Yadkin Project
FERC No. 2197

INVASIVE EXOTIC PLANT PEST SPECIES ASSESSMENT

FINAL STUDY REPORT

JUNE 2005

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SUMMARY

The Invasive Exotic Plant Pest Species Assessment Final Study Report presents the results of a survey of invasive exotic plant pests (IEPPs) found within the Yadkin Project area. The study was conducted by Normandeau Associates, Inc. (NAI) as part of the Federal Energy Regulatory Commission (FERC) relicensing process for the Yadkin Project. The study was conducted in accordance with the IEPP Final Study Plan that was developed by Alcoa Power Generating, Inc. (APGI) in consultation with the Wetlands, Wildlife and Botanical Issue Advisory Group (IAG). Specific objectives identified in the Final Study Plan included:

- Identify potential impact areas within the Project area and inventory for the presence of IEPP species.
- Evaluate the current status of known aquatic IEPPs.
- Evaluate potential impacts of IEPPs on natural communities in areas of concern.

Invasive exotic plant pests are plant species that are of long-term management concern to resource agencies and others. IEPPs are non-native plants that were introduced to this country over the years, and possess characteristics or growth habits that allow them to out-compete native vegetation or occupy new habitats. IEPPs are ubiquitous to developed areas of the United States, and the Yadkin Project area is no exception. Common examples of IEPPs include Japanese honeysuckle and kudzu. IEPPs are of concern in areas where they have the potential to threaten rare plant species or native vegetation that provides important habitat for wildlife.

The focus of this study was to survey the Project area for IEPPs that pose a threat to rare plant species or important wildlife habitats at the Yadkin Project. At the outset of the study, a list of IEPPs that were considered likely to occur in the Project area and would be the focus of the inventory was developed and approved by the Wetlands, Wildlife & Botanical IAG. In total, 32 IEPPs, including both aquatic and terrestrial plants, were included on the initial IEPP search list. Field searches for IEPPs were conducted by NAI during the spring, summer and fall of 2004.

Results of the field surveys found 20 species of IEPPs in the Yadkin Project area, including 3 aquatic species and 14 terrestrial species that had been included on the original search list. In addition, NAI found 3 other terrestrial IEPP species in the Project area that were not included on the original search list. Among the aquatic IEPP species located, only one, a small population of *Hydrilla* found on Tuckertown, was of any concern. NAI concluded that this *Hydrilla* population "bears watching" to see if the population is expanding or stable. Two aquatic IEPP species that were previously reported to occur in one or more of the Project reservoirs, variable-leaf milfoil (*Myriophyllum heterophyllum*) and Brazilian elodea (*Egeria densa)* were never found during the 2004 surveys.

Among the terrestrial IEPP species found in the Project area, only one bush honeysuckle (*Lonicera X bella*), was determined to be of immediate management concern. On the Falls Reservoir shoreline, this species was found growing in close association with two RTE species, piedmont indigo-bush (*Amorpha schwerinii*) and thick-pod white wild indigo (*Baptisia alba*). At this site, an area commonly referred to as the "Yadkin River Scour Banks", the bush honeysuckle occupied most of the available space that appeared to provide suitable habitat for the two RTE species.

Many IEPP species appear to be irreversibly incorporated in their respective plant communities. In most cases, attempts to eliminate or control them would be infeasible. Direct intervention may be justified in only one instance, to improve the survival prospects of the RTE species *Baptisia alba.* Nevertheless, aquatic IEPP do have the potential to take hold at any time, particularly in response to any change in reservoir operation. Therefore, periodic monitoring of aquatic IEPPs, in order to identify and evaluate future management problems and practical strategies for solving them, should be considered.

1.0 INTRODUCTION

Alcoa Power Generating Inc. (APGI) is applying to the Federal Energy Regulatory Commission (FERC) for a new license for the Yadkin Project. The Project consists of four reservoirs, dams, and powerhouses (High Rock, Tuckertown, Narrows, and Falls) located on a 38-mile stretch of the Yadkin River in central North Carolina (Figure 1). The Project generates electricity to support the power needs of Alcoa's Badin Works and its other aluminum operations, or is sold on the open market.

The presence of invasive exotic plant pest (IEPP) species in the Project area and their potential impacts on natural terrestrial and aquatic plant communities is of concern to natural resource agencies and others. The focus of this study was on areas of concern including Uwharrie National Forest (UNF), Morrow Mountain State Park and Shoreline Management Plan (SMP) Conservation Zones (including islands), and on areas with impact potential on Narrows Reservoir.

2.0 BACKGROUND

As part of the relicensing process, APGI prepared and distributed, an Initial Consultation Document (ICD; Alcoa 2002), which provides a general overview of the Project. Agencies, municipalities, non-governmental organizations and members of the public were given an opportunity to review the ICD and identify information and studies that were needed to address relicensing issues. To further assist in the identification of issues and study needs, APGI formed Issue Advisory Groups (IAG) to advise APGI on resource issues throughout the relicensing process. Through meetings, reviews and comments, the IAGs assisted in developing the Study Plans for the various resource issues, and will further review and comment on the findings resulting from the implementation of the study plans. The Wetlands, Wildlife and Botanical IAG was interested in the presence of IEPP species in the Project area, their potential impacts on natural terrestrial and aquatic plant communities in areas of concern under existing conditions, and in assessing how these species could be affected by existing Project operations. Any changes that may occur as a result of altered Project operations, if proposed, were assessed. This report presents the findings of the IEPP species studies, following implementation of the Final Study Plan, dated June 2003.

3.0 STUDY AREA

The IEPP Study Area encompassed all four reservoirs under APGI management: High Rock, Tuckertown, Narrows, and Falls. Upstream Project limits extended up the Yadkin River to approximately 1 mile north of Boone’s Cave State Park. On the South Branch of the Yadkin, the Project limits occurred approximately 6 miles from its confluence with the Yadkin River. The downstream Project limits extended approximately 1 mile below Falls Dam, which was estimated to be the maximum extent of riverine flow in the Falls dam tailrace during low water on Tillery Reservoir. All wetlands and riparian habitats within the zone of influence of reservoir operations were included in the study area, as well as all lands within 200 feet of the shoreline.

IEPP surveys were also performed on the Falls and Narrows transmission line corridors and Project lands within the vicinity of the four dams and powerhouses. The combined length of the two transmission line corridors is approximately 4.6 miles. The survey included the maintained corridor

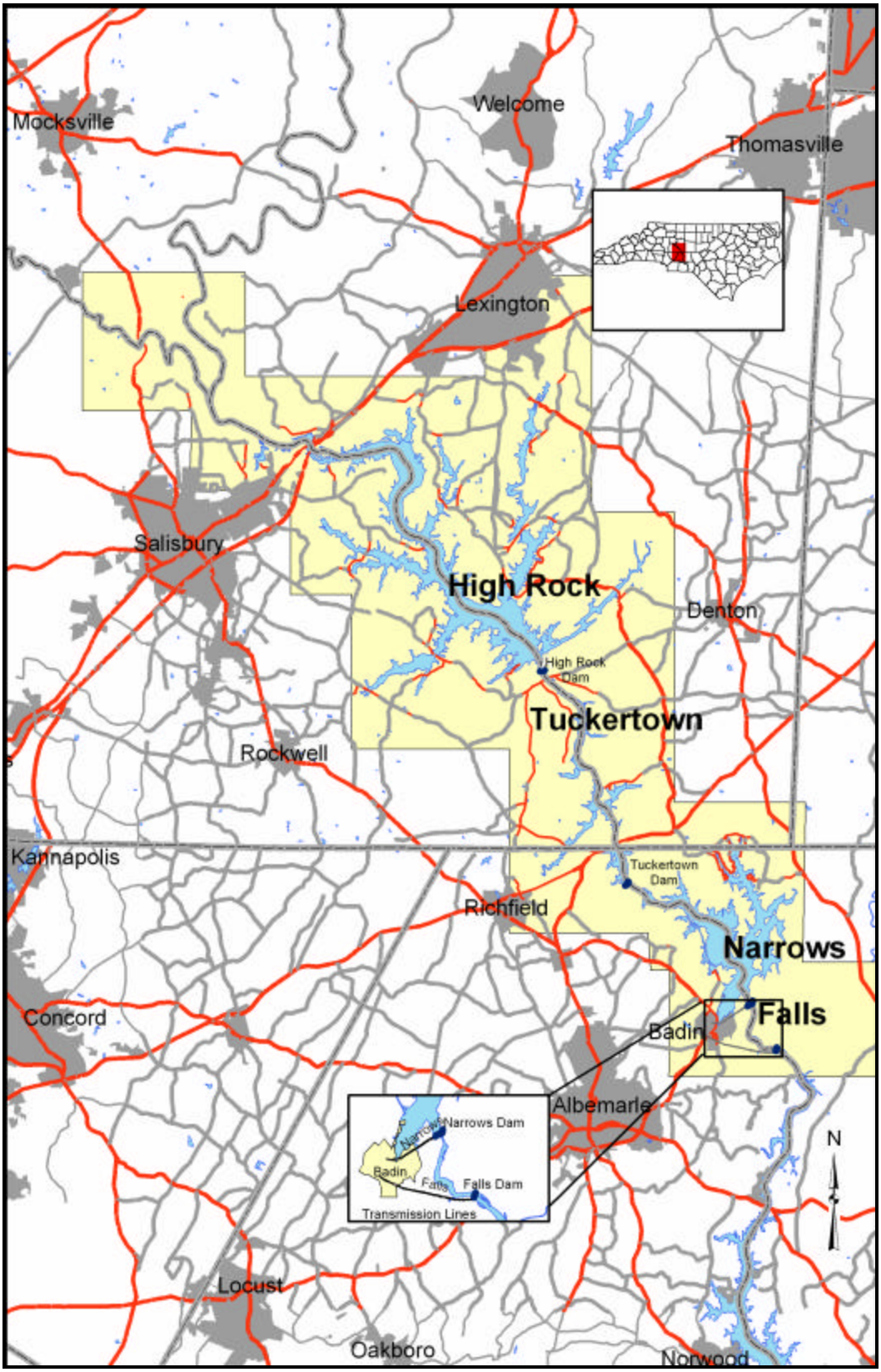

Figure 1. Locus of Yadkin Project.

plus an additional area extending 50 feet from either side. The land and facilities in the immediate area of the four dams, including parking lots and access roads were also included (Figures 2-5).

4.0 STUDY PURPOSE AND OBJECTIVES

Over a series of meetings the Wetlands, Wildlife and Botanical IAG discussed objectives for IEPP species study. Over the course of those discussions the following objectives were identified for the study.

- Identify potential impact areas within the Project area and inventory for presence of IEPP species.
- Evaluate the current status of known aquatic IEPPs.
- Evaluate potential impacts of IEPPs on natural communities in areas of concern.

5.0 STUDY METHODS

5.1 DEVELOPMENT OF INVASIVE EXOTIC PLANT PEST SPECIES LIST

A preliminary list of invasive exotic plant pest (IEPP) species was compiled from lists produced by five sources: North Carolina Aquatic Weed Control Program (NCDACS 2003a); North Carolina Department of Agriculture Noxious Weeds List (NCDACS 2003b); North Carolina State University Aquatic Weed Management Program (NCSU 2003); the Southeast Exotic Pest Plant Council (USDA Forest Service 2001); and the USDA Forest Service Regional Invasive Exotic Plant Species List (Miller et al. 2003). These species were divided into two groups, Aquatic and Terrestrial. Because the Terrestrial species are commonly abundant in several habitat types, and because they are only minimally affected by reservoir operations, these species were noted as they appeared in the field but were not individually investigated.

The Aquatic species were divided into two groups via the assistance of Dr. Alan Weakley (UNC Herbarium Curator), who has performed botanical surveys along the Yadkin Project, and recently completed an invasives inventory for the Uwharrie National Forest (S. Sharp, 2004). Dr. Weakley was recommended as the most appropriate reviewer for invasive plants by the other two botanists who contributed to the development of the rare, threatened and endangered species list (Dr. Moni Bates, Dr. Pete Diamond), and by Shannon Sharp, USFS botanist at the Uwharrie. Dr. Weakley noted those species that are present, questionable, unknown or unlikely to occur within the Project boundaries. Normandeau then ranked the species according to their likelihood of being influenced by changes in Project operations. The following categories were used:

Primary Aquatic- aquatic species that are currently present, or their status is unknown but potentially could occur;

Secondary Aquatic - aquatic species not known or unlikely to occur in the Project boundaries; and

Secondary Terrestrial – terrestrial species that are likely to occur within the Project Area, but do not typically occur within the full pond of the reservoirs.

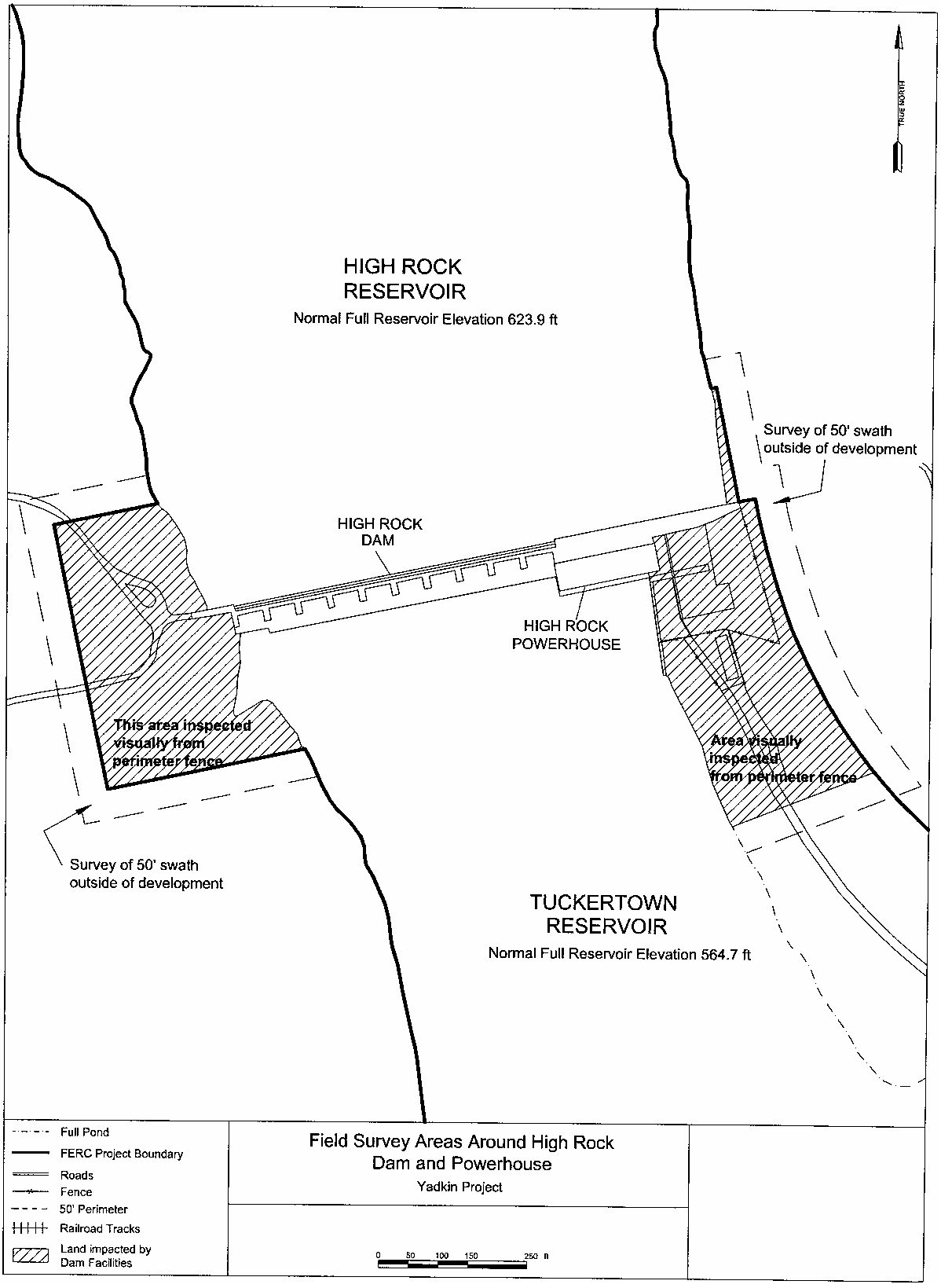

Figure 2. High Rock Reservoir dam facility.

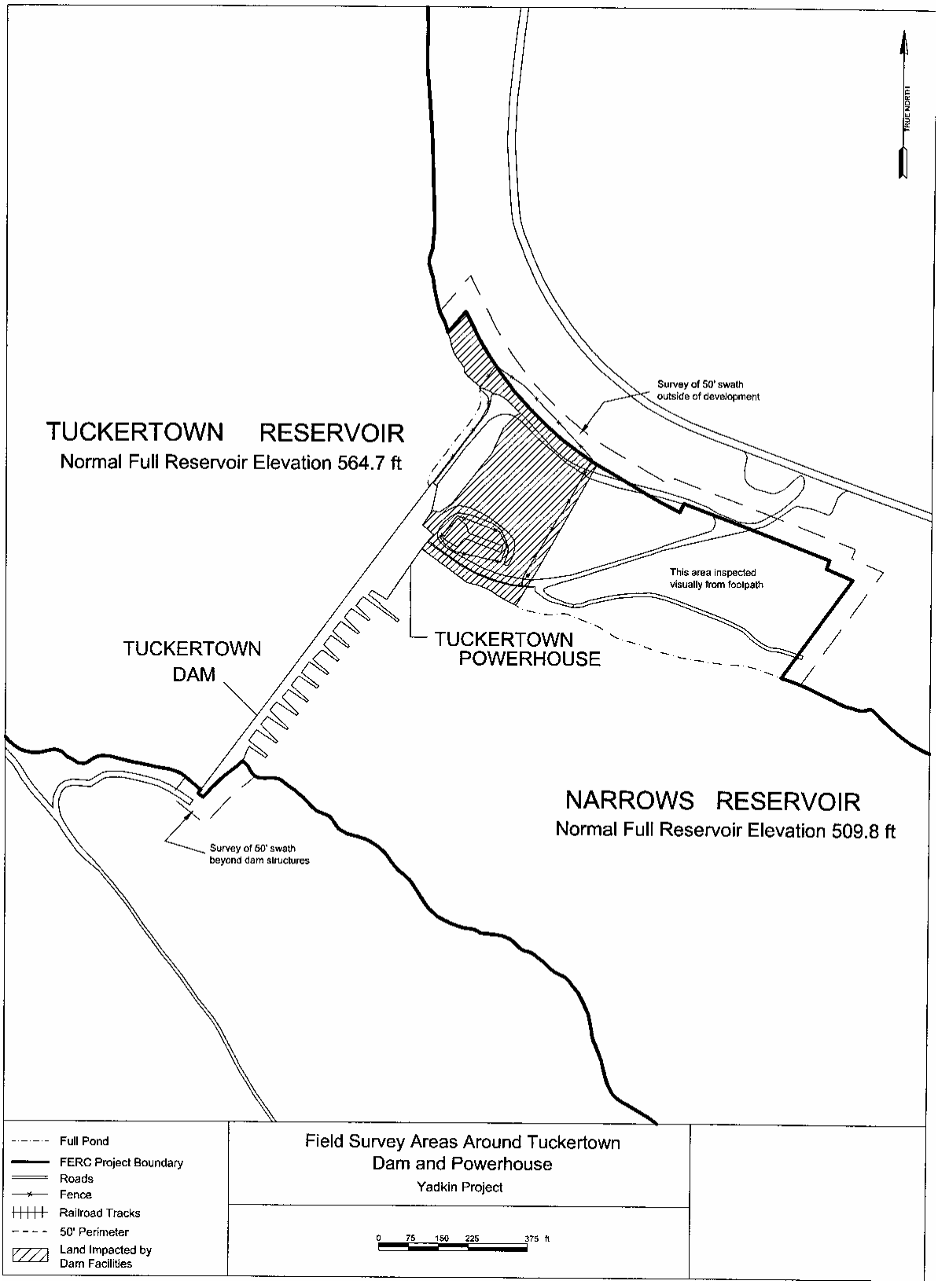

Figure 3. Tuckertown Reservoir dam facility.

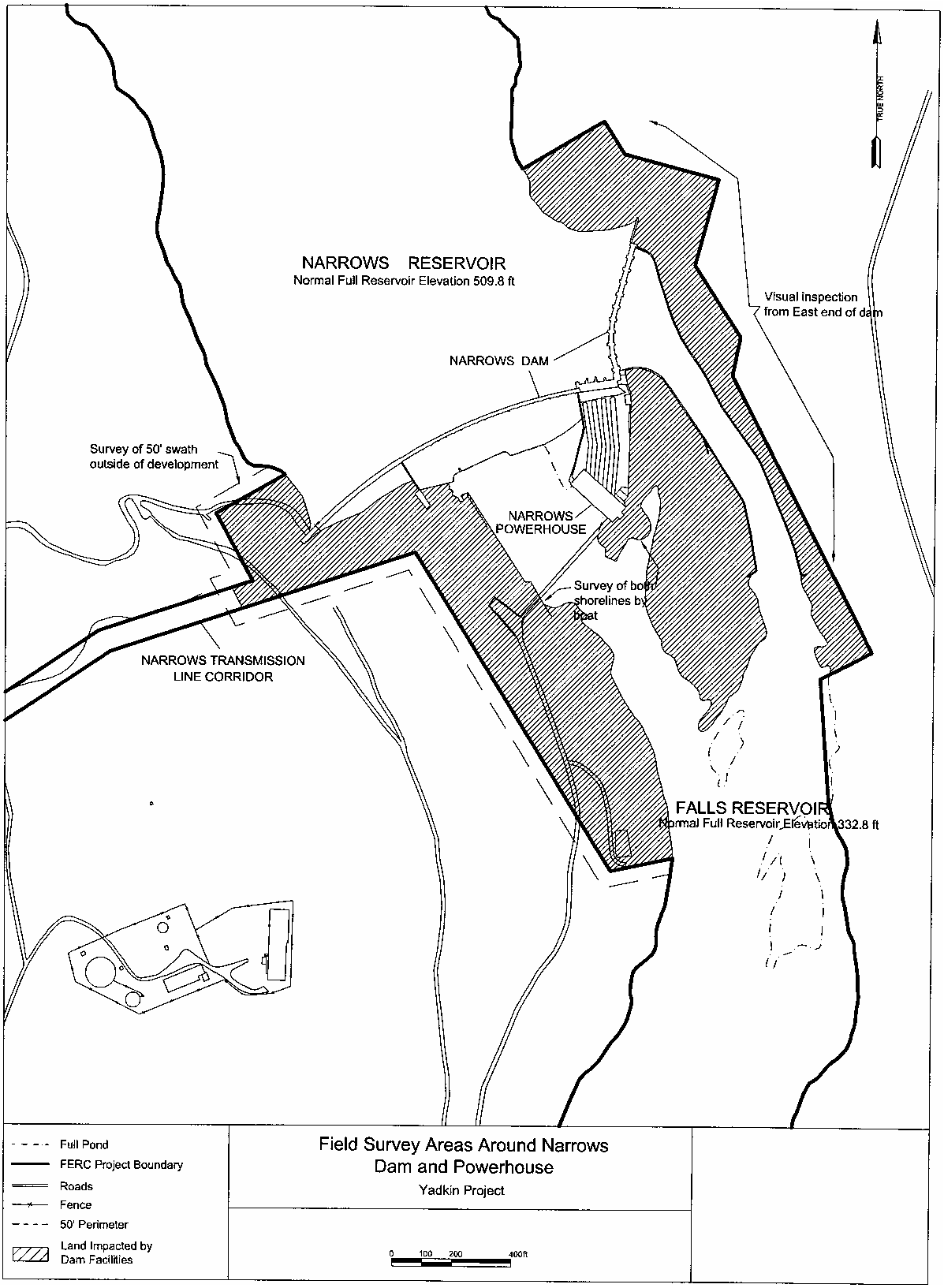

Figure 4. Narrows Reservoir dam facility.

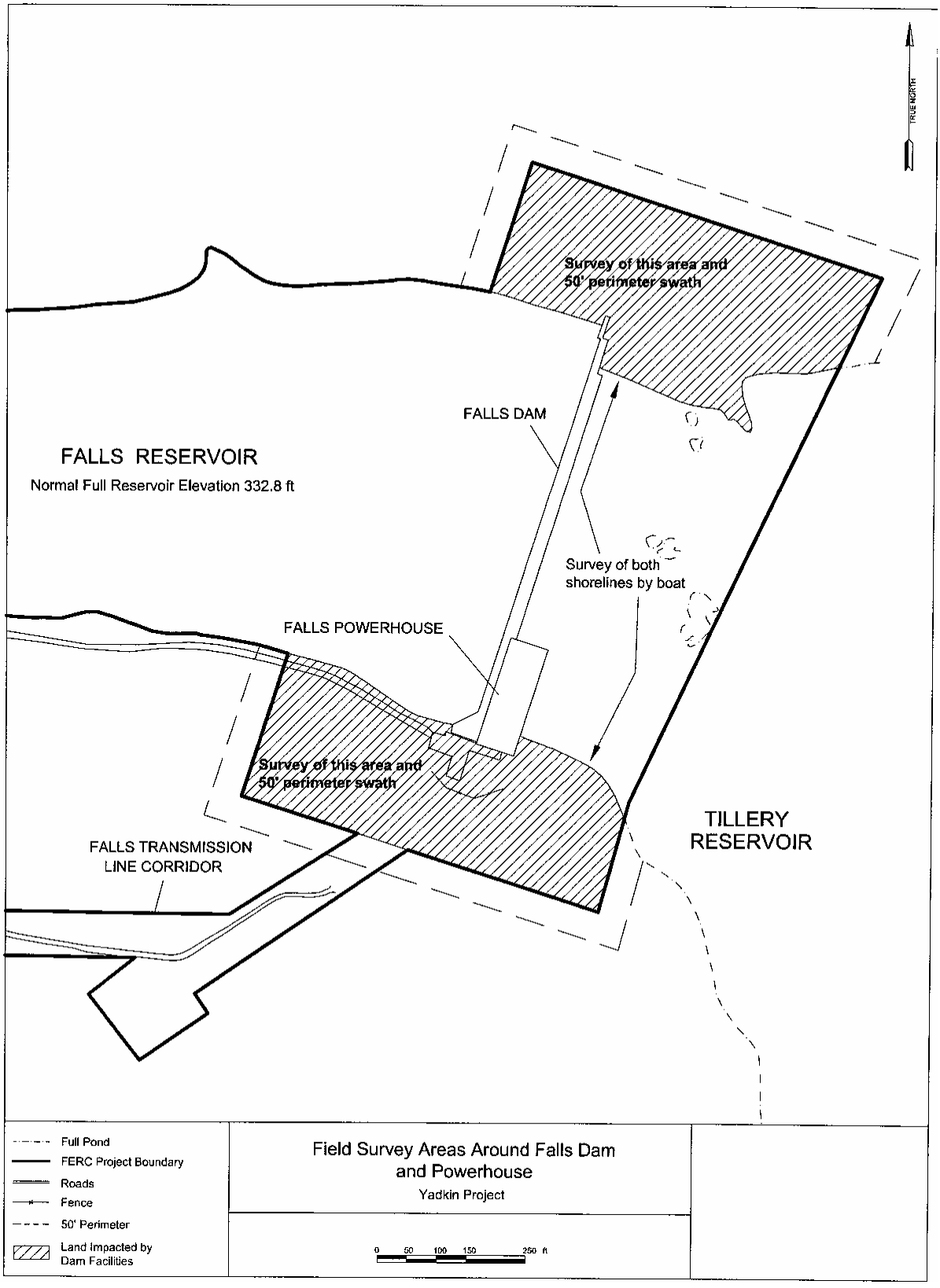

Figure 5. Falls Reservoir dam facility.

The Preliminary IEPP list was distributed at the February 8, 2004 Wetlands, Wildlife and Botanical Interagency Advisory Group meeting. It contained 7 Priority Aquatic species, 7 Secondary Aquatic species and 18 Secondary Terrestrial species. No additional modifications were made following that meeting, thus the list became final (Table 1).

5.2 PLAN AND SCHEDULE FOR CONDUCTING IEPP FIELD STUDIES

Two brief field surveys were performed in the Fall 2003 to look at emergent vegetation in High Rock Reservoir and to perform some preliminary ground truthing. Three extended field surveys were planned and undertaken during 2004. Each coincided with a different field season (spring, summer and fall) and lasted 10, 9, and 13.5 days, respectively. Three NAI senior biologists participated for a total of 55 person-days. For 2, 3 and 3 days respectively during each field season, they were joined by a local botanist, Dr. Peter Diamond from the North Carolina Zoological Park in Asheboro.

Scheduling of the field surveys throughout the growing season ensured that all plant species on the IEPP search list could be encountered, if present, in a reasonably detectable and identifiable condition during at least one life-history stage. The search for IEPP species was only one component of the work being performed during the field studies, along with rare, threatened and endangered species and ground-truthing the vegetation cover type maps. However, during all types of surveys, data on invasive species were collected when they were encountered. Most the entire shoreline of the Project Area was visited one or more times in the course of 2003-2004 fie ld work.

5.3 FIELD SURVEYS

Aquatic plants (submergent, floating, and emergent) were the emphasis of the IEPP field survey, since they were the species expected to undergo the direct impacts of any reservoir water-level management change. The choice of search locations for aquatic IEPP species observed the following criteria:

- Shallow bottoms (to 10 vertical feet below full-pool elevation, depending on water clarity).
- The slack water of creek mouths and embayments with low current and wave energy.
- Water bodies with presumed or observed high dissolved nutrient concentrations.

While the search for aquatic species was extensive, water turbidity and atypically high water levels increased the potential that some aquatic IEPP beds were missed.

Other plant communities received attention commensurate with the degree to which human disturbance appeared to be a factor, because of the frequent association of invasives with human activity. Therefore, the immediate vicinity of dam facilities, power transmission lines and transportation corridors were a focus for the terrestrial component of the IEPP survey. Incidental observations of IEPP occurrence were made in the course of all study components. Residential and commercial areas were not surveyed because of the frequent use of exotic plant species in landscaping and gardens.

It had been the hope that toward the end of the 2004 growing season, with plant biomass at or near its peak, falling reservoir water levels would have exposed emergents and aquatic beds sufficiently to facilitate the description of these plant communities by their extent and species composition. Instead, the passage of two successive tropical storms through the Project Area kept reservoir water at or near

Table 1. List of Invasive Exotic Plant Pests potentially occurring in the Yadkin Project Area.

Scientific Name	Common Name	Life Form	Source	State	Fed	Occurrence
Primary - Aquatic						
Egeria densa	Brazilian elodea	SAV*	2, 5, 6			undocumented report
Hydrilla verticillata	Hydrilla	SAV	1, 2, 3,5, 6	Class A	Y	undocumented report
Ludwigia hexapetala/uruguayensis	Uruguay waterprimrose	SAV	2, 3, 5	Class B		may be present
Myriophyllum aquaticum	Parrotfeather	SAV	1,2, 5			may be present
Myriophyllum heterophyllum	Variable-leaf milfoil	SAV	2, 5			undocumented report
Myriophyllum spicatum	Eurasian watermilfoil	SAV	1, 2, 3, 5, 6	Class B		may be present
Najas minor	Brittle naiad	SAV	2, 5			may be present
Secondary - Aquatic						
Alternanthera philoxeroides	Alligatorweed	SAV	1, 2, 5, 6			unlikely in the area
Azolla pinnata	Feathered waterfern	SAV	2, 3, 5	Class A	Y	not known anywhere in the vicinity
Crassula helmsii	Swamp stonecrop	SAV/emer	3, 5	Class A		not known anywhere in the vicinity
Lagarosiphon major	African elodea	SAV	3, 5	Class A	Y	not known anywhere in the vicinity
Polygonum perfoliatum	Mile-A-Minute	Emergent	3, 5, 6**	Class A		not known anywhere in the vicinity
Salvinia molesta	Giant salvinia/ water fern	SAV	1, 2, 3, 5, 6	Class A	Y	not known anywhere in the vicinity
Trapa natans	Water chestnut	SAV	3, 5	Class A		not known anywhere in the vicinity
Secondary - Terrestrial						
Ailanthus altissima	Tree of Heaven	Tree	5, 6,7,8,9,10			definitely present
Albizia julibrissin	Mimosa	Tree	4, 5, 6			definitely present along shorelines
Arthraxon hispidus	Small carpgrass/hairy jointgrass	Grass	5, 6			definitely present
Elaeagnus umbellata	Autumn/Russian olive	Tree	5, 6,7,8,9,10			definitely present
Lespedeza bicolor	Bicolor lespedeza	Shrub	4, 5			definitely present
Lespedeza cuneata	Chinese lespedeza	Grass	5, 6,8,9,10			definitely present
Ligustrum japonicum	Japanese privet	Shrub	4, 5, 6			may be present
Ligustrum sinense	Chinese privet	Shrub	4, 5, 6			definitely present
Lonicera japonica	Japanese honeysuckle	Vine	4, 5, 6			definitely present
Lonicera spp (morrowii, bella, tartarica)	Bush honeysuckle	Shrub	5, 6, 7			definitely present
Melia azedarach	Chinaberry	Tree	4, 5, 6			definitely present along shorelines
Microstegium vimineum	Nepalese browntop	Grass	5,6,8,9,10			definitely present
Miscanthus sinensis	Chinese silvergrass	Grass	5,6,8,9			definitely present
Pueraria montana	Kudzu	Vine	4, 5, 6			definitely present
Rosa multiflora	Multiflora rose	Shrub	4, 5, 6			definitely present
Sapium sebiferum	Chinese tallowtree	Tree	4, 6			not known anywhere in the vicinity
Vinca minor	Common periwinkle	Forb	5,7,8,10			definitely present
Wisteria sinensis	Chinese wisteria	Vine	4, 5, 6			definitely present

(continued)

Table 1. (Continued)

Notes
Class A, any noxious weed on the Federal list or is not native to the State and poses a serious threat
Class B, any noxious weed not native to the State, is of limited distribution statewide and poses a serious threat

1 = NC Aquatic Weed Control Program
2 = NCSU Aquatic Weed Management
3 = NCDA Noxious Weeds List
4 = Invasive Plants in Southern States, as occurring in NC
5 = Dr. Alan Weakley, UNC Herbarium Curator, Chapel Hill
6 = USDA Forest Service Southern Region
7= Tennessee
8 = Kentucky
9 = Georgia
10 = Virginia
* Submerged aquatic vegetation
** Not listed as occurring in NC

full-pool elevation, with high turbidity, during the Fall Project Area inspection. Aquatic beds had to be sampled primarily by scraping the bottom and grappling water-column growth with a 10-foot-long extendable rake. Some of the shorter species components of the emergent plant community were inundated in a mature, inflorescent state. The degree to which an aquatic invasive like *Hydrilla verticillata* constituted a current threat to its native counterparts had to be deduced by its frequency of appearance and relative abundance in rake-head samples. Qualitative assessment of the terrestrial IEPPs was estimated via field notes and photographs.

6.0 SUMMARY OF EXISTING STUDIES AND INFORMATION ON THE PROJECT AREA

Invasive exotic plants have been listed for the southeastern USA (USDA Forest Service 2001, Miller et al. 2003). The same exercise has been performed for the State of North Carolina (North Carolina Department of Agriculture and Consumer Services 2003a, 2003b; North Carolina State University Aquatic Weed Management Program 2003). Additional Project-specific information on invasives was garnered during discussions in the IAG meetings with individuals familiar with the reservoirs, and Yadkin personnel (R. Smet 2004).

7.0 RESULTS OF FIELD SEARCHES

Observations of IEPP species fall into five discrete categories: water, forested wetland and floodplain, dam facilities, power transmission lines and travel corridors, and forested upland. Excepting Nepalese Browntop (*Microstegium vimineum*), different IEPP species were found in association with each of these categories (Table 2).

Water. Of all five categories, this one proved most free of domination by IEPP species. Figure 6 shows the shallows (within about 10 vertical feet of full pool elevation) where aquatic bed vegetation and aquatic IEPP species were found during the 2004 NAI survey of the Project Area. Two Primary Aquatic target species listed in Table 1 as occurring in the Project Area, Variable-leaf Milfoil (*Myriophyllum heterophyllum*), and Brazilian Elodea (*Egeria densa*) were never found. Hydrilla (*Hydrilla verticillata*), another previously reported Primary Aquatic, occurred just once, in a rake sample in Flat Creek, Tuckertown Reservoir, among abundant native submergents. The only other listed IEPP aquatic species found was Uruguay Water-primrose (*Ludwigia uruguayensis (L. hexapetala)*), and this species occurred in a large monotypic stand in only one location, Abbotts Creek, High Rock Reservoir, at the Rte. 47 bridge (Figure 2). Elsewhere (chiefly Tuckertown and Narrows Reservoirs), it appeared to compete on no better than equal terms with its closest congener, Floating Seedbox (*L. peploides*), in small backwater patches among many other aquatic and emergent species.

Three small specimens of an unlisted IEPP species, the floating Water Lettuce (*Pistia stratiotes*), were found stranded near one another by autumnal floodwaters in Narrows Reservoir, apparently far from their point of origin. Two native submergents, Broad Water-weed (*Elodea canadensis*) and Thread-like Naiad (*Naias gracillima*), were abundant in quiet shallows in Narrows and Tuckertown, but their two respective lookalike IEPP species, Brazilian Elodea and Brittle Naiad (*Naias minor*), both on the Primary Aquatic list, were not detected. Instead of the listed IEPP Feathered Water Fern (*Azolla pinnata*), its lookalike the native Mosquito Fern (*A. caroliniana*) was observed, as a minor constituent of floating duckweed mats.

Table 2. IEPP species observed within Yadkin Project Area

Scientific Name	Common Name	Life Form	Habitat
Aquatic			
Hydrilla verticillata	Hydrilla	SAV	Aquatic bed
Ludwigia hexapetala/uruguayensis	Uruguay waterprimrose	Floating	Aquatic bed
Pistia stratiotes *	Water lettuce	Floating	Aquatic bed
Terrestrial			
Ailanthus altissima	Tree of Heaven	Tree	Upland, dams
Albizia julibrissin	Mimosa	Tree	Upland, dams
Arthraxon hispidus	Small carpgrass/hairy jointgrass	Grass	Powerline
Glechoma hederacea *	Gill-over-the-ground	Herb	Forested wetlands
Lespedeza cuneata	Chinese lespedeza	Grass	Powerline, dams
Ligustrum japonicum	Japanese privet	Shrub	Upland
Ligustrum sinense	Chinese privet	Shrub	Upland, forested wetlands
Lonicera japonica	Japanese honeysuckle	Vine	Upland, forested wetlands
Lonicera spp (morrowii, bella, tartarica)	Bush honeysuckle	Shrub	Upland, forested wetlands
Lysimachia nummularia *	Moneywort	Herb	Forested wetlands
Melia azedarach	Chinaberry	Tree	Powerline
Microstegium vimineum	Nepalese browntop	Grass	Powerline, upland, forested wetlands
Miscanthus sinensis	Chinese silvergrass	Grass	Powerline
Pueraria montana	Kudzu	Vine	Dams
Rosa multiflora	Multiflora rose	Shrub	Upland, dams
Rosa wichuraiana *	Memorial rose	Vine	Dams
Wisteria sinensis	Chinese wisteria	Vine	Dams

* Not listed as occurring in the Yadkin area, but a known invasive in the Southeast.

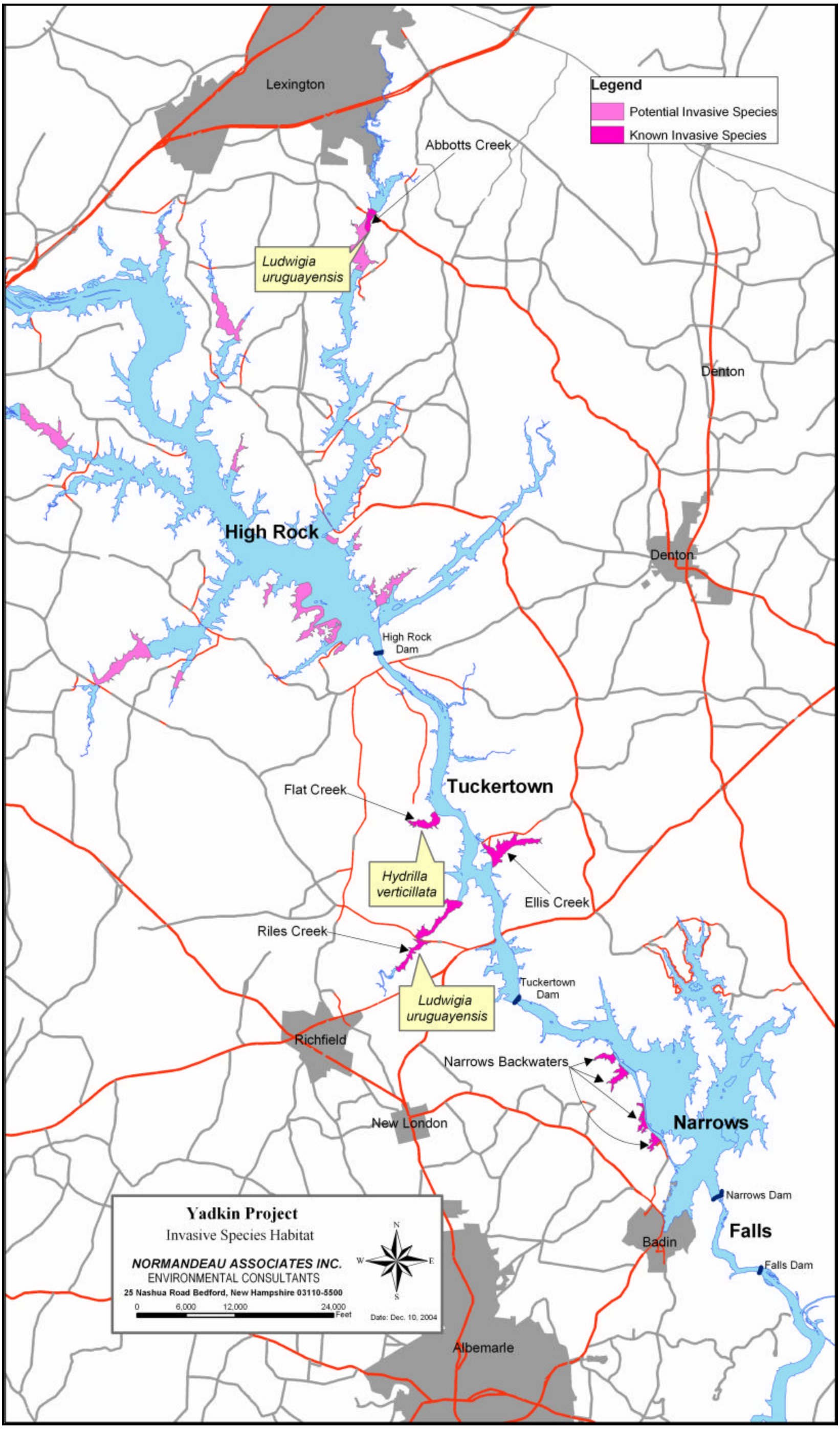

Figure 6. Invasive Exotic Plant Pest (IEPP) occurrence, 2004. Dark-pink areas represent general locations of observed aquatic beds, with associated IEPP species identified wherever found. Light-pink areas represent locations relatively vulnerable to future IEPP invasions, should reservoir management practices change to benefit aquatic IEPPs.

Forested wetland and floodplain. Floodplain habitat around the Yadkin Project reservoirs is limited and occurs primarily on the upper end of High Rock Reservoir along the Yadkin mainstem and the South Yadkin River. In this area, upstream of the Interstate 85 bridge, typical floodplain structure is apparent: a clearly defined river channel bordered by natural levees of well-drained sediment, behind which the alluvium slopes down gradually into forested wetland and often semi-permanent standing water. The floodplain area invaded most aggressively by IEPP species coincides with the relatively high and dry levees, some of which comprise an essentially upland understory flora. At least three IEPP species occur here as understory dominants: Chinese Privet (*Ligustrum sinense*), Japanese Honeysuckle (*Lonicera japonica*), and Nepalese Browntop. Gill-over-the-Ground (*Glechoma hederacea*) and Moneywort (*Lysimachia nummularia*), naturalized European species often listed as invasives in North America, were ground-cover dominants. All but the browntop are semi-evergreen at this latitude, an attribute that confers a competitive advantage over the many native species also present.

Dam facilities. Seven IEPP species occurred around the dams and related facilities. Three were trees: Tree-of-Heaven (*Ailanthus altissima*), Mimosa (*Albizia julibrissin*), Japanese Privet (*Ligustrum japonicum*); four were climbers: Memorial Rose (*Rosa wichuraiana*), not listed in Table 1, Multiflora Rose (*R. multiflora*), Kudzu (*Pueraria montana*), and Chinese Wisteria (*Wisteria sinensis*). All are light-demanding, fast-growing species with an ability to exploit canopy gaps and, in this instance, the openings created by periodic removal of robust woody growth in the immediate vicinity of the fenced dam compounds, buildings and roads. Although often subject to the same routines of periodic cutting and herbicide treatment as all other species, the dominant IEPP species proved able by their superior powers of regeneration to out compete much of the native vegetation.

Power transmission lines and transportation corridors. About a dozen of the IEPP species listed in Table 1 as terrestrial invasives were found in the primarily upland vegetation of both the Falls Dam and Narrows Dam transmission lines. However, only two occurred with sufficient frequency and abundance to indicate a state of pre-emptive dominance: Chinese Bush Clover (*Lespedeza cuneata*) and Nepalese Browntop. With its erect, unspreading growth habit, the bush clover never grew in closed, monotypic stands to the exclusion of all other species, but its numbers clearly amounted to significant biomass over a wide variety of open upland conditions, particularly in the drier sites. By contrast, the browntop's distribution was far more restricted in its transmission-line distribution, but where conditions were suitable (relatively high soil moisture content), it could overwhelm almost all competition in patches up to 25 m^2. It compensates for its relatively small size by lateral spreading with a density and rapidity that inhibits germination and establishment of most other species, and its matted overwintering remains serve effectively as a mulch that deters regenerating competition well into the next growing season. One listed IEPP species, Hairy Joint Grass (*Arthraxon hispidus*), peaked in abundance in association with the wet meadow of Wetland 1 on the Falls Dam power transmission line.

Upland forest. This fifth category includes essentially all forest not associated with the preceding four. As it constitutes generally the least disturbed of any category, it also appears less threatened by IEPP domination. Only two IEPP species, a hybrid bush honeysuckle (*Lonicera X bella*) and the Nepalese Browntop, were observed in situations that appeared threatening to native flora.

The bush honeysuckle was widespread and a frequent dominant of the shrub layer. On the Falls Reservoir shoreline, this species was found in close association with two RTE species, Piedmont Indigo-bush (*Amorpha schwerinii*) and Thick-pod White Wild Indigo (*Baptisia alba*) in an area

referred to as the Yadkin River Scour Banks (Baranski 1994, Normandeau 2005). The bush honeysuckle occupied the preponderance of the available space in this particular site, a rocky shelf under a thin tree canopy near enough to the reservoir to undergo occasional flood-water scouring. The *Amorpha* may be of a size to hold its own against the bush honeysuckle, albeit at some possibly reduced level of viability. However, the *Baptisia*, which attains little more than 1 m in stature and dies back to the root every winter, is probably more vulnerable.

Nepalese Browntop may be found in lowland and mesic forest almost anywhere in the Project Area, often as a major component of the understory flora. Although its very presence in a habitat always precludes the use of certain habitat resources by other species, it attains a fully aggressive state (maximum biomass) in forest canopy gaps and other situations of relatively strong light. Because of its recumbent growth habit and short stature, it is likely to prove most injurious to other species of small size, e.g. members of the Violet Family (Violaceae).

8.0 EFFECTS OF PROJECT OPERATIONS AND FACILITIES ON IEPP SPECIES

The only direct impacts of the current Project hydrologic regime on IEPP species are those caused by the movement and elevation of water within the reservoir system. Such movement affects the hydrologic regime of all aquatic and swamp forest lakeshore habitats. Qualitative observations from the 2004 NAI surveys indicate that current reservoir management practices have not resulted in the presence of large or diverse aquatic IEPP populations. In fact, two species reported from previous years on High Rock, Variable-leaf Milfoil and Brazilian Elodea, were not observed in 2004. A small population of Hydrilla in Tuckertown noted in the 2004 field surveys bears watching to see if the population is expanding or stable.

IEPP species of the floodplain plant community are comparatively numerous and well established. Because of their location on floodplains at the upper end of High Rock Reservoirs, they are chiefly influenced by river flows and flooding rather than reservoir operations.

IEPP species can be expected to continue to flourish around the four dam facilities and the Narrows and Falls connecting power transmission lines, currently in the process of being widened. In both cases, vegetation management by APGI introduces disturbance that sets back plant succession, and often promotes the dominance of certain IEPP species. IEPP species response at the dam facilities includes primarily woody plants; along the power transmission lines, IEPP species are primarily herbaceous.

Any changes in Project operations could alter the potential for IEPPs. For example, aquatic vegetation is limited in shallow water areas of High Rock Reservoir due to fluctuations in reservoir water levels and periodic exposure that these areas experience under existing Project operations. These shallow areas in High Rock have high potential for establishment of aquatics should reservoir levels be maintained at a more constant elevation, some of which could be IEPPs. In general, the longer that stable reservoir pool elevations are maintained during the growing season, the more aquatic plant biomass will be produced, including that of IEPP species. Given the high nutrient levels, particularly in High Rock, the potential for an increase in aquatic IEPPs is clearly a concern. Winter drawdown would serve to control this vegetation, may but not eliminate it. By this reasoning, alternative Project operations that produce more stable water levels year-round would produce

conditions most conducive to the growth and spread of IEPP aquatics, while a greater or longer winter drawdown than currently seen would promote the least favorable conditions.

Overall, modifying the operation of the Project, and thereby the water level regime of High Rock Reservoir, creates the risk of a corresponding increase in undesirable IEPP aquatics. For instance, the North Carolina Extension Service (1992) reminds us that "the explosive growth of this weed and its competitiveness with native vegetation make Hydrilla the most serious weed threat in North Carolina's inland waters".

The only IEPP species that seems in need of immediate control is *Lonicera X bella* at the site where it is suspected of inhibiting the survival of *Baptisia alba* (Section 7.0). The area in question amounts to a few hundred square meters, since the *Baptisia* population is so small and strictly confined. A manual search-and-destroy operation to root out the Lonicera bushes or apply a contact herbicide would be the work of a single day for a knowledgeable botanist or two.

9.0 CONCLUSIONS

In aquatic plant communities, IEPP species constitute no apparent threat to native species, navigation, or water quality under existing conditions. In forested lakeshore upland, several IEPP species appear to be relatively widespread but innocuous, with the exception of one location where bush honeysuckle appears deleterious to the survival of known RTE species, e.g. *Baptisia alba*. IEPP species did occur in large numbers and high biomass in some habitats in the Project Area. Around the dams and associated facilities, they often assumed dominance. In the Project Area's only extensive remaining floodplain, in the upper mainstem Yadkin River above the I85 bridge, IEPP species dominate the herbaceous ground cover and shrub understory. In the Narrows and Falls transmission-line corridors, they reach peak species diversity.

Any changes in Project operations that alter reservoir water levels would directly affect aquatic plant communities (submergent, floating, emergent), and to a lesser extent the contiguous forested wetlands and floodplains on the reservoirs. Maintaining relatively stable reservoir water levels may promote an increase in the number and biomass of many aquatic plant species, including IEPP species, wherever these can exploit previously unvegetated reservoir shallows. However, the limited availability of such shallows imposes limits on the magnitude of this impact, and the sedimentation dynamics in the most extensive shallows (the upper High Rock Reservoir) would probably continue to favor exploitation by native floodplain trees rather than IEPP species.

10.0 REFERENCES CITED

ALCOA. 2002. *Yadkin Hydroelectric Project FERC No. 2197 NC project relicensing Initial Consultation Document,* September 2002. ALCOA Power Generating Inc., Yadkin Division, Badin, North Carolina.

Baranski, M.J. 1993. Natural areas inventory for Yadkin River corridor in Davie, Davidson and Rowan counties, North Carolina. Conservation Trust for North Carolina, Raleigh, NC.

Batcher, M. S. undated. Element stewardship abstract for *Hydrilla verticillata*. The Nature Conservancy, Arlington, Virginia.

Miller, J. H., E. B. Chambliss and C. T. Bargeron. 2003. Invasive plants of the thirteen southern states. University of Georgia Bugwood Network, USDA Forest Service, USDA APHIS PPQ. Internet website: www.invasive.org

North Carolina Agricultural Extension Service. 1992. Hydrilla -a rapidly spreading aquatic weed in North Carolina. Publication No. AG-440.

Normandeau Associates, Inc. 2005. Yadkin Project, FERC No. 2197. Rare, Threatened and Endangered Species Survey Final Study Report. 2005. Prepared for Yadkin, Inc., Badin, NC.

North Carolina Department of Agriculture and Consumer Services. 2003a. North Carolina Aquatic Weed Control Act of 1991, and Aquatic Weed Control Regulations. Internet website: www.agr.state.nc.us/plantind/regs/aqlaw.htm

North Carolina Department of Agriculture and Consumer Services. 2003b. North Carolina Noxious Weeds List. Internet website: www.agr.state.nc.us/plantind/plant/weed/noxweed.htm

North Carolina State University Aquatic Weed Management Program. 2003. North Carolina State University Aquatic Weed Management Website, www.weedscience.ncsu.edu/aquaticweeds/Publications.html

Sharp, S. 2004. Personal communication. Botanist, USDA Forest Service. Uwharrie National Forest, Troy, NC.

Smet, Robert. 2004. Personal communication. Natural Resource Coordinator, Alcoa Power Generating Inc, Yadkin Division, Badin, NC

USDA Forest Service. 2001. Regional invasive exotic plant species list. Southeast exotic Plant Pest Council. Internet website: www.invasive.org/seweeds.cfm

Weakley, A. S. 2004. Personal communication. University of North Carolina Herbarium, University of North Carolina, Chapel Hill, North Carolina.

APPENDIX A

List of Rare, Threatened and Endangered Species for the Yadkin Project Area

Appendix Table A. Final List of Rare, Threatened and Endangered Species for Yadkin Project Search for Terrestrial and Wetland Species only, Including Insects. Birds and Aquatic Wildlife were handled by others.

Scientific Name	Common Name	Source	State*	Federal**	County	Habitat Notes
Priority						
Amorpha schwerinii	Piedmont indigo-bush	1	SR-T		M, R, S, Dd	dry forests
Aster georgianus	Georgia aster	1,2	T	C1	M, R, S, Dd	open woods and roadsides
Aster mirabilis	Piedmont aster	1	SR-T		S	rich slopes and bottomlands
Baptisia alba	Thick-pod white wild indigo	1	SR-P		M, S	open woodland clearings
Baptisia albescens	Thin-pod white wild indigp	1	SR-P		M, R, S	open woodland clearings
Cardamine dissecta	Dissected toothwort	1	SR-P		M, R, Dd	rich woods, bottomlands
Carex impressinervia	Ravine sedge	1,2	SR-T	FSC	M	wet forests
Cirsium carolinianum	Carolina thistle	1	SR-P		M, R	forests, disturbed areas, basic soils
Helenium brevifolium	Littleleaf sneezeweed	1	E		M, R	bogs, seeps, riverbanks
Helianthus schweinitzii	Schweinitz's sunflower	1, 2, 3	E	E	M, R, S, Dd	open woods and roadsides
Plantago cordata	Heart-leaf plantain	1	E		Dd	beds of small, slate-bottomed perennial streams
Porteranthus stipulatus	Indian Physic	1	SR-P		M, Dd	forests and open woods, mainly over mafic rocks
Solidago plumosa	Yadkin River goldenrod	1,2	E	FSC	M, S	riverside rocks
Solidago radula var. radula	Western rough goldenrod	1	SR-P		S	dry woodlands over mafic rocks
Secondary						
Ambystoma talpoideum	Mole salamander	1	SC		M, R	fish-free semipermanent woodland ponds
Anemone berlandieri	Southern anemone/thimbleweed	1	SR-P		M, R, S	thin soils around rock outcrops
Carex bushii	Bush's sedge	1	SR-P		R	open wet areas
Collinsonia tuberosa	Piedmont horsebalm	1	SR-P		M	rich hardwood forests
Corynorhinus rafinesquii	Rafinesque's big-eared bat	***	E	FSC		old buildings, hollow trees, caves, mines, near water
Crotalus horridus	Timber rattlesnake	1	SC		M, S, Dd	rocky, upland forests
Fothergilla major	Large witch-alder	1	SR-T		M, S	dry ridgetop or bluff forests
Gomphus abbreviatus	Spine-crowned clubtail	1	SR		M	rivers
Gomphus fraternus	Midland clubtail	1	SR		S	rocky rivers
Hemidactylium scutatum	Four-toed salamander	1	SC		M	wetlands in hardwood forests
Hexalectris spicata	Crested coralroot	1	SR-P		S, Dd, D	dry or mesic woods on basic soils
Quercus austrina	Bluff oak	1	SR-P		M	bluff and bottomland forests
Ruellia purshiana	Pursh's wild-petunia	1	SR-O		M	glades, woodlands over mafic/calcareous rocks
Spartina pectinata	Freshwater cordgrass	1	SR-P		M	freshwater marshes
Stachys sp 1	Yadkin hedge nettle	1	SR-T		M	sandy edges of forested floodplains
Tradescantia virginiana	Virginia spiderwort	1	SR-P		M	rich woods on circumneutral soils
Verbena riparia	Riverbank vervain	1,2	SR-T	FSC	S	habitat not known
Transmission lines						
Echinacea laevigata	Smooth coneflower	1, 2, 3	E-SC	E	M	glades and open areas over mafic rocks
Gnaphalium helleri var helleri	Heller's rabbit tobacco	1	SR-P		M, R, Dd	dry woodlands, openings, glades over mafic rocks
Helianthus laevigatus	Smooth sunflower	1	SR-P		M, R, S	shaly open woods and roadsides

(continued)

Appendix Table A. (Continued)

Scientific Name	Common Name	Source	State*	Federal**	County	Habitat Notes
Lotus helleri	Carolina birdfoot-trefoil/Heller's trefoil	1,2	SR-T	FSC	R, S, Dd, D	open woods over clay soils, roadsides
Parthenium auriculatum	Glade wild quinine	1	SR-T		M	glades and openings over mafic rocks
Excluded						
Arabis missouriensis	Missouri rockcress	1	SR-P		S	thin soils around basic rock outcrops
Aster laevis var concinnus	Narrow-leaf aster	1	SR-P		S	forests, woodland borders over mafic rocks
Baptisia minor	Prairie blue wild indigo	1	T		S	glades and open forests on basic soils
Clemmys muhlenbergii	Bog turtle	2, 3	T	T/SA	Dd	bogs, wet pastures
Cyperus houghtonii	Houghtons umbrella sedge	1	SR-P			dry soil
Desmodium ochroleucum	Cream ticktrefoil	1,2	SR-T	FSC	D	sandy/rocky woodland openings
Dicanthelium annulum	Ringed witch grass	1	SR-P			dry, sandy or rocky woods, borders of thickets
Dodecatheon meadia var meadia	Eastern shooting star	1	SR-P		S, Dd	rich rocky woods over mafic or calcareous rocks
Erynnis martialis	Mottled duskywing	1	SR		M	upland woods, needs Ceanothus americanus
Fixsenia favonius ontario	Northern oak hairstreak	1	SR		M	dry oak-dominated woods
Gomphus consanguis	Cherokee clubtail	1	SR		D	spring-fed streams
Helenium pinnatifidum	Dissected sneezeweed	1	SR-P		R	savannahs and open mucky sites
Ilex amelanchier	Sarvis holly	1	SR-P		M	blackwater swamps and riverbanks
Isoetes piedmontana	Piedmont quillwort	1	T		R	granite flatrocks and diabase glades
Isoetes virginica	Virginia quillwort	1,2	SR-L	FSC	R	upland depression swamp forests
Juglans cinerea	Butternut	2		FSC	S	coves, stream benches, rock ledges
Lilium canadense ssp editorum	Red Canada lily	1	SR-P		S	bogs, wet meadows
Lindera subcoriacea	Bog spicebush	1,2	E	FSC	M	streamhead pocosins, white cedar swamps, bogs
Masticophis flagellum	Coachwhip	1	SR		S	dry sandy woods, pine/oak sandhills
Matelea decipiens	Glade milkvine	1	SR-P		S, Dd	thin woodlands over mafic or calcareous rocks
Minuartia uniflora	Single-flowered sandwort	1	E		R	granite flatrocks
Oxypolis ternata	Savanna/Piedmont cowbane	***		FSC		wetlands, wet swales, bogs
Pellaea wrightiana	Wright's cliff-brake	1	E-SC		S	rock outcrops, mafic or with nutrient-rich seepage
Pituophis melanoleucus melanoleucus	Northern pinesnake	1,2	SC	FSC	M	dry, sandy woods, pine/oak sandhills
Platanthera integra	Yellow fringeless orchid	1	T		R	savannas
Portulaca smallii	Small's portulaca	1	T		R	granite flatrocks and diabase glades
Puma concolor couguar	Eastern cougar	1, 2, 3	E	E	M	needs open forest
Quercus prinoides	Dwarf Chinquapin oak	1	SR-P		S	dry, rocky slopes
Rhus michauxii	Michaux's sumac	1, 2, 3	E-SC	E	D	sandhills, sandy forests, woodlands and edges
Silphium terebinthinaceum	Prairie dock	1	SR-P		D	diabase glades, open/semi-open areas, mafic rocks
Sistrurus miliarius	Pigmy rattlesnake	1	SC		M	pine flatwoods, pine/oak sandhills
Solidago ptarmicoides	Prairie goldenrod	1	E		R	diabase glades

(continued)

Appendix Table A. (Continued)

Notes:
1 NC Natural Heritage Program County lists updated May 2003,
NHP List of Rare Animal Species 2001, and NHP list of Rare Plant Species, 2002
2 US Fish & Wildlife Service North Carolina County lists updated 2/2003
3 US Fish and Wildlife Service TESS State list updated 2/2004
* based on NCNHP County lists updated May 2003
** based on USFWS County lists updated 2/2003
*** State and/or Federally listed but not found in counties
C1 = Consideration for listing- no protected status
E = Endangered
E/PT = Endangered Potentially Threatened
E-SC = Endangered but available commercially
FSC = Federal Special Concern - no protected status
SC = Special Concern
SR = Significantly Rare
SR-L = Significantly Rare Limited
SR-O = Significantly Rare Other
SR-P = Significantly Rare Peripheral
SR-T = Significantly Rare Throughout
T = Threatened
T/SA = Threat. due to Similarity of Appearance -
no effect on land-management activities by private landowners

Counties
S Stanly
R Rowan
M Montgomery
Dd Davidson
D Davie

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APPENDIX B

Comment Response Table

Appendix B: IEPP Comment Response Table

Copies of the Invasive Exotic Pest Plant (IEPP) Study Draft Report were distributed to the Wetlands, Wildlife and Botanical Issues Advisory Group (IAG) on March 2, 2005. The Draft Report was then summarized and discussed at the meeting, and comments and recommendations were made. Additionally, the IAG was given until April 1, 2005 to submit additional comments. Table 1 below is a summary of the comments received and responses to the comments.

TABLE 1: SUMMARY OF COMMENTS AND RESPONSES

Source of Comment	Comment	Response
Chris Goudreau, NC Wildlife Resources Commission, 3/2/05 WWB IAG meeting	The report should note that some species or beds may have been missed because of turbidity	This notation was added to page 8 of the Final Report.
Todd Ewing, 4/15/05 email	A monitoring and management plan is not proposed	The final study plan called for discussion of any management/control that may be necessary. The Final Report addresses the level of threat (low) and recommendations in the one area where control would be beneficial (Falls Scour Zone). Any further decisions on IEPP management needs would best be addressed in a separate IEPP management plan.