APPENDIX D

BIOLOGICAL RESOURCES

This appendix contains the following:

- FAA Letter to USFWS October 19, 2022
- Biological Resources Assessment
- USFWS Concurrence letter November 15, 2022

U.S. Department
of Transportation
**Federal Aviation
Administration**

Memphis Airports District Office
2600 Thousand Oaks Boulevard
Suite 2250
Memphis, TN 38118-2486

Phone: 901-322-8180

October 19, 2022

Ms. Kathryn Matthews
NC Renewable Energy Coordinator &
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
PO Box 33726
Raleigh, NC 27636-3726

Dear Ms. Matthews:

RE: NEPA Review for Proposed Project
Raleigh-Durham International Airport (RDU)
Wake and Durham Counties, North Carolina

The Federal Aviation Administration (FAA) Memphis Airports District Office is reviewing a proposed project sponsored by the Raleigh-Durham Airport Authority (Airport Sponsor) at the Raleigh-Durham International Airport (RDU) in Wake and Durham Counties in NC. The proposed action, which is being reviewed pursuant to National Environmental Policy Act (NEPA), features building a replacement runway, adjacent taxiway and associated infrastructure.

The Proposed Action includes relocating Runway 5L/23R approximately 537 feet northwest of existing Runway 5L/23R and, after construction is complete, converting the existing Runway 5L/23R to a taxiway. The project also includes use of fill material from Airport borrow sites, use of water from Brier Creek Reservoir, construction of drainage improvements, relocation of a portion of Lumley Road, utility relocations, demolition of four buildings, relocation of aircraft navigational aids, acquisition of property, and removal and/or mitigation of obstacles in accordance with Federal Aviation Administration (FAA) safety standards.

To assist in the environmental review, the FAA is seeking input from the Fish and Wildlife Service to determine if the proposed action would impact the special purpose laws of the Endangered Species Act (ESA) and the Bald and Golden Eagle Protection Act (BGEPA). Based on a review of threatened and endangered species for the project area, the wildlife surveys performed in the area surrounding the project area and documented in the project's biological report the FAA believes that the proposed project would result in a "may affect, not likely to adversely affect" (NLAA) determination for some species and "no effect" for other species. The following species and the proposed determinations are in the following chart:

Scientific Name	Common Name	Feed Status	Biological Conclusion
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	E	No Effect
Picoides borealis	Red-cockaded Woodpecker	E	No Effect
Necturus lewisi	Neuse River Waterdog	T	NLAA
Noturus furiosus	Carolina Madtom	E	NLAA
Fusconaia masoni	Atlantic Pigtoe	T	NLAA
Alasmidonta heterodon	Dwarf Wedgemussel	E	NLAA
Rhus michauxii	Michaux's Sumac	E	No Effect
Canis rufus	Red Wolf	E	No Effect

The biological report can be downloaded from the following link:

https://filesend.landrum-brown.com/download.aspx?f=26819-unDpe9zqJtxZ

There is also one active bald eagle's nest that is within the area of review. The activities and construction of the proposed project would be cordoned off from the nest by providing a 660 –foot buffer around the nest during breeding season. In addition, preliminary noise modeling indicates that the nest would receive an increase of 2.6 dBA (weighted decibel level) from the project by 2033 when the proposed project would be fully operational.

The FAA would like to initiate informal consultation under the Endangered Species Act for the species listed in the table above. The proposed action appears to either not effect or have a may affect but not likely to adversely affect species protected by the ESA. In addition, the FAA would like to begin coordination under the BGEPA for the bald eagle.

Thank you for your time and assistance on this matter. If you have any questions, you may contact Michael Lamprecht by phone at (202) 267-6496 or email at Michael.Lamprecht@FAA.gov.

Sincerely,

Tommy L. Dupree, Manager
FAA, Memphis Airports District Office

Cc: William C. Sandifer, A.A.E., Executive Vice President-CEO, RDUAA
Chris Babb, Landrum & Brown

Proposed Runway 5L/23R Replacement Project
Raleigh-Durham International Airport

Biological Resources Assessment

July 11, 2023

Prepared for:

Raleigh-Durham Airport Authority and
Federal Aviation Administration

Prepared by:

Three Oaks Engineering, Inc.
324 Blackwell Street, Suite 1200, Durham, NC 27701

SUMMARY OF FINDINGS

The Raleigh-Durham Airport Authority (RDUAA or Airport) proposes to relocate existing runway 5L/23R 537 feet west of its current location. This includes the runway itself and all other associated construction tasks. To assess the potential environmental impacts associated with this project, an Environmental Assessment (EA) is being conducted by the Airport and the Federal Aviation Administration (FAA), to fulfill actions necessary under the National Environmental Policy Act (NEPA). The assessment of biological resources is a subset of the necessary natural resource survey tasks required to complete this EA. Three Oaks Engineering, Inc. (Three Oaks) has been tasked with compiling a biological resources assessment to accomplish this task. The purpose of this assessment is to address any biological resources associated with the project within the 1,436- acre Detailed Study Area (Appendix A, Figure 1).

This Biological Resources Assessment is being used by the FAA for consultation with the United States Fish and Wildlife Service (USFWS). The analysis includes an evaluation of the Detailed Study Area for potential impacts to Endangered Species Act (ESA)-listed threatened and endangered species and associated critical habitat under the jurisdiction of the USFWS (see Table S1).

Table S1. ESA federally protected species listed for the Detailed Study Area[1]

Scientific Name	Common Name	Federal Status[2]	Habitat Present	Biological Conclusion
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	E	No	No Effect
Perimyotis subflavus	Tricolored Bat	PE	Yes	MALAA[3]
Picoides borealis	Red-cockaded Woodpecker	E	Yes	No Effect
Necturus lewisi	Neuse River Waterdog	T	Yes	MANLAA[3]
Noturus furiosus	Carolina Madtom	E	Yes	MANLAA[3]
Fusconaia masoni	Atlantic Pigtoe	T	Yes	MANLAA[3]
Alasmidonta heterodon	Dwarf Wedgemussel	E	Yes	MANLAA[3]
Rhus michauxii	Michaux's Sumac	E	Yes	No Effect

[1] USFWS Information for Planning and Consultation (IPaC) website checked June 16, 2023.
[2] E – Endangered; PE – Proposed Endangered; T – Threatened
[3] MALAA – May Affect, Likely to Adversely Affect; MANLAA – May Affect, Not Likely to Adversely Affect

Bald Eagle

Although not protected under the ESA, the bald eagle is protected under the Bald and Golden Eagle Protection Act. Therefore, it has been included in the biological assessment for the project.

One bald eagle nest was identified, approximately 1,900 feet north of the existing runway, in a loblolly pine stand between the Brier Creek Reservoir and a large stormwater impoundment. The nest was visited again on January 27, 2022, and it was confirmed that the nest was active, and a breeding pair was present. The nest location was also visited on June 15, 2022 with members of the FAA, United States Army Corps of Engineers (USACE), USFWS, NCWRC, and

the Airport; the nest was still present, and a juvenile bald eagle was observed near the nest location.

To avoid incidental take and the need for an Incidental Take Permit, USFWS recommended that construction not be allowed within a 660-foot buffer around the nest during breeding season (December 1 – July 15 of any year) if the nest continues to be active. Per the Bald and Golden Eagle Protection Act, activities within 660 feet of the nest during the non-breeding season may also still potentially result in an Incidental Take Permit being required, depending on the action.

The current design will modify a stormwater basin adjacent to the nest by increasing its size (away from the nest) and converting it to a dry stormwater facility. No tree clearing adjacent to the nest is anticipated. The nearby Brier Creek Reservoir, which is likely the eagle's primary food source, will not be impacted. If any non-breeding season activities associated with this stormwater basin conversion will occur within 660 feet of the nest, or if any construction activities are required during the breeding season, additional coordination with USFWS will occur to determine if an Incidental Take Permit may be required.

LIST OF ACRONYMS

dBA – Decibel level, weighted
DNL – Day-Night Average Sound Level
DSA – Detailed Study Area
E – Endangered
EA – Environmental Assessment
ESA – Endangered Species Act
FAA – Federal Aviation Administration
IPaC – Information for Planning and Consultation
MALAA – May Affect, Likely to Adversely Affect
MANLAA – May Affect, Not Likely to Adversely Affect
MBTA – Migratory Bird Treaty Act
NCNHP – North Carolina Natural Heritage Program
NCPCP – North Carolina Plant Conservation Program
NCWRC – North Carolina Wildlife Resources Commission
NEPA – National Environmental Policy Act
NLEB – Northern Long-Eared Bat
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
RCW – Red-cockaded Woodpecker
RDU – Raleigh-Durham International Airport
RDUAA – Raleigh-Durham Airport Authority
SC – Special Concern
SC-V – Special Concern-Vulnerable
SR – Significantly Rare
T – Threatened
Three Oaks – Three Oaks Engineering, Inc.
US – United States
USACE – United States Army Corps of Engineers
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service

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1.0 INTRODUCTION

The following Biological Resources Assessment has been completed to support the Environmental Assessment (EA) document and provide information on biological resources, such as terrestrial communities and protected species, within the 1,436-acre Detailed Study Area (DSA; Appendix A, Figures 1 and 2).

2.0 METHODOLOGY

The purpose of this assessment is to address biological resources associated with the project. Included in this assessment are the following:

- A description and mapping of vegetative communities;
- A discussion of wildlife and their habitats in/around the DSA;
- A listing of potential federal- and state-protected species; and
- An assessment of potential habitat and individuals in the DSA (including survey results) for federally protected species.

Three Oaks conducted site visits on the following dates in 2021: July 15, 20-21 | August 4-5, 10-11, 17, 19, 21, 29, and 31 | September 8, 15, 21, 22, 27, and 29 | October 4 | November 1, 15-19 | December 7-9. The site was also visited on January 27, 2022 and March 23, 2023. A site visit with regulatory agencies was also completed on June 15, 2022 to review the DSA.

3.0 TERRESTRIAL COMMUNITIES

Six unique terrestrial communities were identified in the DSA. Figure 3 (Appendix A) shows the location and extent of these terrestrial communities (Note: there is a gradual transition between natural community types in the field; however, a distinct boundary was drawn for mapping purposes). Terrestrial community data are presented in the context of total coverage of each type within the DSA (Table 1).

Table 1. Coverage of terrestrial communities in the DSA

Community	Notable Species (*Scientific Name*)	Coverage (acres)[1]
Maintained/Disturbed	Fescue (*Festuca* spp.) Goldenrod (*Solidago* spp.) Sawtooth blackberry (*Rubus argutus*)	646.0
Mixed/Pine Hardwood Forest	White oak (*Quercus alba*) Loblolly pine (*Pinus taeda*) Tulip poplar (*Liriodendron tulipifera*)	148.2
Pine-dominant Forest	Loblolly pine (*Pinus taeda*) Sweetgum (*Liquidambar styraciflua*) Sourwood (*Oxydendrum arboreum*)	452.4
Hardwood Forest (Altered)	Tulip poplar (*Liriodendron tulipifera*) White oak (*Quercus alba*)	13.7

Jim Mason, Senior Environmental Scientist
Three Oaks Engineering, Inc.
324 Blackwell Street, Suite 1200
Durham, NC 27701

Table 1. Coverage of terrestrial communities in the DSA (continued)

Community	Notable Species (*Scientific Name*)	Coverage (acres)[1]
	Red maple (*Acer rubrum*)	
Floodplain Forest	River birch (*Betula nigra*) Ironwood (*Carpinus caroliniana*) Lizard-tail (*Saururus cernuus*)	16.6
Lacustrine Fringe	Woolgrass (*Scirpus cyperinus*) Sericea lespedeza (*Lespedeza cuneata*) Cattail (*Typha latifolia*)	11.0
	Total	**1,287.9**

[1] The remaining 150.1 acres of the DSA are comprised of open water in the form of large ponds and reservoirs.

Maintained/Disturbed

The Maintained/Disturbed community includes roadside and utility rights-of-way; cleared areas adjacent to the runway, buildings, reservoirs, and stormwater ponds; and previously cleared areas that still have not developed into another terrestrial community type, including old building/yard footprints. Many of the maintained/disturbed areas are regularly mowed/maintained.

Mixed Pine/Hardwood Forest

The Mixed Pine/Hardwood Forest community is comprised of a mixed canopy of loblolly pine and various hardwood species. It has a moderate to open sub-canopy and relatively open shrub and herbaceous (i.e., plants with little to no persistent above-ground woody stem) layers. In the DSA, this community exists on hillslopes, hilltops, and, to a certain extent, in floodplains and on floodplain edges where floodplains are narrow and do not have a community type discernable from the surrounding upland communities.

Pine-dominant Forest

The Pine-dominant Forest community has a canopy primarily comprised of loblolly pine. Some hardwoods do exist in the canopy, but to a much lesser degree than the Mixed/Pine Hardwood Forest community. Depending on the location, shrub/sub-canopy density varies in thickness. The herbaceous layer is typically sparse.

Hardwood Forest (Altered)

The Hardwood Forest (Altered) community is specific to an area west of Pleasant Grove Church Road. At some point in the recent to moderate past, this area was altered/cleared; older aerial imagery suggests fields of unknown use. Pines are absent, which separates it from the adjacent community. Older hardwoods are present, with a thick herbaceous/grass layer. There is evidence of buildings formerly occupying this area and at least one monitoring well was observed. This community was upslope towards the hilltop.

Floodplain Forest

The Floodplain Forest community is located along Little Brier Creek near where it crosses Interstate 540. This floodplain is wide and flat and discernable from the surrounding upslope community types. A moderate canopy and sub-canopy exist, with a relatively open shrub layer. The herbaceous layer is thick in areas and the community contains a large wetland complex.

Lacustrine Fringe

The Lacustrine Fringe community exists along an artificial shelf that surrounds Brier Creek Reservoir. These areas are herbaceous-dominant and may flood when the reservoir water level is high. They appear man-made and have an altered substrate indicative of non-native soil/fill being brought into the area.

4.0 WILDLIFE AND HABITATS

Per the North Carolina Wildlife Resources Commissions (NCWRC), there are at least 1,099 species of wild animals in the State of North Carolina. This includes 121 species of mammals, 234 species of fish, 475 species of birds, 91 species of amphibians, 71 species of reptiles, 47-plus species of freshwater crustaceans, and 60 species of freshwater mussels.

With almost 650 acres of wooded/natural areas, plus multiple streams, wetlands, and open bodies of water, potential habitat for wildlife is abundant in the DSA and the wooded areas adjacent to the DSA. Wooded areas provide habitats for all major groups of fauna. These include bird species such as American crow (*Corvus brachyrhynchos*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), barred owl (*Strix varia*), black vulture (*Coragyps atratus*), and several passerine species. Mammal species may include rabbit species (*Sylvilagus* spp.), racoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), Eastern gray squirrel (*Sciurus carolinensis*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), and grey fox (*Urocyon cinereoargenteus*). Herp species such as green treefrog (*Hyla cinerea*), American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), black rat snake (*Pantherophis obsoletus*), green anole (*Anolis carolinensis*), and marbled salamander (*Ambystoma opacum*) may also be present. Additional transient species may also be observed in the area.

There is an overlap between species within the wooded habitat and open, maintained habitat, with many bird species, white-tailed deer, and other species with dynamic ranges being common in the open spaces.

Aquatic habitats and associated terrestrial areas also provide abundant habitat for many species. Fish species such as Eastern mosquitofish (*Gambusia holbrooki*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*) and other *Lepomis* species, and largemouth bass (*Micropterus salmoides*) may be present. Mussel and clam species such as Eastern elliptio (*Elliptio complanata*) and Asian clam (*Corbicula fluminea*) may exist within the DSA, along with other bivalve species. Please see the Aquatic Species Survey Report in Appendix C for a more detailed list of aquatic species identified in the DSA.

Lacustrine fringe areas and mudflats associated with the large reservoirs (which also extend outside of the DSA) also provides habitat for migratory birds such as ducks, geese, and shorebirds (roseate spoonbill [*Platalea ajaja*] was observed), plus several turtle species.

5.0 PROTECTED SPECIES

5.1 Endangered Species Act Protected Species

As of June 16, 2023, the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) website lists six federally protected species, under the Endangered Species Act (ESA), that may have habitat that overlaps the DSA. One additional species, tricolored bat, is

also proposed for listing. The National Oceanic and Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS) also lists one federally protected species under the ESA, Atlantic sturgeon, which may occur in Wake County.

On the Federal level, statuses that apply to species listed for the project include the following:

- Endangered - Any species which is in danger of extinction throughout all or a significant portion of its range.
- Threatened - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Table 2 includes species applicable to this project. For each species, a discussion of the presence or absence of habitat is included below along with the Biological Conclusion rendered based on survey results in the DSA.

Table 2. ESA federally protected species listed for the DSA[1]

Scientific Name	Common Name	Federal Status[2]	Habitat Present	Biological Conclusion
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	E	No	No Effect
Perimyotis subflavus	Tricolored Bat	PE	Yes	MALAA[3]
Picoides borealis	Red-cockaded Woodpecker	E	Yes	No Effect
Necturus lewisi	Neuse River Waterdog	T	Yes	MANLAA[3]
Noturus furiosus	Carolina Madtom	E	Yes	MANLAA[3]
Fusconaia masoni	Atlantic Pigtoe	T	Yes	MANLAA[3]
Alasmidonta heterodon	Dwarf Wedgemussel	E	Yes	MANLAA[3]
Rhus michauxii	Michaux's Sumac	E	Yes	No Effect

[1] USFWS IPaC website checked June 16, 2023.

[2] E – Endangered; PE – Proposed Endangered; T – Threatened

[3] MALAA – May Affect, Likely to Adversely Affect; MANLAA – May Affect, Not Likely to Adversely Affect

Atlantic Sturgeon

USFWS/NMFS Optimal Survey Window: surveys not required; assume presence in appropriate waters

Biological Conclusion: No Effect

Suitable habitat for the Atlantic sturgeon does not exist within the DSA as no mainstem portion of the Neuse River is present within the DSA. Additionally, no Designated Critical Habitat is present within the DSA. Furthermore, a review of the Spring (April) 2023 North Carolina Natural Heritage Program (NCNHP) dataset indicates no known Atlantic sturgeon occurrences within the DSA or within proximity of the DSA.

Tricolored Bat

USFWS Optimal Survey Window: To Be Determined, although tentatively winter months for winter roosting, May 15 – August 15 for mist netting/summer roosting

Biological Conclusion: May Affect, Likely to Adversely Affect

Tricolored bat was proposed by USFWS for listing as Endangered on September 14, 2022 (87 FR 56381). It is anticipated that the species will be formally listed in the Fall of 2023. Please see the attached Tricolored Bat Report (Appendix C) for more details on the species and proposed conservation measures. Based on the results of the attached report, the proposed Biological Conclusion for Tricolored Bat is May Affect, Likely to Adversely Affect. However, actions associated with this project are Unlikely to Jeopardize the species. Based on anticipated impacts to the species, the FAA has entered conferencing with USFWS.

Red-cockaded Woodpecker

USFWS Optimal Survey Window: year-round; November – Early March (optimal)

Biological Conclusion: No Effect

Suitable nesting (open to semi-open pine stands ≥ 60 years of age) and foraging (open to semi-open pine stands ≥ 30 years of age) habitat for the red-cockaded woodpecker (RCW) exists within the DSA, primarily within the Mixed Pine/Hardwood Forest and Pine-dominant Forest communities. Specifically, the wooded areas off of Pleasant Grove Church Road (on both the east and west side of the road) and directly north of the existing runway contain potential foraging habitat with nesting-sized trees. Loblolly pine is the predominant pine species present. No nesting cavities, potential starts, or individuals were identified within the DSA. However, due to the presence of potential habitat, a 0.5-mile survey surrounding suitable habitat was conducted. Suitable foraging and nesting habitat are present to the south and southeast of the DSA near and within William B. Umstead State Park; however, this habitat was more than 0.5 miles away and separated from the DSA by the airport, highways, and other roads that would present an impediment to RCWs attempting to move between the two areas, resulting in a lack of habitat connectivity. The areas of habitat within the DSA are surrounded in the remaining directions by an extensive anthropogenic landscape, which isolates the potential habitat from connectivity to other suitable habitat. No cavities, potential starts, or individuals were identified during the 0.5-mile survey. The airport and the noise produced there may also present an additional deterrence to any potential RCW settlement. A review of the Spring (April) 2023 NCNHP dataset indicates no known occurrences of RCW within the DSA or within 1.0 mile of the DSA. Additionally, there are currently no extant RCW occurrences located in Wake County and USFWS recently recommended that surveys for this species would no longer be required in the County.

Neuse River Waterdog

USFWS Optimal Survey Window: winter months for trapping

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix D) for more details regarding this species.

Carolina Madtom

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix D) for more details regarding this species.

Atlantic Pigtoe

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix D) for more details regarding this species.

Dwarf Wedgemussel

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix D) for more details regarding this species.

Michaux's Sumac

USFWS Optimal Survey Window: May – October

Biological Conclusion: No Effect

Suitable habitat for Michaux's sumac includes open areas caused by disturbances, usually along roadsides, in highway rights-of-way, or around margins of regularly maintained clearings. Suitable habitat for this species was present within the DSA along roadsides and other utility rights-of-way. Therefore, surveys were conducted by Three Oaks staff during the July, August, and September 2021 field visit dates. No individuals were found. Additionally, a review of the Spring (April) 2023 NCNHP dataset indicates no known occurrences of Michaux's sumac within the DSA or within 1.0 mile of the DSA.

5.2 Bald and Golden Eagle Protection Act

The bald eagle is not protected under the ESA. However, it still has federal protection under the Bald and Golden Eagle Protection Act, which is also enforced by the USFWS. Golden Eagles do not nest in North Carolina. Habitat for the bald eagle primarily consists of mature forests in proximity to large bodies of open water for foraging. Large dominant trees are utilized for nesting sites, typically within 1.0 mile of open water.

A desktop-GIS assessment of the DSA, as well as the area within a 1-mile radius of the project limits, was performed on July 15, 2021, using the most currently available orthoimagery. Multiple water bodies large enough or sufficiently open to be considered potential feeding sources were identified.

Since foraging habitat was found within the review area, a survey of the DSA and the area within 660 feet of the project limits was conducted by Three Oaks staff during the July, August, and September 2021 field visits. One bald eagle nest was identified, approximately 1,900 feet north of the existing runway, in a loblolly pine stand between the Brier Creek Reservoir and a large stormwater impoundment. The nest was visited again on January 27, 2022, and it was confirmed that the nest was active, and a breeding pair was present. The nest location was also visited on June 15, 2022 with members of the FAA, United States Army Corps of Engineers (USACE), USFWS, NCWRC, and the Airport; the nest was still present, and a juvenile bald eagle was observed near the nest location. This is a previously non-reported nesting site. A review of the Spring (April) 2023 NCNHP dataset revealed no additional occurrences of bald eagle within the DSA or within 1.0 mile of the DSA.

A noise study was completed to assess the potential impact of airport activities on the eagle nest (Table 3).

Table 3. Potential noise level impacts on bald eagle nest

Noise Level (DNL[1]; measured in dBA[2])	2019 Pre-COVID	2020-21 Existing Conditions	2028 No Action	2028 Proposed Action	2033 No Action	2033 Proposed Action
	63.81	61.25	64.4	67.08	64.85	67.5

1 DNL – Day-Night Average Sound Level. DNL is a metric that reflects cumulative exposure to sound over a 24-hour period, expressed as the noise level for the average day of the year on the basis of annual aircraft operations.

2 dBA – decibel level, weighted according to the weighting curves to approximate the way the human ear hears.

Due to the presence of the bald eagle nest, the suggested conservation measure is that construction will not occur within a 660-foot buffer around the nest during breeding season (December 1 – July 15 on any year) if the nest continues to be active. This will minimize/eliminate potential disturbance to nesting bald eagles and eliminate the need for an Incidental Take Permit from USFWS. Per the Bald and Golden Eagle Protection Act, activities within 660 feet of the nest during the non-breeding season may still potentially result in an Incidental Take Permit being required, depending on the action.

The current design will modify a stormwater basin adjacent to the nest by increasing its size (away from the nest) and converting it to a dry stormwater facility. No tree clearing adjacent to the nest is anticipated. The nearby Brier Creek Reservoir, which is likely the eagle's primary food source, will not be impacted.

Coordination with USFWS

A version of this Biological Resources Assessment (dated October 7, 2022) was submitted to the USFWS on October 19, 2022 for review and to request concurrence under informal consultation for the Biological Conclusions rendered for federally-listed species. In a letter dated November 15, 2022, the USFWS concurred with the Biological Conclusions rendered for this project and the conservation measures suggested for the bald eagle. A copy of the USFWS letter is included in Appendix E.

If any non-breeding season activities associated with this stormwater basin conversion will occur within 660 feet of the nest, or if any construction activities are required during the breeding season,

additional coordination with USFWS will occur to determine if an Incidental Take Permit may be required.

5.3 North Carolina Natural Heritage Program State-Listed Species

The NCNHP tracks state listed species that are not currently protected by the USFWS under the Federal ESA but are tracked by the State due to their rarity in North Carolina. These species are compiled in the NCNHP 2020 Rare Animal and Plant Lists.

The NCNHP Rare Plant List includes North Carolina legal status information from the North Carolina Plant Conservation Program (NCPCP), a unit of the Department of Agriculture and Consumer Services and the agency responsible for the listing and protection of North Carolina's endangered and threatened plants, under provisions of the North Carolina Plant Protection and Conservation Act (North Carolina General Statutes - Chapter 106, Article 19B). The NCNHP Rare Animal List contains species listed by the NCWRC. NCWRC is responsible for the listing and protection of the state's nongame species of mammals, birds, reptiles, amphibians, freshwater fishes, mollusks, and crustaceans, under North Carolina General Statutes - Chapter 113, Article 25.

On the State level, statuses that apply to species listed for Wake County include the following:

- Endangered - Any native or once-native species of wild animal whose continued existence as a viable component of the state's fauna is determined to be in jeopardy or any species of wild animal determined to be an Endangered species pursuant to the Federal ESA (General Statute 113-25.).
- Threatened - Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a Threatened species pursuant to the Federal ESA (General Statute 113-25.).
- Special Concern - Any species of wild animal native or once-native to North Carolina which is determined by the NCWRC to require monitoring, but which may be taken under regulations adopted under the provisions of the Article. (General Statute 113-25).
- Special Concern – Vulnerable - Any species or higher taxon of plant which is likely to become a threatened species within the foreseeable future. (North Carolina Administrative Code 02 NCAC 48F .0401).
- Significantly Rare - Any species which has not been listed as an Endangered, Threatened, or Special Concern species, but which exists in the state (or recently occurred in the state) in small numbers (generally fewer than 100 statewide populations) and has been determined by the NCNHP to need monitoring. Significantly Rare species include species of historical occurrence with some likelihood of rediscovery in the state and species substantially reduced in numbers by habitat destruction, direct exploitation, or disease (NCNHP designation).

NCNHP is not a regulatory agency; however, NCPCP, NCWRC, and other state agencies may include state-listed species when considering project commitments and/or conservation measures or may require permits if a species is to be collected, moved, or impacted. Surveys are typically not required (unless a project is on United States Forest Service [USFS] land, which this project is not); however, an assessment of habitat will allow for determination of what species have potential to be present, thus providing a more complete biological assessment of the DSA. Furthermore, a review

of existing NCNHP data within the DSA and within 1.0 mile of the DSA identifies known occurrences of species that may be impacted by the project.

Tables 4 and 5 list the animal and plant species currently tracked by NCNHP and identify whether habitat is present within the DSA. A review of the Spring (April) 2023 NCNHP dataset was completed for these species; species with known occurrences within proximity of the project are identified in the tables.

Of the species listed below, only the Savannah lilliput was identified within the DSA during surveys for the project. The species was thought to have been previously extirpated from the Neuse River Basin. Coordination with NCWRC may be required for this species to determine if any special considerations or conservation measures would be requested/required. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.

Table 4. NCNHP state-listed animal species listed for Wake County

Taxonomic Group	Scientific Name	Common Name	NC Status[1]	Federal Status[1]	County Status[2]	Habitat Present
Amphibian	*Ambystoma talpoideum*	Mole Salamander	SC	None	Historical	Yes
Amphibian	*Ambystoma tigrinum*	Eastern Tiger Salamander	T	None	Current	No
Amphibian	*Eurycea quadridigitata*	Dwarf Salamander	SC	None	Historical	No
Amphibian	*Hemidactylium scutatum*	Four-toed Salamander	SC	None	Current	Yes[5]
Bird	*Ammodramus henslowii* (syn. *Centronyx henslowii*)	Henslow's Sparrow	E	None	Historical	No
Bird	*Lanius ludovicianus*	Loggerhead Shrike	SC	None	Current	Yes
Bird	*Loxia curvirostra*	Red Crossbill	SC	None	Historical	No
Bird	*Peucaea aestivalis*	Bachman's Sparrow	SC	None	Historical	No
Crustacean	*Orconectes carolinensis* (syn. *Faxonius carolinensis*)	North Carolina Spiny Crayfish	SC	None	Current	Yes
Freshwater Bivalve	*Alasmidonta undulata*	Triangle Floater	T	None	Current	Yes
Freshwater Bivalve	*Elliptio lanceolata*[3]	Yellow Lance	E	T	Current	Yes
Freshwater Bivalve	*Elliptio roanokensis* (syn. *Elliptio judithae*)	Roanoke Slabshell	SC	None	Current	Yes
Freshwater Bivalve	*Lampsilis radiata* (syn. *Lampsilis radiata radiata, Lampsilis fullerkati, Lampsilis radiata conspicua*)	Eastern Lampmussel	T	None	Current	Yes
Freshwater Bivalve	*Lasmigona subviridis*	Green Floater	E	None	Current	Yes[5]

Table 4. NCNHP state-listed animal species listed for Wake County (continued)

Taxonomic Group	Scientific Name	Common Name	NC Status[1]	Federal Status[1]	County Status[2]	Habitat Present
Freshwater Bivalve	*Strophitus undulatus*	Creeper	T	None	Current	Yes
Freshwater Bivalve	*Toxolasma pullus*	Savannah Lilliput	E	None	Current	Yes[5]
Freshwater Bivalve	*Villosa constricta*	Notched Rainbow	T	None	Current	Yes
Freshwater Fish	*Lampetra aepyptera*	Least Brook Lamprey	T	None	Current	Yes
Freshwater Fish	*Notropis volucellus*	Mimic Shiner	T	None	Historical	Yes
Mammal	*Condylura cristata* pop. 1	Star-nosed Mole - Coastal Plain population	SC	None	Historical	No
Mammal	*Myotis austroriparius*	Southeastern Bat	SC	None	Current	No
Reptile	*Crotalus horridus*	Timber Rattlesnake	SC	None	Historical	No
Reptile	*Heterodon simus*	Southern Hognose Snake	T	None	Historical	No
Sawfly, Wasp, Bee, or Ant	*Bombus affinis*[4]	Rusty-patched Bumble Bee	SR	E	Historical	Yes

1 E – Endangered; T- Threatened; SC – Special Concern; SR – Significantly Rare

2 – *Current* - The species has been identified recently within the County (NCNHP does not define "recently" in their documentation).
Historical - Of historical occurrence, with some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years. An element is not automatically assigned a historical status if it has not been verified in the past 20 years; some effort must have been made to locate or relocate occurrences. A Historical status does not impact the State Status of a species.

3 This species is federally listed but does not have a range that overlaps with the project per USFWS IPaC; therefore, it is included here.

4 NCWRC does not currently list this species as protected by the State, as it is currently believed that there are no extant records in North Carolina. However, the species is listed as Endangered on the Federal level throughout its range, which includes North Carolina.

5 One known occurrence of this species was identified within 1.0 mile of the DSA; only the Savannah lilliput occurrence encroaches into the DSA.

Table 5. NCNHP state-listed plant species listed for Wake County

Taxonomic Group	Scientific Name	Common Name	NC Status[1]	Federal Status	County Status[2]	Habitat Present
Vascular Plant	*Acmispon helleri*	Carolina Birdfoot-trefoil	T	None	Current	Yes
Vascular Plant	*Buchnera americana*	American Bluehearts	E	None	Historical	Yes
Vascular Plant	*Carex meadii*	Mead's Sedge	E	None	Historical	Yes
Vascular Plant	*Carex reniformis*	Kidney Sedge	T	None	Historical	Yes

Table 5. NCNHP state-listed plant species listed for Wake County (continued)

Taxonomic Group	Scientific Name	Common Name	NC Status[1]	Federal Status	County Status[2]	Habitat Present
Vascular Plant	*Cirsium carolinianum*	Carolina Thistle	E	None	Historical	Yes
Vascular Plant	*Cyperus granitophilus*	Granite Flatsedge	T	None	Current	No
Vascular Plant	*Cyperus virens*	Green Flatsedge	SC-V	None	Historical	Yes
Vascular Plant	*Dichanthelium annulum*	Ringed Witch Grass	E	None	Historical	Yes[3]
Vascular Plant	*Gillenia stipulata*	Indian Physic	T	None	Historical	Yes
Vascular Plant	*Helenium brevifolium*	Littleleaf Sneezeweed	E	None	Historical	Yes
Vascular Plant	*Isoetes piedmontana*	Piedmont Quillwort	T	None	Current	No
Vascular Plant	*Lindera subcoriacea*	Bog Spicebush	SC-V	None	Current	No
Vascular Plant	*Magnolia macrophylla*	Bigleaf Magnolia	SC-V	None	Current	No
Vascular Plant	*Micranthes pensylvanica*	Swamp Saxifrage	E	None	Historical	No
Vascular Plant	*Polygala senega*	Seneca Snakeroot	SC-V	None	Current	Yes
Vascular Plant	*Portulaca smallii*	Small's Portulaca	T	None	Current	No
Vascular Plant	*Pseudognaphalium helleri*	Heller's Rabbit-Tobacco	E	None	Current	Yes[3]
Vascular Plant	*Ruellia humilis*	Low Wild-petunia	T	None	Current	Yes
Vascular Plant	*Ruellia purshiana*	Pursh's Wild-petunia	SC-V	None	Historical	Yes
Vascular Plant	*Sagittaria weatherbiana*	Grassleaf Arrowhead	E	None	Historical	Yes
Vascular Plant	*Scutellaria australis*	Southern Skullcap	E	None	Historical	Yes
Vascular Plant	*Scutellaria nervosa*	Veined Skullcap	E	None	Current	Yes
Vascular Plant	*Solidago radula*	Western Rough Goldenrod	E	None	Historical	Yes
Vascular Plant	*Symphyotrichum concinnum* (syn. *Symphyotrichum laeve var. concinnum*)	Narrow-leaved Smooth Aster	E	None	Historical	Yes
Vascular Plant	*Trifolium reflexum*	Buffalo Clover	T	None	Current	Yes

Table 5. NCNHP state-listed plant species listed for Wake County (continued)

Taxonomic Group	Scientific Name	Common Name	NC Status[1]	Federal Status	County Status[2]	Habitat Present
Vascular Plant	*Trillium pusillum* var. *virginianum*	Virginia Least Trillium	E	None	Current	Yes

[1] E – Endangered; T- Threatened; SC-V – Special Concern-Vulnerable; SR – Significantly Rare

[2] – *Current* – The species has been identified recently within the County (NCNHP does not define "recently" in their documentation)
Historical - Of historical occurrence, with some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years. An element is not automatically assigned a historical status if it has not been verified in the past 20 years; some effort must have been made to locate or relocate occurrences. A Historical status does not impact the State Status of a species.

[3] One known occurrence of this species was identified within 1.0 mile of the DSA; however, none were located within the DSA itself.

5.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by USFWS. Bird species are listed by USFWS in the List of Migratory Birds protected by the MBTA, which is updated regularly. A migratory bird species is included on the list if it meets one or more of the following criteria:

- It occurs in the United States (US) or US territories as the result of natural biological or ecological processes and is currently, or was previously listed as, a species or part of a family protected by one of the four international treaties or their amendments that the MBTA implements (with Canada, Mexico, Japan, and Russia);
- Revised taxonomy results in it being newly split from a species that was previously on the list, and the new species occurs in the US or US territories as the result of natural biological or ecological processes; or
- New evidence exists for its natural occurrence in the US or US territories resulting from natural distributional changes and the species occurs in a protected family.

Table 6 below includes the MBTA species listed for Wake County, which may occur in the DSA, per NCWRC. All species in this list are designated as occurring in the State and County; have been recorded on the Cornell Lab of Ornithology eBird website (a citizen science database of bird species observations) within the last 10 years; and are known to breed in the State. Bald Eagle is also included as a MBTA species; however, it is not included in this list since it is already addressed in Section 5.2. Surveys and/or conservation measures may be recommended/required for these species or authorization may be required to impact species habitat; however, input/coordination with NCWRC and USFWS will be required to determine whether either will be needed for this project.

Table 6. Bird species subject to the MBTA

Scientific Name	**Common Name**
Accipiter cooperii	Cooper's Hawk
Accipiter striatus	Sharp-shinned Hawk
Agelaius phoeniceus	Red-winged Blackbird
Aix sponsa	Wood Duck

Table 6. Bird species subject to the MBTA (continued)

Scientific Name	**Common Name**
Ammodramus savannarum	Grasshopper Sparrow
Antrostomus carolinensis	Chuck-will's-widow
Antrostomus vociferus	Eastern Whip-poor-will
Archilochus colubris	Ruby-throated Hummingbird
Ardea herodias	Great Blue Heron
Baeolophus bicolor	Tufted Titmouse
Branta canadensis	Canada Goose
Bubo virginianus	Great Horned Owl
Buteo jamaicensis	Red-tailed Hawk
Buteo lineatus	Red-shouldered Hawk
Butorides virescens	Green Heron
Cardinalis cardinalis	Northern Cardinal
Cathartes aura	Turkey Vulture
Chaetura pelagica	Chimney Swift
Charadrius vociferus	Killdeer
Chordeiles minor	Common Nighthawk
Coccyzus americanus	Yellow-billed Cuckoo
Colaptes auratus	Northern Flicker
Colinus virginianus	Northern Bobwhite
Contopus virens	Eastern Wood-Pewee
Coragyps atratus	Black Vulture
Corvus brachyrhynchos	American Crow
Corvus ossifragus	Fish Crow
Cyanocitta cristata	Blue Jay
Dryobates pubescens	Downy Woodpecker
Dryobates villosus	Hairy Woodpecker
Dryocopus pileatus	Pileated Woodpecker
Dumetella carolinensis	Gray Catbird
Empidonax virescens	Acadian Flycatcher
Eremophila alpestris	Horned Lark
Falco sparverius	American Kestrel
Geothlypis formosa	Kentucky Warbler
Geothlypis trichas	Common Yellowthroat
Hirundo rustica	Barn Swallow
Hylocichla mustelina	Wood Thrush
Icteria virens	Yellow-breasted Chat
Icterus spurius	Orchard Oriole

Table 6. Bird species subject to the MBTA (continued)

Scientific Name	**Common Name**
Ictinia mississippiensis	Mississippi Kite
Lanius ludovicianus	Loggerhead Shrike
Limnothlypis swainsonii	Swainson's Warbler
Megaceryle alcyon	Belted Kingfisher
Megascops asio	Eastern Screech-Owl
Melanerpes carolinus	Red-bellied Woodpecker
Melospiza melodia	Song Sparrow
Mimus polyglottos	Northern Mockingbird
Mniotilta varia	Black-and-white Warbler
Molothrus ater	Brown-headed Cowbird
Myiarchus crinitus	Great Crested Flycatcher
Pandion haliaetus	Osprey
Parkesia motacilla	Louisiana Waterthrush
Passerina caerulea	Blue Grosbeak
Passerina cyanea	Indigo Bunting
Pipilo erythrophthalmus	Eastern Towhee
Piranga olivacea	Scarlet Tanager
Piranga rubra	Summer Tanager
Poecile carolinensis	Carolina Chickadee
Polioptila caerulea	Blue-gray Gnatcatcher
Progne subis	Purple Martin
Protonotaria citrea	Prothonotary Warbler
Quiscalus quiscula	Common Grackle
Regulus satrapa	Golden-crowned Kinglet
Sayornis phoebe	Eastern Phoebe
Scolopax minor	American Woodcock
Seiurus aurocapilla	Ovenbird
Setophaga americana	Northern Parula
Setophaga citrina	Hooded Warbler
Setophaga coronata	Yellow-rumped Warbler
Setophaga discolor	Prairie Warbler
Setophaga dominica	Yellow-throated Warbler
Setophaga pinus	Pine Warbler
Setophaga ruticilla	American Redstart
Sialia sialis	Eastern Bluebird
Sitta carolinensis	White-breasted Nuthatch
Sitta pusilla	Brown-headed Nuthatch

Table 6. Bird species subject to the MBTA (continued)

Scientific Name	**Common Name**
Spinus tristis	American Goldfinch
Spizella passerina	Chipping Sparrow
Spizella pusilla	Field Sparrow
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Strix varia	Barred Owl
Sturnella magna	Eastern Meadowlark
Tachycineta bicolor	Tree Swallow
Thryothorus ludovicianus	Carolina Wren
Toxostoma rufum	Brown Thrasher
Troglodytes aedon	House Wren
Turdus migratorius	American Robin
Tyrannus tyrannus	Eastern Kingbird
Tyto alba	Barn Owl
Vireo griseus	White-eyed Vireo
Vireo olivaceus	Red-eyed Vireo
Vireo solitarius	Blue-headed Vireo
Zenaida macroura	Mourning Dove

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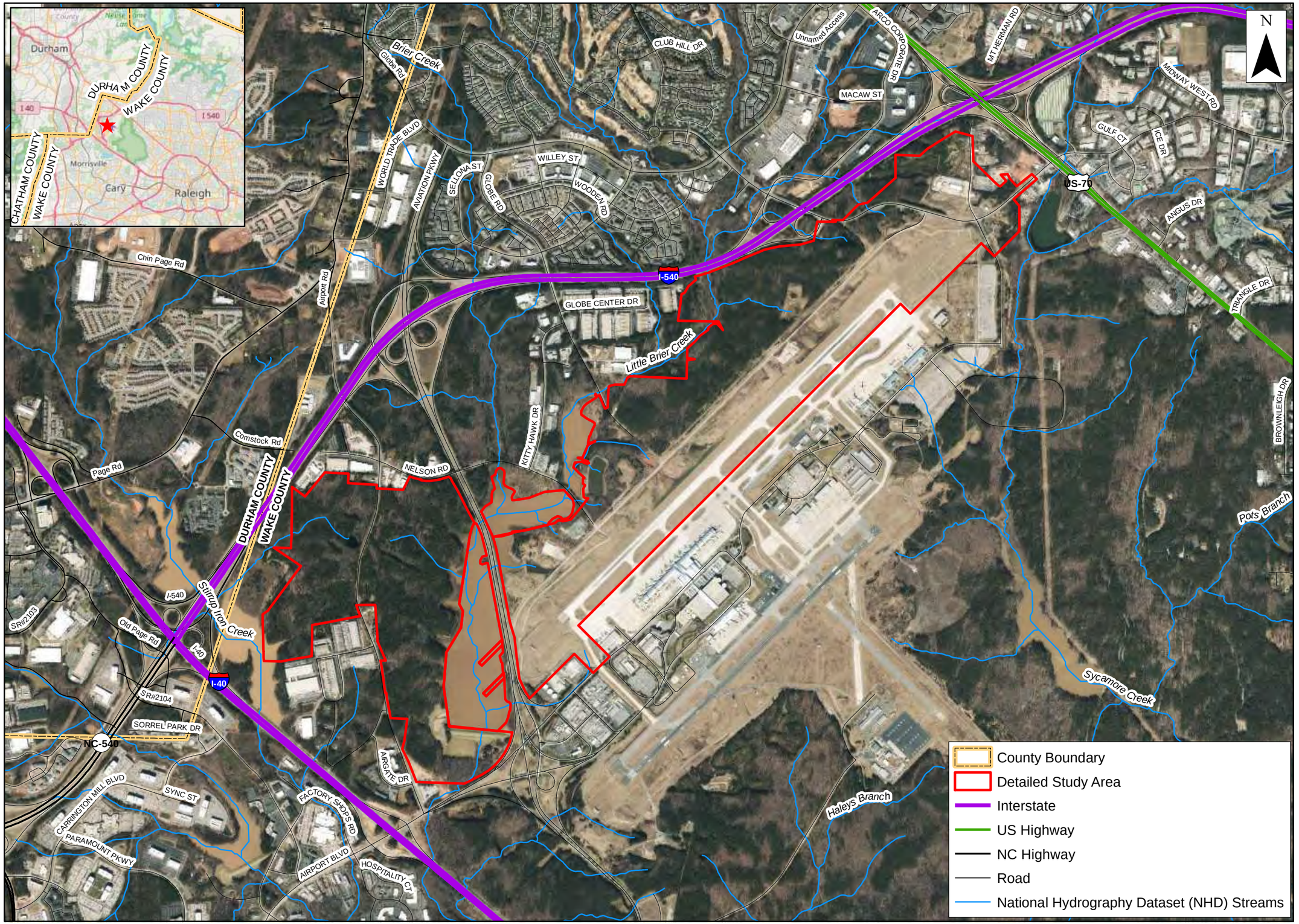
Appendix A
Figures



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Vicinity Map

Wake County, North Carolina

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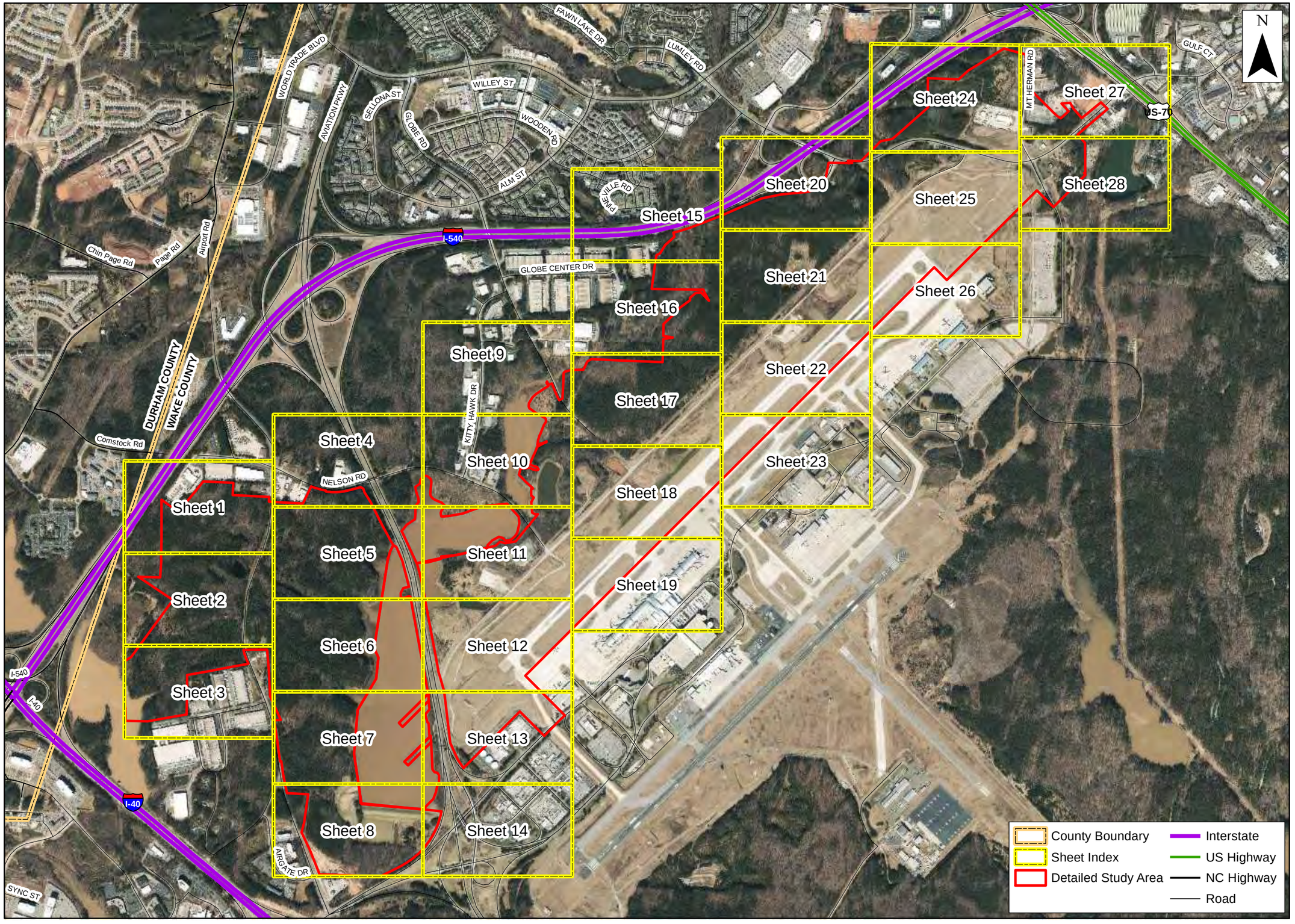

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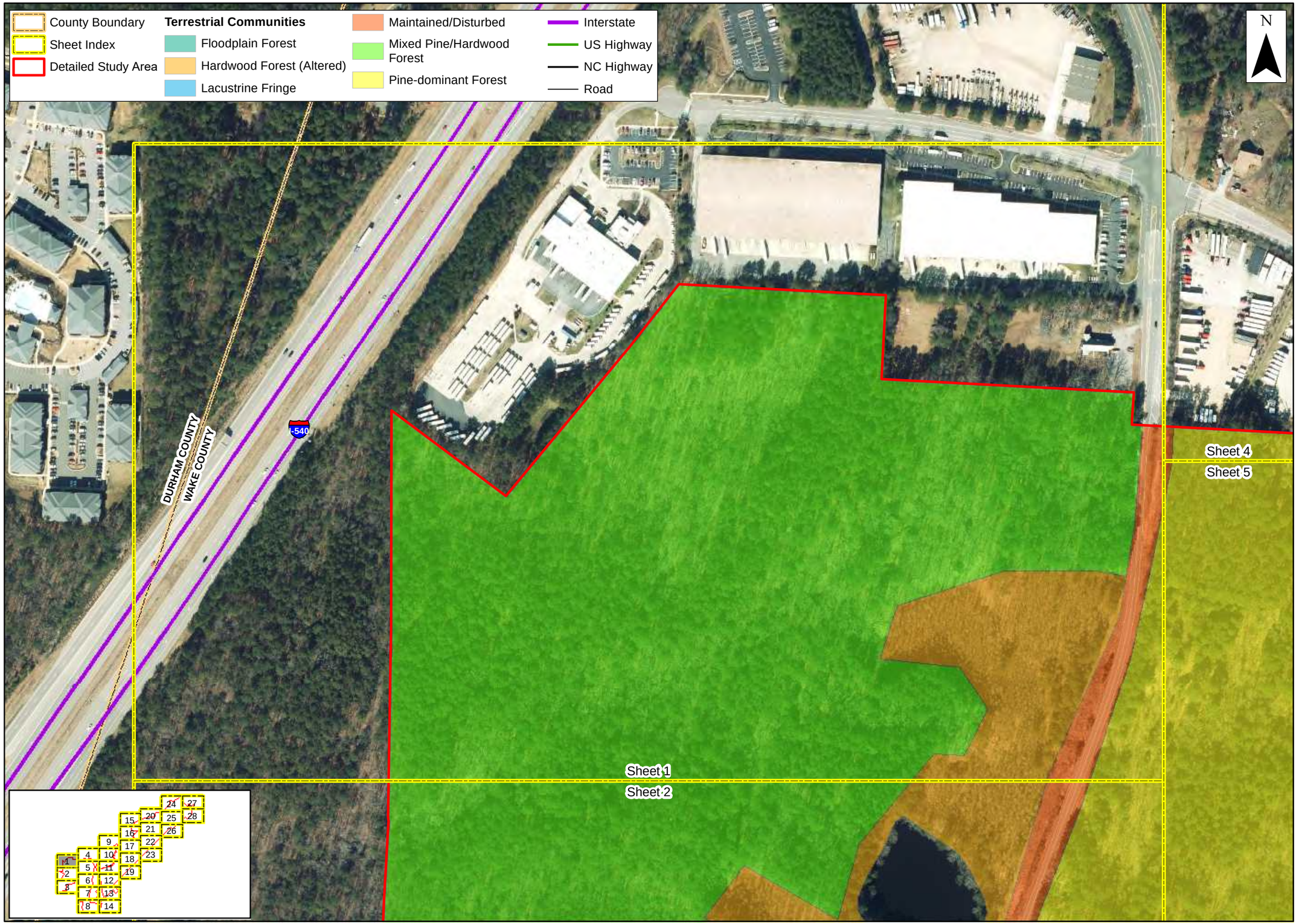

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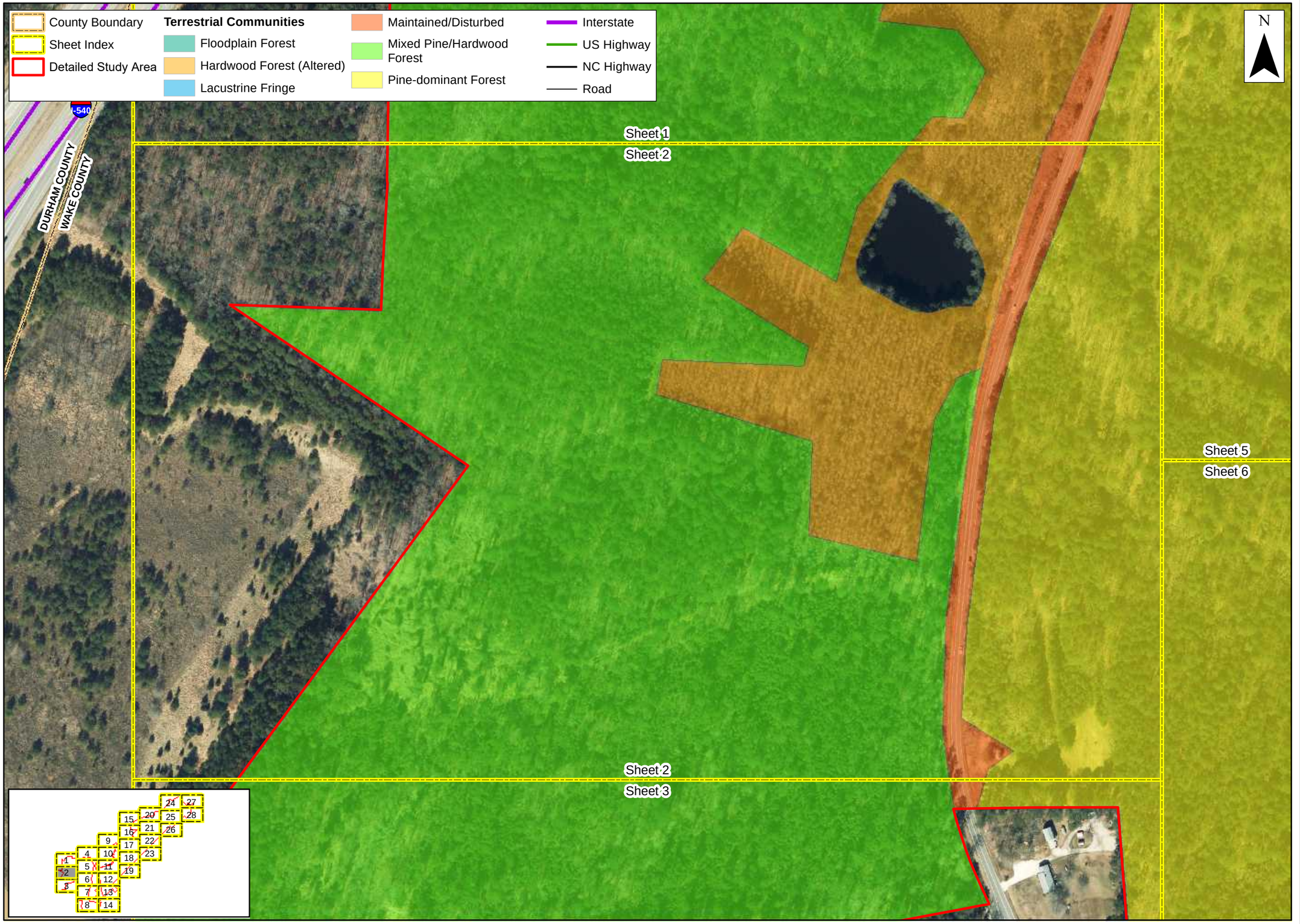

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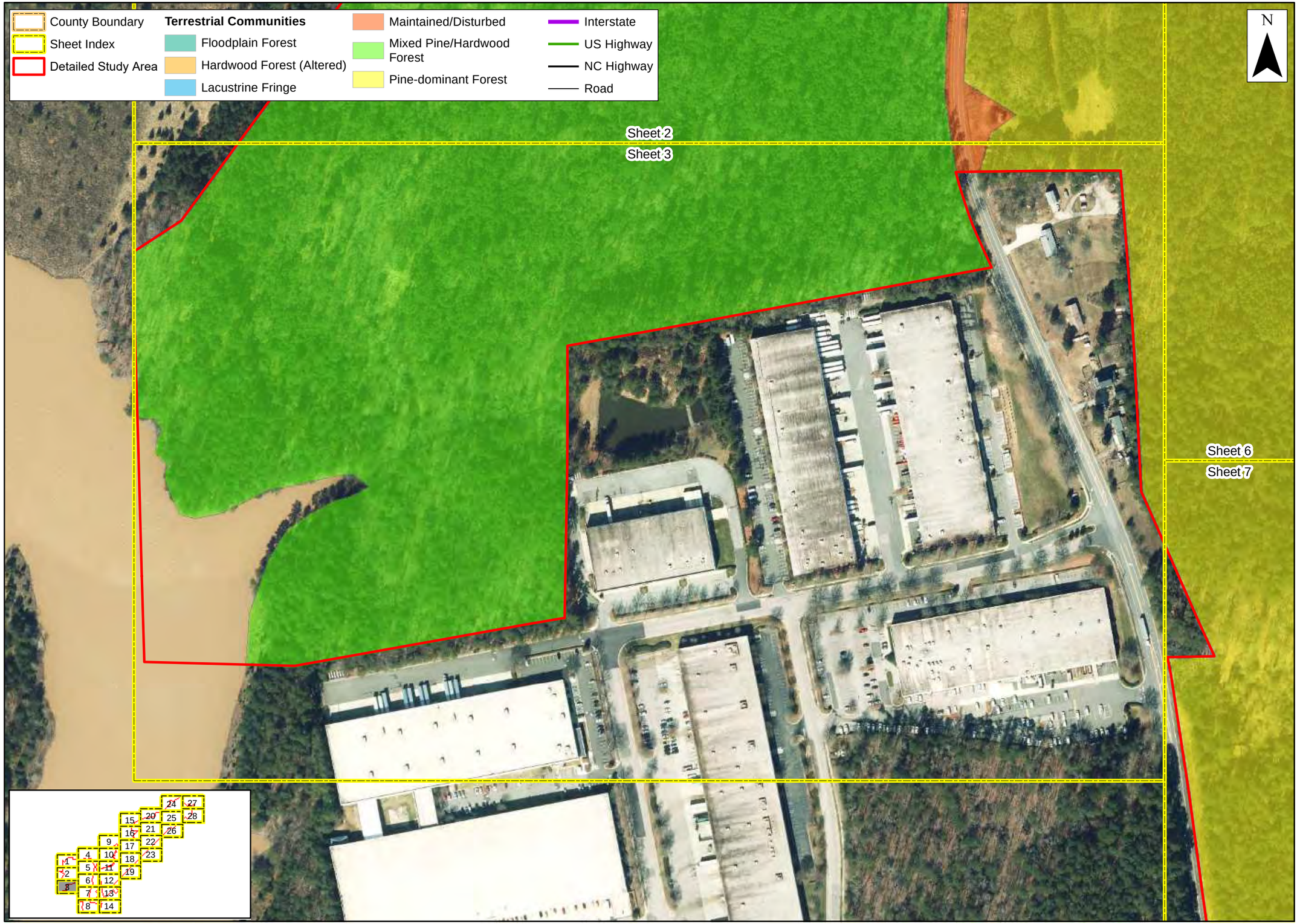

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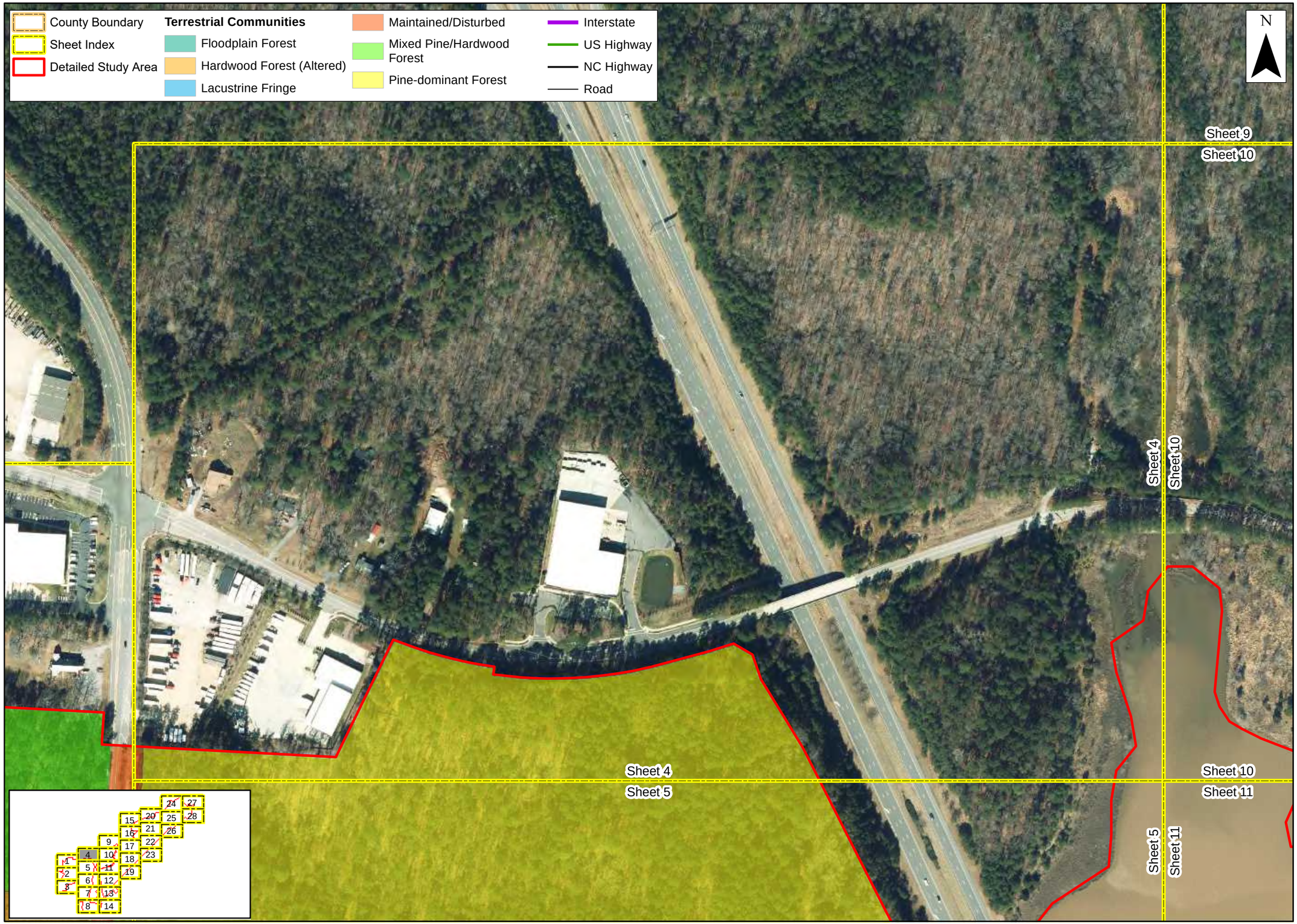

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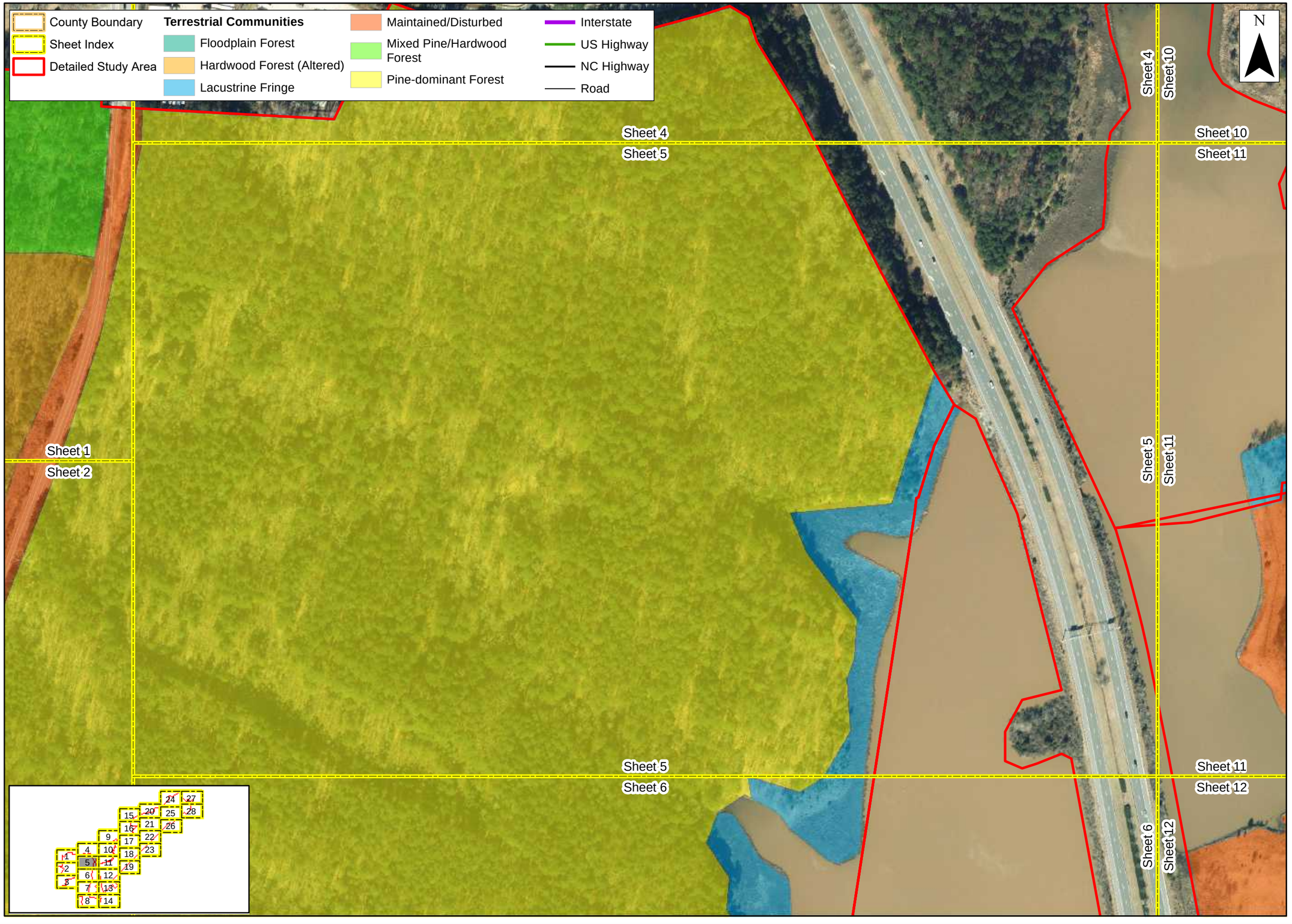

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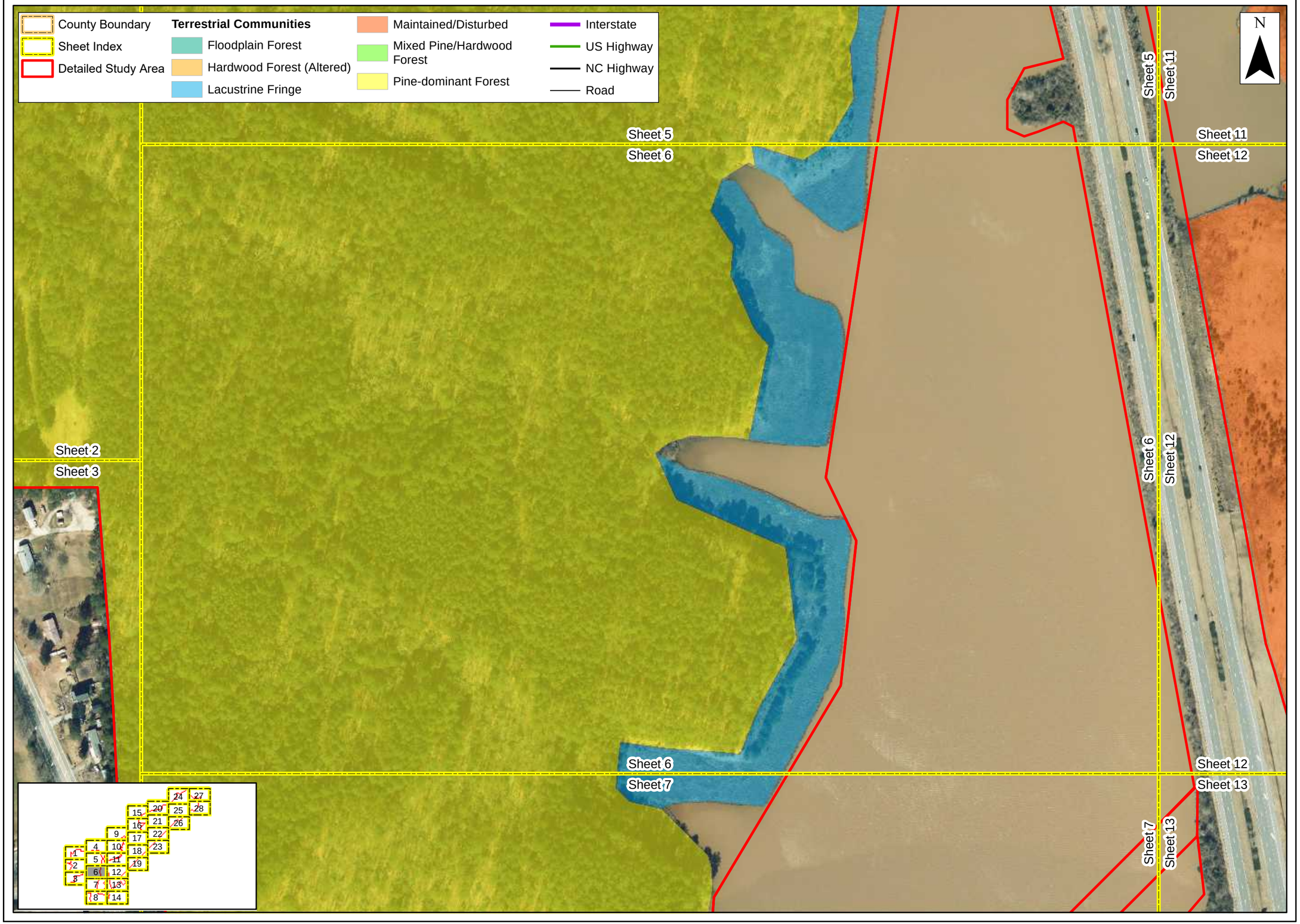

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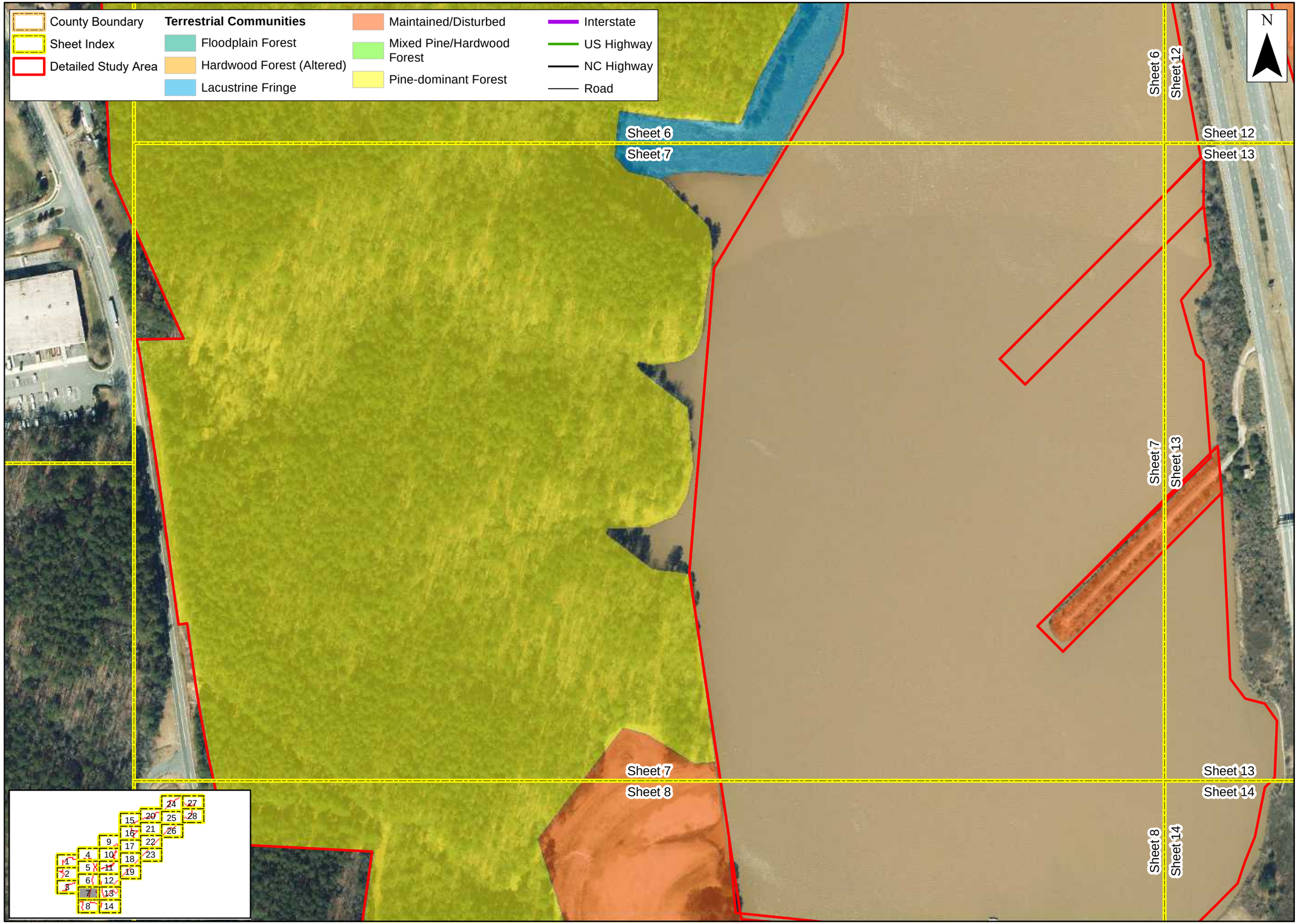

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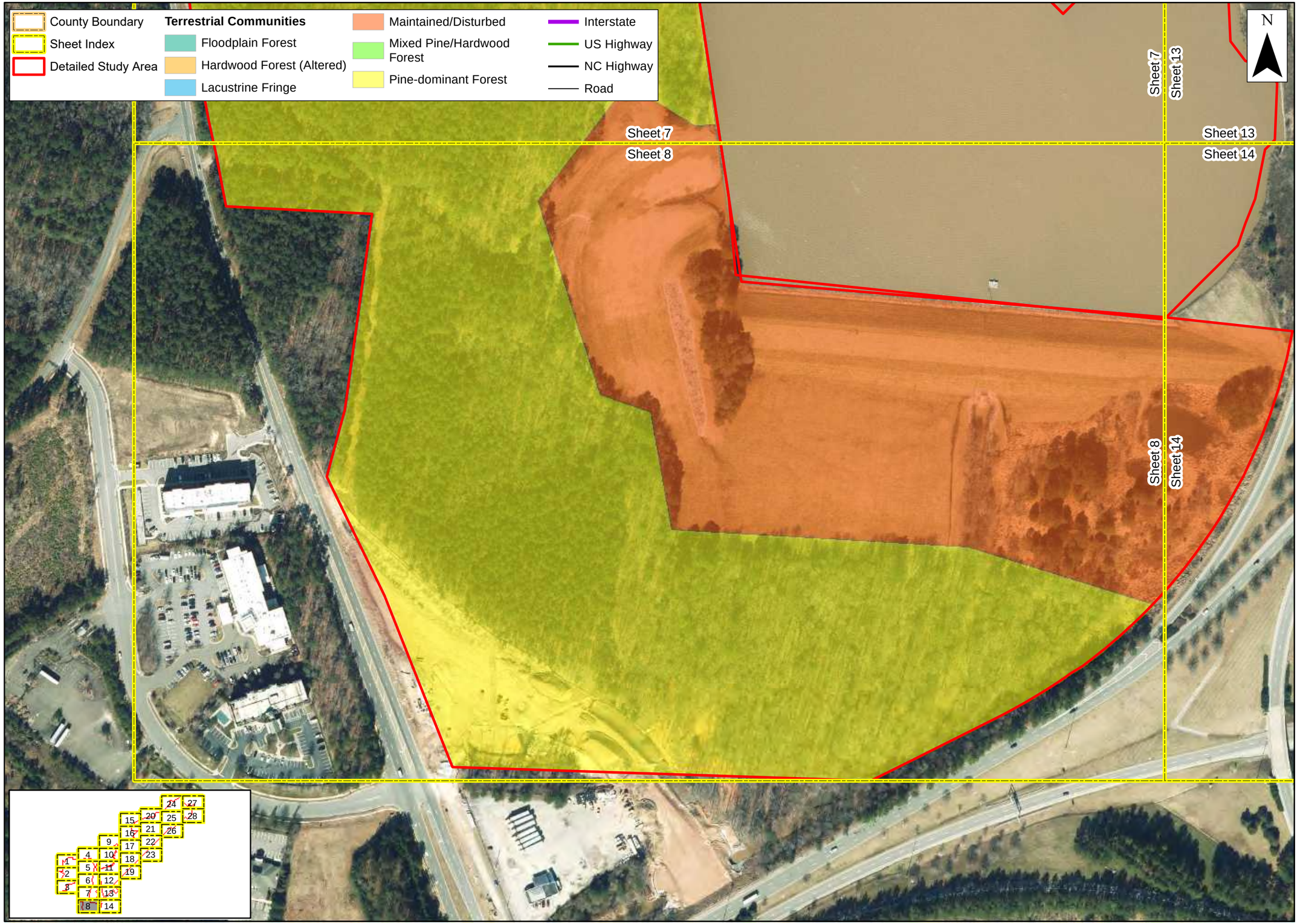

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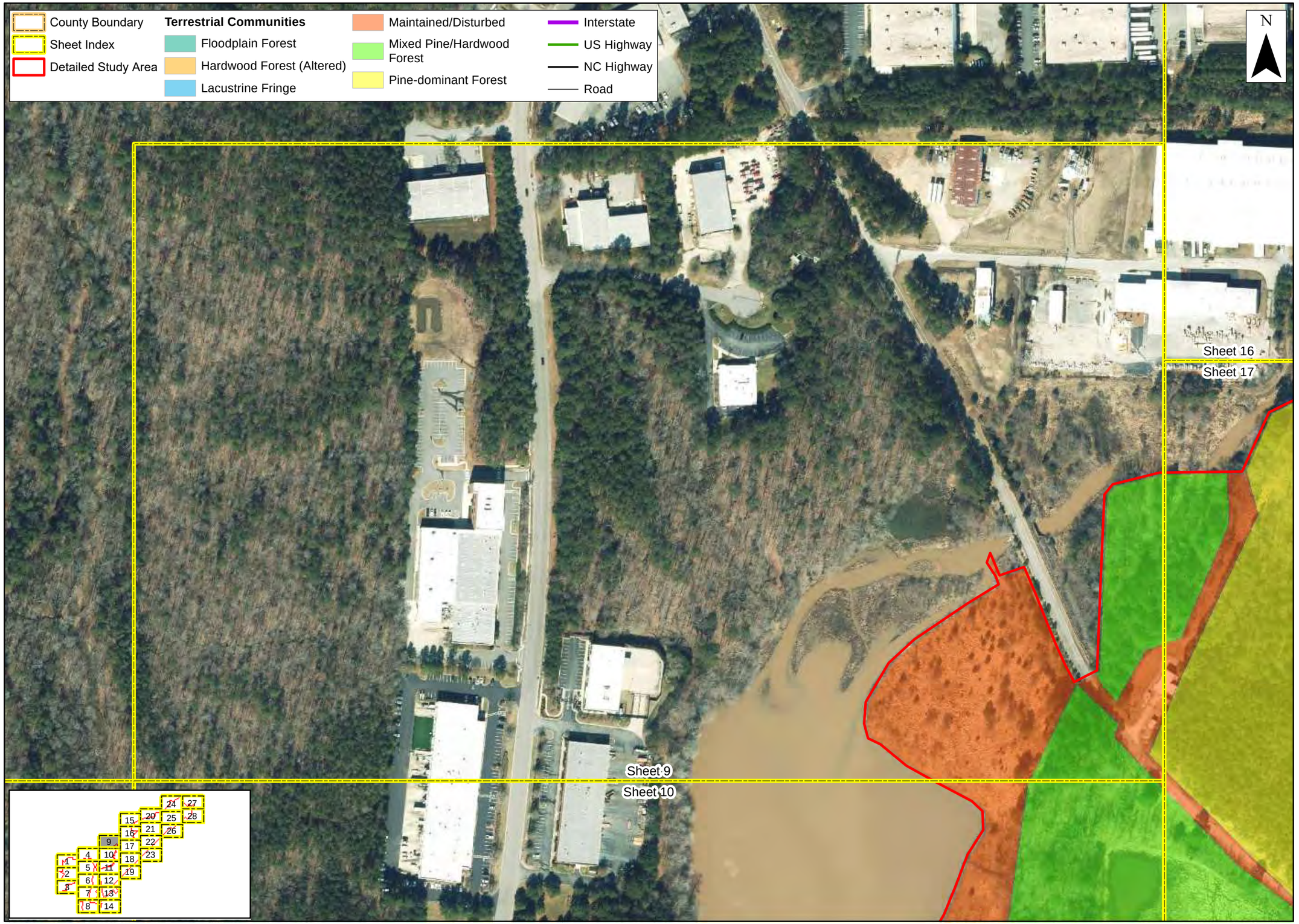

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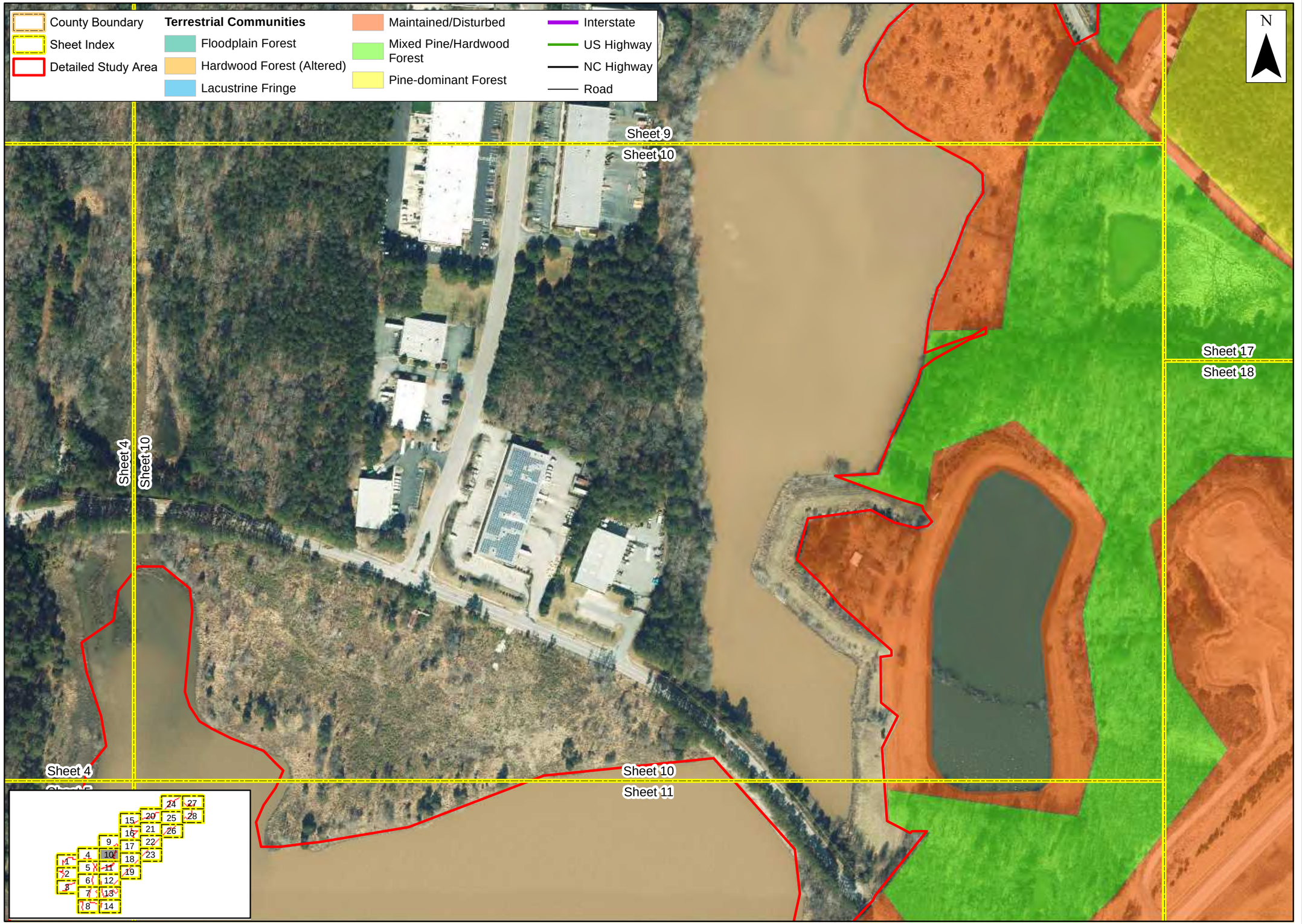

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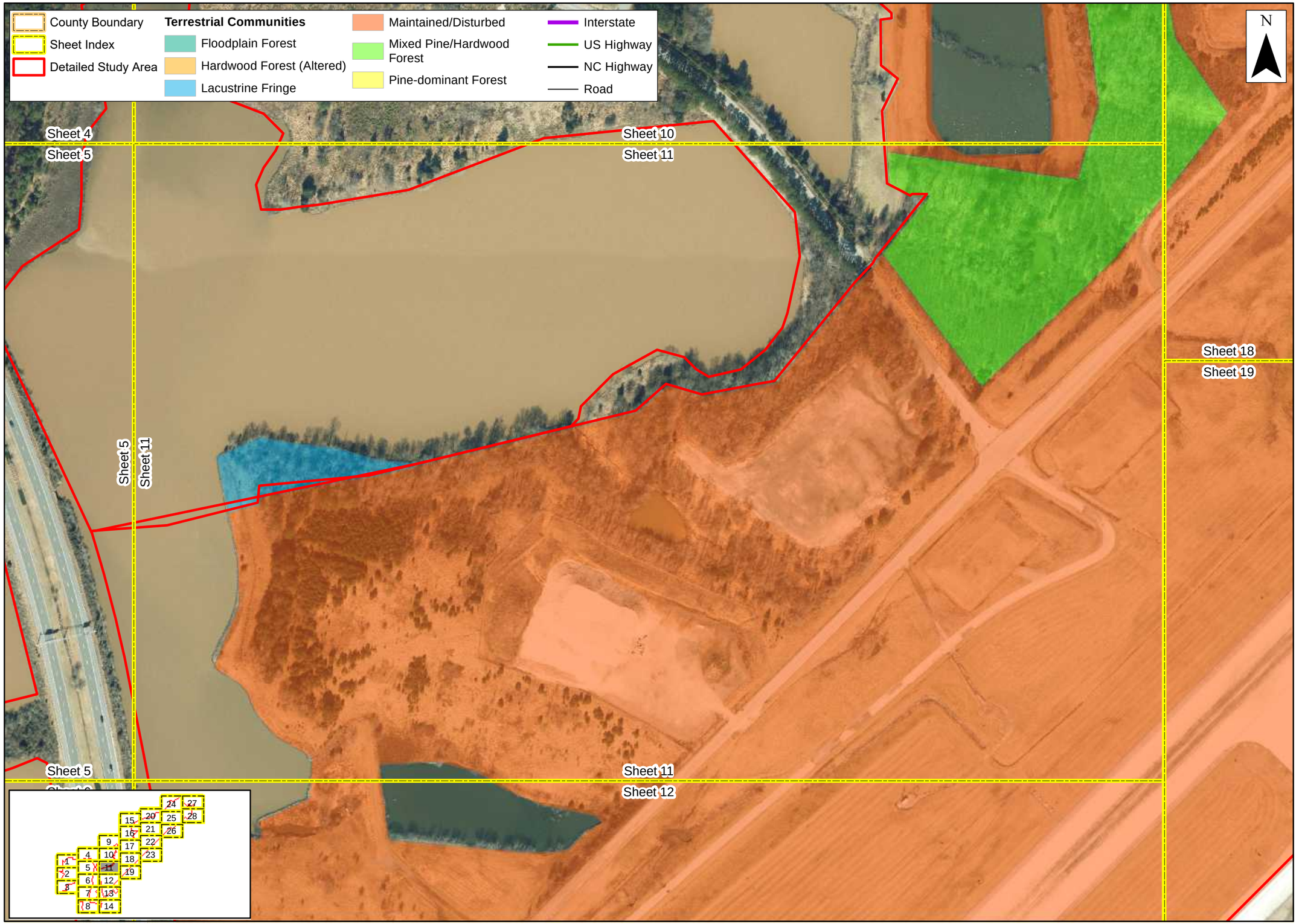

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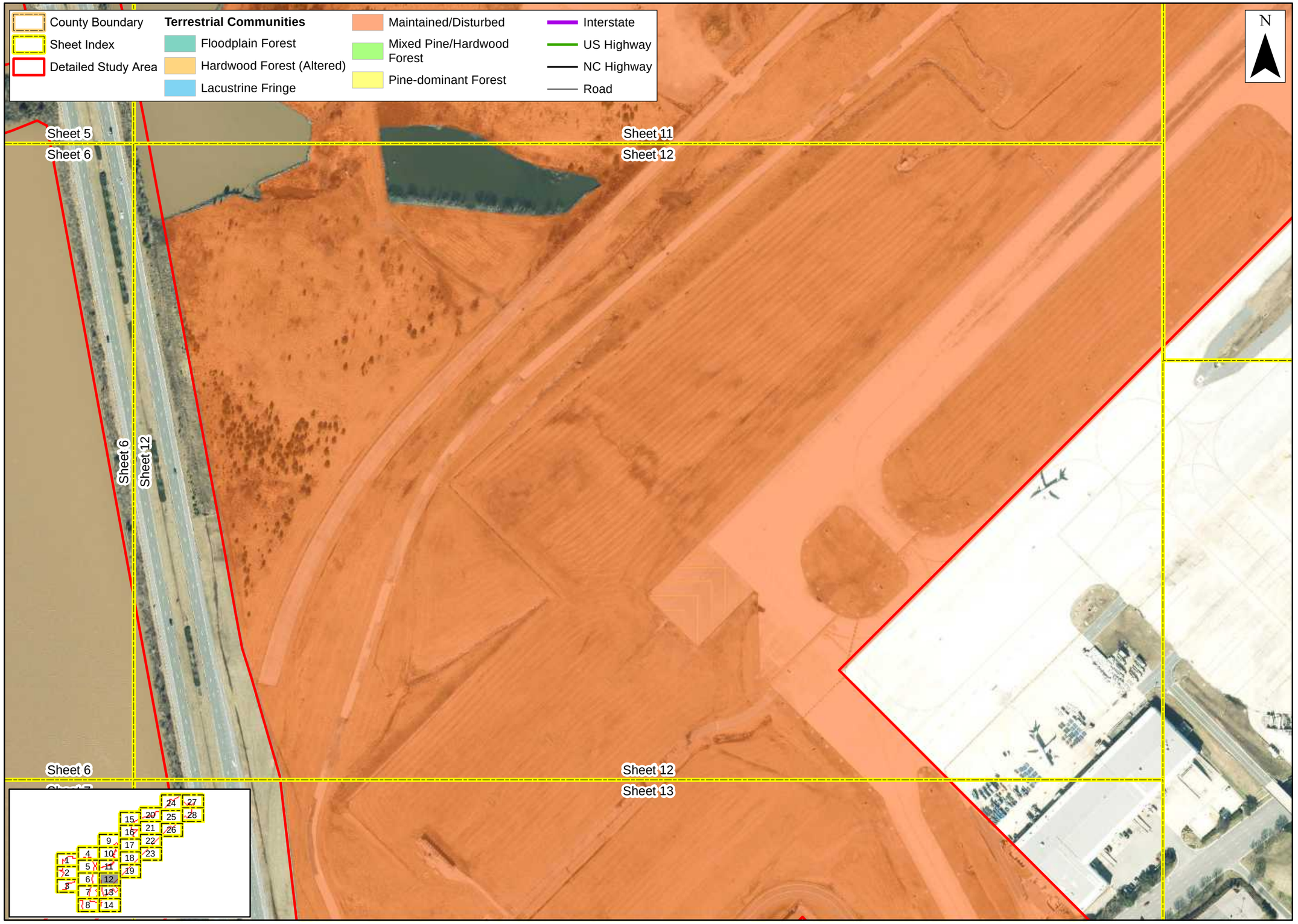

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Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Federal Environmental Assessment

Terrestrial Communities

Wake County, North Carolina

Date:	September 2022
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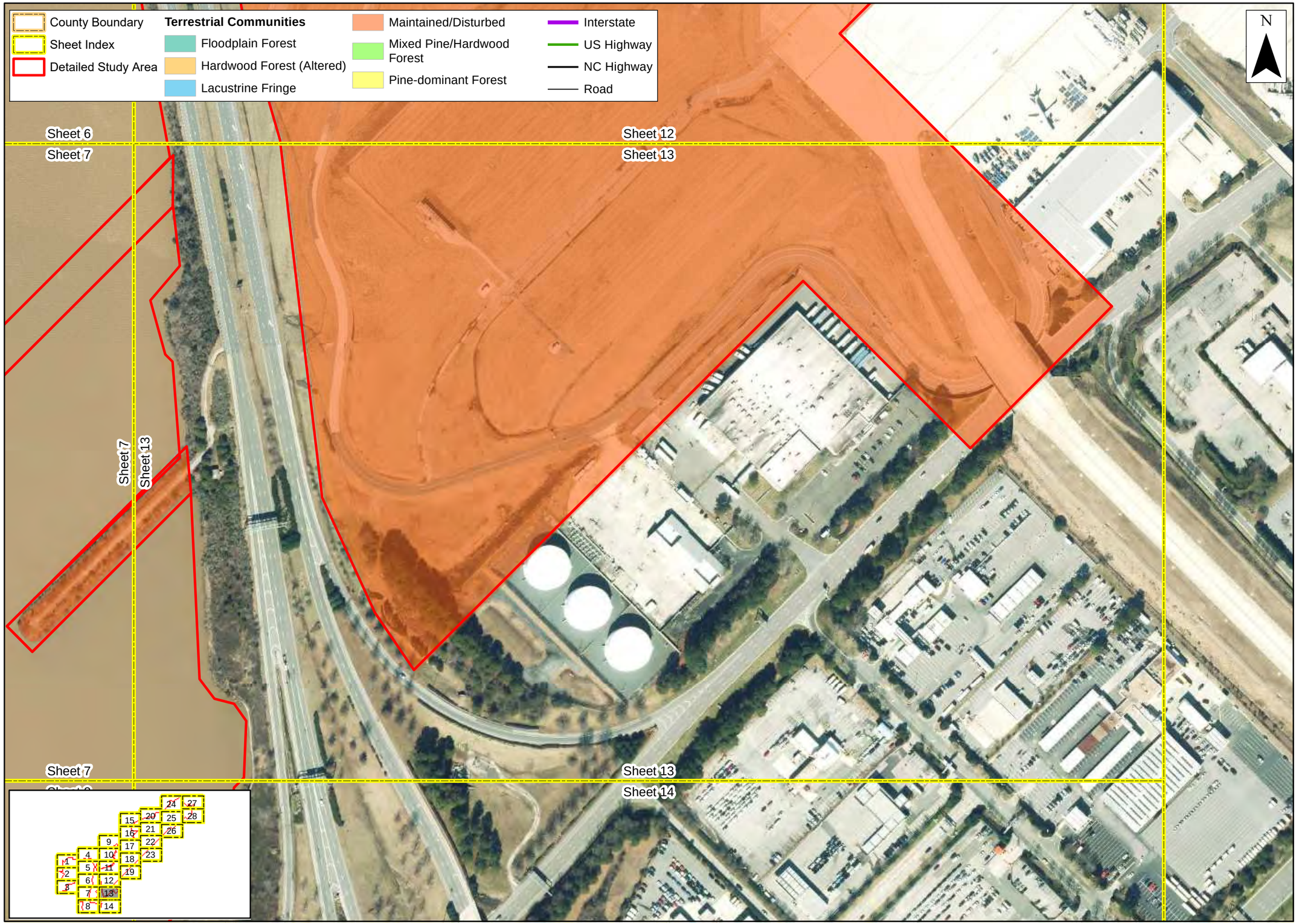

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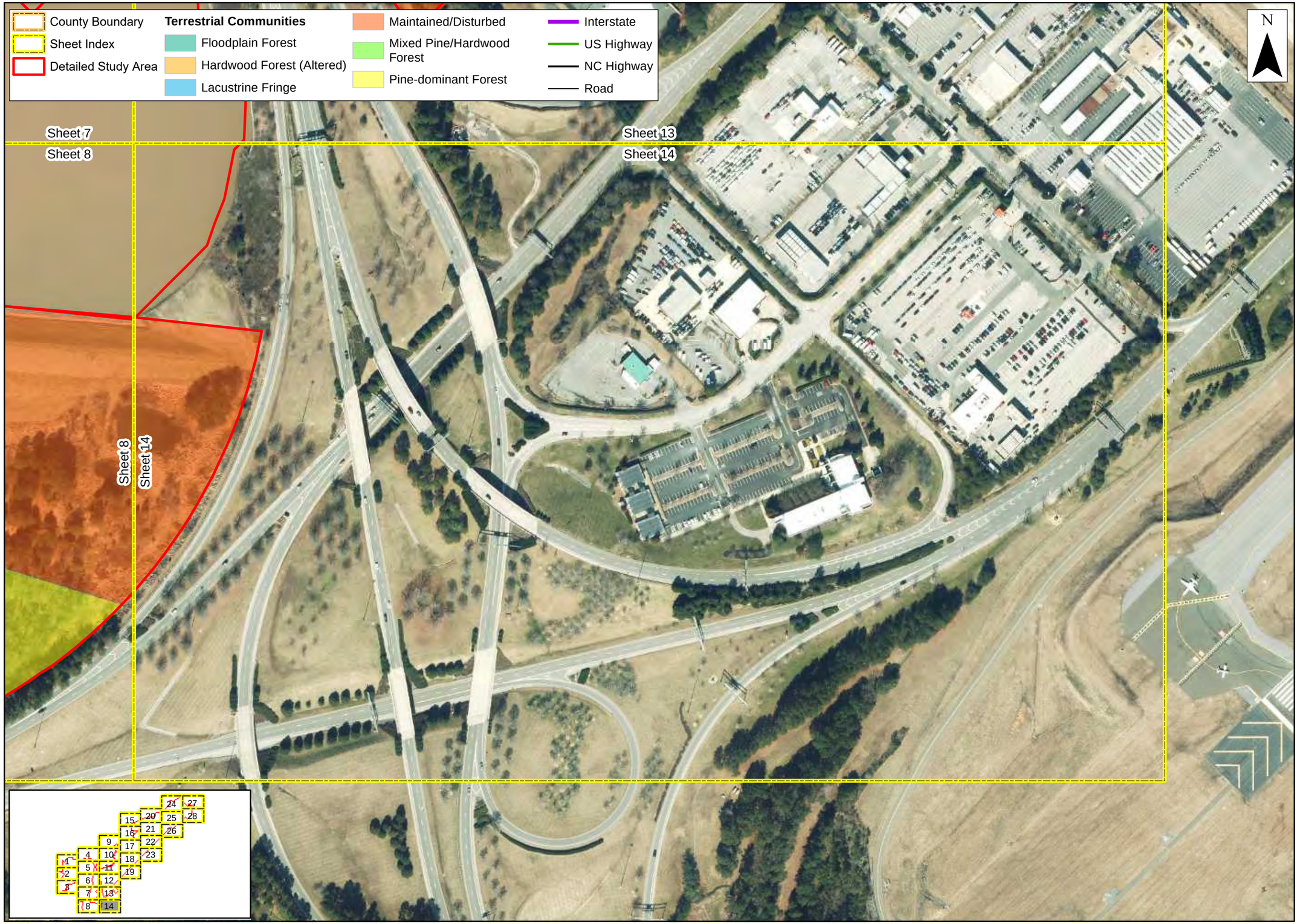

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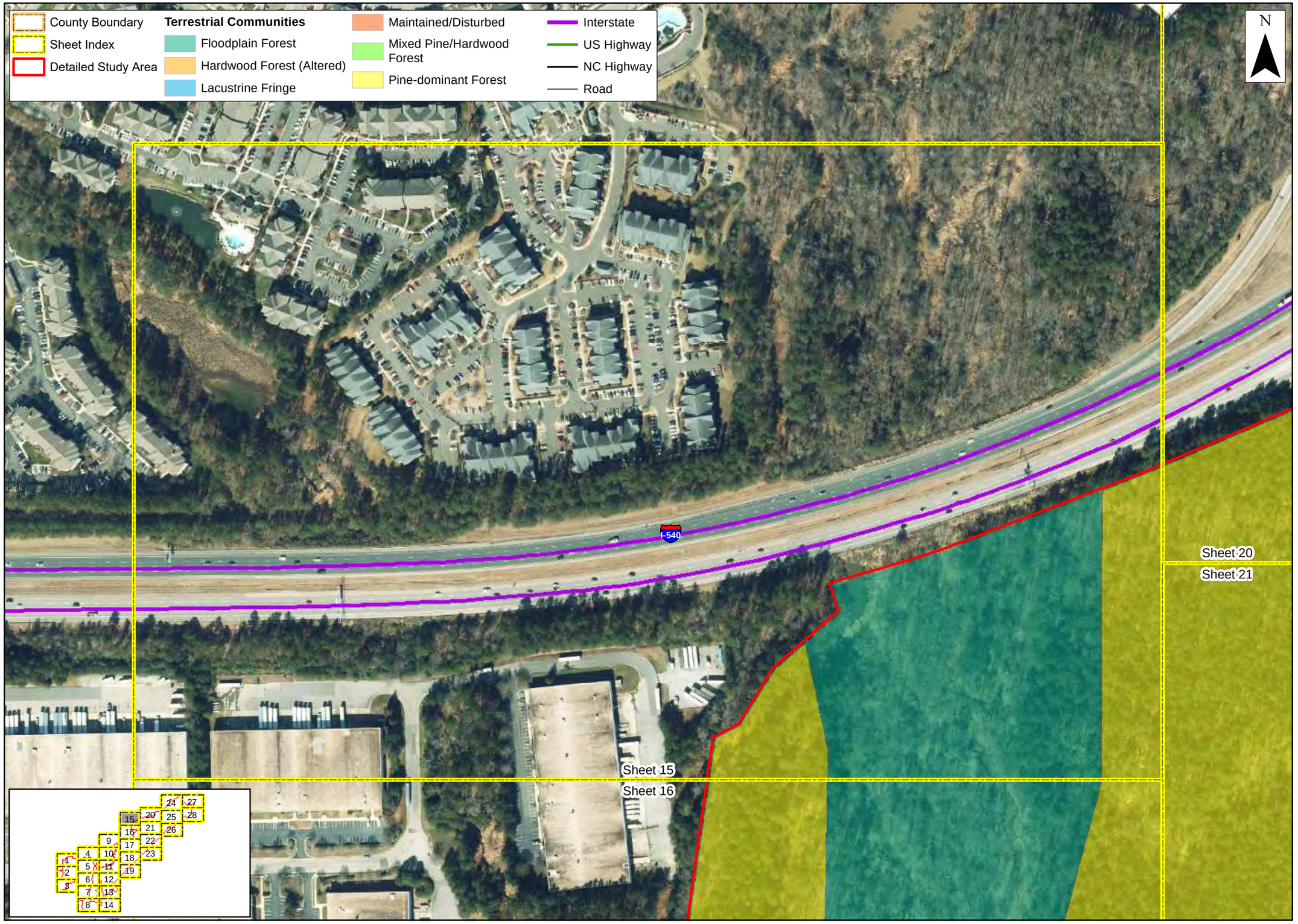

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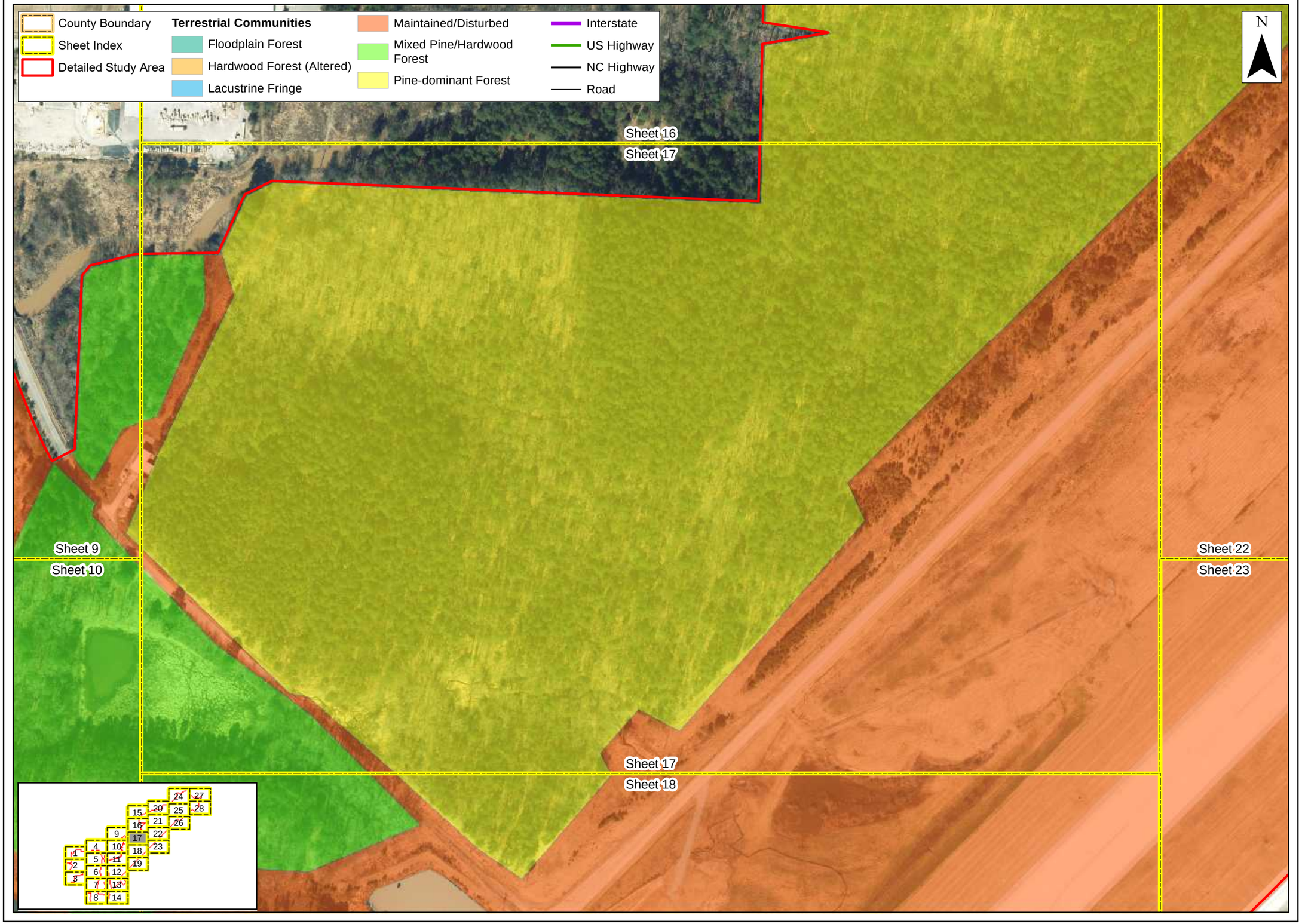

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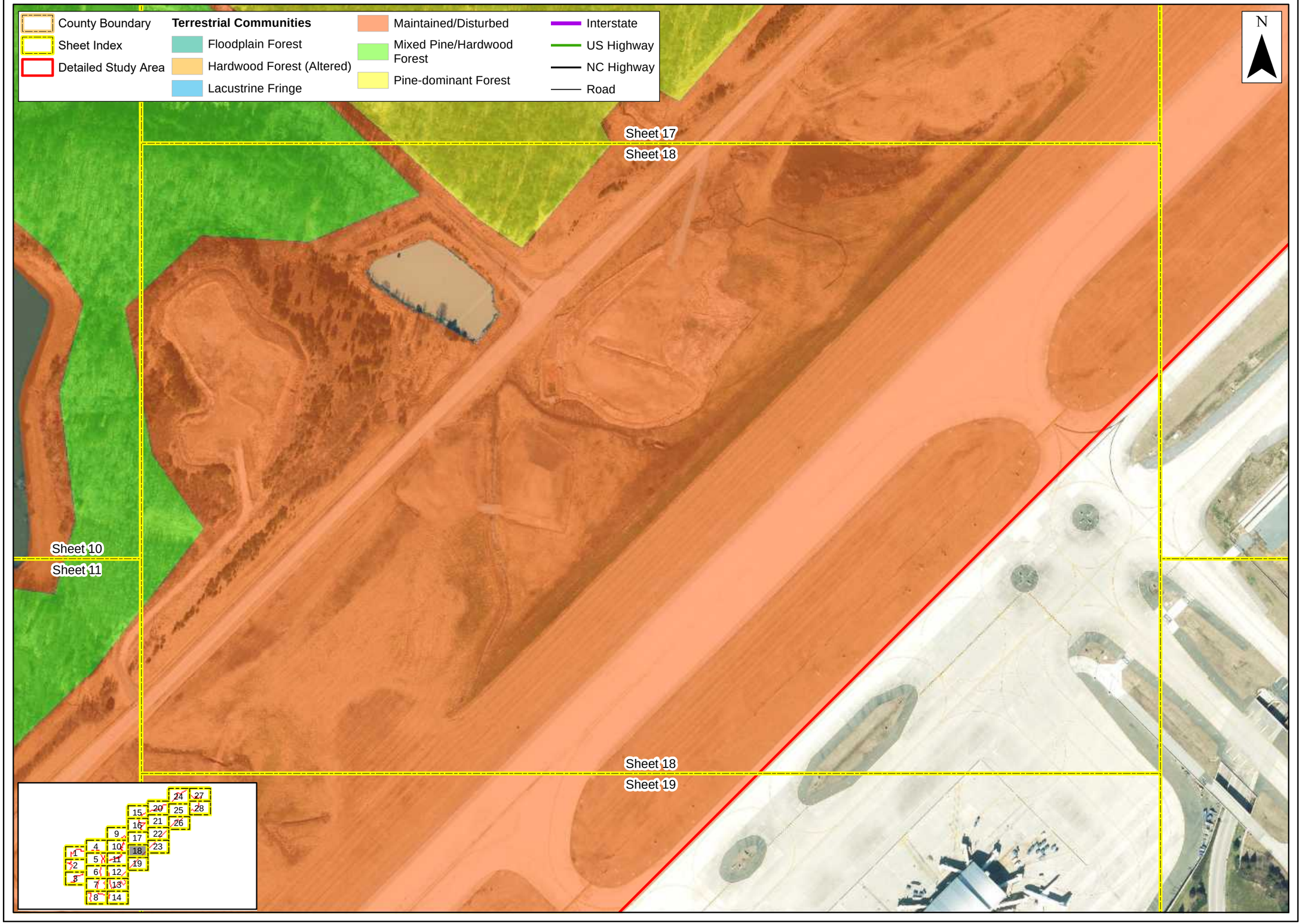

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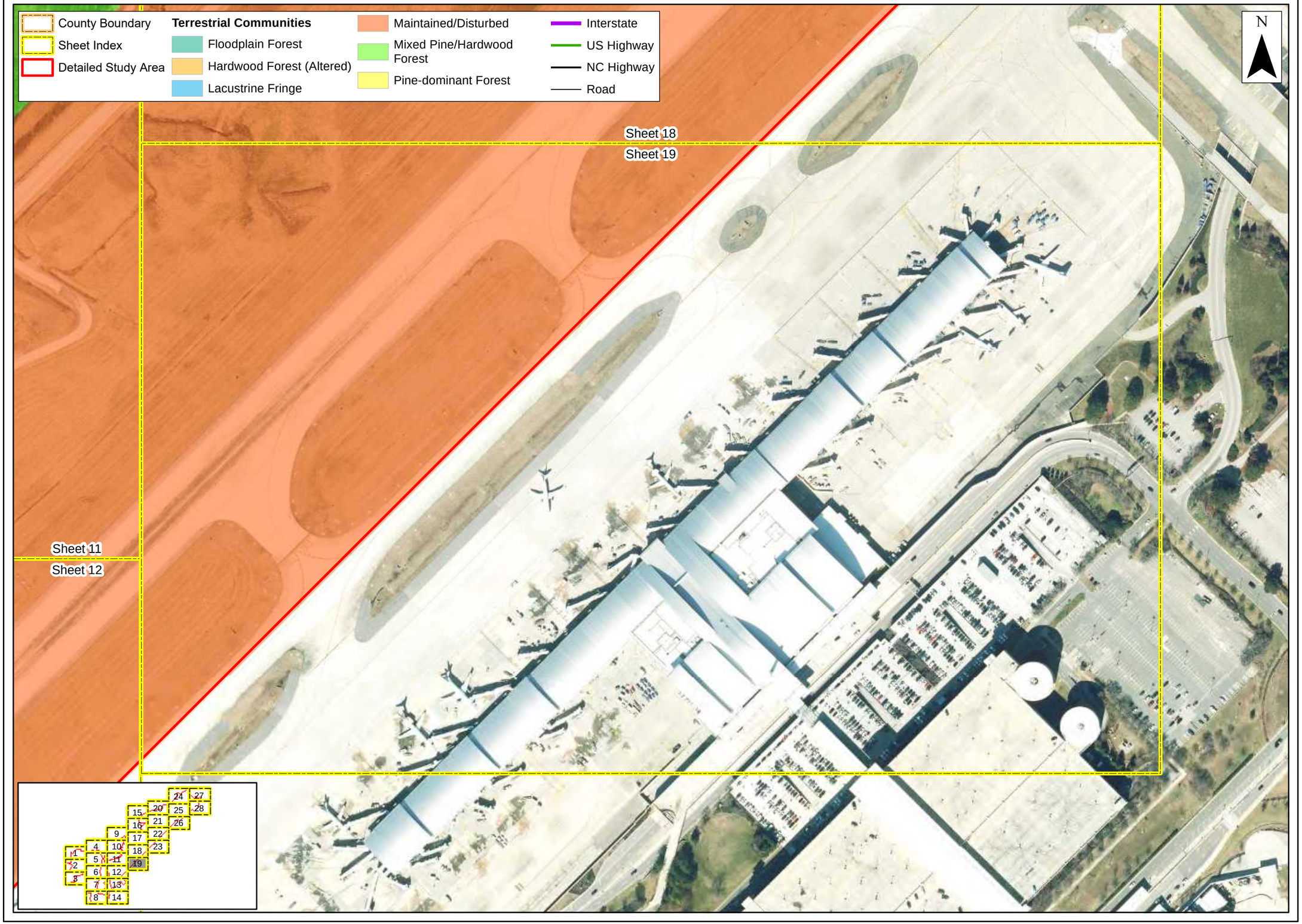

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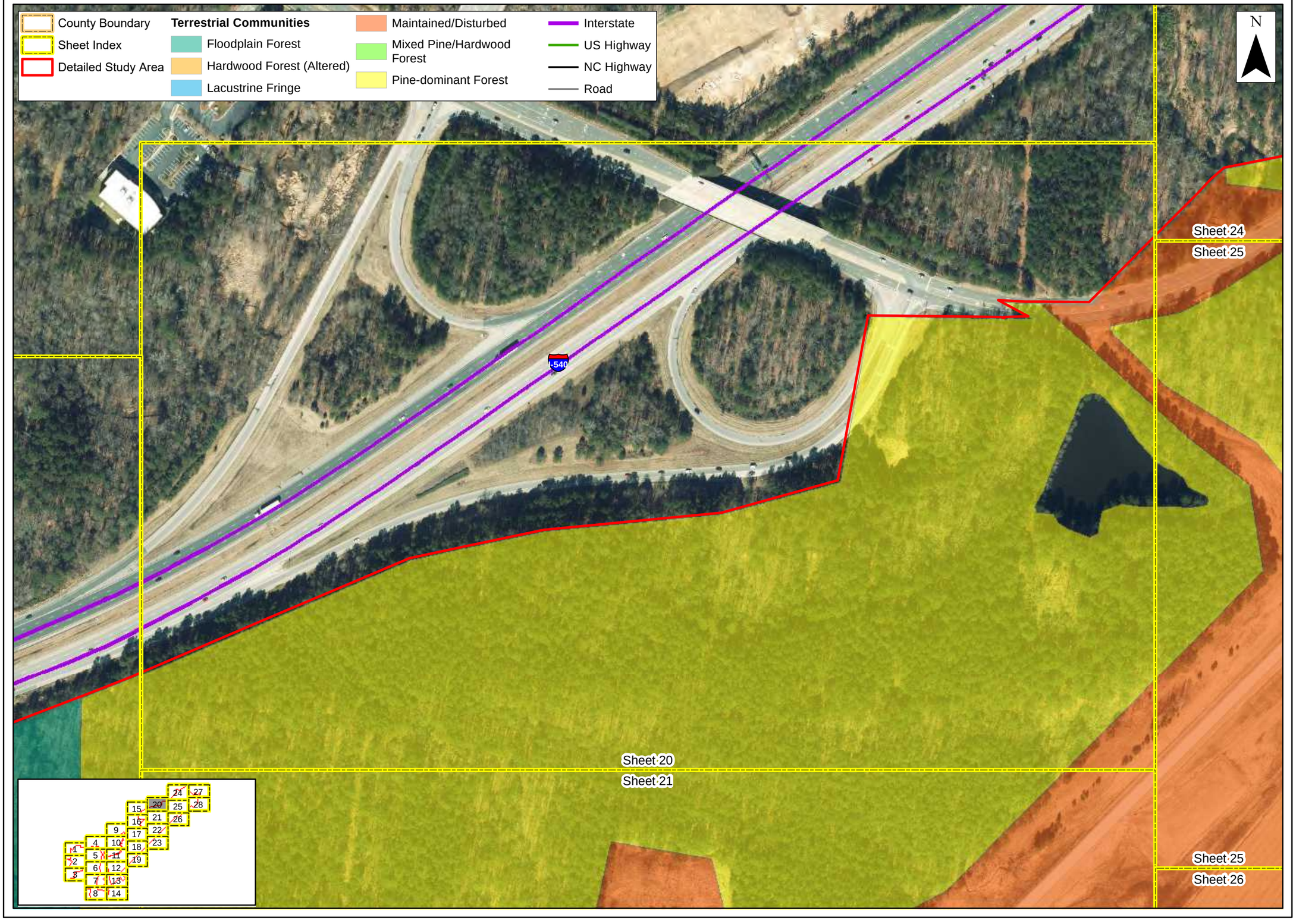

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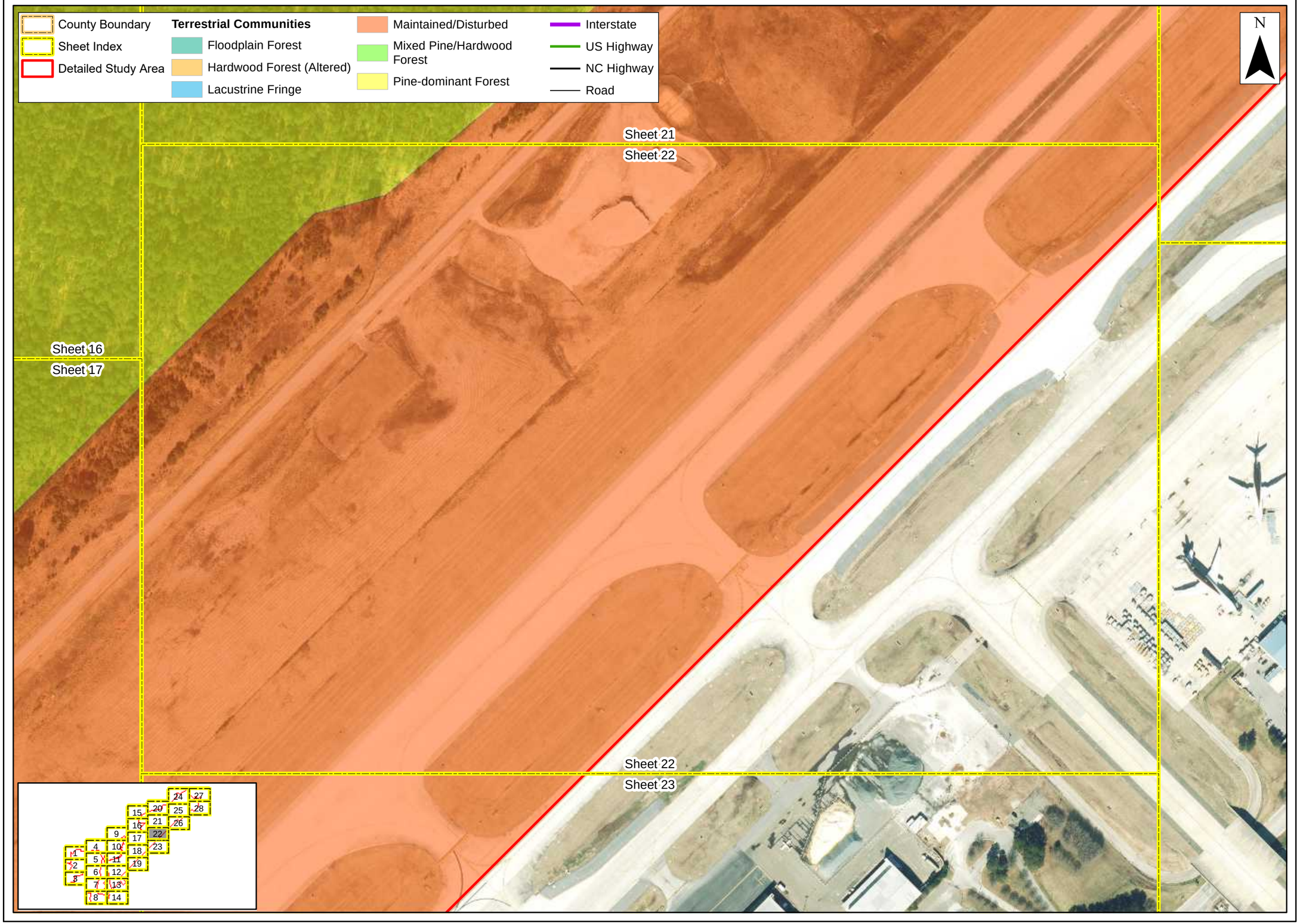

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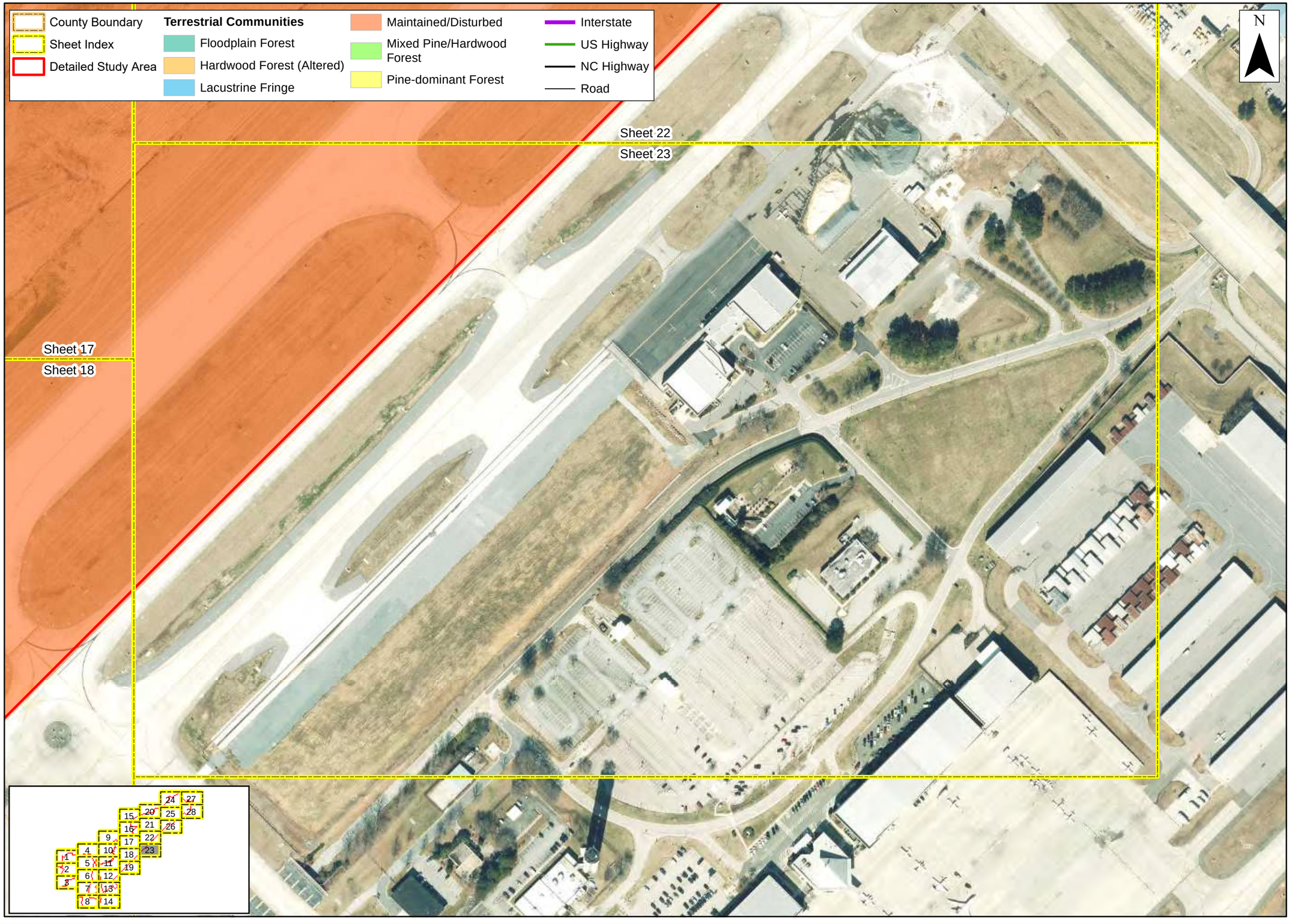

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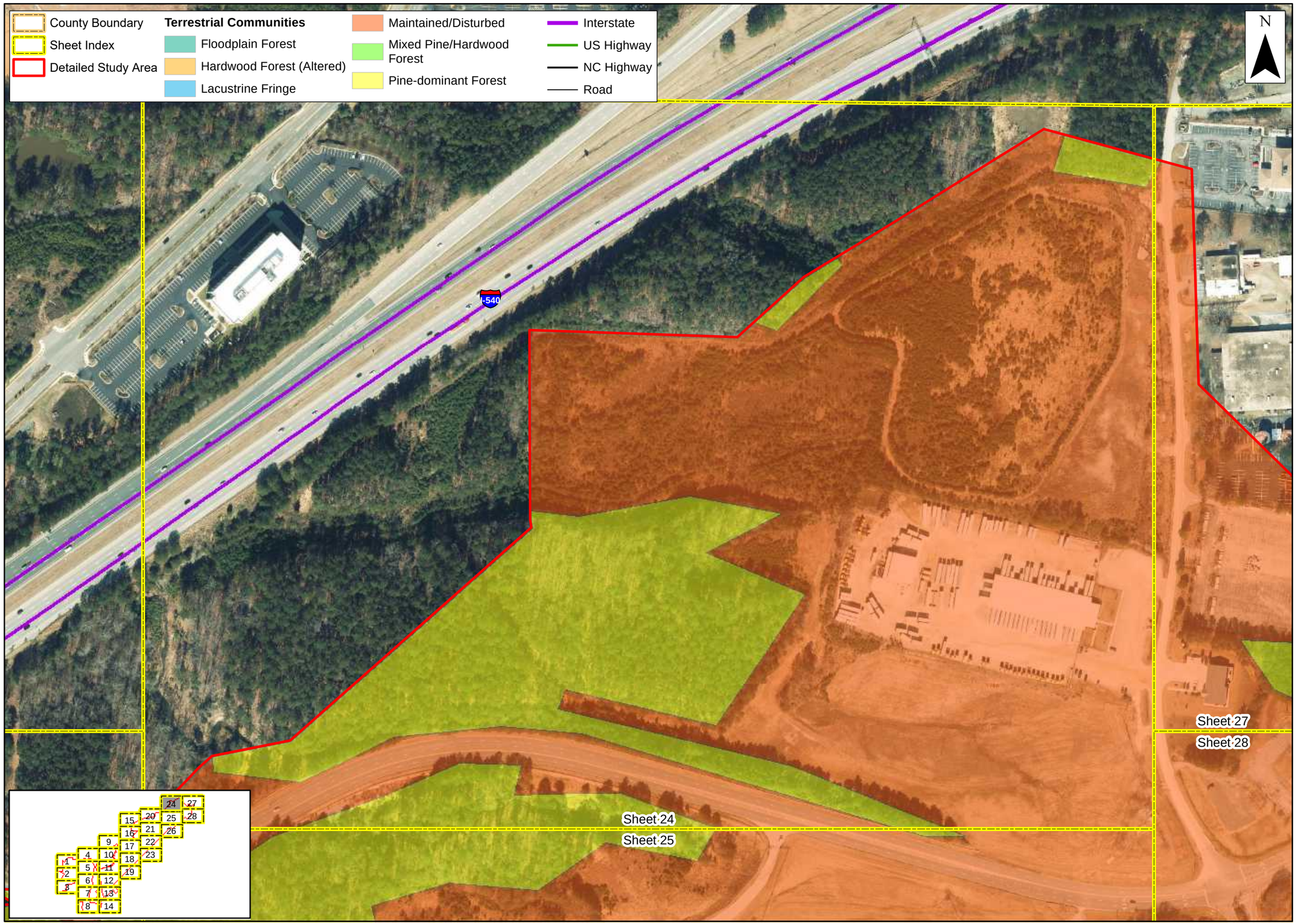

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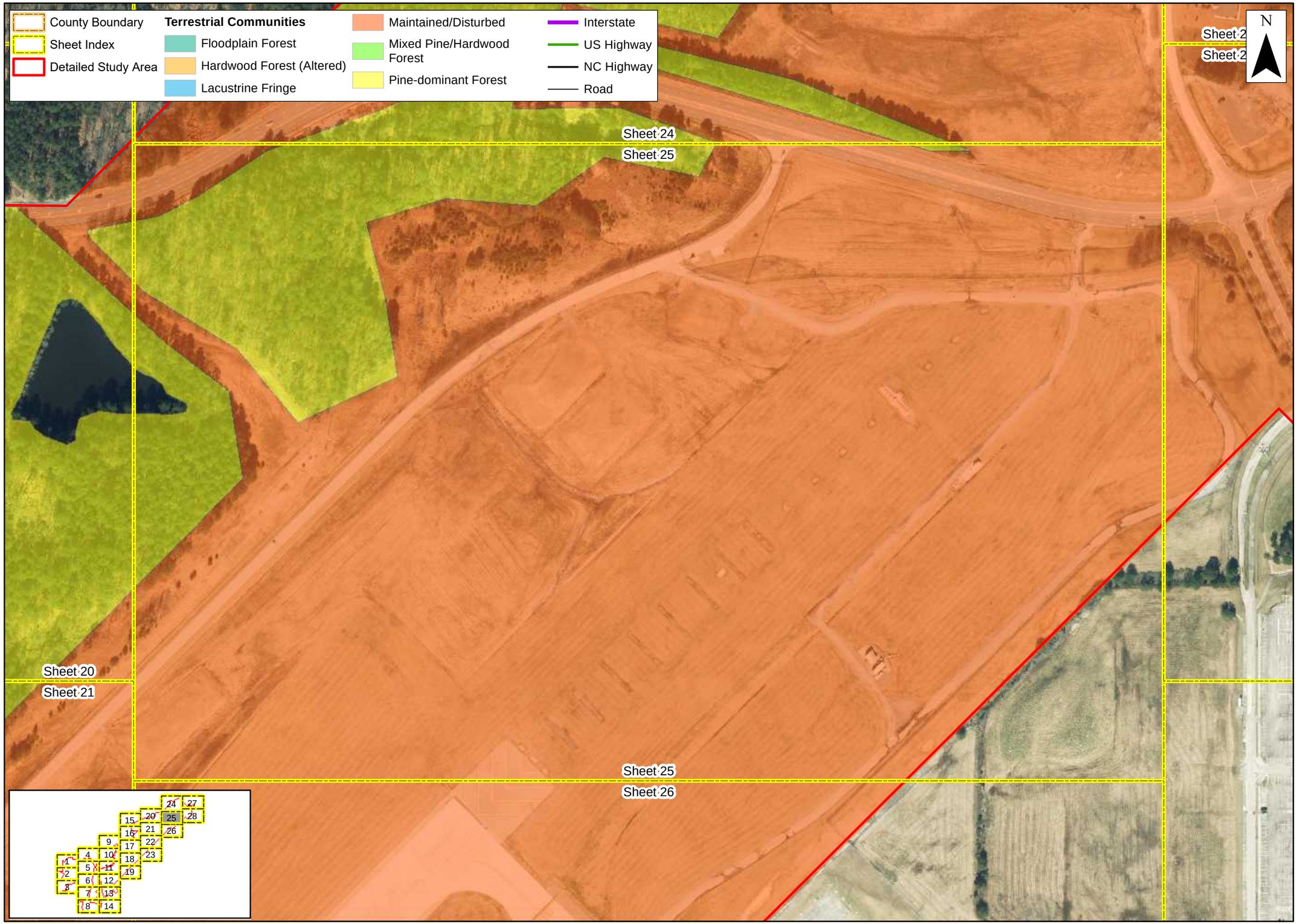

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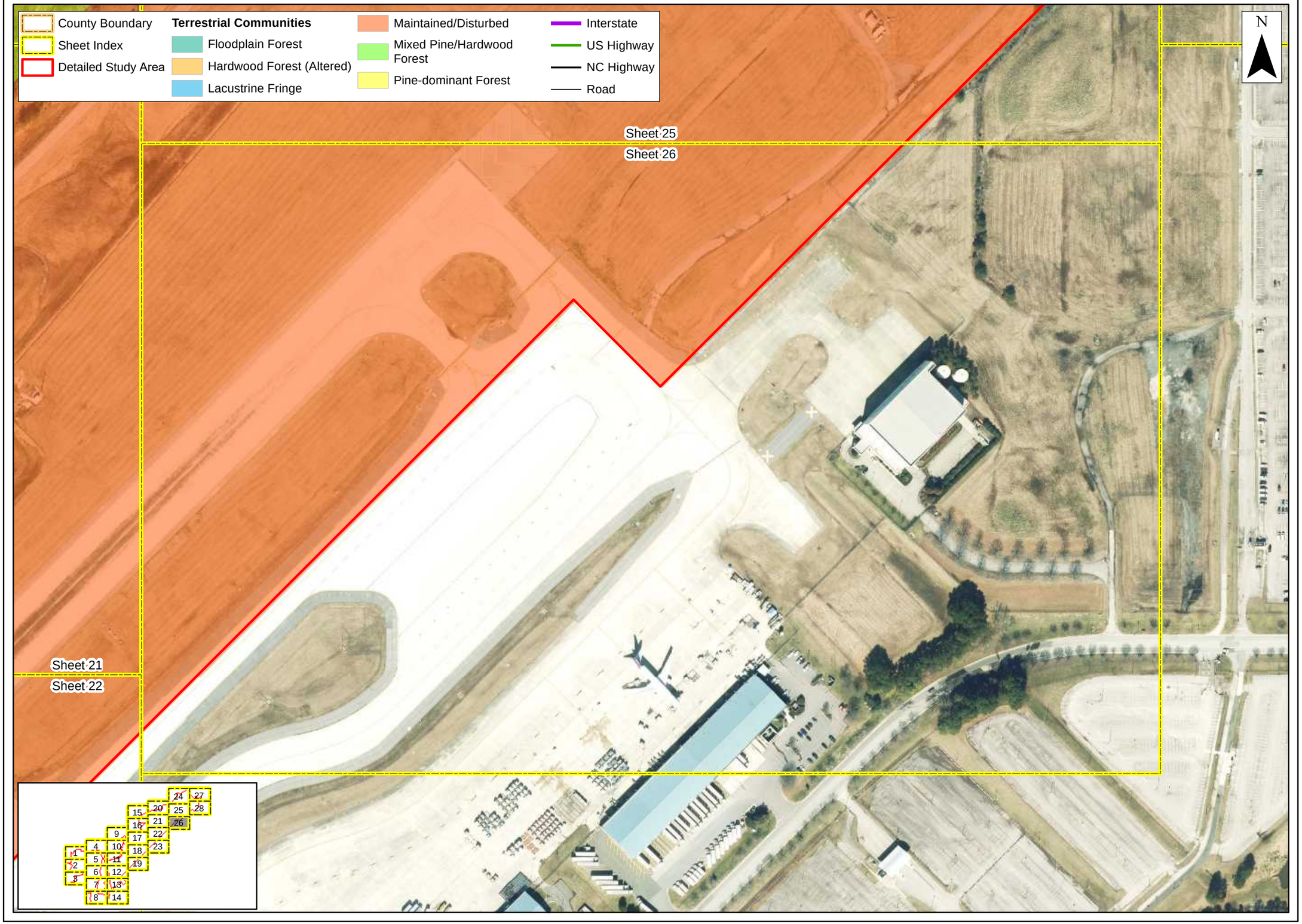

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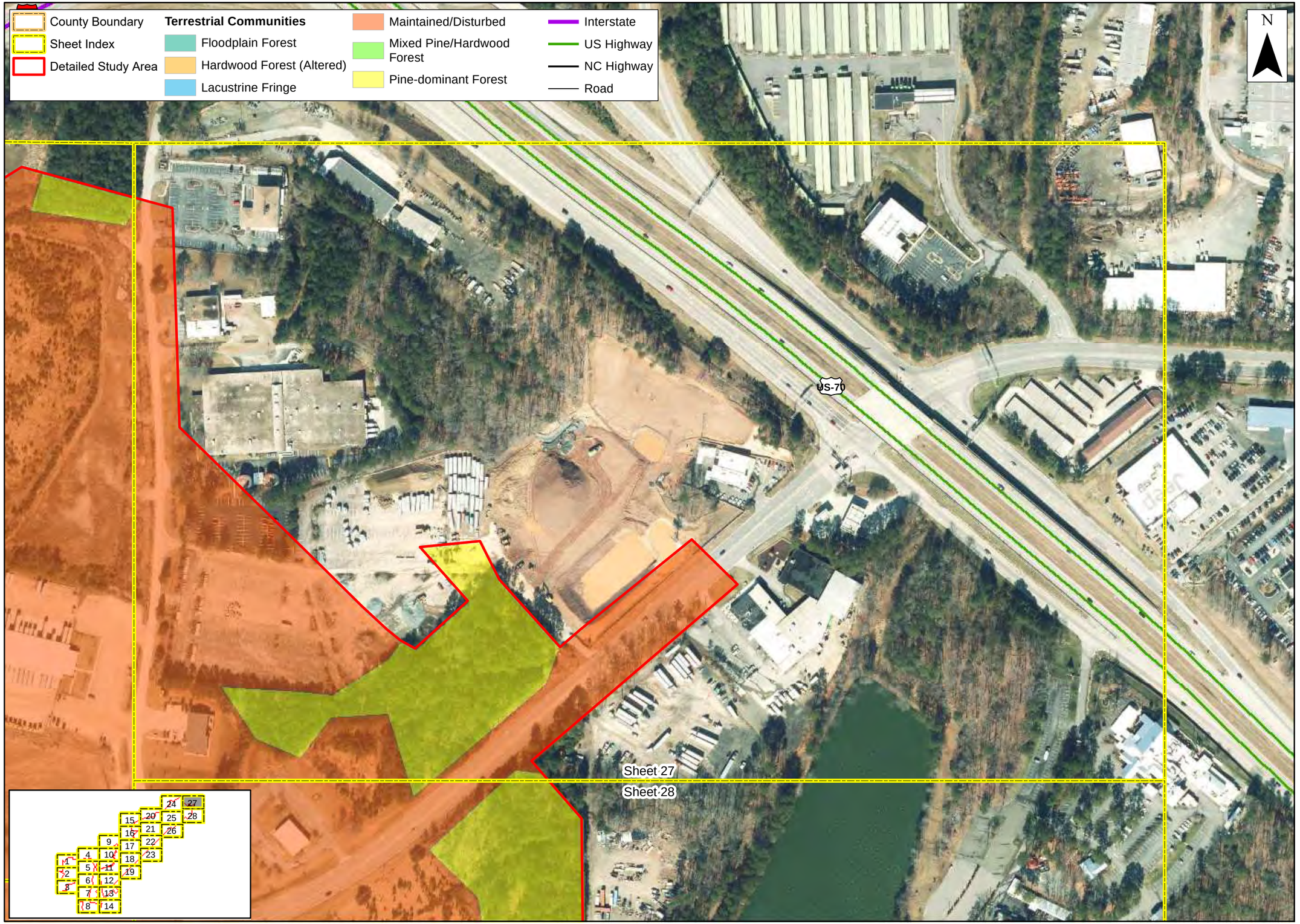

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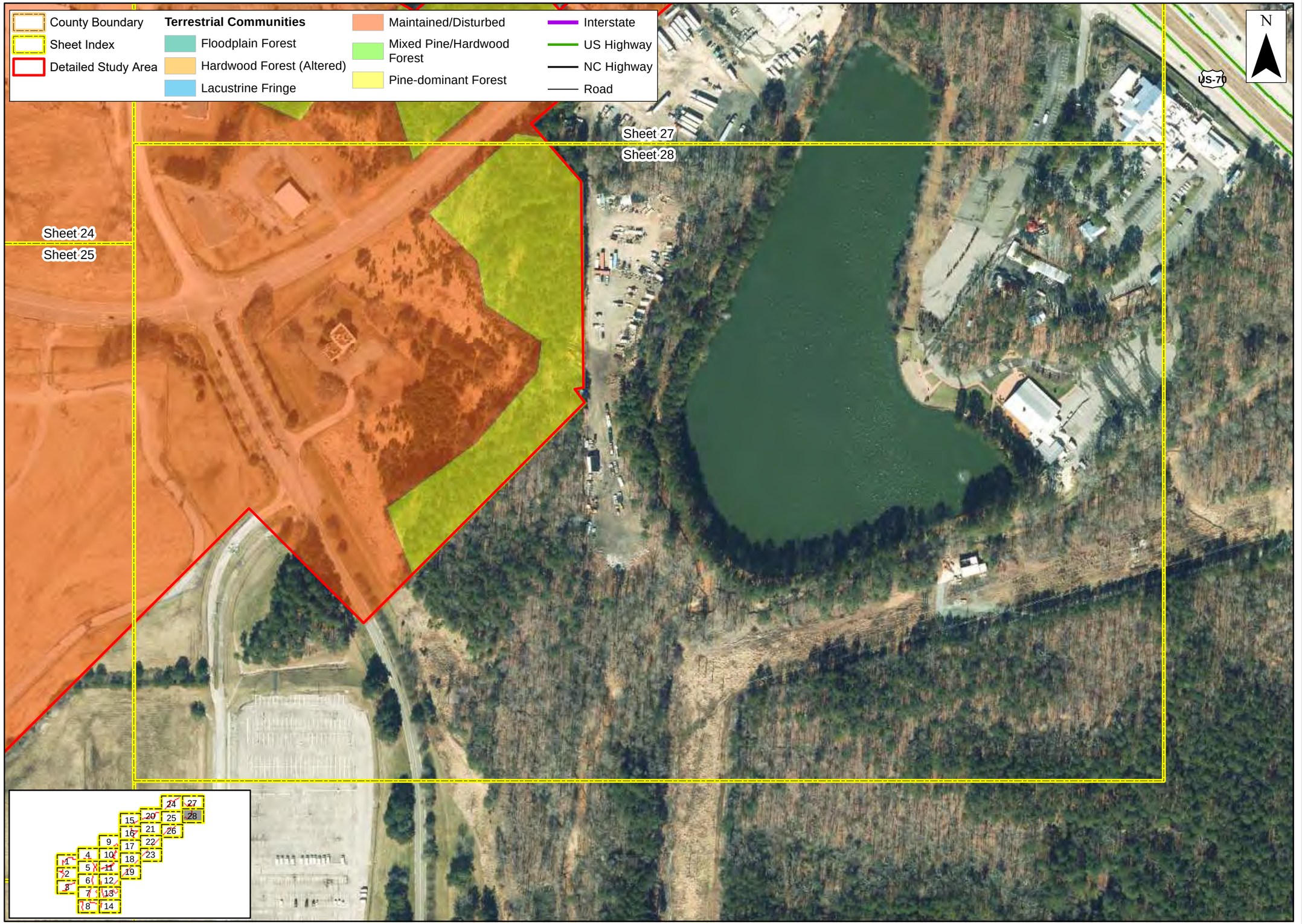

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Appendix B
Qualifications of Contributors

Investigator:	Tom Dickinson
Education:	B.S. Forestry/Natural Resources, Sewanee: The University of the South, 2001
Experience:	Environmental Supervisor/Aquatic Biologist, Three Oaks Engineering, June 2015-present Environmental Scientist, The Catena Group. June 2003-June 2015
Responsibilities:	Aquatics surveys and reporting
Investigator:	Trevor Hall
Education:	BS, Environmental Science: Ecology and Organismal Biology, University of Delaware, 2016
Experience:	Environmental Scientist, Three Oaks Engineering, July 2021-Present Jr. Environmental Scientist, NV5 Consultants and Engineers, April 2019-July 2021 Senior Fisheries Technician, North Carolina State University, October 2018-April 2019
Responsibilities:	Terrestrial and aquatic surveys, aquatics reporting
Investigator:	Nathan Howell, PWS
Education:	B.S. Fisheries, Wildlife, and Conservation Biology, North Carolina State University, 2013 M.S. Plant and Microbial Biology, North Carolina State University, 2015
Experience:	Environmental Scientist, Three Oaks Engineering, October 2015-Present
Responsibilities:	Document preparation and review, terrestrial surveys
Investigator:	Byron Levan
Education:	B.S. Fisheries, Wildlife, and Conservation Biology; North Carolina State University, 2011 M.FW. Fisheries, Wildlife, and Conservation Biology, North Carolina State University, 2019
Experience:	Environmental Scientist, Three Oaks Engineering, 2021-Present Junior Environmental Scientist, NV5 Global Inc. 2019-2021
Responsibilities:	Document preparation and review, terrestrial surveys
Investigator:	James Mason, PWS
Education:	B.A. Biology, Colby College, 2000 M.S. Biology/Ecology, UNC-Charlotte, 2004
Experience:	Environmental Senior Scientist, Three Oaks Engineering, April 2018-Present
Responsibilities:	Document preparation and review, terrestrial surveys
Investigator:	Tess Moody

Education:	B.S. in Natural Resources Management – Wildlife Biology, University of Tennessee at Martin, 2011 M.S. in Forestry, Wildlife, and Fisheries – Wildlife Health, University of Tennessee , 2013
Experience:	Wildlife Research Technician/Assistant, UT Knoxville, May 2011-September 2013 Natural History Interpretive Aide, Charleston County Parks, February 2016-September 2018 Environmental Scientist, Three Oaks Engineering, September 2018–Present
Responsibilities:	Terrestrial surveys
Investigator:	Joanna Salvucci
Education:	B.S. Environmental Geoscience, Bridgewater State University, 2020
Experience:	Environmental Scientist, Three Oaks Engineering, March 2021-Present
Responsibilities:	Document preparation and review
Investigator:	Tim Savidge (Permit No. 21-ES0034)
Education:	B.S. Biology, Guilford College, 1987 M.S. Marine Biology/Biological Oceanography, University of North Carolina at Wilmington, 1998
Experience:	Environmental Manager & Aquatic Biologist, Three Oaks Engineering, June 2015-present Environmental Specialist, NCDOT, 1992-2002
Responsibilities:	Aquatics surveys and reporting
Investigator:	Kate Sevick (Permit No. ES-00485)
Education:	M.S. Environmental Sciences, University of Rhode Island, 2004 B.A. Biology, Reed College, 2000
Experience:	Environmental Scientist, Three Oaks Engineering, June 2015-present Environmental Scientist, The Catena Group, November 2004-June 2015
Responsibilities:	GIS Mapping, Neuse River Waterdog surveys
Investigator:	Lizzy Stokes-Cawley
Education:	M.E.M. Water Resources, Duke University, 2016 B.S. Conservation Biology, St. Lawrence University, 2011
Experience:	Environmental Scientist, Three Oaks Engineering, April 2017-May 2023
Responsibilities:	Terrestrial and aquatic surveys, aquatics reporting

Appendix C
Tricolored Bat Report

TRICOLORED BAT REPORT

For

Proposed Runway 5L/23R Replacement Project
Raleigh-Durham International Airport

July 11, 2023

Prepared for:

Raleigh-Durham Airport Authority and
Federal Aviation Administration

Prepared by:

Three Oaks Engineering, Inc.
324 Blackwell Street, Suite 1200, Durham, NC 27701

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1.0 INTRODUCTION

The subject project proposes to replace Runway 5L/23R (Proposed Action) at the Raleigh-Durham International Airport (the Airport or RDU) (Appendix A, Figure 1). The Airport property is located in Wake and Durham Counties, North Carolina. The Proposed Action includes relocating Runway 5L/23R approximately 537 feet northwest of existing Runway 5L/23R and, after construction is complete, converting the existing Runway 5L/23R to a taxiway. The project also includes use of fill material from Airport borrow sites, use of water from Brier Creek Reservoir, construction of drainage improvements, relocation of a portion of Lumley Road, utility relocations, demolition of four airport-owned buildings, relocation of aircraft navigational aids, acquisition of property, and removal and/or mitigation of obstacles in accordance with Federal Aviation Administration (FAA) safety standards. Approximately 480 acres of tree clearing is proposed as part of this project.

The purpose of this report is to supplement the project's Biological Resources Assessment Report with information specific to the Tricolored Bat (*Perimyotis subflavus*). This will assist the United States Fish and Wildlife Service (USFWS) in their evaluation of potential effects of the project on this species in accordance with Section 7 of the Endangered Species Act of 1973 (ESA) (16 United States Code [USC] 1536 (c)). Section 7(a)(2) of the ESA (16 USC 1531-1544 and Section 1536) requires that each Federal agency shall, in consultation with the United States Fish and Wildlife Service (USFWS), ensure that any action authorized, funded, or carried out by such agency, is not likely to jeopardize the continued existence of an endangered or threatened species, or result in the destruction or adverse modification of critical habitat. Since the proposed project includes funding from the FAA and approval by the United States Army Corps of Engineers (USACE) pursuant to the Clean Water Act (CWA), the project is subject to consultation under Section 7 of the ESA. FAA is the lead federal agency for actions under the National Environmental Policy Act (NEPA) and the ESA. FAA is evaluating the project under NEPA, as amended (42 USC 4321, et seq.).

1.1 Statutory Authority of Action

The Raleigh-Durham Airport Authority (RDUAA) is proposing airport improvements with funding from federal sources through the FAA. FAA derives their statutory authority via 49 USC 106. FAA has initiated conferencing with the USFWS for the Tricolored Bat.

In accordance with the requirements of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, the USACE will review and authorize, as appropriate, the proposed impacts to Waters of the United States (e.g., streams, rivers, most wetlands, lakes, etc.) for this project.

1.2 Summary of Consultation History

The following information provides a consultation history for the subject project.

- In December 2022, the FAA submitted a letter to USFWS requesting conference for the Tricolored Bat.

- On March 3, 2023, Three Oaks submitted a site-specific culvert survey plan for the project. USFWS replied with a letter on the same day concurring with the survey plan.
- In addition to this formal correspondence, several additional emails and meetings between Kathy Matthews of USFWS and those representing RDUAA have occurred.

2.0 PROJECT VICINITY AND DESCRIPTION OF ACTION AREA

2.1 General Information

The proposed project lies in the Piedmont physiographic region of North Carolina. Land use within the project vicinity is primarily commercial, industrial, residential, and transportation infrastructure, interspersed with forested habitat. William B. Umstead State Park is located southeast of the subject project.

2.2 Description of Action Area

The Action Area as defined in 50 CFR 402.02 includes all areas in which federally listed species will be affected directly and indirectly by the proposed action. The "effects of the action" to be analyzed are defined as all consequences caused by the proposed action, including the consequences of other activities that are caused by the proposed action.

The Action Area is comprised of the Detailed Study Area (DSA), which is 1,436 acres in size and includes the limits of disturbance associated with the project activities described in Section 1.0. (Appendix A, Figure 2). The Action Area is comprised of forested areas, maintained/disturbed habitat, impervious surfaces, and open water (large ponds, stormwater basins, reservoirs). Within the forested areas, several riparian corridors exist within the DSA. A subset of the DSA, the limits of disturbance, is where all activity associated with the project will occur.

3.0 TARGET SPECIES DESCRIPTION

Tricolored Bat (*Perimyotis subflavus*)
Status: Proposed Endangered
Family: Vespertilionidae

3.1 Species Characteristics

The Tricolored Bat is a small bat with a wingspan of 8 to 10 inches. The term “tricolored” refers to the bat’s yellowish-brown coat that is dark at the base, yellowish-brown in the middle, and dark at the tips. The wing membranes are blackish, but the face and ears have a pinkish color. An obvious identifying characteristic of this species is the pink color of the skin on the forearm (USFWS 2019).

3.2 Distribution

Tricolored Bats are found throughout the eastern United States, extending north and east into Nova Scotia and Quebec, and southwest to the eastern edge of Mexico and northern Honduras. They have been found state-wide through North Carolina (NCNHP 2023).

The maximum known migration distance for Tricolored Bats was a female who flew a straight-line distance of 151 miles from her winter hibernaculum in Tennessee to a summer roost in Georgia (Samoray et al. 2019).

3.3 Population Trends

White Nose Syndrome (WNS) has caused Tricolored Bat population declines of 90-100 percent across 59 percent of the species' range (Cheng et al. 2021). The oldest known Tricolored Bat was a male captured 14.8 years after it was first banded (Nowak 1991).

3.4 Roost Habitats

Tricolored Bats are generally associated with forested landscapes; they can also be found over water and adjacent to water edges (USFWS 2019). During the spring, summer and fall, Tricolored Bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead hardwoods, but they may also be found in Spanish moss, pines, and occasionally human structures (USFWS 2022b). The species will readily roost in bridges and culverts (Newman et al. 2021).

In the winter, they are often found in places where the temperature stays constant, such as caves, rock crevices, and mines (North Carolina Bat Working Group 2013b). Tricolored Bats are one of the first cave-hibernating species to enter hibernation in the fall and one of the last to leave in the spring (LaVal and LaVal 1980, Merritt 1987). In areas of the southern United States where caves are sparse, Tricolored Bats may roost in culverts, where they go through shorter torpor bouts and may forage during warm winter nights (USFWS 2022a).

3.5 Diet

Tricolored Bats are generally associated with forested landscapes; they can also be found over water and adjacent to water edges (USFWS 2019). They are opportunistic feeders and consume small insects including caddisflies (Trichoptera), moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera) (Whitaker 1972, LaVal and LaVal 1980, Griffith and Gates 1985).

3.6 Threats to Species

WNS is the major threat to Tricolored Bats. As noted above, WNS has caused Tricolored Bat mortality of 90-100 percent across much of the species' range (Cheng et al. 2021). Mortality at wind energy facilities can be consequential at local and regional levels, especially in combination with effects from WNS (USFWS 2022b). Because populations of the species are depressed by WNS, human activities and other factors that were not significantly adverse before may be so now (USFWS 2022b). Disturbance or destruction of natural and artificial roost structures may pose threats, especially at hibernacula and maternity roosts. Pesticide poisoning is a concern as it has been shown to cause population declines in insectivorous bats. Habitat loss due to deforestation is another potential threat (USFWS 2019). Changes in temperature and precipitation caused by climate change may affect Tricolored Bat resources, such as roosting habitat, foraging habitat, and prey availability (USFWS 2022b).

Due to these threats, Tricolored Bat was proposed for listing as Endangered on September 14, 2022 (87 FR 56381) and is anticipated to be officially listed by Fall 2023. Currently, the only

protocol that has been officially developed and released by USFWS for this species is the inclusion of the Tricolored Bat in the Indiana Bat/Northern Long-eared Bat survey guidelines (USFWS 2023).

3.7 Designated Critical Habitat

There is no designated critical habitat for the Tricolored Bat.

3.8 Presence Within and Nearby Action Area

Forested habitat which could be used for summer roosting, foraging, and commuting is present in the Action Area. Additional contiguous forested habitat surrounding the Action Area, including in and around William B. Umstead State Park, is also present. Riparian corridors and open water that could be used for foraging are also present.

On March 24, 2023, Three Oaks biologists assessed, within the project's limits of disturbance (which is the subset of the DSA that project activity will occur in), for the presence of suitable culverts that could be used for roosting. There were 12 culverts large enough to meet the criteria for requiring inspection (at least 36" in diameter and at least 60' long). All culverts were located in proximity to the existing runway and access road; it was confirmed that no culverts were located within proximity of the borrow sites or along existing Lumley Road within the project's limits of disturbance. Culverts were inspected as thoroughly as possible. Binoculars, a spotting scope, and high-powered spotlights were employed to see as far as possible into the culverts from all accessible locations. However, there were some instances where portions/ends of culverts were not accessible, either due to being gated or having an outlet outside of the project's limits of disturbance. No evidence of bats was found in any of the accessible portions of the culverts that were inspected. Please see the culvert survey report, located in Appendix B, for more information about this assessment effort.

No mist netting has occurred as part of the subject project. However, mist netting was conducted in June 2023 on another nearby RDUAA project, the Park Economy 3 parking lot expansion, located approximately 1.3 miles southeast of the subject project. Mist netting was conducted for a total of 10 net nights for the Park Economy 3 project, which is proposing approximately 120 acres of tree clearing (versus 480 acres for the subject project). Forty-three bats were captured, but no Tricolored Bats or other federally protected (or proposed for protection) species were captured. Big Brown Bat (*Eptesicus fuscus*) and Eastern Red Bat (*Lasiurus borealis*) were the only species found.

According to the USGS mines database, no caves or mines were observed within or within 0.5 miles of the project footprint (USGS 2022 [http://mrdata.usgs.gov/mrds/find-mrds.php]). The nearest North Carolina Natural Heritage Program (NCNHP; April 2023 dataset) record is approximately 4.0 miles southeast of the project study area in William B. Umstead State Park, dating from 2002 (mist netting site, 1 netted; EO ID 36282). The next closest occurrence is approximately 5.3 miles east/northeast of the project, last observed in 2021 (winter roosting site; EO ID42741).

3.9 Effects to Action Area Tricolored Bat Population from Other Projects

Due to their ability to roost in caves, mines, rock outcrops, trees, and structures such as bridges and culverts, it is possible that logging or construction projects in the vicinity of the RDU runway replacement project could affect Tricolored Bats in the project Action Area. Not enough is known about the size or movements of the Tricolored Bat population in the vicinity to determine if any such activities taking place outside the project Action Area could have measurable effects on Tricolored Bats within the Action Area.

4.0 ENVIRONMENTAL BASELINE FOR BATS

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed federal projects in the Action Area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in progress. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR Section 402.02).

Human activity has shaped much of the Action Area. RDU is located with an anthropogenically modified landscape, with a large portion of the airport itself covered by impervious surface. The surrounding areas are maintained/disturbed, with commercial, industrial, and residential development and transportation infrastructure being prevalent. Landscape modifications resulting from the creation of nearby Brier Creek, Little Brier Creek, and Stirrup Iron Creek Reservoirs are also present nearby.

It is likely that this human activity in the project Action Area has reduced available habitat for bats, or reduced the quality of habitat, by removing forested areas and creating more open space. This open habitat may create a barrier to some bat movements, with bat activity unlikely within the runway, concourses, and other human-impact areas within the Action Area due to lack of habitat and the extensive human activity present therein, including lights and noise.

Buildings or other man-made structures in the project vicinity may provide roosting opportunities for certain bat species. No bats were present within suitably-sized culverts; however, to date, no buildings have been surveyed.

Even with extensive human modification and habitat reduction, contiguous areas of forested habitat that could provide protected areas for bat foraging, commuting, or roosting is present within and adjacent to the Action Area. Due to that habitat being present, plus nearby known occurrences of Tricolored Bat, it is not possible to rule out the possibility of Tricolored Bats being present in some capacity within the Action Area.

5.0 EFFECTS OF THE PROPOSED ACTION ON FEDERALLY PROTECTED BATS

Any bats roosting in the Action Area may be negatively affected by construction activities, as described below. Effects associated with this project are not a concern in winter months when bats are hibernating.

5.1 Potential Effects from Project Improvements

Tricolored Bats are potentially vulnerable to effects from construction from April 1 – October 15 of any given year. Stressors from construction will last the length of the project while bats are active. Individual stressors will generally be short term in nature and include noise, lighting, vibration, and removal of woody vegetation.

5.1.1 Lighting Effects

Night work is likely during the life of the subject project. This activity may cause displacement of bats since they may have to expend time and energy looking for new roosts. In addition, bats may have to commute further from new roost locations or to reach new foraging sites, resulting in a loss of fitness and increased exposure to predation. This may result in reduced survivorship. To minimize impacts from lighting effects, stationary lighting fixtures used at night during the active season (April 1 – October 15) will be positioned so that they are not focused on forested areas or open water (this does not include vehicle lighting, which may cause short-term, incidental illumination of these areas)..

There is a potential for an increase in overall disturbance from permanent lighting due to changes in lighting location, increase in the overall number of light, lights on taller light poles, etc. Changes/increases in permanent lighting may impact bats by forcing them to find different roosting locations. Additional permanent lighting may also affect insect movement and abundance, potentially impacting bats by requiring them to find new locations to forage and longer travel for foraging. Additional movement for bats for either roosting or foraging may increase loss of fitness and chances of predation.

5.1.2 Acoustic and Vibration Effects

Animal response to sound and vibration depends on a number of factors, including level and frequency, distance and event duration, equipment type and condition, frequency of disruptive events over time, slope, topography, weather conditions, previous exposure to similar events, hearing sensitivity, reproductive status, time of day, behavior during the event, and the location of the animal relative to the source (Delaney and Grubb 2003).

The use of construction equipment is anticipated to cause increased noise and vibration within the Action Area, specifically within currently forested areas. Areas adjacent to the existing runway already experience increased noise levels during certain times of the day/night due to existing airport activity. Noise will be generated primarily from equipment used to transport materials, clear and grade areas, and construction activities. Specifically, percussive noise or vibrations from blasting (anticipated to be the loudest noise associated with the project) may affect bats roosting in the Action Area. Construction activities have the potential to take place during both daylight and nighttime hours, but will be temporary in nature.

Day-time construction activities associated with the subject project have the potential to result in noise-related adverse effects to roosting bats, if any are present at the time. However, bats roosting near existing airport facilities may already be accustomed to some degree of noise and/or vibration. Since night work is likely to occur, bats that are commuting, foraging, or migrating may be affected by project noise or vibration.

Increased noise or vibrations may cause the temporary loss of roost sites within the Action Area, including day-roosting sites The displacement of bats may cause them to have to expend time and energy looking for new roosts and may require them to commute further from new roost locations to preferred foraging sites, resulting in a loss of fitness and increased exposure to predation. Nighttime work may result in disturbance of foraging and commuting activities. To minimize effects to roosting bats during the bat maternity season and to avoid stressing bats coming out of hibernation in the spring, blasting activities will be limited in duration and locality each day between April 1 – October 15, when bats are most active (e.g., widespread blasting will not occur throughout the project's limits of disturbance and will localized; blasting will be completed over as short of duration as possible each day; blasting days will be grouped as much as possible to avoid long-term disturbance). Blasting will not occur during pup rearing season (June/July). Nighttime blasting will also not take place during the life of the project.

5.1.3 Effects from Removal of Woody Vegetation

Tricolored Bats can be found over water (USFWS 2019) and may use riparian corridors and open waters in the Action Area to travel or forage. Forested areas may be used for foraging or roosting.

As a worst-case scenario, tree-clearing was estimated at 480 acres for the entire project. Actual tree-clearing is likely to be less once final design is completed. Cleared areas may serve as ecological barriers for some species, including bats. If bats avoid areas where clearing has occurred, this may lead to increased travel time between their roosts and foraging areas. Any bats that travel/forage along riparian corridors, or other areas where tree-clearing has occurred, may be adversely affected by tree-clearing. Bats may have to commute further from new roost locations or to reach new foraging sites, resulting in a loss of fitness and increased exposure to predation. This may result in reduced survivorship.

Tree-clearing activities will be scheduled to take place when bats are minimally active (October 16 – March 31), and no direct mortality is expected as a result of these winter tree-clearing activities. Tree clearing will only be considered during the active season between April 1 and October 15 if absolutely required (e.g., the project cannot wait until winter months to clear an area for a stormwater device). No tree clearing will occur during pup rearing season (June/July). Any active season clearing will be presented to USFWS to determine what additional survey/conservations efforts, if any, are required when completing the work.

Additionally, the Airport Authority would leave 100 feet of the existing trees and vegetation in place as a buffer around the borrow areas. This would help provide wildlife a remaining functional corridor to other forested areas.

5.1.4 Water Quality Effects

The extent of sediment inputs into waterways associated with the project is difficult to determine. Duration and timing of rainfall, extent of clearing, proximity to a body of water, slope of cleared area, and other factors can all have a bearing on the amount of sediment that may potentially be

generated during rainfall events. Likewise, the type, timing, amount, and proximity to a water source of any accidental spills relate to the magnitude of effect in the event of a spill.

Diminished water quality caused by sedimentation or contamination, if it were to reach streams or open waters, may reduce the availability of certain aquatic insects for bats and reduce the availability or quality of drinking sources. Tricolored Bats may forage over waterways (Barbour and Davis 1969, USFWS 2019) and could be affected by a reduction in prey base, however, as opportunistic feeders (Whitaker 1972, LaVal and LaVal 1980, Griffith and Gates 1985), they may be able to shift to food sources not associated with aquatic habitat.

A detailed Erosion and Sedimentation Control Plan will be developed, and approved by the North Carolina Department of Environmental Quality, for the project to minimize the effect on water quality from the project. This plan will also be submitted as part of the environmental permitting application. Erosion control measures will be regularly inspected during the life of the project to minimize failures and appropriate revegetation measures will be taken after sites are graded to limit bare earth to actively constructed areas.

5.2 Potential Effects from Facility Operation

As this project intends to replace the existing runway, effects from facility operation, including traffic/airplane noise and vibrations, are not anticipated to change to the point of additional impact to the Tricolored Bat. Any bats in the Action Area will be exposed to a similar amount of noise and vibration as they would have been pre-construction.

If long-team lighting is significantly greater than existing lighting, or if lights are placed closer to forested areas or water bodies that provide foraging habitat, it may result in permanent displacement of Tricolored Bats from roosting, foraging and commuting habitat. Permanent lighting location and color will be considered when developing the lighting design, as much a practicable and allowed per FAA safety requirements.

6.0 CONCLUSION OF EFFECTS – TRICOLORED BAT

Culvert surveys did not reveal any winter roosting Tricolored Bats in the Action Area. Additionally, mist netting surveys related to the nearby RDUAA Park Economy 3 project did not result in the capture of any Tricolored Bats or other federally protected species. However, due to the presence of nearby occurrences and suitable contiguous forested habitat with the Action Area, the presence of Tricolored Bats in the Action Area cannot be ruled out. Therefore, it is assumed that Tricolored Bats are likely present in the Action Area.

Due to this potential for Tricolored Bats to be present, the following conservation measures are currently being proposed for the project:

- Stationary lighting fixtures used at night during the active season (April 1 – October 15) will be positioned so that they are not focused on forested areas or open water.
- To minimize effects to roosting bats during the bat maternity season and to avoid stressing bats coming out of hibernation in the spring, blasting activities will be limited in duration and locality each day between April 1 – October 15, when bats are most active (e.g., widespread blasting will not occur throughout the project's limits of disturbance and will localized; blasting will be completed over as short of duration as possible each day; blasting days will be grouped as much as possible to avoid long-term disturbance).

- Blasting will not occur during pup rearing season (June/July).
- Nighttime blasting will not take place during the life of the project.
- Tree-clearing activities will be scheduled to take place when bats are minimally active (October 16 – March 31).
- Tree clearing will only be considered during the active season between April 1 and October 15 if absolutely required (e.g., the project cannot wait until winter months to clear an area for a stormwater device). No tree clearing will occur during pup rearing season (June/July). Any active season clearing will be presented to USFWS to determine what additional survey/conservations efforts, if any, are required when completing the work.
- The Airport Authority would leave 100 feet of the existing trees and vegetation in place as a buffer around the borrow areas. This would help provide wildlife a remaining functional corridor to other forested areas.
- A detailed Erosion and Sedimentation Control Plan will be developed, and approved by the North Carolina Department of Environmental Quality, for the project to minimize the effect on water quality from the project. This plan will also be submitted as part of the environmental permitting application.

Based on currently available data and the conservation measures proposed by the project, it has been proposed that the actions of the subject project described herein "**May Affect, and are Likely to Adversely Affect"** the Tricolored Bat. However, the activities associated with the project are "**Unlikely to Jeopardize**" the species. RDUAA understands that once the species is officially listed and guidance is officially released, additional coordination and/or consultation with USFWS will be required for the species.

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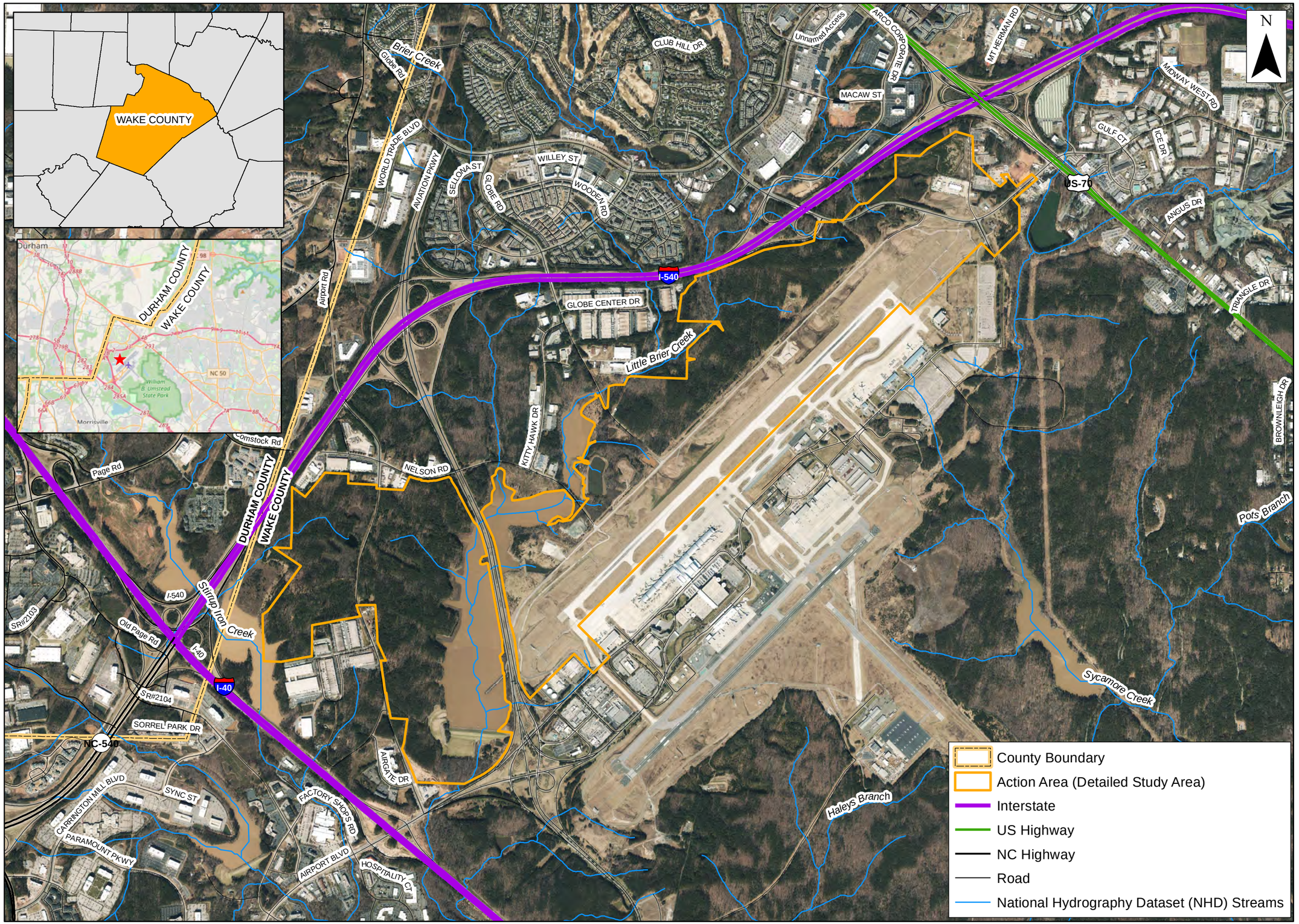
Appendix A. Figures



THREE OAKS ENGINEERING

Prepared For:

RDU

Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Tricolored Bat Report

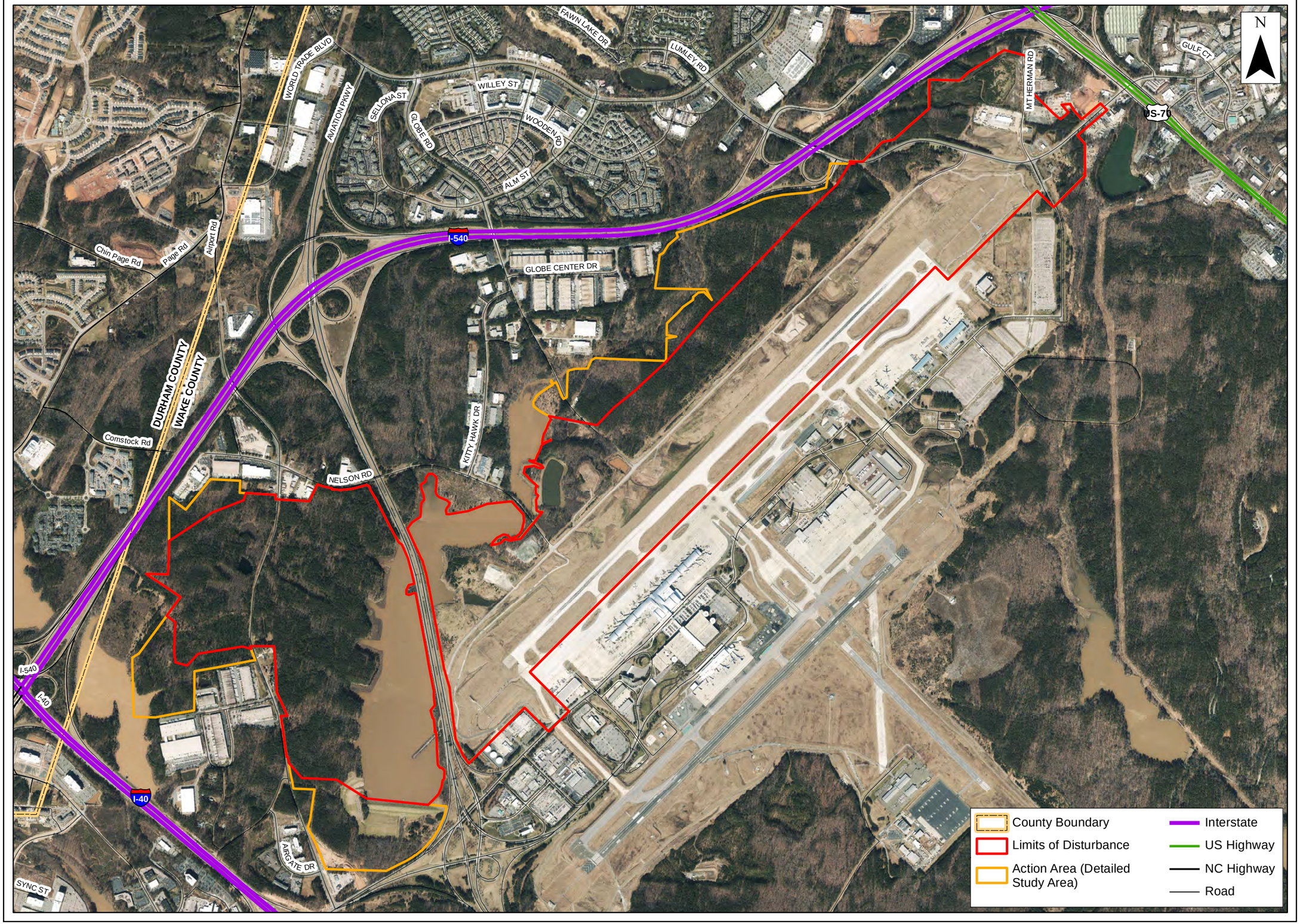
Vicinity Map

Wake County, North Carolina

Date:	June 2023
Scale:	0 1,000 2,000 Ft
Job No.:	19-018
Drawn By: KEMS	Checked By: NDH

Figure

1



THREE OAKS ENGINEERING

Prepared For:

RDU

Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Tricolored Bat Report

Action Area

Wake County, North Carolina

Date:	June 2023
Scale:	0 500 1,000 Ft
Job No.:	19-018
Drawn By: KEMS	Checked By: NDH

Figure

2

Appendix B. Tricolored Bat Survey (Culverts) Report

Tricolored Bat Survey (Culverts)

For

Raleigh-Durham International Airport Environmental Assessment
Proposed Runway 5L/23R Replacement Project
Wake County, North Carolina

Prepared for:

Raleigh-Durham Airport Authority and
Federal Aviation Administration

Prepared by:

Three Oaks Engineering
324 Blackwell Street, Suite 1200
Durham, NC 27701
(919) 732-1300

May 2023

The Raleigh-Durham Airport Authority (RDUAA) proposes to replace runway 5L/23R at Raleigh-Durham International Airport in Wake County, North Carolina. Three Oaks Engineering (Three Oaks) was contracted to perform culvert inspections for the Tricolored Bat. In addition, an inspection for the Little Brown Bat was also conducted.

The USFWS recently published its proposal to list the Tricolored Bat *(Perimyotis subflavus)* as Endangered on September 14, 2022 (87 Federal Register [FR] 56381–56393). The Little Brown Bat *(Myotis lucifugus)*, which may become federally listed in the future and is currently under review for listing, may also be found in Wake County.

HABITAT DESCRIPTIONS AND NEAREST KNOWN OCCURRENCES

Tricolored Bat *(Perimyotis subflavus - PESU)*

Tricolored Bats are generally associated with forested landscapes. In summer, they will roost in tree foliage, or sometimes in buildings. They are also known to roost in bridges and culverts. The species has been observed in Wake County (LeGrand et al. 2022). The nearest North Carolina Natural Heritage Program (NCNHP; January 2023 dataset) record is approximately 4.0 miles southeast of the project study area at William B. Umstead State Park, dating from 2002 (EO ID36282).

Little Brown Bat *(Myotis lucifugus – MYLU)*

The Little Brown Bat will readily use man-made structures such as buildings and bridges/culverts for roosting, while using forested areas and corridors along water bodies for foraging. This species has been observed in Wake County (LeGrand et al. 2022). The nearest NCNHP (January 2023 dataset) record is 11.0 miles southeast of the project study area, dating from 1981 (EO ID32135).

SURVEY METHODS

The inspection followed the guidance set forth in the North Carolina Department of Transportation's (NCDOT) Standard Operating Procedures (SOP) for Preliminary Bat Habitat Assessments (Structures, Caves & Mines) (2022). Specifically, binoculars, a spotting scope, and high-powered spotlights were employed during the assessments. This procedure has been accepted by the United States Fish and Wildlife Service (USFWS) for use on non-NCDOT projects. Additionally, a site-specific survey plan was submitted to and approved by USFWS on March 3, 2023 (which follows the NCDOT protocol) (see Appendix).

Bat habitat assessment forms were completed as specified in the SOP. All surveys performed were consistent with the protocols stipulated in the USFWS National White-Nose Syndrome Decontamination Protocol (USFWS 2020b), North Carolina's White-Nose Syndrome Surveillance and Response Plan (NCWRC 2016), and the NCDOT White-Nose Syndrome Decontamination Protocol (NCDOT 2014). No acoustic or mist-net surveys were conducted.

A review of the existing culvert data in AutoCad was conducted. In discussions with USFWS, only culverts that have a 36" or greater diameter were surveyed. Per the NCDOT protocol, structures also needed to be at least 60'long. Attached is a map (Appendix, Figure 1) identifying the pipes with equal to 36" or greater diameter. Three Oaks surveyed these pipe openings for indicators of bat presence including: bats flying, sounds of bats in the pipes, bat droppings (guano), and presence of staining within the pipes. If there were any additional culverts/structures that met the size criteria but were not listed in the culvert data that was reviewed, those structures were surveyed as well. A survey form was completed for each feature. No culverts were identified on Lumley Road or near the borrow sites after review of the NCDOT structures dataset; however, these areas were still visually inspected to confirm that no suitable structures were present.

Spatial data containing records for active and inactive mine locations were obtained from the United States Geological Survey (USGS) Mineral Resources On-Line Spatial Data website (USGS 2022). The project footprint was compared to the mine database to check for mine locations within a half-mile of the project.

SURVEY FINDINGS

On March 24, 2023, Three Oaks biologists (Mary Frazer, Nathan Howell, and Mark Guerard) assessed within the project's limits of disturbance for the presence of suitable culverts that could be used for roosting. There were 12 culverts in the project footprint large enough to meet the criteria for requiring inspection (at least 36"in diameter and at least 60' long). It was confirmed that no culverts were located within proximity of the borrow sites or along existing Lumley Road within the project's limits of disturbance.

Culverts were inspected as thoroughly as possible. Binoculars, a spotting scope, and high-powered spotlights were employed to see as far as possible into the culverts from all accessible locations. However, there were some instances where portions/ends of culverts were not accessible, either due to being gated or being outside of the project's limits of disturbance. No evidence of bats was found in any of the accessible portions of the culverts that were inspected. Data forms for culverts are included in the Appendix.

According to the USGS mines database, no caves or mines were observed within or within 0.5 miles of the project footprint (USGS 2022 [http://mrdata.usgs.gov/mrds/find-mrds.php]).

No additional non-structure habitat assessments/surveys were completed.

If you have any questions or require any additional information, please contact Mary Frazer at either mary.frazer@threeoaksengineering.com or (919) 215-5724.

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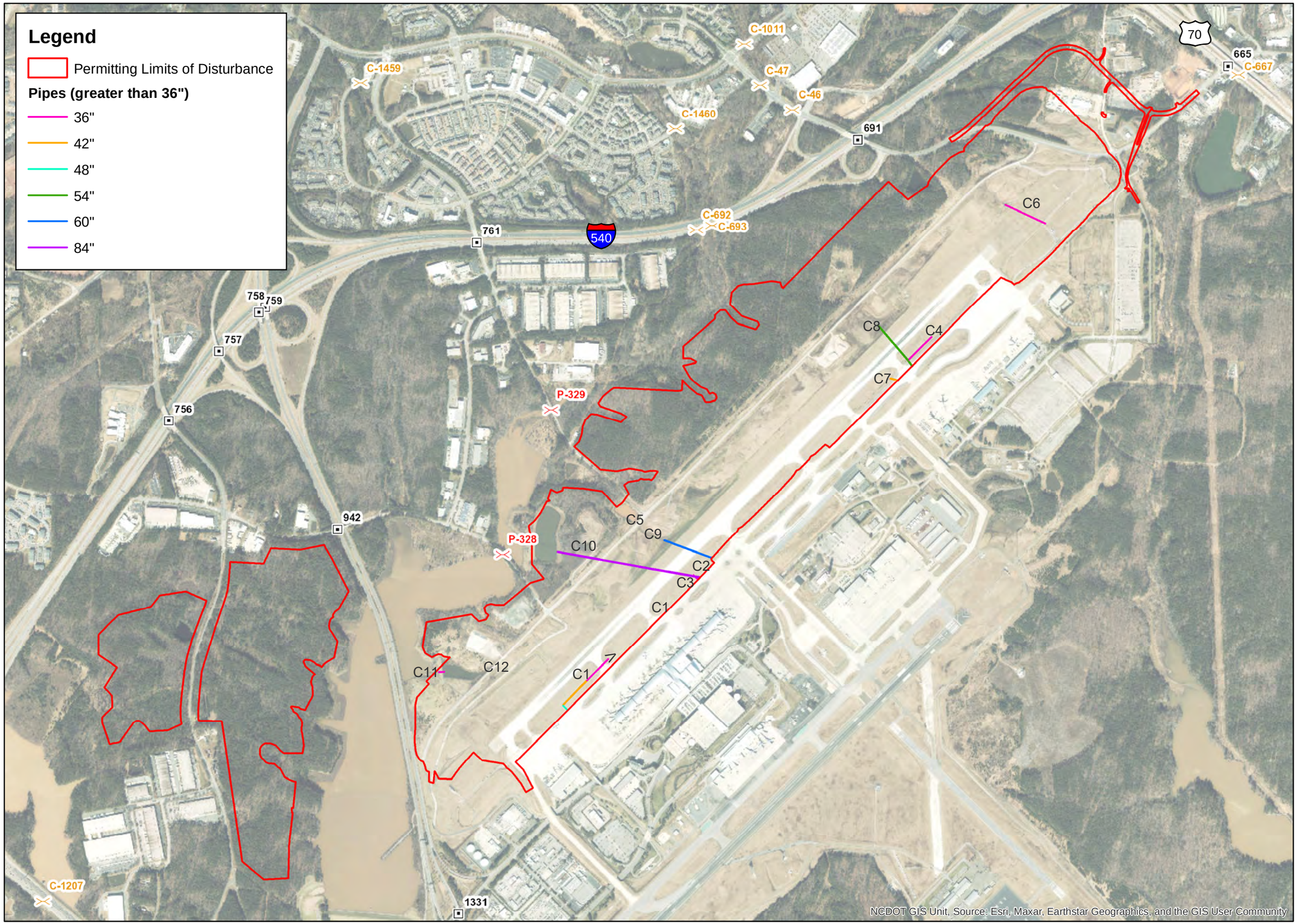
APPENDIX



THREE OAKS ENGINEERING

Prepared For:

RDU

Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Bat Structures Map

N

Wake County, North Carolina

Date:	March 2023
Scale:	0 500 1,000 Ft
Job No.:	19-018
Drawn By: CMR	Checked By: JSM

Figure

1

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Macy Frazer / Nathan Howell Project number/name: RDU Culverts Runway
Date: 3-24-23 Time 11:30 AM Road Name/SR Number: C1
County: Wake Structure #: yellow->pink
Crossing (Name of the feature intersected): _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? (N/A) yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: (N/A) river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes no N/A
Structure specific questions:

Guard rails	(none)	concrete	timber	metal	
Culvert material	(concrete)	timber	metal	plastic	
Number of barrels: single (double, triple, etc.)					
Culvert height: 36 in	Culvert width: 36 in		Culvert length: >1,000 Ft		
If culvert is buried (sedimentation) observed smallest opening height: _____					
Culvert type	(pipe)	box	arch	other _____	
Openings protected from high winds	(yes)	no			
Crevices present:	(yes)	no	weep holes	yes	no
Rough surfaces, imperfections, bird nests	(yes)	no			
Human disturbance in culvert	high	med	low	(none)	
Depth of water in culvert (if applicable) 1-2 in					

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats

Bat species present:
Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Culvert runs between existing taxiway and runway. Culvert drains stormwater, runs parallel to taxiway for several thousand feet. Culvert inlets are all drop inlets, which were inspected at multiple locations along taxiway.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell Project number/name: RDU Runway Culverts
Date: 2-24-23 Time 11:50 AM Road Name/SR Number: C2 Not Mapped
County: Wake Structure #: _____
Crossing (Name of the feature intersected): _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: (N/A) river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes X no N/A
Structure specific questions:

Guard rails	none	concrete	timber	metal
Culvert material	concrete	timber	metal	plastic

Number of barrels: ~~50 in~~ Single (double, triple, etc.)
Culvert height: 30 in Culvert width: 30 in Culvert length: ≥ 100 ft
If culvert is buried (sedimentation) observed smallest opening height: _____

Culvert type	(pipe)	box	arch	other _____
Openings protected from high winds	(yes)	no		
Crevices present:	(yes)	no	weep holes yes	no
Rough surfaces, imperfections, bird nests	(yes)	no		
Human disturbance in culvert	high	med	low	(none)

Depth of water in culvert (if applicable) 1 in

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains stormwater into C1. Runs perpendicular to taxiway. East end could not be accessed, since drains into C1. Was not shown on original map.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell
Date: 3-24-23 Time 12:10 PM
County: Wake
Project number/name: RDU Runway Culverts
Road Name/SR Number: C3 Short pink
Structure #:
Crossing (Name of the feature intersected):

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential
Herb/Shrub/Grassland Agricultural
Deciduous/Evergreen/Mixed Forest
Woody Wetland/Herb Wetland/Open Water

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: X N/A river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes X no N/A
Structure specific questions:

Guard rails	(none)	concrete	timber	metal
Culvert material	X concrete	timber	metal	plastic

Number of barrels: 1 (double, triple, etc.)
Culvert height: 36 Culvert width: 36 Culvert length: 10000+
If culvert is buried (sedimentation) observed smallest opening height:

Culvert type	(pipe)	box	arch	other
Openings protected from high winds	(yes)	no		
Crevices present:	(yes)	no	weep holes yes	no
Rough surfaces, imperfections, bird nests	(yes)	no		
Human disturbance in culvert	high	med	low	(none)

Depth of water in culvert (if applicable) 1 in

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats

Bat species present:
Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains stormwater into C1. Runs perpendicular to taxiway. East end of culvert could not be accessed. since it drains into C1

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell
Date: 3-24-23 Time 12:27 PM
County: Wake
Crossing (Name of the feature intersected): drains to C8

Project number/name: RDU Runway Culverts
Road Name/SR Number: C4 Pink - C8 adjacent XXXXXXXXXXX
Structure #:

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential
Herb/Shrub/Grassland Agricultural
Deciduous/Evergreen/Mixed Forest
Woody Wetland/Herb Wetland/Open Water

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	no	yes	no
abandoned mines	yes	no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: N/A river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes no X N/A

Structure specific questions:

Guard rails	none	concrete	timber	metal
Culvert material	concrete	timber	metal	plastic
Number of barrels: 1 (double, triple, etc.)				
Culvert height: 36 Culvert width: 36 Culvert length: 100				
If culvert is buried (sedimentation) observed smallest opening height:				
Culvert type	pipe	box	arch	other
Openings protected from high winds	yes	no		
Crevices present:	yes	no	weep holes yes	no
Rough surfaces, imperfections, bird nests	yes	no		
Human disturbance in culvert	high	med	low	none
Depth of water in culvert (if applicable) 0 in				

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Pink culvert running parallel to taxiway. Drains stormwater to culvert C8.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Culverts

Observers: Mary Frazer/Nathan Howell Project number/name: BDU Runway
Date: 3-24-23 Time 1:00 PM Road Name/SR Number: C5 Unmapped/Runs under service Road
County: Wake Structure #:
Crossing (Name of the feature intersected):

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential
Herb/Shrub/Grassland Agricultural
Deciduous/Evergreen/Mixed Forest
Woody Wetland/Herb Wetland/Open Water

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: (N/A) river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes no X N/A
Structure specific questions:

Guard rails	X none	concrete	timber	metal	
Culvert material	(concrete)	timber	metal	plastic	

Number of barrels: Single (double, triple, etc.)
Culvert height: 4 Ft Culvert width: 4 Ft Culvert length: 80-100 Ft
If culvert is buried (sedimentation) observed smallest opening height:

Culvert type	pipe	(box)	arch	other
Openings protected from high winds	yes	(no)		
Crevices present:	(yes)	no	weep holes	yes no
Rough surfaces, imperfections, bird nests	(yes)	no		
Human disturbance in culvert	high	med	low	(none)

Depth of water in culvert (if applicable) 2 ft

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats

Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Runs under service road, west of runway. Not shown in original map. Gated, could not access interior, but could see through pipe with equipment.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer / Nathan Howell
Date: 3-24-23 Time 12:40 PM
County: Wake
Project number/name: RDU Runway 5 Culverts
Road Name/SR Number: Pink North
Structure #:
Crossing (Name of the feature intersected):

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential
Herb/Shrub/Grassland Agricultural
Deciduous/Evergreen/Mixed Forest
Woody Wetland/Herb Wetland/Open Water

Any trees >3" DBH within project footprint? (N/A) yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinity (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: (N/A) river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes Xno N/A
Structure specific questions:

Guard rails	X none	concrete	timber	metal	
Culvert material	(concrete)	timber	metal	plastic	
Number of barrels: (double, triple, etc.)					
Culvert height: 36	Culvert width: 36		Culvert length: 700ft +		
If culvert is buried (sedimentation) observed smallest opening height:					
Culvert type	(pipe)	box	arch	other	
Openings protected from high winds	(yes)	no			
Crevices present:	(yes)	no	weep holes	yes	no
Rough surfaces, imperfections, bird nests	(yes)	no			
Human disturbance in culvert	high	med	low	Xnone	
Depth of water in culvert (if applicable)	0 in				

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats
Bat species present:			

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains stormwater north of runway.

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell
Date: 3-24-23 Time 12:27 PM
County: Wake
Crossing (Name of the feature intersected): _____

Project number/name: RDU Runway Culverts
Road Name/SR Number: C7 Yellow (short)
Structure #: _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinity (0.5 mi)	
caves	yes	no	yes	no
abandoned mines	yes	no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: XN/A river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes X no N/A

Structure specific questions:

Guard rails	X none	concrete	timber	metal	
Culvert material	concrete	timber	metal	plastic	
Number of barrels: 1	(double, triple, etc.)				
Culvert height: XXX 42	Culvert width: XXX 42		Culvert length: 100ft +		
If culvert is buried (sedimentation) observed smallest opening height: _____					
Culvert type	pipe	box	arch	other _____	
Openings protected from high winds	yes	no			
Crevices present:	yes	no	weep holes	yes	no
Rough surfaces, imperfections, bird nests	yes	no			
Human disturbance in culvert	high	med	low	none	
Depth of water in culvert (if applicable) 1 in					

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats

Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains stormwater west into median between existing runway and taxiway. East end of culvert inaccessible, but outside of LOD. Mapped as 42 inch culvert.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell
Date: 3-24-23 Time 1:00 PM
County: Wake
Crossing (Name of the feature intersected): _____

Project number/name: RDU Runway Culverts
Road Name/SR Number: CS Green
Structure #: _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinity (0.5 mi)	
caves	yes	(no)	yes	no
abandoned mines	yes	(no)	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: (N/A) river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes Xno N/A

Structure specific questions:

Guard rails	X none	concrete	timber	metal
Culvert material	Xconcrete	timber	metal	plastic
Number of barrels: 1	(double, triple, etc.)			
Culvert height: XXX 54	Culvert width: XXX 54		Culvert length: 750 Ft +	
If culvert is buried (sedimentation) observed smallest opening height: _____				
Culvert type	(pipe)	box	arch	other _____
Openings protected from high winds	(yes)	no		
Crevices present:	(yes)	no	weep holes yes	no
Rough surfaces, imperfections, bird nests	(yes)	no		
Human disturbance in culvert	high	med	low	Xnone
Depth of water in culvert (if applicable) _____				

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

other End Inaccessible

Drains stormwater under runway to the northwest. West end gated. Accessible near east end via drop inlet.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer / Nathan Howell
Date: 3-24-23 Time 1:10 PM
County: Wake
Crossing (Name of the feature intersected): _____

Project number/name: BDU Runway Culverts
Road Name/SR Number: CG Long Blvd
Structure #: _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinity (0.5 mi)	
caves	yes	no	yes	no
abandoned mines	yes	no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: N/A river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes no N/A
Structure specific questions:
Guard rails X none concrete timber metal
Culvert material X concrete timber metal plastic
Number of barrels: Single (double, triple, etc.)
Culvert height: XXX 60 Culvert width: XXX 60 Culvert length: 750ft +
If culvert is buried (sedimentation) observed smallest opening height: _____
Culvert type pipe box arch other _____
Openings protected from high winds yes no
Crevices present: yes no weep holes yes no
Rough surfaces, imperfections, bird nests yes no
Human disturbance in culvert high med low none
Depth of water in culvert (if applicable) 3 in

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains stormwater under runway to the west. East end could not be located, presumed outside of LOD.

Bat Habitat Assessment Form

Culverts

Observers: Mary Frazer / Nathan Howell Project number/name: RDU Runway
Date: 3-24-23 Time 1:23 PM Road Name/SR Number: 610 Long Purple
County: Wake Structure #:
Crossing (Name of the feature intersected):

% Surrounding habitat w/in 1 mi. of project footprint (approx)	Urban/commercial ✓	Suburban/residential	
	Herb/Shrub/Grassland	Agricultural	
	Deciduous/Evergreen/Mixed Forest		
	Woody Wetland/Herb Wetland/Open Water		

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	X no	yes	no
abandoned mines	yes	X no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: N/A river stream/creek X pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? yes no N/A

Structure specific questions:

Guard rails	X none	concrete	timber	metal	
Culvert material	X concrete	timber	metal	plastic	
Number of barrels: 1 (double, triple, etc.)					
Culvert height: XXXXXX 84 in	Culvert width: XXXXXX 84 in		Culvert length: 2,000 Ft +		
If culvert is buried (sedimentation) observed smallest opening height:					
Culvert type	(pipe)	box	arch	other	
Openings protected from high winds	(yes)	no			
Crevices present:	(yes)	no	weep holes	yes	no
Rough surfaces, imperfections, bird nests	(yes)	no			
Human disturbance in culvert	high	med	low	(none)	
Depth of water in culvert (if applicable) 2-3 Ft					

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X

Emergence count performed? (If yes, complete form)	yes	no	
Evidence of bats using bird nests or weep holes, if present?	yes	no	
Type of evidence	guano	staining	bats

Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains from taxiway under runway to small stormwater pond. West end of culvert was gated and inaccessible. East end could not be found, presumably outside of LOD. Drop inlets used to assess pipe.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Observers: Mary Frazer/Nathan Howell Project number/name: BDU Runway Culverts
Date: 3-24-23 Time 2:00 PM Road Name/SR Number: C11
County: Wake Structure #: short pink
Crossing (Name of the feature intersected): _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes X no

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	no	yes	no
abandoned mines	yes	no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: N/A river stream/creek pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? X yes no N/A
Structure specific questions:

Guard rails: none concrete timber metal
Culvert material: ~~concrete~~ timber metal plastic
Number of barrels: 1 (double, triple, etc.)
Culvert height: 36 Culvert width: 36 Culvert length: 115 ft long Not accesible
If culvert is buried (sedimentation) observed smallest opening height: _____
Culvert type: pipe box arch other _____
Openings protected from high winds: yes no
Crevices present: yes no weep holes yes no
Rough surfaces, imperfections, bird nests: yes no
Human disturbance in culvert: high med low none
Depth of water in culvert (if applicable) 2 in

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:
Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

Drains water from one stormwater pond to larger, western pond. East end of pipe was a drop inlet located in pond.

Bat Culvert Habitat Assessment Form
Updated 2023

Bat Habitat Assessment Form

Culverts

Observers: Mary Frazer / Nathan Howell Project number/name: RDU Runway
Date: 3-24-23 Time 2:10 PM Road Name/SR Number: 212
County: Wake Structure #: _____
Crossing (Name of the feature intersected): _____

% Surrounding habitat w/in 1 mi. of project footprint (approx)
Urban/commercial ✓ Suburban/residential _____
Herb/Shrub/Grassland _____ Agricultural _____
Deciduous/Evergreen/Mixed Forest _____
Woody Wetland/Herb Wetland/Open Water _____

Any trees >3" DBH within project footprint? N/A yes no X

Complete this section for Indiana bat counties:

Any shaggy trees or snags >5" DBH? N/A yes no
If yes to shag/snag, how much sunlight do they receive during the day? N/A 1-3 hours 4-6 hours 7+ hours
If yes to shag/snag, list spp of habitat trees >5" dbh _____
If large hollow trees or snags >5"DBH are present in sunlit areas, provide photos and location.

Presence of:	In project footprint		In vicinty (0.5 mi)	
caves	yes	X no	yes	no
abandoned mines	yes	X no	yes	no

If 'yes' to any of the above, provide description and location.

Major water source in project footprint: N/A river stream/creek X pond lake swamp
Suitable drinking habitat in the form of non stagnant, smooth or slack water areas? X yes no N/A
Structure specific questions:

Guard rails: X none concrete timber metal
Culvert material: X concrete timber metal plastic
Number of barrels: 1 (double, triple, etc.)
Culvert height: 8 ft Culvert width: 8 ft Culvert length: 100 ft + Could not access
If culvert is buried (sedimentation) observed smallest opening height: _____
Culvert type: pipe (box) arch other _____
Openings protected from high winds: yes (no)
Crevices present: (yes) no weep holes yes no
Rough surfaces, imperfections, bird nests (yes) no
Human disturbance in culvert: high med low (none)
Depth of water in culvert (if applicable) 3 ft

Below section completed only if bats/evidence of bats observed: Evidence of bats using? yes no X
Emergence count performed? (If yes, complete form) yes no
Evidence of bats using bird nests or weep holes, if present? yes no
Type of evidence guano staining bats
Bat species present:

Notes (include description of bat location within culvert, sedimentation buildup, drainage inlets inside culvert, etc.)

1 Birds Nest - Active

Drains stormwater under service road to small stormwater pond. Not indicated on original map.

ATTACHMENT B

Project Name: RDU Environmental Assessment Proposed Runway 5L/23R Replacement Project
Contractor Name: Landrum & Brown (Three Oaks Engineering)

RDU AIRPORT IMPACT NOTIFICATION

DATE OF NOTIFICATION: 3/8/2023 IMPACT # 9

ANTICIPATED WORK START DATE: 3/14/2023 ANTICIPATED WORK START TIME: 9:00am

ANTICIPATED WORK END DATE: 3/17/2023 ANTICIPATED WORK END TIME: 5:00pm

☑ Landside Projects
☑ Airside Projects

NOTIFICATION:

A field survey will be conducted to identify the potential presense of a bat species as directed by the FAA and US Fish and Wildlife Service. This is in support of the Runway 5L/23R and TW B Replacement Program. Please see the attached description and exhibit for areas to be surveyed. The Team will need an Airport escort for airside areas.

OTHER COMMENTS:

Primary Contacts: Jim Mason, Three Oaks Engineering james.mason@threeoaksengineering.com, 704-604-8358; Chris Babb, Landrum & Brown, chris.babb@landrumbrown.com; 513-560-1242

REQUESTED BY:

Kenny Perry
Name
Director, Project Management Office (PMO)
Title
3/8/2023
Date

AUTHORIZED BY:

John A Connell
Name
SVP & COO
Title
3/14/2023
Date

Project: Proposed Runway 5L23R Replacement Project

To: Kathryn Matthews, USFWS
Michael Lamprecht, FAA
Jackie Sweatt-Essick, FAA
George Phillips, USACE
Bill Sandifer, RDUAA
Kenny Perry, RDUAA
Chris Babb, L&B

From: James Mason, MS, PWS
NC Natural Systems Group Lead
Three Oaks Engineering

Date: March 3, 2023

Subject: Methodology for Tricolored Bat Survey (Culverts)

1.0 Introduction

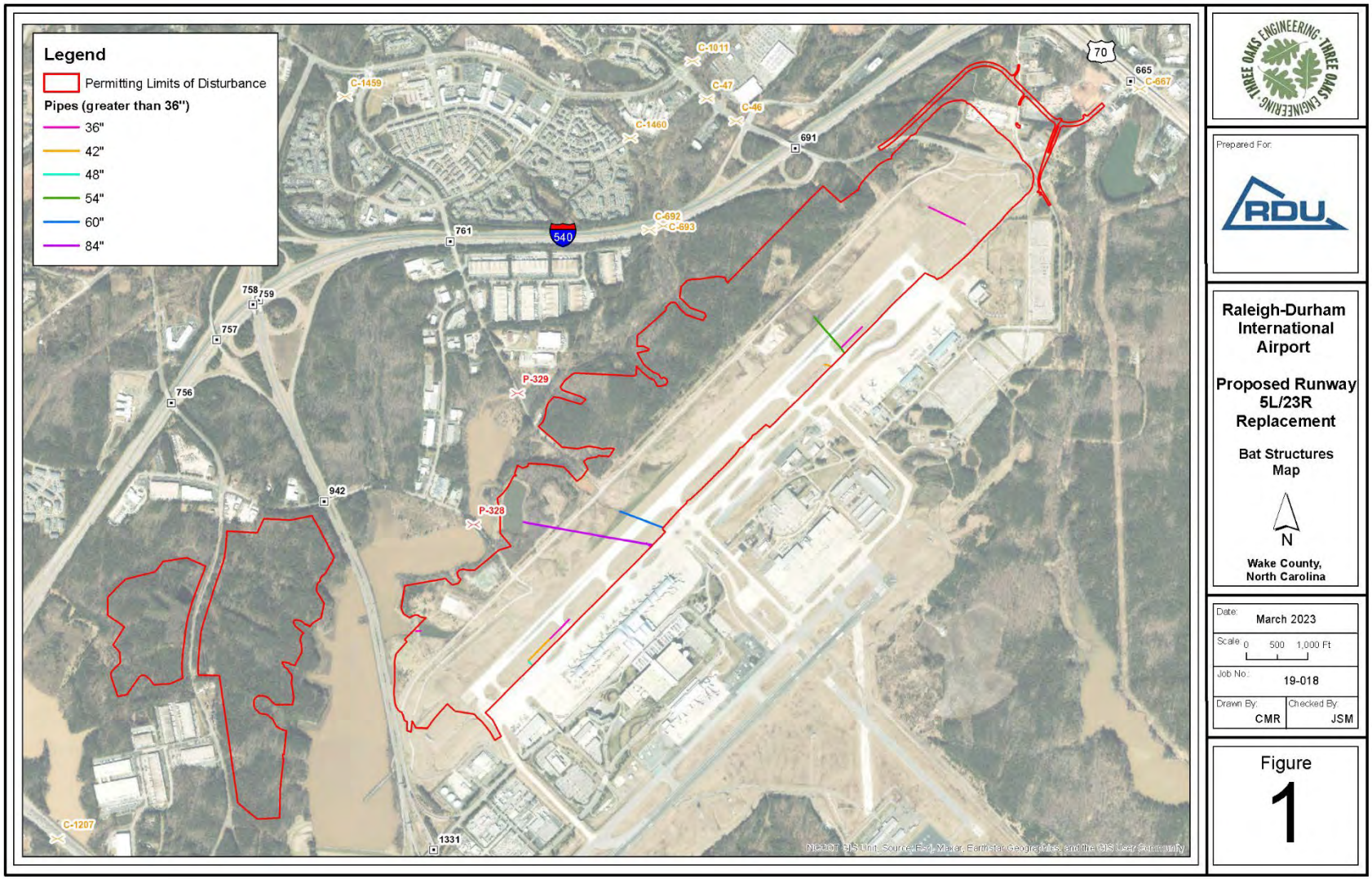
The USFWS recently published its proposal to list the tricolored bat (*Perimyotis subflavus*)) as endangered on September 14, 2022 (87 Federal Register [FR] 56381–56393). This small bat species is known to occur in Wake County. It is an insectivore, and forages in forests and on the edges of forests. It may roost in forests, culverts, and structures. A final listing decision may come as soon as September 2023. The FAA has initiated conferencing on the tricolored bat with USFWS. The purpose of this memo is to describe the methodology to survey culverts for the presence or absence of the tricolored bat within the current Draft Environmental Assessment Limits of Disturbance.

2.0 Methodology

A review of the existing culvert data in AutoCad was conducted. In discussions with USFWS, only culverts that have a 36” or greater diameter will be surveyed. Attached is the map identifying the pipes with greater that a 36” or greater diameter. Three Oaks will survey these pipe openings for indicators of bat presence including, bats flying, sounds of bats in the pipes, bat droppings (guano), and presence of staining within the pipes. In addition, if there or any additional culverts/structures that meet the criteria but were not listed in the data that we looked at, we will survey those as well. A survey form will be completed for each feature. No culverts were identified on Lumley Road or near the borrow sites after review of the NCDOT structures dataset; however, these areas will still be visually inspected to make sure none are present. This survey would be conducted before the end of March 2023.

3.0 Deliverable

Bat Assessment Forms, a memorandum with the field results, and mapping will be provided to document the survey efforts.


Legend
Permitting Limits of Disturbance
Pipes (greater than 36")
36"
42"
48"
54"
60"
84"
C-1459
C-1011
C-47
C-46
C-1460
C-692
C-693
C-667
665
70
691
761
540
758
759
757
756
P-329
942
P-328
C-1207
1331
Prepared For:
RDU
Raleigh-Durham International Airport
Proposed Runway 5L/23R Replacement
Bat Structures Map
N
Wake County, North Carolina
Date: March 2023
Scale: 0 500 1,000 Ft
Job No.: 19-018
Drawn By: CMR
Checked By: JSM
Figure
1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Raleigh ES Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

March 3, 2023

James Mason, MS, PWS
NC Natural Systems Group Lead
Three Oaks Engineering
(via email)

Subject: Raleigh-Durham International Airport; Proposed Runway 5L23R Replacement Project
Concurrence with Site-Specific Survey Plans for Bats

Dear Mr. Mason:

This letter serves as concurrence from the U.S. Fish and Wildlife Service that the proposed culvert survey activities at the Raleigh-Durham International Airport may be conducted as stated in your March 3, 2023, study plan. We look forward to seeing the results of your surveys. If you have questions or concerns, please feel free to contact Kathy Matthews at Kathryn_Matthews@fws.gov.

Sincerely,

Pete Benjamin
Field Supervisor

Appendix C. List of Preparers

Investigator:	Mary Frazer
Education:	M.E.M., Resource Ecology, Duke University, 1991
B.S.	Zoology, University of Wisconsin, 1988
Experience:	Environmental Specialist, Three Oaks Engineering, 2015-present Environmental Program Consultant, NCDOT, 2000-2015 Environmental Specialist, Wisc. Coastal Mgt Program, 1996-2000 Water Regulation Specialist, Wisc. Dept Natural Resources, 1994-1996 Biologist, Soil and Environmental Consultants, 1992-1994
Responsibilities:	Document review

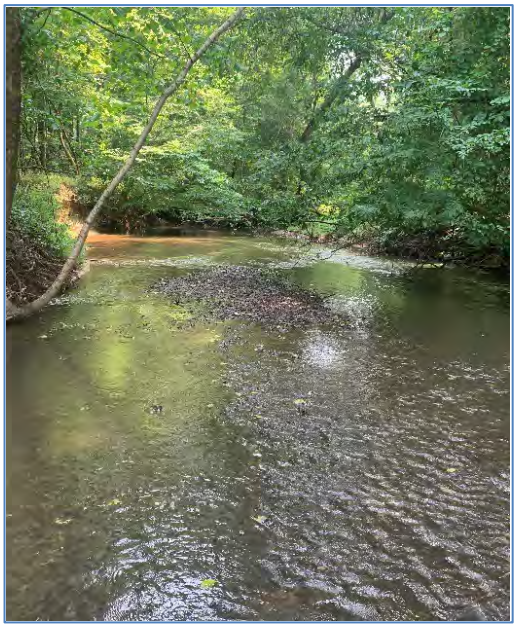
Investigator:	James Mason
Education:	B.A. Biology, Colby College, 2000 M.S. Biology/Ecology, UNC-Charlotte, 2004
Experience:	Natural Resources Team Lead, Three Oaks Engineering, January 2023 - Present Environmental Senior Scientist, Three Oaks Engineering, April 2018-December 2022
Responsibilities:	Document preparation and review

Appendix D
Aquatic Species Survey Report

Aquatic Species Survey Report

Natural Resources Evaluation of the Raleigh Durham International Airport

Wake County, North Carolina



Brier Creek in Survey Reach

Prepared For:

Landrum & Brown
Raleigh, North Carolina

January 31, 2022
Revised May 24, 2022

Prepared by:

324 Blackwell Street, Suite 1200
Durham, NC 27701

Contact Person:

Tim Savidge
tim.savidge@threeoaksengineering.com
919-732-1300

Table of Contents

Appendix A. Figures:

1.0 INTRODUCTION

Landrum & Brown Inc. (Landrum & Brown) is conducting a natural resource evaluation located at the Raleigh Durham International Airport (RDU) property in Wake County (Figure 1). The project area encompasses multiple named streams in the Neuse River Basin. The Federally Endangered Dwarf Wedgemussel (*Alasmidonta heterodon*, DWM), Tar River Spinymussel (*Parvaspina steinstansana*), Cape Fear Shiner (*Notropis mekistocholas*), and Carolina Madtom (*Noturus furiosus*) are listed by the U.S. Fish and Wildlife Service (USFWS) for Wake County. The Federally Threatened Neuse River Waterdog (*Necturus lewisi*), Atlantic Pigtoe (*Fusconaia masoni*), and Yellow Lance (*Elliptio lanceolata*), are listed by USFWS for Wake County. The USFWS Information for Planning and Consultation (IPaC) system lists DWM, Atlantic Pigtoe, Neuse River Waterdog, and Carolina Madtom as species that could be affected by activities in this location as of January 17, 2022 (USFWS IPaC 2022a). Because the Cape Fear Shiner is restricted to the Cape Fear River Basin, and the Tar River Spinymussel and Yellow Lance are not known from this portion of the Neuse River Basin, they are not listed as vulnerable species at this location (USFWS IPaC 2022a); thus, they are not further addressed in this report.

The Green Floater (*Lasmigona subviridis*) is being considered for listing by the USFWS and is known to occur in Wake County. Although the Green Floater was not listed by IPaC in this location, it was added due to a historical record of the species in close proximity to the Detailed Study Area (DSA; Figure 2). The Savannah Lilliput (*Toxolasma pullus*) has no current federal listing status but is listed as endangered in North Carolina and was presumed extirpated (Bogan 2017) from the Neuse River Watershed (USFWS 2016). During surveys of Brier Creek conducted for this project, Three Oaks staff located shells and one live individual.

Table 1 lists the nearest element occurrence (EO) for targeted species in approximate river miles (RM) from Brier Creek at its exit of the study area. Data are from the NC Natural Heritage Program database (NCNHP 2022) most recently updated in January 2022 (Figure 2-1 through 2-5).

Table 1. Element Occurrences

Species Name	EO ID	EO Waterbody	Distance (river miles)	First Observed	Last Observed	EO Status*	Figure Number
Dwarf Wedgemussel	7699	Neuse River	23.5	1951	1951	H	2-1
	13799	Swift Creek/Middle Creek	>50	March 1991	March 2020	C	
Atlantic Pigtoe	14599	Crabtree Creek	5.9	October 1995	May 2003	C	2-2
Neuse River Waterdog	12592	Crabtree Creek	7.8	1979	1979	H	2-3
	40669	Crabtree Creek	16.5	March 2021	March 2021	C	
Carolina Madtom	10676	Neuse River/ Crabtree Creek	22.0	August 1888	August 1902	H	2-4
	3858	Little River	>50	June 1961	July 2005	C	

Species Name	EO ID	EO Waterbody	Distance (river miles)	First Observed	Last Observed	EO Status*	Figure Number
Green Floater	39613	Stirrup Iron Creek	2.0	1960	1960	H	2-5
	28706	Neuse River	23.5	July 2010	May 2018	C	
Savannah Lilliput**	41253	Brier Creek	Within Study Area	September 2021	September 2021	C	N/A

*: C-NCNHP Current; H –NCNHP Historic
**: EO added from this project

As part of the federal permitting process that requires an evaluation of potential project-related effects to federally protected species, Landrum & Brown contracted Three Oaks to conduct surveys targeting the DWM, Atlantic Pigtoe, Neuse River Waterdog, Carolina Madtom, Green Floater, and Savannah Lilliput.

2.0 WATERS IMPACTED

The DSA is located in the Upper Neuse River subbasin (HUC# 03020201) of the Neuse River Basin. Areas within the DSA drain either to Brier Creek or Stirrup Iron Creek before exiting the DSA. Brier Creek flows approximately 1.9 RM to the confluence with Lake Crabtree/ Crabtree Creek. Stirrup Iron Creek flows approximately 2.3 RM from the tailrace of the Stirrup Iron Creek Reservoir to the confluence with Brier Creek just upstream of Lake Crabtree. Crabtree Creek then flows from the tailrace of Lake Crabtree 20.5 RM to its confluence with the Neuse River.

2.1 303(d) Classification

There are several streams within a 5-mile buffer of the DSA area listed on the 2020 303(d) final list of impaired streams (NC Division of Water Resources [NCDWR] 2020). In the study area, Brier Creek and Little Brier Creek are impaired for exceeding criteria for a PCB Fish Tissue Advisory. Crabtree Creek (including Lake Crabtree) and Hare Snipe Creek are impaired for poor bioclassification. Black Creek and Richland Creek are impaired for fair bioclassification (Figure 3).

2.2 NPDES Discharges

The North Carolina Division of Environmental Quality (NCDEQ) lists several active permitted discharges within a 5-mile buffer of the DSA, one of which, the RDU Delivery Facility (NC0081479), is listed as a minor discharger into Brier Creek. The other four discharges within the 5-mile radius occur outside of the DSA. The closest major permitted National Pollutant Discharge Elimination System (NPDES) discharge is the North Cary Water Reclamation Facility (NC0048879), located 3.25 RM downstream of the DSA just downstream of Lake Crabtree. The Triangle Wastewater Treatment Plant (WWTP; NC0026051) is listed as a major discharge but is located in the Cape Fear River Basin. The Hawthorne Subdivision WWTP (NC0049662) and the

Wildwood Green WWTP (NC0063614) are listed as minor discharges and are in a different HUC10 (Middle Falls Lake) than the DSA. (NCDEQ 2020) (Figure 3).

3.0 TARGET SPECIES DESCRIPTIONS

3.1 Dwarf Wedgemussel (Alasmidonta heterodon)

3.1.1 Species Characteristics

The DWM was originally described as *Unio heterodon* (Lea 1829). Simpson (1914) subsequently placed it in the genus *Alasmidonta*. Ortmann (1919) placed it in a monotypic subgenus *Prolasmidonta*, based on the unique soft-tissue anatomy and conchology. Fuller (1977) believed the characteristics of *Prolasmidonta* warranted elevation to full generic rank and renamed the species *Prolasmidonta heterodon*. Clarke (1981) retained the genus name *Alasmidonta* and considered *Prolasmidonta* to be a subjective synonym of the subgenus *Pressodonta* (Simpson 1900).

The specific epithet *heterodon* refers to the chief distinguishing characteristic of this species, which is the only North American freshwater mussel that consistently has two lateral teeth on the right valve and only one on the left (Fuller 1977). All other laterally dentate freshwater mussels in North America normally have two lateral teeth on the left valve and one on the right. The DWM is generally small, with a shell length ranging between 25 millimeters (mm) (1.0 inch) and 38 mm (1.5 inches). The largest specimen reported by Clarke (1981) was 56.5 mm (2.2 inches) long, taken from the Ashuelot River in New Hampshire. The periostracum is generally olive green to dark brown; nacre bluish to silvery white, turning to cream or salmon colored towards the umbonal cavities. Sexual dimorphism occurs in DWM, with the females having a swollen region on the posterior slope, and the males are generally flattened. Clarke (1981) provides a detailed description of the species.

Nearly all freshwater mussel species have similar reproductive strategies; a larval stage (glochidium) becomes a temporary obligatory parasite on a fish. Many mussel species have specific fish hosts, which must be present to complete their life cycle. Based upon laboratory infestation experiments, Michaelson and Neves (1995) determined that potential fish hosts for the DWM in North Carolina include the Tessellated Darter (*Etheostoma olmstedi*) and the Johnny Darter (*E. nigrum*). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

3.1.2 Distribution and Habitat Requirements

The historic range of the DWM is confined to Atlantic slope drainages from the Peticodiac River in New Brunswick, Canada, south to the Neuse River, North Carolina. Occurrence records exist from at least 70 locations, encompassing 15 major drainages, in 11 states and one Canadian Province (USFWS 1993). When the recovery plan for this species was written, the DWM was

believed to have been extirpated from all but 36 localities, 14 of them in North Carolina (USFWS 1993). The most recent assessment (2013 5-Year Review) indicates that the DWM is currently found in 16 major drainages, comprising approximately 75 "sites" (one site may have multiple occurrences). At least 45 of these sites are based on less than five individuals or solely on relict shells. It appears that the populations in North Carolina, Virginia, and Maryland are declining as evidenced by low densities, lack of reproduction, or inability to relocate any individuals in follow-up surveys. Populations in New Hampshire, Massachusetts, and Connecticut appear to be stable, while the status of populations in the Delaware River watershed affected by the multiple flood events between 2004 and 2006 are still being studied (USFWS 2013).

Strayer et al. (1996) conducted range-wide assessments of remaining DWM populations and assigned a population status to each of the populations. The status rating is based on range size, number of individuals and evidence of reproduction. Seven of the 20 populations assessed were considered “poor,” and two others are considered “poor to fair” and “fair to poor,” respectively. In North Carolina, populations are found in portions of the Neuse and Tar River basins; however, the species is believed to have been extirpated from the main stem of the Neuse River.

The DWM inhabits creeks and rivers of varying sizes (down to approximately two meters wide), with slow to moderate flow. A variety of preferred substrates have been described that range from coarse sand, to firm muddy sand, to gravel (USFWS 1993). In North Carolina, DWM often occurs within submerged root mats along stable streambanks. The wide range of substrate types used by this species suggests that the stability of the substrate is likely as important as the composition.

3.1.3 Threats to Species

The cumulative effects of several factors, including sedimentation, point and non-point discharge, stream modifications (impoundments, channelization, etc.) have contributed to the decline of this species throughout its range. Except for the Neversink River population in New York, which has an estimated population of over 80,000 DWM individuals, all the other populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity (Strayer et al. 1996). Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways, railroads, or industrial-municipal complexes.

Siltation resulting from substandard land-use practices associated with activities such as agriculture, forestry, and land development has been recognized as a major contributing factor to degradation of mussel populations. Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than one inch have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the DWM because of accelerated sedimentation and erosion (Smith 1981).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations may not occur for up to two miles below points of chlorinated sewage effluent.

The impact of impoundments on freshwater mussels has been well documented (USFWS 1992a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes in aquatic community composition. The changes associated with inundation adversely affect both adult and juvenile mussels, as well as fish community structure, which could eliminate possible fish hosts for upstream transport of glochidia. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 19 feet of muck (USFWS 1992b). Large portions of all the river basins within the DWM's range have been impounded; this is believed to be a major factor contributing to the decline of the species (Master 1986).

The introduction of exotic species such as the Asian Clam (*Corbicula fluminea*) and Zebra Mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The Asian Clam is now established in most of the major river systems in the United States (Fuller and Powell 1973), including those streams still supporting surviving populations of the DWM. Concern has been raised over competitive interactions for space, food and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1995). The Zebra Mussel, native to the drainage basins of the Black, Caspian, and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s and has rapidly expanded its range into the surrounding river basins, including those of the South Atlantic slope (O'Neill and MacNeill 1991). This species competes for food resources and space with native mussels and is expected to contribute to the extinction of at least 20 freshwater mussel species if it becomes established throughout most of the eastern United States (USFWS 1992b). The Zebra Mussel is not currently known to be present in any river supporting DWM population.

3.1.4 Designated Critical Habitat

The DWM has no official designated critical habitat.

3.2 Atlantic Pigtoe (Fusconaia masoni)

3.2.1 Species Characteristics

The Atlantic Pigtoe was described by Conrad (1834) from the Savannah River in Augusta, Georgia. Although larger specimens exist, the Atlantic Pigtoe seldom exceeds 50 mm (2 inches) in length. This species is tall relative to its length, except in headwater stream reaches where specimens may be elongated. The hinge ligament is relatively short and prominent. The periostracum is normally brownish, has a parchment texture, and young individuals may have greenish rays across the entire shell surface. The posterior ridge is biangulate. The interdentum in the left valve is broad and flat. The anterior half of the valve is thickened compared with the posterior half, and, when fresh, nacre in the anterior half of the shell tends to be salmon colored, while nacre in the posterior half tends to be more iridescent. The shell has full dentation. In addition to simple papillae, branched and arborescent papillae are often seen on the incurrent aperture. In females, salmon colored demibranchs are often seen during the spawning season. When fully gravid, females use all four demibranchs to brood glochidia (VDGIF 2014).

The Atlantic Pigtoe is a tachytictic (short-term) breeder, brooding young in early spring and releasing glochidia in early summer. The Bluegill (*Lepomis macrochirus*) and Shield Darter (*Percina peltata*) have been identified as potential fish hosts for this species (O'Dee and Waters 2000). Additional research has found Rosefin Shiner (*Lythrurus ardens*), Creek Chub (*Semotilus atromaculatus*), and Longnose Dace (*Rhynichthys cataractae*) are also suitable hosts (Wolf 2012). Eads and Levine (2012) found White Shiner (*Luxilus albeolus*), Satinfin Shiner (*Cyprinella analostana*), Bluehead Chub (*Nocomis leptocephalus*), Rosyside Dace (*Clinostomus funduloides*), Pinewoods Shiner (*Lythrurus matutinus*), Swallowtail Shiner (*Notropis procne*), and Mountain Redbelly Dace (*Chrosomus oreas*) to also be suitable hosts for Atlantic Pigtoe.

3.2.2 Distribution and Habitat Requirements

Johnson (1970) reported the range of the Atlantic Pigtoe extended from the Ogeechee River Basin in Georgia north to the James River Basin in Virginia; however, recent curation of the H. D. Athearn collection uncovered valid specimens from the Altamaha River in Georgia (USFWS 2021a). In addition, USFWS (2021a) citing Alderman and Alderman (2014) reported two shells from the 1880's that also documented the historical occurrence in the Altamaha River Basin. It is presumed extirpated from the Catawba River Basin in North and South Carolina south to the Altamaha River Basin (USFWS 2021a, USFWS 2021b). The general pattern of its current distribution indicates that the species is currently limited to headwater areas of drainages and most populations are represented by few individuals. In North Carolina, aside from the Waccamaw River, it was once found in every Atlantic Slope River basin. Except for the Tar River, it is no longer found in the mainstem of the rivers within its historic range (Savidge et al. 2011). It is listed as Endangered in Georgia, South Carolina, and North Carolina, and as Threatened in Virginia. It has a NatureServe rank of G2 (imperiled).

The Atlantic Pigtoe has been found in multiple physiographic provinces, from the foothills of the Appalachian Mountains, through the Piedmont and into the Coastal Plain, in streams less than one meter wide to large rivers. The preferred habitat is a substrate composed of gravel and coarse sand, usually at the base of riffles; however, it can be found in a variety of other substrates and lotic habitat conditions.

3.2.3 Threats to Species

Threats to the Atlantic Pigtoe are similar to those described for the DWM and have contributed to the decline of this species throughout its range. Atlantic Pigtoe appears to be particularly sensitive to pollutants and requires clean, oxygen-rich water for all stages of life. All the remaining Atlantic Pigtoe populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event.

3.2.4 Designated Critical Habitat

As mentioned in Section 1.0, the Atlantic Pigtoe is listed as a Federally Threatened Species under the Endangered Species Act (ESA) with Section 4(d) Rule and Critical Habitat Designation. In accordance with Section 4 of the ESA, Critical Habitat for listed species consists of:

(1) The specific areas within the geographical area occupied by the species at the time it is listed, in which are found those physical or biological features (constituent elements) that are:
    a. essential to the conservation of the species, and
    b. which may require special management considerations or protection
(2) Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the Act, upon a determination by the Secretary that such areas are "essential for the conservation of the species."

On November 16, 2021, USFWS listed the Atlantic Pigtoe as a Threatened species under the ESA. Critical habitat was revised with the listing (86 FR 64000) and consists of the following (USFWS 2021b):

- Unit 1 (JR1) - 29 river mi (46.7 river km) of Craig Creek in Craig and Botetourt Counties, Virginia
- Unit 2 (JR2) - 1 mile (1.6-km) of Mill Creek in Bath County, Virginia
- Unit 3 (CR1) - 4 miles (6.6 km) of Sappony Creek in the Chowan River Basin in Dinwiddie County, Virginia

- Unit 4 (CR2) - 64 river miles (103 river km) of the Nottoway River and a portion of Sturgeon Creek in Nottoway, Lunenburg, Brunswick, Dinwiddie, and Greenville Counties, Virginia
- Unit 5 (CR3) - 5 miles (8 km) of the Meherrin River in Brunswick County, Virginia
- Unit 6 (RR1) - 14 miles (22.5 km) of the Dan River in Pittsylvania County, Virginia and Rockingham County, North Carolina
- Unit 7 (RR2) - 12 miles (19.3 km) of Aarons Creek in Granville County, North Carolina and along the Mecklenburg County-Halifax County line in Virginia and North Carolina
- Unit 8 (RR3) –3 miles (4.8 km) of Little Grassy Creek in the Roanoke River Basin in Granville County, North Carolina
- Unit 9 (TR1) - 91 miles (146.5 km) of the mainstem of the upper and middle Tar River as well as several tributaries (Bear Swamp Creek, Crooked Creek, Cub Creek, and Shelton Creek), in Granville, Vance, Franklin, and Nash Counties, North Carolina.
- Unit 10 (TR2) - 50 miles (80.5km) of Sandy/Swift Creek in Granville, Vance, Franklin, and Nash Counties, North Carolina
- Unit 11 (TR3) - 85 miles (136.8 km) in Fishing Creek, Little Fishing Creek, Shocco Creek, and Maple Branch located in Warren, Halifax, Franklin, and Nash Counties, North Carolina
- Unit 12 (TR4) - 30 miles (48.3 km) of the Lower Tar River, lower Swift Creek and lower Fishing Creek in Edgecombe County, North Carolina
- Unit 13 (NR1) - 60 river miles (95 river km) in four subunits including Flat River, Little River, Eno River, and the Upper Eno River in Person, Durham, and Orange Counties, North Carolina
- Unit 14 (NR2) - 61 river miles (98.2 river km) in five subunits including Swift Creek, Middle Creek, Upper Little River, Middle Little River, and Contentnea Creek in Wake, Johnston, and Wilson Counties, North Carolina
- Unit 15 (CF1) - 4 miles (6.4 km) of habitat in the New Hope Creek in Orange County, North Carolina
- Unit 16 (CF2) - 10 river miles (16.1 river km) of Deep River in Randolph County, North Carolina, including the mainstem as well as Richland Creek and Brush Creek
- Unit 17 (YR1) - 40 miles (64.4 km) of Little River in Randolph and Montgomery Counties, North Carolina

*JR, CR, RR, TR, NR, CF and YR denote James River, Chowan River, Roanoke River, Tar River, Neuse River, Cape Fear River and Yadkin River Basins, respectively.

Brier Creek does not occur within or drain directly to any of the Critical Habitat Units. It is more than 50 RM upstream of proposed Critical Habitat Unit 14 (NR2) (specifically the subunit located in Swift Creek (Figure 2-2).

3.3 Neuse River Waterdog (Necturus lewisi)

3.3.1 Species Characteristics

The Neuse River Waterdog, a fully aquatic salamander, was first described by C.S. Brimley in 1924, as a subspecies of the Common Mudpuppy (*N. maculosus*); it was elevated to species status in 1937 by Percy Viosca, Jr.

The Neuse River Waterdog ranges in size from 6-9 inches (15.24 – 22.86 cm) in length; record length is 11 inches (27.94 cm). It has a somewhat stocky, cylindrical body with smooth skin, a rather flattened, elongate head with a squared-off nose, and small limbs. The tail is vertically flattened with fins on both the top and bottom. Distinct from most salamanders, the Neuse River Waterdog and other Necturus species, have four toes on each foot. The Neuse River Waterdog is a rusty brown color on the dorsal side and dull brown or slate colored on the ventral side. Both dorsal and ventral sides are strongly spotted but the ventral side tends to have fewer and smaller markings; spots are dark bluish to black. They also have a dark line running through the eye. Adults are neotenous and retain three bushy, dark red external gills usually seen in larval amphibians. Both male and female are similar in appearance and can be distinguished only through differences in the shape and structure of the cloaca (Beane and Newman 1996; Conant and Collins 1998; EDGE of Existence 2016).

Individuals become sexually mature at approximately 5-6 years of age. Breeding normally occurs in the spring. The male deposits a gelatinous spermatophore that is picked up by the female and used to fertilize between 30-50 eggs. The fertilized eggs are attached to the underside of flat rocks or other submerged objects and guarded by the female until they hatch in June or July (Conant and Collins 1998; EDGE of Existence 2016).

3.3.2 Distribution and Habitat Requirements

The Neuse River Waterdog is found only in the Neuse and Tar River basins of North Carolina (AmphibiaWeb 2006; Beane and Newman 1996; Frost 2016).

Neuse River Waterdogs inhabit rivers and larger streams, where they prefer leaf beds in quiet waters. They need high levels of dissolved oxygen and good water quality. The Neuse River Waterdog is generally found in backwaters off the main current, in areas with sandy or muddy substrate. Adults construct retreats on the downstream side of rocks or in the stream bank where they remain during the day. They are active during the night, leaving these retreats to feed. Neuse River Waterdogs are carnivorous, feeding on invertebrates, small vertebrates, and carrion. Neuse River Waterdogs are most active during winter months even when temperatures are below freezing. During summer months, they will burrow into deep leaf beds and are rarely found. It has been suggested that this inactivity in summer may be an adaptation to avoid fish predators, which are more active at these times. In addition, Neuse River Waterdogs produce a defensive, toxic skin secretion that is assumed to be distasteful to predators (AmphibiaWeb 2006; Beane

and Newman 1996; Conant and Collins 1998; EDGE of Existence 2016; NatureServe Explorer 2016).

3.3.3 Threats to Species

Any factors that reduce water quality are threats to the Neuse River Waterdog. These can include changes that result in siltation and pollution reducing habitat quality (e.g., channelization, agricultural runoff, and industrial and urban development). Impoundments are also a threat to the dispersal of the species as it is unable to cross upland habitat; Neuse River Waterdogs do not climb and are unlikely to use fish passages (NatureServe Explorer 2016).

3.3.4 Designated Critical Habitat

As mentioned in Section 1.0, the Neuse River Waterdog is listed under the ESA as a Threatened Species with Section 4(d) Rule and Critical Habitat Designation. Critical habitat designation (CFR Vol. 86 No. 109) consists of the following (USFWS 2021c):

- Unit 1 - 12.3 river mi (13.8 river km) of the Upper Tar River in Granville County
- Unit 2 - 10.5 river mi (16.9 river km) of Upper Fishing Creek in Warren County
- Unit 3 – 2 river mi (3.2 river km) of Bens Creek in Warren County
- Unit 4 - 82.8 river mi (133 river km) of lower Little Fishing Creek in Halifax, Nash, Warren and Edgecombe Counties.
- Unit 5 – 72.5-river-mi (116.8-river-km) segment of Sandy Creek and Red Bud Creek in Franklin, and Nash Counties
- Unit 6 - 111-river-mi (179-river-km) segment of the Middle Tar River in Franklin, Nash, and Edgecombe Counties
- Unit 7 - 59.9 river mi (96.3 river km) in the Lower Tar River Subbasin including portions of Town Creek, Otter Creek, and Tyson Creek in Edgecombe and Pitt Counties
- Unit 8 - 43.9 river mi (70.6 river km) of the Eno River in Orange and Durham Counties
- Unit 9 - 15.2-river-mi (24.5-river-km) segment of the Flat River in Person and Durham Counties
- Unit 10 - 30.8-river-mi (49.6-river-km) stretch of Middle Creek in Wake and Johnston Counties
- Unit 11 - 24-river-mi (38.6-river-km) stretch of Swift Creek in Johnston County
- Unit 12 - 90.8-river-mi (146.1-river-km) segment of the Little River including Buffalo Creek in Franklin, Wake, Johnston, and Wayne Counties
- Unit 13 - 20.8-river-mi (33.5-river-km) segment of Mill Creek in Johnston and Wayne Counties
- Unit 14 – 43.2 river-mi (69.5 river-km) segment of Middle Neuse River in Wayne County
- Unit 15 – 114.8 river-mi (184.8 river-km) segments of Contentnea Creek, Nahunta Swamp and the Neuse River in Craven, Green, Lenoir, Pitt, Wayne, and Wilson Counties

- Unit 16 – 10.3 river-mi (16.5 river-km) segment of Swift Creek in Craven County
- Unit 17 – 32.5 river-mi (52.4 river-km) segments of Beaver Creek and Trent River in Jones County
- Unit 18 – 2 river-mi (3.2 km) segment of Tuckahoe Swamp in Jones County

Critical Habitat Unit 11 is located 31.1 RM downstream of where Crabtree Creek enters the Neuse River and is located in Swift Creek (Figure 2-3).

3.4 Carolina Madtom (Noturus furiosus)

3.4.1 Species Characteristics

The Carolina Madtom, a small catfish, was described at Milburnie, near Raleigh, NC in the Neuse River by Jordan (Jordan 1889). The Carolina Madtom reaches a maximum size of 132 mm (5.2 inches). Compared to other madtoms within its range, it has a relatively short stout body and a distinctive color pattern of three to four dark saddles along its back that connect a long black stripe on the side running from the snout to the tail. The adipose fin is mostly dark, making it appear that the fish has a fourth saddle. The Madtom is tan on the rest of its body and yellow to tan between the saddles. The adipose fin and caudal fin are fused together, a distinguishing characteristic from other members of the catfish family (Ictaluridae). There are no speckles on the Madtom's belly, and the tail has two brown bands that follow the curve of the tail. The Carolina Madtom, like other catfishes, has serrae on its pectoral fins and is thought to have the most potent venom of any of the catfish species (NCWRC 2010).

3.4.2 Distribution and Habitat Requirements

The Carolina Madtom is endemic to the Piedmont/Inner Coastal Plain portion of the Tar/Pamlico and Neuse River basins. It occurs in creeks and small rivers in habitats generally consisting of very shallow riffles with little current over coarse sand and gravel substrate (Lee et al. 1980). Burr et al. (1989) found most records came from medium to large streams, i.e., mainstem Neuse and Tar Rivers and their major tributaries. The population in the Trent River system (part of the Neuse River basin) is isolated from the rest of the Neuse River basin by salinity levels, so it is therefore considered a separate population, though it has not been detected in Trent River in the last five years (Sarah McRae, USFWS, personal communication). In the lower portions of these rivers, Carolina Madtom is usually found over debris piles in sandy areas. During nesting season, which is from May to July, Madtoms prefer areas with plenty of cover to build their nests with shells, rocks, sticks, bottles, and cans, being suitable cover types. Males guard the nests, in which females may lay between 80 and 300 eggs.

Carolina Madtom is found in water that ranges from clear to tannin-rich, which is usually free-flowing. It is generally rare throughout its range and is apparently in decline. The Tar River

population has historically been more robust than the Neuse River population (Burr et al. 1989), which has shown declines in recent years (Midway 2008). The Little River of the Neuse River Basin has the largest population of Carolina Madtom in the Neuse River Basin, with records from 2016 indicating it is present (Sarah McRae, USFWS, personal communication). A few specimens have been collected from Swift Creek of the Neuse River Basin. Fishing Creek and Swift Creek of the Tar River Basin are also productive systems in regard to Carolina Madtom populations, with around 14 specimens collected in the mid-1980s from Swift Creek (water levels in Fishing Creek prevented sampling during that study). In 2016, a total of 17 individuals were recorded in Swift Creek and a total of four individuals were recorded in Fishing Creek (Sarah McRae, USFWS, personal communication). The Carolina Madtom has been observed in at least 36 localities (Burr et al 1989).

Carolina Madtom has a lifespan of about four years, with sexual maturity being reached around two years in females and three years in males. Sampling for Carolina Madtom is most effective at dawn and dusk when they are most active and feeding (Mayden and Burr 1981). Their diet consists mostly of benthic macroinvertebrates, which they collect by scavenging for food on the bottom of the stream.

3.4.3 Threats to Species

Identified threats to the species include water pollution and construction of impoundments (Burr et al. 1989). Carolina Madtom is susceptible to threats due to its limited range and low population densities (Angermeier 1995, Burr and Stoekel 1999). As a bottom-dwelling fish, Carolina Madtom is susceptible to habitat loss when stream bottoms are impacted by urbanization, impoundments, deforestation, etc.

3.4.4 Designated Critical Habitat

As mentioned in Section 1.0, the Carolina Madtom is listed under the ESA as an Endangered Species with Section 4(d) Rule and Critical Habitat Designation. Critical habitat designation (CFR Vol. 86 No. 109) consists of the following (USFWS 2021c):

- Unit 1 – 26 river miles (42 river km) of Tar River in Franklin, Granville, and Vance Counties
- Unit 2 – 66 river miles (106 km) of Sandy/Swift Creek in Edgecombe, Franklin, Halifax, Nash, and Warren Counties
- Unit 3 – 86 river miles (138 km) of the Fishing Creek Subbasin in Edgecombe, Franklin, Halifax, Nash, and Warren Counties
- Unit 4 – 20 river miles (32 km) of the Upper Neuse River Subbasin (Eno River) in Durham and Orange Counties
- Unit 5 – 28 river miles (45 km) of the Little River in Johnston County
- Unit 6 – 15 river miles (24 km) of Contentnea Creek in Wilson County
- Unit 7 – 15 river miles (24 km) of the Trent River in Jones County

Critical Habitat Unit 4 is located greater than 50 RM upstream of where Crabtree Creek reaches the Neuse River and is located in the Eno River (Figure 2-4).

4.0 OTHER TARGET SPECIES DESCRIPTIONS

4.1 Savannah Lilliput (Toxolasma pullus)

4.1.1 Species Characteristics

The Savannah Lilliput was described by Conrad (1838) from the Wateree River in South Carolina. This small species of mussel has a semi-inflated ovular/elliptical shell, only reaching approximately 35mm in length. Shells are blackish with fine rays that are not visible on all individuals. The Savannah Lilliput is sexually dimorphic, females typically have a broader more truncated posterior end; males have a narrower and more rounded posterior end (USFWS, 2016). The *Toxolasma pullus* from the lower Savannah River are characterized by slightly difference shell morphology and were at once described as a separate species but have since been synonymized with *T. pullus*.

4.1.2 Distribution and Habitat Requirements

The Savannah Lilliput occurs along the southern Atlantic Slope with a historic range from the Altamaha River Basin in Georgia to the Neuse River Basin in North Carolina. It was presumed extirpated in the Neuse and Waccamaw River Basins (USFWS 2016, Bogan 2017); however, Three Oaks found an individual in Lake Waccamaw in 2017 and these efforts reestablished extant presence in the Neuse Basin. Historic records show specimens collected in Wake County in the Neuse River, but it has not been recorded more recently in the mainstem Neuse River (Johnson 1970). It is believed to be declining throughout its range (Adams et al. 1990, Price 2005). The Savannah Lilliput prefers shallow waters of creeks, rivers, and impounded lakes, tending to inhabit sandy/silty or muddy banks in relatively still water (NCWRC 2022).

4.1.3 Threats to Species

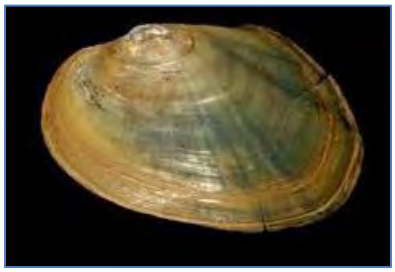
Threats to the Savannah Lilliput are similar to those of the above mussel species. Additionally, given its preference for shallow water in impounded habitats, this species is especially susceptible to fluctuations in water levels, off-road recreational vehicle traffic, and drought. In North Carolina, known populations are generally restricted to short reaches and in isolation, with many populations considered highly vulnerable (NCWRC 2022). Predation by muskrats and raccoons may be an important source of mortality in lake populations (Hanlon and Levine 2004).

4.1.4 Species Listing

The Savannah Lilliput is State Endangered in North Carolina (NCWRC, 2022). The USFWS petitioned to add the Savannah Lilliput for federal listing in 2010 and 2011 and published a 90-day finding the listing may be warranted, however listing has not been granted at this time (USFWS 2016).

4.2 Green Floater (Lasmigona subviridis)

4.2.1 Species Characteristics



The Green Floater was described by Conrad (1835) from the Schuylkill River in Lancaster County, Pennsylvania. This small mussel species has a thin, slightly inflated, subovate shell that is narrower in front and higher behind. The dorsal margin forms a blunt angle with the posterior margin. The shell is dull yellow or tan to brownish green, usually with concentrations of dark green rays.

4.2.2 Distribution and Habitat Requirements

The Green Floater occurs along the Atlantic Slope from the Savannah River in Georgia north to the Hudson River in New York, as well as in the "interior" basins (New, Kanawha, and Watauga Rivers) of the Tennessee River basin. It has experienced major declines throughout its entire range. Based on preliminary genetics research, the southern populations of the Green Floater (Tar-Pamlico, Neuse, and Yadkin/Pee Dee River Basins) appear to be genetically distinct from populations from the Roanoke River to the north and west (Morgan Railey and Arthur Bogan, North Carolina Museum of Natural Sciences, 2007 Personal Communication). Further research is needed to determine if these differences warrant classification of the southern populations as a distinct species. It occurs in small size streams to large rivers, in quiet waters such as pools, or eddies, with gravel and sand substrates.

4.2.3 Threats to Species

Threats to the Green Floater are similar to those described for the above mussel species and have contributed to the decline of this species throughout its range. Remaining Green Floater populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event.

4.2.4 Species Listing

This species was petitioned for federal listing under the Endangered Species Act of 1973, as amended (ESA) within the 2010 Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States by the Center for Biological Diversity (CBD) (CBD 2010). The listing status as of January 31, 2022, is considered under review (USFWS 2022b).

5.0 SURVEY EFFORTS

Mussel surveys for the project were conducted in Brier Creek, Brier Creek Reservoir, Little Brier Creek, and Stirrup Iron Creek by Tim Savidge (Permit # 21-ES0034), Lizzy Stokes-Cawley, and Trevor Hall on September 22, 2021, and September 29, 2021. Additional shoreline mussel

surveys were completed in Brier Creek Reservoir by Tim Savidge and Lizzy Stokes-Cawley on December 7-9, 2021.

Trapping surveys for Neuse River Waterdog were conducted in Stirrup Iron Creek, Brier Creek, and Little Brier Creek by Three Oaks personnel Tim Savidge, Kate Sevick (Permit # ES-00485), Trevor Hall, and Lizzy Stokes-Cawley on November 15-19, 2021.

Electro-fishing surveys for the Carolina Madtom were conducted in Brier Creek by Tim Savidge, Lizzy Stokes-Cawley, and Trevor Hall on September 22, 2021, and in Little Brier Creek by Tim Savidge, Lizzy Stokes-Cawley, and Trevor Hall on November 1, 2021.

The following provide general stream condition descriptions for each stream area visited. Separate conditions are listed for the impounded areas included for the shoreline mussel surveys in the Stirrup Iron Creek and Brier Creek reservoirs. These streams were visited on multiple occasions as detailed in the results section.

5.1 Impoundment Conditions: Brier Creek Reservoir

The shoreline of the Brier Creek Reservoir varied from marsh-wetland areas to steep wooded slopes with several small intermittent/ephemeral stream systems. The shoreline is shallow in most areas, ranging from 0.25-1m in depth. Substrate consisted primarily of sand and gravel, with silt accumulations throughout. Banks were generally stable with moderate scour, ranging from one to three feet. Water was slightly turbid during the time of surveys, but water clarity was not an issue. In drought conditions, the shoreline became exposed, allowing staff biologists to walk the uncovered substrate.

5.2 Stream Conditions: Brier Creek

Habitat in Brier Creek varied highly below the tailrace of the Brier Creek reservoir. Active construction of a new road approximately 100m upstream of the Airport Blvd. stream crossing was ongoing during the mussel surveys. The area downstream of the new road crossing consisted of a sequence of straightened shallow, primarily run and riffle habitat, with small pools present throughout the reach caused by sediment buildup and scour. Erosion/sediment controls were in place; however, sediment was observed entering the stream following a rain event after mussel surveys had been completed. Overall, the channel ranged from 15-20 feet wide with banks four to six feet high that were generally unstable and scoured, as well as lined with rip-rap in sections. Water was slightly turbid during the time of surveys; however, there were no issues with water clarity. Substrates consisted of sand, gravel, cobble, and silt. A narrow natural wooded vegetation buffer was present in this section.

The area upstream of the new crossing construction consisted of similar habitat, with a more sinuous channel throughout. Channel ranged from 20-25 feet wide with banks six to eight feet high that were unstable and eroded. Water was clear in this section during the time of survey, with substrate consisting mainly of gravel and cobble, with sand/silt deposits in the margins and pools. A moderate to wide natural vegetation buffer was present along the right descending bank,

while a buffer less than 100 feet occurs along the left descending bank between the channel and Airport Blvd.

5.3 Stream Conditions: Stirrup Iron Creek

Habitat in Stirrup Iron Creek consisted of long deep run habitat, with pools present throughout the reach caused by woody debris and scour. Overall, the channel ranged from 25 to 35 feet wide with banks six to 10 feet high that were generally unstable and highly eroded. Water was slightly turbid during time of survey. Substrates consisted primarily of unconsolidated sand with silt, clay, and occasional gravel present in riffle areas. A natural wooded vegetation buffer was wide on the right descending bank and moderate on the left descending bank bordered on the left descending bank by a large clear-cut vegetated area. The lower reach of the survey entered a highly developed area with little to no riparian buffer, several roads/parking lots, and industrial buildings near both banks.

5.4 Stream Conditions: Little Brier Creek

Habitat in the lower surveyed portion of Little Brier Creek consisted of a sluggish run/pool associated with the backwaters of Little Brier Creek Reservoir in the vicinity of the Globe Road. Water depths ranged from one to three feet and the substrate was dominated by sand and silt. Approximately 300 feet above the road crossing, the channel transitioned to shallow, primarily riffle and run habitat, with pools present throughout the reach caused by woody debris and scour. Overall, the channel ranged from 24 to 34 feet wide with banks six to 10 feet high that were generally unstable and highly eroded. Water was clear during time of survey. Substrates consisted primarily of unconsolidated sand with silt, clay, and occasional gravel present in riffle areas. A natural wooded vegetation buffer was wide on the left descending bank and moderate on the right descending bank bordered on the right descending bank by several parking lots and industrial buildings.

5.5 Methodology

5.5.1 Mussel Surveys

Mussel surveys were conducted in variable lengths as depicted on Figure 1, covering both streams and impoundments in the study area. Areas of appropriate habitat were searched, concentrating on the habitats preferred by the target species. The survey team spread out across the creek into survey lanes or separated along the shoreline in the case of the impoundment surveys. Visual surveys were conducted using glass bottom view buckets (bathyscopes) and snorkel/mask. Tactile methods were employed, particularly in streambanks under submerged rootmats. All freshwater bivalves were recorded and returned to the substrate. Timed survey efforts provided Catch Per Unit Effort (CPUE) data for each species. Relative abundance for freshwater snails and freshwater clam species were estimated using the following criteria:

- (VA) Very abundant > 30 per square meter
- (A) Abundant 16-30 per square meter
- (C) Common 6-15 per square meter

- (U) Uncommon 3-5 per square meter
- (R) Rare 1-2 per square meter
- (P-) Ancillary adjective “Patchy” indicates an uneven distribution of the species within the sampled site.

While conducting the mussel surveys, searches were also conducted for Carolina Madtom by overturning logs, rocks, and other debris on the stream bottom which are often used for cover by madtom species. These techniques can also incidentally locate Neuse River Waterdog, although standard presence/absence methods involve four consecutive days of trapping during winter months using baited minnow traps upstream and downstream of a project area.

5.5.2 Neuse River Waterdog Surveys

Methods were developed by Three Oaks in consultation with the USFWS and NCWRC and were designed to replicate winter trapping efforts conducted as part of the recent species status assessment undertaken by these agencies and collaborators. A total of ten baited traps were set for four soak nights within the respective survey reaches. Trap sites were selected based on habitat conditions and accessibility. Undercut banks, with some accumulation of leaf pack, as well as back eddy areas within runs were the primary microhabitats selected; however, all of the microhabitats (pool, riffle, run, etc.) occurring at a site were sampled with at least one trap. Traps were baited with a combination of chicken livers and hot dogs and allowed to soak overnight. The traps were checked daily, all species found within the traps were recorded, and the traps were rebaited. If the targeted Neuse River Waterdog was found at a site, trapping efforts were to be discontinued. In addition, dip net sweeps through leaf packs and underneath submerged rootmats were conducted to supplement the trapping efforts.

5.5.3 Carolina Madtom Surveys

During the mussel and waterdog efforts, the presence of preferred habitats for the Carolina Madtom were assessed and, if conditions were appropriate, targeted visual surveys were conducted by overturning rocks and debris in these areas. The species was not observed during these surveys; however, based on habitat observations, further surveys using active collection methods was determined to be warranted. Fish community surveys were completed in Brier Creek and Little Brier Creek. The fish surveys were conducted within the depicted reaches using two Smith Root LR-24 backpack electrofishing unit and dip nets. All habitat types in the survey reach (riffle, run, pool, slack-water, etc.) were sampled. Stunned fish were placed into buckets and were identified, counted, assigned a relative abundance, and released live onsite.

Relative abundance reported was estimated using the following criteria:

- (VA) Very abundant: > 30 collected at survey reach
- (A) Abundant: 16-30 collected at survey reach
- (C) Common: 6-15 collected at survey reach
- (U) Uncommon: 3-5 collected at survey reach
- (R) Rare: 1-2 collected at survey reach

- (P-) Ancillary adjective “Patchy” indicates an uneven distribution of the species within the sampled site.

It should be noted that relative abundances of particular species can be affected by survey methodologies and site conditions. Thus, some species, particularly those that are found in deeper pools and runs and those that can seek cover quickly may be under-represented or not detected within the respective survey reach.

6.0 RESULTS

6.1 Mussel Surveys

Mussel surveys and or habitat evaluations were conducted in the following reaches as depicted in Figure 1. Surveys are listed below in chronological order. Sites were named using the following naming convention: YYMMDD.Xzzz where year is YY, month is MM, day is DD, site number is X, and initials of survey lead are zzz. Across all sites, a total of three mussel species, Savannah Lilliput (*Toxolasma pullus*), Eastern Elliptio (*Elliptio complanata*), and Paper Pondshell (*Utterbackia imbecillis*) were found.

6.1.1 Brier Creek Reservoir 210929.2tws

The shoreline of Brier Creek Reservoir was evaluated in several areas for a total of 1.14 person hours, during which the Paper Pondshell was located. Other mollusk species, the Asian Clam and Banded Mystery Snail, were also located (Table 2).

Table 2. CPUE for Freshwater Mussels in Brier Creek 210929.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	15	common	13.15/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C
Viviparus georgianus	Banded Mystery Snail	~		PC

6.1.2 Brier Creek Reservoir 210929.3tws

This reach was surveyed for a total of 0.66 person hours, during which the Paper Pondshell was located. One other mollusk species, the Asian Clam, was also located (Table 3).

Table 3. CPUE for Freshwater Mussels in Brier Creek 210929.3tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	24	common	16/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C

6.1.3 Brier Creek Reservoir 210929.4tws

This reach was surveyed for a total of 0.74 person hours, during which the Paper Pondshell was located. Other mollusk species, the Asian Clam and Banded Mystery Snail, were also located (Table 4).

Table 4.CPUE for Freshwater Mussels in Brier Creek 210929.4tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	41	common	55.4/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		A
Viviparus georgianus	Banded Mystery Snail	~		C

6.1.4 Brier Creek 210921.2tws

Two reaches of Brier Creek were evaluated during this study. This reach was surveyed for a total of 9.0 person hours, during which two live species of freshwater mussel, the Eastern Elliptio and Paper Pondshell, were located. Other mollusk species, the Pointed Campeloma and Asian Clam, were also located. Shells of the Savannah Lilliput were discovered in this reach (Table 5).

Table 5. CPUE for Freshwater Mussels in Brier Creek 210921.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Elliptio complanata	Eastern Elliptio	974	common	324.33/hr
Utterbackia imbecillis	Paper Pondshell	3	2	1/hr
Toxolasma pullus	Savannah Lilliput	0	7	0/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		A
Campeloma decisum	Pointed Campeloma	~		PU

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.5 Brier Creek 210929.1tws

This reach was surveyed for a total of 7.34 person hours, during which three live species of freshwater mussel, the Eastern Elliptio, Paper Pondshell, and Savannah Lilliput, were located. Other mollusk species, the Pointed Campeloma and Asian Clam, were also located. Shells of the Savannah Lilliput were also discovered in this reach (Table 6).

Table 6. CPUE for Freshwater Mussels in Brier Creek 210922.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Elliptio complanata	Eastern Elliptio	578	common	78.75/hr
Utterbackia imbecillis	Paper Pondshell	7	1	.95/hr
Toxolasma pullus	Savannah Lilliput	1	4	.14/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		A
Campeloma decisum	Pointed Campeloma	~		PU

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.6 Little Brier Creek 210929.5tws

Two reaches of Little Brier Creek were evaluated during this study. This reach, which occurred in the backwaters of the Little Brier Creek Reservoir, was surveyed for a total of 1.54 person hours, during which one live species of freshwater mussel, the Paper Pondshell, was located. One other mollusk species, the Asian Clam, was also located (Table 7).

Table 7. CPUE for Freshwater Mussels in Brier Creek 210922.5tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	16	~	10.39/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.7 Little Brier Creek 210929.6tws

This reach was surveyed for a total of 1.26 person hours, during which only the Asian Clam was located. Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.8 Stirrup Iron Creek 211101.2tws

This reach of Stirrup Iron Creek was surveyed for a total of 1.2 person hours, during which one live species of freshwater mussel, the Paper Pondshell, was located. Three other mollusk species, the Pointed Campeloma, Japanese Mystery Snail, and Asian Clam, were also located (Table 8).

Table 8. CPUE for Freshwater Mussels in Stirrup Iron Creek 211101.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	3	2	2.5/hr
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C
Campeloma decisum	Pointed Campeloma	~		R
Cipangopaludina japonica	Japanese Mystery Snail	~		C

6.1.9 Brier Creek Reservoir 211207.1tws

This reach consisted of exposed reservoir shoreline and was surveyed for a total of 2.0 person hours. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. One other mollusk species, the Asian Clam was also found. Additionally, one Banded Mystery Snail shell was observed (Table 9).

Table 9. CPUE for Freshwater Mussels in Brier Creek Reservoir 211207.1tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	~		C
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C
Viviparus georgianus	Banded Mystery Snail	~	1	R

6.1.10 Brier Creek Reservoir 211207.2tws

This reach consisted of exposed reservoir shoreline and was surveyed for a total of 2.0 person hours. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. The Asian Clam was also abundant. One Banded Mystery Snail shell was also located (Table 10).

Table 10. CPUE for Freshwater Mussels in Brier Creek Reservoir 211207.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	~		A
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		A
Viviparus georgianus	Banded Mystery Snail	~	1	R

6.1.11 Brier Creek 211207.3tws

This reach was surveyed for a total of 1.5 person hours, during which no freshwater mussels were located. Asian Clams were common with a patchy distribution (CP).

6.1.12 Brier Creek Reservoir 211209.1tws

This reach consisted of the shoreline of the Little Brier Creek arm of the reservoir and was surveyed for a total of 1.0 person hour. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. The Asian Clam was common and Japanese Mystery Snails were located in low numbers (Table 11).

Table 11. CPUE for Freshwater Mussels in Brier Creek Reservoir 211209.1tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				**CPUE**
Utterbackia imbecillis	Paper Pondshell	~		C
Freshwater Snails and Clams				**Relative Abundance**
Corbicula fluminea	Asian Clam	~		C
Cipangopaludina japonica	Japanese Mystery Snail	~		UC

6.2 Carolina Madtom Surveys

6.2.1 Brier Creek 210921.1tws

A total of 20 fish species were found in Brier Creek during a total of 1,968 seconds of electrofishing time (Table 12).

Table 12. Fish Survey Results: Brier Creek 210921.1tws

Scientific Name	Common Name	Relative Abundance
Ameiurus brunneus	Snail Bullhead	C
Ameiurus nebulosus	Brown Bullhead	R
Ameiurus platycephalus	Flat Bullhead	C
Cyprinella analostana	Satinfin Shiner	A
Dorosoma cepedianum	Gizzard Shad	C
Etheostoma nigrum	Johnny Darter	A
Gambusia holbrooki	Eastern Mosquitofish	A
Ictalurus punctatus	Channel Catfish	C
Lepomis auritus	Redbreast Sunfish	C
Lepomis cyanellus	Green Sunfish	A
Lepomis gibbosus	Pumpkinseed	R
Lepomis gulosus	Warmouth	R
Lepomis macrochirus	Bluegill	A

Scientific Name	Common Name	Relative Abundance
Micropterus salmoides	Largemouth Bass	R
Notemigonus crysoleucas	Golden Shiner	R
Notropis altipinnis	Highfin Shiner	A
Notropis hudsonius	Spottail Shiner	C
Notropis procne	Swallowtail Shiner	A
Noturus insignis	Margined Madtom	U
Pomoxis nigromaculatus	Black Crappie	C

6.2.2 Little Brier Creek 211101.1tws

A total of 9 fish species were found in Little Brier Creek during a total of 1,426 seconds of electrofishing time (Table 13).

Table 13. Fish Survey Results: Little Brier Creek 211101.1tws

Scientific Name	Common Name	Relative Abundance
Ameiurus brunneus	Snail Bullhead	C
Ameiurus natalis	Yellow Bullhead	C
Dorosoma cepedianum	Gizzard Shad	C
Lepomis auritus	Redbreast Sunfish	C
Lepomis cyanellus	Green Sunfish	A
Lepomis gibbosus	Pumpkinseed	R
Lepomis macrochirus	Bluegill	A
Lepomis microlophus	Redear Sunfish	U
Pomoxis nigromaculatus	Black Crappie	C

6.3 Neuse River Waterdog Surveys

The Neuse River Waterdog was not captured during Waterdog trapping efforts; however, 16 fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish, Redbreast Sunfish, Margined Madtom (*Noturus insignis*), White Shiner (*Luxilus albeolus*), Spottail Shiner, Highfin Shiner, Satinfin Shiner, Black Crappie, Channel Catfish (*Ictalurus punctatus*), Eastern Mosquitofish, and Johnny Darter, were captured (this inventory is separate from what was captured during fish surveys). Two crayfish species, the White River Crayfish (*Procambarus acutus*) and the Variable Crayfish (*Cambarus latimanus*) were also captured during the survey efforts (Tables 14-16).

6.3.1 Little Brier Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Little Brier Creek; however, seven fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish and Redbreast Sunfish, were captured. The Variable Crayfish was also captured during the effort (Table 14).

Table 14 Little Brier Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	Snail Bullhead (1)	~	Snail Bullhead (2)	Brown Bullhead (1)
2	White River Crayfish (1)	Redbreast Sunfish (2), Bluegill (1)	Bluegill (5), Redbreast Sunfish (2)	Yellow Bullhead (2), Redbreast Sunfish (1)
3	~	~	Yellow Bullhead (2)	Yellow Bullhead (2), Redbreast Sunfish (1)
4	Yellow Bullhead (1)	~	Yellow Bullhead (3)	Yellow Bullhead (3)
5	~	Green Sunfish (1), Variable Crayfish (1)	Yellow Bullhead (1)	Yellow Bullhead (2), Variable Crayfish (1)
6	~	Yellow Bullhead (2), Brown Bullhead (1), Variable Crayfish (1)	Yellow Bullhead (1)	Yellow Bullhead (1), Variable Crayfish (1)
7	~	~	Yellow Bullhead (3), Snail Bullhead (1)	Yellow Bullhead (1)
8	Yellow Bullhead (1), Brown Bullhead (1)	Yellow Bullhead (2)	Yellow Bullhead (1)	Yellow Bullhead (2)
9	White River Crayfish (3)	Brown Bullhead (2)	Snail Bullhead (1), Variable Crayfish (2)	Brown Bullhead (1), Cambarus latimanus (1)
10	Yellow Bullhead (1), Green Sunfish (1)	~	Yellow Bullhead (3), Variable Crayfish (3)	Redear Sunfish (1)

6.3.2 Brier Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Brier Creek; however, 15 fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish, Redbreast Sunfish, Margined Madtom, White Shiner, Spottail Shiner, Highfin Shiner, Black Crappie, Channel Catfish, Eastern Mosquitofish, and Johnny Darter, were captured. Two crayfish species, the White River Crayfish and the Variable Crayfish were also captured during the effort (Table 15).

Table 15. Brier Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	Green Sunfish (1)	Yellow Bullhead (1)	White River Crayfish (1)	Green Sunfish (1)
2	~	Snail Bullhead (1), Green Sunfish (2)	Variable Crayfish (2)	Snail Bullhead (2), Variable Crayfish (1)

Trap #	Day 1	Day 2	Day 3	Day 4
3	~	Margined Madtom (1), White Shiner (1)	Spottail Shiner (3)	Black Crappie (1), Highfin Shiner (4), Johnny Darter (1)
4	~	~	Johnny Darter (1), Highfin Shiner (1), Variable Crayfish (1)	White River Crayfish (1)
5	Variable Crayfish (1)	Eastern Mosquitofish (6)	~	Highfin Shiner (1)
6	White Shiner (2), Highfin Shiner (1)	Channel Catfish (2)	Highfin Shiner (4)	White River Crayfish (1), Variable Crayfish (1)
7	Satinfin Shiner (8), Highfin Shiner (32), Johnny Darter (1)	~	~	~
8	~	Bluegill (1)	Bluegill (1)	~
9	Snail Bullhead (1), Highfin Shiner (6), Redbreast Sunfish (2), Bluegill (6), Green Sunfish (1)	Black Crappie (1), Eastern Mosquitofish (4), Yellow Bullhead (1)	~	Eastern Mosquitofish (1), Bluegill (1)
10	~	Black Crappie (1), Satinfin Shiner (1)	~	~

6.3.3 Stirrup Iron Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Stirrup Iron Creek; however, five fish species, consisting of Snail Bullhead, Bluegill, Channel Catfish, Satinfin Shiner, and Highfin Shiner, were captured (Table 16).

Table 16. Stirrup Iron Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	~	Satinfin Shiner (1)	Highfin Shiner (1)	~
2	Bluegill (1)	Highfin Shiner (1)	~	~
3	Snail Bullhead (1)	~	~	~
4	~	~	~	~
5	~	~	Channel Catfish (1)	~
6	~	~	~	~
7	~	Snail Bullhead (1)	~	~
8	~	~	~	Bluegill (1), Highfin Shiner (1)
9	~	~	~	~
10	~	~	~	~

7.0 HABITAT ASSESSMENTS

7.1 Little Brier Creek Reservoir

A habitat assessment was completed in the backwaters of Little Brier Creek Reservoir downstream of Globe Road at 35.887699, -78.800179. The habitat here consisted of a channel ranging from 40-50 ft wide, with steep clay/mud banks. The riparian area was made up of a maintained powerline ROW. The water was slow moving and turbid during the evaluation and was at least 4-6 feet deep.

8.0 DISCUSSION/CONCLUSIONS

The results indicate that three streams and two impoundments within the study area support freshwater mussel species. The widespread and common Eastern Elliptio and Paper Pondshell occur within the surveyed portion of Brier Creek, along with the Savannah Lilliput, which was previously presumed to be extirpated from the Neuse River Basin. The Paper Pondshell was the only mussel species found in the reservoir; it was also found in Little Brier Creek in the backwaters of the reservoir. The other targeted protected mussel species were not found during this effort; in recent years, they have only been documented a considerable distance from the project area and are separated by Lake Crabtree (Section 1.0).

The Neuse River Waterdog and Carolina Madtom were not detected during these efforts and suitable habitat was sparse throughout the study area. While other species were not found during these surveys, appropriate habitat is present; thus, there is the potential for additional species across the three taxa surveyed to occur within the study area.

Based on these survey results, adverse effects to any of the species listed in Section 1.0 are unlikely to occur in the study area. However, strict adherence to erosion control standards should minimize the potential for any adverse impacts to aquatic resources.

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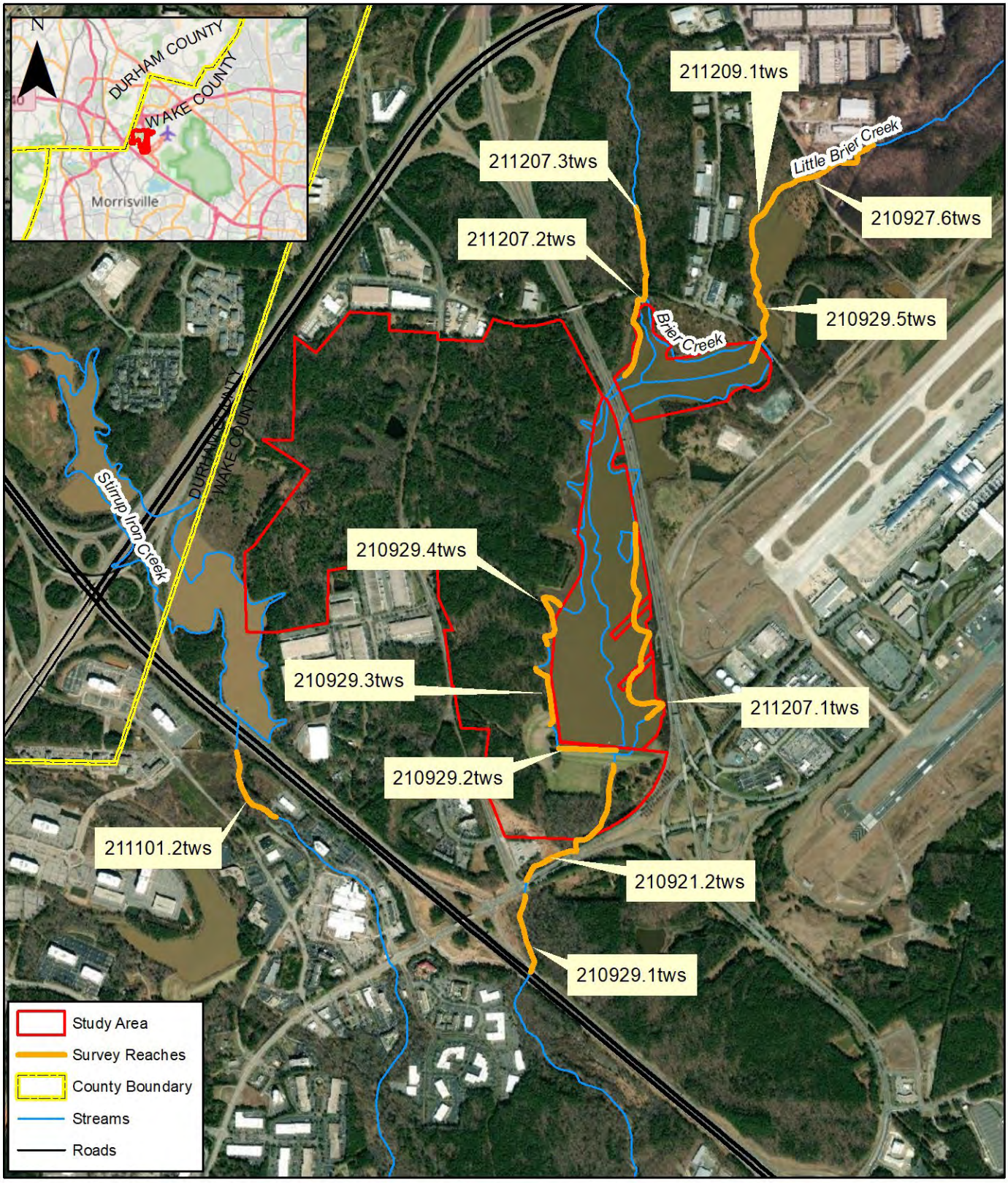
APPENDIX A

Figures



THREE OAKS ENGINEERING

Prepared For: L&B

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
Vicinity Map

Wake County, North Carolina

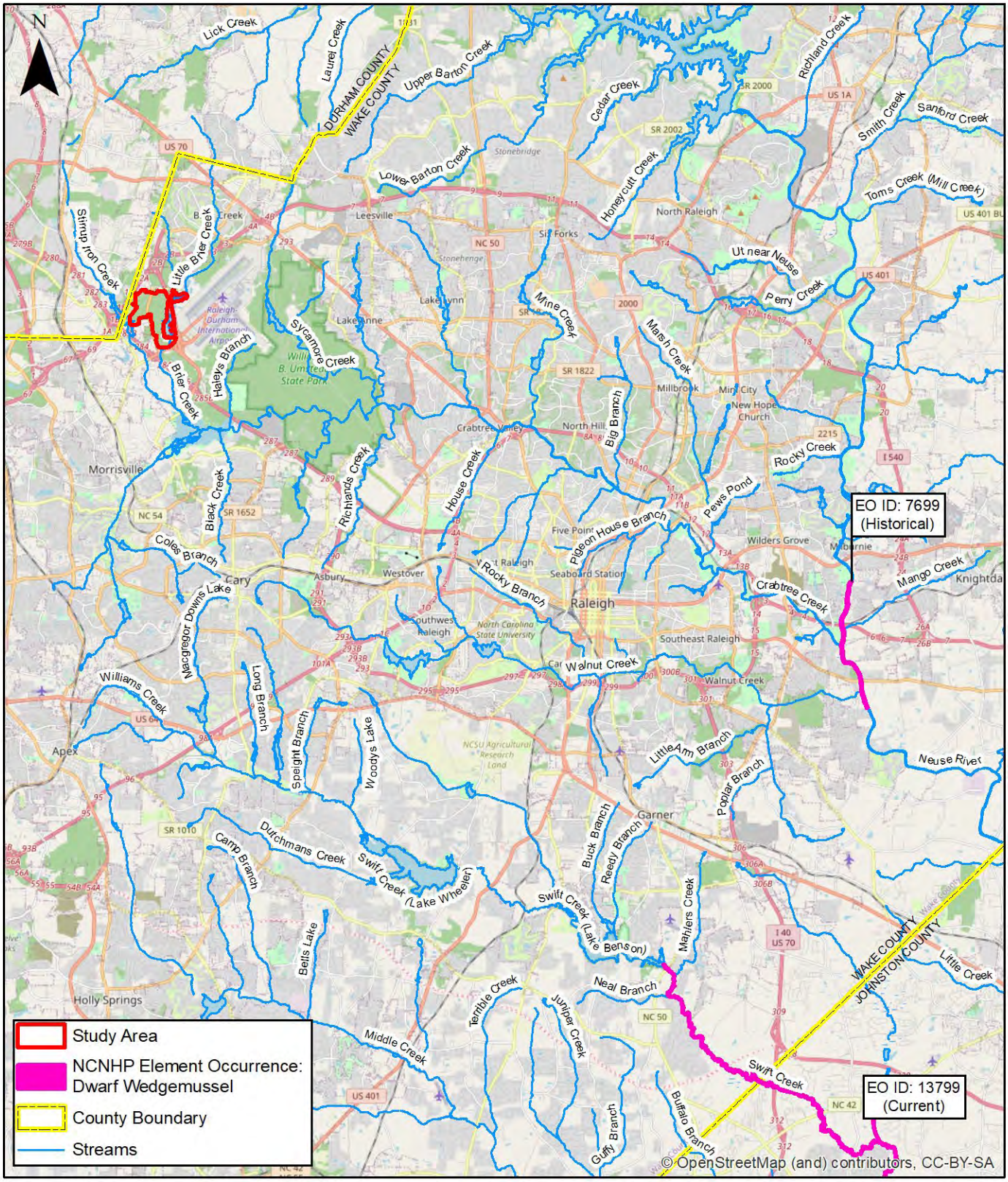
Date: January 2022

Scale: 0 500 1,000 Feet

Job No.: 19-018

Drawn By: TDH | Checked By: TED

Figure 1



THREE OAKS ENGINEERING

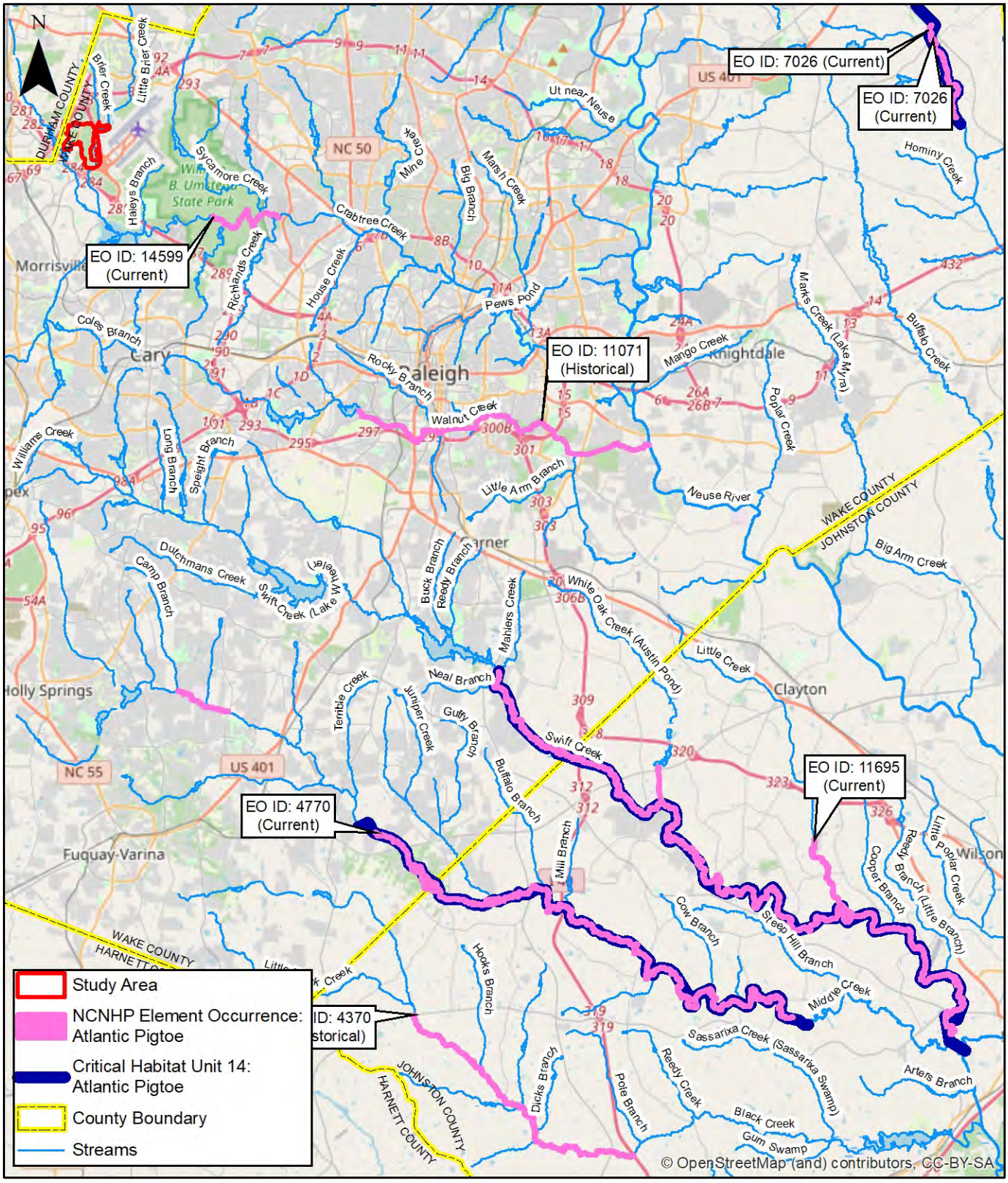
Prepared For: L&B

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Dwarf Wedgemussel
Wake County, North Carolina

Date:	January 2022
Scale:	0 1 2 Miles
Job No.:	19-018
Drawn By:	TDH
Checked By:	TED

Figure
2-1



THREE OAKS ENGINEERING

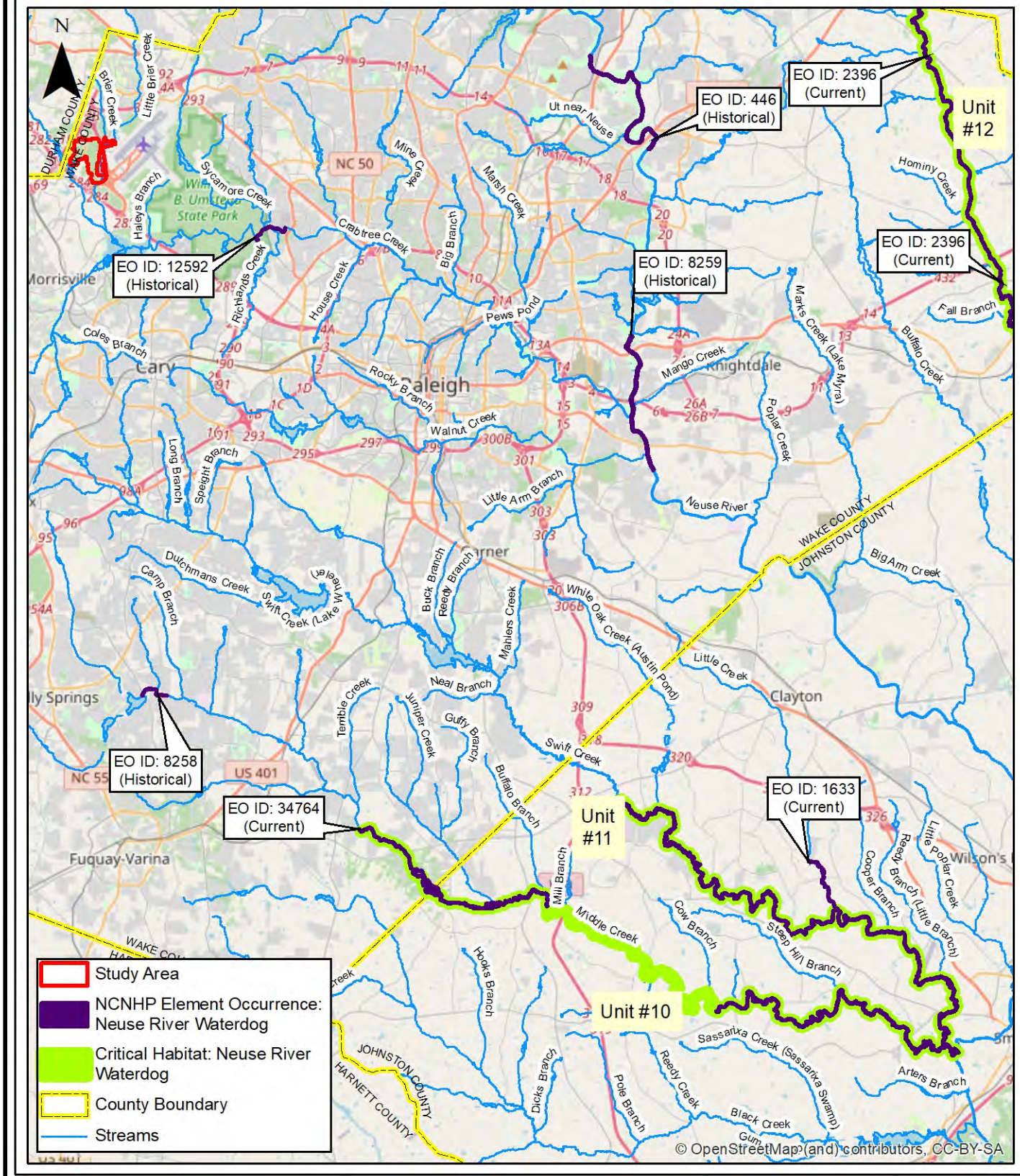
Prepared For: L&B

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Atlantic Pigtoe
Wake County, North Carolina

Date: January 2022
Scale: 0 1 2 Miles
Job No.: 19-018
Drawn By: TDH
Checked By: TED

Figure
2-2



THREE OAKS ENGINEERING

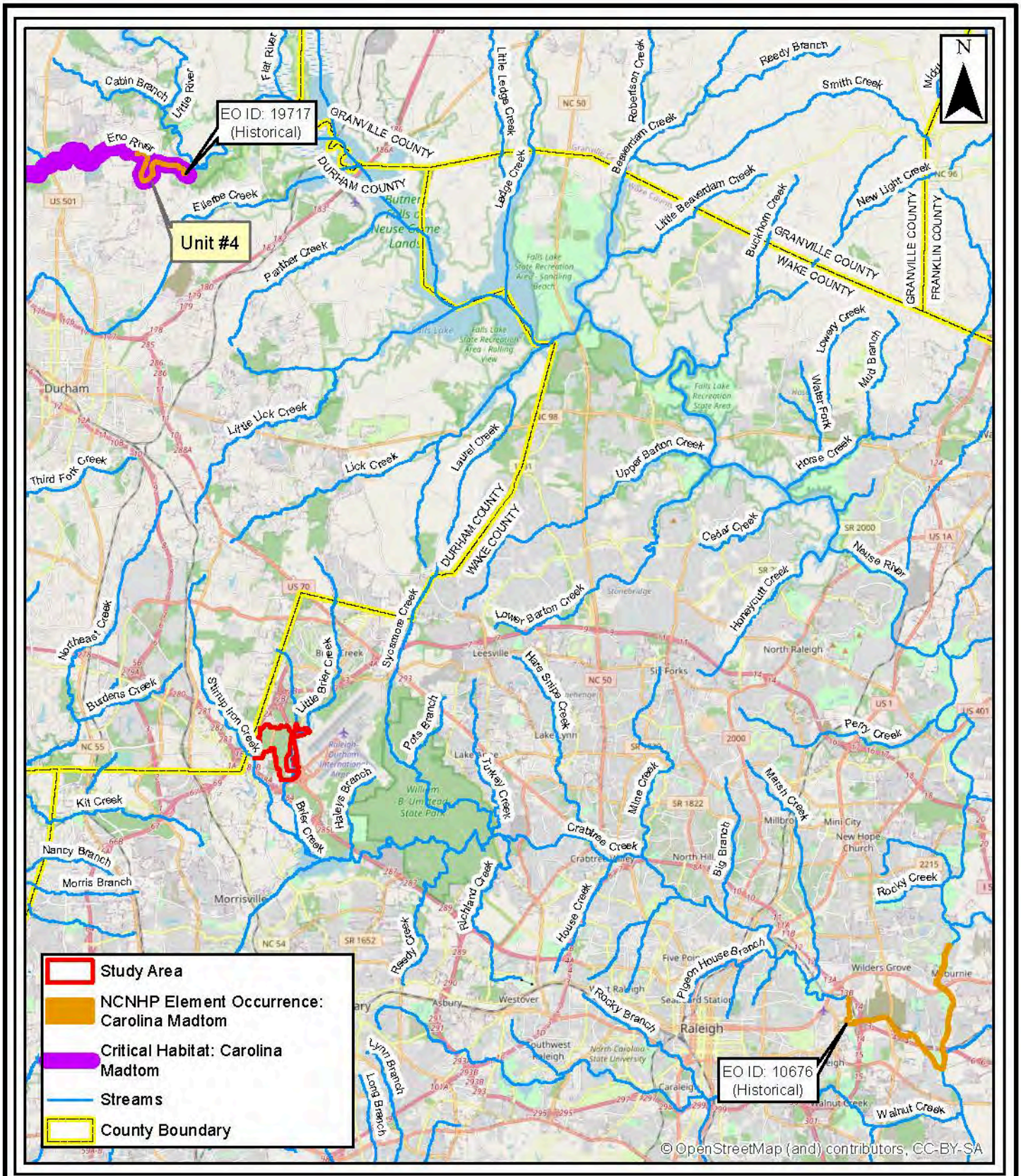
Prepared For: L&B

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Neuse River Waterdog
Wake County, North Carolina

Date:	January 2022
Scale:	0 1 2 Miles
Job No.:	19-018
Drawn By:	TDH
Checked By:	TED

Figure
2-3



Prepared For:

Aquatic Species Surveys
Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Carolina Madtom
Wake County, North Carolina

Date: January 2022
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Job No.: 19-018
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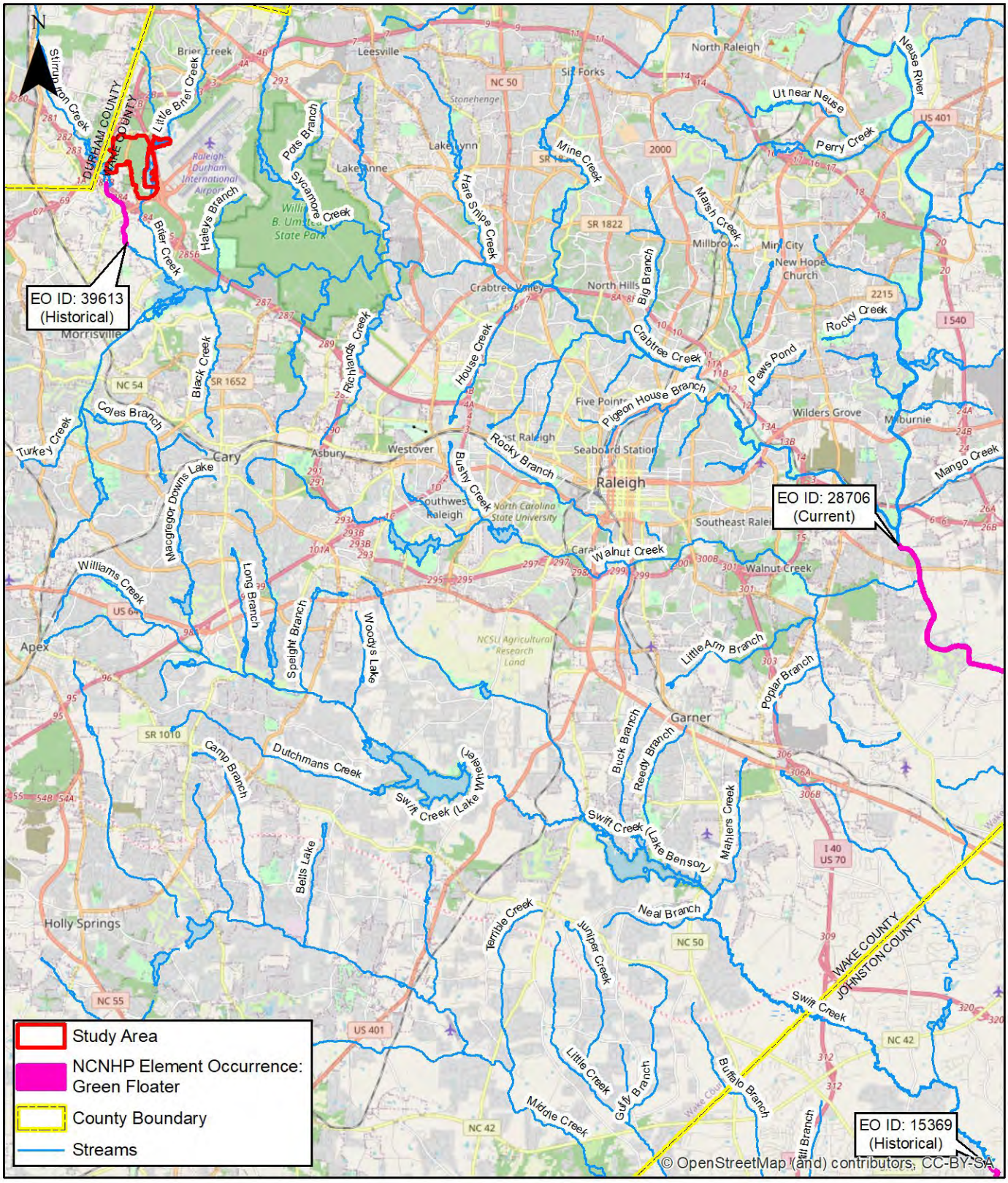
Checked By: TED

Figure
2-4



Prepared For:

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Green Floater
Wake County, North Carolina

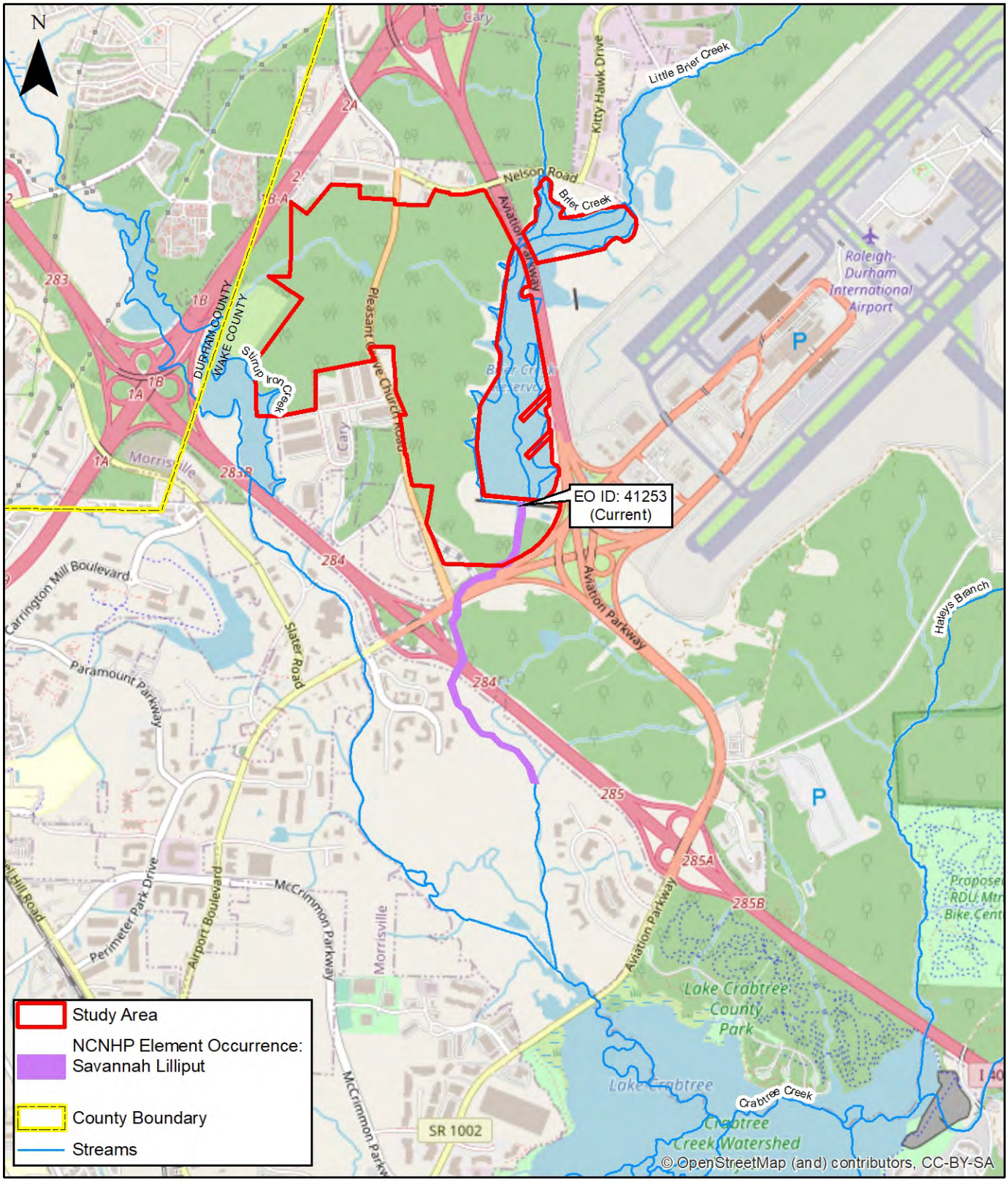
Date: January 2022

Scale: 0 1 2 Miles

Job No.: 19-018

Drawn By: TDH | Checked By: TED

Figure 2-5



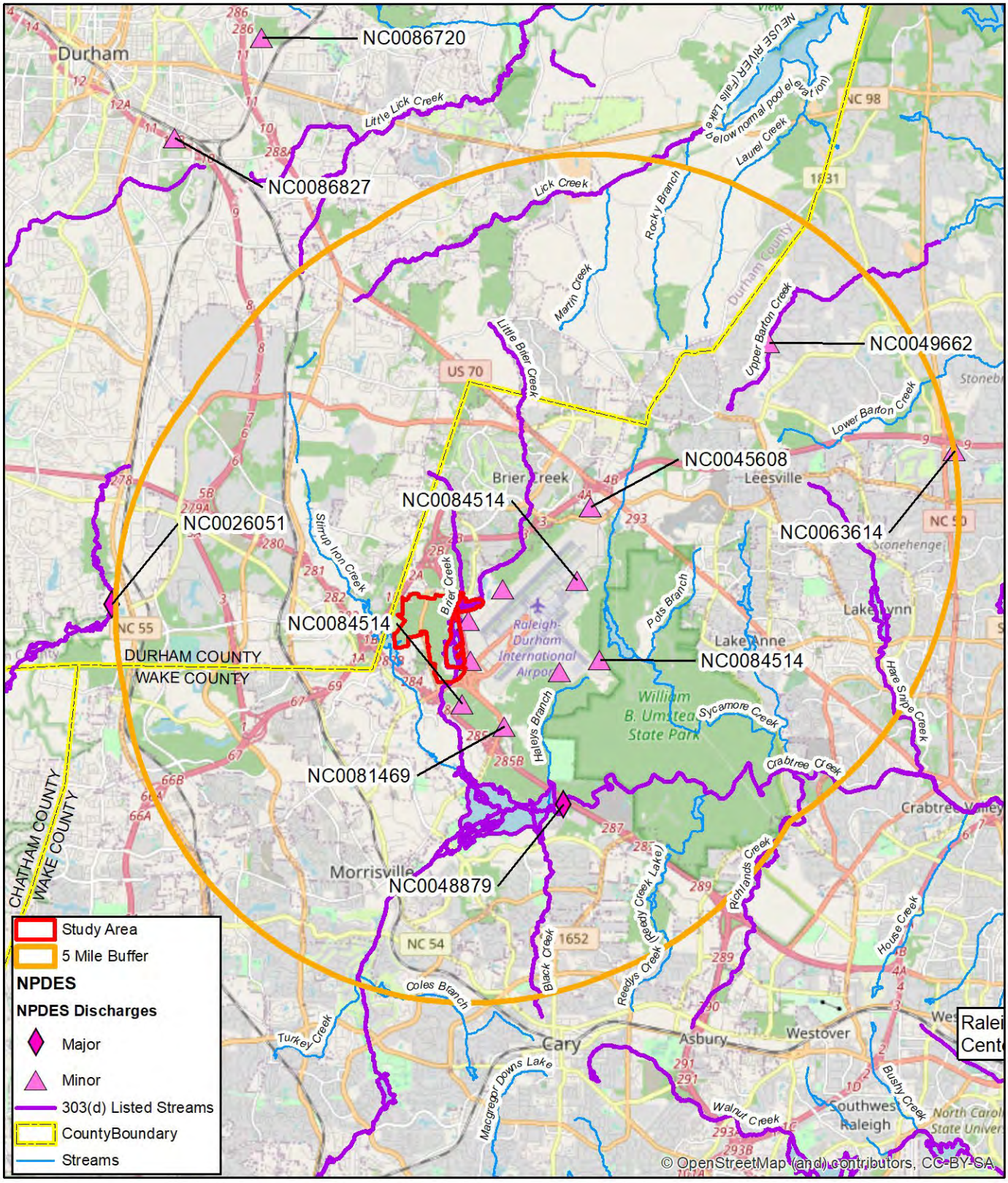
Prepared For:

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
NCNHP Element Occurrences:
Savannah Lilliput
Wake County, North Carolina

Date:	January 2022
Scale:	0 0.1 0.2 Miles
Job No.:	19-018
Drawn By:	TDH
Checked By:	TED

Figure
2-6



Prepared For:

Aquatic Species Surveys

Landrum & Brown
RDU International Airport
303(d) and NPDES

Wake County, North Carolina

Date: January 2022

Scale: 0 0.5 1 Miles

Job No.: 19-018

Drawn By: TDH

Checked By: TED

Figure 3

Appendix E
USFWS Concurrence Letter

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Raleigh ES Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

November 15, 2022

Tommy L. Dupree, Manager
Memphis Airports District Office
2600 Thousand Oaks Blvd., Suite 2250
Memphis, TN 38118-2486

Subject: Proposed Runway 5L/23R Replacement Project; Raleigh-Durham International Airport
Wake County, North Carolina

Dear Mr. Dupree:

This letter is in response to your October 19, 2022 request for informal consultation and concurrence concerning federally listed species at the Raleigh-Durham International Airport (RDU), located in Wake County, North Carolina. The U.S. Fish and Wildlife Service (Service) has reviewed your letter and the October 7, 2022 Biological Resources Assessment (BRA) for the project. According to the submitted information, the project site has been identified for the construction of a replacement runway. The Service participated in a field meeting at the site on June 15, 2022. Our comments are provided In accordance with the Endangered Species Act of 1973, as amended, (ESA) and the Bald and Golden Eagle Act (BGEPA).

The Federal Aviation Administration (FAA) has made a determination of impacts to federally-listed species. Based on the results of species surveys conducted by Three Oaks Engineering, Inc., the Service concurs with the species determinations provided in your letter. We believe that the requirements of section 7 (a)(2) of the ESA have been satisfied for this project. Please remember that obligations under the ESA must be reconsidered if: (1) new information identifies impacts of this action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

Please note that the Service published its decision to list the tricolored bat (*Perimyotis subflavus*) (TCB) as endangered on September 14, 2022 (87 FR 56381–56393). This small bat species is known to occur in Wake County. It is an insectivore, and forages and roosts in forests and on the edges of forests. A final listing decision may come as soon as September, 2023. If the FAA would like to conference on this proposed species prior to listing, please let us know.

The October 19, 2022 letter and BRA state that there is one active bald eagle (*Haliaeetus leucocephalus*) nest, located approximately 1,900 feet from the existing runway. The FAA commits to providing a 660 – foot buffer around the nest during the bald eagle breeding season. In addition, preliminary noise modeling indicates that the nest would receive an increase of 2.6 dBA (weighted decibel level) from the project by 2033 when the proposed project would be fully operational. If the FAA commits to a buffer protecting the area within 660 feet of the bald eagle

nest from construction activities from December 1 to July 15 of any year, the Service agrees that the project is not likely to disturb nesting bald eagles. We recommend that the FAA consider the implementation of other recommendations in the National Bald Eagle Management Guidelines for the benefit of the bald eagle. The guidelines may be found here: https://www.fws.gov/media/national-bald-eagle-management-guidelines.

As we stated in the June 15, 2022 field meeting, the Service remains concerned about concerned about deforestation and the removal or fragmentation of contiguous forest. This area appears to provide a wildlife corridor between Umstead State Park and other areas to the northwest. Loss of the forested areas may push wildlife onto adjacent road rights-of-way and other areas that could pose a safety concern for humans and wildlife.

Further, tree removal may affect the TCB. During the spring, summer, and fall, TCB primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees (Veilleux et al. 2003; Perry and Thill 2007; Thames 2020). In addition, TCB have been observed roosting during summer among pine needles, eastern red cedar, within artificial roosts (e.g., barns, beneath porch roofs, bridges, concrete bunkers), and rarely within caves (Perry and Thill 2007; Thames 2020; Jones and Pagels 1968; Barbour and Davis 1969; Jones and Suttkus 1973; Hamilton and Whitaker 1979; Mumford and Whitaker 1982; Whitaker 1998; Feldhamer et al. 2003; Ferrara and Leberg 2005; Smith 2020, pers. comm; Humphrey et al. 1976; Briggler and Prather 2003; Damm and Geluso 2008). Female TCB exhibit high site fidelity, returning year after year to the same summer roosting locations (Allen 1921; Veilleux and Veilleux 2004a). Female TCB form maternity colonies and switch roost trees regularly (Veilleux and Veilleux 2004a; Quinn and Broders 2007; Poissant et al. 2010). Males roost singly (Perry and Thill 2007; Poissant et al. 2010). Affects to TCB from tree removal include potential injury or mortality of individuals roosting in trees that are removed, and loss of foraging, commuting, and roosting habitat. TCB may be injured or killed while fleeing disturbance during daylight hours due to an increased likelihood of predation. Indirect effects may include reduced fitness of TCB individuals through additional energy expenditure while searching for a new roost site, or a shift in home range. Replanting of tree species on the site would help restore foraging and roosting habitat for the TCB. The amount of mortality would not be determinable since dead TCBs would likely go unnoticed, and estimating such mortality is difficult since TCB density data is not available. Although mortality could potentially occur at any time of the year, it is assumed that mortality would be highest during the maternity season if maternity roost trees are felled.

We appreciate the opportunity to comment on this project. If you have any questions concerning these comments, please contact Kathy Matthews by e-mail at <kathryn_matthews@fws.gov>.

Sincerely,

Pete Benjamin
Field Supervisor

cc (via email):

Gabriela Garrison, NCWRC
Lyle Phillips, USACE