26 species

E - American chaffseed (*Schwalbea americana*)
T - Blue Ridge goldenrod (*Solidago spithamaea*)
E - Bunched arrowhead (*Sagittaria fasciculata*)
E - Canby's dropwort (*Oxypolis canbyi*)
E - Cooley's meadowrue (*Thalictrum cooleyi*)
T - Dwarf-flowered heartleaf (*Hexastylis naniflora*)
E - Green pitcher-plant (*Sarracenia oreophila*)
E - Harperella (*Ptilimnium nodosum (=fluviatile)*)
T - Heller's blazingstar (*Liatris helleri*)

E - Michaux's sumac (*Rhus michauxii*)
T - Mountain golden heather (*Hudsonia montana*)
E - Mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*)
E - Pondberry (*Lindera melissifolia*)
E - Roan Mountain bluet (*Hedyotis purpurea* var. *montana*)
E - Rock gnome lichen (*Gymnoderma lineare*)
E - Rough-leaved loosestrife (*Lysimachia asperulaefolia*)
E - Schweinitz's sunflower (*Helianthus schweinitzii*)
T - Seabeach amaranth (*Amaranthus pumilus*)
T - Sensitive joint-vetch (*Aeschynomene virginica*)
T - Small whorled pogonia (*Isotria medeoloides*)
E - Small-anthered bittercress (*Cardamine micranthera*)
E - Smooth coneflower (*Echinacea laevigata*)
E - Spreading avens (*Geum radiatum*)
T - Swamp pink (*Helonias bullata*)
T - Virginia spiraea (*Spiraea virginiana*)
E - White irisette (*Sisyrinchium dichotomum*)

Code:
E = Endangered
T = Threatened

Exhibit 4. Literature Review and Sources Used for Self Assessment.

Amoroso, Jame L. 1997. Natural Heritage Program List of the Rare Plant Species of North Carolina. N.C. Department of Environment, Health and Natural Resources, Raleigh, N.C.

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Sackschewsky, M. R. 1997. Threatened and Endangered Species Evaluation for 75 Licensed Commercial Nuclear Power Generating Plants. Pacific Northwest National Laboratory, Richland, WA.

United States Fish & Wildlife Service. 1998. Endangered Species Home Page [Internet Site]. http://www.fws.gov/r9endspp/endspp.html

8/12/98

Table 1. Evaluation of Threatened and Endangered Species Reported at Carolina Power and Light Company's Harris Nuclear Plant.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Birds					
Aimophila aestivalis	Bachman's sparrow	SC/SC	Recorded near the confluence of Buckhorn Creek and the Cape Fear River.	None known	Open long-leaf pine forest, open fields
Haliaeetus leucocephalus	bald eagle	T/E	Occasional siting around the lake. No known nesting.	None known	Mature forest near large bodies of water
Lanius ludovicianus	loggerhead shrike	/SC	Not known on site	None known	Fields and pastures
Picoides borealis	red-cockaded woodpecker	E/E	Historically known near plant site	None known	Facility expansion involving removal of large pine trees need to be assessed for its occurrence
Vermivora bachmanii	Bachman's warbler	E/E	Not known on site	None known	Incidental visits to piedmont. Densely wooded swamps and thickets in S.C., Ala, Ark, and Mi.
Clams/Mollusks/ Bivalves					
Alasmidonta heterodon	dwarf wedge mussel	E/E	Not known on site	None known	Found in Tar and Neuse River drainages near Fall Line
Alasmidonta varicosa	brook floater	SC/T	Not known on site	None known	Found in Piedmont systems and along Blue Ridge Escarpment of Catawba River system
Elliptio judithae (included as a taxon within *E. roanokensis*)	Neuse slabshell (= Roanoke slabshell)	/T	Not known	None known	Cape Fear north to the Roanoke river systems
Elliptio lanceolata	yellow lance	FSC/T	Not known on site	None known	Found in Tar and Neuse River drainages near Fall Line

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Elliptio steinstansana	Tar spinymussel= Tar River spiny mussel	E/E	Not known on site	None known	Found in Tar River drainage (Swift Creek)
Fusconaia masoni	Atlantic pigtoe	FSC/T	Not known on site	None known	In lower Piedmont and Coastal Plain, including Black River
Lampsilis cariosa	Yellow lampmussel	FSC/T	Not known on site	None known	A number of river systems; mainly near the Fall Line
Lasmigona subviridis	Green floater	FSC/E	Not known on site	None known	Known in Cape Fear River system
*Strophitus undulatus**	Squawfoot	/T	Recorded in Buckhorn Crk. Downstream of Harris Lake	None known	Found in the Tar, Neuse, Cape Fear, and Pee Dee river systems
Fishes					
Acipenser brevirostrum	shortnose sturgeon	E/E	Known from Pee Dee and Cape Fear rivers	No impact	Remains in the lower Cape Fear near the head of the Estuary just north of Wilmington. Nine have been collected near Wilmington since 1987.
Moxostoma robustum	robust redhorse	FSC/SC	Known in Pee Dee River drainage	No impact	Not know in Cape Fear drainage
Notropis mekistocholas	Cape Fear shiner	E/E	Known in nearby river systems	No impact	Restricted to the Cape Fear River system near the fall line. Nearest recorded specimen was from Parker's Creek near Cokesbury, NC.
Noturus insignis (new subspecies)	spotted (margined) madtom	FSC/SR	Known from Dan River basin	No impact	
*Noturus sp. * (new species)*	broadtail madtom	/SC	Not known on site	None known	Cape Fear, Waccamaw, and Lumber drainages
Amphibians					
*Hemidactylium scutatum**	four-toed salamander	/SC	Nearest specimens were recorded from the intersection of Utley Branch and the headwaters of White	No impact	Distribution spotty with disjunct populations in many states. Associated with sphagnum and boggy woodland ponds

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
			Oak Creek. Specimens also recorded near the confluence of Buck Horn Creek and the Cape Fear River.		
Insects					
Gomphus septima	Septima's clubtail	FSC/SR	Not known on site	No impact	
Speyeria diana	Diana fritillary	FSC/SR	Currently known only in N.C. mountains	No impact	Mountains, piedmont; rich woods and adjacent edges, host plant violets; believed extirpated from the lower piedmont
*Lithophane lemmeri**	Lemmer's pinion	/SR	Recorded near the intersection of the Harris Plant access road and S.R. 1127.	No impact	Cedar glades and Atlantic White Cedar forest in the coastal plain.
Mammals					
Canis rufus	red wolf	E/E	Not known on site	None known	mountains, coastal plains; extensive forest, swamps, pocosins;
Felis concolor cougar	eastern cougar	E/E	Not known on site	None known	Extensive forest in remote areas
Myotis austroriparius	Southeastern myotis	FC/SC	Not known on site	None known	Coastal plains, piedmont; roost and buildings, hollow trees
Neotoma floridana haematoreia	Southern Appalachian eastern woodrat	FSC/SC	Not known on site	None known	Mountains, piedmont; rocky areas in deciduous, mixed forest
Plants					
Amorpha georgiana var. *georgiana*	Georgia lead-plant (= indigo plant)	SC/E	Unsuitable habitat at Harris	No impact	Nearest known populations are in Bladen County and other eastern counties; it is a wet savanna species

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Astragalus michauxii	sandhills milk-vetch	SC/C-PT	Unsuitable habitat at Harris	No impact	Nearest known populations are in Moore County; it is a sandhills species
Echinacea laevigata	smooth coneflower	E/E-SC	Not known on site	None known	Probable habitat; nearby populations are in Orange and Durham counties
Eupatorium resinosum	pine-barrens boneset (= resinous boneset)	SC/T-SC	Not known on site	None known	Nearby populations are known in Harnett and Hoke counties; preferred habitat is seepage bogs, beaver ponds, & shores
Helianthus schweinitzii	Schweinitz's sunflower	E/E	Not known on site	None known	Nearnest known populations are in the western Piedmont in Randolph County
*Hexastylis lewisii**	Lewis's heartleaf	/SR	Species recorded near the intersection of the Harris Plant access road and S.R. 1127.	None known	forest and pocosin edges
Isoetes virginica	Virginia quillwort	SC/C	Not know on site	None known	Nearby populations in Chatham County; possible habitat on site: upland wet depressions with clayey soils
Lilium iridollae	panhandle lily (= Sandhills bog lily)	SC/C-PT	Unsuitable habitat at Harris	No impact	Nearby populations in Moore County under CP&L power lines; very rare. Probable reclassification as a new species.
Lindera melissifolia	pondberry (= Southern spicebush)	E/E	Unsuitable habitat at Harris	No impact	Nearest populations in Bladen and Cumberland counties; preferred habitat is Carolina bays
Lindera subcoriacea	bog spicebush	FSC/E	Unsuitable habitat at Harris	No impact	Nearest populations are in Hoke and Lee counties
Lysimachia asperulaefolia	rough-leaved loosestrife	E/E	Not known on site.	None known.	Nearest populations in Harnett and Hoke counties; habitat preference is pocosin/savanna ecotones
Monotropsis odorata	sweet pinesap	SC/C	Not known on site;	None known	Preferred habitat is dry forests

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
			suitable habitat probably exists		and bluffs; populations are known in Wake County.
Oxypolis canbyi	Canby's cowbane	E/E	Not known on site	None known	Nearest population is in Scotland County
Oxypolis ternata	Piedmont cowbane	FSC/W	Not known on site	None known	Nearest population is Harnett and Hoke counties; pine savanna sandhill seeps
Parnassia caroliniana	Carolina grass-of-parnassus	SC/E	Not known on site; unsuitable habitat	No impact	Nearest population is in Harnett County; prefers wet savannas and sandhill seeps
Parthenium radfordii	waveyleaf wild-quinine	FSC/W	Not known on site	None known	Nearest population is Harnett and Hoke counties; clay soils in sandhills
*Phacelia covillei**	Buttercup phacelia	/C	located near the confluence of Buckhorn Ck. And the Cape Fear River	No impact	Nearby populations occur in Chatham and Harnett counties, found in bottomlands and rich lower slopes
Ptilimnium nodosum	Harperella	E/E	Not known on site; suitable habitat probably exists	None known	Nearby populations occur in Chatham County; preferred habitat is rocky river beds
Pyxidanthera barbulata brevifolia	Well's pixie-moss (= Sandhills pixie-moss)	E/SC	Not known on site; unsuitable habitat	None known	Nearby populations in Harnett, Moore, & Hoke; preferred habitat is sandhills
Rhus michauxii	Michaux's sumac	E/E-SC	Not known on site.	None known	Nearest population is on southern loop of Raleigh belt line—some 20 miles away from Harris lands.
Rudbeckia heliopsidis	blackeyed Susan (= sunfacing coneflower)	SC/E	Not known on site	None known	Nearby populations in Harnett & Moore
Schwalbea americana	American chaffseed	E/E	Not known on site; not suitable habitat	None known	Nearby populations in Cumberland, Hoke & Moore; prefers fire-maintained savannas
Solidago verna	spring-flowering goldenrod	SC/E-PT	Not known on site; possible suitable habitat on site	None known	Nearest populations in Harnett County; prefers mesic to moist pine lands/pocosin ecotones

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Stylisma pickeringii var. *pickeringii*	Pickering's dawn flower	SC/E	Not known on site; not suitable habitat	None known	Nearest population is in Moore County; prefers sandhills habitat
Tofieldia glabra	smooth bog-asphodel	SC/C	Not known on site; unsuitable habitat	None known	Nearest population is in Harnett & Moore; prefers savannas and sandhill seeps
Trillium pusillum pusillum	Carolina least trillium	SC/E	Not known on site; possible suitable habitat	None known	Nearby populations in Wake County; prefers nonriverine wet hardwoods and savanna ecotones
Xyris scabrifolia	roughleaf yellow-eyed grass	SC/C	Not known on site; unsuitable habitat	None known	Nearest populations in Harnett & Hoke; prefers sandhill seeps and bogs

Key:
C—Probable candidate for Endangered or Threatened Status
CPT—Candidate for proposed threatened status
E—Endangered
E-PT—Currently endangered but a candidate for proposed threatened status
FSC—Federal species of concern
SC—Special concern
SR—Significantly rare
T—Threatened
T(S/A)—Threatened by Similarity of Appearance
W—Watch list for proposed classification

Species with no superscript designation are the species identified in the Pacific Northwest National Laboratory report for the NRC. A few species are dually listed on the PNNL report AND a state list; those are identified with an "N."

Species noted with an asterisk (*) are listed by the State of N. C. Natural Heritage Program. No location data of these species is to be distributed to the general public (i.e., through newspapers, magazines, etc.) without the permission from the N. C. Natural Heritage Program of the North Carolina Department of Environment and Natural Resources. Species noted with a (+) are listed on the U. S. Fish and Wildlife Service, Region 4 endangered species list for North Carolina.
++CP&L resources for contact by plant personnel for updated information include personnel in the Environmental Services Section, Real Estate Management Section, and Transmission Department.
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Self Assessment of Carolina Power & Light Company's
Robinson Steam Electric Plant for Compliance with
Threatened and Endangered Species
August 12, 1998

In March 1997, the Ecology Group of Pacific Northwest National Laboratory (PNNL) issued a report to the U.S. Nuclear Regulatory Commission entitled "Threatened and Endangered Species Evaluation for 75 Licensed Nuclear Power Generating Plants" (PNNL-11524). The purpose of the report was to evaluate the Nuclear Regulatory Commission's licensing of commercial nuclear generating facilities to determine compliance with the Endangered Species Act of 1973 (ESA). Such an evaluation was necessary because the ESA requires that federal agencies ensure that actions by one another do not jeopardize the species protected under the ESA.

The PNNL report included the Robinson Steam Electric Plant and listed threatened and endangered species that might be impacted by plant activities. The PNNL assigned low, medium, or high priority for follow up regarding the potential for impacts to species at the nuclear facilities. Those facilities with a high-priority ranking were deemed, according to the PNNL report, in need of detailed follow-up evaluations before full ESA compliance can be assured. The Robinson facility was given Moderate-to-High Priority for the occurrence of the red-cockaded woodpecker and other species.

The purpose of this CP&L self assessment is to evaluate the PNNL report to determine what activities by Robinson plant personnel need to be considered for compliance with the ESA for any species actually or likely occurring on Company property at the site. Transmission rights-of-way were assessed only to the Company property boundary. Beyond the property boundary, CP&L has easements on power line corridors on land that is privately owned.

This self assessment was carried out by considering the species identified in the PNNL report, assessing the potential for their actual occurrence at the site, and what activities, if any, need to be considered to prevent such species impact. The CP&L self assessment compared the list of potential species from the PNNL report to the current federally protected species and any considered state threatened, endangered, and special concern species as listed by the South Carolina Heritage Trust Program.

The results of the self assessment for the Robinson Steam Electric Plant are shown in Table 1. This table lists the species of animals and plants identified in the PNNL report, the current U.S. Fish & Wildlife Service list of protected species for South Carolina. The latter state list identifies species at the county level in which the nuclear facility is located. The status of each species (e.g., whether endangered, threatened, etc.) at the federal or state level is also identified in Table 1 showing their known occurrence in proximity to the nuclear plants (in some cases adjacent counties), and actions, if any, required to avoid impact to these species.

An evaluation was made of the species that reasonably could be impacted by plant activities. The results of the evaluation are provided in Exhibit 1. Recommended actions required of CP&L are also suggested.

A proposed modification addition to the Environmental Self-Assessment Program "Other Items" Compliance Checklist is included as Exhibit 2 as a means of continuing this assessment on an on-going basis.

Included as Exhibit 3 is the current federally listed plants and animals for South Carolina.

Attached as Exhibit 4 is a Literature Review and Sources Used for this self assessment.

<u>Summary</u>:

The report issued by the PNNL included species of plants and animals that were in part extracted from state heritage trust program lists, and were thus not federally endangered or threatened. For this reason, this CP&L self assessment was expanded to include reviews of currently listed endangered, threatened, special concern species, as well as other species designations made by the S. C. Heritage Trust program staff of South Carolina. While this state list does not carry the same regulatory status as the federal U.S. Fish & Wildlife Service list, it is included in this self assessment to more accurately assess the species of concern. The state listed species have the potential for future federal listing and, hence, they are "candidate species."

The self-assessment evaluation of the Robinson Steam Electric Plant shows there is one federally protected species that could be impacted by plant operations, facility expansion, or other activities.

Ongoing communication, regarding activities that potentially could affect threatened and endangered species, is recommended between plant personnel and personnel in CP&L's Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Exhibit 1. Federally Protected Species at or near CP&L's Robinson Steam Electric Plant Requiring Action to Prevent Impact to Species

Species	Recommendations for Reducing Impact to Listed Species*
Red-cockaded woodpecker	Facility expansion or construction requiring removal of pine trees requires on-site assessment for occurrence.

*Note: CP&L resources for consultation include personnel in the Environmental Service Section, Real Estate Management Section, and the Transmission Department.

Under the Endangered Species Act, a Section 7 Consultation among federal agencies is required if a listed species is being impacted. One avenue for resolution includes an incidental take statement.

Exhibit 2

ENVIRONMENTAL SELF-ASSESSMENT PROGRAM

OTHER ITEMS

COMPLIANCE CHECKLIST

Completed by ______________________ Date______________

ENDANGERED SPECIES

1. Has the Environmental Services Section identified any new endangered or threatened species which may be potentially impacted by plant operations, maintenance, or facility expansion? (Contact Environmental Services Section for update.) YES ( ) NO ( )

   Comments:

   If yes, describe:

2. Are any endangered or threatened species or endangered or threatened species habitats being impacted by operation (other than those addressed by existing Biological Opinions), by planned maintenance, or future modification or expansion of the nuclear facility? (Consult Environmental Services Section, Real Estate Management Section, and Transmission Department.) YES ( ) NO ( )

Comments:

If yes, describe:

3. If the answer to number 2 above is "yes," what actions have been taken by the nuclear plant personnel to eliminate impacts to endangered or threatened species, which are occurring on plant property?

Comments:

Describe actions taken:

(For example, did you alter plans after contacting personnel in CP&L's Environmental Services Section, Real Estate Management Section, and Transmission Department?)

Exhibit 3. **U.S. Fish & Wildlife Service List of Endangered and Threatened Species in South Carolina.**

South Carolina--34 species

Animals--15 species

E - Bat, Indiana (*Myotis sodalis*)
T - Eagle, bald (*Haliaeetus leucocephalus*)
E - Falcon, American peregrine (*Falco peregrinus anatum*)
E - Heelsplitter, Carolina (*Lasmigona decorata*)
E - Manatee, West Indian (=Florida) (*Trichechus manatus*)
E - Plover, piping (*Charadrius melodus*)
T - Snake, eastern indigo (*Drymarchon corais couperi*)
E - Stork, wood (*Mycteria americana*)
E - Tern, roseate (*Sterna dougallii dougallii*)
E - Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)
T - Turtle, green sea (*Chelonia mydas*)
E - Turtle, hawksbill sea (*Eretmochelys imbricata*)
E - Turtle, leatherback sea (*Dermochelys coriacea*)
T - Turtle, loggerhead sea (*Caretta caretta*)
E - Woodpecker, red-cockaded (*Picoides borealis*)

Plants--19 species

E - American chaffseed (*Schwalbea americana*)
E - Black-spored quillwort (Isoetes melanospora)
E - Bunched arrowhead (*Sagittaria fasciculata*)
E - Canby's dropwort (*Oxypolis canbyi*)
T - Dwarf-flowered heartleaf (*Hexastylis naniflora*)
E - Harperella (*Ptilimnium nodosum (=fluviatile)*)
T - Little amphianthus (*Amphianthus pusillus*)
T - Miccosukee gooseberry (Ribes echinellum)
E - Michaux's sumac (*Rhus michauxii*)
E - Mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*)
E - Persistent trillium (*Trillium persistens*)
E - Pondberry (*Lindera melissifolia*)
E - Relict trillium (*Trillium reliquum*)
E - Rough-leaved loosestrife (*Lysimachia asperulaefolia*)
E - Schweinitz's sunflower (Helianthus schweinitzii)
T - Seabeach amaranth (*Amaranthus pumilus*)
T - Small whorled pogonia (*Isotria medeoloides*)
E - Smooth coneflower (*Echinacea laevigata*)
T - Swamp pink (*Helonias bullata*)

Code:
E = Endangered
T = Threatened

Exhibit 4. Literature Review and Sources Used for Self Assessment.

Sackschewsky, M. R. 1997. Threatened and Endangered Species Evaluation for 75 Licensed Commercial Nuclear Power Generating Plants. Pacific Northwest National Laboratory, Richland, WA.

South Carolina Heritage Trust. [1998]. Distributions of Threatened and Endangered Species in South Carolina. S. C. Department of Natural Resources, Columbia, S.C.

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Table 1. Evaluation of Threatened and Endangered Species Reported at Carolina Power and Light Company's H. B. Robinson Steam Electric Plant.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Birds					
Charadrius melodus	piping plover	FT/	Not known on site	None known	Ocean beaches and island-end flats
Falco perigrinus	peregrine falcon	FE/	Not known on site	None known	Mountain cliffs and tidewater coastal ponds and sounds
Haliaeetus leucocephalus	bald eagle	FT/SE	Infrequent visitor around the lake; no known nesting	None known	Mature forests near large bodies of water; lakes and sounds
Lanius ludovicianus	loggerhead shrike	/SC	Inhabits open land (e.g., ROWs/fields) in site area	None known	Coastal plain fields and pastures
Mycteria americana	wood stork	FE/	Not known on site	None known	Tidewater fresh or brackish ponds
Picoides borealis	red-cockaded woodpecker	FE/	Historically inhabited Darlington Co. CT lands	None known	Surveys will be required if there is timber harvest or construction and land clearing of mature longleaf pine trees; Chesterfield Co., Darlington Co.
*Limnothlypis swainsonii**	Swainson's warbler	/SC	Seasonal resident; nests in Black Creek bottomland upstream of Robinson Impoundment	None known	Chesterfield Co.
Clams					
Lasmigona decorata	Carolina heelsplitter	FE			Chesterfield Co.
*Villosa constricta**	notched rainbow bivalve	/SC	Not known on site	None known	Chesterfield Co.
Amphibians					
*Hyla andersonnii**	pine barrens treefrog	/ST	Not known on site	None known	Sandhills wetlands with open herbaceous/shrub bogs; occurs

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
					in Chesterfield Co.
Reptiles					
*Pituophis melanoleucus**	pine or gopher snake	/SC	Not known on site	None known	Chesterfield Co.
Caretta caretta	loggerhead sea turtle	FT/	Not known on site	None known	Species is coastal and oceanic; nests on well-drained sites on sandy beaches
Ophisaurus mimicus	Mimic glass lizard	SC	Not known on site	None known	Pine flatwoods, savannas, and pine/oak sandhills
Fishes					
Acipenser brevirostrum	shortnose sturgeon	FE/	Not known on site	None known	Found in lower estuaries in winter and upstream as far as fall line in summer. Known in Pee Dee River
Notropis mekistocholas	Cape Fear shiner	FE/ #	Not known on site	None known	Known only from Cape Fear River drainage in N.C.
*Etheostoma flabellare**	fantail darter	/SC	Not known on site	None known	Chesterfield Co.
*Notropis chiliticus**	redlip shiner	/SC	Not known on site	None known	Chesterfield Co.
*Semotilus lumbee**	sandhills chub	/ST	Not known on site	None known	Found in slow-flowing sandhill creeks with sand or gravel bottoms where vegetation is sparse; known in Chesterfield Co.
Mammals					
Felis concolor cougar	eastern cougar	FE/	Not known on site	None known	Extensive forests in remote areas
Corynorhinus (=Plecotus) rafinesquii	Rafinesque's big-eared bat	/SE	Not known on site	None known	Roosts in caves, rock houses, and various man-made shelters; known in Darlington Co.
*Condylura cristata**	star-nosed mole	/SC	Known to inhabit Black Creek bottomland upstream of Robinson Impoundment	Not known	One record was found in stomach of largemouth bass collected by CP&L in Chesterfield Co.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Plants					
Amaranthus pumilus+(N)	Seabeach amaranth	FT/	Not known on site	None known	Ocean beaches and island-end flats
*Amorpha georgiana georgiana**	Georgia lead-plant (= savanna indigo bush)	FSC/SC	Not known on site	None known	Moist sandhills areas and sandy terraces; Darlington Co.
Amphianthus pusillus	little amphianthus	FT/	Not known on site	None known	Found on vernal pools on granite outcrops
*Arabis missouriensis** (=*A. laevigata* var. *missouriensis*)*	Missouri rock-cress	/SC	Not known on site	None know	Thin soils around basic rock outcrops; Darlington Co.
*Aristolochia tomentosa**	wooly dutchman's-pipe	/SC	Not known on site	None known	Known near Savannah River
*Asplenium bradleyi**	Bradley's spleenwort	/RC	Not known on site	None known	Chesterfield Co.
Aster georgianus	Georgia aster	NC/SC	Not known on site	None known	Piedmont open roads and roadsides
Astragalus michauxii	sandhills milk-vetch	NC/SC	Not known on site	None known	Sandhills; Chesterfield Co., Darlington Co.
*Balduina atropurpurea**(N)	purple balduina = honeycomb head	SC/SC	Not known on site	None known	Savannas; Darlington Co.; known in dense bottomland hardwood near Hartsville
*Balduina uniflora**	one-flower baldunia	/SC	Not known on site	None known	Darlington Co.
*Burmannia biflora**	northern burmannia	/SC	Not known on site	None known	Chesterfield Co. [Power line right of way]
*Calamovilfa brevipilis**	pine-barrens reed-grass	/SC	Not known on site	None known	Chesterfield Co.; [Power line right of way]
*Calopogon barbatus**	bearded grass-pink (orchid)	/SC	Not known on site	None known	Darlington Co.
*Carex collinsii**	Collin's sedge	/SC	Not known on site	None known	Chesterfield Co., Darlington Co.
*Chrysoma pauciflosculosa** (= *Solidago paucifolosculosa*)*	woody goldenrod	/SC	Not known on site	None known	Sandhills; Chesterfield Co.
*Circaea lutetiana ssp canadensis**	enchanter's nightshade	/SC	Not known on site	None known	Darlington Co.
*Cladium mariscoides**	twig rush	/SC	Not known on site	None known	Bogs, fens, brackish marshes and sandhill seepage bogs;

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
					Darlington Co.
*Danthonia epilis**	bog oat-grass	/SC	Not known on site	None known	Seepage bogs; Chesterfield Co.
*Draba reptans**	Carolina whitlow-grass (=creeping draba)	/SC	Not known on site	None known	Darlington Co.
*Dryopteris spinulosa**	spinulose wood-fern	/SC	Not known on site	None known	Darlington Co.
Echinacea laevigata	smooth coneflower	FE/	Not known on site	None known	Glades, woodlands, and open areas over mafic rocks
*Eriocaulon texense**	pipewort (=Texas hatpins)	/SC	Not known on site	None known	Sphagnum bogs; Chesterfield Co.
*Gentiana autumnalis**	pine barren gentian	/SC	Not known on site	None known	Chesterfield Co.
*Helenium pinnatifidum**	southeastern sneezeweed (dissected sneezeweed)	/SC	Not known on site	None known	Savannas and open, wet and mucky sites; Darlington Co.
Helianthus schweinitzii	Schweinitz's sunflower	FE/	Not known on site	None known	Open woods and roadsides
*Hudsonia ericoides**	Golden-heather	/RC	Not known on site	None known	Chesterfield Co.
*Ilex amelanchier**	sarvis holly	/SC	Not known on site	None known	Blackwater swamps and riverbanks, and clay-based Carolina bays; Darlington Co.
Isoetes melanospora	black-spored quillwort	FE/	Not known on site	None known	Vernal pools on granite outcrops
*Isoetes virginica**(N)	Quillwort	/SC	Not known on site	None known	Upland depression swamp forests and clayey soils; Darlington Co.
Kalmia cuneata	white-wicky	NC/	Not known on site	None known	Pocosins; Chesterfield Co., Darlington Co.
*Lepuropetalon spathulatum**	southern lepuropetalon	/SC	Not known on site	None known	Darlington Co.
Lindera melissifolia	pondberry (=Southern spicebush)	FE/	Not known on site	None known	Carolina bays, upland depressions, and other wet areas
*Lygodium palmatum**	climbing fern	/SC	Not known on site	None known	Darlington Co.
Lysimachia asperulaefolia	rough-leaved loosestrife	FE/	Not known on site	None known	Upland bogs with evergreen shrubs, pocosin and savanna ecotones; known in Darlington Co.
Macbridea cariliniana	Carolina birds-in-a-nest	FSC/	Not known on site	None known	Blackwater swamps, savanna/pocosin ecotones and ditches; Darlington Co.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
Menispermum canadense*	Canada moonseed	/SC	Not known on site	None known	Darlington Co.
*Myriophyllum laxum**	piedmont water-milfoil	/RC	Not known on site	None known	Limesink ponds, waters of natural lakes; Chesterfield Co.
*Nestronia umbellula**	nestronia	/SC	Not know on site	None known	Upland forests; Chesterfield Co.
*Ophioglossum vulgatum**	adder's tongue	/SC	Not known on site	None known	Darlington Co.
Oxypolis canbyi	Canby's dropwort	FE/	Not known on site	None known	Clay-based Carolina bays and similar open wetlands
Oxypolis ternata	Piedmont cowbane	SC/	Not known on site	None known	Pine savannas and sandhill seeps
*Paspalum bifidum**	beard-grass	/SC	Not known on site	None known	Chesterfield Co.; Sandhills State Forest
*Pleea tenuifolia**	rush false-asphodel	/SC	Not known on site	None known	Darlington Co.
*Potamogeton confervoides**	algae-like pondweed	/SC	Not known on site	None known	Beaver ponds and old millponds on blackwater creeks
*Psilotum nudum**	whisk fern	/SC	Not known on site	None known	Acid swamps; Darlington Co.
*Pyxidanthera barbulata barbulata**	Well's pixie-moss	/SC	Not known on site	None known	Sandhills; Chesterfield Co.
*Pyxidanthera barbulata**	Flowering pixie moss	/NC	Not known on site	None known	Sandhills; Chesterfield Co., Darlington Co.
Pyxidanthera brevifolia (=P. barbulata* var. *Brevifolia)*	Sandhills pixie moss	/NC	Not known on site	None known	Sandhills; Chesterfield Co.,
Rhexia aristosa(N)*	awned meadowbeauty	/SC	Not known on site	None known	Clay-based Carolina bays and limesink ponds; Darlington Co.
Rhus michauxii	Michaux's sumac	FE/	Not known on site	None known	Open uplands
*Rhynchospora alba**	white beakrush (=Northern white beaksedge)	/SC	Not known on site	None known	Fens, bogs, pocosin openings, limesink ponds; Chesterfield Co.

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
*Rhynchospora stenophylla**	Chapman beakrush	/SC	Not known on site	None known	Moist open areas; Chesterfield Co.
Ruellia caroliniensis ssp *ciliosa**	wild "petunia"	/SC	Not known on site	None known	Darlington Co.
*Sarracenia rubra**	sweet pitcher-plant	/SC	Collected East of Trans. D in 7/75 at HBR	None known	Chesterfield Co., Darlington Co.; a survey should be done at the location to determine current occurrence of the species to determine any action to be taken.
Schwalbea americana	American chaffseed	FE/	Not known on site	None known	Savannas and moist to dryish pinelands with frequent fire
*Scirpus etuberculatus**	canby bulrush	/SC	Collected at Trans. G in 1975	To be determined	Chesterfield Co.
*Scirpus subterminalis**	water bulrush	/SC	Not known on site	None known	Darlington Co.
*Scutellaria parvula**	small skullcap	/SC	Not known on site	None known	Darlington Co.
*Sporobolus sp 1**	Carolina dropseed	/SC	Not known on site	None known	Chesterfield Co.
Sporobolus teretifolius	wire-leaved dropseed	NC/	Not known on site	None known	Chesterfield Co.
*Solidago bicolor**	white goldenrod	/SC	Not known on site	None known	Darlington Co.
Solidago verna(N)*	spring-flowering goldenrod	NC/	Not known on site	None known	Mesic to moist pinelands, pocosin ecotones; Chesterfield Co.
*Syngonanthus flavidulus**	yellow pipewort	/SC	Not known on site	None known	Chesterfield Co.; ditches, pocosins ecotones, savannas.
Thalictrum cooleyi	Cooley's meadowrue	FE/ #	Not known on site	None known	Wet savannas
Tofieldia glabra(N)*	smooth bog-asphodel	/SC	Not known on site	None known	Savannas, sandhill seeps, moist sandhills/pocosin ecotones; Darlington Co.
*Tridens carolinianus**	Carolina fluff-grass	/SC	Not known on site	None known	Sandhills and pine flatwoods;

Class/Species	Common Name	Status Fed./State	Location	Impact++	Comments
*Utricularia olivacea**	piedmont bladderwort	/SC	Not known on site	None known	Chesterfield Co. Limesink ponds & beaver ponds; Chesterfield Co.
*Xyris scabrifolia**	Harper's yellow-eyed grass (=roughleaf yellow-eyed grass)	/SC	Not known on site	None known	Sandhill seeps and bogs; Chesterfield Co.

FSC—Federal species of concern
FE—Federal endangered
FT—Federal threatened
PFT—Proposed Federal threatened
CF—Candidate for review (Federal)
NC—Of concern, nationally (unofficial- plants only)
RC—Of concern, regionally (unofficial - plants only)
SE—State of S.C. endangered
ST—State of S.C. threatened
SC—Of concern (State of S.C.)
SX—State extirpated (no longer exists)
PE/PT/C—Proposed candidate for federal listing
T(S/A)—Threatened due to Similarity of Appearance

Species with no superscript designation are the species identified in the Pacific Northwest National Laboratory report for the NRC. A few species are dually listed on the PNNL report AND a state list; those are identified with an "N."

Species noted with an asterisk (*) are listed by the State of S.C. Heritage Trust Program. No location data of these species is to be distributed to the general public (i.e., through newspapers, magazines, etc.) without the permission from the S.C. Heritage Trust Program of the South Carolina Department of Natural Resources.

# Indicates that the species is not tracked by the South Carolina Heritage Trust.

++CP&L resources for contact by plant personnel for updated information include personnel in the Environmental Services Section, Real Estate Management Section, and Transmission Department.

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Response to RAI No. 1
Item 4

SHNP-0103

Harris Nuclear Plant

CP&L

2000 Environmental Monitoring Report

Environmental Services Section

HARRIS NUCLEAR PLANT
2000 ENVIRONMENTAL MONITORING REPORT

September 2001

Environmental Services Section

CP&L – A Progress Energy Company
New Hill, North Carolina

Preface

This copy of the report is not a controlled document as detailed in Environmental Services Section Biology Program Procedures and Quality Assurance Manual. Any changes made to the original of this report subsequent to the date of issuance can be obtained from:

Director
Environmental Services Section
CP&L – A Progress Energy Company
3932 New Hill-Holleman Road
New Hill, North Carolina 27562-0327

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Metric-English Conversion and Units of Measure

Length
1 micron (μm) = 4.0 x 10^{-5} inch
1 millimeter (mm) = 1000 μm = 0.04 inch
1 centimeter (cm) = 10 mm = 0.4 inch
1 meter (m) = 100 cm = 3.28 feet
1 kilometer (km) = 1000 m = 0.62 mile

Area
1 square meter (m^2) = 10.76 square feet
1 hectare (ha) = 10,000 m^2 = 2.47 acres

Volume
1 milliliter (ml) = 0.034 fluid ounce
1 liter = 1000 ml = 0.26 gallon
1 cubic meter = 35.3 cubic feet

Weight
1 microgram (μg) = 10^{-3} mg or 10^{-6} g = 3.5 x 10^{-8} ounce
1 milligram (mg) = 3.5 x 10^{-5} ounce
1 gram (g) = 1000 mg = 0.035 ounce
1 kilogram (kg) = 1000 g = 2.2 pounds
1 metric ton = 1000 kg = 1.1 tons
1 kg/hectare = 0.89 pound/acre

Temperature
Degrees Celsius (°C) = 5/9 (°F-32)

Specific conductance
$\mu S/cm$ = Microsiemens/centimeter

Turbidity
NTU = Nephelometric Turbidity Unit

Water Chemistry Abbreviations

Cl^-	- Chloride	$NO_3^- + NO_2^-$ - N	- Nitrate + nitrite-nitrogen	Cd	- Total cadmium
SO_4^{2-}	- Sulfate	TP	- Total phosphorus	Cu	- Total copper
Ca^{2+}	- Total calcium	TOC	- Total organic carbon	Hg	- Total mercury
Mg^{2+}	- Total magnesium	TS	- Total solids		
Na^+	- Total sodium	TDS	- Total dissolved solids		
TN	- Total nitrogen	TSS	- Total suspended solids		
NH_3-N	- Ammonia-nitrogen	Al	- Total aluminum		

EXECUTIVE SUMMARY

Harris Reservoir supplies makeup water to the closed-cycle cooling system for the Harris Nuclear Plant. The Harris Nuclear Plant discharges primarily cooling tower blowdown along with low volume waste discharges into the reservoir near the main dam.

Nutrient concentrations, including total phosphorus and total nitrogen concentrations, remained stable for the reporting period (1996-2000) and were in an acceptable range for a productive reservoir in this area. The concentrations of most chemical constituents did not exhibit any consistent statistically significant temporal changes and were in ranges that were not considered detrimental to the biological community.

Bluegill, redear sunfish, largemouth bass, and black crappie dominated the fish community in Harris Reservoir during 2000. Annual catch rates for bluegill, largemouth bass, and black crappie were similar to catch rates in previous years while the 2000 annual catch rate for redear sunfish was generally greater than previous years. Length-frequency distributions indicated good reproduction with multiple size groups present for all species. The largemouth bass population remains balanced with a large percentage of larger fish present in the population.

Hydrilla stands reaching the surface of the water were not observed in the intake canal in Harris Reservoir or in the littoral zone of the auxiliary reservoir during 2000. The attempt to control hydrilla in the auxiliary reservoir by releasing grass carp in the autumns of 1994, 1996, and 1997 appears to have been effective in reducing the quantity and area covered by this vegetation.

HARRIS NUCLEAR PLANT 2000 ENVIRONMENTAL MONITORING REPORT

Reservoir Description

Harris Reservoir, located in Chatham and Wake Counties, North Carolina, was created by impounding Buckhorn Creek, a tributary of the Cape Fear River (Figure 1). The main body of Harris Reservoir has a surface area of 1680 ha; the auxiliary reservoir has a surface area of 130 ha. The main reservoir has a maximum depth of 18 m, a mean depth of 5.3 m, a volume of 8.9×10^7 m^3, a full-pool elevation of 67.1 m National Geodetic Vertical Datum (NGVD), and an average residence time of 28 months. The reservoir began filling in December 1980 and full-pool elevation was reached in February 1983. The 64.5-km shoreline is mostly wooded and the 183.9-km^2 drainage area is mostly rolling hills with land used primarily for forestry and agriculture. The conversion of areas from forestry or agricultural purposes to residential uses continued in many areas of the drainage.

Harris Reservoir was constructed to supply cooling tower makeup and auxiliary reservoir makeup water to the 900-MW Harris Nuclear Plant, which began commercial operation in May 1987. In 1986 the bottom waters of the reservoir near the main dam began receiving National Pollutant Discharge Elimination System (NPDES)-permitted wastewater discharges from the power plant cooling tower. Tributaries also receive NPDES-permitted discharges from the Harris Energy and Environmental Center and from wastewater treatment plants at Apex and Holly Springs. The reservoir is a source of drinking water for some Company employees.

Objectives

The primary objectives of the 2000 Harris Nuclear Plant non-radiological environmental monitoring program were to: (1) assess the reservoir's overall water quality, (2) identify any natural or power plant-induced effects on the water quality in the reservoir, (3) document the introduction and expansion of nonnative plant and animal populations in the reservoir, and (4) demonstrate the existence of a reasonable recreational fishery. These objectives have also been addressed in previous annual monitoring reports with the most recent detailed in CP&L 1996, 1997, 1998, 1999, and 2000.

Methods

The 2000 environmental program included monitoring the reservoir's: (1) limnological characteristics (water quality, water chemistry, and chlorophyll *a*), (2) distribution of aquatic vegetation, (3) possible introductions of the zebra mussel and the quagga mussel, and (4) fisheries community. Sampling methods, data summaries, and statistical analyses for data collected during 2000 were similar to those used for data collected during 1999 (CP&L 2000) (Tables 2 and 3). Trend analyses of the data were evaluated for the most recent five years of monitoring (1996-2000) for most programs. Supporting data summaries and appropriate statistical analyses were used to describe and interpret the environmental quality of the reservoir (Table 3). Electrofishing data were not collected from 1992 to 1994 and from 1996 to 1998. Therefore, annual catch rates for 2000 data were compared to data from 1988 to 1991 and 1995. Three stock assessment indices were used as indicators of a balanced largemouth bass population (Gablehouse 1984). These indices include: Proportional Stock Density (PSD), the percentage of all fish ≥ 300 mm; Relative Stock Density for preferred length (RSD_P), the percentage of all fish ≥ 380 mm; and Relative Stock Density for memorable length (RSD_M), the percentage of all fish ≥ 510 mm.

All analytical testing, except total phosphorus analyses, completed in support of the Harris Reservoir environmental monitoring program was performed by testing laboratories that are certified by the N. C. Division of Water Quality's Laboratory Certification Program to perform water and wastewater testing. Perkins Limnological Consulting, LLC, a vendor approved by CP&L for this testing, conducted total phosphorus analysis. The accuracy and precision of laboratory analyses of water chemistry data were determined with analytical standards, spikes, and replicates. Quality assurance information including the accuracy and percent recovery of water chemistry standards are available upon request. In this report where concentrations were less than the laboratory-reporting limit, the concentrations were assumed to be at one-half the reporting limit for the calculation of the mean. Where statistically significant results were reported, a Type I error rate of 5% (α = 0.05) was used and Fisher's protected least significant difference test was applied to determine where significant differences in mean values occurred.

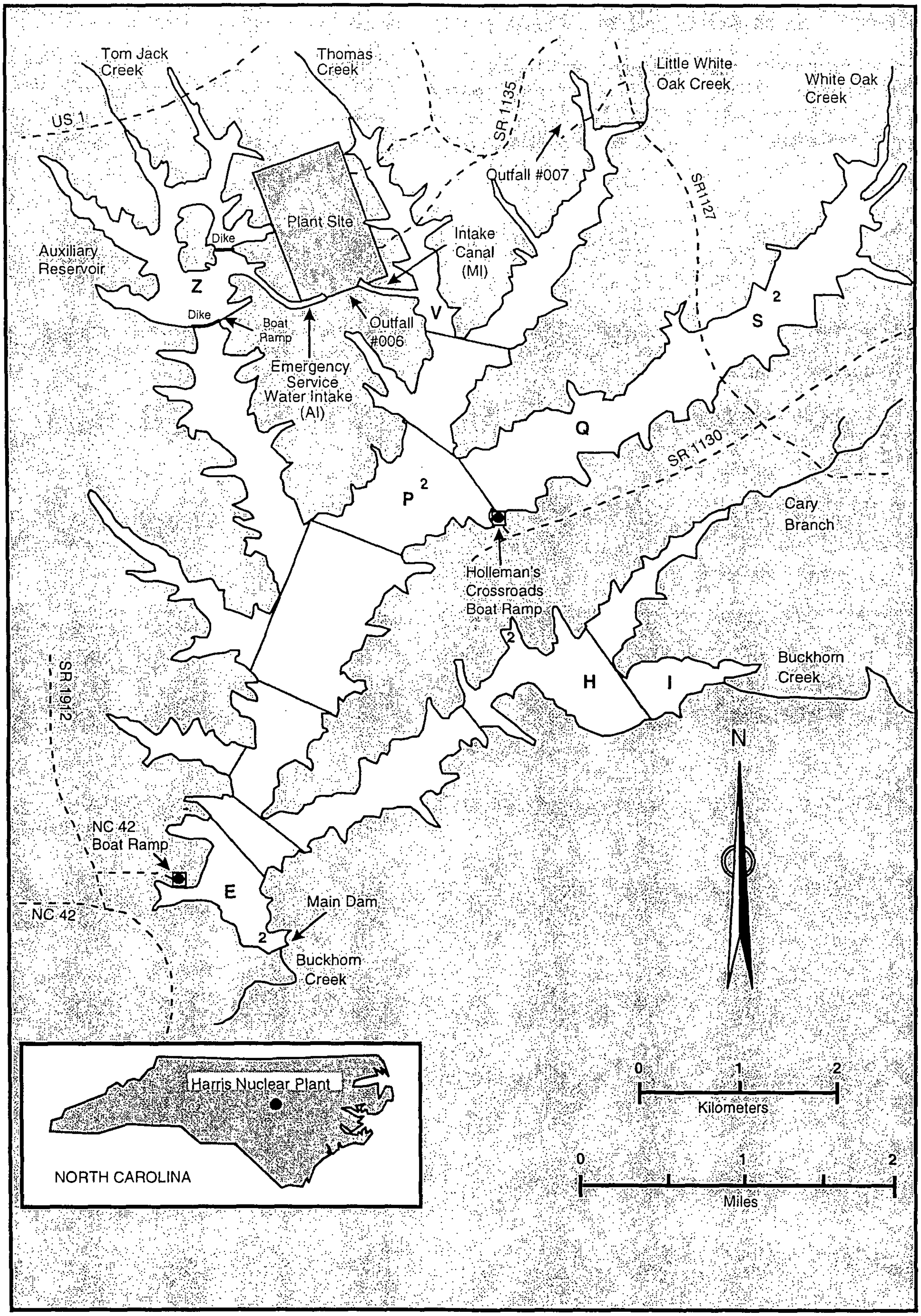

Figure 1. Sampling areas and stations at Harris Reservoir during 2000.

Table 1. Environmental monitoring program at Harris Reservoir for 2000.

Program	Frequency	Location
Water quality	January, May, July, November	Stations E2, H2, P2, and S2 (surface to bottom at 1-m intervals)
Water chemistry	January, May, July, November	Stations E2, H2, P3, and S2 (surface samples at all stations, bottom sample at E2 only)
Plankton+	January, May, July, November	Stations E2, H2, P3, and S2
Biofouling monitoring		
Zebra mussel surveys	January, May, July, November	Areas E, P or Q, and V
Fisheries		
Electrofishing	February, May, August, November	Stations E1, E3, H1, H3, P1, P3, S1, S3, V1, and V3
Aquatic vegetation survey	Once per calendar year (Fall)	Areas MI and Z

+Plankton included phytoplankton (algae) and chlorophyll a samples. Phytoplankton samples were collected and preserved but were not identified because all sampled chlorophyll a concentrations were < 40 μg/L.

Table 2. **Field sampling and laboratory methods followed in the 2000 environmental monitoring program at Harris Reservoir.**

Program	Method
Water quality	Temperature, dissolved oxygen, pH, and specific conductance were measured with calibrated YSI® multiparameter instruments and YSI® dissolved oxygen meters. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface (Stations E2, H2, P2, and S2) and bottom samples (Station E2) were collected in appropriate containers, transported to the laboratory on ice, and analyzed according to accepted laboratory methods.
Phytoplankton	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 250-ml sub sample was taken and preserved with 5 ml of "M3" fixative.
Chlorophyll *a*	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler, placed in a plastic container and mixed, then a 1000-ml sub sample was collected in a dark bottle. All samples were placed on ice and returned to the laboratory. In the laboratory a 250-ml sub sample was analyzed according to Strickland and Parsons (1972) and APHA (1995).
Electrofishing	Fifteen-minute samples were collected at each station using a Smith-Root Type VI-A equipped, Wisconsin-design electrofishing boat with pulsed DC current. Fish were identified, measured to the nearest mm, weighed to the nearest gram, examined for the presence of disease and deformities, and released.
Zebra mussel	The dock at the Holleman's boat ramp, or water quality station marker buoys were visually inspected for the presence of mussels during routine water quality monitoring.
Aquatic vegetation survey	Portions of the shoreline and/or littoral zone of the Harris Plant main reservoir intake canal and auxiliary reservoir were systematically surveyed by boat to document the presence of aquatic vegetation specifically hydrilla and creeping water primrose.

Table 3. **Statistical analyses performed on data collected for the 2000 environmental monitoring program at Harris Reservoir.**

Program	Variable	Transformation	Statistical Test/model+	Main effect(s)
Water quality	Specific conductance and Secchi disk transparency	None	One-way, block on month	Station
	Specific conductance and Secchi disk transparency	None	Two-way, block on month	Station, year
Water chemistry	Select monitoring variables	None	One-way, block on month	Station
	Select monitoring variables	None	Two-way, block on month	Station, year
Phytoplankton	Chlorophyll *a*	None	One-way, block on month	Station
	Chlorophyll *a*	None	Two-way, block on month	Station, year
Fisheries	No. fish per hour	$\ln(x + 1)$	One-way, block on month	Transect
	Relative weight (W_r) ¶		$W_r = W_o/W_s \times 100$	Selected species

+Statistical tests used were one-way and two-way analysis of variance models. A Type I error rate of 5% ($\alpha = 0.05$) was used to judge the significance of all tests. Fisher's protected least significant difference (LSD) test was applied to determine where differences in means occurred.

¶Relative weight (W_r) where W_o is the observed weight of each fish and W_s is the length-specific standard weight predicted by a weight-length regression equation constructed to represent the species as a whole ($W_r = W_o / W_s * 100$). Relative weight (Anderson and Neumann 1996) was calculated for bluegill (Hillman 1982), redear sunfish (Pope et al. 1995), and largemouth bass (Wege and Anderson 1978).

RESULTS OF ENVIRONMENTAL MONITORING AT HARRIS RESERVOIR DURING 2000

Limnology

Temperature and Dissolved Oxygen

- Harris Reservoir waters at all reservoir stations (except Station S2) were strongly stratified during July and were either well mixed or very weakly stratified during January, May, and November, 2000 (Appendix 1). During July, portions of the hypolimnion were anoxic (i.e., conditions where dissolved oxygen concentrations are less than 1 mg/liter) at Stations E2, H2, and P2 (Appendix 1). Station S2, which is comparatively shallow, exhibited a small decrease in oxygenation near the bottom during May and July but otherwise was well mixed and oxygenated for the remainder of the year. A bottom-water oxygen decline is typical at the deeper stations during the warm summer months in Harris Reservoir and in other southeastern productive water bodies when well-defined thermoclines develop and block bottom waters from mixing with the upper, more oxygenated waters.

Water Clarity (Secchi disk transparency, Solids, and Turbidity)

- The Secchi disk transparency depth (a water clarity indicator) generally increased with linear distance from the headwater region (Station S2) to the dam during January and May 2000 (Appendix 1). This spatial pattern is typical of patterns observed during 1995 through 1997 and 1999. However, headwaters were much clearer than downstream stations during November of 2000. Although there monthly spatial differences, there were no significant differences in the annual mean Secchi disk transparencies between stations during 2000.

- While statistical differences were noted in the reservoir-wide annual mean Secchi disk transparency values during the period 1996 to 2000, these variations were considered to minor and not biologically important (Appendix 3).

- There were no significant spatial trends for solids (i.e., total solids, total dissolved solids, and total suspended solids) or turbidity for Harris Reservoir surface waters during 2000 (Appendix 2).

- The annual mean total solids and total dissolved solids were statistically variable during the 1996 through 2000 observation period (Appendix 3). These minor fluctuations were not biologically important.

Chlorophyll *a*

- During 2000, mean chlorophyll *a* concentrations (an indicator of algal biomass) in Harris Reservoir continued to be indicative of moderate to high biological productivity. However, unlike concentrations measured in 1997 and 1998, no chlorophyll *a* concentration exceeded the North Carolina water quality standard of 40 µg/liter during 2000 (NCDEM 1992). There were no significant spatial differences in chlorophyll *a* concentrations during 2000 (Appendix 2).

- While statistically significant fluctuations in annual mean chlorophyll a concentrations were observed during the 1996 through 2000 period, no trends were indicated (Appendix 3).

Nutrients and Total Organic Carbon (surface waters)

- There were no significant spatial differences among stations for mean nutrient (i.e., phosphorus, ammonia-N, nitrate + nitrite-N, and total nitrogen) and total organic carbon concentrations in Harris Reservoir during 2000 (Appendix 2).

- Also, there were no statistically significant temporal trends for nutrient concentrations and 1996 to 2000 (Appendix 3). Total organic carbon concentrations varied significantly during the observations period but were not considered biologically important.

Specific Conductance, Ions, and Hardness (surface waters)

- There were no biologically meaningful spatial differences in conductivity, ion concentration (except chloride), or hardness during 2000 (Appendix 2).

- Annual mean chloride and sulfate concentrations significantly increased during 2000 compared to concentrations during 1999. These values represented only small changes and were similar to concentrations observed during other years within the five-year period from 1996 to 2000 (Appendix 3).

- The annual reservoir mean conductivity was similar among years during the period 1996-2000 (Appendix 3).

pH and Total Alkalinity

- The median pH in the surface waters of Harris Reservoir was 7.2 during 2000 (Appendix 1).

- In 2000 total alkalinity concentrations were not statistically different among stations (Appendix 2). The annual mean total alkalinity concentrations fluctuated significantly but with no consistent pattern during the 1996 to 2000 comparison period (Appendix 3).

Trace Metals and Metalloids (surface waters)

- Overall, the concentrations of trace elements in Harris Reservoir were generally low in 2000 with most concentrations less than or near their respective laboratory reporting limits (Appendices 2 and 5). No spatial trends in any of measure trace elements were observed during 2000 (Appendix 2). Aluminum concentrations ranged from < 50 to 440 µg/liter during 2000 with the greater value recorded in a headwater region where aluminum concentrations may have been influenced by upstream watershed sources (Appendices 2 and 5).

- Copper exhibited statistically significant variations in surface waters but no true temporal trend was observed during the 1996 to 2000 comparison period (Appendix 3). No other temporal differences were observed among trace element concentrations in either surface or bottoms waters of Harris Reservoir for the period 1996 to 2000 (Appendix 3 and 4).

Chemical Constituents in the Bottom Waters at Station E2

- The concentrations of most chemical constituents in the bottom waters of the deepest station (Station E2) near the dam and Harris Plant blowdown pipe were within typical ranges expected for a productive, southeastern reservoir and were not considered detrimental to the biological community (Appendix 4).

- Only chlorides showed statistical variations among years in the bottom waters at Station E2, but these differences were minor and did not represent a temporal trend (Appendix 4).

Sulfate and aluminum concentrations appeared to increase dramatically during May 2000 in the bottom waters of Station E2 (Appendix 5). Also, marked shifts in alkalinity, total nitrogen, ammonia, and total phosphorus concentrations during July of 2000 in the bottom waters at Station E2 were noted. These very notable shifts in the magnitude of chemical concentrations in the bottom waters is typical is Harris Reservoir each year and believed to be related to stratification processes and possibly intermittent blowdown from the power plant. Since this chemical shifting generally occurs in the deepest part of the lake and primarily in anoxic waters, it was not considered to be biologically detrimental to aquatic community.

Biofouling Monitoring Surveys

- No zebra mussels (*Dreissena polymorpha*) or quagga mussels (D. *bugensis*), potentially serious biofouling organisms to power plant operations, were found in Harris Reservoir or the auxiliary reservoir during 2000. Zebra mussels and quagga mussels are not expected to thrive in Harris Reservoir because concentrations of alkalinity, calcium, total hardness, and pH are sub optimal for mussel growth and reproduction (Claudi and Mackie 1993).

Fisheries

- Twenty fish species were collected with quarterly electrofishing sampling during 2000 (Appendix 6). For the second year in a row, a *Morone* spp. (white perch) was collected from Harris Reservoir. Three species collected in 1999--comely shiner, spottail shiner, and yellow bullhead--were not collected during 2000 (CP&L 2000). These species have historically been numerically minor in Harris Reservoir and the absence in the electrofishing samples were considered to be related to geartype selectivity and/or random spatial distribution.

- Bluegill, redear sunfish, largemouth bass, and black crappie comprised approximately 82% of the mean number per hour collected (Appendix 6). While black crappie catch appeared to have tapered off slightly during 2000, these recreationally important species have historically dominated electrofishing samples from Harris Reservoir (Appendix 7 and CP&L 2000).

- Significant differences in the mean catch rate between transects were observed for redear sunfish, largemouth bass, and total catch. As the following table of log-e transformed mean catch rates indicates, significantly more redear sunfish were collected from Transects E and H compared to Transects P, S, and V (means with different superscripts are significantly different). Largemouth bass exhibited uniform catch rates reservoir-wide except at Transect H where the catch rates were lower compared to other transects. The catch rates of other recreational species were uniform among transects.

	Transect				
Species	**E**	**H**	**P**	**S**	**V**
Redear sunfish	**4.3^{a}**	**4.7^{a}**	**3.0^{c}**	**2.2^{c}**	**3.3^{b}**
Largemouth bass	**3.0^{a}**	**2.3^{b}**	**3.3^{a}**	**3.1^{a}**	**3.3^{a}**

- The length-frequency distribution for bluegill indicated strong recruitment during 2000 (Appendix 8). Additionally, there were adequate numbers of older, larger fish to support a recreational fishery. The mean relative weight (84) of bluegill collected during 2000 was less than optimal (100 = optimum) but was consistent with the range that might be expected under relatively high population densities (Appendix 9).

- The annual mean electrofishing catch rate for redear sunfish of 67 fish per hour, while somewhat lower than the 1995 and 1999 values, was still in a range substantially greater than the catches of the late 1980s and early 1990s (Appendix 7). Similar to previous years, the length-frequency distribution for redear sunfish indicated a low reproductive success rate during 2000 (Appendix 8). However, the relatively high mean electrofishing catch rate, increasing population size in recent years, and the presence of older, larger fish in the population indicate a viable redear sunfish fishery exists in Harris Reservoir. Similar to bluegill, the less than optimal mean relative weight (78) was in the range consistent with a relatively large population density (Appendix 9).

- The annual mean electrofishing catch rate for largemouth bass of 27 fish per hour was within the range reported for quarterly data from 1988 through 1999 (Appendix 7). The values for Proportional Stock Density (PSD) and Relative Stock Density preferred length (RSD_p) (Appendix 8) were consistent with objectives for a large bass management strategy (Gablehouse 1984; Willis et al. 1993). The management objective for the largemouth bass population is for the reservoir to contain a large number of big bass equating to a PSD in the range of values from 50 to 80 and an RSD_p in the range from 30 to 60. Also, the relative stock density memorable length index was 9 during 2000, which was in the range (0-10) of values indicative of a balanced largemouth bass population. The mean relative weight of largemouth bass collected during 2000 was 94 indicating a healthy, robust body conditions for the average fish (Appendix 9).

- No disease outbreaks were noted in Harris Lake during 2000. However, a small number (approximately 20) of dead 6-10 pound largemouth bass were reported during the week following the 4th of July weekend of 2000. During that weekend, multiple bass tournaments and heavy fishing pressure occurred. The mortality observed was thought to be related to delayed mortality from improper handling techniques associated with catch and release practices.

- Habitat improvements (Christmas tree reefs) were conducted in the Harris Plant auxiliary reservoir during 2000. Limited fishing is allowed in the auxiliary reservoir.

Aquatic Vegetation

- A visual survey revealed no stands of hydrilla (*Hydrilla verticillata*), a non-native submersed plant, reaching the surface of the water of the intake canal in Harris Reservoir during 2000. However, creeping water primrose (*Ludwigia uruguayensis*) was noted along both sides of the canal and existed in amounts similar to those observed during 1999. Although creeping water primrose was well established in this region, no impacts to the Harris Plant have occurred nor are they expected because of the low velocity of water drawn from the main reservoir into the cooling tower makeup water intake structure.

- During November 2000 large hydrilla stands extending to the water surface were observed in the littoral zone at Station S. At Station E hydrilla and creeping water primrose dominated the aquatic plant community. Small amounts if *Eleocharis* sp. and *Utricularia* sp. were observed. No significant quantities of aquatic vegetation were observed in the auxiliary reservoir during 2000. The continued presence of grass carp (*Ctenopharyngodon idella*) from previous stockings has provided adequate control of potential nuisance overgrowth stands in the auxiliary reservoir.

CONCLUSIONS

During 2000, the Harris Reservoir continued to show characteristics of a typical southeastern, biologically productive reservoir with seasonally occurring oxygen-deficient subsurface waters, elevated nutrient concentrations, and an abundance of rooted shallow-water aquatic plants.

The environmental monitoring program conducted during 2000 continued to provide an assessment of the effects of the Harris Nuclear Plant's operation on the various components of the aquatic environment. Most key indicators of the environmental quality in Harris Reservoir were unchanged from the previous five years. Nutrient concentrations have been a concern in Harris Reservoir since phosphorous and nitrogen concentrations increased rapidly in the late 1980s and early 1990s. Water quality assessments determined that nutrient concentrations have remained stable since 1995 and at levels acceptable for southeastern, productive reservoirs. Assessments of other water quality parameters, including solids, turbidity, total organic carbon, ions (calcium, chloride, magnesium, sodium, and sulfate), total alkalinity, hardness, and metals, indicate few if any consistent statistically significant spatial or temporal trends with none of these variables at concentrations which would be detrimental to the aquatic community.

No nuisance algal blooms, as indicated by chlorophyll *a* concentrations, or exotic mussels were detected in the main reservoir during 2000. Reservoir-wide chlorophyll *a* concentrations demonstrated no consistent statistically significant temporal trend for the period 1996-2000.

Based on surveys conducted during 2000, no stands of the aquatic plant, hydrilla, extending to the surface of the water were observed in the littoral zone of the intake canal of the main reservoir. The reduced size and extent of aquatic vegetation stands in the auxiliary reservoir indicates that grass carp released in the fall of 1994, 1996, and 1997 continued to control the amount and area coverage of hydrilla during 2000. No operational impacts have occurred at the Harris Nuclear Plant because of aquatic vegetation biofouling.

Bluegill, redear sunfish, and largemouth continued to dominate the fishery in Harris Reservoir during 2000. Black crappie catches were slightly lower that usual for 2000. Results indicate the presence of a balanced largemouth bass population exhibiting strong reproduction and the presence of a large percentage of older, larger fish. Abundant forage species such as shad and other sunfish have resulted in very healthy, robust body condition for largemouth bass.

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Appendix 1. Water temperature, dissolved oxygen, conductivity, pH, and Secchi disk transparency data collected from Harris Reservoir during 2000.

January 7, 2000

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (μS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	10.5	10.9	10.5	10.1	11.2	11.7	11.4	10.6	72	70	69	66	7.2	6.9	7.0	6.9	1.7	1.6	1.2	0.8
1.0	10.5	10.5	10.5	9.7	11.2	11.6	11.4	10.5	72	70	69	65	7.2	6.9	7.0	6.9				
2.0	10.5	10.2	10.4	9.4	11.2	11.0	11.4	10.1	72	69	68	65	7.2	6.9	7.0	6.9				
3.0	10.3	10.1	9.9	9.0	11.2	10.7	10.5	9.8	71	69	68	65	7.2	6.9	7.0	6.9				
4.0	10.1	9.7	9.8		11.4	10.0	10.3		71	68	68		7.2	7.0	7.0					
5.0	10.0	9.5	9.8		11.3	9.0	10.2		71	68	68		7.2	7.0	7.1					
6.0	9.7	9.5	9.8		10.4	8.9	9.8		70	68	68		7.2	7.0	7.1					
7.0	9.7	9.5	9.8		10.2	8.9	9.8		70	68	68		7.2	7.0	7.1					
8.0	9.6	9.5	9.8		10.1	8.9	9.7		70	68	68		7.2	7.0	7.1					
9.0	9.5	9.5	9.8		9.9	8.8	9.6		70	68	68		7.2	7.0	7.0					
10.0	9.5				9.8				70				7.2							
11.0	9.5				9.8				70				7.2							
12.0	9.3				9.5				70				7.2							
13.0	9.3				9.5				69				7.2							
14.0	9.3				9.4				69				7.2							
15.0	9.3				9.4				69				7.2							
16.0	9.3				9.4				69				7.2							

May 1, 2000

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (μS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	19.9	19.4	19.0	19.6	10.9	10.4	10.8	10.2	71	69	69	70	8.8	7.8	8.7	7.5	1.6	1.4	1.3	0.8
1.0	19.9	19.4	18.9	19.5	10.9	10.4	10.8	10.2	70	69	69	70	8.8	7.8	8.7	7.5				
2.0	16.8	17.4	18.2	18.0	9.4	9.5	10.6	8.9	66	67	67	69	8.5	7.8	8.5	7.4				
3.0	16.6	16.8	17.3	16.8	8.1	8.1	9.6	5.7	65	65	66	69	8.3	7.7	8.3	7.2				
4.0	16.5	16.6	16.6	15.5	8.0	6.6	8.3	2.9	65	64	65	74	8.1	7.3	8.1	6.9				
5.0	16.5	16.4	16.5		7.8	6.4	7.8		65	65	65		8.0	7.2	7.9					
6.0	16.4	16.3	16.4		7.6	5.6	7.4		65	64	65		8.0	7.2	7.7					
7.0	16.4	16.2	16.3		7.4	5.0	6.9		65	65	65		7.9	7.1	7.7					
8.0	16.3	15.9	16.2		6.9	3.8	6.4		66	75	66		7.8	7.1	7.6					
9.0	16.2	15.8	16.1		6.7	2.8	6.0		66	72	66		7.7	7.0	7.6					
10.0	16.1				6.7				66				7.7							
11.0	16.0				6.6				66				7.6							
12.0	15.3				5.3				67				7.6							
13.0	14.8				3.1				70				7.4							
14.0	14.6				2.6				71				7.3							
15.0	14.5				2.0				72				7.3							
16.0	14.3				0.3				75				7.2							
17.0	14.1				0.0				84				7.4							

Appendix 1 (continued)

July 5, 2000

Depth (m)	Temperature (°C) E2	H2	P2	S2	Dissolved oxygen (mg/L) E2	H2	P2	S2	Conductivity (μS/cm) E2	H2	P2	S2	pH E2	H2	P2	S2	Secchi disk depth (m) E2	H2	P2	S2
0.2	29.0	29.9	28.7	29.5	9.9	10.1	10.0	10.2	107	105	106	108	7.3	7.7	6.7	7.6	1.6	1.7	1.7	2.0
1.0	28.8	28.8	28.5	29.4	10.0	10.3	10.1	10.4	106	104	106	107	7.4	7.7	6.7	7.7				
2.0	28.2	28.6	28.1	28.7	10.1	10.0	9.8	11.0	105	102	105	107	7.4	7.8	6.8	8.3				
3.0	27.1	28.5	28.0	27.7	7.2	9.7	9.7	7.3	103	102	104	105	7.3	7.7	6.9	7.8				
4.0	26.7	26.2	27.9	27.0	5.8	1.0	9.5	3.2	102	98	104	107	7.2	7.5	6.9	6.9				
5.0	25.9	23.5	24.6		1.7	0.2	2.3		102	114	114		7.0	7.1	6.8					
6.0	22.5	22.1	22.5		0.2	0.1	0.6		121	114	119		6.8	7.0	6.6					
7.0	21.6	21.0	21.9		0.1	0.1	0.2		121	116	118		6.7	6.9	6.5					
8.0	20.7	20.7	21.5		0.1	0.1	0.1		118	117	115		6.7	6.7	6.4					
9.0	19.7	20.3	20.1		0.1	0.1	0.0		113	121	116		6.6	6.6	6.3					
10.0	18.7				0.1				110				6.6							
11.0	18.5				0.1				110				6.6							
12.0	17.0				0.0				115				6.6							
13.0	16.2				0.0				124				6.5							
14.0	16.0				0.0				127				6.5							
15.0	15.9				0.0				128				6.5							
16.0	15.7				0.0				135				6.6							

November 14, 2000

Depth (m)	Temperature (°C) E2	H2	P2	S2	Dissolved oxygen (mg/L) E2	H2	P2	S2	Conductivity (μS/cm) E2	H2	P2	S2	pH E2	H2	P2	S2	Secchi disk depth (m) E2	H2	P2	S2
0.2	16.7	16.8	16.5	15.6	6.3	8.8	7.9	10.3	99	96	95	93	6.8	7.0	6.9	6.9	1.6	1.5	1.5	2.5
1.0	16.7	16.8	16.5	15.6	6.3	8.6	7.8	10.1	99	95	95	92	6.8	7.0	6.9	6.8				
2.0	16.7	16.6	16.5	15.6	6.3	8.5	7.8	10.0	99	95	95	92	6.8	7.0	6.9	6.8				
3.0	16.7	16.6	16.5	15.6	6.3	8.4	7.8	10.0	99	95	95	92	6.8	7.0	6.9	6.8				
4.0	16.7	16.6	16.5	15.4	6.3	8.4	7.7	9.9	99	95	95	93	6.8	7.0	6.8	6.8				
5.0	16.6	16.6	16.5		6.2	8.3	7.7		99	95	95		6.7	6.9	6.8					
6.0	16.6	16.6	16.5		6.2	8.3	7.7		99	95	95		6.7	6.9	6.8					
7.0	16.6	16.5	16.5		6.2	8.2	7.7		99	95	95		6.7	6.9	6.8					
8.0	16.6	16.5	16.5		6.2	5.1	7.5		99	95	95		6.7	6.9	6.8					
9.0	16.6				6.2				99				6.7							
10.0	16.6				6.2				99				6.7							
11.0	16.6				6.2				99				6.7							
12.0	16.6				6.2				98				6.7							
13.0	16.5				6.1				98				6.7							
14.0	16.5				6.1				99				6.7							

Appendix 2. Means, ranges, and spatial trends of selected limnological variables from the surface waters of Harris Reservoir during 2000.[+]

Variable	Station E2	Station H2	Station P2	Station S2
Solids (mg/liter)				
Total	49 (46-52)	57 (42-68)	55 (48-60)	38 (< 20-58)
Total dissolved	58 (49-67)	58 (47-70)	56 (40-64)	62 (57-69)
Total suspended	< 5 NA	< 5 (< 5-5)	< 5 NA	< 5 (< 5-6)
Turbidity (NTU)	7.2 (3.4-17)	4.5 (2.6-6.0)	4.6 (3.0-6.4)	8.5 (2.5-17)
Secchi disk transparency (m)	1.6 (1.6-1.7)	1.6 (1.4-1.7)	1.4 (1.2-1.7)	1.5 (0.8-2.5)
Chlorophyll *a* (µg/liter)	18 (4.8-27)	23 (17-31)	19 (9.3-32)	19 (7.2-25)
Nutrients (mg/liter)				
Ammonia-N	< 0.05 (< 0.05-0.07)	< 0.05 NA	< 0.05 (< 0.05-0.06)	< 0.05 (< 0.05-0.05)
Nitrate + Nitrite-N	0.04 (< 0.02-0.14)	0.03 (< 0.02-0.08)	0.03 (< 0.02-0.09)	0.02 (< 0.02-0.04)
Total nitrogen	0.64 (0.47-0.74)	0.58 (0.50- 0.74)	0.62 (0.51-0.75)	0.49 (0.29-0.67)
Total phosphorus	0.036 (0.029-0.042)	0.032 (0.024-0.036)	0.028 (0.022-0.034)	0.031 (0.022-0.038)
Total organic carbon (mg/liter)	8.2 (7.8-8.6)	8.1 (7.4-8.6)	8.3 (7.7-8.9)	8.6 (8.0-9.5)
Ions (mg/liter)				
Calcium	3.7 (3.4-3.9)	3.5 (3.0-3.7)	3.6 (3.4-3.8)	3.8 (3.6-3.9)
Chloride	12[a] (12-14)	12[b] (11-13)	12[ab] (11-13)	12[b] (11-13)
Magnesium	1.7 (1.6-1.8)	1.6 (1.4-1.8)	1.7 (1.6-1.8)	1.6 (1.5-1.8)
Sodium	11 (10-12)	10 (8.9-12)	10 (9.6-11)	10 (8.4-11)
Sulfate	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-12)
Total alkalinity (mg/liter as $CaCO_3$)	14 (11-20)	14 (11-16)	12 (10-16)	15 (11-20)
Hardness (calculated as mg equivalents $CaCO_3$/liter)	16 (15-17)	15 (13-17)	16 (15-17)	16 (16-17)
Conductivity (µS/cm)	87 (71-107)	85 (69-105)	85 (69-106)	84 (66-108)

Appendix 2 (continued)

Variable	N.C. water quality standard	Station			
		E2	H2	P2	S2
Metals (µg/liter)					
Aluminum	None	56 (< 50-150)	< 50 (< 50-59)	< 50 (< 50-79)	167 (< 50-440)
Cadmium	2	< 0.5 NA	< 0.5 NA	< 0.5 NA	< 0.5 NA
Copper	7¶	2.6 (1.4-5.9)	1.3 (< 1.0-3.0)	1.5 (< 1.3-2.0)	1.0 (< 1.0-1.7)
Mercury	0.012	< 0.2 NA	< 0.2 NA	< 0.2 NA	< 0.2 NA

+Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$)—see shaded row. Sample size equaled 4 for all variables unless otherwise noted. The mean separation technique may yield separations that are obscured by data rounding.

¶This value is an action level, not a water quality standard. An action level is for toxic substances, which are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics, or associated waste characteristics (NCDEM 1994b).

NA = All measured values were less than the laboratory lower reporting limit.

Appendix 3. Annual mean water chemistry variables from the surface waters of Harris Reservoir 1996-2000.⁺

	Year				
Variable	**1996**	**1997**	**1998**	**1999**	**2000**
Solids (mg/liter)					
Total	89^{a}	54^{c}	68^{b}	76^{ab}	50^{c}
Total dissolved	78^{a}	54^{c}	69^{ab}	73^{a}	58^{bc}
Total suspended¶	< 6	< 6	4	< 5	< 5
Turbidity (NTU)	4.7	5.7	5.8	8.9	6.2
Secchi disk transparency (m)	1.6^{ab}	1.3^{ab}	1.2^{b}	1.3^{ab}	1.5^{a}
Chlorophyll *a* (µg/liter)	12^{c}	24^{a}	25^{a}	14^{bc}	20^{ab}
Nutrients (mg/liter)					
Ammonia-N	0.05	< 0.07	0.05	< 0.05	< 0.05
Nitrate + nitrite-N	0.03	0.05	0.04	0.08	0.03
Total nitrogen	0.86	0.74	0.56	0.62	0.58
Total phosphorus	0.032	0.034	0.034	0.033	0.032
Total organic carbon (mg/liter)	6.5^{b}	7.2^{b}	7.2^{b}	7.8^{a}	8.3^{a}
Ions (mg/liter)					
Calcium	3.8	3.7	5.3	3.9	3.6
Chloride	9.8^{b}	6.3^{c}	8.6^{b}	9.3^{b}	12^{a}
Magnesium	1.7	1.7	1.6	1.7	1.6
Sodium	9.2	8.9	9.8	11	10
Sulfate	13^{a}	13^{a}	7.1^{c}	9.4^{b}	12^{a}
Total alkalinity (mg/liter as $CaCO_3$)	13^{b}	12^{b}	13^{b}	15^{a}	14^{b}
Hardness (mg equivalents $CaCO_3$/liter)	17	16	20	17	16
Conductivity (µS/cm)	7	81	76	88	85
Metals (µg/liter)					
Aluminum	58	76	83	169	77
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Copper	2.0^{ab}	1.5^{b}	3.5^{a}	2.6^{ab}	1.6^{b}
Mercury	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2

⁺Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$)—see shaded rows. Data were rounded to conform to significant digit requirements. The mean separation technique may yield separations that are obscured by data rounding.

¶In June 1998, the lower reporting limits (LRLs) changed for total suspended solids from 6 to 3 mg/L and in 1999, the LRLs changed for total suspended solids from 3 to 5 mg/l.

Appendix 4. Temporal trends of selected limnological variables from the bottom waters of Harris Reservoir at Station E2, 1996-2000. +

Variable	Year 1996	1997	1998	1999	2000
Solids (mg/liter)					
Total	113	71	82	90	52
Total dissolved	87	78	74	81	65
Total suspended	< 6	6	6	13	< 5
Turbidity (NTU)	4.0	7.2	13	15	14
Nutrients (mg/liter)					
Ammonia-N	0.09	0.70	0.47	0.42	0.57
Nitrate + nitrite-N	0.19	0.06	0.14	0.08	0.06
Total nitrogen	1.3	1.3	1.2	1.0	1.0
Total phosphorus	0.147	0.105	0.147	0.146	0.144
Total organic carbon (mg/liter)	7.4	7.8	8.5	8.4	9.2
Ions (mg/liter)					
Calcium	4.6	4.5	4.7	4.4	4.0
Chloride	9.7[ab]	6.8[b]	9.1[ab]	9.2[ab]	12[a]
Magnesium	2.0	1.9	2.0	1.9	1.8
Sodium	10	10	11	12	10
Sulfate	14	11	7.1	9.2	11
Total alkalinity (mg/liter as $CaCO_3$)	25	26	21	21	22
Hardness (mg equivalents $CaCO_3$/liter)	20	19	20	19	17
Metals (µg/liter)					
Aluminum	42	56	155	222	100
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Copper	2.2	1.9	3.7	5.6	1.4
Mercury	< 0.2	< 0.2	0.2	0.2	< 0.2

+Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Annual means followed by the same superscript were not significantly different ($P > 0.05$)—see shaded row.

Appendix 5. Concentrations of chemical variables in Harris Reservoir during 2000.+

Station E2 (surface)

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	NO_3^- + NO_2^--N
Jan	20	15	12	13	3.4	1.6	10	0.64	< 0.05	0.02
May	12	16	12	13	3.8	1.6	10	0.47	0.06	< 0.02
Jul	11	16	12	11	3.7	1.7	11	0.74	< 0.05	< 0.02
Nov	12	17	14	13	3.9	1.8	12	0.70	0.07	0.14

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.036	8.1	5.1	48	57	< 5	< 50	< 0.5	1.7	< 0.20	18
May	0.038	8.6	17	46	57	< 5	150	< 0.5	1.4	< 0.20	12
Jul	0.029	8.2	3.5	NA	49	NA	< 50	< 0.5	5.9	< 0.20	26
Nov	0.042	7.8	3.4	52	67	< 5	< 50	< 0.5	1.5	< 0.20	17

Station H2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	NO_3^- + NO_2^--N
Jan	16	13	11	13	3.0	1.4	8.9	0.50	< 0.05	< 0.02
May	13	16	12	12	3.6	1.6	9.6	0.50	< 0.05	< 0.02
Jul	11	16	11	11	3.6	1.7	9.9	0.74	< 0.05	< 0.02
Nov	16	17	13	13	3.7	1.8	12	0.59	< 0.05	0.08

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.036	7.8	6.0	60	62	5	52	< 0.5	1.3	< 0.20	14
May	0.034	8.6	5.5	42	53	5	59	< 0.5	< 1.0	< 0.20	15
Jul	0.024	8.5	3.8	NA	47	NA	< 50	< 0.5	< 1.0	< 0.20	31
Nov	0.035	7.4	2.6	68	70	< 5	< 50	< 0.5	3.0	< 0.20	17

Station P2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	NO_3^- + NO_2^--N
Jan	16	15	12	13	3.4	1.6	9.9	0.51	< 0.05	< 0.02
May	10	15	12	13	3.5	1.6	9.6	0.63	0.06	< 0.02
Jul	10	16	11	11	3.8	1.7	10	0.75	< 0.05	< 0.02
Nov	12	17	13	12	3.7	1.8	11	0.60	< 0.05	0.09

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.030	8.4	6.4	58	58	< 5	79	< 0.5	1.4	< 0.20	17
May	0.034	8.9	5.7	48	40	< 5	54	< 0.5	2.0	< 0.20	18
Jul	0.022	8.3	3.4	NA	60	NA	< 50	< 0.5	1.4	< 0.20	34
Nov	0.028	7.7	3.0	60	64	< 5	< 50	< 0.5	1.3	< 0.20	21

Appendix 5 (continued)

Station S2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^- + NO_2^-$-N
Jan	20	16	11	11	3.9	1.5	8.4	0.56	< 0.05	0.04
May	14	16	12	12	3.9	1.6	9.6	0.29	0.05	< 0.02
Jul	11	17	11	11	3.9	1.7	11	0.67	< 0.05	< 0.02
Nov	14	16	13	12	3.6	1.8	11	0.43	< 0.05	< 0.02

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.038	8.7	17	58	59	6	440	< 0.5	1.7	< 0.20	15
May	0.037	9.5	11	46	57	< 5	110	< 0.5	< 1.0	< 0.20	7.8
Jul	0.026	8.0	3.5	NA	61	NA	< 50	< 0.5	< 1.0	< 0.20	26
Nov	0.022	8.3	2.5	< 20	69	< 5	94	< 0.5	< 1.0	< 0.20	20

Station E2 (bottom)

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^- + NO_2^-$-N
Jan	20	13	12	13	2.9	1.4	8.9	0.37	< 0.05	0.05
May	16	18	12	13	4.1	1.8	10	0.92	0.48	0.02
Jul	38	21	12	5.0	5.1	2.1	10	2.18	1.69	< 0.02
Nov	14	18	14	13	3.9	1.9	12	0.71	0.07	0.16

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.034	9.1	22	50	63	5	64	< 0.5	2.1	0.20	11
May	0.080	8.9	26	48	58	< 5	260	< 0.5	1.4	< 0.20	12
Jul	0.422	11	6.1	NA	72	NA	53	< 0.5	< 1.0	< 0.20	5.2
Nov	0.041	7.6	3.7	58	67	< 5	< 50	< 0.5	1.8	< 0.20	17

+Units are in mg/L except for trace elements (μg/L), turbidity (NTU), total alkalinity (mg/L as $CaCO_3$), and hardness (calculated as mg equivalents $CaCO_3$/L).

NA = July water sample was not analyzed for total solids and total suspended solids due to laboratory error.

Appendix 6. **Mean number per hour for fish collected with electrofishing sampling by transect from Harris Reservoir during 2000.**

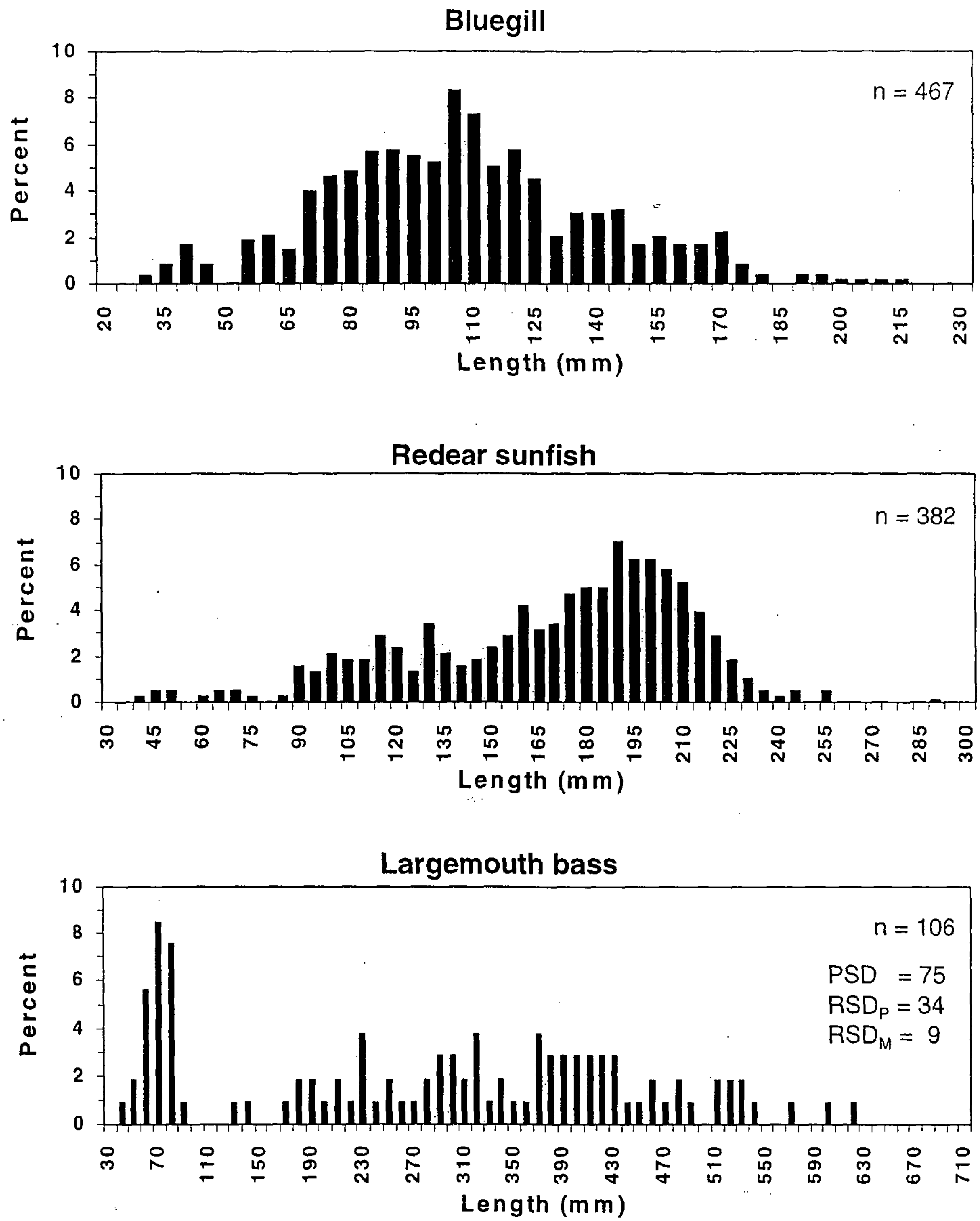
Taxon	Transect E	Transect H	Transect P	Transect S	Transect V	Reservoir mean
Bowfin	0	0	0	2	0	< 1
Gizzard shad	17	6	6	6	2	8
Threadfin shad	6	0	4	26	0	3
Common carp	0	0	0	0	< 1	< 1
Chain pickerel	0	2	0	4	0	1
Golden shiner	11	2	12	18	4	9
Coastal shiner	8	52	4	1	23	18
White catfish	0	0	12	< 1	< 1	3
Flat bullhead	< 1	< 1	0	0	< 1	< 1
Brown bullhead	0	0	1	2	< 1	1
Channel catfish	0	< 1	< 1	0	0	< 1
Bluespotted sunfish	0	0	0	6	2	1
Redbreast sunfish	0	0	0	0	< 1	< 1
Warmouth	2	2	1	< 1	4	2
Bluegill	140	132	63	66	78	96
Redear sunfish	121	110	44	25	36	67
Largemouth bass	30	12	32	24	36	27
Black crappie	2	0	4	1	16	5
White crappie	0	0	0	3	0	1
White perch	1	0	0	0	0	< 1
Total+	**337**	**318**	**184**	**162**	**203**	**241**

+Summations may vary from column totals due to rounding.

Appendix 7. **Mean catch rates (number per hour) for the numerically dominant recreational and forage fish species collected with quarterly electrofishing sampling from Harris Reservoir, 1988-1991, 1995, 1999, and 2000.** $^{+}$

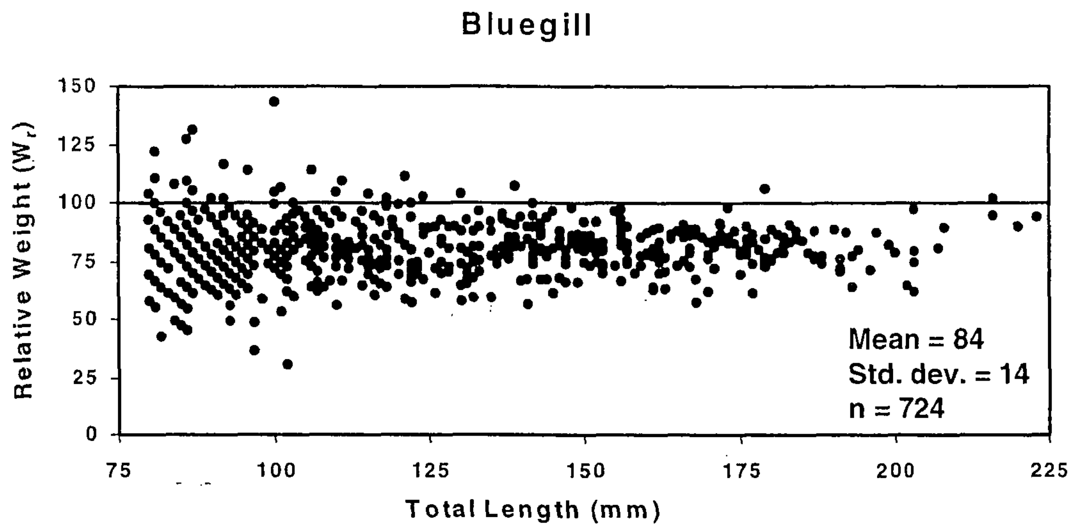
Taxon	Year						
	1988	**1989**	**1990**	**1991**	**1995**	**1999**	**2000**
Gizzard shad	8	29	20	19	5	7	8
Threadfin shad	< 5	12	< 5	< 5	< 5	5	3
Golden shiner	5	9	9	5	7	8	9
Bluegill	86	101	105	92	77	119	96
Redear sunfish	7	14	21	24	73	90	67
Largemouth bass	33	42	24	29	20	43	27
Black crappie	8	14	15	12	6	19	5
Total (all species)	**195**	**299**	**249**	**214**	**203**	**311**	**241**

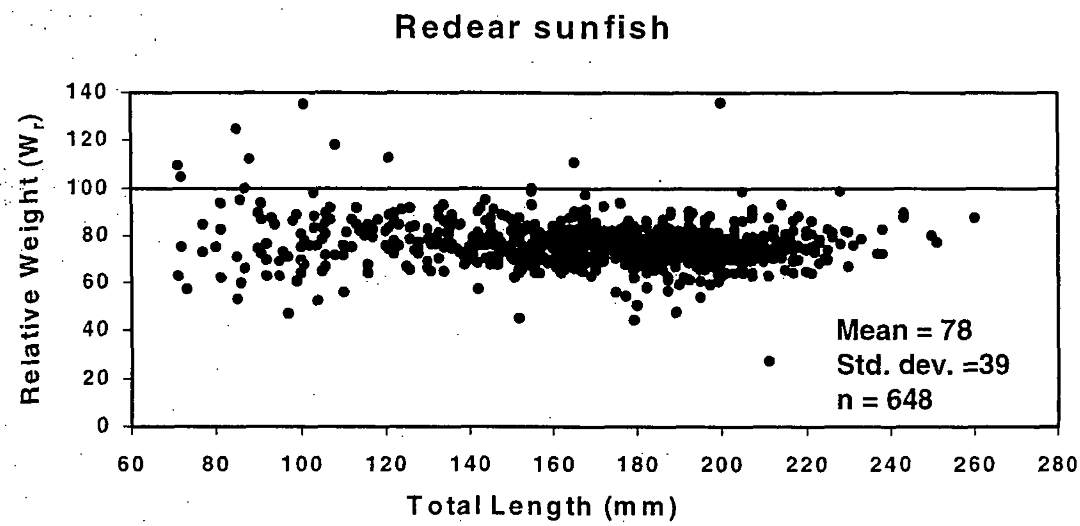
$^{+}$Annual catch rates for 1992-1994 and 1998 were collected semiannually and were not included in this comparison. Data for these years can be obtained from CP&L (1996, 1999, 2000). Sampling was not conducted during 1996 and 1997.

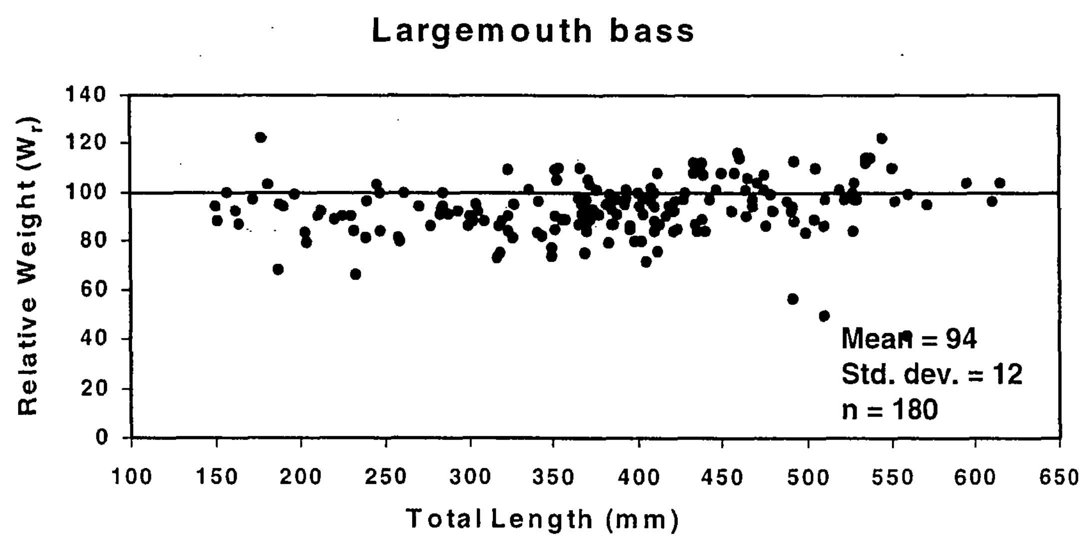


Note: PSD = Proportional Stock Density, RSD_P = Relative Stock Density preferred length, RSD_M = Relative Stock Density memorable length

Appendix 8. Length-frequency distributions for bluegill, redear sunfish, and largemouth bass collected with electrofishing sampling from Harris Reservoir during 2000.







Appendix 9. Relative weight values for bluegill, redear sunfish, and largemouth bass collected with electrofishing sampling from Harris Reservoir during 2000.

Response to RAI No. 1
Item 5

Progress Energy 2003a

HARRIS NUCLEAR PLANT
2002 ENVIRONMENTAL MONITORING REPORT

November 2003

Environmental Services Section

PROGRESS ENERGY CAROLINAS
New Hill, North Carolina

Preface

This copy of the report is not a controlled document as detailed in Environmental Services Section Biology Program Procedures and Quality Assurance Manual. Any changes made to the original of this report subsequent to the date of issuance can be obtained from:

Director
Environmental Services Section
Progress Energy Carolinas
3932 New Hill-Holleman Road
New Hill, North Carolina 27562-0327

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Metric-English Conversion and Units of Measure

Length

1 micron (μm) = 4.0 x 10^{-5} inch
1 millimeter (mm) = 1000 μm = 0.04 inch
1 centimeter (cm) = 10 mm = 0.4 inch
1 meter (m) = 100 cm = 3.28 feet
1 kilometer (km) = 1000 m = 0.62 mile

Area

1 square meter (m^2) = 10.76 square feet
1 hectare (ha) = 10,000 m^2 = 2.47 acres

Volume

1 milliliter (ml) = 0.034 fluid ounce
1 liter = 1000 ml = 0.26 gallon
1 cubic meter = 35.3 cubic feet

Weight

1 microgram (μg) = 10^{-3} mg or 10^{-6} g = 3.5 x 10^{-8} ounce
1 milligram (mg) = 3.5 x 10^{-5} ounce
1 gram (g) = 1000 mg = 0.035 ounce
1 kilogram (kg) = 1000 g = 2.2 pounds
1 metric ton = 1000 kg = 1.1 tons
1 kg/hectare = 0.89 pound/acre

Temperature

Degrees Celsius (°C) = 5/9 (°F-32)

Specific conductance

μS/cm = Microsiemens/centimeter

Turbidity

NTU = Nephelometric Turbidity Unit

Water Chemistry Abbreviations

Cl^-	Chloride	NH_3-N	Ammonia-nitrogen
SO_4^{2-}	Sulfate	NO_3^- + NO_2^- - N	Nitrate + nitrite-nitrogen
Ca^{2+}	Total calcium	TP	Total phosphorus
Mg^{2+}	Total magnesium	TOC	Total organic carbon
Na^+	Total sodium	Cu	Total copper
TN	Total nitrogen	TDS	Total dissolved solids

EXECUTIVE SUMMARY

Harris Reservoir supplies makeup water to the closed-cycle cooling system for the Harris Nuclear Plant. The Harris Nuclear Plant discharges primarily cooling tower blowdown along with low volume waste discharges into the reservoir near the main dam.

Harris Reservoir continued to show qualities of a typical, biologically productive, southeastern reservoir in 2002. Nutrient concentrations, including total phosphorus and total nitrogen concentrations, remained similar to recent years and were in an acceptable range for a productive reservoir in this area.

Bluegill, redear sunfish, largemouth bass, and black crappie dominated the fish community in Harris Reservoir during 2002. Annual catch rates for bluegill and largemouth bass were similar to catch rates in previous years while the annual catch rates for black crappie and redear sunfish were greater than in previous years. Bluegill and largemouth bass were represented by multiple size groups and an abundance of small fish indicated good reproduction. Young redear sunfish were less common in samples but the increasing abundance of this species in recent years indicated sufficient reproduction. The largemouth bass population remained balanced with a large percentage of larger fish present in the population.

Hydrilla stands reaching the surface of the water were observed in the intake canal in Harris Reservoir during 2002. However, no fouling of the plant intake screens occurred. No stands of hydrilla were observed in the littoral zone of the auxiliary reservoir during 2002. The attempt to control hydrilla in the auxiliary reservoir by releasing grass carp appears to have been effective in reducing the quantity and area covered by this vegetation.

HARRIS NUCLEAR PLANT 2002 ENVIRONMENTAL MONITORING REPORT

Reservoir Description

Harris Reservoir, located in Chatham and Wake Counties, North Carolina, was created by impounding Buckhorn Creek, a tributary of the Cape Fear River (Figure 1). The main body of Harris Reservoir has a surface area of 1680 ha; the auxiliary reservoir has a surface area of 130 ha. The main reservoir has a maximum depth of 18 m, a mean depth of 5.3 m, a volume of 8.9×10^7 m^3, a full-pool elevation of 67.1 m National Geodetic Vertical Datum (NGVD), and an average residence time of 28 months. The reservoir began filling in December 1980 and full-pool elevation was reached in February 1983. The 64.5-km shoreline is mostly wooded and the 183.9-km^2 drainage area is mostly rolling hills with land used primarily for forestry and agriculture. The conversion of areas from forestry or agricultural purposes to residential uses continues in many areas of the drainage.

Harris Reservoir was constructed to supply cooling tower makeup and auxiliary reservoir makeup water to the 900-MW Harris Nuclear Plant, which began commercial operation in May 1987. In 1986 the bottom waters of the reservoir near the main dam began receiving National Pollutant Discharge Elimination System (NPDES)-permitted wastewater discharges from the power plant cooling tower. Tributaries also receive NPDES-permitted discharges from the Harris Energy and Environmental Center and from wastewater treatment plants at Apex and Holly Springs. The reservoir is a source of drinking water for Progress Energy employees at the Harris Nuclear Plant and the Harris Energy and Environmental Center.

Objectives

The primary objectives of the 2002 Harris Nuclear Plant non-radiological environmental monitoring program were to: (1) assess the reservoir's overall water quality, (2) identify any natural or power plant-induced effects on the water quality in the reservoir, (3) document the introduction and expansion of nonnative plant and animal populations in the reservoir, and (4) demonstrate the existence of a reasonable recreational fishery. These objectives have also been addressed in previous annual monitoring reports with the most recent detailed in CP&L 1998, 1999, 2000, 2001, and 2002.

Methods

The Harris Nuclear Plant environmental program for 2002 included monitoring the reservoir's: (1) limnological characteristics (water quality, water chemistry, and phytoplankton), (2) fisheries community, (3) possible introductions of the zebra and quagga mussels, and (4) distribution of aquatic vegetation. Sampling methods and statistical analyses for data collected during 2002 were similar to those used for data collected during 2001 (CP&L 2002) (Tables 2 and 3). Supporting data summaries and appropriate statistical analyses were used to describe and interpret the environmental quality of the reservoir (Table 3). A list of common and scientific names of species in this report is provided (Table 4). Three stock assessment indices were used as indicators of a balanced largemouth bass population (Gablehouse 1984). These indices include: Proportional Stock Density (PSD), the percentage of fish ≥ 300 mm; Relative Stock Density for preferred length (RSD_P), the percentage of fish ≥ 380 mm; and Relative Stock Density for memorable length (RSD_M), the percentage of fish ≥ 510 mm. Only fish greater than the minimum stock length (≥ 200 mm) were included in these calculations.

All analytical testing completed in support of the Harris Reservoir environmental program was performed by appropriate laboratories which were qualified to perform water and wastewater testing. The accuracy and precision of laboratory analyses of water chemistry data were determined with analytical standards, spikes, and replicates. Quality assurance information including the accuracy and percent recovery of water chemistry standards are available upon request. In this report where concentrations were less than the laboratory-reporting limit, the concentrations were assumed to be at one-half the reporting limit for the calculation of the mean. Where statistically significant results were reported, a Type I error rate of 5% (∝ = 0.05) was used and Fisher's protected least significant difference test was applied to determine where significant differences in mean values occurred.

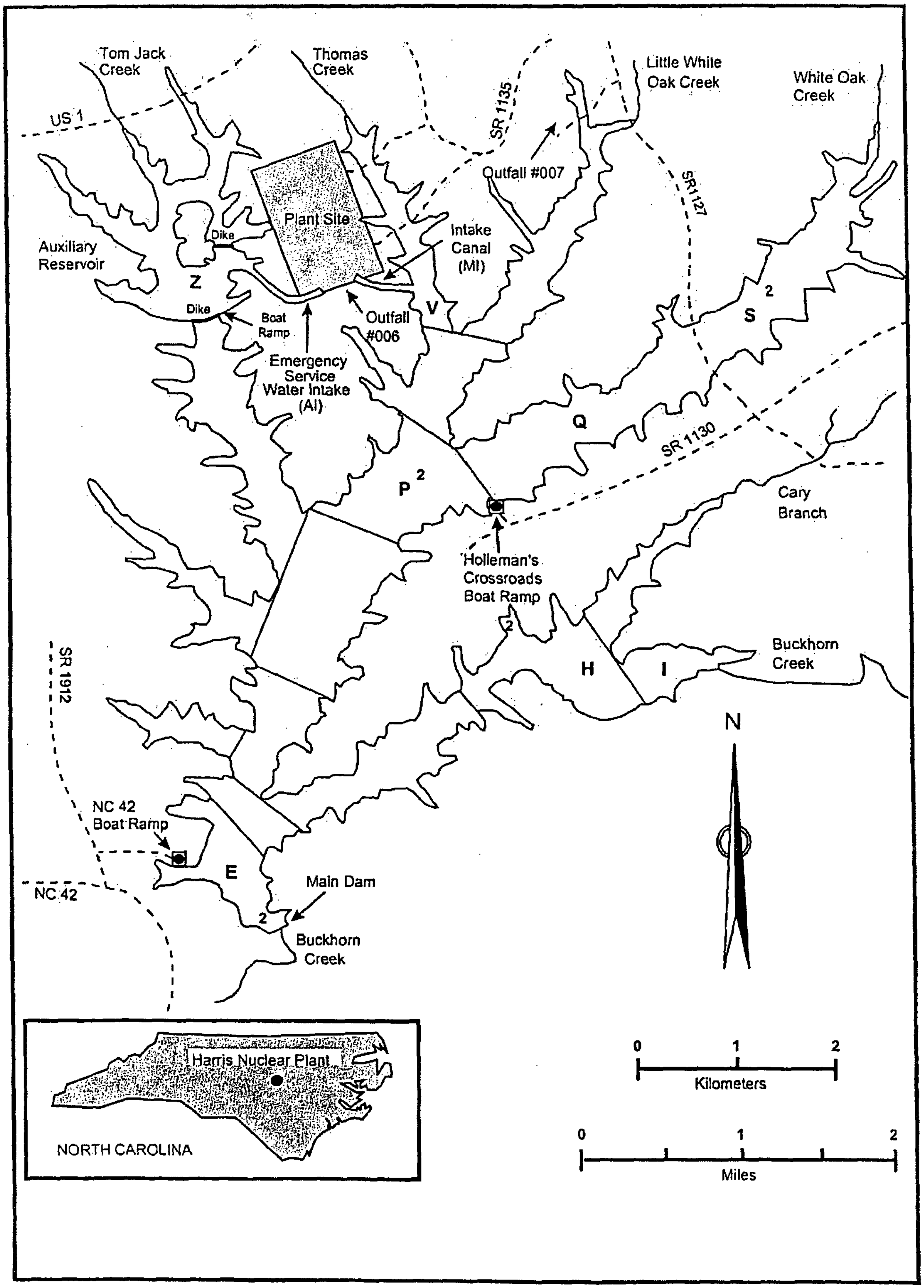

Figure 1. Sampling areas and stations at Harris Reservoir during 2002.

Table 1. Environmental monitoring program at Harris Reservoir for 2002.

Program	Frequency	Location
Water quality	January, May, July, November	Stations E2, H2, P2, and S2 (surface to bottom at 1-m intervals)
Water chemistry	January, May, July, November	Stations E2, H2, P2, and S2 (surface samples at all stations)
Plankton+	January, May, July, November	Stations E2, H2, P2, and S2
Biofouling monitoring		
Zebra mussel surveys	January, May, July, November	Areas E, P or Q, and V
Fisheries		
Electrofishing	February, May, August, November	Stations E1, E3, H1, H3, P1, P3, S1, S3, V1, and V3
Aquatic vegetation survey	November	Areas MI and Z

+Plankton included phytoplankton (algae) and chlorophyll *a* samples. Phytoplankton samples were collected and preserved but were not identified because all sampled chlorophyll *a* concentrations were < 40 μg/L.

Table 2. Field sampling and laboratory methods followed in the 2002 environmental monitoring program at Harris Reservoir.

Program	Method
Water quality	Temperature, dissolved oxygen, pH, turbidity, and specific conductance were measured with calibrated YSI® multiparameter instruments and YSI® dissolved oxygen meters. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface water samples were collected in appropriate containers, transported to the laboratory on ice, and analyzed according to accepted laboratory methods.
Phytoplankton	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 250-ml sub sample was taken and preserved with 5 ml of "M3" fixative.
Chlorophyll *a*	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 1000-ml sub sample was collected in a dark bottle, placed on ice, and returned to the laboratory. In the laboratory a 250-ml sub sample was analyzed according to Strickland and Parsons (1972) and APHA (1995).
Electrofishing	Fifteen-minute samples were collected at each station using a Smith-Root Type VI-A, 5.0 GPP, or 7.5 GPP equipped, Wisconsin-design electrofishing boat with pulsed DC current. Fish were identified to species, measured to the nearest mm, weighed to the nearest gram, examined for the presence of disease and deformities, and released.
Zebra mussel	The dock at the Holleman's boat ramp or water quality station marker buoys were visually inspected for the presence of mussels during routine water quality monitoring.
Aquatic vegetation survey	Portions of the shoreline and/or littoral zone of the Harris Plant main reservoir intake canal and auxiliary reservoir were systematically surveyed by boat to document the presence of aquatic vegetation, specifically hydrilla and water primrose.

Table 3. Statistical analyses performed on data collected for the 2002 environmental monitoring program at Harris Reservoir.

Program	Variable	Transformation	Statistical Test/model+	Main effect(s)
Water quality	Specific conductance and Secchi disk transparency	None	One-way, block on month	Station
Water chemistry	Select monitoring variables	None	One-way, block on month	Station
Phytoplankton	Chlorophyll *a*	None	One-way, block on month	Station
Fisheries	No. fish per hour by species	ln(x + 1)	One-way, block on month	Transect
	Weight per hour by species	ln(x + 1)	One-way, block on month	Transect
	Relative weight (W_r) ¶	None	$W_r = W_o/W_s \times 100$	Selected species

+Statistical tests used were one-way and two-way analysis of variance models. A Type I error rate of 5% ($\alpha = 0.05$) was used to judge the significance of all tests. Fisher's protected least significant difference (LSD) test was applied to determine where differences in means occurred.

¶Relative weight (W_r) where W_o is the observed weight of each fish and W_s is the length-specific standard weight predicted by a weight-length regression equation constructed to represent the species as a whole ($W_r = W_o / W_s * 100$). Relative weight (Anderson and Neumann 1996) was calculated for bluegill (Hillman 1982), redear sunfish (Pope et al. 1995), and largemouth bass (Wege and Anderson 1978). Minimum total lengths for inclusion in these calculations are 80 mm for bluegill and redear sunfish and 150 mm for largemouth bass.

Table 4. Common and scientific names of species in this report.

Common Name	Scientific Name
Fish	
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Bluespotted sunfish	*Enneacanthus gloriosus*
Bowfin	*Amia calva*
Brown bullhead	*Ameiurus nebulosus*
Chain pickerel	*Esox niger*
Channel catfish	*Ictalurus punctatus*
Coastal shiner	*Notropis petersoni*
Common carp	*Cyprinus carpio*
Flat bullhead	*Ameiurus platycephalus*
Gizzard shad	*Dorosoma cepedianum*
Golden shiner	*Notemigonus crysoleucas*
Grass carp	*Ctenopharyngodon idella*
Largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
Redbreast sunfish	*Lepomis auritus*
Redear sunfish	*Lepomis microlophus*
Threadfin shad	*Dorosoma petenense*
Warmouth	*Lepomis gulosus*
White catfish	*Ameiurus catus*
White crappie	*Pomoxis annularis*
White perch	*Morone americana*
Mussels	
Quagga mussel	*Dreissena bugensis*
Zebra mussel	*Dreissena polymorpha*
Aquatic Vegetation	
Water primrose	*Ludwigia* spp.
Hydrilla	*Hydrilla verticillata*
Water hyacienth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*

RESULTS OF ENVIRONMENTAL MONITORING AT HARRIS RESERVOIR DURING 2002

Limnology

Temperature and Dissolved Oxygen

- Reservoir waters were slightly stratified in the Buckhorn Creek arm (Station H2) and in the mid reservoir (Station P2) during May and July and were well mixed during January and November 2002 (Appendix 1). Portions of the hypolimnion just above the reservoir bottom were anoxic (i.e., conditions where dissolved oxygen concentrations are less than 1 mg/liter) during May and July at the deeper stations (Stations E2, H2, and P2) (Appendix 1). During July water at six meters and below was anoxic at these stations and water near the bottom at Station S2 was also anoxic. A bottom-water oxygen decline is typical at the deeper stations during the warm summer months in Harris Reservoir and in other productive southeastern water bodies.

Water Clarity (Secchi Disk Transparency, Total Dissolved Solids, and Turbidity)

- Secchi disk transparency depths were similar among stations during January, May, and July with depths ranging from 1.2 to 1.7 m (Appendix 1) and the maximum difference among stations for any sampling date only 0.5 m. During November, the Secchi disk transparency depth at S2 in the White Oak Creek arm was only 0.8 m. There were no significant differences in the annual mean Secchi disk transparencies among stations during 2002 (Appendix 2).

- There were no significant spatial trends for total dissolved solids or turbidity during 2002 (Appendix 2). Based on consistently low concentrations of total solids and total suspended solids in the historical database, sampling for these variables was discontinued in 2002. Turbidity was generally low at all stations with values ranging from 1.3 to 7.2 NTU; the only exception was the November sample at Station S2 where turbidity was 18 NTU.

Chlorophyll *a*

- During 2002, mean chlorophyll *a* concentrations (an indicator of algal biomass) in Harris Reservoir continued to be indicative of moderate biological productivity. Chlorophyll *a* concentrations were highest at all stations in the May samples and averaged 12 µg/liter reservoir-wide for 2002 (Appendix 2). The greatest recorded chlorophyll *a* concentration was 25 µg/liter at Station H2 in May. Because chlorophyll *a* concentrations did not exceed the North Carolina water quality standard of 40 µg/liter (NCDEM 1992), the collected phytoplankton was not identified. Chlorophyll *a* concentrations at Station H2 were significantly greater than the concentrations at Stations E2 and S2; concentrations at Station P2 were intermediate between Stations H2 and E2.

Nutrients and Total Organic Carbon

- There were no significant spatial differences among stations for mean nutrient (i.e., total phosphorus, ammonia-N, nitrate + nitrite-N, and total nitrogen) and total organic carbon concentrations in Harris Reservoir during 2002 (Appendix 2).

Specific Conductance, Ions, and Hardness

- There were no significant spatial differences in conductivity, ion concentration (calcium, chloride, magnesium, sodium, and sulfate) or hardness during 2002 (Appendix 2).

pH and Total Alkalinity

- The median pH in the surface waters of Harris Reservoir was 7.4 during 2002 (Appendix 1). Surface pH values were highest at all stations during July when values ranged from 8.1 to 8.5.

- In 2002 total alkalinity concentrations were not statistically different among stations (Appendix 2).

Trace Metal - Copper

- Based on consistently low concentrations of aluminum, cadmium, and mercury in the historical database, sampling for these trace elements was discontinued in 2002. All measured concentrations of copper were low (< 2.5 µg/liter) in 2002 with an annual reservoir mean of 1.6 µg/liter (Appendix 2). No spatial trends were observed.

Fisheries

- Nineteen fish species were collected with quarterly electrofishing sampling during 2002 (Appendix 3). White perch, a species not collected in Harris Reservoir before 1999, was collected at two transects in 2002. Four common carp, a species native to Asia, were collected at Transect V during 2002. This introduced species was present in the Cape Fear River before Harris Reservoir was created but had not been collected in the reservoir before 2000, when one common carp was collected at this same transect. White perch and common carp will likely become more abundant and widespread in Harris Reservoir in the near future. Redbreast sunfish and white crappie were not collected during 2002, but were collected in 2000 (CP&L 2001). These species have historically been uncommon in Harris Reservoir and their absence in electrofishing samples was considered to be related to gear selectivity and/or random spatial distribution.

- The reservoir-wide average of 322 total fish per hour during 2002 (Appendix 3) exceeded reservoir means for quarterly electrofishing samples from 1988 to 2000 (CP&L 2001). Reservoir-wide catch per hour values in 2002 for four common species (black crappie, redear sunfish, threadfin shad, and golden shiner) exceeded the maximum catch rates with quarterly electrofishing measured from 1988 to 2000 (CP&L 2001).

- Four sunfish species (bluegill, redear sunfish, largemouth bass, and black crappie) comprised 80% of the mean number per hour collected in Harris Reservoir during 2002 (Appendix 3). By weight, largemouth bass, redear sunfish, bluegill, and gizzard shad were the dominate taxa (Appendix 4).

- Redear sunfish catch rates in electrofishing samples differed significantly among transects (Appendix 3). Significantly more redear sunfish were collected at Transect H than at all other transects. The catch rates of other recreationally important species were not significantly different among transects. Comparisons of redear sunfish weight per hour revealed a similar pattern among transects (Appendix 4). With the exception of golden shiner, there were no significant differences in weights among transects for any of the other species assessed.

- The length-frequency distribution for bluegill indicated strong recruitment during 2002 (Appendix 5). Additionally, there were adequate numbers of older, larger fish to support a recreational fishery. The mean relative weight of bluegill (n = 1,023, fish ≥ 80 mm TL) collected during 2002 was 82. This was less than optimal (100 = optimum), but was consistent with the range that might be expected under relatively high population densities.

- The annual mean electrofishing catch rate for redear sunfish of 92 fish per hour (Appendix 3) was the highest ever for quarterly sampling (CP&L 2001) and continued an increasing trend in redear sunfish catch rates. Similar to previous years, the length-frequency distribution for redear sunfish indicated low reproductive success during 2002 (Appendix 5). However, the relatively high mean electrofishing catch rate, increasing population size in recent years, and the presence of older, larger fish in the population indicated that a viable redear sunfish fishery exists in Harris Reservoir. Similar to bluegill, the less than optimal mean relative weight (77) for redear sunfish (n = 916, fish ≥ 80 mm TL) was in the range consistent with a relatively large population density.

- The annual mean electrofishing catch rate for largemouth bass of 29 fish per hour was within the range reported for quarterly data from 1988 through 2000 (CP&L 2001). Proportional Stock Density (PSD) and Relative Stock Density preferred length (RSD_p) values of 78 and 50, respectively, were consistent with objectives for a largemouth bass management strategy targeting larger fish (Gablehouse 1984; Willis et al. 1993). The management objective for Harris Reservoir to contain a large number of big bass equates to a PSD ranging from 50 to 80 and an RSD_P in the range of 30 to 60. Also, the Relative Stock Density memorable length index (RSD_M) was 5 during 2002, which was in the range (0-10) of values indicating a balanced largemouth bass population. The mean relative weight of largemouth bass collected during 2002 (n = 126, fish ≥ 150 mm TL) was 96, indicating a healthy, robust body condition.

- Largemouth bass length-frequency analysis revealed a large number of bass < 100 mm TL (Appendix 5). Length-frequency analysis for the four sampling periods revealed that the majority of the bass < 100 mm TL were from the 2002 year class. Young-of-Year (YOY) were well distributed among the five transects with each transect contributing at least 10% of the total YOY and Transect P contributing 41% of the YOY. Largemouth bass weight per hour ranged from 3.8 kg/hour at Transect E to 25.0 kg/hour at Transect V, which is a restricted area that prohibits angling access. However, these differences among transects were not significant (Appendix 4).

- No fish kills or disease outbreaks were noted in Harris Reservoir during 2002.

- Seven bundles of Christmas trees were added to the reservoir to improve fish habitat near the fishing pier at Harris Lake County Park.

Biofouling Monitoring Surveys

- No zebra mussels or quagga mussels, potentially serious biofouling organisms to power plant operations, were found in Harris Reservoir or the auxiliary reservoir during 2002. Zebra and quagga mussels are not expected to thrive in Harris Reservoir because alkalinity, calcium, total hardness, and pH levels are sub-optimal for mussel growth and reproduction (Claudi and Mackie 1993).

Aquatic Vegetation

- During November 2002 water hyacinth and water lettuce, two species of invasive aquatic plants new to Harris Reservoir, were found across the reservoir from the Holleman's Crossroads boat ramp at Transect P. Both are free floating vascular plants native to South America that are widely imported for the ornamental pond trade. All observed plants were removed from this location. A follow-up visual survey later in November failed to locate any additional water hyacinth or water lettuce.

- A visual survey for troublesome aquatic vegetation was conducted in the Harris Auxiliary Reservoir, Harris Reservoir main intake canal, and in the Thomas Creek arm during November 2002. No hydrilla was observed in the auxiliary reservoir. These observations indicated that grass carp stocked in 1994, 1996, and 1997 had effectively controlled the abundance of hydrilla in the auxiliary reservoir. The dominant species growing in the main intake canal were hydrilla and water primrose. Both shorelines of the main intake canal were covered with dense stands of water primrose and appeared to be similar in density and coverage area to previous years. Hydrilla in the intake canal and in the Thomas Creek area just outside the intake canal was relatively less abundant in 2002 than in 2001, possibly due to drought conditions throughout most of 2002. Similar levels of hydrilla growth in the past have had no effect on Harris Nuclear Plant operations.

- No impacts to Harris Nuclear Plant operations from aquatic vegetation occurred during 2002.

CONCLUSIONS

During 2002, Harris Reservoir continued to typify a biologically productive southeastern reservoir with seasonally occurring oxygen-deficient subsurface waters, elevated nutrient concentrations, abundant rooted, shallow-water aquatic plants, and a sunfish dominated fishery.

The environmental monitoring program conducted during 2002 continued to provide an assessment of the effects of the Harris Nuclear Plant's operation on the various components of the aquatic environment. Most key indicators of the environmental quality in Harris Reservoir were unchanged from previous years. Nutrient concentrations have been a concern in Harris Reservoir since phosphorous and nitrogen concentrations increased rapidly in the late 1980s and early 1990s. Water quality assessments determined that nutrient concentrations have remained stable in recent years and at levels acceptable for productive, southeastern reservoirs. Assessments of other water quality parameters, including total dissolved solids, turbidity, total organic carbon, ions, total alkalinity, hardness, and copper, indicated no consistent, statistically significant spatial trends. None of these variables were at concentrations that would be detrimental to the aquatic community.

Bluegill, redear sunfish, and largemouth bass continued to dominate the Harris Reservoir fishery during 2002. Bluegill of various size classes were abundant throughout the reservoir. Redear sunfish were increasingly abundant in Harris Reservoir, especially at the Buckhorn Creek arm and near the dam. Results indicated the presence of a balanced largemouth bass population exhibiting strong reproduction and the presence of a large percentage of larger fish. Abundant forage species have resulted in a very healthy, robust body condition for largemouth bass. White perch and common carp were collected for the first time in Harris Reservoir in recent years but will likely become more abundant and widespread in the near future.

No nuisance algal blooms, as indicated by chlorophyll *a* concentrations or exotic mussels were detected in the main reservoir during 2002. Water hyacinth and water lettuce plants were discovered in the main reservoir and all known individuals were removed during November 2002. Hydrilla was relatively less abundant in the intake canal during 2002 compared to 2001. Grass carp continued to control the amount and areal coverage of hydrilla in the auxiliary reservoir during 2002. No operational impacts have occurred at the Harris Nuclear Plant because of aquatic vegetation biofouling.

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Response to RAI No. 1
Item 6

SHNP-0100

Harris Nuclear Power Plant

CP&L

1992 Environmental Monitoring Report

Environmental Services Section

HARRIS NUCLEAR POWER PLANT
1992 ANNUAL ENVIRONMENTAL MONITORING REPORT

Prepared by:

R. R. Bryson	-	Limnology
D. H. Schiller	-	Aquatic Vegetation
J. M. Swing	-	Benthic Invertebrates and Fisheries
B. H. Tracy	-	Limnology and Report Writer

Environmental Services Section

CAROLINA POWER & LIGHT COMPANY

New Hill, North Carolina

July 1994

Reviewed and Approved by:

Manager
Biological Assessment Unit

Manager
Environmental Assessment Unit

This report was prepared under my supervision and direction, and I accept full responsibility for its content.

Manager
Environmental Services Section

This copy of the report is not a controlled document as detailed in the *Biological Monitoring Unit, Biological Assessment Unit, and Environmental Assessment Unit Procedures Manual and Quality Assurance Manual.* Any changes made to the original of this report subsequent to the date of issuance can be obtained from:

Manager
Environmental Services Section
Carolina Power & Light Company
P.O. Box 1551
411 Fayetteville Street
Raleigh, North Carolina 27602

Acknowledgments

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Metric-English Conversion and Units of Measure

Length

1 micron (m) = 4.0 x 10^{-5} inch
1 millimeter (mm) = 1000 m = 0.04 inch
1 centimeter (cm) = 10 mm = 0.4 inch
1 meter (m) = 100 cm = 3.28 feet
1 kilometer (km) = 1000 m = 0.62 mile

Area

1 square meter (m^2) = 10.76 square feet
1 hectare (ha) = 10,000 m^2 = 2.47 acres

Weight

1 microgram (g) = 10^{-3} mg or 10^{-6} g = 3.5 x 10^{-8} ounce
1 milligram (mg) = 3.5 x 10^{-5} ounce
1 gram (g) = 1000 mg = 0.035 ounce
1 kilogram (kg) = 1000 g = 2.2 pounds
1 metric ton = 1000 kg = 1.1 tons
1 kg/hectare = 0.89 pound/acre

Volume

1 milliliter (ml) = 0.034 fluid ounce
1 liter = 1000 ml = 0.26 gallon
1 cubic meter = 35.3 cubic feet

Temperature

Degrees Celsius (°C) = 5/9 (°F-32)

Specific Conductance

Microsiemens/centimeter = μS/cm = μmhos/cm

Turbidity

NTU = Nephelometric Turbidity Unit

Water Chemistry Abbreviations

Cl^-	Chloride	TOC	Total organic carbon	Cu	Total copper
SO_4^{2-}	Sulfate	TS	Total solids	Hg	Total mercury
Ca^{2+}	Total calcium	TDS	Total dissolved solids	Ni	Total nickel
Mg^{2+}	Total magnesium	TSS	Total suspended solids	Pb	Total lead
Na^+	Total sodium	Al	Total aluminum	Se	Total selenium
TN	Total nitrogen	As	Total arsenic	Zn	Total zinc
NH_3-N	Ammonia nitrogen	Cd	Total cadmium		
TP	Total phosphorus	Cr	Total chromium		

Executive Summary

Harris Lake was constructed by Carolina Power & Light Company to supply cooling tower makeup and auxiliary reservoir makeup water to the Harris Nuclear Power Plant. Prior to commercial operation of the Harris Plant in May 1987, the reservoir was moderately productive. However, the reservoir became more biologically productive when the Harris Plant began discharging, under the auspices of the plant's National Pollutant Discharge Elimination System permit, primarily cooling tower blowdown along with low volume waste discharges into the reservoir near the main dam.

The aquatic monitoring program conducted in 1992 continued to support the Environmental Protection Plan for the Harris Plant and provided an assessment of the effects of plant operation on the various components of the aquatic environment. Water quality assessments in 1992 determined that nutrient concentrations, as measured by total phosphorus and total nitrogen, seemed to have stabilized but at a level greater than the concentrations observed when the reservoir was first created and prior to power plant operations. Algal blooms, although not uncommon in piedmont reservoirs, now occur at least several times each year. However, the blooms have not been of the undesirable, noxious blue-green algal types and have not resulted in any fish kills.

The major ions increased in 1992 as compared with their concentrations in previous years. Such increases reflected the prolonged retention time of water in the reservoir and the infrequent discharge of water over the spillway. Seventy-eight percent of the 300 metal and metalloid samples analyzed in 1992 were less than their respective laboratory reporting limit concentrations.

Biofouling by introduced nonnative organisms--the Asiatic clam and the aquatic plant hydrilla--did not affect Harris Plant operations. The distributions of both species continued to expand throughout much of the shallow-water zone. No Asiatic clams were collected in samples taken from the auxiliary intake canal, the intake structures, or the fire protection system. No zebra mussels were found in the main or the auxiliary reservoirs.

During 1992 the fishery was dominated by largemouth bass and several species of sunfish. An increasing proportion of the largemouth bass fishery was represented by quality-length fish which presented the recreational fisherman and bass tournament participants with excellent sportfishing opportunities.

HARRIS NUCLEAR POWER PLANT
1992 ANNUAL ENVIRONMENTAL MONITORING REPORT

Reservoir Description

The main body of Harris Lake has a surface area of 1680 ha; the auxiliary reservoir has a surface area of 130 ha (Appendix 1). The main reservoir has a maximum depth of 18 m, a mean depth of 5.29 m, a volume of 8.88 x 10^7 m^3, a full-pool elevation of 67.1 m (220 ft) National Geodetic Vertical Datum (formerly called mean sea level by the U.S. Geological Survey), and an average residence time of 28 months. The reservoir began filling in December 1980, and full-pool elevation was reached in February 1983. The 64.5-km shoreline is mostly wooded, and the 183.89-km^2 drainage area is mostly rolling hills with land used primarily for forestry and agriculture.

Historical Overview

Harris Lake was constructed to supply cooling tower makeup and auxiliary reservoir makeup water to the 900-MW, single-unit Harris Nuclear Power Plant which began commercial operation in May 1987. In 1986 the bottom waters of the reservoir began receiving NPDES-permitted wastewater discharges near the main dam. In 1987 macronutrients (as estimated by total phosphorus and total nitrogen concentrations) and ions (as estimated by total chloride and total sulfate concentrations) increased above the previous years' concentrations in the reservoir, particularly at the monitoring station closest to the dam (CP&L 1990a). Concomitantly, an increase in algal biomass (as estimated by chlorophyll *a* concentrations) was also observed throughout much of the reservoir. In May 1989 an algal bloom was observed throughout the reservoir for the first time, and chlorophyll *a* concentrations were measured above the North Carolina water quality standard (40 µg/liter) at each of the four monitoring stations. In 1990 chlorophyll *a* concentrations approached or exceeded the water quality standard on three separate occasions and in 1991 on two separate occasions.

The increased nutrient loadings from all point and nonpoint sources accelerated the primary productivity of Harris Lake from low/moderate productivity to moderate/high productivity within the period 1986-1989. The nutrient and chlorophyll *a* concentrations between

1989 and 1991 have remained stable but were at greater concentrations than what they were when the reservoir was first created and prior to operation of the plant.

The shift in productivity has also resulted in a greater volume of the hypolimnion being oxygen-depleted during the summer months, diurnal fluctuations in the dissolved oxygen concentration in the shallow-water zone during the summer months, and reduced water clarity. In June 1991 a die-off of freshwater mussels occurred, primarily in the Buckhorn Creek and White Oak Creek arms. This die-off was the first reported incident of this type in Harris Lake, and low dissolved oxygen concentrations in the shallow-water zone may have caused the die-off.

Another significant change to the reservoir's benthic invertebrate community since impoundment was the colonization of the reservoir by the Asiatic clam *Corbicula fluminea* during 1988-1989. This nonnative organism has the potential to block power plant pipes and tubes in raw water systems. Until 1990 no clams had been collected from the intake structures or the auxiliary reservoir. In 1990 one individual was collected in the main intake canal. Although densities remained at low levels during 1991 and the reservoirwide monitoring program has not shown a rapid population increase, the presence of shells along the shoreline in many areas has indicated that the clam has continued to spread throughout the reservoir. No incidences of biofouling within the Harris Plant have occurred from the clams and operations have not been affected.

The fishery has been dominated by the sport fishes bluegill, pumpkinseed, largemouth bass, redear sunfish, black crappie, and by gizzard shad. Monitoring of fish populations through 1987 and a study of largemouth bass age and growth in 1985 documented slow growth rates for this species. However, during 1988 and 1989, the size distributions shifted towards larger-size bass. This shift was probably the result of the increased primary productivity, the availability of suitable-size forage fish due to the introduction of threadfin shad by the North Carolina Wildlife Resources Commission (NCWRC) in 1987, and an increased abundance of suitable-size gizzard shad. This shift towards intermediate- to large-size largemouth bass has presented anglers the opportunity for greater fishing success. No detrimental impacts on the fish community from plant operations have been observed since the Harris Plant became operational.

The aquatic plant hydrilla *Hydrilla verticillata* was initially found in 1988 growing in the White Oak Creek arm of the reservoir. Within a two-year period, this nonnative macrophyte had displaced the native species and had become the dominant littoral plant species. Since 1990 creeping water primrose *Ludwigia uruguayensis* has also increased its littoral zone coverage in the main reservoir. The auxiliary reservoir, however, has remained relatively free of aquatic vegetation since its impoundment. Despite these shifts in the structure of the aquatic macrophyte community, the community has not impacted Harris Plant operations.

Objectives

The primary objective of the nonradiological environmental monitoring program for 1992 was to continue to support the Environmental Protection Plan for the Harris Nuclear Power Plant. Secondary objectives were to provide an assessment of the effects of plant operations on the various components of the aquatic environment in Harris Lake, to document any natural changes or changes induced by sources other than the power plant, and to assess the impact of any introduced nonnative species. These objectives have also been addressed in previous reports (e.g., CP&L 1990a, 1990b, and 1991, 1992).

The 1992 environmental program included monitoring the limnology (water quality and chemistry and phytoplankton [algae]); Asiatic clam, zebra mussel, and fish populations; and the distribution of aquatic vegetation (Appendices 2 and 3). Sampling methods in 1992 were similar to those used in previous years (Appendix 4), except the electrofishing sampling was conducted biannually (May and November) rather than quarterly. Supporting data summaries, statistical analyses (Appendix 5), and key environmental indicators were used to describe and interpret the environmental quality of the reservoir. These indicators were included when a significant change or abnormal event occurred, an important trend was observed, or the potential for any of these was present. Other data were included as key indicators when there was environmental, public, or regulatory interest.

The accuracy and precision of laboratory analyses of water chemistry data were determined with analytical standards, spikes, and replicates (Appendix 6). In this report where concentrations were less than the laboratory reporting limit, the concentrations were assumed to be at one-half the reporting limit for the calculation of the mean.

Key Indicators of Environmental Quality During 1992

Limnology

(Appendices 7-18)

Reservoir Elevations

- Reservoir water surface elevations ranged from 218 to 221 ft (66.5-67.4 m) in 1992 (Appendix 7). Water spillage occurred from mid-June to mid-July and from early November to the end of the year. There was no spillage from the reservoir between early July 1991 until mid-June 1992--a period of approximately 350 days.

Temperature

- Harris Lake is a warm-water, monomictic reservoir. [A monomictic reservoir is defined as a reservoir whose water temperature is not less than 4°C and whose waters circulate freely in the winter but thermally stratify during the summer.] During 1992 surface water minimum temperatures ranged from 7.2° to 9.2°C and maximum temperatures ranged from 29.6° to 31.6°C (Appendix 8). The waters at the deeper stations (E2, H2, and P2) were stratified from April (except Station P2) through September and were freely circulating from January through March (except Station H2) and October through December (Appendix 9).

Specific Conductance

- Specific conductance (an estimate of the concentration of the dissolved ions) ranged from 51 to 198 µS/cm throughout the water column during 1992 (Appendix 8). Specific conductance increased with depth during the summer months as the reservoir became thermally stratified. When the bottom waters became increasingly devoid of oxygen during stratification, conditions were favorable for chemical reduction to occur and subsequent dissolution of ions.

Dissolved Oxygen

- A clinograde oxygen curve was observed for all stations from May through September and during November (Appendices 8 and 10). [A clinograde oxygen curve is defined as an abrupt depletion and undersaturation of oxygen with a concomitant increase in depth.] As water temperature increased and a well-defined thermocline developed during the summer, dissolved oxygen concentrations in the hypolimnion (bottom waters) typically decreased to anoxic (where dissolved oxygen concentrations were < 1 mg/liter) conditions (Appendices 8 and 10).

- The depressed percent oxygen saturation levels observed in January 1991 (CP&L 1992) were not repeated in 1992. Surface water percent saturation levels remained above 65% in 1992 (CP&L unpublished data), except for slightly lower levels during the fall turnover in October when oxygen-depleted bottom waters circulated to the surface.

Solids, Turbidity, and Water Clarity

- During 1992 there was no consistent spatial trend among the surface waters for all indicators and measurements of the optical clarity of the water--solids (total, total dissolved, and total suspended), turbidity, and Secchi disk transparency depth data (Appendices 11-13). However, the annual mean turbidity value at Station S2 (the upper reservoir station) was significantly greater than the values from the middle and lower reservoir stations (Stations E2, H2, and P2) (Appendix 13). Conversely, the mean Secchi disk transparency depth value at Station S2 was significantly less than at the other stations. This relationship was expected due to the tributary inflow and subsequent sediment transport from White Oak Creek and the negative relationship between two variables.

- There were no significant spatial trends for solids, turbidity, and Secchi disk transparency depth data during the period 1987-1992 (Appendix 14). Secchi disk transparency depth data was not inversely related to the temporal trend of decreasing annual mean turbidity values from 1987 to 1992, except for the peak turbidity mean in 1989 which corresponded to a peak chlorophyll *a* mean (Appendix 15). There were no significant temporal differences among the solids data for the period 1987-1992.

Algal Biomass

- Reservoirwide mean chlorophyll *a* concentrations (an algal pigment that is used as an approximate measure of algal biomass) during 1992 ranged from 3.8 to 44.4 µg/liter (Appendices 11 and 13). There were no significant spatial differences in mean chlorophyll *a* concentrations during 1992 or from 1987 to 1992 (Appendices 13 and 14). The annual mean chlorophyll *a* concentration for 1992 was not significantly different than the annual means for the period 1987-1991, except for 1989 which had the greatest mean value for this period (Appendix 15).

- The mean chlorophyll *a* concentrations for January 1992 at Station H2 (40.2 µg/liter) and for August 1992 at Station E2 (44.4 µg/liter) were greater than the North Carolina water quality standard of 40 µg/liter (Appendices 11 and 16) which indicated the occurrences of algal blooms as defined by the NCDEM (1992). Occasional chlorophyll *a* concentrations greater than the water quality standard are not an uncommon occurrence in piedmont reservoirs and have occurred periodically in Harris Lake since 1989.

- When the mean chlorophyll *a* concentration at Station H2 was elevated in January, the total algal density was in the lower end (9969 units/ml) of the range of conditions defined as an algal bloom (i.e., total density ≥ 10,000 units/ml). The diatom *Melosira distans* and the flagellated cryptophyte *Chroomonas minuta* constituted approximately 45% of the total algal density. *Chroomonas minuta* was the taxon in greatest abundance (26% of the total density) during the bloom in August at Station E2. However, the total algal density for this month (5110 units/ml) was only in the moderate range (5-10,000 units/ml).

Nutrients

- There were no clear spatial differences in mean total phosphorus concentrations during 1992 (Appendix 13). Mean concentrations remained approximately 1.5-1.8 times greater at Station E2 than at either Station H2 or P2 during the 1987-1992 period (Appendix 14). The annual mean concentration for 1992 was not significantly different from the mean for 1991 and was significantly less than the mean for 1990 (Appendix 15). The annual mean concentrations in Harris Lake seemed to have stabilized at a level greater than the concentrations observed prior to the operation of the plant.

- During 1992 mean total nitrogen concentrations in the surface waters at Station E2 were greater than the concentrations at all other stations (Appendix 13). This pattern, however, was not evident from the long-term analyses during the period 1987-1992 (Appendix 14).

The annual mean concentration for 1992 was significantly less than the concentrations in 1990 and 1991 and returned to the lower levels that were observed during 1987-1989 (Appendix 15).

Ions

- Annual mean calcium concentrations in 1992 were significantly greater than the mean concentrations measured since 1989 but were within the range (3.3-3.8 mg/liter) of means for the 1987-1989 period (Appendix 15).

- Annual mean concentrations of magnesium, sodium, chloride, and sulfate in 1992 were significantly greater than mean concentrations of these ions measured for the 1987-1991 period and continued a general increasing trend each year (Appendix 15). This trend may be reflective of the increased retention time of the water in the reservoir and the infrequent discharge over the spillway during the 1990-1992 period (Appendix 7).

- There were no clear spatial trends in the sodium concentrations during 1992 (Appendix 13). However, concentrations were significantly greater at Station E2 compared to the concentrations at either Station H2 or P2 during the period 1987-1992 (Appendix 14).

Trace Metals and Metalloids

- Excluding mercury and copper, all metal and metalloid concentrations measured in 1992 were less than the respective North Carolina water quality standard or action level (Appendices 12 and 17).

- All mercury concentrations, except the sample collected from the bottom waters at Station E2 during November (0.11 µg/liter) and from the surface waters at Station E2 during March (0.05 µg/liter), were below the laboratory detection level of 0.05 µg/liter (Appendices 12 and 17). The North Carolina water quality standard for mercury is 0.012 µg/liter.

- All copper concentrations during 1992 were less than the North Carolina action level (7 µg/liter), except during January when the concentration in bottom waters at Station E2 was 7.5 µg/liter (Appendices 12 and 17). The 1992 annual mean concentration was similar to the values calculated for 1989 and 1991 and was less than the annual mean concentrations observed for the years 1987-1988 and 1990 (Appendix 15). There were no significant spatial differences during the period 1987-1992 (Appendix 14).

- The annual mean aluminum concentration measured at Station S2 during 1992 was significantly greater than at all other stations (Appendix 17). Elevated values during January (610 µg/liter) and March (1200 µg/liter) contributed to the elevated mean for this station (Appendix 12). There were no significant spatial differences in the concentrations in the surface waters for the period 1987-1992 and there was not a clear temporal trend during this period (Appendices 14 and 15).

Chemical Constituents from the Bottom Waters at Station E2

- There were no significant differences in measured chemical concentrations between the surface and bottom waters at Station E2 during 1992 (Appendix 13). Significant differences were unlikely due to the expected variability in the concentrations in the bottom waters between periods of stratification and of uniform mixing in the water column. Concentrations of most chemical constituents (i.e., total alkalinity, hardness, the solids, total phosphorus, total nitrogen, ammonia, total organic carbon, total calcium, and total magnesium) increased during stratification to a maximum concentration by September because of the movement of chemicals across the sediment-water interface under the reducing anoxic conditions found in the bottom waters during that time (Appendix 12). Sulfate concentrations decreased during the stratification period because the sulfate was reduced to hydrogen sulfide.

- There were no significant differences among years (1987-1992) for solids (total, dissolved, and suspended solids), turbidity, nutrients (total nitrogen, nitrate + nitrite-N, ammonia-N, and total phosphorus), and total organic carbon in the bottom water at Station E2 (Appendix 18).

- There were significant increases in the concentrations of the major ions--such as magnesium, sodium, chloride, and sulfate--in the bottom waters of Harris Lake at Station E2 during the period 1987-1992 (Appendix 18). There was no clear trend for total alkalinity and hardness concentrations for the period 1987-1992.

- Aluminum and copper concentrations for 1992 in the bottom waters at Station E2 remained relatively unchanged for the period 1987-1992 (Appendix 18).

Benthic Invertebrates

Freshwater Mussels

- There was no die-off of freshwater mussels in 1992 as there was in June 1991 in Harris Lake.

Asiatic Clam Surveys

- No Asiatic clams *Corbicula fluminea* were collected in either of the two intake canals during April 1992; however, during October one specimen was collected near the intake structure at Station MI (Appendix 1). The estimated density at this location decreased from 43 clams/m^2 in 1991 to 14 clams/m^2 in 1992. No Asiatic clams were collected in the auxiliary reservoir intake canal, in the intake structures, or in the fire protection system during 1992.

- Asiatic clam shells were qualitatively observed at many locations along the shoreline which indicated that the species has continued to spread throughout the reservoir.

Zebra Mussel Surveys

- Zebra mussels *Dreissena polymorpha*, potentially serious biofouling organisms to power plant operations, were not found during special monitoring activities. Although the species has not yet been reported from North Carolina, it has the potential to colonize the state during the next few years.

Fisheries

(Appendices 19-35)

Fish Community Structure

- The species composition during 1992 (i.e., 17 species representing 7 families) was similar to that observed in previous years (Appendix 19), and, as in previous years, the fish community and sport fishery were dominated by bluegill, largemouth bass, redear sunfish, gizzard shad, and pumpkinseed (Appendices 20 and 21). Construction of beaver lodges at some stations provided increased cover which concentrated fish and made them more susceptible to electrofishing. There were, however, no significant spatial differences in the mean catch rate for any of these dominant species during 1992 (Appendix 20).

- Although no channel catfish were collected and the mean catch rate for black crappie was low during 1992 (Appendix 20), conversations with anglers indicated that these species were being caught in sufficient numbers to also be considered an important part of the sport fishery.

- The mean catch rate of total fish using electrofishing sampling has not changed significantly during the past ten years, except during 1989 when the catch rate was significantly greater at a rate of 309 fish/hour (Appendices 21 and 22). The mean catch rate of total fish during the period 1983-1992 was significantly greater at Area V than at all other areas (Appendix 22).

- The mean catch rates for bluegill have not changed significantly since 1988 (Appendices 21 and 22). During the past ten years, the mean catch rate at Area V was significantly greater than at all other areas (Appendix 22). The quality of the bluegill fishery was evaluated with a length-frequency index based on the concept of total lengths as a percentage of world record lengths (Gabelhouse 1984). The catch rates of stock- and quality-length fish have generally increased since 1985, while the catch rate of preferred-length fish has generally been constant at approximately 1-3 fish/hr since 1986 (Appendix 23).

- The mean catch rates for redear sunfish during 1990-1992 were significantly greater than the catch rates during all the other years (Appendices 21 and 22). There were no significant spatial differences in the mean catch rates for the period 1983-1992. The quality of the redear sunfish fishery was similarly evaluated with the length-frequency index based on world record lengths. The catch rates of stock- and quality-length fish have generally shown a steady increase since 1983 and the greatest rates were measured during 1992 (Appendix 24). The catch rate for preferred-length fish has fluctuated between 1-6 fish/hr since 1984, while the catch rate for memorable-length fish peaked in 1990 (Appendix 24).

- The mean catch rate for pumpkinseed during 1992 was significantly less than the catch rate in 1989 (Appendices 21 and 22). There were no significant spatial differences in the mean catch rates for the period 1983-1992.

- The mean catch rate of black crappie during 1992 was significantly lower than the catch rate in 1989 but not significantly different from any other year (Appendices 21 and 22). Black crappie were collected at significantly higher rates at Areas S and V than the other three areas during the same time period (Appendix 22). A study conducted by the North Carolina Wildlife Resources Commission (NCWRC) during 1992 concluded that the black crappie population in Harris Lake experienced "good" growth rates and size structure among the various age classes of fish (Mr. Wayne Jones, NCWRC, pers. comm.).

- As in 1991, greater numbers of intermediate- to large-size sport fishes were collected by electrofishing sampling during 1992 than in previous years based upon a comparison of the length-frequency distributions (Appendices 25-28). The length-frequency histograms for redear sunfish indicated adequate recruitment and size distributions during 1992 (Appendix 26). Recruitment for bluegill, pumpkinseed, and black crappie was as low or lower than observed in previous years as indicated by few fish < 60 mm (Appendices 26-28).

- The length-frequency histograms for gizzard shad and brown bullhead in 1992 indicated a greater proportion of larger fish was collected than what would have been expected (Appendices 29 and 30). This may have occurred because electrofishing sampling can be biased against the collection of small (i.e., < 65 mm) fish (Reynolds 1983). The small individuals of these two species are usually found in dense vegetation (brown bullhead) or in open deep water (gizzard shad)--areas not usually sampled efficiently with the boat electrofisher.

Largemouth Bass Population Structure

- The mean catch rate of largemouth bass during 1992 was not significantly different from catch rates during 1985-1988 and 1991 but was significantly less than the catch rates during the years 1983-1984 and 1989 (Appendices 21 and 22). The mean catch rate at Area S was significantly less than the catch rates at all other areas during the period 1983-1992

(Appendix 22). A study conducted by the NCWRC during 1992 concluded that the catch rate at Harris Lake (3.9 fish/100 m of shoreline) was slightly greater than the catch rates for Falls of the Neuse Reservoir and Lake Gaston (2.4 and 1.5 fish/100 m of shoreline, respectively) (Mr. Wayne Jones, NCWRC, pers. comm.).

- The length-frequency histogram indicated adequate recruitment and size distribution during 1992 (Appendix 31).

- The quality of the largemouth bass fishery was evaluated with the length-frequency index based on world record lengths as previously applied to the bluegill and redear sunfish fishery. The catch rate of stock-length fish has generally decreased since 1984 to a level of approximately 5-8 fish/hr (Appendix 32). Quality-length fish peaked in 1988 at a rate of 9 fish/hr and have gradually increased during the past two years as have preferred-length fish. Prior to 1991, no memorable-length fish had been collected in Harris Lake during the May and November electrofishing sampling. In 1992 the memorable-length fish catch rate was approximately 1 fish/hr.

- The quality of the largemouth bass fishery was further assessed with two correlated indicies--Proportional stock Density (PSD) and Relative Stock Density (RSD). The PSD is a measure of the proportion of quality-size fish (fish ≥ 300 mm) in the population (all fish collected ≥ 200 mm), and the RSD is the proportion of fish of any designated size group in a population (Anderson and Gutreuter 1983). For example, an RSD-380 (i.e., preferred-length) is the proportion of the population that was ≥ 380 mm.

- The PSD of largemouth bass in 1992 continued to be in the optimal range (Appendix 33), indicating that the population contained many quality-length fish and was balanced for a moderate density objective (Gabelhouse 1984). A moderate density objective is defined as where largemouth bass are one of several species of equal importance in a balanced community (Gabelhouse 1984). This was opposite the situation which occurred during the period 1983-1987, when the PSD was below the optimal level indicating that the population contained few quality-size fish.

- The RSD-380 of largemouth bass also showed continued improvement during 1992 (Appendix 33). The RSD-380 since 1989 has also remained in the optimal range for a moderate density objective (Gabelhouse 1984). This proportion of the total population was the greatest since impoundment, further supporting the observations that the largemouth bass sport fishery has continued to improve.

- During March 1992, 126 anglers participated in a largemouth bass tournament held at Harris Lake. The tournament rules allowed each team to "weigh-in" ten fish. Two of the fish were allowed to be between 12 and 14 inches (305-356 mm) and the eight other fish were required to be ≥ 14 inches. Two hundred sixteen fish were "weighed-in" during the tournament. This resulted in the greatest tournament weigh-in catch rate, 0.20 fish/angler-hour, since 1987 (Appendix 34). [Note: "tournament weigh-in catch rate" is not synonymous with the term "catch rate" used elsewhere in this report. This term is used by CP&L fishery biologists to conveniently measure the relative success of largemouth bass tournaments.]

- The length-frequency distribution of "weighed-in" fish during the tournament indicated that a greater number of fish ≥ 356 mm were caught in 1992 as compared with the distributions in either 1987 or 1990 (Appendix 35). The 1992 length-frequency distribution was similar to that from the 1991 tournament.

Aquatic Vegetation

(Appendix 36)

- During 1992, hydrilla *Hydrilla verticillata* continued to be the dominant species of aquatic vegetation in Harris Lake. This nonnative, submersed plant grew in homogeneous stands throughout the littoral zone (< 3 m deep) of the reservoir except for the Buckhorn Creek arm (Appendix 36). A previously observed small patch in that arm was not present in 1992. Also, the amount of hydrilla in a cove near the dam greatly decreased in surface area from that of 1991. The areal coverage of hydrilla in Harris Lake in 1992 was approximately 430 ha, an increase of only 5 ha since 1991. This species had no impact to the Harris Plant's operation.

- Only one species of submersed vegetation, naiad *Najas minor*, was observed growing in the auxiliary reservoir. This occurred in the shallow areas of the headwaters near U.S. Highway 1. One small patch of water shield *Brasenia schreberi* occurred near the auxiliary reservoir dam.

- Emergent vegetation grew along the shoreline of both the main and the auxiliary reservoirs. The dominant species were cat-tail *Typha latifolia*, rush *Juncus effusus*, bulrush *Scirpus cyperinus*, and the emergent form of creeping water primrose *Ludwigia uruguayensis* (which did not occur at the auxiliary reservoir). The littoral zone of the Buckhorn Creek arm supported three submersed native species; spike-rush *Eleocharis baldwinii*, naiad, and musk-grass *Chara* sp. Coverage varied from sparse to dense and most vegetation occurred in protected coves.

- Floating-leaf vegetation throughout Harris Lake was dominated by creeping water primrose and lotus *Nelumbo lutea*. Creeping water primrose grew along the shoreline of all major arms of the lake, primarily in the coves. Lotus was restricted to several stands in the headwater area of the White Oak Creek arm. Water shield and water-lily *Nymphaea odorata* also grew in small to moderate areas throughout the reservoir's littoral zone.

Conclusions

The primary objective of the 1992 nonradiological environmental monitoring program was to continue to support the Environmental Protection Plan for the Harris Nuclear Power Plant. Secondary objectives were to provide an assessment of the effects of plant operations on the various components of the aquatic environment, to document any natural changes or changes induced by sources other than the power plant, and to assess the impact of any introduced nonnative species.

The environmental monitoring programs that were conducted prior to commercial operation of the Harris Plant determined that Harris Lake was in many ways a typical southeastern, moderately productive reservoir. However, after the Harris Plant began discharging cooling tower blowdown and other NPDES-permitted wastewater discharges into the reservoir, the reservoir became more biologically productive. Environmental characteristics of a typical southeastern, biologically productive reservoir include the presence of oxygen-deficient subsurface waters, elevated nutrient and algal concentrations, reduced water clarity, an abundance of rooted shallow-water aquatic plants, and a productive sport fishery--all characteristics of Harris Lake.

Water quality assessments determined that nutrients, as measured by total phosphorus and total nitrogen, did not increase during 1992 and seemed to have stabilized but at a level greater than the concentrations observed prior to the operation of the Harris Plant. Algal blooms, although not uncommon in piedmont reservoirs, now occur several times per year in Harris Lake. The blooms, however, have not been composed of the noxious blue-green algal types and have not resulted in any fish kills.

The major ions (i.e., calcium, magnesium, sodium, chloride, and sulfate) continued to increase in 1992 as compared with concentrations in previous years. Such increases may reflect the reservoir's prolonged retention time and the infrequent spillage of water from the reservoir. Seventy-eight percent of the 300 metal and metalloid concentrations analyzed in 1992 were less than the laboratory reporting limit.

Biofouling by the Asiatic clam and the aquatic plant hydrilla did not impact Harris Plant operations. Each of these species continued to slowly expand its distribution throughout much of the littoral zone of the reservoir. No clams were collected in the auxiliary intake canal, in the intake structures, or in the fire protection system. The zebra mussel, another potentially biofouling organism, was not found in the main or the auxiliary reservoirs.

The recreational and sport fishery, as in previous years, was dominated by largemouth bass and several species of sunfish. During the past several years, an increasing proportion of the largemouth bass fishery has been represented by quality- or better-length fish which have provided the recreational fishermen with a greater opportunity for fishing success.

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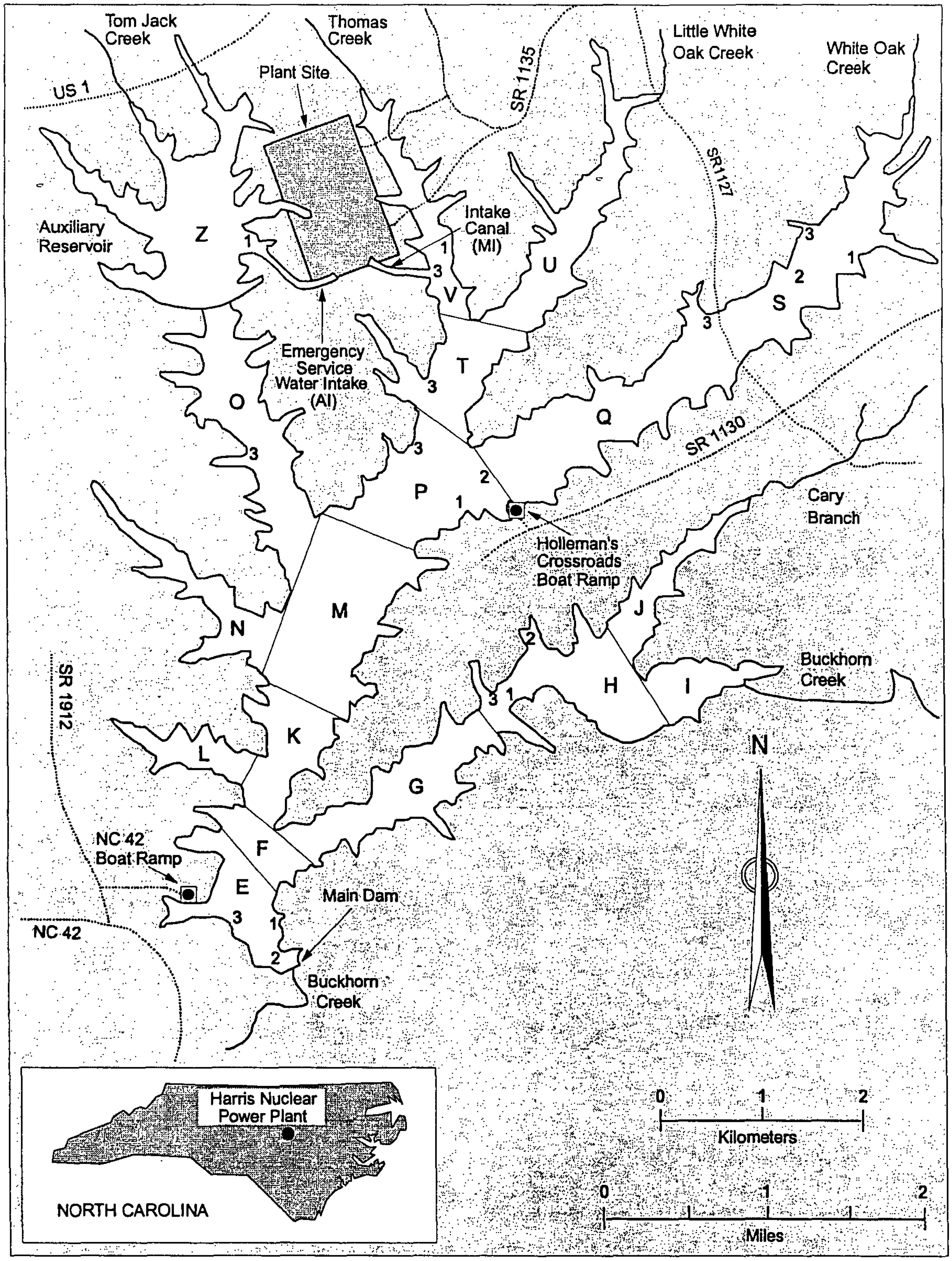


Appendix 1. Harris Lake sampling areas and stations during 1992.

Appendix 2. Harris Lake environmental monitoring program for 1992.

Program	Frequency	Location
Limnology		
Water quality (temperature, dissolved oxygen, pH, specific conductance, and Secchi disk transparency)	Once per calendar month	E2, H2, P2, and S2 (surface to bottom at 1-m intervals)
Water chemistry		
Monitoring	Alternate months (Jan, Mar, May, Jul, Sep, Nov)	E2 (surface and bottom); H2, P2, and S2 (surface)
Nutrients (turbidity, solids, total phosphorus, ammonia-nitrogen, nitrate + nitrite-nitrogen, and total nitrogen)	Once per calendar month	E2 (surface and bottom); H2, P2, and S2 (surface)
Plankton (phytoplankton+ and chlorophyll *a*)	Once per calendar month	E2, H2, P2, and S2 (surface, Secchi disk transparency depth, and twice the Secchi disk transparency depth)
Benthic invertebrates		
Asiatic clam surveys	Twice per calendar year (April, October)	Emergency service water and cooling tower makeup system intake structures and Stations V3, Z1, MI, and AI
Zebra mussel surveys	Once per calendar month	Intake structure, water quality station buoys, or Holleman's boat ramp
Fisheries		
Fish community structure	Twice per calendar year (May, Nov)	E1, E3, H1, H3, P1, P3, S1, S3, V1, V3
Largemouth bass tournaments	March	Harris Lake boat ramps
Aquatic vegetation		
Survey	October	I, E, P, Q, S, V, Z

+Phytoplankton samples were collected and preserved but identified and enumerated only when the chlorophyll *a* concentrations at a station were > 40 μg/liter to assess bloom conditions.

Appendix 3. Harris Lake environmental monitoring program changes from 1991 to 1992.

Program	Change
Limnology	
Water quality, water chemistry (nutrients), and plankton	Increased sampling frequency from alternate months to monthly to model nutrient and chlorophyll *a* relationships and the eutrophication of Harris Lake.
Benthic invertebrates	
Asiatic clam surveys	Discontinued littoral zone survey because reservoir monitoring was not a Nuclear Regulatory Commission requirement (Generic Letter 89-13).
Zebra mussel surveys	Added to monitoring program as a Special Study to document possible introduction of the species into the reservoir.
Fisheries	
Fish community structure	Reduced sampling frequency from quarterly to biannually (spring and fall) to adequately monitor the general status of the fishery.
Aquatic vegetation	
Survey	Discontinued summer survey because hydrilla was well established and one fall survey was sufficient for documenting its distribution.

Appendix 4. **Field sampling and laboratory methods followed in the 1992 Harris Lake environmental monitoring program.**

Program	Method
Limnology	
Water quality	Temperature, dissolved oxygen, pH, and conductivity were measured with a calibrated Martek Mark XV® instrument and YSI® dissolved oxygen meter. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface and bottom samples were collected with a nonmetallic Van Dorn sampler, transferred to appropriate containers, transported to the laboratory on ice, and analyzed according to USEPA (1979) and APHA (1986).
Plankton	
Phytoplankton	Equal amounts of water from the surface, the Secchi depth, and twice the Secchi depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 250-ml subsample was taken and preserved with 5 ml of "M3" fixative. Subsamples were identified and enumerated in the laboratory.
Chlorophyll *a*	Three 1000-ml samples were collected from the surface, the Secchi depth, and twice the Secchi depth with a Van Dorn sampler, placed in dark bottles, and transported to the laboratory on ice. At the laboratory, two 250-ml subsamples were analyzed according to Strickland and Parsons (1972) and APHA (1986).
Benthic invertebrates	
Asiatic clam surveys	At Stations V3, Z1, MI, and AI, three replicate samples were collected with a petite Ponar at the 2-m depth. In the emergency service water and cooling tower makeup intake structures, seven samples were collected with a petite Ponar. Samples were preserved with 5% formalin and returned to the laboratory where they were elutriated through 1000-, 500-, and 300-μ mesh sieves. Asiatic clams were counted, measured, and preserved.

Appendix 4 (continued)

Benthic invertebrates	
Zebra mussel surveys	An artificial substrate sampler, constructed of a PVC frame and fitted with removable PVC plates, was placed near the cooling tower makeup intake structure. This sampler, the dock at the Holleman's boat ramp, or the water quality station marker buoys were visually inspected for the presence of mussels during routine water quality or Asiatic clam survey monitoring.
Fisheries	
Fish community structure	Fifteen-minute samples were collected at each station using a Smith-Root equipped Wisconsin-design electrofishing boat with pulsed DC current. Fish were weighed, measured, and released.
Largemouth bass tournaments	After largemouth bass tournament officials had recorded their necessary measurements, fish were weighed, measured, tagged, and released.
Aquatic vegetation	Portions of the shoreline and/or littoral zone of the lake and auxiliary reservoir were systematically surveyed by boat for the presence of aquatic vegetation. The location and extent of observed species were recorded on maps and in field notes. Estimation of areal coverage of hydrilla was made by measuring the maximum depth of its growth at 49 transects throughout the lake and applying these data to topographic maps.

Appendix 5. Statistical analyses performed on data collected in the 1992 and 1983-1992 Harris Lake environmental monitoring programs.

Variable	Statistical test/model+	Main effect(s)	Interaction term
For 1992 data only			
Secchi disk transparency depth, specific conductance, selected chemical variables, and chlorophyll *a*¶	One-way ANOVA block on month	Station	
	Paired t-test at Station E2	Surface *vs.* bottom	
Catch rate of individual fish species§	One-way ANOVA	Area	
For 1983-1992 data			
Secchi disk transparency depth, specific conductance, selected chemical variables, and chlorophyll *a*¶	Multi-factor ANOVA, block on month	Station, year	Station-by-year
Catch rate of individual fish species§	One-way ANOVA	Area	
	One-way ANOVA	Year	

+A Type I error rate of 5% ($\alpha = 0.05$) was used to judge the significance of all tests. Fisher's protected least significant difference test was applied to determine where difference in means occurred if the overall F test from the analysis of variance (ANOVA) indicated that the main effect was significant.

¶Chlorophyll *a* ANOVA models were structured using the mean station-by-month concentration based on three paired replicate samples.

§Fisheries data were transformed using the $\log_e$ (number of fish/hour + 1) transformation. Because of the change in the sampling regime between 1992 and previous years (i.e., from quarterly to biannual [May and November] sampling), the ANOVA models were fitted with only the biannual data across all years.

Appendix 6. **Mean percent recovery and sample size of water chemistry standards for the CP&L Chemistry Laboratory during 1992.**

Variable	Standard[+]	Known value	Units	n	Mean	Standard deviation	Recovery (%)	RSD[¶] (%)
Chloride	LQC	1.0	mg/L	15	0.9830	0.0146	98.3	1.49
	HQC	2.0	mg/L	15	1.9170	0.0295	95.9	1.54
	Low Spike	1.0	mg/L	3	0.9440	0.0510	94.4	5.35
	High Spike	2.0	mg/L	4	2.0300	0.0460	101.0	2.27
T. Phosphorus	LQC	0.005	mg/L	14	0.0058	0.0007	116.0	12.07
	HQC	0.05	mg/L	14	0.0498	0.0009	99.6	1.81
	Low Spike	0.00498	mg/L	5	0.00516	16.3000	103.2	4.7
	High Spike	0.0498	mg/L	6	0.0515	4.8600	103	4.7
T. Nitrogen	LQC	0.1	mg/L	10	0.0983	0.0048	98.3	4.88
	HQC	0.2	mg/L	10	0.2018	0.0055	100.9	2.73
	Spike	0.2	mg/L	6	0.2062	0.0149	103.1	7.23
Sulfate	LQC	2.0	mg/L	15	2.0250	0.0290	101.3	1.43
	HQC	5.0	mg/L	15	4.8840	0.0814	97.7	1.67
	Low Spike	2.0	mg/L	3	1.8100	0.0330	90.4	1.84
	High Spike	5.0	mg/L	5	4.8800	97.5000	0.1	2.26
TOC (1)[§]	LQC	4.1	mg/L	6	3.9600	0.1960	96.6	4.95
TOC (2)[§]	LQC	5.1	mg/L	7	4.7600	0.0620	93.3	1.30
TOC (3)[§]	LQC	6.8	mg/L	1	6.6500	0.0000	97.8	0.00
Aluminum	LQC	50.0	µg/L	2	52.1500	1.4849	104.3	2.85
	HQC	100.0	µg/L	9	104.7000	10.4898	104.7	10.02
	Spike	100.0	µg/L	5	92.3000	13.9000	92.3	15.10
Arsenic	LQC	5	µg/L	25	5.2000	0.1000	104.0	1.92
	Spike	500	µg/L	23	457.000	68.3000	91.4	14.95
Cadmium	LQC	0.2	µg/L	40	0.2133	0.0347	106.7	16.27
	HQC	0.5	µg/L	40	0.5038	0.0294	100.8	5.84
	Spike	0.5	µg/L	8	0.5100	0.0480	102.5	9.42
Calcium	LQC	1.0	mg/L	8	0.9659	0.0513	96.6	5.31
	MQC	5.0	mg/L	8	4.8075	0.203	96.15	4.22
	HQC	10.0	mg/L	8	9.8513	0.3013	98.5	3.06
	Spike	5.0	mg/L	10	4.5320	0.2954	90.6	6.52
Chromium	LQC	5.0	µg/L	31	5.6200	0.6120	112.4	10.89
	HQC	10.0	µg/L	31	10.0100	0.9280	100.1	9.27
	Spike	10.0	µg/L	5	10.3700	0.1901	103.7	1.83
Copper	LQC	5.0	µg/L	7	5.0600	0.2517	101.2	4.97
	HQC	10.0	µg/L	7	9.9600	0.4531	99.6	4.55
	Spike	5.0	µg/L	11	5.3791	0.3640	107.6	6.77
Lead	LQC	2.0	µg/L	40	2.1400	0.2810	107.0	13.13
	HQC	5.0	µg/L	40	5.1900	0.4270	103.8	8.23
	Spike	5.0	µg/L	8	4.6800	0.3210	93.6	6.85

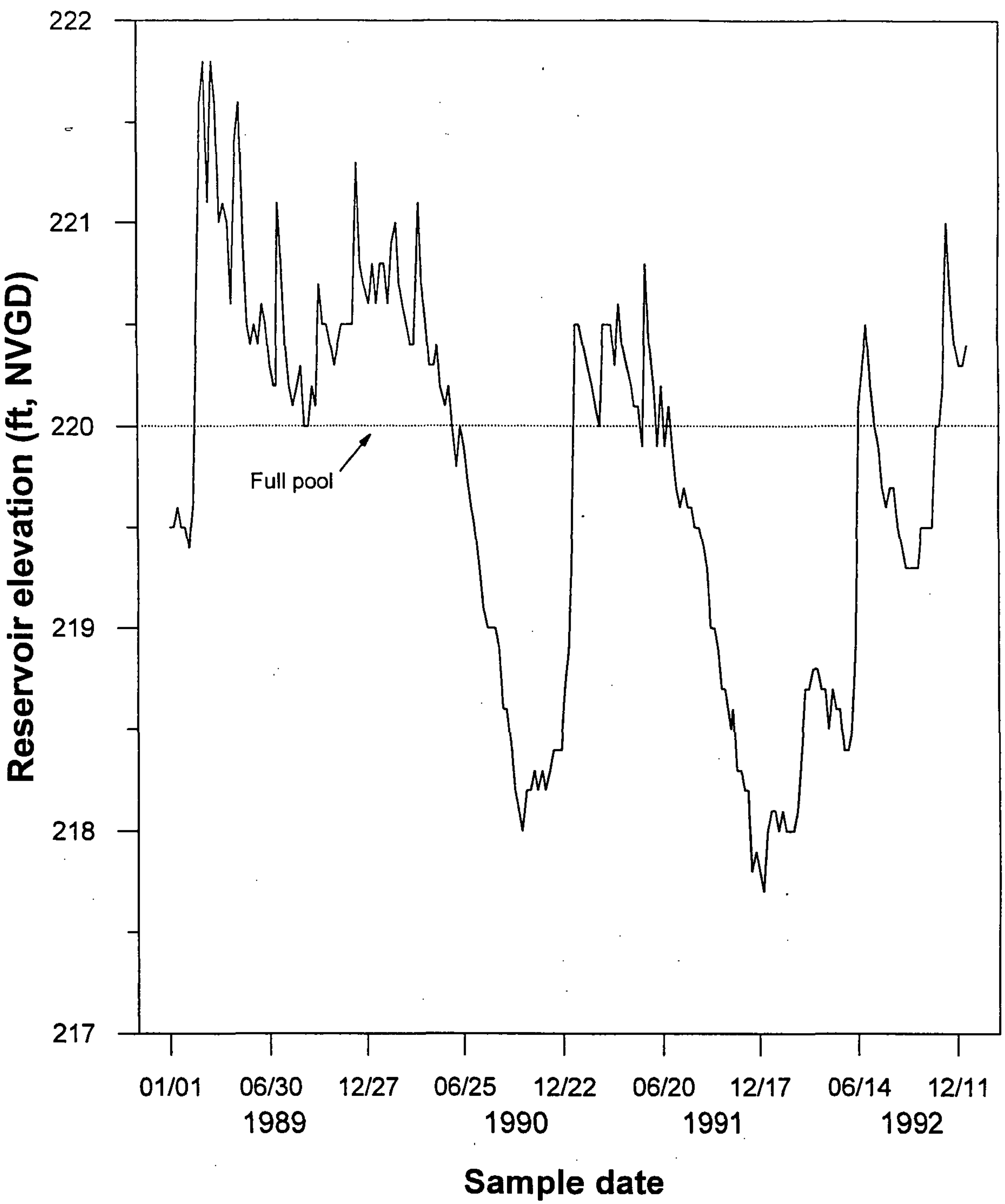
Appendix 6 (continued)

Variable	Standard+	Known value	Units	n	Mean	Standard deviation	Recovery (%)	RSD (%)
Magnesium	LQC	1.0	mg/L	8	0.9956	0.0242	99.6	2.43
	MQC	5.0	mg/L	8	5.0213	0.1761	100.4	3.51
	HQC	10.0	mg/L	7	10.1329	0.2654	101.3	2.62
	Spike	5.0	mg/L	10	4.9000	0.1441	98.0	2.94
Mercury	LQC	0.10	μg/L	22	0.0850	0.0330	85.0	38.82
	HQC	0.30	μg/L	23	0.2740	0.0406	91.3	14.82
Nickel	LQC	10.0	μg/L	31	10.4300	0.9190	104.3	8.81
	HQC	20.0	μg/L	30	19.8500	1.3120	99.3	6.61
	Spike	20.0	μg/L	5	20.8000	0.8820	104.2	4.24
Selenium	LQC	5	μg/L	33	5.1000	0.1000	102.0	1.96
	Spike	500	μg/L	70	493.0000	86.2000	98.6	17.50
Sodium	LQC	1.0	mg/L	11	1.0075	0.0348	100.8	3.45
	HQC	2.0	mg/L	11	2.0375	0.0628	101.9	3.08
	Spike	2	mg/L	10	1.9800	0.0610	99.0	3.06
Zinc	LQC	50	μg/L	8	50.3000	4.3000	100.6	8.55
	MQC	100	μg/L	8	98.6000	8.7000	98.6	8.82
	HQC	500	μg/L	8	502.6000	10.6000	100.5	2.11
	Spike	50	μg/L	10	52.2000	3.7000	104.4	7.09

+LQC = low-range quality control standard, MQC = mid-range quality control standard, HQC = high-range quality control standard, Spike = sample matrix spike.

¶RSD = Relative standard deviation = standard deviation ÷ mean x 100.

§There were three different concentrations used for the known values of total organic carbon in the laboratory analyses.



Appendix 7. **Water surface elevations at Harris Lake, 1989-1992. NVGD = National Geodetic Vertical Datum (formerly called mean sea level by the U.S. Geological Survey).**

Appendix 8. Water temperature, dissolved oxygen, specific conductance, and pH data collected from Harris Lake during 1992.

January 14, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	9.2	9.8	9.1	9.6	10.0	11.0	10.2	10.4	96	88	86	82	6.7	7.0	6.6	6.7
1.0	9.1	9.7	9.1	9.6	9.5	10.4	10.2	9.4	96	88	86	82	6.7	7.0	6.6	6.7
2.0	9.1	9.6	9.1	9.6	9.2	10.2	10.1	9.3	93	85	85	81	6.7	7.0	6.6	6.7
3.0	9.0	9.5	9.1	9.6	9.1	10.0	10.1	9.1	93	85	85	81	6.7	7.0	6.6	6.7
4.0	9.0	9.5	9.1	9.5	8.9	9.9	10.0	9.0	94	85	85	81	6.7	7.0	6.6	6.7
5.0	8.9	9.4	9.1		8.8	9.8	9.9		94	84	85		6.7	7.0	6.6	
6.0	8.9	9.4	9.0		8.7	9.8	9.8		92	84	84		6.7	7.0	6.6	
7.0	8.8	9.4	9.0		8.4	9.7	9.8		93	84	84		6.6	7.0	6.6	
8.0	8.7				8.4				93				6.6			
9.0	8.7				8.2				93				6.6			
10.0	8.6				8.1				93				6.6			
11.0	8.6				8.1				93				6.6			
12.0	8.6				7.9				93				6.6			
13.0	8.6				7.8				93				6.6			
14.0	8.6				7.8				93				6.6			
15.0	8.6				7.7				93				6.6			

February 3, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	9.2	9.2	7.8	7.2	10.6	11.0	11.8	11.0	96	87	88	86	7.1	7.2	6.8	6.9
1.0	7.6	7.9	7.8	6.8	10.5	11.0	11.8	10.6	96	88	85	85	7.1	7.2	6.8	6.8
2.0	7.5	7.3	7.6	6.4	10.5	10.8	11.7	10.2	96	86	85	84	7.1	7.2	6.9	6.8
3.0	7.5	7.2	7.3	6.3	10.1	10.5	11.3	9.8	94	85	85	84	7.1	7.2	6.9	6.8
4.0	7.5	7.2	7.3		10.0	10.5	11.0		93	85	85		7.1	7.2	6.9	
5.0	7.5	7.2	7.2		9.9	10.4	10.9		93	83	85		7.1	7.2	6.9	
6.0	7.5	7.2	7.2		9.8	10.3	10.8		93	83	85		7.0	7.2	6.9	
7.0	7.4	7.1	7.2		9.6	9.9	10.6		93	83	85		7.0	7.1	6.9	
8.0	7.4		7.2		9.7		9.8		93		85		7.0		6.9	
9.0	7.4				9.4				92				7.0			
10.0	7.4				9.4				92				7.0			
11.0	7.4				9.4				92				7.0			
12.0	7.4				9.4				92				7.0			

Appendix 8 (continued)

March 2, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (μS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	10.7	14.9	11.7	13.8	11.6	11.0	11.6	10.0	98	94	90	90	7.3	7.4	7.2	7.1
1.0	10.1	11.5	11.1	11.7	11.2	10.9	11.5	10.0	98	92	91	90	7.3	7.4	7.2	7.1
2.0	9.8	10.8	10.6	10.8	10.5	10.4	11.0	9.6	96	89	90	89	7.3	7.4	7.2	7.1
3.0	9.8	10.8	10.6	10.8	10.2	10.1	10.8	9.6	96	88	89	87	7.3	7.4	7.2	7.1
4.0	9.7	10.7	10.6	10.8	10.2	10.1	10.8	8.4	95	88	89	87	7.3	7.4	7.2	7.1
5.0	9.7	10.7	10.5		9.9	10.1	10.6		95	88	89		7.2	7.4	7.2	
6.0	9.7	10.6	10.5		9.9	9.4	10.5		95	86	89		7.1	7.4	7.2	
7.0	9.7	9.9	10.2		9.8	7.9	9.0		95	90	88		7.1	7.3	7.2	
8.0	9.7	9.7			9.8	6.1			95	90			7.1	7.3		
9.0	9.7				9.7				95				7.1			
10.0	9.7				9.7				93				7.1			
11.0	9.4				9.0				94				7.1			
12.0	9.2				8.1				94				7.1			

April 6, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (μS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	13.4	13.7	12.3	13.0	9.4	10.0	8.5	8.0	101	91	95	84	6.3	6.0	6.2	5.6
1.0	11.8	12.3	11.7	11.6	9.2	10.0	8.2	7.5	101	90	93	84	6.3	6.0	6.2	5.6
2.0	11.4	11.5	11.5	10.7	8.9	9.7	7.8	7.0	99	90	92	83	6.3	6.1	6.1	5.7
3.0	11.4	11.4	11.4	10.5	8.9	9.3	7.4	6.7	99	89	91	83	6.3	6.1	6.1	5.7
4.0	11.4	11.4	11.4	10.4	8.6	9.1	7.6	6.2	99	89	91	82	6.3	6.1	6.0	5.7
5.0	11.3	11.4	11.3		8.6	9.1	7.7		98	88	91		6.3	6.1	5.9	
6.0	11.3	11.3	11.3		8.4	8.7	7.5		98	86	90		6.3	6.1	5.8	
7.0	11.3	11.3	11.2		8.4	8.2	7.6		98	86	90		6.3	6.1	5.8	
8.0	11.3	11.2	11.2		8.2	7.9	7.3		98	86	90		6.3	6.1	5.8	
9.0	11.2				8.2				97				6.3			
10.0	11.2				8.2				96				6.3			
11.0	11.2				8.2				96				6.3			
12.0	11.1				8.0				96				6.3			

Appendix 8 (continued)

May 4, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	19.9	21.6	20.6	21.2	9.1	9.0	9.5	8.7	101	99	99	95	7.4	7.8	7.2	6.3
1.0	19.9	20.8	20.6	21.1	9.0	8.8	9.1	8.4	100	98	98	94	7.4	7.8	7.2	6.3
2.0	19.9	19.4	20.5	20.4	8.9	7.5	9.0	6.0	99	96	99	94	7.4	7.6	7.2	6.3
3.0	19.8	19.1	20.2	19.5	8.8	6.5	8.8	4.1	99	97	98	96	7.4	7.5	7.2	6.1
4.0	19.8	17.1	18.5		8.8	3.9	6.1		98	100	97		7.4	7.3	7.0	
5.0	19.8	16.9	17.1		8.6	3.6	4.6		97	101	99		7.4	7.1	7.1	
6.0	19.5	15.5	16.2		8.2	1.7	3.6		97	102	99		7.4	7.1	7.1	
7.0	19.0	15.0	15.5		7.3	1.7	2.2		97	104	104		7.3	7.0	7.1	
8.0	16.6	14.9	15.1		4.3	1.7	1.6		102	105	105		6.7	6.9	7.1	
9.0	14.7				3.1				104				6.7			
10.0	13.9				2.9				103				6.7			
11.0	13.2				2.4				104				6.5			
12.0	12.7				1.6				106				6.4			
13.0	12.4				0.7				108				6.4			

June 4, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	20.7	22.1	21.3	21.7	7.5	8.9	8.9	8.8	103	100	102	100	6.9	7.3	7.3	7.1
1.0	20.3	22.1	21.3	21.7	5.6	8.9	8.8	8.8	103	99	102	99	6.9	7.4	7.3	7.1
2.0	19.9	22.1	21.0	21.4	4.3	8.8	8.4	8.0	104	98	102	98	6.7	7.4	7.3	7.0
3.0	19.4	22.0	20.7	19.1	4.2	7.9	7.5	0.7	105	98	102	92	6.6	7.4	7.2	6.5
4.0	18.7	21.7	19.1	18.6	3.9	7.9	4.5	0.4	106	98	103	90	6.6	7.1	7.0	6.3
5.0	18.6	17.8	18.1		3.7	1.0	3.3		107	106	103		6.5	6.9	6.8	
6.0	18.2	17.3	17.7		3.1	0.7	2.7		113	108	103		6.4	6.8	6.7	
7.0	17.9	17.3	17.1		2.5	0.5	1.2		113	117	106		6.4	6.6	6.6	
8.0	17.4		16.9		2.3		0.6		109		114		6.4		6.4	
9.0	16.4				2.0				105				6.5			
10.0	16.1				2.1				105				6.3			
11.0	15.8				1.7				104				6.3			
12.0	14.3				0.6				116				6.2			
13.0	13.3				0.6				139				6.3			
14.0	13.2				0.6				141				6.3			

Appendix 8 (continued)

July 14, 1992

Depth (m)	Temperature (°C) E2	H2	P2	S2	Dissolved oxygen (mg/liter) E2	H2	P2	S2	Specific conductance (μS/cm) E2	H2	P2	S2	pH E2	H2	P2	S2
0.2	29.6	31.6	30.9	31.4	6.8	7.5	6.8	6.7	101	102	104	102	7.0	7.1	7.0	6.8
1.0	29.4	31.4	30.9	31.4	6.5	7.3	6.6	6.6	101	102	104	102	7.0	7.1	7.0	6.8
2.0	28.1	31.2	30.7	31.4	3.2	6.4	6.5	6.5	100	101	104	101	7.0	7.1	7.0	6.8
3.0	26.8	28.7	30.4	29.8	1.1	1.6	6.0	0.7	97	97	102	100	6.9	7.1	6.9	6.7
4.0	23.7	24.6	23.8	27.0	0.5	0.7	0.8	0.4	108	87	106	110	6.7	6.9	6.9	6.5
5.0	22.3	21.7	22.4		0.5	0.6	0.6		110	94	106		6.7	6.8	6.7	
6.0	20.4	20.2	20.7		0.6	0.6	0.6		116	101	106		6.6	6.6	6.7	
7.0	19.3	19.4	19.4		0.6	0.5	0.6		114	107	108		6.6	6.6	6.5	
8.0	18.7		18.5		0.6		0.6		111		112		6.6		6.5	
9.0	18.2				0.7				111				6.6			
10.0	17.7				0.7				108				6.6			
11.0	16.9				0.6				106				6.6			
12.0	15.7				0.6				105				6.5			
13.0	14.5				0.6				115				6.3			
14.0	13.9				0.5				128				6.4			

August 3, 1992

Depth (m)	Temperature (°C) E2	H2	P2	S2	Dissolved oxygen (mg/liter) E2	H2	P2	S2	Specific conductance (μS/cm) E2	H2	P2	S2	pH E2	H2	P2	S2
0.2	28.1	28.2	27.6	28.1	6.3	6.0	6.3	5.2	96	94	100	96	6.8	6.9	7.1	6.9
1.0	28.0	28.1	27.6	28.1	6.3	5.6	6.1	5.2	96	94	99	95	6.8	6.9	7.1	6.8
2.0	27.9	28.0	27.6	27.9	6.0	4.8	5.8	4.9	95	93	98	93	6.7	6.9	7.0	6.6
3.0	27.9	27.8	27.6	27.7	5.2	3.4	5.7	3.5	95	93	98	93	6.7	6.8	6.9	6.5
4.0	27.3	27.6	27.5	27.2	3.0	0.5	5.4	1.3	95	94	98	93	6.7	6.8	6.8	6.5
5.0	22.0	25.2	24.7		0.2	0.3	0.2		140	114	122		6.7	6.7	6.7	
6.0	21.1	21.0	22.0		0.2	0.3	0.2		139	122	130		6.6	6.6	6.6	
7.0	20.4	19.7	20.0		0.2	0.3	0.2		138	129	131		6.6	6.6	6.5	
8.0	19.4	19.3	18.8		0.2	0.2	0.2		136	135	140		6.6	6.6	6.5	
9.0	18.4				0.2				134				6.6			
10.0	17.8				0.2				134				6.6			
11.0	16.9				0.2				135				6.7			
12.0	15.4				0.2				143				6.6			
13.0	14.4				0.2				163				6.6			
14.0	13.7				0.2				180				6.6			
15.0	13.4				0.2				186				6.6			
16.0	13.0				0.2				198				6.6			

Appendix 8 (continued)

September 9, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (μS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	27.7	27.6	27.1	27.1	8.3	7.8	8.0	6.8	101	97	98	95	8.2	7.6	7.7	7.3
1.0	27.6	27.6	27.1	27.0	8.1	7.6	7.9	6.6	100	96	97	95	8.2	7.6	7.7	7.3
2.0	27.5	27.4	27.1	26.9	8.0	7.2	7.9	5.3	98	96	97	94	8.2	7.6	7.7	7.2
3.0	26.7	26.5	27.0	26.3	4.7	2.5	7.4	0.6	97	97	95	94	8.0	7.5	7.7	7.1
4.0	25.8	26.1	26.2	25.4	1.0	0.8	2.0	0.3	97	95	96	105	7.9	7.5	7.6	6.9
5.0	24.5	24.6	25.4		0.3	0.3	0.4		109	102	98		7.7	7.3	7.5	
6.0	23.6	23.5	23.4		0.3	0.3	0.4		123	110	117		7.5	7.1	7.3	
7.0	23.1	22.6	22.4		0.3	0.3	0.3		127	125	125		7.3	7.0	7.1	
8.0	22.1	21.9	21.6		0.3	0.3	0.3		131	138	132		7.2	6.9	7.0	
9.0	20.8				0.3				129				7.0			
10.0	20.0				0.3				127				6.9			
11.0	19.0				0.3				123				7.0			
12.0	16.9				0.3				123				7.1			
13.0	15.3				0.3				135				7.1			
14.0	14.8				0.4				152				7.0			

October 5, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (μS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	20.5	20.3	20.2	19.0	5.5	6.5	6.5	7.9	90	87	91	84	6.6	6.6	6.5	6.2
1.0	20.5	20.3	20.3	19.0	5.4	6.5	6.6	7.9	90	86	90	84	6.6	6.6	6.5	6.3
2.0	20.5	20.3	20.2	19.0	5.4	6.4	6.6	7.9	89	88	90	84	6.6	6.6	6.5	6.3
3.0	20.5	20.3	20.2	18.4	5.4	6.4	6.6	7.7	88	86	88	79	6.6	6.7	6.5	6.3
4.0	20.5	20.3	20.3		5.4	6.4	6.5		88	84	87		6.5	6.7	6.5	
5.0	20.5	20.3	20.3		5.4	6.3	6.5		88	84	87		6.5	6.7	6.5	
6.0	20.5	20.3	20.3		5.3	6.2	6.4		89	85	87		6.5	6.6	6.5	
7.0	20.5	20.3	20.3		5.3	6.1	6.4		89	86	87		6.5	6.7	6.5	
8.0	20.5		20.3		5.3		6.5		89		90		6.5		6.5	
9.0	20.5				5.3				87				6.5			
10.0	20.5				5.3				88				6.5			
11.0	20.5				5.3				88				6.5			
12.0	20.5				5.3				87				6.5			
13.0	20.5				5.2				89				6.5			

Appendix 8 (continued)

November 5, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	18.1	18.3	18.1	18.0	7.2	8.3	8.7	8.1	87	83	86	82	6.9	7.0	6.6	6.8
1.0	17.9	18.2	18.0	17.9	7.0	8.2	8.7	8.2	86	85	85	83	6.9	7.0	6.6	6.8
2.0	17.4	17.8	17.9	17.8	5.5	6.9	8.6	7.9	86	83	86	83	6.9	7.0	6.6	6.8
3.0	17.3	17.4	17.8	17.1	5.6	5.0	7.9	6.1	84	80	85	84	6.9	7.0	6.6	6.7
4.0	17.3	17.2	17.7	16.7	5.4	4.7	7.8	3.8	84	80	85	84	6.8	6.9	6.7	6.7
5.0	17.2	17.2	17.4		5.3	4.3	7.0		84	82	83		6.8	6.9	6.7	
6.0	17.2	17.1	17.1		5.1	4.0	5.5		84	80	84		6.7	6.8	6.7	
7.0	17.2	17.1	17.0		5.2	3.5	5.3		84	80	83		6.7	6.8	6.7	
8.0	17.2	17.0	17.0		4.9	2.5	5.1		84	82	84		6.7	6.7	6.7	
9.0	17.2				4.8				84				6.7			
10.0	17.2				4.7				84				6.7			
11.0	17.1				4.5				86				6.7			
12.0	17.1				4.0				85				6.7			
13.0	17.0				3.1				87				6.7			
14.0	16.9				1.8				90				6.7			

December 9, 1992

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/liter)				Specific conductance (µS/cm)				pH			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	10.7	9.5	9.9	7.6	8.7	8.4	8.8	9.4	69	57	68	53	6.7	7.6	6.4	6.7
1.0	10.8	9.5	9.9	7.6	8.6	8.5	9.1	9.4	72	60	69	53	6.7	7.5	6.4	6.7
2.0	10.8	9.5	9.9	7.6	8.5	8.4	9.1	9.2	71	61	68	52	6.7	7.5	6.4	6.7
3.0	10.7	9.5	9.9	7.6	8.5	8.5	9.1	9.3	70	60	68	52	6.7	7.5	6.4	6.7
4.0	10.7	9.5	9.9	7.5	8.4	8.4	9.1	9.3	69	60	68	51	6.7	7.4	6.4	6.7
5.0	10.7	9.5	9.9		8.3	8.4	9.1		70	59	68		6.7	7.4	6.4	
6.0	10.7	9.5	9.9		8.3	8.4	9.1		69	60	68		6.7	7.4	6.4	
7.0	10.7	9.4	9.9		8.3	8.3	9.1		69	60	68		6.7	7.4	6.4	
8.0	10.7	9.4	9.8		8.4	8.2	9.0		69	59	68		6.7	7.4	6.4	
9.0	10.7				8.3				69				6.7			
10.0	10.7				8.3				69				6.7			
11.0	10.7				8.3				69				6.7			
12.0	10.7				8.3				70				6.7			
13.0	10.6				8.3				70				6.7			

Appendix 11. Secchi disk transparency depth and chlorophyll *a* data collected from Harris Lake during 1992.

Date	Station E2	H2	P2	S2
Secchi disk transparency depth (m)				
January 14	1.2	0.9	1.2	0.5
February 3	1.0	0.9	0.9	0.6
March 2	0.9	0.9	0.8	0.3
April 6	1.0	1.0	0.9	0.6
May 4	1.7	1.3	1.7	0.6
June 4	1.2	1.1	1.2	0.9
July 14	1.2	1.4	1.2	1.2
August 3	1.3	1.2	1.4	0.7
September 9	1.9	1.7	2.6	1.1
October 5	1.0	1.1	1.1	1.3
November 5	1.6	1.3	1.9	2.0
December 9	1.4	1.3	1.3	0.8
Annual mean	**1.3**	**1.2**	**1.4**	**0.9**
Chlorophyll *a* (μg/liter)				
January 14	14.5	40.2	21.5	10.7
February 3	27.2	35.3	26.9	14.5
March 2	27.9	25.1	28.6	19.8
April 6	16.7	27.2	24.7	27.9
May 4	12.8	17.7	13.5	30.0
June 4	35.5	28.7	35.2	32.0
July 14	28.0	16.9	14.3	12.9
August 3	44.4	27.3	18.3	18.5
September 9	13.1	11.8	9.3	8.0
October 5	14.1	17.9	11.1	3.8
November 5	15.5	28.5	21.9	4.9
December 9	11.0	12.8	16.9	5.8
Annual mean	**21.7**	**24.1**	**20.2**	**15.7**

Appendix 12. **Concentrations of chemical variables in Harris Lake during 1992. Units are in mg/liter except trace metals and metalloids which are in μg/liter and turbidity which is in NTU.**

Station E2, surface

Month	Total Alkalinity ($CaCO_3$)	Hardness (calculated)	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	Nitrate + nitrite-N	TP	TOC
Jan	10	16	9.2	16	3.2	2.0	11	0.35	0.17	0.20	0.067	6.7
Feb								0.45	0.14	0.20	0.052	
Mar	9.7	16	9.2	17	3.1	1.9	12	0.70	0.14	0.10	0.042	6.6
Apr								0.67	+	+	0.058	
May	10	16	9.7	17	3.4	1.9	12	0.63	0.04	< 0.02	0.038	6.8
Jun								0.89	0.05	0.02	0.062	
Jul	11	15	8.4	14	3.3	1.7	10	0.59	0.06	< 0.02	0.034	7.8
Aug								0.49	0.02	< 0.02	0.037	
Sep	14	16	9.2	13	3.3	1.9	11	0.34	< 0.02	< 0.02	0.028	7.1
Oct								0.30	0.19	0.02	0.030	
Nov	15	19	9.6	13	4.1	2.1	11	0.29	0.05	0.11	0.030	7.2
Dec								0.39	0.10	0.14	0.032	

Month	Turbidity	TS	TDS	TSS	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Jan	3.2	63	26	12	78	< 1	< 0.1	< 2	2.1	< 0.05	< 5	< 1	< 1	20
Feb	1.3	60	58	10										
Mar	1.4	62	< 10	< 10	140	< 1	< 0.1	< 2	< 2.0	0.05	< 5	< 1	< 1	32
Apr	3.9	80	60	< 10										
May	2.3	65	35	< 10	76	< 1	< 0.1	< 2	< 2.0	< 0.05	< 5	< 1	< 1	< 20
Jun	3.3	70	55	< 10										
Jul	2.7	80	70	6	43	< 1	< 0.1	< 2	1.7	< 0.05	< 5	< 1	< 1	< 20
Aug	1.8	80	70	2										
Sep	1.8	100	100	< 1	82	< 1	< 0.1	< 2	6.0	< 0.05	< 5	< 1	1	< 20
Oct	1.9	80	70	2										
Nov	1.8	74	89	2	25	< 1	< 0.1	< 2	1.7	< 0.05	< 5	< 1	< 1	< 20
Dec	2.0	72	50	12										

Appendix 12 (continued)

Station E2, bottom

Month	Total Alkalinity ($CaCO_3$)	Hardness (calculated)	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	Nitrate + nitrite-N	TP	TOC
Jan	11	16	9.1	16	3.2	2.0	11	0.39	0.20	0.20	0.076	6.7
Feb								0.45	0.17	0.20	0.057	
Mar	9.9	16	9.2	17	3.1	1.9	12	0.69	0.19	0.12	0.060	6.8
Apr								0.85	+	+	0.067	
May	13	18	10	18	3.6	2.1	12	0.98	0.32	0.10	0.073	7.0
Jun								0.80	0.21	0.16	0.042	
Jul	47	22	10	9.3	4.7	2.5	12	2.1	1.4	< 0.02	0.023	9.2
Aug								3.0	2.7	< 0.02	0.040	
Sep	78	27	10	< 1.0	6.0	3.0	12	7.3	4.6	< 0.02	0.93	12
Oct								0.28	0.20	0.02	0.032	
Nov	19	20	9.8	14	4.2	2.2	12	0.49	0.21	0.12	0.10	7.2
Dec								0.45	0.10	0.14	0.032	

Month	Turbidity	TS	TDS	TSS	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Jan	5.0	45	27	11	99	< 1	< 0.1	< 2	7.5	< 0.05	< 5	< 1	< 1	30
Feb	0.9	50	48	10										
Mar	2.3	57	44	< 10	130	< 1	< 0.1	< 2	5.8	< 0.05	< 5	< 1	< 1	24
Apr	4.3	60	50	< 10										
May	3.5	65	45	< 10	120	< 1	< 0.1	< 2	2.4	< 0.05	< 5	< 1	< 1	20
Jun	1.9	75	55	< 10										
Jul	14	160	140	8	57	< 1	< 0.1	< 2	2.5	< 0.05	< 5	< 1	< 1	< 20
Aug	15	120	100	4										
Sep	22	150	140	8	74	3	< 0.1	< 2	2.6	< 0.05	< 5	< 1	1	< 20
Oct	1.9	80	80	3										
Nov	2.1	85	97	6	< 20	1	< 0.1	< 2	1.3	0.11	< 5	< 1	< 1	< 20
Dec	2.2	72	48	2										

Appendix 12 (continued)

Station H2, surface

Month	Total Alkalinity ($CaCO_3$)	Hardness (calculated)	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	Nitrate + nitrite-N	TP	TOC
Jan	9.9	16	8.7	14	3.3	1.9	10	0.31	0.04	0.15	0.044	6.4
Feb								0.30	0.11	0.08	0.033	
Mar	9.7	15	8.8	16	3.1	1.8	11	0.46	0.10	< 0.02	0.044	6.6
Apr								0.58	+	+	0.044	
May	10	17	9.6	16	3.6	2.0	11	0.65	0.02	< 0.02	0.035	6.9
Jun								0.71	0.05	< 0.02	0.042	
Jul	11	15	8.1	13	3.4	1.6	8.9	0.48	0.06	< 0.02	0.031	7.8
Aug								0.38	< 0.02	< 0.02	0.037	
Sep	14	16	8.9	12	3.4	1.9	10	0.36	0.02	< 0.02	0.023	7.3
Oct								0.17	0.05	< 0.02	0.032	
Nov	14	18	9.3	12	4.0	2.0	11	0.19	< 0.02	0.06	0.029	7.0
Dec								0.43	0.12	0.16	0.026	

Month	Turbidity	TS	TDS	TSS	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Jan	3.4	43	23	12	170	< 1	< 0.1	< 2	2.3	< 0.05	< 5	< 1	< 1	< 20
Feb	1.4	57	26	< 10										
Mar	1.2	38	27	< 10	170	< 1	< 0.1	< 2	3.5	< 0.05	< 5	< 1	< 1	< 20
Apr	2.7	60	50	< 10										
May	1.8	60	40	< 10	91	< 1	< 0.1	< 2	< 2.0	< 0.05	< 5	< 1	< 1	< 20
Jun	3.6	70	50	< 10										
Jul	2.8	30	10	6	66	< 1	< 0.1	< 2	3.8	< 0.05	< 5	< 1	< 1	< 20
Aug	2.0	80	70	3										
Sep	1.9	80	80	< 1	92	< 1	< 0.1	< 2	3.1	< 0.05	< 5	< 1	1	< 20
Oct	1.9	80	80	3										
Nov	1.8	76	69	5	< 20	< 1	< 0.1	< 2	1.1	< 0.05	< 5	< 1	< 1	< 20
Dec	5.1	72	46	4										

Appendix 12 (continued)

Station P2, surface

Month	Total Alkalinity ($CaCO_3$)	Hardness (calculated)	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	Nitrate + nitrite-N	TP	TOC
Jan	9.0	15	8.8	14	3.0	1.8	10	0.24	0.03	0.17	0.032	6.3
Feb								0.37	0.13	0.11	0.025	
Mar	9.1	15	8.9	16	2.9	1.8	11	0.49	0.12	0.06	0.034	6.8
Apr								0.62	+	+	0.038	
May	9.6	17	9.8	17	3.5	2.0	11	0.70	0.02	< 0.02	0.036	6.8
Jun								0.63	0.07	< 0.02	0.044	
Jul	11	17	8.5	14	3.4	2.0	10	0.47	0.08	< 0.02	0.029	7.9
Aug								0.41	< 0.02	< 0.02	0.032	
Sep	14	16	9.1	13	3.4	1.9	11	0.28	0.02	< 0.02	0.021	7.3
Oct								0.31	0.11	0.03	0.023	
Nov	15	18	9.7	13	3.9	2.0	11	0.22	< 0.02	0.09	0.056	7.1
Dec								0.44	0.03	0.12	0.022	

Month	Turbidity	TS	TDS	TSS	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Jan	2.9	87	26	11	84	< 1	< 0.1	< 2	4.3	< 0.05	< 5	< 1	1	30
Feb	0.9	70	69	< 10										
Mar	1.0	40	33	< 10	130	< 1	< 0.1	< 2	2.2	< 0.05	< 5	< 1	< 1	< 20
Apr	2.2	50	40	< 10										
May	2.0	60	45	< 10	81	< 1	< 0.1	< 2	< 2.0	< 0.05	< 5	< 1	< 1	< 20
Jun	3.3	70	60	< 10										
Jul	2.7	90	90	4	58	< 1	< 0.1	< 2	1.3	< 0.05	< 5	< 1	< 1	< 20
Aug	1.6	80	80	3										
Sep	1.5	180	130	< 1	41	< 1	< 0.1	< 2	3.4	< 0.05	< 5	< 1	< 1	< 20
Oct	1.6	80	70	3										
Nov	1.2	79	64	3	< 20	< 1	< 0.1	< 2	2.0	< 0.05	< 5	< 1	< 1	< 20
Dec	2.2	75	39	4										

Appendix 12 (continued)

Station S2, surface

Month	Total Alkalinity ($CaCO_3$)	Hardness (calculated)	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	Nitrate + nitrite-N	TP	TOC
Jan	9.2	15	9.2	12	3.2	1.8	9.1	0.27	0.11	0.11	0.039	6.9
Feb								0.34	0.15	0.13	0.038	
Mar	8.1	14	9.6	14	3.0	1.7	10	0.61	0.15	0.08	0.056	6.9
Apr								0.42	+	+	0.048	
May	10	17	9.3	14	3.7	1.9	10	0.71	0.04	< 0.02	0.048	7.7
Jun								0.63	0.04	< 0.02	0.042	
Jul	11	15	8.1	13	3.4	1.6	9.8	0.48	0.08	< 0.02	0.030	8.4
Aug								0.41	0.02	< 0.02	0.074	
Sep	14	16	9.1	12	3.4	1.9	11	0.28	0.02	< 0.02	0.021	5.6
Oct								0.18	0.03	< 0.02	0.020	
Nov	15	18	9.4	12	3.9	2.1	11	0.14	< 0.02	0.04	0.055	6.9
Dec								0.36	0.09	0.09	0.028	

Month	Turbidity	TS	TDS	TSS	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Jan	10	103	54	12	610	< 1	< 0.1	< 2	< 2.0	< 0.05	< 5	< 1	< 1	< 20
Feb	8.3	67	12	< 10										
Mar	6.2	62	33	< 10	1200	1	< 0.1	< 2	2.7	< 0.05	< 5	< 1	< 1	< 20
Apr	4.9	60	50	12										
May	8.3	65	35	10	230	< 1	< 0.1	< 2	< 2.0	< 0.05	< 5	< 1	< 1	< 20
Jun	5.1	70	55	< 10										
Jul	3.6	90	80	4	88	< 1	< 0.1	< 2	< 1.0	< 0.05	< 5	< 1	< 1	< 20
Aug	3.2	90	90	5										
Sep	3.6	170	120	< 1	240	1	< 0.1	< 2	2.6	< 0.05	< 5	< 1	1	< 20
Oct	1.6	80	80	3										
Nov	1.2	70	61	3	< 20	< 1	< 0.1	< 2	1.0	< 0.05	< 5	< 1	< 1	< 20
Dec	12	77	50	4										

+Missing datum

Appendix 13. Means, ranges, and spatial trends of selected limnological variables from the surface and bottom waters of Harris Lake during 1992.⁺

Variable	Station E2§ (surface)	E2§ (bottom)	H2	P2	S2
Solids (mg/liter)					
Total solids	74[ab] (60-100)	85 (45-160)	62[b] (30-80)	80[a] (40-180)	84[a] (60-170)
Total dissolved	57[ab] (< 10-100)	73 (27-140)	48[b] (10-80)	62[a] (26-130)	60[ab] (12-120)
Total suspended	5 (< 10-12)	6 (< 10-11)	5 (< 10-12)	4 (< 10-11)	6 (< 10-12)
Turbidity (NTU)	2.3[b] (1.3-3.9)	6.3 (0.9-22)	2.5[b] (1.2-5.1)	1.9[b] (0.9-3.3)	5.7[a] (1.2-12)
Secchi disk transparency (m)	1.3[a] (0.9-1.9)	NA	1.2[a] (0.9-1.7)	1.4[a] (0.8-2.6)	0.9[b] (0.3-2.0)
Chlorophyll *a* (µg/liter)	21.7 (11.0-44.4)	NA	24.1 (11.8-40.2)	20.2 (9.3-35.2)	15.7 (3.8-32.0)
Nutrients (mg/liter)					
Total nitrogen (TN)	0.51[a] (0.29-0.89)	1.48 (0.28-7.3)	0.42[b] (0.17-0.71)	0.43[b] (0.22-0.70)	0.40[b] (0.14-0.71)
Ammonia-N	0.09[a] (< 0.02-0.19)	0.94 (0.10-4.6)	0.05[b] (< 0.02-0.12)	0.06[b] (< 0.02-0.13)	0.07[ab] (< 0.02-0.15)
Nitrate + Nitrite-N	0.08[a] (< 0.02-0.20)	0.10 (< 0.02-0.20)	0.05[b] (< 0.02-0.16)	0.06[ab] (< 0.02-0.17)	0.05[b] (< 0.02-0.13)
Total phosphorus (TP)	0.043[a] (0.028-0.067)	0.128 (0.023-0.930)	0.035[ab] (0.023-0.044)	0.033[b] (0.021-0.056)	0.042[a] (0.020-0.074)
TN:TP	12	12	12	13	10
Total organic carbon (mg/liter)	7.0 (6.6-7.8)	8.2 (6.7-12)	7.0 (6.4-7.8)	7.0 (6.3-7.9)	7.1 (5.6-8.4)
Ions (mg/liter)					
Cations					
Calcium	3.4[ab] (3.1-4.1)	4.1 (3.1-6.0)	3.5[a] (3.1-4.0)	3.4[b] (2.9-3.9)	3.4[ab] (3.0-3.9)
Magnesium	1.9 (1.7-2.1)	2.3 (1.9-3.0)	1.9 (1.6-2.0)	1.9 (1.8-2.0)	1.8 (1.6-2.1)
Sodium	11[a] (10-12)	12 (11-12)	10[b] (8.9-11)	11[ab] (10-11)	10[b] (9.1-11)

Appendix 13 (continued)

Variable	E2 (surface)	E2 (bottom)	H2	P2	S2
	Station				
Anions					
Chloride	9.2 (8.4-9.7)	9.7 (9.1-10)	8.9 (8.1-9.6)	9.1 (8.5-9.8)	9.1 (8.1-9.6)
Sulfate	15[a] (13-17)	12 (< 1.0-18)	14[b] (12-16)	15[ab] (13-17)	13[c] (12-14)
Total alkalinity¶	12 (9.7-15)	30 (9.9-78)	11 (9.7-14)	11 (9.0-15)	11 (8.1-15)
Hardness (calculated)¶	16 (15-19)	20 (16-27)	16 (15-18)	16 (15-18)	16 (14-18)

+Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Sample size equaled 12 for all variables except for total alkalinity, hardness, and all ions which equalled 6. The variable TN:TP was not subjected to statistical analyses.

¶Total alkalinity units are mg/liter as $CaCO_3$ and hardness is calculated as mg equivalents $CaCO_3$/liter.

§There were no spatial differences in the mean concentrations of all the variables measured between the surface and bottom waters at Station E2.

NA = Not applicable.

Appendix 14. Spatial trends of selected limnological variables from the surface waters of Harris Lake at Stations E2, H2, and P2, 1987-1992.[+]

Variable[¶]	Station E2	Station H2	Station P2
Solids (mg/liter)			
Total solids (90)	59	58	68
Total dissolved (36)	5.4	43	54
Total suspended (72)	4.2	6.0	3.9
Turbidity (NTU)	2.6	3.4	3.0
Secchi disk transparency (m)	1.5	1.4	1.4
Chlorophyll *a* (μg/liter)	21.2	24.7	20.4
Nutrients (mg/liter)			
Total nitrogen	0.52	0.49	0.48
Ammonia-N (72)	0.07[a]	0.04[b]	0.05[b]
Nitrate + nitrite-N (72)	0.09	0.07	0.07
Total phosphorus	0.049[a]	0.033[b]	0.028[b]
TN:TP[£]	11	15	17
Total organic carbon (mg/liter)	6.8	6.7	6.8
Ions (mg/liter)			
Cations			
Calcium	3.3	3.2	3.2
Magnesium	1.7	1.7	1.7
Sodium	8.2[a]	7.6[b]	7.7[b]
Anions			
Chloride	6.5	6.2	6.4
Sulfate	10	9.5	9.9
Total alkalinity[§]	12.4[a]	11.6[b]	11.7[b]
Hardness[§]	15	15	15
Specific conductance (μS/cm)	79	75	77
Metals (μg/liter)			
Aluminum	56	70	52
Copper	3.5	2.9	2.9

[+]Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Data were rounded to conform to significant digit requirements. The mean separation technique may yield separations which are obscured by data rounding.

[¶]Sample size (n) equalled 108 unless otherwise noted in parentheses.

[§]Total alkalinity units are mg/liter as $CaCO_3$ and hardness units are calculated as mg equivalents $CaCO_3$/liter.

[£]Variable was not subjected to statistical analyses.

Appendix 15. Temporal trends of selected limnological variables from the surface waters of Harris Lake at Stations E2, H2, and P2, 1987-1992.+

Variable¶	Year 1987	1988	1989	1990	1991	1992
Solids (mg/liter)						
Total solids (90)	57	NS	67	56	56	73
Total dissolved (36)	47	NS	NS	NS	NS	53
Total suspended (72)	NS	NS	3.0	7.3	3.3	5.1
Turbidity (NTU)	3.7[ab]	2.8[b]	4.0[a]	2.5[bc]	2.5[c]	2.1[c]
Secchi disk transparency (m)	1.4[bc]	1.3[c]	1.4[bc]	1.6[a]	1.5[ab]	1.4[abc]
Chlorophyll *a* (µg/liter)	15.8[b]	20.2[b]	33.6[a]	24.7[ab]	18.3[b]	20.1[b]
Nutrients (mg/liter)						
Total nitrogen	0.44[b]	0.47[b]	0.49[b]	0.58[a]	0.58[a]	0.43[b]
Ammonia-N (72)	0.05	0.05	NS	NS	0.06	0.06
Nitrate + nitrite-N (72)	0.06[b]	0.07[b]	NS	NS	0.11[a]	0.06[b]
Total phosphorus	0.024[d]	0.029[cd]	0.045[ab]	0.049[a]	0.037[abc]	0.036[bc]
TN:TP£	18	16	11	12	16	12
Total organic carbon (mg/liter)	6.1[d]	6.7[bc]	7.4[a]	7.1[ab]	6.3[cd]	7.0[ab]
Ions (mg/liter)						
Cations						
Calcium	3.5[b]	3.8[a]	3.3[b]	2.6[c]	2.7[c]	3.4[b]
Magnesium	1.5[d]	1.7[c]	1.7[c]	1.7[c]	1.8[b]	1.9[a]
Sodium	5.1[d]	7.8[c]	7.3[c]	7.6[c]	8.5[b]	10.7[a]
Anions						
Chloride	4.3[e]	5.7[d]	5.5[d]	6.3[c]	7.4[b]	9.1[a]
Sulfate	6.8[e]	8.7[cd]	7.8[d]	9.5[c]	12[b]	14[a]
Total alkalinity§	13[b]	15[a]	12[bc]	9.9[d]	10[d]	11[c]
Hardness§	15[bc]	17[a]	15[b]	14[d]	14[cd]	16[a]
Specific conductance (µS/cm)	68[e]	83[b]	73[cd]	75[c]	69[de]	95[a]
Metals (µg/liter)						
Aluminum	21[d]	55[bc]	84[a]	45[cd]	71[abc]	80[ab]
Copper	3.5[a]	3.7[a]	3.1[ab]	3.8[a]	2.2[b]	2.4[b]

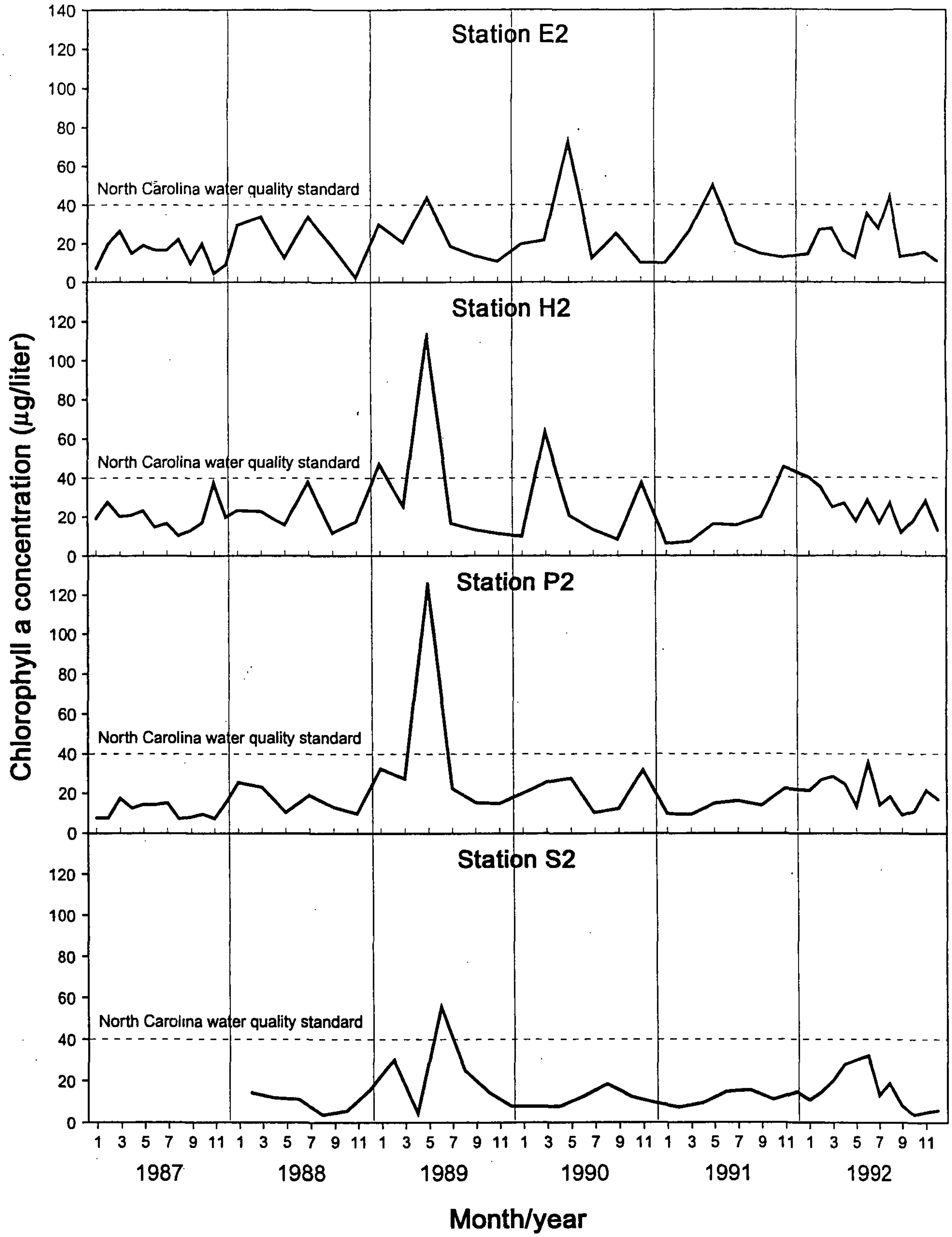
+Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Data were rounded to conform to significant digit requirements. The mean separation technique may yield separations which are obscured by data rounding.

¶Sample size (n) equalled 108 unless otherwise noted in parentheses.

§Total alkalinity units are mg/liter as $CaCO_3$ and hardness units are calculated as mg equivalents $CaCO_3$/liter.

£Variable was not subjected to statistical analyses.

NS = Not sampled.



Appendix 16. Chlorophyll *a* concentrations by station in Harris Lake, 1987-1992.

Appendix 17. Means, ranges, and spatial trends of metals and metalloids in the surface and bottom waters of Harris Lake during 1992[+].

Variable	E2 (surface)[¶]	E2 (bottom)[¶]	H2	P2	S2	N.C. water quality standard	CP&L reporting limit[§]
	Station						
Aluminum	74[b] (25-140)	82 (< 20-130)	100[b] (< 20-170)	67[b] (< 20-130)	396[a] (< 20-1200)	None	20
Arsenic	< 1	1 (< 1-3)	< 1	< 1	0.7 (< 1-1)	50	1
Cadmium	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	2	0.1
Chromium	< 2	< 2	< 2	< 2	< 2	50	2
Copper	2.3 (< 2.0-6.0)	3.7 (< 1.3-7.5)	2.5 (< 2.0-3.8)	2.4 (< 2.0-4.3)	1.5 (< 2.0-2.7)	7[£]	1
Lead	< 1	< 1	< 1	< 1	< 1	25	1
Mercury	< 0.05 (< 0.05-0.05)	0.04 (< 0.05-0.11)	< 0.05	< 0.05	< 0.05	0.012	0.05
Nickel	< 5	< 5	< 5	< 5	< 5	88	5
Selenium	0.6 (< 1-1)	0.6 (< 1-1)	0.6 (< 1-1)	0.6 (< 1-1)	0.6 (< 1-1)	5	1
Zinc	15 (< 20-32)	17 (< 20-30)	< 20	13 (< 20-30)	< 20	50	20

[+]Statistical analyses were applied only to the aluminum and copper surface water data. Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$).

[¶]There were no significant spatial differences in the mean concentrations of all the variables measured between the surface and bottom waters at Station E2.

[§]A statistically determined lower reporting limit (LRL) beyond which a chemical concentration cannot be reliably reported. $LRL = 3\ sx + |\ x\ |$, where x = the concentration of the blank, $|\ x\ |$ = the absolute concentration of the blank, and s = sample standard deviation.

[£]This value is an action level (NCDEM 1989).

Appendix 18. Temporal trends of selected limnological variables from the bottom waters of Harris Lake at Station E2, 1987-1992.⁺

Variable¶	Year					
	1987	1988	1989	1990	1991	1992
Solids (mg/liter)						
Total solids	75	NS	77	66	68	94
Total dissolved (12)	67	NS	NS	NS	NS	82
Total suspended (24)	NS	NS	3.8	11.3	6.8	7.2
Turbidity (NTU)	14	10	5.2	4.2	7.1	8.2
Nutrients (mg/liter)						
Total nitrogen	1.28	2.67	1.02	0.98	1.05	1.99
Nitrate + nitrite-N (24)	0.80	0.07	NS	NS	0.14	0.09
Ammonia-N (24)	0.59	2.04	NS	NS	0.58	1.15
Total phosphorus	0.278	0.312	0.214	0.153	0.197	0.210
TN:TP£	4.6	8.6	4.8	6.4	5.3	9.5
Total organic carbon (mg/liter)	6.6	6.8	7.9	7.4	6.9	8.2
Ions (mg/liter)						
Cations						
Calcium	4.5^{b}	5.5^{a}	4.2^{b}	3.2^{c}	3.2^{c}	4.1^{bc}
Magnesium	1.7^{d}	2.1^{ab}	1.9^{bcd}	1.8^{cd}	2.0^{bc}	2.3^{a}
Sodium	4.6^{d}	7.8^{c}	8.2^{bc}	7.5^{c}	9.1^{b}	11.8^{a}
Anions						
Chloride	4.2^{e}	5.6^{d}	5.8^{cd}	6.2^{c}	7.8^{b}	9.7^{a}
Sulfate	5.1^{c}	5.3^{c}	8.2^{b}	8.3^{b}	11.2^{a}	12.5^{a}
Total alkalinity§	26^{ab}	42^{a}	22^{b}	19^{b}	19^{b}	30^{ab}
Hardness§	18^{bc}	22^{a}	18^{bc}	15^{c}	16^{c}	20^{ab}
Specific conductance (µS/cm)	148	139	125	102	94	111
Metals (µg/liter)						
Aluminum	37^{b}	55^{b}	113^{a}	69^{ab}	76^{ab}	82^{ab}
Copper	4.4	3.7	4.5	4.0	2.3	3.7

⁺Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$).

¶Sample size (n) equalled 36 unless otherwise noted in parentheses.

§Total alkalinity units are mg/liter as $CaCO_3$ and hardness is calculated as mg equivalents $CaCO_3$/liter.

£Variable was not subjected to statistical analyses.

NS = Not sampled.

Appendix 19. Fish taxa collected by electrofishing sampling from Harris Lake, 1985-1991 and 1992.

Scientific name	Common name	Year 1985-1991	Year 1992
Amiidae	**bowfins**		
Amia calva	bowfin	X	X
Anguillidae	**freshwater eels**		
Anguilla rostrata	American eel	X	
Clupeidae	**herrings**		
Dorosoma cepedianum	gizzard shad	X	X
D. pretenense	threadfin shad	X	X
Esocidae	**pikes**		
Esox americanus americanus	redfin pickerel	X	
E. niger	chain pickerel	X	X
Cyprinidae	**carps and minnows**		
Clinostomus funduloides	rosyside dace	X	
Notemigonus crysoleucas	golden shiner	X	X
Notropis petersoni	coastal shiner	X	
N. spp.	unidentified shiner	X	X
Catostomidae	**suckers**		
Erimyzon oblongus	creek chubsucker	X	
Ictaluridae	**bullhead catfishes**		
Ameiurus natalis	yellow bullhead	X	X
A. nebulosus	brown bullhead	X	X
A. platycephalus	flat bullhead	X	
A. spp.	unidentified bullhead	X	
Ictalurus punctatus	channel catfish	X	
Noturus spp.	unidentified madtom	X	
Pylodictis olivaris	flathead catfish	X	
Poeciliidae	**livebearers**		
Gambusia holbrooki	eastern mosquitofish	X	X
Centrarchidae	**sunfishes**		
Centrarchus macropterus	flier	X	
Enneacanthus gloriosus	bluespotted sunfish	X	X
Lepomis auritus	redbreast sunfish	X	X
L. cyanellus	green sunfish	X	X
L. gibbosus	pumpkinseed	X	X
L. gulosus	warmouth	X	X
L. macrochirus	bluegill	X	X
L. microlophus	redear sunfish	X	X
L. sp.	hybrid sunfish	X	X
Micropterus salmoides	largemouth bass	X	X
Pomoxis annularis	white crappie	X	
P. nigromaculatus	black crappie	X	X
Percidae	**perches**		
Etheostoma fusiforme	swamp darter	X	
E. spp.	unidentified darter	X	

+Taxonomic nomenclature follows Robins et al. (1991).

Appendix 20. **Mean catch rate of fish collected (No./hour) during electrofishing sampling at Harris Lake during 1992.⁺**

Taxon	Area E	Area H	Area P	Area S	Area V	Area mean
Bowfin	1	0	0	1	0	< 1
Gizzard shad	13	39	22	30	14	24
Threadfin shad	0	10	0	15	4	6
Golden shiner	25	2	5	2	1	7
Unidentified shiner	1	0	0	0	1	< 1
Yellow bullhead	0	0	1	0	0	< 1
Brown bullhead	5	6	11	14	5	8
Chain pickerel	1	1	2	1	1	1
Eastern mosquitofish	0	1	0	0	0	< 1
Hybrid sunfish	0	0	0	0	1	< 1
Bluespotted sunfish	0	0	0	1	1	< 1
Redbreast sunfish	10	16	3	2	0	6
Pumpkinseed	21	9	27	16	42	23
Warmouth	4	2	1	0	3	2
Bluegill	68	61	83	63	124	80
Redear sunfish	32	30	31	20	35	29
Largemouth bass	27	33	60	24	51	39
Black crappie	1	0	3	9	1	2
Total¶	**207**	**209**	**249**	**198**	**283**	**229**

⁺The ANOVAs determined there were no significant spatial differences ($P > 0.05$) for any species during 1992.

¶Totals may vary from column sums due to rounding.

Appendix 21. **Annual mean catch rate (No./hour) of the numerically dominant fish species collected by electrofishing sampling at Harris Lake, May and November, 1983-1992.+**

Species	Year									
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Gizzard shad	15	14	8	6	11	14	35	10	25	24
Threadfin shad	¶	¶	¶	¶	0	0	24	0	0	6
Chain pickerel	1	2	<1	1	1	3	1	3	2	1
Golden shiner	2	7	1	2	4	10	16	8	3	7
Brown bullhead	17	9	24	19	32	29	12	10	10	8
Flat bullhead	0	0	0	0	< 1	< 1	0	< 1	13	0
Redbreast sunfish	3	2	2	2	2	1	6	3	6	6
Pumpkinseed	16	15	13	7	10	14	68	33	19	23
Warmouth	11	13	14	17	16	9	13	9	4	2
Bluegill	40	32	48	43	18	91	131	134	96	80
Redear sunfish	5	8	5	6	10	10	15	28	29	29
Largemouth bass	63	65	40	58	36	46	63	20	27	39
Black crappie	2	3	1	1	2	12	18	19	8	3
Total§	**188**	**180**	**171**	**167**	**145**	**244**	**414**	**280**	**230**	**229**

+Areas E, H, P, S, and V combined.

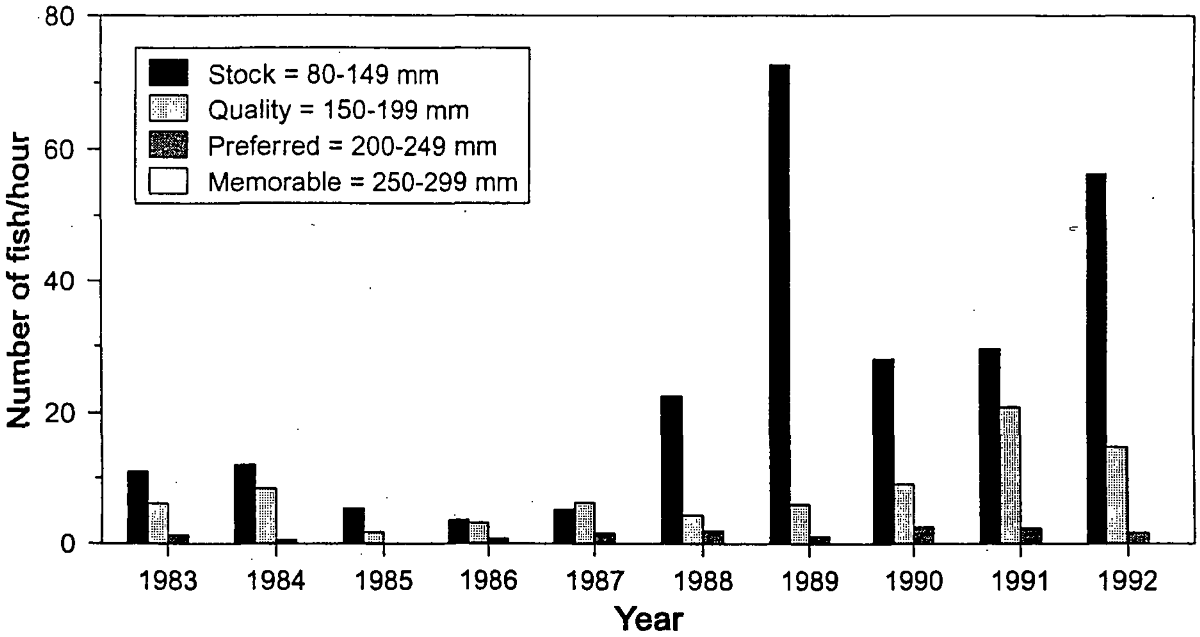
¶Threadfin shad were introduced into Harris Lake in 1987.

§Total is the total catch rate of all species (i.e., numerically dominant and subordinate species).

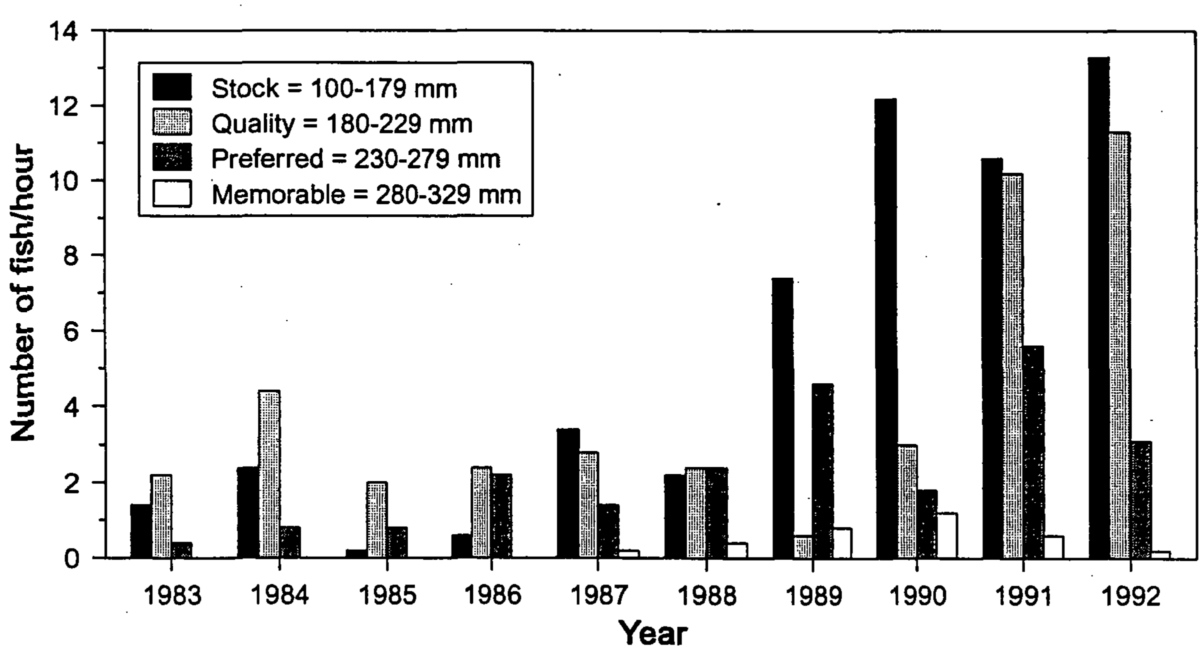
Appendix 22. Spatial and temporal trends of the catch rates (number of fish/hour) of total fish and selected fish species collected during electrofishing sampling at Harris Lake, May and November, 1983-1992.

Source	Area					Year									
	V	P	H	E	S	89	92	88	90	84	91	83	85	86	87
Total fish	253	180	159	158	151	309	194	184	181	174	169	163	159	148	135
	V	P	H	S	E	92	89	90	91	88	85	86	83	84	87
Bluegill	58	31	29	27	18	58	50	38	36	35	35	25	23	23	11
						91	92	90	89	87	88	84	85	83	86
Redear sunfish	Not significant					24	22	19	9	7	6	5	3	2	1
						89	90	92	83	85	84	88	91	87	86
Pumpkinseed	Not significant					44	20	13	10	9	9	9	7	6	3
	S	V	P	E	H	89	90	84	88	91	92	83	87	86	85
Black crappie	3	3	1	1	< 1	4	2	2	2	2	1	1	1	< 1	< 1
	V	P	H	E	S	84	89	83	86	88	92	87	85	91	90
Largemouth bass	46	41	34	34	21	61	56	53	43	36	30	29	26	18	17

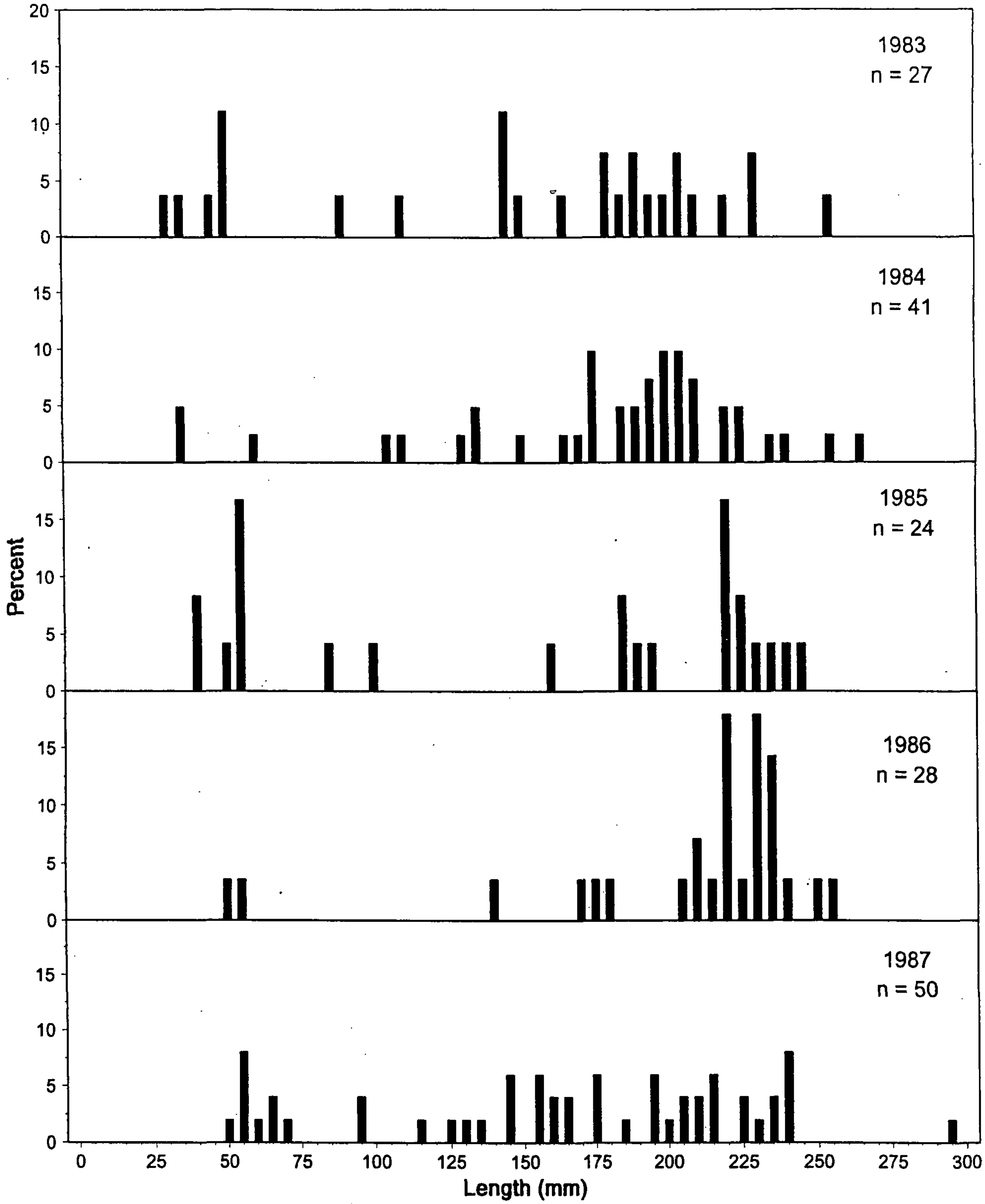
+Means are arranged in decreasing order (from left to right) and means with overlapping bars were not significantly different (P > 0.05). Fisher's LSD test ranking of areas or years was based on $\log_e$-transformed (number of fish/hour + 1) means which may not agree with the simple arithmetic rankings listed in Appendices 24 and 25.



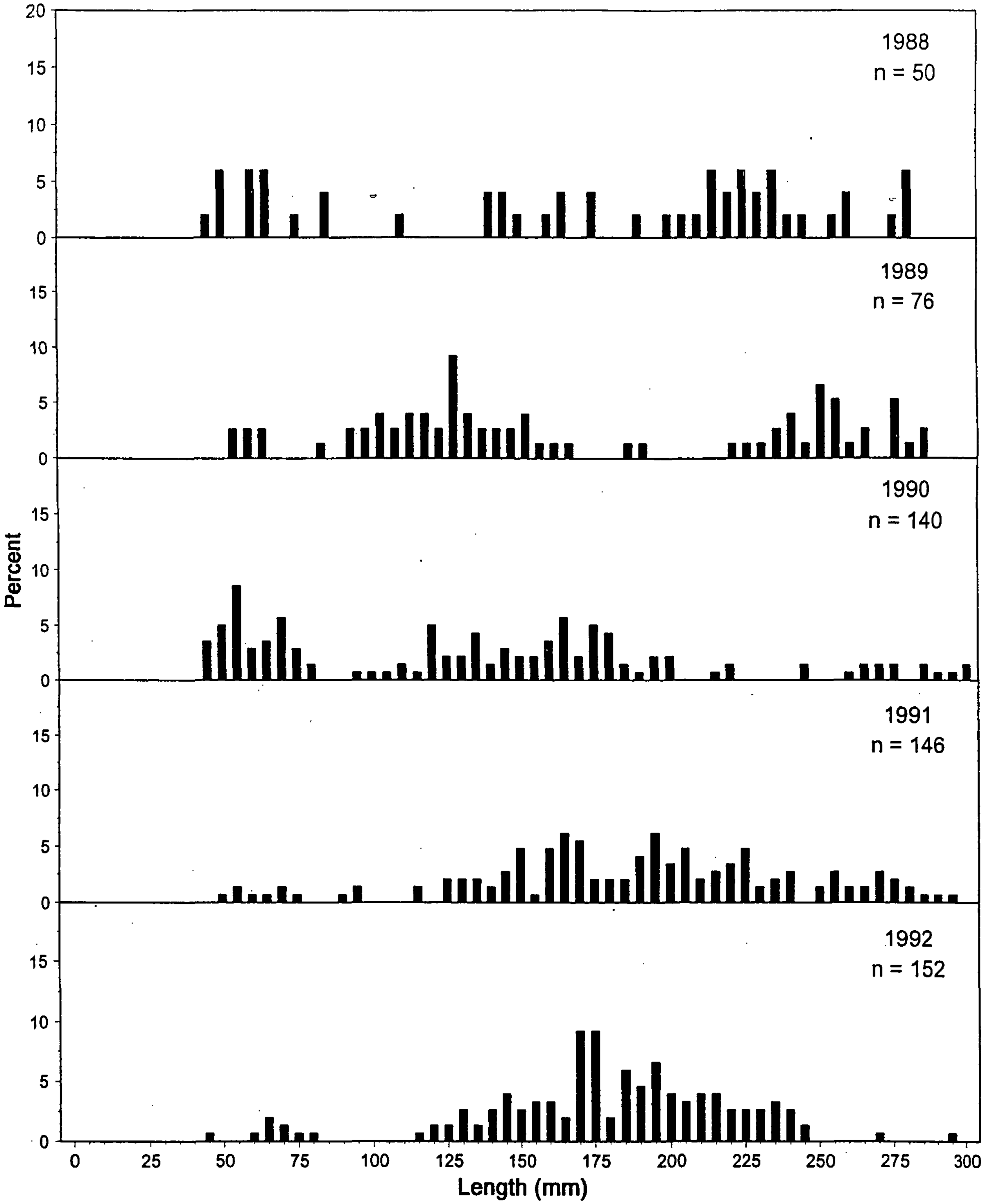
Appendix 23. Catch rate of bluegill by length group at Harris Lake, 1983-1992. Length groups were adopted from Gabelhouse (1984).



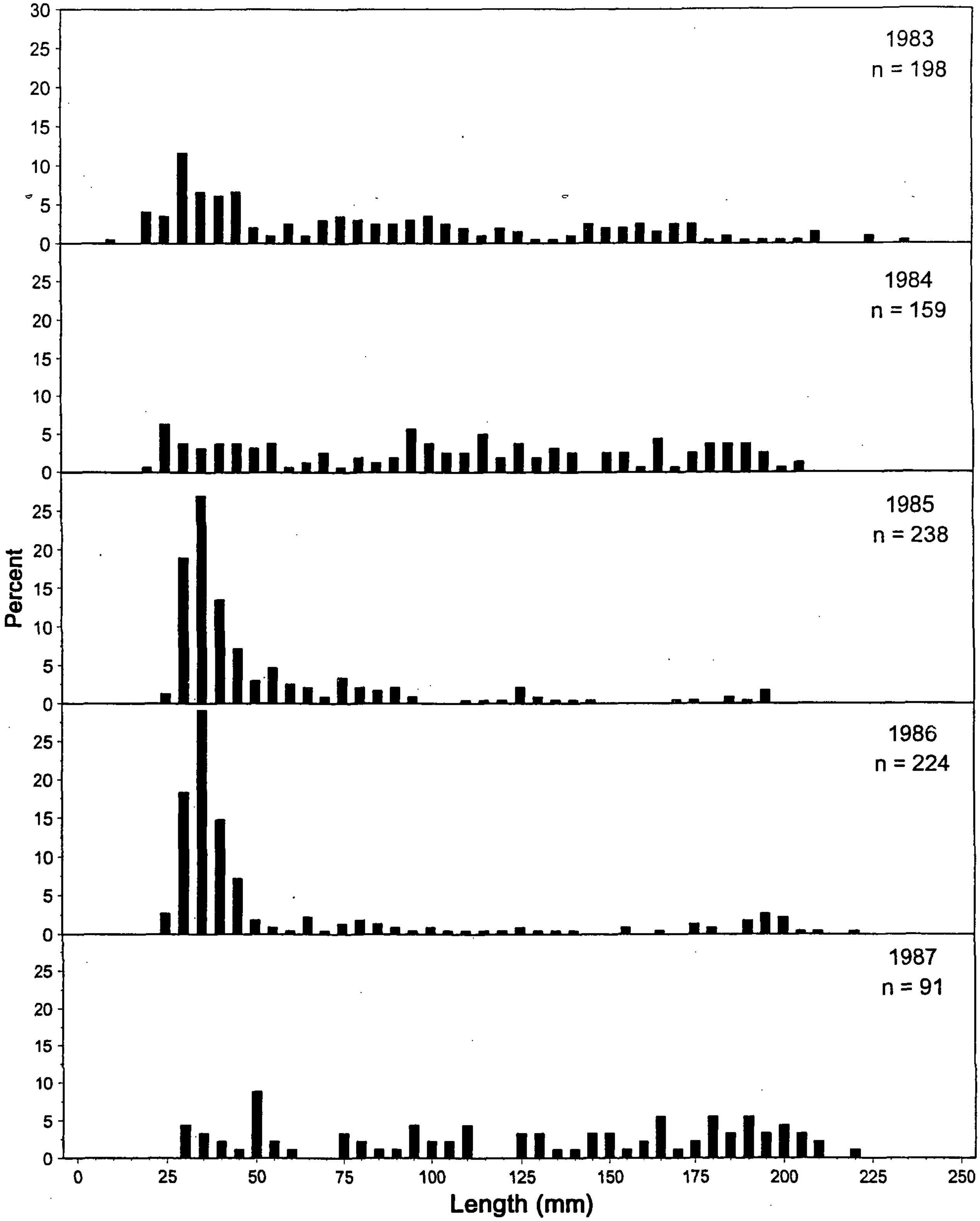
Appendix 24. Catch rate of redear sunfish by length group at Harris Lake, 1983-1992. Length groups were adopted from Gabelhouse (1984).



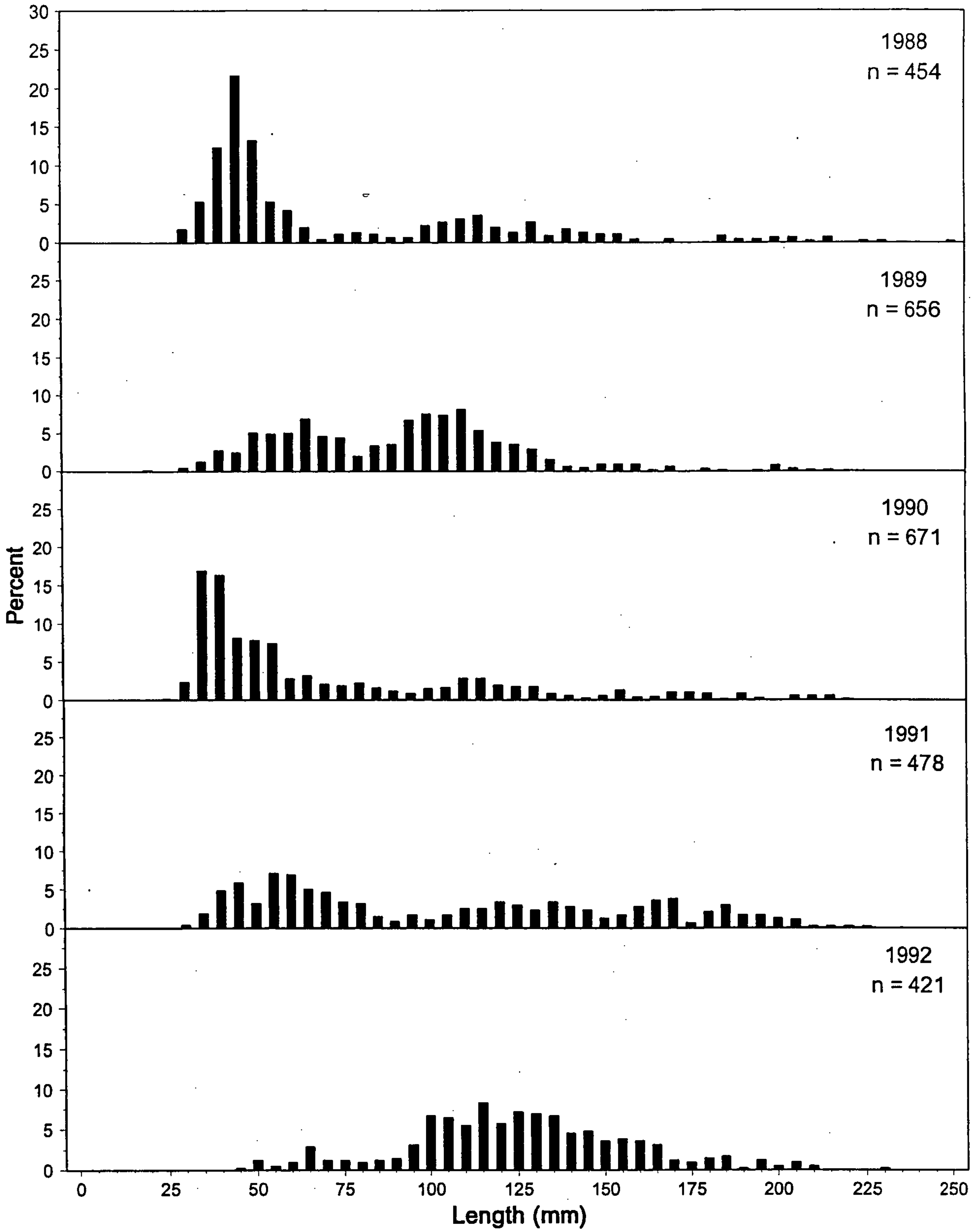
Appendix 25. Length-frequency distributions of redear sunfish collected during electrofishing sampling at Harris Lake, 1983-1992.



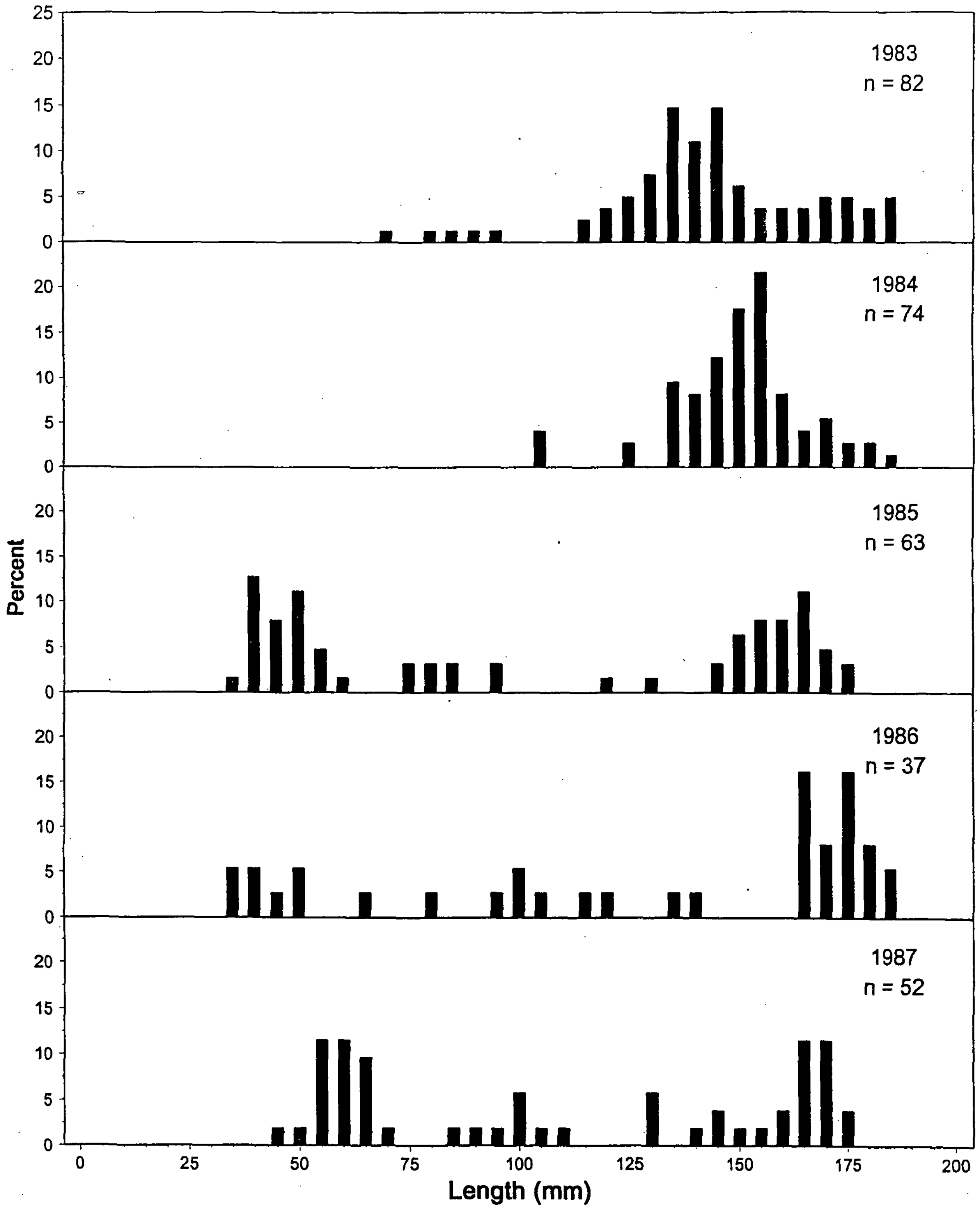
Appendix 25 (continued)



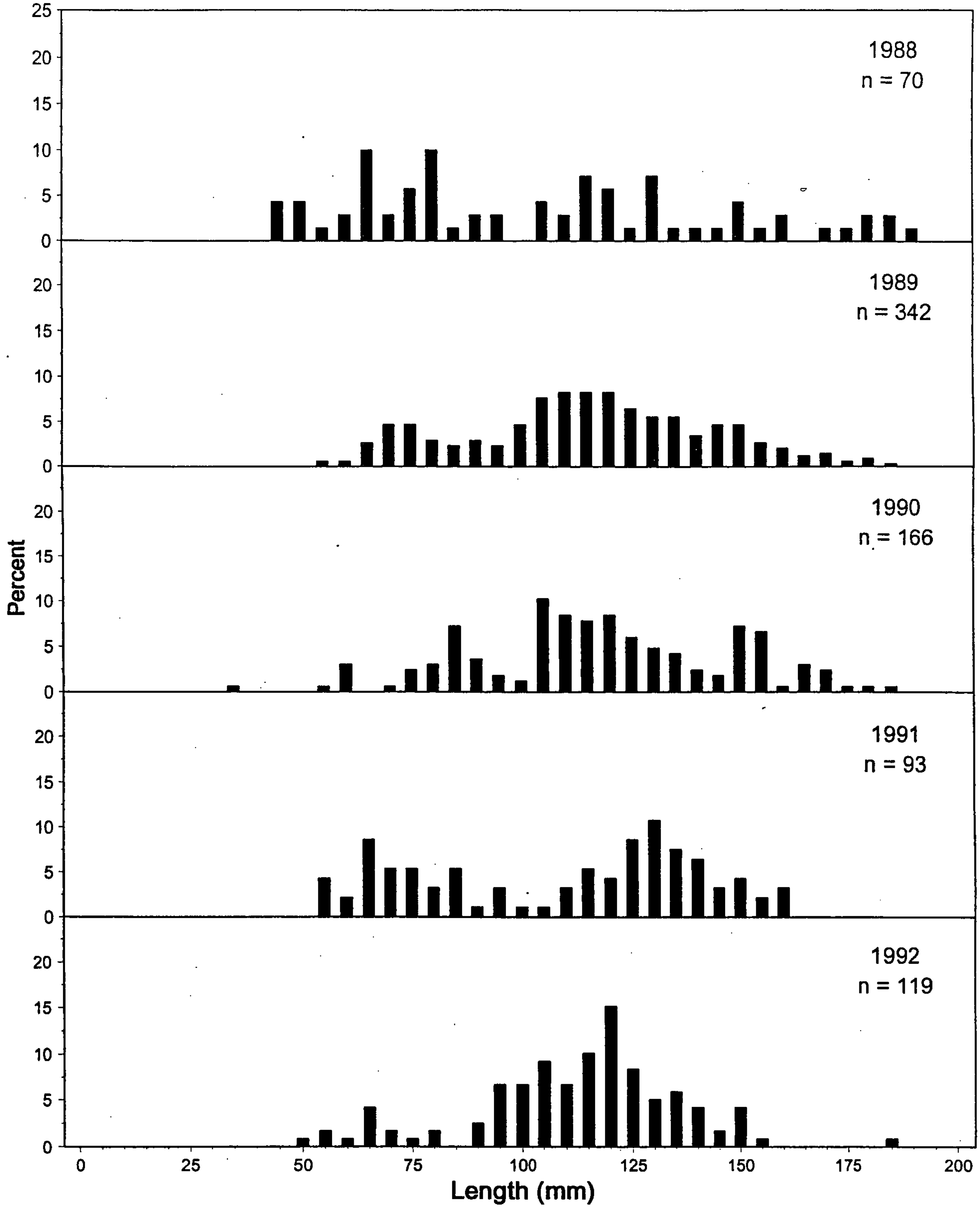
Appendix 26. **Length-frequency distributions of bluegill collected during electrofishing sampling at Harris Lake, 1983-1992.**



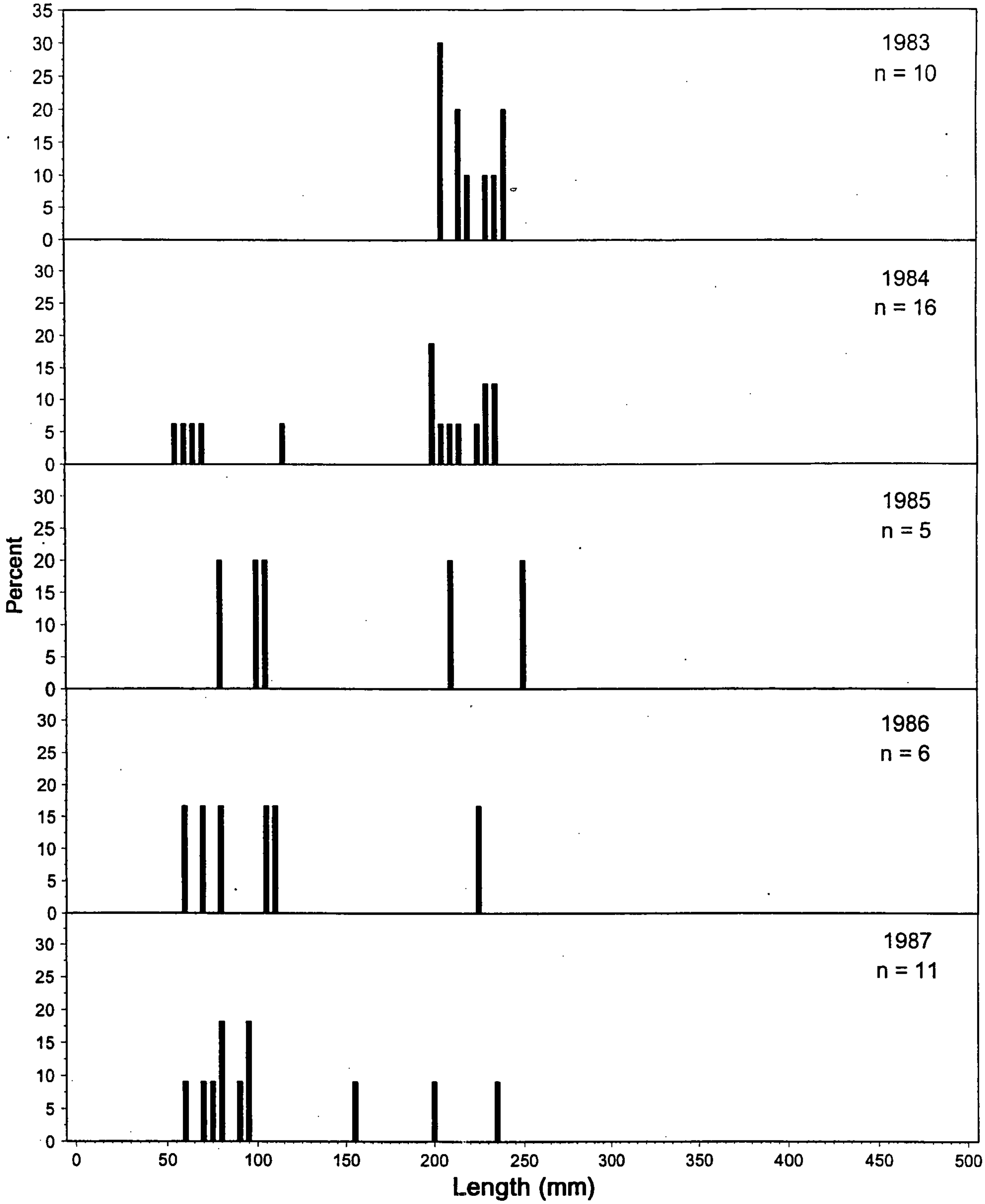
Appendix 26 (continued)



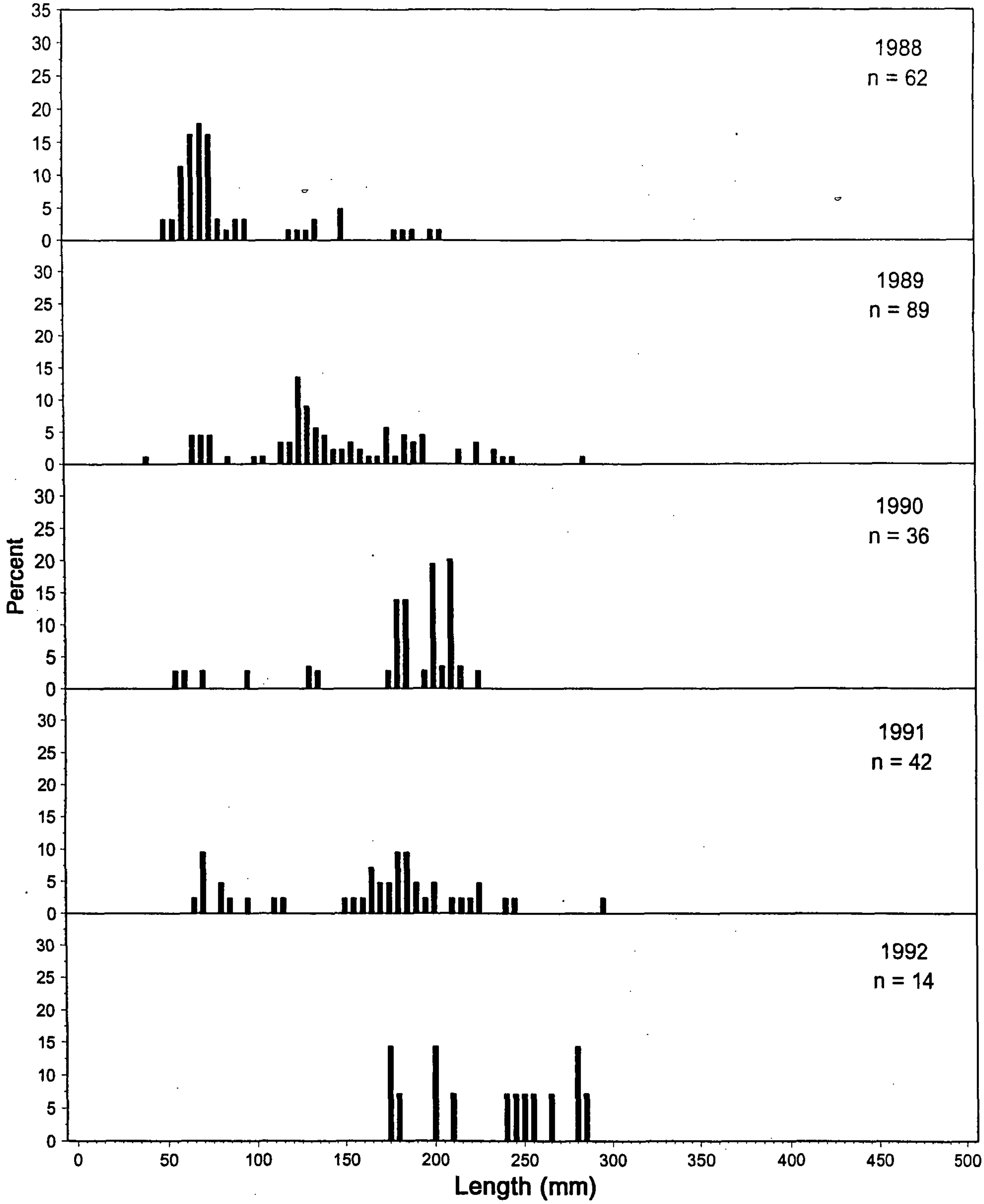
Appendix 27. **Length-frequency distributions of pumpkinseed collected during electrofishing sampling at Harris Lake, 1983-1992.**



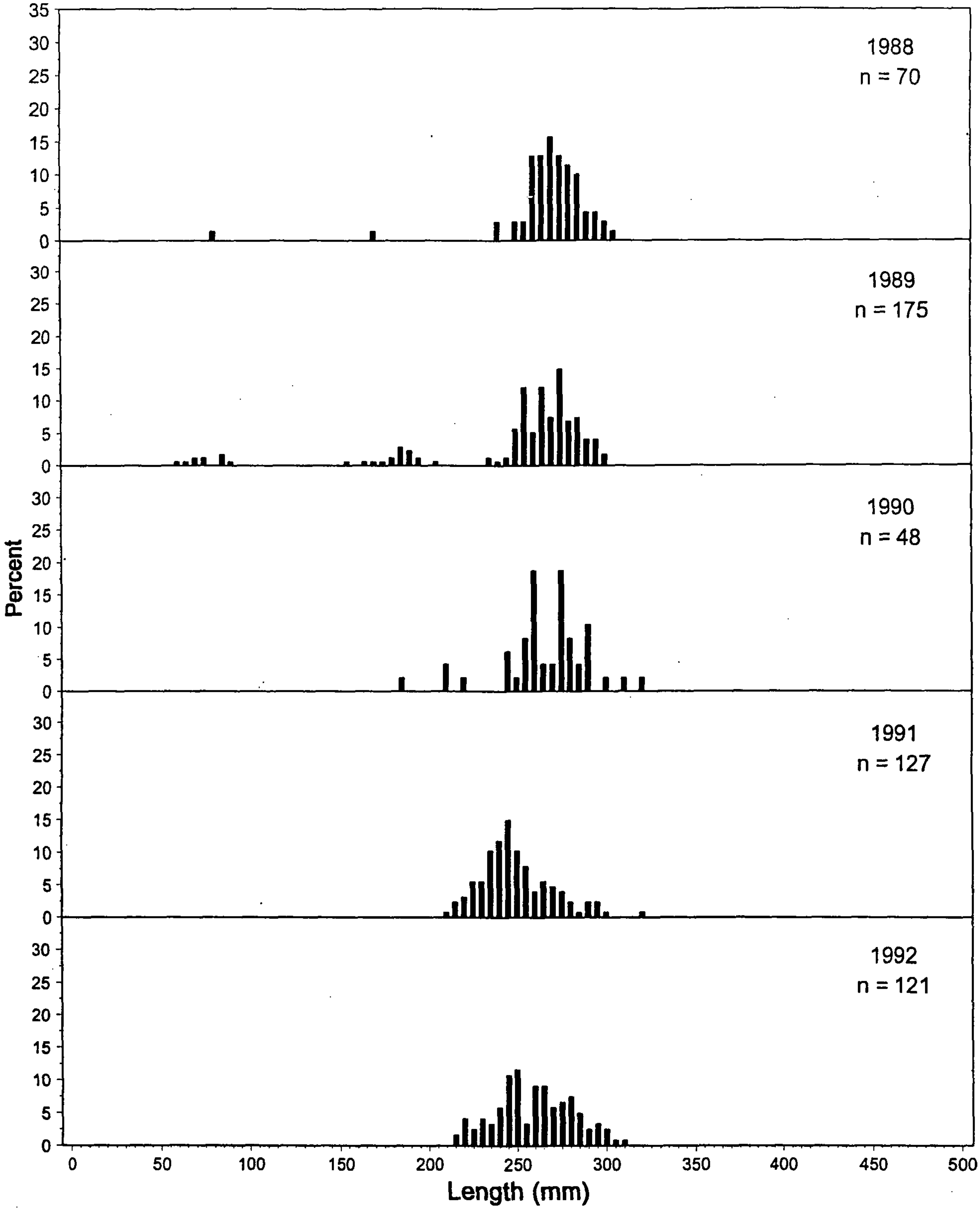
Appendix 27 (continued)



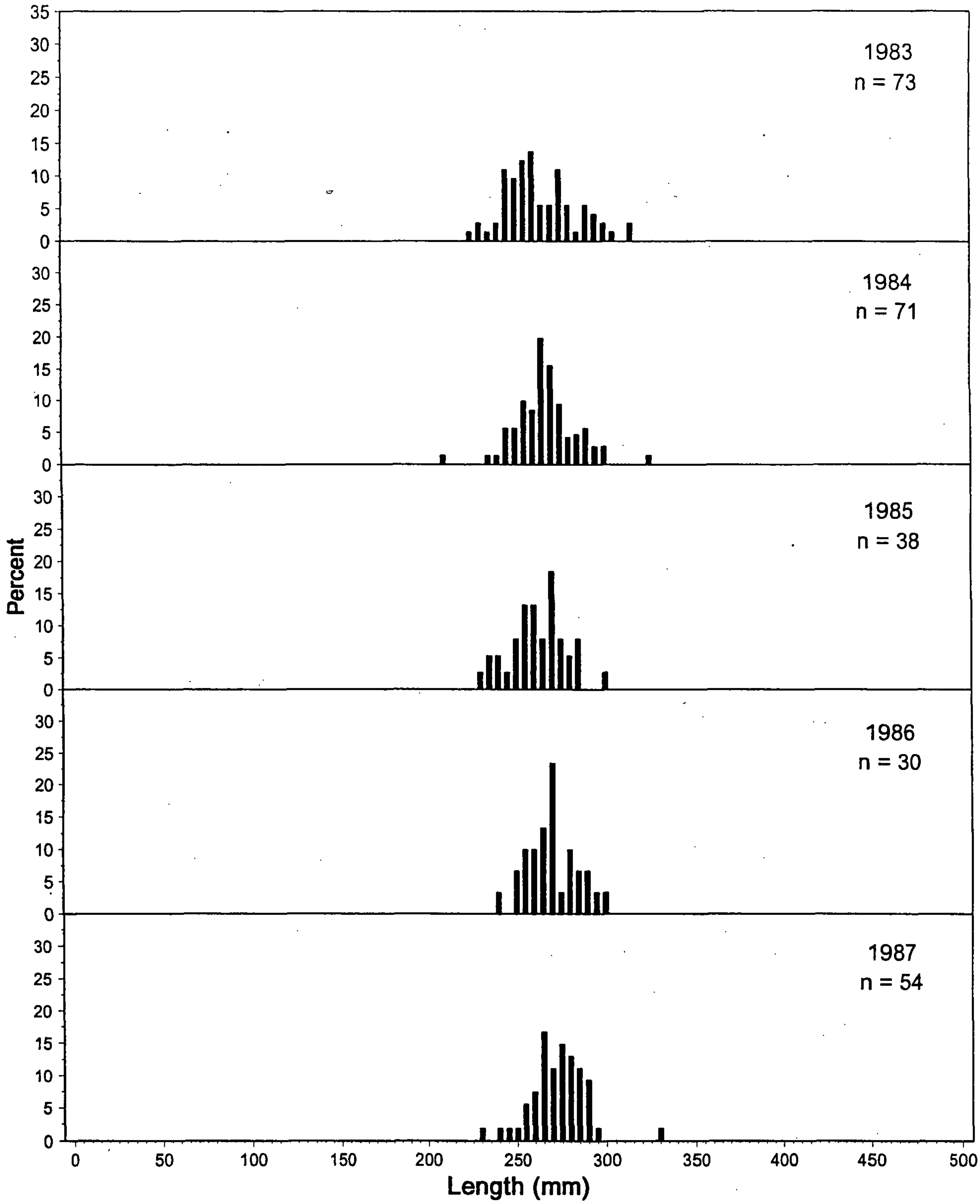
Appendix 28. **Length-frequency distributions of black crappie collected during electrofishing sampling at Harris Lake, 1983-1992.**



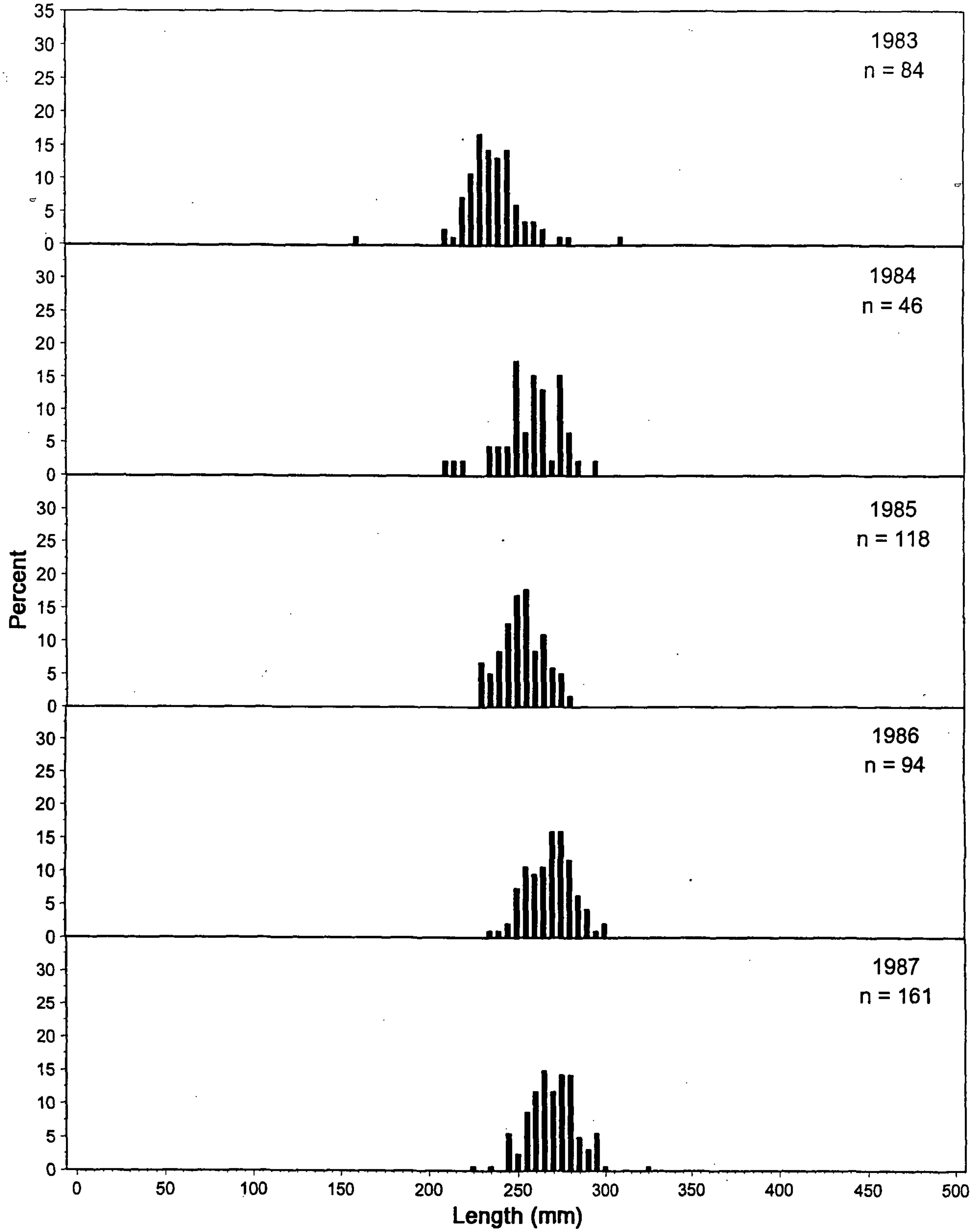
Appendix 28 (continued)



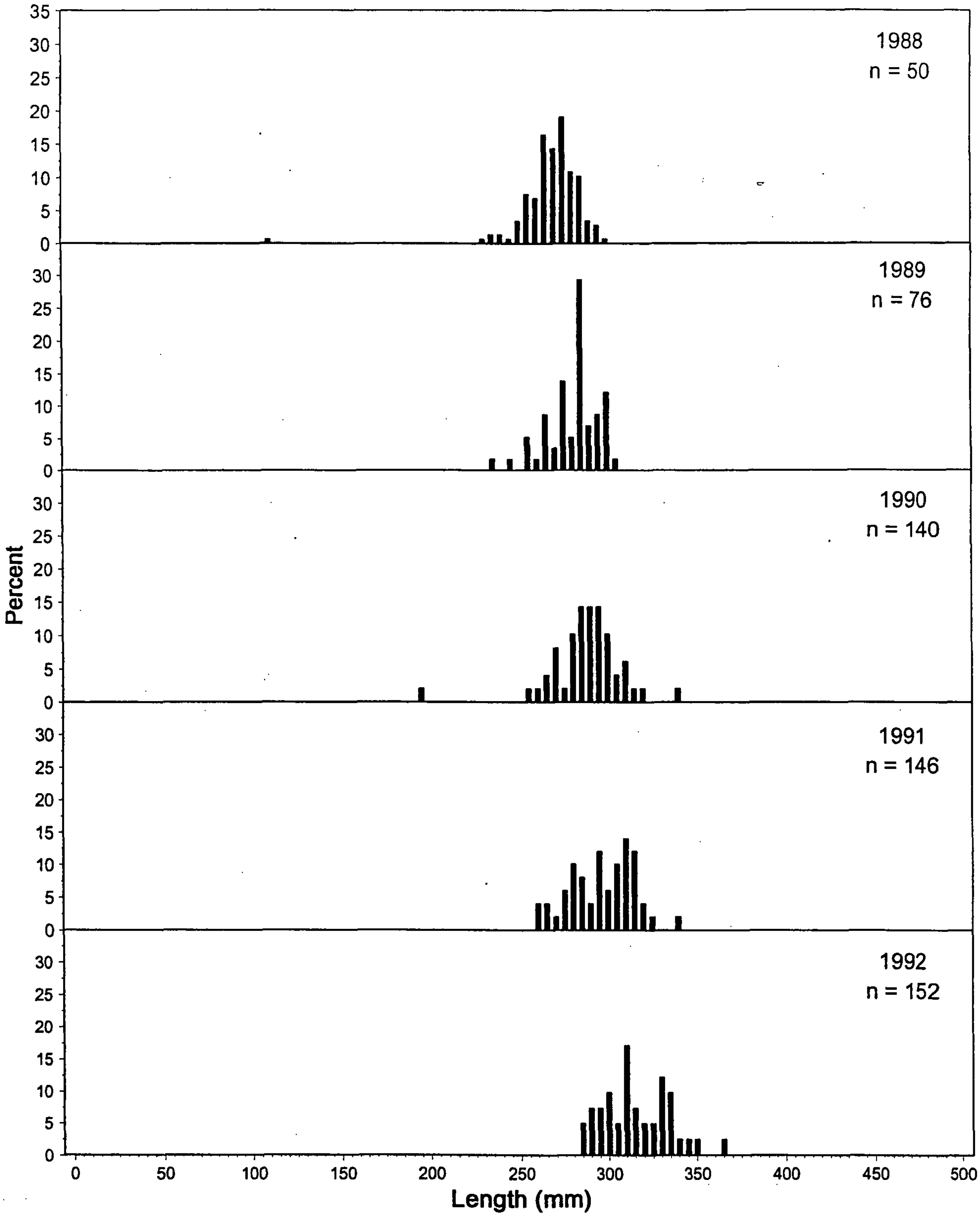
Appendix 29. **Length-frequency distributions of gizzard shad collected during electrofishing sampling at Harris Lake, 1983-1992.**



Appendix 29 (continued)



Appendix 30. Length-frequency distributions of brown bullhead collected during electrofishing sampling at Harris Lake, 1983-1992.



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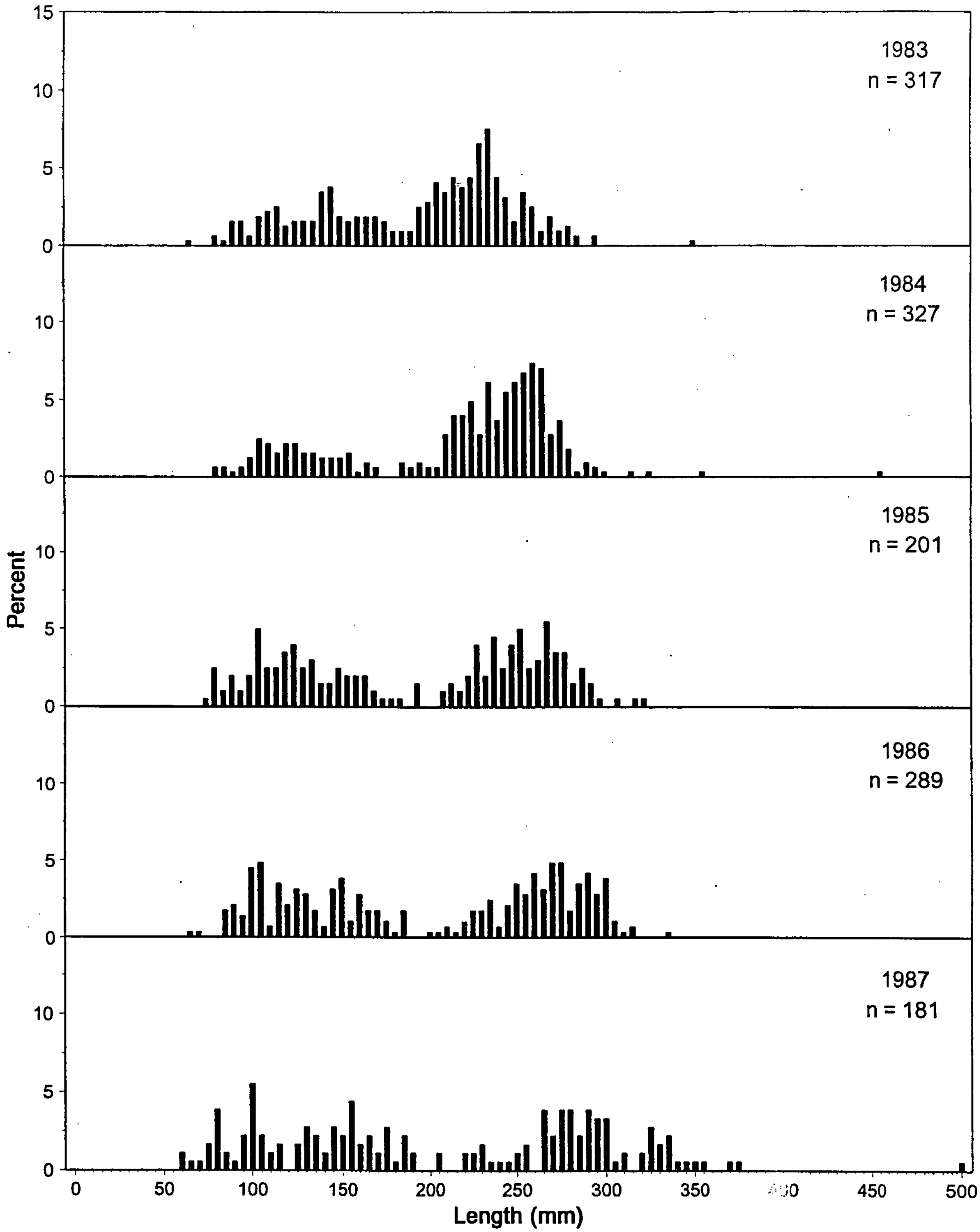
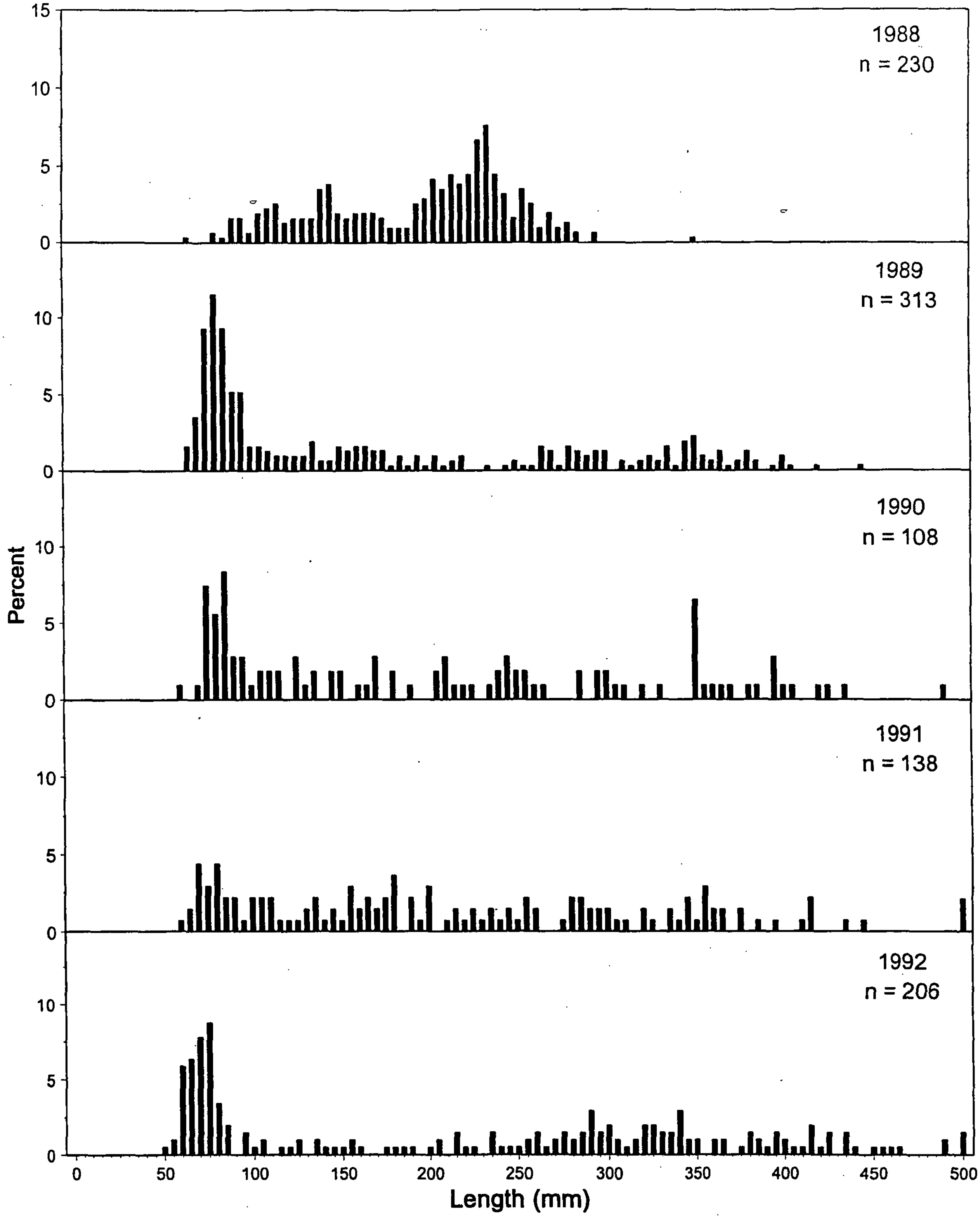


Appendix 31. Length-frequency distributions of largemouth bass collected during electrofishing sampling at Harris Lake, 1983-1992.



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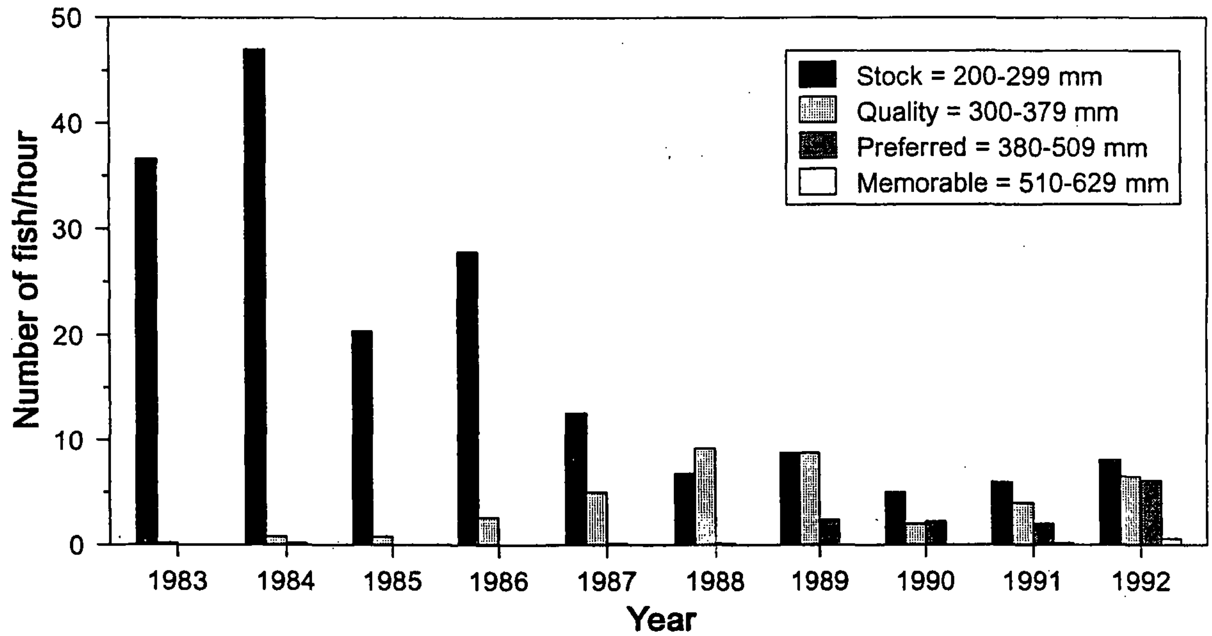
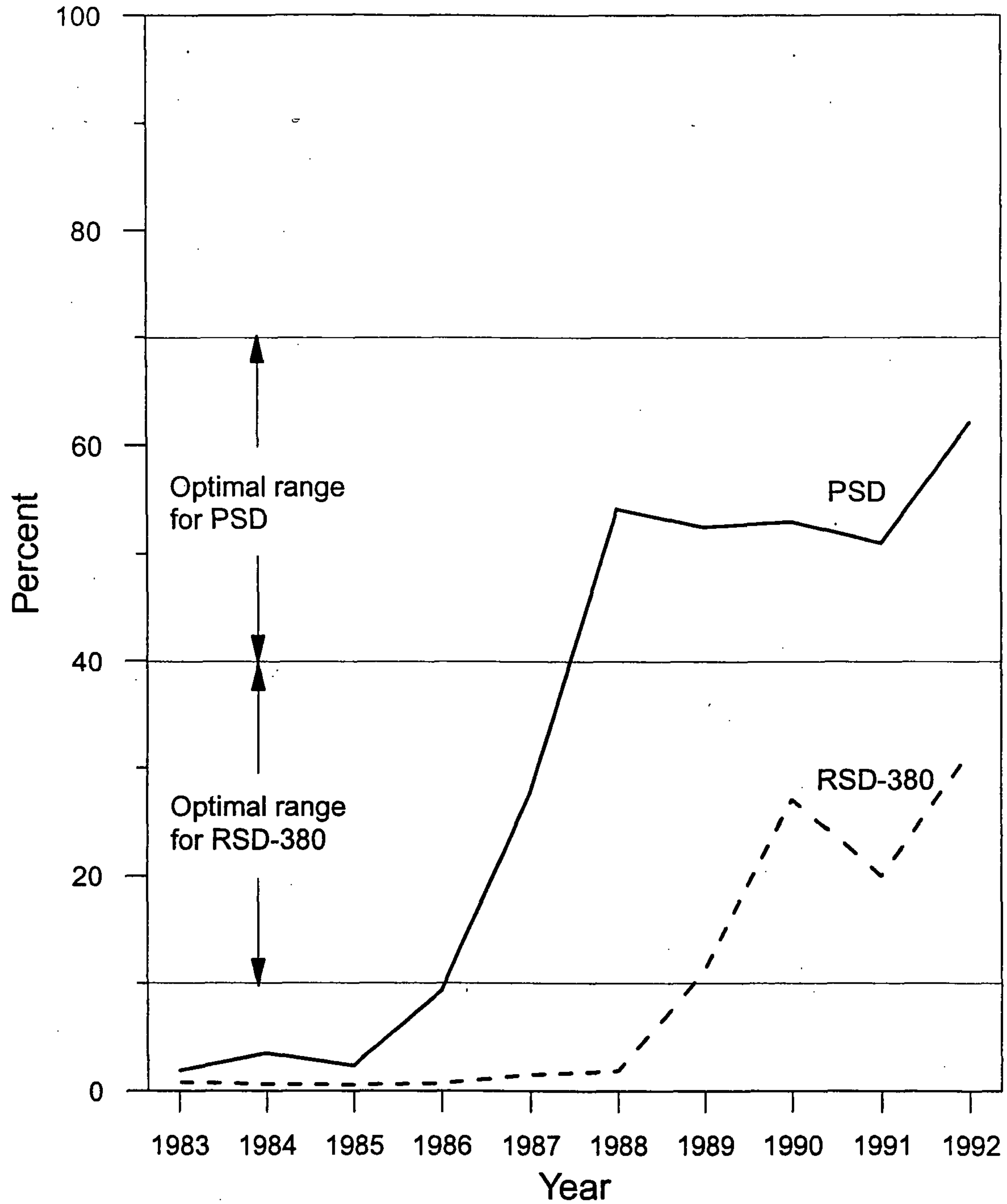
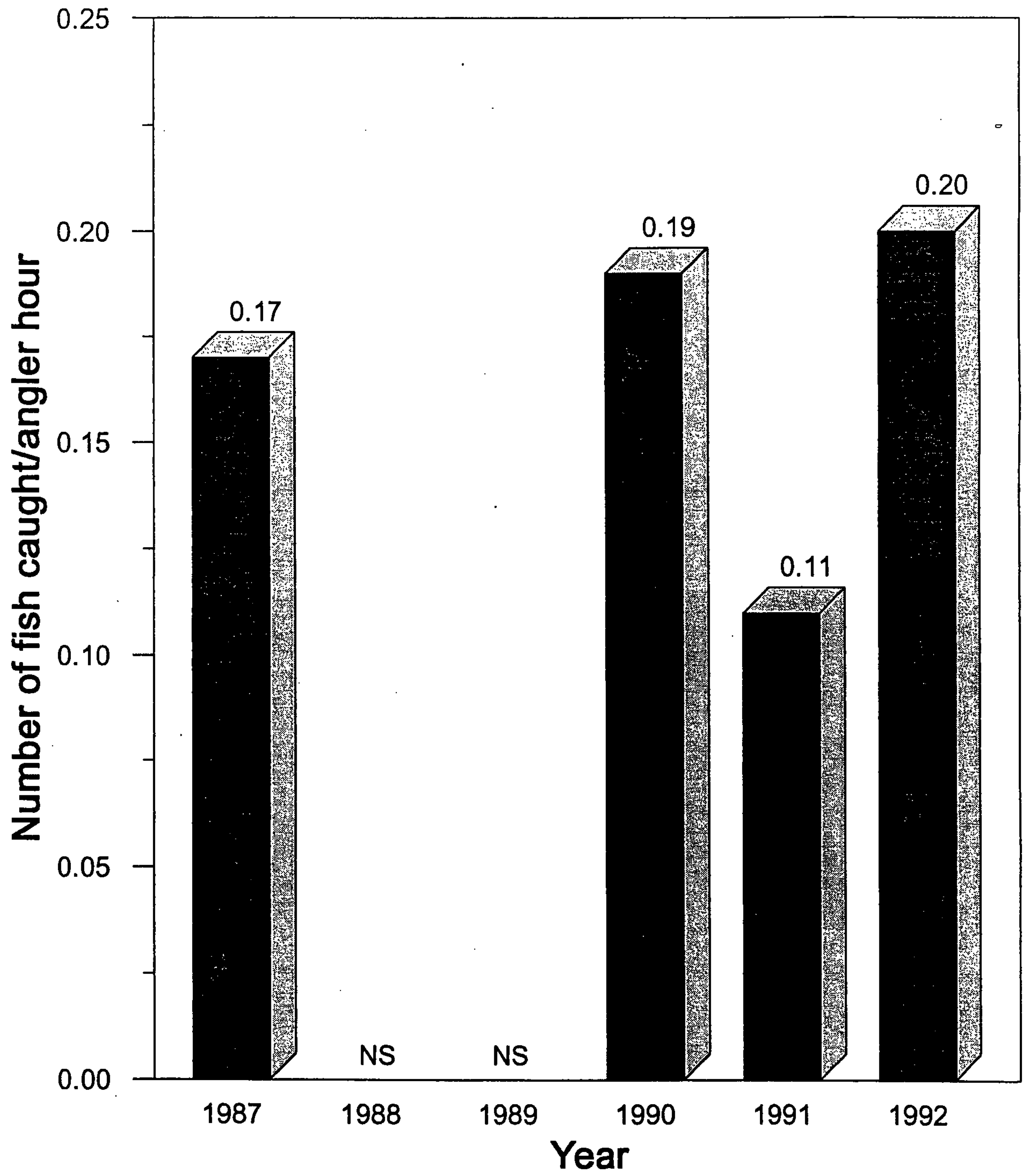


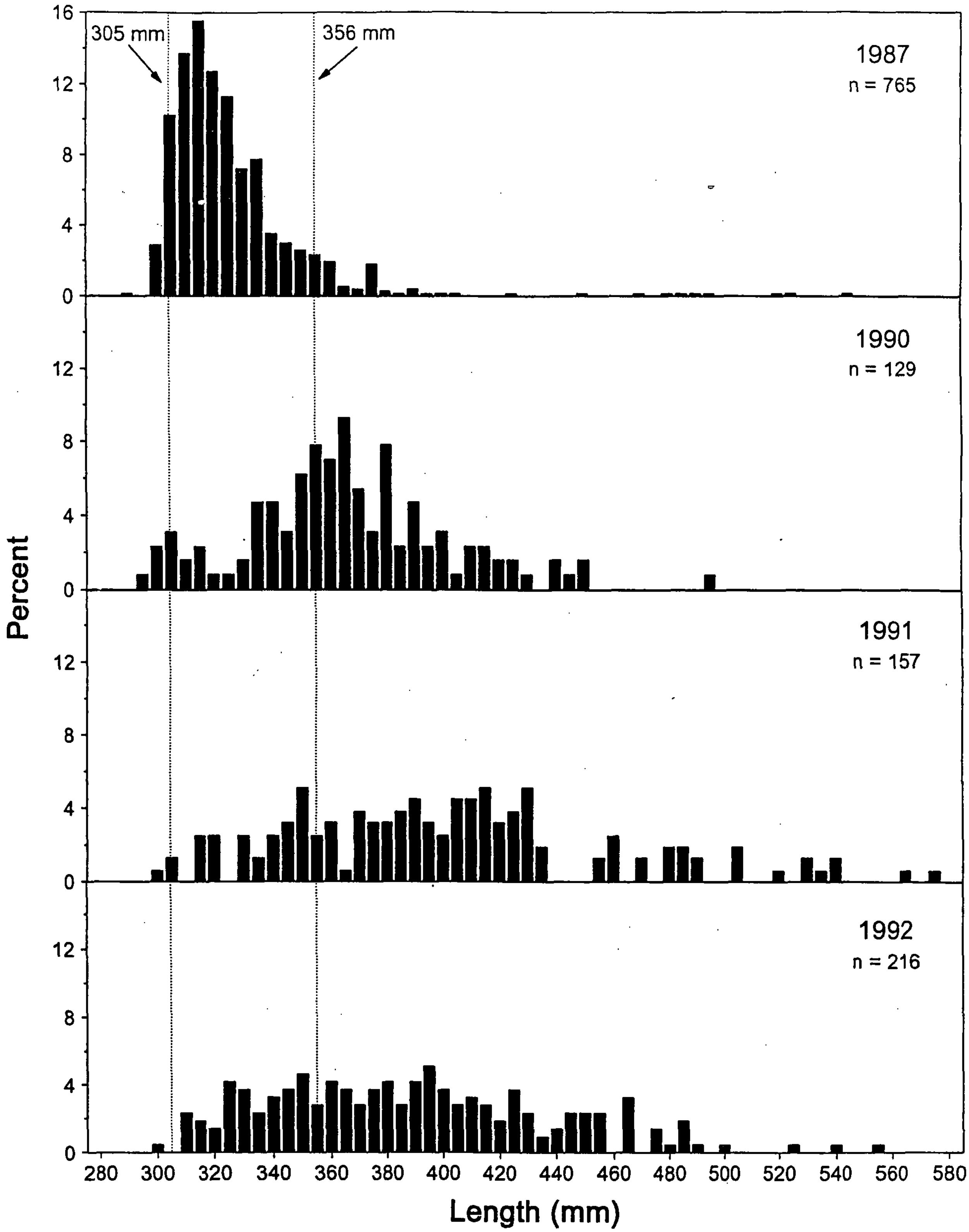
Appendix 32. Catch rate of largemouth bass by length group at Harris Lake, 1983-1992. Length groups were adopted from Gabelhouse (1984).



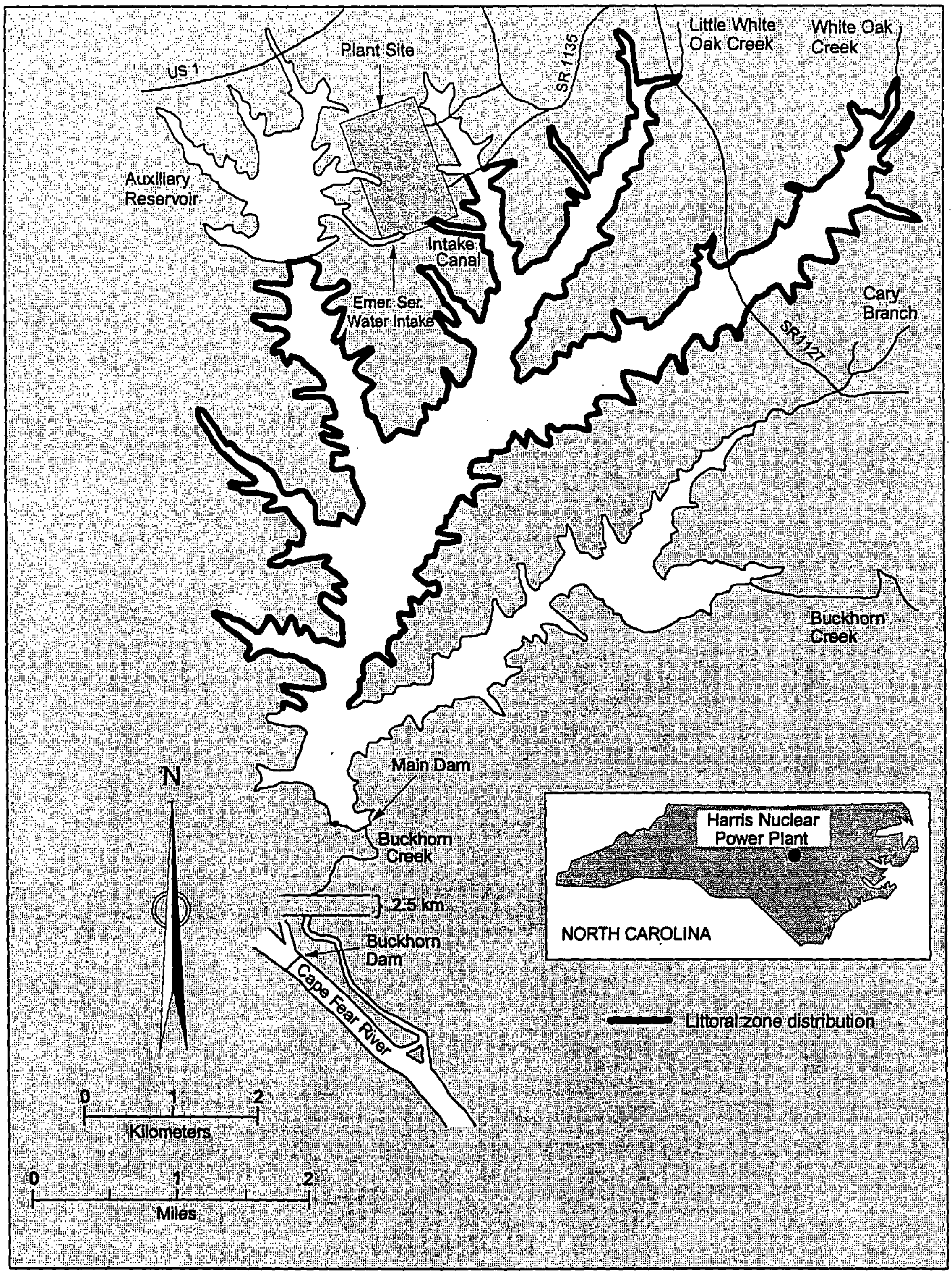
Appendix 33. **Proportional Stock Density (PSD) and Relative Stock Density-380 mm (RSD-380) for largemouth bass collected during electrofishing sampling at Harris Lake, 1983-1992. The optimal ranges were adopted from Gabelhouse (1984).**



Appendix 34. Catch rate of largemouth bass caught during selected Harris Lake fishing tournaments, 1987-1992. NS = Not sampled.



Appendix 35. **Length-frequency distributions of largemouth bass caught during selected fishing tournaments at Harris Lake, 1987-1992.**



Appendix 36. Distribution of hydrilla in Harris Lake during 1992.

Progress Energy 2003a

HARRIS NUCLEAR PLANT
2002 ENVIRONMENTAL MONITORING REPORT

November 2003

Environmental Services Section

PROGRESS ENERGY CAROLINAS
New Hill, North Carolina

Response to RAI No. 1
Item 7

RARE SPECIES KNOWN TO OCCUR WITHIN OR ADJACENT TO SHNPP-ASSOCIATED TRANSMISSION LINE RIGHTS-OF-WAY

(1) Harris Plant-Method 230 KV Line (Wake County)

Sciurus niger **Eastern Fox Squirrel** (State Significantly Rare) open forests, mainly longleaf pine/scrub oak
Near Apex US #1 230 KV Substation, about 350 ft north of line (Page 1)

(2) Harris Plant-Wake 500 KV Line (Wake County)

Hexastylis lewisii **Lewis's Heartleaf** (State Significantly Rare—Limited) forests, pocosin edges
Off 1127, about 660 ft north of line (Page 1)

Ambystoma tigrinum **Eastern Tiger Salamander** (State Threatened) breeds in fish-free semipermanent ponds; forages in adjacent woods, usually sandy pinewoods
Near Holly Springs 230 KV Substation, about 330 ft from line (Page 2)

(3) Harris Plant-Erwin 230 KV Line (Wake/Harnett)

None

(4) Harris Plant-Fayetteville 230 KV Line (Wake County/Chatham/Lee/Harnett/Cumberland)

Solidago verna **Spring-flowering Goldenrod** (State Significantly Rare—Limited; Federal Species of Concern) mesic to moist pinelands, pocosin ecotones
North of Manchester 115 KV Substation, on line (Page 27)

Parnassia caroliniana **Carolina Grass-of-parnassus** (State Endangered) wet savannas
North of Manchester 115 KV Substation, on line (Page 27)

Picoides borealis **Red-cockaded Woodpecker** (State Endangered; Federal Endangered) mature open pine forests, mainly in longleaf pine
North and south of Manchester 115 KV Substation, several trees/sitings, 200-650 ft from line (Pages 27, 28)

Semotilus lumbee **Sandhills Chub** (State Special Concern; Federal Species of Concern) streams in the sandhills
South of Manchester 115 KV Substation, in stream crossing line (Page 28)

(5) Harris Plant-Asheboro 230 KV Line (Wake/Chatham/Randolph)

Enemion biternatum **Eastern Isopyrum** (State Significantly Rare—Peripheral) rich bottomlands, levees, and lower slopes
Northwest of Cape Fear Plant, on line (Page 31)

(6) Cape Fear-Harris Plant North 230 KV Line (Wake/Chatham)

Phacelia covillei **Buttercup Phacelia** (State Significantly Rare—Throughout; Federal Species of Concern) bottomlands, rich lower slopes
Near Corinth Road between transmission line corridors, about 300 ft from lines (Page 31)

(7) Cape Fear-Harris Plant South 230 KV Line (Wake/Chatham)

None

TABLE X-X
ENDANGERED AND THREATENED SPECIES KNOWN TO OCCUR IN WAKE COUNTY OR IN COUNTIES CROSSED BY SHEARON HARRIS NUCLEAR POWER PLANT-ASSOCIATED TRANSMISSION LINES[a]

Scientific Name	Common Name	State Status[b]	Federal Status[b]
Birds			
Haliaeetus leucocephalus	Bald eagle	T	T (PD)
Picoides borealis	Red-cockaded woodpecker	E	E
Reptile			
Micrurus fulvius	Eastern coral snake	E	---
Alligator mississippiensis	American alligator	T	T(S/A)
Crotalus adamanteus	Eastern diamondback rattlesnake	E	---
Micrurus fulvius	Eastern coral snake	E	---
Amphibian			
Ambystoma tigrinum	Eastern tiger salamander	T	---
Insect			
Neonympha mitchellii francisci	Saint Francis' satyr	---	E
Fish			
Lampetra aepyptera	Least brook lamprey	T	---
Notropis mekistocholas	Cape Fear shiner	E	E
Mollusk			
Alasmidonta heterodon	Dwarf wedgemussel	E	E
Alasmidonta undulata	Triangle floater	T	---
Alasmidonta varicosa	Brook floater	E	---
Elliptio lanceolata	Yellow lance	E	---
Elliptio roanokensis	Roanoke slabshell	T	---
Fusconaia masoni	Atlantic pigtoe	E	---
Lampsilis radiata radiata	Eastern lampmussel	T	---
Lampsilis cariosa	Yellow lampmussel	E	---
Lampsilis radiata conspicua	Carolina fatmucket	T	---
Lasmigona subviridis	Green floater	E	---
Strophitus undulatus	Creeper	T	---
Villosa vaughaniana	Carolina creekshell	E	---
Toxolasma pullus	Savannah lilliput	E	
Vascular Plant			
Helenium brevifolium	Littleleaf sneezeweed	E	---
Isoetes piedmontana	Piedmont quillwort	T	---
Lindera subcoriacea	Bog spicebush	T	---
Lindera melissifolia	Southern spicebush	E	E
Portulaca smallii	Small's portulaca	T	---
Rhus michauxii	Michaux's sumac	E-SC	E
Ruellia humilis	Low wild-petunia	T	---
Trillium pusillum var *pusillum*	Carolina least trillium	E	---
Ptilimnium nodosum	Harperella	E	E
Amorpha georgiana var	Georgia indigo-bush	E	---

georgiana			
Lilium pyrophilum	Sandhills lily	E-SC	---
Parnassia caroliniana	Carolina grass-of-parnassus	E	---
Astragalus michauxii	Sandhills milk-vetch	T	---
Carex barrattii	Barratt's sedge	E	---
Carex exilis	Coastal sedge	T	---
Eupatorium resinosum	Resinous boneset (=Pine barrens boneset)	T-SC	---
Isotria medeoloides	Small whorled pogonia	E	T
Lysimachia asperulifolia	Rough-leaf loosestrife	E	E
Macbridea caroliniana	Carolina bogmint	T	---
Pyxidanthera barbulata var *brevifolia*	Sandhills pyxie-moss	E	---
Rhynchospora macra	Southern white beaksedge	E	---
Rudbeckia heliopsidis	Sun-facing coneflower	E	---
Stylisma pickeringii var *pickeringii*	Pickering's dawnflower	E	---
Chrysoma pauciflosculosa	Woody goldenrod	E	---
Lobelia boykinii	Boykin's lobelia	T	---
Muhlenbergia torreyana	Pinebarren smokegrass	E	---
Myriophyllum laxum	Loose watermilfoil	T	---
Pteroglossaspis ecristata	Spiked medusa (=Eulophia)	E	---
Rhexia aristosa	Awned meadow-beauty	T	---
Solidago pulchra	Carolina goldenrod	E	---
Utricularia olivacea	Dwarf bladderwort	T	---
Helianthus schweinitzii	Schweinitz's sunflower	E	E
Symphyotrichum georgianum	Georgia aster	T	---

Source: NC DENR 2004, North Carolina Natural Heritage Program

[a]Includes Chatham, Cumberland, Harnett, Lee, Randolph, and Wake Counties

[b]Explanation of Codes: E = Endangered; E-SC = State Endangered but may be propagated and sold under specific regulations; T = Threatened; T(PD) = Currently listed as Threatened but proposed for delisting; T(S/A) = Threatened due to similarity of appearance; T-SC = State Threatened but may be propagated and sold under specific regulations; --- = not listed.

TABLE X-X
FEDERALLY-LISTED ENDANGERED AND THREATENED SPECIES KNOWN TO OCCUR IN THE VICINITY OF SHEARON HARRIS NUCLEAR POWER PLANT OR IN THE VICINITY OF SHNPP TRANSMISSION LINES[a]

Species	Federal Status	Reason for concern for SHNPP	Protective measures taken by Progress Energy
Red-cockaded woodpecker	Endangered	Known to occur in mature longleaf pine forests in Cumberland and Harnett Counties and regularly observed in the Fayetteville-Ft. Bragg area.	Any facility expansion involving removal of mature longleaf pine would require surveys for this species to ensure that no red-cockaded woodpeckers or trees with their nest-cavities are harmed.

Source: NC DENR 2004, North Carolina Natural Heritage Program

[a]Includes Chatham, Cumberland, Harnett, Lee, Randolph, and Wake Counties

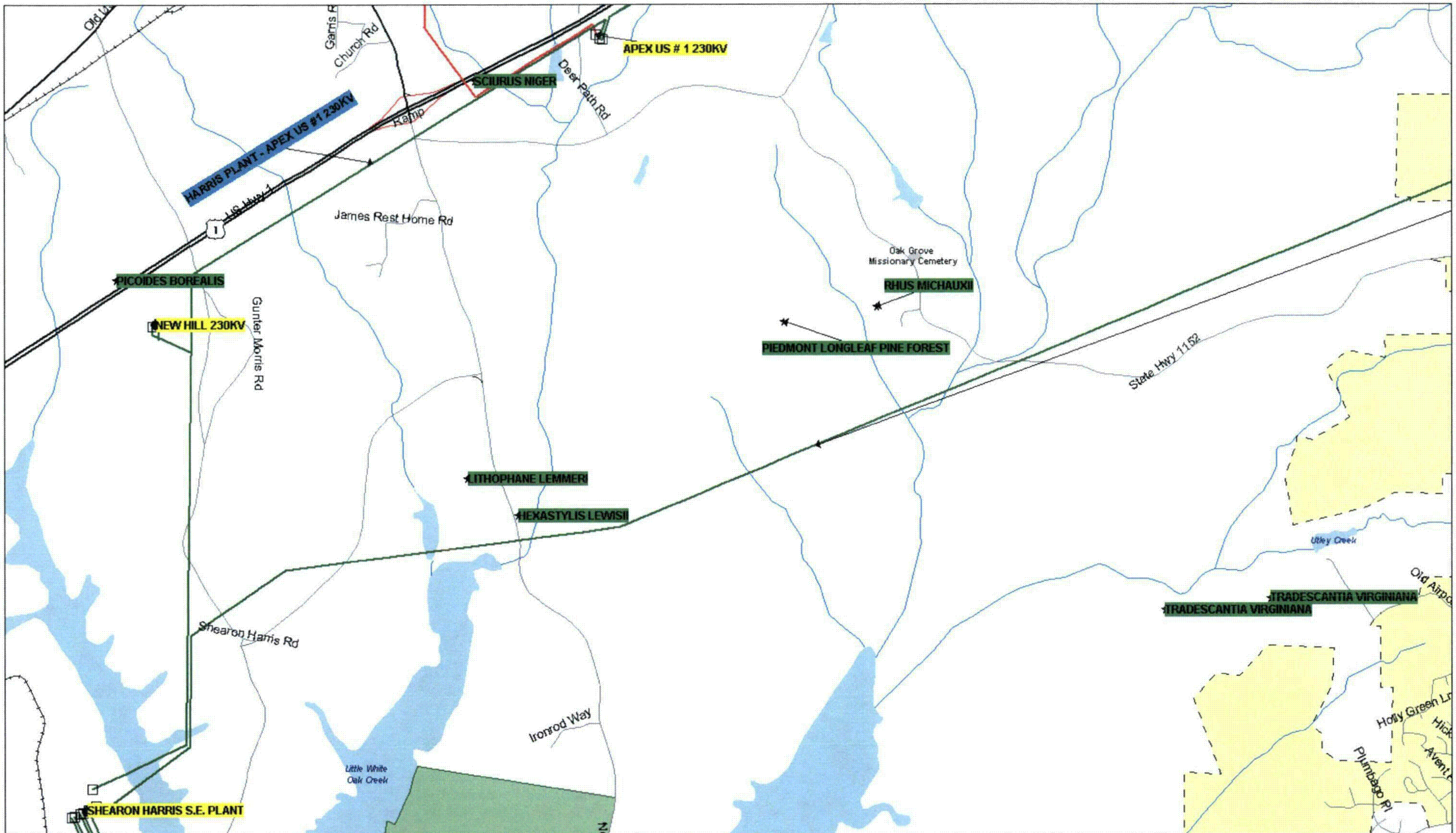
TABLE X-X
RARE PLANT SPECIES KNOWN TO OCCUR WITHIN THE RIGHTS OF WAY OF SHEARON HARRIS NUCLEAR POWER PLANT TRANSMISSION LINES[a]

Species	State/Federal Status	Reason for concern for SHNPP	Protective measures taken by Progress Energy
Spring Flowering Goldenrod	State SR—L/ Federal SC	Known to occur within pocosin habitats that occur within the Harris Plant-Ft. Bragg-Woodruff 230 KV line corridor.	(This location needs to be added to the rights of Way manual).
Carolina Grass-of-parnassus	State E	Known to occur within the wet savanna habitats that occur within the Harris Plant-Ft. Bragg-Woodruff 230 KV line corridor.	(This location needs to be added to the rights of Way manual).
Eastern Isopyrum	State SR—P	Known to occur within the rich bottomlands and lower wet slopes that occur within the Harris Plant-Asheboro 230 KV line corridor.	(This location needs to be added to the rights of Way manual).

Source: NC DENR 2004, North Carolina Natural Heritage Program

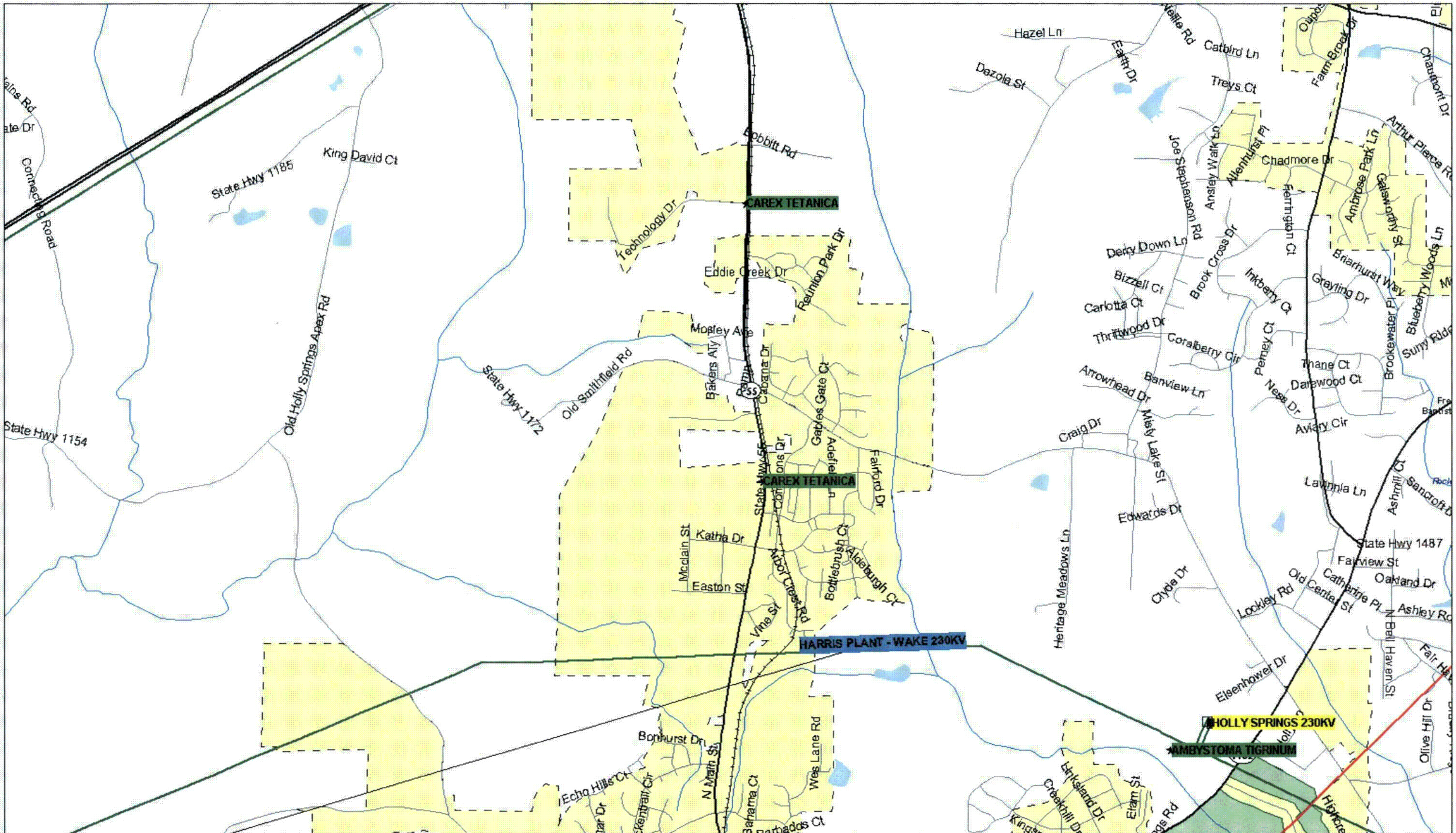
[a]Includes Chatham, Cumberland, Harnett, Lee, Randolph, and Wake Counties

[b]Explanation of Codes: SR—L = Significantly Rare and the range of the species is limited to North Carolina and adjacent states; SC = Species of Concern; E = Endangered; SR—P = Significantly Rare and the species is at the periphery of its range in North Carolina.



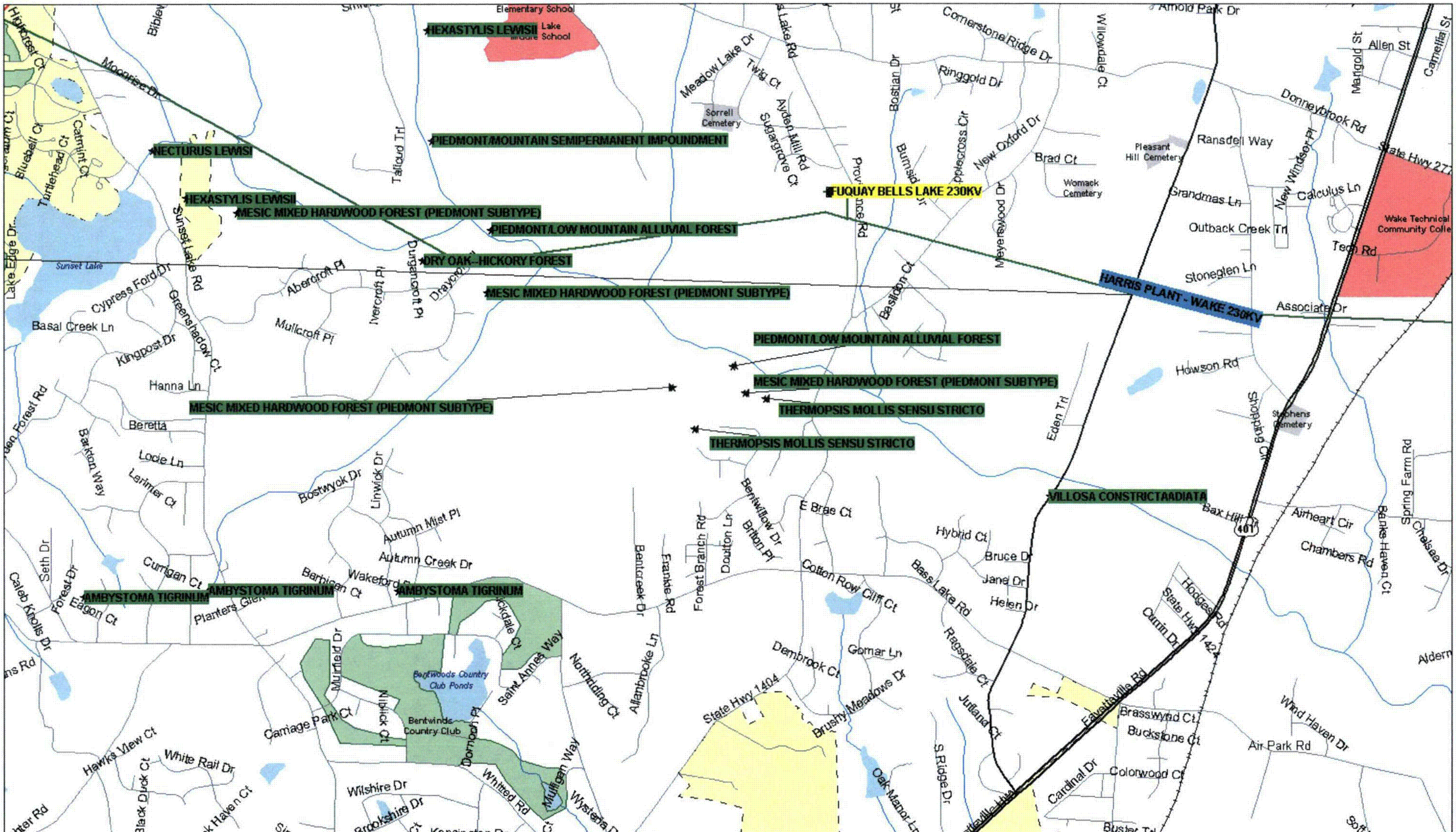
Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map

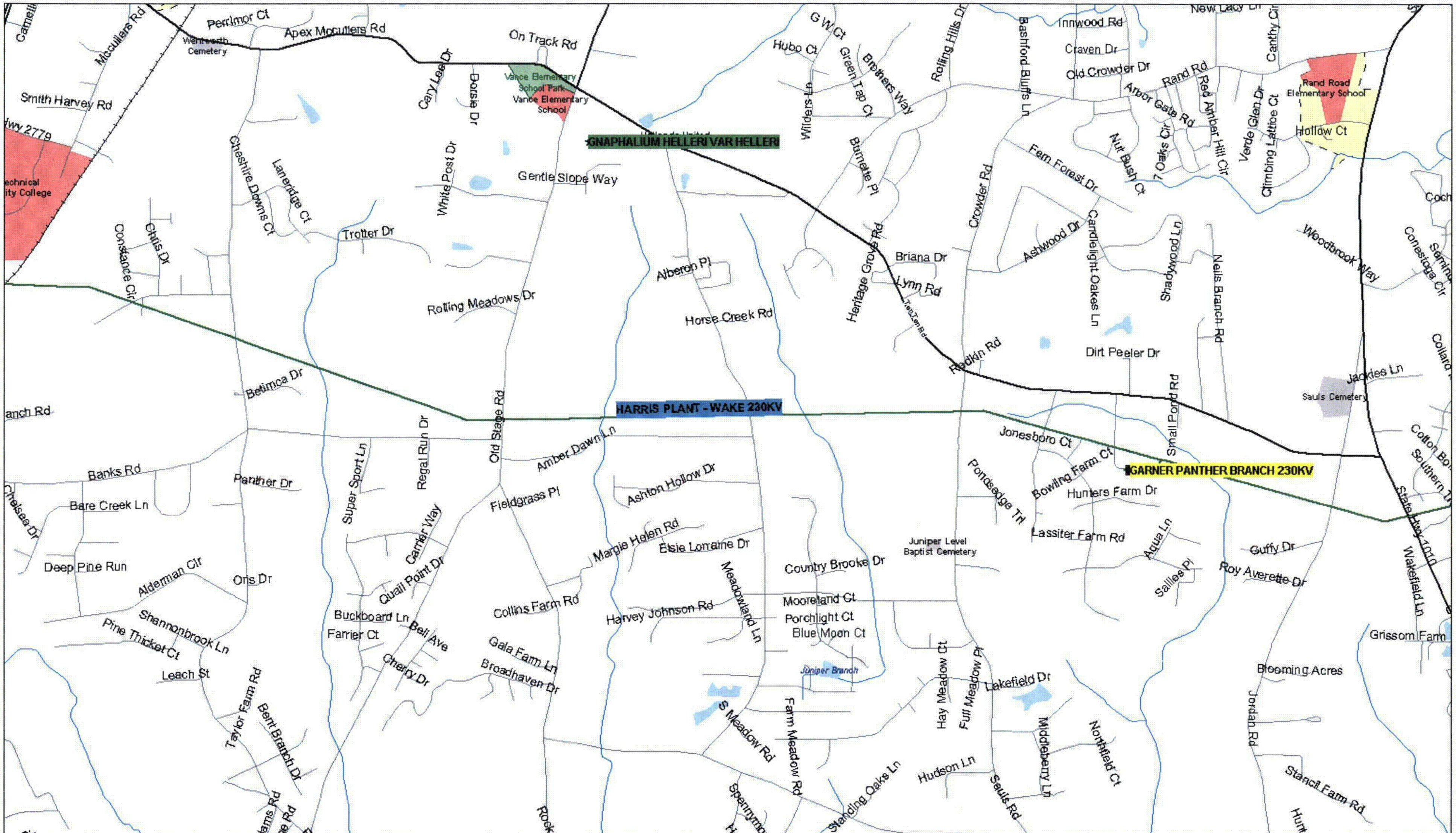


Harris Nuclear Plant Relicensing Project
Endangered Species Map

Progress Energy

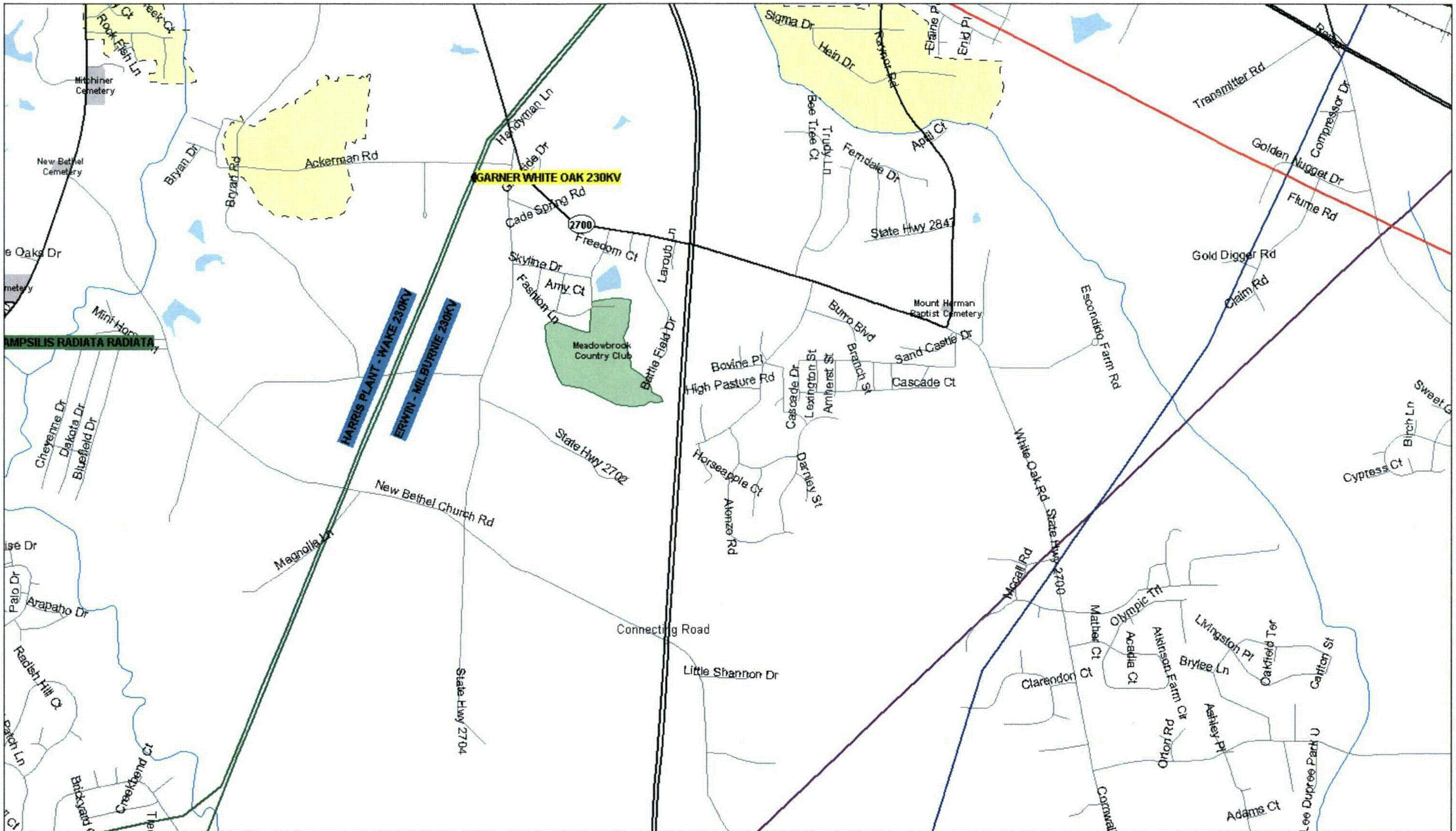


Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 3 of**



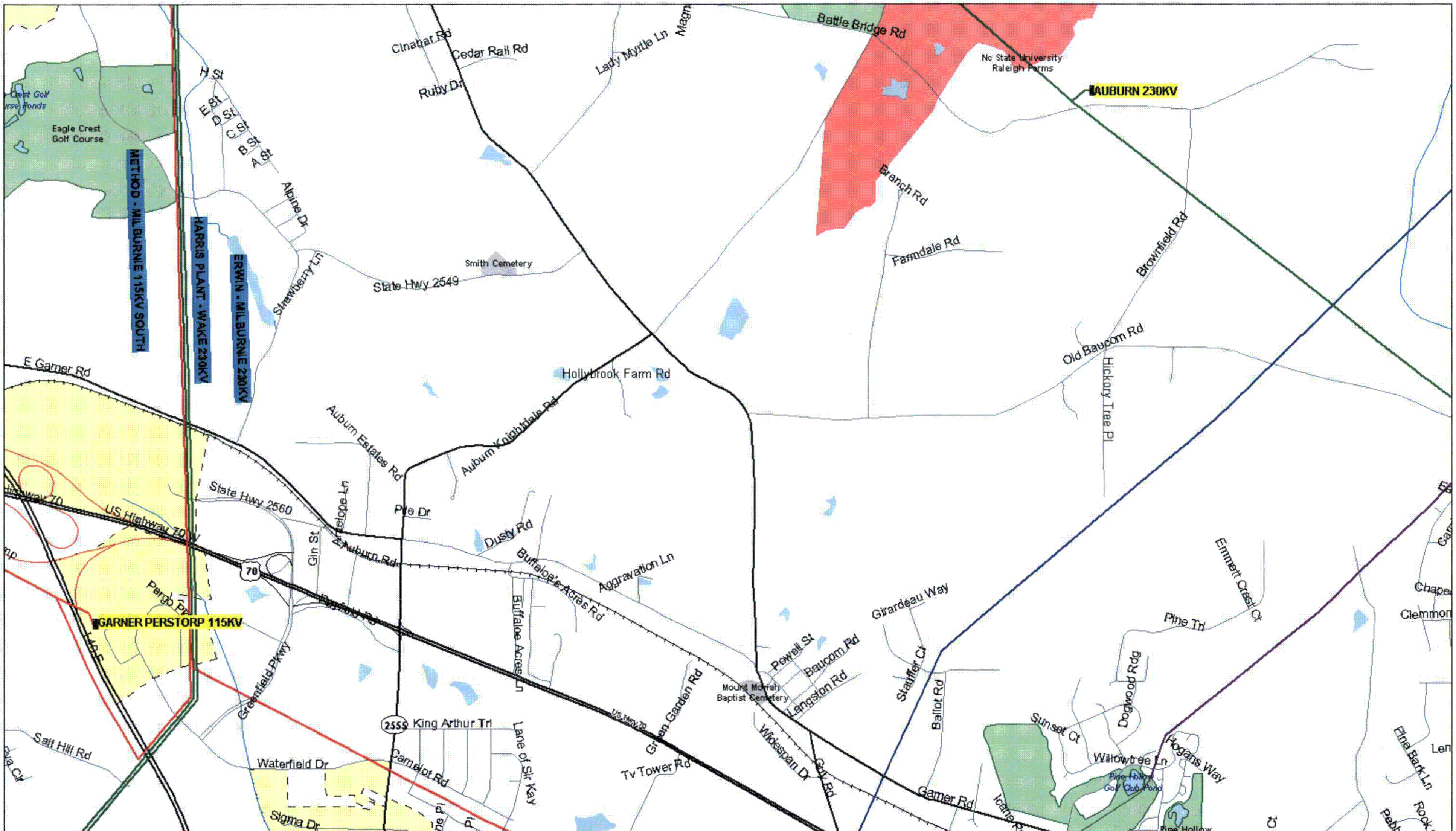
Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



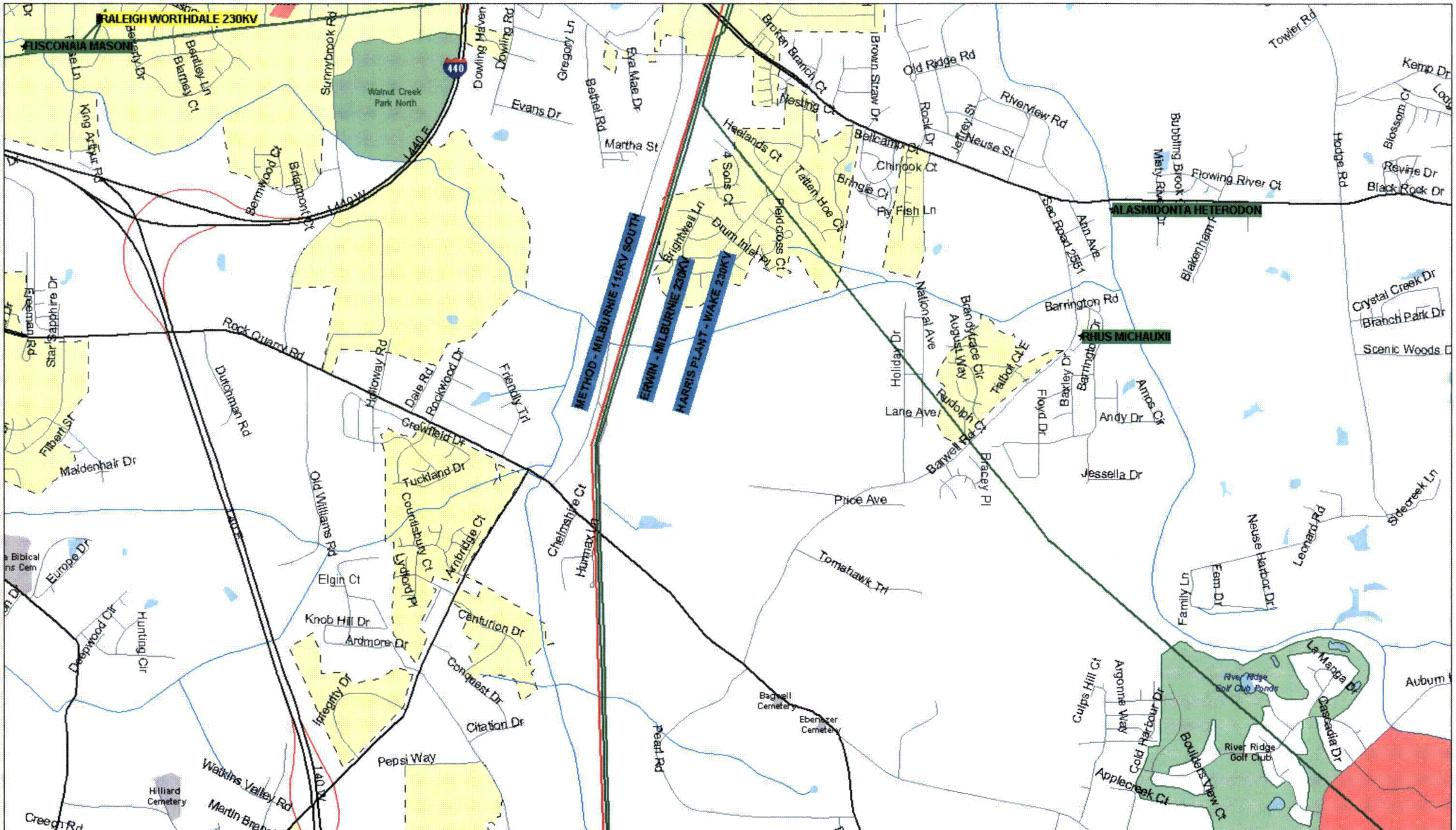
Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



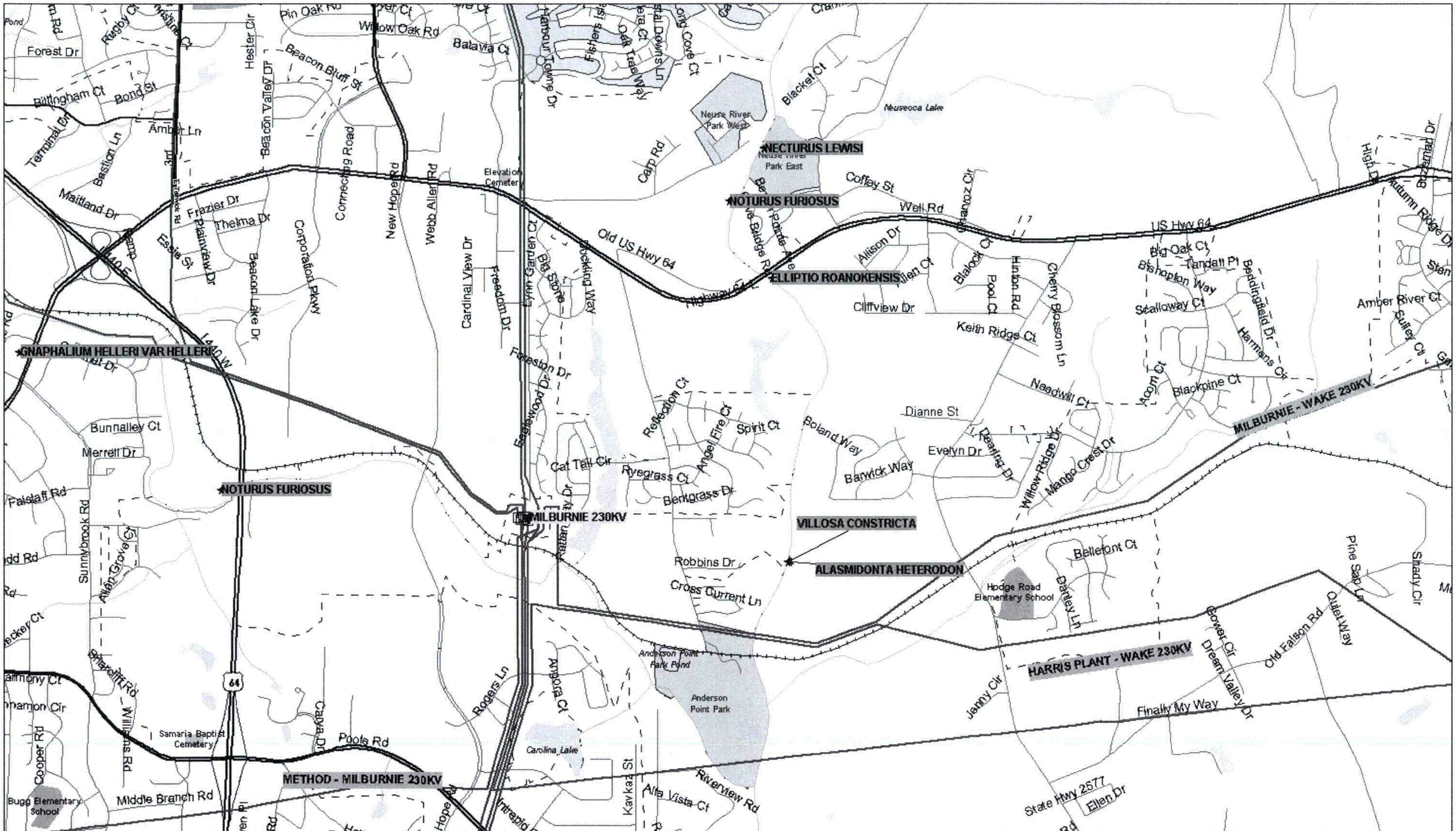
Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



Harris Nuclear Plant Relicensing Project
Endangered Species Map

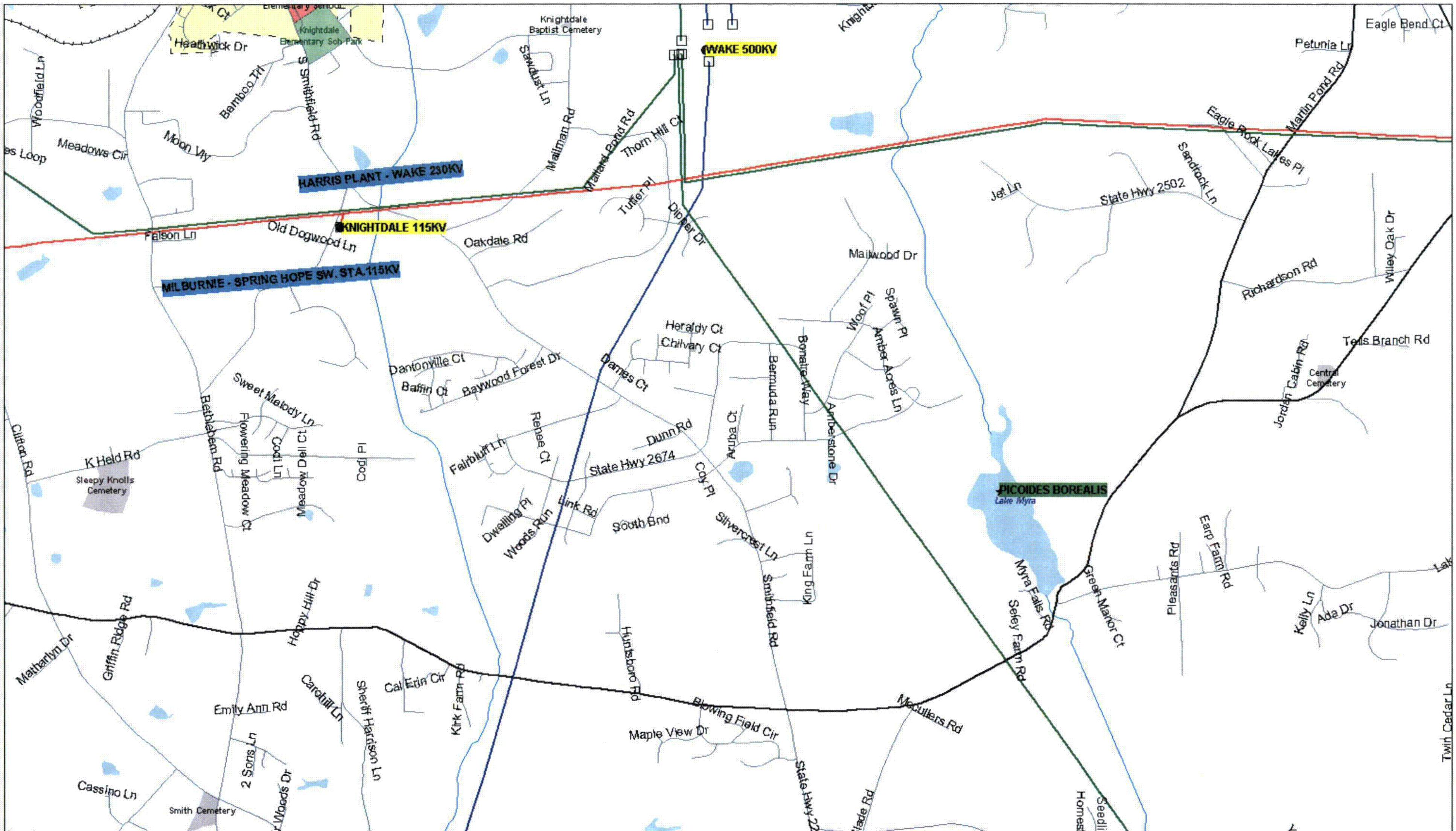
Progress Energy

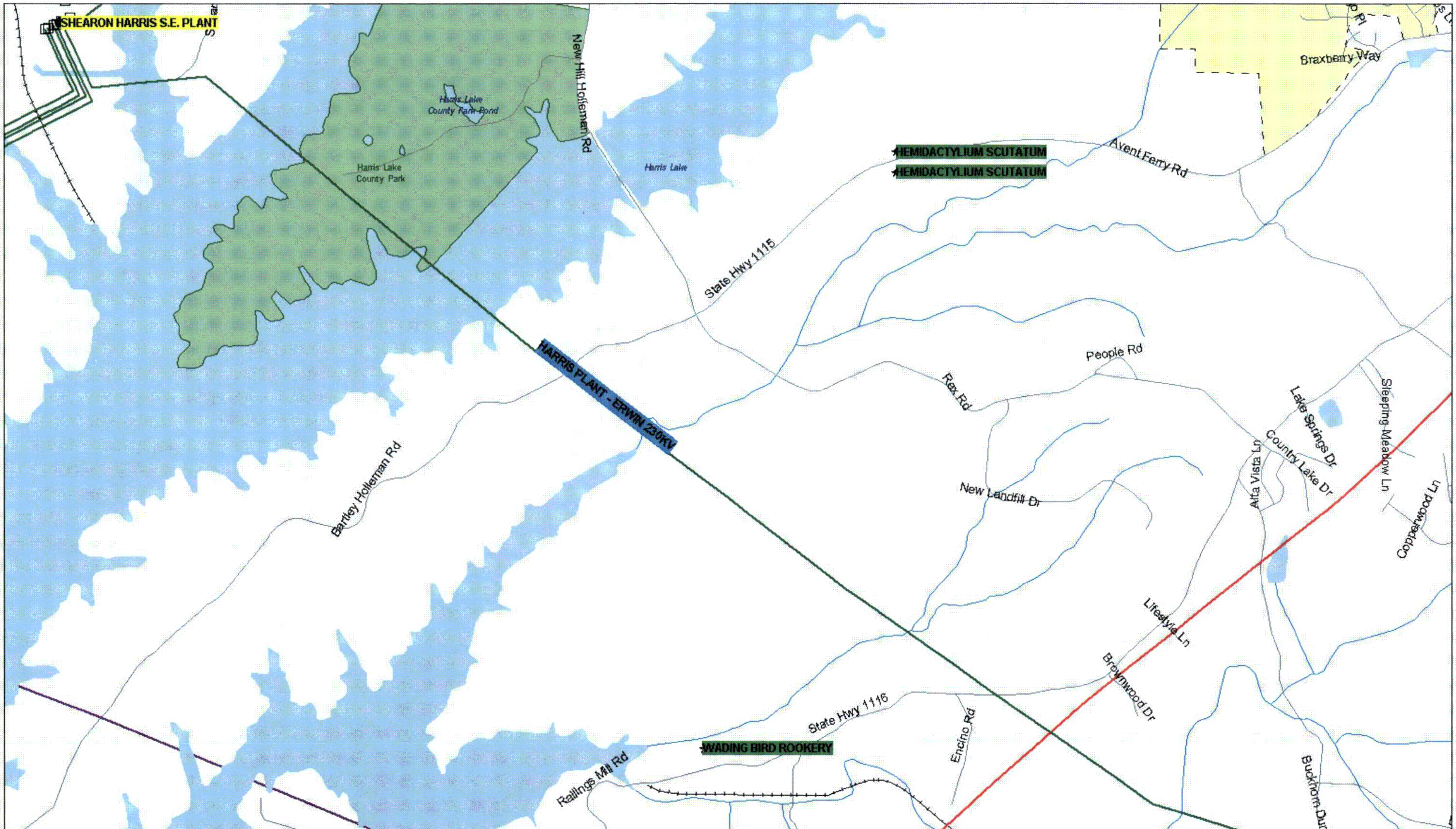


Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map

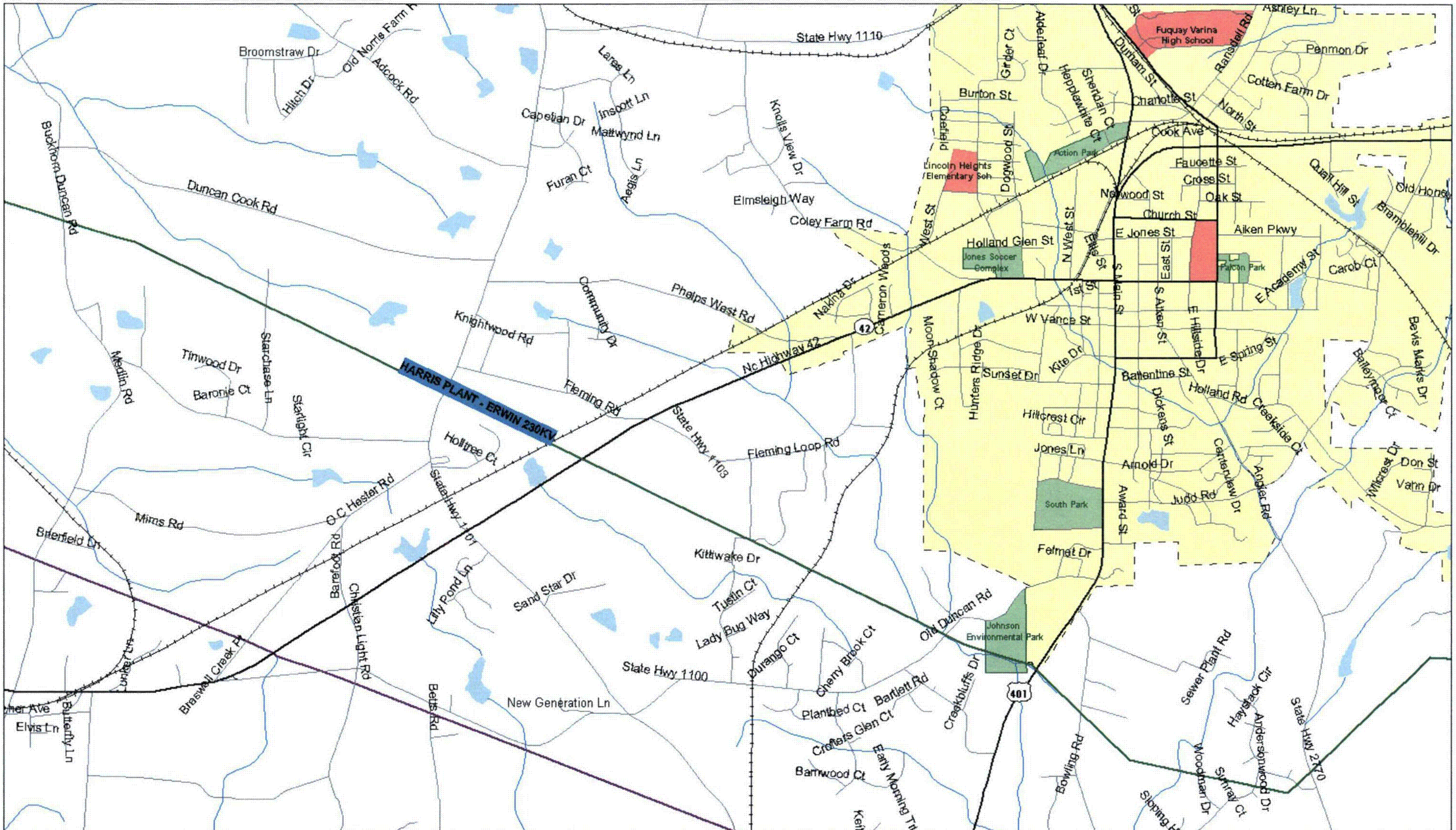
Page 8 of


WAKE 500KV
HARRIS PLANT - WAKE 230KV
KNIGHTDALE 115KV
MILBURNIE - SPRING HOPE SW. STA.115KV
PICOIDES BOREALIS
Lake Myra
Knightdale Baptist Cemetery
Knightdale Elementary Sch Park
Heathwick Dr
Bamboo Trl
S Smithfield Rd
Sawdust Ln
Mailman Rd
Mallard Pond Rd
Thorn Hill Ct
Woodfield Ln
Meadows Cir
Moon Vly
Eagle Bend Ct
Petunia Ln
Martin Pond Rd
Eagle Rock Lakes Pl
Sandrock Ln
State Hwy 2502
Jet Ln
Tuffer Pl
Dipper Dr
Falson Ln
Old Dogwood Ln
Oakdale Rd
Mailwood Dr
Richardson Rd
Willey Oak Dr
Tells Branch Rd
Jordan Cabin Rd
Central Cemetery
Heraldy Ct
Chilvary Ct
Woof Pl
Spawn Pl
Amber Acres Ln
Bonaire Way
Bermuda Run
Ambertone Dr
Dantonville Ct
Baffin Ct
Baywood Forest Dr
Dames Ct
Sweet Melody Ln
Bethlehem Rd
Flowering Meadow Ct
Codi Ln
Meadow Dell Ct
Cod Pl
Clifton Rd
K Held Rd
Sleepy Knolls Cemetery
Fairbluff Ln
Renee Ct
Dunn Rd
State Hwy 2674
Aruba Ct
Coy Pl
Dwelling Pl
Woods Run
Link Rd
South Bnd
Silvercrest Ln
King Farm Ln
Smithfield Rd
Myra Falls Rd
Green Manor Ct
Pleasants Rd
Earp Farm Rd
Kelly Ln
Ada Dr
Jonathan Dr
Seley Farm Rd
Matharlyn Dr
Griffin Ridge Rd
Hoppy Hill Dr
Huntsboro Rd
Cal Erin Cir
Kirk Farm Rd
Carothill Ln
Sheriff Harrison Ln
Emily Ann Rd
Blowing Field Cir
Maple View Dr
Mccullers Rd
State Hwy 222
Slade Rd
Twin Cedar Ln
Cassino Ln
Smith Cemetery
2 Sons Ln
Woods Dr



Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



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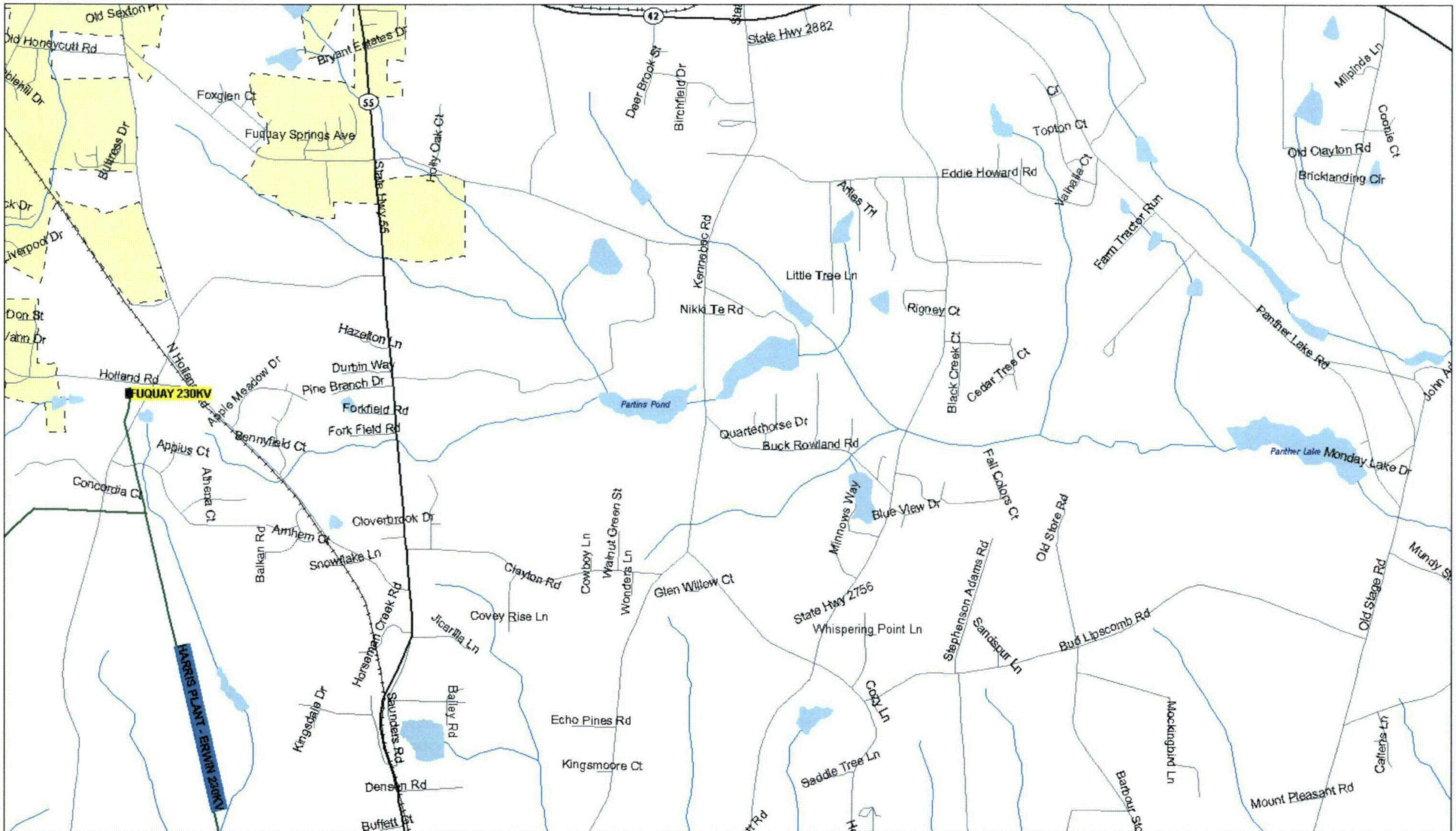

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Harris Nuclear Plant Relicensing Project
Endangered Species Map

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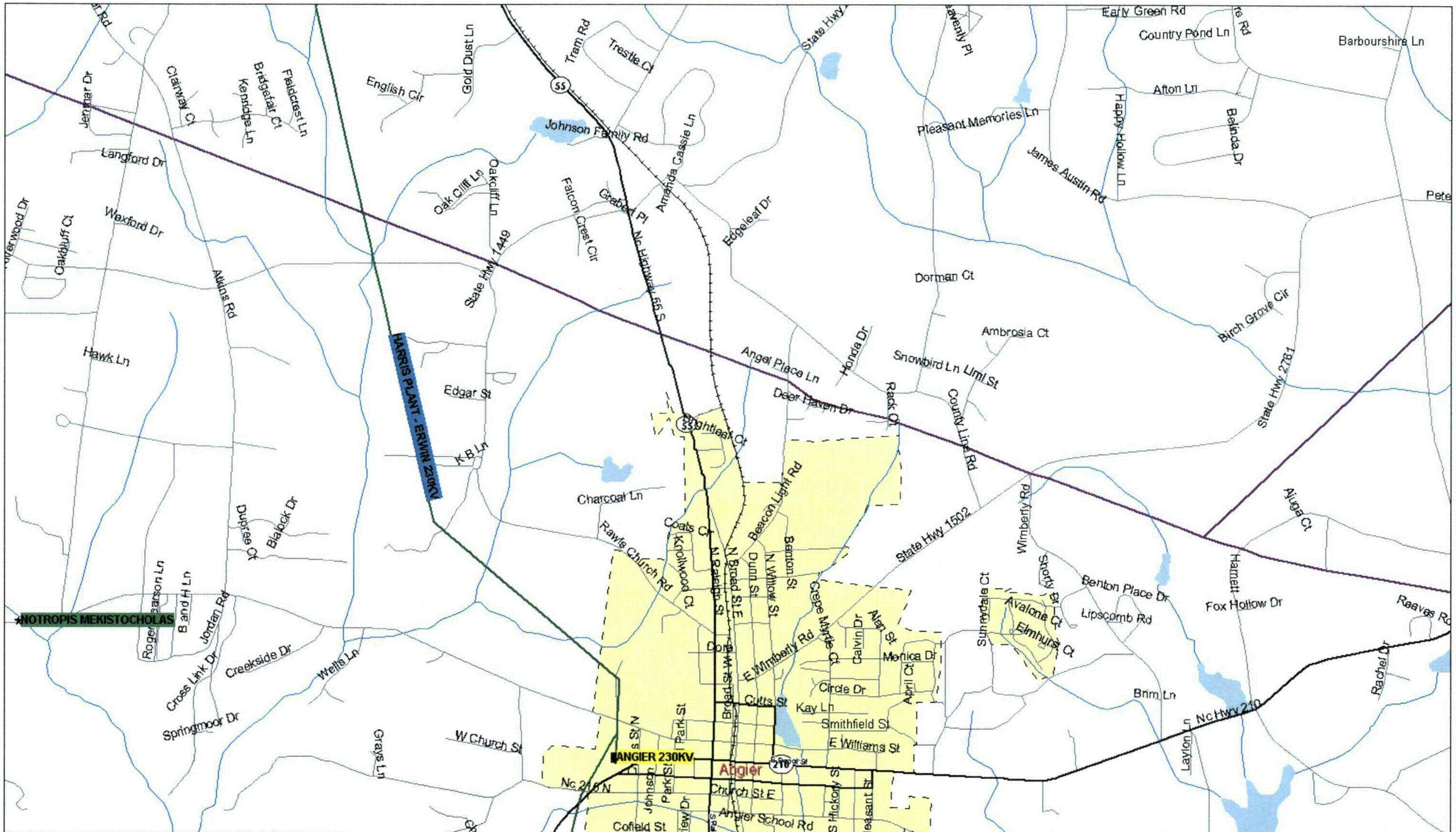
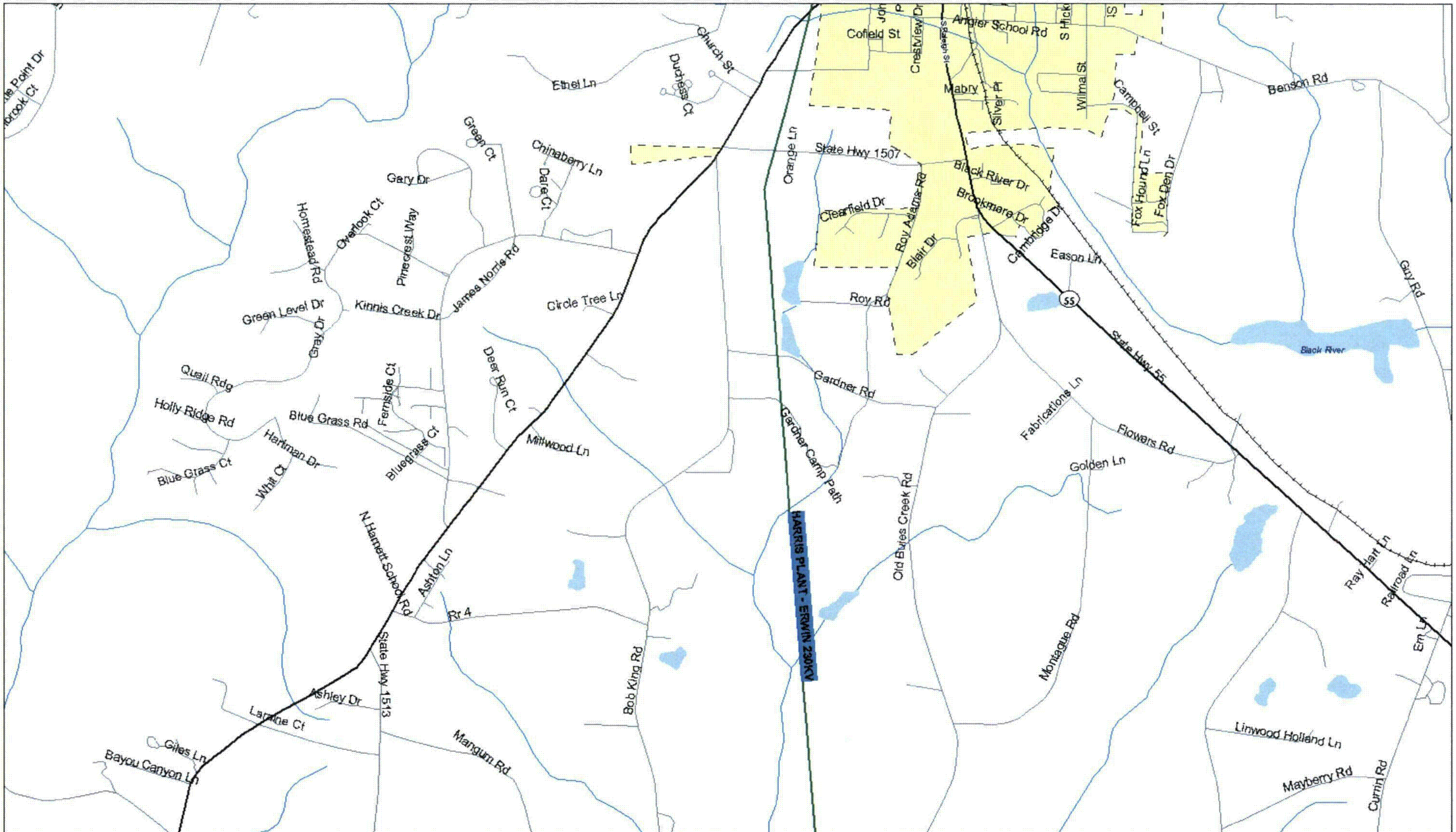
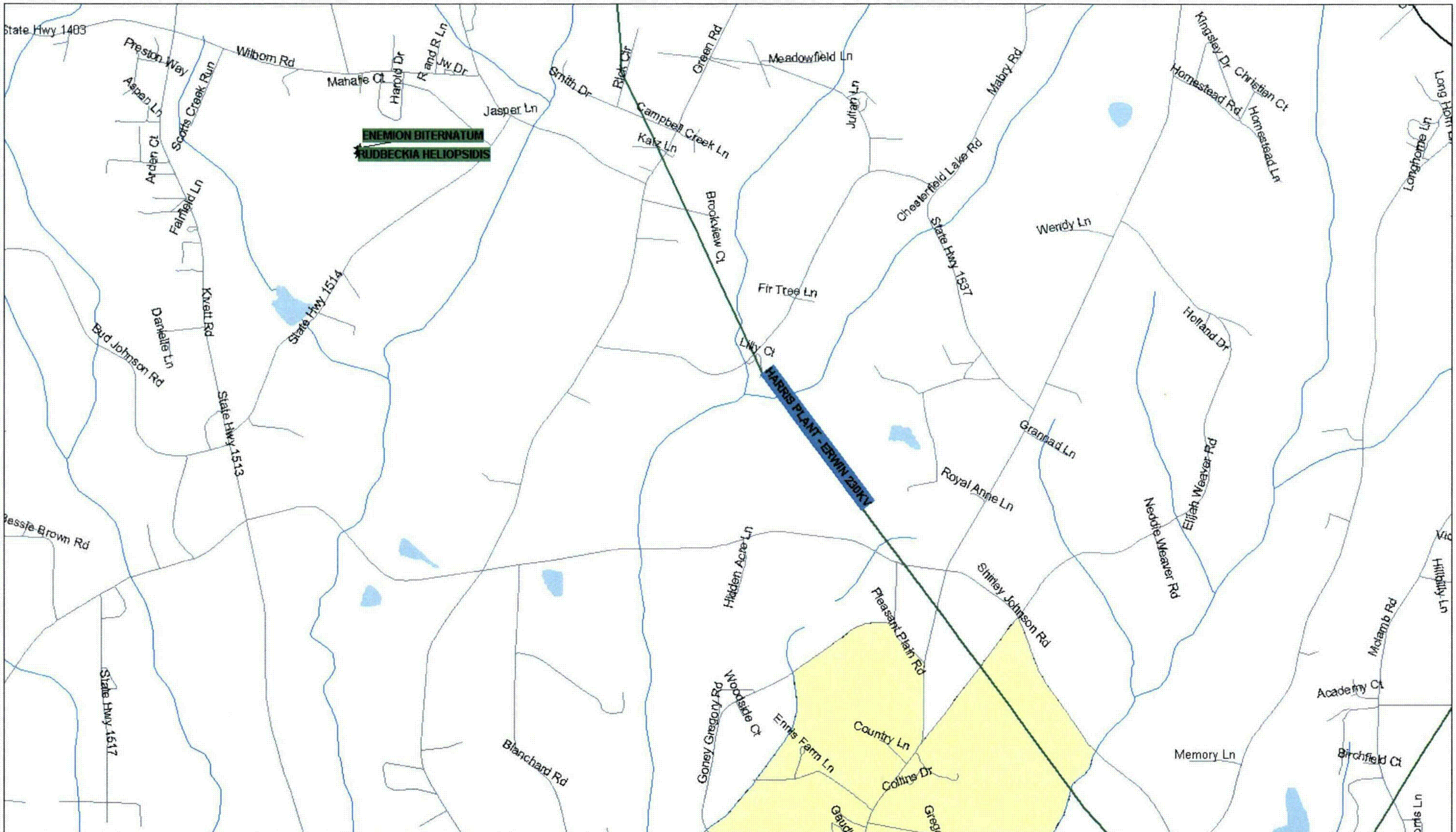


Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 13 of**

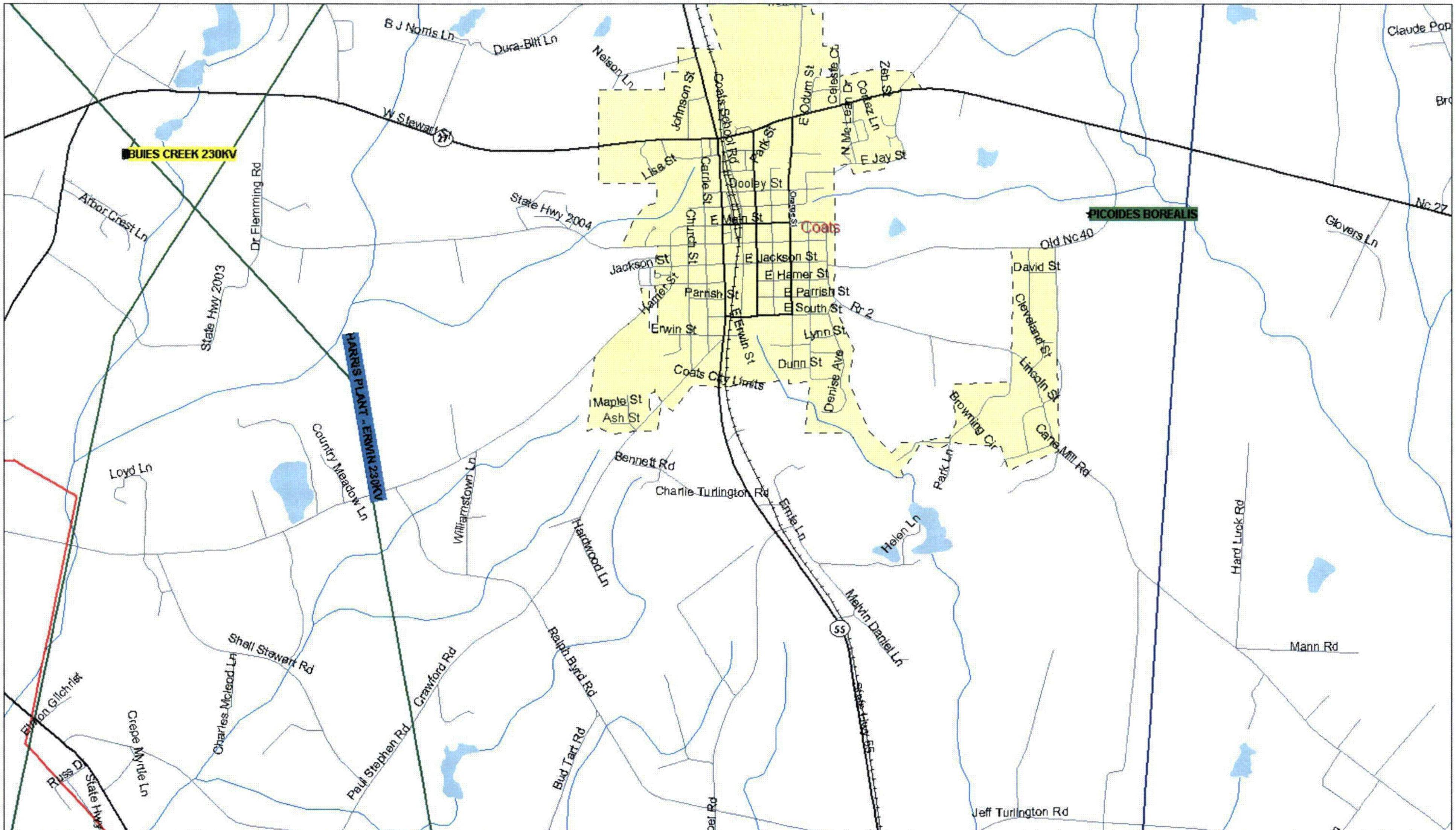


Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map

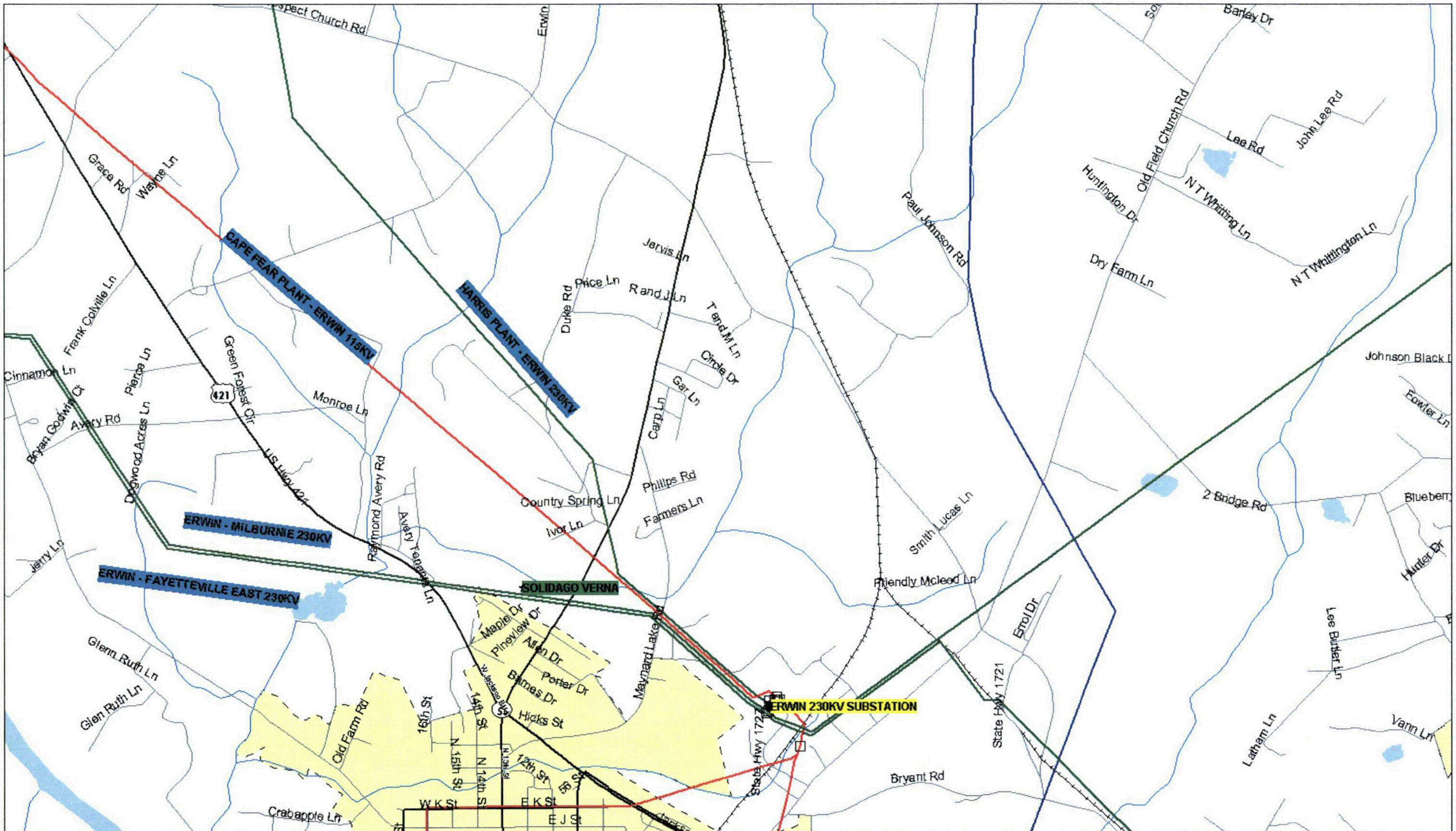


Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 15 of**



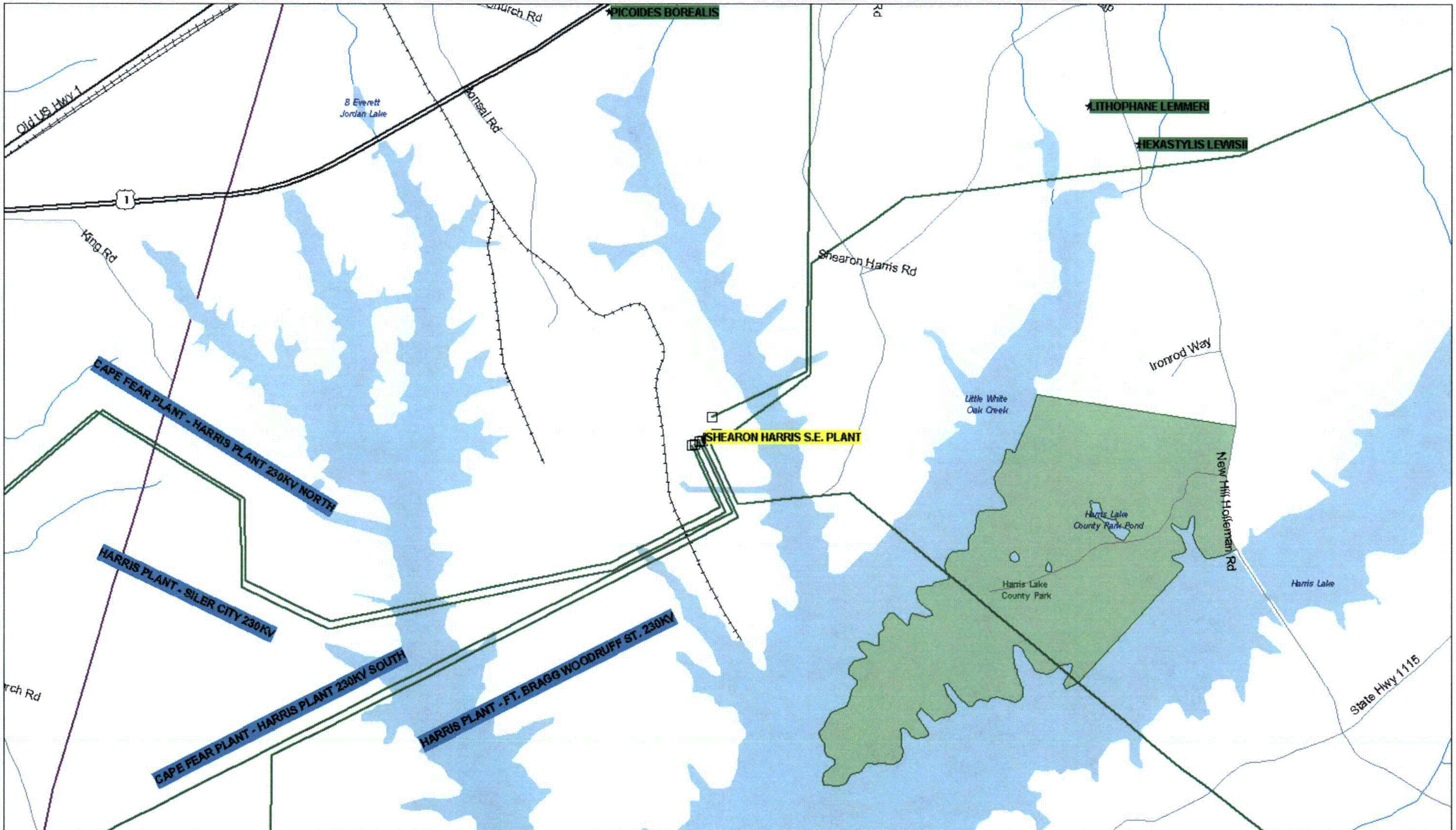
Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map

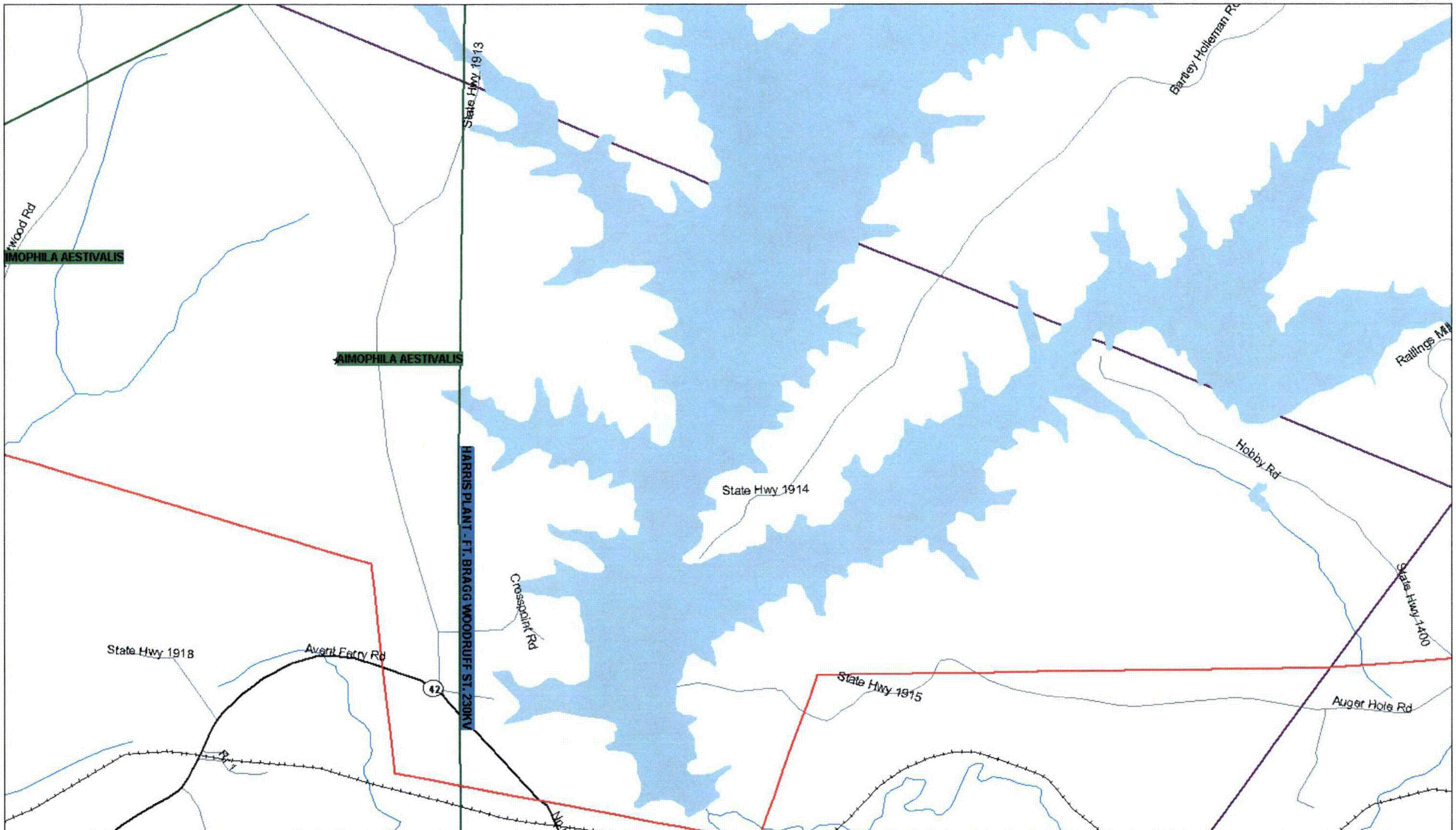


Progress Energy

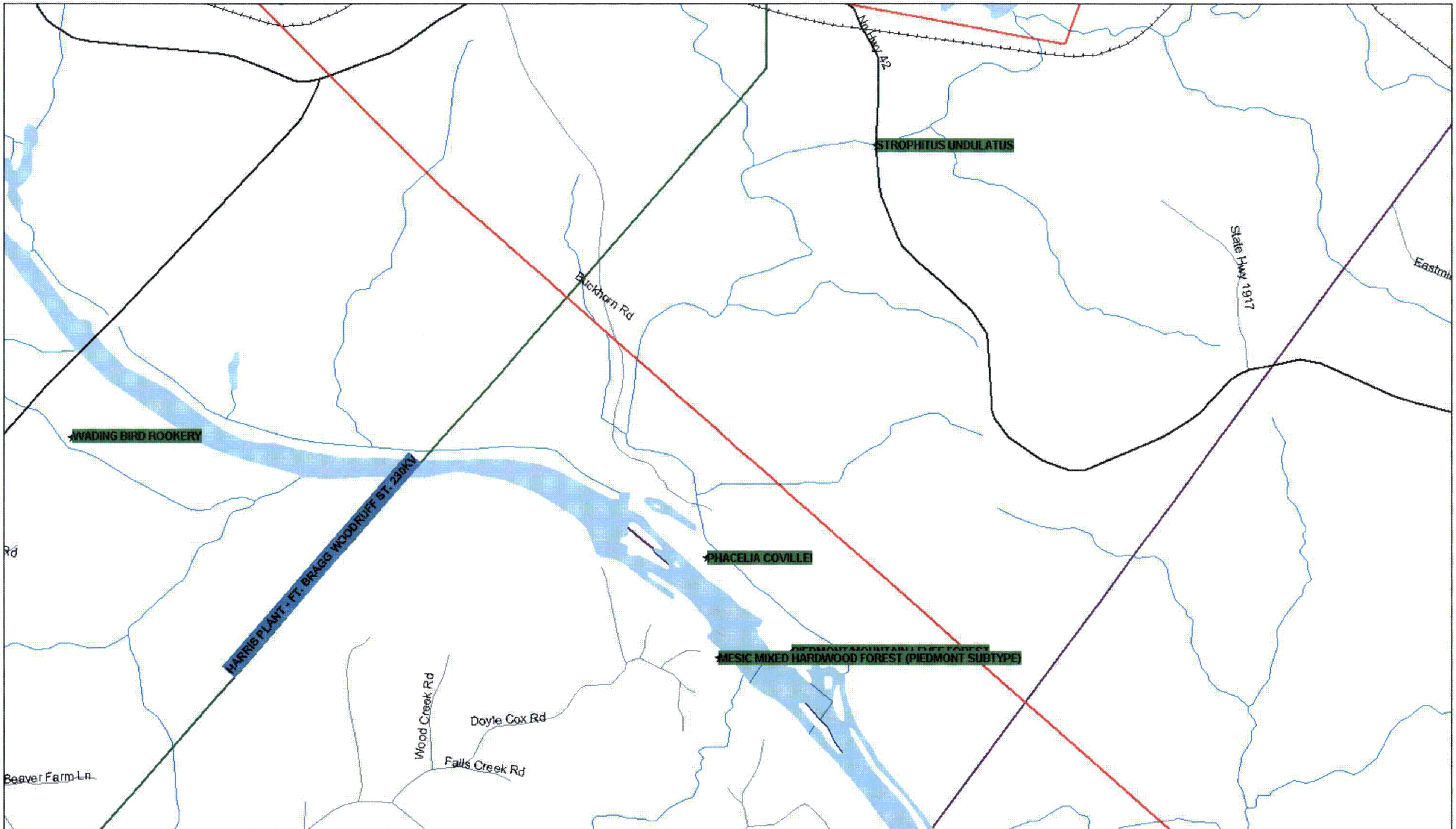
Harris Nuclear Plant Relicensing Project
Endangered Species Map



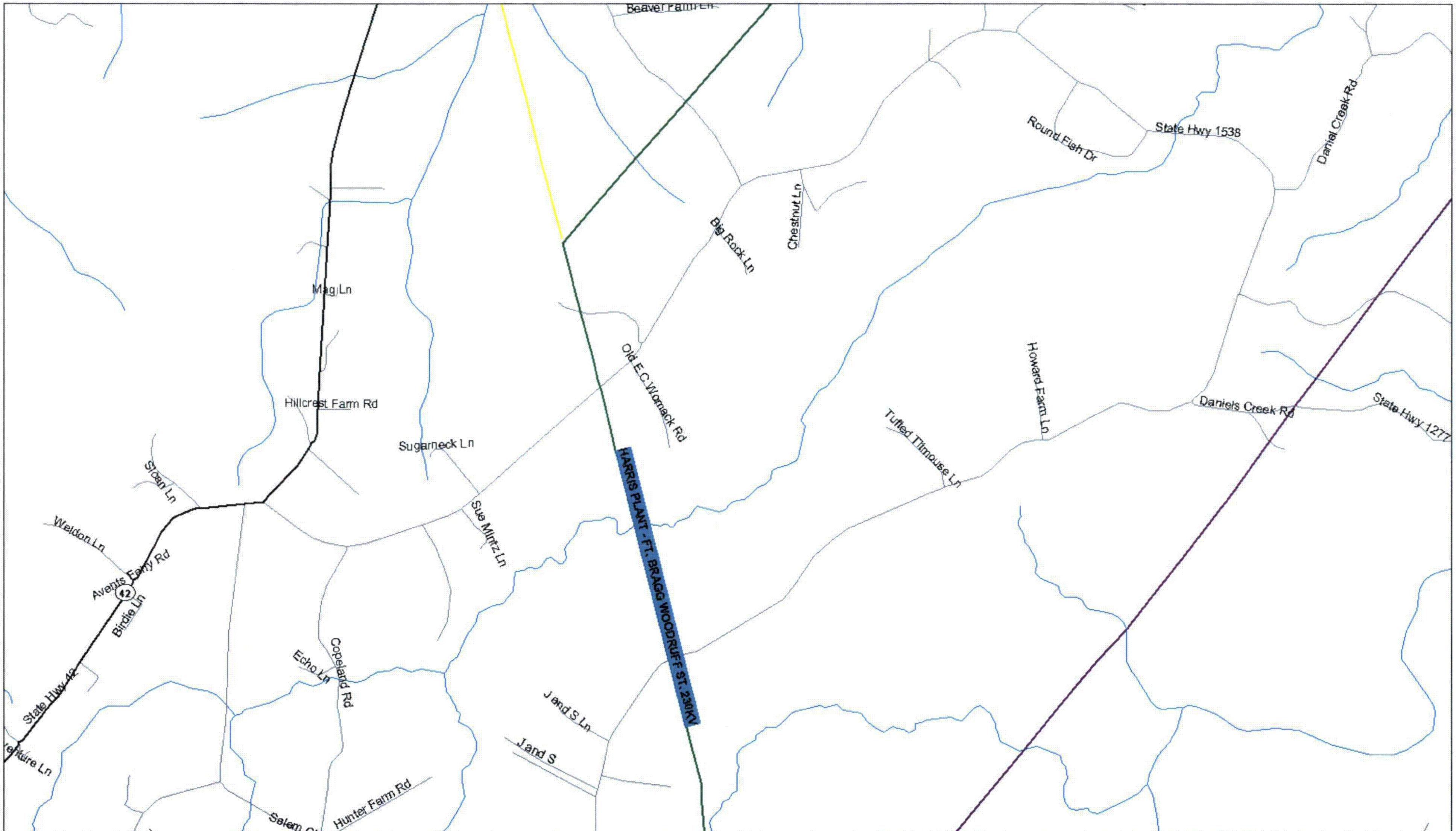
Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 18 of**



Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 19 of**

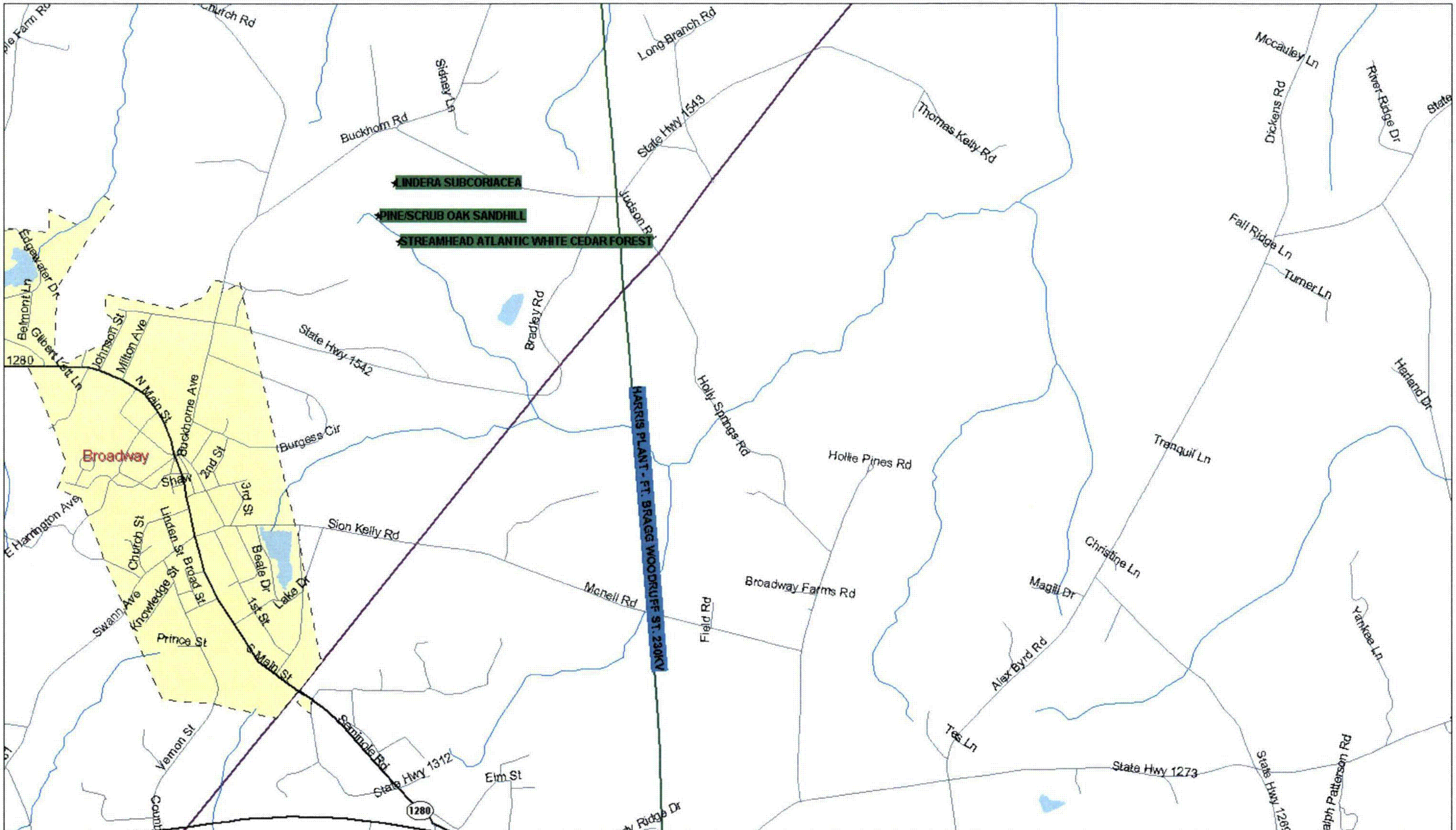


Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 20 of**



Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



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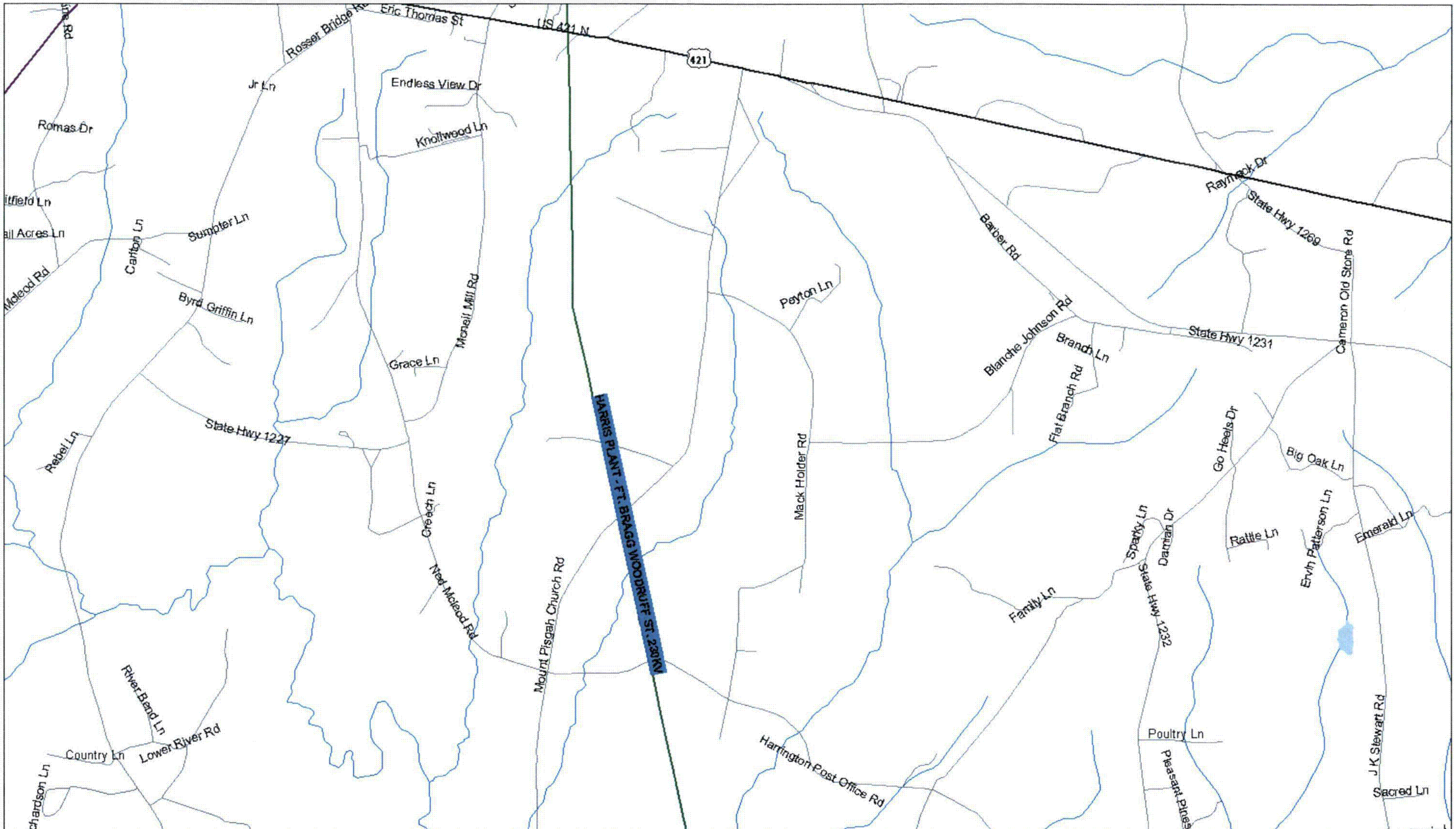
Harris Nuclear Plant Relicensing Project
Endangered Species Map



Progress Energy

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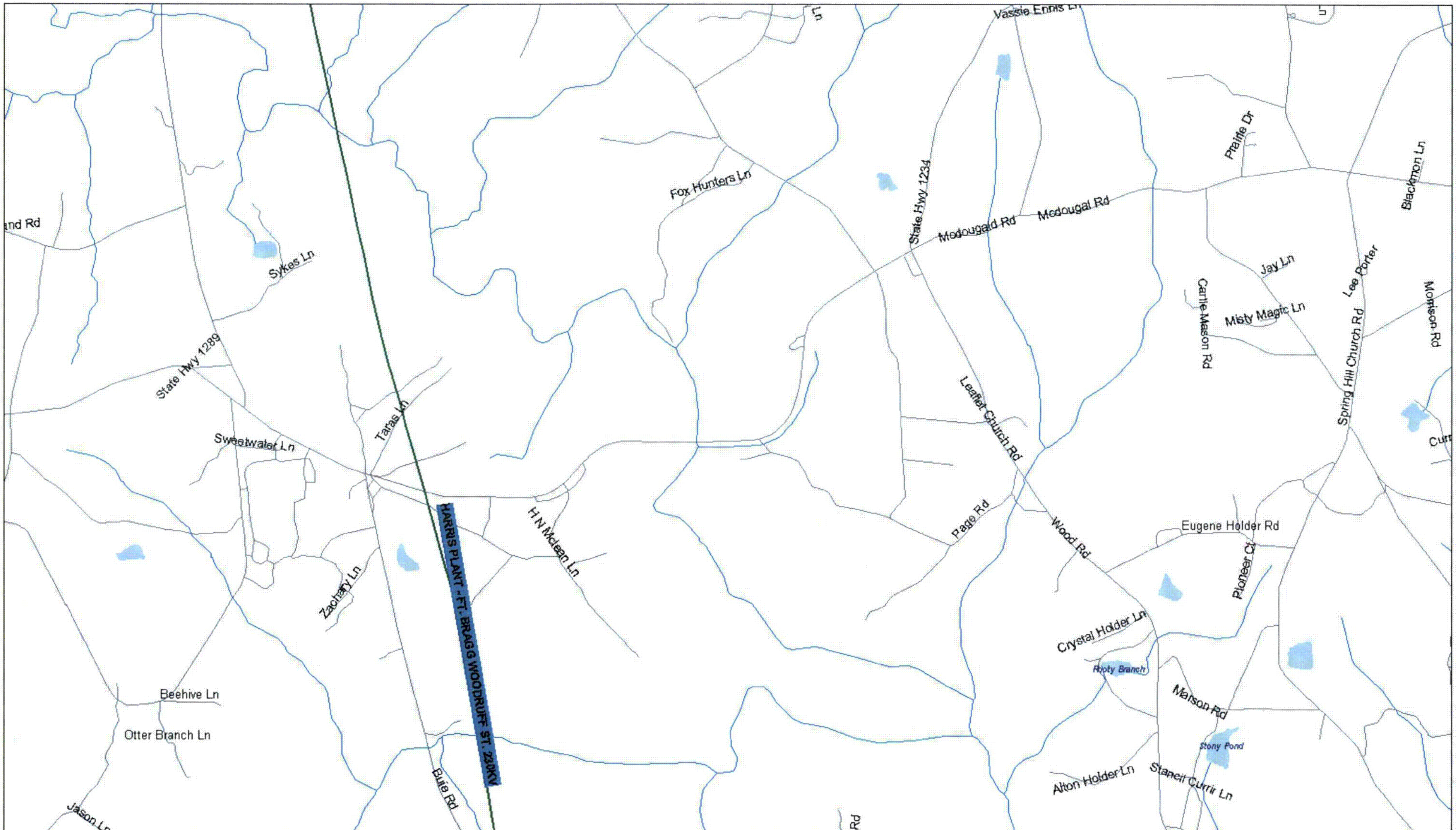
Endangered Species Map



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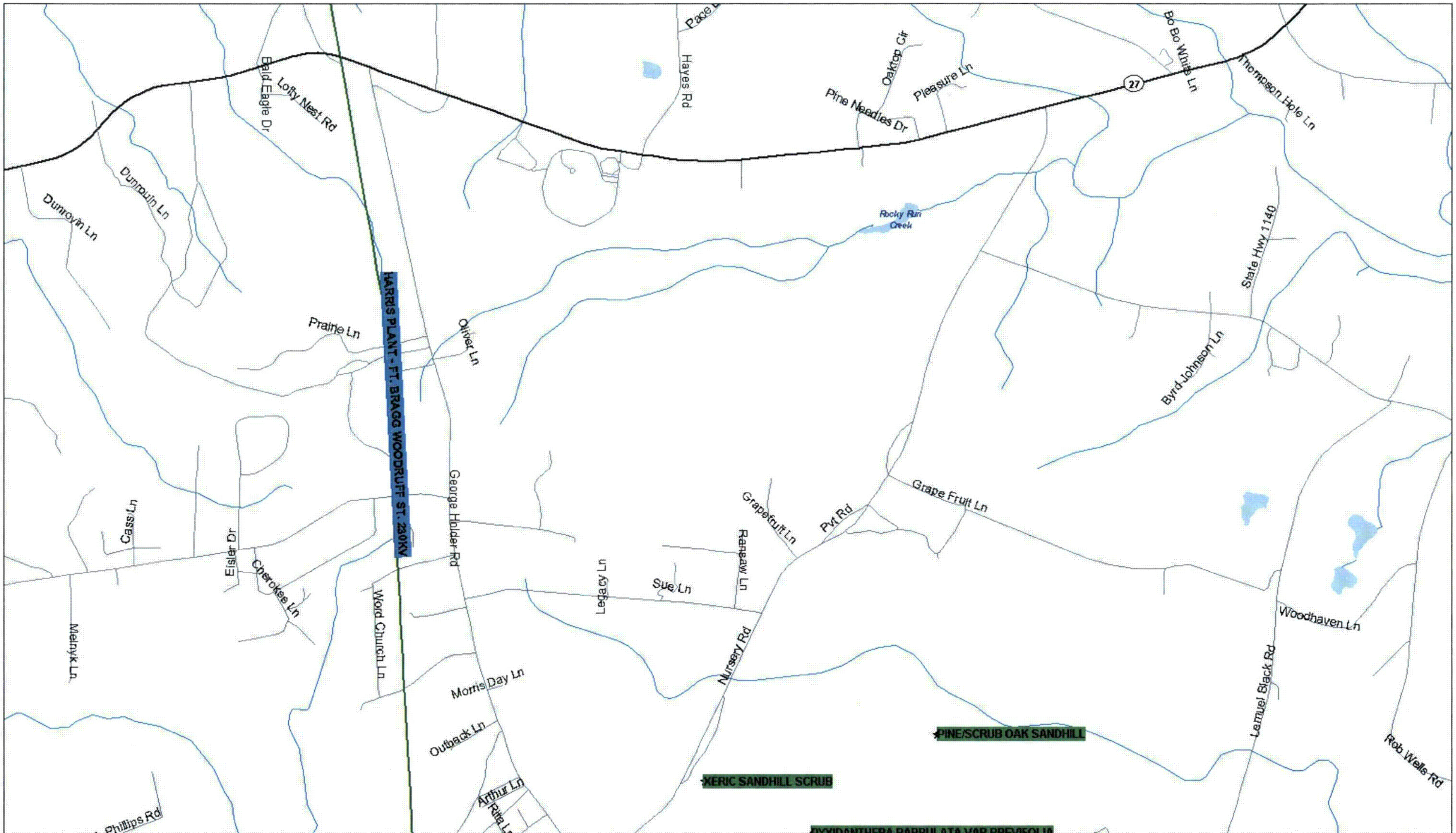
Endangered Species Map



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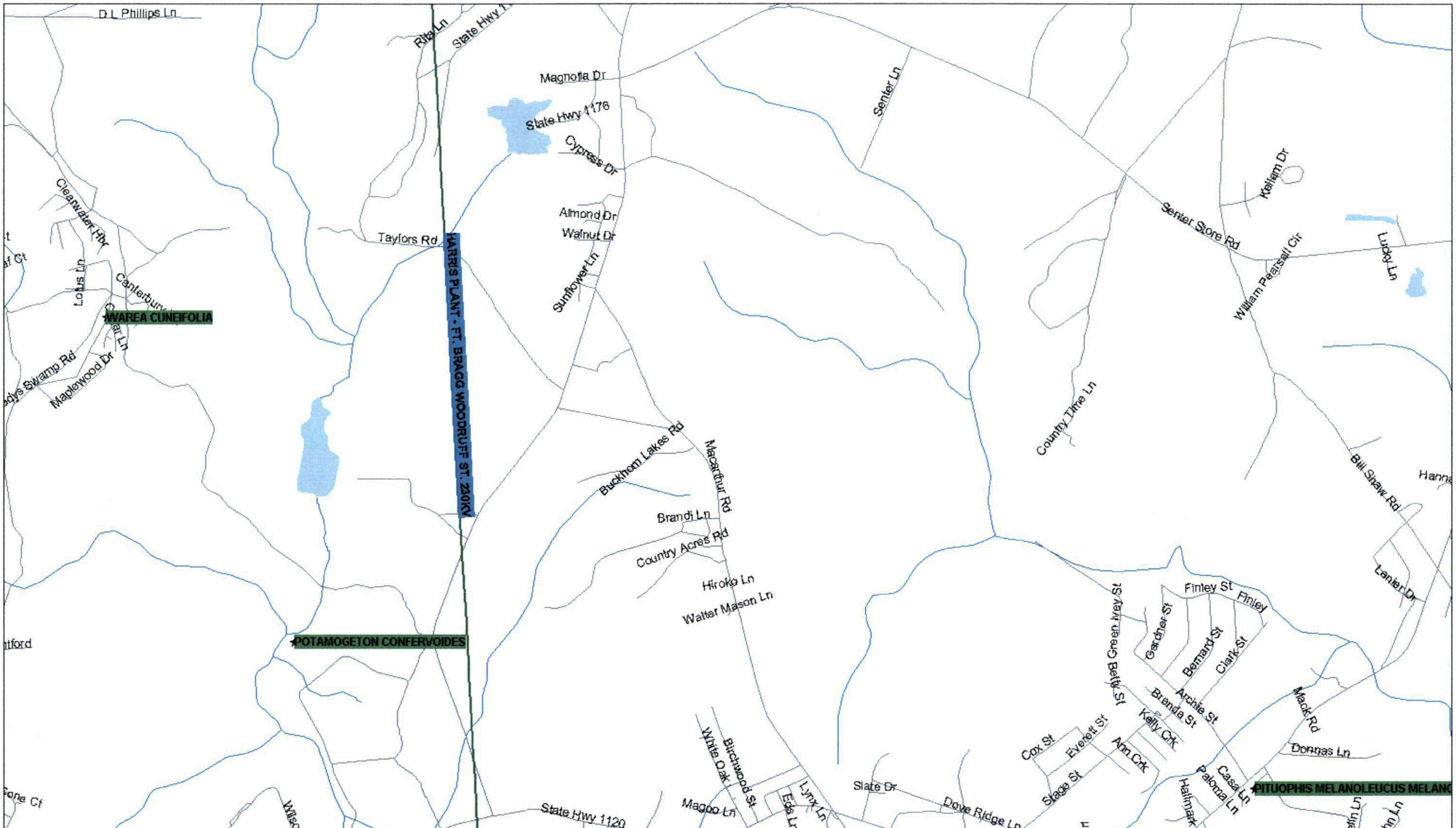
Harris Nuclear Plant Relicensing Project
Endangered Species Map



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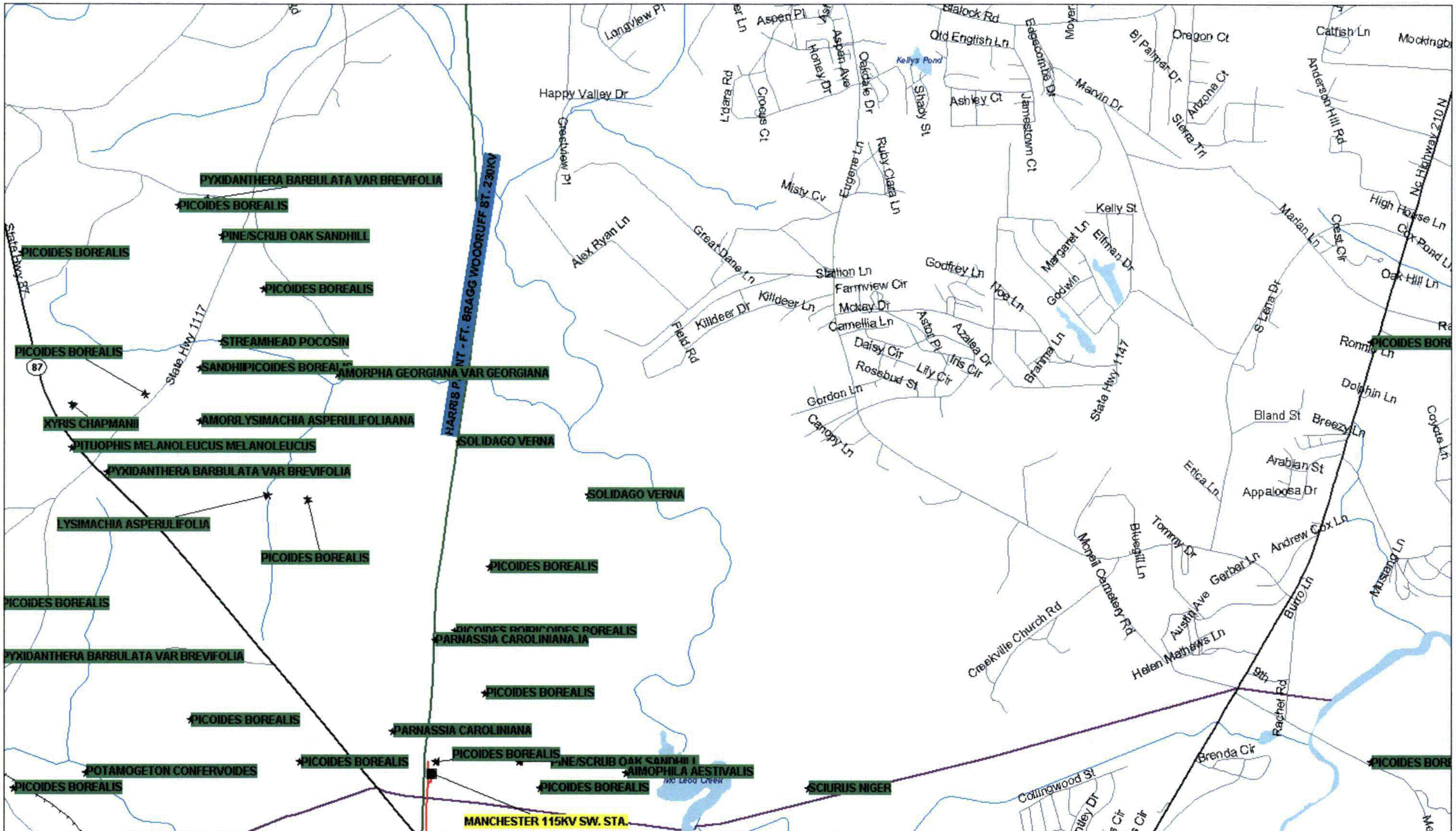
Endangered Species Map



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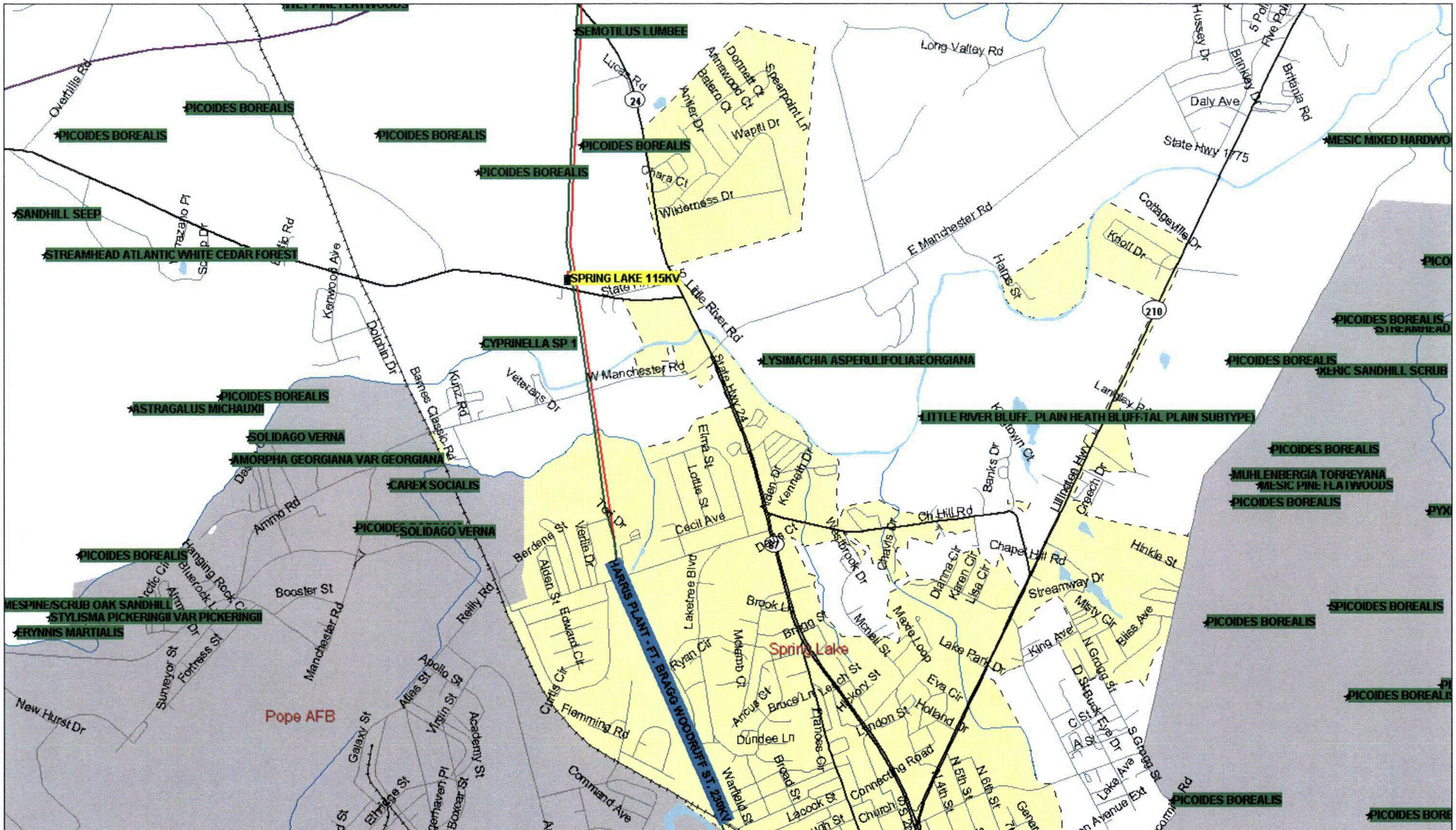
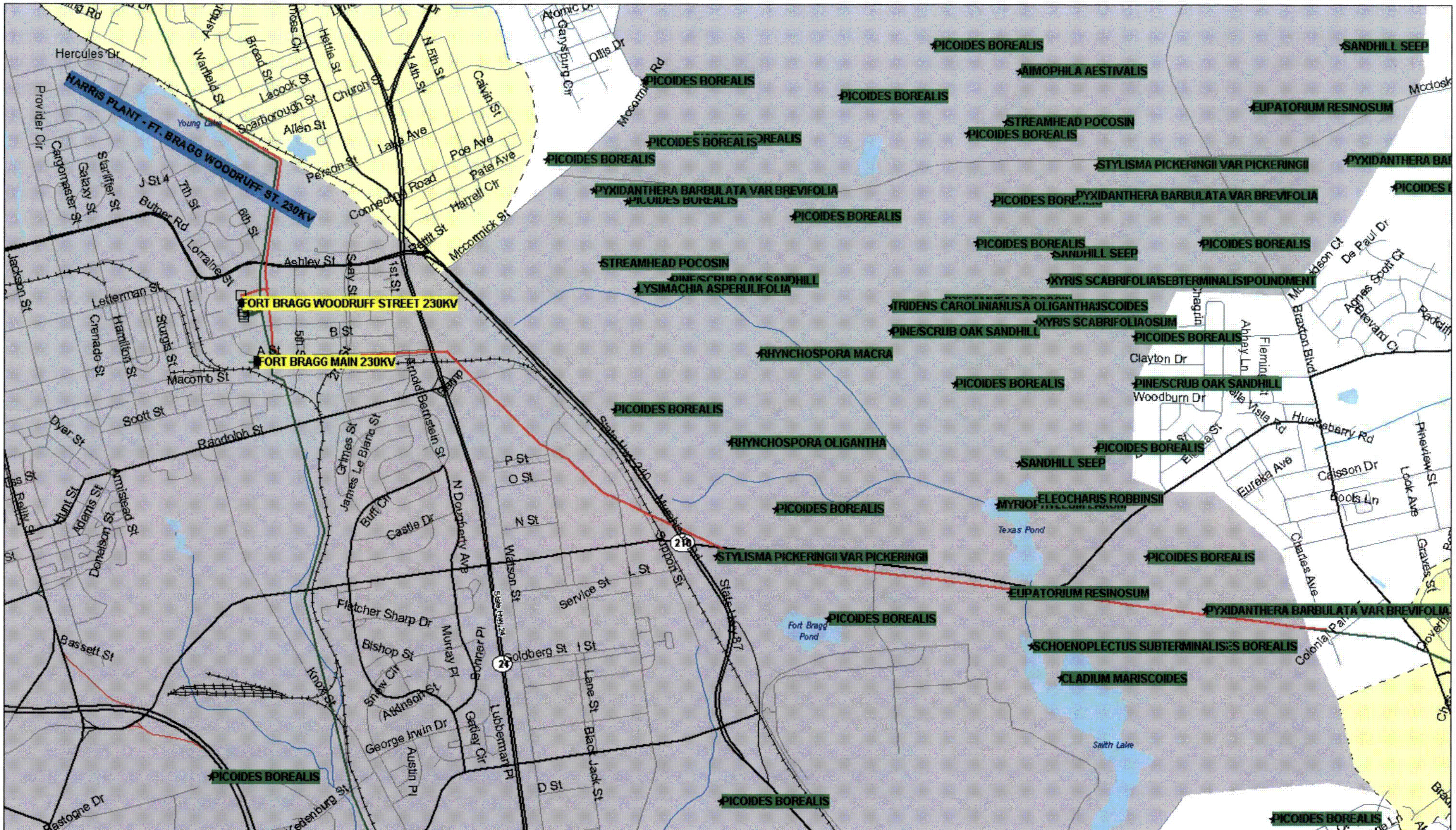
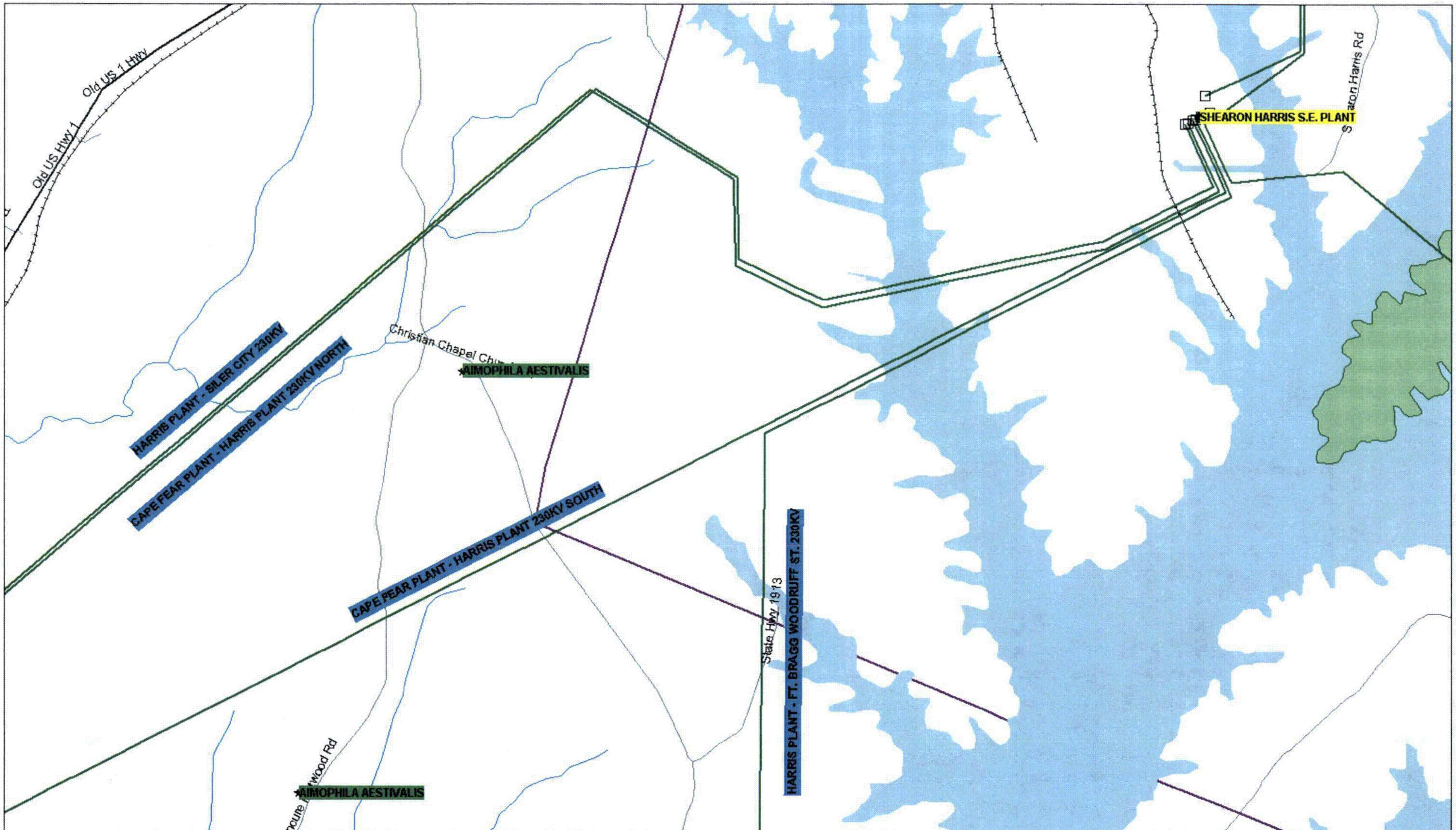
Endangered Species Map


SEMOTILUS LUMBEE
PICOIDES BOREALIS
SANDHILL SEEP
STREAMHEAD ATLANTIC WHITE CEDAR FOREST
SPRING LAKE 115KV
CYPRINELLA SP 1
LYSIMACHIA ASPERULIFOLIA
GEORGIANA
ASTRAGALUS MICHAUXII
SOLIDAGO VERNA
AMORPHA GEORGIANA VAR GEORGIANA
CAREX SOCIALIS
LITTLE RIVER BLUFF...PLAIN HEATH BLUFF...TAL PLAIN SUBTYPE)
MESIC MIXED HARDWO
XERIC SANDHILL SCRUB
MUHLENBERGIA TORREYANA
MESIC PINE FLATWOODS
MESPINE/SCRUB OAK SANDHILL
STYLISMA PICKERINGII VAR PICKERINGII
ERYNNIS MARTIALIS
HARRIS PLANT - FT. BRAGG WOODRUFF ST. 230KV
Spring Lake
Pope AFB
Long Valley Rd
Overhills Rd
E Manchester Rd
W Manchester Rd
Little River Rd
State Hwy 24
State Hwy 1775
Wilderness Dr
Chara Ct
Wapiti Dr
Cottageville Dr
Knoll Dr
Daly Ave
Britania Rd
Kenwood Ave
Dolphin Dr
Barnes Classic Rd
Kunz Rd
Veterans Dr
Ammo Rd
Booster St
Manchester Rd
Reilly Rd
Hanging Rock Ct
Surveyor St
Fortress St
New Hurst Dr
Apollo St
Atlas St
Virgin St
Academy St
Galaxy St
Command Ave
Flemming Rd
Edward Ct
Alden St
Berdene St
Veritas Dr
Tori Dr
Cecil Ave
Laketree Blvd
Ryan Cir
Elma St
Lottie St
Kenneth Dr
Chapel Hill Rd
Hinkle St
Streamway Dr
Misty Cir
Bliss Ave
King Ave
Lake Park Dr
Maxie Loop
Mcneil St
Brook Ln
Bragg St
Leach St
Hickory St
Eva Cir
Holland Dr
London St
Connecting Road
Dundee Ln
Broad St
Lacock St
Church St
N 5th St
N 6th St
14th St
Lake Ave
Lillington Hwy
Creech Dr
Banks Dr
Westbrook Dr
Chavis Dr
Dianna Cir
Karen Cir
Lisa Cir
Hussey Dr
Brinkley Dr
Five Point Rd
Harris St
Lucas Rd
Donnatt Ct
Spearpoint Ln
Antler Dr
Langley Rd
Wadfield St
Metamb Ct
Ancus Ct
Bruce Ln
Flamoss Cir
S Gregg St
N Gregg St
A St
C St
D St
Buck Eye Dr
24
87
210

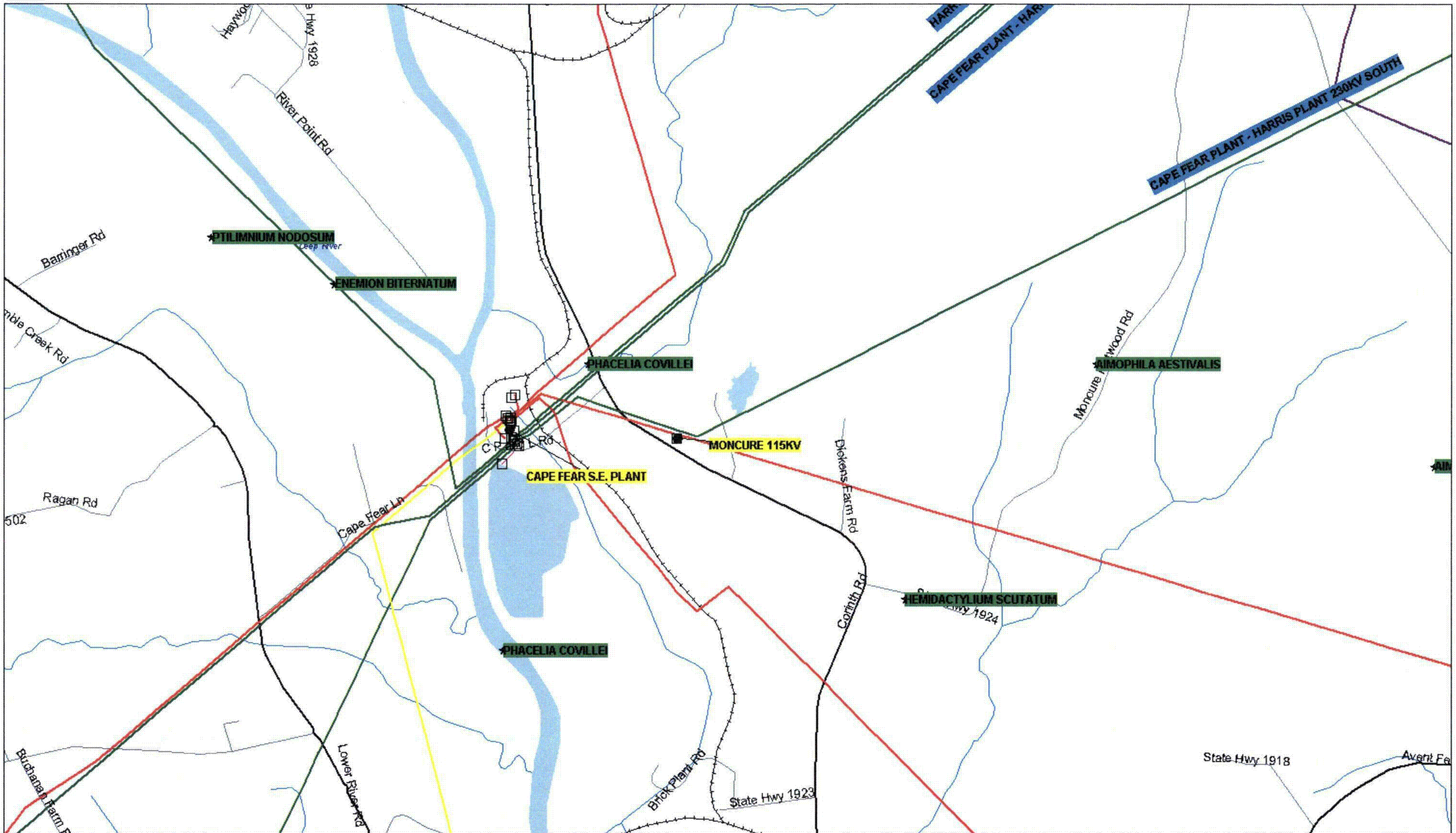


Progress Energy	**Harris Nuclear Plant Relicensing Project** **Endangered Species Map**	**Page 29 of**



Progress Energy

Harris Nuclear Plant Relicensing Project
Endangered Species Map



Progress Energy

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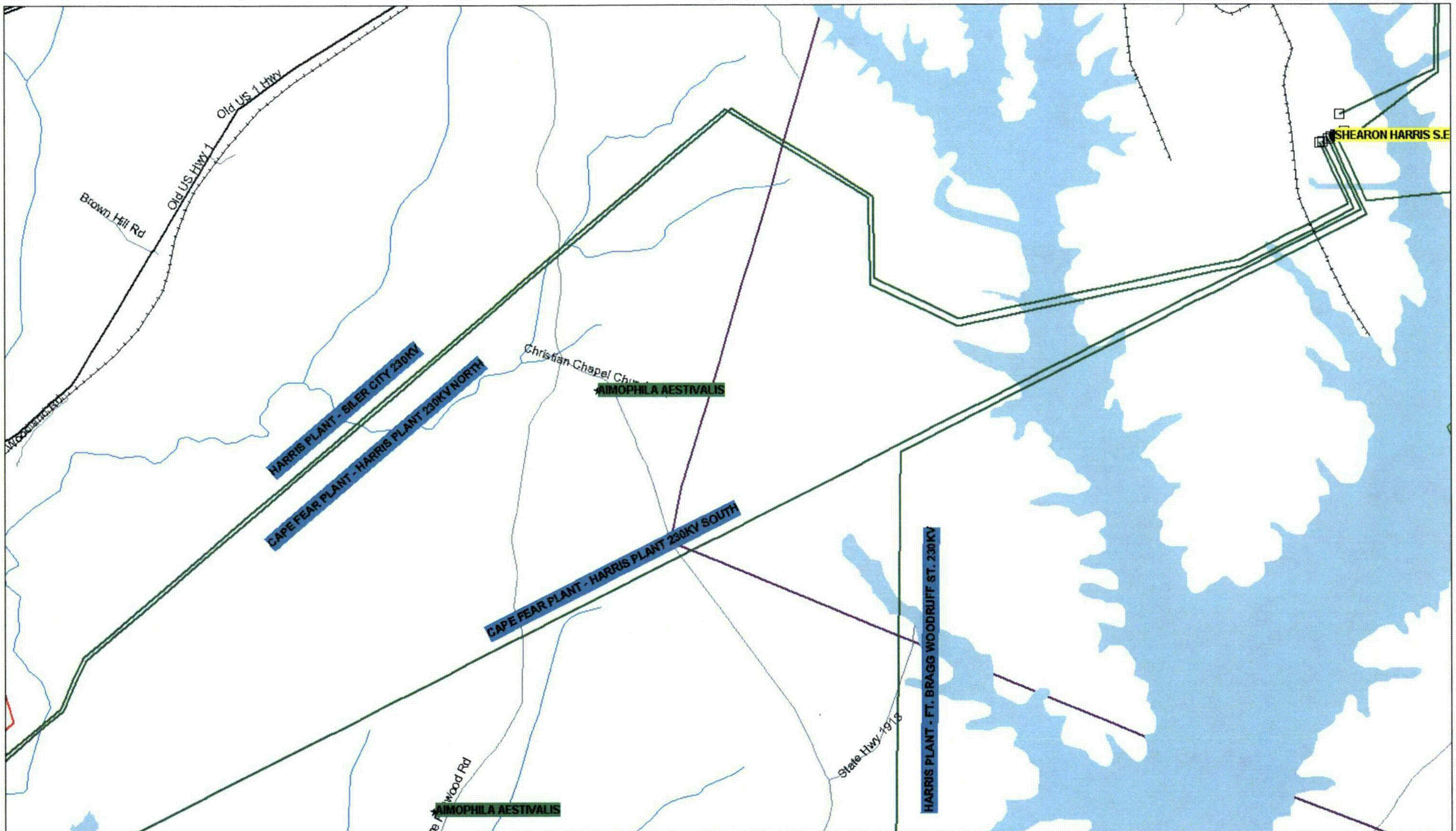
Endangered Species Map



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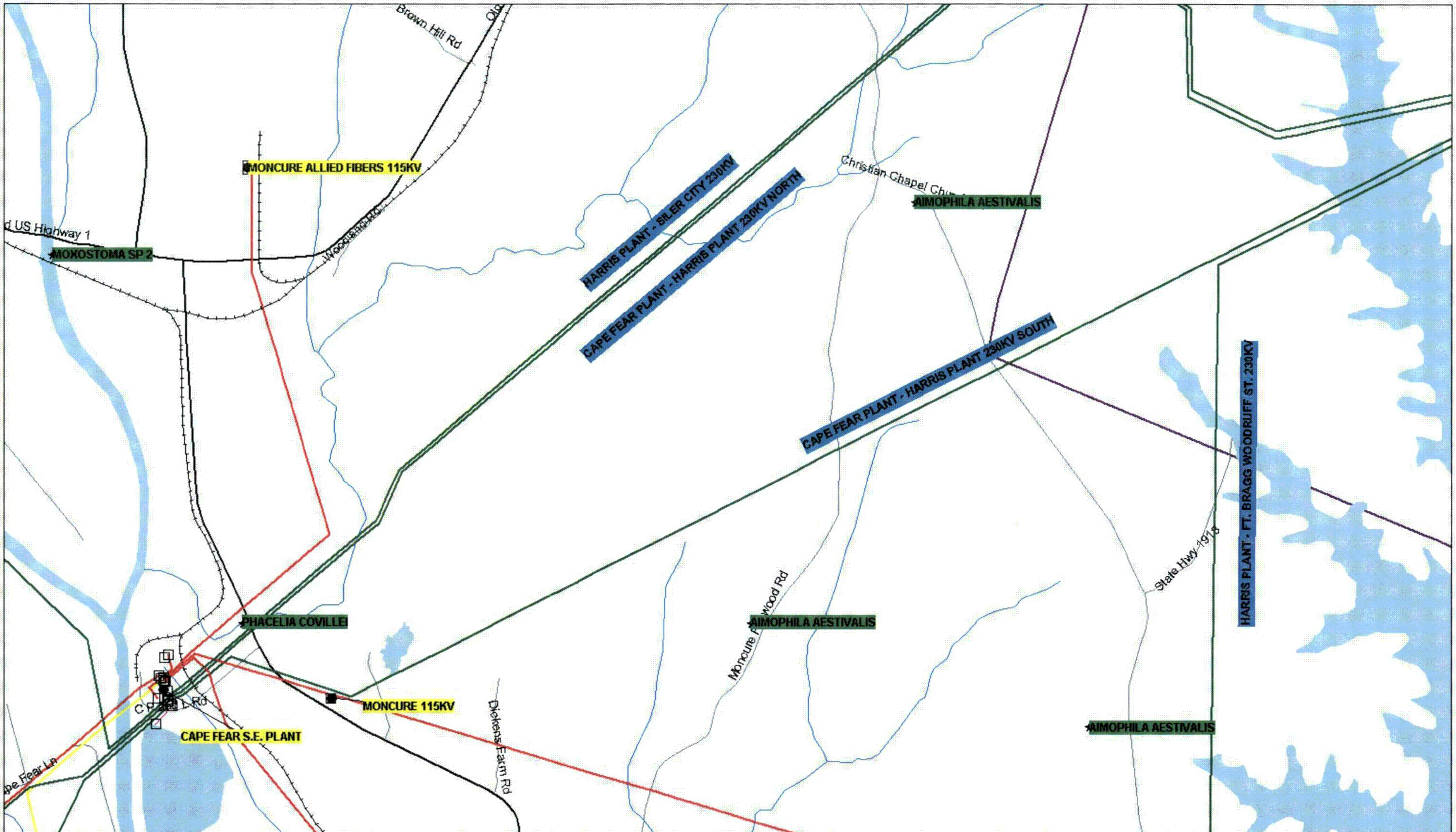
Endangered Species Map



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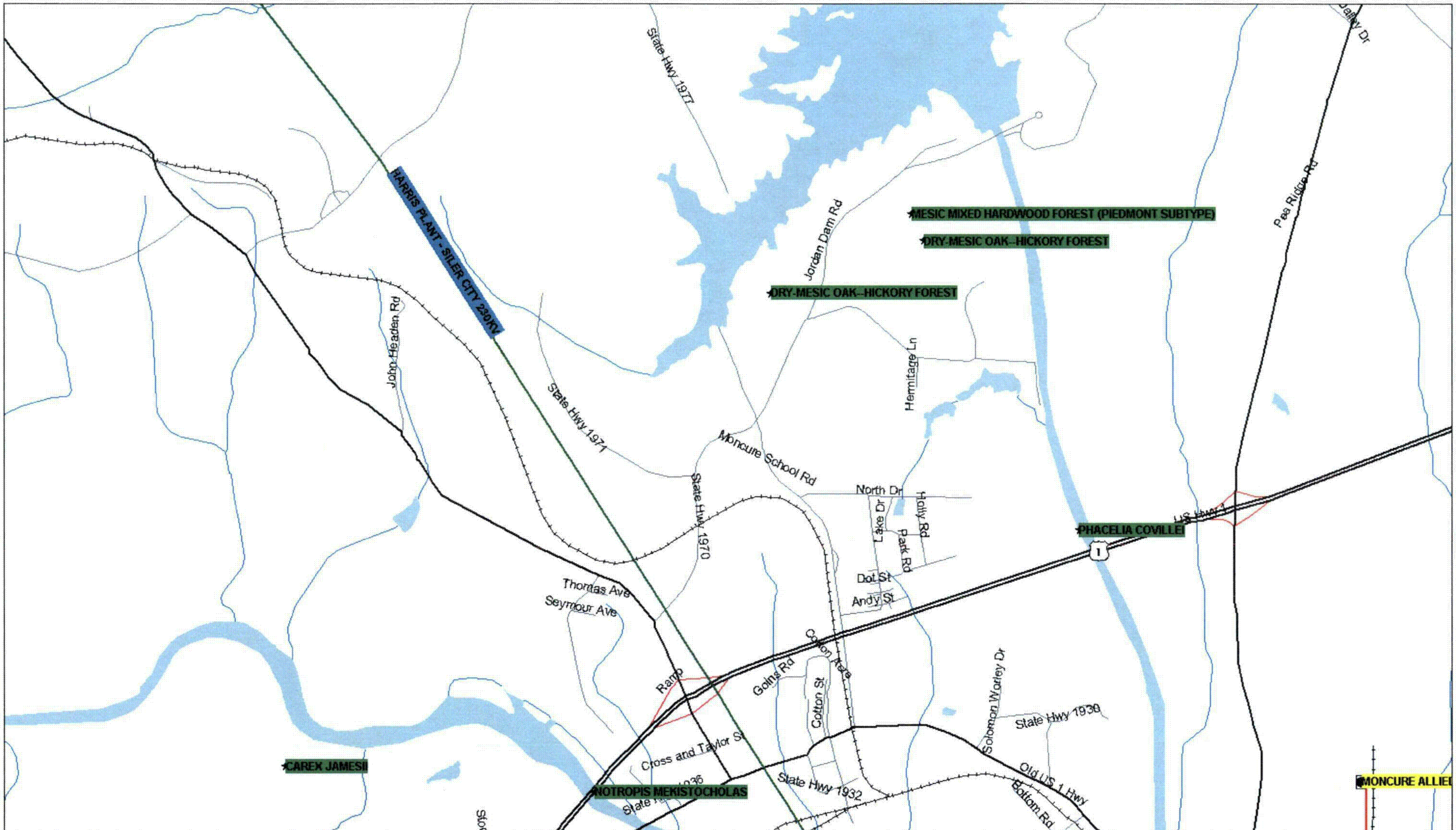
Harris Nuclear Plant Relicensing Project
Endangered Species Map

NOTROPIS MEKISTOCHOLAS
MONCURE ALLIED FIBERS 1
MOXOSTOMA SP 2
HARRIS PLANT - SILER CITY 230KV
PTILIMNIUM NODOSUM
ENEMION BITERNATUM
PHACELIA COVILLEI
CAPE FEAR S.E. PLANT
PHACELIA COVILLEI
State Hwy 1932
US 1 Hwy
Bottom Rd
Old US Highway 1
Haywood Rd
State Hwy 1928
River Point Rd
Nance Rd
Ramp
W Forest Oaks Dr
Atkins Ln
Doe Run Rd
E Forest Oaks Dr
Toomer Ln
Breezewood Dr
Doe Run Dr
State Hwy 1469
Barringer Rd
Womble Creek Rd
Allen Farm Rd
Ragan Rd
State Hwy 1502
Cape Fear Ln
Mini Mobile Ln
State Hwy 1425



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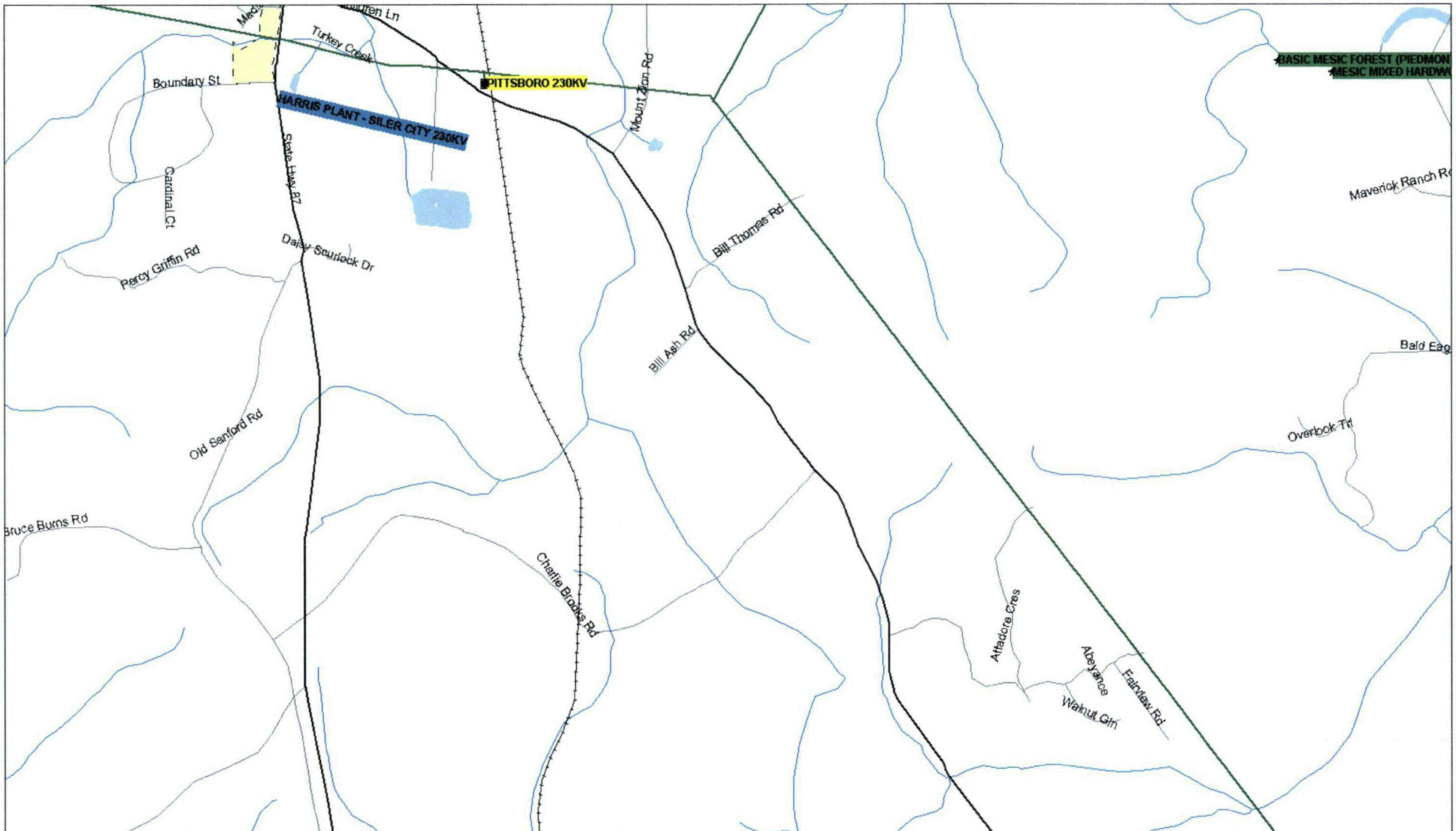
Endangered Species Map



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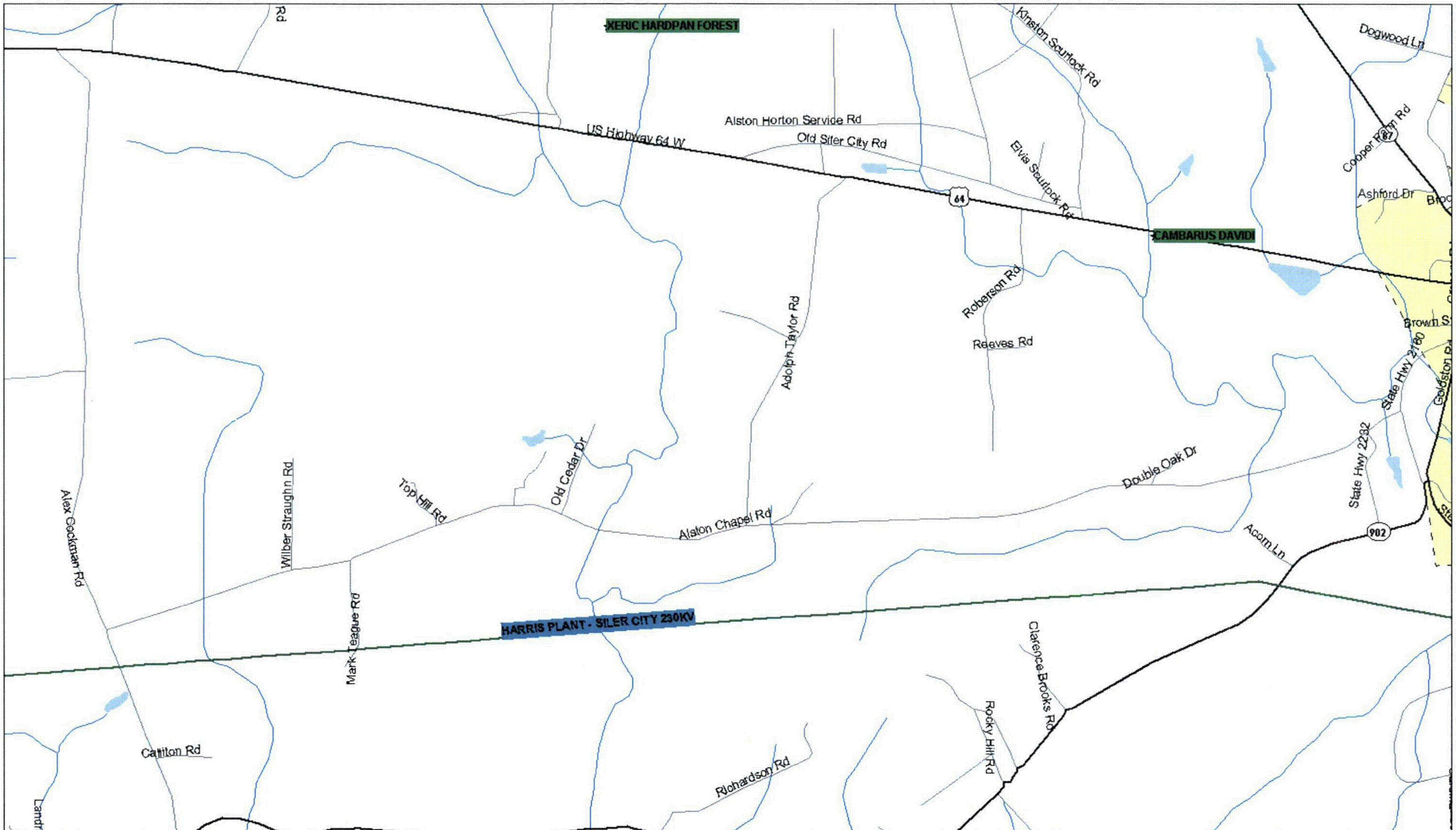
Endangered Species Map



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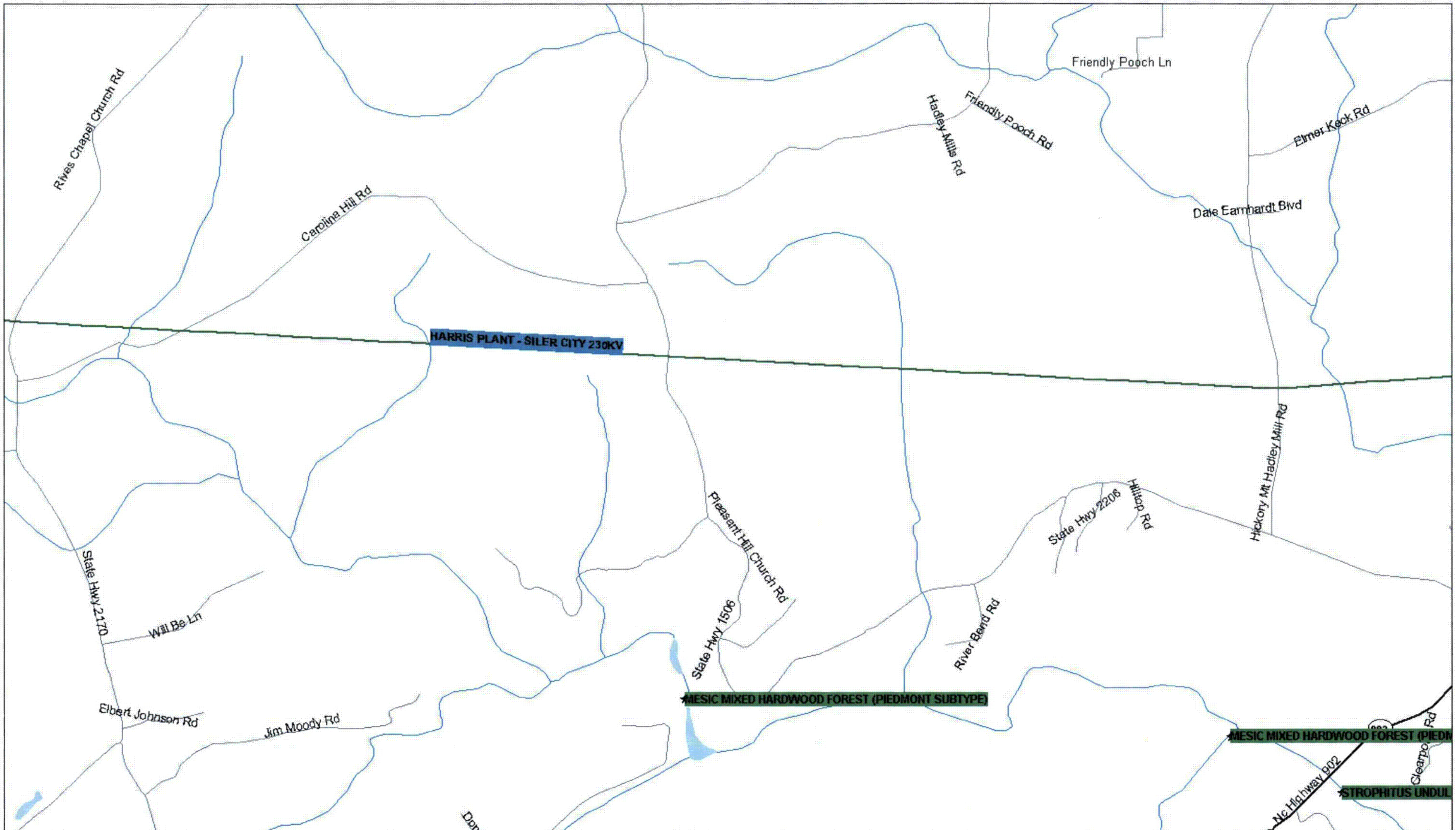

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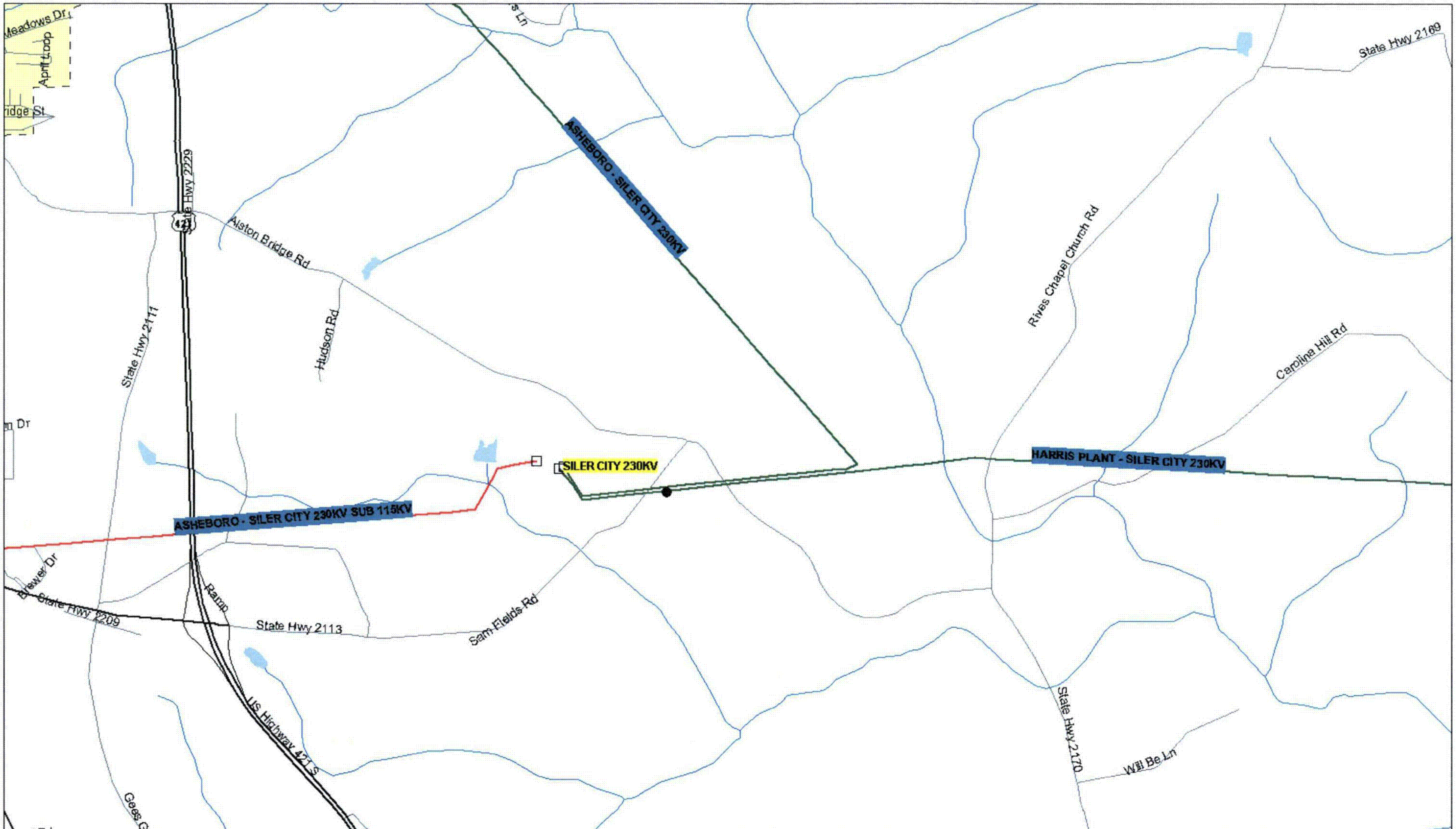
Endangered Species Map



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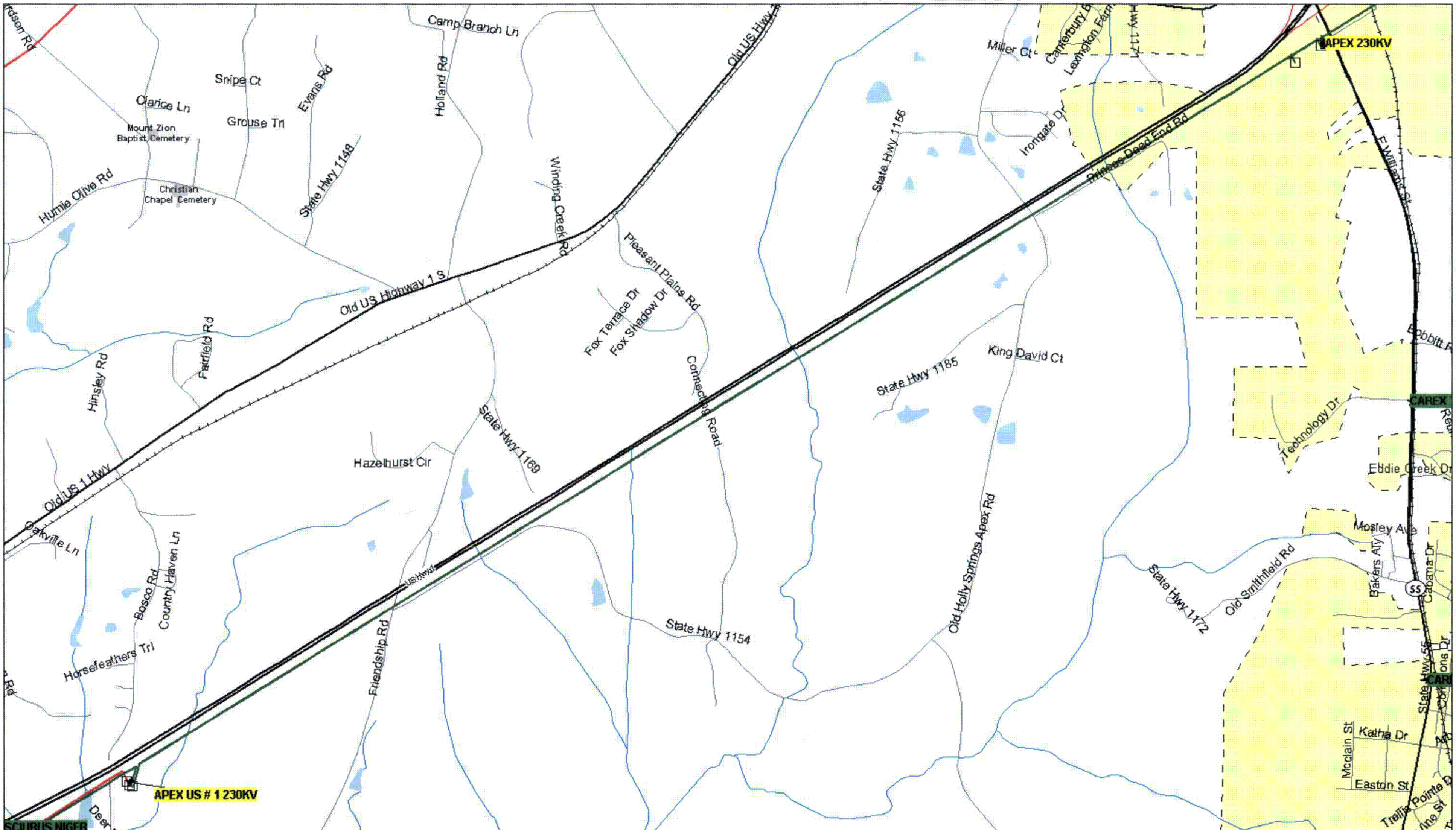

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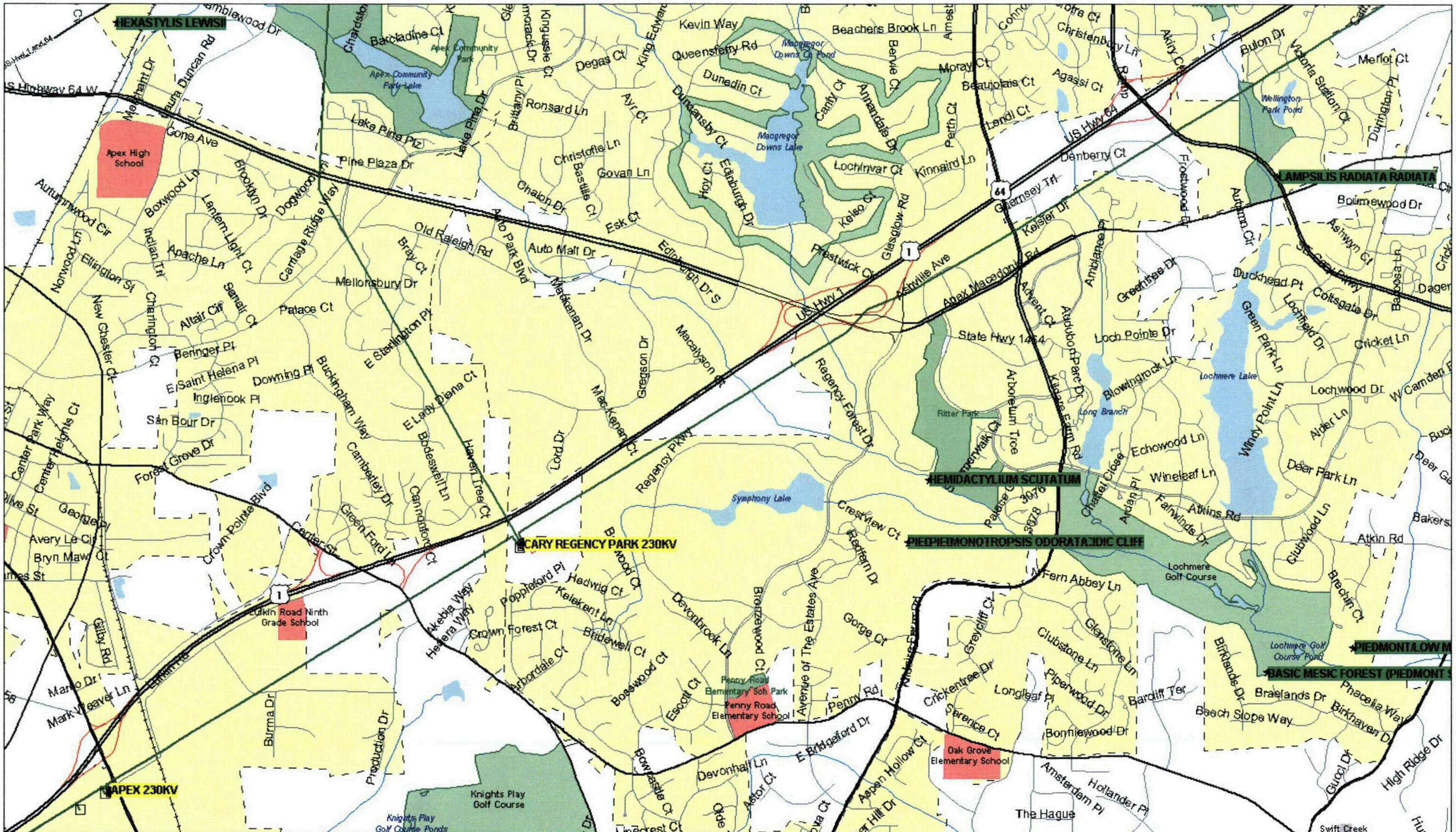
Endangered Species Map



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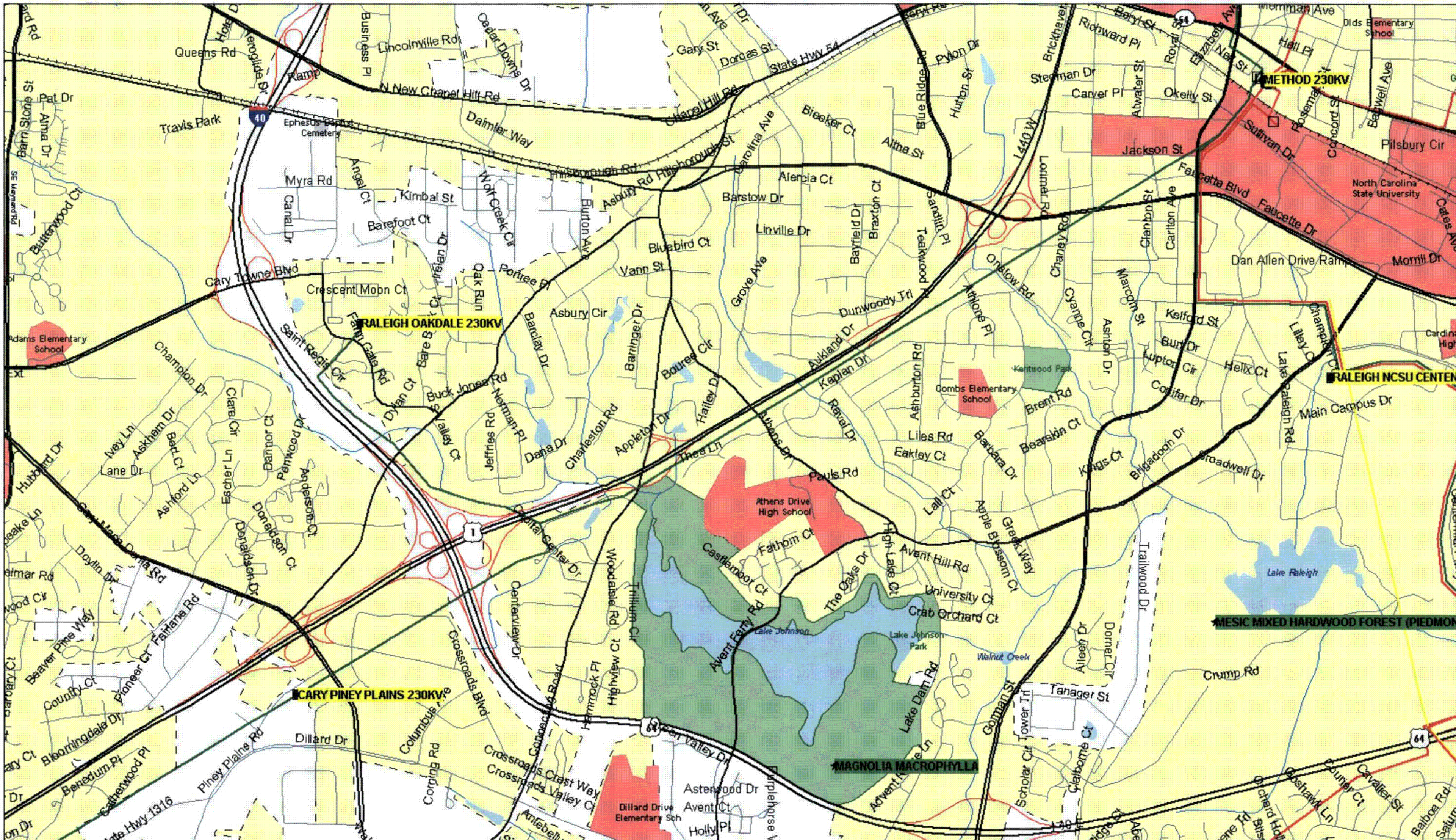

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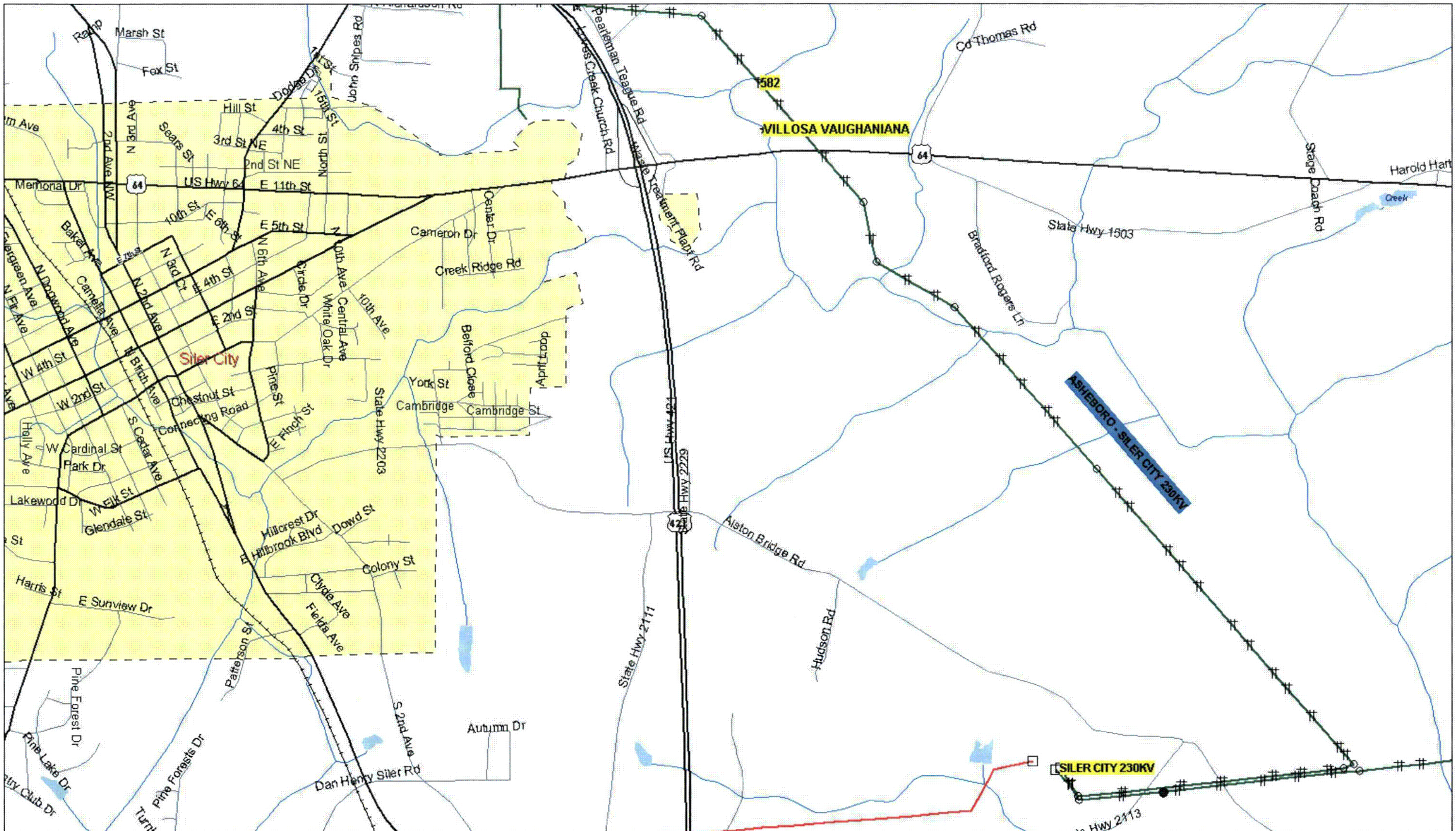

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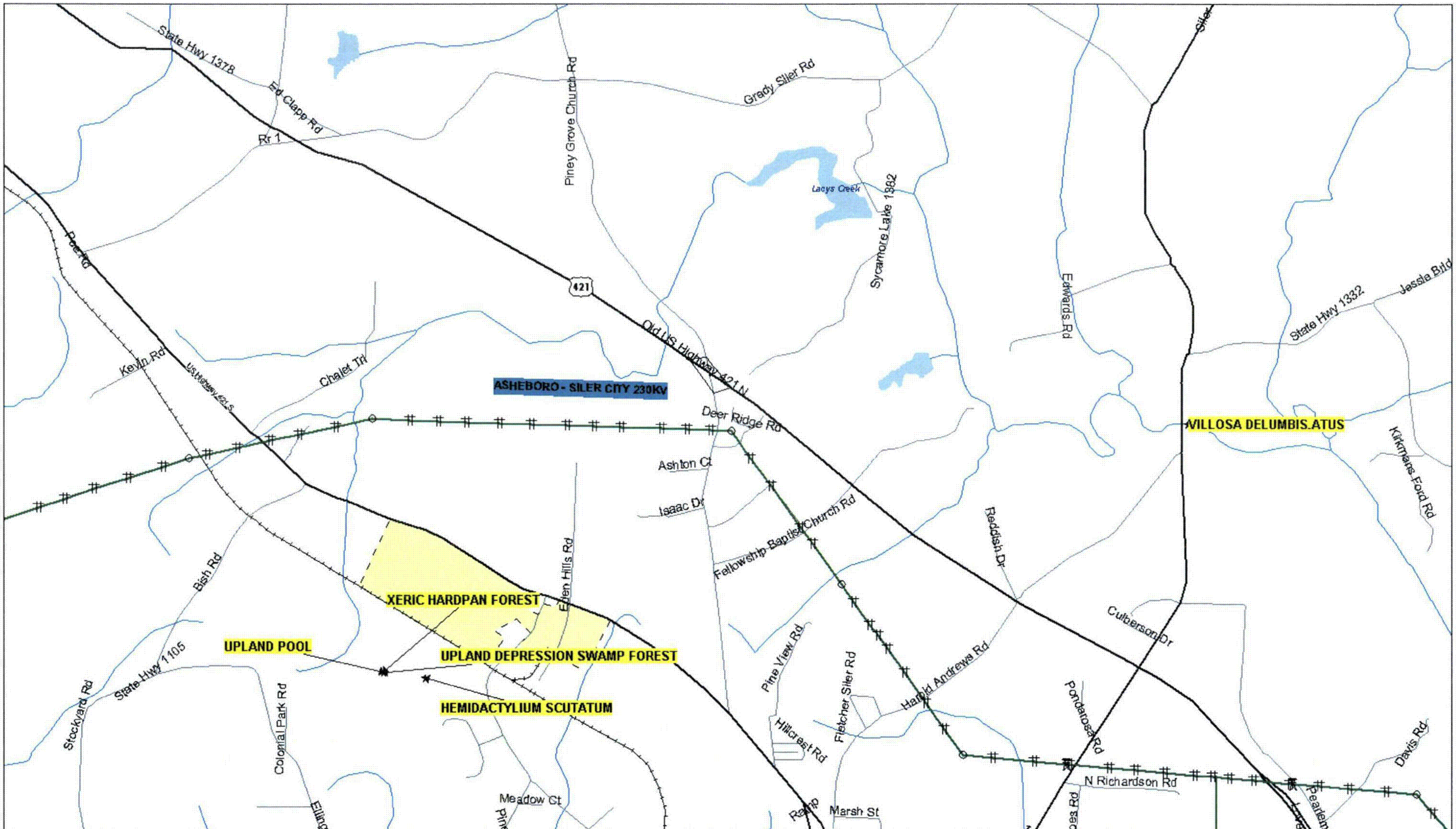

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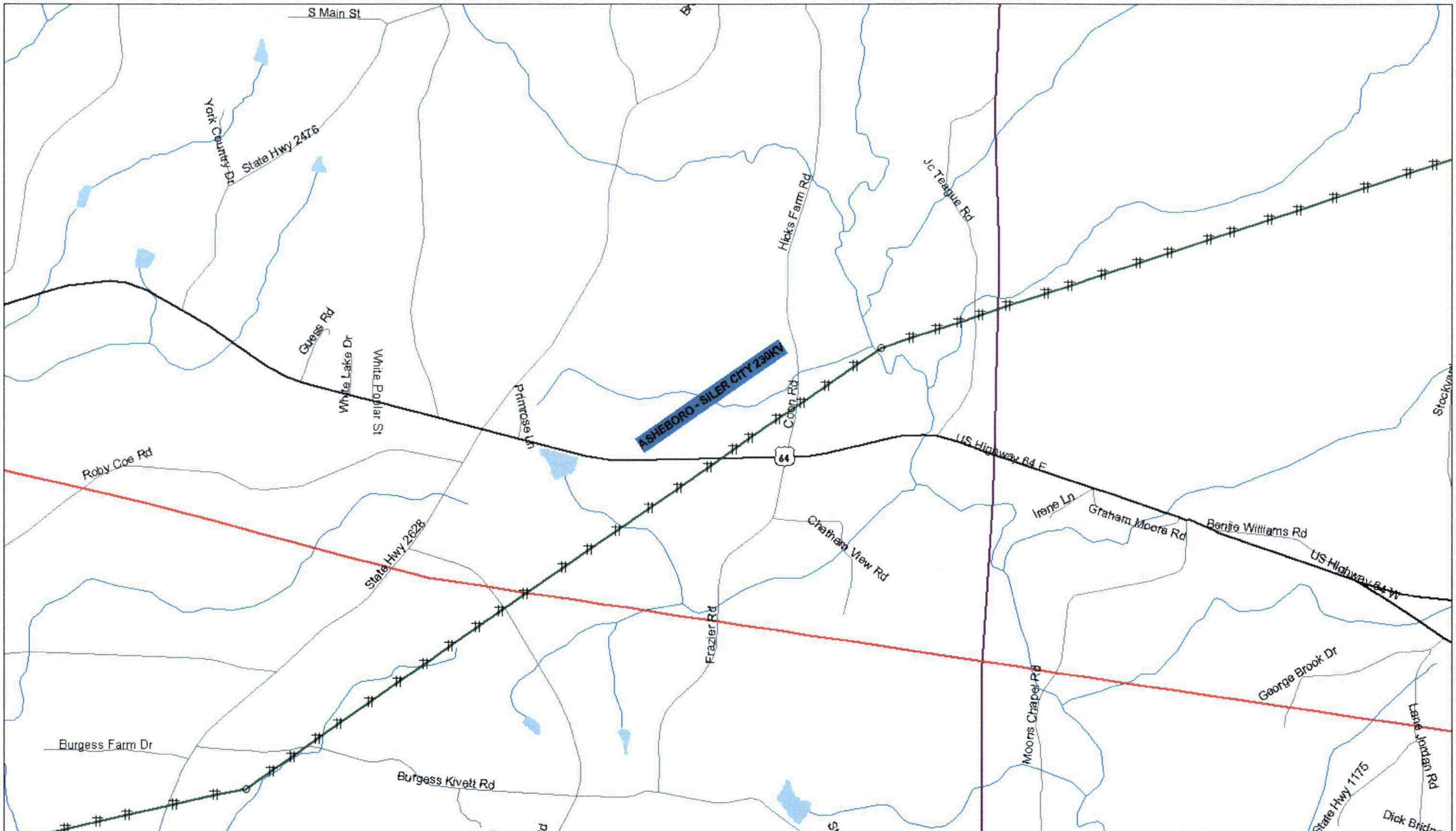

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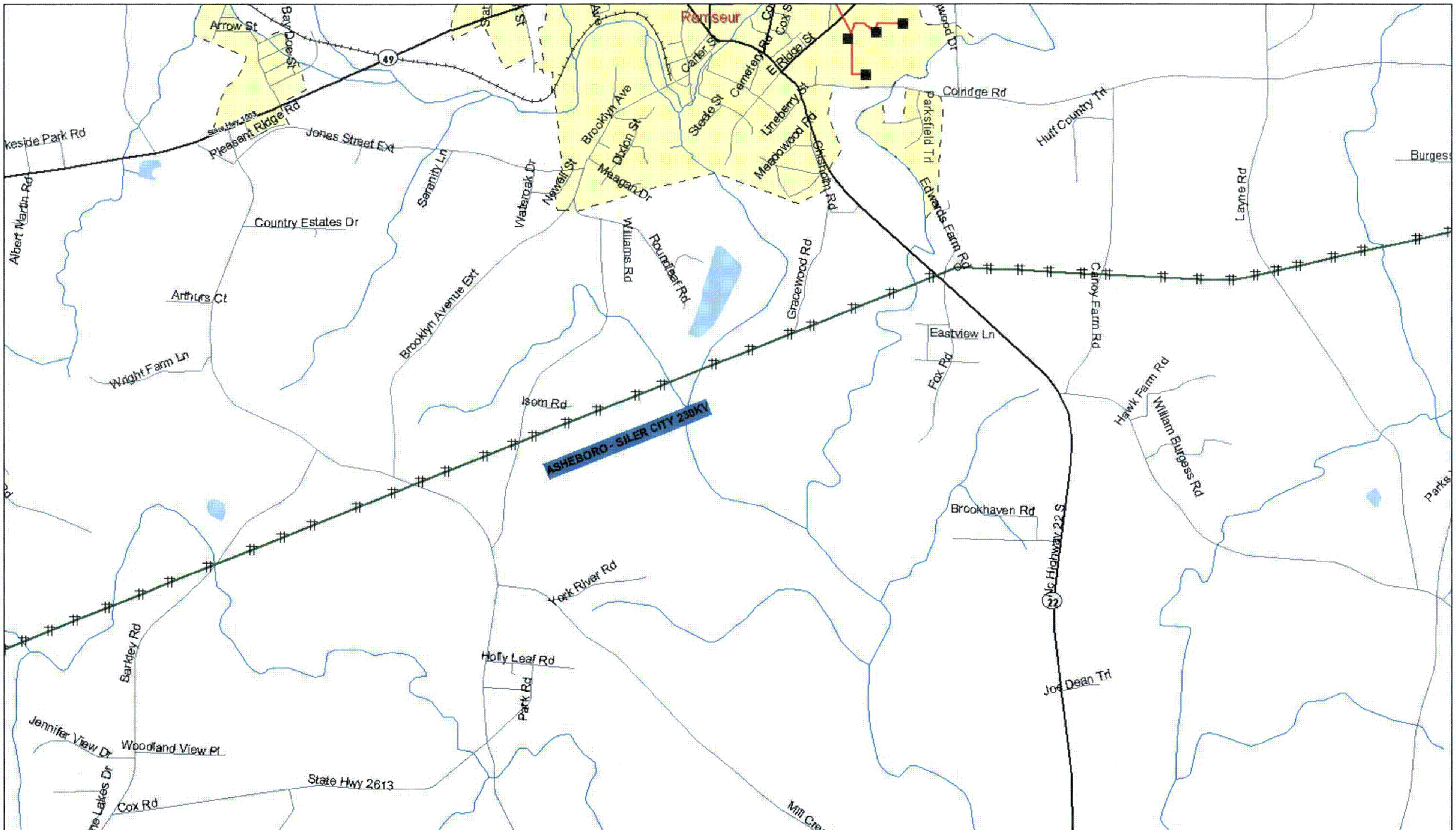

Harris Nuclear Plant Relicensing Project
Endangered Species Map

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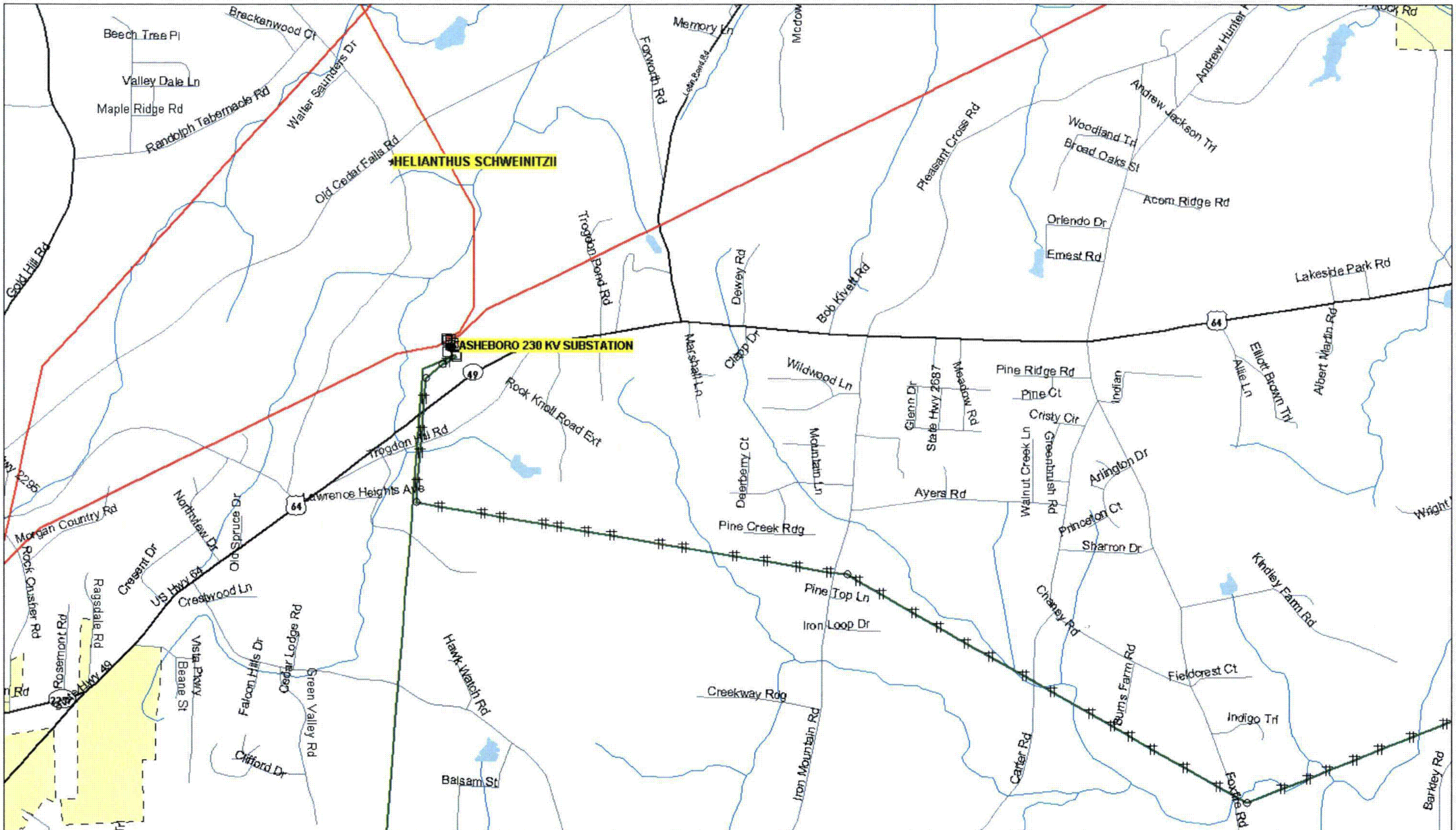

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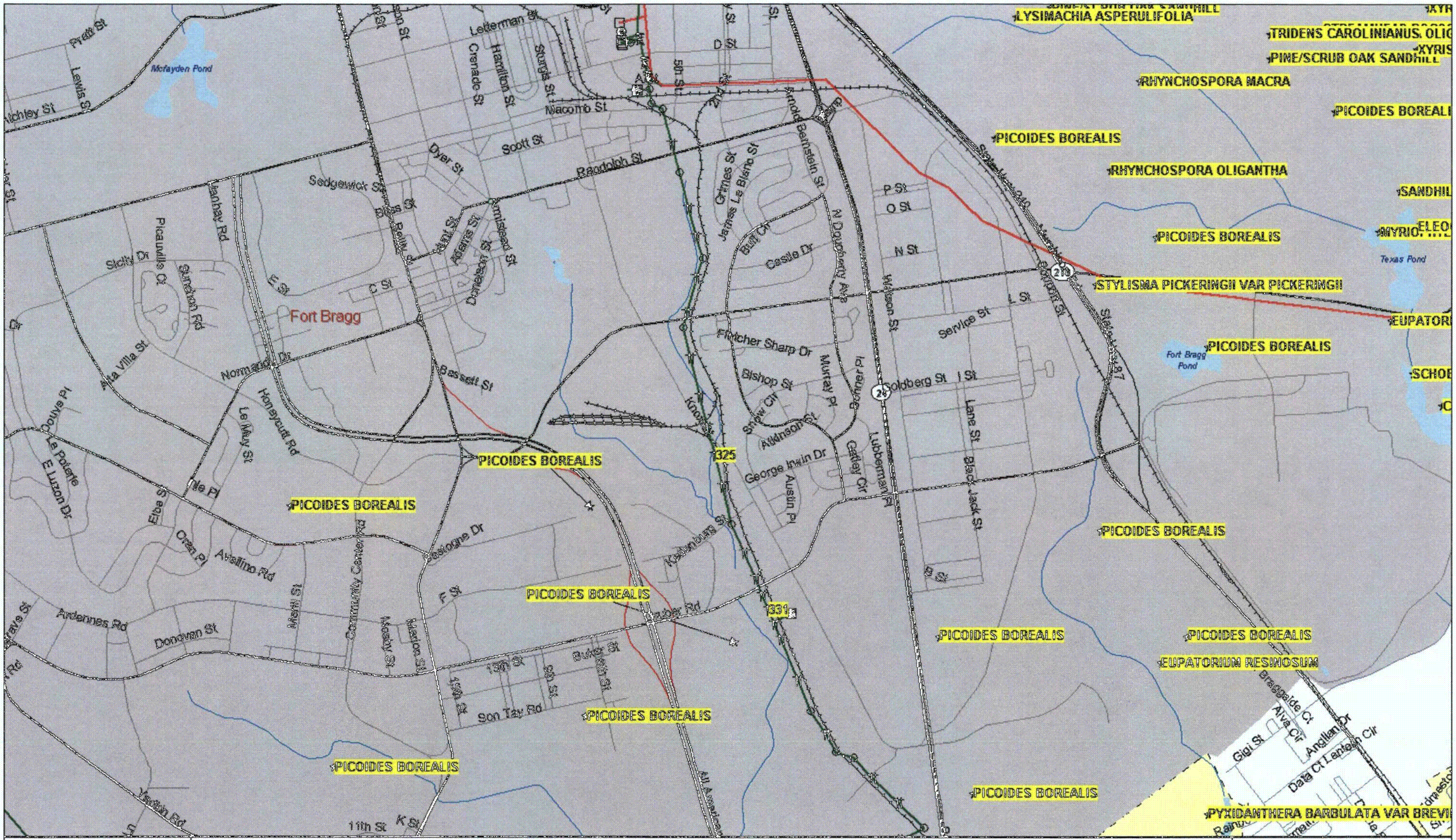

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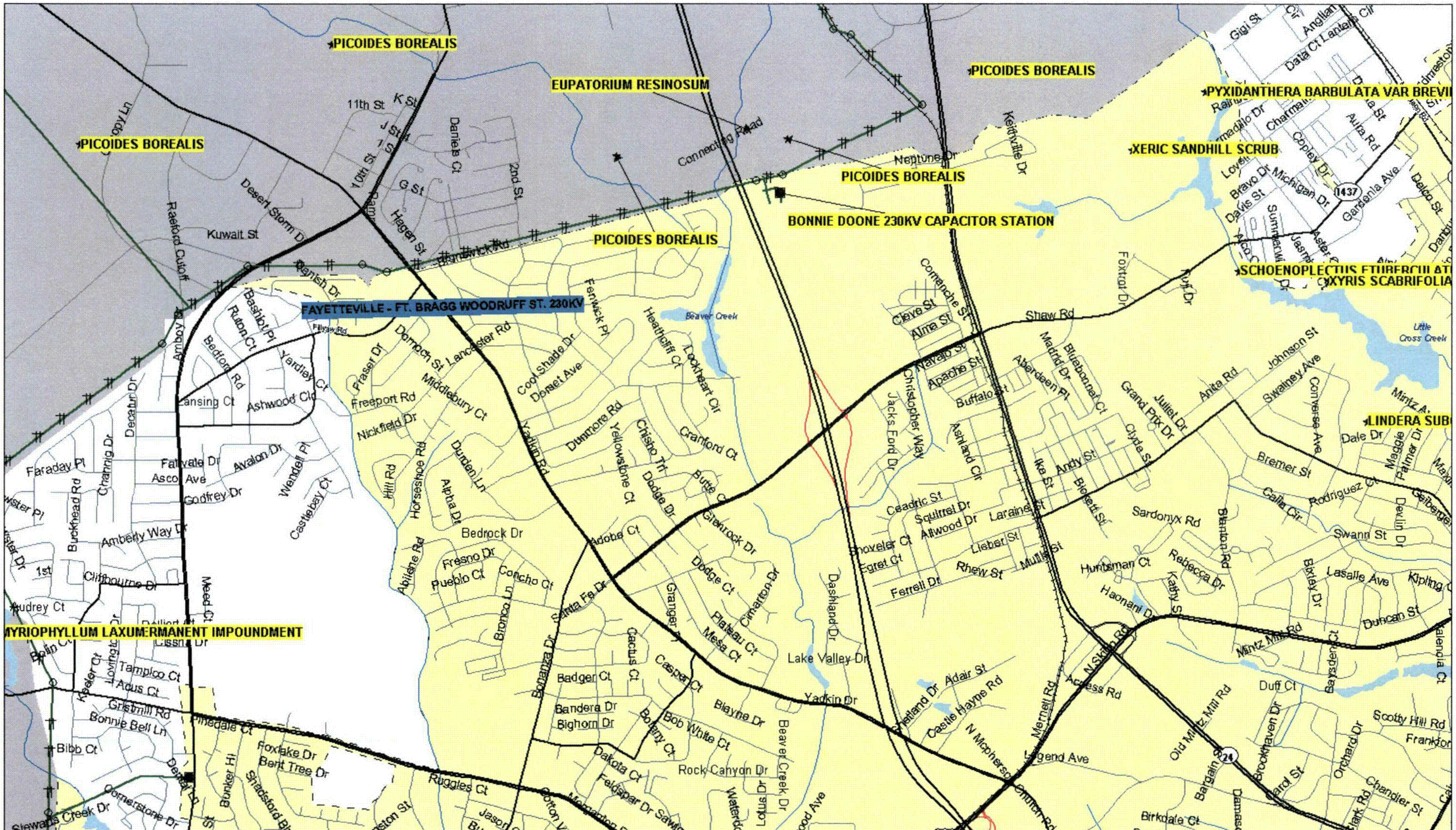

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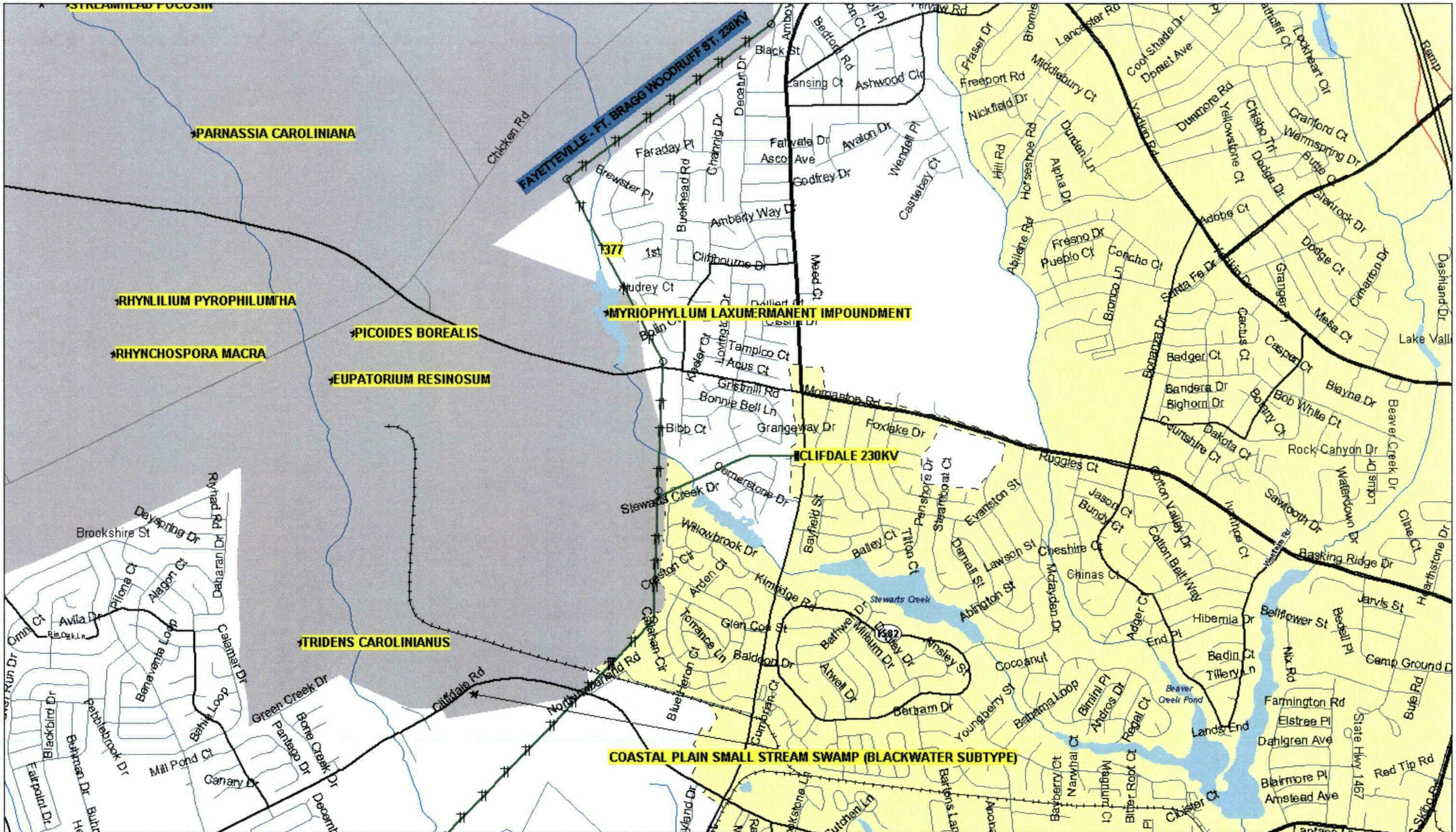

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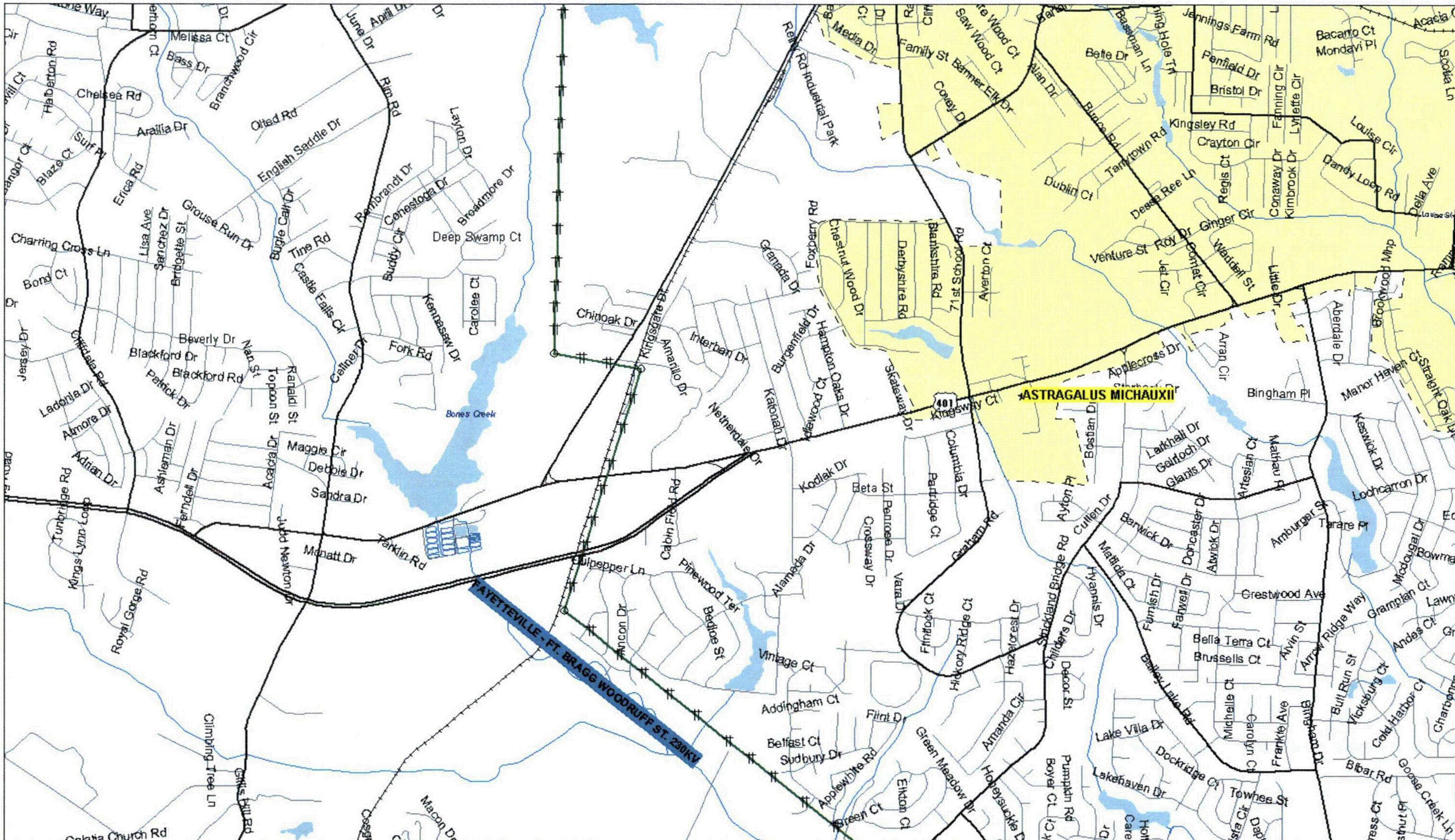

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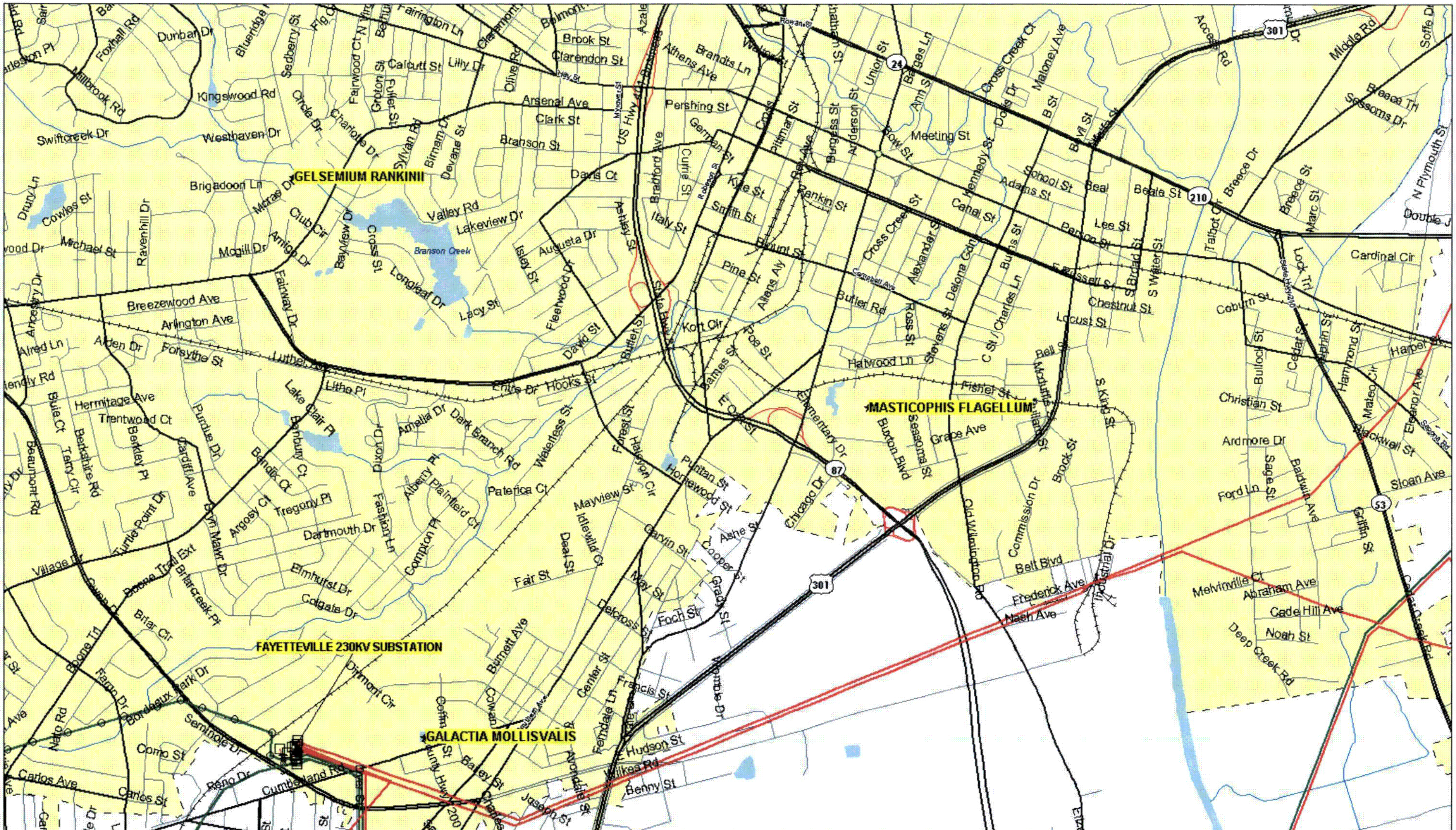

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